



Dell Precision 5690: Accelerate AI workloads, speed creative workflows, and support sustainability goals

Compared to an Apple MacBook Pro 16" with similar specs, this system delivered better performance while also being easier to manage, secure, and repair

As artificial intelligence (AI) applications proliferate, workers across all fields are beginning to integrate AI into their workflows to save time and gain efficiencies. These applications are typically very resource-intensive, and it's important that the systems you select for your employees are up to the task. Creative workloads can also place heavy demands on hardware. Along with delivering performance that provides for a good user experience, your systems should minimize the burden on IT administrators. Finally, choosing systems that are easy to repair can support your commitment to sustainability and help your bottom line by avoiding replacement costs.

To help decision makers select systems for workers using AI and creative applications, Principled Technologies executed a study of the Dell™ Precision™ 5690 with an Intel® Core™ Ultra 9 processor 185H and an NVIDIA® RTX™ 3500 Ada 12GB GDDR6 graphics processing unit (GPU) and the Apple® MacBook Pro® 16" with an M3 Max processor and a 40-core GPU. We performed a variety of performance tests, researched the effort involved in managing and securing each system, and investigated the relative ease of replacing parts.

In all three of these arenas, we uncovered advantages for the Dell Precision 5690 mobile workstation, which supports choosing this system for your workforce.



Give employees a speedy experience when using resource-hungry AI and creative apps



Allow admins to manage and secure systems with less work



Support sustainability and reduce spending with systems that are easier to repair

The ascendance of AI and the demand for powerful hardware

AI applications are powerful tools that can augment and improve the work of a skilled professional who uses them correctly. A study conducted by researchers from Harvard Business School, Wharton, and the MIT Sloan School of Management found “when artificial intelligence is used within the boundary of its capabilities, it can improve a worker’s performance by as much as 40% compared with workers who don’t use it.”¹ Determining the situations in which AI is appropriate might require some serious reflection on the part of managers and workers. However, one aspect of AI and machine learning applications is not open to question: They almost always require a great deal of computational resources. Creative workers are accustomed to using programs that require serious horsepower, but now that they are also using AI, their systems must handle greater demands than ever.

Dell Technologies is meeting these needs with an “enterprise-wide AI strategy adoption through an end-to-end holistic approach from desk side to the data center.”² A mobile workstation component of this effort includes the AI-ready Precision 5690. We tested a model equipped with an Intel Core Ultra 9 processor 185H that includes a dedicated neural processing unit (NPU) for certain AI operations.

Through a combination of hands-on testing and research, we investigated how the Dell Precision 5690 compares to the Apple MacBook Pro 16" in several areas:

- How well do they meet the performance demands of workers using AI and creative applications?
- How easy are they for administrators to manage and secure?
- How easily can you repair the systems or upgrade components?
- How does software development differ on the platforms that underlie the two systems?

This report begins with the results of our hands-on testing comparing performance. Next, it presents research findings on the relative effort of maintaining and securing the systems. Then, we dive into hands-on testing results, exploring repairing the systems. Finally, we present research comparing the experience of developing software on the Windows and macOS platforms.

Boost employee productivity with stronger AI performance

To compare the AI performance capabilities of the Dell Precision 5690 over the Apple MacBook Pro 16", we conducted a series of hands-on tests on the following configurations:

Dell Precision 5690 mobile workstation

- 16-core Intel Core Ultra 9 processor 185H
- NVIDIA RTX 3500 Ada 12GB GDDR6 GPU
- 32 GB of LPDDR5x RAM
- Latest Wi-Fi standard supported: Wi-Fi 7
- Retail price as of 7/31/24: \$4,236.23³

VS.

Apple MacBook Pro 16"

- 16-core M3 Max CPU
- 40-core GPU
- 48 GB of unified memory
- Latest Wi-Fi standard supported: Wi-Fi 6E
- Retail price as of 7/31/24: \$3,999⁴

For greater detail on the system configurations and testing, see the [science behind the report](#).

Speedier AI task execution means less time waiting

In this section, we present the results of the benchmark testing we conducted to assess how well the two test devices handled AI tasks.

MLPerf® ResNet-50 benchmark (TensorRT/TensorFlow) performance

One of the most popular uses for AI is deep learning for image classification. Its real-world use cases include photo editing tasks, natural disaster impact assessment, and medical imaging analysis. We selected the ResNet-50 model to measure image classification performance. Many real-world applications use ResNet-50, a convolutional neural network that runs 50 layers deep. The MLPerf® implementation of ResNet-50 reports the rate of queries per second (QPS) that the two workstations classified in a given amount of time. A higher QPS rate means a system can perform AI inference operations faster. The Dell Precision 5690 overwhelmingly outperformed the MacBook Pro, completing 67 times as many QPS, indicating it could save significant time on these image classification workloads (see Figure 1).

The MLPerf® ResNet-50 tests use TensorRT and TensorFlow APIs on NVIDIA and Apple hardware, respectively. TensorRT is a GPU-only API designed specifically for ML operations on NVIDIA hardware. The TensorFlow API is accelerated using a Metal plugin from Apple. Metal is a low-level API designed to cover a variety of hardware-accelerated tasks on macOS® hardware. To fully optimize performance for macOS, the MLCommons developers would have to convert the MLPerf models to the Apple CoreML API, which they have not done as of this writing.

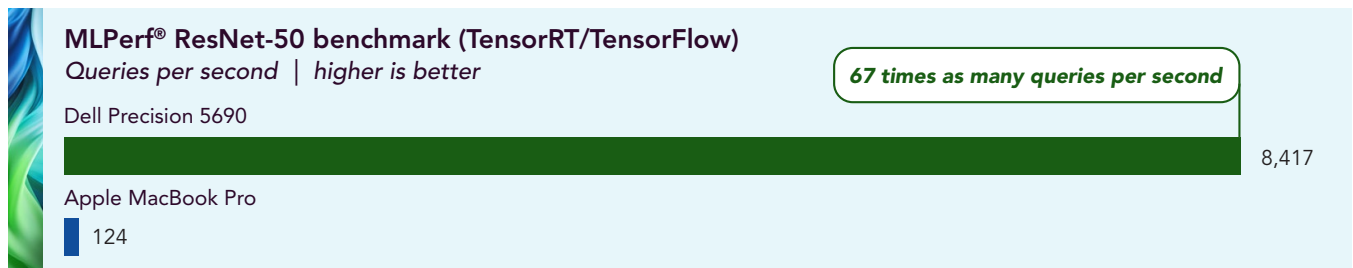


Figure 1: Number of MLPerf® ResNet-50 queries per second. Higher is better. Source: Principled Technologies.

Geekbench ML performance

Geekbench benchmarks use workloads that represent machine learning tasks—such as image classification and face detection—in popular real-world apps and realistic datasets to measure GPU performance.⁵ GeekbenchML uses the MobileNetV1 image classification model, a lighter-weight image classification model than ResNet-50 that is designed for mobile applications. Investing in systems that deliver higher Geekbench ML scores can allow creative workers to complete tasks such as AI-powered photo editing faster, completing projects sooner and opening opportunities for more iterations. The Dell Precision 5690 outperformed the MacBook Pro on the Geekbench ML benchmark, achieving a 21.9 percent higher score (see Figure 2).



Figure 2: Geekbench ML GPU performance score. Higher is better. Source: Principled Technologies.

About Dell Precision 5690 workstations

Dell calls the Precision 5690 “a premium workstation built for users who want a large display and exceptional, intelligent performance in a thin and light design.”⁶ Dell also says it has the world’s smallest footprint for 16-inch mobile workstations and provides up to 5 hours more battery life than previous generations.⁷ Dell offers a range of Precision 5690 workstation configurations to meet the needs of creative workers. To learn more about available configurations, visit <https://www.dell.com/en-us/shop/dell-computer-laptops/precision-5690-workstation/spd/precision-16-5690-laptop>.

Procyon AI Computer Vision performance

Procyon® AI Computer Vision generates an overall benchmark score by running a set of several common image-based AI inference models. Systems that deliver higher AI inference scores provide speedier performance on image classification, object detection, image segmentation, and accurately increasing the resolution of low-res images. The Dell Precision 5690 delivered a 37.8 percent higher Procyon AI Computer Vision Overall score than the MacBook Pro (see Figure 3).

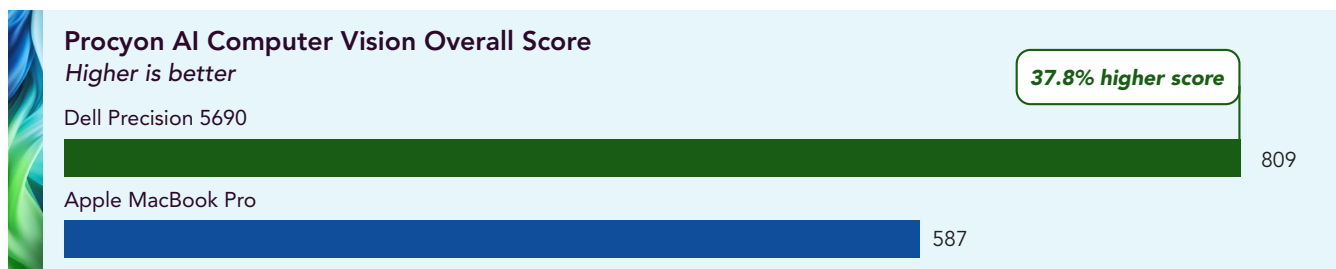


Figure 3: Procyon AI Computer Vision Overall score. Higher is better. Source: Principled Technologies.

Stable Diffusion performance

Generative AI uses existing data to learn patterns and infers answers based on those patterns. Stable Diffusion is a generative AI model that uses text and image prompts to produce photorealistic images. In this test, we measured how long it took for each system to use the Stable Diffusion text-to-image AI model to generate an image based on our text prompt input. As Figure 4 shows, the Dell Precision 5690 generated an image in 47.1 percent less time than the MacBook Pro.

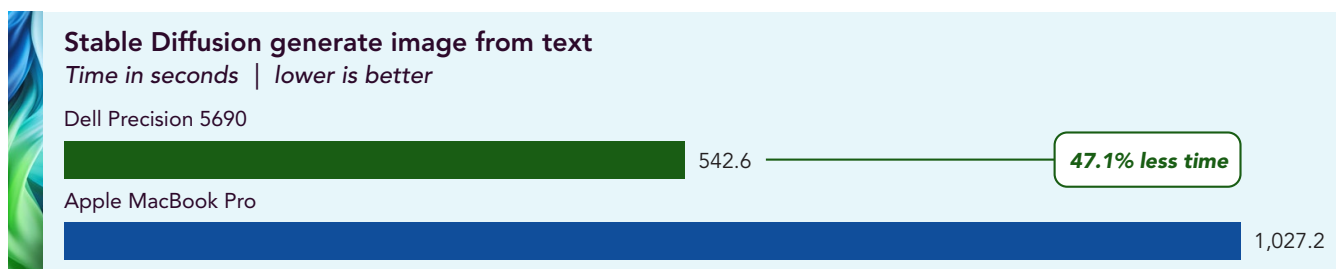


Figure 4: Stable Diffusion time to generate image from text. Lower is better. Source: Principled Technologies.

Completing creative tasks in less time helps boost productivity

In this section, we present the results of testing we conducted to measure performance on creative tasks. We timed the following tasks:

- Enhancing speech in Adobe® Premiere® Pro
- Rendering in Autodesk Maya

Enhancing speech in Adobe Premiere Pro

The Enhance Speech feature in Adobe Premiere uses AI to remove noise and “improve the quality of your dialogue clips.”⁸ Figure 5 shows the time in seconds to execute this feature on an audio track from a 60-second video. The Dell Precision 5690 was able to complete this task in less than one-third the time that the MacBook Pro needed. This speed advantage could enable video editors to be more productive and spend less time waiting.

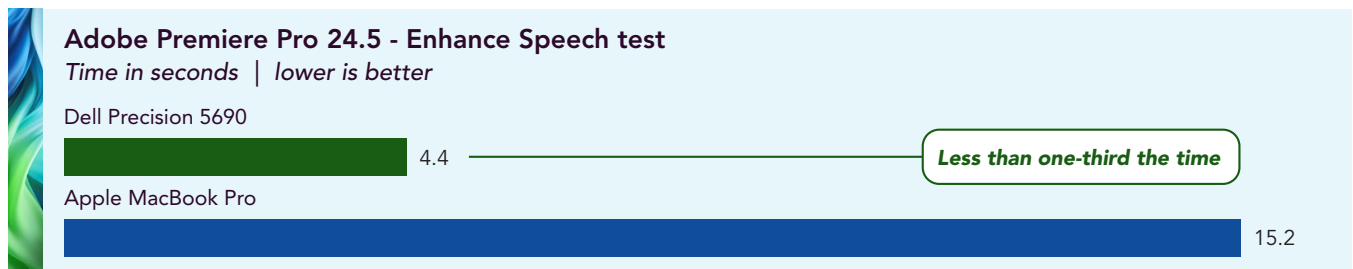


Figure 5: Time in seconds to execute the Enhance Speech Test in Adobe Premiere Pro 24.5. Lower is better. Source: Principled Technologies.

Rendering on Autodesk Maya

We measured the time it took for each system to render a 250-frame sequence of a sample 3D scene. The Dell Precision 5690 was able to complete this task less than 20 minutes, less than one-fourth of the 1 hour and 19 minutes that the MacBook Pro needed (see Figure 6). A worker could use that extra hour to get a head start on their next project.



Figure 6: Time in hours:minutes:seconds to render a 250-frame sequence of a sample 3D scene in Autodesk Maya. Lower is better. Source: Principled Technologies.

Web browsing performance

Because workers in all fields use web-browsing and web-based applications, we tested both mobile workstations using WebXPRT, an internet browser benchmark that runs a series of tests that include HTML and JavaScript handling, as well as photo manipulation and face detection tasks. The Dell Precision 5690 delivered a WebXPRT benchmark score that was 6.9 percent higher than that of the MacBook Pro (see Figure 7), indicating that the Dell system can provide a better, more responsive web-browsing experience.



Figure 7: WebXPRT benchmark score. Higher is better. Source: Principled Technologies.

Save time and do more with Copilot

According to Microsoft, Copilot is “an AI companion that works everywhere you do and intelligently adapts to your needs” available on the web, in the Copilot app, or integrated into Microsoft 365 apps.¹⁰ The Dell Precision 5960 includes an integrated Copilot key in its keyboard.¹¹ We used Copilot for Microsoft 365 to complete several productivity and creativity workflows on the Dell Precision 5960 device. Among other tasks, Copilot was able to:

1. Review and summarize an agenda: Based on our user’s recent emails and calendar invites, Copilot made a table of all scheduled meetings and calls in 31.7 seconds.
2. Conduct research: Copilot generated a 500-word research report on best practices for creating short animation projects, including at least five examples of animation projects, in 35.6 seconds.
3. Generate a social media plan: Copilot compiled a plan for relevant social media platforms, proposing promotions and other means to engage audiences, in 25.6 seconds.
4. Create a PowerPoint template and add a new slide: First, Copilot created a presentation—including a project timeline, internal milestones, and estimated budget—for a short film in 27.1 seconds. Then, with our prompt, it added a slide to the deck about the social media plan in 13.9 seconds.

Note: We did not test Copilot on the MacBook Pro. The first and third workflows we tested would have worked the same way on that device and second would have required use of the browser.

For a detailed look at these and other tests, including the prompts we input, see the [science behind the report](#). These workflows represent only a fraction of what this tool can do—imagine what else you could accomplish in a matter of seconds.

To learn more about Microsoft Copilot, visit <https://www.microsoft.com/en-us/microsoft-copilot/>.

Enable administrators to manage systems more easily

Key management advantages with Dell Precision 5690:

- Your existing mobile device management (MDM) solution for PCs is likely sufficient
- You can avoid devoting time to learning or developing new workflows to manage macOS devices

If you're already managing PCs running Windows, you're in luck with Dell Precision mobile workstations—the Dell Precision 5690 will fit into your framework without admins having to learn anything new. If you add Apple systems to your environment, however, you'll need to develop new systems to support the separate macOS ecosystem.

When managing macOS, you can't rely on Windows procedures that you've already implemented. Your team will need to spend time creating new scripts, settings, configuration profiles, and security policies. That may mean building custom configuration profiles and scripts for advanced settings,¹² which can take additional administrator effort. The amount of time involved varies widely depending on an organization's needs, culture, compliance requirements, and so forth.

For endpoint device management, you'll need to choose a solution—or solutions—that can support both operating systems. Microsoft Intune supports macOS;¹³ however, many organizations with macOS devices rely on Jamf for enterprise management. To achieve more of a turnkey MDM solution for environments with both Windows and macOS devices, some organizations use Microsoft Intune and Jamf together. This approach has its downsides. Administrators must create and maintain separate applications for macOS in Intune or Jamf¹⁴ and maintain separate security profile settings to support macOS devices. How critical it is to perform these activities depends on your organization. For example, an organization that allows bring-your-own-device (BYOD) might have more lenient security policies than entities that deal with proprietary designs, intellectual property, compliance laws, and other sensitive data. In these latter environments, high levels of security and device management are critical and employees typically must use only devices the organization owns and manages by the organization itself.



Another disadvantage is financial: Using all features for both Intune and Jamf requires licenses for both solutions. At the time of testing, licensing fees for those macOS systems would cost an additional \$14.33 per month, or \$171 per device per year.¹⁵ For an organization with 500 devices, the annual price tag for this licensing would be \$85,500. When you add in the additional development time for supporting two operating systems instead of just one, this number grows.

If your organization currently supports a mix of Windows devices and macOS devices, migrating any of your macOS users to Windows is straightforward. While you can't directly transfer a system image from a macOS device to a PC, users need only to move over their personal files and reinstall the apps they use. Your process might look as simple as the following:

1. Copy all personal files from the macOS device to an external drive or cloud folder.
2. Paste the files into the appropriate folder(s) of your choice onto the Windows device.
3. Install any necessary applications onto the Windows device.

The amount of time required ranges from less than an hour to several hours depending on factors such as the number of applications, the number and size of files, and the speed of the network connection.

Greater security functionality

Key security advantages with Dell Precision 5690:

- All Microsoft conditional access policies are available (vs. a limited set available on macOS devices)
- Greater Intune functionality is available because Intune and Windows 11 are both Microsoft products

Conditional Access

Many organizations rely on the Microsoft security ecosystem for authentication and maintaining compliance of end-user devices. Conditional Access allows organizations to restrict access based on a device's attributes, such as the device being in a different location unexpectedly. However, we found that there is limited visibility into all available attributes for macOS devices and that some Conditional Access policies available for Windows are not available on macOS. macOS is missing the following:^{16,17}

- App protection policies – which are rules that manage a user's access to data within applications¹⁸
- Antivirus or antispymware requirement
- Microsoft Defender integrations

Greater Intune functionality

Additionally, the Code Integrity feature is not supported on macOS.¹⁹ With Intune, Code Integrity checks driver files and system files each time the system accesses them. This ensures that no one has altered those files, which protects those critical files from malicious actors. Administrators can use Code Integrity in combination with Azure Sign-on Settings to prevent compromised devices from accessing company resources.²⁰

Similarly, your team would also need to perform additional work to set up your environment to support macOS devices. This issue highlights the gap in Intune/macOS security solutions. Because Intune and Windows 11 are both Microsoft products, Intune developers can easily implement new functionality for Windows. But with Intune/macOS, Microsoft only has control over one side of the equation. Therefore, Intune development on macOS has historically lacked features that are available for Windows.²¹

Intune offers fewer built-in tools for native macOS applications—such as those for patching, security, and device encryption—than it does for Windows applications. Within the security space, we found the following concerns:

- Intune provides less information about device vulnerabilities on macOS. For Windows devices, Windows Defender vulnerability scans include security advisories for weak and exposed devices. Intune collects data around those vulnerabilities on other OSes, but does not report weaknesses for other platforms, including macOS.²²
- Not all Windows Conditional Access policies are supported on macOS.²³
- On Windows hardware, Microsoft has integrated System Guard with Intune for assessing the root of trust.²⁴ Intune does not have a similar visibility into Secure Enclave, a macOS tool comparable to System Guard.²⁵
- For Dell devices, Dell Trusted Device includes BIOS verification tools that detail low-level BIOS events and report them to Windows Event Viewer for SIEM detection.²⁶ We did not find evidence of similar firmware-level system event logging available for Intune for macOS.

- Microsoft offers a self-service portal to recover BitLocker encryption keys for Intune managed computers. We did not find a comparable feature for FileVault, a macOS feature comparable to Bitlocker.²⁷
- Windows Defender is more accessible “out-of-box” on Windows than on macOS. Microsoft Defender is not installed by default on macOS and requires additional steps to install and configure the product, while the software is included on Windows systems by default.²⁸
- Microsoft recommends against running Microsoft Defender for Endpoint on Mac alongside other endpoint protection software, and says that doing so can lead to performance problems and unpredictable behaviors.²⁹ Running Microsoft Defender for Endpoint on Mac means that you’re on your own if you need to use a second security solution.

Because Intune doesn’t support the same security features on macOS as it does on Windows, organizations may need to explore additional security solutions to meet compliance standards. Alternatively, obtaining compliance data may require additional development work and ongoing testing and maintenance. Based on the limitations above, we believe Intune is not able to access the same security data on macOS devices as on Windows devices, but we did not test this. If you’re managing with Intune, the Dell Precision 5690 may provide simpler and more comprehensive security than the Apple MacBook Pro.

About Intel Core Ultra processors

According to Intel, Core Ultra processors offer the following:³⁰

- Up to 47 percent better office app productivity than a 3-year-old PC
- Up to 36 percent better processor power reduction gen-over-gen for video conferencing
- Up to 2.2x the AI performance gen-over-gen for video editing

Learn more about Intel Core Ultra processors at <https://www.intel.com/content/www/us/en/products/details/processors/core-ultra.html>.

Dell sustainability principles and the Precision 5690

In its commitment to help protect the planet, Dell approaches sustainable design with circularity, which “keeps products and materials in circulation longer through repair, recovery and reuse.”³¹ The Dell Precision 5690 highlights these environmentally conscious principles in a number of areas:³²

- **Recycled materials:** Among other parts built with recycled materials, the chassis contains 75 percent recycled aluminum, and its charging cable contains 90 percent post-consumer recycled plastic.
- **Sustainable packaging:** The mobile workstation’s shipping material comprises totally recycled or renewable content, which is also 100 percent recyclable.
- **Environmental certifications:** With ENERGY STAR® 8.0 and TCO Generation 9 certifications, the Dell Precision 5690 is also EPEAT Gold registered with Climate+ designation.
- **Lifecycle management:** Organizations can leverage services such as Dell APEX and Asset Recovery Services to access and replace parts, extending the life of their systems while minimizing e-waste.

To learn more about sustainable design in Dell devices, visit <https://www.dell.com/en-us/lp/dt/sustainable-devices>.

Support your corporate commitment to sustainability with devices that are easier to repair

Key repairability advantages with Dell devices:

- You can replace a greater number of components than on the MacBook Pro
- You can replace components more easily and more quickly than on the MacBook Pro

Repairability

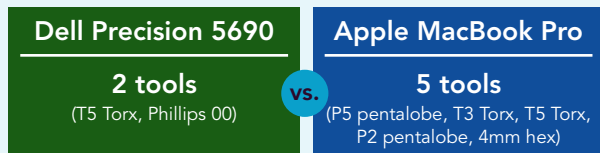
When a critical hardware device, such as a creative worker’s mobile workstation, fails, you have two choices: to repair it or to replace it. Repairing the device, when it is possible and practical to do so, is the more sustainable choice: You avoid recycling efforts, reduce waste, and save on shipping and manufacturing costs. Choosing hardware that is easier to repair can be part of a corporate commitment to sustainability.

We began our investigation of the repairability of each device by reviewing the documentation each manufacturer provided.³³ Next, PT technicians attempted to remove and replace each device’s fan, battery, storage, and heatsink. Figure 8 shows the effort that each of these replacements took in terms of both time and steps. Note that technicians were unable to replace the storage on the MacBook Pro, because it was soldered to the motherboard. As this figure clearly shows, component replacement on the MacBook Pro, when possible, was much more complicated than it was on the Precision 5690 system, taking from 4 to 10 times as long to complete.



Our technicians also found that disassembling the MacBook Pro required two sizes of pentalobe screwdrivers, which are proprietary to Apple, along with three sizes of Torx drivers and a hex screw bit. Taking apart the Dell Precision 5690 required a single size Torx driver and two sizes of Phillips head drivers.

Tools required to remove and replace fan (lower is better)



Tools required to remove and replace heatsink (lower is better)



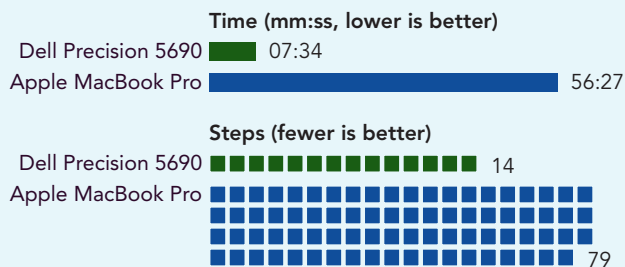
Tools required to remove and replace battery (lower is better)



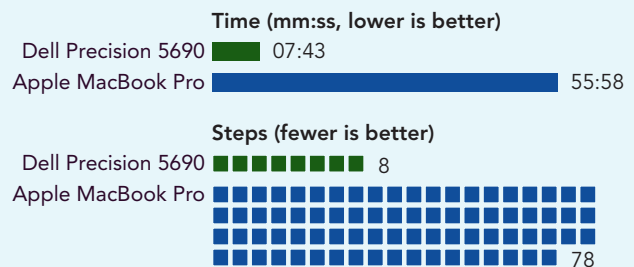
Tools required to remove and replace storage (lower is better)



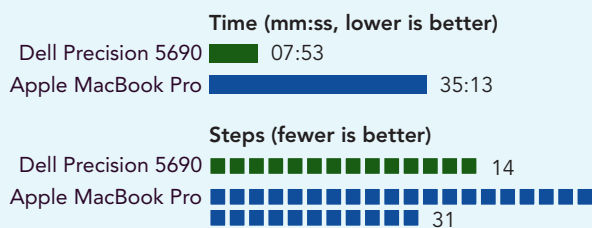
Removing and replacing fan



Removing and replacing heatsink



Removing and replacing battery



Removing and replacing storage

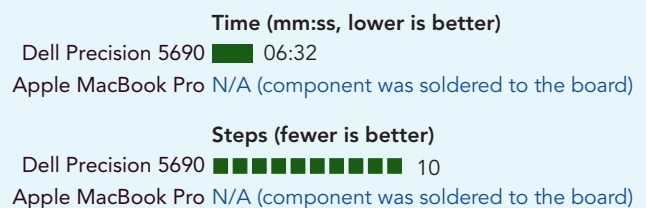


Figure 8: Tools, time, and steps required to remove and replace four components from the Dell Precision 5690 and Apple MacBook Pro 16". Lower is better. Source: Principled Technologies.

Software development on XPU platforms

Summary of the issues:

- “XPU environment” is another term for a heterogeneous environment that include CPUs, GPUs, and NPUs.
- Applications can boost performance and reduce battery drain by running tasks on the right type of cores and balancing workloads.
- Developers need coding, debugging, tuning, and testing tools that let them reuse code among the different XPUs, tune workloads to run on systems with different XPU configurations, and fix bugs that cross those platforms.
- Last year, Intel joined with Qualcomm, Google, AMD, and other hardware and software vendors to form the Unified Acceleration (UXL) Foundation.
- UXL builds on oneAPI, “a common unified and open multiarchitecture multivendor programming model”³⁴ that Intel adopted.

The results in this report highlight the AI and content creation performance of a system powered by the new Intel Core Ultra processor and NVIDIA professional graphics. However, strong performance is not a result of hardware alone. The Intel Core Ultra processor shines when running applications that take full advantage of the capabilities of its heterogeneous CPU, GPU, and NPU hardware architecture.

Creating and optimizing apps for XPU environments, another term for heterogeneous environments, can be a challenge for developers. The CPU, GPU, NPU, and other XPU architectures each have their own separate code bases with different languages, instruction sets, libraries, tools, and processes—some of them vendor-specific—for developers to master. Developers must also become adept at parallel programming methods to support the ability of GPUs and NPUs to run multiple processes simultaneously. That said, programmers don’t necessarily have to program “different ways for different devices.”³⁵ Intel recognized the software development challenges of “multiple architectures, vendors, and programming models” and developed tools for XPU environments. In 2020, Intel adopted oneAPI, “a common unified and open multiarchitecture multivendor programming model.”³⁶

Intel has since released tools and toolkits powered by oneAPI. These include cross-platform analyzers and debuggers, compilers, performance libraries, frameworks, and AI tools.³⁷ Toolkits include an Intel oneAPI Base Toolkit and add-on toolkits that target different users and use cases, including an AI Tools toolkit for AI developers, a high-performance computing (HPC) kit for HPC developers, an Intel Distribution OpenVINO™ toolkit for deep learning inference developers, and an Intel Rendering Toolkit for visual creators, scientists, and engineers.³⁸ The goal of these tools is for developers to not “need to think about the processor [they] are targeting when writing software.”³⁹

In September 2023, Intel—along with Qualcomm, Google, AMD, and other hardware and software vendors—joined the Linux Foundation’s Unified Acceleration (UXL) Foundation. The UXL Foundation expands the oneAPI initiative to those vendors’ platforms and products with the goal of uniting “the accelerator ecosystem around open standards and open-source software so that developers can build applications — now and in the future — able to target multivendor, multiarchitecture systems.”⁴⁰

In addition to improving application performance, cross-platform application development models such as these can “save organizations significant time and money.”⁴¹ With these XPU tools empowering developers and AI capabilities inspiring software designers, we are likely to see more apps emerge that take advantage of the XPU capabilities.



Conclusion

When your employees use resource-intensive AI and creative applications, they need powerful workstations. Decision makers must weigh these performance requirements along with other factors, including ease of management, security implementation, and repair. Through our hands-on testing with and research into the Dell Precision 5690 and the Apple MacBook Pro 16", we uncovered strengths for the Dell device in all of these areas, making it a great option for those who are embracing AI and performing creative workflows.

To learn more about the Dell Precision 5690, visit <https://www.dell.com/en-us/shop/dell-computer-laptops/precision-5690-workstation/spd/precision-16-5690-laptop>.

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