

GPU Price-Performance Benchmarking

AWS, AZURE, GCP, LINODE



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Introduction

Today, GPUs are utilized by leading companies to push both technical and creative boundaries in a wide range of industries. Car manufacturers are focused on bringing autonomous driving to the masses. Universities and research groups use GPUs to simulate physics, solve complex problems, and understand genes to find vaccines for new viruses and diseases, including COVID-19.

GPU computing can be performed on a computer or server while using a single GPU or multiple GPUs working together. Developers and scientists can spread workloads across multiple computers, using multiple GPUs, while communicating over a high-speed network. Graphic Processing Unit (GPU) computing is dramatically advancing different market verticals, and the accelerating use of GPU technology shows no signs of slowing down.

Science and research projects are increasingly reliant on GPU compute to solve complex problems. Projects such as Folding@Home spread the work between hundreds, if not thousands, of computers owned by total strangers who are willing to lend some of their GPU power for a larger purpose.

E-commerce websites are more focused on training neural networks to predict what a user might want to buy based on previous purchases. GPUs power these predictions and recommendation engines, and they will only get smarter, faster, and more powerful.

No matter where you look, GPUs are not cheap. The high cost to both own and lease GPU technology in the cloud makes it even more important to understand how each GPU offering performs. The potential to invest in future GPU resources increases when a GPU service is more cost-effective.

Now that you can purchase on-demand GPUs in the cloud, we are only scratching the surface of GPUs capabilities. As GPUs become more and more powerful, they also become more accessible in the cloud.

Key Findings

Linode commissioned Cloud Spectator to evaluate the performance of its GPU-based virtual machines (VMs) against three different Cloud Service Providers (CSPs): Amazon Web Services (AWS), Microsoft Azure, and Google Compute Engine.

The purpose of the study was to understand how various GPU-based workloads perform on Linode compared to hyperscale CSPs that also offer GPU-based VMs. Using a standardized and repeatable testing methodology, Cloud Spectator tested four different GPU-based VMs to evaluate GPU compute performance for a wide range of workloads.

Linode is unique in the sense that it's one of the first Alternative Cloud providers to offer GPU compute to the masses. Based on our analysis, Linode's GPU VM performed well, but the real story is the price- performance offered by Linode's GPU VM. Linode far exceeded the other CSPs in terms of the GPU performance per dollar spent. The primary drivers for Linode's strong price-performance are:

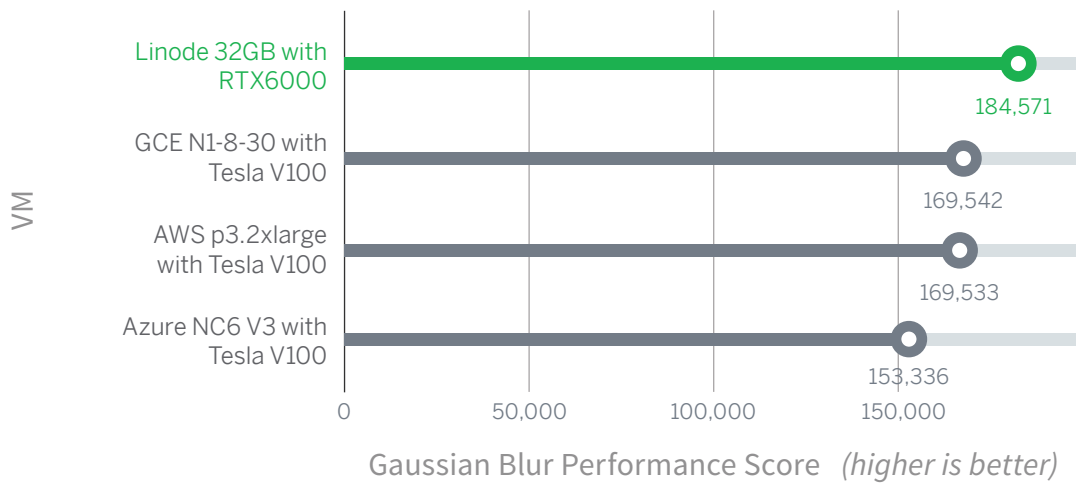
1. Linode's competitive pricing strategy, which includes basic and simple pricing across all data center locations as well as low price points in general, especially for hourly on-demand pricing.
2. Linode's solid performance scores especially for video and image rendering workloads like Gaussian blur and depth of field.

Linode offers a simple and straightforward pricing model compared to the other providers. It provides hourly and monthly pricing, which is the same for all locations. Bandwidth is bundled in with each VM. The 32GB GPU VM comes with 10TB included in the \$1000/mo price. With other providers, pricing can be much more complicated, sometimes based on each data center location.

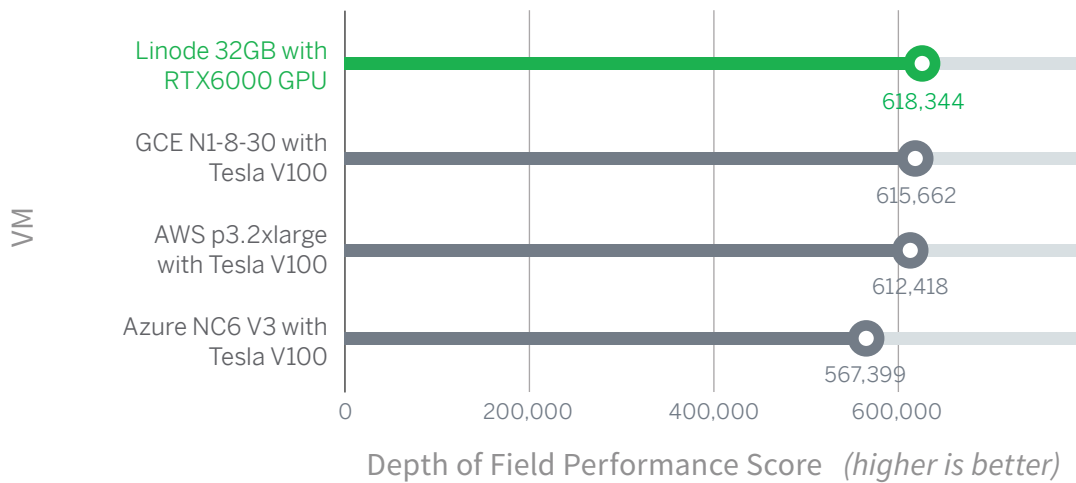
Additionally, you generally have to pay per GB of outgoing bandwidth, which is not always easy to calculate from month to month. Typically, larger providers have higher pricing if you go with hourly or on-demand pricing. If you sign up for 1-3 year contracts, the price goes down a lot, but then you are locked in. For this study, we looked at the hourly pricing.

When you offer reliable performance at a relatively low cost, you can provide excellent value to your clients. Based on this study, Linode delivers the most cost-effective GPU-based VMs on the market, especially for rendering workloads. Below you can see that Linode offers the best performance when it comes to two commonly used imaging techniques.

☆ Gaussian Blur Performance Score



☆ Depth of Field Performance Score



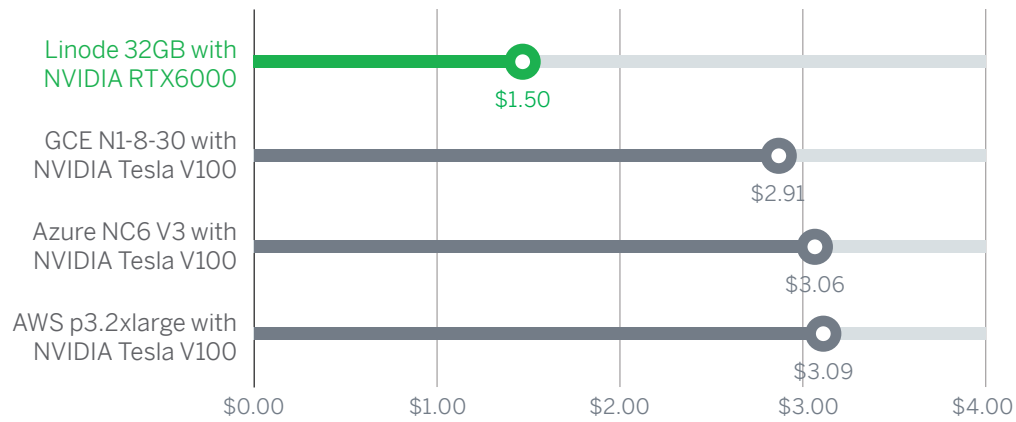
VM and GPU Lineup

For this study, we tested four VMs. All VMs utilized a NVIDIA-based GPU from various generations and product lines. The VMs we chose all had around 8 CPUs. All VMs tested were located in US East data centers. Linode's 32GB GPU-based VM is half the price of the Tesla V100-based VMs.

| Provider | AWS | Azure | GCE | Linode |
|--------------------------|------------------------------|--------------------------|---------------------------|----------------------------------------|
| VM Type | p3.2xlarge NVIDIA Tesla V100 | NC6 V3 NVIDIA Tesla V100 | N1-8-30 NVIDIA Tesla V100 | Dedicated 32GB + NVIDIA RTX6000 GPU x1 |
| GPU Model | NVIDIA Tesla V100 | NVIDIA Tesla V100 | NVIDIA Tesla V100 | NVIDIA RTX6000 |
| vCPU Count | 8 | 6 | 8 | 8 |
| RAM (GB) | 61 | 112 | 30 | 32 |
| Disk (GB) | 200 | 736 | 200 | 640 |
| Storage Type | EBS | Premium LRS | SSD Block Storage | Included SSD |
| Location | us-east-1c | east us | us east | us-east |
| Total VM Hourly Price* | \$3.087 | \$3.060 | \$2.906 | \$1.500 |
| Monthly 730hr VM Price** | \$2253.51 | \$2233.8 | \$2121.38 | \$1000.00 |

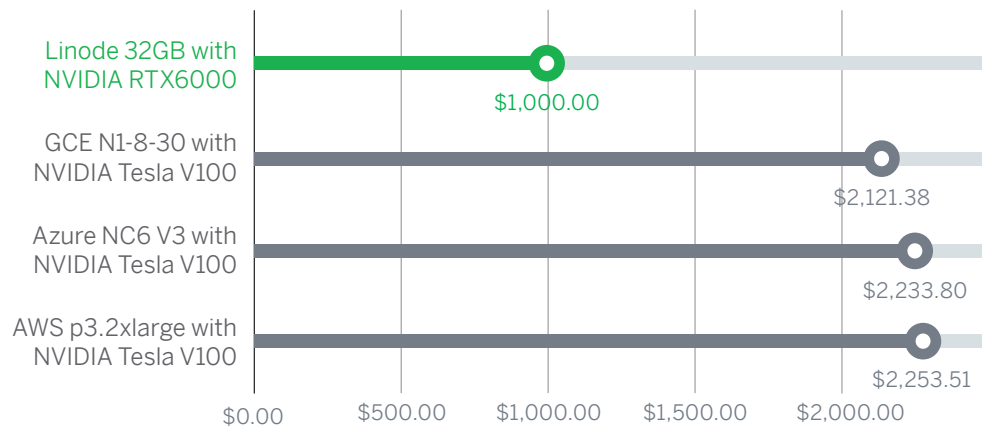
VM prices ranged from a little more than \$1 an hour to a little more than \$3 an hour. The selection of differently priced VMs was done on purpose to understand what performance looks like at each price tier. Linode is the leader with the lowest price.

💰 VM Hourly Price (On-Demand)



Below is the same pricing, just converted to 730 hours (which is the amount of hours in an average month).

💰 VM Monthly Price (730 Hours)



Testing Methodology

Cloud Spectator performed more than 100 benchmark iterations on each VM over multiple days to capture accurate performance data. GeekBench5 GPU Compute workloads were run (using CUDA) on each VM using the same methodology. V-Ray was also run on each VM to understand rendering performance. Each benchmark ran 100 times. All VMs used the latest stable version of Ubuntu (18.04 LTS) and were updated and rebooted before benchmarking.

Particle Physics

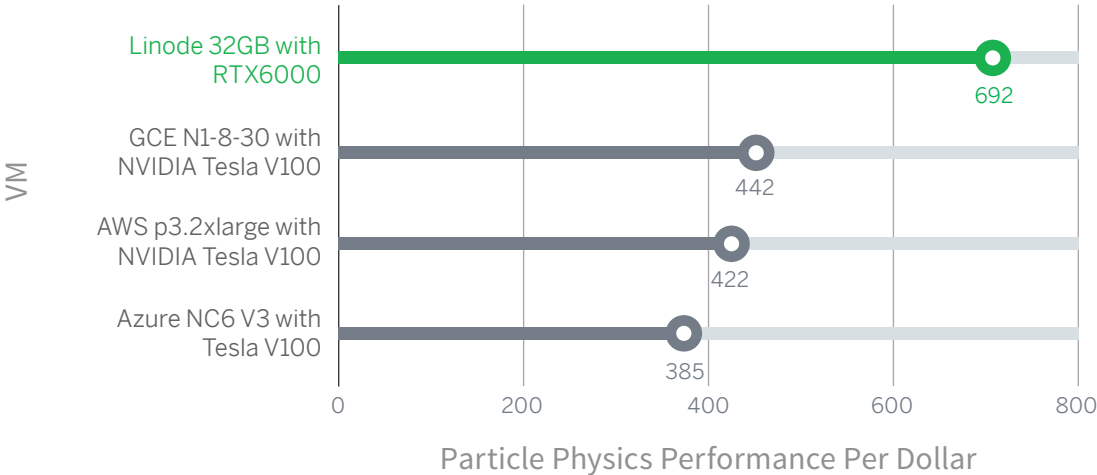
In addition to image and video rendering, Cloud Spectator also compared Linode against other VMs in the field of particle physics. Particle physics (also known as high energy physics) is a branch of physics that studies the nature of the particles that constitute matter and radiation. Although the word particle can refer to various types of tiny objects (e.g., protons, gas particles, or even household dust), particle physics usually investigates the irreducibly smallest detectable particles and the fundamental interactions necessary to explain their behavior.

These tests reveal how the VMs perform when running a different type of workload and enhancing the breadth of testing.

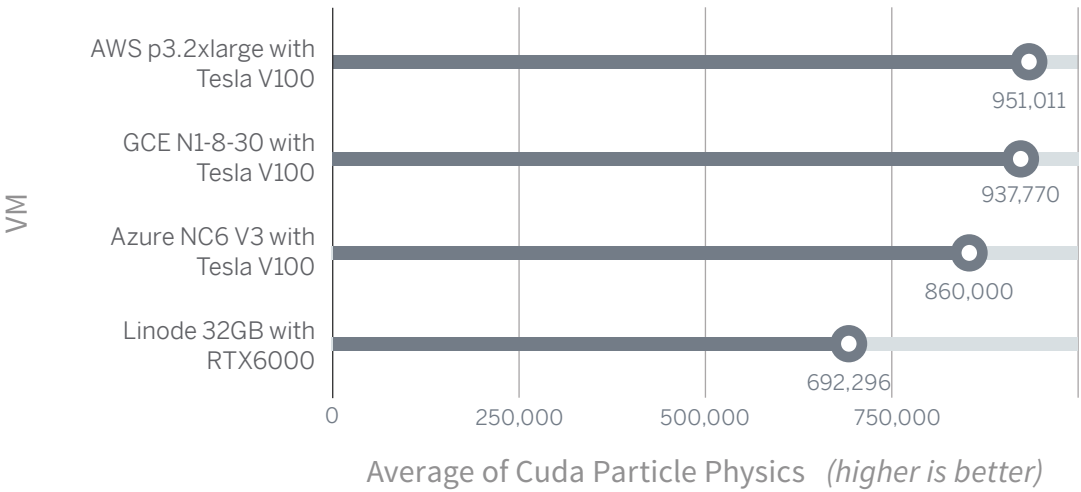
Linode still performed well, although it wasn't the top performer. However, that isn't the end of the story.

When you factor in the VM cost and the performance of a particle physics workload, you see that once again, Linode takes the top spot when it comes to performance per dollar spent, offering 1.5x better performance-per-dollar than the competition.

💰 Particle Physics Performance Per Dollar



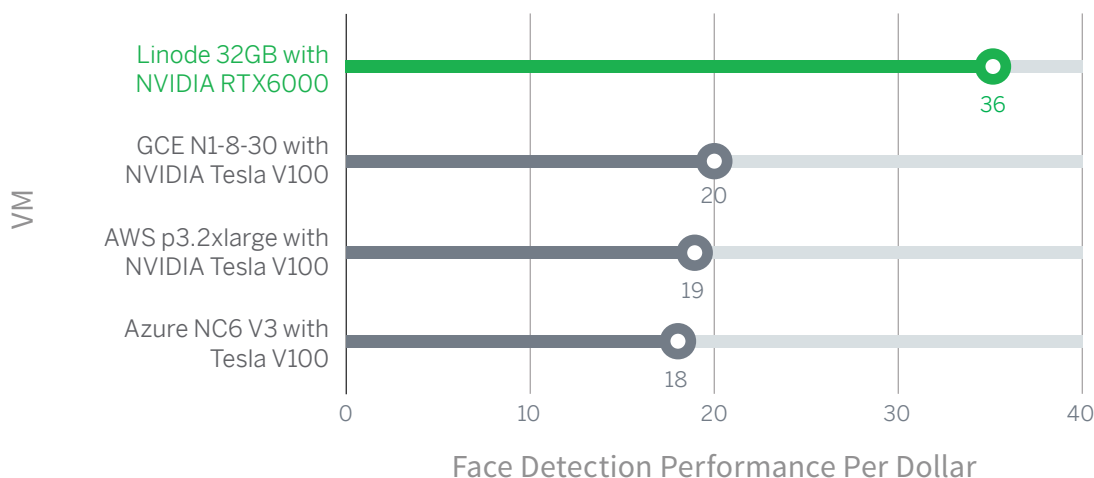
★ Particle Physics Performance Score



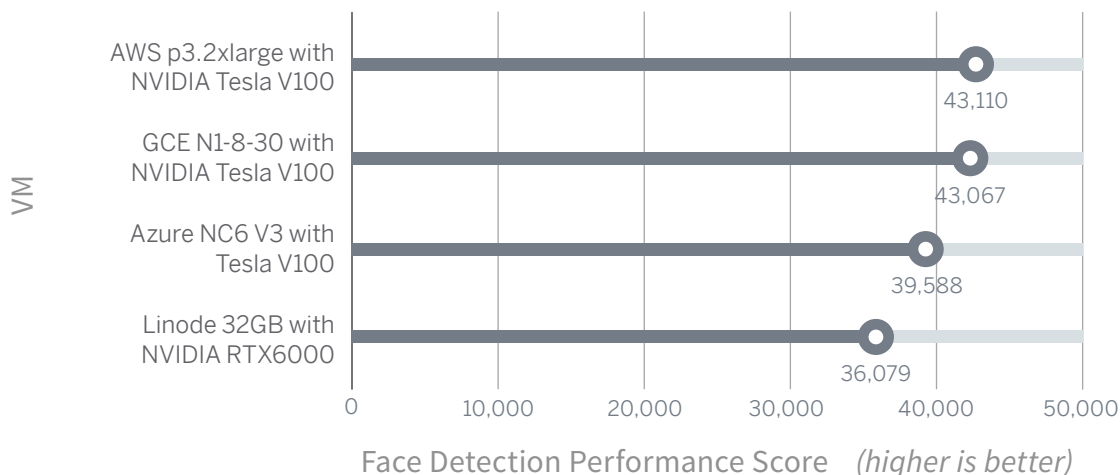
Face Detection

Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. When it comes to Face Detection performance we see that the Tesla V100 VMs take the top spots, however Linode isn't too far behind. Again, performance isn't the whole story here. Linode continues to offer over 1.5x better performance per dollar than the competitors.

💰 Face Detection Performance Per Dollar

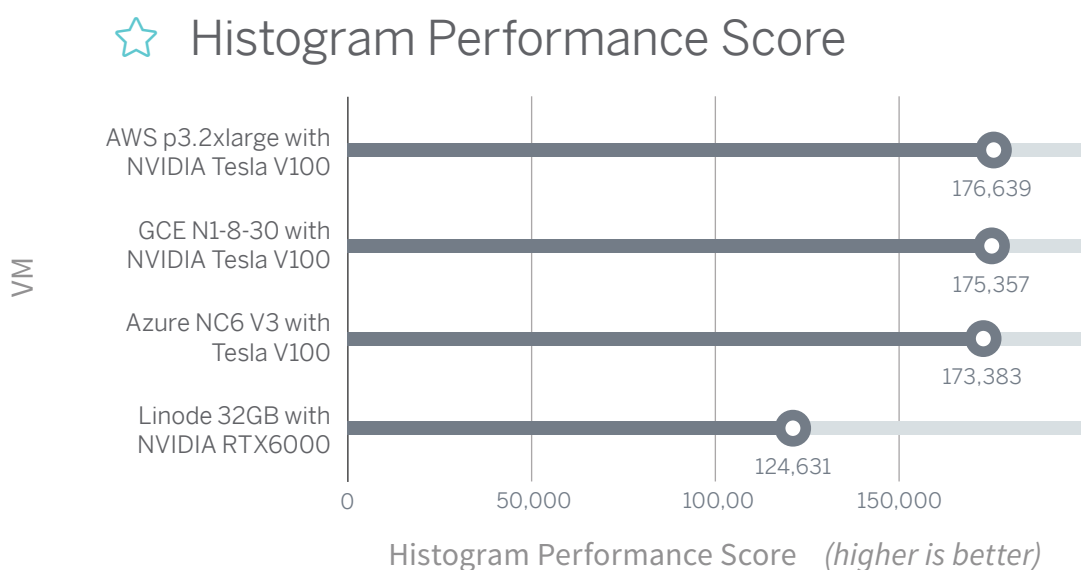
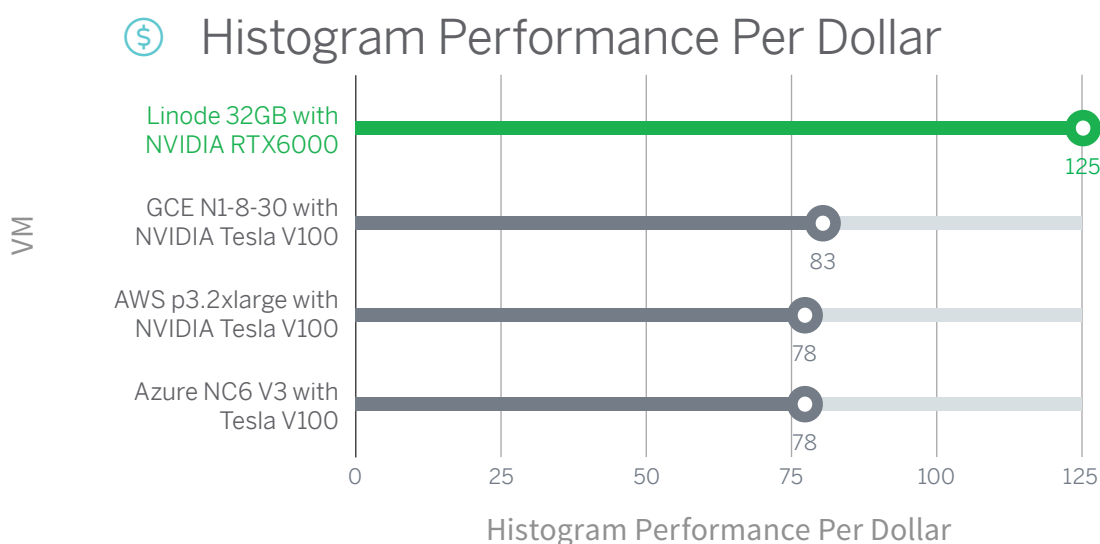


☆ Particle Physics Performance Score



Histogram

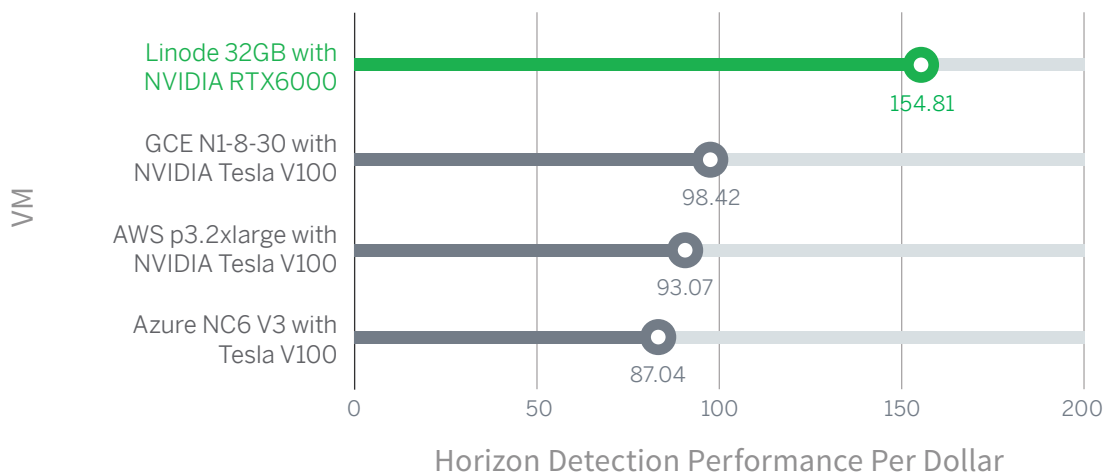
A histogram is a graphical display of data using bars of different heights. In a histogram, each bar groups numbers into ranges. Taller bars show that more data falls in that range. A histogram displays the shape and spread of continuous sample data. The Tesla V100-based VMs seem to excel when it comes to raw performance during the Histogram test. Again, Linode continues to offer an excellent blend of performance and price, offering 1.5x better value than the next closest competitor.



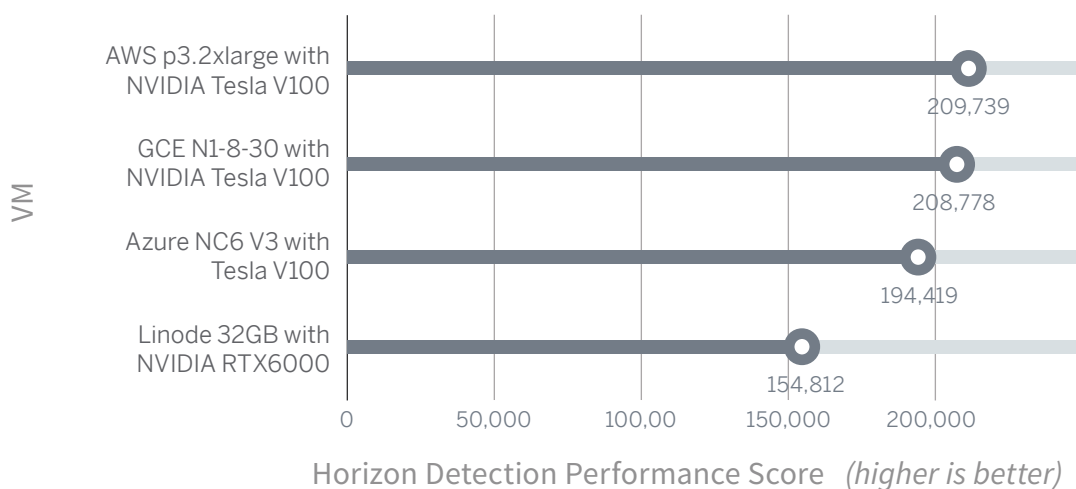
Horizon Detection

Horizon line detection or sky segmentation is the problem of finding a boundary between sky and non-sky regions (ground, water, or mountains) given a grayscale or color image. Horizon detection continues to show the same trend we've been seeing. While Linode isn't taking the top performance spot here, you'll see below how it continues to offer excellent price-performance value.

💰 Horizon Detection Performance Per Dollar

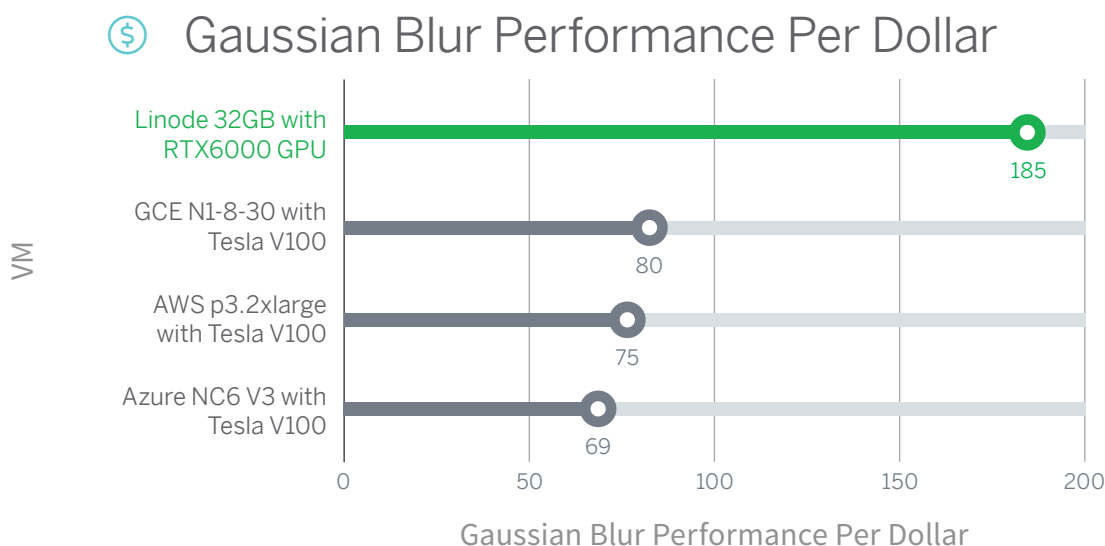


☆ Horizon Detection Performance Score

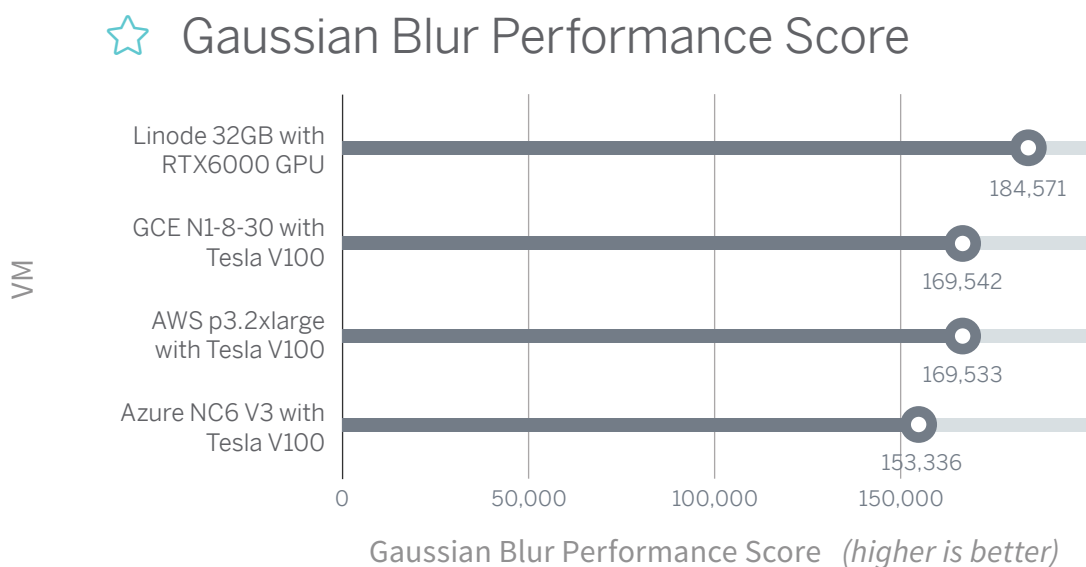


Gaussian Blur

Gaussian blur is an image processing technique used to blur an image, usually done to reduce noise or detail in an image. As you can see below, Linode's 32GB VM takes the top performance spot, beating the next fastest VM by about 9%. Even more impressive is that Linode can do this at a much lower price point than the other VMs.



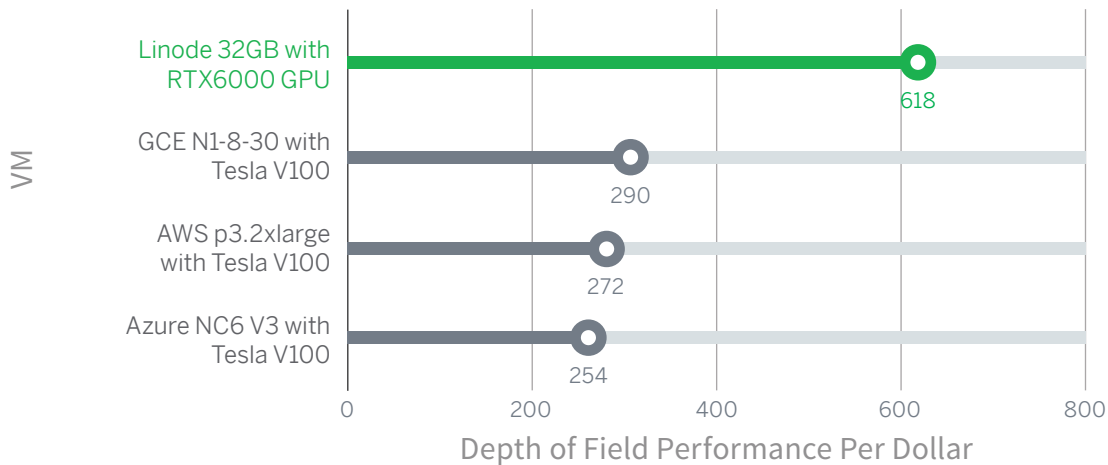
Looking at performance per dollar spent, Linode offers more than two times better Gaussian blur performance per dollar spent than the next closest competitor.



Depth of Field

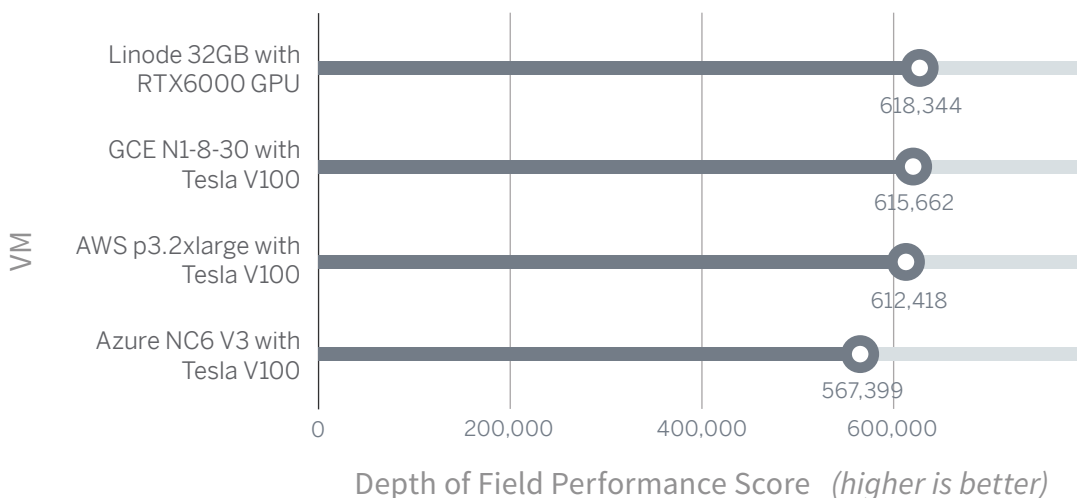
Depth of field is a rendering technique used to provide a sense of depth to an image or video game scene most often used in video games and by photographers and filmmakers for viewers to feel like they are inside the game, photo, or film. Again, Linode's 32GB VM takes the top performance spot, beating out the competition. Linode can provide better performance at a much lower price point than the other VMs.

💰 Depth of Field Performance Per Dollar



Linode pulls further ahead when you look at the performance per dollar, again offering more than two times better price-performance compared to the competition.

☆ Depth of Field Performance Score

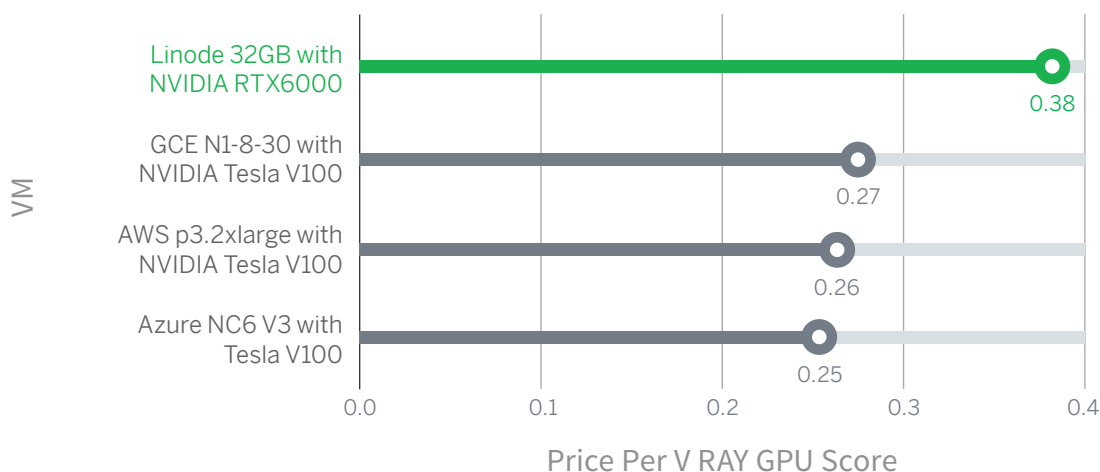


Linode's RTX6000 backed VMs excel at image rendering in terms of performance and overall value. If you run any workloads that perform image or video rendering, you will want to check out Linode, especially if you want to reduce your cloud spend each month!

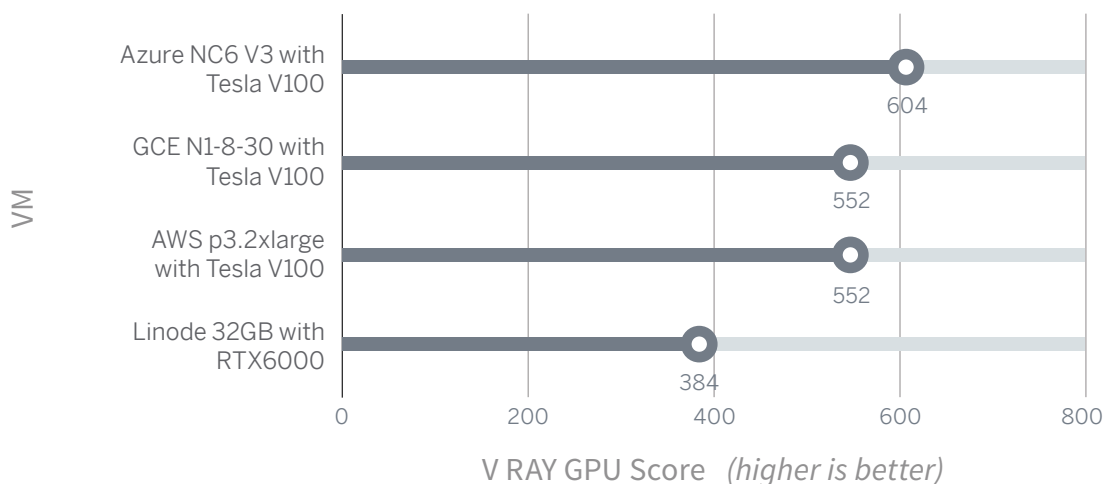
V RAY

V Ray is a free 3D rendering benchmark used to measure GPU and even CPU performance. For this test, we ran the GPU-based test, which runs various rendering workloads. Although Linode doesn't take the top spot for performance, we see that Linode still offers excellent performance per dollar spent.

💰 Price Per V RAY GPU Score vs. VM



☆ V RAY GPU Performance Score



Summary

By using benchmarks on multiple GPU VMs, Cloud Spectator found that Linode offers excellent value when it comes to GPU-based VMs. The RTX6000-based VMs from Linode outperform the competition when it comes to rendering workloads. At the same time, Linode beats every cloud provider in every test when you look at the performance per dollar spent.

GPU compute is powerful, but very expensive. Linode clearly focuses on delivering exceptional value while also offering solid performance. This strategy has been consistent for Linode, and it's nice to see them continue the trend with their introductory GPU VMs!

About Linode

Our mission is to accelerate innovation by making cloud computing simple, affordable, and accessible to all.

Founded in 2003, Linode helped pioneer the cloud computing industry and is today the largest independent open cloud provider in the world. Headquartered in Philadelphia's Old City, the company empowers more than a million developers, startups, and businesses across its global network of 11 data centers.

About Cloud Spectator

Cloud Spectator is a cloud benchmarking and consulting firm focused on the performance of IaaS and applications in the Cloud.

Cloud Spectator provides a full spectrum of cloud consulting services, including strategy and planning, architecture and technology selection, deployment and implementation, as well as Cloud migration services. Cloud Spectator also helps cloud providers understand their market position and helps businesses make intelligent decisions related to cloud strategy, cloud readiness, cost reduction, and vendor analysis.