ETL for CIS 9440 Data Warehousing and Analytics

- Project title: NYC Motor Vehicle Collision Transparency Data Warehouse Project
- Final Project Milestone 3
- Group Number: 5
- Version A: collision as a dimension
- Student(s): Gabriel Fernandez, Jason Jiang

ETL - Extract data

In [1]:
```
#Install the required python packages
# !pip install --upgrade sodapy
```

In [14]:
```
# pip install --upgrade sodapy
# pip install --upgrade db-dtypes
# pip install --upgrade pyarrow
# pip install --upgrade google-cloud-bigquery
#for progress bar
# pip install tqdm
```

In [15]:
```
# import libraries
import pandas as pd
import numpy as np
from sodapy import Socrata
from google.cloud import bigquery
from google.oauth2 import service_account
from tqdm.notebook import tqdm_notebook # to show progress bar
from IPython.display import Image # to attach images
pd.options.mode.chained_assignment = None  # default='warn'
```

Data sets

Dataset 1: Motor Vehicle Collisions - Crashes

he Motor Vehicle Collisions crash table contains details on the crash event. Each row represents a crash event. The Motor Vehicle Collisions data tables contain information from all police reported motor vehicle collisions in NYC.

https://data.cityofnewyork.us/Public-Safety/Motor-Vehicle-Collisions-Crashes/h9gi-nx95

Dataset 2: Motor Vehicle Collisions - Person

The Motor Vehicle Collisions person table contains details for people involved in the crash. Each row represents a person (driver, occupant, pedestrian, bicyclist,..) involved in a crash. The data in this table goes back to April 2016 when crash reporting switched to an electronic system. https://data.cityofnewyork.us/Public-Safety/Motor-Vehicle-Collisions-Person/f55k-p6yu

---

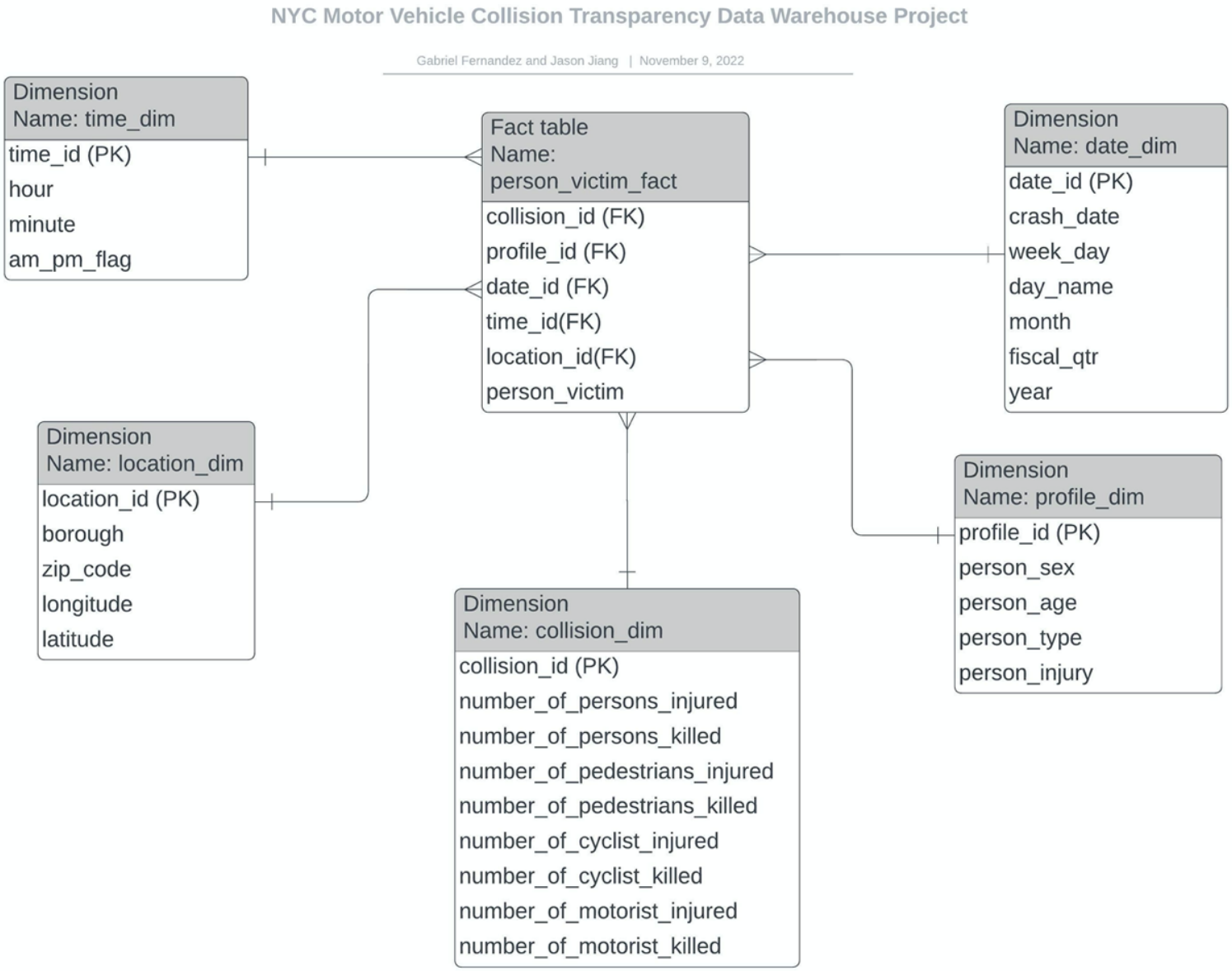
- Get your app-token from: https://data.cityofnewyork.us/profile/edit/developer_settings

Dimensional model (updated)

https://lucid.app/lucidchart/d42f0e3b-891b-49d3-9486-6ffabdc2f6d8/edit?page=0_0&invitationId=inv_b85589a9-5172-40f5-8ca8-450d9098461b#

In [16]:
```
Image("/content/drive/MyDrive/project_DW/project_dimensional_model.jpeg")
```

Out[16]:



In [17]:

```
# setup the host name for the API endpoint for NYC Open Data
data_url = 'data.cityofnewyork.us'
```

In [18]:
```
# setup the data sets at the API endpoint

# end point https://data.cityofnewyork.us/resource/t5n6-gx8c.json
data_set1 = 'h9gi-nx95'
data_set2 = 'f55k-p6yu'
```

In [19]:
```
# Setup your App Token
# You can find your app token by logging into: https://data.cityofnewyork.us/profile/edit/developer_settin
app_token = "your_token"
```

In [20]:
```
# run this cell to setup your Socrata client that connects python to NYC Open Data

# create the client that points to the API endpoint
nyc_open_data_client = Socrata(data_url, app_token, timeout = 200)
print(f"nyc open data client name is: {nyc_open_data_client}")
print(f"nyc open data client data type is: {type(nyc_open_data_client)}")
```

```
nyc open data client name is: <sodapy.socrata.Socrata object at 0x7f1ae17e8190>
nyc open data client data type is: <class 'sodapy.socrata.Socrata'>
```

In [21]:
```
# Define a key_path variable to connect BigQuery
key_path = "your.json"
```

In [22]:
```
# run this cell without changing anything to setup your credentials
credentials = service_account.Credentials.from_service_account_file(key_path,
                                                                    scopes=["https://www.googleapis.com/au
bigquery_client = bigquery.Client(credentials = credentials,
                                  project = credentials.project_id)

print(f"bigquery client name is: {bigquery_client}")
print(f"bigquery client data type is: {type(bigquery_client)}")
```

```
bigquery client name is: <google.cloud.bigquery.client.Client object at 0x7f1ae189dfd0>
bigquery client data type is: <class 'google.cloud.bigquery.client.Client'>
```

In [23]:
```
# Create a new dataset in BigQuery and copy its id

dataset_id = "your_databasae_id"

dataset_id = dataset_id.replace(':', '.')
print(f"your dataset_id is: {dataset_id}")
```

```
your dataset_id is: deft-stratum-361822.ETL_milestone3
```

Extract data

1. connect to NYC Open Data with API Key
2. pull specific dataset as a pandas dataframe
3. Look at shape of extracted data

sodapy client.get parameters (https://dev.socrata.com/docs/:queries/)

1. select
2. where
3. order
4. limit
5. group '

In [24]:
```
# Get the total number of records in our the entire data sets

#data_set1
total_record_count = nyc_open_data_client.get(data_set1, select = "COUNT(*)")
print(f"total records in {data_set1}: {total_record_count[0]['COUNT']}")
```

```
total records in h9gi-nx95: 1943446
```

In [25]:
```
#data_set2
total_record_count2 = nyc_open_data_client.get(data_set2, select = "COUNT(*)")
print(f"total records in {data_set2}: {total_record_count2[0]['COUNT']}")
```

```
total records in f55k-p6yu: 4857091
```

In [26]:

```
# Now, loop through target data set to pull all rows in chunks (we cannot pull all rows at once)
# Maximum chunk size for limit parameter is 50,000 https://dev.socrata.com/docs/queries/limit.html

def extract_socrata_data(data_set,
                         chunk_size = 2500,
                         where = None):

    # measure time this function takes
    import time
    start_time1 = time.time()

    # get total number or records
    if where == None:
        total_records = int(nyc_open_data_client.get(data_set,
                                                     select= "COUNT(*)")[0]["COUNT"])
    else:
        total_records = int(nyc_open_data_client.get(data_set,
                                                     where = where,
                                                     select= "COUNT(*)")[0]["COUNT"])

    # start at 0, empty list for results
    start = 0
    results = []

    # for progress bar
    pbar = tqdm_notebook(desc = 'while loop', total = total_records)

    while True:

        if where == None:
            # fetch the set of records starting at 'start'
            results.extend(nyc_open_data_client.get(data_set,
                                                    offset = start,
                                                    limit = chunk_size))

        elif where != None:
            results.extend(nyc_open_data_client.get(data_set,
                                                    where = where,
                                                    offset = start,
                                                    limit = chunk_size))
        # update the starting record number
```

```
        start = start + chunk_size

        # Update progress bar
        print(start, end ='\r')
        pbar.update(chunk_size)

        # if we have fetched all of the records (we have reached total_records), exit loop
        if (start > total_records):
            print("Loop completed")
            #close progress bar
            pbar.close()
            break

    # convert the list into a pandas data frame
    end_time1 = time.time()
    print(f"Loop took {round(end_time1 - start_time1, 1)} seconds")

    start_time2 = time.time()

    data = pd.DataFrame.from_records(results)

    end_time2 = time.time()
    print(f"Transforming to pandas.DataFrame took {round(end_time2 - start_time2, 1)} seconds")

    print(f"The shape of your dataframe is: {data.shape}")
    return data



# progress bar: https://medium.com/@harshit4084/track-your-loop-using-tqdm-7-ways-progress-bars-in-python-
```

In [27]:

```
# Fetch all rows for data set1

#data_set1 = 'h9gi-nx95'
data1 = extract_socrata_data(chunk_size = 10000,
                             data_set = data_set1)
```

```
Loop completed
Loop took 338.4 seconds
Transforming to pandas.DataFrame took 10.1 seconds
The shape of your dataframe is: (1943446, 29)
```

In [28]:

```
data1.head()
```

Out[28]:

	crash_date	crash_time	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of
0	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2	0	
1	2022-03-26T00:00:00.000	11:45	QUEENSBORO BRIDGE UPPER	NaN	1	0	
2	2022-06-29T00:00:00.000	6:55	THROGS NECK BRIDGE	NaN	0	0	
3	2021-09-11T00:00:00.000	9:35	NaN	NaN	0	0	
4	2021-12-14T00:00:00.000	8:13	SARATOGA AVENUE	DECATUR STREET	0	0	

5 rows × 29 columns

In [29]:

```
# Fetch all rows for data set2
#data_set2 = 'f55k-p6yu'
data2 = extract_socrata_data(data_set = data_set2,
                             chunk_size = 50000)
```

```
Loop completed
Loop took 239.0 seconds
Transforming to pandas.DataFrame took 21.5 seconds
The shape of your dataframe is: (4857091, 21)
```

In [30]:
```
data1.columns
```

Out[30]:
```
Index(['crash_date', 'crash_time', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'location', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5'],
      dtype='object')
```

In [31]:
```
data2.columns
```

Out[31]:
```
Index(['unique_id', 'collision_id', 'crash_date', 'crash_time', 'person_id',
       'person_type', 'person_injury', 'vehicle_id', 'ped_role', 'person_sex',
       'person_age', 'ejection', 'emotional_status', 'bodily_injury',
       'position_in_vehicle', 'safety_equipment', 'complaint', 'ped_location',
       'ped_action', 'contributing_factor_1', 'contributing_factor_2'],
      dtype='object')
```

Merge data

In [32]:
```
data = data1.merge(data2,
                           how = 'inner',
                           left_on = "collision_id",
                           right_on = "collision_id")
```

In [33]:
```
data.shape
```

Out[33]:
```
(4856938, 49)
```

In [34]:
```
data.head()
```

Out[34]:

	crash_date_x	crash_time_x	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_
0	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2	0	
1	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2	0	
2	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2	0	
3	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2	0	
4	2022-03-26T00:00:00.000	11:45	QUEENSBORO BRIDGE UPPER	NaN	1	0	

5 rows × 49 columns

ETL - Transform data

Data profiling

1. Distinct values per column
2. Null values per column
3. Summary statistics per numeric column

In [35]:

```
# what are the columns in our dataframe?
data.columns
```

Out[35]:
```
Index(['crash_date_x', 'crash_time_x', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'location', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_id', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2'],
      dtype='object')
```

In [36]:
```
data.rename(columns = {'person_id':'person_victim','crash_date_x':'crash_date','crash_time_x':'crash_time'
data.columns
```

Out[36]:
```
Index(['crash_date', 'crash_time', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'location', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2'],
      dtype='object')
```

In [37]:

```
# create and run a function to ceate data profiling dataframe

def create_data_profiling_df(data):

    # create an empty dataframe to gather information about each column
    data_profiling_df = pd.DataFrame(columns = ["column_name",
                                                "column_type",
                                                "unique_values",
                                                "duplicate_values",
                                                "null_values",
                                                "non_null_values"])

    # loop through each column to add rows to the data_profiling_df dataframe
    for column in tqdm_notebook(data.columns):

        info_dict = {}

        try:
            info_dict["column_name"] = column
            info_dict["column_type"] = data[column].dtypes
            info_dict["unique_values"] = len(data[column].unique())
            info_dict["duplicate_values"] = data[column].count() - len(data[column].dropna().unique())
            info_dict["null_values"] = data[column].isna().sum()
            info_dict["non_null_values"] = data[column].count()

        except:
            print(f"unable to read column: {column}, you may want to drop this column")

        data_profiling_df = data_profiling_df.append(info_dict, ignore_index=True)

    data_profiling_df.sort_values(by = ['unique_values', "non_null_values"],
                                  ascending = [False, False],
                                  inplace=True)

    return data_profiling_df
```

In [38]:

```
# view your data profiling dataframe
#RUN DATA PROFILING FUNCTION HERE
data_profiling_df = create_data_profiling_df(data = data)
data_profiling_df
```

```
unable to read column: location, you may want to drop this column
```

Out[38]:

	column_name	column_type	unique_values	duplicate_values	null_values	non_null_values
29	unique_id	object	4851693	5245	0	4856938
32	person_victim	object	4656971	199949	19	4856919
35	vehicle_id	object	2236663	2427126	193150	4663788
14	collision_id	object	1313567	3543371	0	4856938
22	cross_street_name	object	184211	783511	3889217	967721
19	latitude	object	145775	4239911	471253	4385685
20	longitude	object	108374	4277312	471253	4385685
3	off_street_name	object	17464	2470852	2368623	2488315
2	on_street_name	object	16238	3834835	1005866	3851072
0	crash_date	object	3781	4853157	0	4856938
30	crash_date_y	object	3781	4853157	0	4856938
16	vehicle_type_code2	object	1615	4208942	646382	4210556
15	vehicle_type_code1	object	1448	4841482	14009	4842929
1	crash_time	object	1440	4855498	0	4856938
31	crash_time_y	object	1440	4855498	0	4856938
38	person_age	object	868	4372028	484043	4372895
18	zip_code	object	234	3006674	1850031	3006907
24	vehicle_type_code_3	object	230	550827	4305882	551056
26	vehicle_type_code_4	object	91	154057	4702791	154147
28	vehicle_type_code_5	object	63	49756	4807120	49818

12	contributing_factor_vehicle_1	object	62	4851558	5319	4851619
13	contributing_factor_vehicle_2	object	62	4349368	507509	4349429
47	contributing_factor_1	object	53	69977	4786909	70029
23	contributing_factor_vehicle_3	object	51	567144	4289744	567194
48	contributing_factor_2	object	51	69884	4787004	69934
25	contributing_factor_vehicle_4	object	38	158399	4698502	158436
4	number_of_persons_injured	object	29	4856868	42	4856896
10	number_of_motorist_injured	object	28	4856910	0	4856938
27	contributing_factor_vehicle_5	object	28	50988	4805923	51015
44	complaint	object	22	2553776	2303141	2553797
43	safety_equipment	object	19	2486956	2369964	2486974
46	ped_action	object	17	71189	4785733	71205
41	bodily_injury	object	15	2553776	2303148	2553790
6	number_of_pedestrians_injured	object	13	4856925	0	4856938
42	position_in_vehicle	object	12	2487033	2369894	2487044
36	ped_role	object	11	4662044	194884	4662054
40	emotional_status	object	9	2553739	2303191	2553747
5	number_of_persons_killed	object	8	4856839	92	4856846
39	ejection	object	7	2486693	2370239	2486699
11	number_of_motorist_killed	object	6	4856932	0	4856938
17	borough	object	6	3007721	1849212	3007726
8	number_of_cyclist_injured	object	5	4856933	0	4856938
45	ped_location	object	5	71302	4785632	71306
7	number_of_pedestrians_killed	object	4	4856934	0	4856938
33	person_type	object	4	4856934	0	4856938

37	person_sex	object	4	4302586	554349	4302589
9	number_of_cyclist_killed	object	3	4856935	0	4856938
34	person_injury	object	3	4856935	0	4856938
21	location	object	NaN	NaN	NaN	NaN

In [39]:
```
#drop location because it is a dictionary and will raise an error in the next sections. Also, we already h
data.drop(['location'], axis=1, inplace=True)
```

Data cleaning

1. drop unneeded columns
2. drop duplicate rows
3. check for outliers

In [40]:
```
# Run this to look at a list of your columns
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4856938 entries, 0 to 4856937
Data columns (total 48 columns):
 #   Column                          Dtype 
---  ------                          ----- 
 0   crash_date                      object
 1   crash_time                      object
 2   on_street_name                  object
 3   off_street_name                 object
 4   number_of_persons_injured       object
 5   number_of_persons_killed        object
 6   number_of_pedestrians_injured   object
 7   number_of_pedestrians_killed    object
 8   number_of_cyclist_injured       object
 9   number_of_cyclist_killed        object
 10  number_of_motorist_injured      object
 11  number_of_motorist_killed       object
```

```
 12  contributing_factor_vehicle_1  object
 13  contributing_factor_vehicle_2  object
 14  collision_id                   object
 15  vehicle_type_code1             object
 16  vehicle_type_code2             object
 17  borough                        object
 18  zip_code                       object
 19  latitude                       object
 20  longitude                      object
 21  cross_street_name              object
 22  contributing_factor_vehicle_3  object
 23  vehicle_type_code_3            object
 24  contributing_factor_vehicle_4  object
 25  vehicle_type_code_4            object
 26  contributing_factor_vehicle_5  object
 27  vehicle_type_code_5            object
 28  unique_id                      object
 29  crash_date_y                   object
 30  crash_time_y                   object
 31  person_victim                  object
 32  person_type                    object
 33  person_injury                  object
 34  vehicle_id                     object
 35  ped_role                       object
 36  person_sex                     object
 37  person_age                     object
 38  ejection                       object
 39  emotional_status               object
 40  bodily_injury                  object
 41  position_in_vehicle            object
 42  safety_equipment               object
 43  complaint                      object
 44  ped_location                   object
 45  ped_action                     object
 46  contributing_factor_1          object
 47  contributing_factor_2          object
dtypes: object(48)
memory usage: 1.8+ GB
```

Drop duplicates

In [41]:

```
def drop_dupli(data):

  #check number of rows
  print(f"number of rows before dropping duplicates: {len(data)}")
  #check for duplciates
  print(f"number of duplicate rows: {len(data[data.duplicated()])}")
  #drop duplicate rows based on entire row
  data = data.drop_duplicates(keep = 'first')
  print(f"number of rows after duplicates dropped: {len(data)}")

  return data
```

In [42]:

```
# drop duplicates
data_sin_du = drop_dupli(data)
```

```
number of rows before dropping duplicates: 4856938
number of duplicate rows: 5245
number of rows after duplicates dropped: 4851693
```

In [43]:

```
data = data_sin_du.copy()
data.shape
```

Out[43]:

```
(4851693, 48)
```

In [44]:

```
# update numeric columns types for data

select_cols = ['latitude',
               'longitude',
               'person_age',
               'collision_id',
               'number_of_persons_injured',
               'number_of_persons_killed',
               'number_of_pedestrians_injured',
               'number_of_pedestrians_killed',
               'number_of_cyclist_injured',
               'number_of_cyclist_killed',
               'number_of_motorist_injured',
               'number_of_motorist_killed']

for column in tqdm_notebook(select_cols):
    try:
        data[column] = data[column].astype(int)

    except:
        data[column] = data[column].astype(float)

data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4851693 entries, 0 to 4856937
Data columns (total 48 columns):
 #   Column                          Dtype
---  ------                          -----
 0   crash_date                      object
 1   crash_time                      object
 2   on_street_name                  object
 3   off_street_name                 object
 4   number_of_persons_injured       float64
 5   number_of_persons_killed        float64
 6   number_of_pedestrians_injured   int64
 7   number_of_pedestrians_killed    int64
 8   number_of_cyclist_injured       int64
 9   number_of_cyclist_killed        int64
 10  number_of_motorist_injured      int64
 11  number_of_motorist_killed       int64
```

```
 12  contributing_factor_vehicle_1  object
 13  contributing_factor_vehicle_2  object
 14  collision_id                   int64
 15  vehicle_type_code1             object
 16  vehicle_type_code2             object
 17  borough                        object
 18  zip_code                       object
 19  latitude                       float64
 20  longitude                      float64
 21  cross_street_name              object
 22  contributing_factor_vehicle_3  object
 23  vehicle_type_code_3            object
 24  contributing_factor_vehicle_4  object
 25  vehicle_type_code_4            object
 26  contributing_factor_vehicle_5  object
 27  vehicle_type_code_5            object
 28  unique_id                      object
 29  crash_date_y                   object
 30  crash_time_y                   object
 31  person_victim                  object
 32  person_type                    object
 33  person_injury                  object
 34  vehicle_id                     object
 35  ped_role                       object
 36  person_sex                     object
 37  person_age                     float64
 38  ejection                       object
 39  emotional_status               object
 40  bodily_injury                  object
 41  position_in_vehicle            object
 42  safety_equipment               object
 43  complaint                      object
 44  ped_location                   object
 45  ped_action                     object
 46  contributing_factor_1          object
 47  contributing_factor_2          object
dtypes: float64(5), int64(7), object(36)
memory usage: 1.8+ GB
```

Check for outliers

In [45]:
```
# select numerics col for data
numerics = ['int16', 'int32', 'int64', 'float16', 'float32', 'float64']

data_numerics= data.select_dtypes(include=numerics)
```

In [46]:
```
# Descriptive statistics for data
data_numerics.drop(columns=['latitude','longitude', 'collision_id']).describe().T
```

Out[46]:

	count	mean	std	min	25%	50%	75%	max
number_of_persons_injured	4851651.0	0.474809	1.017106	0.0	0.0	0.0	1.0	43.0
number_of_persons_killed	4851601.0	0.002248	0.054740	0.0	0.0	0.0	0.0	8.0
number_of_pedestrians_injured	4851693.0	0.051084	0.253341	0.0	0.0	0.0	0.0	27.0
number_of_pedestrians_killed	4851693.0	0.000970	0.034187	0.0	0.0	0.0	0.0	6.0
number_of_cyclist_injured	4851693.0	0.024411	0.156942	0.0	0.0	0.0	0.0	4.0
number_of_cyclist_killed	4851693.0	0.000161	0.013102	0.0	0.0	0.0	0.0	2.0
number_of_motorist_injured	4851693.0	0.396939	0.998329	0.0	0.0	0.0	0.0	43.0
number_of_motorist_killed	4851693.0	0.001101	0.038158	0.0	0.0	0.0	0.0	5.0
person_age	4368517.0	36.972675	118.444215	-999.0	23.0	35.0	50.0	9999.0

In [47]:
```
data.shape
```

Out[47]:
```
(4851693, 48)
```

In [48]:
```
 # Filter out person_age < 0 and > 120
 data= data[(0 < data["person_age"]) & (data["person_age"] < 120)].copy()
```

In [49]:
```
data["person_age"].describe().T
```

Out[49]:
```
count    3.818761e+06
mean     4.018684e+01
std      1.668717e+01
min      1.000000e+00
25%      2.800000e+01
50%      3.800000e+01
75%      5.200000e+01
max      1.190000e+02
Name: person_age, dtype: float64
```

In [50]:
```
data.shape
```

Out[50]:
```
(3818761, 48)
```

Create location dimension

In [51]:
```
# first, copy the entire table
location_dim = data.copy()
```

In [52]:
```
location_dim.columns
```

Out[52]:
```
Index(['crash_date', 'crash_time', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2'],
      dtype='object')
```

In [53]:
```
# second, subset for only the wanted columns in the dimension
location_dim = location_dim[['borough', 'zip_code','latitude', 'longitude']]
```

In [54]:
```
# third, drop duplicate rows in dimension
# create unique row for dimension
unique_row = ['borough', 'zip_code','latitude', 'longitude']
#drop duplicates
location_dim = location_dim.drop_duplicates(subset = unique_row, keep = 'first')
#drop nulls
location_dim.dropna(inplace = True)
#reset index
location_dim = location_dim.reset_index(drop = True)
location_dim
```

Out[54]:

	borough	zip_code	latitude	longitude
0	BROOKLYN	11208	40.667202	-73.866500
1	BROOKLYN	11233	40.683304	-73.917274
2	BRONX	10475	40.868160	-73.831480
3	MANHATTAN	10017	40.751440	-73.973970
4	QUEENS	11413	40.675884	-73.755770
...	...	...	...	...
205230	MANHATTAN	10013	40.723686	-74.004720
205231	BROOKLYN	11249	40.713642	-73.966070
205232	QUEENS	11432	40.718758	-73.800570
205233	QUEENS	11378	40.719110	-73.913216
205234	QUEENS	11419	40.693993	-73.826805

205235 rows × 4 columns

In [55]:

```
# fourth, add location_id as a surrogate key
location_dim.insert(0, 'location_id', range(1, 1 + len(location_dim)))
location_dim
```

Out[55]:

	location_id	borough	zip_code	latitude	longitude
0	1	BROOKLYN	11208	40.667202	-73.866500
1	2	BROOKLYN	11233	40.683304	-73.917274
2	3	BRONX	10475	40.868160	-73.831480
3	4	MANHATTAN	10017	40.751440	-73.973970
4	5	QUEENS	11413	40.675884	-73.755770
...	...	...	...	...	...
205230	205231	MANHATTAN	10013	40.723686	-74.004720
205231	205232	BROOKLYN	11249	40.713642	-73.966070
205232	205233	QUEENS	11432	40.718758	-73.800570
205233	205234	QUEENS	11378	40.719110	-73.913216
205234	205235	QUEENS	11419	40.693993	-73.826805

205235 rows × 5 columns

In [56]:

```
# fifth, add the location_id to the data table
data = data.merge(location_dim,
                  left_on = unique_row,
                  right_on = unique_row,
                  how = 'left')

data.head(100)
```

Out[56]:

	crash_date	crash_time	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_c
0	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
1	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
2	2021-09-11T00:00:00.000	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
3	2022-03-26T00:00:00.000	11:45	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	
4	2022-03-26T00:00:00.000	11:45	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	
...	...	...	...	...	...	...	
95	2021-07-09T00:00:00.000	0:43	ELIOT AVENUE	NaN	0.0	1.0	
96	2021-07-09T00:00:00.000	0:43	ELIOT AVENUE	NaN	0.0	1.0	
97	2022-04-24T00:00:00.000	16:45	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	
98	2022-04-24T00:00:00.000	16:45	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	
99	2022-04-24T00:00:00.000	16:45	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	

100 rows × 49 columns

In [57]:

```
data.shape
```

Out[57]:
```
(3818761, 49)
```

Create date dimension

In [58]:
```
# change to data data type
data['crash_date'] = pd.to_datetime(data['crash_date'])
#get the date portion
data['crash_date']= data['crash_date'].dt.floor('D')
data['crash_date']
```

Out[58]:
```
0          2021-09-11
1          2021-09-11
2          2021-09-11
3          2022-03-26
4          2022-03-26
              ...
3818756    2022-11-02
3818757    2022-11-06
3818758    2022-11-06
3818759    2022-11-06
3818760    2022-11-06
Name: crash_date, Length: 3818761, dtype: datetime64[ns]
```

In [59]:

```
## ACTION REQUIRED: update the start and end date at the bottom of the sql_query variable to fit your need

sql_query = """
            SELECT
              CONCAT (FORMAT_DATE("%Y",d),FORMAT_DATE("%m",d),FORMAT_DATE("%d",d)) as date_id,
              d AS crash_date,
              FORMAT_DATE('%w', d) AS week_day,
              FORMAT_DATE('%A', d) AS day_name,
              FORMAT_DATE('%B', d) as month,
              FORMAT_DATE('%Q', d) as fiscal_qtr,
              FORMAT_DATE('%Y', d) AS year,
            FROM (
              SELECT
                *
              FROM
                UNNEST(GENERATE_DATE_ARRAY('2012-07-01', '2024-01-01', INTERVAL 1 DAY)) AS d )
            """

# store extracted data in new dataframe
date_dim = bigquery_client.query(sql_query).to_dataframe()

# validate that > 0 rows have been extracted and return dataframe
if len(date_dim) > 0:
    print(f"date dimension created successfully, shape of dimension: {date_dim.shape}")
else:
    print("date dimension FAILED")
```

```
date dimension created successfully, shape of dimension: (4202, 7)
```

In [60]:

```
#check date_dim
date_dim.head()
```

Out[60]:

	date_id	crash_date	week_day	day_name	month	fiscal_qtr	year
0	20120701	2012-07-01	0	Sunday	July	3	2012
1	20120702	2012-07-02	1	Monday	July	3	2012
2	20120703	2012-07-03	2	Tuesday	July	3	2012
3	20120704	2012-07-04	3	Wednesday	July	3	2012
4	20120705	2012-07-05	4	Thursday	July	3	2012

In [61]:

```
date_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4202 entries, 0 to 4201
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   date_id     4202 non-null   object
 1   crash_date  4202 non-null   object
 2   week_day    4202 non-null   object
 3   day_name    4202 non-null   object
 4   month       4202 non-null   object
 5   fiscal_qtr  4202 non-null   object
 6   year        4202 non-null   object
dtypes: object(7)
memory usage: 229.9+ KB
```

In [62]:

```
# convert date_id to int
date_dim['date_id'] = date_dim['date_id'].astype(int)
date_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4202 entries, 0 to 4201
Data columns (total 7 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   date_id      4202 non-null   int64 
 1   crash_date   4202 non-null   object
 2   week_day     4202 non-null   object
 3   day_name     4202 non-null   object
 4   month        4202 non-null   object
 5   fiscal_qtr   4202 non-null   object
 6   year         4202 non-null   object
dtypes: int64(1), object(6)
memory usage: 229.9+ KB
```

In [63]:

```
# create date_id column in the Fact Table
data['date_id'] = data['crash_date'].apply(lambda x: pd.to_datetime(x).strftime("%Y%m%d"))
```

In [64]:

```
#check date_dim
data.head()
```

Out[64]:

	crash_date	crash_time	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of_pede
0	2021-09-11	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
1	2021-09-11	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
2	2021-09-11	2:39	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
3	2022-03-26	11:45	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	
4	2022-03-26	11:45	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	

5 rows × 50 columns

In [65]:
```
data.shape
```

Out[65]:
```
(3818761, 50)
```

In [66]:
```
# Drop date from complete dataset.
data.drop("crash_date", axis = 1, inplace = True)
```

In [67]:
```
data.shape
```

Out[67]:
```
(3818761, 49)
```

Create time dimension

In [68]:

```
time_ids = []
hours = []
minutes = []

for hour in range(0,24):
    for minute in range(0,60):
        time_ids.append((str(hour) + str(minute)).zfill(4))
        hours.append(hour)
        minutes.append(minute)

time_dim_dict = {"time_id" : time_ids,
                 "hour" : hours,
                 "minute" : minutes}

time_dim = pd.DataFrame(data = time_dim_dict)
```

In [69]:

```
# add a column for AM and PM
time_dim['am_pm_flag'] = np.where(time_dim['hour'] >= 12,'PM','AM')
```

In [70]:

```
time_dim
```

Out[70]:

	time_id	hour	minute	am_pm_flag
0	0000	0	0	AM
1	0001	0	1	AM
2	0002	0	2	AM
3	0003	0	3	AM
4	0004	0	4	AM
...	...	...	...	...
1435	2355	23	55	PM
1436	2356	23	56	PM
1437	2357	23	57	PM
1438	2358	23	58	PM
1439	2359	23	59	PM

1440 rows × 4 columns

In [71]:

```
time_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1440 entries, 0 to 1439
Data columns (total 4 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   time_id     1440 non-null   object
 1   hour        1440 non-null   int64 
 2   minute      1440 non-null   int64 
 3   am_pm_flag  1440 non-null   object
dtypes: int64(2), object(2)
memory usage: 45.1+ KB
```

In [72]:
```
# Convert time_id ot int
time_dim['time_id'] = time_dim['time_id'].astype(int)
time_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1440 entries, 0 to 1439
Data columns (total 4 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   time_id     1440 non-null   int64 
 1   hour        1440 non-null   int64 
 2   minute      1440 non-null   int64 
 3   am_pm_flag  1440 non-null   object
dtypes: int64(3), object(1)
memory usage: 45.1+ KB
```

In [73]:
```
# Remove ":"" from crash time
data["crash_time"]
```

Out[73]:
```
0           2:39
1           2:39
2           2:39
3          11:45
4          11:45
           ...
3818756    21:48
3818757     5:00
3818758     5:00
3818759     5:00
3818760     5:00
Name: crash_time, Length: 3818761, dtype: object
```

In [74]:
```
data["crash_time"] = data["crash_time"].replace({':': ''}, regex=True).str.strip()
```

In [75]:
```
data["crash_time"]
```

Out[75]:
```
0           239
1           239
2           239
3          1145
4          1145
           ...
3818756    2148
3818757     500
3818758     500
3818759     500
3818760     500
Name: crash_time, Length: 3818761, dtype: object
```

In [76]:
```
# USE ZFILL AND PAD here to make time_id
data["crash_time"] = data["crash_time"].str.zfill(2).str.pad(4, side = "right", fillchar = "0")
```

In [77]:
```
# check fact table progress
data.head()
```

Out[77]:

	crash_time	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injur
0	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
1	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
2	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	
3	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	
4	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	

5 rows × 49 columns

In [78]:
```
data.rename(columns = {'crash_time':'time_id'}, inplace = True)
data["time_id"]
```

Out[78]:
```
0          2390
1          2390
2          2390
3          1145
4          1145
           ...
3818756    2148
3818757    5000
3818758    5000
3818759    5000
3818760    5000
Name: time_id, Length: 3818761, dtype: object
```

Create collision dimension

In [79]:
```
# Create person dimension from data2
data.head()
```

Out[79]:

	time_id	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured
0	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
1	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
2	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
3	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0
4	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0

5 rows × 49 columns

In [80]:
```
data.shape
```

Out[80]:
```
(3818761, 49)
```

In [81]:
```
backup = data.copy()
```

In [82]:
```
# first, copy the entire table
collision_dim= data.copy()
```

In [83]:
```
collision_dim.columns
```

Out[83]:
```
Index(['time_id', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2', 'location_id',
       'date_id'],
      dtype='object')
```

In [84]:
```
# second, subset for only the wanted columns in the dimension
collision_dim= collision_dim[['collision_id',
                              'number_of_persons_injured',
                              'number_of_persons_killed',
                              'number_of_pedestrians_injured',
                              'number_of_pedestrians_killed',
                              'number_of_cyclist_injured',
                              'number_of_cyclist_killed',
                              'number_of_motorist_injured',
                              'number_of_motorist_killed']].copy()
```

In [85]:
```
collision_dim.shape
```

Out[85]:
```
(3818761, 9)
```

In [86]:

```
# third, drop duplicate rows in dimension
# create unique row for dimension

unique_row = ['collision_id',
              'number_of_persons_injured',
              'number_of_persons_killed',
              'number_of_pedestrians_injured',
              'number_of_pedestrians_killed',
              'number_of_cyclist_injured',
              'number_of_cyclist_killed',
              'number_of_motorist_injured',
              'number_of_motorist_killed']
# drop duplicates
collision_dim = collision_dim.drop_duplicates(subset = unique_row, keep = 'first').copy()
#drop nulls
collision_dim.dropna(inplace = True)
collision_dim = collision_dim.reset_index(drop = True)
collision_dim
```

Out[86]:

	collision_id	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured	number_of_pedestrians_
0	4455765	2.0	0.0	0	
1	4513547	1.0	0.0	0	
2	4541903	0.0	0.0	0	
3	4456314	0.0	0.0	0	
4	4486609	0.0	0.0	0	
...	...	...	...	...	
1263546	4579631	0.0	0.0	0	
1263547	4580066	1.0	0.0	1	
1263548	4580080	0.0	0.0	0	
1263549	4580097	1.0	0.0	0	
1263550	4579716	0.0	0.0	0	

1263551 rows × 9 columns

In [87]:

```
collision_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1263551 entries, 0 to 1263550
Data columns (total 9 columns):
 #   Column                         Non-Null Count    Dtype
---  ------                         --------------    -----
 0   collision_id                   1263551 non-null  int64
 1   number_of_persons_injured      1263551 non-null  float64
 2   number_of_persons_killed       1263551 non-null  float64
 3   number_of_pedestrians_injured  1263551 non-null  int64
 4   number_of_pedestrians_killed   1263551 non-null  int64
 5   number_of_cyclist_injured      1263551 non-null  int64
 6   number_of_cyclist_killed       1263551 non-null  int64
 7   number_of_motorist_injured     1263551 non-null  int64
 8   number_of_motorist_killed      1263551 non-null  int64
dtypes: float64(2), int64(7)
memory usage: 86.8 MB
```

In [88]:

```
#convert to correct type
collision_dim['number_of_persons_injured'] = collision_dim['number_of_persons_injured'].astype(int)
collision_dim['number_of_persons_killed']= collision_dim['number_of_persons_killed'].astype(int)
```

In [89]:

```
collision_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1263551 entries, 0 to 1263550
Data columns (total 9 columns):
 #   Column                         Non-Null Count    Dtype
---  ------                         --------------    -----
 0   collision_id                   1263551 non-null  int64
 1   number_of_persons_injured      1263551 non-null  int64
 2   number_of_persons_killed       1263551 non-null  int64
 3   number_of_pedestrians_injured  1263551 non-null  int64
 4   number_of_pedestrians_killed   1263551 non-null  int64
 5   number_of_cyclist_injured      1263551 non-null  int64
 6   number_of_cyclist_killed       1263551 non-null  int64
 7   number_of_motorist_injured     1263551 non-null  int64
 8   number_of_motorist_killed      1263551 non-null  int64
dtypes: int64(9)
memory usage: 86.8 MB
```

In [90]:
```
collision_dim.shape
```

Out[90]:
```
(1263551, 9)
```

In [91]:
```
# fourth, add collision_id as a surrogate key
collision_dim.insert(0, 'collision_id_surrogate', range(1, 1 + len(collision_dim)))
collision_dim
```

Out[91]:

	collision_id_surrogate	collision_id	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured
0	1	4455765	2	0	0
1	2	4513547	1	0	0
2	3	4541903	0	0	0
3	4	4456314	0	0	0
4	5	4486609	0	0	0
...	...	...	...	...	...
1263546	1263547	4579631	0	0	0
1263547	1263548	4580066	1	0	1
1263548	1263549	4580080	0	0	0
1263549	1263550	4580097	1	0	0
1263550	1263551	4579716	0	0	0

1263551 rows × 10 columns

In [92]:
```
data.columns
```

Out[92]:
```
Index(['time_id', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2', 'location_id',
       'date_id'],
      dtype='object')
```

In [93]:
```
# fifth, add the new  collision_id to the data table
data = data.merge(collision_dim,
                  left_on = unique_row,
                  right_on = unique_row,
                  how = 'left')
```

In [94]:
```
data.shape
```

Out[94]:
```
(3818761, 50)
```

In [95]:
```
collision_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1263551 entries, 0 to 1263550
Data columns (total 10 columns):
 #   Column                          Non-Null Count    Dtype
---  ------                          --------------    -----
 0   collision_id_surrogate          1263551 non-null  int64
 1   collision_id                    1263551 non-null  int64
 2   number_of_persons_injured       1263551 non-null  int64
 3   number_of_persons_killed        1263551 non-null  int64
 4   number_of_pedestrians_injured   1263551 non-null  int64
 5   number_of_pedestrians_killed    1263551 non-null  int64
 6   number_of_cyclist_injured       1263551 non-null  int64
 7   number_of_cyclist_killed        1263551 non-null  int64
 8   number_of_motorist_injured      1263551 non-null  int64
 9   number_of_motorist_killed       1263551 non-null  int64
dtypes: int64(10)
memory usage: 96.4 MB
```

In [96]:

```
#drop collision_id from collision_dim
collision_dim.drop('collision_id', axis = 1, inplace = True)
```

In [97]:

```
collision_dim.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1263551 entries, 0 to 1263550
Data columns (total 9 columns):
 #   Column                          Non-Null Count    Dtype
---  ------                          --------------    -----
 0   collision_id_surrogate          1263551 non-null  int64
 1   number_of_persons_injured       1263551 non-null  int64
 2   number_of_persons_killed        1263551 non-null  int64
 3   number_of_pedestrians_injured   1263551 non-null  int64
 4   number_of_pedestrians_killed    1263551 non-null  int64
 5   number_of_cyclist_injured       1263551 non-null  int64
 6   number_of_cyclist_killed        1263551 non-null  int64
 7   number_of_motorist_injured      1263551 non-null  int64
 8   number_of_motorist_killed       1263551 non-null  int64
dtypes: int64(9)
memory usage: 86.8 MB
```

In [98]:
```
#change name of collision_id_surrogate to collision_id
collision_dim.rename(columns = {'collision_id_surrogate':'collision_id'}, inplace = True)
```

In [99]:
```
collision_dim.head()
```

Out[99]:

	collision_id	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured	number_of_pedestrians_killed
0	1	2	0	0	0
1	2	1	0	0	0
2	3	0	0	0	0
3	4	0	0	0	0
4	5	0	0	0	0

Create profile dimension

In [100…
```
# first, copy the entire table
profile_dim = data.copy()
```

In [101…
```
profile_dim.columns
```

Out[101…

```
Index(['time_id', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2', 'location_id',
       'date_id', 'collision_id_surrogate'],
      dtype='object')
```

In [102…

```
# second, subset for only the wanted columns in the dimension
profile_dim = profile_dim[['person_sex', 'person_age', 'person_type','person_injury']].copy()
```

In [103…

```
# third, drop duplicate rows in dimension
# create unique row for dimension
unique_row = ['person_sex', 'person_age', 'person_type','person_injury']
profile_dim = profile_dim.drop_duplicates(subset = unique_row, keep = 'first')
profile_dim = profile_dim.reset_index(drop = True)
profile_dim
```

Out[103…

	person_sex	person_age	person_type	person_injury
0	M	29.0	Occupant	Injured
1	M	25.0	Occupant	Unspecified
2	M	33.0	Occupant	Injured
3	F	28.0	Occupant	Injured
4	M	29.0	Occupant	Unspecified
...	...	...	...	...
2715	M	5.0	Other Motorized	Injured
2716	F	67.0	Other Motorized	Killed
2717	F	80.0	Occupant	Killed
2718	F	59.0	Other Motorized	Unspecified
2719	M	87.0	Other Motorized	Unspecified

2720 rows × 4 columns

In [104…

```
# fourth, add profile_id as a surrogate key
profile_dim.insert(0, 'profile_id', range(1, 1 + len(profile_dim)))
profile_dim
```

Out[104…

	profile_id	person_sex	person_age	person_type	person_injury
0	1	M	29.0	Occupant	Injured
1	2	M	25.0	Occupant	Unspecified
2	3	M	33.0	Occupant	Injured
3	4	F	28.0	Occupant	Injured
4	5	M	29.0	Occupant	Unspecified
...	...	...	...	...	...
2715	2716	M	5.0	Other Motorized	Injured
2716	2717	F	67.0	Other Motorized	Killed
2717	2718	F	80.0	Occupant	Killed
2718	2719	F	59.0	Other Motorized	Unspecified
2719	2720	M	87.0	Other Motorized	Unspecified

2720 rows × 5 columns

In [105…

```
# fifth, add the profile_id to the data table
data = data.merge(profile_dim,
                  left_on = unique_row,
                  right_on = unique_row,
                  how = 'left')

data.head(100)
```

Out[105...

	time_id	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured
0	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
1	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
2	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
3	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0
4	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0
...	...	...	...	...	...	...
95	0430	ELIOT AVENUE	NaN	0.0	1.0	0
96	0430	ELIOT AVENUE	NaN	0.0	1.0	0
97	1645	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	0
98	1645	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	0
99	1645	STATEN ISLAND EXPRESSWAY	NaN	1.0	0.0	0

100 rows × 51 columns

Create fact table for person_victim

In [106…

```
data.head()
```

Out[106…

	time_id	on_street_name	off_street_name	number_of_persons_injured	number_of_persons_killed	number_of_pedestrians_injured
0	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
1	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
2	2390	WHITESTONE EXPRESSWAY	20 AVENUE	2.0	0.0	0
3	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0
4	1145	QUEENSBORO BRIDGE UPPER	NaN	1.0	0.0	0

5 rows × 51 columns

In [107…

```
data.shape
```

Out[107…

```
(3818761, 51)
```

In [108…

```
data.columns
```

Out[108…
```
Index(['time_id', 'on_street_name', 'off_street_name',
       'number_of_persons_injured', 'number_of_persons_killed',
       'number_of_pedestrians_injured', 'number_of_pedestrians_killed',
       'number_of_cyclist_injured', 'number_of_cyclist_killed',
       'number_of_motorist_injured', 'number_of_motorist_killed',
       'contributing_factor_vehicle_1', 'contributing_factor_vehicle_2',
       'collision_id', 'vehicle_type_code1', 'vehicle_type_code2', 'borough',
       'zip_code', 'latitude', 'longitude', 'cross_street_name',
       'contributing_factor_vehicle_3', 'vehicle_type_code_3',
       'contributing_factor_vehicle_4', 'vehicle_type_code_4',
       'contributing_factor_vehicle_5', 'vehicle_type_code_5', 'unique_id',
       'crash_date_y', 'crash_time_y', 'person_victim', 'person_type',
       'person_injury', 'vehicle_id', 'ped_role', 'person_sex', 'person_age',
       'ejection', 'emotional_status', 'bodily_injury', 'position_in_vehicle',
       'safety_equipment', 'complaint', 'ped_location', 'ped_action',
       'contributing_factor_1', 'contributing_factor_2', 'location_id',
       'date_id', 'collision_id_surrogate', 'profile_id'],
      dtype='object')
```

In [109…
```
# take a subset of fact_table for only the needed columns: which are keys and measures
fact_table = data[['collision_id_surrogate', 'profile_id', 'date_id','time_id','location_id','person_victi
```

In [110…
```
fact_table.shape
```

Out[110…
```
(3818761, 6)
```

In [111…
```
fact_table.dropna(inplace = True)
```

In [112…
```
fact_table.shape
```

Out[112…
```
(2234475, 6)
```

In [113…
```
fact_table.head()
```

Out[113...

	collision_id_surrogate	profile_id	date_id	time_id	location_id	person_victim
7	4.0	8	20210911	9350	1.0	3cb21800-426f-47c8-a79e-fb65f2d2115e
8	4.0	8	20210911	9350	1.0	d7bbe88a-d44d-4155-8076-923b24b371be
9	5.0	9	20211214	8130	2.0	49b837fa-d00c-40a2-8af1-31ea2ce302f2
14	8.0	12	20211214	8170	3.0	a1699487-c586-4e1b-bf8c-a08cf53e331a
15	8.0	13	20211214	8170	3.0	1519c5d0-94a1-4dde-9f62-5311797ec6a2

In [114...

```
fact_table = drop_dupli(fact_table)
```

```
number of rows before dropping duplicates: 2234475
number of duplicate rows: 0
number of rows after duplicates dropped: 2234475
```

In [115...

```
fact_table.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2234475 entries, 7 to 3818756
Data columns (total 6 columns):
 #   Column                  Dtype  
---  ------                  -----  
 0   collision_id_surrogate  float64
 1   profile_id              int64  
 2   date_id                 object 
 3   time_id                 object 
 4   location_id             float64
 5   person_victim           object 
dtypes: float64(2), int64(1), object(3)
memory usage: 119.3+ MB
```

In [116…

```
# change to proper type


for column in ['collision_id_surrogate',
               'profile_id',
               'date_id',
               'time_id',
               'location_id',
               'person_victim']:
    try:
        fact_table[column] = fact_table[column].astype(int)

    except:
        fact_table[column] = fact_table[column].astype(object)
```

In [117…

```
fact_table.rename(columns = {'collision_id_surrogate':'collision_id'}, inplace = True)
fact_table.head()
```

Out[117…

	collision_id	profile_id	date_id	time_id	location_id	person_victim
7	4	8	20210911	9350	1	3cb21800-426f-47c8-a79e-fb65f2d2115e
8	4	8	20210911	9350	1	d7bbe88a-d44d-4155-8076-923b24b371be
9	5	9	20211214	8130	2	49b837fa-d00c-40a2-8af1-31ea2ce302f2
14	8	12	20211214	8170	3	a1699487-c586-4e1b-bf8c-a08cf53e331a
15	8	13	20211214	8170	3	1519c5d0-94a1-4dde-9f62-5311797ec6a2

In [118…

```
fact_table.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2234475 entries, 7 to 3818756
Data columns (total 6 columns):
 #   Column          Dtype 
---  ------          ----- 
 0   collision_id    int64 
 1   profile_id      int64 
 2   date_id         int64 
 3   time_id         int64 
 4   location_id     int64 
 5   person_victim   object
dtypes: int64(5), object(1)
memory usage: 119.3+ MB
```

In [119…

```
fact_table = fact_table.reset_index(drop = True)
fact_table.head()
```

Out[119…

	collision_id	profile_id	date_id	time_id	location_id	person_victim
0	4	8	20210911	9350	1	3cb21800-426f-47c8-a79e-fb65f2d2115e
1	4	8	20210911	9350	1	d7bbe88a-d44d-4155-8076-923b24b371be
2	5	9	20211214	8130	2	49b837fa-d00c-40a2-8af1-31ea2ce302f2
3	8	12	20211214	8170	3	a1699487-c586-4e1b-bf8c-a08cf53e331a
4	8	13	20211214	8170	3	1519c5d0-94a1-4dde-9f62-5311797ec6a2

ETL - Load data

Deliver Facts and Dimensions to Data Warehouse (BigQuery)

In [120…

```
# create a function to load dataframes to BigQuery

def load_table_to_bigquery(df,
                           table_name,
                           dataset_id):

    dataset_id = dataset_id #change dataset id to match your project id

    dataset_ref = bigquery_client.dataset(dataset_id)
    job_config = bigquery.LoadJobConfig()
    job_config.autodetect = True
    job_config.write_disposition = "WRITE_TRUNCATE"

    upload_table_name = f"{dataset_id}.{table_name}"

    load_job = bigquery_client.load_table_from_dataframe(df,
                                                         upload_table_name,
                                                         job_config = job_config)

    print(f"completed job {load_job} for table {table_name}")
```

In [135…

```
#Load each table to BigQuery: "fact_table", "date_dim", "location_dim", "time_dim", and "person_dim."

tables_objects = [[fact_table, "person_victim_fact"], [date_dim,"date_dim" ],
                  [location_dim,"location_dim"], [time_dim,"time_dim"],
                  [profile_dim,"profile_dim"],[collision_dim,"collision_dim"]
                  ]
```

In [136…

```
for table in tables_objects:
    load_table_to_bigquery(df = table[0],
                           table_name = table[1],
                           dataset_id = dataset_id)
```

```
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a3cc890> for table person_victim_fact
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a354f10> for table date_dim
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a3cc790> for table location_dim
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a378910> for table time_dim
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a3bfcd0> for table profile_dim
completed job <google.cloud.bigquery.job.LoadJob object at 0x7f192a3ca1d0> for table collision_dim
```

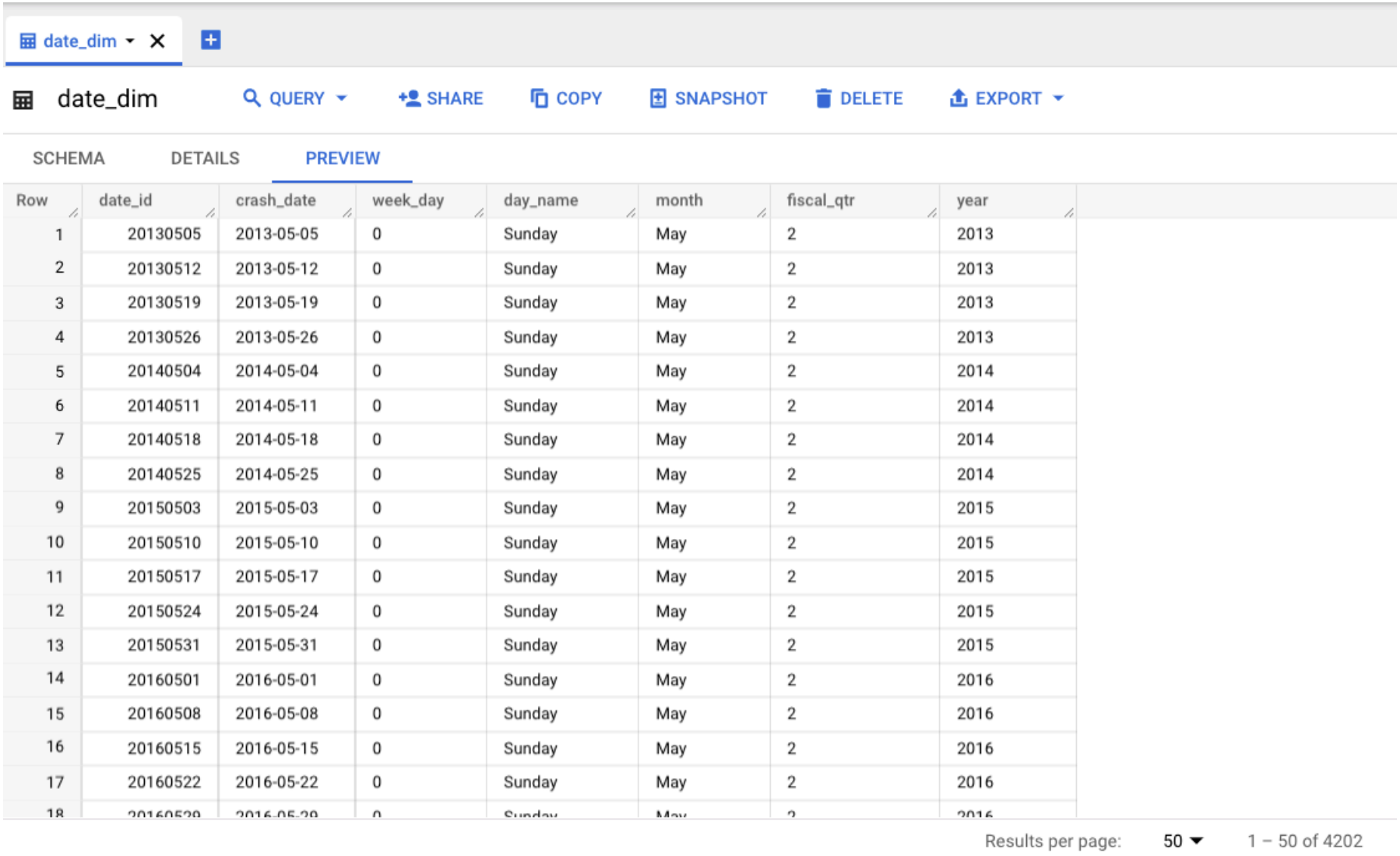
Screenshots of database tables

Date dimension

In [123…

```
Image("/content/drive/MyDrive/project_DW/date_dim.png")
```

Out[123…



date_dim

QUERY SHARE COPY SNAPSHOT DELETE EXPORT

SCHEMA DETAILS PREVIEW

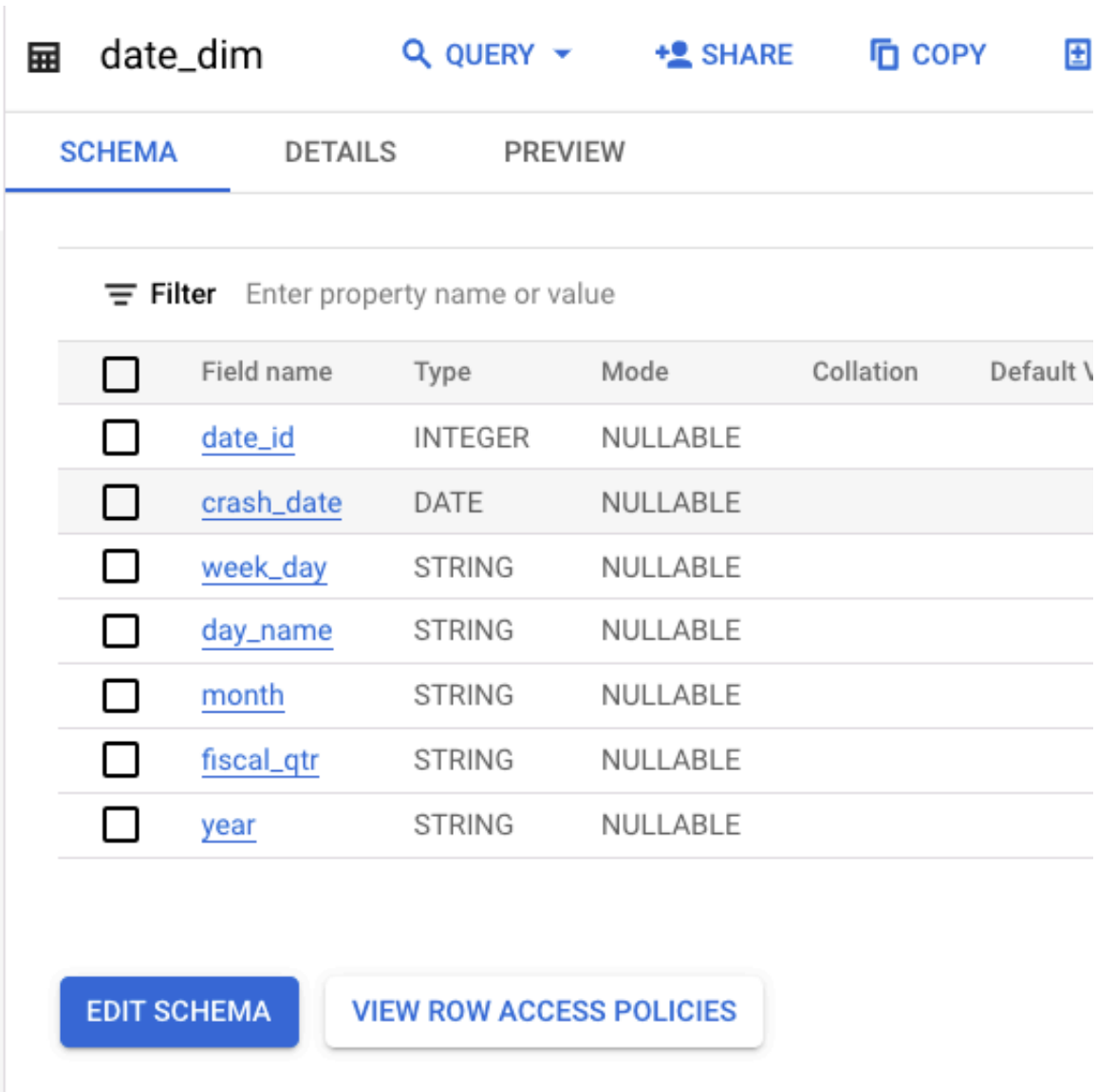
Row	date_id	crash_date	week_day	day_name	month	fiscal_qtr	year
1	20130505	2013-05-05	0	Sunday	May	2	2013
2	20130512	2013-05-12	0	Sunday	May	2	2013
3	20130519	2013-05-19	0	Sunday	May	2	2013
4	20130526	2013-05-26	0	Sunday	May	2	2013
5	20140504	2014-05-04	0	Sunday	May	2	2014
6	20140511	2014-05-11	0	Sunday	May	2	2014
7	20140518	2014-05-18	0	Sunday	May	2	2014
8	20140525	2014-05-25	0	Sunday	May	2	2014
9	20150503	2015-05-03	0	Sunday	May	2	2015
10	20150510	2015-05-10	0	Sunday	May	2	2015
11	20150517	2015-05-17	0	Sunday	May	2	2015
12	20150524	2015-05-24	0	Sunday	May	2	2015
13	20150531	2015-05-31	0	Sunday	May	2	2015
14	20160501	2016-05-01	0	Sunday	May	2	2016
15	20160508	2016-05-08	0	Sunday	May	2	2016
16	20160515	2016-05-15	0	Sunday	May	2	2016
17	20160522	2016-05-22	0	Sunday	May	2	2016
18	20160529	2016-05-29	0	Sunday	May	2	2016

Results per page: 50 1 – 50 of 4202

In [124…

```
Image("/content/drive/MyDrive/project_DW/date_dim_types.png")
```

Out[124…



Time dimension

In [125…

```
Image("/content/drive/MyDrive/project_DW/time_dim.png")
```

Out [125…

time_dim

time_dim QUERY SHARE COPY SNAPSHOT DELETE EXPORT

SCHEMA DETAILS PREVIEW

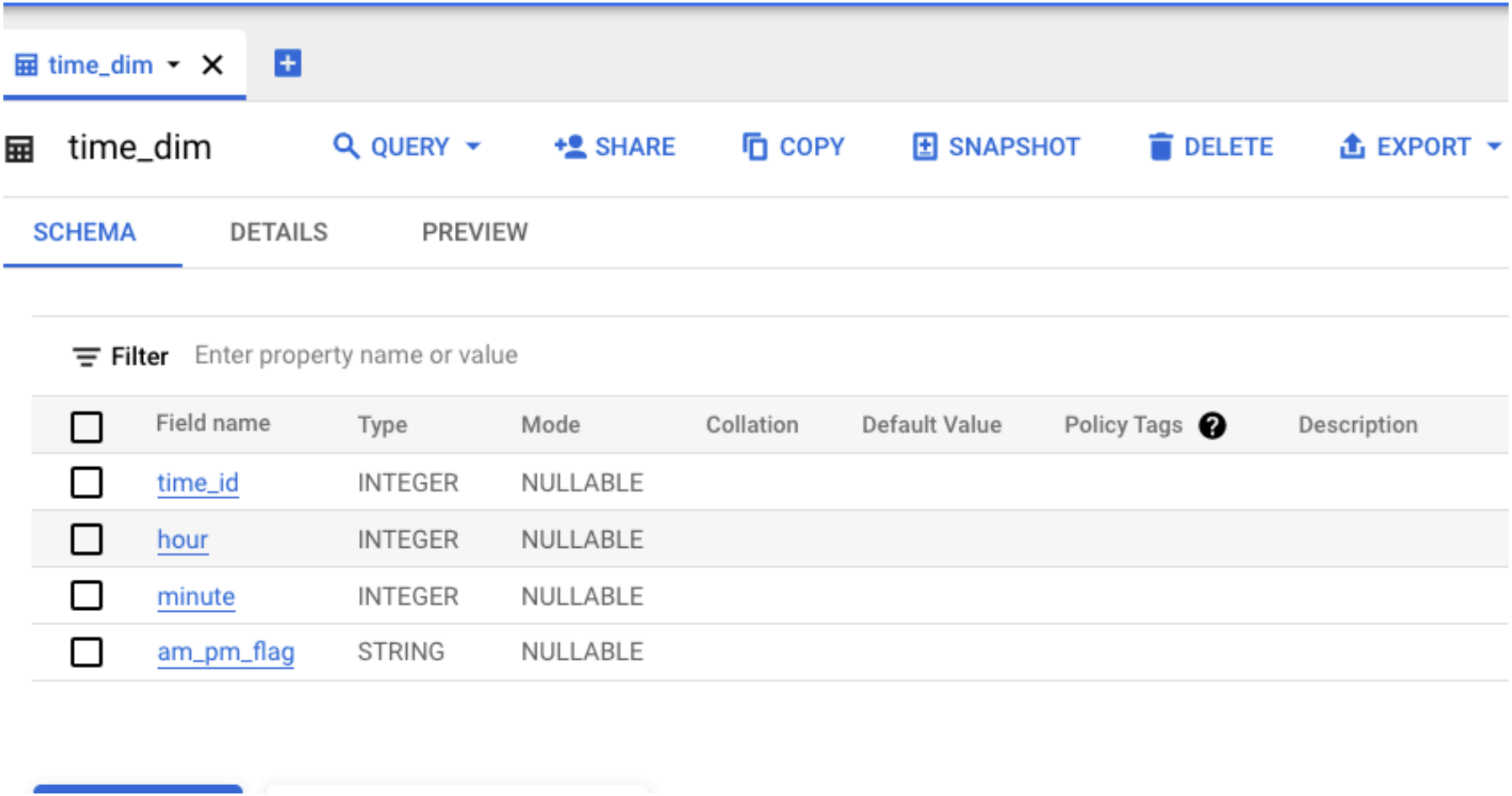
Row	time_id	hour	minute	am_pm_flag
1	0	0	0	AM
2	1	0	1	AM
3	2	0	2	AM
4	3	0	3	AM
5	4	0	4	AM
6	5	0	5	AM
7	6	0	6	AM
8	7	0	7	AM
9	8	0	8	AM
10	9	0	9	AM
11	10	0	10	AM
12	11	0	11	AM
13	12	0	12	AM
14	13	0	13	AM
15	14	0	14	AM
16	15	0	15	AM
17	16	0	16	AM
18	17	0	17	AM

Results per page: 50 1 – 50 of 1440

In [126…

```
Image("/content/drive/MyDrive/project_DW/time_dim_types.png")
```

Out[126…



Collision dimension

In [127…

```
Image("/content/drive/MyDrive/project_DW/collision_dim.png")
```

Out[127…

collision_dim

collision_dim QUERY SHARE COPY SNAPSHOT DELETE EXPORT

SCHEMA DETAILS PREVIEW

Row	collision_id	number_of_...	number_of_...	number_of_...	number_of_...	number_of_...	number_of_...	number_of_...	number_of_...
1	412	5	0	0	0	0	0	5	0
2	436	7	0	0	0	0	0	7	0
3	474	5	0	0	0	0	0	5	0
4	744	6	0	0	0	0	0	6	0
5	2028	6	0	1	0	0	0	5	0
6	2098	5	0	0	0	0	0	5	0
7	2148	5	0	0	0	0	0	5	0
8	2409	5	0	0	0	0	0	5	0
9	2506	6	0	0	0	0	0	6	0
10	2571	6	0	0	0	0	0	6	0
11	2668	6	0	0	0	0	0	6	0
12	2780	5	0	0	0	0	0	5	0
13	2784	5	0	0	0	0	0	5	0
14	2924	5	0	0	0	0	0	5	0
15	3181	5	0	0	0	0	0	5	0
16	3290	5	0	0	0	0	0	5	0
17	3642	5	0	0	0	0	0	5	0
18	3690	6	0	0	0	0	0	6	0

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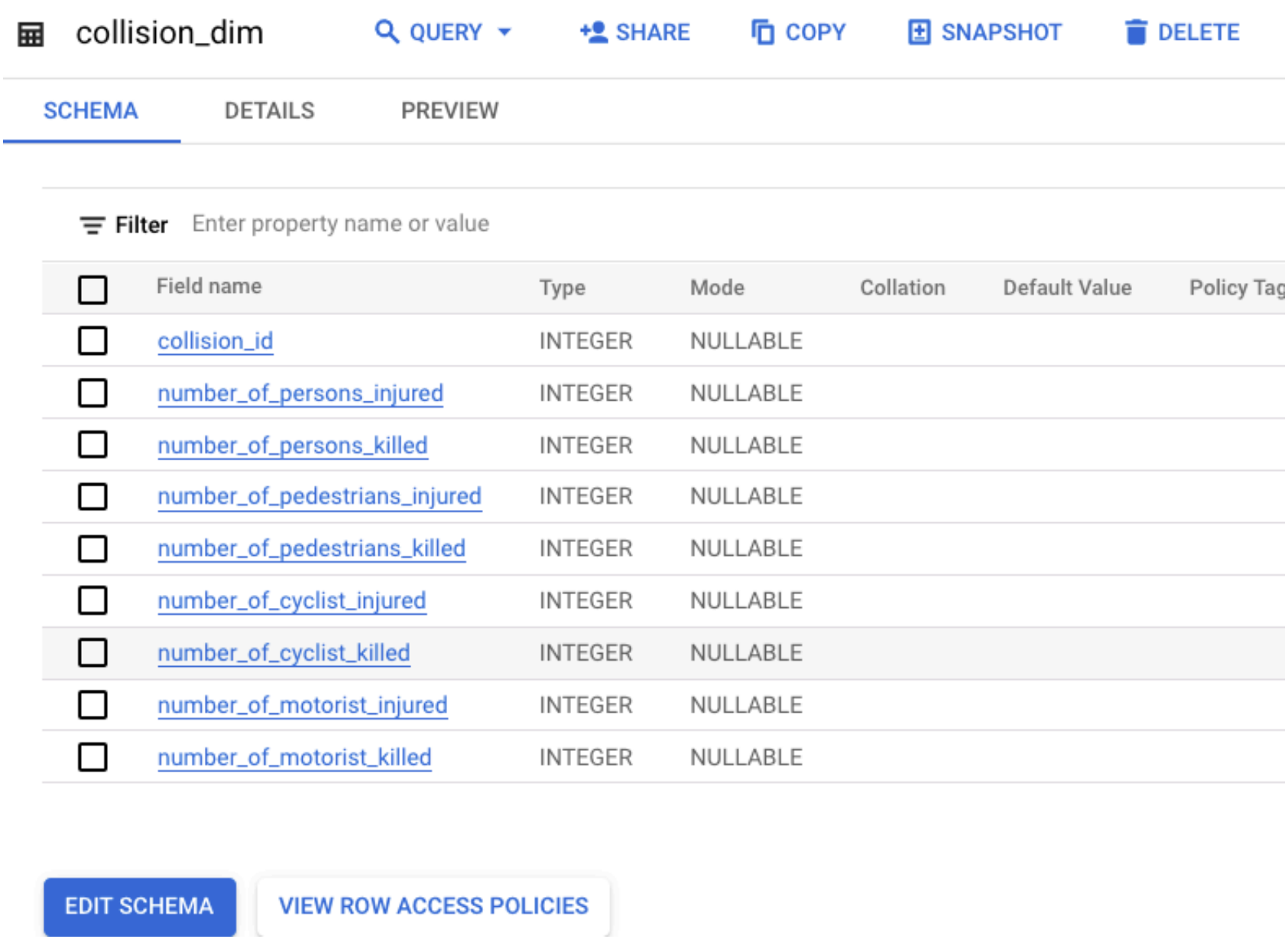
In [128…

```
Image("/content/drive/MyDrive/project_DW/collision_dim_types.png")
```

Out [128…



Location dimension

In [129…

```
Image("/content/drive/MyDrive/project_DW/location_dim.png")
```

Out[129…

location_dim

location_dim QUERY SHARE COPY SNAPSHOT DELETE EXPORT

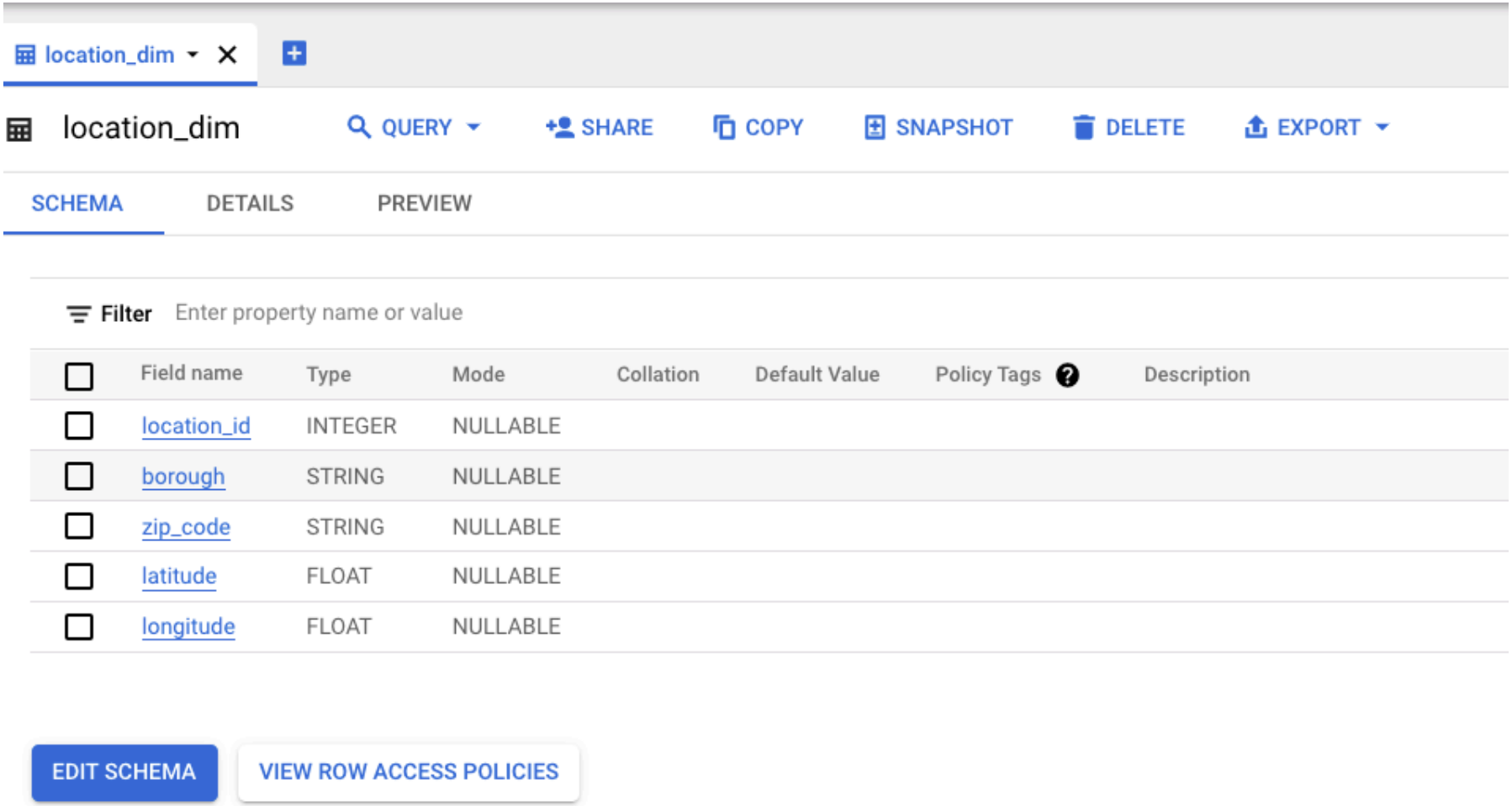
SCHEMA DETAILS PREVIEW

Row	location_id	borough	zip_code	latitude	longitude
1	284	BRONX	10451	40.817696	-73.922615
2	332	BRONX	10451	40.817627	-73.92366
3	521	BRONX	10451	40.827824	-73.91934
4	716	BRONX	10451	40.825455	-73.91317
5	809	BRONX	10451	40.813663	-73.931244
6	826	BRONX	10451	40.81934	-73.93012
7	882	BRONX	10451	40.81655	-73.91955
8	898	BRONX	10451	40.821667	-73.915184
9	955	BRONX	10451	40.818012	-73.92519
10	976	BRONX	10451	40.817387	-73.92277
11	1256	BRONX	10451	40.820198	-73.921486
12	1472	BRONX	10451	40.81693	-73.921036
13	1525	BRONX	10451	40.822304	-73.91485
14	1538	BRONX	10451	40.823658	-73.91206
15	1598	BRONX	10451	40.824806	-73.91352
16	1645	BRONX	10451	40.81738	-73.9257
17	1900	BRONX	10451	40.823383	-73.91834
18	2009	BRONX	10451	40.819202	-73.92597

In [130…

```
Image("/content/drive/MyDrive/project_DW/location_dim_types.png")
```

Out[130…



Profile dimension

In [131…

```
Image("/content/drive/MyDrive/project_DW/profile_dim.png")
```

Out[131…

profile_dim QUERY SHARE COPY SNAPSHOT DELETE EXPORT

SCHEMA DETAILS PREVIEW

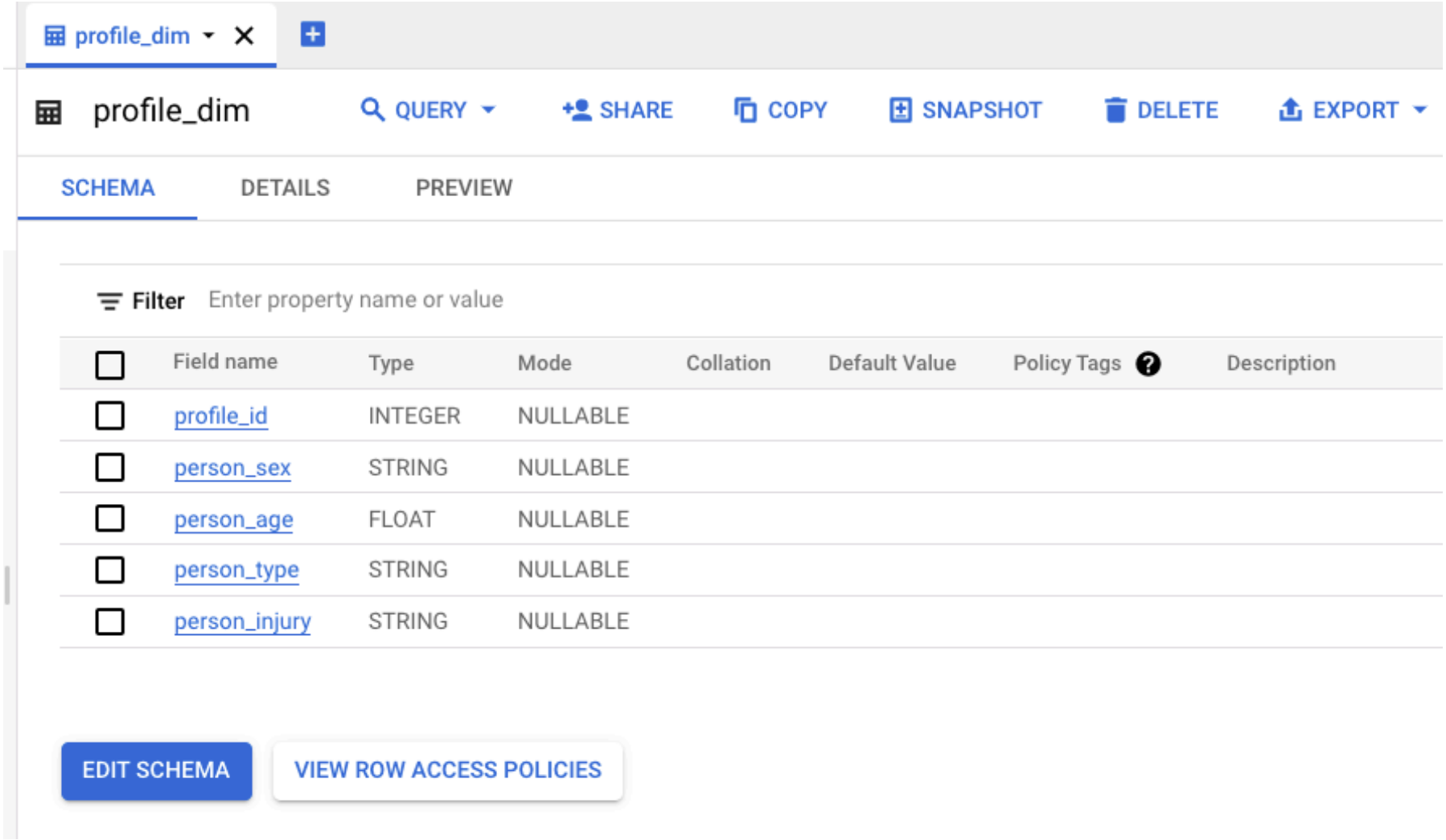
Row	profile_id	person_sex	person_age	person_type	person_injury
1	349	F	18.0	Occupant	Killed
2	579	M	45.0	Occupant	Killed
3	586	M	36.0	Occupant	Killed
4	591	M	19.0	Occupant	Killed
5	638	M	24.0	Occupant	Killed
6	704	M	40.0	Occupant	Killed
7	723	M	26.0	Occupant	Killed
8	742	M	23.0	Occupant	Killed
9	748	M	22.0	Occupant	Killed
10	836	M	35.0	Occupant	Killed
11	839	M	42.0	Occupant	Killed
12	848	M	56.0	Occupant	Killed
13	901	M	37.0	Occupant	Killed
14	940	M	34.0	Occupant	Killed
15	946	M	21.0	Occupant	Killed
16	964	M	53.0	Occupant	Killed
17	971	F	19.0	Occupant	Killed
18	979	M	72.0	Occupant	Killed

Results per page: 50 1 – 50 of 2720

In [132…

```
Image("/content/drive/MyDrive/project_DW/profile_dim_types.png")
```

Out [132…



Fact table for person_victim_fact

In [133…

```
Image("/content/drive/MyDrive/project_DW/person_victim_fact.png")
```

Out[133…

person_victim_fact

person_victim_fact QUERY SHARE COPY SNAPSHOT DELETE EXPORT

SCHEMA DETAILS PREVIEW

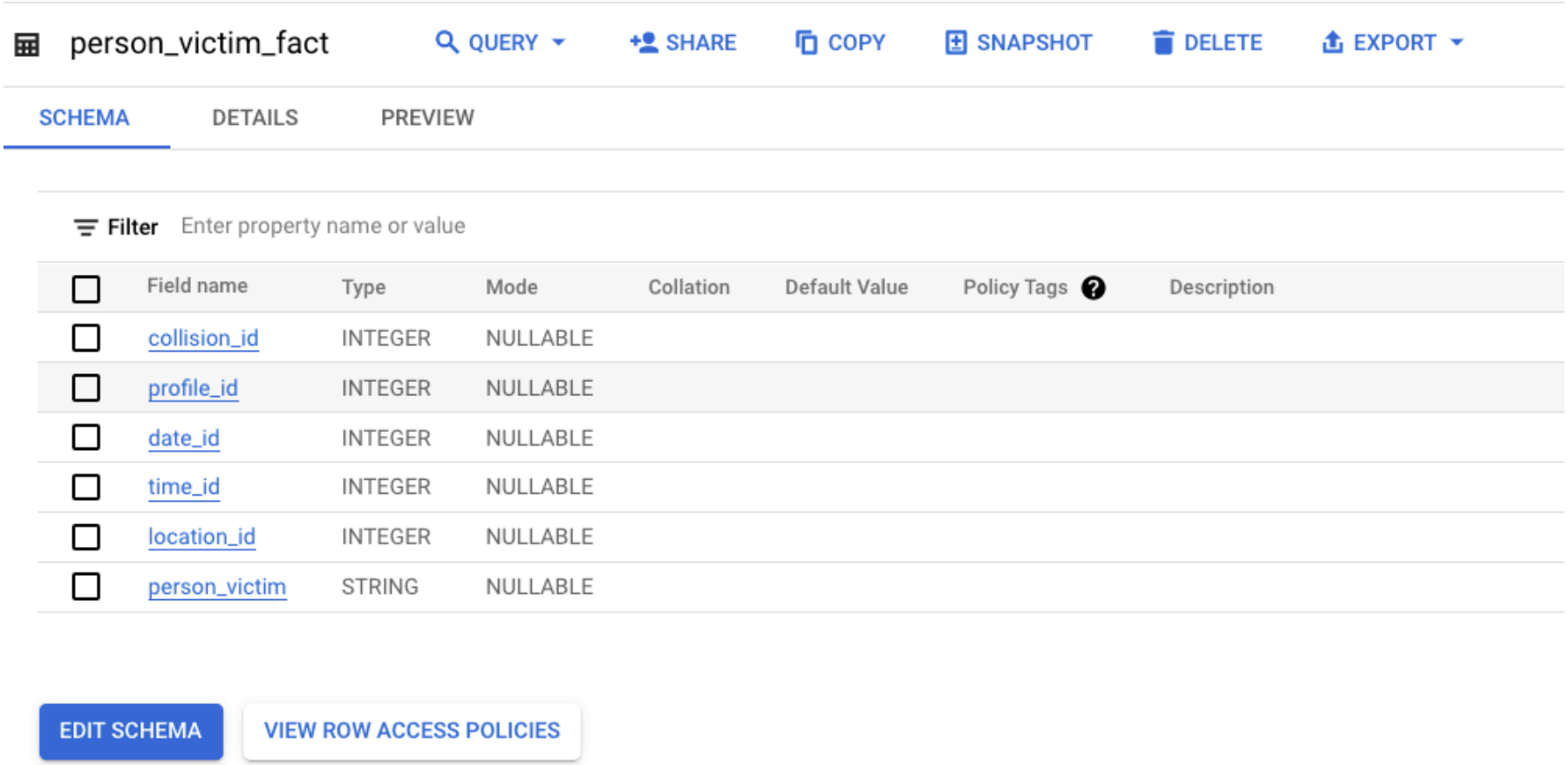
Row	collision_id	profile_id	date_id	time_id	location_id	person_victim
1	5	9	20211214	8130	2	49b837fa-d00c-40a2-8af1-31e…
2	8	12	20211214	8170	3	a1699487-c586-4e1b-bf8c-a08…
3	8	14	20211214	8170	3	72b05818-8e92-481a-ae72-9c0…
4	11	20	20211214	1650	5	501ef4bb-7180-4943-9d47-345…
5	11	20	20211214	1650	5	66475e18-b46d-4240-9480-89…
6	14	24	20211214	2310	6	d3bfea67-0a48-4510-9370-1c4…
7	14	25	20211214	2310	6	543a8ff2-4efd-48f1-8fb9-780d…
8	14	26	20211214	2310	6	cca678b5-8845-4ab2-b752-695…
9	16	28	20211214	2003	8	b1ad3506-709e-4ec8-99ce-afb…
10	16	29	20211214	2003	8	6aa9cdbb-6d28-40b8-9e05-88…
11	16	30	20211214	2003	8	1026933c-44fd-4065-832c-cb8…
12	16	31	20211214	2003	8	0833cb42-b0c8-4884-b3c2-218…
13	18	34	20211211	1943	9	d51ec997-f864-4f1c-85c1-7ab…
14	18	35	20211211	1943	9	a1cc5400-72f7-4b78-85b8-af7…
15	18	36	20211211	1943	9	4e195903-5981-4751-b3e7-e1e…
16	18	34	20211211	1943	9	e4abfc6b-e00d-4870-8cac-a6d…
17	22	42	20211213	1740	10	c23fbe63-963e-4dc4-a5b6-c42…
18	22	43	20211213	1740	10	56a57cf9-70ec-4697-a347-352…

Results per page: 50 1 – 50 of 2234864

In [134…

```
Image("/content/drive/MyDrive/project_DW/person_victim_fact_types.png")
```

Out [134…



References

- ETL Pipeline tutorial by Michael O'Donnell (CIS 9440 Data Warehousing and Analytics).
- Track your loop using tqdm: 7 ways progress bars in Python make things easier: https://medium.com/@harshit4084/track-your-loop-using-tqdm-7-ways-progress-bars-in-python-make-things-easier-fcbbb9233f24