Final Project Report: Montgomery County Crime Rates Database

INST 327

Section: ESG1 - Group 5

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## 1. Introduction

Problem Domain

- Montgomery County faces an important challenge in managing and analyzing crime data effectively. As urban populations grow and diversify, law enforcement agencies must adapt to increasingly complex crime related situations. There is a pressing need for a structured system that can consolidate crime data, facilitating efficient analysis and proactive policing. A comprehensive database system is essential for aggregating, querying, and managing crime information to help law enforcement respond more effectively to crime patterns and trends.

Motivation

- The motivation behind developing the Montgomery County Crime Rates Database stemmed from a desire to enhance public safety and improve the operational efficiency of local law enforcement agencies. We as citizens of Montgomery County benefit from this project directly. This project also aims to provide a versatile tool for crime analysis, enabling law enforcement to track and analyze crime incidents accurately across various districts and locations. Some impacts that this would include are:
    - Enhanced crime analytics, adding crime prevention
    - Public transparency with clear and clean statistics
    - Improved resource allocation, money and resources go to the places most needed

2. Database Description

Logical Design
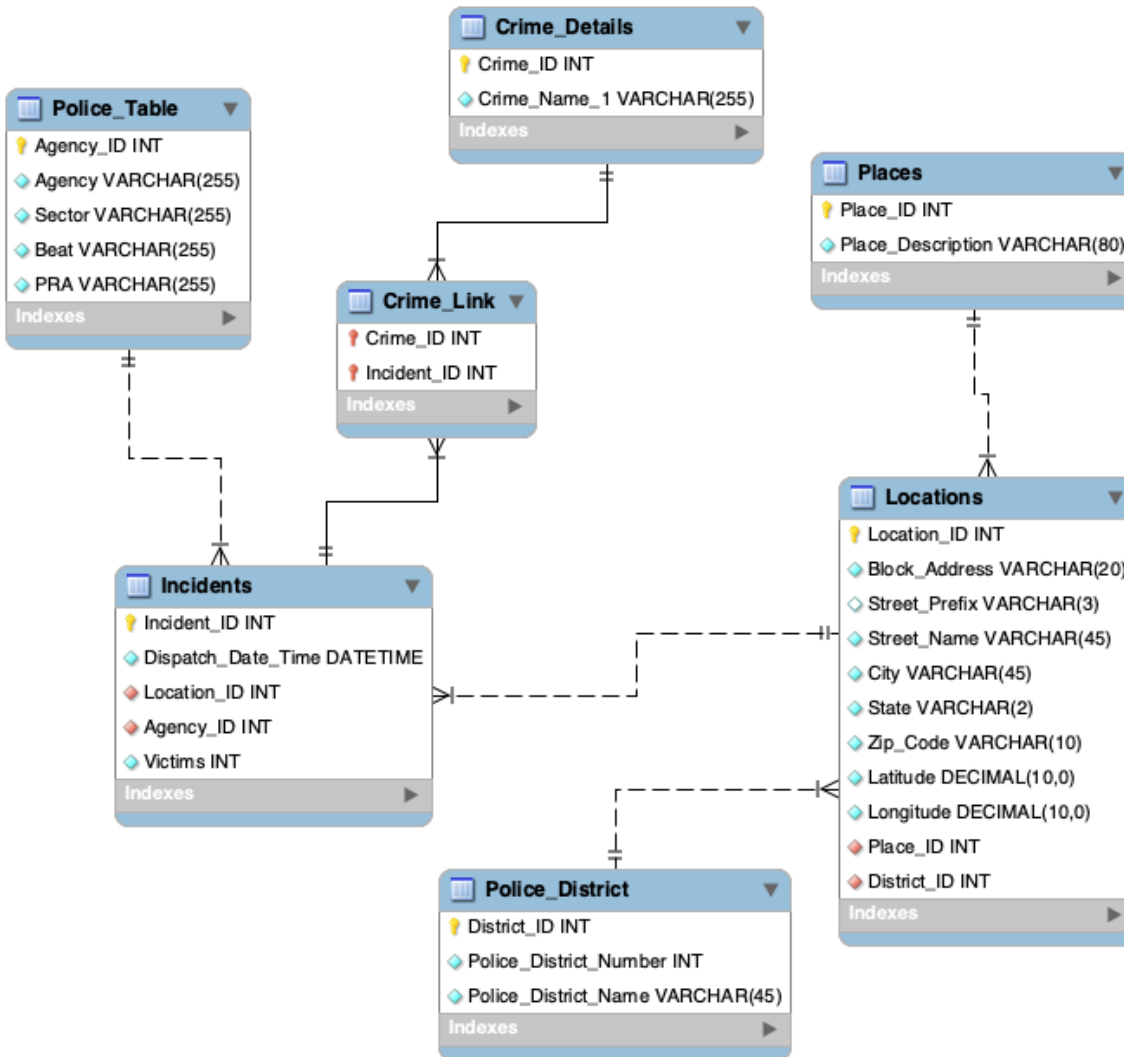
- Our ERD serves as a visual representation of our database's structure. It outlines the relationships between various entities, helping us understand how data flows and interacts within the system. The ERD has been carefully designed to reflect the scope and objectives of our project, ensuring that it captures all necessary details while maintaining clarity. We used mySQL and VCL to create this model.

Physical Database

Tables:

Police_District:

- **Columns**: District_ID (PK), Police_District_Number, Police_District_Name
- **Description**: Stores information about each police district.

Places:

- **Columns**: Place_ID (PK), Place_Description
- **Description**: Contains details about various locations.

Locations:

- **Columns**: Location_ID (PK), Block_Address, Street_Prefix, Street_Name, City, State, Zip_Code, Latitude, Longitude, Place_ID (FK to Places), District_ID (FK to Police_District)
- **Description**: Geographical information about incident locations, linking to Places and Police Districts.

Police_Table:

- **Columns**: Agency_ID (PK), Agency, Sector, Beat, PRA
- **Description**: Details on police agencies and operational sectors.

Crime_Details:

- **Columns**: Crime_ID (PK), Crime_Name_1
- **Description**: Records multiple crime names associated with each incident.

Incidents:

- **Columns**: Incident_ID (PK), Dispatch_Date_Time, Location_ID (FK to Locations), Agency_ID (FK to Police_Table), Victims
- **Description**: Logs individual incidents, linked to Locations and Police_Table.

Crime_Link:

- **Columns**: Crime_ID (CPK, FK to Crime_Details), Incident_ID (CPK, FK to Incidents)
- **Description**: Connects multiple crimes to incidents, facilitating many-to-many relationships.

Relationships:

- **One-to-Many:**

  -Police districts are linked to multiple locations

  -Police agencies are linked to multiple incidents.

- **Many-to-Many:**

  -Incidents are associated with multiple crime types through the Crime_Link table.

Constraints:

- **Primary Keys: Serve as unique identifiers within each table.**
- **Foreign Keys:** Ensure data integrity between tables

Indexes:

- **Primary Key Indexes:** Improve search speed and query performance.
- **Foreign Key Indexes:** Optimize join operations across tables.

Sample Data

Source of Sample Data:

- The data for the Montgomery County Crime Rates database is a combination of simulated and real-world-like records designed to reflect various crime scenarios and classifications.

Structure of Sample Data (Rough Data):

Police_District:

- Records identifiers like District_ID, Police_District_Number, and Police_District_Name.

Places:

- Describes location types such as parks, malls, and schools.

Incident_Codes:

- Contains crime codes and descriptions.

Locations:

- Holds geographical data, including addresses and city names.

Police_Table:

- Represents police agencies with identifiers like Agency_ID and Sector.

Crime_Details:

- Describes crime names like "Theft" or "Robbery."

Incidents:

- Logs reported incidents with crime names, Dispatch_Date_Time, and links to locations and agencies.

Real-World Representation:

The dataset covers 15 records per non-join table and 30 records for each of the join tables, Locations and Incidents, ensuring comprehensive data coverage across multiple police districts and diverse geographic locations in Montgomery County. This setup aligns with national

standards for crime data classification and facilitates robust analysis by connecting incidents to specific locations and police details, thus encompassing a wide array of scenarios typical for a regional crime database.

Views / Queries

View 1: Requirement A, B, C

- **Explanation**: This view retrieves information about locations in Maryland, including the block address, city, state, place description, and police district name. It joins the Locations, Places, and Police_District tables and filters the results to only include locations in Maryland.
- **Output**: The output of this view provides a list of locations in Maryland along with their respective details such as block address, city, state, place description, and police district name.

View 2: Requirement A, B, D

- **Explanation**: View_2 retrieves detailed information about locations specifically in the Rockville police district, with a focus on burglary crimes. It joins the Locations, Places, Police_District, and Crime_Details tables, filtering the results to only include locations in Rockville where the crime name is 'Burglary'.
- **Output**: The output of this view provides a list of locations in Rockville along with their respective details, such as block address, city, state, place description, police district name, and the crime name 'Burglary'.

View 3: Requirement A, C, E

- **Explanation**: View_3 aggregates data from multiple tables to analyze crime by location, counting unique incidents and different crime types. This provides a detailed view necessary for understanding crime patterns and law enforcement challenges.
- **Output**: The output lists each location's details along with counts of unique crime incidents and types. This information helps in evaluating both the frequency and diversity of crimes, crucial for effective crime prevention strategies.

View 4: Requirement A, D, E

- **Explanation**: View_4 retrieves information about incidents in areas with police sector 'North'. It joins the Incidents, Locations, and Police_Table tables, filtering the results to include incidents in the specified sector.
- **Output**: The output of this view provides details about incidents in the 'North' police sector, including incident ID, dispatch date-time, block address, and agency.

View 5: Requirement A, B, C, D, E- subquery

- **Explanation**: View_5 calculates the count of incidents and crimes for each location in the Silver Spring police district. It provides comprehensive details including block address, city, state, place description, police district name, and the counts of incidents and crimes. This view joins the Incidents, Locations, Places, Police_District, and Crime_Link tables and uses a subquery to ensure it includes only the locations with the maximum count of distinct crimes in Silver Spring.
- **Output**: The output of this view shows the block address, city, state, place description, police district name, and the counts of incidents and crimes at each location in Silver Spring.

Reporting Table:

View name	Req. A (JOIN)	Req. B (Filtering)	Req. C (Aggregation)	Req. D (Join Table)	Req. E (Subquery)
View_1	X	X	X		
View_2	X	X		X	
View_3	X		X	X	X
View_4	X			X	X
View_5	X	X	X	X	X

3. Changes from Original Design

Modifications Overview

Throughout the development of our database, significant changes were made from the initial design to enhance its functionality:

- **Increased Complexity:** We evolved from a simpler initial schema to a bit more complex one with additional tables, enabling sophisticated queries and expansive data analysis.
- **Enhanced Accuracy:** We refined the definitions of entities and attributes to better align with real-world crime reporting needs.

Other modifications made include:

- Adjustments to the crime link table.
- Elimination of the link_id field.

- Conversion of Crime_id and Incident_id into composite primary keys (CPK).
- Deletion of crime name 2 and 3, along with corresponding updates in inserts.
- Revisions to views 2 and 5 to avoid redundancy with existing views.

4. Database Ethics Considerations

In developing the Montgomery County Crime Rates Database, our team prioritized three ethical pillars: privacy, fairness, and data security. We anonymized all crime data to protect individuals' identities, ensuring that no one could be identified directly or indirectly. Another thing we did was we aimed for balanced, non-discriminatory data representation to prevent reinforcing stereotypes or biased policing. Sensitive information, such as exact locations and PII, is accessible only to authorized roles, while less personalized incident data is available more broadly.

5. Lessons Learned

Developing the Montgomery County Crime Rates Database required careful design and collaboration. We created an interconnected table system, set rules, and performed validation checks for data accuracy. Indexing and query tuning optimized data retrieval, while encryption, role-based access control, and anonymization safeguarded data. Despite challenges, effective communication and technical expertise resulted in a robust database solution.

6. Potential Future Work

Integrating predictive analytics and machine learning can help anticipate crime trends, while geospatial analysis will identify hotspots. Real-time data feeds and socio-economic insights could enable proactive policing, improve resource allocation, and optimize crime prevention strategies.

References

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