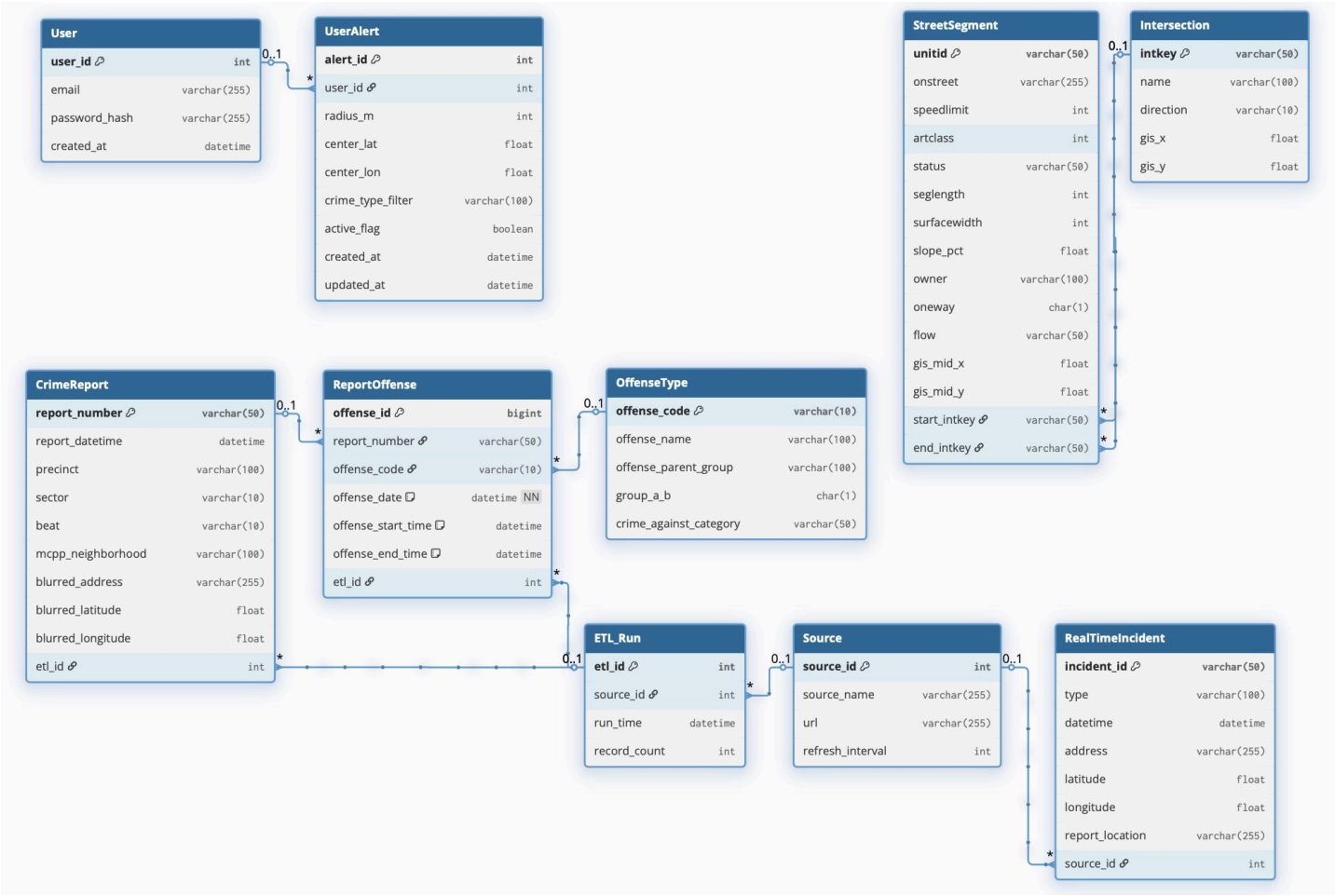
UML

> At least 10 classes must be defined.

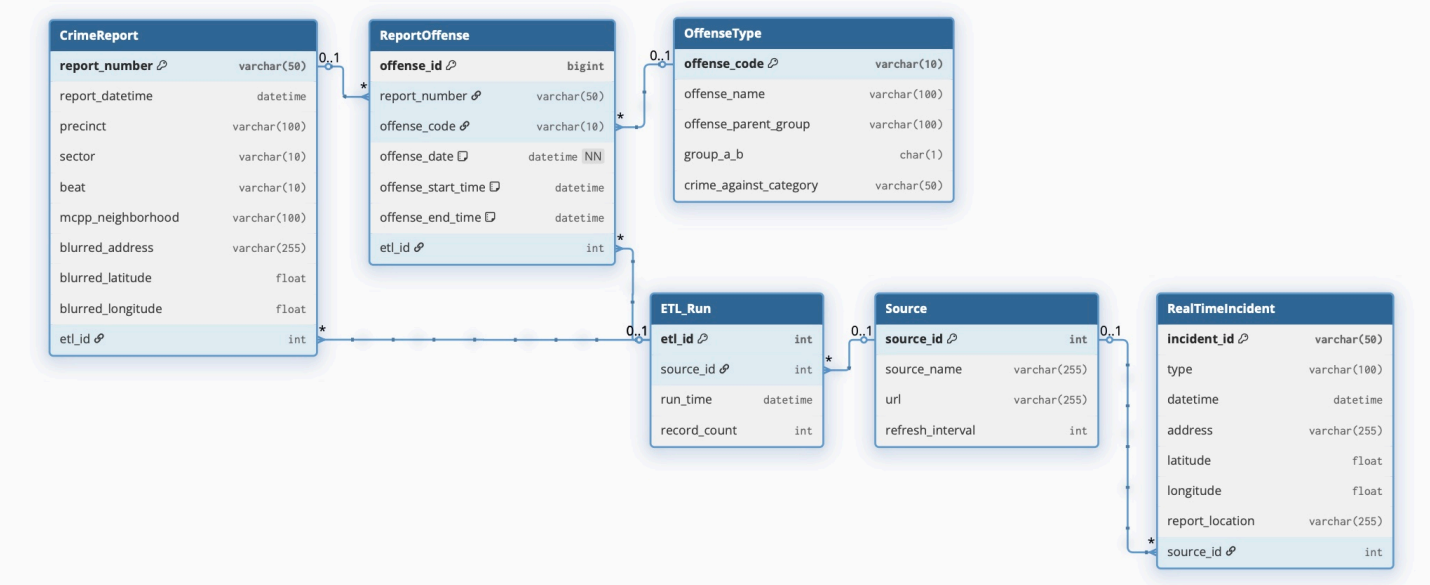


UML is divided into three main parts:

- CrimeReport / OffenseType / ReportOffense + ETL / Source
- StreetSegment / Intersection
- User / UserAlert

These three modules together form a data-driven urban safety system (Urban Safety Intelligence System), which supports historical analysis, real-time monitoring, spatial visualization and user-personalized early warning.

Crime Information



ETL / Source's goal is to explain how does the system manage this data.

Table Name	Meaning
ETL_Run	Record "when and how many data is imported into the system"
Source	Record where the data comes from

> **Why should ETL_Run and Source be separated?**
>
> ETL_Run and Source are both metadata, but they are designed separately for the separation of concerns in data modeling.
>
> - Source representes the static definition of the data (the identity of the data source itself).
> - ETL_Run represented the dynamic loading records of data (execution status of each import).
>
> The configuration file (Source) is static, and the log (ETL_Run) is dynamic. Each source (such as SPD Crime Data) may be imported hundreds of times.
>
> Therefore, Source records "who it is" and ETL_Run records "how long it ran and how much it ran." Separating them avoids data redundancy and supports detailed data lineage tracking.

CrimeReport / OffenseType / ReportOffense's goal is to convert the raw SPD crime data (1M rows of CSV) into a reusable, queryable, and extensible standard structure.

- A CrimeReport may contain multiple ReportOffenses and each ReportOffense belongs to a certain OffenseType.
- Split SPD crime data into three clean tables, each responsible for:

Table Name	Meaning
CrimeReport	Basic metadata of a case report.
OffenseType	A standard dictionary of all crime types
ReportOffense	The specific crime that occurred in each report
RealTimeIncident	Basic metadata of a real-time police calls

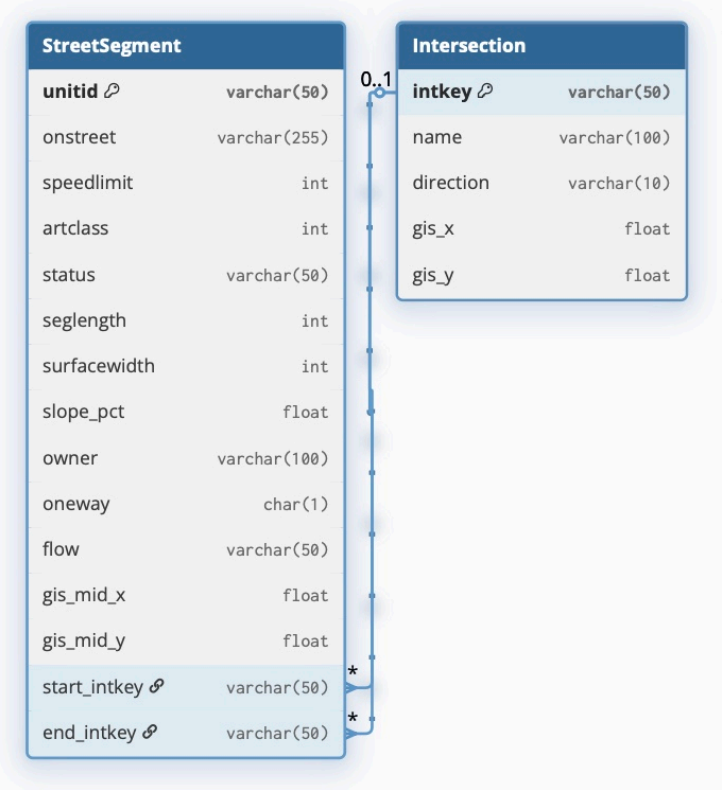
A unified mapping layer will be designed to semantically align categories between historical and real-time data. Specificly, we have 2 crime-related data sources (SPD Crime Data + 911 Calls).

- SPD Crime Data is official police report (confirmed crime). It is historical, structured and established crime data.
- Seattle 911 Calls is real-time police calls (may become a case or may be a false alarm). It is real-time, streaming potential crime data.

So we will storing them in two modules in parallel to allows the system to view both historical cases (CrimeReport) and real-time calls (RealTimeIncident).

> Each imported record in CrimeReport and ReportOffense includes a foreign key etl_id to trace its ETL batch. RealTimeIncident also links to its ETL_Run for 911 calls, enabling refresh monitoring for live data ingestion.

Geographic Information

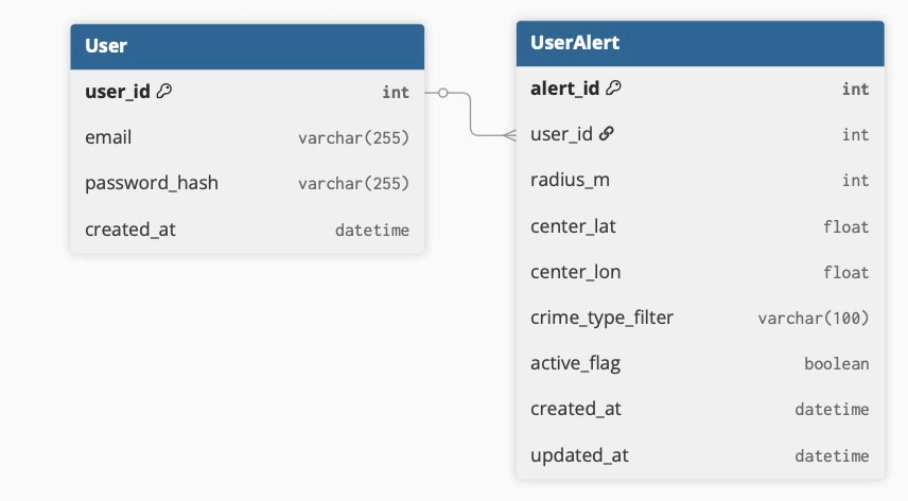


This part is to build a geospatial infrastructure to enable the system to put crime data, real-time events, user alerts, and more on a map. It is not "business data" but the "spatial layer" of the system, providing support for all subsequent spatial calculations.

Table Name	Meaning
StreetSegment	Road segments (street skeletons)
Intersection	Road intersection (spatial node)

- Each StreetSegment record represents a continuous road segment, typically imported from a city GIS (GeoJSON). Crime data analysis utilizes spatial joins to perform segment-by-segment crime frequency statistics and identify high-risk roads.
- Each Intersection record represents a street junction; in GIS, these are network nodes, useful for analyzing intersection density and accident-prone areas.

User Information



This part is to store application users and their security preferences, supporting personalized alerts and geo-filtering. It is combined with crime data and geographic data to form a complete closed loop of "user -> alert -> space".

Table Name	Meaning
User	Application user information
UserAlert	User Security Alert Settings

- User only stores basic login information; passwords must be hashed (not plaintext); this is typically used in conjunction with security modules (JWT/Auth).
- Each UserAlert is equivalent to a "virtual geofence." The system periodically checks: Has a qualifying crime incident fallen within this radius in the past 24 hours? This geo-query triggers a push notification (email/app notification) using CrimeReport.

SQL Operations

> Also include DROP TABLE IF EXISTS statements at the top so the relational model can be easily recreated.

Create tables

> CREATE TABLE statements for all tables. Ensure the CREATE TABLE statements are in an order that respect referential integrity.

```sql
-- ////////////////////////////////////////////////////
-- Global Settings
-- ////////////////////////////////////////////////////
CREATE DATABASE IF NOT EXISTS safepath;

ALTER DATABASE safepath
  CHARACTER SET = utf8mb4
  COLLATE = utf8mb4_unicode_ci;

USE safepath;  # Select the current database

SET NAMES utf8mb4;
SET CHARACTER SET utf8mb4;
SET COLLATION_CONNECTION = 'utf8mb4_unicode_ci';
SET default_storage_engine=INNODB;


-- ////////////////////////////////////////////////////
-- Delete from the table with the strongest foreign key dependency first
-- ////////////////////////////////////////////////////
DROP TABLE IF EXISTS user_alerts;
DROP TABLE IF EXISTS users;
DROP TABLE IF EXISTS street_segments;
DROP TABLE IF EXISTS intersections;
DROP TABLE IF EXISTS realtime_incidents;
DROP TABLE IF EXISTS report_offenses;
DROP TABLE IF EXISTS offense_types;
DROP TABLE IF EXISTS crime_reports;
DROP TABLE IF EXISTS etl_runs;
DROP TABLE IF EXISTS sources;

-- ////////////////////////////////////////////////////
-- App Internal Data
-- ////////////////////////////////////////////////////
CREATE TABLE sources (
    source_id INT AUTO_INCREMENT PRIMARY KEY,
    source_name VARCHAR(255) NOT NULL,
    url VARCHAR(255),
    refresh_interval INT,
    created_at DATETIME DEFAULT CURRENT_TIMESTAMP
);

CREATE TABLE etl_runs (
    etl_id INT AUTO_INCREMENT PRIMARY KEY,
    source_id INT NOT NULL,
    run_time DATETIME NOT NULL,
    record_count INT,
    created_at DATETIME DEFAULT CURRENT_TIMESTAMP,
    FOREIGN KEY (source_id) REFERENCES sources(source_id)
```

```
        ON UPDATE CASCADE ON DELETE CASCADE
);

-- ////////////////////////////////////////////////////
-- SPD Crime Data
-- ////////////////////////////////////////////////////
CREATE TABLE crime_reports (
    report_number VARCHAR(50) PRIMARY KEY,
    report_datetime DATETIME,
    precinct VARCHAR(100),
    sector VARCHAR(10),
    beat VARCHAR(10),
    mcpp_neighborhood VARCHAR(100),
    blurred_address VARCHAR(255),
    blurred_latitude DOUBLE,
    blurred_longitude DOUBLE,
    etl_id INT,
    FOREIGN KEY (etl_id) REFERENCES etl_runs(etl_id)
        ON UPDATE CASCADE ON DELETE SET NULL
);

CREATE TABLE offense_types (
    offense_code VARCHAR(10) PRIMARY KEY,
    offense_name VARCHAR(100) NOT NULL,
    offense_parent_group VARCHAR(100),
    group_a_b CHAR(1),
    crime_against_category VARCHAR(50)
);

CREATE TABLE report_offenses (
    offense_id BIGINT AUTO_INCREMENT PRIMARY KEY,
    report_number VARCHAR(50) NOT NULL,
    offense_code VARCHAR(10) NOT NULL,
    offense_date DATETIME NOT NULL COMMENT 'Primary offense date from SPD data',
    offense_start_time DATETIME NULL,
    offense_end_time DATETIME NULL,
    etl_id INT,
    FOREIGN KEY (report_number) REFERENCES crime_reports(report_number)
        ON UPDATE CASCADE ON DELETE CASCADE,
    FOREIGN KEY (offense_code) REFERENCES offense_types(offense_code)
        ON UPDATE CASCADE ON DELETE RESTRICT,
    FOREIGN KEY (etl_id) REFERENCES etl_runs(etl_id)
        ON UPDATE CASCADE ON DELETE SET NULL,
    INDEX idx_report_number (report_number),
    INDEX idx_offense_code (offense_code)
);

-- ////////////////////////////////////////////////////
-- Real-Time Data
    ////////////////////////////////////////////////////
```

```sql
-- ////////////////////////////////////////////////////
CREATE TABLE realtime_incidents (
    incident_id VARCHAR(50) PRIMARY KEY,
    incident_type VARCHAR(100),
    event_datetime DATETIME,
    address VARCHAR(255),
    latitude DOUBLE,
    longitude DOUBLE,
    report_location VARCHAR(255),
    source_id INT,
    FOREIGN KEY (source_id) REFERENCES sources(source_id)
        ON UPDATE CASCADE ON DELETE SET NULL
);

-- ////////////////////////////////////////////////////
-- GIS Streets Data
-- ////////////////////////////////////////////////////
CREATE TABLE intersections (
    intkey VARCHAR(50) PRIMARY KEY,
    name VARCHAR(100),
    direction VARCHAR(10),
    gis_x DOUBLE,
    gis_y DOUBLE
);

CREATE TABLE street_segments (
    unitid VARCHAR(50) PRIMARY KEY,
    onstreet VARCHAR(255),
    speedlimit INT,
    artclass INT,
    status VARCHAR(50),
    seglength INT,
    surfacewidth INT,
    slope_pct DOUBLE,
    owner VARCHAR(100),
    oneway CHAR(1),
    flow VARCHAR(50),
    gis_mid_x DOUBLE,
    gis_mid_y DOUBLE,
    start_intkey VARCHAR(50),
    end_intkey VARCHAR(50),
    FOREIGN KEY (start_intkey) REFERENCES intersections(intkey)
        ON UPDATE CASCADE ON DELETE SET NULL,
    FOREIGN KEY (end_intkey) REFERENCES intersections(intkey)
        ON UPDATE CASCADE ON DELETE SET NULL
);

-- ////////////////////////////////////////////////////
-- App Users & Alerts
-- ////////////////////////////////////////////////////
```

```sql
-- ////////////////////////////////////////////////////
CREATE TABLE users (
    user_id INT AUTO_INCREMENT PRIMARY KEY,
    email VARCHAR(255) NOT NULL UNIQUE,
    password_hash VARCHAR(255) NOT NULL,
    created_at DATETIME DEFAULT CURRENT_TIMESTAMP
);

CREATE TABLE user_alerts (
    alert_id INT AUTO_INCREMENT PRIMARY KEY,
    user_id INT NOT NULL,
    radius_m INT,
    center_lat DOUBLE,
    center_lon DOUBLE,
    crime_type_filter VARCHAR(100),
    active_flag BOOLEAN DEFAULT TRUE,
    created_at DATETIME DEFAULT CURRENT_TIMESTAMP,
    updated_at DATETIME DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
    FOREIGN KEY (user_id) REFERENCES users(user_id)
        ON UPDATE CASCADE ON DELETE CASCADE
);
```

Data preprocessing & Insert

> Row counts for each table. You can submit a screenshot of the row counts in MySQL Workbench. At least 100K rows must be loaded (in aggregate).

The three data sources (SPD Crime Data, Seattle Street Data, and Real-time 911 Calls) do not correspond one-to-one to the logical table structure in UML. So next step is to transform real-world data fields into database logical model fields.

SPD Crime Data

Clean and transform the SPD Crime Data and import it into three tables:

- `offense_types`
- `crime_reports`
- `report_offenses`

And write the associated `etl_id` and `source_id` correctly.

```python
import pandas as pd
import mysql.connector
from datetime import datetime
import time

# ============================
# MySQL connection configuration
# ============================
conn = mysql.connector.connect(
    host="localhost", user="root", password="zcc663280", database="safepath"
)
cursor = conn.cursor()

# ========================
# Initialize Source
# ========================
source_name = "SPD Crime Data"
source_url = "https://data.seattle.gov/Public-Safety/SPD-Crime-Data-2008-Present"
refresh_interval = 1440

cursor.execute("SELECT source_id FROM sources WHERE source_name=%s", (source_name,))
row = cursor.fetchone()
if row:
    source_id = row[0]
else:
    cursor.execute(
        "INSERT INTO sources (source_name, url, refresh_interval) VALUES (%s, %s, %s)",
        (source_name, source_url, refresh_interval),
    )
    conn.commit()
    source_id = cursor.lastrowid
print(f"Source ID = {source_id}")

# ========================
# Create ETL_Run
# ========================
cursor.execute(
    "INSERT INTO etl_runs (source_id, run_time, record_count) VALUES (%s, %s, 0)",
    (source_id, datetime.now()),
)
conn.commit()
etl_id = cursor.lastrowid
print(f"ETL Run ID = {etl_id}")

# ============================
# Reading CSV
# ============================
print("Loading CSV...")

df = pd.read_csv("./data/spd_crime_data.csv")
```

```
df = pd.read_csv("./data/spd_crime_data.csv")

# ============================
# Clean fields & rename
# ============================
df = df.rename(
    columns={
        "Report Number": "report_number",
        "Report DateTime": "report_datetime",
        "Offense ID": "offense_id",
        "Offense Date": "offense_date",
        "NIBRS Group AB": "group_a_b",
        "NIBRS Crime Against Category": "crime_against_category",
        "Offense Sub Category": "offense_sub_category",
        "Offense Category": "offense_parent_group",
        "NIBRS Offense Code Description": "offense_name",
        "NIBRS_offense_code": "offense_code",
        "Block Address": "blurred_address",
        "Latitude": "blurred_latitude",
        "Longitude": "blurred_longitude",
        "Precinct": "precinct",
        "Sector": "sector",
        "Beat": "beat",
        "Neighborhood": "mcpp_neighborhood",
    }
)

# Convert date format
df["report_datetime"] = pd.to_datetime(
    df["report_datetime"], format="%Y %b %d %I:%M:%S %p", errors="coerce"
)

df["offense_date"] = pd.to_datetime(
    df["offense_date"], format="%Y %b %d %I:%M:%S %p", errors="coerce"
)

# Convert all NaNs to None, letting the database insert NULL
df = df.where(pd.notnull(df), None)

# Add etl_id
df["etl_id"] = etl_id

# ============================
# To regenerate offense_types
# ============================
print("Inserting offense_types...")
offense_types = df[
    [
        "offense_code",
        "offense_name"
```

```
        "offense_name",
        "offense_parent_group",
        "group_a_b",
        "crime_against_category",
    ]
].drop_duplicates()

offense_data = [tuple(row) for row in offense_types.to_numpy()]

# Batch insert offense_types
cursor.executemany(
    """
    INSERT IGNORE INTO offense_types
    (offense_code, offense_name, offense_parent_group, group_a_b, crime_against_category)
    VALUES (%s, %s, %s, %s, %s)
    """,
    offense_data,
)
conn.commit()
print(f"Inserted {len(offense_data)} offense types.")

# ============================
# INSERT INTO crime_reports
# ============================
print("Inserting crime_reports...")
crime_reports = df[
    [
        "report_number",
        "report_datetime",
        "precinct",
        "sector",
        "beat",
        "mcpp_neighborhood",
        "blurred_address",
        "blurred_latitude",
        "blurred_longitude",
        "etl_id",
    ]
].dropna(subset=["report_number"])  # Remove report_number that is empty

crime_data = [tuple(row) for row in crime_reports.to_numpy()]

batch_size = 1000
for i in range(0, len(crime_data), batch_size):
    batch = crime_data[i : i + batch_size]
    cursor.executemany(
        """
        INSERT IGNORE INTO crime_reports
        (report_number, report_datetime, precinct, sector, beat,
         mcpp_neighborhood, blurred_address, blurred_latitude,
```

```
         mapp_neighborhood, blurred_address, blurred_latitude,
         blurred_longitude, etl_id)
        VALUES (%s,%s,%s,%s,%s,%s,%s,%s,%s,%s)
        """,
        batch,
    )
    conn.commit()
    if i % 10000 == 0:
        print(f"   Progress: {i + len(batch)} / {len(crime_data)} rows")

print(f"Inserted {len(crime_data)} crime reports.")

# ============================
# INSERT INTO report_offenses
# ============================
print("Inserting report_offenses...")

valid_reports = set(crime_reports["report_number"].unique())

report_offenses = df[
    ["report_number", "offense_code", "offense_date", "etl_id"]
].dropna(subset=["report_number"])

report_offenses = report_offenses[report_offenses["report_number"].isin(valid_reports)]

report_data = [tuple(row) for row in report_offenses.to_numpy()]

for i in range(0, len(report_data), batch_size):
    batch = report_data[i : i + batch_size]
    cursor.executemany(
        """
        INSERT INTO report_offenses
        (report_number, offense_code, offense_date, etl_id)
        VALUES (%s, %s, %s, %s)
        """,
        batch,
    )
    conn.commit()
    if i % 10000 == 0:
        print(f"   Progress: {i + len(batch)} / {len(report_data)} rows")

print(f"Inserted {len(report_data)} report offenses.")

# ============================
# Update etl_runs record count
# ============================
cursor.execute(
    """
    UPDATE etl_runs
    SET record_count = %s
```

```
    WHERE etl_id = %s
""",
    (len(df), etl_id),
)
conn.commit()

cursor.close()
conn.close()

print(f"ETL completed for SPD Crime Data — {len(df)} records processed.")
```

```
(base) chichizhang@Chis-MacBook-Air project % /opt/anaconda3/bin/python
"/Users/chichizhang/Desktop/NEU class notes/1.cs5200/project/etl_spd_crime.py"
Source ID = 1
ETL Run ID = 1
Loading CSV...
Inserting offense_types...
Inserted 65 offense types.
Inserting crime_reports...
  (ignore the process log)
Inserted 1486484 crime reports.
Inserting report_offenses...
  (ignore the process log)
Inserted 1486484 report offenses.
ETL completed for SPD Crime Data — 1486484 records processed.
```

Real time 911 calls

Clean and transform the Seattle Fire Real-Time 911 Data and import it into `realtime_incidents` table. And write the associated `etl_id` and `source_id` correctly.

```
import pandas as pd
import mysql.connector
from datetime import datetime
import time

start_time = time.time()

# ========================
# Connecting to MySQL
# ========================
conn = mysql.connector.connect(
    host="localhost", user="root", password="zcc663280", database="safepath"
)

cursor = conn.cursor()
```

```
# ========================
# Initialize Source
# ========================
source_name = "Seattle Fire Real-Time 911"
source_url = "https://data.seattle.gov/resource/kzjm-xkqj.csv"
refresh_interval = 5

cursor.execute("SELECT source_id FROM sources WHERE source_name=%s", (source_name,))
row = cursor.fetchone()
if row:
    source_id = row[0]
else:
    cursor.execute(
        "INSERT INTO sources (source_name, url, refresh_interval) VALUES (%s, %s, %s)",
        (source_name, source_url, refresh_interval),
    )
    conn.commit()
    source_id = cursor.lastrowid
print(f"Source ID = {source_id}")

# ========================
# Create ETL_Run
# ========================
cursor.execute(
    "INSERT INTO etl_runs (source_id, run_time, record_count) VALUES (%s, %s, 0)",
    (source_id, datetime.now()),
)
conn.commit()
etl_id = cursor.lastrowid
print(f"ETL Run ID = {etl_id}")

# ========================
# Reading Data
# ========================
print("Loading CSV...")

df = pd.read_csv("./data/seattle_realtime_911.csv", sep=",", quotechar='"')

df.columns = df.columns.str.strip()
print("Columns:", list(df.columns))

rename_map = {
    "Incident Number": "incident_id",
    "IncidentNumber": "incident_id",
    "Type": "incident_type",
    "Datetime": "event_datetime",
    "DateTime": "event_datetime",
    "Address": "address",
```

```
    "Latitude": "latitude",
    "Longitude": "longitude",
    "Report Location": "report_location",
    "ReportLocation": "report_location",
}
df = df.rename(columns=rename_map)

# =======================
# Cleaning Field
# =======================
if "event_datetime" not in df.columns:
    raise ValueError(
        f"The event_datetime column does not exist, the current column name is:
{list(df.columns)}"
    )

df["event_datetime"] = pd.to_datetime(
    df["event_datetime"], format="%Y %b %d %I:%M:%S %p", errors="coerce"
)
df["latitude"] = pd.to_numeric(df["latitude"], errors="coerce")
df["longitude"] = pd.to_numeric(df["longitude"], errors="coerce")

df = df.dropna(subset=["incident_id", "latitude", "longitude"])
df = df.where(pd.notnull(df), None)

print(f"{len(df)} valid rows loaded.")

# =======================
# INSERT INTO realtime_incidents
# =======================
print("Inserting realtime_incidents...")

records = [
    (
        row["incident_id"],
        row["incident_type"],
        row["event_datetime"],
        row["address"],
        row["latitude"],
        row["longitude"],
        row["report_location"],
        source_id,
    )
    for _, row in df.iterrows()
]

batch_size = 1000
for i in range(0, len(records), batch_size):
    batch = records[i : i + batch_size]
```

```
    cursor.executemany(
        """
        INSERT IGNORE INTO realtime_incidents
        (incident_id, incident_type, event_datetime, address,
         latitude, longitude, report_location, source_id)
        VALUES (%s, %s, %s, %s, %s, %s, %s, %s)
        """,
        batch,
    )
    conn.commit()

    if i % 10000 == 0:
        print(f"   Progress: {i + len(batch)} / {len(records)} rows inserted")

print(f"Inserted {len(df)} realtime incidents.")

# ========================
# Update ETL_Run Record
# ========================
cursor.execute(
    "UPDATE etl_runs SET record_count = %s WHERE etl_id = %s", (len(df), etl_id)
)
conn.commit()

# ========================
# End
# ========================
cursor.close()
conn.close()

print(f"ETL completed in {time.time() - start_time:.2f}s.")
```

```
(base) chichizhang@Chis-MacBook-Air project % /opt/anaconda3/bin/python
"/Users/chichizhang/Desktop/NEU class notes/1.cs5200/project/etl_realtime.py"
Source ID = 2
ETL Run ID = 2
Loading CSV...
Columns: ['Address', 'Type', 'Datetime', 'Latitude', 'Longitude', 'Report Location',
'Incident Number']
2099930 valid rows loaded.
Inserting realtime_incidents...
   (ignore the process log)
Inserted 2099930 realtime incidents.
ETL completed in 154.91s.
```

Geographic Data

The CSV contains both road segment and intersection information, so we need to process it in two steps:

- Generate Intersections
- Insert Street Segments

```
import pandas as pd
import mysql.connector
import time

start = time.time()
print("Loading Seattle streets data...")

# Connecting to MySQL
conn = mysql.connector.connect(
    host="localhost", user="root", password="zcc663280", database="safepath"
)
cursor = conn.cursor()

# Reading CSV
df = pd.read_csv("./data/seattle_streets.csv", sep=",", low_memory=False)
df = df.where(pd.notnull(df), None)
print(f"Loaded {len(df)} raw rows.")

# Cleaning
df = df.dropna(subset=["UNITID", "INTKEYLO", "INTKEYHI"])
df = df.where(pd.notnull(df), None)

# Extract intersections
intersections = pd.concat(
    [
        df[["INTKEYLO", "INTRLO", "DIRLO", "GIS_MID_X", "GIS_MID_Y"]].rename(
            columns={
                "INTKEYLO": "intkey",
                "INTRLO": "name",
                "DIRLO": "direction",
                "GIS_MID_X": "gis_x",
                "GIS_MID_Y": "gis_y",
            }
        ),
        df[["INTKEYHI", "INTRHI", "DIRHI", "GIS_MID_X", "GIS_MID_Y"]].rename(
            columns={
                "INTKEYHI": "intkey",
                "INTRHI": "name",
                "DIRHI": "direction",
                "GIS_MID_X": "gis_x",
```

```
                "GIS_MID_Y": "gis_y",
            }
        ),
    ]
).drop_duplicates(subset=["intkey"])

print(f"Extracted {len(intersections)} unique intersections.")

# Batch insert intersections
batch_size = 1000
intersections = intersections.where(pd.notnull(intersections), None)
records = [
    tuple(None if (isinstance(v, float) and pd.isna(v)) else v for v in row)
    for row in intersections.itertuples(index=False, name=None)
]
for i in range(0, len(records), batch_size):
    batch = records[i : i + batch_size]
    cursor.executemany(
        """
        INSERT IGNORE INTO intersections (intkey, name, direction, gis_x, gis_y)
        VALUES (%s, %s, %s, %s, %s)
    """,
        batch,
    )
    conn.commit()
    if i % 10000 == 0:
        print(f"   Progress: {i + len(batch)} / {len(records)} intersections")

# Insert street_segments
segments = df[
    [
        "UNITID",
        "ONSTREET",
        "SPEEDLIMIT",
        "ARTCLASS",
        "STATUS",
        "SEGLENGTH",
        "SURFACEWIDTH",
        "SLOPE_PCT",
        "OWNER",
        "ONEWAY",
        "FLOW",
        "GIS_MID_X",
        "GIS_MID_Y",
        "INTKEYLO",
        "INTKEYHI",
    ]
].drop_duplicates(subset=["UNITID"])
```

```
segments = segments.where(pd.notnull(segments), None)

segment_records = [
    tuple(None if (isinstance(v, float) and pd.isna(v)) else v for v in row)
    for row in segments.itertuples(index=False, name=None)
]

print(f"Ready to insert {len(segment_records)} street segments...")

for i in range(0, len(segment_records), batch_size):
    batch = segment_records[i : i + batch_size]
    cursor.executemany(
        """
        INSERT IGNORE INTO street_segments (
            unitid, onstreet, speedlimit, artclass, status,
            seglength, surfacewidth, slope_pct, owner,
            oneway, flow, gis_mid_x, gis_mid_y, start_intkey, end_intkey
        ) VALUES (%s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s)
    """,
        batch,
    )
    conn.commit()
    if i % 10000 == 0:
        print(f"   Progress: {i + len(batch)} / {len(segment_records)} street segments")

cursor.close()
conn.close()
print(f"Completed in {time.time() - start:.2f}s.")
```

```
(base) chichizhang@Chis-MacBook-Air project % /opt/anaconda3/bin/python "/Users/chichizha
ng/Desktop/NEU class notes/1.cs5200/project/geographic_data_processor.py"
Loading Seattle streets data...
Loaded 23872 raw rows.
Extracted 15482 unique intersections.
   Progress: 1000 / 15482 intersections
   Progress: 11000 / 15482 intersections
Ready to insert 2586 street segments...
   Progress: 1000 / 2586 street segments
Completed in 0.99s.
```

User Data

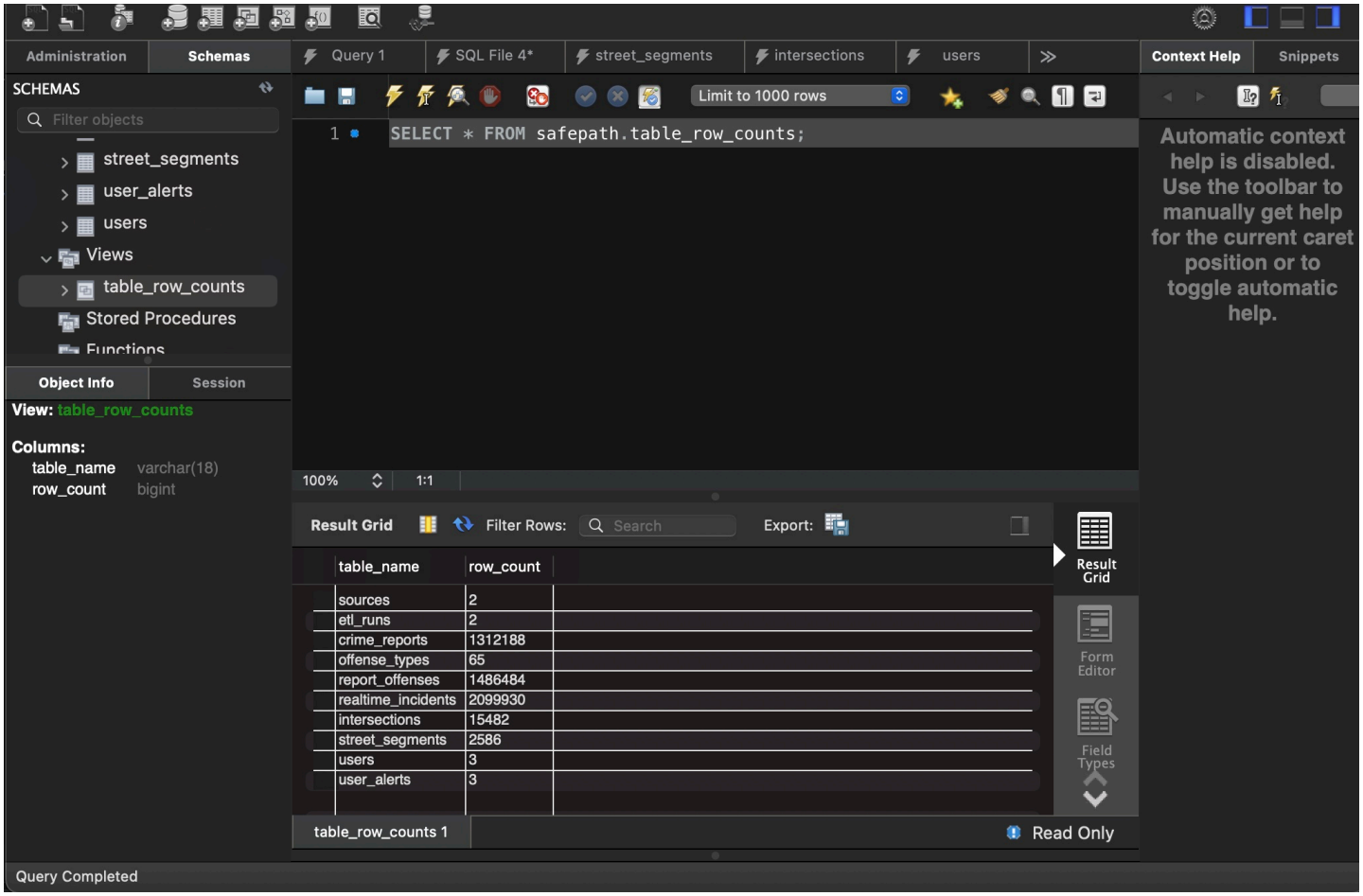
In order to ensure the integrity of the data pipeline, some simulated data are manually inserted.

```
# Insert three data into users
```

```
# Insert three data into users
INSERT INTO users (email, password_hash)
VALUES
('admin@safepath.com', 'hash_admin123'),
('alice@gmail.com', 'hash_alice123'),
('bob@gmail.com', 'hash_bob123');

# Insert three data into user_alerts
INSERT INTO user_alerts (user_id, radius_m, center_lat, center_lon, crime_type_filter)
VALUES
(1, 1000, 47.6062, -122.3321, 'ASSAULT'),
(2, 500, 47.6205, -122.3493, 'BURGLARY'),
(3, 1500, 47.6097, -122.3331, 'ROBBERY');
```

Row Count Screenshoot

```
USE safepath;

DROP VIEW IF EXISTS table_row_counts;

-- Create a view
CREATE VIEW table_row_counts AS
SELECT 'sources' AS table_name, COUNT(*) AS row_count FROM sources
UNION ALL
SELECT 'etl_runs', COUNT(*) FROM etl_runs
UNION ALL
SELECT 'crime_reports', COUNT(*) FROM crime_reports
UNION ALL
SELECT 'offense_types', COUNT(*) FROM offense_types
UNION ALL
SELECT 'report_offenses', COUNT(*) FROM report_offenses
UNION ALL
SELECT 'realtime_incidents', COUNT(*) FROM realtime_incidents
UNION ALL
SELECT 'intersections', COUNT(*) FROM intersections
UNION ALL
SELECT 'street_segments', COUNT(*) FROM street_segments
UNION ALL
SELECT 'users', COUNT(*) FROM users
UNION ALL
SELECT 'user_alerts', COUNT(*) FROM user_alerts;
```



Team Work

Member	Task
Jiaqi Guo	Initial design for UML based on raw data to build basic structure.
Yuchen Huang	Led the UML design and repository management, coordinating internal design tasks.
Minglu Sun	Improved the initial UML model by refining attributes and table relationships, and delivered the final relational design.
Hanhan Guo	Provided design suggestions and contribute to geographic information tables.
Chichi Zhang	Summarized team results, prepared documentation, performed data cleaning, and wrote SQL statements for data insertion.