

# PC MAGAZINE

**The Best Laptops  
for All Students,  
Top Note-Taking Apps,  
& What Tech to Take Abroad**

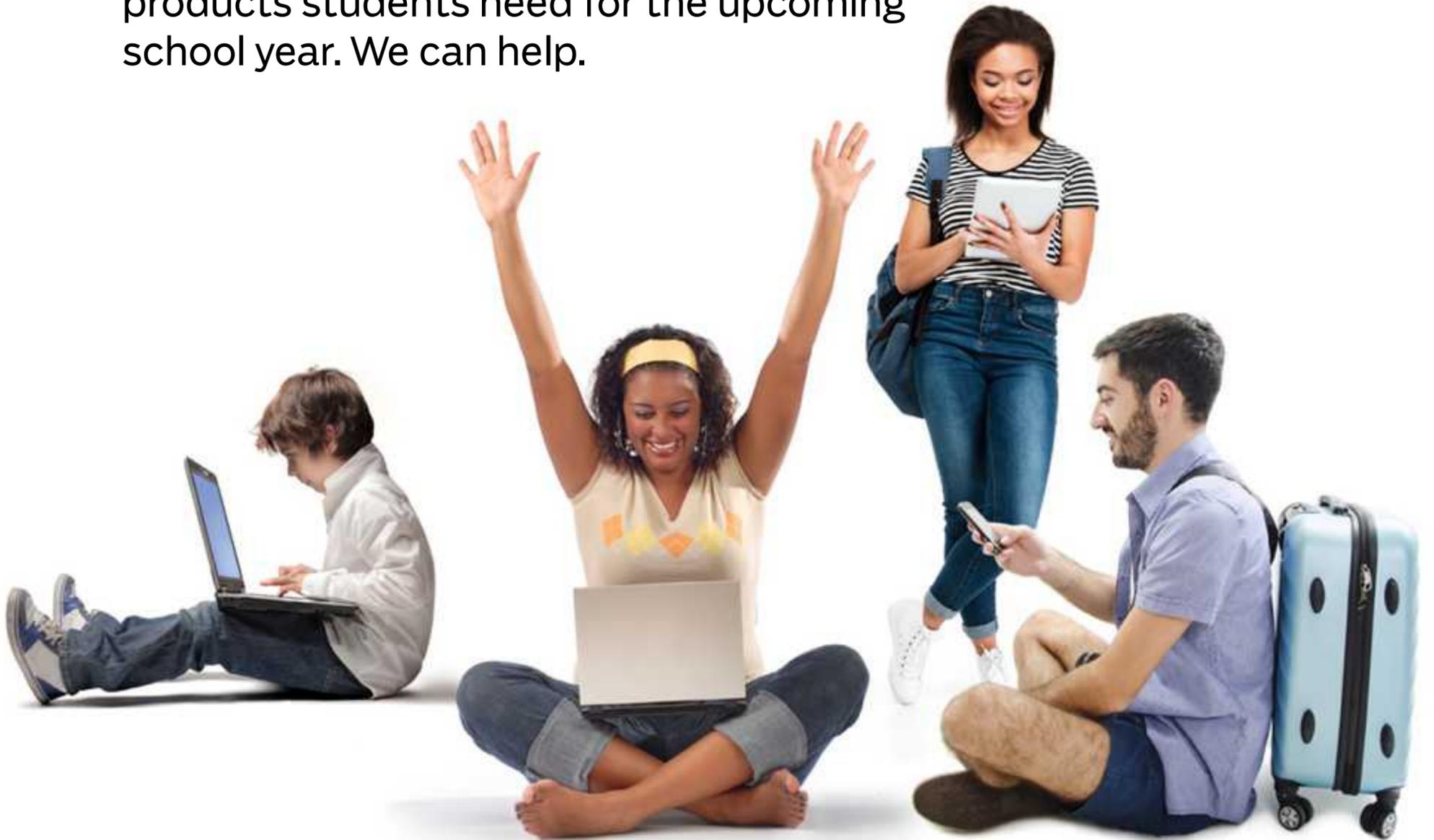
**40 Online Resources  
All Women in Tech Careers  
Should Know About**



**COVER STORY**

**BACK TO SCHOOL**

It's time to start thinking about the tech products students need for the upcoming school year. We can help.



**FEATURES**

**40 ONLINE RESOURCES  
ALL WOMEN IN TECH  
CAREERS SHOULD  
KNOW ABOUT**



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## RESTORING VISION WITH BIONIC EYES IS NO LONGER SCIENCE FICTION

Neuroengineers are developing brain interfaces to help restore vision to the blind.

## INTEL DEMOS AMBIENT PC THAT OBSERVES YOU AND ADAPTS TO YOUR NEEDS

The company showed a prototype at Computex 2019.

## E3 2019: EVERYTHING YOU MISSED

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## HARDWARE

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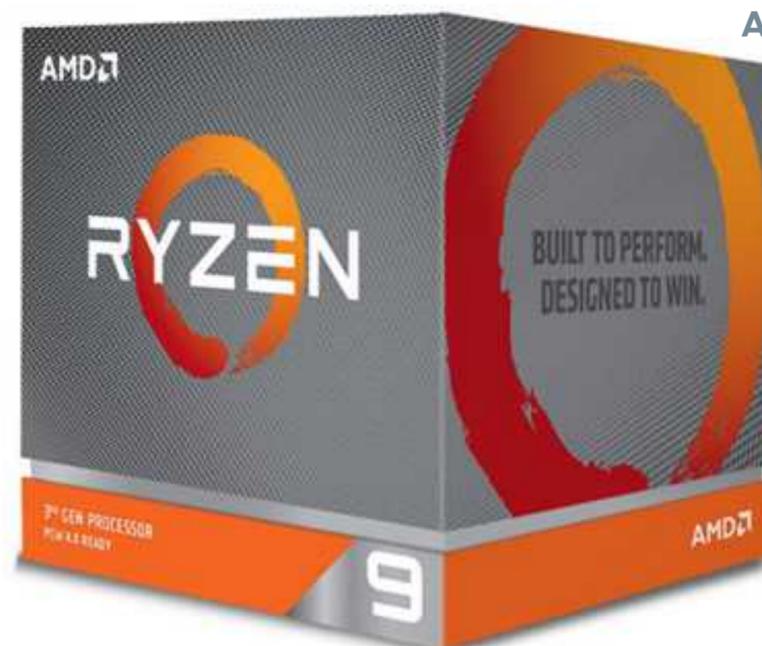
**Roundup: The Best Password Managers**



Bose Noise Cancelling Headphones 700



Nvidia GeForce RTX 2070 Super



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## COMMENTARY

**CAROL MANGIS**

First Word

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**MAX EDDY**

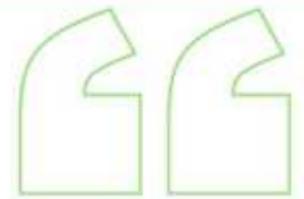
Never Give Ransomware Scammers Your Money

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**MAX EDDY**  
SecurityWatch

## TIPS & HOW TOS



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## The Best Tech for Your Favorite Students

**I**t's been a long time since I've experienced those back-to-school feelings (or had an entire summer free, for that matter!). I remember the excitement and nerves about taking on harder subjects, encountering new teachers and classmates, and shopping for clothes and supplies.

Way back then, the latter were mostly notebooks, pens and pencils, and (paper) books. But the world is a very different place now.

From elementary school to high school and through college, students need technology products to get their work done. As an example, in 2017, Deloitte estimated 18 percent of US parents would buy their child an electronic gadget, the average amount spent at \$254. Computers and hardware had an even higher average spend per child, at \$307. College students will probably need to spend even more for their devices, especially those who are studying away from home.

Whether you're one of the parents with little students to buy for or you're spending your own money on schools supplies, you've come to the right place. As you're undoubtedly aware, PCMag reviews computers and many other kinds of gadgets. But we also slice and dice our reviews for different segments, including students. So for our Back to School issue, we included some roundups specifically for students.

First and most important are our computer recommendations: You'll find roundups of the best

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laptops for kids and for college students. We also included a roundup of the best note-taking apps. And our fourth back-to-school story, “10 Must-Have Electronics for Your Semester Abroad,” is not only useful for traveling students and dorm-dwellers but also was written by our intern this summer, Jake Leary, who was personally invested in this story—he’s spending his fall semester in Rome. He’ll definitely be taking these recommended products along for the ride.

We hope you find everything you need for the students in your life. If there’s a product you need that we haven’t included here, check at PCMag.com, and you’ll almost certainly find reviews to guide your back-to-school tech shopping.

*[carol\\_mangis@pcmag.com](mailto:carol_mangis@pcmag.com)*



### Global Chip Sales Took a Dive

“Semiconductor firms have taken a collective beating,” according to our July news story. While that’s not in question, readers differ widely on why it happened.

You need only a basic PC with an Intel Core i3 for Netflix and cloud gaming. The market for \$1,000-plus gaming PCs and expensive dedicated GPUs is shrinking rapidly. PC gaming got way too expensive.

—*Gondino*

Not really. We’re just in kind of a holding pattern right now... Most users with Sky Lake or better have no reason to upgrade their CPUs (and mobos), and Turing GPUs probably aren’t going to suddenly skyrocket.

—*Daniel Glass*

What I see is more and more people who are no longer upgrading their PCs. They use cloud gaming, they use Netflix, they browse the internet, and they have zero need for a 16-core CPU or a \$600 GPU. They need a \$100 i3 with iGPU and they’re set; they don’t upgrade their PC until it breaks.

—*Gondino*

The PC gaming industry is a multi-billion dollar industry that is doing fine. Even though you might not be able to afford it, plenty of us can. What one needs or wants or uses for games is utterly none of your business; thanks for telling us what we “need”.

—*powerwiz*

Cryptocurrencies and crypto mining was a pretty big thing in 2018; it isn't now. That's likely the reason there was such a big decline.

—*DaKangaroo*

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Unless you have some type of data on units sold (which admittedly would be difficult) there's no way to know whether the revenue decline is caused by less demand, more supply, or a combination of both.

—*Kary*

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Everyone focuses on gaming, but many people use their computers for video and photo work. We are seeing more apps that use AI, and they require a lot of power, usually from GPUs. I see people with dinky MacBooks falling flat when using these apps. They should get a real computer (Windows tower PC with a good GPU) to use for photos work.

—*Wholewitt*

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Unless you're into benchmarks, cutting-edge gaming, or graphics, most computers are fast enough. My 4-year-old Haswell i5 got a boost several years ago when I switched from an HDD to an SSD. It runs Photoshop like lightning, which is the most I tax my PC.

—*RH*

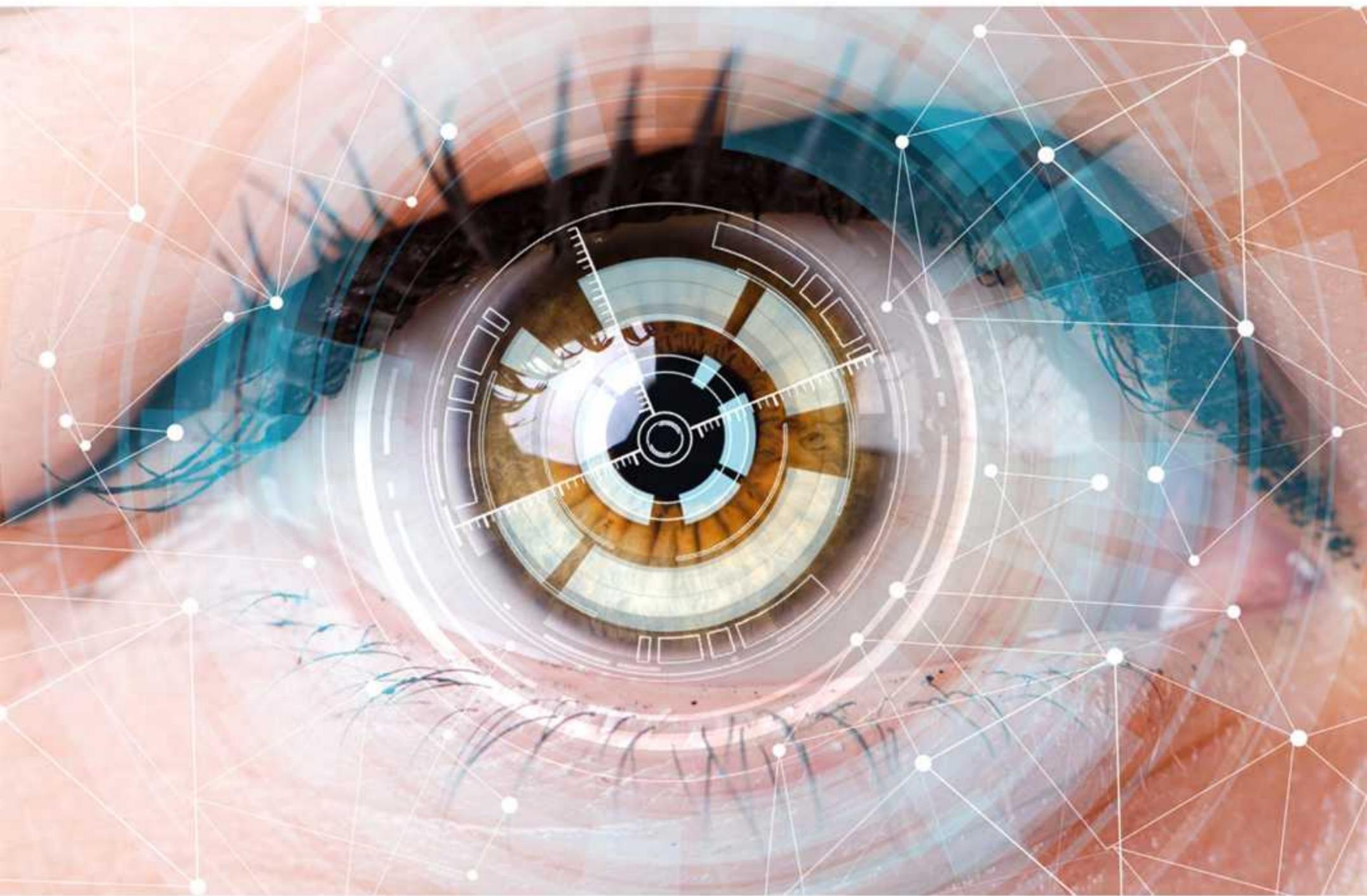
## Ask us a question!

Have a question about a story in *PC Magazine*, one of the products we cover, or how to better use a tech product you own? Email us at [letters@pcmag.com](mailto:letters@pcmag.com) and we'll respond to your question here. Questions may be edited slightly for content and clarity.



# Restoring Vision With Bionic Eyes Is No Longer Science Fiction

BY S.C. STUART



**B**ionic vision might sound like science fiction, but Dr. Michael Beyeler is working on just that. Originally from Switzerland, Dr. Beyeler is wrapping up his postdoctoral fellowship at the University of Washington before moving to the University of California Santa Barbara this fall to head up the newly formed Bionic Vision Lab in the Departments of Computer Science and Psychological & Brain Sciences.

We spoke with him about this “deep fascination with the brain” and how he hopes his work will eventually be able to restore vision to the blind. Here are edited and condensed excerpts from our conversation.

**PCMag: Dr. Beyeler, give us an overview of the ‘neural engineering’ field that will lead to bionic sight in the future.**

**Dr. Michael Beyeler:** Neuroengineering is an emerging interdisciplinary field aiming to engineer devices that can interface with the brain. Kind of like the brain implants from *Black Mirror* but much less creepy. *[Laughs]*

The human brain has roughly 100 billion nerve cells, or neurons, and trillions of connections between them, organized into different brain areas each supporting a particular task; for example, processing visual or auditory information, making decisions, or getting from A to B. You can imagine that understanding how these neural circuits give rise to perception and action requires bringing together skills from a variety of disciplines, such as neuroscience, engineering, computer science, and statistics.

**Explain how these BMIs [brain-machine interfaces] work in your field. I’ve tested them for mood elevation but not connected to visual states.**

Right. “Brain-computer interfaces” can be used both for treating neurological and mental disorders as well as for understanding brain function, and now engineers have developed ways to manipulate these neural circuits with electrical currents, light, ultrasound, and magnetic fields. Remarkably, we can make a finger, arm, or even a leg move just by activating the right neurons in the motor cortex. Similarly, we can activate neurons in the visual cortex to make people see flashes of light. The former allows us to treat neurological conditions such as Parkinson’s disease and epilepsy, whereas the latter should eventually allow us to restore vision to the blind.

**Amazing. And what kinds of devices are currently in the field?**

The idea of a visual prosthesis or “bionic eye” is no longer science fiction. You might have heard of the Argus II, a device developed by a company called Second Sight, which is available across the US, Europe, and in some Asian countries. It’s for people who have lost their sight due to a retinal degenerative disease such as retinitis pigmentosa and macular degeneration.

## **How many people today have these retinal prostheses?**

I believe there are now more than 300 Argus II users around the world. And the manufacturer, Second Sight, has also started implanting ORION, a device that skips the eye entirely and directly interfaces with the visual cortex. Apart from that, we are also anxiously awaiting the first results of PRIMA, a new subretinal device developed at Stanford University and commercialized by a French company called Pixium Vision.

## **So this is a growing field?**

Definitely. In fact, some 30 more devices are in development across the globe. Overall, there should be a wide variety of sight restoration technologies available within the next decade.

## **For clarity, explain how the current systems work.**

When individuals, due to different diseases, no longer have their photoreceptors—the light-gathering cells in the back of the eye—the idea is to replace these cells with a microelectrode array that mimics their functionality. Argus II users also wear a pair of glasses with a small camera embedded, so the visual input of the camera can be translated into a series of electrical pulses that the implant delivers to the neural circuits in the eye. For most patients, Argus II provides “finger-counting” levels of vision—people can differentiate light from dark backgrounds and see motion, but their vision is blurry and often hard to interpret. Unfortunately, with current technology, it turns out to be really hard to mimic the neural code in the eye and the visual cortex to fool the brain into thinking that it saw something meaningful. This is where I come in.



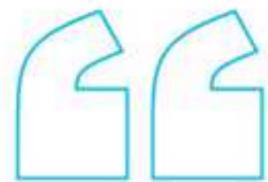
My goal is basically to understand how to go from camera input to electrical stimulation and come up with a code that the visual system can interpret. This requires both a deep understanding of the underlying neuroscience as well as the technical skills to engineer a viable real-time solution.

### **And how do you do this?**

By using tools from computer science, neuroscience, and cognitive psychology. For example, we come up with mathematical equations that describe how individual neurons respond to electrical stimulation. We also perform simple psychophysical experiments, such as asking Argus II users to draw what they see when we stimulate different electrodes. We then use insights from these experiments to develop software packages that predict what people should see for any given electrical stimulation pattern, which can be used by the device manufacturer to make the artificial vision, provided by these devices, more interpretable for the user.

### **Are you focusing on bionic (artificial) rather than biomimicry (natural) vision?**

Yes, because instead of focusing on “natural” vision, we might be better off thinking about how to create “practical” and “useful” artificial vision. We have a real opportunity here to tap into the existing neural circuitry of the blind and augment their visual senses much like Google Glass or the Microsoft HoloLens—for example, make things appear brighter the closer they get, use computer vision to mark safe paths and combine it with GPS to give visual directions, warn users of impending dangers in their immediate surroundings, or even extend the range of ‘visible’ light with the use of an infrared sensor. Once the quality of the generated artificial vision reaches a certain threshold, there are a lot of exciting avenues to pursue.



**We develop software packages that predict what people should see for any given electrical stimulation**



## **On a practical level, how are you using technology in your research?**

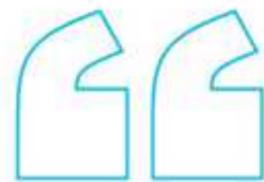
Since we don't develop our own implants, we often collaborate with different device manufacturers. Recently, we have been making extensive use of Argus II, which comes with its own quite sophisticated software development kit. Second Sight has been very forthcoming with us, both by providing access to patients as well as by enduring our nagging requests to make minor software modifications so that we can field-test our crazy theories. In the end, these collaborations should be a win-win for both parties, ideally trading data for insight.

## **What other tools and software do you use in your work?**

The field is currently dominated by different device manufacturers, who (understandably) can be very protective of their intellectual property. However, the Swiss in me regards it as important to provide a neutral academic voice promoting tools and resources that are available to all. We, therefore, focus heavily on open-science practices.

## **You've developed some open-source projects, haven't you?**

Yes, in this spirit, we were the first to make our simulation engine, pulse2percept, available as an open-source Python package. The goal of pulse2percept is to predict what a patient should see for any given input stimulus. Interestingly, this approach has already gained the attention of Second Sight and Pixium Vision, which expressed interest in using our software to predict what their patients are seeing. In the future, my goal is to adapt this software to other devices as they become available.



**We were the first to make our simulation engine, pulse2percept, available as an open-source Python package.**



**You're about to join the Departments of Computer Science and Psychological & Brain Sciences at the University of California Santa Barbara and build a Bionic Vision Lab, which is such a cool name.**

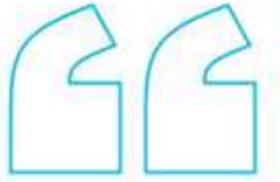
Yes; I am super stoked about this opportunity. There are lots of clinical research groups studying the effects of blinding degenerative diseases, and several biomedical groups engineering new devices. But nobody is really focusing on novel methods and algorithms to improve the code with which these devices interact with the human visual system itself. Our group will be an interdisciplinary effort that tries to combine insights from neuroscience with computer science and engineering to build smarter brain-computer interfaces and dream up new ways to maximize the practicality of artificial vision.

### **How did you become interested in this field?**

To me, this is the ultimate scientific quest, and it has the potential to cure blindness. In the end, it all comes back to a deep fascination with the brain—this mysterious hunk of meat that uses less power than a light bulb to give rise to our conscious perception of the world. How on earth does the brain do it?

### **It is extraordinary, when you really think about it.**

It's perhaps one of the last big remaining scientific mysteries. And what better way to test our understanding of the brain than to build a device that can safely and meaningfully interact with it? I mean, the technology to tap into this complex circuitry is coming, there is no way around that, and it will allow us to manipulate our perception, our decisions, our actions. We better start thinking about how to use these powers for good.



**What better way to test our understanding of the brain than to build a device that can safely and meaningfully interact with it?**



# Intel Demos Ambient PC That Observes You and Adapts to Your Needs

BY ADAM DACHIS

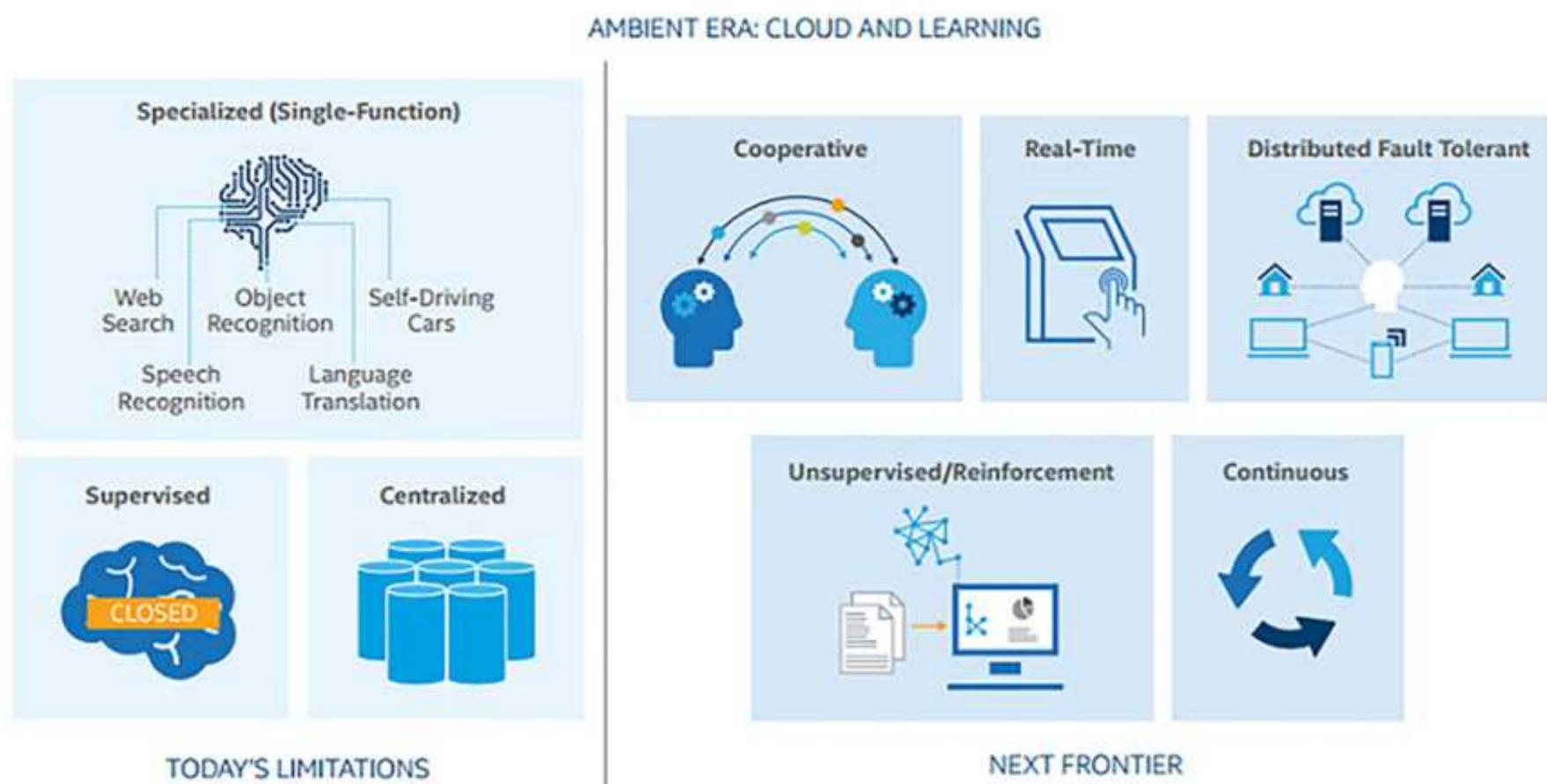


**F**or a long while, you'd rarely find a computer without an Intel CPU. But with the recent rise of GPU-centric processing in blockchain and AI as well as ARM's dominance in mobile computing, Intel has struggled to keep up. To compete and remain innovative, the company has announced myriad strange ideas over the past few years. The latest addition—an ambient PC prototype—lands somewhere between cool and creepy.

At this year's Computex event in Taipei, Intel showed off a handful of prototypes to demonstrate its efforts in artificial intelligence, modular hardware, and ambient computing. But what is ambient computing, exactly? The term refers to a responsive breed of electronics that observe and react to the presence of people. These devices remain on at all times, always watching, to adapt to and serve our needs. Futurist and communications marketing executive Gary Grossman explains how this technology will ideally fit into our lives:

“Ambient computing covers applications incorporating machine learning and other forms of artificial intelligence and is characterized by human-like cognitive and behavioral capabilities and contextual awareness,” Grossman said. “It creates a digital environment in which companies integrate technology seamlessly and invisibly into everything around us, maximizing usefulness while minimizing demands on our attention.”

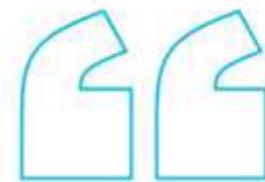
Let's ignore the dystopian implications of an ever-watching, always-learning computer and start with the technology's potential advantages. Much like how our smartphones predict which apps we'll search for or tasks we'll perform, ambient computing anticipates us by learning how we use connected technologies in our homes.



Intel hopes to increase usefulness and efficiency through this technology by introducing more “closed-lid” tasks to minimize the transition from sleeping states to waking states. Ambient devices remain connected while dormant to download information users may want without delay, much like we’ve seen with Apple’s several-year-old Power Nap feature. Leveraging local voice ID technology, presence sensors, and 180- to 360-degree cameras, Intel also expects ambient computing to improve the quality of video conferencing and provide heightened security while enabling hands-free conveniences.

While that sounds nice, we live in a reality filled with security exploits that have likely already affected you and people you know. No matter how meticulously we attempt to secure our own data, we cannot control or even anticipate the vulnerabilities many companies leave open. While Intel attempts to proactively address these issues—which is more than can be said for most companies—it’s had problems in the past. Necessary Spectre and Meltdown patches are hitting Intel processor performance the hardest. Security and performance require a delicate balance that may prove difficult for a company in a hurry to achieve.

Intel continues to assert its commitment to user privacy specifically regarding ambient computing, and unexpected security flaws will occur regardless of anyone’s best efforts. It’s not alone in developing ambient computing devices, and the first exploit may target another company’s technology. Potential flaws in large microchip companies’ components don’t represent the best target for malicious hackers; connected technologies remain more vulnerable by nature. Each connection is a link in a chain of multiple products from different companies, and it takes only one weak link to break it. Even with a perfect approach,



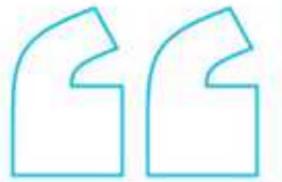
**Ambient devices remain connected while dormant to download information users may want without delay.**



Intel's technology can assert only so much control over the other links in its chains. It will be important to keep these risks in mind as more intelligent, adaptive devices reach the consumer market.



Along with the ambient computing prototypes demoed at Computex, Intel announced an “AI on the PC” development kit, in partnership with Asus, and a NUC Compute Element that continues their efforts to modularize PC building. While ambient computing may feel like a technology surrounded by risk, these parallel announcements demonstrate Intel's interest in making development more accessible. Today, purchasing smart home devices can feel like putting a black box of convenience in the home and leave us wondering whether we've relinquished our privacy and put ourselves at other risks. In the future, though, the creation of ambient devices may become a more simple task with modular parts. When we have a hand in creating the technology ourselves, we can retain more control over our security and privacy.



**When we have  
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# E3 2019: Everything You Missed

BY WILL GREENWALD



**A**fter days of booths and press conferences, gameplay reveals and story trailers, E3 2019 wrapped up in June. Some of the most prominent video games companies attended this year and brought a slew of announcements. Here are the biggest stories.

## MICROSOFT

The next Xbox system is definitely coming, and it'll be powerful, with a custom CPU featuring AMD's Zen-2 architecture that can output 8K graphics at 120 frames per second. Beyond its beefy specs, all we know about "Project Scarlett" is that it will be released in the 2020 holiday season.

Until then, Xbox One is Microsoft's console of the day. The company also announced a PC-only version of the Xbox Game Pass service, along with a \$15 monthly Xbox Game Pass Ultimate that wraps up the Xbox One and PC Xbox Game Pass libraries and the Xbox Live Gold service into a single subscription. Microsoft is also developing its Project xCloud service, which will offer game streaming similar to Google Stadia.

As for game announcements, Microsoft unveiled a September 10 release date for Gears (of War) 5 and featured Battletoads, Psychonauts 2, and the long-awaited Western release of Phantasy Star Online 2. The next Halo game, Halo: Infinite, was also teased and is planned to be released alongside Project Scarlett next year.

## NINTENDO

Nintendo regularly makes announcements in its Nintendo Direct streams, so it didn't have many massive reveals at E3 2019. Super Smash Bros. Ultimate got the most hype with the announcement of two new fighters: Warrior from Dragon Quest and Banjo-Kazooie. The company also teased Animal Crossing: New Horizons, which has been pushed back to 2020. It also briefly showed the upcoming Pokemon Sword and Pokemon Shield, Luigi's Mansion 3, and The Legend of Zelda: Link's Awakening remake for the Switch. No 3DS games were shown, nor was Metroid Prime 4.



## **SQUARE-ENIX**

The long-awaited Final Fantasy 7 Remake finally has a release date: March 3, 2020. And the company showed more details about its combat system. Square-Enix also unveiled Marvel's Avengers, a third-person action game based on the Marvel universe (though not strictly the Marvel Cinematic Universe) with multiple playable heroes. The company plans to offer extensive free expansions over the next few years. It also announced multiple ports and remakes, including a remaster of Final Fantasy VIII that was previously assumed to have been abandoned.

## **UBISOFT**

Watch Dogs: Legion was announced. It takes place in a dystopian, presumably post-Brexit London. Ubisoft also revealed Roller Champions, a roller-derby-inspired competitive sports game that looks and feels similar to Rocket League. And it's jumping into the game-subscription market with UPlay+, which will provide access to a wide variety of Ubisoft games, including its newest releases, for a flat fee.

## **WARNER BROS. INTERACTIVE ENTERTAINMENT**

Lego Star Wars: The Skywalker Saga was the biggest reveal for Warner Bros. at E3. It's an ambitious, open-world game that looks to overhaul and reboot Lego's licensed games as a meta-series.





## BETHESDA

The Elder Scrolls 6 and Starfield, Bethesda's longest-awaited games, were nowhere to be seen at E3 2019. But the free Wastelanders expansion to Fallout 76 was shown: It adds NPCs and quests to the game later this year, and the Nuclear Winter expansion will add a 52-player battle royale mode. Bethesda also announced Ghostwire: Tokyo, a supernatural adventure game from Shinji Mikami's Tango Gameworks, and showed more Wolfenstein: Youngblood and Doom Eternal.

## EA

EA didn't appear at E3 2019, but it held its EA Play event nearby, where it showed off Star Wars: Jedi: Fallen Order, a long-requested single-player Star Wars game, and revealed plans for new Apex Legends and Battlefield 5 content.

## PLAYSTATION

Sony was notably absent from E3 and made no announcements. This is a significant departure for the company, which was a staple at previous E3s.

# Never Give Ransomware Scammers Your Money

**R**ansomware is a pernicious plague that shows no sign of letting up. In fact, if Riviera Beach, Florida, is any indication, it might be getting worse. After being crippled by ransomware, that city voted to pay \$600,000 to the perpetrators in the hope of regaining control of its systems.

I applaud the city leaders who put the issue to a vote—even if it wasn't a public vote—and handled the issue with the seriousness it deserves. That said, I believe no one should ever pay the ransom. It's not just because "we don't negotiate with terrorists." It's far simpler: there's no guarantee paying the ransom will work.

## RANSOM WHAT?

For those who may have forgotten, ransomware is malware that takes the files of an infected computer hostage. The malware encrypts any and all files it can get its claws on, and then demands a ransom payment in order to hand over the encryption key that unlocks the files.

Some ransomware is backed by a highly professional operation, with FAQs and even criminal customer service. Others take a more militant route, with countdown timers ticking away the seconds until the encryption key is deleted and the information is lost forever.



PC Magazine Senior Software Analyst Max Eddy has also written for publications such as *International Digital Times*, *International Science Times*, and *The Mary Sue*.

Ransomware has exploded in the last few years and evolved from simple attacks to complex malware. It used to be that restoring from a backup would wipe away the problem, but some ransomware seeks out and encrypts backup files to prevent that easy fix. There are even specific security products to help fight off ransomware.

Part of the evolution in ransomware is due to an NSA tool known as “EternalBlue” being leaked and then incorporated by the bad guys, but I digress.

Ransomware found its earliest targets with individuals like you and me: poor souls who clicked the wrong link in an email. But ransomware became an epidemic when it started showing up in hospitals and government computers. The city of Baltimore and the Port of San Diego are just two of the most recent examples of major organizations that suffered ransomware attacks and are still struggling to recover.

If you’re a regular person, it’s hard but not catastrophic to walk away from a ransomware-laden computer. The loss of your personal files, family photos, and home videos is incalculable, but it’s not a life-or-death situation. Ransomware in hospitals and city transit systems raises the stakes. These (often woefully out of date and poorly protected) computer systems have to work.

I still believe paying the ransom is never the answer.

### **SO WHY NOT PAY UP?**

First, most cyberattacks—including ransomware—don’t last long. The command and control servers that issue the unlock commands and receive

Max Eddy

payment can be found and taken offline. Sometimes, the bad guys do it because they need to cover their tracks and move on to the next nefarious campaign; other times, law enforcement takes down the system. In either case, anyone who has been infected and not paid the ransom can no longer get their system unlocked, even if they pay.

Second, even when the ransomware system is working as “advertised,” there’s no incentive for the bad guys to follow through. They got the money—mission accomplished. They don’t really gain anything from unlocking your files, except maybe incentivizing you to do it again the next time it happens.

Third, even if you get your files unlocked, there might be other dangers awaiting you. It’s conceivable the attackers may have left some unpleasant surprises behind or taken advantage of the confusion and done who knows what to your system. Perhaps in addition to encrypting your files, they decided to lift a copy for themselves and sell it on the Dark Web. Paying the ransom won’t undo that potential damage.

Last, paying the ransom will almost certainly not save you money in the long run. After Atlanta was hit with ransomware, it had to spend \$2.6 million to recover. The initial ransom was \$50,000. That ransom cash is better served to help rebuild.

I’m not one to blame victims. I have never made life-or-death decisions in a hospital, and I’ve never tried to run a city that didn’t have the word “Sim” in front of it. I cannot imagine the pressure legislators face when ransomware comes knocking. They surely made the decision they thought best.

But whenever anyone asks me about what to do if they get infected with ransomware, I’ll always say: Don’t pay.

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# Shenmue III and the Myth of PC Game Store Exclusivity

**W**ords have meaning. Though their definitions may change over time, words convey ideas that help explain the world and bring context to it. As such, it's important not to misuse them, lest confusion reign. Shenmue III Epic Game Store "exclusivity" is one example of this.

If you haven't been following the Shenmue III controversy, here it is in a nutshell: During E3, publisher Deep Silver revealed that the long-awaited title would not be headed to Steam as originally stated. Instead, it would find a PC home in Epic's marketplace. Anger ensued. Blood boiled. The internet went full internet. "How dare Shenmue III be an Epic Game Store exclusive!?"

Yet, Shenmue III exclusivity matters only if you work for Epic Games or Valve, the company that owns the Steam store. If you're a gamer, you're just an Epic Game Store client download away from experiencing Ryo Hazuki's continued adventures.

## THE PC GAME EXCLUSIVITY ILLUSION

Now, I cannot speak on the legalities of a Kickstarted product being promised for one digital game store and delivered to another, but I can say this: We as a gaming community need to



Lead Analyst Jeffrey L. Wilson has penned gadget- and video game-related nerd-copy for a variety of publications, including 1UP, 2D-X, Laptop, Parenting, and of course, PCMag.

stop speaking with publishers' words. It gets us nowhere and results only in online bickering.

Though Shenmue III is an Epic Game Store exclusive, it's not locked behind an impenetrable wall. Unlike consoles that lock you into purchasing video games from the Nintendo eShop, PlayStation Store, or Xbox Live, PCs give you the freedom to shop where you like. My gaming desktop currently has the Steam, Xbox, and Epic Game Store apps installed, and that's a fraction of the PC gaming marketplace that also includes Battle.net, GOG, Origin, and other clients. There is no PC game in a digital storefront I cannot play on my Windows 10-powered rig.

So, I ask you: Where's the exclusivity? Though I purchase or redeem the majority of my PC games through Steam, I have zero issues firing up another game store app. They're just launchers, after all. If a game existing in a single game store—a store you can access at any time after creating an account—is what keeps you from playing it, you didn't really want it. Or worse, you're a store fanboy, a concept I didn't even realize existed until the Epic Game Store's arrival prompted Steam adherents to drop super-spicy takes.

That mentality benefits publishers, not you and fellow gamers. Ponder the concept: A game is "exclusive" on PC because one storefront has the ability to sell it. Yet if your computer hardware matches the minimum specs, you can play it without question.

## THE EXCEPTION

That said, I see an issue with PC game store exclusivity, but it's an anomaly. Earlier this year, Epic Games purchased Psyonix, the publisher behind the mega-popular and insanely fun Rocket League. The game is set for an Epic Game Store debut in late 2019, which could be a problem.

Rocket League has a strong Steam userbase and is one of the platform's best sellers. If Epic denies other shops a piece of that sweet Rocket League pie and brings it to the Epic Games Store, a large number of players will be left high and dry.

The move would also raise many questions. Would Epic leave the Steam version unsupported and focus only on updating the Epic Game Store version? Would Epic force you to buy the game (and potentially the DLC) again if you're a Steam user who plans to migrate to Epic Game Store? Would Epic ignore the inevitable cross-play plea from Steam users who want face off against Epic Game Store players?

Still, this is an outlier situation and not one that should be used to support awful takes—such as the idea that two major game stores will fracture the PC gaming community. That makes no sense. If, for example, Epic Game Store is the only shop that sells Game X, guess what? If my friends and I want to mix it up in Game X, we'll buy it from Epic Game Store. It's that simple.

## THE COMPETITIVE CALM

With Epic Game Store's rise, Steam finally has serious competition. As Epic gobbles up

exclusives, whether they're timed or permanent, the conflict will benefit you, the gamer. Perhaps seasonal sales will receive deeper cuts across the many shops. Perhaps we'll see new and innovative app features. Perhaps Valve will go all-in on the idea of being a video game maker again.

So keep Epic Game Store, Steam, and the many other PC video game shops on your desktop. Choice is a benefit, not a hindrance.

“Don't talk like one of them, you're not! Even if you'd like to be,” a line from Christopher Nolan's *The Dark Knight*, immediately comes to mind and summarizes my stance on this topic. It's also a line to keep in mind the next time you fire up your rig.

And Shenmue III is headed to Steam less than three months after its Epic Game Store debut. What's this exclusivity anger about, again?

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# Why AI Is Terrible at Content Moderation

Every day, Facebook's artificial intelligence algorithms tackle the enormous task of finding and removing millions of posts containing spam, hate speech, nudity, violence, and terrorist propaganda. And though the company has access to some of the world's most coveted talent and technology, it struggles to find and remove toxic content fast enough.

In March, a shooter in New Zealand live-streamed the brutal killing of 51 people on Facebook. But the social-media giant's algorithms failed to detect the gruesome video. It took Facebook an hour to take the video down, and even then, the company was hard-pressed to deal with users who reposted it.

Facebook recently published figures on how often its AI algorithms successfully find problematic content. Though the report shows the company has made tremendous advances in its years-long effort to automate content moderation, it also highlights contemporary AI's frequent failure to understand context.

## NOT ENOUGH DATA

Artificial neural networks and deep-learning technologies, categories at the bleeding edge of artificial intelligence, have helped automate tasks



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previously beyond the reach of computer software, including speech recognition, image classification, and natural language processing (NLP). In many cases, the precision of neural networks exceeds that of humans. For example, AI can predict breast cancer five years in advance.

But deep learning also has limits. Namely, it needs to be “trained” on numerous examples before it can function optimally. If you want to create a neural network that detects adult content, for instance, you must first show it millions of annotated examples. Without quality training data, neural networks make dumb mistakes.

Last year, Tumblr declared it would ban adult content on its website and use machine learning to flag posts that contained NSFW images. But a premature deployment of its AI blocked harmless content such as troll socks, LED jeans, and a picture of Joe Biden.

And in many cases—violent content, for instance—there aren’t enough examples to train a reliable AI model. “Thankfully, we don’t have a lot of examples of real people shooting other people,” Yann LeCun, Facebook’s chief artificial intelligence scientist, told Bloomberg.

Neural networks also lack situational awareness. They make statistical comparisons only between new content and examples they’ve been shown. Even when trained on many examples, neural networks act erratically when faced with edge cases that look different from their training data.

Ben Dickson

Facebook's AI failed to detect the New Zealand massacre video because it was streamed from a first-person viewpoint and didn't resemble anything uploaded in the past. A person reviewing the video would immediately recognize its violent content. But Facebook's neural networks, which only extract and compare patterns of pixels, dismissed it as safe.

## CONTEXT AND INTENT

Facebook could have trained its AI on plenty of violent scenes from movies to enhance its moderation ability. But this would have confused the AI, because it wouldn't be able to tell the difference between movies and real violence and would have blocked both.

One of the most pressing problems facing neural networks is their inability to understand context and intent. Facebook CEO Mark Zuckerberg explained this in layman's terms in a call with analysts last year, on which he said, "It's much easier to make an AI system that can detect a nipple than it is to determine what is linguistically hate speech."

A well-trained neural network can excel at detecting nudity. According to Facebook's figures, its AI can detect nudity with 96 percent accuracy, but it struggles to differentiate safe nudity—say, breastfeeding or Renaissance art—from banned content such as sexual activity.

In 2016, Facebook removed a Vietnam War photo on the page of Norway's Prime Minister because it contained the image of a naked 9-year-old girl fleeing after a napalm attack. The company's algorithms flagged the iconic picture as child pornography; Facebook later apologized to the PM and restored the post.

In 2017, YouTube acknowledged that its AI mistakenly flagged videos posted by journalists and researchers as extremist content because it couldn't tell the difference between videos that promote extremism and reports on the topic.

Things get even more complicated when AI has to deal with speech or text. Deep-learning algorithms efficiently capture and evaluate temporal consistency: That's why they're very good at recognizing speech,

converting audio to text, and detecting spam. But they fall apart when they're tasked with detecting hate speech and harassment.

Those tasks require an AI to understand the nuances of human language, a problem that's hard to solve with ones and zeros. Hate speech can differ immensely across languages, and humans often disagree about what comprises bad activity.

According to Facebook's report, its AI performs poorly when presented with hate speech and harassment. Last year, in testimony before the US Congress, Zuckerberg said it would take the company five to ten years to develop AI that can detect hate speech. But if the history of artificial intelligence is any indication, it will probably take longer.

### **MODERATION STILL REQUIRES HUMANS**

As Facebook and other social media networks work on their AI algorithms, humans will remain a big part of online content moderation. Facebook currently employs more than 20,000 people across the world to review user-generated content.

These people, who are often underpaid and must deal with disturbing images and content throughout the day, review the posts flagged by the AI algorithms to restore those that have been wrongly blocked and remove others that violate the site's policies. Their work further trains the AI and improve its accuracy. But there's no indication whether or when artificial intelligence will be able to independently moderate the billions of social media posts uploaded every day.

For the time being, content moderation will remain a cat-and-mouse game that will require a lot of human labor. In an interview with *The New York Times*, Facebook CTO Mike Schroepfer acknowledged that AI alone would not solve the company's toxic content problem.

"I do think there's an endgame here," Schroepfer said. But "I don't think it's 'everything's solved,' and we all pack up and go home."



**LG V50 ThinQ** | \$1,152.00 | Editors' Rating: ●●●●○ GOOD

## LG V50 ThinQ: First 5G Phone We've Tested

**T**he LG V50 ThinQ joins a small number of phones with 5G connectivity. It's a solid device in every way, from its flagship-level specs to its gorgeous display, but the addition of a 5G modem comes with a hefty price tag. Unless you're an early adopter who doesn't want to wait for the improved Snapdragon X55 modem later this year (not to mention more 5G coverage), you're better off with the less expensive Google Pixel 3 or Samsung Galaxy S10.

### DESIGN DISPLAY, AND DURABILITY

To mistake the LGV50 for the V40 or even the V30 is forgivable. LG has maintained much of its V-series design aesthetic in its latest flagship. On the front of the phone, you'll find a 6.4-inch OLED display with minimal bezels and a small notch for the speaker and cameras. The device measures 6.25 by 2.98 by 0.44 inches (HWD) and comes in at 6.46 ounces. It's a little heavier than other flagships but by no means difficult to hold for extended periods of time.

Flip the V50 over, and you'll find an all-glass case with a horizontal camera array. Above that is a yellow 5G logo that glows when the phone is in use, and below it is a fingerprint sensor that's quick to respond but can be hard to reach with small hands. Silver LG logos decorate the center and bottom of the phone.

The top of the V50 is bare; the bottom is home to a speaker, headphone jack, and USB-C charging port. On the left side are volume buttons and a convenience button that opens Google Assistant by default. The convenience button is easy to identify, but the volume buttons are a bit small and close together. On the right edge is the power button.



The OLED display has a 19.5:9 aspect ratio. Screen resolution is 3,120 by 1,330 for 538 pixels per inch. In our display tests, the V50 had excellent but slightly cool color accuracy. If you prefer a warmer look, you can customize screen temperature in the settings menu.

## LG V50 ThinQ

**PROS** 5G connectivity on Sprint's network. Excellent audio quality. Solid performance.

**CONS** First-generation 5G modem. Battery life is just okay. Unpredictable software updates. Expensive.

**BOTTOM LINE** The LG V50 ThinQ is one of the first phones to ship with 5G connectivity—but 5G is in its infancy and a first-gen modem gives the phone limited shelf life.

Brightness is good at 335 nits, though you might have some difficulty seeing the display in direct sunlight.

Although the V50 is constructed primarily of glass, it's still pretty durable. The front is Gorilla Glass 5, and the back uses Gorilla Glass 6. It's a good mix that gives the screen a little more rigidity to prevent scratches and the back more protection from drops.

In addition to strengthened glass, the V50 has an IP68 rating for water and dust protection. And it's MIL-STD-810G-tested, meaning it should withstand shock from accidental drops. It's still an all-glass phone, though, so you'll want to invest in a protective case.



## **NETWORK, CALL, AND AUDIO QUALITY**

The LG V50 is locked to Sprint, with 5G supported only on Sprint's network. That said, the phone supports LTE bands 1/2/3/4/5/7/8/12/13/17/20/25/26/28/40/46/66/71, which covers every carrier except AT&T. The addition of band 71 is particularly interesting since it would provide Sprint customers better coverage in rural areas should the Sprint/T-Mobile merger be approved.

Call quality on the V50 is excellent. Test calls were crystal clear on Sprint's network and voice cancellation worked perfectly. In downtown Manhattan, upload speeds were superb at 94Mbps, but download speeds lagged behind at 15Mbps. We were unable to test 5G on the phone as it had not launched in New York during our tests, but we plan to update this review when it does. For a look at Sprint's 5G network, check [PCMag.com](https://www.pcmag.com) for our test results in Dallas.

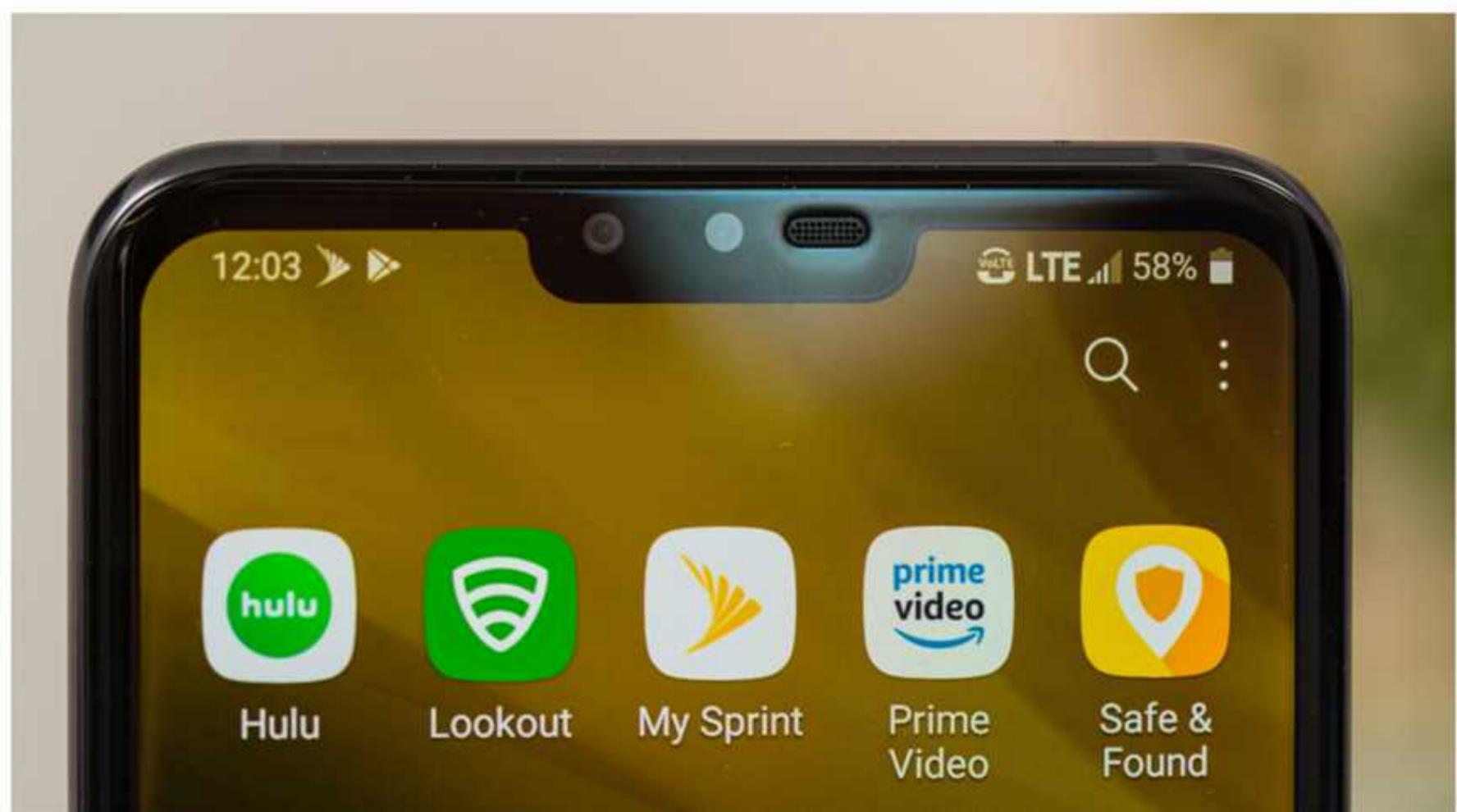
The V50 supports Wi-Fi on the 2.4 GHz and 5GHz bands and includes NFC connectivity for mobile payments. Bluetooth 5.0 is also on board for wireless audio and wearable connectivity.

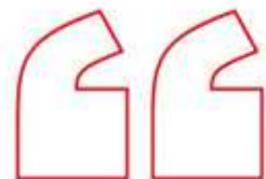
Audio quality is also impressive on the LG V50. The phone features dual speakers with DTS:X 3D Surround Sound to provide an immersive experience for gaming and streaming multimedia. At 93dB, it's loud enough to fill a room and sounds good in your hands and on a table. Overall sound is clean with a hint of bass, but audiophiles will appreciate the headphone jack and Hi-Fi Quad DAC. Put simply, it's one of the best-sounding phones on the market, surpassing other flagships like the Apple iPhone XS and Samsung Galaxy S10 by a healthy margin.

## **HARDWARE AND PERFORMANCE**

The LG V50 is powered by a Qualcomm Snapdragon 855 processor and 6GB of RAM. Storage is 128GB; 103GB is available out of the box. If you like to store lots of images or video on your phone, you can add up to an additional 2TB of storage via a microSD slot.

Performance is excellent. Apps open instantly, and we had no problem multitasking with more than a dozen apps open simultaneously. The V50 is also a solid gaming phone, with no lag or skipped frames in over an hour of Asphalt 8 gameplay. In fact, the phone has a feature called Game Tools that lets you take screenshots, disable alerts, and even take a break from your game.





**It's one of the best-sounding phones, surpassing other flagships like the Apple iPhone XS and Samsung Galaxy S10.**



Compared with other flagships, the V50 performed admirably in our benchmark tests. On PCMark 2.0, a suite of tests that emulates everyday tasks, the V50 scored 8,727. That's slightly slower than the Galaxy S10 (9,547), but it's not something you'll notice in daily use.

The V50 is powered by a 4,000mAh battery. In our battery drain test, which streams video over Wi-Fi at full brightness, it lasted 8 hours and 52 minutes. That's a couple of hours behind the Galaxy S10 (10 hours, 54 minutes), though you should be able to get a full day of power with conservative use. The V50 supports Qualcomm Quick Charge 3.0, as well as wireless charging via the Qi standard.

## **CAMERAS**

Although LG isn't as well-known for its smartphone cameras as Google, Huawei, and Samsung are, the V50 delivers solid imaging performance in any lighting. The phone features a triple camera stack including a 12MP lens with a wide f/1.5 aperture, a 12MP telephoto lens with an f/2.4 aperture, and a 16MP super-wide angle lens with a 107-degree field of view and f/1.9 aperture.



The dual front-facing sensors come in at 8MP and 5MP.

In addition to rear lenses for just about any scenario, the V50 also features AI Cam to make camera adjustments based on different lighting and scene scenarios. In bright light, images are crisp, with excellent foreground and background detail.

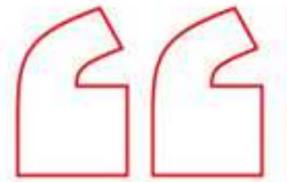
Low-light photos with the V50 are good, even though they can't compare with Pixel 3 and Pixel 3 XL photos. Like Google's flagship, the V50 has a dedicated night mode. For the most part, it works well, though we noticed some minor background detail loss and oversaturation in test shots. If you take lots of low-light images and want the absolute best quality, you'll want a Pixel 3.

The front of the V50 has standard and wide-angle lenses. Both performed well in our daylight test photos: subjects were clearly defined, color accuracy was on point, and background details were sharp. Portrait mode with the front-facing lenses is also solid on the V50, selecting foreground subjects accurately and creating natural bokeh.

Low-light test images using the front cameras were good, but noise crept in on a few shots, and dynamic range was absent from nearly all of our photos. It still manages to perform better than most smartphones in low light, even if it can't keep up with the Galaxy S10 or the Pixel 3.

## **SOFTWARE**

The V50 ships with Android Pie 9.0 with LG UX 8.0. While most handset manufacturers have moved to pared-down software layers, LG continues to use a heavy hand. In addition to such basic things as unique app icons, it makes drastic changes to settings,



**The V50 also features AI Cam to make camera adjustments based on different lighting and scenes.**



notifications, and the quick settings menus.

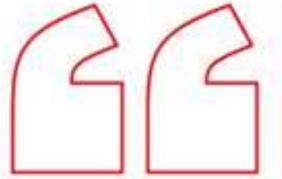
One of our biggest complaints about the V50 is the amount of bloatware it comes with. Since we tested only the Sprint version, we can't comment on what you'll find on other models, but it's safe to assume at least some bloatware will be included. Our test unit had nearly two dozen extraneous apps installed; fortunately, most of them can be uninstalled.

And while the LG V50 features the latest version of Android, don't expect to update to Android Q soon after it comes out; LG has been slow to push OS updates in the past. Last year LG announced a new initiative and software center in South Korea to speed updates to its handsets, but so far it doesn't seem to be very effective. If you want fast updates, your best bet is the Pixel 3.

## CONCLUSIONS

LG consistently delivers solid hardware, and the V50 ThinQ is no exception. It has plenty of power, a solid display, and looks sharp. That said, it's expensive for a first-generation 5G handset that offers connectivity on only a single spectrum band. Right now, we recommend waiting for 5G to mature. Until then, the Samsung Galaxy S10 is a less expensive option that features a cleaner UI and faster software updates. And if you're looking for the best camera and the fastest OS updates available, the Google Pixel 3 is hard to beat.

**STEVEN WINKELMAN**



**Our test unit had nearly two dozen extraneous apps installed; fortunately, most of them can be uninstalled.**





**Bose Noise Cancelling Headphones 700** | \$399.95 | **EDITORS' CHOICE** Rating: ●●●●○ EXCELLENT

# Bose Noise Cancelling Headphones 700: Terrific Audio Performance

**F**or years, Bose has ruled the active-noise-cancellation (ANC) market with its QuietComfort series of headphones. The manufacturer wrote the book on noise cancellation and has always seemed a step ahead of the competition. The new Bose Noise Cancelling Headphones 700 are the company's first to exist outside the QuietComfort/QuietControl lineup. They offer a more streamlined, modern look; built-in support for Amazon Alexa and Google Assistant; an improved mic system for clearer communication on calls; and the best noise cancellation we've tested. All that adds up to an Editors' Choice for noise-cancelling headphones.

## DESIGN

Available in black or silver, the stylish, minimalist Noise Cancelling Headphones 700 feature a graceful headband connecting the generously cushioned circumaural (over-ear) earcups. The fit is comfortable even over long listening sessions, and the faux-leather earpads block out plenty of ambient noise even without ANC turned on. The outer surfaces on the earcups and headband have a sleek, eggshell-like finish.

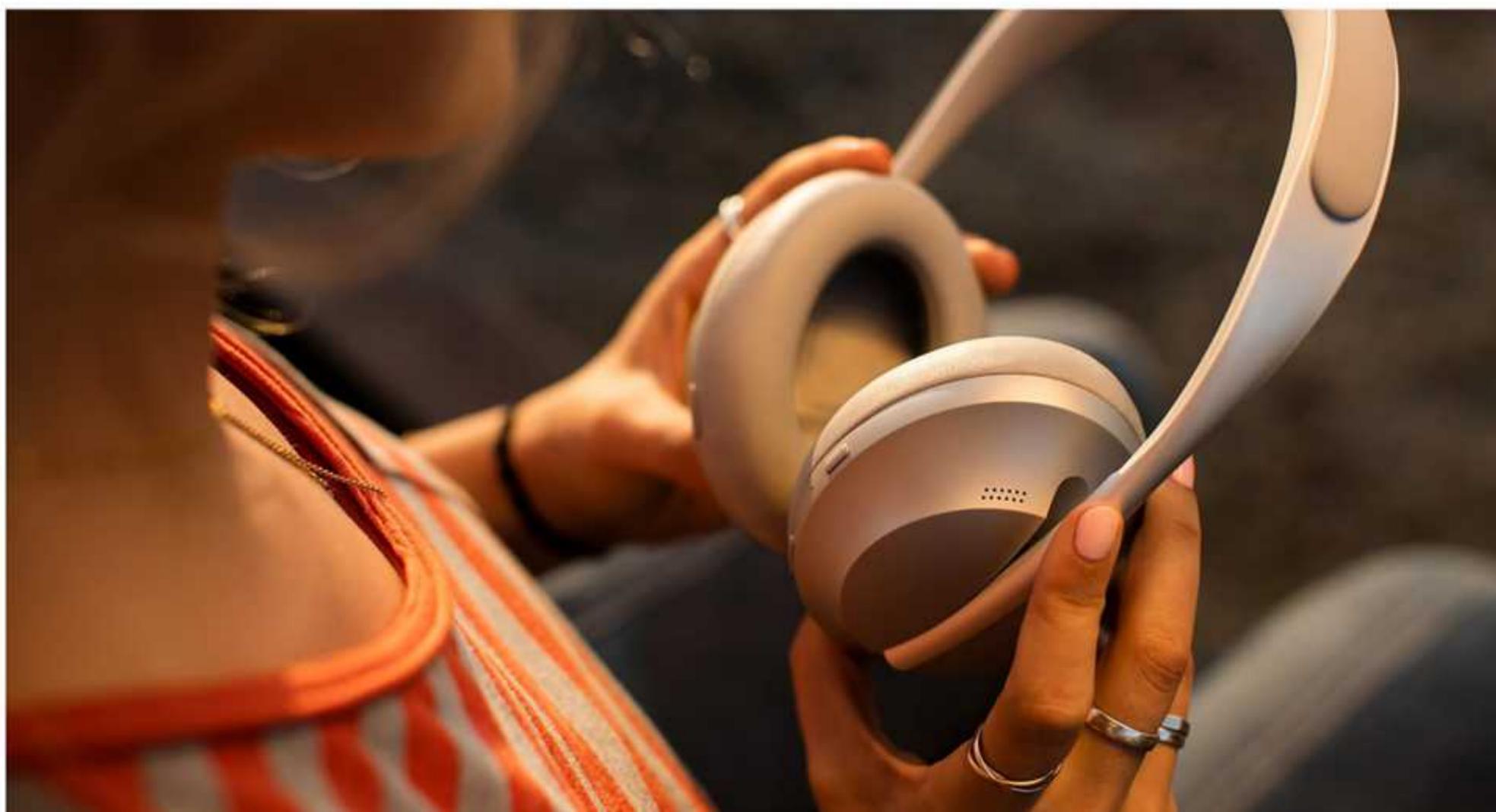
The right earcup's outer panel houses a touch-sensitive control pad, power/pairing buttons, a voice assistant button, and a status LED. Double-tapping the control pad plays and pauses music, swiping your finger up or down changes the volume, and swiping forward or backward skips tracks. Tapping and holding on the panel gives you a battery life prompt, or you can customize this action to enable or disable the wake word for voice assistants. For calls, tapping once answers, tapping and holding declines, and pressing the voice assistant button while on a call mutes the mic. This is one of the more intuitive and useful control pads we've operated on wireless headphones and is easy to learn and use.

## Bose Noise Cancelling Headphones 700

**PROS** Best-in-class noise cancellation and ambient listening mode. Excellent microphone clarity. Powerful bass depth. Comfortable.

**CONS** Expensive. Sculpted audio not for purists. No EQ (yet).

**BOTTOM LINE** The wireless Bose Noise Cancelling Headphones 700 offer terrific audio performance, hands-free voice assistant access, and the best active noise cancellation you can buy.



The left earcup houses the ANC button and a port for the included headphone cable. The audio cable can be used with the headphones for passive listening with the power turned off. When the headphones are on and the cable is connected, Bluetooth functions turn off automatically. The difference between the audio performance in passive and active wired modes is dramatic, and some users may prefer the passive sound signature's lighter emphasis on bass. Unplugging the cable when the power is on triggers auto-pairing with your mobile device. The cable lacks an inline remote or mic, which is a bummer, since wired mode disables the on-ear controls.

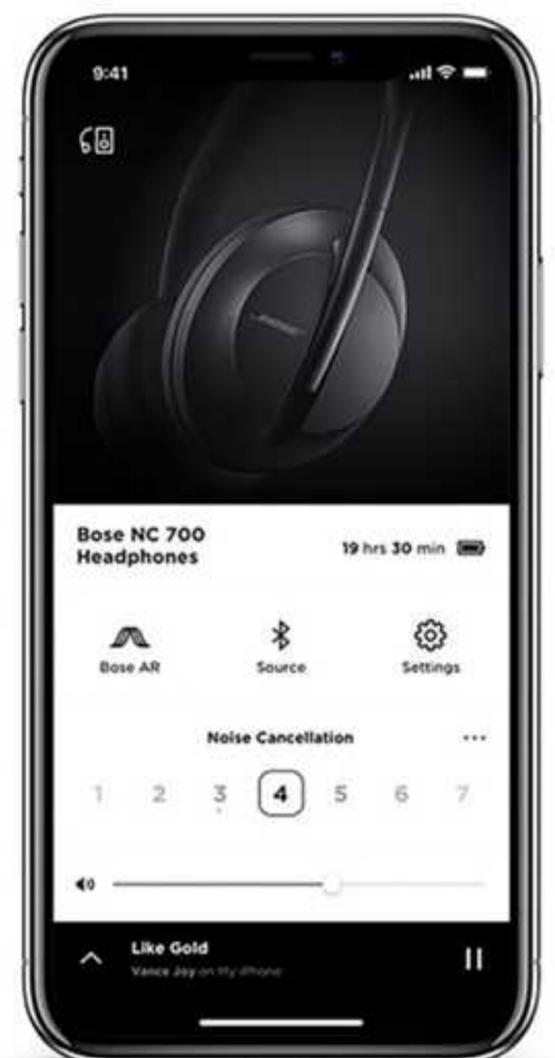
The included charging cable connects to a USB-C port on the bottom of the right earcup, and the other end of the cable is a standard USB-A plug to use with any compatible port or charger (no charger base is included). The Noise Cancelling Headphones 700 also ship with an impressively flat zip-up travel case that the headphones fold into; it has an interior compartment for the included cables.

Bose estimates battery life is up to 20 hours, but your results will vary based on volume levels and use of ANC and other extra features.

## **APP AND VOICE ASSISTANTS**

The Bose Music app (for Android and iOS) walks you through pairing the headphones, naming them, and selecting the music services you want to access through the app (Amazon, Deezer, and Pandora are a few options). You can then set up the voice assistant of your choosing.

Setting up Amazon Alexa or Google Assistant is simple, but you need the corresponding app for each service (Amazon Alexa or Google Home) for voice commands to function. The voice assistant button on the right earcup defaults to Siri on an iPhone but will summon your voice assistant of choice once the app setup is complete. You can set Alexa to listen for its wake word, so you don't even need to tap the button. (Google Assistant currently doesn't work with a wake word yet, though Bose says this functionality is coming.) The mics are exceptionally sensitive, and you can control Amazon Music hands-free with vocal commands, just like with a smart speaker.



The app also provides ANC control, letting you dial in noise-cancellation levels between Level 0 (none) and 10 (maximum). The ANC button on the left earcup can cycle through your “favorite” ANC settings—it defaults to 0, 5, and 10 out of the box, but you can assign any three values in the app to cycle through when the button is pressed. Pressing the ANC button on the left earcup and holding it puts the headphones in conversation mode, which automatically switches the level to 0, allowing you to hear your surroundings clearly.

You can disable voice prompts, change prompt language, and set some more granular variables such as adjusting how much of your own voice you can hear on phone calls through the app. A detailed battery life status is also listed on the main screen.

Bose plans to introduce augmented reality apps that work with its products, so there’s a Bose AR button in the app. This feature is currently underwhelming; it’s limited to a handful of apps that are essentially interactive maps or discovery tools for things to do near your location. But it has the potential to be cool.

What’s missing in the app? EQ. Bose says this will be included in a future update, but it isn’t there now.

## **NOISE CANCELLATION AND MICS**

Bose avoids one pitfall common with wireless ANC headphones: There’s little difference in audio performance across the noise-cancellation modes. The ANC has little to no impact on how the headphones sound and doesn’t add background hiss, which isn’t true of plenty of competing ANC models.



As mentioned, the ANC has varying degrees of intensity, which is blended with ambient mics that pick up the outside world so you can hear your surroundings when you want to. Let's start with maximum ANC, Level 10: It's probably the most effective noise cancellation I've heard to date. It blocks out most of my typing as I write this, along with the relatively loud AC whir in my office. It also removes wide swaths of the low-frequency rumble you hear on planes and trains and drastically reduces nearby chatter.

Dialing down to Level 5 is actually quite useful—you still block out plenty of noise, but now you can hear some of your surroundings without them being a distraction. My guess is people will use these headphones in the levels between 5 and 10, because sometimes maximum ANC can seem too quiet, especially when you're not playing music.

Level 0 is what other ANC manufacturers call “ambient listening” or “hear-through mode,” but it's far more natural than any other ambient mode we've tested. The mics pick up your surroundings quite well and levels are adjusted to match reality to an impressive degree. This means there's very little difference between what your surroundings sound like with the headphones set to ANC Level 0 and what they sound like without headphones at all. The other impressive feat is the lack of delay—most ambient modes include a very slight slapback delay that's noticeable when you're typing (the clicks arrive later than they are happening) or chatting with someone. So Level 0 is an impressive new height for ambient listening.



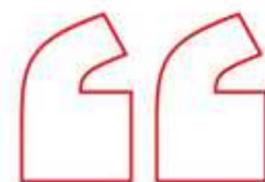
This does mean there's never any true ANC Off mode for the Noise Cancelling Headphones 700. Mode 0 uses the ambient mics, and Modes 1 to 9 are varying degrees of the ANC mixed in with those mics. By Level 10, the ambient mics are not in the mix. Regardless, either the ambient mics or the ANC are always active, and the only way to disable them completely is to turn the headphones off and use them in passive mode, which affects the audio performance dramatically.

Bose developed a mic array system that focuses on your voice and rejects nearby ambient noise, which not only makes for clearer phone calls but also results in more efficient digital-assistant voice communication. It also offers excellent call intelligibility. Using the Voice Memos app on an iPhone 8, we could understand every word we recorded clearly and crisply. Hints of Bluetooth audio artifacts still fuzz up the edges, but background noise is no longer an issue, even in windy or noisy environments.

## **AUDIO PERFORMANCE**

On tracks with intense sub-bass content, such as The Knife's "Silent Shout," the Noise Cancelling Headphones 700 deliver powerful low-frequency depth while also sculpting the highs to balance things out. At top, the bass doesn't distort. This isn't a sound signature for purists, but bass lovers will be pleased.

Bill Callahan's "Drover," a track with far less deep bass in the mix, gives us a better sense of the Noise Cancelling Headphones 700's general sound signature. The drums on this track sound almost thunderous—they aren't quite over the top, but they have more bass presence than is strictly accurate. Thankfully, the bass is balanced out with crisp high-mid and high-frequency presence, keeping things clear and defined rather than muddled by the low and low-mid richness.



**Using the Voice Memos app on an iPhone 8, we could understand every word we recorded clearly and crisply.**



On Jay-Z and Kanye West's "No Church in the Wild," the kick drum loop receives plenty of high-mid presence, allowing its attack to retain its punch. While the vinyl crackle and hiss are usually relegated to the background, they take a step forward in the mix. The loop also sounds beefed up in the lows, and the sub-bass synth hits that punctuate the beat are delivered with plenty of added depth. The vocal performances on this track are delivered cleanly and clearly, but with an occasional bit of added sibilance.

Orchestral tracks, such as the opening scene from John Adams' "The Gospel According to the Other Mary," tend to pack a little too much bass punch. It doesn't sound ridiculous, but the lows are pushed forward notably in the mix, while the higher register brass, strings, and vocals retain their crisp, bright presence despite the bass boosting.

## CONCLUSIONS

The Bose Noise Cancelling Headphones 700 live up to the standards set by the QuietComfort series and add to the listening experience with excellent mic clarity, enhanced voice-assistant functionality, and granular ANC control. At \$399.95, they're expensive but worth the money, and they easily earn our Editors' Choice for their best-in-class noise cancellation.

For \$50 less, the Bose QuietComfort 35 II are your top option next to the 700. The primary differences between the QC 35 II and the Noise Cancelling Headphones 700 are a completely different physical build, the lack of adjustable ANC, a different mic, and the need to press a button to use your phone's voice assistant. If these differences aren't a big deal to you, go ahead and save \$50.

If your primary concern is audio performance with strong noise cancellation coming in a close second, the Sony WH-1000XM3 headphones (\$348) are an excellent option with plenty of bass depth and high-frequency clarity, along with an EQ function to please audiophiles looking for a balanced sound signature. If these are all out of your budget, though, the more affordable Marshall Mid ANC headphones deliver solid audio for \$279.99, though their noise cancellation isn't in the same league as these other models.

**TIM GIDEON**



**Nvidia GeForce RTX 2070 Super** | \$499.00 | **EDITORS' CHOICE** Rating: ●●●●○ **EXCELLENT**

## Nvidia GeForce RTX 2070 Super: A Killer Card for the Money

**A**MD's new line of "Navi" graphics cards was barely a surprise by the time the company detailed it at E3 (leakers did it in), but another GPU manufacturer still had a few shockers up its sleeve. With the GeForce RTX Super family, Nvidia unveiled three new graphics cards. (AMD's Navi launch on July 7 added more.) Neck-deep in the world of GPUs as we are, even we were caught off guard by the Supers' sudden arrival.

We were also surprised by this: Providing near-GeForce RTX 2080-level speeds at a much lower price, the RTX 2070 Super is a rocket at its price point. The card consistently hit our expectations and exceeded them once we ran some overclocking tests. Perhaps Nvidia overshot the market last August with its first RTX cards, but this is a deft, impressive course correction. The GeForce RTX 2070 Super earns our Editors' Choice as the \$499 high-end card that the GeForce RTX 2080 should have been. Its stellar performance at its price makes up for the wait—and makes it without peer.

## BUILDING A BETTER RTX 2070

When Nvidia first announced its GeForce RTX line of cards, the reveal was met with “ooh” and “ahh,” followed quickly by a resounding “oof” when the prices were announced: \$499 for the RTX 2070, \$699 for the RTX 2080, and a hefty \$999 for the RTX 2080 Ti. (Those prices were the starting prices for its stock—or reference—boards, not to be confused with Nvidia’s slightly upticked Founders Edition cards.)

Good graphics cards have never been the cheapest upgrade component for your gaming PC, but the new pricing paradigm that Nvidia set with the RTX cards put the RTX 2070 and higher cards on a high shelf for most folks, with the RTX 2080 and RTX 2080 Ti essentially establishing a new “elite” price tier.

And that affected their adoption; according to the Steam Hardware Survey, GeForce RTX cards make up less than 3 percent of the total pool of GPUs that gamers are using on Steam’s platform, while cheaper/older options in the “Pascal” GeForce GTX 10 line account for more than 40 percent of the systems that reported to the survey.

## Nvidia GeForce RTX 2070 Super

**PROS** Superb price for performance. Stable overclocking results help it rival original RTX 2080. Runs quiet. RT and Tensor cores ensure future-proofing.

**CONS** That it didn’t come sooner.

### BOTTOM LINE

Packing near-RTX 2080 performance and similar specs, Nvidia’s GeForce RTX 2070 Super rules for solid 4K play at 60Hz and high-refresh gameplay at 1440p. It’s a killer card for the money.



With such a huge gulf in adoption rates, Nvidia has been trying its best to convince gamers that GeForce RTX is the way forward (among cards for AAA, single-player games), while also bridging the price gap with cheaper options such as the non-RTX GeForce GTX 1660 Ti, cards targeted more toward the needs of esports-focused players and budget-minded shoppers playing at 1080p, tops.

Nvidia now has three new weapons in the RTX arsenal: the GeForce RTX 2060 Super, RTX 2070 Super, and RTX 2080 Super GPUs, which are 15 percent faster on average than their non-super counterparts, according to Nvidia. The RTX 2060 Super is \$399, just \$50 more than the non-Super, and the RTX 2070 Super retails for \$499. Both were released July 8. The RTX 2080 Super went on sale for \$699 on July 23rd.

Retaining both the RT and Tensor cores that distinguish the RTX line (and which make ray-tracing and DLSS possible), the Super line looks like Nvidia's second attempt to convince gamers that investing in RTX is worthwhile, despite the fact that roughly a year after the first RTX cards launched, ray-tracing is implemented in just a smattering of popular titles. (Battlefield V, Metro Exodus, and Shadow of the Tomb Raider are the big ones at the moment.)

But with no mention of an architecture overhaul or heavy new tech under the hood, what makes Super cards so super?



## A MYSTERY GPU?

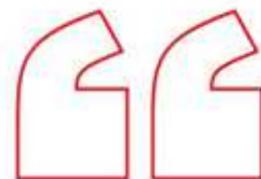
I asked Nvidia about this. An exchange with PR revealed that the Super line refines clock-speed performance, and “...increased yields that have allowed us to offer more cores and more performance at each price point. In the 10-plus months that we’ve had Turing, we’ve been working to improve Turing. Tuning faster memory clocks, improving processes and yields. This has allowed us to increase the core count on RTX 2070 Super and 2060 Super.”

We’ll get into those performance increases in a bit, and they are most definitely real. I suspect, though, that a well-known process known as “binning” may be behind at least some the Super line’s magic. (Mind you, that’s not a bad thing.)

When a GPU or CPU die is “baked” (that is, etched) into silicon, the process doesn’t yield perfect results every time. Rather than getting 100 GPUs that all perform identically, the chip maker might get 25 that underperform, 50 that perform on spec, and another 25 that can perform above spec.

The dies that perform above spec can be put in the “bin” for cards where overclocking is done at the factory or encouraged right out of the box, while those within spec might make it into reference versions instead. The underperforming die might have one of several fates: It could be discarded (inefficient!), or, in some cases, depending on how the card is marketed, the overperforming and on-spec dies might be pitched as the premium product (in our made-up example, 75 percent of the yield), while the underperformers make their way into the “standard” version.





**Nearly every aspect of the original RTX 2070 card is replicated here, aside from a few subtle changes to the shell.**



My assumption here (without firm confirmation from Nvidia) is that at least a couple of the Super line of GPUs (the RTX 2070 Super and RTX 2060 Super) could be binned versions of the GPU released last year that, in each case, is one tier above. The company's claim that "the Supers are based on the same Turing GPUs as the original 20 Series" lends credence to that idea.

The two options are that, for example in the case of the RTX 2070 Super, either Nvidia has improved its ability to engineer a 10.8-billion transistor TU106 chip to produce sub-RTX 2080 results on a die that's exactly the same transistor count (13.6 billion) as the TU104 die's (the RTX 2080's). Or the Supers represent amped-up versions of the RTX 2060, RTX 2070, and RTX 2080 based on forms of the GPU next up the stack. The first scenario seems rather unlikely.

This assumption is shored up by the fact that Nvidia hasn't announced an RTX 2080 Ti Super card. If each Super is sourcing its GPU from another, existing one, the GeForce RTX 2080 Ti doesn't have any up-ladder equivalent outside of the Nvidia RTX Titan, which is twice the cost of the RTX 2080 Ti and based on an entirely different architectural ethos, one that doesn't put gaming performance first and foremost.

Finally, there's another clue: The GeForce RTX 2070 and RTX 2080 will be replaced by the RTX 2070 Super and RTX 2080 Super, respectively, but the non-Super GeForce RTX 2060 will remain on sale.

### **HAVEN'T WE SEEN YOU BEFORE?**

If you've already seen what the RTX 2070 Founders Edition looks like, you won't be too surprised by what the RTX 2070 Super has on offer. Nearly every aspect of the original RTX 2070 card is replicated here, aside from a few subtle changes to the shell.

A shiny mirror slapped in the center of the card wraps around the two cooling fans, and a small green “Super” label is at the end of the card name. Other than that, Nvidia is sticking to what it knows, and as long as it works, you won’t see any complaints from us. You’ll also note that Nvidia isn’t dubbing these new Nvidia-made versions of the RTX 2070 Super card as “Founders Editions.”

The card has different power requirements. Where the original RTX 2070 Founders Edition required just a single eight-pin power connector, the RTX 2070 Super needs both an eight-pin and six-pin to boot up. There’s nothing “super” about the number of ports, which still sits at five: three DisplayPort 1.4, one HDMI 2.0, and one USB-C/VirtualLink.

## **NVIDIA GEFORCE RTX 2070 SUPER VS. NVIDIA GEFORCE RTX 2080**

So is the RTX 2070 Super its own thing or a binned RTX 2080? You decide! Here are the key specs that Nvidia provides on each card:

	<b>Nvidia GeForce RTX 2080 (Reference)</b>	<b>Nvidia GeForce RTX 2070 Super</b>
Architecture	Turing	Turing
Date of Introduction	8/20/2018	7/2/2019
Manufacturing Process / Die Size	12nm / 545mm <sup>2</sup>	12nm / 545mm <sup>2</sup>
Transistor Count	13.6 billion	13.6 billion
Processing Cores	2,944	2,560
Base / Boost GPU Clocks	1,515MHz / 1,710MHz	1,605MHz / 1,770MHz
Video Memory	8GB GDDR6	8GB GDDR6
Memory Interface / Bandwidth	256-bit / 448GBps	256-bit / 448GBps
Board Power	215 watts	215 watts
Power Connectors	One six-pin, one eight-pin	One six-pin, one eight-pin
Recommended Launch Price	\$699	\$499

Same die size? Check. Same number of transistors? Check. Same memory bus size and bandwidth, power requirements, and power-connector configuration? Check, check, and check.

In fact, the only numbers that differ on these two cards are the clock speeds, the number of processing cores, and the gigatexels-per-second rate, stats which are both notorious for missing spec when the die is binned downward.

## NVIDIA GEFORCE RTX 2070 SUPER VS. NVIDIA GEFORCE RTX 2070

As similar as the specs of the RTX 2070 Super and RTX 2080 are, the numbers between the RTX 2070 reference cards and the RTX 2070 Super are pretty different:

	Nvidia GeForce RTX 2070 (Reference)	Nvidia GeForce RTX 2070 Super
Architecture	Turing	Turing
Date of Introduction	8/20/2018	7/2/2019
Manufacturing Process / Die Size	12nm / 445mm <sup>2</sup>	12nm / 545mm <sup>2</sup>
Transistor Count	10.8 billion	13.6 billion
Processing Cores	2,304	2,560
Base / Boost GPU Clocks	1,410MHz / 1,620MHz	1,605MHz / 1,770MHz
Video Memory	8GB GDDR6	8GB GDDR6
Memory Interface / Bandwidth	256-bit / 448GBps	256-bit / 448GBps
Board Power	175 watts	215 watts
Power Connectors	One eight-pin	One six-pin, one eight-pin
Recommended Launch Price	\$499	\$499

That said, how much does the identity of the actual GPU matter? Who cares, if it's fast for its price bracket. Let's get down to finding out.

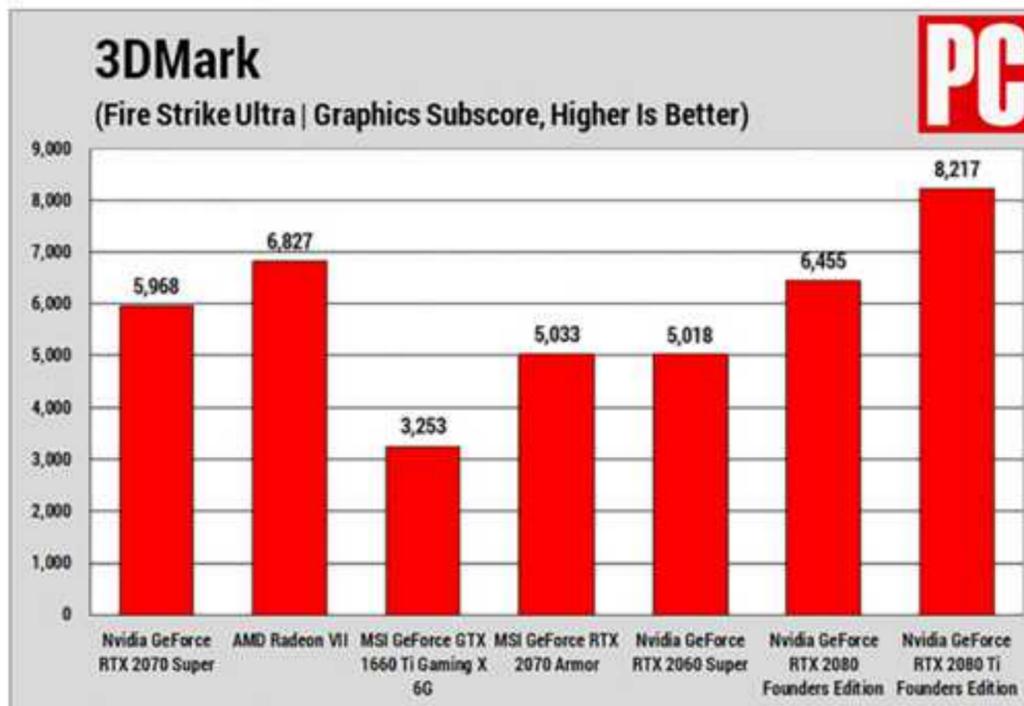
### TESTING: ENGAGE THE SUPER-CHARGER!

PC Labs ran the GeForce RTX 2070 Super card (and its RTX 2060 Super sibling) through a series of DirectX 11- and 12-based synthetic and real-world benchmarks. Our test rig is equipped with an Intel Core i7-8700K processor, 16GB of G.Skill DDR4 memory, a solid-state boot drive, and an Aorus Z370 Gaming 7 motherboard.

For our benchmark results, we focused some effort on the esports abilities of this card, in addition to the rest of our standard benchmarks, which test a card's abilities to handle AAA games at the highest possible quality settings.

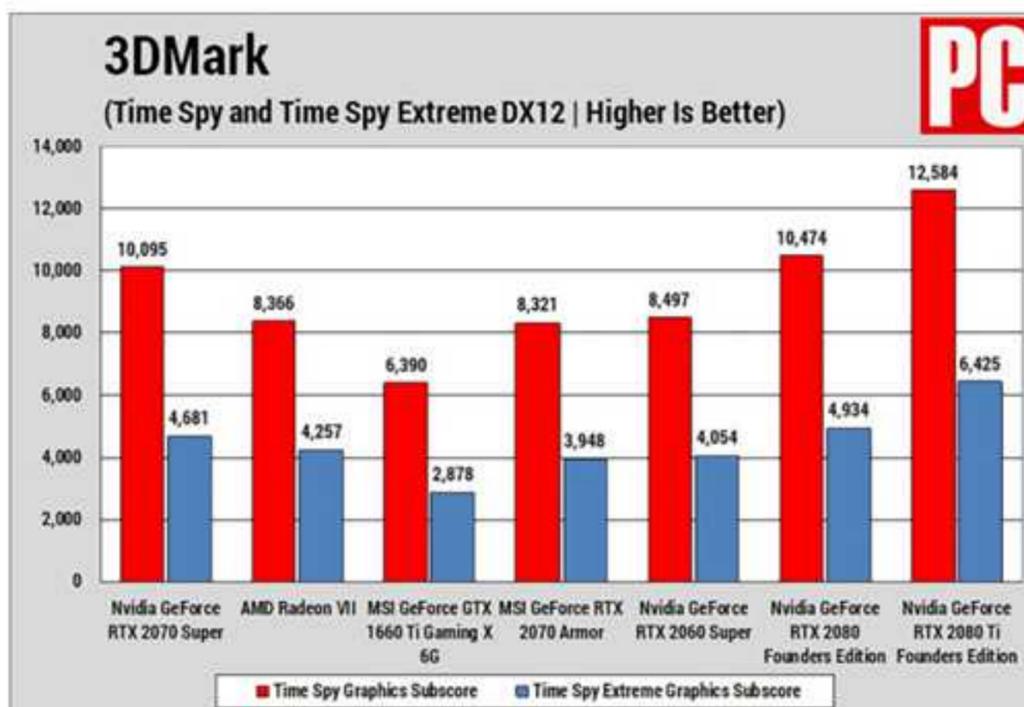
### SYNTHETIC BENCHMARKS

3DMark Fire Strike Ultra: Synthetic benchmarks can be good predictors of real-world gaming performance. Futuremark's circa-2013 Fire Strike Ultra is still a go-to for simulating 4K-based gaming. We're looking only at the Graphics Subscore (which isolates the video card's contribution), not the test's Overall Score.



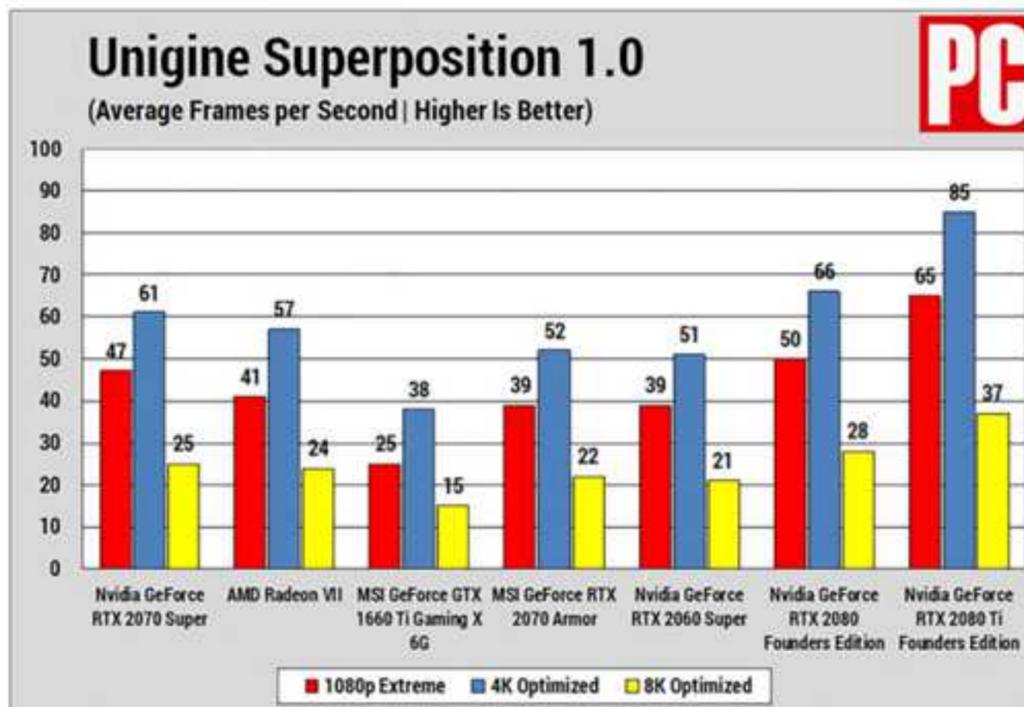
You can see that the RTX 2070 Super is inching into the territory that used to be exclusively occupied by the RTX 2080, while maintaining exactly the 15 percent boost over the standard RTX 2070 that Nvidia quotes.

**3DMark Time Spy and Time Spy Extreme:** This is Futuremark's DirectX 12-enabled benchmark for predicting the performance of DirectX 12-enabled games. It uses major features of the API, including asynchronous compute, explicit multi-adapter, and multi-threading.



Time Spy and Time Spy Extreme show the RTX 2070 Super card really starting to show its mettle, with a boost of 17 percent over the standard RTX 2070, and even beating the AMD Radeon VII (\$699) by the same margin in straight Time Spy.

**Unigine Superposition:** Our last synthetic benchmark is Unigine's 2017 release, Superposition. This benchmark does incorporate ray tracing, but it's done in software, not hardware, so it doesn't utilize the RT cores of the RTX 20 series.



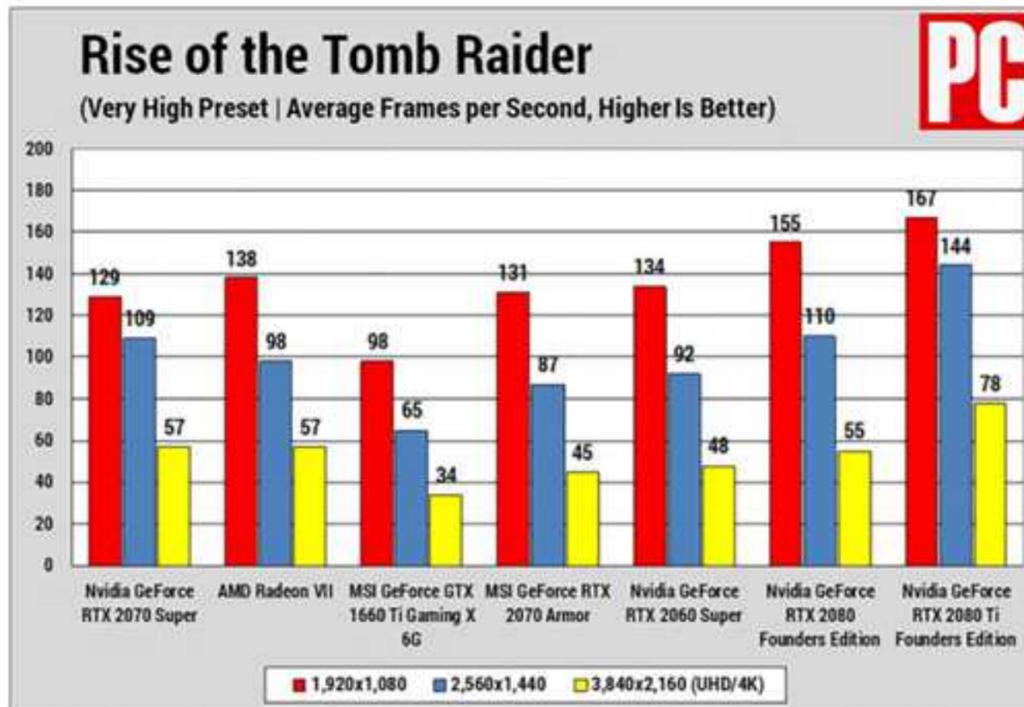
On this test, the 2070 Super is in close proximity to the RTX 2080 while trouncing the original RTX 2070 by lustrous margins.

## REAL-WORLD GAMING

The following benchmarks are games that you can actually play. The charts detail the settings we used (typically the highest in-game preset and, if available, DirectX 12). A quick note: Though most of our game tests are maxed out in graphical fidelity to push cards to their limits, multiplayer gaming is about maintaining the best balance between graphical fidelity and high-as-possible frame rates.

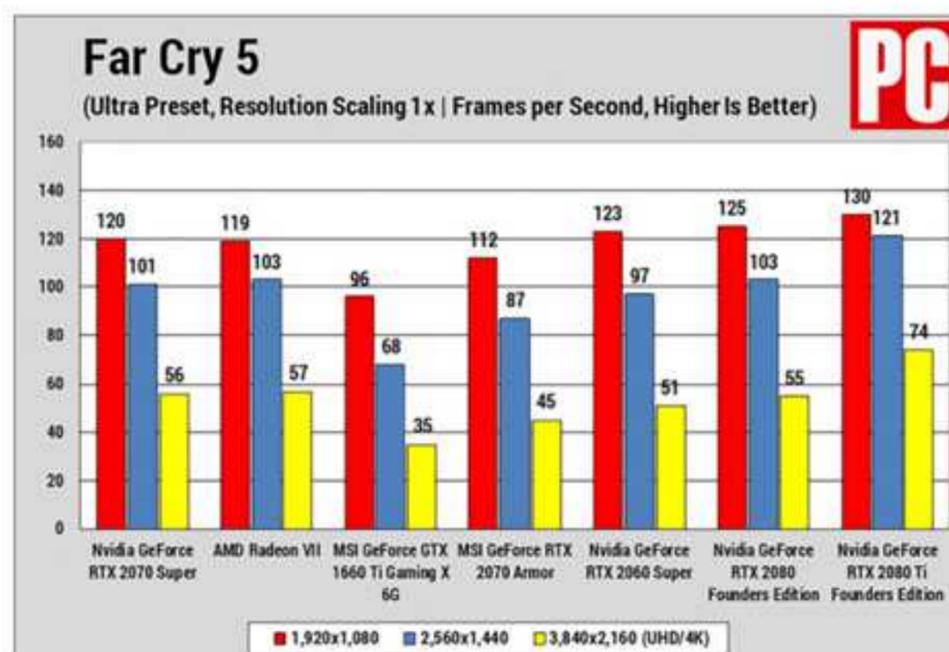
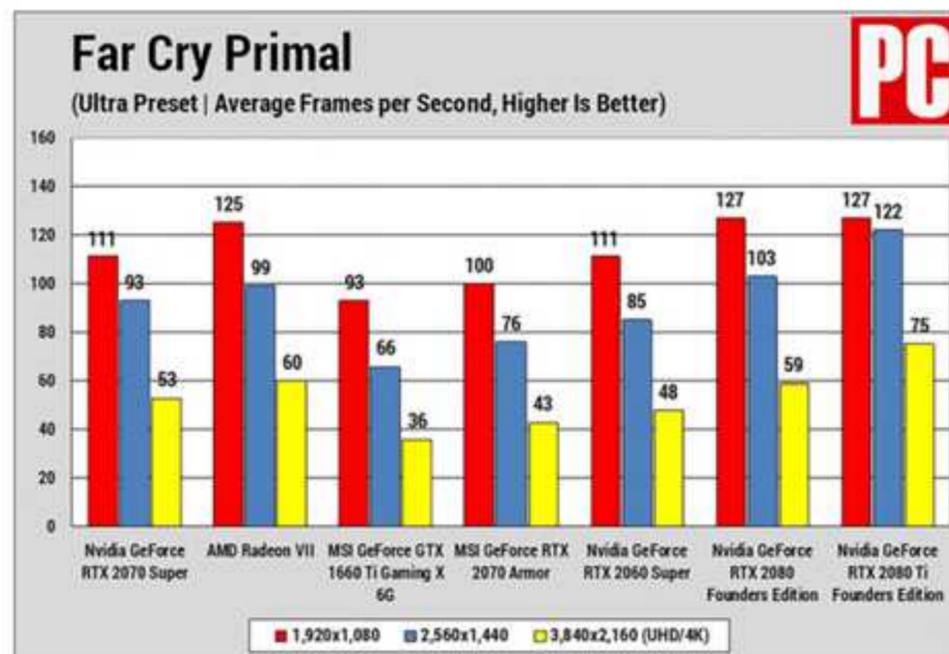
As such, we've kept the test sequences for Apex Legends, CS:GO, and Rainbow Six: Siege tuned to the best combination of necessary improvements in settings (higher anti-aliasing and lower shadows, for example) to keep frame rates at 1080p above that coveted 120Hz or 144Hz mark for high-refresh monitors. Playing at the more common 60Hz is a cinch with these games using a card of this caliber.

**Rise of the Tomb Raider:** The 2015 predecessor to Shadow of the Tomb Raider is still a great benchmark.



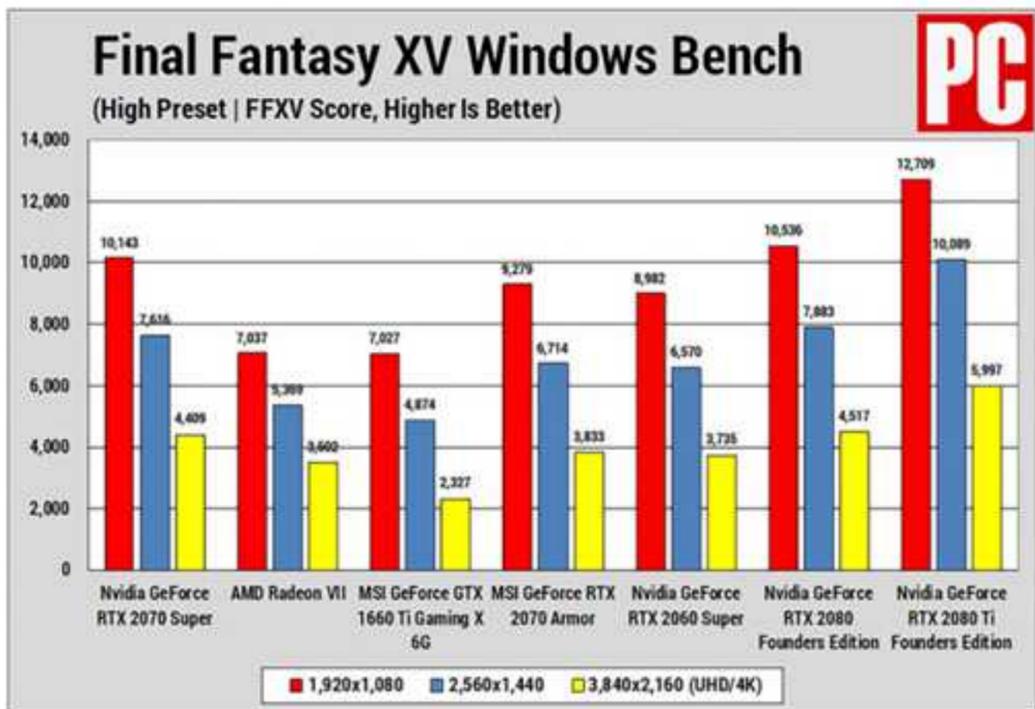
Here again the GeForce RTX 2070 Super achieves a near-RTX 2080 result, as the two cards show nearly identical scores on both 1440p and 4K results.

**Far Cry Primal and Far Cry 5:** These installments in the Far Cry series are based on DirectX 11 but still demanding. We're looping the benchmark charts together here since the games play out similarly in a relative sense.



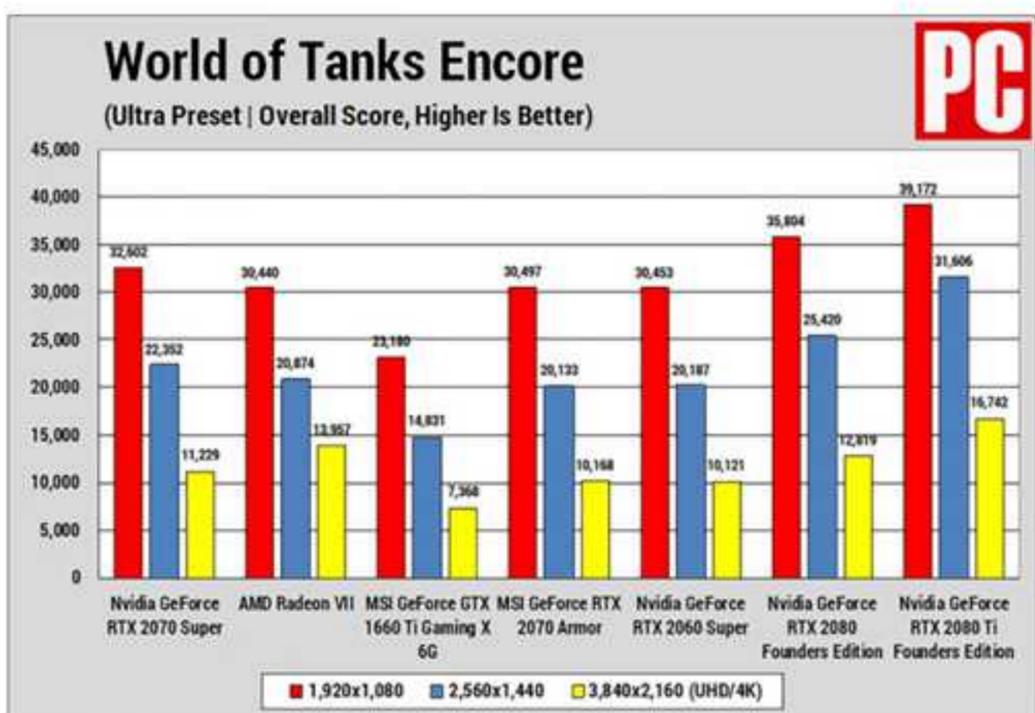
The RTX 2070 Super maintained its neck-and-neck pace with the RTX 2080 Founders Edition on both Far Cry 5 and Far Cry Primal, while just missing the mark set by AMD's Radeon VII in each.

**Final Fantasy XV:** We'll take a respite from frame-rate-based benchmarks for a moment with Final Fantasy XV.



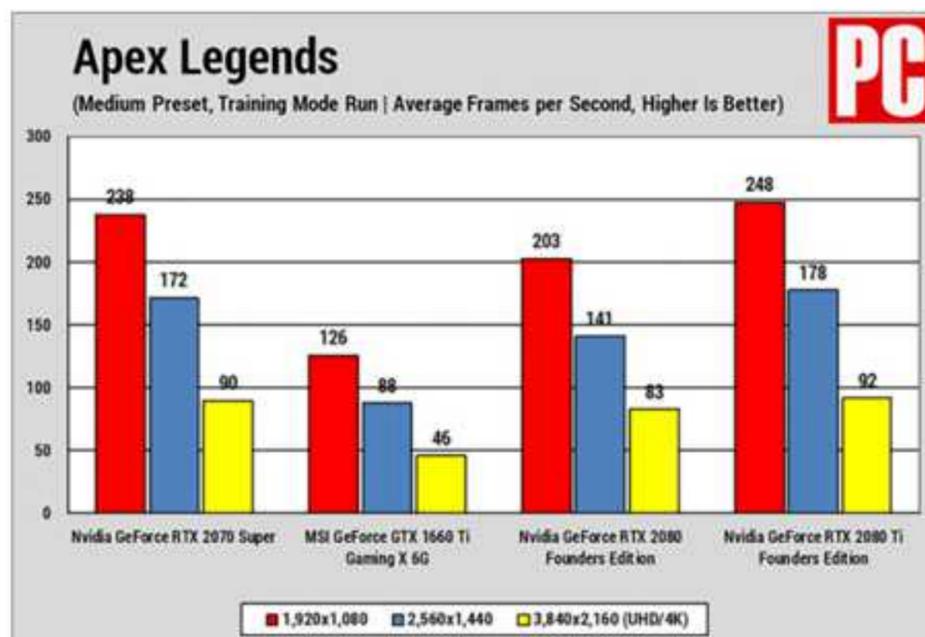
Final Fantasy XV always leans in favor of Nvidia cards, so we won't point to the thrashing it gave to the AMD Radeon VII here; we'll focus more on its razor-thin loss to the RTX 2080.

**World of Tanks Encore:** This is another non-fps-based benchmark that's available as a free download. It's not super-demanding, but it's still a reliable test.



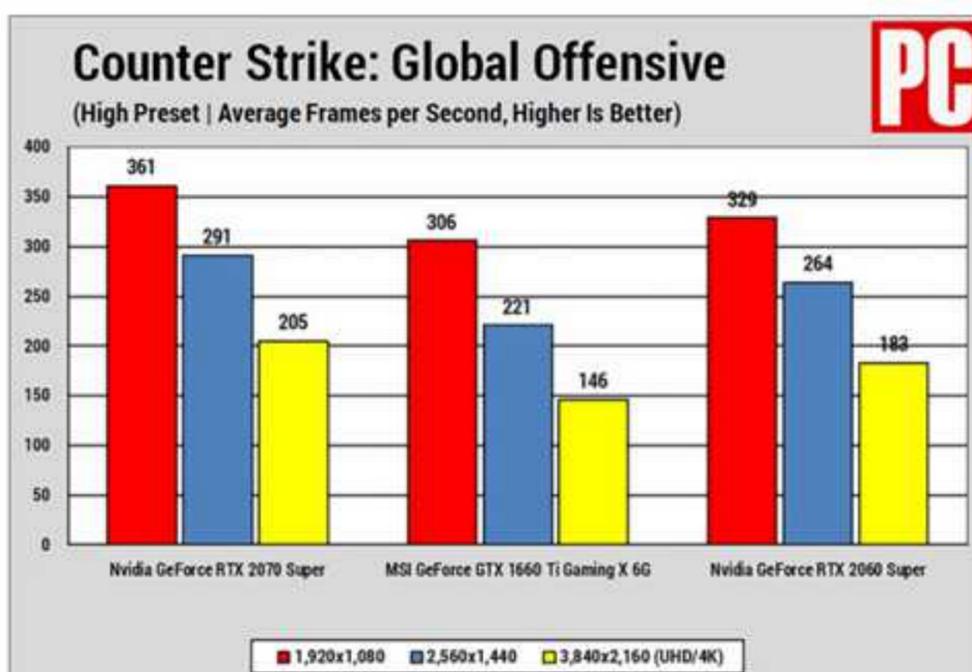
Here the RTX 2070 Super trailed behind the RTX 2080, but it still performed in spec relative to both the vanilla RTX 2070 and the RTX 2060 Super.

**Apex Legends:** Apex Legends is the newest, most exciting battle royale on the planet, and it's gaining adherents by the millions.



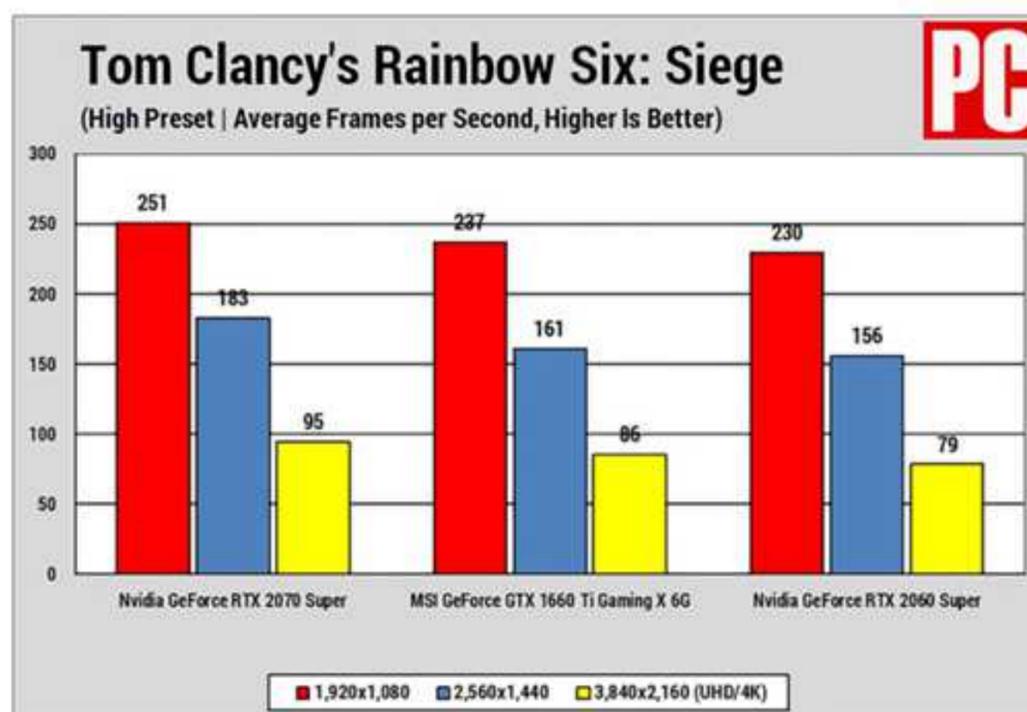
Though these numbers may look superb for the RTX 2070 Super (hitting just under the RTX 2080 Ti), keep in mind that with Apex Legends being the newer game, engine improvements are coming with every new patch. This means that results from a few months ago may not be relevant to the sort of frame rates you'd see if you played the game today.

**Counter Strike: Global Offensive:** One of the oldest online games, yet still popular, Counter Strike: Global Offensive (CS:GO) is the latest in a long line of titles that have changed little of their core gameplay over the years, and gamers wouldn't have it any other way. The engine is considered one of the best optimized in all of PC gaming, which makes it easy to compare major gaps in any one card's abilities versus another's.



These results help make an interesting case for the esports-focused GeForce GTX 1660 Ti, if this game happens to be your main squeeze and you play on a high-refresh-rate monitor. All three cards topped the coveted 144Hz boundary (even at 4K resolution) using our test settings, and each cleanly surpassed 240Hz at 1080p.

**Tom Clancy's Rainbow Six: Siege:** Despite Rainbow Six: Siege languishing thanks to bugs and server problems during its first year, Ubisoft has worked hard on this competitor to CS:GO to make it one of the most highly played games on the Steam platform, with 45 million players and growing as of early



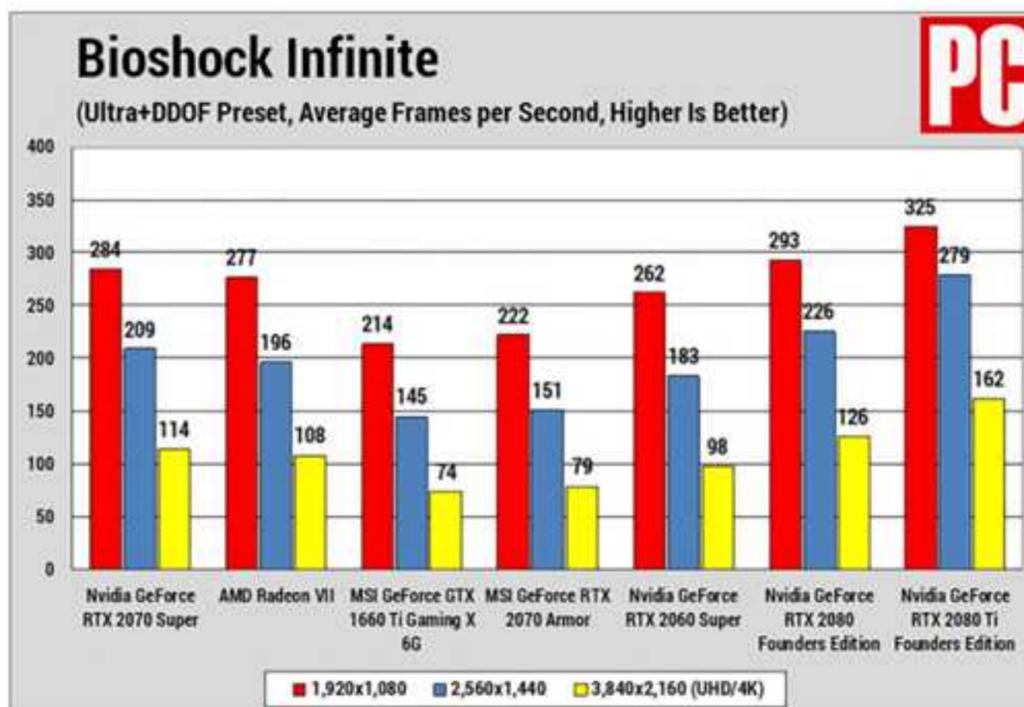
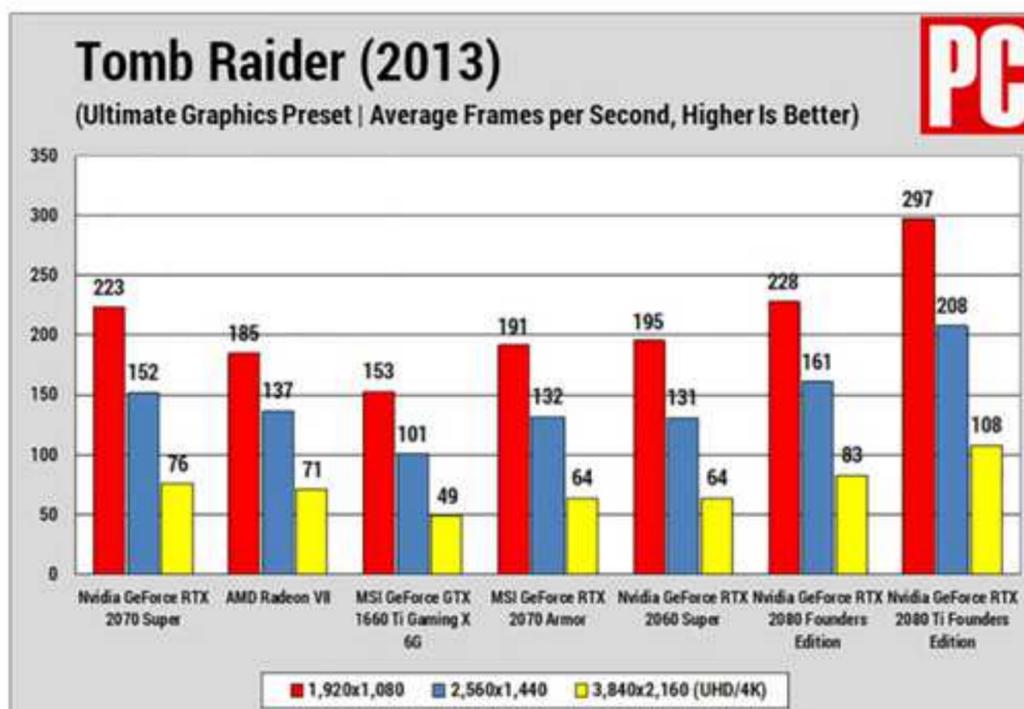
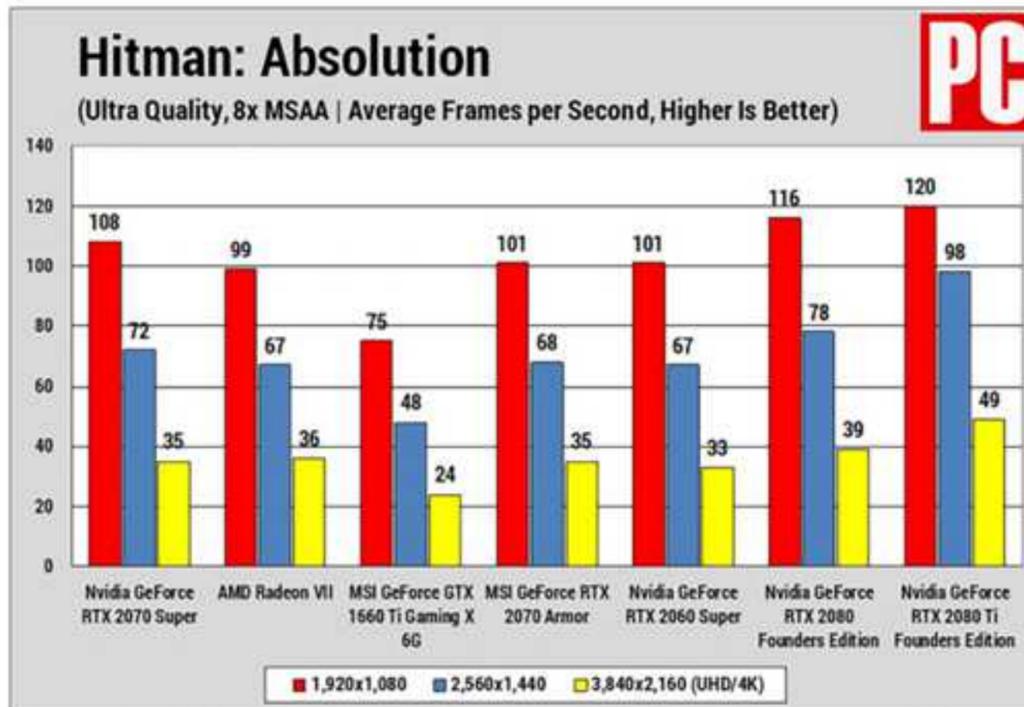
2019.

We don't have a ton of numbers to compare Rainbow Six: Siege's score to, given its recent entry into our testing regimen. But the numbers we have show that while the RTX 2070 Super is plenty powerful enough to keep your frame rates above the 144Hz/1440p golden ratio, in this test specifically, it was also eerily close to Nvidia's esports-focused, much less costly GeForce GTX 1660 Ti.

If you're buying a card only for esports titles, given the results we saw above, you're likely better off saving \$220 and going with the GeForce GTX 1660 Ti. AAA games, on the other hand? This is a nice-priced beast.

## LEGACY GAMES

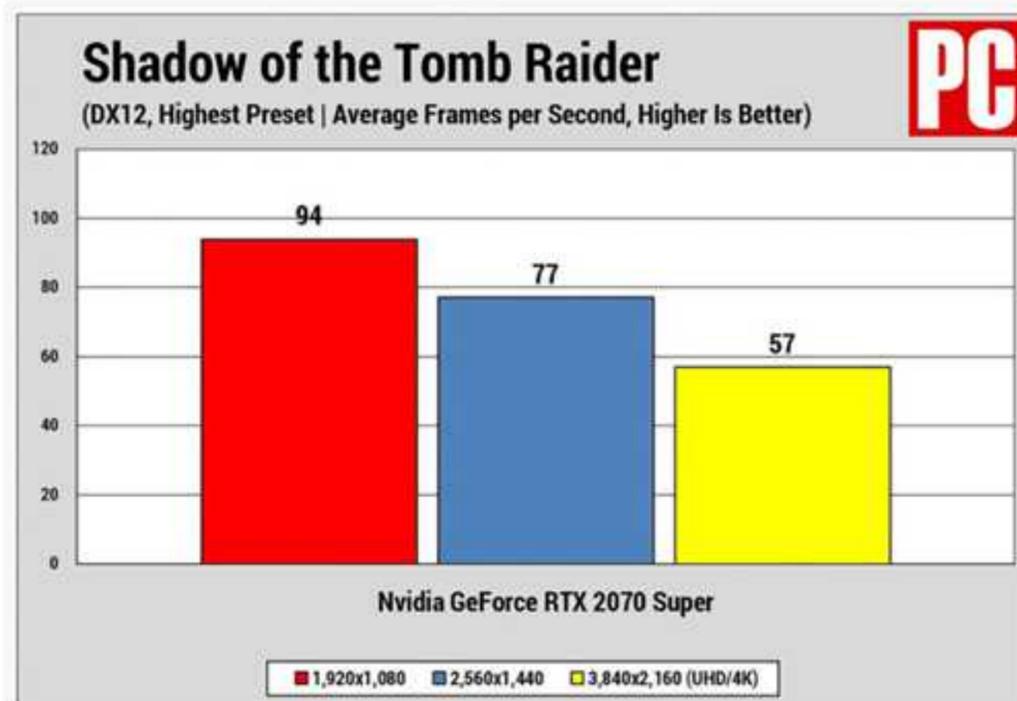
We ran quick tests on some oldies but goodies that still offer the AAA gaming experience, despite being more than a few years old. These legacy tests include runs of Hitman: Absolution, Tomb Raider (2013), and Bioshock: Infinite.



In these tests, the RTX 2070 Super continued to nip at the heels of the RTX 2080, coming in just behind the Founders Edition of that card on all three benchmarks.

## TRACING ALL THE RAYS, OVERCLOCKING THE GPU

Seeing as how Shadow of the Tomb Raider is, at the moment, the only working ray-tracing-enabled GeForce RTX test for the RTX 2070 in our test smorgasbord (the Metro Exodus benchmark is on the fritz), it was important to see how the RTX 2070 Super held up to the first half of its name: the RT bit.



While the original RTX 2070 was just barely powerful enough to handle ray tracing above 60fps on this title, the RTX 2070 Super just about hits the 4K 60Hz mark with ray tracing and DLSS turned on, and sails right past it when the resolution is bumped down to 1440p.

I also tried a bit of concerted overclocking. Using EVGA's X1 Precision overclocking tool, I was able to achieve an overclock of 175MHz on the GPU, and 450MHz of memory overclock on the 8GB of GDDR6. This clock was as stable as it gets, and problems only started to pop up around the 200MHz mark. (That's also the case with most of the Nvidia Founders Edition cards.)

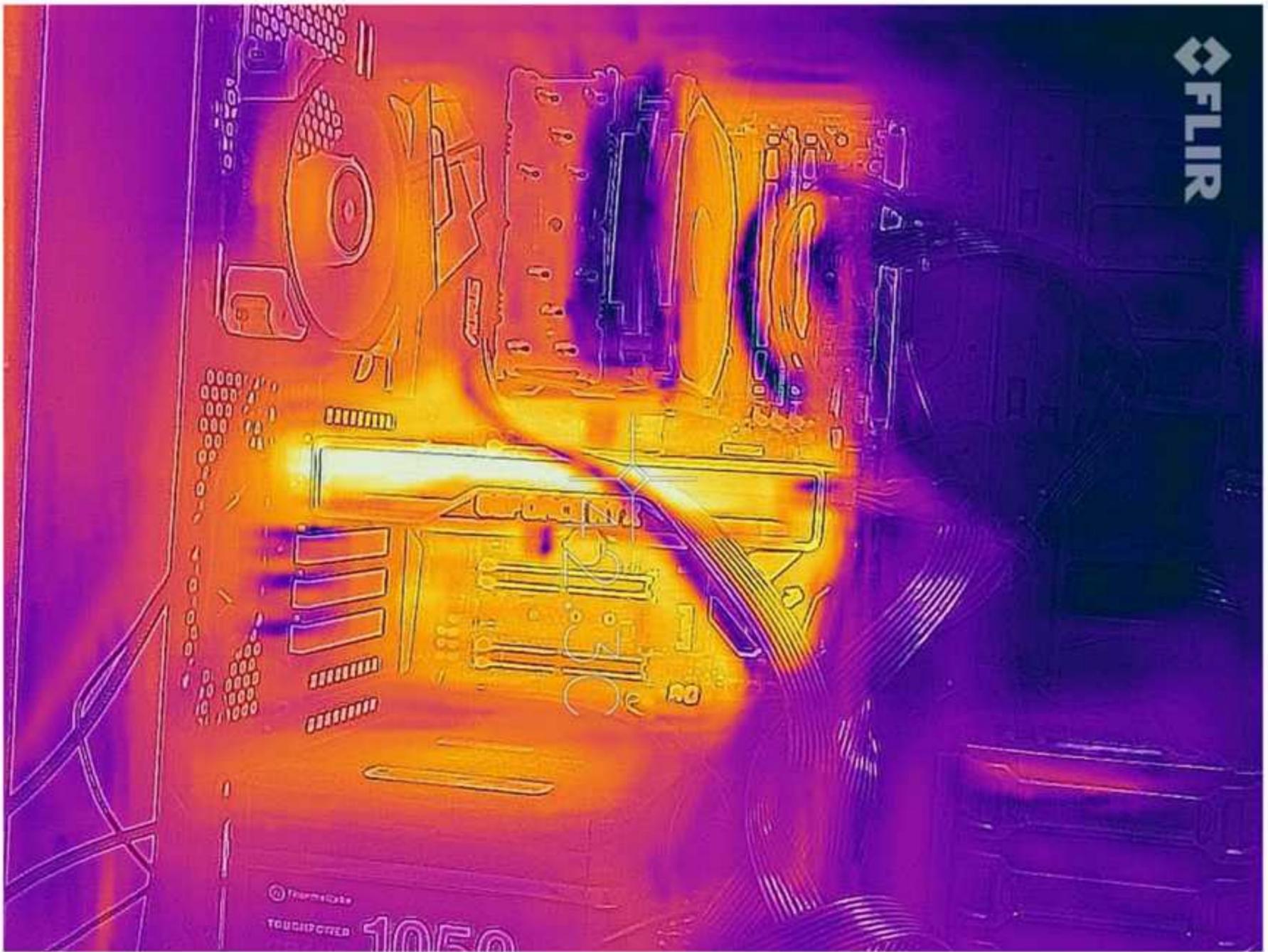
Under these clocks, I saw around a 7 percent increase in scores on our 3DMark runs, and just under a 10 percent frame-rate boost on Rainbow Six: Siege. Given that the increase of 175MHz is a roughly 9 percent increase on the boost clock, these numbers fall in line with what we'd expect.

And unsurprisingly, once I did achieve a stable overclock, I noticed the RTX 2070 Super was regularly beating the Nvidia GeForce RTX 2080 Founders Edition.

## A BIT OF TEMPERATURE-TAKING

Then there are the thermals. During our temperature measurements, taken during a 10-minute 3DMark stress test run, the software utility GPU-Z reported that the GeForce RTX 2070 Super never edged above 74 degrees C. This result isn't surprising, given the consistent results posted by the RTX Founders Edition cards that this card resembles.

Then, we ran our FLIR imaging test:



Here, the heat can be seen collecting mainly around the backplate of the card, as well as exhausting near the back vent of the RTX 2070 Super. Founders Edition cards aren't generally known for their top-notch ability to push air out the back of your PC, but it looks like Nvidia might have made airflow adjustments to make it easier for excess heat to escape your case.

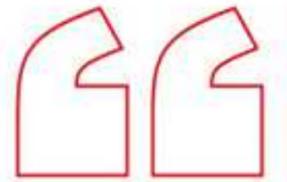
## **IN PRACTICAL FACT, A PRICE CUT ON THE RTX 2080**

Binned GPU or something else, whatever the RTX 2070 Super is, it's made of awesome. Look at the price. You can overclock the RTX 2070 Super just a bit, and for all intents and purposes, you get GeForce RTX 2080-level performance for almost 40 percent off. And if overclocking gives you the shivers, just run it at stock for a close-enough approximation.

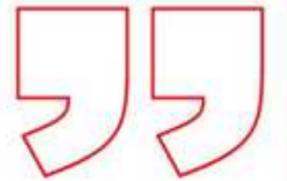
We tested the GeForce RTX 2060 Super alongside it, but we think that the RTX 2070 Super is where the value is at of that pair. We'll have to see about the RTX 2080 Super, which we haven't gotten hands on quite yet. It has its work cut out for it: The GeForce RTX 2070 Super hits the sweet spot between near-consistent 60fps frame rates at 4K for 60Hz monitors, and solid 144fps-plus esports performance at a price primed for the upper-midrange market. And with access to Nvidia's RT and Tensor cores, it's future-proofed.

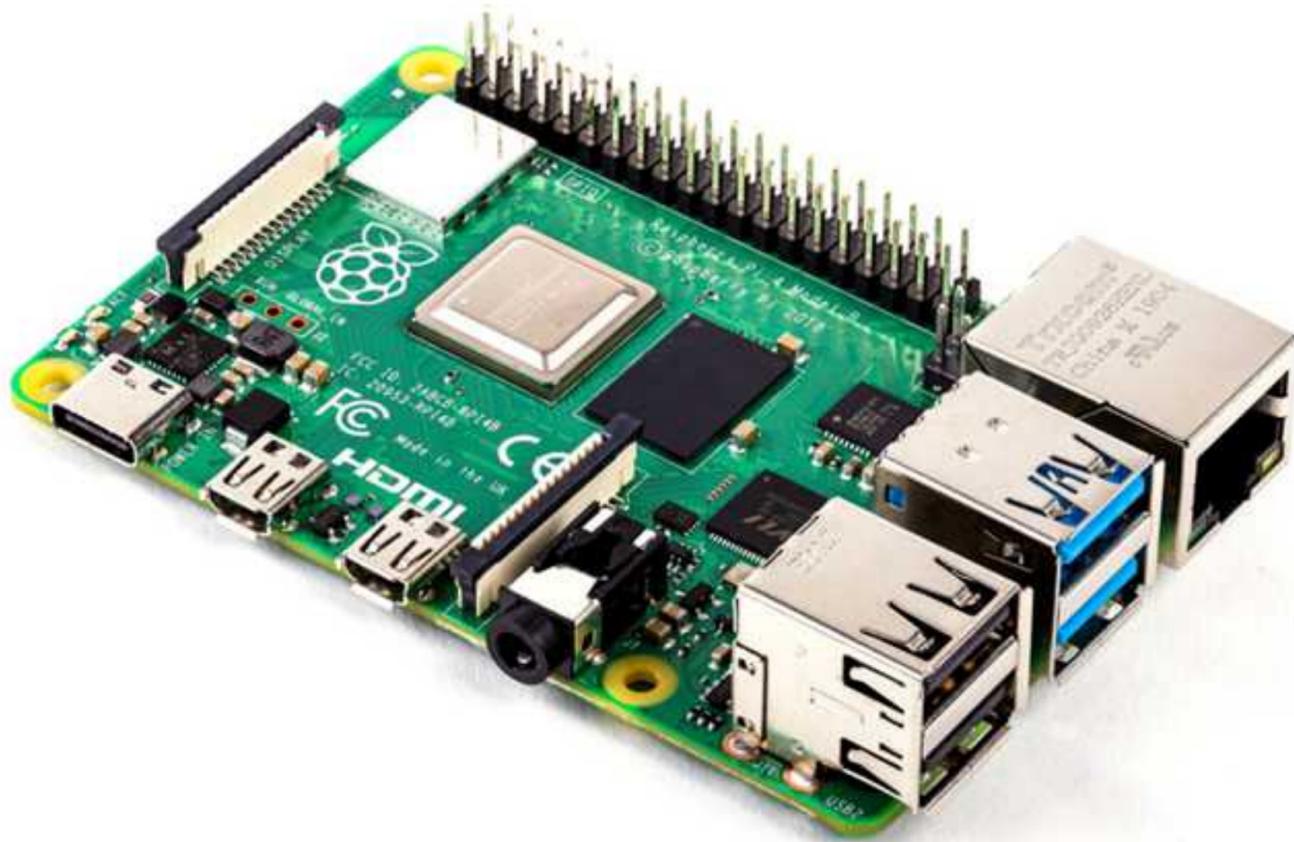
If you've been waiting for the GeForce RTX 2080 to come down in price to take the plunge, the release of the RTX 2070 Super is the card you've been waiting for.

**CHRIS STOBING**



**Overclock the  
RTX 2070  
Super just a  
bit, and for all  
intents and  
purposes, you  
get GeForce  
RTX 2080-level  
performance.**





**Raspberry Pi 4 Computer Desktop Kit** | \$120.00 | Rating: ●●●○ GOOD

## Raspberry Pi 4 Computer Desktop Kit: Good for Beginners

**T**ickling the fancy of tinkerers, the Raspberry Pi is a tiny circuit board with memory, a CPU, and several I/O connectors. It offers anyone access to the building blocks of computer programming—from making an app to controlling a hobbyist robot—for the price of a good dinner. The newest model, the Raspberry Pi 4, still promises all of this, but it adds the tantalizing possibility of serving as a basic desktop PC with minimal setup effort, in the form of the Raspberry Pi 4 Computer Desktop Kit. At \$120, the Desktop Kit, which includes an upgraded version of the Pi 4 board, is much pricier than a Pi board on its own (they start at \$35). It delivers good value, though, and gets Pi first-timers up and running quickly. But persistent quirks mean it's still not a realistic substitute for an actual PC. Prospective buyers who have used Pi before and own the supporting accoutrements will be better off getting the Pi 4 board by itself.

## DESIGN

The Raspberry Pi 4 is the same basic size and shape as all of its Model B predecessors, though significantly bigger than the Model A and Zero versions. It's a 2.2-by-3.4-inch rectangle, and its various components stick up about 0.6-inch tall. Among those components are a Broadcom quad-core processor running at 1.5GHz, four USB Type-A ports, two micro HDMI video outputs, a gigabit Ethernet port, and radios for 802.11ac Wi-Fi and Bluetooth 5.0.

These are recognizable specs to people shopping for a new laptop or desktop to use as their main computer. But other unique aspects to the Raspberry Pi 4 hint at its true identity as a building block for tinkerers and makers.

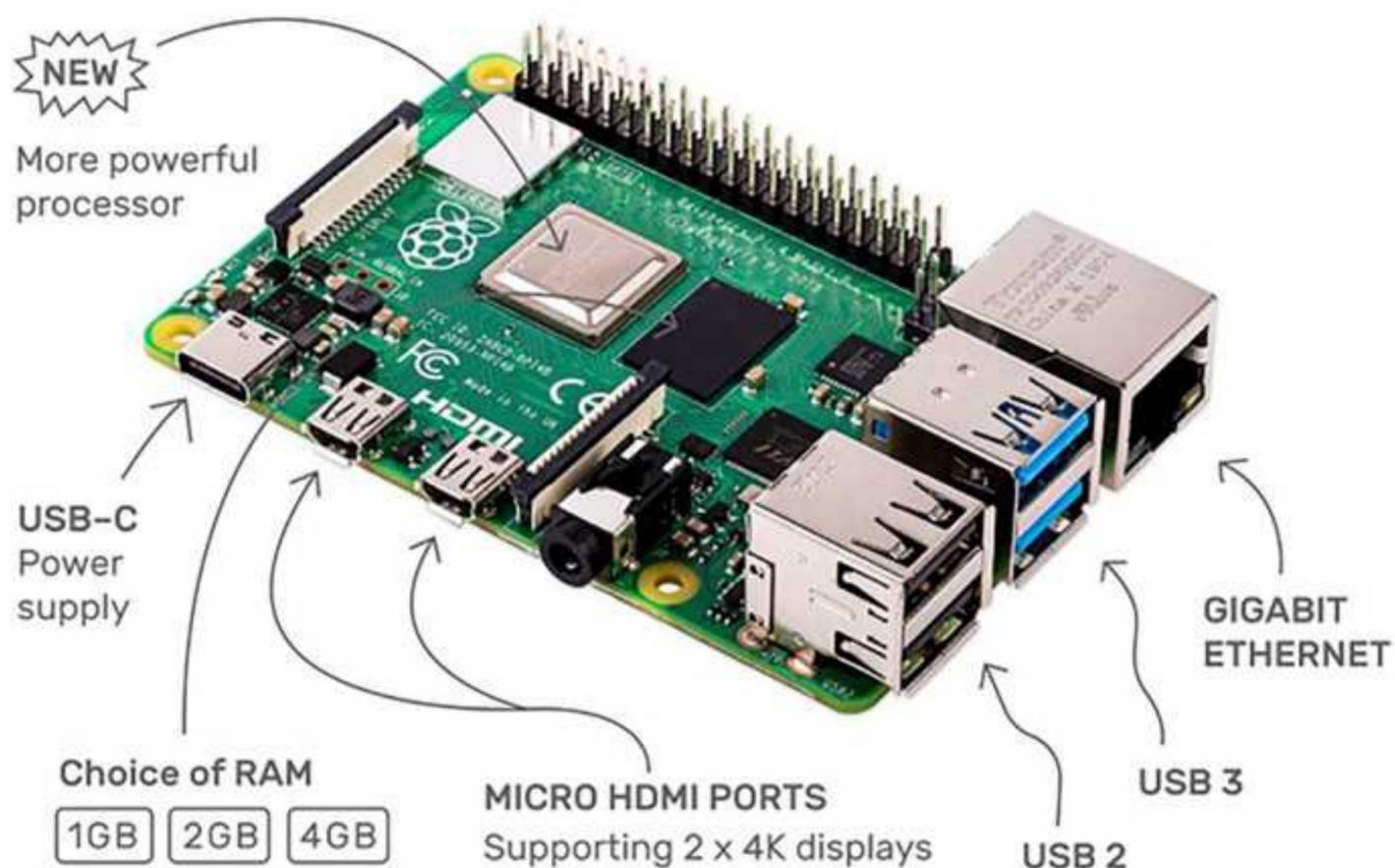
The first is the General Purpose Input-Output (GPIO) header, a versatile 40-pin connector that can power and communicate with virtually anything you might want to create, from a DIY weather station to a motor for a small robot. All of its uses require a fair amount of tinkering to write code and attach hardware like sensors and lights. Taming the GPIO connector is far outside the consumer-PC use case.

## Raspberry Pi 4 Computer Desktop Kit

**PROS** High-quality, stylish peripherals. Best-performing Raspberry Pi yet. Two video outputs.

**CONS** Kit is relatively expensive. Pi 4 board runs warm when stressed. Impractical for use as a consumer PC without tinkering and know-how.

**BOTTOM LINE** It costs a lot more than the Pi 4's bare-board \$35 starting price, but the Raspberry Pi 4 Computer Desktop Kit transforms the latest Pi into a nifty desktop with minimal effort. It mostly succeeds, though a learning curve remains.



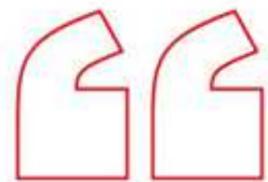
The second unique aspect is the microSD card slot on the bottom. It looks like any microSD card reader you'd find on a laptop, but since the Raspberry Pi 4 lacks a hard drive, an SSD, or any other form of onboard non-volatile storage, you must download and install the operating system you want to use onto a microSD card (which you buy separately) using a different computer. You'll need to insert this OS-readied card into the slot before you can actually turn on your Raspberry Pi.

In the past, this represented a significant barrier to entry for people who just wanted to buy a Raspberry Pi, plug it in, and perform basic computing actions such as surfing the web. Sure, you could buy an SD card pre-formatted with Raspbian, the Linux-based operating system designed for the Raspberry Pi, but it was still an additional step that also added to the price.

With the Raspberry Pi 4 Desktop Kit, this process is much simpler, if not cheaper. In the kit, you get everything you need to plug the Raspberry Pi 4 into an HDMI-equipped monitor or TV and start surfing. In addition to the Pi 4 and a pre-formatted 16GB microSD card, you also get the official Raspberry Pi keyboard and mouse, two micro HDMI cables, a power adapter, an adorable plastic case for the Pi 4, and a hard copy of *The Official Raspberry Pi Beginner's Guide*. The book's subtitle ("How to use your new computer") suggests that the Desktop Kit could be a rival to any other cheap PC you might find while roaming the aisles of your local electronics shop.

## **BREAKING DOWN THE BUNDLE VALUE**

The Desktop Kit represents an \$85 increase over the cheapest Raspberry Pi 4 board alone (\$35), which Pi veterans may find an extravagant price for some peripherals, cables, and a book. But looking at the details softens this seemingly outsize impact on your wallet.



**You'll need to insert this OS-readied card into the slot before you can actually turn on your Raspberry Pi.**



First, although the peripherals are basic plastic, they are all well designed, unified in look, and branded with the Raspberry Pi logo. The keyboard includes a USB hub and even the Raspberry Pi logo in place of the Windows key, which, in Raspbian, launches a menu of shortcuts similar to the Windows Start menu. It's clad in the same red and white colors as the case and the mouse. The color scheme would look great on a kid's desk.

Second, the Desktop Kit includes a version of the Raspberry Pi 4 board with 4GB of memory, compared with the 1GB included in the \$35 entry-level version. The idea of differing memory amounts is a new one in the Raspberry Pi world—previous models have had only a single memory amount (1GB, in the case of the Pi 3 Model B+). But increasing the onboard memory is crucial to using the Raspberry Pi as anything approaching a consumer PC. A gigabyte of memory is simply not enough to stream video smoothly or run multiple modern apps at the same time. A 4GB Raspberry Pi 4 on its own will cost you \$55, which takes the effective cost of the rest of the Desktop Kit components down to a more palatable \$65.

Finally, if you're planning on using your Pi 4 as anything resembling a desktop PC (as opposed to integrating it into a hobby project or other DIY environment), you'll almost certainly need to buy a Raspberry Pi 4 case and power supply anyway. A case is necessary for protecting the exposed circuits, and the Pi 4's new component layout and I/O complement mean that cases designed for previous Raspberry Pi generations won't fit. The Raspberry Pi 4 is also the first Pi to use a USB-C port for power delivery, and it works best with the official power adapter. (Some third-party USB-C cables will work, but others won't, as some early adopters found.)



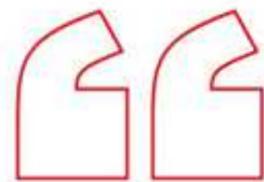
The USB-C port is only for power delivery—peripherals like external drives still need to connect to the USB Type-A ports, two of which support USB 3.0 speeds (a first for any Raspberry Pi). So if you've got a USB-C device to plug in, you'll still need an adapter or a USB Type-A-to-C cable.

### **WHAT IT'S LIKE TO USE A RASPBIAN PC**

To test out the Desktop Kit's potential to serve as a fully functioning consumer PC, I devised a simple set of tasks: Plug it in, turn it on, and surf the web. To give the testing a mainstream focus and to demand more of the Pi 4, I decided to surf the web using the familiar Mozilla Firefox web browser instead of the open-source Chromium default, and to do it at a 4K screen resolution. Thanks to the Pi 4's twin HDMI outputs and upgraded graphics processor, it can—theoretically—power up to two 4K displays simultaneously, something that's impossible with previous Pi generations and many cheap Windows desktop PCs.

Plugging in and powering up proved very easy. I dropped the Raspberry Pi 4 into the case and snapped the lid on. I then plugged in the peripherals, inserted the bundled microSD card, and connected one of the included HDMI cables to a 27-inch 4K monitor. Finally, I plugged in the USB-C power adapter. Plugging in the cable automatically powers up the Pi 4. (There's no power button.)

The Raspbian desktop appeared after a few seconds, and the only first-time setup steps were choosing a keyboard language, connecting to a Wi-Fi network, and checking for updates. So far, so good—that's several steps fewer than are required for setting up most Windows 10 or macOS computers.



**To test the Kit's potential to serve as a consumer PC, I devised a simple set of tasks: Plug it in, turn it on, and surf the web.**





**For a single \$120 price, the desktop kit bundles all the hardware and software you need to plug the Raspberry Pi 4 into your monitor or TV and start surfing the web. Although the peripherals are made of plastic, they are all nicely designed and branded with the Raspberry Pi logo.**

Installing the Firefox web browser proved more difficult. As with most Linux-based operating systems, Raspbian doesn't let you just download an app from a store or website. You must compile the software package yourself using a command-line interface, and instructions can be sketchy and hard to find, depending on the program. Fortunately, I found the command for installing Firefox after a single Google search. Once you type the command into the terminal (accessed via an icon in the task bar) and execute it, the OS does the rest, and I soon had a Firefox window open and ready to browse.

Basic browsing and opening and closing app windows are very smooth with the Pi 4, a benefit of its upgraded processor and RAM. The Pi 4's processor runs at a base clock speed of 1.5GHz, versus 1.4GHz of the Model 3 B+, and uses newly upgraded ARM Cortex cores.

I then performed some formal benchmark tests. The Pi 4 scored an impressive 845 milliseconds on the Sunspider 1.0.02 JavaScript benchmark, a lightning-quick time for a Pi. In contrast, the Raspberry Pi 3 Model B+ took 1.92 seconds to execute this test, while the Raspberry Pi Zero W took an agonizing 20 seconds.

The Pi 4's score on the browser-based Jetstream 1.1 benchmark was an equally impressive 38.14; the Pi 3 Model B+ could not even complete this test. From a theoretical performance standpoint, the Pi 4 itself is clearly the best Raspberry Pi yet, at least in the 4GB configuration included with the Desktop Kit.



“  
**Even at a resolution of 800 by 600, streaming HTML5 videos over the web is jerky, though at least the Pi 4 doesn't crash.**  
”

Changing the resolution to 4K from the default 800-by-600 pixels proved easy enough (there's a straightforward settings menu), but unfortunately, I wasn't able to stream video from YouTube at this resolution. Each time I tried, the Pi 4 froze and shut down, likely a victim of overheating—the board itself was very hot. Even at a resolution of 800 by 600, streaming HTML5 videos over the web is jerky, though at least the Pi 4 doesn't crash. Overheating has been a consistent problem with the Raspberry Pi boards I've used in the past, including the Pi 3 Model B+, which periodically overheated and shut down during benchmark testing.

## **FEATURES FOR MAKERS**

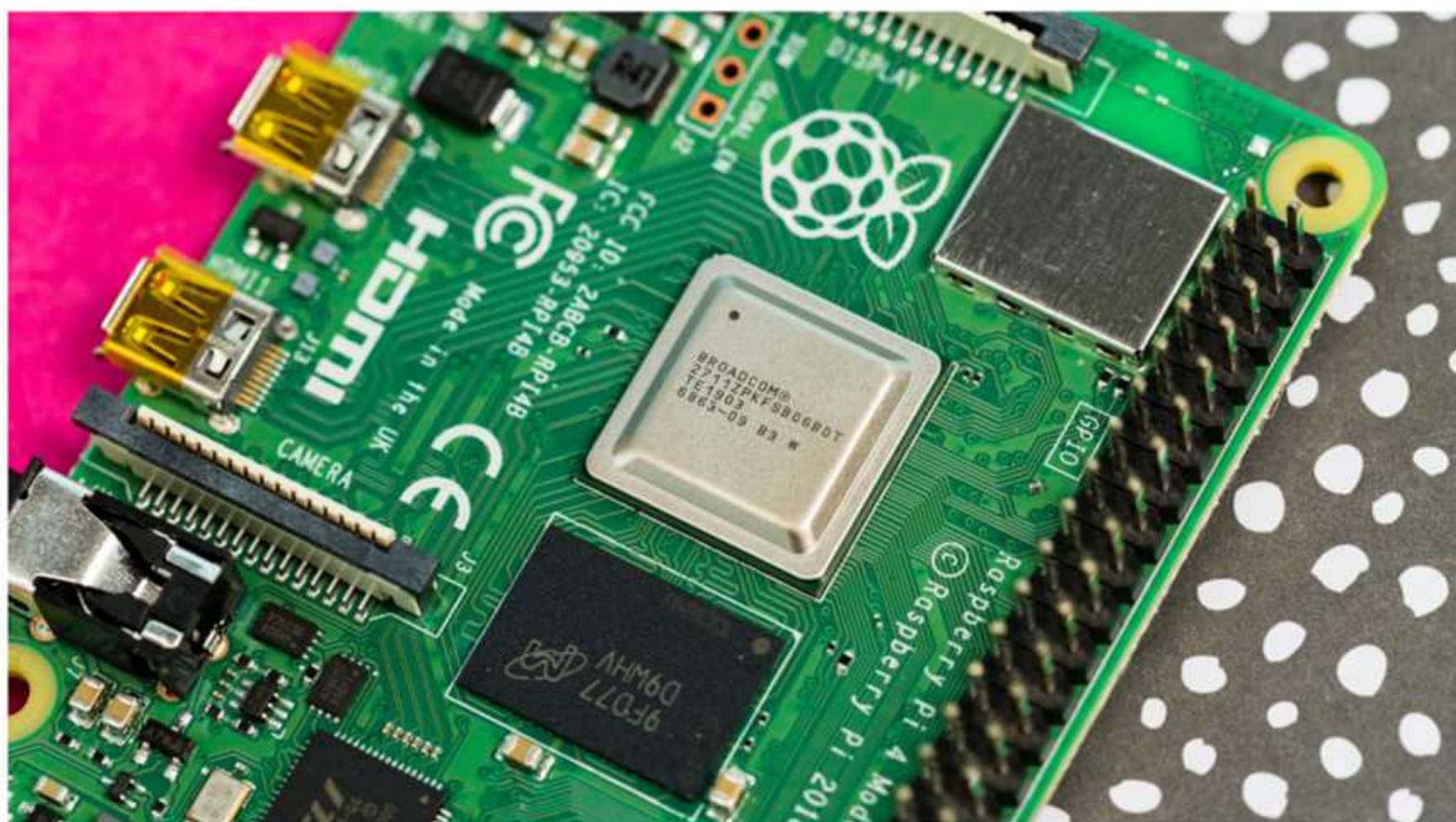
Raspberry Pi fans, though, would categorize this overheating and many of the Pi 4's other quirks as challenges to be solved, not design flaws. Some have simple solutions. For example, you can install the official Raspberry Pi 4 Power over Ethernet (PoE) add-on module, which includes a built-in fan. It also lets you run the Pi off of the power from a networking cable—no separate USB-C power connection required.

Other solutions depend on specific use cases. Using a Raspberry Pi to monitor data from a weather station, for example, is far less resource-intensive than using it as a general-purpose desktop. Overheating is less likely with less-demanding tasks. And to push the limit of your Pi 4 now and then, you could connect a USB-powered personal cooling fan and point it at the Pi 4 board with the chassis lid off.

In fact, that sort of creative solution-finding and experimentation is what the Pi is all about. Sure, you could easily buy an off-the-shelf streaming device or a bathroom mirror with a built-in TV, but if you've got the programming and tinkering expertise, it's much more satisfying to build your own with a Raspberry Pi. (For more ideas, check out the Raspberry Pi forums.) The book included with the Desktop Kit is also a good starting point, offering several Python coding projects. These include creating a simple video game using a button plugged into the GPIO connector.

### **BARE BOARD OR KIT?**

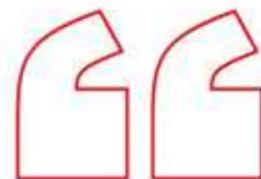
If you're already in the Pi camp and are just pining for more able hardware, the Pi 4 definitely deserves your attention. It's arguably the best Pi yet, from a strict board-hardware standpoint. It's the most powerful Pi we've tested, and if you don't need as much computing power, you can get a version with less memory to keep the price at the same \$35 level of its predecessors. It's an obvious upgrade for the maker crowd, even if you've already got a Pi 3 Model B+.



The Raspberry Pi 4 Desktop Kit, though, is less of a no-brainer, except perhaps as a keepsake item or a gift for an aspiring young coder or maker. If you understand the Pi 4's limitations, from software quirks to overheating, the Desktop Kit is the quickest way to transform this single-board computer into a desktop PC with attractiveness in spades. If you're expecting to get an experience akin to a cheap Windows desktop PC—and many refurbished ones can be had for \$150 to \$200—you'll be disappointed.

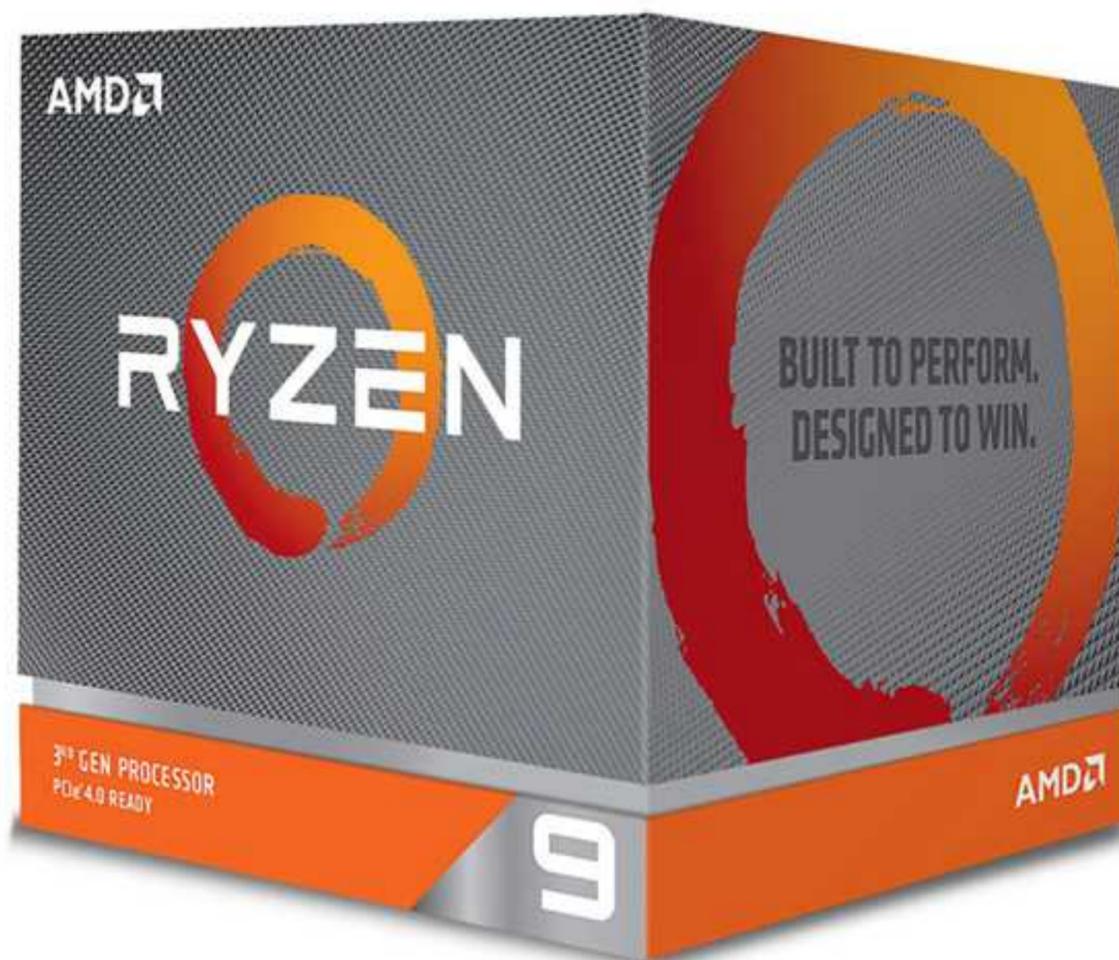
Ultimately, most people interested in using a Raspberry Pi as their main desktop should first buy the 4GB version of the Pi 4 as a standalone board. Add the necessary power adapter (\$10) and a micro HDMI cable (\$9), connect a mouse and keyboard you already own, and see if you can deal with the limitations. If you're interested in pursuing things further, buy a Pi 4-specific case (\$8) for a more permanent installation, check out a library book or two to learn coding basics, and enjoy the wonderful world of Pi computing for significantly less than \$120.

**TOM BRANT**



**Most people interested in using a Raspberry Pi as their main desktop should first buy the 4GB version of the Pi 4.**





AMD Ryzen 9 3900X | \$499.00 | EDITORS' CHOICE Rating: ●●●●● EXCELLENT

## AMD Ryzen 9 3900X: An Excellent 12-Core Beast

**W**atch out, Threadripper; take cover, Core i9! AMD's new high-end, mainstream CPU for gamers and content-creating power users is the Ryzen 9 3900X, and it's brute force in silicon form. This third-generation, 12-core Ryzen processor, based on the same AM4 platform and socket as earlier Ryzens, refines the standout features the Ryzen brand is known for, including power efficiency, simple overclocking, and competitive performance per dollar.

Despite its new name and guts—this is the first CPU to bear the “Ryzen 9” moniker and one of the initial wave of Ryzen 3000 CPUs to support the Zen 2 microprocessor architecture—it’s an evolution of AMD’s consumer CPUs, with core features similar to its first- and second-generation Ryzens. That means it’s an excellent choice for PC-building enthusiasts and upgraders. It’s not consistently better than Intel’s comparable Core i9-9900K, but if you need all the cores and threads you can get, it’s a superb, Editors’ Choice value among power CPUs, even elbowing in on the lower-end chips in AMD’s own beastly Ryzen Threadripper line.

### **A MASSIVE CORE AND THREAD COUNT**

The Ryzen 9 3900X’s standout feature is its massive core count. Twelve-core CPUs like this one are rare in the consumer PC world; before this, you had to step up to AMD’s Ryzen Threadripper line or Intel’s Core X-Series to see core counts like these. Even most high-end pre-built gaming desktops come with “just” six- or eight-core chips. To truly take advantage of the Ryzen 9 3900X’s power, you need to be running the latest applications designed to operate on as many CPU cores as possible. (Those tend to be content-creation apps such as video or photo editors.)

## **AMD Ryzen 9 3900X**

**PROS** Superb price-for-performance ratio in multithreaded scenarios. Among the first consumer CPUs to support PCI Express 4.0. Relatively low power consumption. Huge L3 cache. Easy overclocking tools. Includes attractive cooling fan.

**CONS** Single-core performance and 1080p gaming a touch behind on some benchmark tests. No integrated graphics.

**BOTTOM LINE** With more cores and threads than its pricey Intel competitor, AMD’s Ryzen 9 3900X is a 12-core beast of a CPU for high-end gaming rigs or a multimedia editing stations.



Since the Ryzen 9 3900X also supports multi-threading, two computing tasks can run simultaneously on each processor core for a maximum of 24 threads of compute power. That matches the spec of the 12-core, 24-thread (12C/24T) AMD Ryzen Threadripper 2920X, the lowest-end of the elite AMD Threadripper lineup aimed at content creators and other creative professionals. It also has significantly more cores and threads than the previous mainstream Ryzen flagship, the 8C/16T AMD Ryzen 7 2700X. That chip, in turn, offers more threads and cores than its direct competitor, the 6C/12T Intel Core i7-8700K. Here is how it stacks up versus the rest of the new Ryzen 3000 line, five of which are rolling out at the same time:

	Cores / Threads	TDP (in Watts)	Boost / Base Frequency	L2 & L3 Cache (MB)	MSRP
Ryzen 9 3950X	16 / 32	105	4.7GHz / 3.5GHz	72MB	\$749 (available Sept. 2019)
Ryzen 9 3900X	12 / 24	105	4.6GHz / 3.8GHz	70MB	\$499
Ryzen 7 3800X	8 / 16	105	4.5GHz / 3.9GHz	36MB	\$399
Ryzen 7 3700X	8 / 16	65	4.4GHz / 3.6GHz	36MB	\$329
Ryzen 5 3600X	6 / 12	95	4.4GHz / 3.8GHz	35MB	\$249
Ryzen 5 3600	6 / 12	65	4.2GHz / 3.6GHz	35MB	\$199

Like the Ryzen 7 2700X, the Ryzen 9 3900X offers a core- and thread-count advantage over its own direct Intel competitor, the Intel Core i9-9900K. Both chips are \$499, but the Intel has eight cores and 16 threads. A higher maximum clock speed remedies that deficiency somewhat, however. The Core i9-9900K has a base speed of 3.6GHz and a maximum boost clock of 5GHz, versus the Ryzen 9 3900X's 3.6GHz base speed and 4.6GHz base boost. (Of course, you can overclock either chip; Intel's "K" series CPUs are unlocked, and all of the Ryzens are unlocked.)

Put these specs together, and it's clear that the consumer CPU market remains just as competitive as it was when AMD announced the first Ryzen chips in early 2017. Deciding between Intel and AMD, therefore, comes down to subtle performance differences and ancillary features. And at the heart of it all is how much you need lots of cores and threads at your command. The Ryzen 9 3900X has plenty of advantages here.

## **AN EVOLVED PROCESSOR ARCHITECTURE**

The Ryzen 9 3900X is the first of two chips we've tested that uses AMD's Zen 2 microarchitecture (the other being the AMD Ryzen 7 3700X). Zen 2 makes 12 cores possible—the initial Zen architecture only supported a maximum of eight cores. Chips on the Zen 2 microarchitecture also feature the debut of a smaller 7 nanometer (7nm) process node. Zen silicon was built on a 12nm node, and most Intel consumer chips that are currently on the market are made on 14nm or 12nm nodes.

Reducing the node size is key to improving a chip's energy efficiency. It doesn't necessarily improve clock speeds, though. The Ryzen 9 3900X's base clock is actually 100MHz lower than the Ryzen 7 2700X's, for example. (The 2700X was the highest-end AM4 chip before the current generation rolled out.)

Besides better efficiency and more cores, Zen 2 also features other behind-the-scenes improvements that boost the Ryzen 9 3900X's appeal. Some of these involve hardware changes, including double the bandwidth of the bus that enables different parts of the CPU to communicate with each other, a feature that AMD refers to as "Infinity Fabric."



**The Ryzen 9 3900X features cutting-edge hardware including double bus bandwidth allowing intra-CPU communication within the AMD chip.**

Other software improvements to the Windows operating system on Ryzen include the ability to switch between clock states more quickly. Clock-state changes in Zen-based CPUs take approximately 30ms, while they take only 2ms in Zen 2, according to AMD: The improvement is akin to changing gears more quickly in a transmission. To take advantage of this, you'll need to have the Windows 10 May update installed, version 1903.

## **A NEW EXPRESS LANE**

In addition to a new microarchitecture, two other standout additions roll out with the latest Ryzen lineup: support for the fourth-generation PCI Express standard for connecting peripherals, and add-in cards and improvements to memory speed and latency that help boost the performance of certain graphics-intensive games.

AMD achieves support for the new PCI Express (PCIe) Gen 4 through a brand-new AMD X570 chipset; it's the first mainstream PC-compatible platform to support PCIe 4.0. The main benefits of PCIe Gen 4 are added bandwidth for video cards and storage components like SSDs.

Storage will be the more likely beneficiary. PCI Express 4.0 M.2 SSDs will soon be available from ADATA, Corsair, Gigabyte, and others, offering throughput speeds well above the approximate 3,500MBps ceiling of PCIe Gen 3. If you plan to build a new system from scratch with the Ryzen 9 3900X, you'll also want to invest in a new X570-based motherboard to take advantage of these increased speeds.

We tested the Ryzen 9 3900X with MSI's MEG X570 Godlike motherboard, which includes a built-in fan over the chipset to keep things cool, a relatively uncommon feature even on high-end gaming motherboards but a common trait among X570 models. (The chipset runs at a higher-than-ordinary wattage, necessitating active cooling.) The Ryzen 9 3900X is also compatible with many existing AM4-based motherboards, though, which means that if you're looking to upgrade just the CPU in your existing Ryzen-based PC, you may not need to buy any other components. Pre-X570 motherboards will not bring the PCIe 4.0 support with them, however.

Third-generation Ryzen chips also have support for faster memory and caches that are twice as large as the ones in previous generations. With memory running at a peak of 3,600MHz (assuming you have compatible RAM) and the whopping 70MB of L3 cache in the Ryzen 9 3900X (here dubbed “GameCache”), the system can address available memory much faster. This is especially important for gamers, since the performance of some games can be dependent on a CPU’s ability to access memory, especially at screen resolutions below 4K. (At the highest resolutions and detail settings, the graphics card tends to be limited.) It’s also an area in which earlier Ryzen chips have been a bit deficient under certain resolution/card combinations versus their Intel counterparts. PC Labs did some deeper-than-ordinary testing in that regard.

### **OTHER RYZEN BENEFITS**

As with some previous high-end Ryzen chips, AMD offers a premium Wraith cooling fan in the box with the Ryzen 9 3900X. The cooler, the Wraith Prism, features a nifty ring of RGB lighting with support for the Chroma lighting system from Razer, which means you can sync the LED effects with your other Razer Chroma peripherals, such as keyboards and mice. Even without Chroma, you get a cool rainbow effect.

All Ryzen chips use the Ryzen Master Windows app for quick settings adjustments without the need to shut down your PC and enter the BIOS. Among other capabilities, Ryzen Master lets you see the current state of each CPU core and highlights which of the cores perform best. This is a boon to overclockers who want to boost the clock speed of individual cores, something you can also do with precision within Ryzen Master.



**The Ryzen 9 3900X has a Wraith Prism cooling fan system with a nifty ring of RGB lighting and support for Razer’s Chroma peripherals.**

Intel offers similar capabilities with its own apps, including the Extreme Tuning Utility, but I prefer the visual layout of Ryzen Master. AMD updated the app to version 2.0 concurrent with the Ryzen 3000-series third-generation CPU release. Differences include a redesigned dashboard interface and the ability to switch among Default, Precision Boost Overdrive (automatic overclocking), and Manual modes without restarting your PC.



In addition to the Ryzen 9 3900X, as mentioned, four more third-generation Ryzen chips go on sale at the same time: the eight-core Ryzen 7 3800X and Ryzen 7 3700X and the six-core Ryzen 5 3600X and Ryzen 5 3600.

THE 3 <sup>RD</sup> GEN AMD RYZEN™ FAMILY			
MORE CORES, MORE CACHE, MORE TECH			
\$499 USD	AMD Ryzen™ 9	3900X	\$499 USD Core i9-9900K
\$399 USD	AMD Ryzen™ 7	3800X	\$385 USD Core i7-9700K
\$329 USD	AMD Ryzen™ 7	3700X	
\$249 USD	AMD Ryzen™ 5	3600X	\$263 USD Core i5-9600K
\$199 USD	AMD Ryzen™ 5	3600	\$224 USD Core i5-9600

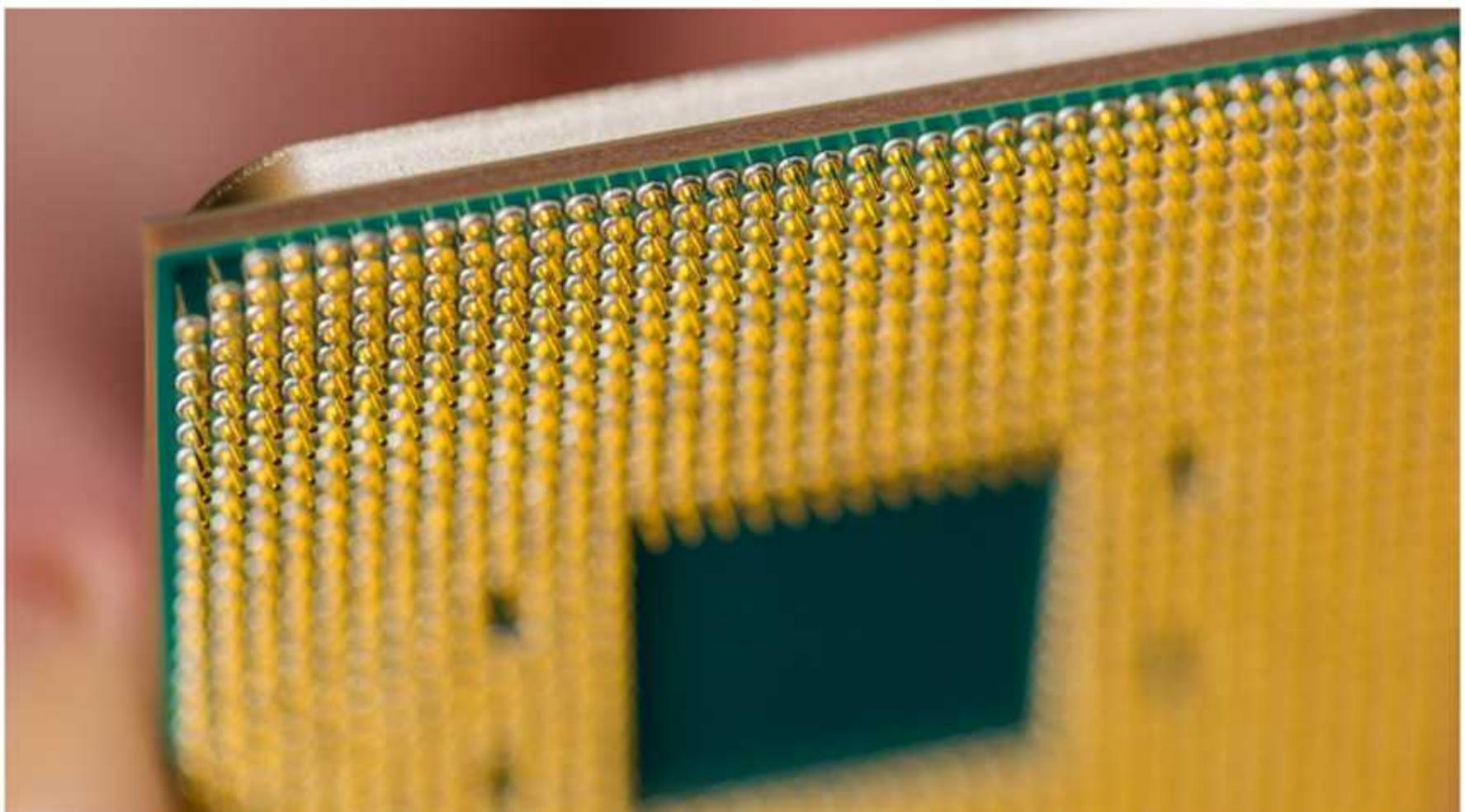
All are unlocked for overclocking, but adjusting the clock speeds either manually or with AMD's presets (described below) voids the standard three-year warranty. Also in the hopper is a 16-core Ryzen 9 3950X CPU, announced just before E3 2019 and due in September.

## LET'S GET TESTING

In addition to the MSI X570 motherboard, our test setup for benchmarking the Ryzen 9 3900X includes 16GB of G.Skill DDR4-3600 memory, a Corsair MP600 PCI Express Gen 4 SSD boot drive, and an Nvidia GeForce GTX 1080 Founders Edition card to handle video output during the CPU tests. (Like earlier Ryzen chips not ending in “G,” these new Zen 2-based Ryzens do not have on-chip graphics, so a video card is necessary.) For all tests, we ran the memory at its maximum 3,600MHz speed, using the Godlike board’s top supported XMP profile.

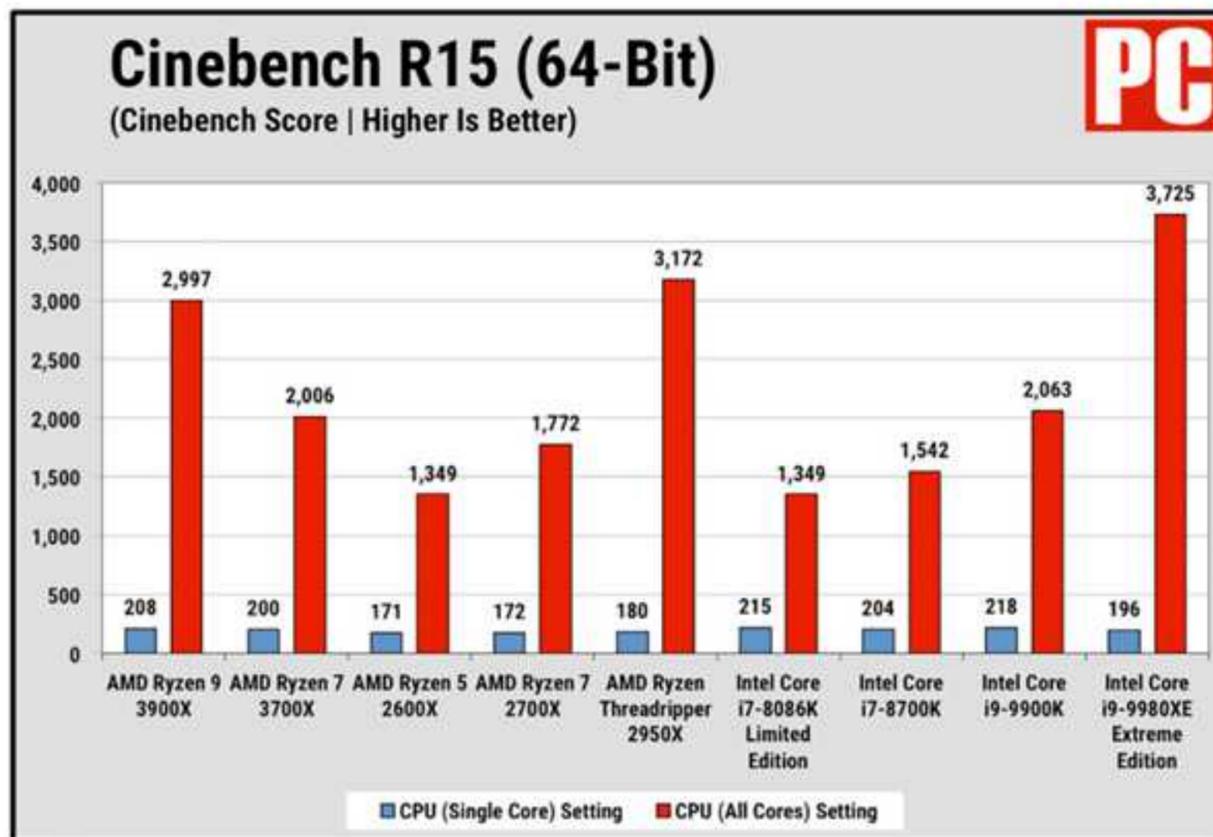
We used AMD’s in-box Wraith Prism cooler for these tests, which is plenty powerful enough to handle the heat generated from the Ryzen 9 3900X at stock settings. At 105 watts, the chip’s thermal design power (TDP) is slightly higher than the 95-watt TDP of the Intel Core i9-9900K, but it’s still remarkably low for a 12-core CPU. The lowest-end Ryzen Threadripper, the 2920X, by contrast, has a massive 180-watt TDP for the same number of cores, and sports a much bigger die.

We test CPUs using a variety of synthetic benchmarks that serve up proprietary scores, as well as real-world tests using consumer apps including Apple iTunes and 3D games such as Far Cry 5. Overall, the Ryzen 9 3900X offers remarkable performance for a 105-watt CPU, especially on tests that take full advantage of its 12 processing cores and 24 threads. Ryzen 9 excels at Multicore over single-core scenarios.



## CINEBENCH R15

Maxon's 64-bit Cinebench R15 synthetic benchmark offers a good overview of performance on many different types of demanding apps. It's a CPU-centric test that gauges both the single-core performance and the multicore performance of a processor. The resulting scores are proprietary numbers that represent the CPU's capabilities while rendering a complex 3D image.

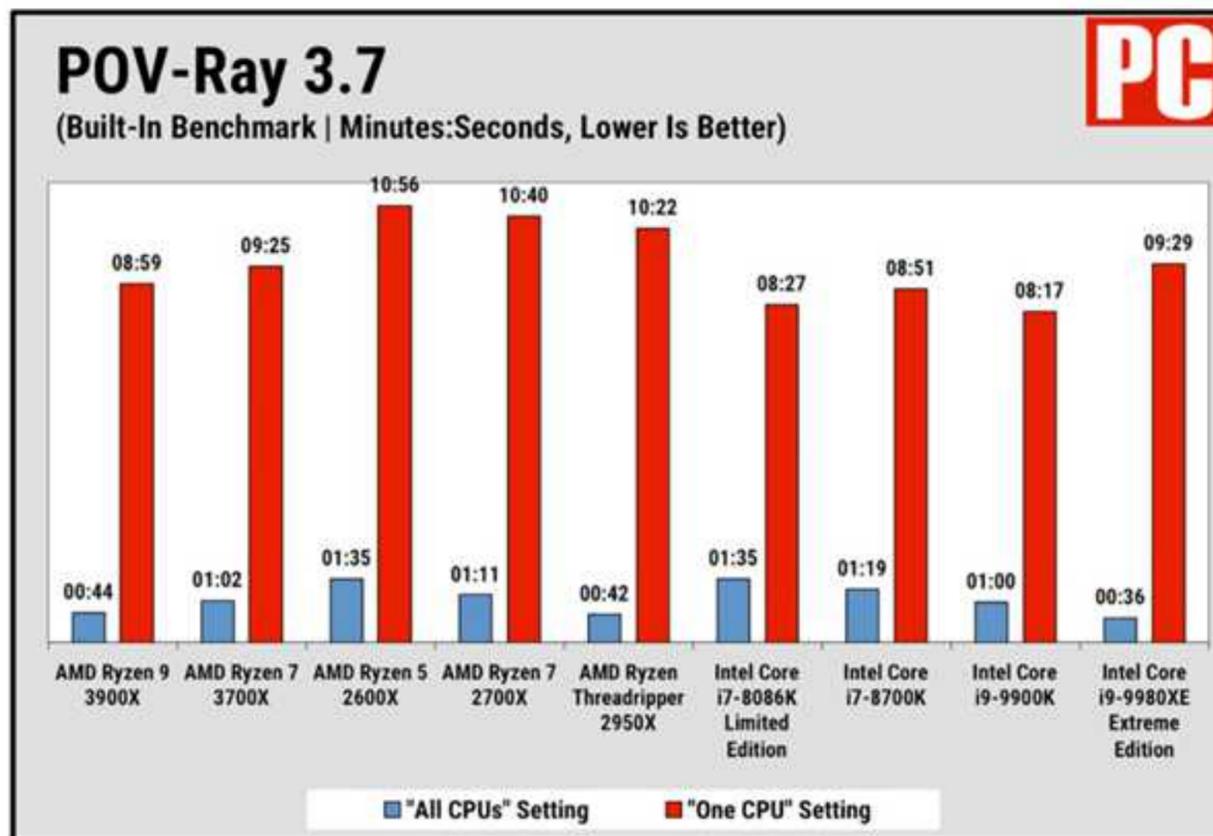


With a score of just under 3,000 on the Cinebench all-cores test, the Ryzen 9 3900X far outpaces the Core i9-9900K and gives even the Ryzen Threadripper 2950X a run for its money. That's especially impressive since the 2950X is a far more expensive chip, on the more expensive AMD X399 platform, all while packing 16 cores.

Also consider the performance delta between the Ryzen 9 3900X and the around-\$2,000 Intel Core i9-9980XE Extreme Edition, if you're tempted by that 18C/36T Core X-Series chip at four times the price. The single-core performance on the Cinebench test is quite competitive, albeit less impressive.

## POV-RAY 3.7

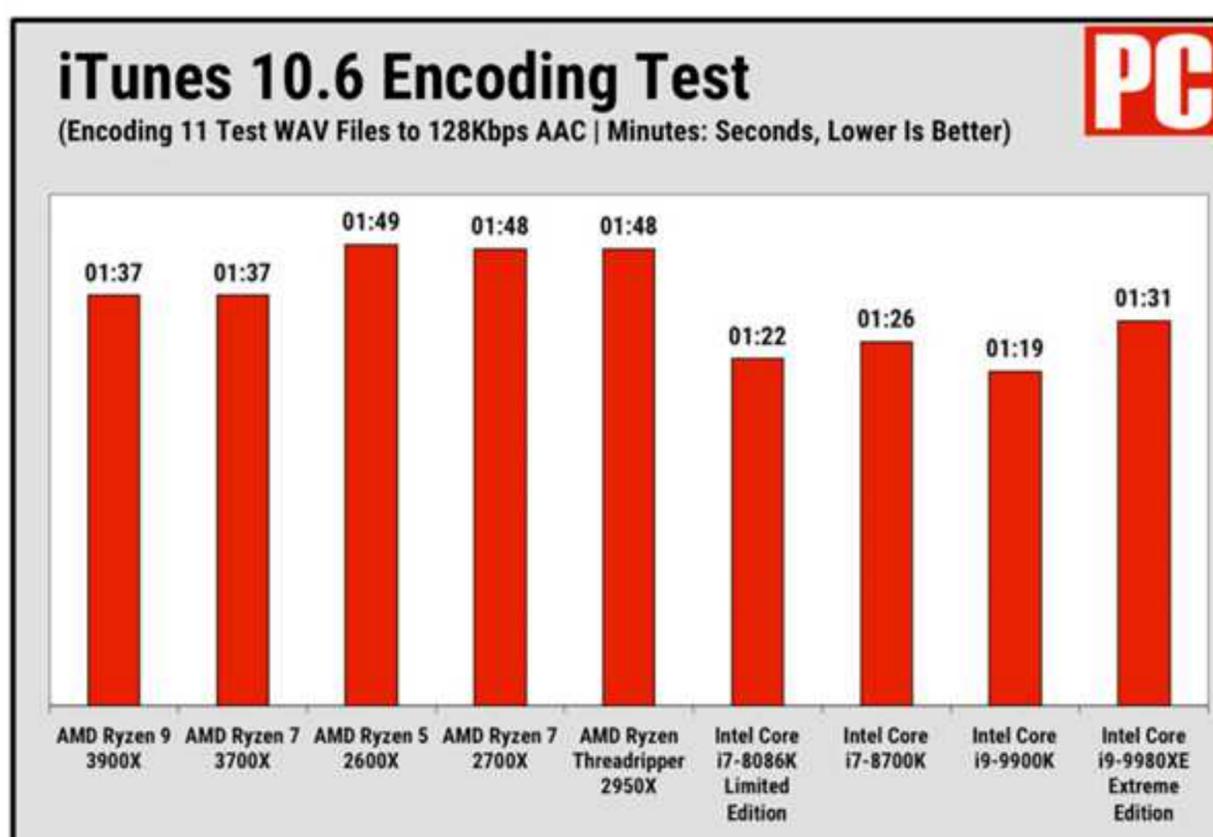
The POV-Ray benchmark is a synthetic, highly threaded rendering test that offers a second opinion on the Cinebench results. Here, the Ryzen 9 3900X was quite competitive on the multicore test, recording a 16-second advantage over the Core i9-9900K, albeit a bit behind on the single-core.



Although many complex modern apps are designed to run on multiple cores and threads, single-core performance is nevertheless still important when you rely on legacy software. Many older games, especially those built on DirectX 9, use just one or two cores. And manufacturing variabilities mean that there are slight variations in each core’s maximum performance, so better performance from each core “lifts all sails,” as an AMD spokesperson puts it.

## iTUNES 10.6

For a real-world look at single-core performance, we use an older version of iTunes to encode a series of music tracks. This is legacy software in spades—Apple has already announced iTunes’ extinction—and it’s decidedly single-threaded, which means that piling on more cores and threads doesn’t help.

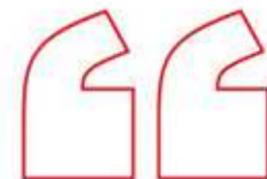


Indeed, we see that all the Intel chips in the chart above surpassed all the Ryzen chips on this test. Both third-gen Ryzens did better than their predecessors (better even than the Threadripper 2950X) but in general, parallel Intel chips offer better single-core performance when running certain apps.

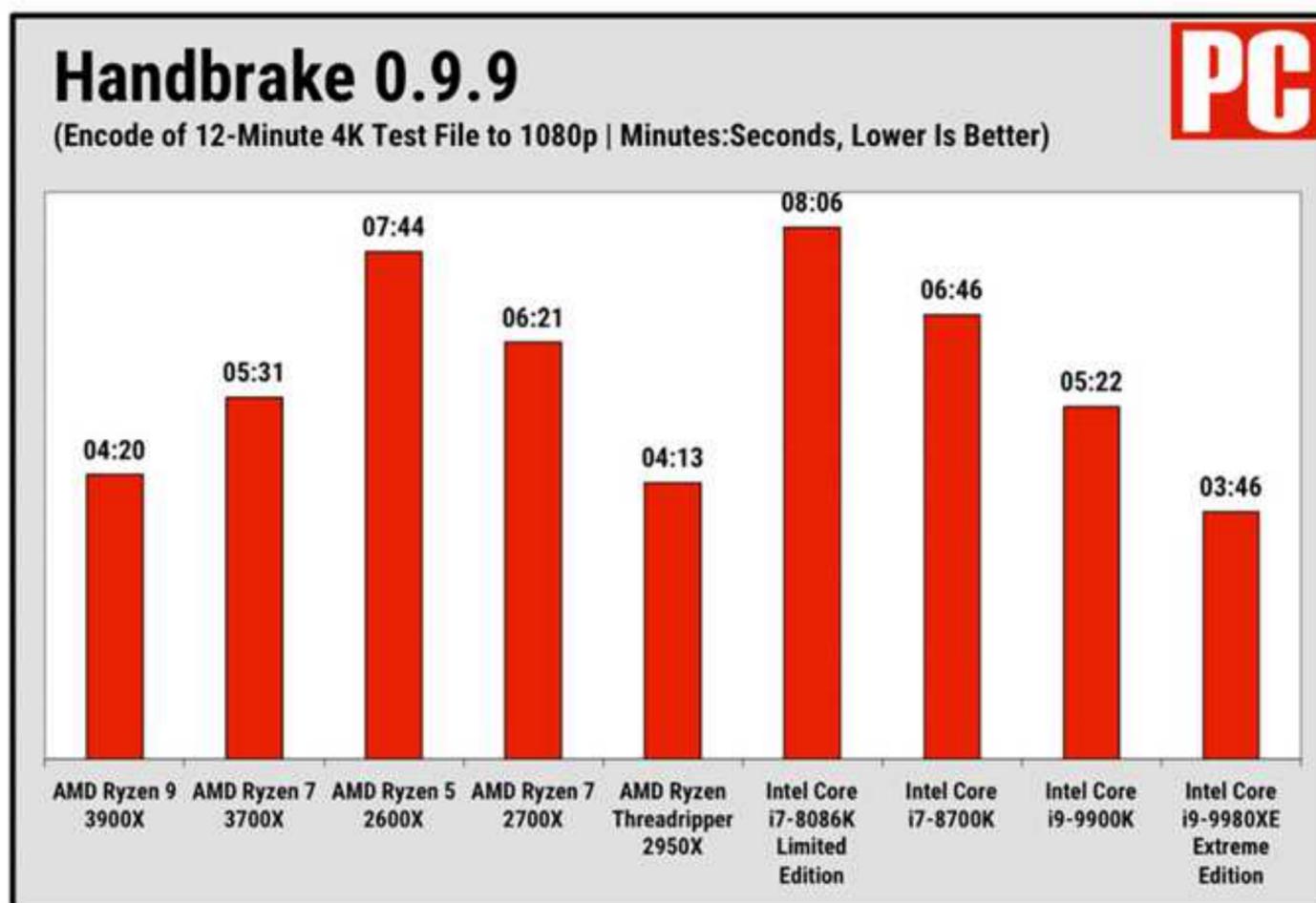
## HANDBRAKE & BLENDER

Many gamers who can justify spending \$500 on a CPU need it for more than just frag fests. If you're planning to run demanding apps that lap up the Ryzen 9 3900X's cores and threads, check the results of our Handbrake and Blender encoding tests and workstation-class benchmarks like POV-Ray.

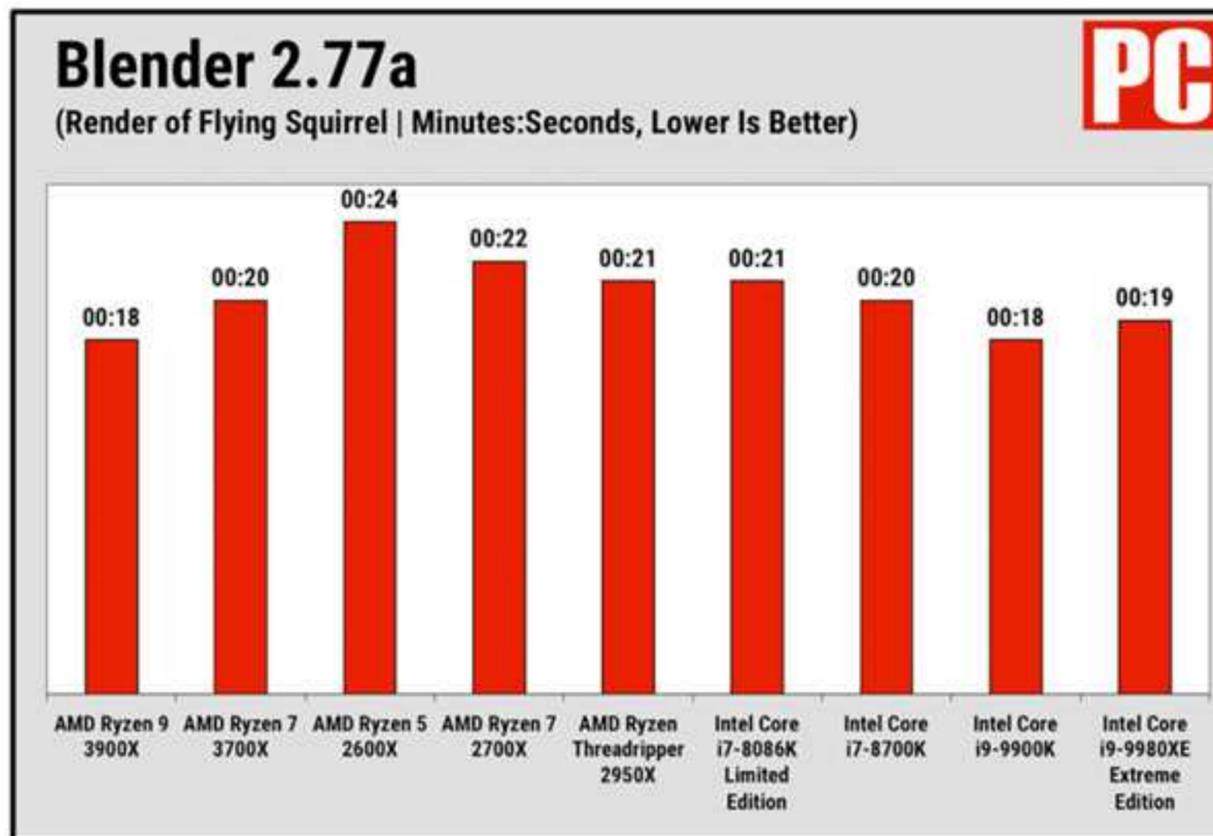
The Ryzen 9 3900X took just 4 minutes and 20 seconds to encode a 12-minute 4K video to 1080p, beating all comers except the Threadripper 2950X and the far more expensive 18-core Intel Core i9-9980XE (\$2,000) mentioned earlier. This is excellent performance for the money, plain and simple.



**The Ryzen 9 3900X did well on our benchmark tests. It boasts excellent performance for the money, plain and simple.**

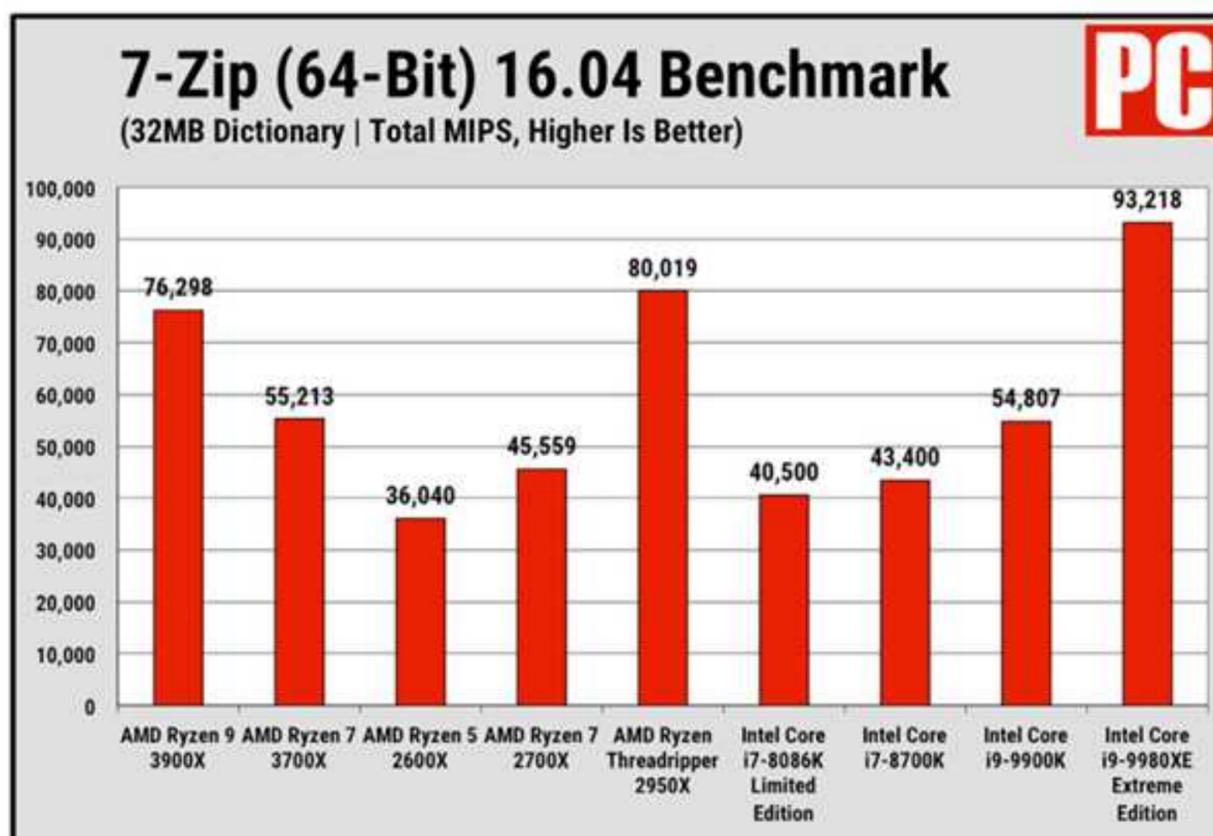


It's the same story when it comes to Blender, a popular open-source 3D rendering application for crafting 3D visual effects, animations, and models. Our test file is a cartoonish flying-squirrel render that most modern processors take less than a minute to complete.



## 7-ZIP

The Ryzen 9 3900X can make short work of compressing files, too, scoring nearly equal with the Threadripper 2950X and significantly higher than the Core i9-9900K on our 7-Zip benchmark. (Like Handbrake and POV-Ray, this test is capable of leveraging all the threads it can get.)



One note: Our testbed did not have the Windows 10 May update installed during testing (the Windows Update service would not push the update to our testbed until just before the launch here), which means that in some cases, the Ryzen 9 3900X's performance could be slightly better than shown above. AMD estimates a 6 percent improvement from faster clock-state switching when launching apps and as much as a 15 percent improvement when running games like Rocket League.

## A PEEK AT GAMING PERFORMANCE

The Ryzen 9 3900X will appeal to content creators relying on heavily multithreaded software as well as to folks building a tricked-out gaming desktop. So we ran a host of games—cutting-edge and older ones—to see what frame rates you can expect. We also ran the 3DMark Fire Strike Ultra test, a simulation that taxes a chip's graphics capabilities. (3DMark reports a proprietary score rather than the frames per second from the benchmarks in the individual games.)

For all these tests, on the graphics-card side we used an Nvidia GeForce RTX 2080 Ti instead of the GeForce GTX 1080 used for the tests above. We did that to show performance at the extremes. In the case of the 4K numbers, the RTX 2080 Ti graphics card is the likely limiter; at 1080p, the CPU comes more into play. Memory was set at 3,600MHz for the Ryzen 9 and 3,400MHz for the Core i9-9900K. We also included numbers here for our Core i7-8700K video card testbed using the same RTX 2080 Ti card as additional context.

Discrete Card Graphics Tests				
<i>(Tests run using Nvidia GeForce RTX 2080 Ti Founders Edition at presets indicated in parentheses. All scores in frames per second except 3DMark.)</i>				
	AMD Ryzen 9 3900X	AMD Ryzen 7 3700X	Intel Core i9-9900K	Intel Core i7-8700K
<b>Far Cry 5 (DX11, Ultra)</b>				
1080p	123	122	141	130
4K	69	71	69	74
<b>Rise of the Tomb Raider (DX12, Very High)</b>				
1080p	162	164	177	167
4K	76	80	81	78
<b>Counter Strike: Global Offensive (High)</b>				
1080p	399	400	376	NA
4K	224	236	229	NA
<b>Rainbow Six: Siege (High)</b>				
1080p	329	313	346	NA
4K	165	172	155	NA
<b>3DMark Fire Strike Ultra</b>				
Overall Score	8,055	7,940	8,093	8,235
Graphics Subscore	7,865	7,802	7,931	8,217
<b>Bioshock Infinite (Ultra+DDOF)</b>				
1080p	317	321	359	325
4K	154	154	154	162
<b>Sleeping Dogs (Extreme)</b>				
1080p	198	199	206	208
4K	67	67	64	69
<b>Hitman: Absolution (Ultra)</b>				
1080p	106	105	135	120
4K	47	46	46	49
<b>Tomb Raider (2013) (Ultimate)</b>				
1080p	289	289	281	297
4K	107	109	101	108

The really important results here are at 1080p resolution. At 4K, all systems performed nearly identically (within a few frames per second), as you'd expect when the game in question relies solely on the video card.

On demanding AAA game Far Cry 5, the Ryzen 9 3900X scored 18 frames per second (fps) lower than the Core i9-9900K did, a difference of about 13 percent. We saw smaller deficits on older games like Bioshock Infinite and Hitman: Absolution. On one classic, less demanding esports favorite, Counter Strike: Global Offensive (and on 2013's Tomb Raider reboot), the Ryzen 9 3900X outperformed its main Intel competitor.

Few of these differences will be perceptible during gameplay except in edge cases. In fact, on less-demanding esports games (the ones most watched, by competitive esports players, for fine shades of frame rates in the hundreds), both the Ryzen and Intel chips, paired with a high-end video card, are capable of driving frame rates in excess of the 144Hz or 240Hz that even the highest-end gaming monitors can display. Another interesting trend is that the Ryzen 9 3900X offers virtually identical gaming performance to that of its little sibling, the Ryzen 7 3700X.

Now, no subset of games is enough to establish anything definitively on this front; too many games and combinations of video cards exist. But with today's elite RTX 2080 Ti video card on today's two most elite mainstream CPUs, the gaming situation with the third generation of Ryzen looks a tad improved over the previous two. On some recent titles, at 1080p resolution, the Ryzen 9 3900X will be a handful of frames per second on a percentage basis behind its main Intel competitor; in others, it'll be a wash.

The difference matters only to extremely competitive gamers looking to eke out every last frame from their PCs and who can afford to give up a host of cores and threads to that end for the same money. For casual gamers, especially those who prefer 4K eye candy, the capabilities of the graphics card matter far more than the capabilities of the CPU.

## **AND NOW, OVERCLOCKING**

I didn't get overly deep into overclocking the Ryzen 9 3900X, as we performed the rest of our tests on the Wraith Spire cooler. But I gave the new version of Ryzen Master a spin.

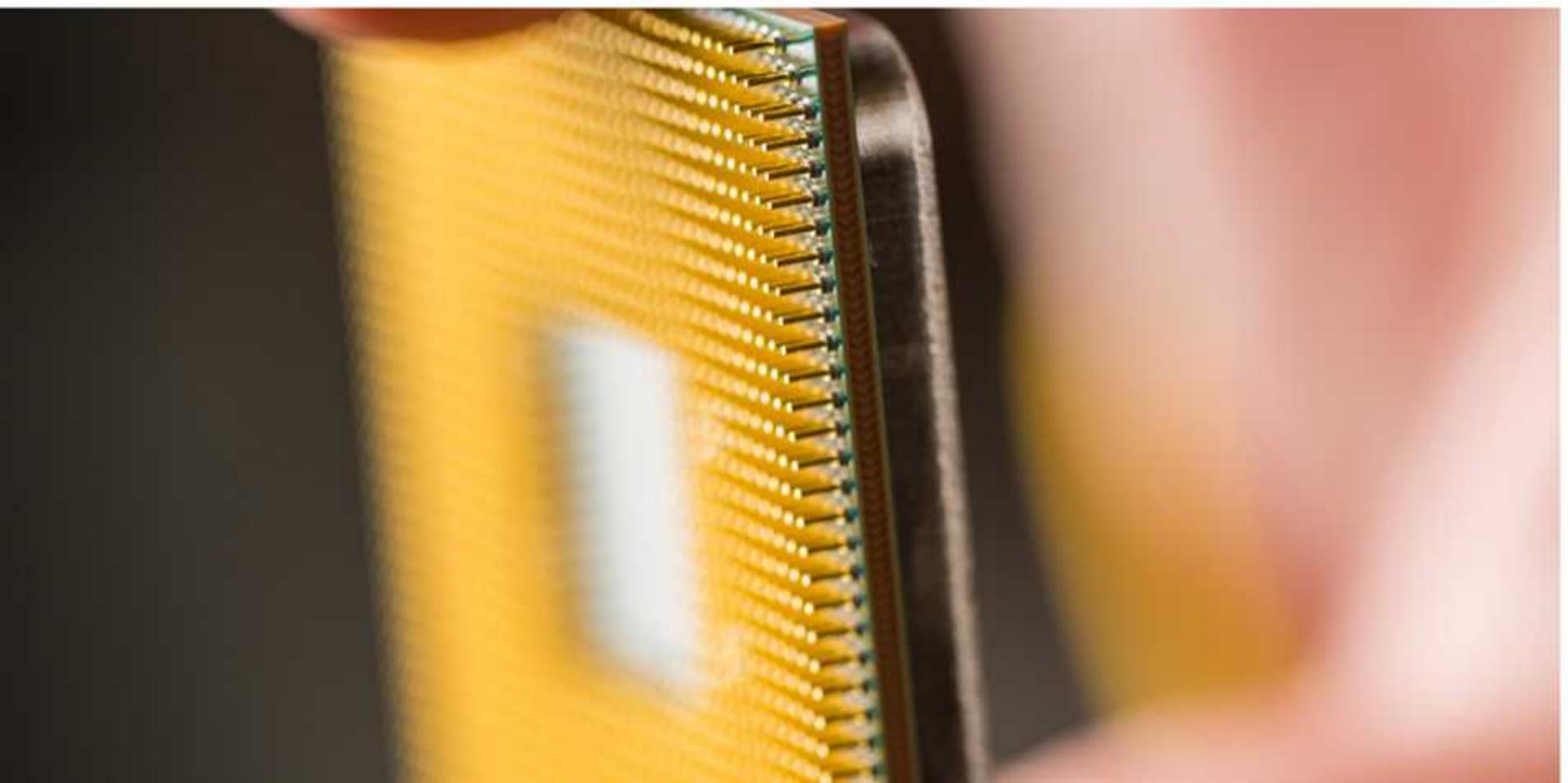
Using the Precision Boost Overdrive feature in Ryzen Master, I was able to achieve a modest improvement in the all-cores Cinebench score to 3,076, a 3 percent gain over our initial result at default settings. Precision Boost Overdrive automatically adjusts voltage, clock speeds, and other settings to eke out as much power from the CPU as the system thinks is possible without crashing.

It's highly dependent on the CPU cooler you're using, and since we're using the stock cooler, a trivial performance gain isn't entirely unexpected. But it was an improvement essentially gained by a click of a button.

If you've got a more aggressive liquid cooler and the time to adjust the clock speed of the memory and each core manually, you can likely achieve a better overclocking result. Not everyone is comfortable with this level of tinkering, however, so I appreciate that AMD includes an automatic feature that will give you a small boost. As with any overclocking adjustments, using Precision Boost Overdrive will void the warranty, so proceed with caution.

## **CONCLUSIONS**

The AMD Ryzen 9 3900X is an excellent, top-value choice to power a high-end gaming or content-creation PC. Its standout achievement is the ability to offer comparable performance to the low-end Ryzen Threadripper chips while consuming less power and having a significantly less painful effect on your wallet. Even better, it outperforms its main Intel competitor, the Core i9-9900K, in many multithreaded computing scenarios thanks to its higher core and thread count.



If you're reliant on single-core computing performance with older applications, you probably aren't (and shouldn't be) looking at a beastly CPU like this one, and it's not a slam-dunk over the equivalent Intel silicon when single-core is your main concern. And while gaming performance at 1080p shows some wins and some losses in our tests when paired with a GeForce RTX 2080 Ti, Intel still holds a small edge here.

That said, these are edge cases. This chip capably rivals the Core i9-9900K and the lower-tier prosumer CPUs in AMD's own Ryzen Threadripper and Intel's Core X-Series families. For most people, even enthusiasts and power users, the gaming and single-core differences between the Core i9-9900K and the Ryzen 9 3900X (and for that matter, the Ryzen 7 3700X) are modest, but the core- and thread-count advantage is far from it. And there the Ryzen 9 3900X delivers big-time.

Choosing the Ryzen 9 comes down to whether you can leverage those extra cores for the money. Gamers may choose the more power-efficient Ryzen 7 3700X if they don't need 12 cores for other things; after all, the gaming performance should be near-indistinguishable. (It's also possible that the new Ryzen 5 CPUs, not yet tested, may be even better pure-gaming values.) Don't discount Ryzen's cutting-edge features such as PCIe 4.0 support, as well as niceties including its slick, bundled cooling fan and backward-compatibility with previous chipsets. For those building a new PC, leading-edge features and the in-box cooler are compelling; you gain a top-performing CPU right now as well as future-proofing. And as a core-crunching power chip, the Ryzen 9 3900X is without peer on value for money in mid-2019. If you can harness all the power of this beast, then you won't regret building your computing world around it.

**TOM BRANT**



# Roundup: The Best Password Managers

Everyone needs a password manager. Most sites you visit insist you create a username and think up a password, from dating apps to hyper-secure banking websites. The human memory can't keep up with dozens and dozens of these arcane combinations of letters, numbers, and symbols. Some folks get the bright idea to use the simplest possible passwords, easy-to-remember phrases such as "12345678" or "password." Others memorize one superbly random password and use it for everything. Either path is likely to make you a victim of identity theft.

With a password manager, you don't have to remember a strong, unique password for every website. The password manager takes care of that and even helps you come up with random passwords. We've tested and analyzed dozens, so you can pick the password manager that best suits your needs.

All the products in this story earned at least 3.5 stars, and all of them cost money, though you can use some of them for free by accepting certain limitations. Most free tools lack advanced features, but they get the job done. Whether free or paid, a password manager is essential for everyone.

## THE PASSWORD BASICS

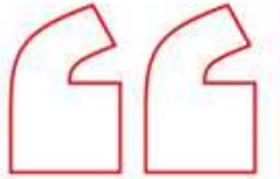
The typical password manager installs as a browser plug-in to handle password capture and replay. When you log in to a secure site, it offers to save your credentials.

When you return to that site, it can automatically fill in those credentials. If you've saved multiple logins for the site, the password manager offers you multiple login options. Most also include a browser toolbar menu of saved logins, so you can go straight to a saved site and log in automatically.

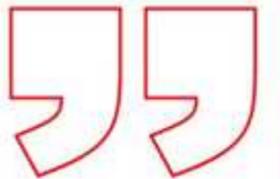
Some products detect password-change events and offer to update the existing record. Some even record your credentials when you sign up for a new secure website. On the flip side, a password manager that doesn't include password capture and replay automation needs to offset that lack with significant perks.

Those who are already using a password manager may find the grass looks greener in another app. Most password managers include the ability to export your saved data or import from other products, easing the process of switching to a new password manager.

Getting all your existing passwords into the password manager is a good first step. Next, you need to identify weak and duplicate passwords and replace them with tough ones. Many password managers flag weak and duplicate passwords, and some offer help with the update process. The most advanced ones can automate the password-change process for you.



**Most free tools lack advanced features, but they get the job done. Whether free or paid, a password manager is essential.**



When you create a new secure account or update a weak password, you don't want to strain your brain trying to come up with something strong and unique. Why bother? You don't have to remember it. All but one of our top-rated products include a built-in random password generator. Make sure your generated passwords are at least 16 characters long; too many products default to a shorter length.

Entering a password like @2a&AY8mePu8HU@H on your smartphone's tiny keyboard can be tough. Fortunately, most of our top password managers sync across all your Windows, Mac, Android, and iOS devices. A few even let you authenticate on iOS or Android with your fingerprint or face in lieu of typing the master password. Most include some form of two-factor authentication, be it biometric, SMS-based, Google Authenticator, or something else.

## **FILL FORMS AUTOMATICALLY**

Since most password managers auto-fill stored credentials, it's a small step for them to automatically fill in personal data on web forms—first and last name, email address, phone number, and so on. Most of the top-rated products include a form-filling function. The breadth and flexibility of their personal data collections vary, as does their accuracy when matching web form fields with their stored items. Even if they miss a field or two, the ones they do fill are ones you don't have to type. Think about how many sites you go to that want the same information; this feature is a huge time-saver.

Some websites offer to save your address, credit card details, and so on, for convenience. If you accept that offer, you've put your personal data at risk. Who knows if the site is storing your deets securely? Equifax certainly didn't. Let the password manager fill the form each time. It's safer.

Different products handle form-filling in their own ways. Some immediately fill recognized fields, some wait for you to click in a field, and some pop up and ask what you'd prefer. You'll even find products that offer your choice of credit cards using images denoted by the correct color and bank logo.



## **ADVANCED PASSWORD-MANAGEMENT FEATURES**

Given that all these products take care of basic password management tasks, how can a product stand out from the pack? One handy advanced feature is managing passwords for applications, not just for websites. Another is the provision of a secure browser that's designed to protect sensitive transactions and is invoked automatically when you visit a financial site. And of course, automating the password-change process is a big bonus.

As noted, these top products let you sync your passwords across all of your devices. Some also include a mechanism for securely sharing passwords with other users. Some let you share a login without making the password visible, let you revoke sharing, or allow password sharing to go both ways—that is, if the recipient makes a change, it will change the original.

On a grim note, what happens to your secure accounts after you've died? A growing number of products include some provision for a digital legacy and include a way to transfer logins to a trusted individual in the event of your death or incapacity.

Logging in with your secure username and password to a website that doesn't use a secure HTTPS connection is a big no-no. Some password managers even warn you about insecure login pages. Even when you do use HTTPS, sniffers and snoopers can still learn some things about your activity, such as the simple fact that you're logging in to the secure site and the IP address from which you're connecting. Running your secure connections through a VPN (virtual private network) service adds an additional layer of protection. Dashlane now includes a simple built-in VPN, and RememBear comes from the same source as the well-regarded TunnelBear VPN.

## **WHAT'S NOT HERE**

As mentioned, every product in this roundup earned at least a 3.5-star rating. Bear in mind that some 3.5-star products didn't fit. Three-star products are still good, but they're not quite up there with the very best. Anything with a sub-three-star score is just not good enough to make the cut. If you're looking for a particular password manager that isn't in this table, we've probably reviewed it, but found it wanting in some way. Check at PCMag.com.

As mentioned earlier, you also won't find any free password managers here, because they have their own, separate roundup. LastPass and Myki Password Manager & Authenticator are our Editors' Choice free password managers.

## THE TOP PASSWORD MANAGEMENT SOFTWARE

It's important for a password manager to offer advanced features, but it has to do so while retaining ease of use. Users who get annoyed or baffled by a password manager may abandon it, going back to sticky notes or to using the same password everywhere. Slick and polished Dashlane boasts a ton of features; Keeper Password Manager & Digital Vault has also leapt into the winner's circle, with a full set of advanced features, a sleek and elegant user interface, and support for every popular platform and browser. You won't go wrong choosing one of these two Editors' Choice products. Even the products not named as Editors' Choice have their merits, though; you may prefer one of them instead depending on your personal password needs.



**Dashlane**

\$59.88



**EDITORS' CHOICE**

**Pros:** Syncs across Windows, macOS, Android, and iOS devices. Offers essential and advanced password management features. Includes VPN protection. Scans Dark Web for compromised accounts. Captures online shopping receipts.

**Cons:** Expensive, especially if you already have a VPN. Can't choose VPN server country. No special handling for nonstandard logins. Limited support for Internet Explorer.

**Bottom Line:** The well designed and executed Dashlane makes smart password management a breeze, and it now comes with a simple VPN built in. One caveat: The price is also going up.



**Keeper Password Manager & Digital Vault**

\$29.99



**EDITORS' CHOICE**

**Pros:** Supports all popular platforms and browsers. Two-factor authentication. Secure password sharing and inheritance. Optional secure file storage. Retains full history of passwords and files. Fills web forms and app passwords.

**Cons:** Web form filling can often be somewhat limited. No fully automated password updates.

**Bottom Line:** With a strong focus on security, Keeper Password Manager & Digital Vault works on all popular platforms and browsers. The latest edition brings a new look and all the advanced features you could want.



### Bitwarden Premium

\$10.00



**Pros:** Supports all popular platforms and browsers. Two-factor authentication using Yubikey or FIDO. Generates TOTP codes for 2FA-supporting sites. Analyzes passwords and security. Inexpensive.

**Cons:** Edge extension not working correctly. Support for iOS somewhat limited. Full-scale secure sharing costs extra.

**Bottom Line:** Bitwarden Premium supports advanced two-factor authentication and can serve as an authenticator itself. This password manager costs little more than the impressive free edition and gives you quite a lot.



### LastPass Premium

\$24.00



**Pros:** Enhanced multifactor authentication choices. Includes 1GB of secure online file storage. Manages application passwords. Priority customer support. No ads.

**Cons:** Not a significant difference between the paid and free version. No longer offers shared folders. Price has doubled since our previous review.

**Bottom Line:** With LastPass Premium, you get all the powerful features of the free LastPass, along with a handful of enhancements you don't necessarily need. Stick with the free edition.



### LogMeOnce Password Management Suite Ultimate

\$39.00



**Pros:** Syncs across Windows, macOS, Linux, iOS, and Android. New, streamlined interface. Contains a vast number of features, many of which are unique and patented.

**Cons:** Some features cost extra. All-features installation quite expensive. Vast number of features may overwhelm users.

**Bottom Line:** LogMeOnce Password Management Suite Ultimate offers more

features than any competing product. However, we're not convinced those features are all necessary, strictly speaking, and enabling them all makes the product very expensive.



### **Password Boss**

\$29.99



**Pros:** Syncs across Windows, macOS, iOS, and Android devices. Secure sharing and password inheritance. Two-factor authentication. Security Dashboard. Fills web forms.

**Cons:** No online access to stored passwords. Some configuration settings could be more flexible.

**Bottom Line:** Password Boss handles all basic password management tasks and includes advanced features, such as secure sharing and password inheritance. It's worth your consideration.



### **Sticky Password Premium**

\$29.99



**Pros:** Syncs across devices. Secure no-cloud Wi-Fi sync available. Captures oddball logins. Two-factor authentication. Manages application passwords. Online console manages trusted devices.

**Cons:** Security Dashboard lists only the very weakest passwords. No online access to passwords. No secure password sharing or digital inheritance.

**Bottom Line:** Sticky Password Premium does everything you'd expect from a password manager, though it lacks advanced features such as digital inheritance. If you choose the unusual no-cloud Wi-Fi sync, your passwords never leave your home network.



### **AgileBits 1Password**

\$35.88



**Pros:** Apps for Windows, macOS, Android, and iOS. Secure yet simple authentication when adding new devices. Two-factor authentication. Extensions for most browsers. All-platform Chrome extension.

**Cons:** Not compatible with Internet Explorer. Limited import options.

**Bottom Line:** AgileBits 1Password syncs passwords and personal data across all your devices. It's not quite as automated as many competitors, but it's still a slick, easy-to-use utility.



## Authentic8 Silo

\$10.00



**Pros:** Local browser is completely insulated from all web-based attacks. No local traces of web activity. Masks IP address. Includes full password manager. Two-factor authentication. Brute-force hack protection.

**Cons:** No support for Android devices. More expensive than dedicated password managers.

**Bottom Line:** Authentic8 Silo completely insulates your browser from malicious websites and also manages your passwords. You can use it on Windows, Mac, Ubuntu, or iOS (iPad only).



## RoboForm 8 Everywhere

\$19.95



**Pros:** Syncs across many different device types and browsers. Security Center identifies weak and duplicate passwords. Includes digital inheritance and secure sharing. Comprehensive web form filling. Manages application passwords.

**Cons:** Limited import capability. User interface can be confusing. Password generator defaults aren't optimal. Limited two-factor authentication.

**Bottom Line:** RoboForm 8 Everywhere adds new features like digital inheritance and secure file sharing to the venerable RoboForm's password management and form filling capabilities, but it hasn't quite caught up with the top product.

*NEIL J. RUBENKING*

**FEATURES**

# THE BEST LAPTOPS FOR KIDS

BY TOM BRANT



**T**he question of whether (and when) to buy your child a smartphone is fraught with concerns over responsibility, online safety, and much more. The same goes for buying a laptop, with an additional important difference: Some schools require parents to purchase laptops, offering a selection of recommended models. And many elementary and middle schools consider them essential educational tools and equip classrooms with machines for their students.

While their effectiveness as teaching tools is up for debate, your kid might need to use a laptop at school whether you like it or not. They'll almost certainly want to use it at home, too, both for fun (messaging their friends, watching videos, playing Fortnite) and to complete their homework (looking up information and typing book reports).

Kids being kids, the list of factors to consider doesn't end there. Don't forget about parental controls, durable plastic, and water-resistant keyboards. At least you won't have to worry about the cost. Buying a kid-friendly laptop need not break the bank—just because they're inexpensive doesn't mean they're slow or poorly made. All of our recommended models cost less than \$600.

## **WHICH OPERATING SYSTEM?**

Before you even begin to evaluate features, you'll start with the essential question that has plagued PC shoppers for decades: Which operating system should I choose?

This is not the traditional Mac versus Windows debate. New Apple laptops aren't available for less than \$500—not even close. The least expensive Mac laptop, the MacBook Air, starts around \$1,100 and is still overkill for an elementary- or middle-school student. If you're an Apple fan and want to raise your son or daughter to be one too, you're best off giving them a hand-me-down and buying a new MacBook or MacBook Pro for yourself.

Reused Macs aside, most parents will choose between Windows 10 and Chrome OS, Google's operating system. In addition to running web apps within the Chrome browser, Chrome OS can also run apps from the Google Play store designed for Android smartphones and tablets, including Microsoft Office. If you've decided against buying a smartphone for your kids but they talk your ear off about wanting to play mobile games, buying a Chromebook might be a good compromise for both of you.

Windows 10 has also become more viable as an operating system for kid-oriented laptops thanks to the Windows 10 S Mode, which is aimed at the education market. Among other security enhancements, it prevents apps from being installed unless they're available on the Microsoft Store. This means you've got the ability to block games and apps based on their content ratings (something you can also do with Google Play apps). When your son or daughter gets older and more responsible, you can easily upgrade to the full version of Windows 10 to remove these limitations.

If your child's school has specific software that only runs on Windows, your operating system choice will be decided for you. If not, you'll want to take a close look at Chrome OS, since many Chromebooks include gimmicky but kid-friendly features such as display lids that double as whiteboards.

## **ASSESSING RUGGEDNESS**

These unique features transform ordinary cheap laptops into school-friendly machines that kids won't outgrow or destroy in a few months. Arguably the most important attribute is a rugged case.

A few Chromebooks and inexpensive Windows laptops have spill-resistant keyboards, which means that they should survive being splashed with an ounce or so of water. It's rarer to find entire laptops that are waterproof; the ones that are (models including Panasonic's Toughbook line and Dell's Latitude Rugged Extremes) typically cost several thousand dollars and aren't geared toward kids. Likewise, it's relatively easy to find reinforced lids or cases made of rubber to help absorb drops from a few feet, but you won't find fully ruggedized machines anywhere close to this price range.



Portability is another key concern, especially for middle- and high-schoolers who walk to school with textbook-laden backpacks. Most laptops in this category with screen sizes from 11 inches to 13 inches weigh about 2.5 pounds. Go above 3 pounds, and you're putting a real burden on your child's shoulders. Some laptops include handles so kids can bring them class-to-class without a backpack or a visit to their lockers.

Battery life is important, too, but it's no longer the limiting factor that rendered the laptops of a decade ago useless if they spent more than an hour or so away from a power outlet. Nowadays, even some of the cheapest laptops boast 10-hour times on PCMag's battery rundown test, thanks to their power-sipping Intel processors.

### **KEY PARTS TO LOOK FOR**

Speaking of presentations, the final consideration is how your kids will use the laptop, which in turn determines the processor, storage, and memory configurations you should select. Tasks such as taking notes, writing papers, and making PowerPoint slides require the bare minimum, so an Intel Celeron or Pentium processor will suffice. (Intel Atom chips are lower-end than these and sluggish by any measure.) The next step up is an Intel Core i3, which you should consider if your kid's teachers regularly have them stream online educational videos. An Intel Core i5 or i7 is all-but-impossible to find on a laptop or Chromebook that costs about \$300.



If you opt for a more powerful processor so your kids can stream videos, you might also want to consider a 2-in-1 convertible or detachable laptop, which can double as a tablet thanks to a hinge that rotates 360 degrees or a screen that detaches completely from the keyboard base. Most hybrids and convertibles are more expensive than the price range we've discussed up to this point, but you can find a few high-quality models for less than \$500 in lines such as Lenovo's Miix, Microsoft's Surface, and Asus' VivoBook. These are best for middle-school-age children or older, since they're by nature less durable than a conventional laptop.

As for memory and storage, a common configuration is 4GB of RAM and a 64GB flash drive. Consider bumping up the storage capacity to 128GB, since the operating system files on a Windows 10 PC can take up more than 20GB, leaving your kid with a paltry 40GB or so of built-in storage. The exception is if you choose a laptop that has a roomier but slower (and more easily breakable) spinning hard drive, or one with a built-in SD card reader. In the latter case, you could stick with the base configuration and ask your kids to store their bulkier files on SD cards if needed, which you can buy in 32GB capacities for about \$20 each.

### **TIME FOR FUN: WHAT ABOUT GRAPHICS AND GAMES?**

Even though you're selecting from relatively slow processors and limited memory capacities, gaming isn't out of the question when your kid is done with schoolwork. Some games can even help kids learn. Microsoft, for example, offers an educational version of its immensely popular open-world construction game Minecraft. Students can use it to explore real-world history such as the Oregon Trail, solving math problems as they begin to understand how long and challenging the trail was or researching fur-trading companies to learn about the economic concepts of monopolies and supply and demand.

Minecraft and similar games will run on Core i3 systems with as little as 2GB of RAM, but if your kid is looking forward to playing them, you'll make the experience more enjoyable by selecting a laptop with 6GB or 8GB. If your child is planning on doing more intense gaming, you'll need to step up the power and the price to a full-fledged gaming laptop or desktop. You won't find current-generation gaming laptops for less than \$700; \$750 to \$800 is really the on-ramp for machines with game-worthy GeForce GTX dedicated graphics chips.

## OUR RECOMMENDATIONS

Giving your son or daughter a laptop grants them a portal to the internet, even if the laptop itself isn't all that potent. It's up to you (and your kids' teachers) to make sure that tool isn't harmful. Fortunately, both Chromebooks and Windows laptops have parental control features, and modern kids laptops make it easier to monitor activity and set ground rules such as disallowing computer use after homework is finished.

Check out our top picks below for laptops designed for school-age kids.

### Acer Chromebook 514

EDITORS' CHOICE



\$349.00

**Pros:** Sharp-looking aluminum design for a budget machine. Excellent battery life. Touch display (as tested) looks great. Comfortable backlit keyboard. Big touchpad.

**Cons:** Processor could use a pick-me-up. Ho-hum speakers.

**Bottom Line:** Aluminum-clad and ready for all day off the plug, the Acer Chromebook 514 is a reasonably priced standout on the premium Chromebook stage that's priced right for students and budget buyers.



### Acer Chromebook Spin 11



EDITORS' CHOICE

\$399.99

**Pros:** Rugged enough for school use. Wacom stylus included. Two USB-C and two USB 3.0 ports. Two cameras. Very snappy keyboard.

**Cons:** Small, low-res screen. Easy-to-lose stylus. Imperfect Android compatibility.

**Bottom Line:** The Acer Chromebook Spin 11 is an 11.6-inch convertible that offers keyboard, touch, and stylus input, runs Chrome OS and Android apps, and shrugs off knocks, drops, and water spills. It's the best Chromebook we've seen for kids.





### Asus Chromebook C523



**EDITORS' CHOICE**

\$379.99

**Pros:** Bargain-basement price for a large-screen Chromebook. Sleek, part-aluminum design. 1080p panel looks crisp. Comfortable keyboard and touchpad.

**Cons:** Glossy screen coat is a glare magnet. Mediocre battery life. No keyboard lighting. Poor audio output.

**Bottom Line:** With its sleek design and big 1080p touchscreen, the 15.6-inch Asus Chromebook C523 is an unusual bargain: a budget-friendly big-screen Chromebook.

### HP Chromebook x2



**EDITORS' CHOICE**

\$599.99

**Pros:** Elegant detachable design. Spiffy screen. More lap-friendly than tablets with kickstands. Strong performance and battery life.

**Cons:** Expensive. No backlit keyboard. Mediocre cameras.

**Bottom Line:** It could use a \$50 or \$100 price cut, but HP's pioneering Chromebook x2 detachable joins Google's \$999 Pixelbook as the elite of the Chrome OS field.



### Dell Chromebook 3189 Education 2-in-1



\$349.00

**Pros:** More than 11 hours of battery life. Rugged, spill-proof exterior. 2-in-1 convertible form factor. Support for Google for Education administration and features.

**Cons:** Low-resolution screen. No USB-C ports.

**Bottom Line:** The Dell Chromebook 3189 is a durable convertible laptop, with a long-lasting battery, a multimode hinge, and enough juice to help power online and classroom learning.



### Acer Chromebook 11 (2018)



\$269.99

**Pros:** Low price. Chassis feels solid, despite the mostly plastic build.

**Cons:** Modest-at-best processing performance. Touchpad is inconsistent.

**Bottom Line:** The Acer Chromebook 11 won't surprise you with speed, but its low price gets you a well-made chassis and enough just pep for everyday tasks.

### Asus VivoBook Flip 14 (TP401CA)



\$399.99

**Pros:** Sleek aluminum looks. Excellent battery life. Operates in fanless silence. Surprisingly good audio.

**Cons:** Next-to-nil storage space. Limited performance. No keyboard backlighting. Lid flexes some.

**Bottom Line:** It doesn't pack much local storage in our test configuration, but the Asus VivoBook Flip 14 is a long-running, sleek-looking, and sweet-sounding 14-inch convertible laptop.



### Dell Inspiron 11 3000 Series 2-in-1 (3179)



\$249.99

**Pros:** Core m3 processor. Includes HDMI port. Touch screen. Attractive design.

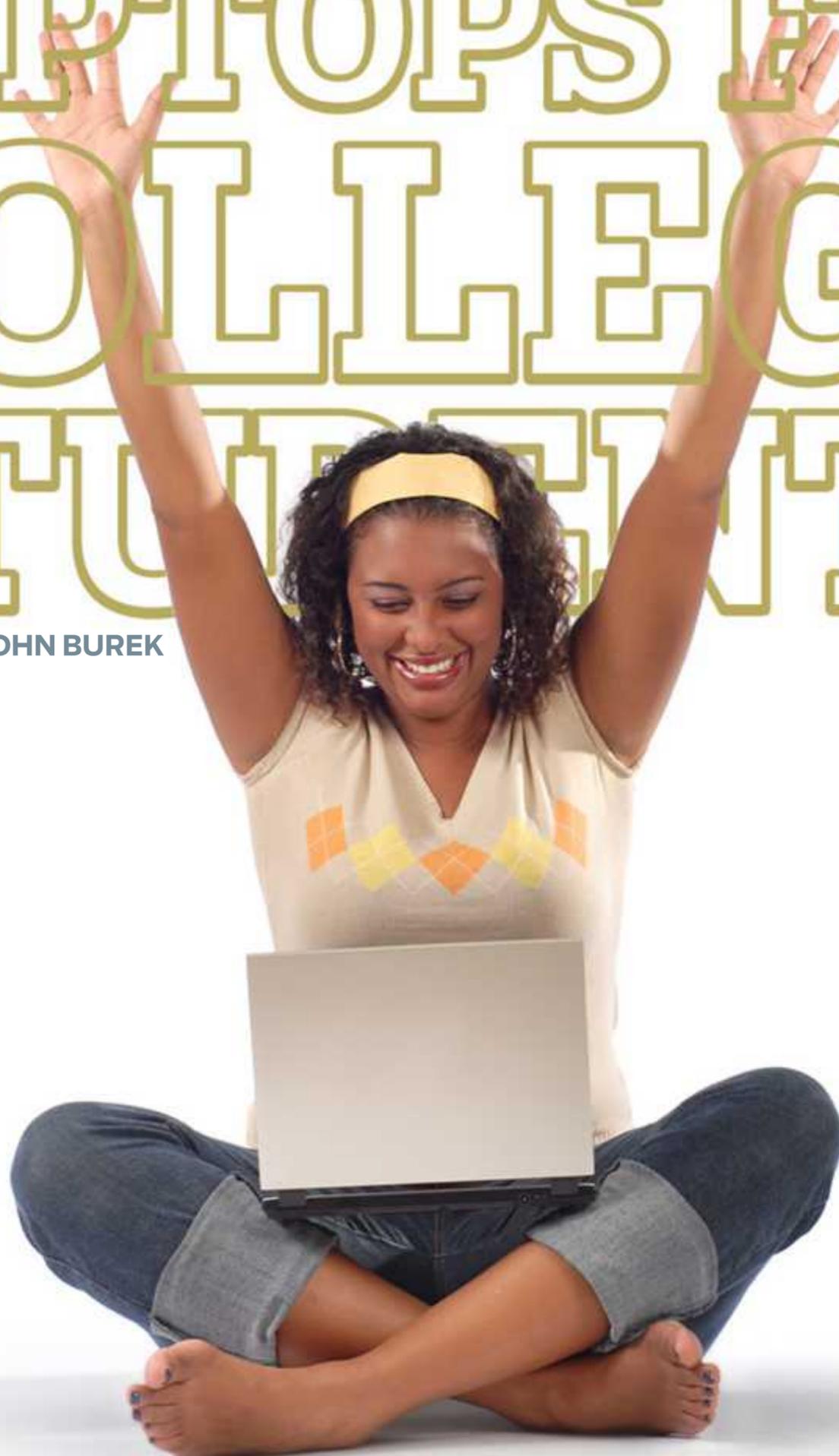
**Cons:** No 5GHz Wi-Fi. Slow 5,400rpm hard drive. 1,366-by-768 resolution screen. Relatively short battery life.

**Bottom Line:** The Dell Inspiron 11 3000 Series 2-in-1 is a convertible-hybrid laptop that has a better processor and subsequently higher performance than rivals, but makes a few compromises to meet its relatively inexpensive price.

# FEATURES

# THE BEST LAPTOPS FOR COLLEGE STUDENTS

BY TOM BRANT, JOHN BUREK



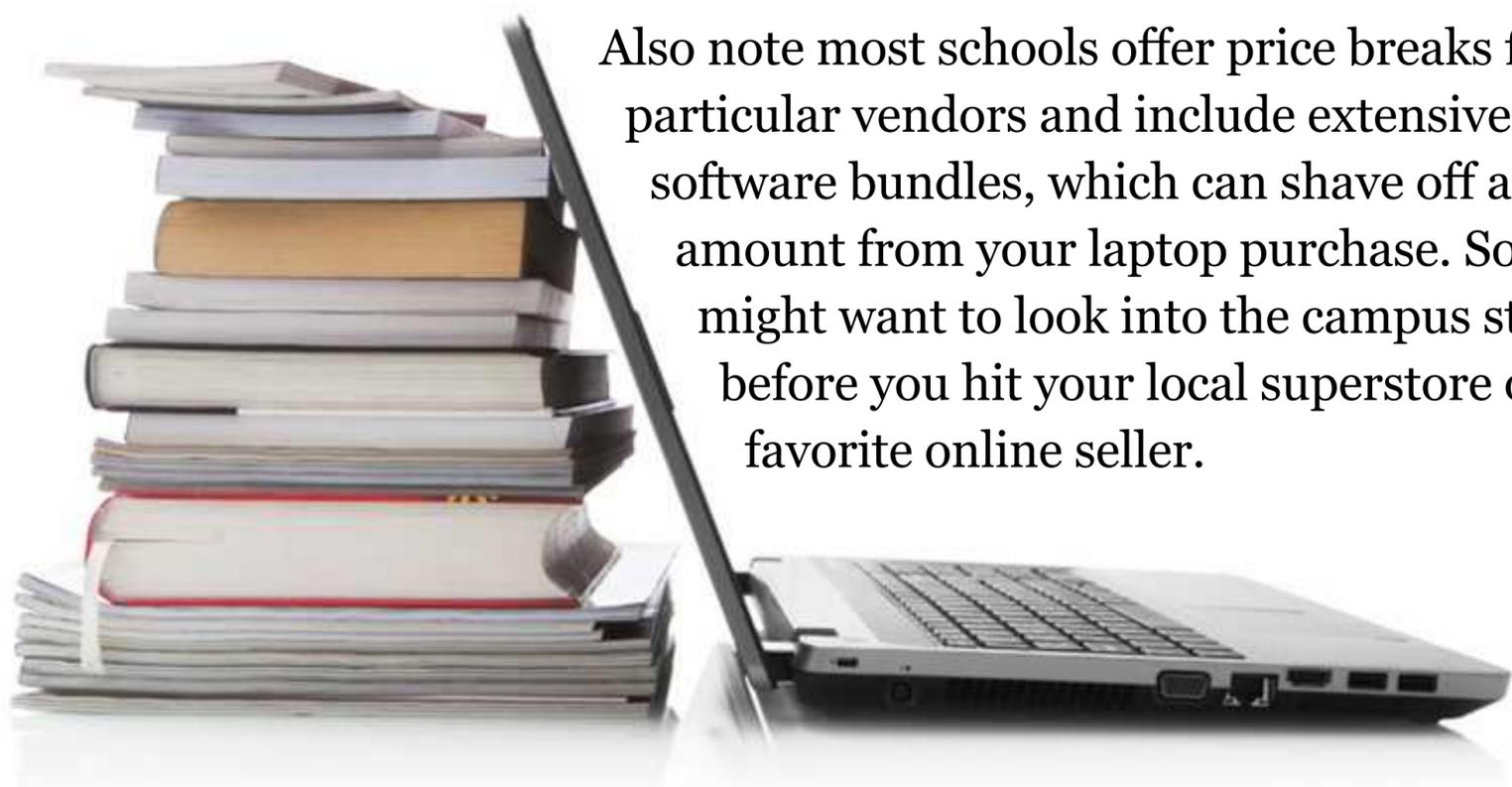
**W**hen you're a student, a laptop is as essential as your textbooks and school ID—and not just because of your school work. It should also be able to handle your big extracurricular activities: keeping up with your social networks, streaming movies, listening to music, posting photos, gaming, and video chatting with the 'rents back home. Of course, the best laptops for college students last for the long haul, preferably through four years of undergrad and maybe a year of grad work.

Lucky for you, we have a bunch below that fit the description perfectly—and they won't drain your savings account. Here are the basics you should keep in mind while looking at a laptop for college.

## **RESEARCH YOUR COLLEGE**

The first and most important thing to do is check with your school for specific system requirements. They may have hard-and-fast hardware recommendations (or not).

Some colleges and universities want their students equipped with Windows-based laptops to cut down on software incompatibility issues or to keep technical support concentrated on one platform. Others don't care which operating system you use, whether it's Windows, macOS, or even Linux. Some institutions have on-site computer repair centers that service laptops purchased from the university or an affiliated computer store on campus; the turnaround time will be much quicker at one of these facilities than if you were to send it overnight to the original manufacturer.



Also note most schools offer price breaks for particular vendors and include extensive software bundles, which can shave off a good amount from your laptop purchase. So you might want to look into the campus store before you hit your local superstore or favorite online seller.

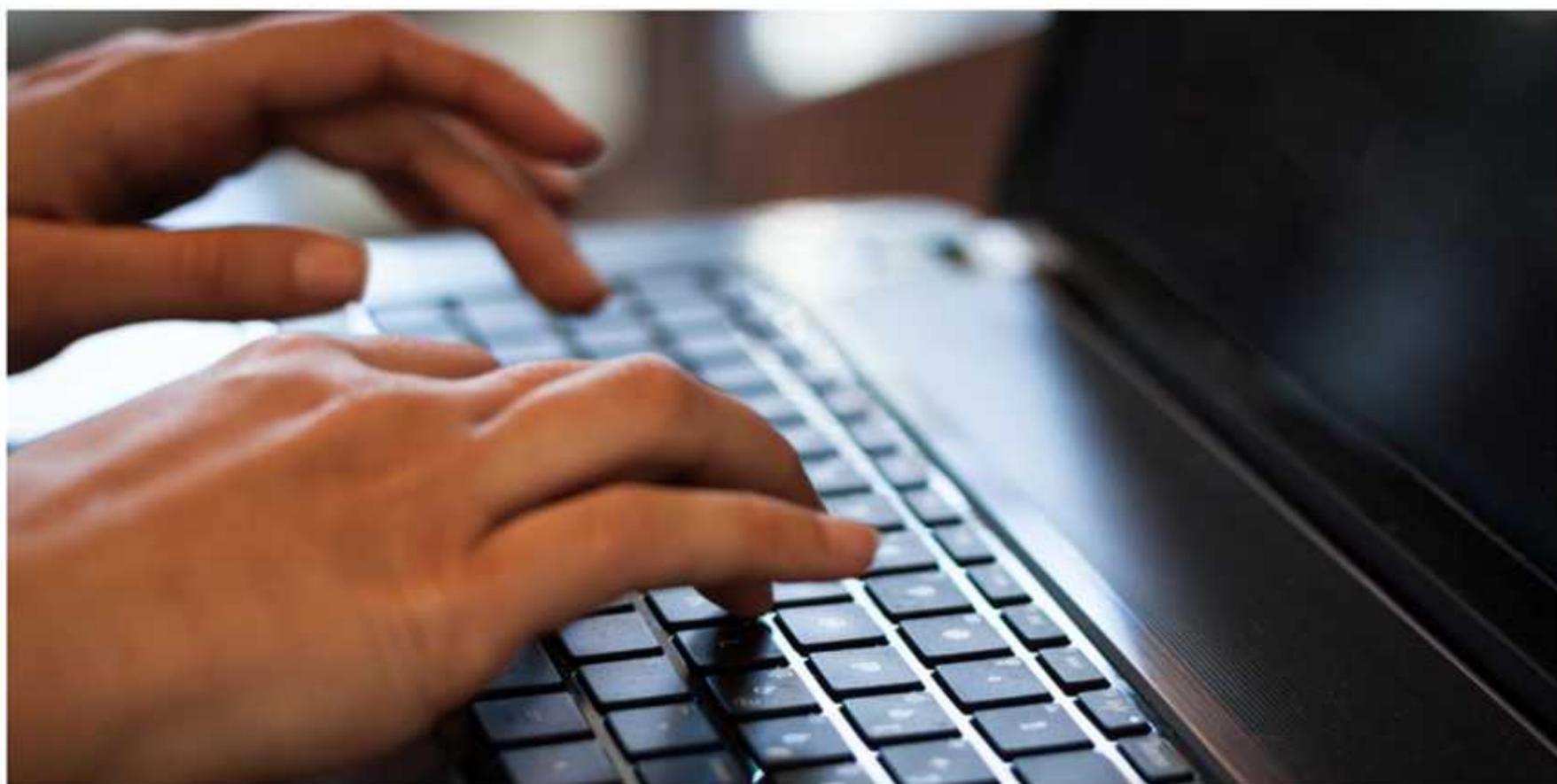
## **WEIGHT MATTERS**

Not every student will agree, but depending on how far you'll haul it every day, a big-screen notebook may not be such a good idea.

It's nice to have a mini home theater in your dorm room or play the latest games in big-screen 1080p glory, but a 6-pound-plus laptop with a 15-inch or 17-inch screen will be a chore to haul across campus while you're running from class to class. You're better off with something light: If you value screen size less than convenience, a super-thin ultraportable could be the way to go.

For most people, a 13- or 14-inch widescreen panel is ideal; it leaves room for other items in your backpack and minimizes the weight burden. A smaller display works as long as you understand that full webpages and productivity applications will require more scrolling to navigate, and fonts will appear smaller than they do on larger screens, assuming they carry the same resolution and zoom level.

Essays, research papers, and chatting with your classmates will take up most of your computing time, so a full-size keyboard and a comfortable touchpad are crucial. When you venture smaller than a 13-inch laptop, you run the risk of not getting the same typing experience. The easiest way to ensure you have the best keyboard is to stop by a brick-and-mortar store and spend some time typing on prospective picks.

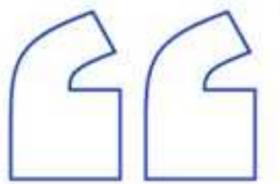


If you do decide to buy a smaller, less expensive laptop, it's probably worth investing in a standalone keyboard you can keep at home or in the dorm for when you need to do a lot of typing. A desktop monitor you attach via HDMI could be a nice complement, too.

## HOW MUCH POWER DO YOU NEED?

Laptops offer a wide selection of processors across both budgets and usage cases. You can choose one that maximizes performance or one that favors battery life—or you can select one that plays to both strengths. Intel's latest “Kaby Lake R,” “Coffee Lake,” and “Whiskey Lake” Core CPUs (all various forms of 8th Generation Intel processors) confer the benefits of both power and battery efficiency.

If you want all-day battery life and spend most of your time in a web browser, consider a Chromebook. They typically run on low-powered processors (mostly Intel Celeron and Pentium chips), but these CPUs suffice for the kinds of workaday online tasks at which Chromebooks excel. But if performance ranks high on your list, a Windows 10 or macOS machine with an Intel Core i5 or Core i7 CPU will give you the most oomph.



**If you want all-day battery life and spend most of your time in a web browser, consider going with a Chromebook.**



Not all Core i5 and i7 chips are created equal. The ones ending in “H” or “HQ” are the highest-performance chips, typically found in larger gaming-focused and power-user laptops. The ones ending in “U” are efficient, low-power CPUs meant for use in thinner, portable machines. More performance means more generated heat, which generally requires a more substantial chassis and support gear to cool the chip.

If you like playing games in your downtime, you might want to splurge on a gaming laptop. Most general-purpose machines won’t have the kind of discrete graphics chip (GPU) necessary to make the hottest AAA game titles look good and play smoothly. But if you hunt around a little, you can find gaming laptops starting at around \$700 with a decent Nvidia GeForce GTX or (less commonly) AMD Radeon RX GPU for playing games at 1080p and moderate or better settings. A powerful GPU can also help in certain high-end and scientific applications, but like high-powered processors, they also feast on the battery.

The good news is, in most other cases (unless, say, you’re an architecture major with a heavy reliance on CAD software), integrated graphics solutions should suffice for your day-to-day tasks. This is the graphics silicon built into the processors of most budget and midrange laptops. Today, that means some form of Intel integrated graphics: Intel HD Graphics, Intel UHD Graphics, or Intel Iris or Iris Plus graphics. Our reviews detail their comparative performance levels, but none is a match for even a moderate dedicated GPU.



## **STORAGE: SSDS ARE TOPS**

With the increasing prevalence of cloud storage and web applications, having plentiful local storage space is less vital now than it used to be, but you should still make sure your laptop meets your needs. If you plan to install a lot of programs or hang onto large media files, you'll need 500GB of space or more. If you don't foresee needing all that local storage or are content with leaving a lot of your work online, you can get by with a laptop with less space.

Whichever way you go, remember that storage affects speed. If you go with a hard drive because you get more storage for less money, it will be noticeably slower than a snappy solid-state drive (SSD). The higher cost and lower capacity of a faster SSD is a trade-off some students are willing to make. We strongly recommend SSDs for laptops that are carried around campus a lot, since they are impervious to drop damage. They're a lot faster than hard drives, too, and give a laptop a much snappier feel.

The good news is: By plugging an external hard drive into one of your laptop's USB ports, you can add more space whenever you need it. Although you probably won't have to do this unless you're a video junkie or an aspiring filmmaker, it's a good option to have.

Gamers may take an altogether different view. With many AAA game installations topping 40GB or 50GB, a small SSD can get eaten up fast. You'll want to think about that before you buy a machine with, say, a 256GB SSD alone, or at least be prepared to swap games on and off the drive as you complete them.

## **BATTERY LIFE: HOW LONG MUST IT HOLD OUT?**

A sizable battery can be your biggest ally on a day filled with classes and extracurriculars. A few school-oriented laptops come with multiple battery options. Most, though, have only one, and it's non-removable.

In this case, figure out where battery life ranks in the grand scheme of things. If removable batteries are an option (increasingly they are not, alas), think about getting a second one or a larger "extended" one, if available. The more "cells" the battery contains within a given model line, the better the battery life.



A big battery adds some heft, but the weight gain is worthwhile if it means leaving the system unplugged from dawn until dusk. We test battery runtime with nonstop video playback on every laptop we review, so you can get a good idea of relative endurance between models.

## **WHAT ABOUT CHROMEBOOKS?**

In the past several years, we have seen a strong push by Chromebook manufacturers into the education market. Chromebooks have evolved from glorified netbooks running the Chrome OS to web-centric laptops with relatively full feature sets. If your school puts its coursework in the cloud, a Chromebook can offer you much of the functionality of a regular laptop, and it may deliver longer battery life.

It'll likely cost you a lot less than other types of notebooks. Chromebooks typically cost between \$200 and \$300 (although higher-end models can go for as much as \$1,000). Just be sure you have ready access to stable Wi-Fi, as there is scant local storage on these systems, and you have to plan ahead to use them effectively offline.

PC gamers, of course, won't find much use for one of these laptops; they run only Chrome OS apps and (in the case of more recent Chromebooks) Android apps from the Google Play store. But a Chromebook could also be a good, inexpensive second laptop you carry around campus to take notes, while your beastly gaming rig (or desktop gaming PC) hangs back at the dorm or at home.

## 2-IN-1S FOR SCHOOL

In recent years, a new category of laptop has emerged. Hybrids, also known as 2-in-1s, function as traditional clamshell-style laptops and can transform into tablets when your task requires more mobility. Some (generally called convertibles) sport a folding design that flips the keyboard out of the way, usually by rotating all the way around its hinge. Others (“detachables”) let you dock the tablet/screen portion of the PC with an accessory keyboard for laptop-like functionality.

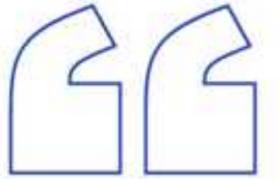
If you’re considering a detachable 2-in-1 design, make sure the keyboard base is included in the price. In some cases, it is; in others, it’s an added cost.

## WHAT ABOUT WINDOWS 10 S?

You probably won’t run across Windows 10 S in your shopping, but it’s good to know what it is, since it’s most often encountered in education environments.

Microsoft’s new student-centric flavor of its operating system is a locked-down version of Windows, aimed at preventing inadvertent malware downloads. It’s compatible with any app in the Windows Store, but it doesn’t allow third-party Windows programs unless you convert your laptop to full Windows 10 Home or Pro. You can easily switch to the full version of Windows 10 using the Microsoft Store app, but a fee may apply, depending on your device, and you won’t be able to go back to Windows 10 S once you convert. Also, this version of the OS supports only the Edge browser.

Windows 10 S comes preloaded on portables such as the Microsoft Surface Laptop (a \$999 ultraportable model with a target placed firmly on the backs of Apple’s line of MacBooks; the newer Surface Laptop 2 ships with straight-up Windows 10) and the consumer versions of the Microsoft Surface Go.



**Hybrids, also known as 2-in-1s, function as traditional clamshell-style laptops and transform into tablets for more mobility.**



## A WORD ON WARRANTIES

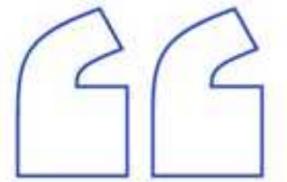
Almost every laptop you might buy today is backed by at least a one-year warranty on parts and labor. Extended warranties are also available, but whether they're worthwhile depends on what kind of user you are.

For starters, the standard warranty doesn't cover accidents caused by a spilled drink or a hard fall. Most manufacturers sell accident coverage as a separate plan, on top of extended warranties that supplement a standard one, so you might end up spending close to \$300 for three years of coverage. Apple offers a maximum three-year extended warranty (\$250), while most Windows-based laptop vendors will offer up to four years.

In our opinion, if the warranty costs more than 15 percent of the total laptop price, you're better off spending the money on backup drives or services that minimize downtime in case something goes awry. Of course, you can't put a price on peace of mind. In rare instances, the logic board or the display—the most expensive pieces of a laptop—can fail and cost you half of what the laptop is worth in repairs. Faulty components usually break down during the first year; anything after that is probably more about regular wear and tear.

## READY FOR OUR RECOMMENDATIONS?

So, what's the best laptop to get for school? There are more choices on the market today than ever before, and slogging through them can be daunting. No worries, though: We did the work for you. Read on to check out the hottest laptops to grace the dorm room, classroom, and quad for this school year. (We kept the pricing below \$1,000, with the exception of the latest MacBook Air, which we consider the best value in the current MacBook Pro line for most Apple-loyal students who don't need heavy processing power.)



**If the warranty costs more than 15 percent of the price, you're better off spending the money on backup drives.**





### Dell XPS 13 (9380)

\$899.99



**EDITORS' CHOICE**

**Pros:** Compact and classy. Beautiful rose-gold-and-white color scheme. 4K touch screen. Two Thunderbolt 3 ports plus USB-C.

**Cons:** No HDMI or USB Type-A ports. 4K

display isn't the best for battery life. Loaded models get pricey.

**Bottom Line:** Dell moves the webcam to where it always should have been, fixing one of the very few faults of the drop-dead gorgeous, highly capable XPS 13. Earning our highest recommendation and a rare five-star rating, the XPS 13 (9380) is, indisputably, the best ultraportable laptop you can buy.

### Asus VivoBook S15 S530UA



**EDITORS' CHOICE**

\$699.99

**Pros:** Thin, light design. Slender bezels. Hinge with lifting action works well. Plenty of ports. Comfy keyboard.

Fingerprint scanner.

**Cons:** Poor webcam quality. Awkward touchpad.

**Bottom Line:** A svelte laptop with thin bezels, lots of color options, and a unique hinge design that keeps it running cool and quiet, the Asus VivoBook S15 is a winner for students and casual buyers alike.



### HP Chromebook x2



**EDITORS' CHOICE**

\$599.99

**Pros:** Elegant detachable design. Spiffy screen. More lap-friendly than tablets with kickstands. Strong performance and good battery life.

**Cons:** Expensive. No backlit keyboard. Mediocre cameras.

**Bottom Line:** It could use a \$50 or \$100 price cut, but HP's pioneering Chromebook x2 detachable joins Google's \$999 Pixelbook as the elite of the Chrome OS field.



### Lenovo Legion Y530



**EDITORS' CHOICE**

\$949.99

**Pros:** Aggressive price. Slim, sturdy build is nice for the money. No garish gamer aesthetic. Super-slim bezels. HD gaming capable. Above-average keyboard.

**Cons:** GTX 1050's performance ceiling with demanding games is limited. Smallish 256GB SSD in this model.

**Bottom Line:** Lenovo's Legion Y530 tops today's class of budget gaming laptops with a sleek, distinctive build, alongside solid performance and a full feature set.

### Lenovo Yoga 730 (13-Inch)



**EDITORS' CHOICE**

\$799.99

**Pros:** Thin and light. Comfortable keyboard and touchpad. Two Thunderbolt ports. Quick charging. Good everyday computing performance.

**Cons:** Slightly bulky in Tablet mode. Screen bounces in Laptop mode. No SD card slot.

**Bottom Line:** The Lenovo Yoga 730 convertible laptop is a small but worthy iteration on its already-excellent predecessor, with better computing performance and a subtle redesign.



### Acer Swift 5



\$999.99

**Pros:** Unbelievably light for its screen size. Sunny 1080p screen. Good battery life.

**Cons:** No Thunderbolt 3 port or SD card slot. Screen is reflective. Beaucoup bloatware.

**Bottom Line:** The lightest 15.6-inch laptop the world has ever seen, Acer's 2.2-pound Swift 5 is a design landmark whose portability outweighs its minor imperfections.



## Apple MacBook Air (2018)



\$1,199.00

**Pros:** Retina display offers vivid colors. Very comfortable Force Touch trackpad. Secure boot capability. Two Thunderbolt 3 ports. Excellent battery life.

**Cons:** No CPU configuration options.

Y-series, not U-series, CPU. No touch screen. No USB Type-A ports or dedicated video output. Shallow key travel. Expensive as configured. Occasional fan noise.

**Bottom Line:** Though no speedster, the refreshed MacBook Air finally gets a Retina display and updated components, making it a sleek ultraportable laptop worthy of its pioneering predecessor's name.

## Microsoft Surface Pro 6



\$899.00

**Pros:** Speedy new 8th Generation Intel processor. Good battery life. Premium feel. Sleek all-black color option. Brilliant display. Well-implemented kickstand.

**Cons:** Minimal changes from previous model. As ever, keyboard sold separately. Not ideal for in-lap use.

Somewhat restrictive configuration combinations. Limited ports.

**Bottom Line:** With a modest speed boost and a new color choice, the Microsoft Surface Pro 6 hasn't changed much from the previous iteration, but what we loved about this 2-in-1 convertible then, we still love now.



# FEATURES

# THE BEST NOTE TAKING APPS

BY JILL DUFFY



**N**ote-taking apps are not created equal in concept or in abilities. While a solid note-taking app is a necessary piece of any suite of productivity apps, figuring out what to do with it in the first place is half the challenge.

Getting the right note-taking app is about finding one that clicks with you as well as the service's nitty-gritty details. In general, a reliable note-taking app lets you jot down all the things you want to remember quickly and easily, no matter where you are, and lets you refer to your notes anytime and anywhere.

The giants in the space, Editors' Choice Evernote and runner-up Microsoft OneNote, aim to do it all, offering rich features, support for multimedia notes, and tools that blur the lines between apps for personal use and those intended for work.

Evernote has caused a ruckus among its paying users for hiking the price and slashing the lower tiers of service. Many people are considering leaving Evernote, a sad state of affairs for an inimitable service. For those who use the full gamut of Evernote's features and functionality, there simply isn't a good Evernote alternative yet. OneNote is a close second, but transitioning to it from Evernote is tough. The two services have structural differences that make it difficult to map one set of notes to the other app.

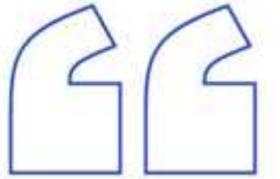


There are alternatives, of course, and hopefully, some of them will get better in time. Zoho Notebook is a fine example. It scored low in our testing because it's available on limited platforms (a Mac app and web clipper just became available), but the company formerly had a full range of apps for a very similar product by the same name that's been retired. With the rebirth of Zoho Notebook, we should soon see more apps and additional functionality in this rookie service.

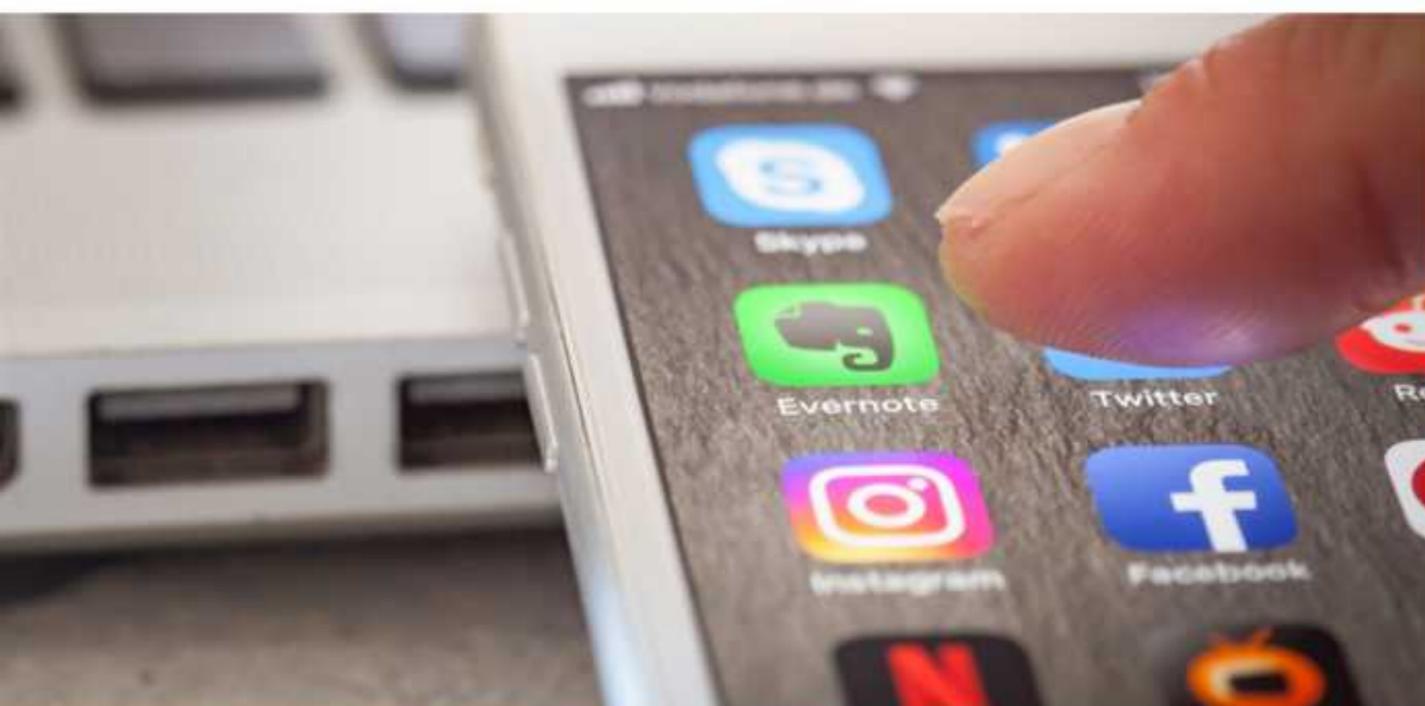
## PRICING AND PLANS

A huge part of the reason people got miffed at Evernote was its price hike. And users were right; it costs more than any other note-taking and syncing app. While Evernote does have a free version, non-paying members are limited to syncing their notes among only two devices and the web app. That's painfully restrictive.

Evernote accounts come in four tiers of service: Basic (free), Plus (\$34.99 per year or \$3.99 per month), Premium (\$69.99 per year or \$7.99 per month), and Evernote Business. The free tier lets you upload only 60MB of data each month, but the data you use is yours to keep. Technically, the total storage is unlimited, because you get more every month ad infinitum. Plus and Premium members can upload more and get a whole host of features that aren't included for free.



**Transitioning from Evernote to OneNote is tough. Structural differences can make it difficult to map one set of notes to the other app.**



Google Keep is free with no upsells or special plans. All it requires is a Google account. The amount of storage space you get in Keep depends on your Google Drive storage, which is 15GB by default. You can pay \$1.99 per month for 100GB of storage, which will be shared across all Google apps. There is an upload limit for images of 10MB and 25MP.

Microsoft OneNote handles storage similarly to Google Keep, using OneDrive for storage the same way Keep uses Google Drive. OneNote is also free with no special upgrades for extra features. The max file upload size is 100MB. Free users get 5GB of space, whereas Office 365 account holders get 1TB all told, shared among other Office Online apps. An Office 365 Personal account costs \$6.99 per month or \$69.99 per year.

Simplenote is a free service with no upgrades or in-app purchases. It has a variety of apps for all major platforms, and there is no limit on storage, so long as you don't abuse it, according to the company's terms. Simplenote doesn't support uploads, multimedia, or even formatting—just text. You'd have a hard time abusing limitless storage with plain text.

## **FEATURES WORTH HAVING**

A few features worth having in a note-taking app are optical character recognition (OCR), a good web clipper, and easy-to-use organizational tools.

OCR comes in handy when snapping pictures of text. Google Keep can actually transcribe image text into typed text that you can then copy and paste or edit at will. Evernote Premium can run OCR on all text in images, including handwriting, when you look for words in a search. Microsoft OneNote can also read OCR text from photos, and it has a useful Digital Ink feature that turns your own handwriting into typed text when you use a tablet. It's handy for writing equations that are otherwise difficult to type with a keyboard.

A web clipper is another great feature for your note-taking app. For example, I clip a lot of recipes that I find online into my note-taking apps. Evernote and OneNote have web clippers, and both give you options for saving the entire page or just core elements. Google Keep has a web clipper, but it saves only the URL and a title, not the actual contents.

The organizational tools within every app are different, but the important thing is to have an interface that makes sense to you and helps you find what you need. Evernote uses notes, notebooks, stacks of notebooks, and tags, whereas OneNote has pages, sections, and notebooks. Both Simplenote and Google Keep only use tags, so if you prefer to not think about where you're putting your notes, those tools might be better options.

## TAKE NOTES, SYNC, AND GO

While Evernote remains PCMag's Editors' Choice for note-taking and syncing apps, we did lower its rating to reflect its drop in value after the changes in its pricing and services. Hopefully, the uproar caused by Evernote will light a fire under competitors to improve their apps. There are a lot of promising apps, but most of them need more time to mature.

## FEATURED NOTE-TAKING APP REVIEWS



### Evernote



**EDITORS' CHOICE**

Free basic tier, numerous premium tiers

**Pros:** Effortless note-taking and syncing. Incredible search. Great features. Flexible.

**Cons:** Free level too restrictive. Premium plan too expensive.

**Bottom Line:** Evernote has long been one of the best productivity apps. Even though rising costs have lessened the value proposition, long-time users will have a hard time finding a compelling replacement.



### Microsoft OneNote (Web)



Free, \$34.99 per year, \$69.99 per year

**Pros:** Feature-rich. Reliable. Treats all note content as distinct page elements. Familiar interface for Office users. Office 365 users get 1TB of space.

**Cons:** Slow and clunky. Confusing structural design. Poor search in web app. Requires OneDrive for some management features. Can only share at the notebook level.

**Bottom Line:** OneNote is a feature-rich note-taking and syncing app, and it gives away a lot for free. But it's still second best to Evernote.



### Quip



Free, \$30 a month

**Pros:** Combines team messaging with collaborative document creation and editing tools. Quick to set up. Easy to use. Free version available. Supported by Zapier.

**Cons:** No team calendar or other apps to add. Interface could be more sophisticated. No rich markup tools. Lacks explicit limits on storage space for free accounts. Limited API.

**Bottom Line:** Quip is a team collaboration tool for both document editing and group communication. It's quick to set up and easy to use, but it may not scale for fast-growing businesses.



### Bear (for Mac)



Free, \$14.99 per year

**Pros:** Supports Markdown. Good export options. Can import notes from Evernote as well as other services. Inexpensive Pro account.

**Cons:** Extremely feature-light. For Mac and iOS users only. No option to selectively sync to iOS devices. Syncing requires paid plan.

**Bottom Line:** Bear is a lightweight among note-taking and syncing apps, although it could meet your needs if you only use macOS and iOS devices and only take simple notes.



### Simplenote (Web)



Free

**Pros:** Simple. Apps for a wide variety of devices. Unique sharing options. Reliable search. Supports Markdown on some devices. Free.

**Cons:** Lacks notebooks or folders for organizing. Only supports text notes. No formatting tools. No web clipper.

**Bottom Line:** For a basic note-taking and syncing experience, Simplenote is a reliable, if stripped-down, choice. If simplicity is what you're after, this free service is worth a try.



### Zoho Notebook (for Mac)



Free

**Pros:** Great implementation of locked notes feature. Can stack notes. Free.

**Cons:** No web or Windows apps. Can't upload documents.

Limited sorting and organization features.

**Bottom Line:** Zoho Notebook is a free Mac app that makes note-taking simple, but for it to be really useful, it needs a web version and better organizational features.



### Google Keep (Web)



Free with Google account

**Pros:** Fast. Customizable labels (tags). Transcribes image text to typed text. Works well with other Google apps.

Reminders are well integrated. Free.

**Cons:** No audio recording ability in the web app. No desktop apps. Can't mark up images, PDFs. Weak web clipper. Preview images not well displayed. OCR feature not automatic nor intuitive.

**Bottom Line:** Google Keep is a free note-taking and syncing app with a nifty OCR feature, but it lacks the features and mobile apps that are offered by the competition.

# 10 MUST-HAVE ELECTRONICS FOR YOUR SEMESTER ABROAD

BY JAKE LEARY



**S**tudying abroad is a rite of passage (and tremendous privilege). It's a chance to explore new places, meet new people, and experience new soul-rending, sleep-killing anxieties; but, if you're smart, you can nix some pre-and post-departure paranoia by packing the right gear.

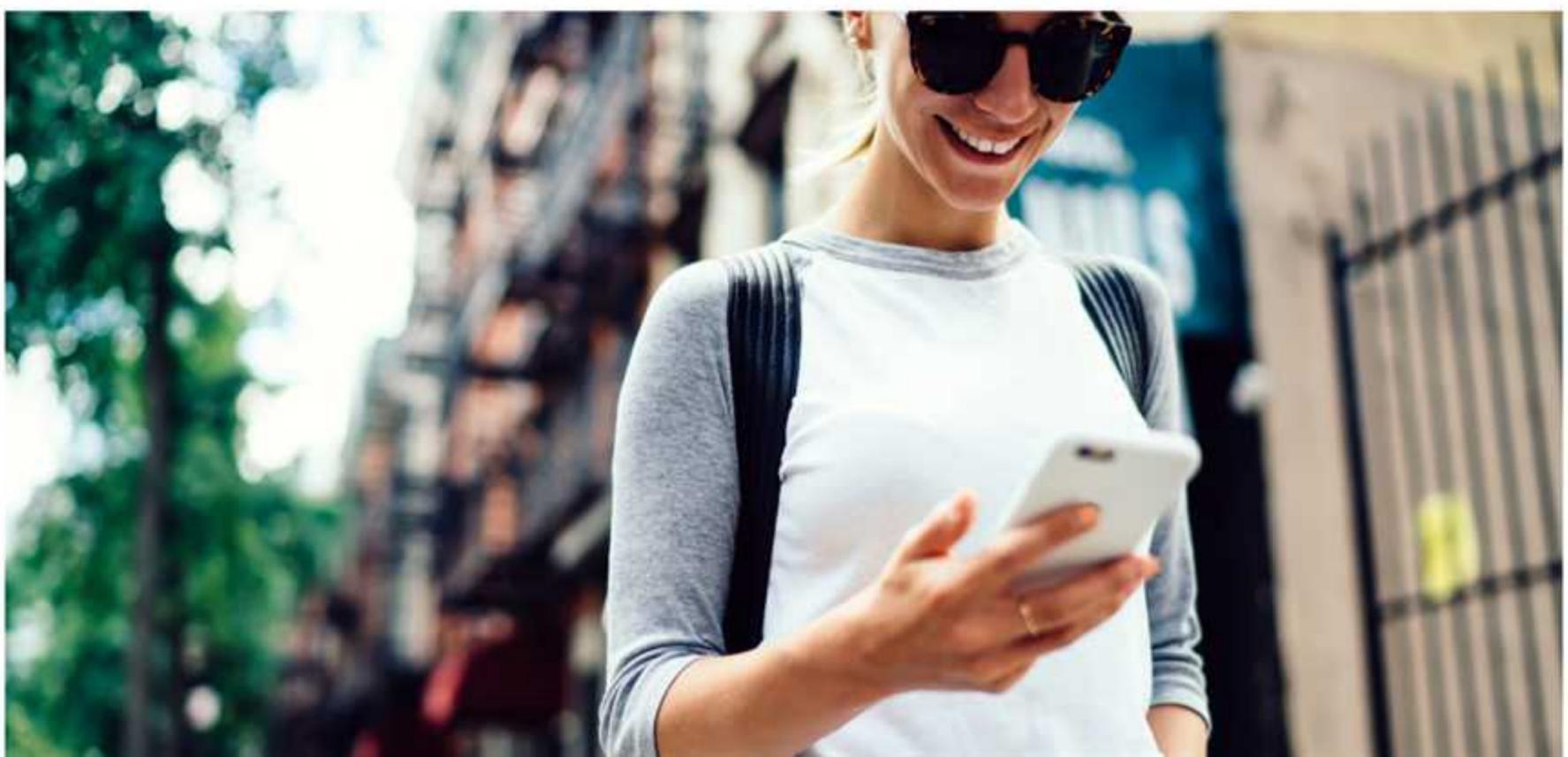
Some gadgets (say, smartphones and laptops) are obvious travel companions. But others, including portable batteries and mobile hotspots, may not seem essential until you're stranded in the Italian countryside with no Wi-Fi and waning battery life. You can't go overboard—you still need room for those knickknacks you promised Mom, making luggage space a valuable commodity. So let this list serve as a space-conscious checklist.

## **SMARTPHONE**

Of course you need a phone! You shouldn't cavort around an unfamiliar city without ready access to maps, music, and emergency numbers. (Granted, you probably shouldn't roam your hometown without those things either.) Whether you choose Apple or Android, there's no shortage of capable phones to help you stay in touch with your friends and family.

If you're willing to shell out the big bucks, pick up the Apple iPhone XS Max, PCMag's best phone of 2019; it packs a stellar camera, long-lasting battery, and whip-quick processor into a sleek shell. Plus, most of your friends probably have an iPhone, and iMessage makes it easy to catch up over Wi-Fi. If you prefer an Android device, the Google Pixel 3 is a compact, gorgeous choice.

While you've got phones on the brain, don't forget to swap your home-country SIM card for an appropriate one.



## **LIGHTWEIGHT LAPTOP WITH GOOD BATTERY LIFE**

You'll be more mobile while abroad. You may have to commute to classes, and you'll spend tons of time wandering your temporary home. But if you're schlepping a 5-pound gaming laptop, travel will seem more like a chore than a carefree adventure.

A lightweight computer such as the Dell XPS 13 (9380) or the Acer Swift 5 can save you a lot of pain, especially since you probably won't need a super-powerful device to get through your daily social-media scrolling or TV binging (and essay writing). Buying a cheap Chromebook and leaving your bulky Alienware stateside may also serve you well. Both the Asus Chromebook Flip (C302CA-DHM4) and the Acer Chromebook 514 are lightweight with 10-plus-hour batteries.

Don't worry about CPU power. There's plenty of time to play Doom Eternal when you get home; for now, go out and see the world.

For more details and recommendations, read "The Best Laptops for College Students" in this issue.

## **HIGH-QUALITY CAMERA**

Yes, the Pixel 3 has a damn good camera, but your smartphone can't compete with the real deal. Imagine all the incredible tableaus waiting for you abroad; don't you want to remember them in perfect detail?

But a bulky DSLR might not be an economical choice (spatially or financially). Instead, consider a bridge camera, a device for prosumers and professionals who want an near-SLR quality without the size. The Panasonic Lumix DMC-FZ1000 fits snugly in that category; for under \$600 you can take advantage of the Lumix's 25x zoom and 1-inch sensor.

## **MOBILE HOTSPOT**

The pay-per-day Roaming Man U2 Global 4G Wi-Fi Hotspot can alleviate some of your data woes; its fast, reliable network and long battery life can help you circumvent dicey public WI-Fi and keep you connected in data-less zones so you can check Google Maps, refresh your emails, or download the daily Crossword Puzzle. Just be careful; the Roaming Man's price adds up over time, potentially costing you as much as \$200 a month.

## **PORTABLE CHARGER**

You never know where you'll end up. The allure of a new restaurant or previously unexplored museum may be too strong to ignore, and hey, when in Rome, right? But all-day exploration will exhaust you and your devices, too. There's nothing worse than getting lost in a foreign country with a dead phone in your pocket and no one to ask for help.

For \$35, the Anker PowerCore 10000 keeps your phone juiced through every unexpected diversion; it's small and supports Qualcomm's Quick Charge 3.0 so you can refuel your device in no time. It's PCMag's Editors' Choice for mobile batteries; but if you're looking for something with more oomph, check out the Anker \$130 PowerCore+ 26800PD, which can charge your laptop, tablet, or phone in a flash.

## **PORTABLE HARD DRIVE**

Abroad, everything becomes an adventure and a mystery. There's so much to see, so much to document, so much that could go wrong—such as losing your passport or ID. Though cloud storage (via Google Drive or Microsoft One Drive) should be sufficient for school work and photo storage, you'll want important backups of visa documents, passport photos, and other assorted goodies kept safe and accessible. For portability and durability, we recommend the \$90 2TB Seagate Backup Plus Ultra Touch.



## **NOISE-CANCELING HEADPHONES**

There will come a time when you'll want the world to shut up so you can be homesick in peace. Unfortunately, that's not possible, but you can shut out some of the noise with a pair of noise-canceling headphones such as the Bose QuietComfort 25, a PCMag Editors' Choice that will silence everything from honking cars to snoring roommates.

## **UNIVERSAL ADAPTER**

In America, every outlet has that Munchian, three-hole shape; not so across the pond! Some countries have different socket shapes and energy outputs that can fry your precious tech. Snag a universal adapter to circumvent this issue. The Joomfeen Worldwide All in One Universal Power Converter is a cheap, effective option. It includes surge protection and has two USB ports.

## **DIGITAL LUGGAGE SCALE**

You'll thank me for this one later. A digital luggage scale lets you weigh your bags before you get to the airport (do you really want to be the person holding up the line while you fish five miniature Parthenons out of your suitcase to avoid bag fees?). Luggage scales are portable and can save you tons of money and frustration, but be careful—they're fragile and may go on the fritz if they're hit too hard.

## **EREADER**

Whether you're a book-a-week fiend or dread the sound of two pages rubbing together, you'll probably want an eReader. Space is at a premium, and you'll still need books for classes, so why pack "Intro to Italian Culture" and the entire "Dune" series when you can bring a single, pocket-sized Kindle Paperwhite (2018); it's the best reading experience you can get for the price and unlike the slightly cheaper Kindle (2019), the Paperwhite has a higher-resolution screen and can survive up to an hour in fresh water. Plus, you'll be traveling quite a bit, even if it's just to and from classes, and nothing makes public transport tolerable like a good book (and loads of hand sanitizer). Amazon's eReaders can take a beating and the Paperwhite frequently dips below \$100 during sales.

## 40 ONLINE RESOURCES ALL WOMEN IN TECH CAREERS SHOULD KNOW ABOUT

BY ESTHER SCHINDLER



**W**omen who aim to get ahead in the tech industry—or simply to survive corporate life, for that matter—often feel alone, lacking work friends or other tech women to call upon in times of need. This feeling is confirmed by research: the “2017 Women in Technology Study,” conducted by the Information Systems Audit and Control Association (ISACA), concluded that 48 percent of women in tech reported a marked lack of mentors and advisors.

That’s almost half of the women in tech jobs, who all feel isolated. However, I’m here to reassure you that you aren’t alone. There are plenty of ways for women in tech professions to connect with one another, whether for moral support or career networking. Whether you’re looking for venture capital (VC) funding, in-person meetups, or just an understanding ear, one of the following 40 resources is bound to put a smile on your face.

While this is a fairly long list, it’s far from complete. Not only have I undoubtedly missed a number of existing resources, but new ones spring up all the time. One commonality among all of these organizations and communities is a desire to encourage more women to get into STEM fields. That’s a great goal, but not the focus of this article. The resources here foster interaction and encourage support among women in tech jobs.



## CONVERSATION AND COMMUNITY

I'll start where I began. I've been a woman in tech for a long time. My first significant experience with tech women's online communities was Systers, a private email list begun by Anita Borg in 1987. I've been a member of Systers since the mid-1990s and it's still going strong. Systers is always my first recommendation for techie women because it's a safe space to ask for advice no matter where you are in your career path. To join, you must be a woman involved in technical computing. Messages posted must be relevant to those subjects (no cat photos here), and moderation is firm yet friendly. Systers' success led AnitaB.org to generate other support systems for women in IT, such as the annual Grace Hopper Celebration of Women in Computing (the conference is held in both the United States and India; Ms. Hopper pictured below) and The Anita Borg Systers Pass It On Awards.



Systers isn't the only email list. But as with other email groups, many have disbanded as participants move to other social media. For example, Wise-Women is a friendly community for women web developers and Debian women continues to have conversations about topics such as "Gender diversity and inclusiveness in free software" and "Who wants to get together for lunch at the conference?" The same applies to PyLadies (for Python enthusiasts).

Many online forums and email lists were replaced by other online communities. One small-but-useful favorite is Elpha, which is basically “Hacker News without testosterone poisoning.” I haven’t found an ideal home on Reddit yet, but three places that warmly welcome tech women with happy, lively conversations are Ladies of Science, Girls Gone Wired, and Feminisms. I’m always in search of more.

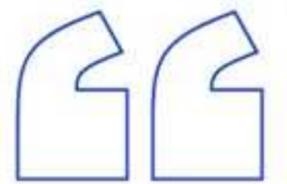
In other cases, women have built private or public “tree houses” for themselves in larger communities. For instance, the Rands Leadership Slack group has a “women in leadership” channel. And some online community are for women only, such as the Women in Technology Slack group.

If you’re a fan of more mainstream social media communities, then check out the Women in Tech (WIT) organization, which has groups on both Facebook and LinkedIn. Another large group is Women Who Reign on Facebook. There are many smaller groups, too.

## **ORGANIZATIONS**

As I mentioned, plenty of nonprofit organizations cater to tech women. The organizations may be general, such as the services offered by the aforementioned AnitaB.org. In addition to the Grace Hopper conference, AnitaB.org also helps women (especially students) find jobs at job fairs and offers speakers at local events. As you can probably tell, I’m most familiar with its services. However, many more organizations serve the interests unique to different communities. I may not have personal experience with them, but they certainly are worth exploring.

Lesbians Who Tech seeks to increase the number of LGBTQ+ in tech. They’re primarily known for inclusive conferences, with 42 chapters worldwide in major tech hubs. The organization also has a coding scholarship.



**If you’re a fan of mainstream social media communities, check out Women in Tech (WIT) on Facebook and LinkedIn.**



Girls in Tech is a global nonprofit and community for women in tech and entrepreneurship. They host events, conferences, and workshops, such as coding boot camps, mentorship programs, and “fireside chats” with entrepreneurial women. Related organizations, with varying services, include Black Girls Code, Brown Girls in Tech, Latinas in Tech, CyberTech Girls, and STEM Advantage. Practically speaking, your best choices are likely driven by geographical compatibility (in other words, ones with a chapter near you) or by age range. For instance, CyberTech Girls is for girls in grades 7 through 12.

Not every community is based on what you are; some are based on what you do. For example, Women in CyberSecurity is a professional organization dedicated to increasing the number of women in the tech field. It provides support, mentorship, training, networking opportunities, and access to industry and academic leaders. The organization also offers a forum and an annual conference hosted at a university.

Speaking of conferences, you should always look for the “Women’s track” at any conference that you attend, or take initiative by starting your own brown-bag lunch session. For example, the Wicked Hackathon during Black Hat in Las Vegas will raise funds for the Women’s Society of Cyberjutsu, which hosts webinars and workshops nationwide.



Many of these organizations aim to encourage young women to enter the tech field or get started on their careers. But plenty more promise guidance to those who are already invested. Those resources may be specific or they may be overarching. For instance, if your interest is mainly in finding a career mentor or paying it forward by providing mentoring, then the Tech Women program connects professionals with women worldwide.

Women Who Code exemplifies organizations with a more general focus. The woman who recommended it to me was passionate about its benefits, such as shared stories of women working in technical roles as well as conference and boot camp scholarships. Similar organizations worth exploring include Women Techmakers and Women in Technology International. There are over 20 of these organizations on IBM's Women in Technology (WIT) list. Each organization has its own social vibe as well as unique services, such as workshops in soft skills like public speaking. If one doesn't work for you, don't give up; try another.

## **NEWSLETTERS AND OTHER INFORMATION SOURCES**

Sometimes we don't want to talk, virtually or otherwise. We just want information. In the context of women in IT, that means sensible curation of "news I can use."

I subscribe to a scary number of newsletters. But my favorite for the topic at hand is Femstreet, which describes itself as "Your Weekly Newsletter on Women in Tech, Entrepreneurship, and Diversity in Venture Capital." Each newsletter includes investment-related events, current stories about women in business (for example, a VC's article on the current VC landscape for women business leaders), and general business guidance. I click on at least one item every week, which is high praise for any newsletter I receive.

Other highly recommended newsletters (though I haven't relied on them long) are Women2 and Veni Kunche's Diversify Tech. Both promise event lists, job postings, scholarship opportunities, and much more.

Finally, I'm not a podcast person, but if you are, then Battle Tactics for Your Sexist Workplace is highly regarded. Jeannie Yandel, Eula Scott Bynoe, and "some badass expert" promise to bring you real tactics to survive the workplace or change it.



## **BUSINESS AND CAREER RESOURCES**

Often, we care about human networking only when it's time to find a better job. If that's the real reason you're reading this article, then sign up (for free) with Tech Ladies. This is a robust and worldwide community with 50,000 members. It provides a job board, a sometimes-useful newsletter (it's at least worth scanning), and networking events all over the US and Canada.

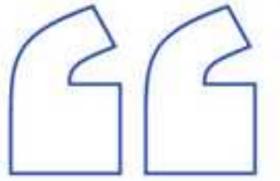
Fairygodboss describes itself as “a community of women sharing advice and asking questions,” but it appears that many of those conversations are about work. Beyond active job listings, it also includes salary comparisons and maternity benefits.

MotherCoders' mission is to help women with kids dive into careers in tech “so they can thrive in a digital economy.” It's a bit more about up-leveling your skill sets to get back into the workforce.

Other groups in the same realm include the aforementioned Diversify Tech, which offers job listings and scholarship/speaking opportunities; inclusion (yes, that's spelled correctly), which connects professionals and women of color to companies looking for freelancers. There is also theBoardlist, which connects exceptional and experienced women in senior positions with opportunities to serve on company boards.

Another option for ambitious women is more and better speaking opportunities. To make yourself a little more searchable for keynoting conferences, consider adding yourself to Women Who Keynote. The website's goal is to contribute to the elimination of all-male panels and to help improve the visibility of women in male-dominated industries.

As you explore these resources, you will no doubt notice that many of the nonprofit organizations have scholarships and other funding opportunities for women. One perennial example is the The Anita Borg Systems Pass It On Awards; it offers grants of up to \$1,000 for women working on projects that inspire and support girls and women to enter computing. One recent award supported a project that provides Tech-in-a-Box kits to rural schools. Another award helps users create personalized STEM-inspirational storybooks for their children. (For transparency: I've been among the volunteer reviewers since 2010, and am the incoming chairperson for The Anita Borg Systems Pass It On Awards.) But that's far from the only option for funding.



**To make yourself more searchable for keynoting conferences, consider adding yourself to Women Who Keynote.**



# 7 Simple Steps for Cleaning Up Your Google Drive

BY JILL DUFFY



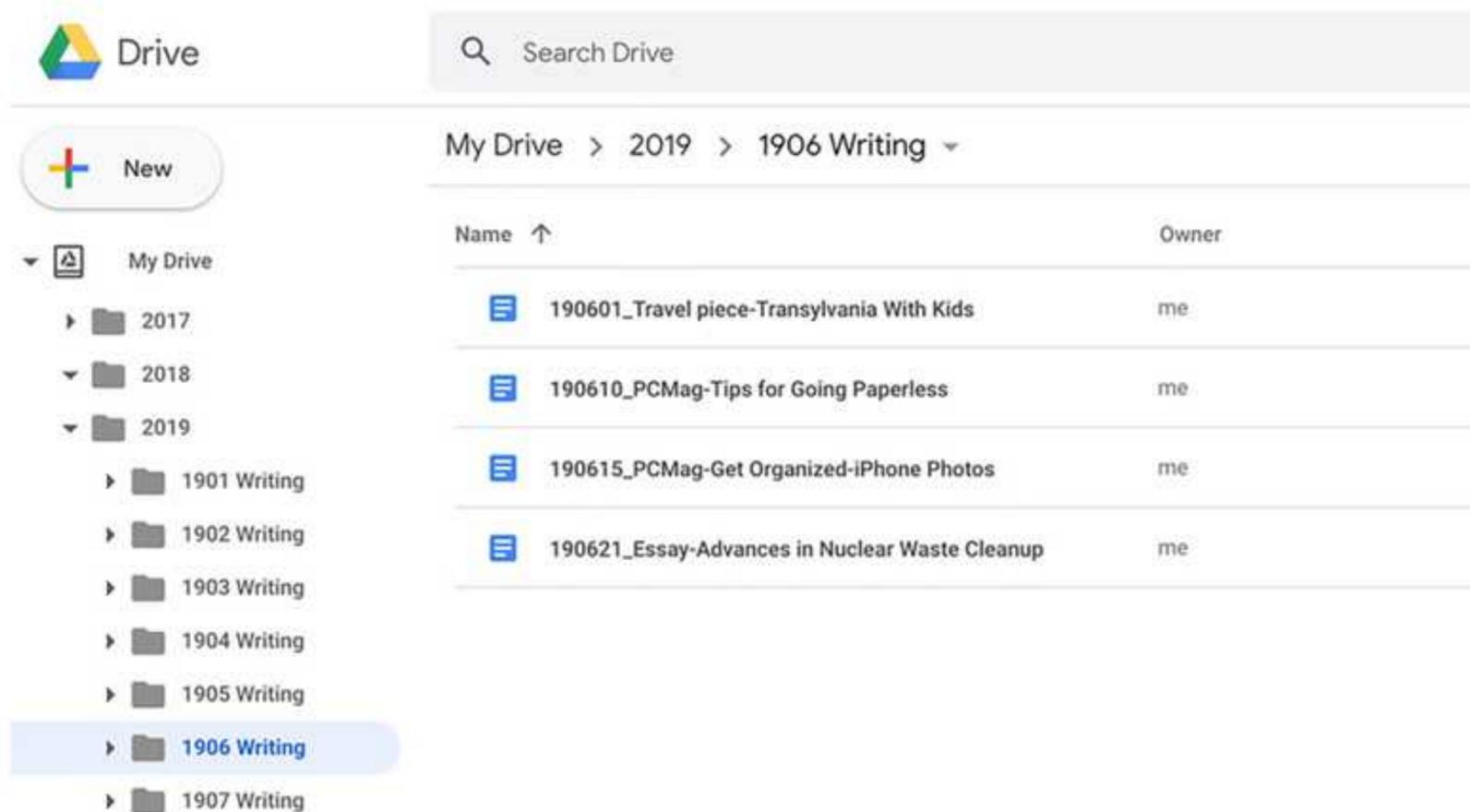
**J**ust like any place you keep stuff, Google Drive can get messy. You make a file or two, import a couple of documents from Gmail, accept a shared folder, and before you know it, the whole place is a disaster.

You can organize Google Drive files by putting them into folders and using other tools, both conceptual and actual, to ensure you can always find what you need. These tips will show you how to organize files in Google Drive for work or personal convenience.

## 1. SET YOUR DEFAULT VIEW

You can view files and folders in Google Drive in numerous ways. For instance, you can display everything in a list or grid view, as well as set the line spacing to comfortable, cozy, or compact. Decide how you like to look at your Google Drive by fiddling with the settings until you're happy. I like list view with comfortable spacing, so that's what you'll see in most of the screenshots here.

Don't overlook the left side rail. A lot of people focus on the center of the screen when they look at Google Drive. You can see your folders and subfolders easily and reserve the center of the screen for the contents of whatever folder you choose to view.



## 2. CREATE A SKELETON OF FOLDERS

Create a skeleton of folders for yourself using whatever structure and names work best for you. How do you organize your files and folders in other apps? What comes to mind when you think about a document you need? The best way to figure out how to set up your folders is to answer those two questions.



**You can organize Google Drive files by putting them into folders, both conceptual and actual, to find what you need.**



For many people, what comes to mind first is the content of their work, so they use thematic names such as Project X or School Work for folders. Personally, I cling to dates. When I need to find a file, be it a piece of writing or a picture, I always think about when I created it. As a result, I use dates heavily in my folder and file naming conventions. For example, I have folders for 2019, 2018, 2017, and so forth. I also use numbers that correspond to years and months. For example, 1906 means the year 2019 and the sixth month. Then when I look at a folder that begins with numbers, I know exactly what they mean, and it helps me find the files I need quickly.

I've seen some people online recommend adding an emoji to your folder names to give you more visual cues. Don't! Emoji don't always convert to other formats, so when you try to create a shared link to a folder or export it, the images can break it.

### **3. CREATE SUBFOLDERS**

Subfolders are an organizational windfall. Make them and use them! They help you sort and classify your files into smaller and more specific groups.

If you've created folders but are stuck trying to figure out which subfolders to make, then perhaps you don't need them yet. You might also make a folder called DONE or OLD so that when work is completed or a folder is out of use, you can drag and drop it in there.

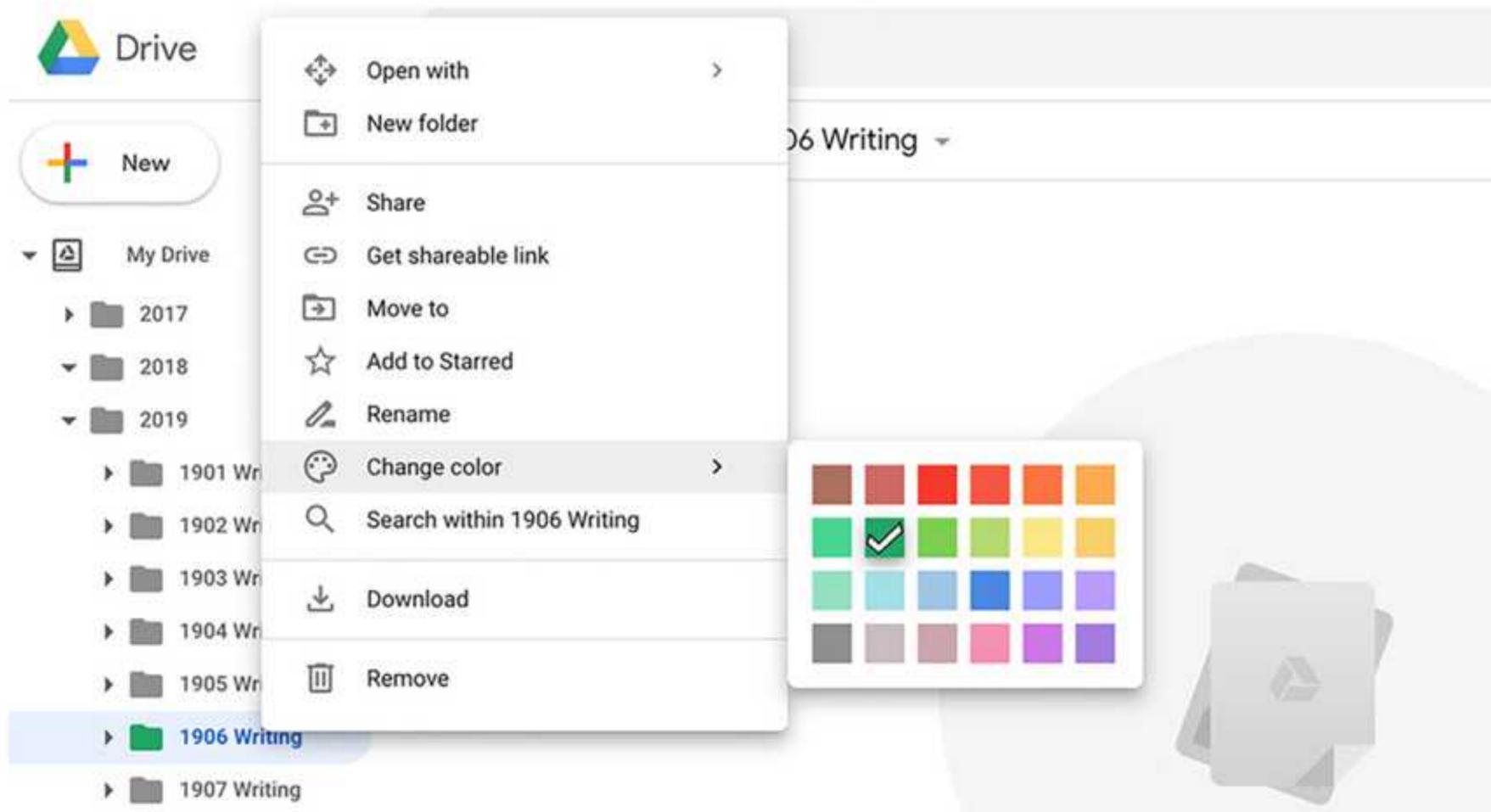
### **4. USE COLOR**

Colors are a great visual cue, and Google Drive lets you add custom colors to your folders. Right-click on any folder, either from the sidebar or main window, and choose Change Color. Then select the color you want.



**If you've created folders but are stuck trying to figure out which subfolders to make, perhaps you don't need them yet.**





A trick I use is to make my active folders green. Sometimes I have folders or subfolders that sit idle for a while, but one or two folders among them are still in use. I highlight the active folders in green and leave the others gray. That way, when I want to jump right into my work, I have a green light guiding me toward relevant folders.

## **5. ADD STARS TO FREQUENTLY USED FILES AND FOLDERS**

Google Drive lets you add a star to files and folders. You do it the same way you add a color: Right-click on the file or folder and choose Add to Starred.

I recommend adding a star to frequently used files. That way, you can pull a list of all the materials you access regularly, no matter where they are in Drive, by clicking on the Starred heading in the left rail.

## **6. MOVE IMPORTANT “SHARED WITH ME” FILES**

Take a look at the header in the left rail called Shared With Me. Click it, and a mess of files and folders may appear. Don't worry too much about them. If there's anything important in that batch of stuff, there are three useful things you can do with them:

Add a star. Adding a star to a file that's been shared with you does the same thing as adding a star to one of your own files: It makes it appear in the list of Starred content.

Save to Drive/move to a folder. Another option is to add the file to your Google Drive and put it in a folder. You can right-click on the file and select Move To. Then, in the window that appears, navigate to the folder where you want to keep this file. Alternately, select the item you want to save and then click the Google Drive icon in the top right portion of the screen. You then have an opportunity to move it to the folder of your choice. Either way, you effectively create a shortcut to the shared file from the new location you choose. The file is still shared with everyone and still belongs to the original owner.

Make a copy. If you make a copy of a file that was shared with you, the new copy becomes yours. And it's just that, a copy. It's no longer connected to the shared file, and the same people don't necessarily have permission to access it anymore.

## 7. DUMP THE TRASH

When you remove a file or folder from Google Drive, it goes into the trash, and it stays there until you take out the trash. The longer you let trash build up, the less likely you are to have total faith that everything in it should be utterly destroyed, and then you'll hang onto your trash even longer. Do yourself a favor and empty the trash from time to time. It will help keep your Google Drive storage space at an accurate level, and more importantly, it will help your sanity as you try to keep an organized account.



**The longer trash builds up, the less likely you are to have total faith that everything should be utterly destroyed.**



# How to Spot a Fake Review on Amazon

BY JASON COHEN



**A**s wonderful as the internet can be, it also lies to us every day. Fake reviews—seemingly legitimate reviews created by the seller or a paid lackey—are becoming harder to spot. We now make more and more of our purchases online, so if you're not careful, fake reviews can end up costing you serious money.

The good news is that there are solutions. Though Amazon and other e-commerce sites have been hesitant to wade into these reviews, others have rushed in to do the work for them. Just as we have tools to spot fake news, we also have ways to identify phony reviews.

## HOW TO SPOT A FAKE REVIEW

It's important to differentiate a bogus review from the real thing. Be on the lookout for overly positive or overly negative reviews that don't offer enough detail. Be wary of very brief five-star and one-star reviews. If a bunch of these similar-looking reviews are posted around the same time, they're likely unreliable.

Amazon added a Verified Purchase label that accompanies legitimate reviews to combat fake ones. This Amazon-confirmed tag guarantees the reviewer actually purchased the item they are reviewing.

## HOW TO REPORT A FAKE REVIEW

If you happen across a suspicious review, you can report it to the e-commerce website and mark it for investigation and possible removal.

Amazon, Best Buy, and Walmart make it easy by asking you to click the report/flag button next to the review. However, this simple system doesn't allow for depth or context in reporting a suspicious poster.

Steam, on the other hand, allows you to write a message. Just click on the review's Recommended/Not Recommended banner to view the full review. Click the flag icon and enter your message.

Other websites require you to log into an account before you can do anything about a review. You must sign into Yelp before a report option is even made available, while TripAdvisor lets you start a report, but you must sign in with your email, Facebook, or Google account to see it through.



**Be wary of very brief five-star and one-star reviews. If a bunch are posted at the same time, they're likely unreliable.**



Helpful

Comment

Report abuse

Facebook Marketplace and eBay allow you to report sellers, but there are currently no ways to flag a review as fake. Other websites don't provide clear ways to report abuses of any kind.

## FAKESPOT

The online tool Fakespot rates how reliable product pages are on Amazon, Best Buy, Google, Sephora, Steam, TripAdvisor, Walmart, and Yelp. Fakespot's algorithm looks at both review and reviewer, analyzing language, previous reviews, and purchase history to determine trustworthiness.

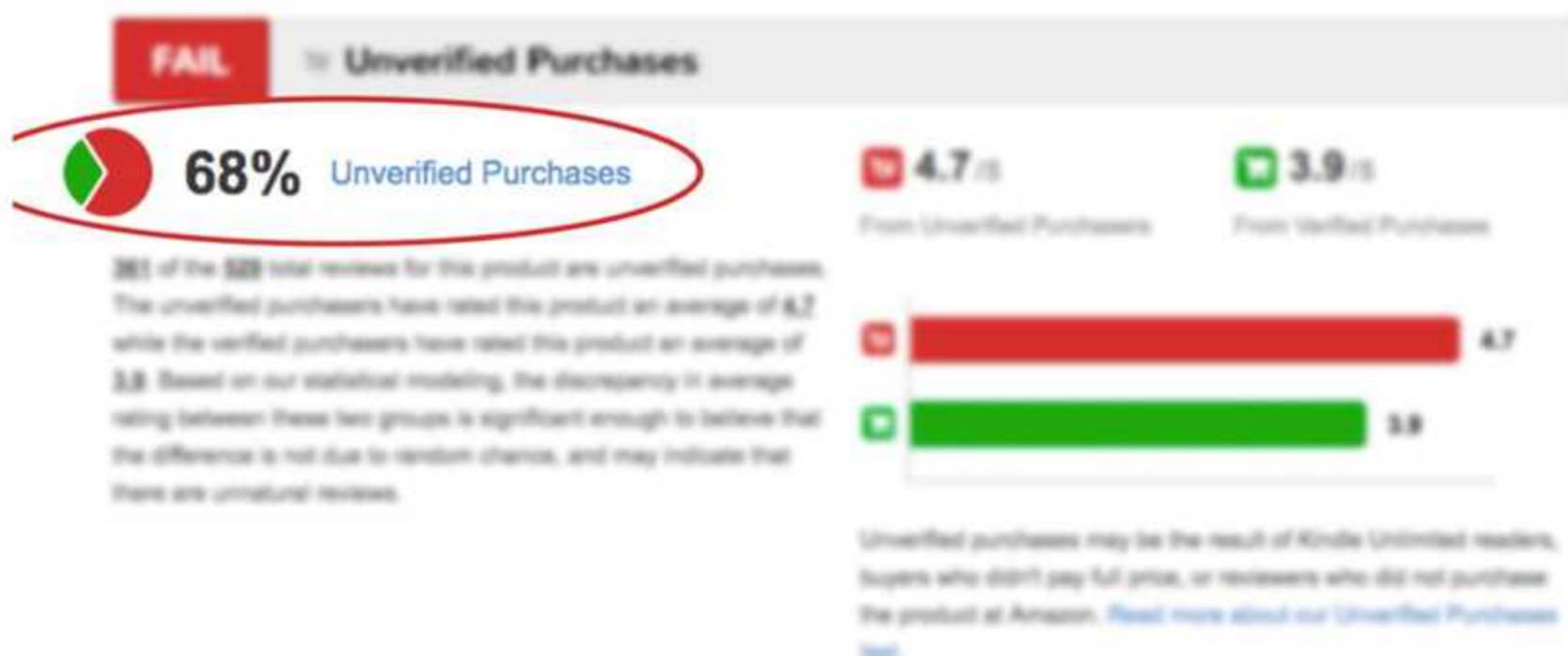
Just copy and paste the page's URL it onto the Fakespot website, and it will investigate the link. Once it's done, Fakespot spits out a grade that should tell you whether the page has reliable information.

It also filters out reviews considered fake in order to create a more reliable product rating. This grade won't tell you if the product in question is actually good or bad, but it will allow you to make a more informed decision.

Extensions for Chrome, Firefox, and Safari allow online shoppers to analyze a webpage with the push of a button. Fakespot is also available as an app for iOS and Android, where pages can be shared through a web browser to the app for quick analysis.

## REVIEWMETA

Another tool, called ReviewMeta, works pretty much the same way as FakeSpot, but it exclusively works on Amazon pages. Like with Fakespot, you copy and paste the URL in question, but in this case, ReviewMeta does not hand out a grade for the webpage. Instead, it eliminates the reviews it deems unreliable and replaces Amazon's aggregate rating with one from ReviewMeta.



This tool offers the unique ability to tweak ReviewMeta's algorithm. After the website analyzes a page, you can go into the grading mechanics and adjust how categories are weighted. The site also provides detailed breakdowns—complete with graphs—to explicate the adjusted rating.

Add the browser extension for Chrome, Firefox, Safari, or Edge to quickly analyze a webpage and receive a Warn/Pass/Fail grade depending on the results. An iOS and Android app also exists to help analyze pages from your phone.

### THE REVIEW INDEX

The Review Index is an online tool focused on aggregating tech product ratings on Amazon and Steam and can still determine if a product's score has been boosted by fake reviews. There are Chrome and Firefox extensions that make the process easier.

Paste the URL into the site and The Review Index breaks the product out into different categories based directly on the words it parsed from reviews. At the same time, The Review Index runs a spam test to ensure that the reviews are authentic, providing a Pass/Fail grade at the end.

### REVIEW SKEPTIC

Created by researchers at Cornell University, Review Skeptic works a little differently: It uses machine learning to identify fake hotel reviews. This is a simple online tool that gives you a quick true or false indicator when you pop a URL into the website. Review Skeptic claims it has achieved 90 percent accuracy.

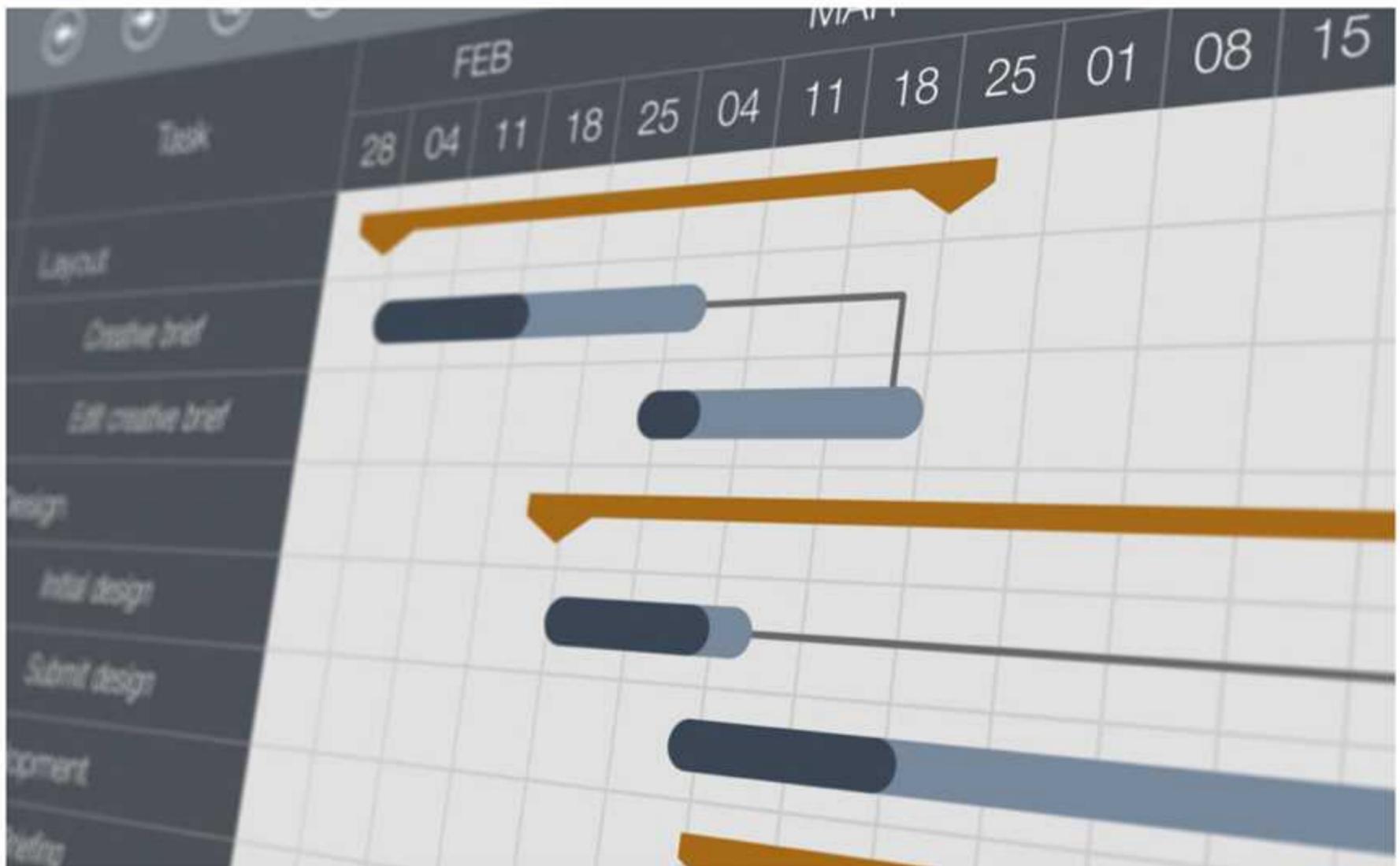


**Review Skeptic is a simple online tool that gives you a true or false indicator when you pop a URL into the site.**



# Getting Started With Project Management

BY JILL DUFFY



**P**roject management is a tough job. Teams and organizations are trying to work leaner, and often that means eliminating a dedicated project manager. While it's still possible to earn an advanced degree in the subject, it's not uncommon for people with little-to-no experience to find themselves thrust into the role, often on top of their official job. While this can be an overwhelming experience, there's so much powerful software for project management on the market that a small project or two may not require a project manager at all.

If you don't have much experience managing projects, here are some pointers to get you started. Many thanks to Peter Clarkson, formerly of Maestro Development, and Jason Westland, CEO of ProjectManager.com, for their insight on an earlier version of this article.



Below are some questions to explore while you're in discovery.

- What will the project be? How specific can you get in defining it?
- What is its purpose?
- What outcomes do you want?
- What resources do you have to take on this project?
- When do you need the final product, and is your deadline reasonable given your resources?

### **3. Define the Scope**

You might hear an experienced project manager say, “If it’s not in the scope, it’s not in the project.”

Every project needs a locked-down list of all the facets, assets, features, deliverables, and other details associated with the project. Once it’s locked down, you cannot add to it. For example, if you’re building a house, the scope will define how many stories the house will contain, its square footage, how many windows there will be, how many stairs, light switches, and so forth.

Projects need a clear scope before you begin so no one tries to add anything that’s outside the scope once you’ve started. Adding to a project’s scope after it has started throws off its timeline, budget, and available resources. If you keep adding tasks to a project, it might cease to become a project—it might just become ongoing work.

Defining the scope can happen in a discovery meeting, or it might come from conversations between the client and potential lead or manager of the project.

### **4. Hold a Kickoff Meeting**

Every team member will be introduced to the project during a kickoff meeting. This meeting sets the tone for the work ahead and makes sure everyone on the team has clear information about what they’ll be doing and why.

Note that holding a kickoff meeting isn’t even close to the first thing you do when managing a project. Because the kickoff helps get everyone on the same page, you want to be sure you have a clear grasp of the project and scope so that you deliver it to everyone else with confidence.

During a kickoff meeting, the project lead should define these four things: project scope, players and their roles, deliverables, and milestones.

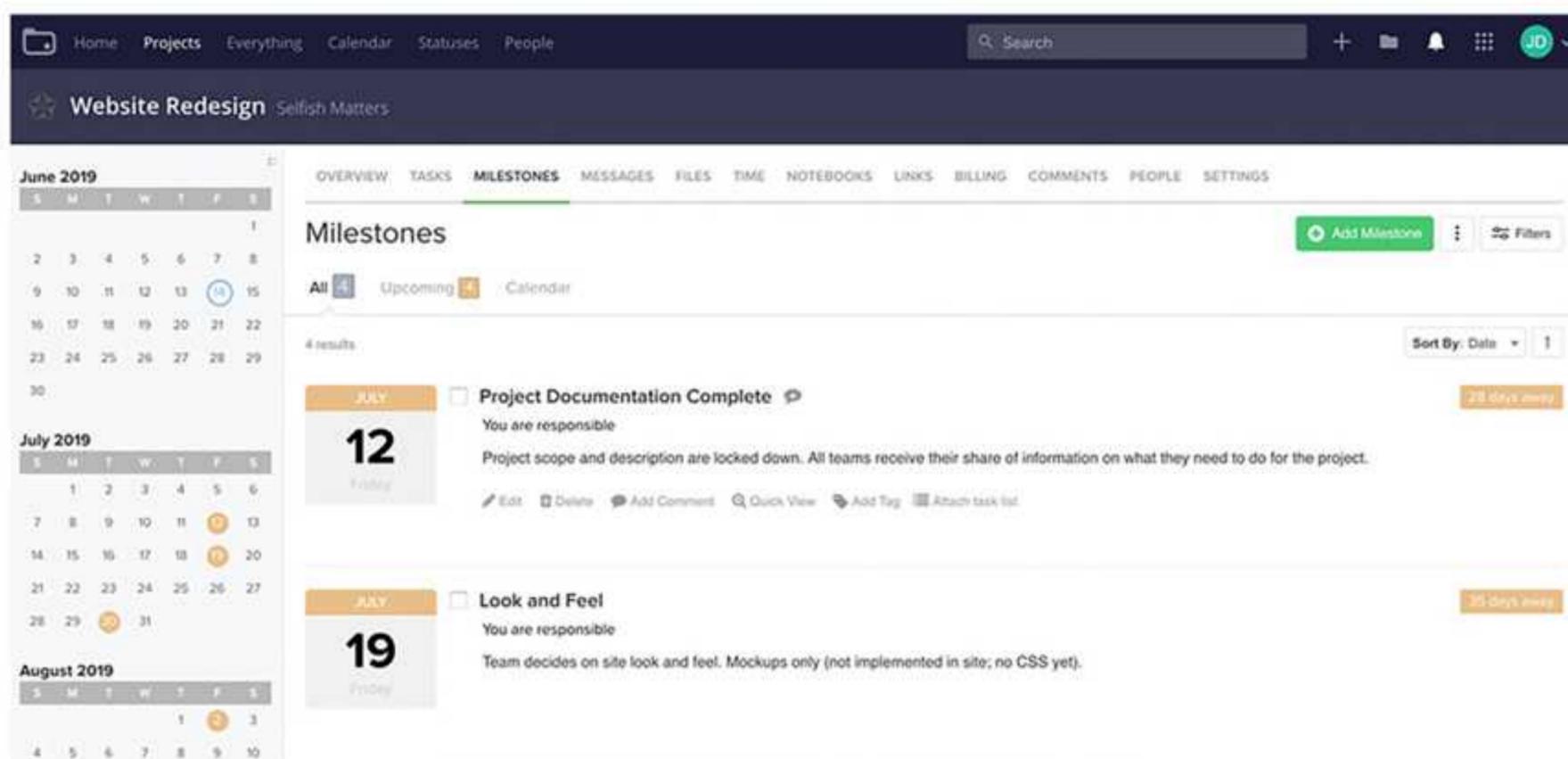
We've already talked about project scope. For players and their roles, the project lead introduces teams and contributors to one another. Additionally, the kickoff meeting is an ideal time to discuss hierarchy, that is, who reports to whom and who signs off on work.

A discussion of the deliverables will overlap with the discussion of hierarchy because you must determine who will receive each deliverable.

Milestones are points in a project that show clear progress toward the final goal. When building a house, completing the foundation poured and set might be a milestone. When you have the frame in place, that's another milestone. At the time of a kickoff meeting, you should know what the project milestones will be even if you don't have dates locked down. Sometimes you need other team experts, such as the programming lead or the design lead, to help figure out when those milestones should fall. It's good to go into a kickoff meeting with a rough idea of your deadlines, but give each team lead a chance to weigh in and make adjustments to them.



**During a kickoff meeting, the project lead should define 4 things: scope, players and their roles, deliverables, and milestones.**

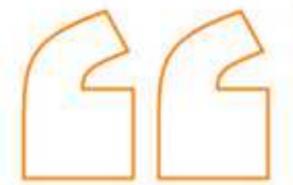


## 5. Map Out Your Project's Deadlines

Earlier, we talked about how every project has a start date and end date. The kickoff can be your official start date. The end date should mark the absolute conclusion of all the work. No work on the project happens after that date. It's a hands-off, pencils-down moment.

Now that you've had a kickoff meeting, all the key players (such as the project manager and team leads) can figure out the exact milestones and delivery dates and plot them onto a calendar between the start date and end date.

If you're using project management software, this is when you'll start using it. Put all your important dates and documents into the app. Now is also the right time to invite the team to join the software. Once people join the app, they can receive assignments, update their progress, and collaborate in other ways.

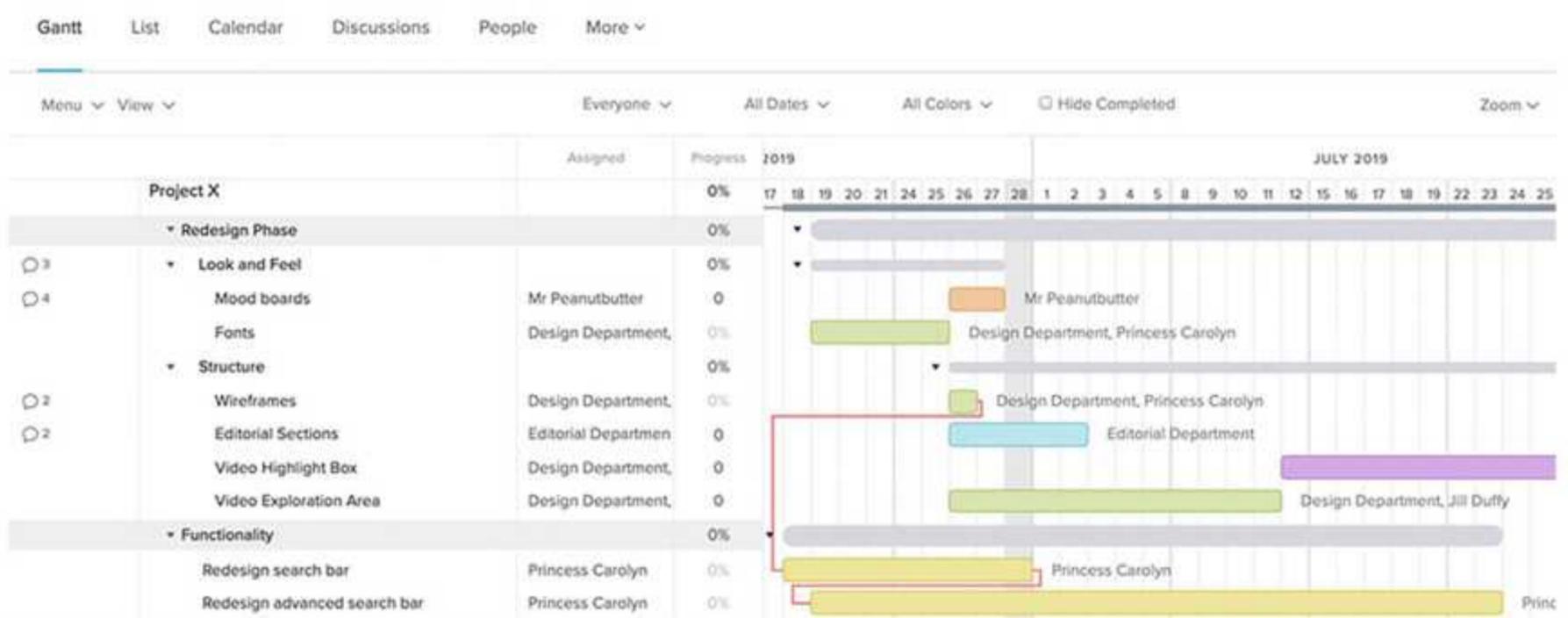


**No work on the project happens after the deadline date. It's a hands-off, pencils-down moment.**



## 6. Set Expectations for Communication

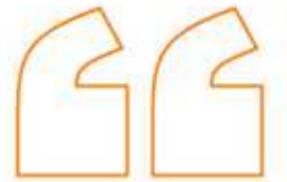
Both after the kickoff meeting and throughout the project, it's important to keep lines of communication open. Whether your group has a full-time project manager or not, the main point of contact for the project needs to encourage and facilitate communication. It's not a bad idea to hold another all-hands meeting before the project full ramps up so that people can ask any remaining questions.



Set expectations for communication early. Will team leads submit a weekly update on their team's progress? How many all-hands meetings will you have during the course of the project—sometimes they're not necessary at all; what does your project need? Often, smaller teams within a project, such as the design team or the programming team, have recurring check-in meetings where everyone recaps what they've done recently and raises any potential problems. The earlier people voice potential problems, the better everyone's chances are of thwarting them.

### **MOVING FORWARD**

Armed with these tips for getting started, you can dig into the meat of the project. Project management software goes a long way to helping keep everyone involved in the project up to date on its progress. However, it also takes a good amount of human interaction, and as much clarity about the project and all of its details as possible.

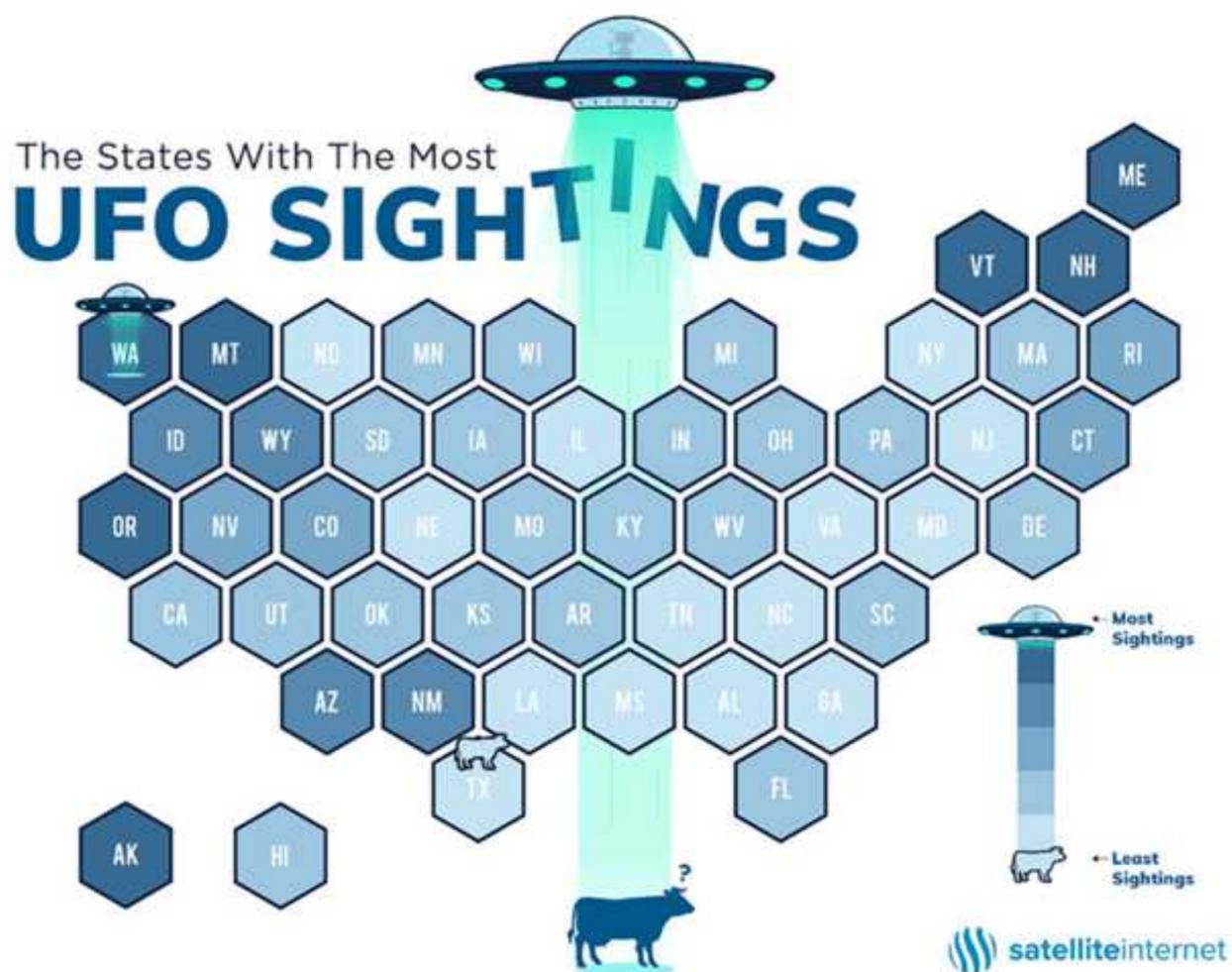


**The earlier people voice potential problems, the better the chances are of thwarting them.**



# Washington Tops List of States With Most UFO Sightings Per Capita

BY ANGELA MOSCARITOLO



If you're searching for signs of alien life, head to Washington state. According to a new analysis by SatelliteInternet.com, Washington is the state with the most UFO sightings per capita: For every 100,000 people in Washington, some 78 have reported seeing a UFO. That works out to 5,894 UFO sightings in the state.

Montana comes in at number two for UFO sightings, with around 77 sightings per 100,000 people, followed closely by Vermont. Alaska and then Maine round out the top five "UFO hotspots" in the US.

To compile its list, SatelliteInternet.com used the National UFO Reporting Center's online database to get the number of UFO sightings in each state, then compared those figures with US census data.

More UFO sightings have been reported in California (13,559) than anywhere else in the US, but the Golden State ranks number 22 per capita with 34 reports for every 100,000 people, according to SatelliteInternet.com.

Looking to avoid aliens? Head to Texas, the state with the fewest number of UFO incidents per capita. Aliens apparently don't prefer the Deep South: Louisiana, Georgia, Mississippi, and Alabama are also near the bottom of the list.

Skeptical of aliens and UFOs?

SatelliteInternet.com said there's been a "flood of UFO news" as of late that could make you a believer.

"This includes UFO incident reports from Navy pilots and former Pentagon intelligence officers and the release of classified UFO research from the NSA (National Security Agency)," the company wrote.

Meanwhile, NASA is ramping up its search for alien life with plans to send a nuclear-powered drone to explore Saturn's moon Titan, which scientists believe may harbor organic life.



States With  
**THE MOST**  
UFO SIGHTINGS

1. **Washington**
2. **Montana**
3. **Vermont**
4. **Alaska**
5. **Maine**



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