

CS145: Data Management and Data Systems
Stanford University, Fall 2021

Getting Started with BigQuery

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Overview

CS145 uses BigQuery for its three projects; we also recommend playing around with BigQuery to enforce your understanding of class material. This is a guide about getting started with BigQuery, from getting the credits that we will provide to querying BigQuery public datasets. **You are responsible for the information in this document, especially the portions about how to prevent yourself from burning all your credits.**

Getting Credits

Google has provided all students in this class with \$50 of credit to use for BigQuery. This should be enough to finish the course, possibly even with credit remaining.

Credit policies & information:

1. \$50 of credit is enough to query **10 Terabytes** of data (\$5/TB). This is a very large amount of data for the purposes of this class. You would need to run 1000 queries on 10GB in order to exhaust this, for example.
2. Google provides all users of BigQuery an additional **1TB free / month**. You may find that you don't even use 1TB over the course of the first two projects.
3. You are responsible for your credit. If you are in danger of running out (eg, you are running \$2 queries) please contact the TAs. We are able to help students *before* they use up their credits, but there's not much we can do *after* you've used them up.

4. Google charges by **# of rows * # of columns * size of column** for each query. The easiest and best way to keep the amount of data you handle down is to use **only the columns you need for your query**. It can be a little verbose at times, but if you stick to the practice of writing **SELECT column1, column2 ...**, you will save lots of credits over the course of the quarter.

Note: AVOID USING **SELECT ***. Google will charge the query as scanning the whole table, even if it doesn't.

In order to get your BigQuery credits, you will need to:

1. Go to this [link](#). You'll see the following page:

The screenshot shows a web form titled "Cloud Platform Education Grants". The header text reads: "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." The main body of the form contains the following fields and instructions:

- A message: "Thank you for your interest in Google Cloud Platform Education Grants. Please fill out the form below to receive a coupon code for credit to use on Google Cloud Platform."
- Input fields for "First Name" and "Last Name", each with a small "i" icon for help.
- An input field for "School Email" with a dropdown suffix "@stanford.edu". Below it is a note: "If you do not see your domain listed, please contact your course instructor: shiva@cs.stanford.edu".
- A note below the email field: "By clicking "Submit" below, you agree that we may share the following information with your educational institution and course instructor (shiva@cs.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 at the bottom.

2. Enter your name and **Stanford email address**.
3. Check your Stanford email. A verification link should have been sent to your Stanford email address (see below).



Dear [Jennie](#),

Thank you for your interest in downloading a Google Cloud Platform Coupon Code. Please click on this [link](#) to verify your email address and a code will be sent to your email account.

Instructor Name: Shiva Shivakumar

Email Address: shiva@cs.stanford.edu

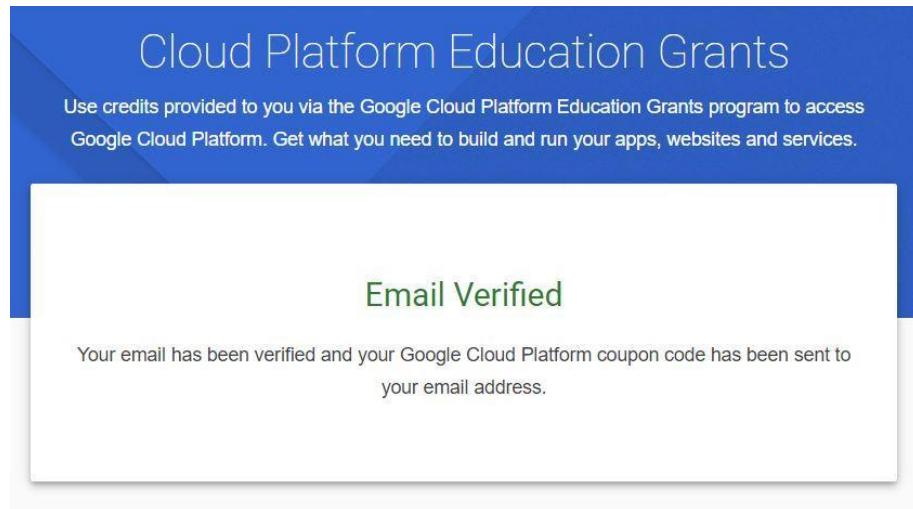
School: Stanford

Course/project: CS 145 - Data Management and Data Systems

If you have any questions, please contact your course instructor as listed above.

Thanks,
Google Cloud Platform Education Grants Team

4. Click the link. You should see the following page:



5. Check your Stanford email again. You should see an email like the following:



Dear [Jennie](#),

Here is your Google Cloud Platform Coupon Code: **0VU7-3WR5-ALUQ-MYFB**

Click [\[here\]](#) to redeem.

Course/Project Information

Instructor Name: [Shiva Shivakumar](#)

Email Address: shiva@cs.stanford.edu

School: [Stanford](#)

Course/project: [CS 145 - Data Management and Data Systems](#)

Activation Date: [9/23/2019](#)

Redeem By: [1/23/2020](#)

Coupon Valid Through: [9/23/2020](#)

If you have any questions, please contact your course instructor as listed above.

Thanks,

Google Cloud Platform Education Grants Team

6. Click the link in the email. You will see a page to redeem the code (see below). Unlike step 2, make sure you are logged in to a **personal Google account, NOT your Stanford account**. From now on, you'll use your personal Google account with BigQuery, not your Stanford account.

Education grants

Please enter the coupon code provided to you via the Google Cloud Platform Education Grants programme to receive credit for Google Cloud Platform. Get what you need to build and run your apps, websites and services.

Coupon code

OVU7-3WR5-ALUQ-MYFB

Credit amount	Expiry date	Course
\$50.00	22 Sep 2020	CS 145 - Data Management and Data Systems

Terms of Service

Country of residence

United States ▾

Google Cloud Platform education grants credits terms and conditions

By clicking "Accept and continue" below, you, on behalf of yourself and the organization you represent ("You") agree to these terms and conditions:

The credit is valid for Google Cloud Platform products and is subject to Your acceptance of the applicable Google Cloud Platform License Agreement and any other applicable terms of service. The credit is non-transferable and may not be sold or bartered. Unused credit expires on the date indicated on the media conveying the promotion code. The credit may be issued in increments as You use the credit over the period of time during which the credit is valid. Offer void where prohibited by law.

You represent that you are accepting the promotional credit on behalf of your educational institution and the credit can only be used on behalf of the educational entity and not for your personal use. You represent, on behalf of such educational entity, that (i) You are authorized to accept this credit; (ii) the credit is consistent with all applicable laws and regulations, including relevant ethics rules and laws; and (iii) the provision of credits will not negatively impact Google's current or future ability to do business with such educational entity.

You agree that we may share the following information with your educational institution and course instructor: (1) personal information that you provide to us during the coupon redemption process and (2) information regarding your use of the coupon and Google Cloud Platform products.

[Accept and continue](#)

[Clear](#)

- Once you've verified that you are logged in to a personal Google account, click "Accept and continue". You'll be taken to a page with a billing overview (see below). This is where you can keep track of how much of your credit you have used and how much you have left.

The screenshot shows the Google Cloud Billing Overview page. At the top, it says "Overview" and "CS 145 - Data Management and Data Systems". Below that, it says "BILLING ACCOUNT OVERVIEW". A message at the top left says "Welcome to the new Billing Overview! Billing permissions, project associations and credit details can now be found on the account management page." with "DISMISS" and "ACCOUNT MANAGEMENT" buttons. The main area has two sections: "Current month" (1–24 September 2019) and "Cost trend" (1 September 2018 – 30 September 2019). The "Current month" section shows "Month-to-date total cost" (US\$0.00) and "End-of-month total cost (forecasted)" (Not enough historical data to project cost). The "Cost trend" section shows "Average monthly total cost" (US\$0.00). To the right, there's a summary of the "Billing account" (Manage, CS 145 - Data Management and Data Systems, 018070-0F14EB-989851), "Organisation" (No organisation), and "Promotional credits" (View, US\$50.00).

Initial Setup

This section will guide you through creating a BigQuery project and setting up your account so that you can easily query datasets. **Remember that all of this should be done on your personal Google account.**

Note: This quarter, we will be focusing support on BigQuery's new Web UI. You are welcome to use the Classic Web UI if you prefer, but all instructions below will be for the new Web UI and most support will be for the new Web UI.

1. Click this [link](#). You'll see the page below; click “Create” to make a GCP (Google Cloud Platform) project.

The screenshot shows the Google Cloud Dashboard. At the top, it says "Dashboard". Below that, a message says "To view this page, select a project." with "SELECT" and "CREATE" buttons. The "CREATE" button is highlighted.

2. Fill in the information to make a new project. You can name your project anything, but we recommend something with a short project ID you can easily remember and type. Make sure to select the new billing account you should have after getting the class credits. (After you create the project, you can double check the linked billing account of your project through instructions [here](#)).

New Project

⚠ You have 23 projects remaining in your quota. Request an increase or delete projects. [Learn more](#)

[MANAGE QUOTAS](#)

Project name *
cs145-fa19 ?

Project ID: cs145-fa19. It cannot be changed later. [EDIT](#)

Billing account *
CS 145 - Data Management and Data Systems ▼

Any charges for this project will be billed to the account that you select here.

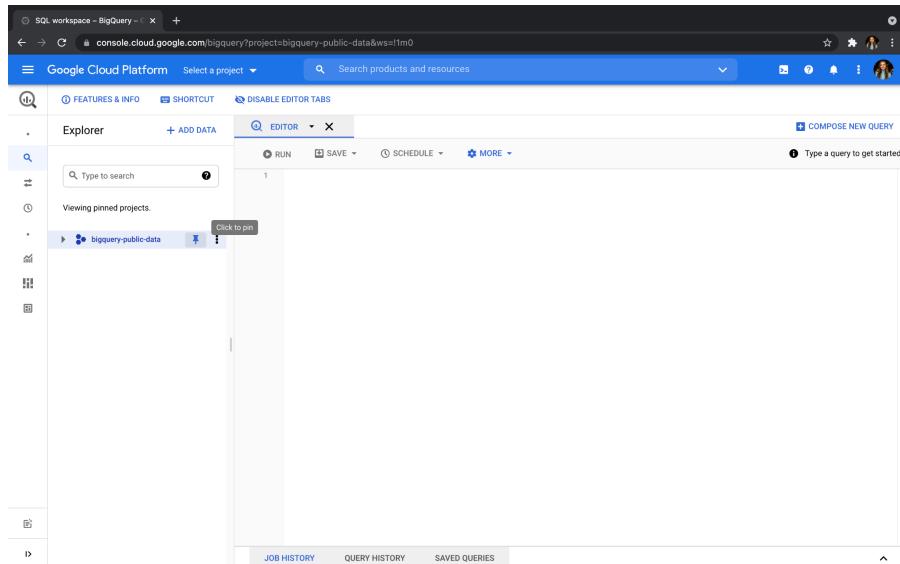
Location *
 No organisation [BROWSE](#)

Parent organisation or folder

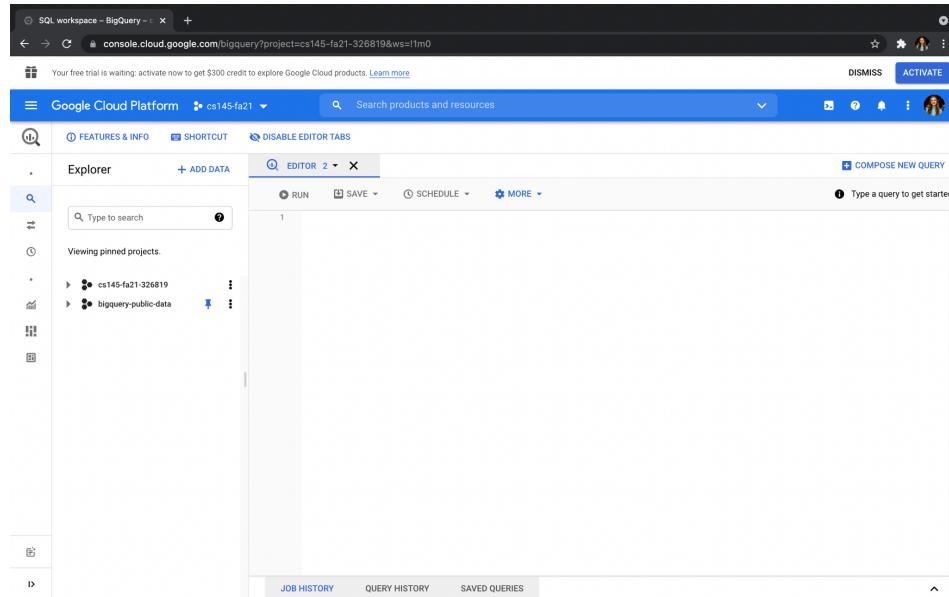
[CREATE](#) [CANCEL](#)

After creating your project, you'll be brought to an overview page for your project.

3. Go to this [link](#), which is the page for BigQuery's public datasets. Click the pin in the left sidebar, next to the name "bigquery-public-data" (see screenshot below).



4. Now when you visit the console, you'll be able to easily find the datasets in your sidebar (see screenshot below).



Querying Public Datasets

Here are some step-by-step instructions on how to get started with making queries on BigQuery's public datasets. This is what you will do for all three projects (and perhaps in your spare time).

1. Go to <https://console.cloud.google.com/bigquery>. You should see "bigquery-public-data" pinned on the left menu.
2. Click on "bigquery-public-data" and scroll until you find the dataset `ncaa_basketball`. Alternatively, search for `ncaa_basketball` in the search bar above your pinned projects.
3. Click the three dots next to the dataset name, then click "Open". You'll see a brief description of what information the dataset contains, as well as a brief overview of information such as the dataset size.

The screenshot shows the Google Cloud Platform BigQuery interface. At the top, there's a banner for a free trial and buttons for 'DISMISS' and 'ACTIVATE'. Below the banner is the Google Cloud Platform navigation bar with 'Google Cloud Platform' and 'cs145-fa21'. A search bar says 'Search products and resources'. On the left is a sidebar with icons for 'FEATURES & INFO', 'SHORTCUT', and 'DISABLE EDITOR TABS'. The main content area shows a dataset named 'bigquery-public-data:ncaa_basketball'. A search bar at the top of this section shows 'ncaa_basketball'. Below it, a 'Description' panel states: 'This dataset contains data about NCAA Basketball games, teams, and players. Game data covers play-by-play and box scores back to 2009, as well as final scores back to 1996. Additional data about wins and losses goes back to the 1894-5 season in some teams' cases.' It also includes a note from Sportradar: 'Copyright Sportradar LLC. Access to data is intended solely for internal research and testing purposes, and is not to be used for any business or commercial purpose. Data are not to be exploited in any manner without express approval from Sportradar.' A 'Labels' section indicates 'None'. Under 'Dataset info', there's a table with the following details:

Dataset ID	bigquery-public-data:ncaa_basketball
Created	Jan 23, 2018, 12:25:09 PM
Default table expiration	Never
Last modified	Mar 20, 2019, 2:10:55 PM
Data location	US

At the bottom of the dataset page, there are tabs for 'JOB HISTORY', 'QUERY HISTORY', and 'SAVED QUERIES'.

4. In the sidebar, click on one of the tables in the dataset (for example, `mascots`). Here, you can find the table schema with a description of what each column represents. You can also find table details (such as the size of the table, which will give you a sense of how safe it is to query repeatedly given your data limits) and a preview of the table (see these three tabs in the screenshot below).

mascots

SCHEMA DETAILS PREVIEW

Table schema

Filter Enter property name or value

Field name	Type	Mode	Policy Tags	Description
<code>id</code>	STRING	NULLABLE		University unique ID from Sportradar
<code>market</code>	STRING	NULLABLE		The university to which the mascot belongs
<code>name</code>	STRING	NULLABLE		The name of the university's team
<code>mascot</code>	STRING	NULLABLE		The name of the university's mascot
<code>mascot_name</code>	STRING	NULLABLE		The proper name of the university's mascot, if available (e.g. a character)
<code>mascot_common_name</code>	STRING	NULLABLE		The type of being or creature that the mascot embodies
<code>tax_subspecies</code>	STRING	NULLABLE		The subspecies to which the mascot belongs
<code>tax_species</code>	STRING	NULLABLE		The species to which the mascot belongs
<code>tax_genus</code>	STRING	NULLABLE		The genus to which the mascot belongs
<code>tax_family</code>	STRING	NULLABLE		The family to which the mascot belongs
<code>tax_order</code>	STRING	NULLABLE		The order to which the mascot belongs
<code>tax_class</code>	STRING	NULLABLE		The class to which the mascot belongs
<code>tax_phylum</code>	STRING	NULLABLE		The phylum to which the mascot belongs

JOB HISTORY QUERY HISTORY SAVED QUERIES

mascots

SCHEMA DETAILS PREVIEW

Table info

EDIT DETAILS

Table ID	bigrquery-public-data:ncaa_basketball.mascots
Table size	55.57 KB
Long-term storage size	55.57 KB
Number of rows	351
Created	Apr 1, 2018, 9:55:30 AM UTC-7
Last modified	Apr 1, 2018, 9:55:30 AM UTC-7
Table expiration	NEVER
Data location	US
Description	

JOB HISTORY QUERY HISTORY SAVED QUERIES

mascots

SCHEMA DETAILS PREVIEW

Row	<code>id</code>	<code>market</code>	<code>name</code>	<code>mascot</code>	<code>mascot_name</code>
1	2959bd24-7007-41ae-a3a3-abdf26888cfc	Tulsa	Golden Hurricane	Hurricane	Captain Cane
2	ad4bc983-8d2e-4ef6-a8f9-80840a786c64	Arizona State	Sun Devils	Devil	Sparky
3	f2d01b77-0f5d-4574-9e49-2a3ea822e44	Drexel	Dragons	Dragon	Mario the Magnificent
4	b47d10b8-a2a5-47df-a2f9-7bdb09d51beb	Bradley	Braves	Gargoyle	Kaboom!
5	0113ea0-e943-4fff-9780-ae0fb099e7ef	Canisius	Golden Griffins	Griffin	Pete
6	bdc2561d-f603-4fab-a262-f1d2af462277	Michigan	Wolverines	None	null
7	dfe0d93f-94a5-47fb-b7aa-f74786e09acb	Illinois-Chicago	Flames	Dragon	Sparky
8	61a3e5ab-1be3-4694-b83f-edae0953f409	Green Bay	Phoenix	Phoenix	Phlash
9	5873529e-e5e3-4a06-8a03-f4cbe509880	Mississippi Valley State	Delta Devils	Devil	null
10	8accb91e-6086-41b3-8420-7a82fe442365	Elon	Phoenix	Phoenix	Elon
11	4fbebfb0a-e117-4a0c-8f15-c247535a2ab	Wake Forest	Demon Deacons	Demon	Demon Deacon
12	71874e7e-8260-43f9-bb7c-65f267dbe8ce	Northwestern State	Demons	Demon	Vic
13	fe21a988-3e96-4f3c-8f9f-b449ccda43b0	Texas A&M-CC	Islanders	Tiki Totem	Izzy
14	1747d0df-c8f1-458b-9412-8c76279a2bb4	Pepperdine	Waves	Wave	Willie

Rows per page: 100 1 - 100 of 351 First page < > Last page

JOB HISTORY QUERY HISTORY SAVED QUERIES

5. Click “Query Table” in the main window for the console to pop up, and try to run your query.

The screenshot shows the Google Cloud Platform BigQuery SQL workspace. The URL in the browser is `console.cloud.google.com/bigquery?project=cs145-fa21&ws=!m5!1m4!1m3!1scs145-fa21-326819!2sbquxjob_5f5ec940_17c0ef2d5c9!3sUS&j=bq:US:bquxjob_5f5...`. The main interface includes a sidebar with 'Explorer' and a search bar at the top. A query editor window is open with the following SQL code:

```
1 SELECT market FROM `bigquery-public-data.ncaa_basketball.mascots` LIMIT 1000
```

The results section shows the output of the query:

Row	market
1	Tulsa
2	Arizona State
3	Drexel
4	Bradley
5	Canisius
6	Michigan
7	Illinois-Chicago
8	Green Bay
9	Mississippi Valley State
10	Elon

At the bottom, there are navigation links for 'JOB HISTORY', 'QUERY HISTORY', and 'SAVED QUERIES'.

Best Practices

1. Pay attention to the estimated number of bytes read by the query. Once you compose your query, you should see the number on the right side of the bottom panel.
 - a. You will be billed by the number of bytes read by the query.
 - b. If the estimated number of bytes is greater than 1GB, try to put on some constraints on your query. For example, only select the columns that you need.

The screenshot shows the BigQuery Web UI interface. At the top, there's a toolbar with 'RUN', 'SAVE', 'SCHEDULE', 'MORE', and a message box containing the text 'This query will process 4.5 KiB when run.' A red box highlights this message. Below the toolbar, the query is displayed: '1 SELECT market FROM `bigquery-public-data.ncaa_basketball.mascots` LIMIT 1000'. Underneath the query, there's a 'Query results' section with tabs for 'Results' (which is selected), 'JSON', and 'Execution details'. The results table has a header 'Row market' and contains three rows of data: 1 Tulsa, 2 Arizona State, and 3 Drexel.

2. If you are just exploring/trying out queries, use **LIMIT** to query fewer data. Also, avoid using **SELECT ***. Google will charge the query as scanning the whole table.
3. It's always helpful to use the "Preview" pane on a BigQuery table to see the first few rows of the table to see what data you're dealing with when writing your query.
4. In declarative languages, it's easier to build up the query piece by piece. Start with a basic frame of what you're looking for (maybe write the conditions, or do a join). Then add complexity to your query one bit at a time. It's much easier to debug this way as well.
5. BigQuery can auto-format your SQL queries with CTRL-SHIFT-F on Windows or CMD-SHIFT-F on Mac. This might be nice to learn about conventional SQL style guidelines (and will also make your queries more readable, which we appreciate).
6. BigQuery has a shortcut to run queries. This is CTRL-ENTER on Windows or CMD-RETURN on Mac.
7. Make sure that you are using **Standard SQL**, not legacy SQL. This should be the default with BigQuery's Web UI.
 - a. Check the SQL dialect by navigating through "More" -> "Query settings" on the top of the bottom panel (see screenshot below).

- b. Scroll down to “Additional settings”. Make sure the SQL dialect is “Standard” (see screenshot below).

References

1. <https://cloud.google.com/bigquery/docs/reference/standard-sql/functions-and-operators> for a list of functions that BigQuery supports

2. <https://cloud.google.com/bigquery/docs/best-practices-costs> for more best practices to save cost