The science behind the report:

HP ZBook Power 16-inch G11 Mobile Workstation PC: Accelerate growth and performance

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report *HP ZBook Power 16-inch G11 Mobile Workstation PC: Accelerate growth and performance*.

We concluded our hands-on testing on October 28, 2024. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on October 7, 2024 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

To learn more about how we have calculated the wins in this report, go to *http://facts.pt/calculating-and-highlighting-wins*. Unless we state otherwise, we have followed the rules and principles we outline in that document.

Table 1: Results of our industry-standard benchmark and AI tool testing. Higher benchmark scores and lower Stable Diffusion times are better.

	HP ZBook Power 16-inch G11 Mobile Workstation PC	HP ZBook Power 15.6-inch G10 Mobile Workstation PC	Win percentage
Cinebench 2024 benchmark			
CPU multi-core score	928	905	2.54
3DMark® benchmark			
Fire Strike Extreme score	6,651	4,833	37.61
Time Spy Extreme score	2,851	1,970	44.72
Geekbench AI - GPU benchmark (ONNX, DirectML)			
Single Precision score	11,175	6,779	64.84
Half Precision score	19,718	13,343	47.77
Quantized score	8,611	4,520	90.50
Stable Diffusion (time in seconds, lower is better)			
Time to generate an image	208.50	319.90	34.82

	HP ZBook Power 16-inch G11 Mobile Workstation PC	HP ZBook Power 15.6-inch G10 Mobile Workstation PC	Win percentage
MLPerf ResNet-50 inferencing benchmark			
Samples per second	4,601.94	3,481.82	32.17
SPECworkstation® 3.1 benchmark			
Product Development overall score	3.47	2.68	29.47
Graphics overall score	3.58	3.20	11.87
Financial Services overall score	3.28	2.93	11.94
GPU Compute overall score	3.25	2.53	28.45

System configuration information

Table 2: Detailed information on the systems we tested.

System configuration information	HP ZBook Power 16-inch G11 Mobile Workstation PC	HP ZBook Power 15.6-inch G10 Mobile Workstation PC
Processor		
Vendor	Intel®	Intel
Model number	vPro® with Intel Core™ Ultra 7 processor 165H	vPro with Intel Core i7-13800H
Core frequency (GHz)	3.8 – 5.0	4.0 – 5.2
Number of cores	16	14
Logical processors	22	20
Cache (MB)	24	24
AI technology	Intel DL Boost on CPU Intel DL Boost on GPU Intel AI Boost on NPU	Intel DL Boost on CPU
Memory		
Amount (GB)	32 (2 x 16)	32 (2 x 16)
Type	DDR-5600	DDR-5200
Integrated graphics		
Vendor	Intel	Intel
Model number	Arc™ Graphics	Iris® Xe Graphics
Driver	Intel 32.0.101.5763	Intel 32.0.101.5763
Discrete graphics		
Vendor	NVIDIA®	NVIDIA
Model number	RTX™ 500 Ada Graphics	RTX A500 Graphics
Driver	NVIDIA v32.0.15.5612	NVIDIA v32.0.15.5612
Storage		
Model	Micron MTFDKBA512QFM-1BD1AABHA	Samsung MZVL4512HBLU-00BH1
Amount (TB)	512	512
Type	PCIe® Gen4 x4 NVMe M.2 2280	PCIe Gen4 x4 NVMe M.2 2280
Display		
Specifications	16-inch diagonal, WUXGA LED UWVA, anti-glare IR webcam, touchscreen (1,920 x 1,200 resolution), 300 nits	15.6-inch diagonal, FHD LED UWVA, anti-glare for IR webcam, non-touchscreen, (1,920 x 1,080 resolution), 250 nits

System configuration information	HP ZBook Power 16-inch G11 Mobile Workstation PC	HP ZBook Power 15.6-inch G10 Mobile Workstation PC
Connectivity/expansion		
Wired internet	Intel Ethernet Connection I219-LM	Intel Ethernet Connection I219-LM
Wireless internet	Intel Wi-Fi 6E AX211	Intel Wi-Fi 6E AX211
Bluetooth	5.3	5.2
Number of USB Type A	2	3
Number of USB Type C	2	1
Video outputs	1 x HDMI®	1 x HDMI
OS		
Vendor	Microsoft	Microsoft
Name	Windows 11 Pro	Windows 11 Pro
Build number or version	23H2 Build 22631.4249	23H2 Build 22631.4249
BIOS		
BIOS name and version	HP W97 Ver. 01.03.04 (09/06/2024)	HP V97 Ver. 01.06.03 (08/15/2024)
Battery		
Type (WHr)	6-cell, 83	6-cell, 83
Dimensions		
Height (in.)	0.90	0.90
Width (in.)	14.15	14.15
Depth (in.)	9.88	9.21
Weight (lbs.)	4.87	4.53

How we tested

Setting up the systems

When running the tests, we used a factory provided image. To prevent software from corrupting the test image, we reset the system image between tests.

Setting up and updating the OEM image

1. Boot the system.
2. To complete installation, follow the on-screen instructions, using the default selections when appropriate.
3. Set the Windows Power Plan to Best Performance.
4. Set Screen and Sleep options to Never:

   - Right-click the desktop, and select Display settings.
   - Select System from the left-hand column, select System.
   - Click Power.
   - For all power options listed under Screen and Sleep, select Never.

5. Disable User Account Control notifications:

   - Select Windows Start, type UAC, and press Enter.
   - Move the slider control to Never notify, and click OK.

6. Run Windows Update, and install all updates available.
7. Launch each vendor proprietary utility app installed on each system, and update any drivers or BIOS files:

   - For HP, Check for updates using the HP Support Assistant Application. After running updates, disable automatic software updates in application settings.

8. For both integrated and discrete graphics cards, we used the latest graphics drivers available from HP.
9. Verify the date and time are correct, and synchronize the system clock with the time server.
10. Pause Automatic Windows Updates:

    - Click Windows Start.
    - Type `Windows Update settings`, and press Enter.
    - From the Pause updates drop-down menu, select Pause for 5 weeks.

Capturing an image

1. Connect an external HDD to the system.
2. Click Windows Menu.
3. In the search bar, type `Control Panel`.
4. Click Control Panel→System and Security→Backup and Restore (Windows 7)→Create a system image.
5. Verify that the external HDD is selected as the save drive, and click Next.
6. Verify that all drives are selected to back up, and click Next.
7. Click Start backup.
8. At Do you want to create a system repair disc, select No, and close the dialogs.

Restoring an image

1. Connect an external HDD to the system.
2. While restarting the system, press and hold the Shift key.
3. Select Troubleshoot.
4. Select Advanced options.
5. Select See more recovery options.
6. Select System image recovery.
7. Select the User account.
8. Enter the system password, and click Continue.
9. At the Restore system files and settings screen, select Next.
10. Verify that the external HDD is selected, and click Next.
11. Once the recovery has completed, click Finish.

Running virus scan and process idle tasks

Once every 24-hour period, before testing, we reboot the system and run a full virus scan followed by the ProcessIdleTasks command. This forces idle processes to complete, minimizing the chance of background tasks affecting test runs.

1. Restart the system.
2. Open the HP Wolf Security application.
3. Click Start Full Scan.
4. After the virus scan finishes, select Windows Start.
5. Type `cmd`, and press Ctrl+Shift+Enter.
6. Type `Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
7. After the command completes, wait 5 minutes before running the test.

Measuring performance with benchmarks and AI tools

3DMark testing

Setting up 3DMark

1. Download the 3Dmark benchmark from http://www.futuremark.com/benchmarks/3dmark/all.
2. To install 3DMark with the default options, double-click the 3DMark installer.exe file.
3. To launch 3DMark, double-click the 3Dmark desktop icon, enter the registration code, and click Register.
4. Exit 3DMark.

Running 3Dmark

1. To launch the benchmark, double-click the 3DMark desktop icon.
2. At the top of the 3DMark Home screen, click the Benchmarks tab.
3. Select the desired benchmark to run (i.e., Time Spy Extreme or Fire Strike Extreme).
4. To turn off the Include Demo feature, move the slider.
5. Click Run.
6. When the benchmark run completes, record the results.
7. Wait 10 minutes.
8. Perform steps 3 through 7 two more times for each benchmark.
9. Record the median result.

Cinebench 2024 testing

Setting up the test

1. Download and install Cinebench 2024 from **https://www.maxon.net/en/downloads/cinebench-2024-downloads** .
2. Launch Cinebench 2024.
3. Select File→Advanced benchmark.
4. From the Minimum Test Duration drop-down menu, select Off.

Running the test

1. Launch Cinebench 2024.
2. Click File, Run All tests.
3. Record the result.
4. Wait 10 minutes before re-running.
5. Perform steps 1 through 4 two more times.
6. Record the median result.

Geekbench AI testing

Setting up the test

1. Purchase and download a Geekbench AI Pro license from **https://www.geekbench.com/ai/download/**.
2. Using all the defaults, run the installer, and install the benchmark.

Running the test

1. Launch Geekbench AI.
2. Enter the license key.
3. For GPU testing, select:

	• AI Framework: ONNX

	• AI Backend: DirectML

	• AI Device: discrete NVIDIA graphics card

4. Click Run AI Benchmark.
5. Wait 5 minutes, and perform steps 3 through 5 two more times.
6. Record the median result.

MLPerf ResNet-50 inferencing benchmark testing

We set up an MLPerf container in Ubuntu 22.04 on WSL2. We used the container to run a TensorRT-supported workload focused on edge systems. This workload targets the GPU exclusively. For more information about this workload, see the following URL: **https://docs.mlcommons.org/inference/benchmarks/image_classification/resnet50/.**

We performed this section on 10/20/2024 and updated files at that time.
At the time of testing, NVIDIA Studio driver release 565.90 was required for GPU functionality in the WSL2 environment.

1. On the target system, Enable Microsoft Hyper-V and WSL.

```
Enable-WindowsOptionalFeature -online -featurename Microsoft-Hyper-V-All,VirtualMachinePlatform,Micr
osoft-Windows-Subsystem-Linux -a
```

2. Reboot the system.
3. After rebooting, update WSL.

```
wsl --update
```

4. Install Ubuntu 22.04

```
wsl --install Ubuntu-22.04
```

5. Once installed, enter the following username and create a password:

```
username: ptuser
```

6. Use `sudo nano /etc/profile` and add the following to the end of /etc/profile

```
export PATH=”/home/ptuser/.local/bin:$PATH”
```

7. Run updates and exit.

```
sudo apt update && sudo apt upgrade -y
exit
```

8. Close the Terminal window, and start a new one using Ubuntu. Run the following to install dependencies.

```
sudo apt install python3 python3-pip python3-venv git wget curl zlib1g unzip -y
```

9. Create and activate a Python virtual environment for CM.

```
python3 -m venv cm
source cm/bin/activate
```

10. Install the CM4MLOPS Python packages.

```
pip install cm4mlops
```

11. Verify `cmind` functionality by running the following command.

```
cm test core
```

12. Build and initialize the test container environment.

```
cm run script --tags=run-mlperf,inference,_find-performance,_full,_r4.1-dev \
    --model=resnet50 \
    --implementation=nvidia \
    --framework=tensorrt \
    --category=edge \
    --scenario=Offline \
    --execution_mode=test \
    --device=cuda  \
    --gpu_name=rtx_4090 \
    --docker --quiet \
    --test_query_count=5000
```

13. If you have not previously installed Docker on the system,you may need to exit the terminal, and run the command again. This is to initialize environment variables that were changed during the first run of the script. When successful, the prompt will be inside the built container.

Running the test

1. After the initialization script completes, run the following command to run the benchmark in the container context.

```
cm run script --tags=run-mlperf,inference,_r4.1-dev \
    --model=resnet50 \
    --implementation=nvidia \
    --framework=tensorrt \
    --category=edge \
    --scenario=Offline \
    --execution_mode=valid \
    --device=cuda \
    --quiet \
    --gpu_name=rtx_4090 \
    --test_query_count=1000000 \
    --rerun
```

2. Record the resulting throughput result.
3. Wait 15 minutes.
4. Perform steps 1 through 3 two more times.
5. Record the median result.

SPECworkstation 3.1 testing

Setting up the test

1. Go to **https://www.spec.org/gwpg/wpc.static/workstation3-info.html**, purchase, and download the vendor license of the benchmark.
2. Unzip the SPECworkstation_304.zip file to C:\.
3. To install, navigate to the extracted SPECworkstation_304 directory, and click the SPECworkstation_304.exe.
4. Turn off Windows Defender Firewall.

5. Click Windows Menu.
6. In the search bar, type `Firewall.`
7. Select Windows Defender Firewall.
8. In the left-hand column, select Turn Windows Defender Firewall on or off.
9. Under both Private and Public network settings, choose Turn off Windows Defender Firewall, and click OK.

Running the test

1. Launch SPECworkstation.
2. Next to Official Run, check the box.
3. Click OpenCL Configuration, and select the discrete graphics card option.
4. Click Run Benchmark.
5. Perform steps 1 through 4 two more times.
6. Record the median result.

Stable Diffusion testing

The information below is used to install Stable Diffusion AUTOMATIC111 with the V1-5-pruned-emaonly model.

Installing Stable Diffusion

1. Download Python from **https://www.python.org/ftp/python/3.10.6/python-3.10.6-amd64.exe**.
2. Double-click the installer.
3. Check the box for Add Python 3.10 to PATH, and click Install Now.
4. To end the installer wizard, click Close.
5. Download git from **https://github.com/git-for-windows/git/releases/download/v2.45.2.windows.1/Git-2.45.2-64-bit.exe**.
6. Double-click the installer.
7. Click Next through the default options, and click Install.
8. To end the installer wizard, click Finish.
9. Reboot the system.
10. Open a command prompt, and navigate to c:\Users\[your username].
11. From that prompt, enter the following command:

```
git clone https://github.com/AUTOMATIC1111/stable-diffusion-webui.git
```

12. On completion, open file explorer, and browse to C:\Users\[your username]\stable-diffusion-webui\models\.
13. Open a web browser, and download a checkpoint file from **https://huggingface.co/runwayml/stable-diffusion-v1-5/resolve/main/v1-5-pruned-emaonly.ckpt** .
14. Copy that downloaded checkpoint file into the C:\Users\[your username]\stable-diffusion-webui\models\Stable-diffusions folder.
15. Browse up two levels to C:\Users\[your username]\stable-diffusion-webui\, and execute the webui-user.bat file. The batch file will take about 5 minutes to complete and will launch a browser with **http://127.0.0.1:7860** as the address. Use this browser window to execute testing.
16. Close the command session, and repeat step 15 for each subsequent test.

Using Stable Diffusion

For testing, we used default settings, except for the following modifications:

1. Set width to 640 and height to 360.
2. Check the box for Hires. Fix. Expand the panel, and change the upscale to 2 for 720p image quality.
3. Change sampling steps from 20 to 100.
4. Enter a prompt into the txt2image text box. We used, `A monster truck rally but the spectators are dinosaurs.`
5. To start the image creation, click Generate.
6. Perform steps 1 through 5 two more times.
7. Report the median result.

Read the report at https://facts.pt/VxR8ez1 ▶

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