CS145: Data Management and Data Systems

Stanford University, Fall 2018

BigQuery Project

Part 1: Exploring NCAA Basketball Data
5% of Course Grade

Due Date: Friday, October 12th, 11:59PM

Overview

Welcome to CS145! Throughout the course you will be using Google's BigQuery platform to gain hands-on practice with real-world data systems.

BigQuery is Google's service for big data. Throughout the three parts of the class project, we will be using BigQuery's basic SQL querying interface, its interface with Colaboratory[1], and its built-in machine learning features.

Google has published many datasets on BigQuery -- these range from StackOverflow statistics to real-time air quality data. In this first part of the course project you will be using BigQuery's SQL interface to answer questions about the NCAA Basketball dataset.

Task A: Getting Setup

Before proceeding, make sure you have read and understood the **Getting Started with BigQuery** support document (available on the course website) which describes how to get up and running with your BigQuery account, how to manage your course credit, etcetera.

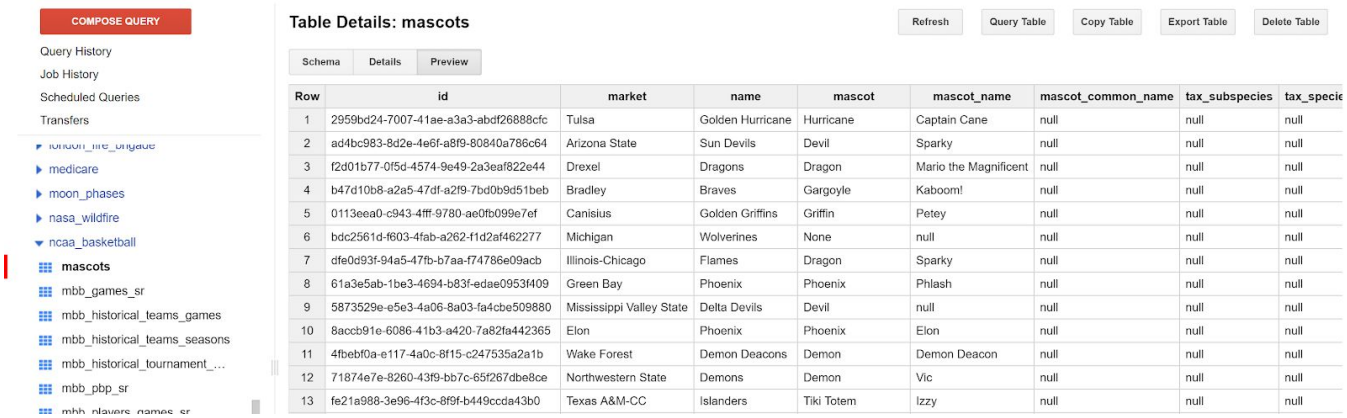
Note: This is a *very important step* as we will be unable to give extra Google Cloud credit to students that use up all of their credit. If you have any questions about Google Cloud, your account, or your credits, check Piazza for similar questions or make a post yourself.

Task B: Familiarize yourself with the NCAA Basketball Dataset

Now that you've oriented yourself in BigQuery, your second task is to examine the schemas and the descriptions of the NCAA Basketball dataset tables and understand the data that you will be working with.

[1]Colaboratory is a free document collaboration tool built on top of Jupyter. You can think of it as a Jupyter notebook, except that you are able to collaborate on it with multiple people.

You may try running some simple queries over the tables to get a feel for them, or use BigQuery's "Preview" tab to see what the data looks like.



Row	id	market	name	mascot	mascot_name	mascot_common_name	tax_subspecies	tax_specie
1	2959bd24-7007-41ae-a3a3-abdf26888cfc	Tulsa	Golden Hurricane	Hurricane	Captain Cane	null	null	null
2	ad4bc983-8d2e-4e6f-a8f9-80840a786c64	Arizona State	Sun Devils	Devil	Sparky	null	null	null
3	f2d01b77-0f5d-4574-9e49-2a3eaf822e44	Drexel	Dragons	Dragon	Mario the Magnificent	null	null	null
4	b47d10b8-a2a5-47df-a2f9-7bd0b9d51beb	Bradley	Braves	Gargoyle	Kaboom!	null	null	null
5	0113eea0-c943-4fff-9780-ae0fb099e7ef	Canisius	Golden Griffins	Griffin	Petey	null	null	null
6	bdc2561d-f603-4fab-a262-f1d2af462277	Michigan	Wolverines	None	null	null	null	null
7	dfe0d93f-94a5-47fb-b7aa-f74786e09acb	Illinois-Chicago	Flames	Dragon	Sparky	null	null	null
8	61a3e5ab-1be3-4694-b83f-edae0953f409	Green Bay	Phoenix	Phoenix	Phlash	null	null	null
9	5873529e-e5e3-4a06-8a03-fa4cbe509880	Mississippi Valley State	Delta Devils	Devil	null	null	null	null
10	8accb91e-6086-41b3-a420-7a82fa442365	Elon	Phoenix	Phoenix	Elon	null	null	null
11	4fbebf0a-e117-4a0c-8f15-c247535a2a1b	Wake Forest	Demon Deacons	Demon	Demon Deacon	null	null	null
12	71874e7e-8260-43f9-bb7c-65f267dbe8ce	Northwestern State	Demons	Demon	Vic	null	null	null
13	fe21a988-3e96-4f3c-8f9f-b449ccda43b0	Texas A&M-CC	Islanders	Tiki Totem	Izzy	null	null	null

Some notes:

- Note that BigQuery's dataset is about *Men's* NCAA Basketball teams. All questions in the next section assume we are asking about Men's NCAA basketball teams.
- _sr stands for "Sportradar", which is a company that collects sports data, down to the x/y coordinates of events (shot attempted, rebound, turnover, foul).
- The historical data makes a distinction between tournament games and regular season games. Please make sure you're using the right table!
- "pbp" means play-by-play, which is very granular data about each event that happens in the game
- Remember, while playing around on BigQuery, **use standard SQL**, not legacy SQL.

Task C: Querying!

Now that you've gotten comfortable and familiar with BigQuery and its SQL querying interface, let's get to work and answer some questions about the NCAA Basketball dataset.

We intend for part of this assignment to be about how to translate a question in plain english to a schema - in other words, we want you to read the tables and explore the data and think about which tables and columns are necessary in answering the question we're asking. This skill is both necessary for the remainder of the projects, and is exactly how real world data querying and analysis works! Often times, someone (possibly you) has a question they want answered through data and it's up to us computer scientists to translate it into something the database understands, much like how we translate product specs into code a computer understands when writing an application.

Your queries should be fairly efficient -- they should each take at most ten seconds to execute on BigQuery, and most of them will be finished in less than ~4 seconds. If any of your queries are taking much longer than that, you've probably written them in particularly inefficient way; please try rewriting them, and see the course staff if you need help. Please also check to make sure you're not querying more than a couple GBs of data - we've specifically chosen this dataset so that no one need exhaust their credits completing the assignment. All the queries you write should fit within the 1TB of free querying you're alloted for the month.

You can save your queries for each question from the BigQuery interface directly, or you can keep track of your queries in separate files yourself. Remember that you can use BigQuery's "Query History" tab to inspect previous queries you've run.

Write standard SQL queries to answer the following questions:

1. (1 point) What is the name and capacity of Stanford's NCAA basketball team venue?

2. (1 point) How many games were played in Stanford's venue in the 2013-2014 season?

3. (1 point) Hexadecimal colors codes are a way of representing color on a computer. Hex color codes are of form #AABBCC, where AA, BB, and CC are hexadecimal numbers (00, 01, … , FE, FF) indicating the intensity of red, green, and blue in the color, respectively.

   Hint: be careful with the case of the colors in the dataset -- some use lower case characters and some use upper case characters.

   What teams have the maximum possible red intensity in their color? Give (team market, color) as your answer. Order your results alphabetically by the team name.

4. (1 point) How many *home* games has Stanford won in seasons 2013 to 2017 (inclusive)? Give (number of games won, average score for Stanford in those games, average score of the opponents in those games) as your answer. Round any decimal values to two places.

5. (2 points) How many players have played for a team based in the same city where they were born? For this question, please only use the player's birth city and state (do not include the player's birth country).

6. (2 points) What is the biggest margin of victory in the historical tournament data? Output the winning team name, losing team name, winning team points, losing team points, and the win margin of that game.

7. (3 points) In a basketball tournament, teams are ranked from best to worst prior to starting the matches. This ranking is called the "seed" of the team (1 is the best team, and a higher number indicates a worse team). In general, a higher ranked team is expected to beat a lower ranked team.

   Definition: An **upset** occurs whenever a team with seed A beats a team with seed B, and $A > B$.

   What percentage of historical tournament games are upsets? Round to two decimal places. For example, if 50.2489% of games are upsets, your query should return 50.25.

8. (3 points) Which pairs of NCAA basketball teams are 1) based in the same state and 2) have the same team color? Output the team names and the state. Put the team name that comes alphabetically first in each pair on the leftmost column, and order the rows alphabetically by the first column.

9. (4 points) Since the start of the 2013 season, which teams have had more than 5 players score 15 or more points in the first half in a single game? **Note**: These players did not all have to score 15+ points in the first half of the *same* game.

   Output the top 5 team markets and the number of players for each team meeting this criteria from most to least, breaking ties by team names in alphabetical order.

10. Definition: A **geographical location** *L* is a unique tuple (city, state, country).

    Definition: A geographical location *L* "makes" points for a team *T* whenever a player that was born in *L* or "identifies closely[2]" with *L* scores points for *T*.

    (3 points) What three geographical locations made the most points for Stanford's team in seasons 2013 through 2017, and how many points did they make?

    Restrictions:
    - For the purposes of this query, avoid using the "*birth_place*" column.

11. Definition: Team *X* is a **top performer** on season *Y* if no other team had more wins than *X* in the same season.

    (4 points) What five teams (identify them here by their "markets") were top performers in the most seasons between 1900 and 2000 (inclusive), and how many times were they top performers? Output the team markets and the number of times each team was a top performer. If there are ties, break them by giving a higher ranking to team markets that come first alphabetically. Ignore teams with NULL markets.

Your answers to the above queries should be the following (as displayed on BigQuery):

1.

Row	venue_name	venue_capacity
1	Maples Pavilion	7392

2.

Row	games_at_stanford_season_2013
1	16

3.

Row	market	color
1	Idaho State	#ff7800
2	Morehead State	#ffc300
3	North Carolina A&T	#ffb82b

[2] Sportradar data for a birth place can mean that either the player was born there or the player identifies closely with that place.

4	Northern Colorado	#ffb500
5	Oklahoma State	#FF6600
6	Pacific	#ff6900
7	South Dakota	#ff2310
8	Syracuse	#ff5113
9	Tennessee-Martin	#ff6900

4.

Row	number	avg_stanford	avg_opponent
1	71	78.04	64.21

5. 606
6.

Row	win_name	lose_name	win_pts	lose_pts	margin
1	Jayhawks	Panthers	110	52	58

7. 27.26
8.

Row	teamA	teamB	venue_state
1	Bearcats	Norse	KY
2	Cougars	Red Raiders	TX
3	Razorbacks	Red Wolves	AR

9.

Row	team_market	num_players
1	Kentucky	14
2	Oregon	14
3	UCLA	14
4	Duke	13
5	Marquette	13

10.

Row	city	state	country	total_points
1	Phoenix	AZ	USA	2223
2	Minneapolis	MN	USA	1427
3	Rock Island	IL	USA	1399

11.

Row	team_market	top_performer_count
1	University of California, Los Angeles	6
2	University of Kentucky	6
3	Texas Southern University	5
4	University of Pennsylvania	5
5	Western Kentucky University	5

Submission Instructions

Once you have written queries that answer all questions and conform to the given result schemas, you're ready to submit.

To submit:

1. Copy all the queries you wrote for Task C into the `project1_submission.py` file (available on the course website), pasting all of your queries into the corresponding places.
2. If you collaborated with others to generate your queries, add their names and SUNet IDs to the comment at the top of the `project1_submission.py` file.
3. Submit this Python file on Gradescope[3].

You may resubmit as many times as you like; however, only the latest submission and timestamp will be saved, and we will use your latest submission for grading your work and determining any late penalties that may apply. Submissions via email will not be accepted!

Note: We will be using an automated system to grade your queries. Make sure that:

1. You use the "Standard" SQL dialect on BigQuery, and not "legacy" SQL -- you can do this by checking the correct box on the "Query settings" pane of the BigQuery querying interface.
2. Your final submission is free from Python or SQL syntax errors.
3. You follow the instructions in this section carefully (i.e. pair the right query with the right question).

We reserve the right to deduct points from your project if you do not follow the submission instructions, or if you have syntax errors in your queries.

[3] When you submit to Gradescope, we will run a syntax checker that will make sure that your SQL runs OK. It should run immediately and return whether the query ran OK or if there were errors - please make sure that you get a positive result from this test in your final submission.