

GCP Guide for CS224n

For your class project, we recommend setting up a GPU instance on GCP (Google Cloud Platform).

BIG REMINDER: Make sure you stop your instances once you are done running!

(We know you won't read until the very bottom once your assignment is running, so we are printing this at the top too since it is super important)

Don't forget to stop your instance when you are done (by clicking on the stop button at the top of the page showing your instances), otherwise you will run out of credits and that will be very sad. :(

If you follow our instructions below correctly, you should be able to restart your instance and the downloaded software will still be available.

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Colab vs GCP

While [Colab](#) is good for assignments, and is still a helpful and free tool for experimentation for your project, you will likely need a dedicated GPU instance when you start training on large datasets and collaborating as a team:

- Colab will disconnect after 12 hours or ~30 min of idling (and you will lose your unsaved data). A GCP VM instance will not disconnect until you stop it (or run out of credits).
- A GCP VM instance's disk space allows you to deal with larger datasets. In Colab's case, you will have to save all your data and models to Google Drive.
- Colab does not innately support real-time collaboration.
- You can choose your GPU models and can set >1 GPUs for distributed training on GCP.

Create and Configure Your Account

You should use your personal GMail account for GCP, i.e. NOT SUID@stanford.edu, because Stanford University managed email accounts do not support creating a new project.

For the class project, we offer students \$50 GCP coupons for each student to use Google Compute Engine for developing and testing your implementations. When you first sign up on GCP, you will have \$300 free credits. You can receive these credits by using an account that has not previously been used for GCP.

This tutorial lists the necessary steps of working on the projects using Google Cloud. We expect this tutorial to take up to an hour. Don't get intimidated by the steps, we tried to make the tutorial detailed so that you are less likely to get stuck on a particular step. Please tag all questions related to Google Cloud with Cloud (GCP) on Ed.

Sign Up GCP for the First Time

You should receive \$300 credits from Google when you first sign up with **Personal GMail** and also **UPGRADE it into a full account**. Please try to use the resources judiciously.

1. Create Google Cloud account by going to the [Google Cloud homepage](#). Click on the blue Get Started for free button. Sign into your Gmail account. Here is an illustrative

example.

The screenshot shows the initial step of creating a Google Cloud account. At the top, there's a 'Try Google Cloud for free' button. Below it, the title 'Step 1 of 2 Account Information' is displayed. On the left, a user profile is shown with a green 'M' icon, the name 'Mai Bhago', and the email 'maibhago224n@gmail.com'. A 'SWITCH ACCOUNT' link is also present. A dropdown menu for 'Country' is set to 'United States'. Below this, terms of service are listed: 'By using this application, you agree to the [Google Cloud Platform](#), [Supplemental Free Trial](#), and [any applicable services and APIs](#) Terms of Service.' A 'AGREE & CONTINUE' button is at the bottom. To the right, three sections provide additional information: 'Access to all Google Cloud products', '\$300 credit for free', and 'No autocharge after free trial ends'. Each section includes a brief description and a small decorative graphic of colored dots and dashed lines.

2. Choose Account type to be Individual. Click on create new payment profile and fill in details. Then, you will need to add a payment method. Between the two steps, you will then fill in your name, address and credit card information. You may need to verify your card.

The screenshot shows the second step of creating a payment profile. The title 'Step 2 of 2 Payment Information' is at the top. It includes a note about payment information being used to reduce fraud and prevent charges until manual activation. Below this, there are sections for 'Payments profile' (with a 'Create new payments profile' button) and 'Payment method' (with a 'Add payment method' button). A note says to complete previous sections before continuing. A 'START FREE' button is at the bottom left. The main focus is a 'Create a payments profile' form. It asks for 'Profile type' (set to 'Individual'), 'Legal name' (input field containing 'Mai Bhago'), 'Street address' (input field containing '353 Jane Stanford Way'), 'Apt, suite, etc. (optional)', 'City' (input field containing 'Palo Alto'), 'State' (dropdown menu showing 'California'), and 'Zip code' (input field containing '94301'). A 'Cancel' button is on the left and a 'Create' button is on the right. The background features the same decorative graphic of colored dots and dashed lines as the first screenshot.

3. Click the "Google Cloud" (in red circle), and it will take you to the main project dashboard. You can then click on the “My first project” link under “Welcome, Name.”

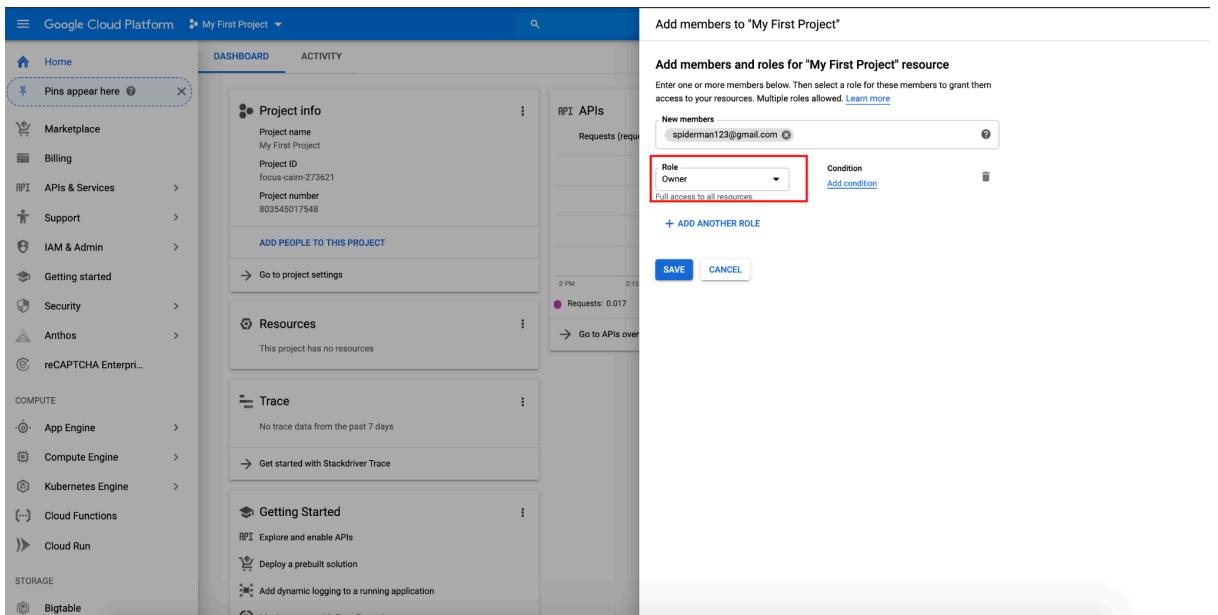
The screenshot shows the Google Cloud Project Dashboard. At the top, it says "Welcome, Mai Bhago". Below that, it says "You're working on project My First Project". There are buttons for "Add people to your project", "Set up budget alerts", and "Review product spend". To the right, there's a callout for "Try our most advanced model: Gemini 1.5 Pro Experimental" and a "Try Gemini" button. Below this, there's a section titled "Recommended based on your interest in General". It shows three pre-built solution templates: "Deploy a three-tier web app", "Deploy load balanced managed VMs", and "Create a data warehouse with BigQuery". There's also a "View all Solutions" button and a "Products" section.

Configure Your Project

1. On the main project dashboard, you can change the name of your project by clicking Go to project settings.

The screenshot shows the Google Cloud Platform Dashboard. On the left, there's a sidebar with links like Home, Marketplace, Billing, APIs & Services, Support, IAM & Admin, Getting started, Security, Anthos, and reCAPTCHA Enterprise. The main area has tabs for DASHBOARD and ACTIVITY. Under DASHBOARD, there's a "Project info" section with fields for Project name (My First Project), Project ID (focus-caim-273621), and Project number (803545017548). Below this, there are buttons for "ADD PEOPLE TO THIS PROJECT", "Go to project settings", and "Change your project name". Other sections include APIs (with a chart showing requests over time), Resources (which has none), Trace (with a note about no data for the past 7 days), and Getting Started (with links to API exploration and deployment). On the right, there are sections for Google Cloud Platform status (all services normal), Error Reporting (no signs of errors), News (about AI-driven features in Dataprep), and Documentation (links to Compute Engine, Cloud Storage, and App Engine).

2. To add project collaborators, click ADD PEOPLE TO THIS PROJECT. Add their email and make their role owners.



3. Upgrade your account in order to use GPUs following [this instruction](#). Otherwise [Google Cloud Free Tier](#) does not come with GPU support or quota.

The screenshot shows the Google Cloud Platform dashboard for a project named 'My First Project'. A red box highlights the top banner which reads: 'Free trial status: \$300.00 credit and 364 days remaining - with a full account, you'll get unlimited access to all of Google Cloud Platform.' To the right of the banner are 'DISMISS' and 'ACTIVATE' buttons. An arrow points from the text above to the 'ACTIVATE' button.

Project info

- Project name: My First Project
- Project ID: focus-caim-273621
- Project number: 803545017548

APIs & Services

Resources

Trace

Getting Started

Google Cloud Platform status

All services normal

Error Reporting

No sign of any errors. Have you set up Error Reporting?

News

Helping contact centers respond rapidly to customer concerns about COVID-19 6 hours ago

New AI-driven features in Dataprep enhance the wrangling experience 6 hours ago

Learn to build secure and reliable systems with a new book from Google 6 hours ago

Documentation

Learn about Compute Engine

A modal window titled 'Upgrade your account' is overlaid on the dashboard. It contains the following text:

You're one step away from unlocking all of Google Cloud Platform.
 You won't be charged until after your free credits run out or expire (whichever comes first). [Learn more](#)

You only pay for what you use. [View pricing details](#)

CANCEL **UPGRADE**

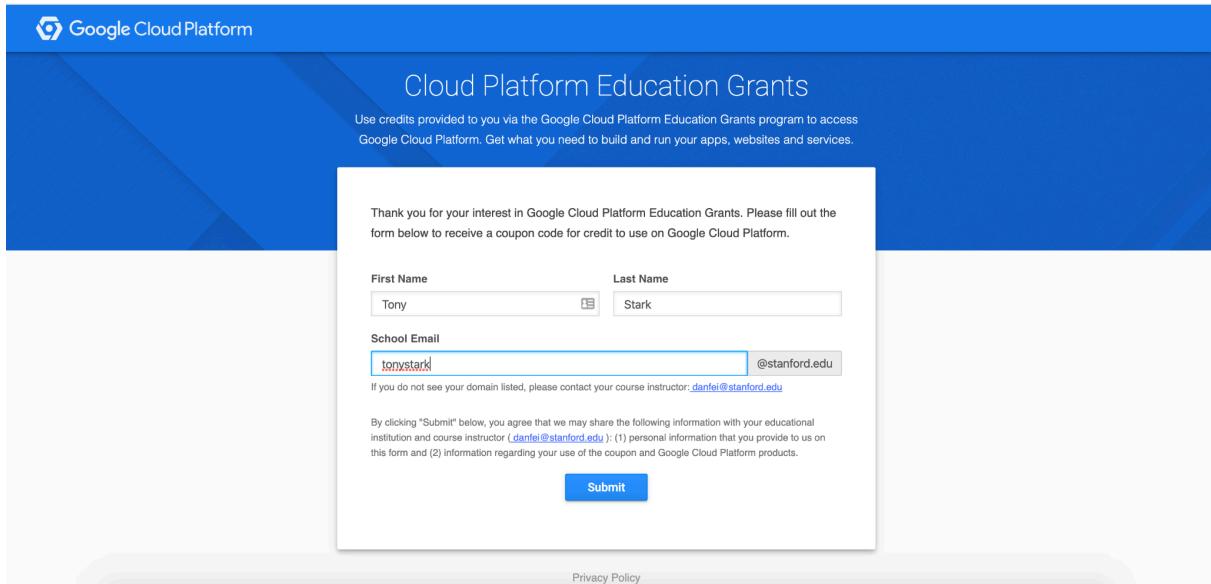
The background dashboard elements are visible through the modal.

Claim CS224n GCP Credits

NOTE: You should have created and logged in your GCP account registered with your personal gmail account by now.

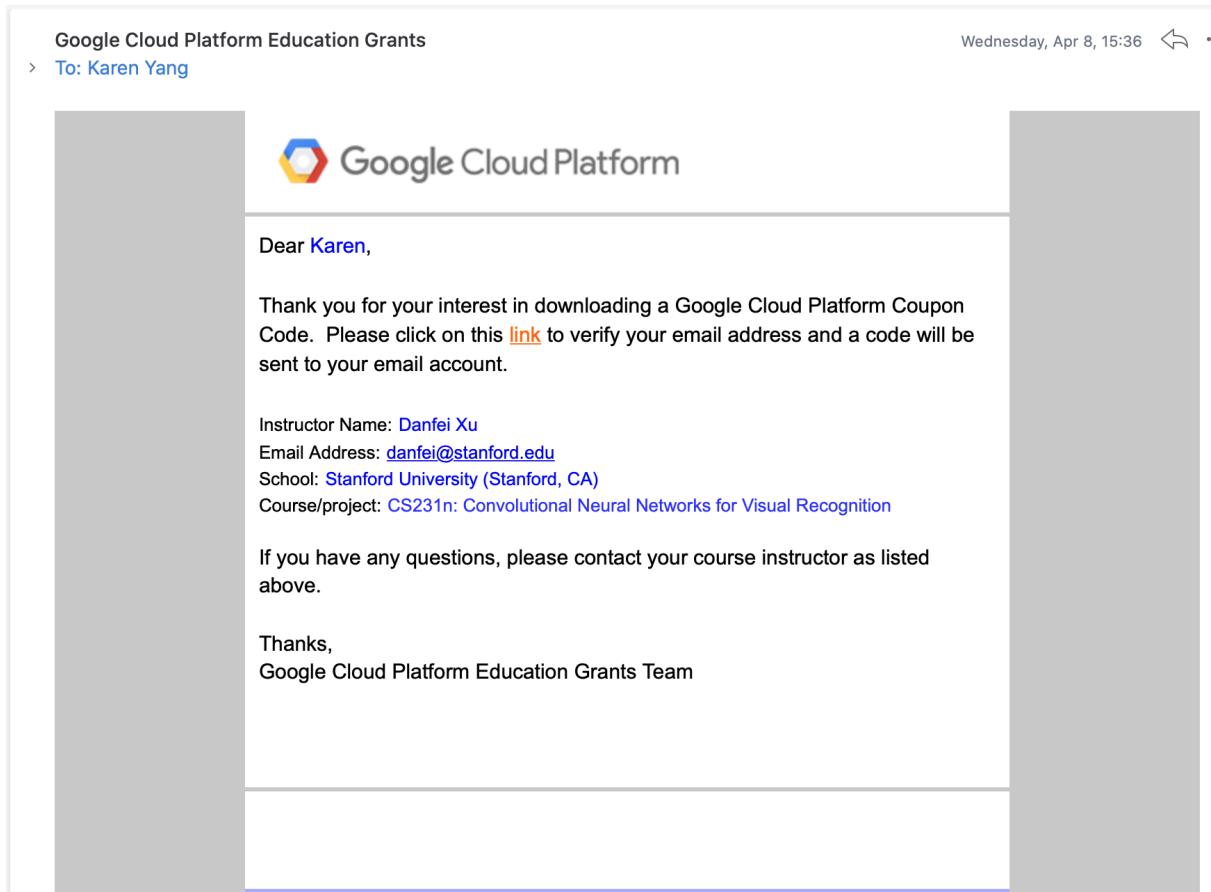
1. We will release the link to claiming \$50 GCP credits on Ed. After you complete the form, you will see a link to Google Cloud Education Grants page. It requires your Stanford email to receive the credits. (These credits can be applied to your GCP

account registered with Personal GMail.)



The screenshot shows the Google Cloud Platform Education Grants application page. At the top, it says "Cloud Platform Education Grants" and "Use credits provided to you via the Google Cloud Platform Education Grants program to access Google Cloud Platform. Get what you need to build and run your apps, websites and services." Below this is a form with fields for "First Name" (Tony), "Last Name" (Stark), and "School Email" (tonystark@stanford.edu). There is a note below the email field: "If you do not see your domain listed, please contact your course instructor: danfei@stanford.edu". A small note at the bottom states: "By clicking "Submit" below, you agree that we may share the following information with your educational institution and course instructor (danfei@stanford.edu): (1) personal information that you provide to us on this form and (2) information regarding your use of the coupon and Google Cloud Platform products." A blue "Submit" button is at the bottom right of the form.

2. After submission, you should receive an email from GCP with a link to confirm your email address. Click the link to verify your Stanford email.



3. You will soon receive another email from GCP with a link that applies the \$50 credits to your account. After that the website will jump to your Billing page where you should see your have linked to CS224N billing account with \$50 free credits.

GCP credit application

Fill in the following information below to apply GCP credits to your account listed below.

First name *
Mai

Last name *
Bhago

Account email
[REDACTED]

Credits will be applied to this account. If you'd like to apply credits to a different account, specify your preference [here](#).

Coupon code *

Terms and conditions

The following terms and conditions apply to the credit you received for Google Cloud products (the "Credit(s)").

The Credit is subject to valid registration and acceptance of an account with Google Cloud and satisfaction of any applicable eligibility requirements including the Google Cloud Platform [Terms of Service](#). You will be responsible for all usage in excess of the Credit and you may not be notified once the Credit is exhausted. The Credit is non-transferable and may not be sold or bartered. The Credit is valid for a limited time only and expires on the date indicated when you receive the applicable Credit code or on such date as designated by Google (in which case the earlier date applies). You may not use the Credit to engage in mining cryptocurrency unless you have obtained Google's written consent, which consent may be revoked by Google in its sole discretion at any time. Google reserves the right to cancel the Credit or change these terms at any time. You are responsible for determining the applicable tax treatment of receiving the Credits and for paying all applicable taxes. Offer void where prohibited by law.

Except for graduate or work-study students participating in an event in their personal capacities, if you are a government employee, including an employee of a public university, public educational institution or state-owned enterprise, you may not use (and you are ineligible to receive) any Credits.

ACCEPT AND CONTINUE

* Indicates required

The screenshot shows the Google Cloud Platform Billing Overview page for the project 'CS231n: Convolutional Neural Networks for Visual Recognition'. The left sidebar includes options like Reports, Cost table, Cost breakdown, Commitments, Budgets & alerts, Billing export, and Account management. The main content area displays 'BILLING ACCOUNT OVERVIEW' with 'Month-to-date total cost' at \$0.00 and 'End-of-month total cost (forecasted)' as 'Not enough historical data to project cost'. It also features a 'View report' button. Below this is a 'Cost trend' chart for April 1, 2019 – April 30, 2020, showing an average monthly total cost of \$0.00. To the right, there are sections for 'Organization' (No organization), 'Billing health checks' (with 0 red, 1 yellow, and 0 green indicators), and 'Promotional credits' (a large green circle indicating \$50.00 remaining out of \$50.00, with a link to 'Credit details').

- Switching billing accounts from Free Tier credits to CS224N credits Google Cloud does not support combining credits. You will need to switch billing account if you want to use 2 sources of gcloud credits.

i.e. You can use up the \$300 free credits first. Then switch to the CS224N billing account referring to this [GCloud documentation](#).

Request an Increase in GPU Quota

Your account typically does not come with GPU quota. You have to explicitly request for it under IAM Admin > Quotas.

Please request the quota increase ASAP, because they will take up between couple minutes to a week to process! If you don't have GPU quota, you will have to create a CPU-only VM first and create another GPU VM later, explained in the next section.

You will need to change your quota for GPU (all regions).

- Go to [IAM & Admin](#)

Service	Name	Type	Dimensions (e.g. location)	Value	Current usage percentage	Current usage	Adjustable
Compute Engine API	GPUs (all regions)	Quota		1	0%	0	Yes

- Select the checkbox to the left of the first item in the table, and click EDIT QUOTAS. Set the New limit to 1, and make the Request description "Stanford CS 224N class"

project".

The screenshot shows the Google Cloud Platform interface. On the left, a sidebar lists various administrative tools like IAM, Identity & Organization, and Quotas. The 'Quotas' option is selected. In the main area, a specific quota metric for Compute Engine API is being edited. A modal window titled 'Compute Engine API' is open, showing a table with one row: Location (Global), Current Usage (0), 7 Day Peak Usage (0), and Limit (0). A red box highlights the 'Edit Quotas' button at the top of the main page and the 'New limit' input field in the modal.

3. Wait until GCP sends you a second email (first email is just to notify that they received the request) that looks like this. It could take a couple minutes to a couple days for them to approve.

The screenshot shows an email inbox with two messages. The first message is from 'Google Cloud Platform Support' with the subject '[#22937897] Quota Increase Request For focus-cairn-273621 [ref:_OOD00VNwG._500 5w1XmyXS:ref]'. It contains a link to the quota request. The second message is from 'Google Compute Engine Quota Support' with the subject 'Re: [#22937897] Quota Increase Request For focus-cairn-273621 [ref:_OOD00VNwG._500 5w1XmyXS:ref]'. It confirms the request has been approved and provides the new quota details:

Changed Quota:
+-----+-----+
GLOBAL Attribute GPUS_ALL_REGIONS
+-----+-----+
Changes 0 -> 1
+-----+-----+

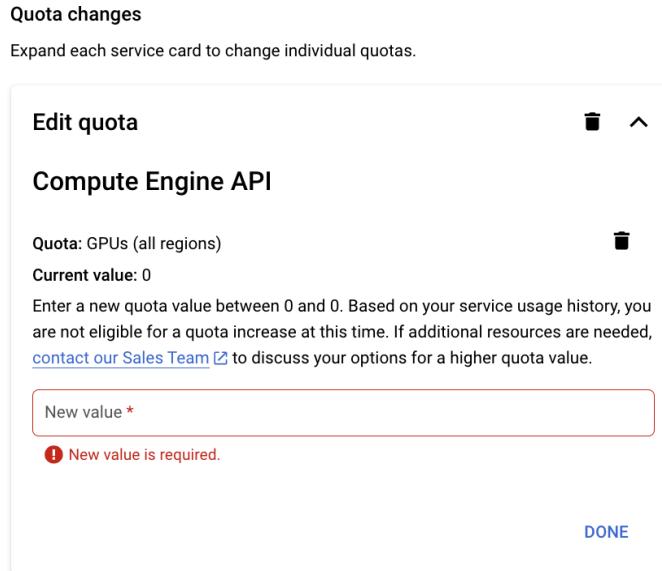
Please visit <https://console.cloud.google.com/iam-admin/quotas?project=803545017548&service=compute.googleapis.com> to review your updated quota.

Happy Computing!

Google Cloud Platform Support

If GCP doesn't allow you to try to increase your quota, please try to use another platform that has GPUs (colab, modal, etc).

How do I know if GCP won't allow me to increase my quota? If you get a popup that says enter a new value between "0 and 0", it is likely that you may not be able to get GCP to work for you. We have tried to contact Google support regarding this issue, but to no avail



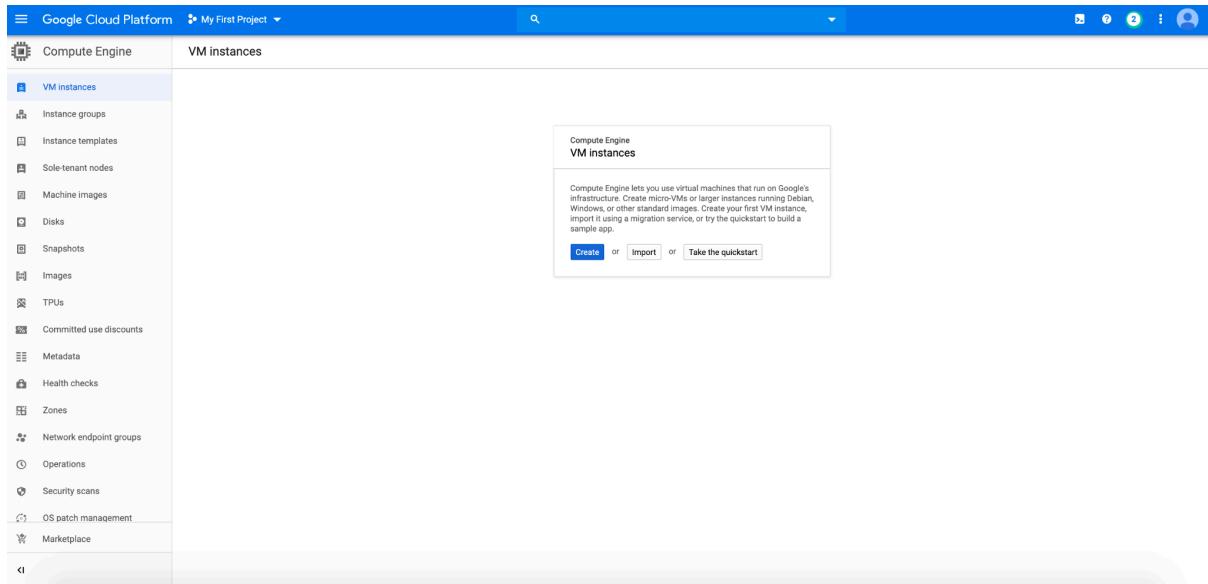
Why don't I See Any GPU-related Quota

1. First, make sure you upgrade your free tier account to a full account following these [instructions](#).
2. If you just registered a Google Cloud account, GCP can be slow on setting up its Compute Engine API services (this is the service that provides GPU access, so the GPU quota won't show up before it is ready).

One way I found that can make Compute Engine API setup faster is by visiting the [VM instance page](#) by clicking Compute Engine > VM instances

If you see that Compute Engine is not ready yet, wait for a couple minutes until you see something like this screenshot below. The GPU-related Quota should now show up in IAM

Admin > Quotas.



3. For region-specific GPUs: Check that you have a default zone and region set under Compute Engine > Settings > Region / Zone. Some zones do not have certain GPU resources. Check [pricing and spec for GCP GPUs](#) to find the availability of GPU resources.

More instructions at [General quota instructions](#) and [Step-by-step GPU-specific walk-through](#) (all answers in the link are useful)

Set Up Google Cloud VM Image

Customize VM Hardware

1. Go to [this gcloud marketplace](#). You may (or may not) be taken to a page where you have to click on "Launch", and then you should see a configuration sheet with the title "**NVIDIA GPU-Optimized VM deployment**".
2. Fill in Deployment name field with your preferred VM name.
3. For Zone, pick one of the zones from [this list](#) (trial and error to see which zone has resources!) that supports your desired GPU type (eg T4): If when deploying you get a ZONE_RESOURCE_POOL_EXHAUSTED error, then try again with another zone until it works.
 - a. <https://github.com/doitintl/gpu-finder>. You can use this link to help you find a GPU that works for you! Another, option is just trial and error with different zones to see which zone works well.
4. In Machine type box, click GPUs.
5. For GPU type, NVIDIA T4 is typically enough. P100 and V100 are way more expensive (check the price on the right), but also faster and has larger memory. Check pricing and spec for GCP GPUs. GPU drivers and CUDA will be automatically installed only if you select at least 1 GPU.

6. Choose your desired number of CPUs and memory (if you are unsure, keep the default).
7. Leave all other options as default.
8. Click the blue button Deploy at the end of the page. It will automatically start your instance, so if you don't need to use it now, stop it immediately.

Your configuration sheet should look similar to the image below. Follow exactly the same configuration for the ones with red boxes. For configurations with orange boxes, you can adjust it based on your project need as discussed below.

Pay attention to the monthly price, make sure you claim only necessary HW resources, so that you can use your GCP instance for longer. **Once you run out of credits, the VM instance will be shut down automatically and you might lose unsaved data and**

models. If you are almost running out of credits, contact the course staff.

Deployment name* nvidia-gpu-optimized-vmi-1

Zone us-west4-b

GPU availability is limited to certain zones. [Learn more](#)

Additional information

NVIDIA GPU-Optimized VMi overview
Product provided by NVIDIA

NVIDIA GPU-Optimized VMi Usage Fee NVIDIA does not charge a usage fee.	USD 0.00/mo
Infrastructure fee	
VM instance: 1 vCPU + 3.75 GB memory (n1-standard-1)	USD 39.05/mo
Standard Persistent Disk: 128GB	USD 5.63/mo
NVIDIA T4 GPU	USD 270.10/mo
Sustained use discount	- USD 92.75/mo
Estimated monthly total	
USD 222.04/mo	

Price estimates based on 30-day, 24hrs per day usage of the listed resources in the selected region. The Estimated Monthly Infrastructure Fee calculation may not reflect all Google Cloud IaaS resources actually created or consumed by this product (or the fees charged for such consumption). NVIDIA may be able to provide a more accurate estimate of monthly GCP IaaS consumption.

Machine type

General purpose
Compute optimized
Memory optimized
 GPUs

Graphics processing units (GPUs) accelerate specific workloads on your instances such as machine learning and data processing. [Learn More](#)

GPU type NVIDIA T4
Number of GPUs 1

Enable Virtual Workstation (NVIDIA GRID)

Series N1

Machine type n1-standard-1 (1 vCPU, 3.75 GB memory)

	vCPU 1	Memory 3.75 GB
--	------------------	--------------------------

Additional local SSDs. Each disk is 375G.

Boot Disk

Primary Boot Disk type Standard Persistent Disk

Primary Boot Disk size in GB 128

Networking

Network interfaces

default default (10.182.0.0/20)

[ADD A NETWORK INTERFACE](#)

Firewall

Add tags and firewall rules to allow specific network traffic from the Internet

Creating certain firewall rules may expose your instance to the Internet. Please check if the rules you are creating are aligned with your security preferences. [Learn more](#)

Allow TCP port 22 traffic from the Internet

Source IP ranges for TCP port 22 traffic

Stackdriver

Monitoring and management for services, containers, applications, and infrastructure

Enable Stackdriver Logging
 Enable Stackdriver Monitoring

[DEPLOY](#)

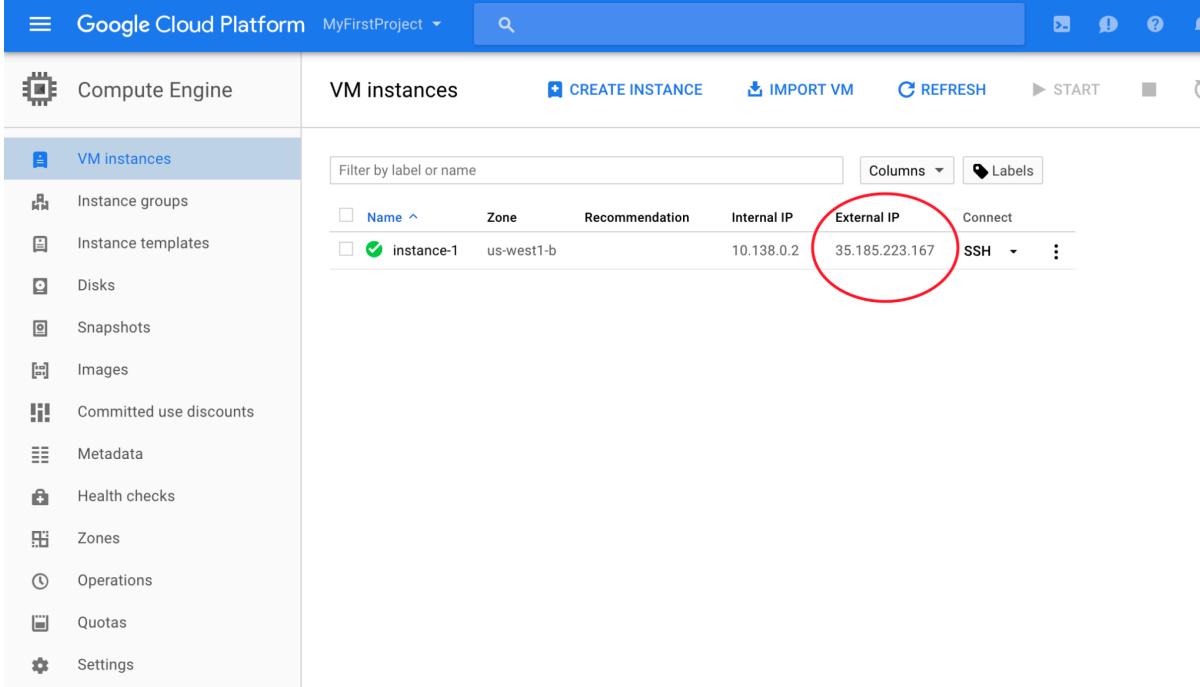
Change Configuration on Already Created VM Instances

1. You can always change the number of CPUs, number of GPUs, CPU memory, and GPU type after your VM has been created.

2. Just stop your instance, go to your VM instance's details at Compute Engine > VM instances > [click on instance name].
3. Click "edit" on your VM's page to modify the settings. Finally click "Save".

Getting a Static IP Address

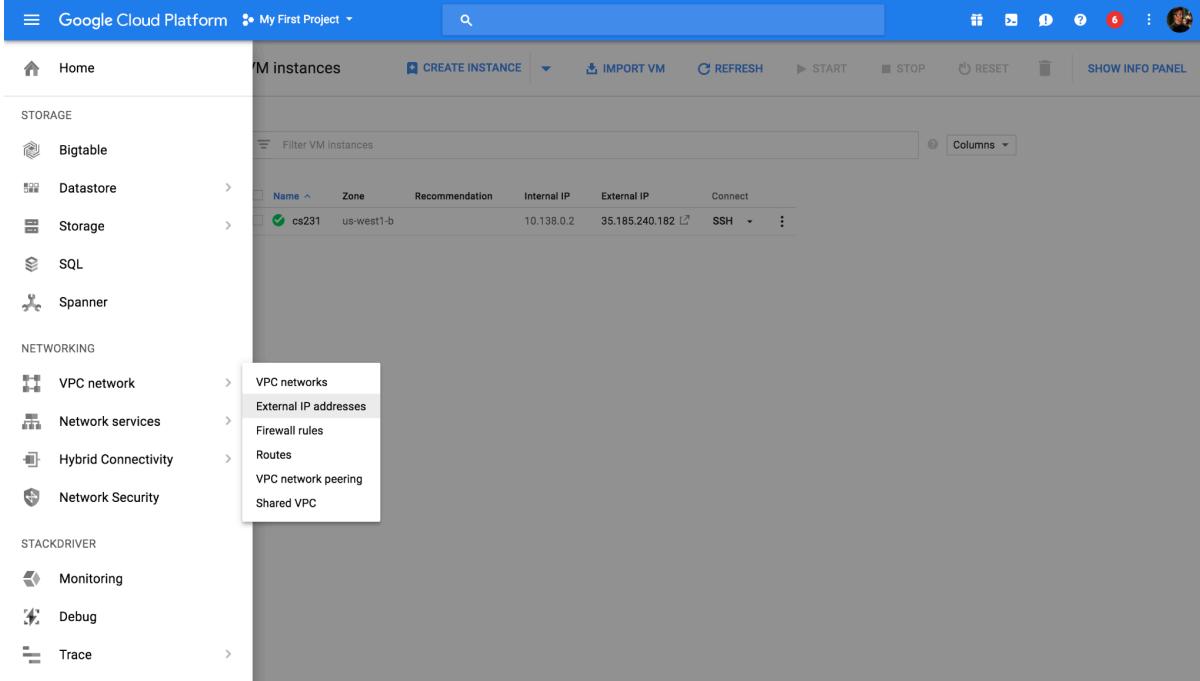
If you want to have a static IP for ease of access, you can change the External IP address of your Google Cloud Engine instance to be static (see screenshot below).



The screenshot shows the Google Cloud Platform Compute Engine interface. On the left, there's a sidebar with various options like Instance groups, Instance templates, Disks, Snapshots, Images, Committed use discounts, Metadata, Health checks, Zones, Operations, Quotas, and Settings. The main area is titled 'VM instances' and shows a table with columns: Name, Zone, Recommendation, Internal IP, External IP, and Connect. A single row is selected for 'instance-1' in the 'us-west1-b' zone. The 'External IP' field contains '35.185.223.167'. This specific cell is highlighted with a large red circle.

Name	Zone	Recommendation	Internal IP	External IP	Connect
instance-1	us-west1-b		10.138.0.2	35.185.223.167	SSH

To Do this, click on the 3 line icon next to the Google Cloud Platform button on the top left corner of your screen, go to VPC network > External IP addresses (see screenshot below).



The screenshot shows the Google Cloud Platform navigation bar with 'My First Project' selected. The 'VPC network' option in the 'NETWORKING' section is expanded, revealing a dropdown menu with several options: VPC networks, External IP addresses, Firewall rules, Routes, VPC network peering, and Shared VPC. The 'External IP addresses' option is highlighted with a red circle.

To have a static IP address, change Type from Ephemeral to Static. Enter your preferred name for your static IP, ours is cs224n-ip (see screenshot below). And click on Reserve.

NOTE: At the end of CS 224N when you don't need your instance anymore, release the static IP address because Google charges a small fee for unused static IPs (according to [this page](#)).

Take note of your Static IP address (circled on the screenshot below). We use 35.185.240.182 for this tutorial.

Name	External Address	Region	Type	Version	In use by	Labels
cs231n-ip	35.185.240.182	us-west1	Static	IPv4	VM instance cs231 (Zone b)	Change

Access Your Newly Created VM

Now that you have created your virtual GCE, you want to be able to connect to it from your computer. The rest of this tutorial goes over how to do that using the command line.

Install gcloud command-line Tools

To access [gcloud commands](#) in your local terminal, install [Google Cloud SDK](#) that is appropriate for your platform and follow their instructions.

If gcloud command is not in your system path after installation, you can also reference it by its full path /<DIRECTORY-WHERE-GOOGLE-CLOUD-IS-INSTALLED>/bin/gcloud. See [this page](#) for more detailed instructions.

To ssh into your VM, go to your VM instance details page by clicking on its name. Start the VM instance first. Once it has a green check mark on, click on the drop-down arrow and select View gcloud command instead to retrieve the terminal command. It should look like

```
gcloud compute --project "<YOUR_PROJECT_ID>" ssh --zone "us-west1-b" "<YOUR_VM_NAME>"
```

The screenshot shows the Google Cloud Compute Engine interface. On the left, a sidebar menu lists various options: VM instances (selected), Instance groups, Instance templates, Sole tenant nodes, Disks, Snapshots, Images, TPUs, Committed use discounts, Metadata, Health checks, and Zones. The main area is titled 'VM instances' and displays a table with one row. The row for 'torch-vm' shows the following details: Name (torch-vm), Zone (us-west1-b), Internal IP (10.138.0.4 (nic0)), External IP (35.233.171.74), and Connect (SSH dropdown set to SSH). A context menu is open over the 'torch-vm' row, listing: Open in browser window, Open in browser window on custom port, Open in browser window using provided private SSH key, View gcloud command (highlighted in grey), and Use another SSH client.

You should now be able to run `nvidia-smi` and see the list of attached GPUs and their usage statistics. Run `watch nvidia-smi` to monitor your GPU usage in real time.

Remote Server Development

Transferring Files From Your Instance To Your Computer

For instance, to transfer `file.zip` from GCE instance to your local laptop. There is an [easy command](#) for this purpose:

```
gcloud compute scp <user>@<instance-name>:/path/to/file.zip  
/local/path
```

For example, to download files from our instance to the current folder:

```
gcloud compute scp tony Stark@cs224n:/home/shared/file.zip .
```

The transfer works in both directions. To upload a file to your instance:

```
gcloud compute scp /my/local/file tony Stark@cs224n:/home/shared/
```

If you would like to transfer an entire folder, you will need to add a recursive flag:

```
gcloud compute scp --recurse /my/local/folder  
tony Stark@cs224n:/home/shared/
```

Other Tips

You can use [Tmux](#) to keep the training sessions running when you close your laptop. Also, if your collaborators log into the same account on the VM instance, they will see the same tmux session screen in real time.

You can develop your code on a remote server directly if you are comfortable with vim or emacs.

You can develop locally on your favorite editor, push to your branch on Github, and pull on a remote server to run. (git commit frequently is also one of [good Github practices](#))

Besides `gcloud compute scp`, another tool you can check out is [rsync](#) which can synchronize files and folders between your local machine and remote server.

BIG REMINDER: Make sure you stop your instances!

Don't forget to stop your instance when you are done (by clicking on the stop button at the top of the page showing your instances). You can restart your instance and the downloaded software will still be available.

We have seen students who left their instances running for many days and ran out of credits. **You will be charged per hour when your instance is running.** This includes code development time. We encourage you to read up on Google Cloud, regularly keep track of your credits and not solely rely on our tutorials.