unir LA UNIVERSIDAD EN INTERNET

Actividad 1. Limpieza de un Dataset.</header1> </centre>

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Fase 0. Inicialización y configuración

0. Inicializar pySpark e Imporatar librerias

In [25]:

```
import os
import chardet
from IPython.display import display, HTML
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import re

os.getcwd()
```

Out[25]:

```
'/Users/juandavidescobarescobar/Documents/Unir/Materias/BD Big Data/Actividad 1'
```

In [26]:

```
#testing pyspark installation
import findspark
findspark.init('/Users/juandavidescobarescobar/Documents/Apache Spark/spark-3.2.0-bin-hado
findspark.find()
import pyspark
findspark.find()
```

Out[26]:

```
'/Users/juandavidescobarescobar/Documents/Apache Spark/spark-3.2.0-bin-hadoop3.2'
```

In [27]:

```
#Libs Spark Context

from pyspark import SparkContext, SparkConf
from pyspark.sql import SparkSession
from pyspark.sql.types import StructType, StructField, StringType, IntegerType, Timestamp
from pyspark.sql import functions as f
from pyspark.sql.functions import trim
```

In [28]:

```
#Init Spark Context

conf = pyspark.SparkConf().setAppName('SparkApp').setMaster('local')
sc = pyspark.SparkContext(conf = conf)
spark = SparkSession(sc)
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
```

```
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLeve
l).
```

```
21/12/13 18:56:33 WARN NativeCodeLoader: Unable to load native-hadoop library for your pla
tform... using builtin-java classes where applicable
```

Out[28]:
```
DataFrame[key: string, value: string]
```

Fase 1. Interpretación de datos crudos (Raw Zone)

Definición funciones de validacion - CSV

In [ ]:
```
'''
En esta parte del código se encarga de validar la lectura correcta del archivo en formato
a sus propiedades (encabezados, encoding, separador de línea, separador de columna, filas,
y el esquema o tipología de los datos.
'''
```

In [30]:
```
"""
Descripción: Retorna boolean que determina si el archivo cuenta con el encoding UTF-8.
Responsables: Juan David Escobar E
Fecha: 30/11/2021
"""

def is_valid_encoding_csv(ar_file):
    this_encoding = 'UTF-8'
    result = chardet.detect(open(ar_file, 'rb').read())
    charenc = result['encoding']
    return  True if this_encoding in charenc.upper() else False
```

In [31]:
```
"""
Descripción: Retorna una lista con los registros que no cumplen
             con el patrón de texto o expresión regular parametrizada
             para una columna.
Responsables: Juan David Escobar E
Fecha: 05/12/2021
"""

def is_valid_txt_regrex(reg, col_pattern, col_pk):

    col_pattern_reg = col_pattern + '_reg'

    df = df.withColumn(col_pattern_reg, f.col(col_pattern)\
           .rlike(reg))
    lst_bad_records = df.filter(f.col(col_pattern_reg) == False)\
                        .select(col_pk, col_pattern_reg)\
                        .collect()

    return lst_bad_records
```

In [32]:
```
"""
Descripción: Valida el formato de los valores de campos tipo timestamp.
Return:
    List con los bad records
Responsables: Juan David Escobar E
Fecha: 05/12/2021.

Ejecucion: validate_format_timestamp('10/02/1991 01:30')
"""

def validate_format_timestamp(df, col_timestamp, col_format = "dd/mm/yy HH:mm"):
    df2 = df.withColumn("badRecords",\
                        f.when(f.to_timestamp(f.col(col_timestamp), col_format)\
                         .cast("Timestamp")\
                         .isNull()  & \
                         f.col(col_timestamp)\
                         .isNotNull(),\
                         f.lit("Not a valid Timestamp"))\
                         .otherwise(f.lit(None))
                         )
    list_bad_rows = df2.filter((f.col("badRecords").isNotNull()) & (f.col("badRecords") ==

    return list_bad_rows
```

In [33]:
```
"""
Descripción: Retorna los registros duplicados a partir de un Dataframe, y los registros ur
Parámetros:
    ar_file -- Archivo a validar
    gb_records -- String el cual contiene los nombres de la columna que son unicos del Dat
Responsables: Juan David Escobar E
Fecha: 01/12/2021
"""

def get_duplicates(df_csv, df_pk):
    is_error = False
    msg_error = ''
    separator = ''
    result_dic = {'is_error' : '', 'msg_error' : ''}

    try:
        df_Campo = df_csv.groupby(df_pk).count()
        df_duplicados = df_Campo.select(f.col(df_pk), f.col("count")).filter(f.col("count'
        duplicados = [str(df_pk + ": " + str(row[df_pk]) + " - Cantidad: " + str(row['cour

        if len(duplicados) > 0:

            for i in range(len(duplicados)):
                lista_duplicados = duplicados[i].split(",")
                msg_error += separator + "["+(lista_duplicados[0].replace('"','))+"]"
                separator = ', '

            is_error = True
            result_dic = {'is_error' : is_error, 'msg_error' : msg_error}

    except Exception as error:
        is_error = False
        msg_error = 'No se pudo validar duplicados. !ERROR¡: ' + str(error)
        result_dic = {'is_error' : is_error, 'msg_error' : msg_error}
    return result_dic
```

In [34]:
```
'''
Descripción: Lectura desde una ruta local un archivo en formato CSV, el cual se  intenta i
             interpretar por primera vez, asumiendo que el archivo posee un encoding tipo
             se especifica esquema, delimitador el caracter ";", salto de linea el caracte
             la primera fila con encabezado.
Responsables: Juan David Escobar E
Fecha: 30/11/2021
'''

def read_csv():

    # File location (https://www.youtube.com/watch?v=-tZbkgTnGs4)
    file_location = '/Users/juandavidescobarescobar/Documents/Unir/Materias/BD Big Data/Ac
    file_type = 'csv'

    # CSV options
    infer_schema = 'true'
    first_row_is_header = 'true'
    delimiter = ';'

    # Validate encoding UTF-8
    is_valid_encode = is_valid_encoding_csv(file_location)

    if is_valid_encode:

        try:
            # The applied options are for CSV files. For other types, these will ignored.
            df = spark.read.format(file_type) \
                          .option('inferSchema', infer_schema) \
                          .option('header', first_row_is_header) \
                          .option('sep', delimiter) \
                          .load(file_location)
        except Exception as error:

            print('Error leyendo el archivo: ' + str(error))

    return df
```

Lectura y limpieza

In [35]:

```
# Init clean and file validations

# 1. Comparar el esquema inferido por pySpark Dataframe vs Los valores almacenados en el a

df = read_csv()
df.limit(20).toPandas().head()
```

Out[35]:

	CrimeId	OriginalCrimeTypeName	OffenseDate	CallTime	CallDateTime	Disposition	Address	City
0	160903280	Assault / Battery	2016-03-30T00:00:00	18:42	2016-03-30T18:42:00	REP	100 Block Of Chilton Av	San Francisco
1	160912272	Homeless Complaint	2016-03-31T00:00:00	15:31	2016-03-31T15:31:00	GOA	2300 Block Of Market St	San Francisco
2	160912590	Susp Info	2016-03-31T00:00:00	16:49	2016-03-31T16:49:00	GOA	2300 Block Of Market St	San Francisco
3	160912801	Report	2016-03-31T00:00:00	17:38	2016-03-31T17:38:00	GOA	500 Block Of 7th St	San Francisco
4	160912811	594	2016-03-31T00:00:00	17:42	2016-03-31T17:42:00	REP	Beale St/bryant St	San Francisco

Descripción y analisis de los datos

In [36]:

```
df_pd = df.toPandas()
df_pd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10051 entries, 0 to 10050
```

```
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype 
---  ------                --------------  ----- 
 0   CrimeId               10051 non-null  int32 
 1   OriginalCrimeTypeName 10051 non-null  object
 2   OffenseDate           10051 non-null  object
 3   CallTime              10051 non-null  object
 4   CallDateTime          10051 non-null  object
 5   Disposition           10051 non-null  object
 6   Address               10051 non-null  object
 7   City                  9730 non-null   object
 8   State                 10048 non-null  object
 9   AgencyId              10051 non-null  object
 10  Range                 0 non-null      object
 11  AddressType           10051 non-null  object
dtypes: int32(1), object(11)
memory usage: 903.1+ KB
```

In [37]:

```
#df.printSchema()
df_pd.describe(include='all')
```

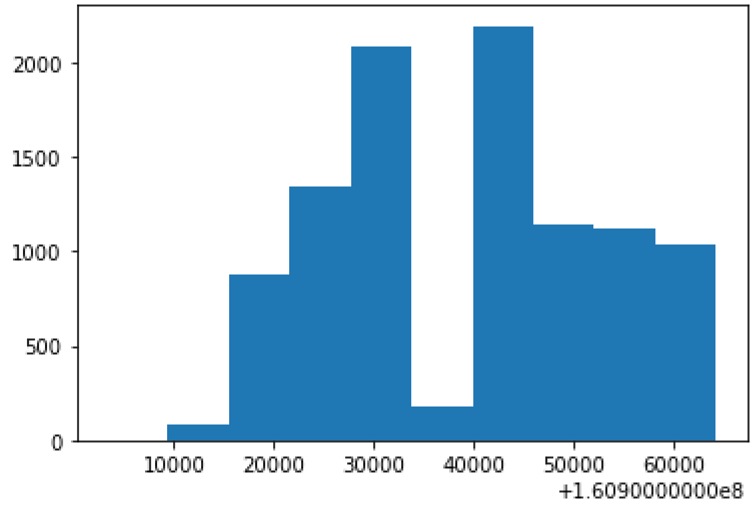
Out[37]:

	CrimeId	OriginalCrimeTypeName	OffenseDate	CallTime	CallDateTime	Disposition	Address	
count	1.005100e+04	10051	10051	10051	10051	10051	10051	
unique	NaN	575	9	1416	5116	19	5387	
top	NaN	Traffic Stop	2016-04-02T00:00:00	17:39	2016-04-04T12:23:00	HAN	900 Block Of Market St	F
freq	NaN	1215	2259	19	8	2820	58	
mean	1.609394e+08	NaN	NaN	NaN	NaN	NaN	NaN	
std	1.327006e+04	NaN	NaN	NaN	NaN	NaN	NaN	
min	1.609033e+08	NaN	NaN	NaN	NaN	NaN	NaN	
25%	1.609303e+08	NaN	NaN	NaN	NaN	NaN	NaN	
50%	1.609408e+08	NaN	NaN	NaN	NaN	NaN	NaN	
75%	1.609513e+08	NaN	NaN	NaN	NaN	NaN	NaN	
max	1.609642e+08	NaN	NaN	NaN	NaN	NaN	NaN	

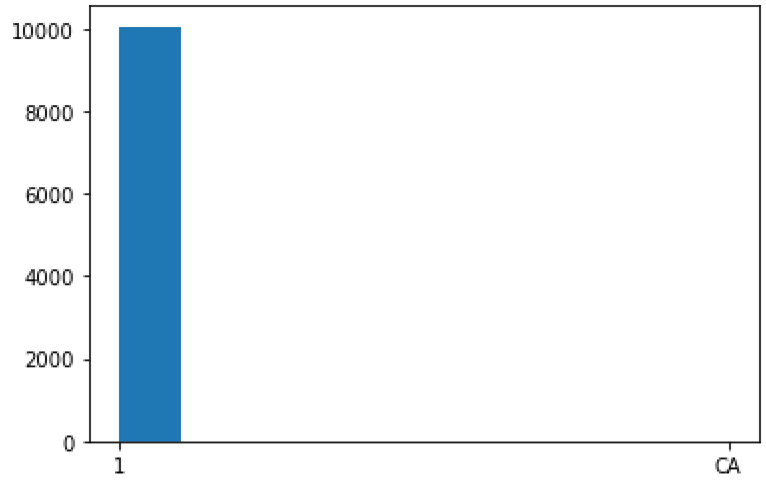
Descripción de datos numericos por medio de graficos

In [38]:

```
'''
Generamos los histogramas de dos variables numéricas que presenta
la tabla de datos: CrimeId y a AgencyId
'''

data_crime_id = list(df_pd["CrimeId"])

plt.hist(data_crime_id, 10)
plt.show()
```



In [39]:
```python
'''
Generamos los histogramas de dos variables numéricas que presenta
la tabla de datos: CrimeId y a AgencyId
'''

data_agency_id = list(df_pd["AgencyId"])

plt.hist(data_agency_id, 10)
plt.show()
```



Descripción manual por cada columna

In [ ]:
```
# -- CrimeId: integer (nullable = true), El tipo de dato corresponde al que se infiere en
#              identificador de registro este campo no debería aceptar valores nulos, por 
#              corregir en el esquema inferido de manera automatica por Spark Dataframe.

# -- OriginalCrimeTypeName: string (nullable = true), Los valores concuerdan con el tipo 
#                           el cual acepta valores nulos sin ningun inconveniente, a simp
#                           logra identificar algunos patrones de información numerica co
#                           caracteres sin sentido o en código "lp" que no concuerdan con
#                           campo, se puede concluir que son datos errados que quiza deba
#                           muy presente la previa autorización y validación del analista

# -- OffenseDate: timestamp (nullable = true),  Formato de la fecha:YYYY-MM-DD T HH:MM:SS,
#                 identificado a ojo en el archivo CSV cumpla su estructura, se debe gene
#                 lectura del dataset leído o inferido de manera original, a un nuevo dat
#                 el formato que predomina para la fecha y tipo de dato inferido de maner
#                 un constrain en un nuevo schema definido por el usuario. Adicional a es
#                 casteo de este formato para todos los valores del dataset e identificar
#                   el esquema que lo inferio de manera automatica tiene un tipo de dato tir
#                   de sasber que los valorers estan correctos para este formato de estampa

# -- CallTime: string (nullable = true) Formato HH:MM, el tipo de dato se infirio de tipo
#                un factor que se relaciona con la descripción o nombre del campo, para aseg
#                cumplan con este formato, es importante validarlo por medio de una expresio
#                aquellos valores nulos. Otra manera es recrear el dataset con un esquema es
#                asignemos este tipo de dato como timestamp con el formato HH:MM.

# -- CallDateTime: timestamp (nullable = true), Aplica la misma descripción que se especi
#                    "OffenseDate"

# -- Disposition: string (nullable = true), Los valores concuerdan con el tipo de dato in
#                   se analiza la longitud de los caracteres de cada campo, la cual es de 3
#                   A simple vista se detectan algunos campos vacios, lo cual es normal, pe
#                   cumplen el mismo patron 3 caracteres en letra mayuscula, se identifican
#                   "Not recorded", lo cual se puede asumir que es un Dummy que se almaceno
#                   valor, en este caso lo mejor es limpiar esta información para dejar la

# -- Address: string (nullable = true), Los valores concuerdan con el tipo de dato inferio
#               buen indicio ya que es el tipo de dato comunmente usado para las direcciones
#               de información, ya que almacenan valores alfanumericos. No se identifican va

# -- City: string (nullable = true), Los valores concuerdan con el tipo de dato inferido
#               buen indicio ya que es el tipo de dato comunmente usado para las ciudades,
#               completa de una sola ciudad la cual es San Francisco, algunos campos tienen
#               se deben dejar tal cual ya que no se posee información de cual ciudad del es
#               pertenecer Ej: (Los Angeles, San Francisco, San Jose, entre otros). El facto
#               lo correcto sería reportar estos campos a los dueños de la informacón para
#               y actualizarlos por el ID.

# -- State: string (nullable = true) CA 2 CHARACTERS, Los valores concuerdan con el tipo
#            es un buen indicio ya que es el tipo de dato comunmente usado para las estados
#            https://es.wikipedia.org/wiki/Anexo:Abreviaciones_de_los_estados_de_Estados_Un
#            de la información se puede hacer un distinc de la información para conocer las
#            registradas, y se debe validar que cumplen el formato de 2 caracteres en mayús

# -- AgencyId: string (nullable = true) INT, Los valores no concuerdan con el tipo de dato
#                debería ser un INT, esta columna no es relevante en esta sabana de datos ya
#                Id numerico de la agencia donde se reporto el crimen, pero que no brinda un
#                este dato se deba conservar para poder relacionar esta tabla de registro de
#                dataset de agencias.

# -- Range: string (nullable = true) Los valores no concuerdan con la descriopcion del car
#            un rango es un tipo de dato entero, pero que tambien puede ser la descripcion
#            superior, en este caso esta columna no tiene valores y no proporciona informac
#            todos los valores son null.

# -- AddressType: string (nullable = true), Los valores concuerdan con el tipo de dato in
#                   la calidad de la información se puede hacer un distinct de las categoria
#                   y validar cual de ellas es un dato errado que no pertenece a un tipo de
```

Fase 2. Datos procesados (Processed Zone)

Validar y eliminar registros duplicados

In [40]:

```python
# Validar cantidad de valores duplicados en cada variable

for column in df_pd:

    current_lst = df_pd[column].unique()
    current_lst = list(filter(None, current_lst))
    print('{0},  Valores Unicos {1}'.format(column, len(current_lst)))
    #print('{0},  Valores Unicos {1}'.format(column, df_pd[column].unique()))
```

```
CrimeId,  Valores Unicos 10047
OriginalCrimeTypeName,  Valores Unicos 575
OffenseDate,  Valores Unicos 9
CallTime,  Valores Unicos 1416
CallDateTime,  Valores Unicos 5116
Disposition,  Valores Unicos 19
Address,  Valores Unicos 5387
City,  Valores Unicos 8
State,  Valores Unicos 1
AgencyId,  Valores Unicos 2
Range,  Valores Unicos 0
AddressType,  Valores Unicos 6
```

In [41]:
```
# 7. Limpieza general - Elimina las filas duplicadas - por todos los campos

df = df.drop_duplicates()
df.count()
```

Out[41]:
```
10051
```

Identificar tipos de datos, patrones y formatos

In [ ]:
```
# |-- CrimeId: integer (nullable = true)
# |-- OriginalCrimeTypeName: string (nullable = true)
# |-- OffenseDate: timestamp (nullable = true)  YYYY-MM-DD T HH:MM:SS
# |-- CallTime: string (nullable = true) HH:MM
# |-- CallDateTime: timestamp (nullable = true) YYYY-MM-DD T HH:MM:SS
# |-- Disposition: string (nullable = true) 3 charascter MAX EX: REP
# |-- Address: string (nullable = true)
# |-- City: string (nullable = true)
# |-- State: string (nullable = true) CA 2 CHARACTERS
# |-- AgencyId: string (nullable = true) INT (OJO ERROR)
# |-- Range: string (nullable = true) INT?? OJO SIN DATOS
# |-- AddressType: string (nullable = true) String
```

Identificar y analizar posible eliminación filas duplicadas por llave primaria

In [42]:
```
df_pd["CrimeId"].value_counts() #10047 uniques

#df_pd["CrimeId"].drop_duplicates()
```

Out[42]:
```
160950496    3
160913455    3
160943740    1
160943710    1
160943712    1
            ..
160931823    1
160931824    1
160931825    1
160931827    1
160964249    1
Name: CrimeId, Length: 10047, dtype: int64
```

In [43]:
```
# 8. Limpieza general - Elimina las filas duplicadas - por "CrimeId"

df_pk = 'CrimeId'
```

```
list_duplicates = get_duplicates(df, df_pk)
print(list_duplicates)

# '''
# No se elimina ya que el ID tiene valores diferentes para
# cada valor en la columna repetido

# if result_duplicates['is_error']:
#     #df.drop_duplicates(subset = [df_pk])
#     print('Identificadores duplicados: {0}'.format(result_duplicates))
#     '''
```

```
[Stage 10:>                                                         (0 + 1) / 1]
{'is_error': True, 'msg_error': '[CrimeId: 160950496 - Cantidad: 3], [CrimeId: 160913455 -
Cantidad: 3]'}
```

In [44]:

```
df2 = df.filter(f.col("Crimeid") == '160950496')

df2.limit(20).toPandas().head()
```

Out[44]:

	CrimeId	OriginalCrimeTypeName	OffenseDate	CallTime	CallDateTime	Disposition	Address	Cit
0	160950496	Trespasser	2016-04-04T00:00:00	6:51	2016-04-04T06:51:00	CAN	Block Of Hampshire St	Sa Francisc
1	160950496	Passing Call	2016-04-04T00:00:00	6:51	2016-04-04T06:51:00	HAN	University St/felton St	Sa Francisc
2	160950496	Suspicious Vehicle	2016-04-04T00:00:00	6:51	2016-04-04T06:51:00	ND	1400 Block Of Cabrillo St	Sa Francisc

In [45]:

```
df2 = df.filter(f.col("Crimeid").isNull())

df2.limit(20).toPandas().head()
```

Out[45]:

CrimeId	OriginalCrimeTypeName	OffenseDate	CallTime	CallDateTime	Disposition	Address	City	State

Validar formatos de fecha y tiempo

In [46]:

```
# Validar formato fechas

list_bad_rec_offense_date = validate_format_timestamp(df, "OffenseDate", col_format = "yyy
list_bad_rec_call_time = validate_format_timestamp(df, "CallTime", col_format = "HH:mm")
list_bad_rec_call_date_time = validate_format_timestamp(df, "CallDateTime", col_format = '

print('list_bad_rec_offense_date: ', list_bad_rec_offense_date)
print('list_bad_rec_call_time: ', list_bad_rec_call_time)
print('list_bad_rec_call_date_time: ', list_bad_rec_call_date_time)
```

```
list_bad_rec_offense_date:  []
list_bad_rec_call_time:  []
list_bad_rec_call_date_time:  []
```

Eliminar columnas con información redundate

In [47]:

```
# Eliminación de variables redundantes y sin información

columns_to_drop = ['OffenseDate', 'CallTime', 'Range']
df = df.drop(*columns_to_drop)
df.limit(20).toPandas().head()
```

Out[47]:

	CrimeId	OriginalCrimeTypeName	CallDateTime	Disposition	Address	City	State	AgencyId	Ac
0	160913997	Pay	2016-03-31T23:51:00	ABA	1600 Block Of Green St	San Francisco	CA	1	
1	160920463	Well Being Check	2016-04-01T05:49:00	ND	Ada Ct/ofarrell St	San Francisco	CA	1	
2	160920488	Encampent	2016-04-01T06:15:00	ADV	500 Block Of Florida St	San Francisco	CA	1	
3	160920709	Suspicious Vehicle	2016-04-01T08:00:00	HAN	Granada Av/holloway Av	San Francisco	CA	1	
4	160920723	Traffic Stop	2016-04-01T08:05:00	CIT	7th St/mission St	San Francisco	CA	1	

Validar formatos de texto estandarizados para texto (Expresiones regulares)

In [48]:

```
# Validar formatos estandarizados de texto (Disposition, State)

col_pk = 'CrimeId'
reg = r'^[A-Z]{3}'                # r'^[A-Z]{3}' , r'^[A-Z]{2}'
col_pattern = 'Disposition'        #'Disposition', 'State'
col_pattern_reg = col_pattern + '_reg'

df_formats = df.withColumn(col_pattern_reg, f.col(col_pattern).rlike(reg))
df_formats = df_formats.filter(f.col(col_pattern_reg) == False)
df_formats = df_formats.select(col_pk, col_pattern, col_pattern_reg)

#print(lst)
df.limit(20).toPandas().head()
```

Out[48]:

	CrimeId	OriginalCrimeTypeName	CallDateTime	Disposition	Address	City	State	AgencyId	Ac
0	160913997	Pay	2016-03-31T23:51:00	ABA	1600 Block Of Green St	San Francisco	CA	1	
1	160920463	Well Being Check	2016-04-01T05:49:00	ND	Ada Ct/ofarrell St	San Francisco	CA	1	
2	160920488	Encampent	2016-04-01T06:15:00	ADV	500 Block Of Florida St	San Francisco	CA	1	
3	160920709	Suspicious Vehicle	2016-04-01T08:00:00	HAN	Granada Av/holloway Av	San Francisco	CA	1	
4	160920723	Traffic Stop	2016-04-01T08:05:00	CIT	7th St/mission St	San Francisco	CA	1	

Estandarizar valores tipo texto (Mayúsculas, sin espacios y homologados)

In [54]:
```
# Eliminación de espacios en blancos para las variables tipo texto
# [OriginalCrimeTypeName, Disposition, Address, City, State y Range]
# Estandarizacion de la los datos en Mayusculas
from pyspark.sql.functions import *

list_cols_str = [item[0] for item in df.dtypes if item[1].startswith('string')]

for col_name in list_cols_str:
    df = df.withColumn(col_name, upper(trim(f.col(col_name))))

df.limit(20).toPandas().head()
```

```
['OriginalCrimeTypeName', 'CallDateTime', 'Disposition', 'Address', 'City', 'State', 'Agen
cyId', 'AddressType']
```

Out[54]:

	CrimeId	OriginalCrimeTypeName	CallDateTime	Disposition	Address	City	State	AgencyI
0	160913997	PAY	2016-03-31T23:51:00	ABA	1600 BLOCK OF GREEN ST	SAN FRANCISCO	CA	
1	160920463	WELL BEING CHECK	2016-04-01T05:49:00	ND	ADA CT/OFARRELL ST	SAN FRANCISCO	CA	
2	160920488	ENCAMPENT	2016-04-01T06:15:00	ADV	500 BLOCK OF FLORIDA ST	SAN FRANCISCO	CA	
3	160920709	SUSPICIOUS VEHICLE	2016-04-01T08:00:00	HAN	GRANADA AV/HOLLOWAY AV	SAN FRANCISCO	CA	
4	160920723	TRAFFIC STOP	2016-04-01T08:05:00	CIT	7TH ST/MISSION ST	SAN FRANCISCO	CA	

Tratamiento y validación de Null Values (Variables númericas)

In [55]:
```
import pyspark.sql.functions as F
def count_missings(spark_df, sort = True):
    """
    Counts number of nulls and nans in each column
    """
    df = spark_df.select([F.count(F.when(F.isnan(c) | F.isnull(c), c)).alias(c) for (c,c_t

    if len(df) == 0:
        print("There are no any missing values!")
        return None

    if sort:
        return df.rename(index={0: 'count'}).T.sort_values("count",ascending=False)

    return df

count_missings(df)
```

Out[55]:

	count
City	321
State	3
CrimeId	0

	count
OriginalCrimeTypeName	0
CallDateTime	0
Disposition	0
Address	0
AgencyId	0
AddressType	0

In [ ]:

```
# Calculo del valor medio sin tener encuneta los valores Nan,
# este paso solo aplica para variables tipo númericas, aplica
# cuando tenego valores nulos en una muestra menor al 50% para rellenar

'''
from pyspark.sql.functions import mean as _mean, stddev as _stddev

col_name = 'colName'

df_stats = df.select(
    _mean(f.col(col_name)).alias('mean'),
    _stddev(f.col(col_name)).alias('std')
).collect()

mean = df_stats[0]['mean']
std = df_stats[0]['std']

print(mean, std)
'''
```

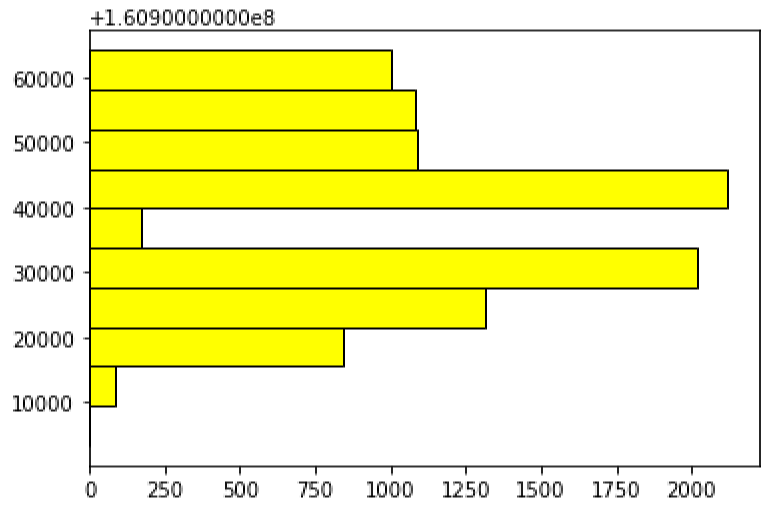
In [56]:

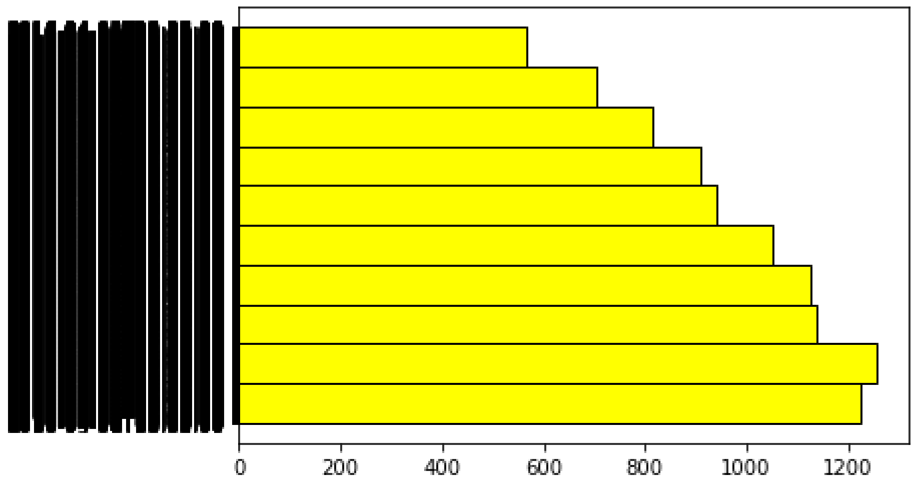
```
# Eliminar filas NULL

df = df.na.drop()

# Rellenar valores NULL con comodin -99, solo para variables
# categoricas que son las que cuentan con valores NULL

df.na.fill("-99").show()

df_pd = df.toPandas()
df_pd.info()
```

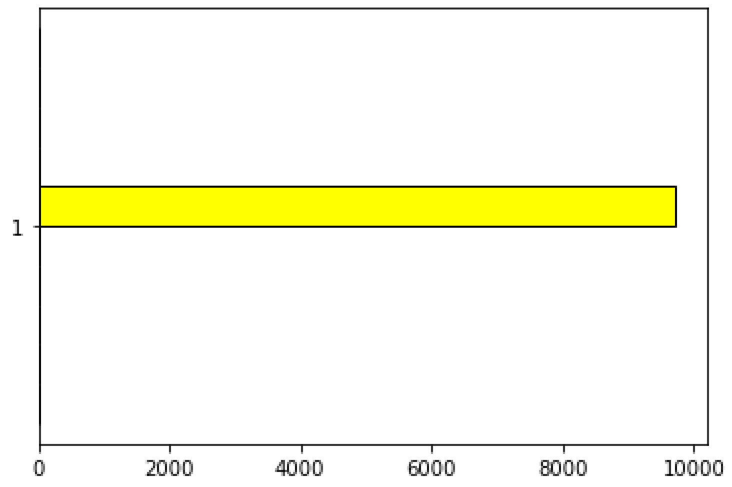
```
+---------+---------------------+-------------------+------------+--------------------+---
----------+-----+--------+---------------+
|  CrimeId|OriginalCrimeTypeName|       CallDateTime| Disposition|             Address|
      City|State|AgencyId|    AddressType|
+---------+---------------------+-------------------+------------+--------------------+---
----------+-----+--------+---------------+
|160913997|                  PAY|2016-03-31T23:51:00|         ABA|1600 BLOCK OF GRE...|SAN
FRANCISCO|   CA|       1|PREMISE ADDRESS|
|160920463|    WELL BEING CHECK|2016-04-01T05:49:00|          ND|  ADA CT/OFARRELL ST|SAN
FRANCISCO|   CA|       1|   INTERSECTION|
|160920488|            ENCAMPENT|2016-04-01T06:15:00|         ADV|500 BLOCK OF FLOR...|SAN
FRANCISCO|   CA|       1|PREMISE ADDRESS|
|160920709|   SUSPICIOUS VEHICLE|2016-04-01T08:00:00|         HAN|GRANADA AV/HOLLOW...|SAN
FRANCISCO|   CA|       1|   INTERSECTION|
|160920723|         TRAFFIC STOP|2016-04-01T08:05:00|         CIT|   7TH ST/MISSION ST|SAN
FRANCISCO|   CA|       1|   INTERSECTION|
|160920844|         VEH ACCIDENT|2016-04-01T08:41:00|         REP|SANTOS ST/BLYTHDA...|SAN
FRANCISCO|   CA|       1|   INTERSECTION|
|160921106|        AUDIBLE ALARM|2016-04-01T10:02:00|         NCR|2600 BLOCK OF UNI...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160921603|               22500F|2016-04-01T12:38:00|         CIT| 0 BLOCK OF MCLEA CT|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160921638|   SUSPICIOUS VEHICLE|2016-04-01T12:41:00|          ND|MISSION ST/SANTA ...|SAN
FRANCISCO|   CA|        1|   INTERSECTION|
|160922230|         PASSING CALL|2016-04-01T15:27:00|NOT RECORDED|100 BLOCK OF CHRI...|SAN
FRANCISCO|   CA|        1|COMMON LOCATION|
|160923621|                  811|2016-04-01T21:47:00|         GOA|400 BLOCK OF GEAR...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160923719|         DRUNK DRIVER|2016-04-01T22:11:00|         HAN|   BUSH ST/KEARNY ST|SAN
FRANCISCO|   CA|        1|   INTERSECTION|
|160930051|   SUSPICIOUS VEHICLE|2016-04-02T00:20:00|         CIT|200 BLOCK OF EDDY ST|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160930231|   HOMELESS COMPLAINT|2016-04-02T01:32:00|         GOA|1100 BLOCK OF NAT...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160930960|   HOMELESS COMPLAINT|2016-04-02T09:14:00|         ADV|400 BLOCK OF ELLI...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160931164|         TRAFFIC STOP|2016-04-02T10:15:00|         CIT|500 BLOCK OF SUTT...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160931247|    SUSPICIOUS PERSON|2016-04-02T10:43:00|         HAN|HYDE ST/GOLDEN GA...|SAN
FRANCISCO|   CA|        1|   INTERSECTION|
|160931399|         PASSING CALL|2016-04-02T11:31:00|NOT RECORDED|22ND ST/TENNESSEE ST|SAN
FRANCISCO|   CA|        1|   INTERSECTION|
|160931506|       STOLEN VEHICLE|2016-04-02T12:02:00|         REP|300 BLOCK OF SAGA...|SAN
FRANCISCO|   CA|        1|PREMISE ADDRESS|
|160931554|    SUSPICIOUS PERSON|2016-04-02T12:13:00|         ADV|     CAPP ST/19TH ST|SAN
FRANCISCO|   CA|        1|   INTERSECTION|
+---------+---------------------+-------------------+------------+--------------------+---
----------+-----+--------+---------------+
only showing top 20 rows

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9729 entries, 0 to 9728
Data columns (total 9 columns):
 #   Column                 Non-Null Count  Dtype 
---  ------                 --------------  ----- 
 0   CrimeId                9729 non-null   int32 
 1   OriginalCrimeTypeName  9729 non-null   object
 2   CallDateTime           9729 non-null   object
 3   Disposition            9729 non-null   object
 4   Address                9729 non-null   object
 5   City                   9729 non-null   object
 6   State                  9729 non-null   object
 7   AgencyId               9729 non-null   object
 8   AddressType            9729 non-null   object
dtypes: int32(1), object(8)
memory usage: 646.2+ KB
```

In [57]:

```python
# Validación de datos atipicos - Variables Numericas

def draw_hist_num_vars(list_var_num):

    for col_nm in list_var_num:

        list_data_col = df.select(col_nm).rdd.flatMap(lambda x: x).collect()
        plt.hist(list_data_col,
                 color="yellow",
                 ec="black",
                 orientation ='horizontal')

        plt.show()

list_var_num = ['CrimeId','CallDateTime', 'AgencyId']
draw_hist_num_vars(list_var_num)
```





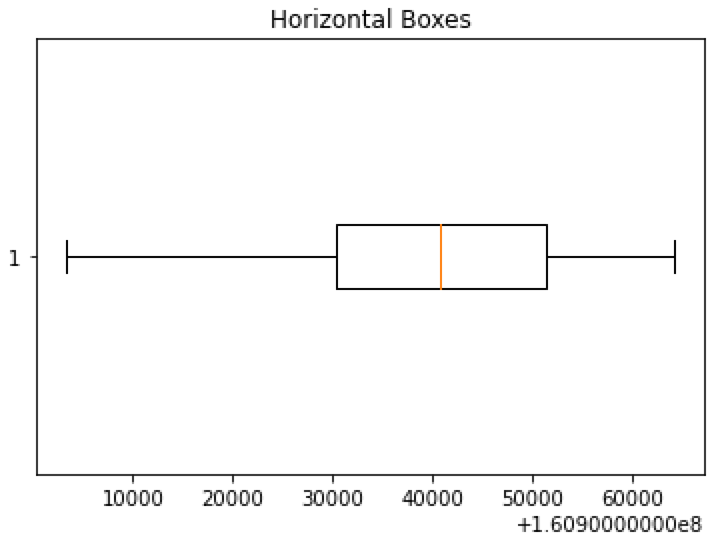


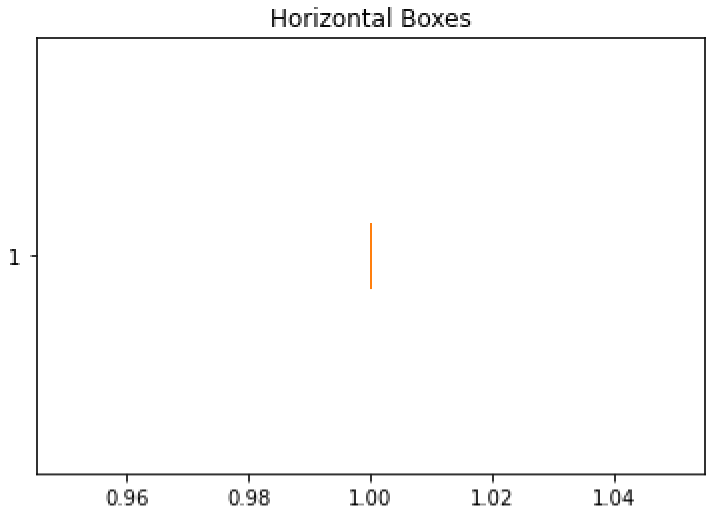
In [65]:

```
from pyspark.sql.functions import *

df = df.withColumn("AgencyId", f.col("AgencyId").cast(IntegerType()))
```

In [67]:

```
# Grafico de bigotes, distribución de los datos
# para analizar los datos de la variable fecha
# se debe convertir en un numero entero

def draw_bigotes_num_vars(list_var_num):

    for col_nm in list_var_num:

        list_data_col = df.select(col_nm)\
                            .rdd.flatMap(lambda x: x)\
                            .collect()
        red_square = dict(markerfacecolor='r', marker='s')
        fig5, ax5 = plt.subplots()
        ax5.set_title('Horizontal Boxes')
        ax5.boxplot(list_data_col,
                    vert=False,
                    flierprops=red_square)

        plt.show()

list_var_num = ['CrimeId', 'AgencyId']
draw_bigotes_num_vars(list_var_num)
```

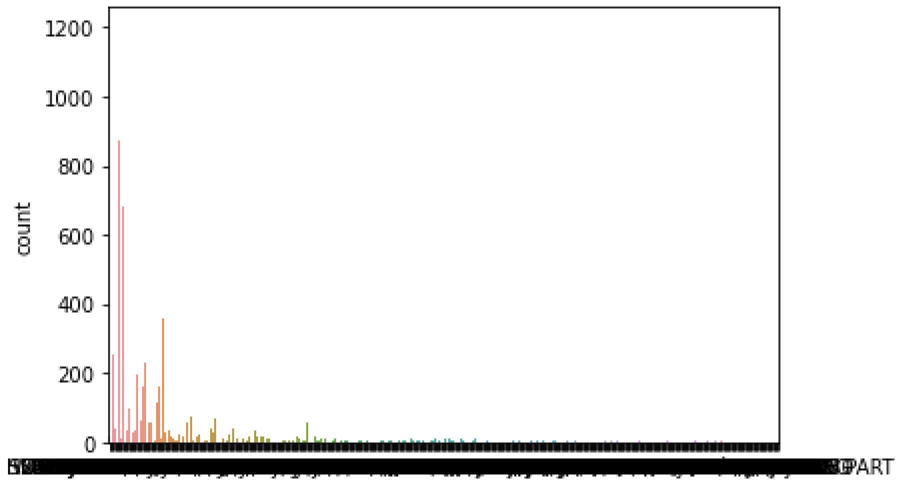




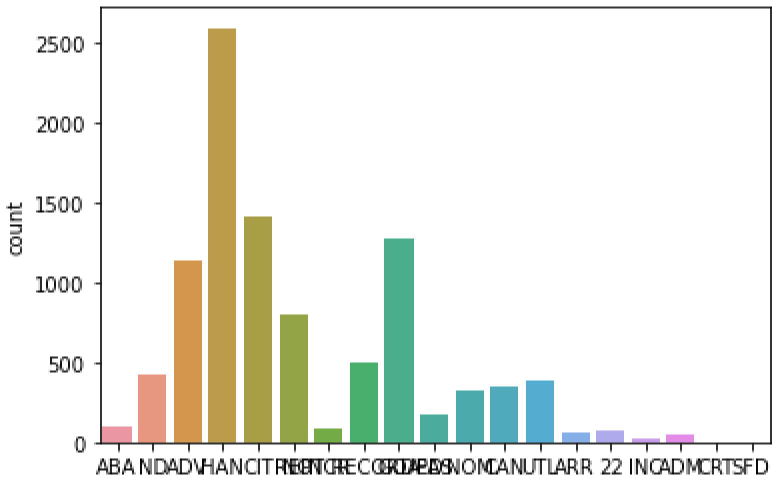
In [68]:

```
# Validacion de datos atipicos - Variables Categoricas

def draw_hist_cat_vars(list_var_cat):

    for col_nm in list_var_cat:

        list_data_col = df.select(col_nm)\
                            .rdd.flatMap(lambda x: x)\
                            .collect()
        sns.countplot(list_data_col, )
        plt.show()


list_var_cat = ['OriginalCrimeTypeName','Disposition',\
                'Address','City','State','AddressType']
draw_hist_cat_vars(list_var_cat)
```

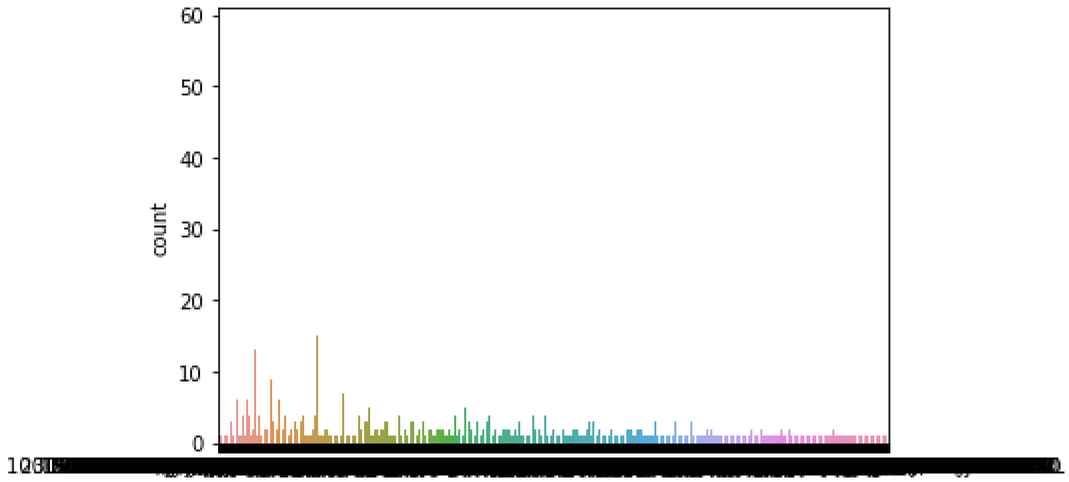
```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

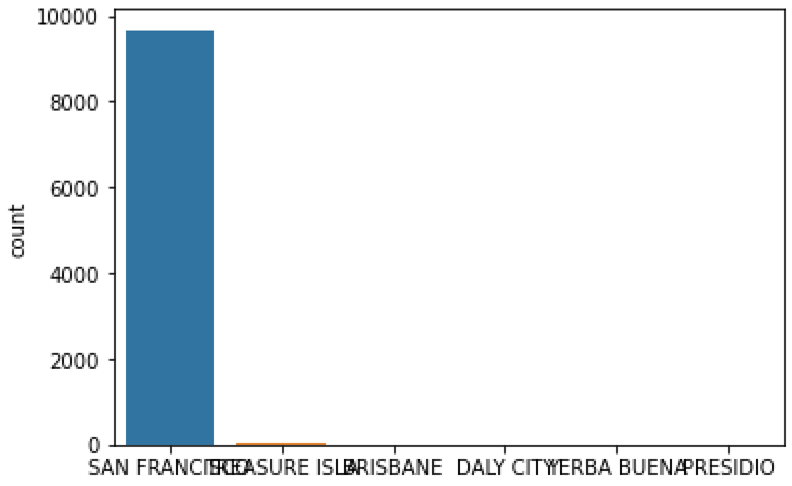


```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

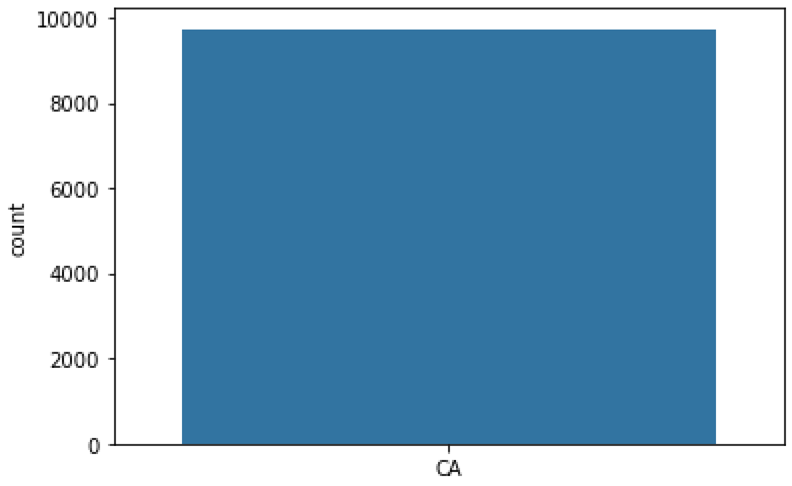


```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
```

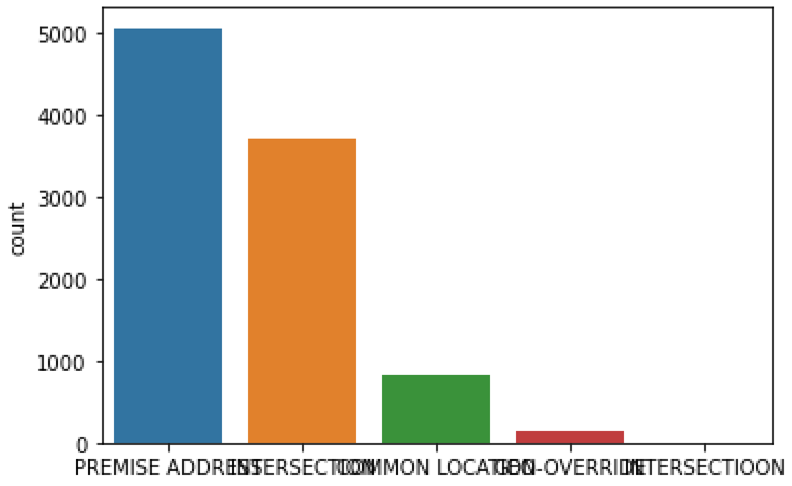
```
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorato
rs.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



In [70]:
```
df.filter(f.col("State").isNull()).count()
```

```
Out[70]: 0
```

Tratamiento y validación de Null Values (Variables categóricas)

```
In [71]:
# grafico histograma para variables categoricas, analiza
# la distribución de los datos

# 1. Conteo de las categorías por variable categorica

def count_categ(df, list_var_cat):
    for col_nm in list_var_cat:
        df.groupby(col_nm).count().show()


list_var_cat = ['OriginalCrimeTypeName','Disposition',\
                 'Address','City','State','AddressType']

count_categ(df, list_var_cat)
```

```
+---------------------+-----+
|OriginalCrimeTypeName|count|
+---------------------+-----+
|                FRAUD|   54|
|                 BAND|    2|
|        WIRELESS-OPEN|    1|
|           THREATS DV|    3|
|              HOLD UP|    1|
|                  800|    6|
|              YELLING|    3|
|             911-DROP|    1|
|            22500F/CW|    1|
|    ASSAULT / BATTERY|  113|
|                  919|   15|
|    PSYCH EVAL / HOLD|    4|
|                 MUNI|    1|
|            FIREWORKS|    1|
|          915 SLEEPER|    1|
|            EXPLOSION|    1|
|           368CA POSS|    1|
|               ATTEMP|    1|
|             POSS/420|    1|
|                UNOCC|    4|
+---------------------+-----+
only showing top 20 rows

+-----------+-----+
|Disposition|count|
+-----------+-----+
|        ABA|   97|
|        INC|   17|
|         22|   77|
|        NOM|  324|
|        GOA| 1272|
|        CIT| 1406|
|        HAN| 2589|
|        ADM|   46|
|         ND|  423|
|        SFD|    1|
|        PAS|  170|
|        CRT|    2|
|        UTL|  383|
|        NCR|   82|
|        CAN|  353|
|        ARR|   65|
|NOT RECORDED|  496|
|         ADV| 1129|
|         REP|  797|
+------------+-----+

+--------------------+-----+
|             Address|count|
+--------------------+-----+
|1100 BLOCK OF FEL...|    1|
|   14TH ST/JULIAN AV|    1|
|     BAY ST/MASON ST|    1|
|100 BLOCK OF ANDE...|    1|
|300 BLOCK OF TURK ST|    6|
|1200 BLOCK OF HOW...|    7|
|400 BLOCK OF MONT...|    2|
|  CLEMENT ST/15TH AV|    1|
|300 BLOCK OF POTR...|    2|
|1600 BLOCK OF 17T...|    2|
|   MASON ST/GREEN ST|    1|
|POLK ST/NORTH POI...|    1|
|600 BLOCK OF HILL ST|    1|
|1300 BLOCK OF 38T...|    1|
|20TH ST/TENNESSEE ST|    1|
|1600 BLOCK OF 25T...|    1|
|    31ST AV/JUDAH ST|    1|
|600 BLOCK OF EL C...|    1|
|1300 BLOCK OF 3RD AV|    1|
|BAKER ST/JEFFERSO...|    1|
+--------------------+-----+
only showing top 20 rows

+-------------+-----+
|         City|count|
+-------------+-----+
|  YERBA BUENA|    3|
|    DALY CITY|    5|
|TREASURE ISLA|   51|
|     PRESIDIO|    3|
|     BRISBANE|    1|
|SAN FRANCISCO| 9666|
+-------------+-----+

+-----+-----+
|State|count|
+-----+-----+
|   CA| 9729|
+-----+-----+

+----------------+-----+
|    AddressType|count|
+----------------+-----+
|    INTERSECTION| 3701|
|COMMON LOCATION|  817|
|PREMISE ADDRESS| 5059|
|  INTERSECTIOON|    1|
|    GEO-OVERRIDE|  151|
+----------------+-----+
```

In [72]:

```python
df_pd2 = df.toPandas()

list_var_cat = ['OriginalCrimeTypeName','Disposition',\
                'Address','City','State','AddressType']
```

```
col_nm = list_var_cat[1]
df_pd2.head()
```

Out[72]:

	CrimeId	OriginalCrimeTypeName	CallDateTime	Disposition	Address	City	State	AgencyI
0	160913997	PAY	2016-03-31T23:51:00	ABA	1600 BLOCK OF GREEN ST	SAN FRANCISCO	CA	
1	160920463	WELL BEING CHECK	2016-04-01T05:49:00	ND	ADA CT/OFARRELL ST	SAN FRANCISCO	CA	
2	160920488	ENCAMPENT	2016-04-01T06:15:00	ADV	500 BLOCK OF FLORIDA ST	SAN FRANCISCO	CA	
3	160920709	SUSPICIOUS VEHICLE	2016-04-01T08:00:00	HAN	GRANADA AV/HOLLOWAY AV	SAN FRANCISCO	CA	
4	160920723	TRAFFIC STOP	2016-04-01T08:05:00	CIT	7TH ST/MISSION ST	SAN FRANCISCO	CA	

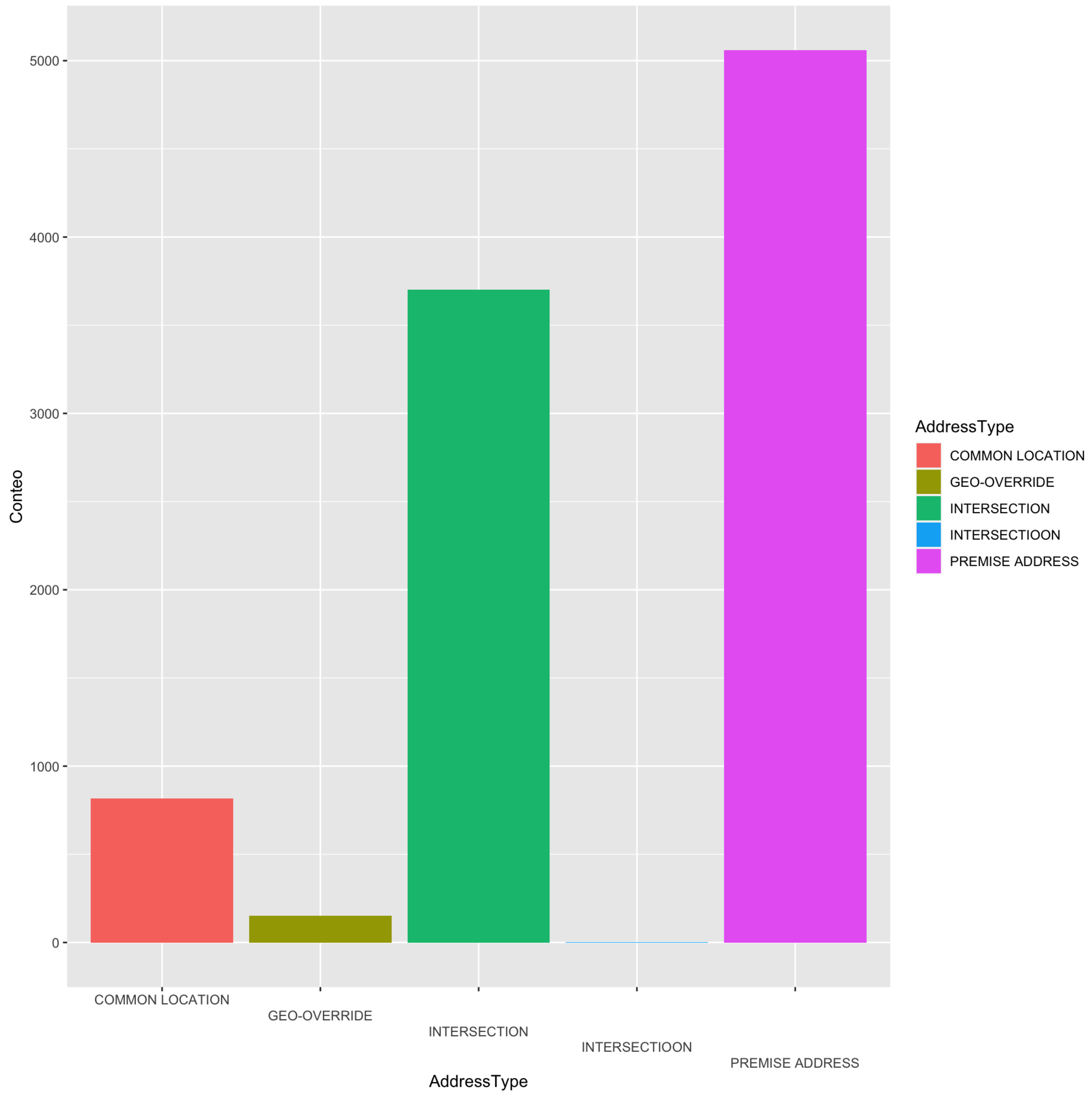
Tratamiento y validación de valores atipicos

In [73]:

```
#enables the %%R magic, not necessary if you've already done this
#%%R -i df -w 5 -h 5 --units in -r 200
%load_ext rpy2.ipython
```

In [74]:

```
%%R -i df_pd2 -w 10 -h 10 --units in -r 200

install.packages("ggplot2", repos="http://cran.us.r-project.org", quiet=TRUE)
library(ggplot2)

ggplot_result <- ggplot(df_pd2)+
                 geom_bar(aes(x = AddressType, fill = AddressType)) +
                 xlab("AddressType") + ylab("Conteo") +
                 #scale_x_discrete(guide = guide_axis(check.overlap = TRUE))
                 scale_x_discrete(guide = guide_axis(n.dodge=5))
                 #theme(axis.text.x = element_text(angle = 30))
ggplot_result
```



In [75]:

```
# Eliminar valor atipico 22 por el valor equivalente al 1% de los registos
df = df.filter(f.col("Disposition") != '22')

# Eliminar valores no grabados por el valor equivalente a la media
# df = df.filter(f.col("Disposition") != 'Not recorded')
# df.count()

# Remplazar valores no grabados por el valor  Dummy -99

df = df.withColumn("Disposition",
      f.when(df["Disposition"] == "Not recorded", -99)
       .otherwise(df["Disposition"]))
```

In [76]:

```
# Validación de los datos contenidos en la variable OriginalCrimeTypeName

df_original = df.groupby('OriginalCrimeTypeName').count().orderBy(f.col('count').asc())
```

```
#dfa = df_original.filter(f.col('count') == '1')
#dfa.show()

list_ditinct_origin = df_original.select('count')\
                                  .distinct()\
                                  .orderBy(f.col('count').asc()).show()

#Min: 1
#Max: 1194

print(list_ditinct_origin)
```

```
+-----+
|count|
+-----+
|    1|
|    2|
|    3|
|    4|
|    5|
|    6|
|    7|
|    8|
|    9|
|   10|
|   11|
|   12|
|   13|
|   14|
|   15|
|   16|
|   17|
|   18|
|   19|
|   21|
+-----+
only showing top 20 rows

None
```

In [77]:
```
# Eliminación registros que continenen valores númericos en
# la variable OriginalCrimeTypeName

df.count()
#9156

df = df.filter(~f.col("OriginalCrimeTypeName").cast("int").isNotNull())
df.count()
#9631
```

Out[77]:
```
9233
```

In [78]:
```
# Remplazar valor atipico o incongruente de la variable City = 'S'

df = df.withColumn("City",
        f.when(df["City"] == "S", "SAN FRANCISCO")
         .otherwise(df["Disposition"]))
```

In [79]:
```
# Remplazar valor atipico o incongruente de la variable AddressType = '1'

df = df.withColumn("AddressType",
      f.when(df["AddressType"] == "1", "-99")
       .otherwise(df["AddressType"]))
```

In [80]:
```
# Remplazar valor atipico o incongruente de la variable State = 'NA'

df = df.withColumn("State",
      f.when(df["AgencyId"] == "CA", "CA")
       .otherwise(df["AgencyId"]))
```

In [81]:
```
# Remplazar valor atipico o incongruente de la variable AgencyId = 'CA'

df = df.withColumn("AgencyId",
      f.when(df["AgencyId"] == "CA", 1)
       .otherwise(df["AgencyId"]))
```

In [82]:
```
df.describe()
```

Out[82]:
```
DataFrame[summary: string, CrimeId: string, OriginalCrimeTypeName: string, CallDateTime: s
tring, Disposition: string, Address: string, City: string, State: string, AgencyId: strin
g, AddressType: string]
```

Fase 3. Datos resultados (Result Zone)

In [83]:
```
# Ajustar esquema de acuerdo a la naturaleza de los datos analizados en el Datset

df2 = df.withColumn("CallDateTime", f.col("CallDateTime").cast(TimestampType()))\
        .withColumn("AgencyId", f.col("AgencyId").cast(IntegerType()))

df2.describe()
#df2.show()
```

Out[83]:
```
DataFrame[summary: string, CrimeId: string, OriginalCrimeTypeName: string, Disposition: st
ring, Address: string, City: string, State: string, AgencyId: string, AddressType: string]
```

In [84]:
```
# Ajustar esquema de acuerdo a la naturaleza de los datos analizados en el Datset

# StructField("Range", StringType(), True),   \ # col eliminada
# StructField("OffenseDate", StringType(), True),   \ # col eliminada
# StructField("CallTime", StringType(), True),   \ # col eliminada

schema = StructType([ \
    StructField("CrimeId",IntegerType(),False), \
    StructField("OriginalCrimeTypeName",StringType(),True), \
    StructField("CallDateTime", TimestampType(), True), \
    StructField("Disposition", StringType(), True), \
    StructField("Address", StringType(), True), \
    StructField("City", StringType(), True), \
    StructField("State", StringType(), True), \
    StructField("AgencyId", IntegerType(), True), \
    StructField("AddressType", StringType(), True)   \
  ])

df_result = spark.createDataFrame(data = df2.collect(), schema = schema)
df_result.printSchema()
df_result.show()
```

```
root
 |-- CrimeId: integer (nullable = false)
 |-- OriginalCrimeTypeName: string (nullable = true)
 |-- CallDateTime: timestamp (nullable = true)
 |-- Disposition: string (nullable = true)
 |-- Address: string (nullable = true)
 |-- City: string (nullable = true)
 |-- State: string (nullable = true)
 |-- AgencyId: integer (nullable = true)
 |-- AddressType: string (nullable = true)

+---------+---------------------+-------------------+------------+--------------------+---
---------+-----+--------+---------------+
|  CrimeId|OriginalCrimeTypeName|       CallDateTime| Disposition|             Address|
    City|State|AgencyId|    AddressType|
+---------+---------------------+-------------------+------------+--------------------+---
---------+-----+--------+---------------+
|160913997|                  PAY|2016-03-31 23:51:00|         ABA|1600 BLOCK OF GRE...|
      ABA|    1|       1|PREMISE ADDRESS|
|160920463|     WELL BEING CHECK|2016-04-01 05:49:00|          ND|  ADA CT/OFARRELL ST|
       ND|    1|       1|   INTERSECTION|
|160920488|             ENCAMPENT|2016-04-01 06:15:00|         ADV|500 BLOCK OF FLOR...|
      ADV|    1|       1|PREMISE ADDRESS|
|160920709|   SUSPICIOUS VEHICLE|2016-04-01 08:00:00|         HAN|GRANADA AV/HOLLOW...|
      HAN|    1|       1|   INTERSECTION|
|160920723|         TRAFFIC STOP|2016-04-01 08:05:00|         CIT|   7TH ST/MISSION ST|
      CIT|    1|       1|   INTERSECTION|
|160920844|         VEH ACCIDENT|2016-04-01 08:41:00|         REP|SANTOS ST/BLYTHDA...|
      REP|    1|       1|   INTERSECTION|
|160921106|        AUDIBLE ALARM|2016-04-01 10:02:00|         NCR|2600 BLOCK OF UNI...|
      NCR|    1|       1|PREMISE ADDRESS|
|160921603|               22500F|2016-04-01 12:38:00|         CIT| 0 BLOCK OF MCLEA CT|
      CIT|    1|       1|PREMISE ADDRESS|
|160921638|   SUSPICIOUS VEHICLE|2016-04-01 12:41:00|          ND|MISSION ST/SANTA ...|
       ND|    1|       1|   INTERSECTION|
|160922230|         PASSING CALL|2016-04-01 15:27:00|NOT RECORDED|100 BLOCK OF CHRI...|NOT
RECORDED|    1|       1|COMMON LOCATION|
|160923719|         DRUNK DRIVER|2016-04-01 22:11:00|         HAN|   BUSH ST/KEARNY ST|
      HAN|    1|       1|   INTERSECTION|
|160930051|   SUSPICIOUS VEHICLE|2016-04-02 00:20:00|         CIT|200 BLOCK OF EDDY ST|
      CIT|    1|       1|PREMISE ADDRESS|
|160930231|   HOMELESS COMPLAINT|2016-04-02 01:32:00|         GOA|1100 BLOCK OF NAT...|
      GOA|    1|       1|PREMISE ADDRESS|
|160930960|   HOMELESS COMPLAINT|2016-04-02 09:14:00|         ADV|400 BLOCK OF ELLI...|
      ADV|    1|       1|PREMISE ADDRESS|
|160931164|         TRAFFIC STOP|2016-04-02 10:15:00|         CIT|500 BLOCK OF SUTT...|
      CIT|    1|       1|PREMISE ADDRESS|
|160931247|    SUSPICIOUS PERSON|2016-04-02 10:43:00|         HAN|HYDE ST/GOLDEN GA...|
      HAN|    1|       1|   INTERSECTION|
|160931399|         PASSING CALL|2016-04-02 11:31:00|NOT RECORDED|22ND ST/TENNESSEE ST|NOT
RECORDED|    1|       1|   INTERSECTION|
|160931506|       STOLEN VEHICLE|2016-04-02 12:02:00|         REP|300 BLOCK OF SAGA...|
      REP|    1|       1|PREMISE ADDRESS|
|160931554|    SUSPICIOUS PERSON|2016-04-02 12:13:00|         ADV|     CAPP ST/19TH ST|
      ADV|    1|       1|   INTERSECTION|
|160932688|               7.2.27|2016-04-02 17:26:00|         GOA|5800 BLOCK OF GEA...|
      GOA|    1|       1|PREMISE ADDRESS|
+---------+---------------------+-------------------+------------+--------------------+---
---------+-----+--------+---------------+
only showing top 20 rows
```

Analisis de correlación entre las variables númericas

In [ ]:

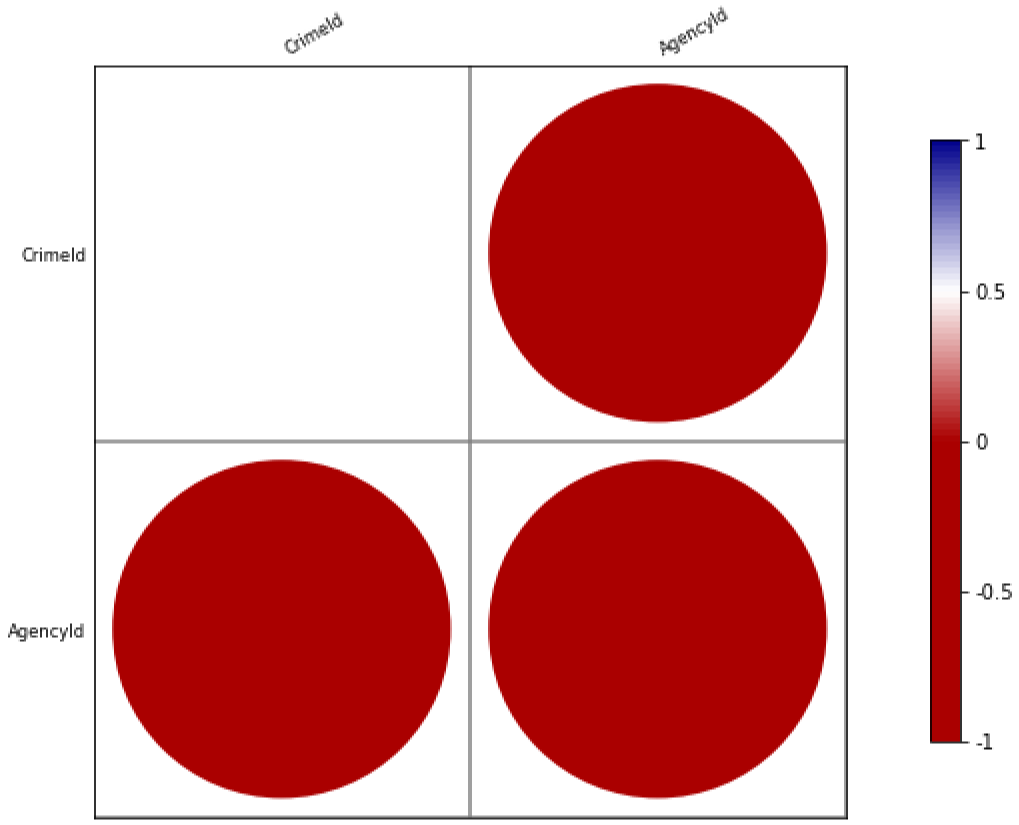
```
import numpy as np; np.random.seed(1)
import pandas as pd
import seaborn as sns
```

```python
import matplotlib.pyplot as plt

# Generate a random dataset
df_correl = df_result.select('CrimeId', 'AgencyId').toPandas()

# Compute the correlation matrix
corr = df_correl.corr()
print(corr)
# Generate a mask for the upper triangle
mask = np.zeros_like(corr, dtype=np.bool)
mask[np.triu_indices_from(mask)] = True

# Set up the matplotlib figure
fig, ax = plt.subplots()

# Draw the heatmap with the mask and correct aspect ratio
vmax = np.abs(corr.values[~mask]).max()
sns.heatmap(corr, mask=mask, cmap=plt.cm.PuOr, vmin=-vmax, vmax=vmax,
            square=True, linecolor="lightgray", linewidths=1, ax=ax)
for i in range(len(corr)):
    ax.text(i+0.5,len(corr)-(i+0.5), corr.columns[i],
            ha="center", va="center", rotation=45)
    for j in range(i+1, len(corr)):
        s = "{:.3f}".format(corr.values[i,j])
        ax.text(j+0.5,len(corr)-(i+0.5),s,
            ha="center", va="center")
ax.axis("off")
plt.show()
```

In [85]:

```python
import pandas
import numpy
from pyensae.graphhelper import Corrplot

df_correl = df_result.select('CrimeId', 'AgencyId').toPandas()

c = Corrplot(df_correl)

print(c.params)
c.plot(figsize=(12,6))
plt.show()
```

```
{'colorbar.N': 100, 'colorbar.shrink': 0.8, 'colorbar.orientation': 'vertical'}
/Users/juandavidescobarescobar/opt/anaconda3/lib/python3.9/site-packages/pyensae/graphhelp
er/linkage.py:43: ClusterWarning: scipy.cluster: The symmetric non-negative hollow observa
tion matrix looks suspiciously like an uncondensed distance matrix
  Y = linkage(D, method=method, metric=metric)
```



In [86]:
```
df_result.head()
```

Out[86]:
```
Row(CrimeId=160913997, OriginalCrimeTypeName='PAY', CallDateTime=datetime.datetime(2016,
3, 31, 23, 51), Disposition='ABA', Address='1600 BLOCK OF GREEN ST', City='ABA', State
='1', AgencyId=1, AddressType='PREMISE ADDRESS')
```

Converción de Dataframe a formato JSON

In [87]:
```
# Crear JSON-Result
import json

df_json = df_result.limit(2).toJSON()

for row in df_json.collect():
    #json string
    print(row, '\n')


def print_rows(row):
    data = json.loads(row)

    for key in data:
        print("{key}:{value}".format(key=key, value=data[key]))

    print('\n')

df_json.foreach(print_rows)
```

```
{"CrimeId":160913997,"OriginalCrimeTypeName":"PAY","CallDateTime":"2016-03-31T23:51:00.000
-05:00","Disposition":"ABA","Address":"1600 BLOCK OF GREEN ST","City":"ABA","State":"1","A
gencyId":1,"AddressType":"PREMISE ADDRESS"}

{"CrimeId":160920463,"OriginalCrimeTypeName":"WELL BEING CHECK","CallDateTime":"2016-04-01
T05:49:00.000-05:00","Disposition":"ND","Address":"ADA CT/OFARRELL ST","City":"ND","Stat
e":"1","AgencyId":1,"AddressType":"INTERSECTION"}
```

```
CrimeId:160913997
OriginalCrimeTypeName:PAY
CallDateTime:2016-03-31T23:51:00.000-05:00
Disposition:ABA
Address:1600 BLOCK OF GREEN ST
City:ABA
State:1
AgencyId:1
AddressType:PREMISE ADDRESS


CrimeId:160920463
OriginalCrimeTypeName:WELL BEING CHECK
CallDateTime:2016-04-01T05:49:00.000-05:00
Disposition:ND
Address:ADA CT/OFARRELL ST
City:ND
State:1
AgencyId:1
AddressType:INTERSECTION
```

In [24]:

```
list_result = [
{
    "_id": 1,
    "CrimeId": 160913997,
    "OriginalCrimeTypeName": "Pay",
    "CallDateTime": "2016-03-31T23:51:00.000-05:00",
    "Disposition": "ABA",
    "Address": "1600 Block Of Green St",
    "City": "ABA",
    "State": "1",
    "Agency": {
        "_id": 1
    },
    "AddressType": "Premise Address"
},
{
    "_id": 2,
    "CrimeId": 160920463,
    "OriginalCrimeTypeName": "Well Being Check",
    "CallDateTime": "2016-04-01T05:49:00.000-05:00",
    "Disposition": "ND",
    "Address": "Ada Ct/ofarrell St",
    "City": "ND",
    "State": "1",
    "Agency": {
        "_id": 1
    },
    "AddressType": "Intersection"
}
]

print(list_result)
```

```
[{'_id': 1, 'CrimeId': 160913997, 'OriginalCrimeTypeName': 'Pay', 'CallDateTime': '2016-03
-31T23:51:00.000-05:00', 'Disposition': 'ABA', 'Address': '1600 Block Of Green St', 'Cit
y': 'ABA', 'State': '1', 'Agency': {'_id': 1}, 'AddressType': 'Premise Address'}, {'_id':
2, 'CrimeId': 160920463, 'OriginalCrimeTypeName': 'Well Being Check', 'CallDateTime': '201
6-04-01T05:49:00.000-05:00', 'Disposition': 'ND', 'Address': 'Ada Ct/ofarrell St', 'City':
'ND', 'State': '1', 'Agency': {'_id': 1}, 'AddressType': 'Intersection'}]
```

Almacenar nuevo Dataset en fuente de datos destino (MongoDB)

```
In [1]:  import pip
         pip.main(['install', 'pymongo'])
```

```
WARNING: pip is being invoked by an old script wrapper. This will fail in a future version
of pip.
Please see https://github.com/pypa/pip/issues/5599 for advice on fixing the underlying iss
ue.
To avoid this problem you can invoke Python with '-m pip' instead of running pip directly.
Collecting pymongo
  Downloading pymongo-4.0.1-cp39-cp39-macosx_10_9_universal2.whl (351 kB)
Installing collected packages: pymongo
Successfully installed pymongo-4.0.1
```

```
Out[1]: 0
```

```
In [22]:
import pymongo
from pymongo import MongoClient

#client = MongoClient('localhost', 27017)
client = pymongo.MongoClient("mongodb://localhost:27017/")
db = client['crimesdb']

print(db)

my_collect = db["crimenes"]

print(my_collect)

collist = db.list_collection_names()

print(db.list_collection_names())

if "crimenes" in collist:

    print("The collection exists.")

    results = collection.insert_many(dic_result)
    print ("Insert a many documents: inserted ids: " + str(results.inserted_ids) + ", ackn

    x = my_collect.insert_many(dic_result)
    print(x.inserted_ids)
```

```
Database(MongoClient(host=['localhost:27017'], document_class=dict, tz_aware=False, connec
t=True), 'crimesdb')
Collection(Database(MongoClient(host=['localhost:27017'], document_class=dict, tz_aware=Fa
lse, connect=True), 'crimesdb'), 'crimenes')
[]
```

```
In [30]:
# Select all values from CrimesDB
import json
myclient = pymongo.MongoClient("mongodb://localhost:27017/")
mydb = myclient["crimesdb"]
mycol = mydb["crimenes"]

print(mycol.find())

for x in mycol.find():
    print(x)
```

```
<pymongo.cursor.Cursor object at 0x7f9318176fd0>
{'_id': 1, 'CrimeId': 160913997, 'OriginalCrimeTypeName': 'Pay', 'CallDateTime': '2016-03-
31T23:51:00.000-05:00', 'Disposition': 'ABA', 'Address': '1600 Block Of Green St', 'City':
'ABA', 'State': '1', 'Agency': {'_id': 1}, 'AddressType': 'Premise Address'}
{'_id': 2, 'CrimeId': 160920463, 'OriginalCrimeTypeName': 'Well Being Check', 'CallDateTim
e': '2016-04-01T05:49:00.000-05:00', 'Disposition': 'ND', 'Address': 'Ada Ct/ofarrell St',
'City': 'ND', 'State': '1', 'Agency': {'_id': 1}, 'AddressType': 'Intersection'}
```

In [31]:

```python
import pip
pip.main(['install', 'nbconvert'])
```

```
WARNING: pip is being invoked by an old script wrapper. This will fail in a future version
of pip.
Please see https://github.com/pypa/pip/issues/5599 for advice on fixing the underlying iss
ue.
To avoid this problem you can invoke Python with '-m pip' instead of running pip directly.
Requirement already satisfied: nbconvert in /Users/juandavidescobarescobar/opt/anaconda3/l
ib/python3.9/site-packages (6.1.0)
Requirement already satisfied: jinja2>=2.4 in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from nbconvert) (2.11.3)
Requirement already satisfied: entrypoints>=0.2.2 in /Users/juandavidescobarescobar/opt/an
aconda3/lib/python3.9/site-packages (from nbconvert) (0.3)
Requirement already satisfied: jupyterlab-pygments in /Users/juandavidescobarescobar/opt/a
naconda3/lib/python3.9/site-packages (from nbconvert) (0.1.2)
Requirement already satisfied: pygments>=2.4.1 in /Users/juandavidescobarescobar/opt/anaco
nda3/lib/python3.9/site-packages (from nbconvert) (2.10.0)
Requirement already satisfied: nbformat>=4.4 in /Users/juandavidescobarescobar/opt/anacond
a3/lib/python3.9/site-packages (from nbconvert) (5.1.3)
Requirement already satisfied: bleach in /Users/juandavidescobarescobar/opt/anaconda3/lib/
python3.9/site-packages (from nbconvert) (4.0.0)
Requirement already satisfied: defusedxml in /Users/juandavidescobarescobar/opt/anaconda3/
lib/python3.9/site-packages (from nbconvert) (0.7.1)
Requirement already satisfied: traitlets>=5.0 in /Users/juandavidescobarescobar/opt/anacon
da3/lib/python3.9/site-packages (from nbconvert) (5.1.0)
Requirement already satisfied: testpath in /Users/juandavidescobarescobar/opt/anaconda3/li
b/python3.9/site-packages (from nbconvert) (0.5.0)
Requirement already satisfied: pandocfilters>=1.4.1 in /Users/juandavidescobarescobar/opt/
anaconda3/lib/python3.9/site-packages (from nbconvert) (1.4.3)
Requirement already satisfied: jupyter-core in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from nbconvert) (4.8.1)
Requirement already satisfied: nbclient<0.6.0,>=0.5.0 in /Users/juandavidescobarescobar/op
t/anaconda3/lib/python3.9/site-packages (from nbconvert) (0.5.3)
Requirement already satisfied: mistune<2,>=0.8.1 in /Users/juandavidescobarescobar/opt/ana
conda3/lib/python3.9/site-packages (from nbconvert) (0.8.4)
Requirement already satisfied: MarkupSafe>=0.23 in /Users/juandavidescobarescobar/opt/anac
onda3/lib/python3.9/site-packages (from jinja2>=2.4->nbconvert) (1.1.1)
Requirement already satisfied: nest-asyncio in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from nbclient<0.6.0,>=0.5.0->nbconvert) (1.5.1)
Requirement already satisfied: jupyter-client>=6.1.5 in /Users/juandavidescobarescobar/op
t/anaconda3/lib/python3.9/site-packages (from nbclient<0.6.0,>=0.5.0->nbconvert) (6.1.12)
Requirement already satisfied: async-generator in /Users/juandavidescobarescobar/opt/anaco
nda3/lib/python3.9/site-packages (from nbclient<0.6.0,>=0.5.0->nbconvert) (1.10)
Requirement already satisfied: python-dateutil>=2.1 in /Users/juandavidescobarescobar/opt/
anaconda3/lib/python3.9/site-packages (from jupyter-client>=6.1.5->nbclient<0.6.0,>=0.5.0-
>nbconvert) (2.8.2)
Requirement already satisfied: pyzmq>=13 in /Users/juandavidescobarescobar/opt/anaconda3/l
ib/python3.9/site-packages (from jupyter-client>=6.1.5->nbclient<0.6.0,>=0.5.0->nbconvert)
(22.2.1)
Requirement already satisfied: tornado>=4.1 in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from jupyter-client>=6.1.5->nbclient<0.6.0,>=0.5.0->nbconve
rt) (6.1)
Requirement already satisfied: ipython-genutils in /Users/juandavidescobarescobar/opt/anac
onda3/lib/python3.9/site-packages (from nbformat>=4.4->nbconvert) (0.2.0)
Requirement already satisfied: jsonschema!=2.5.0,>=2.4 in /Users/juandavidescobarescobar/o
pt/anaconda3/lib/python3.9/site-packages (from nbformat>=4.4->nbconvert) (3.2.0)
Requirement already satisfied: six>=1.11.0 in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconvert) (1.
16.0)
Requirement already satisfied: attrs>=17.4.0 in /Users/juandavidescobarescobar/opt/anacond
a3/lib/python3.9/site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconvert) (2
1.2.0)
Requirement already satisfied: setuptools in /Users/juandavidescobarescobar/opt/anaconda3/
lib/python3.9/site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconvert) (58.
0.4)
Requirement already satisfied: pyrsistent>=0.14.0 in /Users/juandavidescobarescobar/opt/an
aconda3/lib/python3.9/site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconver
t) (0.18.0)
Requirement already satisfied: packaging in /Users/juandavidescobarescobar/opt/anaconda3/l
ib/python3.9/site-packages (from bleach->nbconvert) (21.0)
Requirement already satisfied: webencodings in /Users/juandavidescobarescobar/opt/anaconda
3/lib/python3.9/site-packages (from bleach->nbconvert) (0.5.1)
Requirement already satisfied: pyparsing>=2.0.2 in /Users/juandavidescobarescobar/opt/anac
onda3/lib/python3.9/site-packages (from packaging->bleach->nbconvert) (3.0.4)
```

Out[31]:
```
0
```

In [34]:
```
%%bash
jupyter nbconvert --to webpdf --allow-chromium-download "Limpieza Datos Dataset - CSV.ipyn
```

```
[NbConvertApp] Converting notebook Limpieza Datos Dataset - CSV.ipynb to webpdf
[NbConvertApp] Building PDF
[NbConvertApp] PDF successfully created
[NbConvertApp] Writing 623951 bytes to Limpieza Datos Dataset - CSV.pdf
```

In [ ]:
```
sc.stop()
```

4. Limpieza Específica

In [ ]:
```
# '''
# # 3. Filas leidas

# df.count()
# # 10051
```

In [ ]:
```
# '''
# # 4. Columnas leidas

# len(df.columns)
# # 12
```

In [ ]:
```
# '''
# # 5. Limpieza general - Datos perdidos N/A or None (Elimina las filas duplicadas - por t

# #df.dropna()
# display(HTML("<style>pre { white-space: pre !important; }</style>"))
# df.dropna(how='all').show()
# df.count()
```

In [ ]:
```
# '''
# # 6. Limpieza general - Borrar columnas con None / NAN

# df = df.toPandas().dropna(axis=1, how='all')
# len(df.columns)
```

In [ ]:
```
# '''
# # 7. Limpieza general - Elimina las filas duplicadas - por todos los campos
# df = df.drop_duplicates()
# df.count()
```

In [ ]:

```
# '''
# # 8. Limpieza general - Elimina las filas duplicadas - por "CrimeId"

# df_pk = 'CrimeId'
# result_duplicates = get_duplicates(df, df_pk)

# if result_duplicates['is_error']:
#     df.drop_duplicates(subset = [df_pk])
#     print('Identificadores duplicados: {0}'.format(result_duplicates['is_error']))
```

In [ ]:

```
# '''
# # 1. Ajustar esquema de acuerdo a la naturaleza de los datos analizados en el Datset
# #StructField("Range", StringType(), True),   \ # col eliminada


# schema = StructType([ \
#     StructField("CrimeId",IntegerType(),False), \
#     StructField("OriginalCrimeTypeName",StringType(),True), \
#     StructField("OffenseDate",TimestampType(),True), \
#     StructField("CallTime", StringType(), True), \
#     StructField("CallDateTime", TimestampType(), True), \
#     StructField("Disposition", StringType(), True), \
#     StructField("Address", StringType(), True), \
#     StructField("City", StringType(), True), \
#     StructField("State", StringType(), True), \
#     StructField("AgencyId", IntegerType(), True), \
#     StructField("AddressType", StringType(), True)   \
#   ])

# data = df.values.tolist()
# df = spark.createDataFrame(data = data)


# df_new = spark.createDataFrame(data = df.rdd, schema = schema)
# df_new.printSchema()
# df_new.show()
```

In [ ]:

```
# '''
# display(df_new)
```

In [ ]:

```
# '''
# # 1. Validar el porcentaje de correlación de los datos

# # df2.stat.corr('CrimeId', 'CallTime')
```

In [ ]:

```
# '''
# # 2. Validar la variable media y desviacion estandar para los tipos de datos númericos
```

In [ ]:

```
# '''
# df_pd = df_pd.fillna(df_pd.mean())

# df_pd.info()
# df_pd['Range']
```

In [ ]:

```
# '''
# #display(HTML("<style>pre { white-space: pre !important; }</style>"))
# #df.show()
# df.limit(20).toPandas().head()
# df.printSchema()

# #len(df.columns)
# df.limit(20).toPandas().head()
# '''
```

In [ ]:

```
# '''
# |-- CrimeId: integer (nullable = true)
# |-- OriginalCrimeTypeName: string (nullable = true)
# |-- OffenseDate: timestamp (nullable = true)  YYYY-MM-DD T HH:MM:SS
# |-- CallTime: string (nullable = true) HH:MM
# |-- CallDateTime: timestamp (nullable = true) YYYY-MM-DD T HH:MM:SS
# |-- Disposition: string (nullable = true) 3 charascter MAX EX: REP
# |-- Address: string (nullable = true)
# |-- City: string (nullable = true)
# |-- State: string (nullable = true) CA 2 CHARACTERS
# |-- AgencyId: string (nullable = true) INT (OJO ERROR)
# |-- Range: string (nullable = true) INT?? OJO SIN DATOS
# |-- AddressType: string (nullable = true) String
# '''
```

In [ ]:

```
# '''
# df2.describe('CrimeId', 'OriginalCrimeTypeName').show()
# df2.describe('OffenseDate', 'CallTime').show()
# '''
```

In [ ]:

```
# '''
# # Almacenar la informacion del DF en una tabla temporal para poder manipularlo mediante

# temp_table_csv_name = 'crimes'

# df.createOrReplaceTempView(temp_table_csv_name)
# df2 = spark.sql('SELECT * FROM ' + temp_table_csv_name)
# df2.limit(20).toPandas().head()
# df2.cache()
# '''
```

In [ ]:

```
# '''
# Describe de los valores enteros, para validar los numeros:
# MAX, MIN, COUNT, MEAN (PROMEDIO) Y LA
# DESVIACION ESTANDAR

# X   |X - (~X)          | (X - (~X))^2

# 5   |5 - 15,6 = -10,6 | (-10,6)^2 = 112,36
# 15  |-0,6              | 0,36
# 12  |-3,6              | 12,96
# 18  |2,4               | 5,76
# 28  |12,4              | 153,76
#                          (285,2)

# ~X = 5 +15 + 12 +18 + 28 / 5 = 15,6
# s = raiz(sum( (X - (~X))^2 ) / N-1)
# s = raiz(285,1 / (5-1)) = 8,44


# La desviacion estandar me indica la variacion que existe en los datos de la muestra,
# es decir que tan diferentes o parecidos son.




# import matplotlib.pyplot as plt
# import numpy as np

# x = np.array([5, 15, 12, 18, 28])
# y = np.power(x, 2) # Effectively y = x**2

# plt.errorbar(x, y, linestyle='None', marker='x')

# plt.show()

# '''
```

In [ ]:

```
# '''
# ---------------------------------------------------------------------------------------
# 0. Contar filas
# 0. Contar columnas
# ---------------------------------------------------------------------------------------
# Limpieza de datos:

# 1. Datos perdidos N/A or None

# Encontrar Nulos
# df.isnull()

# Filtrar datos perdidos
# from numpy import nan as NA
# df.dropna()

# Borrar filas que todos los registros sean None / NA
# df.dropna(how='all')

# Borrar columnas con None / NA
# df.dropna(axis=1, how='all')

# Borrar ciertos NA, es decir solo lo que le indiquemos
# df.dropna(thresh=2)

# Rellenar datos con un valor predeterminado
# df.fillna(0)

# Rellenar datos con un valor de un key de un dic
# para la col 1 y 2
# df.fillna({1:0.5, 2:5})

# df.fillna(method='ffill') #fordward fill, rellena con el ultimo valor que no era NA
# df.fillna(method='ffill', limit=1) #lo mismo pero solo para un NAN

# df.fillna(data.mean()) #rellena con un promedio de los valores de la fila y no con 0

# ---------------------------------------------------------------------------------------
# 2. Datos duplicados

# Nos dice las filas que estan duplicadas
# df.duplicated()

# Elimina las filas duplicadas

# df.drop_duplicates()


# 3. Manipulación de strings
# 4. Transformación de datos

# '''
```

In [ ]:

```
# '''
# df_disposition_count = df.groupby('Disposition').count()
# df_disposition_media = df_disposition_count.withColumn('count_media', f.expr("approx_per

# df_grp_mean = df_disposition_count.groupBy('Disposition')\
#                                     .agg(f.mean(df_disposition_count['count'])\
#                                     .alias('mean_val'))
# df_grp_mean.show()
# '''
```

In [ ]:

```
# '''
# # Remplazar valores no grabados por el valor equivalente a la media
# df = df.withColumn("Disposition",
#       f.when(df[update_col] == "Not recorded", "")
#        .otherwise(df["Disposition"]))
# '''
```

In [10]:

```
# from pymongo import MongoClient

# if __name__ == '__main__':
#     client = MongoClient("mongodb://localhost:27017/")

#     with client.start_session(causal_consistency = True) as my_session:
#         with my_session.start_transaction():

#             db = client.mydb
#             collection = db.mycollection

#             print(db)

#             # GET THE COUNT OF DOCUMENTS
#             count = collection.count_documents({"firstname": "John"})
#             print ("count of documents: " + str(count))

#             # ITERATE A QUERY
#             for result in collection.find({"firstname": "John"}):
#                 print ("Iterate a query: " + str(result))

#             # INSERT A SINGLE DOCUMENT
#             results = collection.insert_one({"firstname": "John"}, session = my_session,
#             print ("Insert a single document: inserted id: " + str(results.inserted_id)

#             # INSERT MANY DOCUMENTS (INCLUDE A FIELD CALLED 'number' WITH A RANGE FROM (
#             results = collection.insert_many([{"firstname": "John", "number": i} for i i
#             print ("Insert a many documents: inserted ids: " + str(results.inserted_ids,

#             # UPDATE ONE (TACK ON ANOTHER FIELD CALLED 'lastname')
#             results = collection.update_one({"number": 1}, {"$set": {"lastname": "Doe"},
#             print ("Update one: acknowledged: " + str(results.acknowledged) + ", matchec
#              # UPSERT ONE (THIS WILL CREATE A DOCUMENT WITH FIELD CALLED 'number' WITH A
#              results = collection.update_one({"number": 23}, {"$set": {"firstname": "John
#              print ("Upsert one: acknowledged: " + str(results.acknowledged) + ", matched

#              # UPDATE MANY
#              results = collection.update_many({"firstname": "John"}, {"$set": {"city": "I
#              print ("Update many: acknowledged: " + str(results.acknowledged) + ", matche

#              # UPSERT MANY (THIS WILL ONLY INSERT ONE RECORD IF FILTER NOT FOUND, BUT COU
#              results = collection.update_many({"firstname": "John", "middlename": "Jacob"
#              print ("Upsert many: acknowledged: " + str(results.acknowledged) + ", matche

#              # DELETE MANY
#              results = collection.delete_many({"firstname": "John"}, session = my_sessio
```

```
Database(MongoClient(host=['localhost:27017'], document_class=dict, tz_aware=False, connec
t=True), 'mydb')
```