



# An introduction to the Google Cloud Platform

*a.k.a. Jamie's first public talk as a Googler*

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Google Cloud



### **Jamie Kinney**

- Solutions Architect, Google Cloud Platform
- “Noogler” with 10+ years of cloud computing experience and a passion for Scientific Computing
- Formerly product manager for AWS Batch and HPC



### **Rob Simpson**

- Product Manager, Android Search
- Creator of the first .Astronomy
- Formerly of Zooniverse at the University of Oxford

# Why are Googlers attending .Astronomy X?

Listen  
&  
Learn

Educate

Help

# Agenda

Alphabet,  
Google, & GCP

How are  
researchers  
using Google?

Overivew of  
Relevant  
Services

Things to try at  
.Astronomy X

Questions?

# Alphabet, Google, & GCP

# Alphabet

## Other Bets



verily

Calico

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.



# Google



Google Cloud



Google Cloud Platform

# android



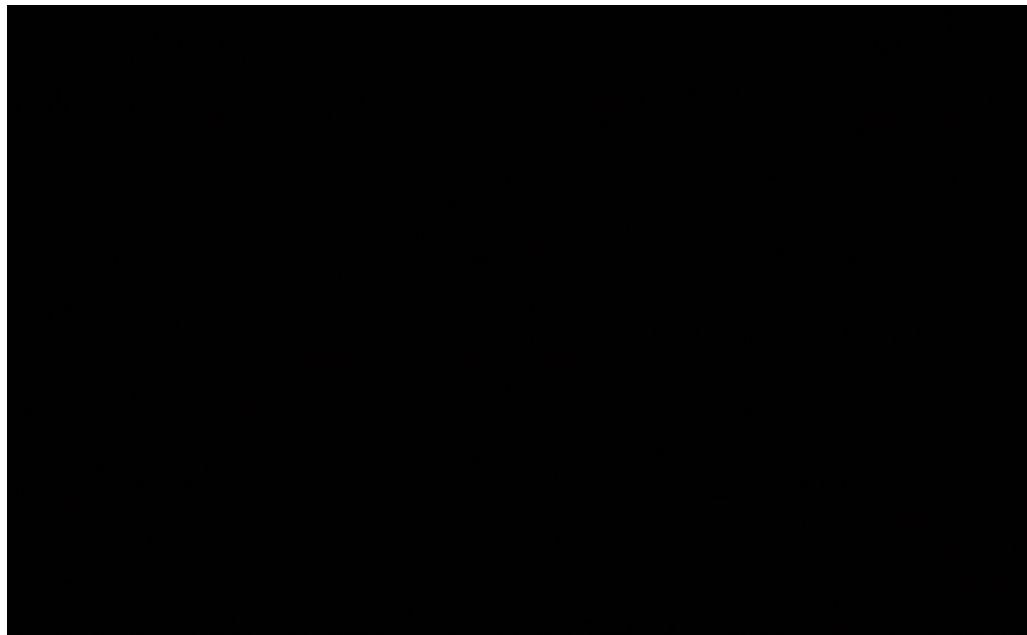
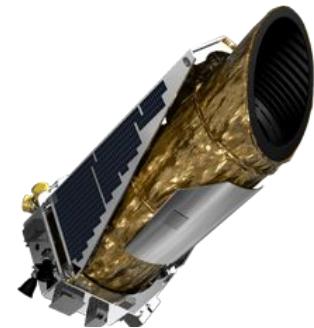
Google Maps Platform



# Examples of Scientific Research on GCP

# Astronet: A Neural Network for Identify Exoplanets in Light Curves

[TensorFlow](#) code for building neural network classification models which operate on Kepler .fits files to identify exoplanets in light curves



Source code: <https://github.com/tensorflow/models/tree/master/research/astronet>

Research paper: <http://adsabs.harvard.edu/abs/2018AJ....155...94S>

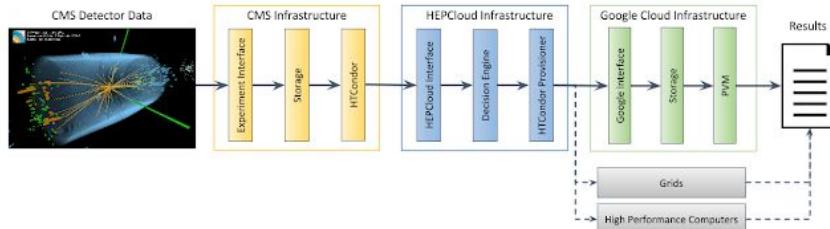
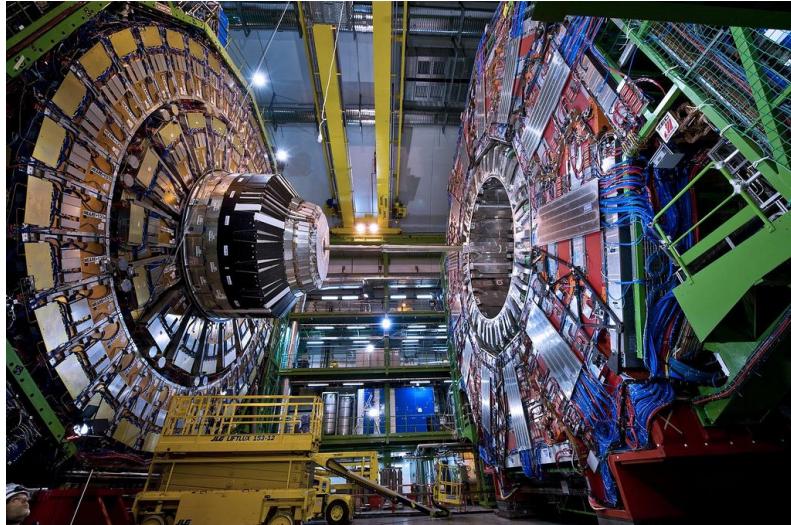
NASA Press release: <https://www.nasa.gov/press-release/artificial-intelligence-nasa-data-used-to-discover-eighth-planet-circling-distant-star>

Chris Shallue - Google

Andrew Vanderburg - UT Austin & Harvard-Smithsonian Center for Astrophysics



# Google Cloud, HEPCloud and probing the nature of Nature



Google Cloud Platform Blog

Product updates, customer stories, and tips and tricks on Google Cloud Platform

## Google Cloud, HEPCloud and probing the nature of Nature

Monday, November 14, 2016

Posted by Paul Rossman, Google Cloud Developer Relations

Understanding the nature of the universe isn't a game for the resource-constrained. Today, we probe the very structure of matter using multi-billion dollar experimental machinery, hundreds of thousands of computing cores and exabytes of data storage. Together, the European Center for Nuclear Research (CERN) and partners such as Fermilab built the Large Hadron Collider (LHC), the world's largest particle collider, to recreate and observe the first moments of the universe.

Today, we're excited to announce that [Google Cloud Platform](#) (GCP) is now a supported provider for HEPCloud, a project launched in June 2015 by Fermilab's Scientific Computing Division to develop a virtual facility providing a common interface to local clusters, grids, high-performance computers and community and commercial clouds. Following the recommendations from a [2014 report by the Particle Physics Project Prioritization Panel](#) to the national funding agencies, the HEPCloud project demonstrates the value of the elastic provisioning model using commercial clouds.

# NOAA Public Data Sets in BigQuery and Cloud Storage

"The great thing about what Google is doing with the public datasets program is they are combining various valuable datasets that are not readily available, nevermind all available in one analytics tool. Getting, for example, NOAA, USGS, EPA, and NSF data all in one place is incredibly valuable for data science and we are continually finding requests for this type of access. This is something that is not being done right now outside of the Google Cloud program."

*Dr. Ed Kearns, NOAA Chief Data Officer*

The screenshot shows a web browser window for [cloud.google.com](https://cloud.google.com). The navigation bar includes links for Google Cloud, Why Google, Products, Solutions, Pricing, Security, Documentation (which is underlined), Customers, Partners, and a search bar. A user profile icon is in the top right.

The main content area is titled "Data Analytics Products". On the left, there's a sidebar with a list of datasets: EPA Historical Air Quality Data, GDELT Books Corpus, GitHub Data, Hacker News, Healthcare Common Procedure Coding System (HCPCS) Level II, IRS 990 Data, Major League Baseball, Medicare, NCAA Basketball Data, NHTSA Traffic Fatality Data, NOAA GHCN Weather, NOAA GSOD Weather, NOAA ICOADS (which is highlighted in blue), NYC 311 Service Requests, NYC Citi Bike Trips, NYC TLC Trips, NYC Tree Census, NYPD Motor Vehicle Collisions, and OpenAQ: Real-time Air Quality Data.

The main content area features the "NOAA International Comprehensive Ocean-Atmosphere Data Set (ICOADS)" dataset. It includes a star rating section, a "SEND FEEDBACK" button, and a detailed description of BigQuery and its capabilities. A sidebar on the right provides links to other datasets and resources, such as "Where were ships during the hours of the Titanic sink?", "What are the top 10 fastest wind speeds ever recorded in the last 350 years of oceanic data?", and "About the data".

<http://www.noaa.gov/big-data-project>

<https://cloud.google.com/noaa-big-data/>

<https://cloud.google.com/public-datasets/>

<https://cloud.google.com/bigquery/sample-tables>

<https://www.youtube.com/watch?v=vTJWb4twnM8>

# Google Dataset Search

Find and discover public datasets with metadata and links to source systems.

For example:  
Hubble site:nasa.gov

CMIP5 site:noaa.gov

The screenshot shows a web browser window for 'toolbox.google.com' displaying the 'Google Dataset Search' results for the query 'hubble site:nasa.gov'. The search bar at the top contains the query. Below the search bar, there are three dataset cards:

- SERVIR Data Catalog** (data.nasa.gov) - Updated Jun 25, 2018
- Compressed Sensing for Space-Based High-Definition Video Technologies, Phase...** (data.nasa.gov) - Updated Jun 26, 2018
- Parfocal wide field near infrared grism design and fabrication for WFIRST** (data.nasa.gov) - Updated Jun 26, 2018

On the right side of the results, there is a summary section for the third dataset:

- Dataset created**: Jun 26, 2018
- Dataset updated**: Jun 26, 2018
- Dataset published**: Jun 26, 2018

Below this, it says "Available download formats from providers" followed by CSV, JSON, RDFXML, RSSXML, and XML. A "Description" section follows, stating: "WFIRST will have Hubble image quality with 100x the field area of HST/WFC3. It requires both imaging and, working in the same optical train, a grism allowing slitless spectroscopy of 10,000's of objects across the same... More".

# Google Scholar

The screenshot shows a Google Scholar search results page for the query "hubble space telescope". The results are filtered by "Articles" and show approximately 162,000 results. The results are listed in descending order of relevance.

**Search Query:** hubble space telescope

**Filter:** Articles

**Time Range:** Any time

**Sort By:** relevance

**Checkmarks:** Include patents, Include citations

**Actions:** Create alert

**Results:**

- Type Ia supernova discoveries at  $z > 1$  from the Hubble Space Telescope: Evidence for past deceleration and constraints on dark energy evolution  
AG Riess, LG Strolger, J Tonry... - The Astrophysical ..., 2004 - iopscience.iop.org  
Abstract We have discovered 16 Type Ia supernovae (SNe Ia) with the Hubble Space Telescope (HST) and have used them to provide the first conclusive evidence for cosmic deceleration that preceded the current epoch of cosmic acceleration. These objects ...  
Cited by 4684 Related articles All 20 versions [PDF] arxiv.org
- Final results from the Hubble Space Telescope key project to measure the Hubble constant  
WL Freedman, BF Madore, BK Gibson... - The Astrophysical ..., 2001 - iopscience.iop.org  
We present here the final results of the Hubble Space Telescope (HST) Key Project to measure the Hubble constant. We summarize our method, the results, and the uncertainties, tabulate our revised distances, and give the implications of these results for cosmology. Our ...  
Cited by 3900 Related articles All 30 versions [PDF] arxiv.org
- New constraints on  $\Omega_M$ ,  $\Omega_\Lambda$ , and  $w$  from an independent set of 11 high-redshift supernovae observed with the Hubble Space Telescope  
RA Knop, G Aldering, R Amanullah... - The Astrophysical ..., 2003 - iopscience.iop.org  
We report measurements of  $\Omega_M$ ,  $\Omega_\Lambda$ , and  $w$  from 11 supernovae (SNe) at  $z = 0.36\text{--}0.86$  with high-quality light curves measured using WFPC2 on the Hubble Space Telescope (HST). This is an independent set of high-redshift SNe that confirms previous SN evidence for an ...  
Cited by 1763 Related articles All 31 versions [PDF] arxiv.org
- New Hubble space telescope discoveries of type Ia supernovae at  $z \geq 1$ : narrowing constraints on the early behavior of dark energy  
AG Riess, LG Strolger, S Casertano... - The Astrophysical ..., 2007 - iopscience.iop.org  
We have discovered 21 new Type Ia supernovae (SNe Ia) with the Hubble Space Telescope (HST) and have used them to trace the history of cosmic expansion over the last 10 billion yr. These objects, which include 13 spectroscopically confirmed SNe Ia at  $z \geq 1$ , were ...  
Cited by 1840 Related articles All 25 versions [PDF] arxiv.org

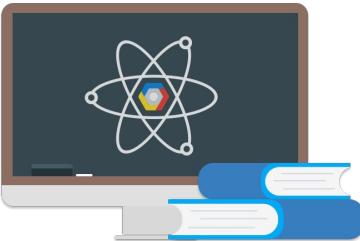
# Cloud Credits & Faculty Research Awards



## GCP Research Credits

- Free access to GCP for research workloads

<https://cloud.google.com/edu/?options=research-credits>



## Faculty Grants

- GCP credits for computer science faculty and students
- Curated resources designed to help CS faculty and students learn GCP

<https://cloud.google.com/edu/?options=faculty-grants>

Google

A screenshot of a web browser displaying the "Faculty Research Awards" page. The page has a header with the Google AI logo and navigation links for About, Stories, Research, Education, Tools, Blog, and Principles. Below the header, there are links for Publications, Teams &amp; Focus Areas, People, Join Us, and Outreach. The main content area features a large image of a blue ribbon or banner on a dotted background. A central box contains the title "Faculty Research Awards" and a brief description: "Providing unrestricted gifts as support for research at institutions around the world. The program is focused on funding world-class technical research in Computer Science, Engineering, and related fields." The URL in the address bar is https://ai.google/research/outreach/faculty-research-awards/

- Unrestricted gifts as support for research at institutions around the world.
- Focused on funding world-class technical research in Computer Science, Engineering, and related fields.

<https://ai.google/research/outreach/faculty-research-awards/>

# Google Credits for the NSF BIGDATA Program

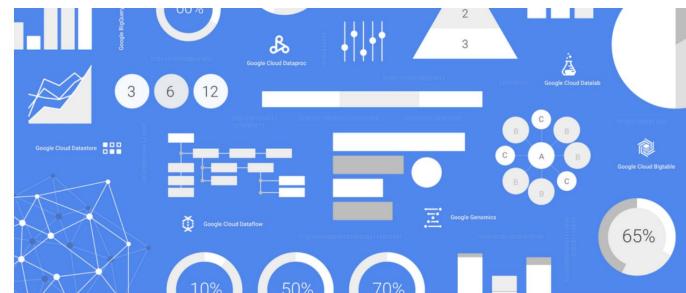
Through the National Science Foundation's BIGDATA grants program, we're offering researchers \$3M in Google Cloud Platform credits to use the same infrastructure, analytics and machine learning that we use to drive innovation at Google.

Has inspired innovative climate analysis and modeling at Columbia University and the launch of pangeo.io



## GOOGLE CLOUD

Google Cloud supports \$3M in grant credits for the NSF BIGDATA program



Bram Bout  
Director, Google for Education

Karan Bhatia  
Cloud Solutions Architect, Google Cloud

Published Feb 22, 2017

Google Cloud Platform (GCP) serves more than one billion end-users, and we continue to seek ways to give researchers access to these powerful tools. Through the National Science Foundation's [BIGDATA grants program](#), we're offering researchers \$3M in Google Cloud Platform credits to use the same infrastructure, analytics and machine learning that we use to drive innovation at Google.

# Northeastern University uses GCP to model Zika's Spread

## WHAT RESEARCHERS ARE SAYING

"We have the flexibility to scale up to several thousand independent virtual instances in parallel, so we can generate a full analysis for a single epidemic scenario—which may consist of up to 250,000 independent simulations—in less than a day."

**Matteo Chinazzi**, Associate Research Scientist, Northeastern University

Stanford Center for Genomics and Personalized Medicine x +

https://cloud.google.com/customers/stanford-universitys-center-of-genomics-and-personalized-medicine

Google Cloud Why Google Products Solutions Pricing Security Documentation Customers Partners Support Marketplace Contact sales

# Stanford Center for Genomics and Personalized Medicine: Building a mega-scale genetic variation analysis pipeline

Using Google Genomics and Google BigQuery, SCGPM can analyze hundreds of entire genomes in days and return query results in seconds while providing reliable security for DNA data.

### Google Cloud Platform Results

- Processed 500 genomes from raw data to variant calls for the Million Veteran Program pilot data in days
- Implemented a variant analysis pipeline that returns query results in less than 10 seconds
- Established security best practices to help genomics labs confidently store and share data in the cloud

### Returning genomics results at unprecedented speed

About Stanford Center for Genomics and Personalized Medicine

The Stanford Center for Genomics and Personalized Medicine (SCGPM) focuses on functional genomics and proteomics and has developed many technologies in this area. Using next-gen DNA sequencing, SCGPM researchers are devising new approaches to study genomic changes in cancers to understand cancer origins and progression.

Industries: Healthcare & Life Sciences

Location: United States

Genomics BigQuery

Stanford Center for Genomics and Personalized Medicine

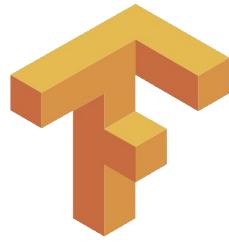
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Industries: Healthcare & Life Sciences

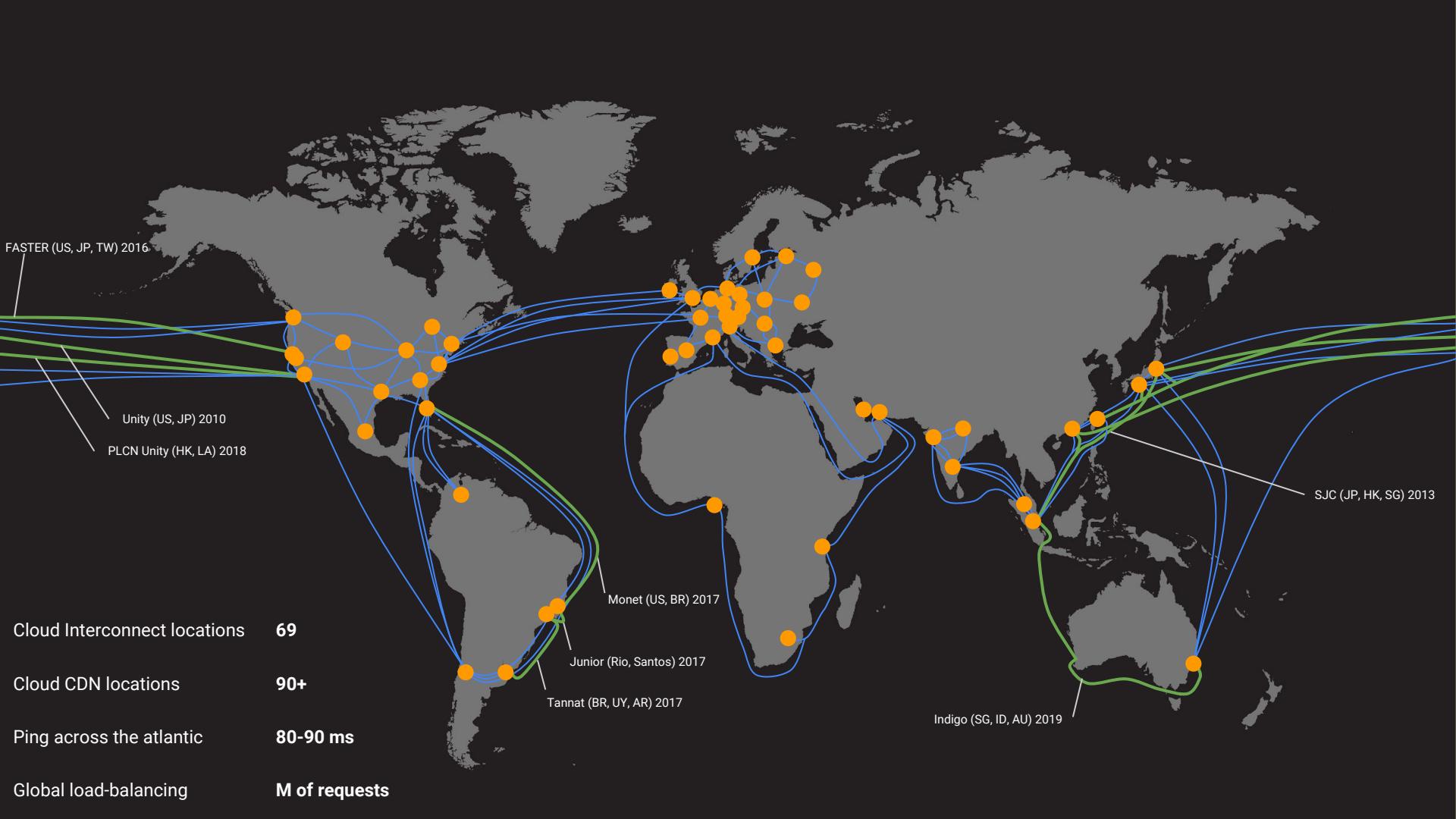
Location: United States

Genomics BigQuery

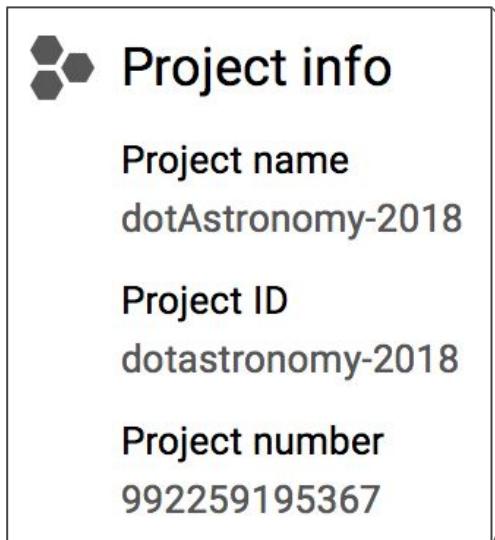


# Overview of Relevant Google Cloud Services





# Organizations vs. Projects



The Google Cloud Platform Dashboard for the project "dotAstronomy-2018". The dashboard includes the following sections:

- Project info**: Displays the project name (dotAstronomy-2018), project ID (dotastronomy-2018), and project number (992259195367). A link to "Go to project settings" is also present.
- Resources**: Shows App Engine (1 version), Cloud Storage (2 buckets), and BigQuery (1 dataset).
- Trace**: States "No trace data from the past 7 days" and links to "Get started with Stackdriver Trace".
- App Engine**: A chart titled "Summary (count/sec)" showing request counts over time. A red triangle indicates a "Request timed out." event at 12:45. A link to "Go to the App Engine dashboard" is provided.
- APIs**: A chart titled "Requests (requests/sec)" showing API request rates. A red triangle indicates a "Request timed out." event at 12:45. A link to "Learn how to set up Error Reporting" is provided.
- Google Cloud Platform status**: Shows "All services normal" and a link to "Go to Cloud status dashboard".
- Billing**: Shows estimated charges of USD \$27.88 for the period Sep 1 – 24, 2018. A link to "View detailed charges" is provided.
- Error Reporting**: States "No sign of any errors. Have you set up Error Reporting?" and a link to "Learn how to set up Error Reporting".
- News**: A news item about visualizing IoT data on Google Cloud Platform, posted 1 hour ago. A link to "Visualize 2030: Google Cloud hosts data storytelling" is provided.

# GCP ↔ On-Prem Connectivity options



## Public internet/VPN

- Simple
- Resilient
- Use Google's existing edge network



## Dedicated interconnect

- Lower GCP egress cost
- Dedicated bandwidth and SLA at up to 100 Gbps
- Private space RFC-1918 addressing
- 70+ locations in 33 countries



## Direct peering

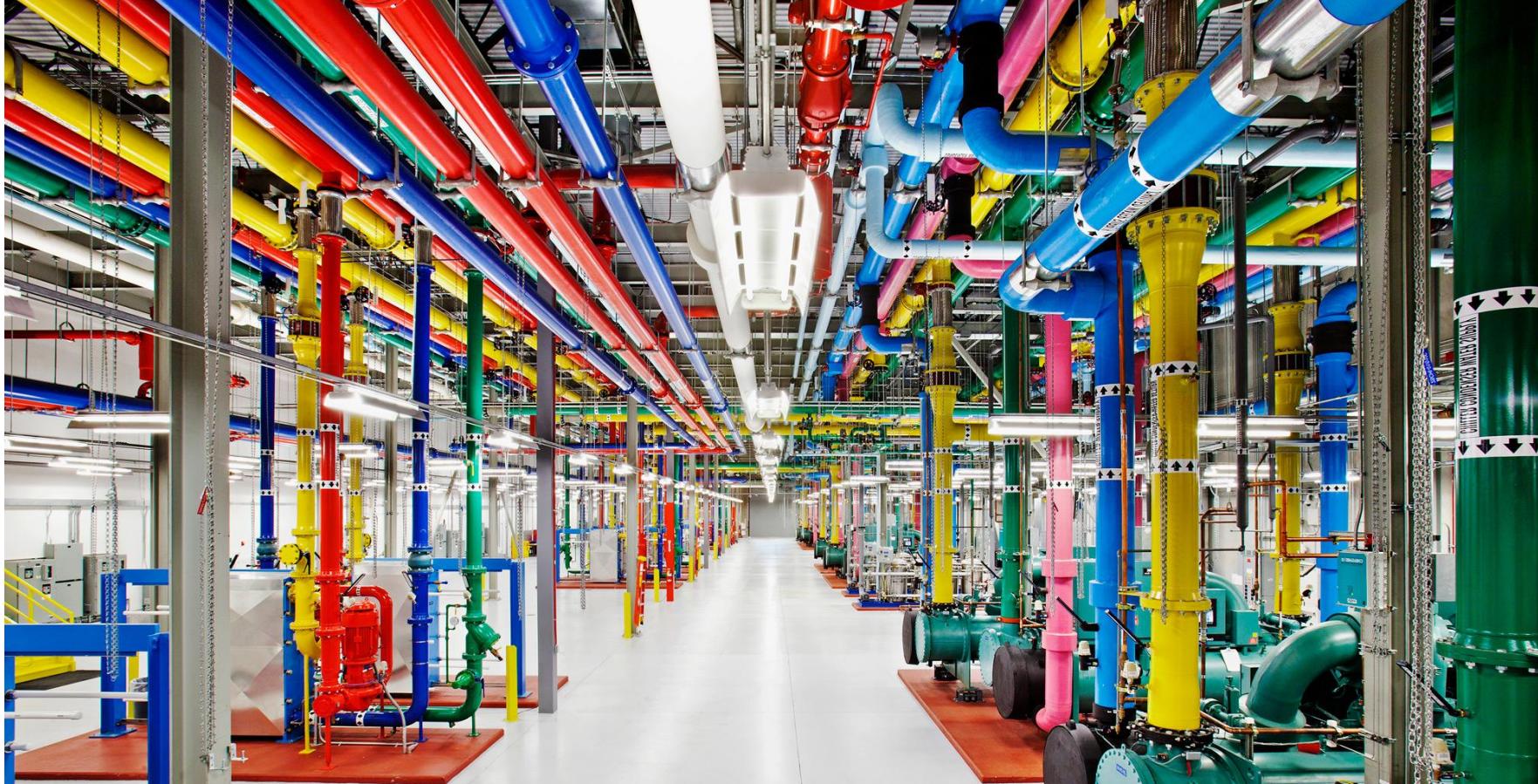
- Utilizes existing BGP route selection and internet routing
- Greater control of peering facilities
- Requirements for peering



## Carrier Peering

- Offers benefits of peering when requirements cannot be met
- Service provider partners can provide SLA







A **GCP project** is a global and locked-down resource

Communication between resources in different projects require Shared VPC

A project can contain many **GCE networks**, which are global

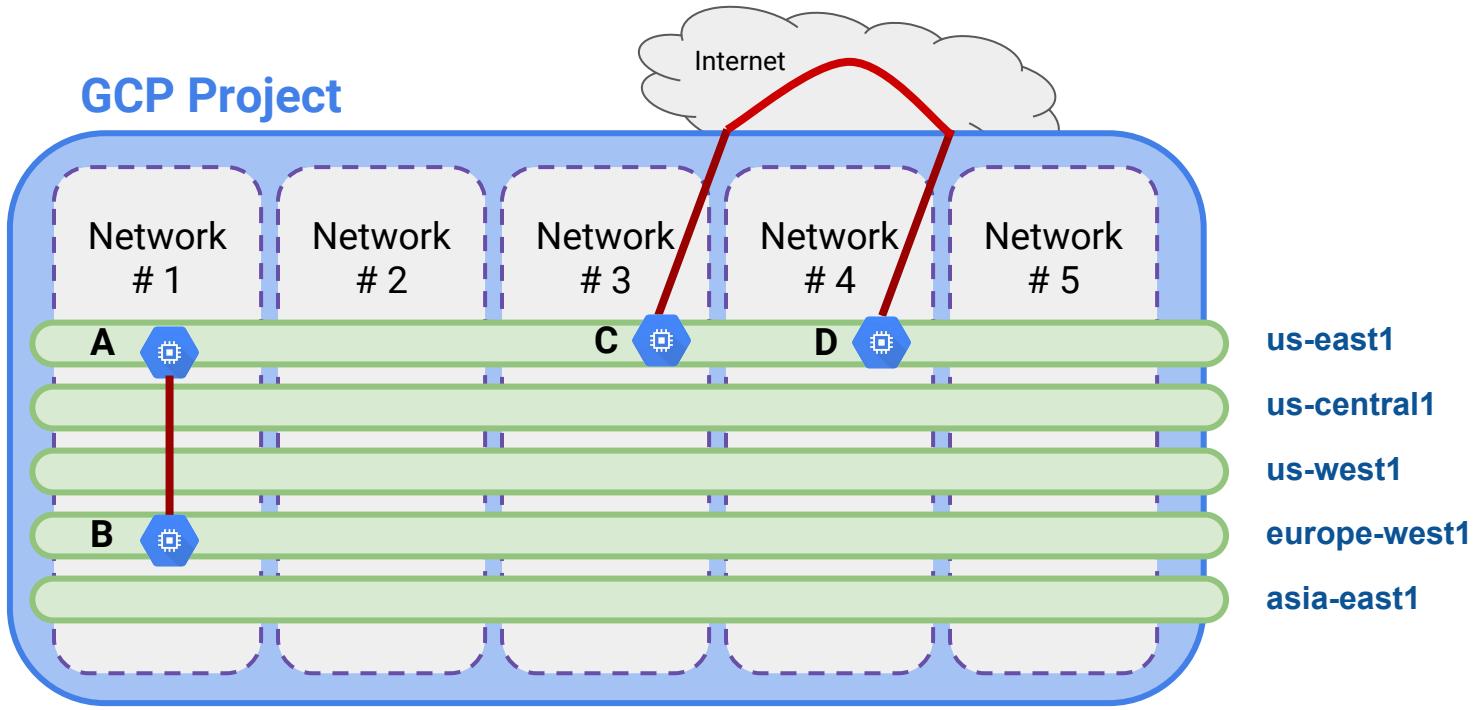
Machines in different zones/regions can live on the same network

**Load balancing** is just a forwarding rule

A single anycast IP to all backend instances in any region

**Network egress** is charged when data is crossing regions

Irrespective if they are connected through a GCP network or not



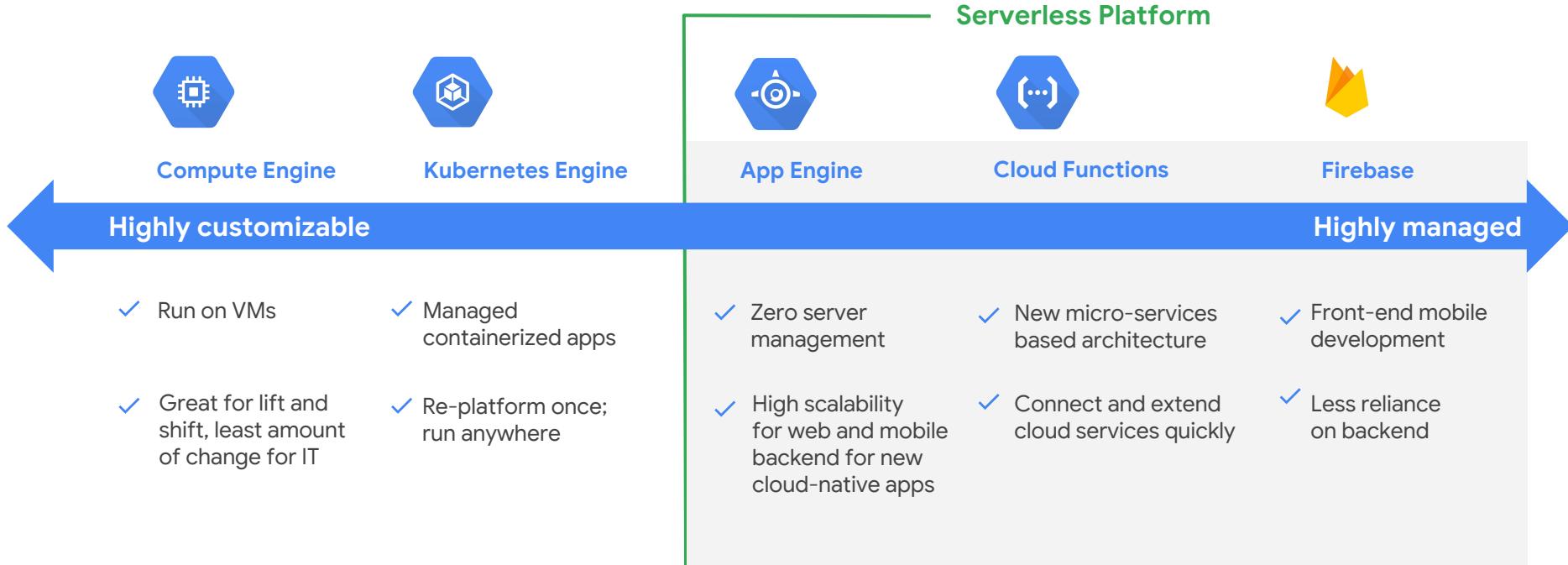
1. A and B can communicate over Internal IPs even though they are *in different regions*
2. C and D must communicate over External IPs even though they are *in the same region*



# The compute continuum

*Hosting infrastructure, containers, apps, and code*

# Compute continuum





# Compute Engine

## Full control: VMs for Linux and Windows Server

### Machine type

Customize to select cores, memory and GPUs.

**Basic view**

**Cores**

96 vCPU 1 - 96

**Memory**

460 GB 86.4 - 624

Extend memory ?

**CPU platform** ?

Intel Skylake or later

**GPUs**

[Choosing a machine type](#) ↗

# How to create your first GCE VM image

```
# Start with a small ubuntu instance
gcloud compute instances create --image-project ubuntu-os-cloud --image ubuntu-1804-bionic-v20180911
--machine-type n1-highmem-8 --boot-disk-size 250GB --boot-disk-type pd-ssd --zone us-west1-b
ubuntu-18-04

# Delete the VM, but keep the disk
gcloud compute instances delete ubuntu-18-04 --keep-disks all

# Create a VM image from the disk
gcloud compute images create my-ubuntu-18-04 --source-disk ubuntu-18-04

# Launch a new VM using the image
gcloud compute instances create --image my-ubuntu-18-04 --machine-type n1-highmem-2 my-new-ubuntu-vm

# Now that you have verified that the image works, you can delete the disk from your source image
gcloud compute disks delete ubuntu-18-04
```



## Kubernetes Engine

Open source Kubernetes-based container orchestration

- Managed by Google
  - Runs a stable, vetted and modern K8s release
    - Optionally use time-limited ‘alpha clusters’
  - Master node managed and upgraded by Google
  - Optional auto-upgrades for worker nodes
  - Zonal and regional clusters
- Nodes run Container-optimised OS
  - Backed by Chromium team
  - Security hardened
  - In-place upgrades and downgrades

Kubernetes Engine - marcus-bench

Secure | https://pantheon.corp.google.com/kubernetes/list?project=marcus-bench

## Google Cloud Platform marcus-bench

Kubernetes Engine

Kubernetes clusters

CREATE CLUSTER REFRESH DELETE SHOW INFO PANEL

Kubernetes clusters

Filter by label or name

Name	Location	Cluster size	Total cores	Total memory	Notifications	Labels
cluster-1	us-central1-a	3	3 vCPUs	11.25 GB		<a href="#">Connect</a> <a href="#">Edit</a> <a href="#">Delete</a>
cluster-2	europe-west1-d	3	3 vCPUs	11.25 GB		<a href="#">Connect</a> <a href="#">Edit</a> <a href="#">Delete</a>
cluster-3	asia-east1-b	3	3 vCPUs	11.25 GB		<a href="#">Connect</a> <a href="#">Edit</a> <a href="#">Delete</a>

Cloud Launcher

Show build data



## App Engine

Deploy your code and we scale it for you

- PHP, Python 2.7/3.5, Java, Go, Node.JS, Ruby, & Custom Runtimes
- Applications run within containers which can be extracted and run elsewhere
- Build **services**, deploy **versions**, auto-scale **instances**
- Integrated debugging, tracing, logging and monitoring



## Cloud Functions

Serverless platform for event-based microservices

- Isolated, secure execution context and lifecycle
- Written in Javascript, executed in Node.js runtime
  - Portability: write and test locally
  - More runtimes to follow
- Triggered by
  - Cloud Pub/Sub topics
  - Cloud Storage object notifications
  - HTTP endpoints
- Access all GCP services using standard GCP client libraries



# Stackdriver



## Monitoring

Platform, system, &  
application metrics  
Uptime/health checks  
Dashboards  
Alerts



## Logging

Platform, system, &  
application logs  
Log search, view,  
filter and  
logs-based metrics



## Debug

Production debug  
snapshots  
Conditional  
snapshots  
IDE integration  
Live breakpoints



## Trace

Invocation statistics  
Latency Reporting  
Per-URL latency  
sampling



## Error Reporting

Error notifications  
Error dashboard





## The storage suite

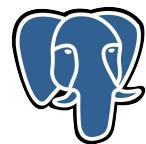
*Structured, unstructured, and everything in between*

Unstructured storage Blobs, plain text, etc.	Cache & look-ups Simple objects	NoSQL Non-relational (big) data	NewSQL “SQL that scales”	SQL OLTP	SQL OLAP
<b>Object storage</b>	<b>Block storage</b>	<b>Key-value stores</b>	<b>Columnar stores</b>	<b>Document stores</b>	<b>Spanner</b>
					
<b>Cloud Storage</b>	<b>Persistent Disk</b>	<b>Cloud Memorystore</b>	<b>Cloud Bigtable</b>	<b>Cloud Datastore</b>	<b>Cloud Spanner</b>
Multiple storage classes	HDD, SSD, and Local SSD	Fast and simple look-ups	Heavy read/writes, low-latency	“Replicated and sharded Bigtable”	Transaction scale-out with global consistency
Images, static assets, backups, etc.	Boot and file partitions	User sessions Game states Caching layer	Ads, finance, IoT, time series	User profiles, product catalog, stream posts	Large and/or global databases
					Any relational data
					Any (relational) data



## Cloud Launcher

Explore, deploy, and manage 3rd party solutions



PostgreSQL



redis



cassandra



mongoDB®



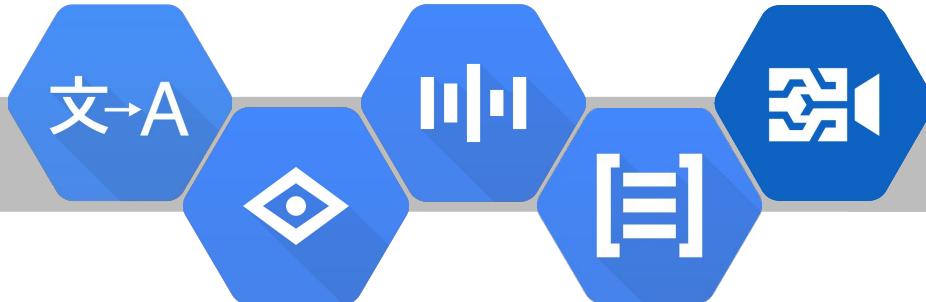
elasticsearch.





## Big data and machine learning

*Fully managed lifecycle of data and ML jobs*



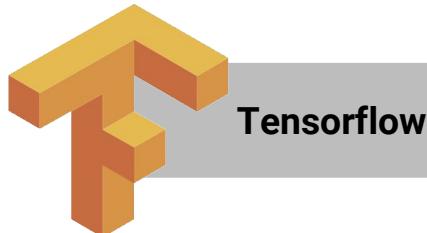
## Google-trained ML APIs

*Translate, Vision, Speech, Natural Language, and Video*



## Cloud ML Engine

*Train and host your own Tensorflow model*



## Tensorflow

# NVIDIA GPUs

Ideal for simulations, analysis, transcoding, and ML

8

Attach up to 8 GPUs per VM

Attached directly to the VM via PCIe x16  
to achieve bare-metal performance.



Per second billing  
Preemptible support (~50% off)

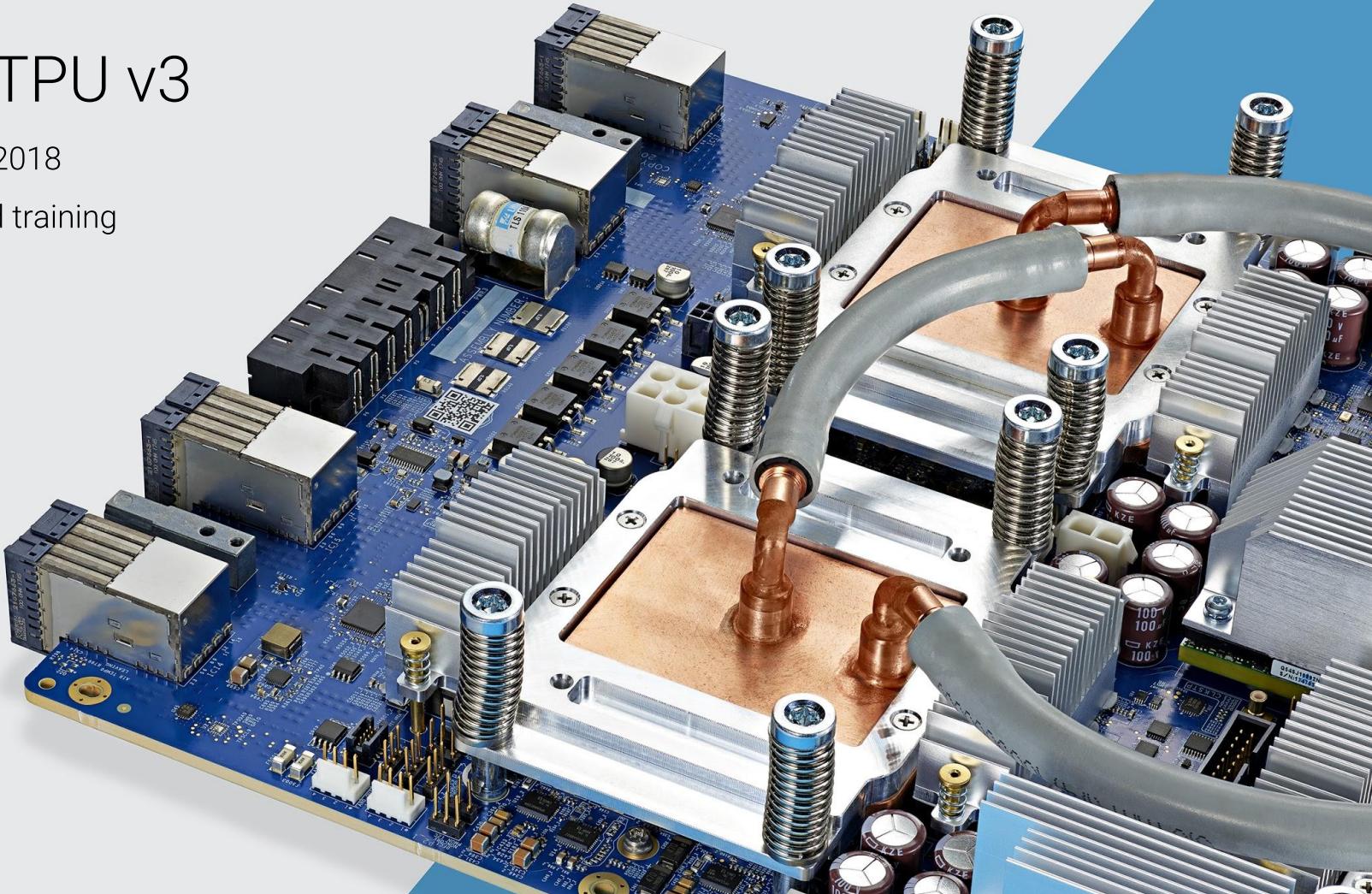
NVIDIA Tesla K80  
NVIDIA Tesla P100  
NVIDIA Tesla V100



# Cloud TPU v3

Launched in 2018

Inference and training



# What is BigQuery?

Google Cloud Platform's enterprise data warehouse for analytics



Petabyte-scale storage and queries

Convenience of standard SQL

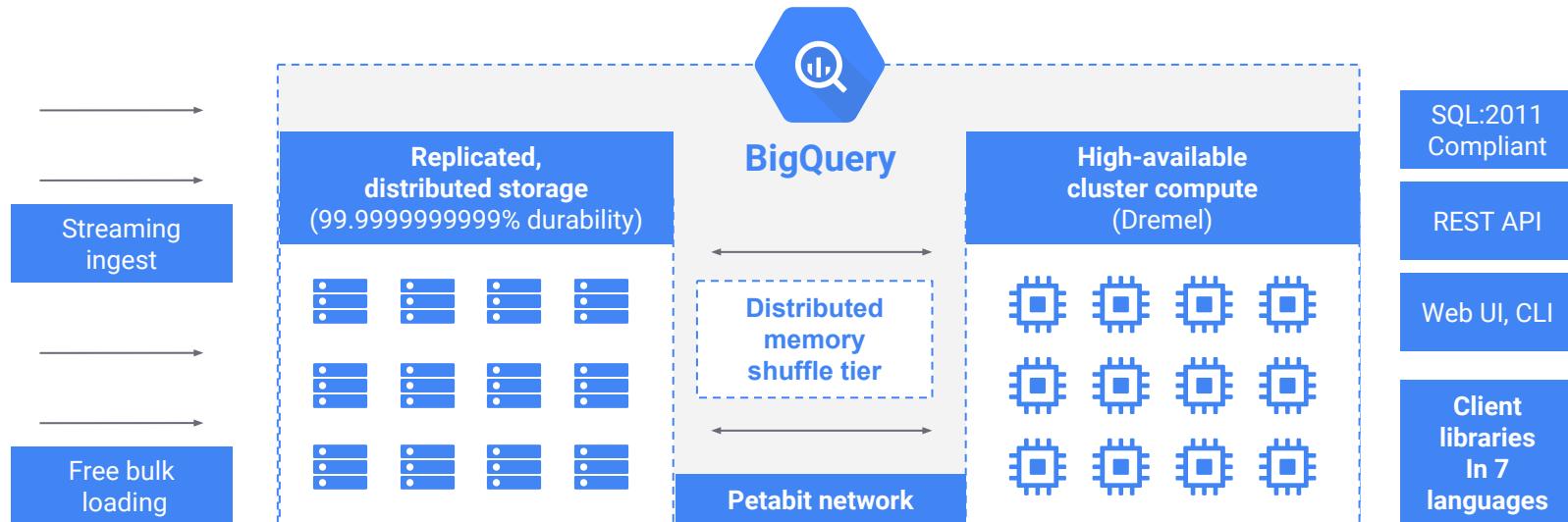
Encrypted, durable and highly available

Fully managed and serverless

Real-time analytics on streaming data

# BigQuery: Architecture

Serverless, decoupled storage and compute for maximum flexibility



# Introducing BigQuery ML

**Execute** ML initiatives without moving data from BigQuery

**Iterate** on models in SQL in BigQuery to increase development speed

**Automate** model selection, and hypertuning



BigQuery ML empowers data analysts and data scientists

# BigQuery ML

Use SQL to...

```
#standardSQL
SELECT
  *
FROM
  ML.EVALUATE(MODEL `bqml_tutorial.sample_model`, (
SELECT
  IF(totals.transactions IS NULL, 0, 1) AS label,
  IFNULL(device.operatingSystem, "") AS os,
  device.isMobile AS is_mobile,
  IFNULL(geoNetwork.country, "") AS country,
  IFNULL(totals.pageviews, 0) AS pageviews
FROM
  `bigquery-public-data.google_analytics_sample.ga_sessions_*`
WHERE
  _TABLE_SUFFIX BETWEEN '20170701' AND '20170801'))
```

## Step 1: Create and train your model

```
#standardSQL
CREATE MODEL `bqml_tutorial.sample_model`
OPTIONS(model_type='logistic_reg') AS
SELECT
  IF(totals.transactions IS NULL, 0, 1) AS label,
  IFNULL(device.operatingSystem, "") AS os,
  device.isMobile AS is_mobile,
  IFNULL(geoNetwork.country, "") AS country,
  IFNULL(totals.pageviews, 0) AS pageviews
FROM
  `bigquery-public-data.google_analytics_sample.ga_sessions_*`
WHERE
  _TABLE_SUFFIX BETWEEN '20160801' AND '20170630'
```

## Step 2: Evaluate your model

```
#standardSQL
SELECT
  country,
  SUM(predicted_label) as total_predicted_purchases
FROM
  ML.PREDICT(MODEL `bqml_tutorial.sample_model`, (
SELECT
  IFNULL(device.operatingSystem, "") AS os,
  device.isMobile AS is_mobile,
  IFNULL(totals.pageviews, 0) AS pageviews,
  IFNULL(geoNetwork.country, "") AS country
FROM
  `bigquery-public-data.google_analytics_sample.ga_sessions_*`
WHERE
  _TABLE_SUFFIX BETWEEN '20170701' AND '20170801'))
GROUP BY country
ORDER BY total_predicted_purchases DESC
LIMIT 10
```

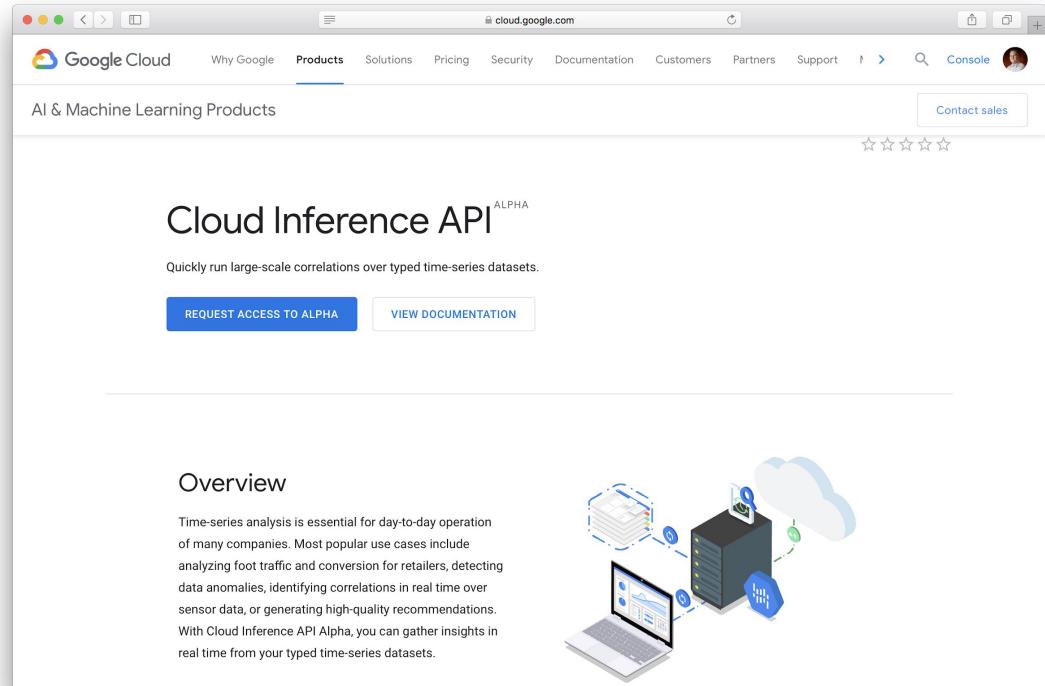
## Step 3: Make predictions



# Cloud Inference API

Recently launched in Alpha:

- Time-series analysis
- Detecting data anomalies
- Identifying correlations in real time over sensor data
- Generate high-quality recommendations



The screenshot shows a web browser window for [cloud.google.com](https://cloud.google.com). The navigation bar includes links for Google Cloud logo, Why Google, Products (which is underlined), Solutions, Pricing, Security, Documentation, Customers, Partners, Support, and a search bar. A "Console" link and a user profile icon are also present. Below the navigation, a secondary header says "AI & Machine Learning Products". On the right, there's a "Contact sales" button and a five-star rating. The main content area features the heading "Cloud Inference API<sup>ALPHA</sup>". Below it is a sub-headline: "Quickly run large-scale correlations over typed time-series datasets." Two buttons are visible: "REQUEST ACCESS TO ALPHA" (blue) and "VIEW DOCUMENTATION" (white). A horizontal line separates this from the "Overview" section. The "Overview" text discusses the importance of time-series analysis for day-to-day operations and lists use cases like foot traffic analysis, anomaly detection, real-time correlation identification, and recommendation generation. It concludes by mentioning the Cloud Inference API Alpha's capability to gather insights in real time from typed time-series datasets. To the right of the text is a 3D-style illustration of a server tower connected to a laptop displaying a chart, with a cloud icon above them.

# Stream data analytics on Google Cloud Platform

## Ingest

Ingest and distribute data reliably



Cloud Pub/Sub

## Transform

Fast, correct computations quickly and simply



Cloud Dataflow

## Analyze

Machine learning & data warehouse



BigQuery



Cloud Machine Learning



Cloud Translation API

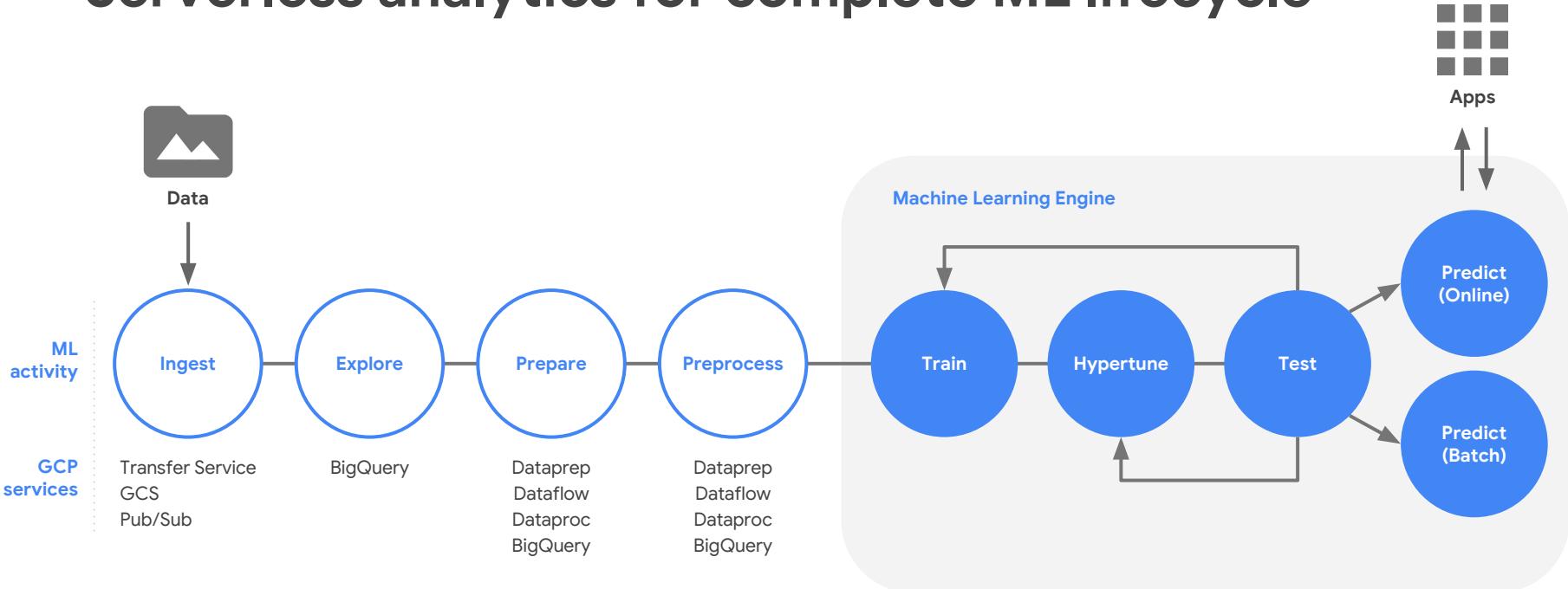


Cloud Vision API



Cloud Natural Language API

# Serverless analytics for complete ML lifecycle



# Google Colaboratory

Jupyter notebook environment

Fully managed by Google

Free-to-use

Notebooks stored in Google drive

Also includes GPU support

The screenshot shows the Google Colaboratory interface. On the left, there's a sidebar with a 'Table of contents' section containing links to various documentation pages like 'Cells', 'Code cells', 'Text cells', etc. The main area has tabs for 'CODE', 'TEXT', 'CELL', and 'FILE'. A 'COPY TO DRIVE' button is also present. The current tab is 'CODE'. Below the tabs, there's a section titled 'Rich, interactive outputs' with a note: 'Until now all of the generated outputs have been text, but they can be more interesting, like the chart below.' It shows a Python code snippet and its resulting plot. The plot is titled 'Fills and Alpha Example' and displays a green filled area plot with a semi-transparent blue line representing a boundary or mean.

```
[ ] import numpy as np
from matplotlib import pyplot as plt
ys = 200 + np.random.randn(100)
x = [x for x in range(len(ys))]
plt.plot(x, ys, '-')
plt.fill_between(x, ys, 195, where=(ys > 195), facecolor='g', alpha=0.6)
plt.title("Fills and Alpha Example")
plt.show()
```

**Rich, interactive outputs**

Until now all of the generated outputs have been text, but they can be more interesting, like the chart below.

```
[ ] import numpy as np
from matplotlib import pyplot as plt
ys = 200 + np.random.randn(100)
x = [x for x in range(len(ys))]
plt.plot(x, ys, '-')
plt.fill_between(x, ys, 195, where=(ys > 195), facecolor='g', alpha=0.6)
plt.title("Fills and Alpha Example")
plt.show()
```

203  
202  
201  
200  
199  
198  
197  
196  
195

0 20 40 60 80 100

**Integration with Drive**

Colaboratory is integrated with Google Drive. It allows you to share, comment, and collaborate on the same document with multiple people:

- The **SHARE** button (top-right of the toolbar) allows you to share the notebook and control permissions set on it.
- **File->Make a Copy** creates a copy of the notebook in Drive.
- **File->Save** saves the File to Drive. **File->Save and checkpoint** pins the version so it doesn't get deleted from the revision history.

# Things to try at .Astronomy X

# Enjoy the GCP Free Tier

The screenshot shows the Google Cloud Platform Free Tier landing page. At the top, the Google Cloud logo is visible. Below it, the text "Google Cloud Platform Free Tier" is displayed. A central call-to-action button says "VIEW MY CONSOLE". The background features a blue hexagonal grid pattern. At the bottom, there are two main options: "12 Months" and "Always Free". The "12 Months" section includes a note about \$300 free credit and a teal plus sign icon. The "Always Free" section includes a note about usage limits and a vertical column of five circular icons with symbols: a red X, a green pencil, a blue arrow, a blue circle, and an orange wrench.

Google Cloud Platform

Google Cloud Platform Free Tier

Learn and build on GCP for free.

VIEW MY CONSOLE

12 Months

\$300 free credit to get started with any GCP product.

+

Always Free

Free usage limits on participating products for eligible customers, during and after the free trial. Offer is subject to change.

# Check out the GCP Codelabs

The screenshot shows a Google Chrome window with the URL [codelabs.developers.google.com/codelabs/hpc-slurm-on-gcp/](https://codelabs.developers.google.com/codelabs/hpc-slurm-on-gcp/). The page title is "Deploy an Auto-Scaling HPC Cluster with Slurm". On the left, a vertical sidebar lists seven steps: 1. Overview (selected), 2. Setup, 3. Prepare and Review Slurm Deployment Configuration, 4. Deploying and verifying the configuration, 5. Login to the Slurm Cluster, 6. Run a Slurm Job and Scale the Cluster, and 7. Conclusion. Step 1 has a blue circle with a white number 1. The main content area shows "1. Overview" with a sub-section about the Slurm workload manager. It features the Slurm logo (blue squares forming a grid) and the text "slurm workload manager". Below the logo, it says: "Google Cloud teamed up with [SchedMD](#) to release a set of tools that make it easier to launch the Slurm workload manager on Compute Engine, and to expand your existing cluster dynamically when you need extra resources. This integration was built by the experts at [SchedMD](#) in accordance with Slurm best practices." At the bottom, there's a "Did you find a mistake? Please file a bug." link and a "Next" button.

Codelabs are self-paced tutorials that you run in your own GCP project.

Take as long as you like.

Be sure to clean up all resources or simply delete the project when you are finished.

Many codelabs are available at [codelabs.developers.google.com](https://codelabs.developers.google.com)

<https://codelabs.developers.google.com/codelabs/hpc-slurm-on-gcp/>

# Take advantage of free Qwiklabs

The screenshot shows a Google Chrome window with the following details:

- Title Bar:** "New Qwiklabs Quest available: Data Science on Google Cloud Platform"
- URL:** <https://cloud.google.com/blog/topics/training-certifications/new-qwiklabs-quest-available-data-science-google-cloud-platform>
- Page Content:**
  - Section Header:** "New Qwiklabs Quest available: Data Science on Google Cloud Platform"
  - Author:** "Google Cloud Training & Certifications Team"
  - Date:** "September 19, 2018"
  - Text:** "Data science and machine learning are two of the most in demand skill-sets available today according to a recent [Harvard Business Review article](#). The U.S. Bureau of Labor Statistics predicts that job growth in these areas will create 11.5 million jobs through 2026. Interest in data science and machine learning has grown dramatically as indicated by analysis of data available on [Google Trends](#) (interest in "web programming" is also shown as a baseline)."
  - Google Trends Comparison:** A chart comparing search interest over time for "data science", "machine learning", and "web programming". The chart shows a significant increase in interest for both data science and machine learning starting around 2012.
- Right Sidebar:** Social sharing icons for G+, Facebook, Twitter, LinkedIn, and Email.

Qwiklabs are self-paced tutorials that run within a GCP account managed by Google.

They typically take 30-60 minutes to complete.

Environments disappear after a few hours.

We typically charge by the lab, but some 'quests' or tracks are free. For example, the "Data Science on GCP" 'quest'.

[google.qwiklabs.com/home](http://google.qwiklabs.com/home)

New Qwiklabs Quest available: Data Science on Google Cloud Platform

TRAINING AND CERTIFICATIONS

# New Qwiklabs Quest available: Data Science on Google Cloud Platform

Google Cloud Training & Certifications Team

September 19, 2018

Data science and machine learning are two of the most in demand skill-sets available today according to a recent [Harvard Business Review article](#). The U.S. Bureau of Labor Statistics predicts that job growth in these areas will create 11.5 million jobs through 2026. Interest in data science and machine learning has grown dramatically as indicated by analysis of data available on [Google Trends](#) (interest in "web programming" is also shown as a baseline).

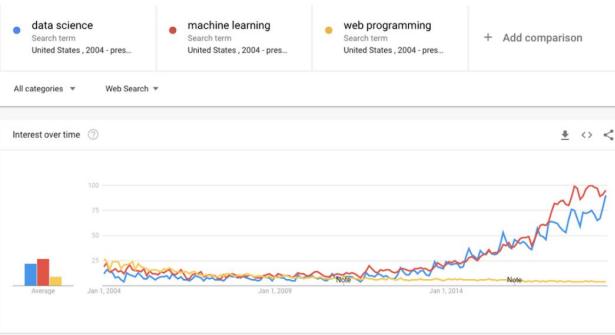
G+ 

f 

t 

in 

e 



The chart displays search interest for three terms: data science (blue), machine learning (red), and web programming (yellow). The Y-axis represents interest level from 0 to 100. The X-axis shows dates from Jan 1, 2004, to Jan 1, 2016. All three terms show a significant increase in interest starting around 2010, with data science and machine learning showing the most dramatic growth.

A screenshot of a GitHub browser window. The URL is https://github.com/wardharold/juli... The repository is wardharold/julia-notebook. The page shows a file named julia-notebook/tutorial.md. The content of the file is a Jupyter Notebook cell containing the following text:

## Run a private Julia Jupyter Notebook server on Google Cloud Platform

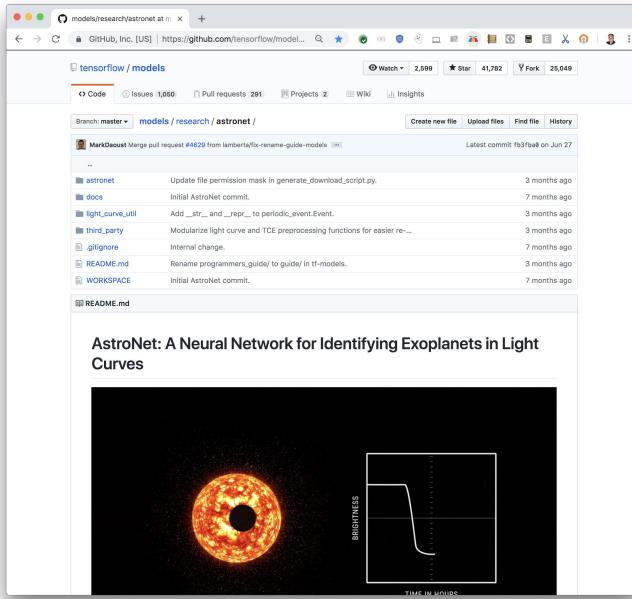
This tutorial shows you how to set up a Jupyter Notebook server with a [Julia](#) kernel installed in a Google Cloud Platform project.

[Open in Google Cloud Shell](#)

**Sandbox:** <https://github.com/wardharold/julia-notebook/blob/master/tutorial.md>

**Production:** <https://github.com/wardharold/community/blob/master/tutorials/julia-jupyter-notebook-server/index.md>

# Analyze Kepler Data Using Tensorflow



Note that this tutorial is designed to use GCE VMs with GPUs or TPUs. These aren't included in the GCP free tier. Also, before you can launch VMs with GPUs or TPUs, you will need to submit a quota request by visiting the GCP web console and searching for "quota."

In the meantime, let me know if you are interested in trying this out. If so, I can grant you access to one of my projects with access to GPUs and TPUs.

# “Serverless” GraphQL on Cloud Functions (for Arfon)

GraphQL Server on Cloud Functions for Firebase

The smoothest GraphQL on FaaS DX to date!

- [Table of Contents](#)
- Previously—[Express.js on Cloud Functions for Firebase](#)
- Continuing on—[Next.js on Cloud Functions for Firebase with Firebase Hosting](#)

Welcome to a series exploring Cloud Functions for Firebase with a modern application stack (React, Apollo, GraphQL, Next.js & Firebase). If you are not familiar with this stack, read on! If you are familiar, checkout the TOC above.

GraphQL on Cloud Functions for Firebase

nicolasdao / google-graphql-functions

Run graphql queries on Google Cloud Functions (beta). This package can also serve a GraphiQL UI out-of-the-box. This project is mainly a modification of the excellent expressjs-graphql maintained by Facebook. This project is published using a BSD-style licence.

graphql-api graphql google-cloud-functions google-cloud

65 commits 2 branches 21 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

nicolasdao Update README.md Latest commit 1fc4c48b on Aug 20, 2017

File	Description	Age
src	fix: Issue when serving the GrappQL option object using a function in...	a year ago
test	fix: Test	a year ago
.DS_Store	1st commit	a year ago
.eslintrc.json	feat: Add support for POST using text/plain content-type	a year ago
.gitignore	1st commit	a year ago
.travis.yml	feat: Add routing support + add unit test + travis config	a year ago
CHANGELOG.md	chore(release): 0.1.0-alpha.20	a year ago
LICENSE	1st commit	a year ago
README.md	Update README.md	a year ago
package.json	chore(release): 0.1.0-alpha.20	a year ago

README.md

```
<a href="https://neap.co" target="_blank"></a>
# GraphQL For Google Cloud Functions
[[1]][2] [[3]][4]

[1]: https://img.shields.io/npm/v/google-graphql-functions.svg?style=flat
[2]: https://www.npmjs.com/package/google-graphql-functions
[3]: https://travis-ci.org/nicolasdao/google-graphql-functions.svg?branch=master
[4]: https://travis-ci.org/nicolasdao/google-graphql-functions
```

<https://github.com/nicolasdao/google-graphql-functions>

<https://codeburst.io/graphql-server-on-cloud-functions-for-firebase-ae97441399c0>



# Resources

*Getting up to speed*

Documentation: <https://cloud.google.com/docs/>  
Product pages and docs

Google Support Center: <http://enterprise.google.com/supportcenter>  
File support cases through the portal, via email, or by phone

GCP tags on Stack overflow: <https://www.stackoverflow.com>  
Actively monitored by Eng/PM staff

Slack: <http://googlecloud-community.slack.com/>  
Unofficial, but full of customers and googlers talking about GCP

Training: <https://cloud.google.com/training/>

Three categories of training, each with multiple webinars/classes

Certifications: <https://cloud.google.com/certification/>

Cloud Architect (coming soon) and Data Engineer (available now)

Coursera: <https://www.coursera.org/learn/gcp-fundamentals>

Highly recommended self-study on GCP Fundamentals

Code labs: <https://codelabs.developers.google.com/>

Covers all things Google, but also GCP and Kubernetes extensively

Google SRE book: <https://landing.google.com/sre/book/index.html>  
This [book](#), but online and free

Research papers: <https://research.google.com/>  
Lots of research, including several on container technology: [1](#), [2](#), and [3](#)

Solution papers: <https://cloud.google.com/docs/tutorials>  
Hidden gem. Lots of good architecture solution papers.

Google Cloud Next videos: <https://goo.gl/c1Vs3h>  
All recorded content from Google Cloud Next 2017

The screenshot shows a web browser window with two tabs open: "Google Cloud Platform for AWS" and "Google Cloud Platform for Azure". The main content area displays the "Google Cloud Platform for AWS Professionals" page. The page has a header with the Google Cloud logo and navigation links for Documentation, CONTACT SALES, and a user profile. Below the header, a breadcrumb trail shows "Documentation > Google Cloud Platform for AWS Professionals". The main title is "Google Cloud Platform for AWS Professionals". On the left, there is a "Contents" sidebar with a blue vertical bar. The contents listed are: Why Google Cloud Platform?, Regions and zones, Accounts, limits, and pricing, Resource management interfaces, Service types, Service comparison, and What's next?. Below the sidebar, a note states "Updated June 29, 2016". The main text area describes the guide's purpose: "This guide is designed to equip professionals who are familiar with Amazon Web Services (AWS) with the key concepts required to get started with Google Cloud Platform. The guide compares Cloud Platform with AWS and highlights the similarities and differences between the two. In addition, the guide provides quick-reference mappings of AWS products, concepts, and terminology to the corresponding products, concepts, and terminology on Cloud Platform." At the bottom, a light blue callout box contains a note: "★ Note: This guide doesn't attempt to compare the syntax and semantics of the SDK, APIs, or command-line tools provided by AWS and Cloud Platform."

Google Cloud Platform for AWS

Secure | https://cloud.google.com/docs/compare/aws/

☰ Google Cloud Platform

CONTACT SALES

Documentation > Google Cloud Platform for AWS Professionals

## Google Cloud Platform for AWS Professionals

**Contents**

- Why Google Cloud Platform?
- Regions and zones
- Accounts, limits, and pricing
- Resource management interfaces
- Service types
- Service comparison
- What's next?

*Updated June 29, 2016*

This guide is designed to equip professionals who are familiar with Amazon Web Services (AWS) with the key concepts required to get started with Google Cloud Platform. The guide compares Cloud Platform with AWS and highlights the similarities and differences between the two. In addition, the guide provides quick-reference mappings of AWS products, concepts, and terminology to the corresponding products, concepts, and terminology on Cloud Platform.

**★ Note:** This guide doesn't attempt to compare the syntax and semantics of the SDK, APIs, or command-line tools provided by AWS and Cloud Platform.

The screenshot shows a web browser window with two tabs open: "Google Cloud Platform for AWS" and "Google Cloud Platform for Azure". The active tab is "Google Cloud Platform for Azure". The URL in the address bar is <https://cloud.google.com/docs/compare/azure/>. The page title is "Google Cloud Platform". The main content area has a header "Documentation" and a "CONTACT SALES" button. Below the header, the breadcrumb navigation shows "Documentation > Google Cloud Platform for Azure Professionals". The main title is "Google Cloud Platform for Azure Professionals". On the left, there is a "Contents" sidebar with the following items: "Why Google Cloud Platform?", "Regions and zones", "Isolation and availability", "Accounts and quotas", and an ellipsis "...". The main content area includes a timestamp "Updated July 18, 2017" and a descriptive paragraph about the guide's purpose. It also states that the guide does not attempt to compare syntax and semantics of SDKs, APIs, or command-line tools. A note at the bottom indicates that the set of articles compares Cloud Platform services to Azure services as they are used in the Resource Manager deployment model, and that the articles do not discuss Azure's deprecated classic.

Google Cloud Platform for Azure Professionals

Documentation > Google Cloud Platform for Azure Professionals

Google Cloud Platform for Azure Professionals

Contents

- Why Google Cloud Platform?
- Regions and zones
- Isolation and availability
- Accounts and quotas

\*\*\*

*Updated July 18, 2017*

This guide is designed to equip professionals who are familiar with Microsoft Azure with the key concepts required to get started with Google Cloud Platform. The guide compares Cloud Platform with Azure and highlights the similarities and differences between the two. In addition, the guide provides quick-reference mappings of Azure products, concepts, and terminology to the corresponding products, concepts, and terminology on Cloud Platform.

This guide doesn't attempt to compare the syntax and semantics of the SDK, APIs, or command-line tools provided by Azure and Cloud Platform.

**Note:** This set of articles compares Cloud Platform services to Azure services as they are used in the Resource Manager deployment model. The articles do not discuss Azure's deprecated classic

# Questions?