Assignment 4

Due at 11:59pm on November 5.

This is an individual assignment. Turn in this assignment as an HTML or PDF file to ELMS. Make sure to include the R Markdown or Quarto file that was used to generate it. Include the GitHub link for the repository containing these files.

GitHub link: https://github.com/gracedesj/727-Assignment-4

In this notebook we will use Google BigQuery, "Google's fully managed, petabyte scale, low cost analytics data warehouse". Some instruction on how to connect to Google BigQuery can be found here: https://db.rstudio.com/databases/big-query/.

You will need to set up a Google account with a project to be able to use this service. We will be using a public dataset that comes with 1 TB/mo of free processing on Google BigQuery. As long as you do not repeat the work in this notebook constantly, you should be fine with just the free tier.

Go to https://console.cloud.google.com and make sure you are logged in a non-university Google account. **This may not work on a university G Suite account because of restrictions on those accounts.** Create a new project by navigating to the dropdown menu at the top (it might say "Select a project") and selecting "New Project" in the window that pops up. Name it something useful.

After you have initialized a project, paste your project ID into the following chunk.

```
project <- "assignment-4-440616"
```

We will connect to a public database, the Chicago crime database, which has data on crime in Chicago.

```
con <- dbConnect(
  bigrquery::bigquery(),
  project = "bigquery-public-data",
  dataset = "chicago_crime",
  billing = project
```

```
)
con
```

```
<BigQueryConnection>
  Dataset: bigquery-public-data.chicago_crime
  Billing: assignment-4-440616
```

We can look at the available tables in this database using `dbListTables`.

Note: When you run this code, you will be sent to a browser and have to give Google permissions to Tidyverse API Packages. **Make sure you select all to give access or else your code will not run.**

```
dbListTables(con)
```

```
[1] "crime"
```

Information on the ‘crime‘ table can be found here:

https://cloud.google.com/bigquery/public-data/chicago-crime-data

Write a first query that counts the number of rows of the ‘crime‘ table in the year 2016. Use code chunks with {sql connection = con} in order to write SQL code within the document.

```
SELECT count(primary_type), count(*)
FROM crime
WHERE year = 2016
LIMIT 10;
```

Table 1: 1 records

f0_	f1_
269922	269922

Next, count the number of arrests grouped by `primary_type` in 2016. Note that is a somewhat similar task as above, with some adjustments on which rows should be considered. Sort the results, i.e. list the number of arrests in a descending order.

```sql
SELECT primary_type, COUNT(*) AS arrest_count
FROM crime
WHERE year = 2016 AND arrest = TRUE
GROUP BY primary_type
ORDER BY arrest_count DESC;
```

Table 2: Displaying records 1 - 10

primary_type	arrest_count
NARCOTICS	13327
BATTERY	10333
THEFT	6522
CRIMINAL TRESPASS	3724
ASSAULT	3492
OTHER OFFENSE	3415
WEAPONS VIOLATION	2511
CRIMINAL DAMAGE	1669
PUBLIC PEACE VIOLATION	1116
MOTOR VEHICLE THEFT	1098

We can also use the `date` for grouping. Count the number of arrests grouped by hour of the day in 2016. You can extract the latter information from `date` via `EXTRACT(HOUR FROM date)`. Which time of the day is associated with the most arrests?

```sql
SELECT EXTRACT(HOUR FROM date) AS hour_of_day, COUNT(*) AS arrest_count
FROM crime
WHERE year = 2016 AND arrest = TRUE
GROUP BY hour_of_day
ORDER BY arrest_count DESC;
```

Table 3: Displaying records 1 - 10

hour_of_day	arrest_count
19	3843
18	3481
20	3302
21	2961
16	2933
22	2896

hour_of_day	arrest_count
11	2895
17	2820
12	2787
14	2774

The time of day that is associated with the most arrests is 19:00/7:00pm.

Focus only on `HOMICIDE` and count the number of arrests for this incident type, grouped by year. List the results in descending order.

```
SELECT year, COUNT(*) AS homicide_arrest_count
FROM crime
WHERE primary_type = 'HOMICIDE' AND arrest = TRUE
GROUP BY year
ORDER BY homicide_arrest_count DESC;
```

Table 4: Displaying records 1 - 10

year	homicide_arrest_count
2001	430
2002	427
2003	382
2020	349
2022	306
2004	294
2021	292
2016	289
2008	287
2006	284

Find out which districts have the highest numbers of arrests in 2015 and 2016. That is, count the number of arrests in 2015 and 2016, grouped by year and district. List the results in descending order.

```
SELECT year, district, COUNT(*) AS arrest_count
FROM crime
WHERE (year = 2015 OR year = 2016) AND arrest = TRUE
GROUP BY year, district
ORDER BY arrest_count DESC;
```

Table 5: Displaying records 1 - 10

year	district	arrest_count
2015	11	8974
2016	11	6575
2015	7	5549
2015	15	4514
2015	6	4474
2015	25	4450
2015	4	4325
2015	8	4113
2016	7	3655
2015	10	3622

Lets switch to writing queries from within R via the `DBI` package. Create a query object that counts the number of arrests grouped by `primary_type` of district 11 in year 2016. The results should be displayed in descending order.

Execute the query.

```
sql <-
"SELECT primary_type, COUNT(*) AS arrest_count
FROM crime
WHERE district = 11 AND year = 2016 AND arrest = TRUE
GROUP BY primary_type
ORDER BY arrest_count DESC;"

result <- dbGetQuery(con, sql)
print(result)
```

```
# A tibble: 27 x 2
   primary_type                     arrest_count
   <chr>                                   <int>
 1 NARCOTICS                                3634
 2 BATTERY                                   635
 3 PROSTITUTION                              511
 4 WEAPONS VIOLATION                         303
 5 OTHER OFFENSE                             255
 6 ASSAULT                                   206
 7 CRIMINAL TRESPASS                         205
 8 PUBLIC PEACE VIOLATION                    135
```

```
 9 INTERFERENCE WITH PUBLIC OFFICER          119
10 CRIMINAL DAMAGE                           106
# i 17 more rows
```

Try to write the very same query, now using the `dbplyr` package. For this, you need to first map the `crime` table to a tibble object in R.

```
crime_tibble <- tbl(con, "crime")
str(crime_tibble)
```

```
List of 2
 $ src       :List of 2
  ..$ con  :Formal class 'BigQueryConnection' [package "bigrquery"] with 7 slots
  .. .. ..@ project       : chr "bigquery-public-data"
  .. .. ..@ dataset       : chr "chicago_crime"
  .. .. ..@ billing       : chr "assignment-4-440616"
  .. .. ..@ use_legacy_sql: logi FALSE
  .. .. ..@ page_size     : int 10000
  .. .. ..@ quiet         : logi NA
  .. .. ..@ bigint        : chr "integer"
  ..$ disco: NULL
  ..- attr(*, "class")= chr [1:4] "src_BigQueryConnection" "src_dbi" "src_sql" "src"
 $ lazy_query:List of 6
  ..$ x         : 'dbplyr_table_path' chr "`crime`"
  ..$ vars      : chr [1:22] "unique_key" "case_number" "date" "block" ...
  ..$ group_vars: chr(0)
  ..$ order_vars: NULL
  ..$ frame     : NULL
  ..$ is_view   : logi FALSE
  ..- attr(*, "class")= chr [1:3] "lazy_base_remote_query" "lazy_base_query" "lazy_query"
 - attr(*, "class")= chr [1:5] "tbl_BigQueryConnection" "tbl_dbi" "tbl_sql" "tbl_lazy" ...
```

```
class(crime_tibble)
```

```
[1] "tbl_BigQueryConnection" "tbl_dbi"                "tbl_sql"
[4] "tbl_lazy"               "tbl"
```

Again, count the number of arrests grouped by `primary_type` of district 11 in year 2016, now using `dplyr` syntax.

```r
query2 <-
  crime_tibble %>%
  filter(year == 2016, district == 11, arrest == TRUE) %>%
  group_by(primary_type) %>%
  summarise(arrest_count = n()) %>%
  arrange(desc(arrest_count))

print(query2)
```

```
# Source:     SQL [?? x 2]
# Database:   BigQueryConnection
# Ordered by: desc(arrest_count)
   primary_type                      arrest_count
   <chr>                                    <int>
 1 NARCOTICS                                3634
 2 BATTERY                                   635
 3 PROSTITUTION                              511
 4 WEAPONS VIOLATION                         303
 5 OTHER OFFENSE                             255
 6 ASSAULT                                   206
 7 CRIMINAL TRESPASS                         205
 8 PUBLIC PEACE VIOLATION                    135
 9 INTERFERENCE WITH PUBLIC OFFICER          119
10 CRIMINAL DAMAGE                           106
# i more rows
```

Count the number of arrests grouped by `primary_type` and `year`, still only for district 11. Arrange the result by `year`.

```r
query3 <-
  crime_tibble %>%
  filter(district == 11, arrest == TRUE) %>%
  group_by(primary_type, year) %>%
  summarise(arrest_count = n(), .groups = 'drop') %>%
  arrange(year)

print(query3)
```

```
# Source:     SQL [?? x 3]
# Database:   BigQueryConnection
# Ordered by: year
```

```
   primary_type                       year arrest_count
   <chr>                             <int>        <int>
 1 OFFENSE INVOLVING CHILDREN         2001           44
 2 HOMICIDE                           2001           48
 3 ROBBERY                            2001           97
 4 LIQUOR LAW VIOLATION               2001           49
 5 INTERFERENCE WITH PUBLIC OFFICER   2001           14
 6 KIDNAPPING                         2001            4
 7 CRIMINAL TRESPASS                  2001          389
 8 CRIMINAL DAMAGE                    2001          163
 9 SEX OFFENSE                        2001           19
10 ASSAULT                            2001          322
# i more rows
```

Assign the results of the query above to a local R object.

```
query3_R_object <-
  crime_tibble %>%
  filter(district == 11, arrest == TRUE) %>%
  group_by(primary_type, year) %>%
  summarise(arrest_count = n(), .groups = 'drop') %>%
  arrange(year) %>%
  collect()
```

Confirm that you pulled the data to the local environment by displaying the first ten rows of the saved data set.

```
str(query3_R_object)
```

```
tibble [613 x 3] (S3: tbl_df/tbl/data.frame)
 $ primary_type: chr [1:613] "ASSAULT" "LIQUOR LAW VIOLATION" "HOMICIDE" "INTERFERENCE WITH P
 $ year        : int [1:613] 2001 2001 2001 2001 2001 2001 2001 2001 2001 2001 ...
 $ arrest_count: int [1:613] 322 49 48 14 4 44 266 97 163 19 ...
```

```
head(query3_R_object, 10)
```

```
# A tibble: 10 x 3
   primary_type                       year arrest_count
   <chr>                             <int>        <int>
 1 ASSAULT                            2001          322
```

```
 2 LIQUOR LAW VIOLATION              2001           49
 3 HOMICIDE                          2001           48
 4 INTERFERENCE WITH PUBLIC OFFICER  2001           14
 5 KIDNAPPING                        2001            4
 6 OFFENSE INVOLVING CHILDREN        2001           44
 7 OTHER OFFENSE                     2001          266
 8 ROBBERY                           2001           97
 9 CRIMINAL DAMAGE                   2001          163
10 SEX OFFENSE                       2001           19
```

Close the connection.

```
dbDisconnect(con)
```