ETL Project

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1. Purpose of the Project.

Extract-Transform-Load (ETL) is the process by which data is extracted from data sources (that are not optimized for analytics), transformed to make it comprehensible and loaded into a target system (a database or a data warehouse). The purpose of our project is to perform and document the ETL process of the crime data in Arlington, VA, Washington, D.C., and Bethesda, MD.

2. Data Extraction.

The first step of the ETL process involved connecting to the source systems, and both selecting and collecting the necessary data required for analytical processing. We used 3 datasets from the counties websites

1. Arlington, VA: https://data.arlingtonva.us/dataviews/225891/police-incident-log/
2. Washington D.C : https://opendata.dc.gov/datasets/crime-incidents-in-2019
3. Bethesda, MD: https://data.montgomerycountymd.gov/Public-Safety/Crime/icn6-v9z3

All of our crime data was based in Arlington, VA, Washington, D.C., and Bethesda, MD, ranging over various years from 1985 to 2019.

3. Data Cleanup/Transformation.

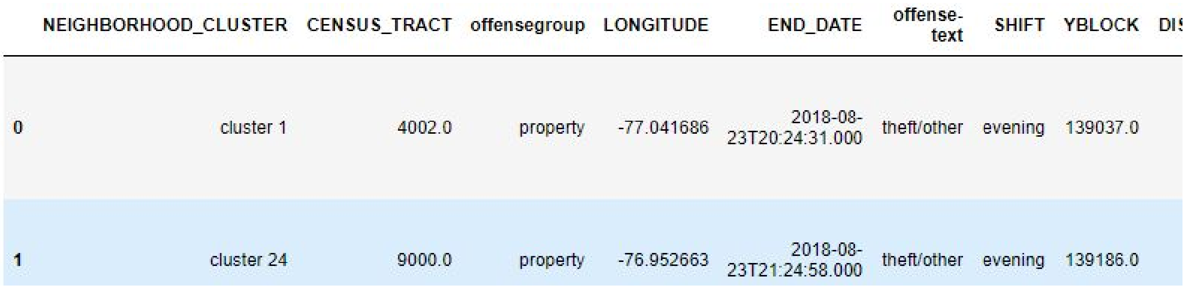
The second step in the ETL process involved data clean-up/transformation to convert it to a standard format.

Our steps in cleaning up the datasets involved analyzing them and determining which variables were not relevant. For all three datasets, we followed the following steps:

- Step 1 was to select relevant columns only;
- Step 2 involved trimming the data;
- Step 3 involved renaming the columns for better readability;
- Step 4 involved merging all three datasets into one file.

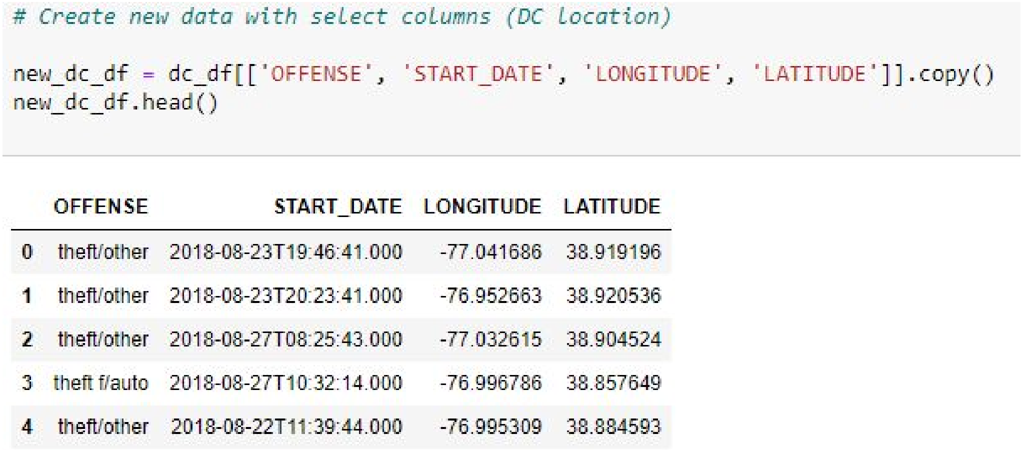
Since all three datasets involved the same cleanup/transformation steps, we only documented the cleanup process for crime data located in Washington, D.C. (see below).

Figure 1. Crime Data in Washington, D.C. (original dataset).



	NEIGHBORHOOD_CLUSTER	CENSUS_TRACT	offensegroup	LONGITUDE	END_DATE	offense-text	SHIFT	YBLOCK	DI!
0	cluster 1	4002.0	property	-77.041686	2018-08-23T20:24:31.000	theft/other	evening	139037.0	
1	cluster 24	9000.0	property	-76.952663	2018-08-23T21:24:58.000	theft/other	evening	139186.0	

Figure 2. Crime Data in Washington, D.C. (dataset with relevant data only).

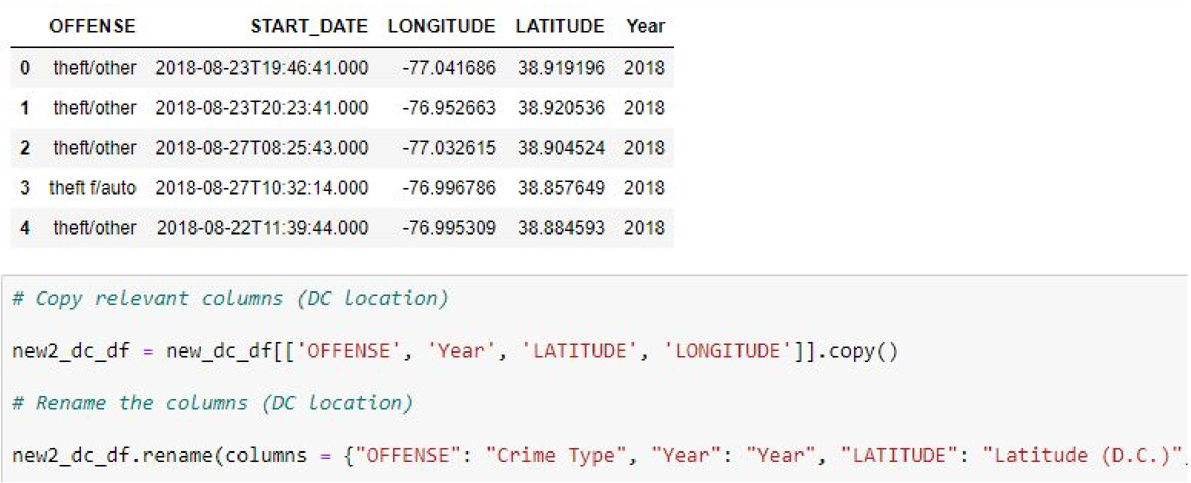


```
# Create new data with select columns (DC location)

new_dc_df = dc_df[['OFFENSE', 'START_DATE', 'LONGITUDE', 'LATITUDE']].copy()
new_dc_df.head()
```

	OFFENSE	START_DATE	LONGITUDE	LATITUDE
0	theft/other	2018-08-23T19:46:41.000	-77.041686	38.919196
1	theft/other	2018-08-23T20:23:41.000	-76.952663	38.920536
2	theft/other	2018-08-27T08:25:43.000	-77.032615	38.904524
3	theft f/auto	2018-08-27T10:32:14.000	-76.996786	38.857649
4	theft/other	2018-08-22T11:39:44.000	-76.995309	38.884593

After selecting relevant columns, we trimmed the date data and renamed the columns for better readability (see Figure 3).

Figure 3. Crime Data in Washington, D.C. (dataset with renamed columns).

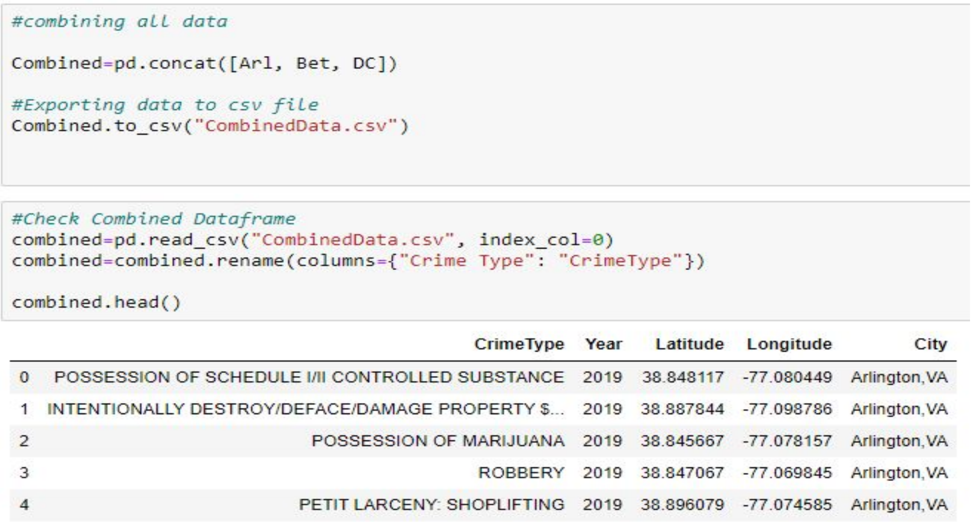


	OFFENSE	START_DATE	LONGITUDE	LATITUDE	Year
0	theft/other	2018-08-23T19:46:41.000	-77.041686	38.919196	2018
1	theft/other	2018-08-23T20:23:41.000	-76.952663	38.920536	2018
2	theft/other	2018-08-27T08:25:43.000	-77.032615	38.904524	2018
3	theft f/auto	2018-08-27T10:32:14.000	-76.996786	38.857649	2018
4	theft/other	2018-08-22T11:39:44.000	-76.995309	38.884593	2018

```
# Copy relevant columns (DC location)

new2_dc_df = new_dc_df[['OFFENSE', 'Year', 'LATITUDE', 'LONGITUDE']].copy()

# Rename the columns (DC location)

new2_dc_df.rename(columns = {"OFFENSE": "Crime Type", "Year": "Year", "LATITUDE": "Latitude (D.C.)",
```

The last step of data transformation involved merging all three datasets into one csv file (see Figure 4), so it could be used for uploading it into SalesForce and PowerBi platforms.

Figure 4. Final output (combined crime data in Washington, D.C, Arlington, VA, and Bethesda, MD).



```
#combining all data

Combined=pd.concat([Arl, Bet, DC])

#Exporting data to csv file
Combined.to_csv("CombinedData.csv")
```

```
#Check Combined Dataframe
combined=pd.read_csv("CombinedData.csv", index_col=0)
combined=combined.rename(columns={"Crime Type": "CrimeType"})

combined.head()
```

	CrimeType	Year	Latitude	Longitude	City
0	POSSESSION OF SCHEDULE I/II CONTROLLED SUBSTANCE	2019	38.848117	-77.080449	Arlington,VA
1	INTENTIONALLY DESTROY/DEFACE/DAMAGE PROPERTY $...	2019	38.887844	-77.098786	Arlington,VA
2	POSSESSION OF MARIJUANA	2019	38.845667	-77.078157	Arlington,VA
3	ROBBERY	2019	38.847067	-77.069845	Arlington,VA
4	PETIT LARCENY: SHOPLIFTING	2019	38.896079	-77.074585	Arlington,VA

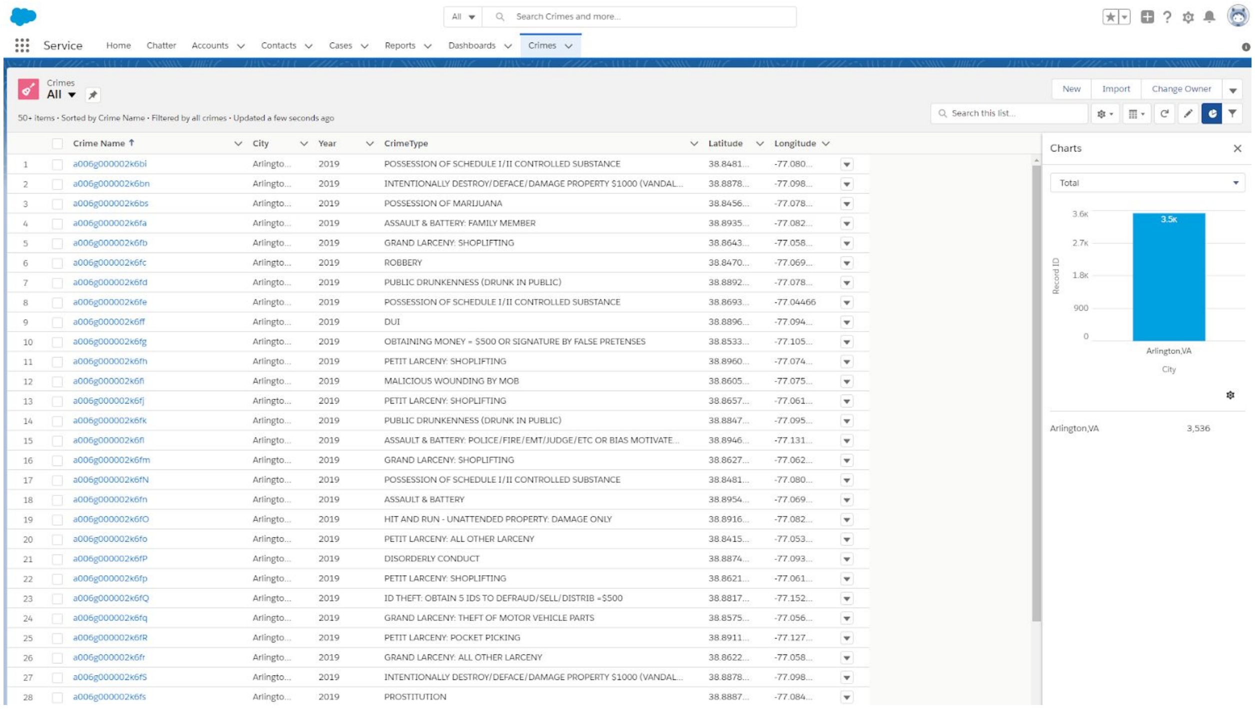
4. Data Storage into a Database.

The third, last step in the ETL process involved storing the data into the SalesForce (see Figure 5) and PowerBi (see Figure 6) platforms.

Using Simple SalesForce module in Python, we uploaded the records from the CSV file to SalesForce. The issues faced were as follows:

1. Limits of 10,000,000 character is set for Bulk upload method which the data exceeded.
2. Limited storage allowed in our SalesForce account which limited the uploaded data to 3500 records.
3. Difficulty in processing Latitude and Longitude variables as geolocation data and the uploaded data had to be defined as Text.

Figure 5. Final output stored in SalesForce (combined crime data in Washington, D.C, Arlington, VA, and Bethesda, MD).



50+ items • Sorted by Crime Name • Filtered by all crimes • Updated a few seconds ago

	Crime Name ↑	City	Year	CrimeType	Latitude	Longitude
1	a006g000002k6bi	Arlingto...	2019	POSSESSION OF SCHEDULE I/II CONTROLLED SUBSTANCE	38.8481...	-77.080...
2	a006g000002k6bn	Arlingto...	2019	INTENTIONALLY DESTROY/DEFACE/DAMAGE PROPERTY $1000 (VANDAL...	38.8878...	-77.098...
3	a006g000002k6bs	Arlingto...	2019	POSSESSION OF MARIJUANA	38.8456...	-77.078...
4	a006g000002k6fa	Arlingto...	2019	ASSAULT & BATTERY: FAMILY MEMBER	38.8935...	-77.082...
5	a006g000002k6fb	Arlingto...	2019	GRAND LARCENY: SHOPLIFTING	38.8643...	-77.058...
6	a006g000002k6fc	Arlingto...	2019	ROBBERY	38.8470...	-77.069...
7	a006g000002k6fd	Arlingto...	2019	PUBLIC DRUNKENNESS (DRUNK IN PUBLIC)	38.8892...	-77.078...
8	a006g000002k6fe	Arlingto...	2019	POSSESSION OF SCHEDULE I/II CONTROLLED SUBSTANCE	38.8693...	-77.04466
9	a006g000002k6ff	Arlingto...	2019	DUI	38.8896...	-77.094...
10	a006g000002k6fg	Arlingto...	2019	OBTAINING MONEY = $500 OR SIGNATURE BY FALSE PRETENSES	38.8533...	-77.105...
11	a006g000002k6fh	Arlingto...	2019	PETIT LARCENY: SHOPLIFTING	38.8960...	-77.074...
12	a006g000002k6fi	Arlingto...	2019	MALICIOUS WOUNDING BY MOB	38.8605...	-77.075...
13	a006g000002k6fj	Arlingto...	2019	PETIT LARCENY: SHOPLIFTING	38.8657...	-77.061...
14	a006g000002k6fk	Arlingto...	2019	PUBLIC DRUNKENNESS (DRUNK IN PUBLIC)	38.8847...	-77.095...
15	a006g000002k6fl	Arlingto...	2019	ASSAULT & BATTERY: POLICE/FIRE/EMT/JUDGE/ETC OR BIAS MOTIVATE...	38.8946...	-77.131...
16	a006g000002k6fm	Arlingto...	2019	GRAND LARCENY: SHOPLIFTING	38.8627...	-77.062...
17	a006g000002k6fN	Arlingto...	2019	POSSESSION OF SCHEDULE I/II CONTROLLED SUBSTANCE	38.8481...	-77.080...
18	a006g000002k6fn	Arlingto...	2019	ASSAULT & BATTERY	38.8954...	-77.069...
19	a006g000002k6fO	Arlingto...	2019	HIT AND RUN - UNATTENDED PROPERTY: DAMAGE ONLY	38.8916...	-77.082...
20	a006g000002k6fo	Arlingto...	2019	PETIT LARCENY: ALL OTHER LARCENY	38.8415...	-77.053...
21	a006g000002k6fP	Arlingto...	2019	DISORDERLY CONDUCT	38.8874...	-77.093...
22	a006g000002k6fp	Arlingto...	2019	PETIT LARCENY: SHOPLIFTING	38.8621...	-77.061...
23	a006g000002k6fQ	Arlingto...	2019	ID THEFT: OBTAIN 5 IDS TO DEFRAUD/SELL/DISTRIB =$500	38.8817...	-77.152...
24	a006g000002k6fq	Arlingto...	2019	GRAND LARCENY: THEFT OF MOTOR VEHICLE PARTS	38.8575...	-77.056...
25	a006g000002k6fR	Arlingto...	2019	PETIT LARCENY: POCKET PICKING	38.8911...	-77.127...
26	a006g000002k6fr	Arlingto...	2019	GRAND LARCENY: ALL OTHER LARCENY	38.8622...	-77.058...
27	a006g000002k6fS	Arlingto...	2019	INTENTIONALLY DESTROY/DEFACE/DAMAGE PROPERTY $1000 (VANDAL...	38.8878...	-77.098...
28	a006g000002k6fs	Arlingto...	2019	PROSTITUTION	38.8887...	-77.084...

Arlington,VA	3,536

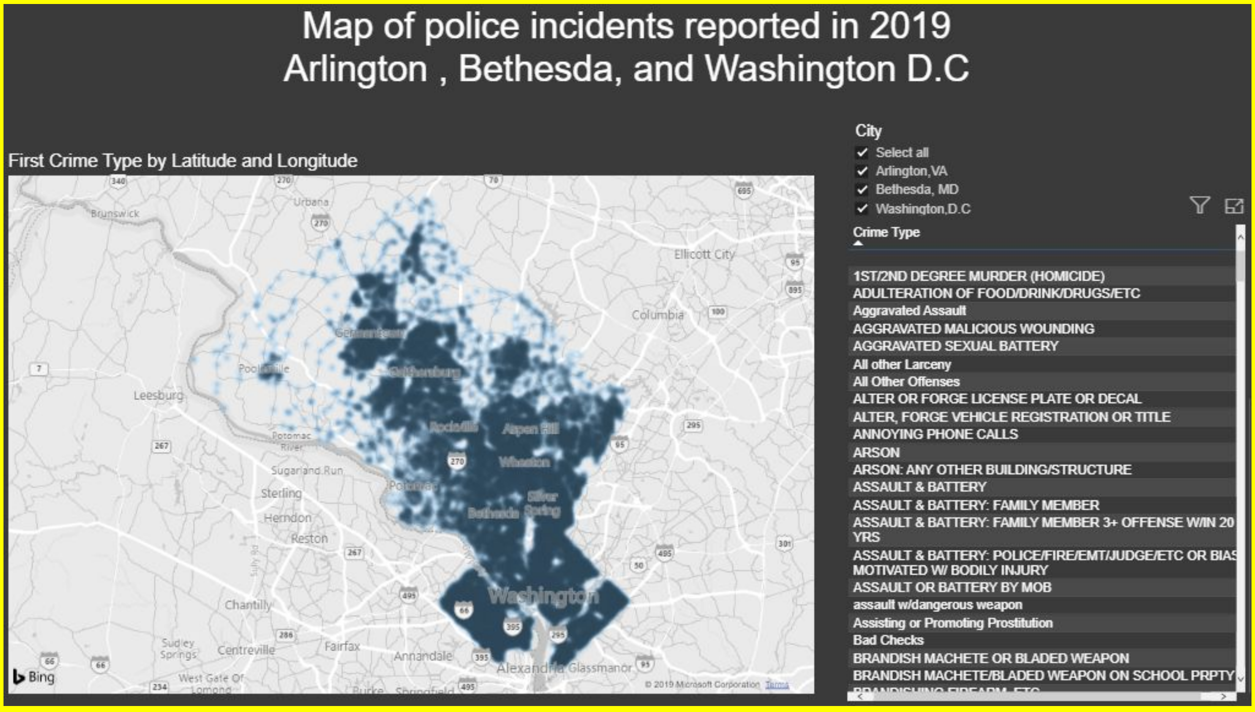
Also, a sample of the data was uploaded on Google Maps by using data import wizard which limited the uploaded data to 2000 records:

https://www.google.com/maps/d/u/0/edit?mid=1pd0piZ58pY0t4gpRhaoU2yHt4FAWG3pe

All data was loaded to PowerBI and easily accessible:

https://app.powerbi.com/view?r=eyJrIjoiYzc1YjZjMGUtM2JjMS00ZjE2LTk5YmYtMzUwNjEyNDJlYWY2IiwidCI6IjgxNWE4NGQ4LTc0NWEtNGFiNC04MzIwLTI2ZGM1MTU1MjM1YiIsImMiOjJ9

Figure 5. Final output uploaded into the PowerBi (combined crime data in Washington, D.C, Arlington, VA, and Bethesda, MD).



Map of police incidents reported in 2019
Arlington , Bethesda, and Washington D.C

First Crime Type by Latitude and Longitude

City
☑ Select all
☑ Arlington,VA
☑ Bethesda, MD
☑ Washington,D.C

Crime Type

1ST/2ND DEGREE MURDER (HOMICIDE)
ADULTERATION OF FOOD/DRINK/DRUGS/ETC
Aggravated Assault
AGGRAVATED MALICIOUS WOUNDING
AGGRAVATED SEXUAL BATTERY
All other Larceny
All Other Offenses
ALTER OR FORGE LICENSE PLATE OR DECAL
ALTER, FORGE VEHICLE REGISTRATION OR TITLE
ANNOYING PHONE CALLS
ARSON
ARSON: ANY OTHER BUILDING/STRUCTURE
ASSAULT & BATTERY
ASSAULT & BATTERY: FAMILY MEMBER
ASSAULT & BATTERY: FAMILY MEMBER 3+ OFFENSE W/IN 20 YRS
ASSAULT & BATTERY: POLICE/FIRE/EMT/JUDGE/ETC OR BIAS MOTIVATED W/ BODILY INJURY
ASSAULT OR BATTERY BY MOB
assault w/dangerous weapon
Assisting or Promoting Prostitution
Bad Checks
BRANDISH MACHETE OR BLADED WEAPON
BRANDISH MACHETE/BLADED WEAPON ON SCHOOL PRPTY
BRANDISHING FIREARM, ETC