IS664 Database Programming
Fall 2022

Fundamentals

Database Programming

LECTURE 3: SIMPLE QUERIES

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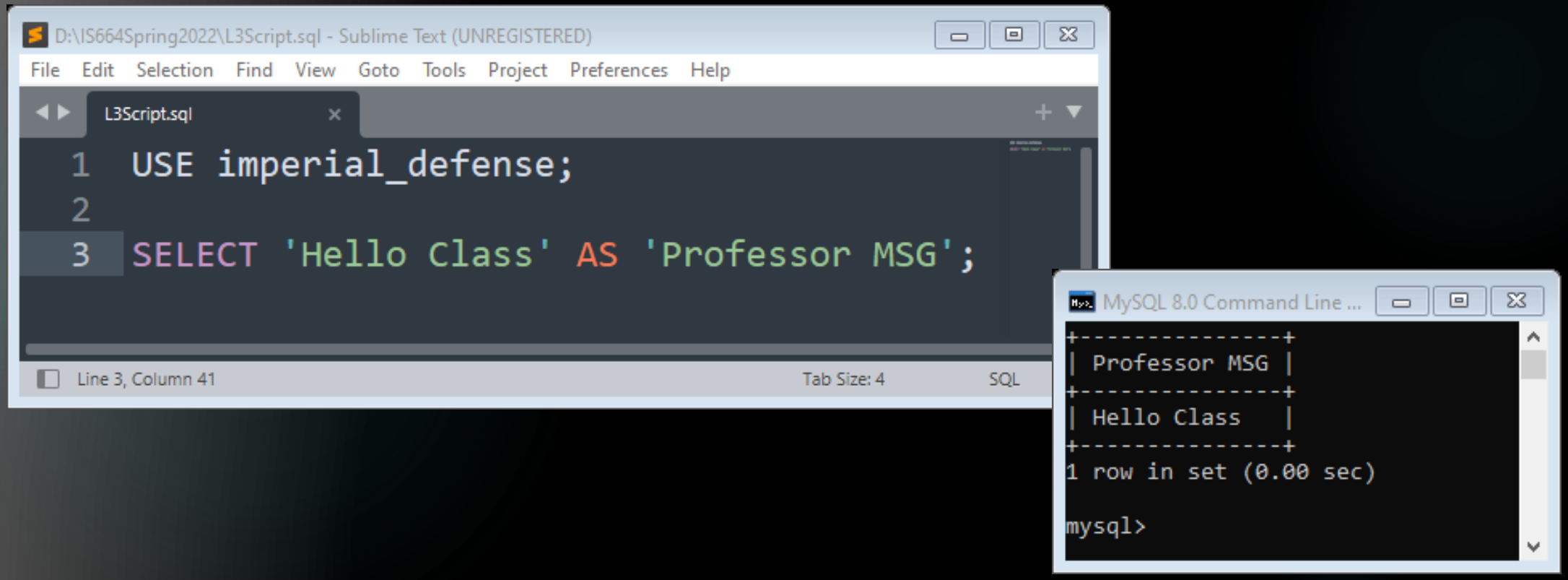
SELECT Statement

- The **SELECT** statement is the most important statement in all of SQL.
- It serves as the means to retrieve information (query) from the database.
- **SELECT** is used in conjunction with other keywords and clauses to compose any time of information request to the database.

- The **SELECT** operation can be divided into three smaller operations:
  - **SELECT Statement**
    - Composed of clauses...some are optional others are required.
    - Clauses have **one or more keywords** which represent required or optional values.
  - **SELECT Expression**
    - Use of expression or function
  - **SELECT Query**
    - Combination of Statement and Expression

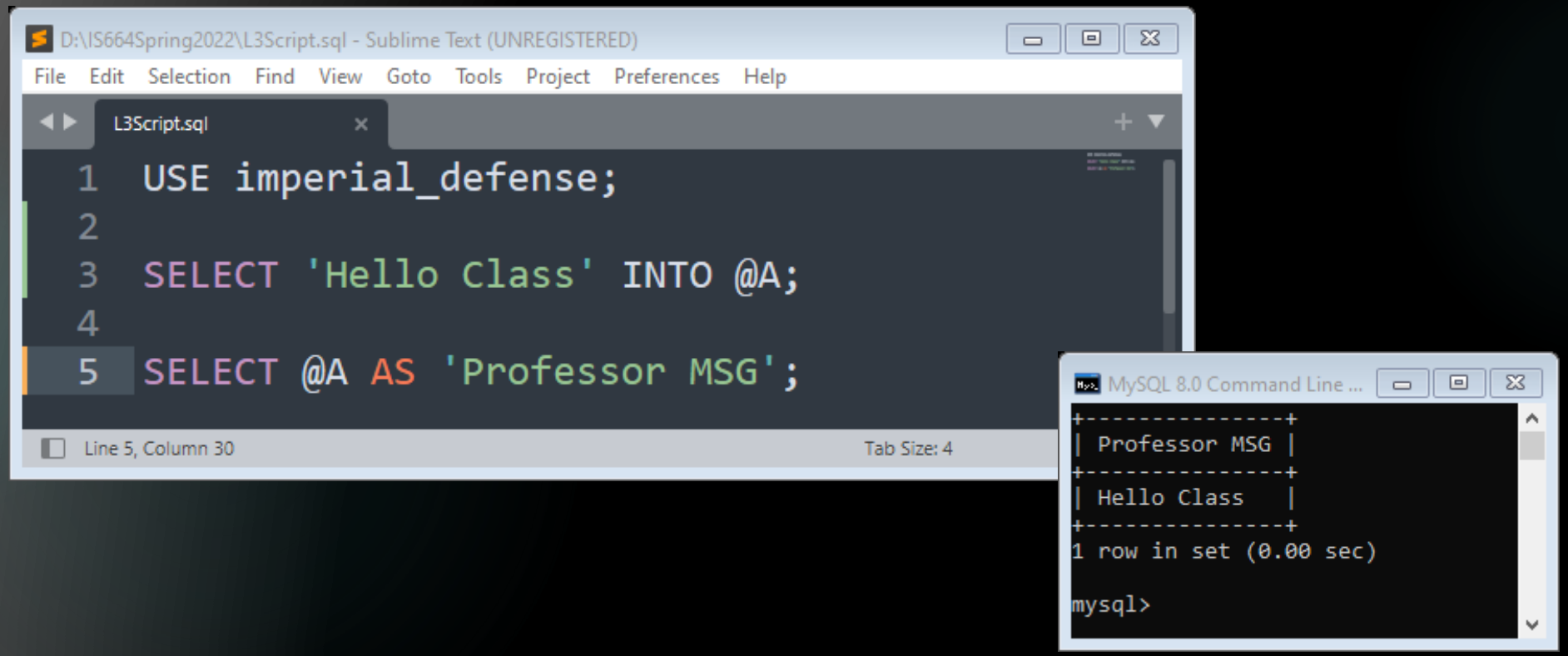
SELECT Statement

- The **SELECT** statement in its most basic form can be used to display values to the MySQL console.



SELECT Statement

- The **SELECT** statement can also be used to place values in variables by combining it with the **INTO** keyword.



SELECT Statement

SELECT Attribute(s) **FROM** Table Name

WHERE Search Condition **GROUP BY** Attribute

HAVING Search Condition

SELECT Statement		
SELECT	Used to specify columns	Required
FROM	Used to specify tables or views	Required
WHERE	Used to filter rows from returned by the FROM clause	Optional
GROUP BY	Used to produce summary information	Optional
HAVING	Used to filter results of aggregate functions/expression	Optional

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT * FROM Hub LIMIT 5;
4  SELECT COUNT(*) FROM Switch;
```

Line 3, Column 1 Tab Size: 4

MySQL 8.0 Command Line Client

```
+-------+-------+-----------+----------+-------------------+
| HID   | Ports | EntryPort | ExitPort | AssignedTo        |
+-------+-------+-----------+----------+-------------------+
| HB-1  |    17 |       495 |      495 | Zebetis02xNET_SAT |
| HB-10 |    18 |      1106 |     1111 | Ginda02xNET_SAT   |
| HB-11 |    15 |       566 |      584 | Ginda02xNET_SAT   |
| HB-12 |    16 |      1585 |     1593 | Brore01wNET_TRACK |
| HB-13 |    12 |       264 |      281 | Zebetis04zNET_CIV |
+-------+-------+-----------+----------+-------------------+
5 rows in set (0.01 sec)

+----------+
| COUNT(*) |
+----------+
|       30 |
+----------+
1 row in set (0.02 sec)

mysql>
```

- Select first 5 rows
- Count rows in table

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT Router.RID FROM Router LIMIT 5;
4
5  SELECT * FROM Router WHERE RID = 'RTR22';
6
7  SELECT RID, RType
8  FROM Router
9  WHERE Connectivity = 'Edge' AND RouteFinding = 'Static';
```

Line 6, Column 1 Tab Size: 4

MySQL 8.0 Command Line Client

```
Database changed
+-------+
| RID   |
+-------+
| RTR1  |
| RTR10 |
| RTR11 |
| RTR12 |
| RTR13 |
+-------+
5 rows in set (0.00 sec)

+-------+----------+--------------+--------------+------------------+
| RID   | RType    | RouteFinding | Connectivity | AssignedTo       |
+-------+----------+--------------+--------------+------------------+
| RTR22 | Exterior | Static       | Backbone     | Trerth01wNET_CIV |
+-------+----------+--------------+--------------+------------------+
1 row in set (0.00 sec)

+-------+----------+
| RID   | RType    |
+-------+----------+
| RTR1  | Border   |
| RTR12 | Exterior |
| RTR16 | Exterior |
| RTR9  | Exterior |
+-------+----------+
```

- Use qualified attribute name
- Select attribute based on condition
- Select multiple attributes based on compound condition

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT CONCAT(RID,'--',RType) AS ID FROM Router LIMIT 3;
4
5  SELECT * FROM Router WHERE RType LIKE 'E%' LIMIT 2;
6
```

Line 5, Column 51

- Use concatenation of attributes and query alias
- Use pattern matching

MySQL 8.0 Command Line Client

```
+-----------------+
| ID              |
+-----------------+
| RTR1--Border    |
| RTR10--Exterior |
| RTR11--Exterior |
+-----------------+
3 rows in set (0.00 sec)

+-------+----------+--------------+-----------------+------------------+
| RID   | RType    | RouteFinding | Connectivity    | AssignedTo       |
+-------+----------+--------------+-----------------+------------------+
| RTR10 | Exterior | Static       | Backbone        | Brore03yNET_SAT  |
| RTR11 | Exterior | Dynamic      | Port Forwarding | Trerth01wNET_CIV |
+-------+----------+--------------+-----------------+------------------+
2 rows in set (0.00 sec)

mysql>
```

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT * FROM Router ORDER BY RouteFinding LIMIT 5;
4
5  SELECT * FROM Router ORDER BY RouteFinding DESC LIMIT 5;
6
```

Line 5, Column 49

- Use ORDER BY
- Use ORDER BY DESC

MySQL 8.0 Command Line Client

```
+-------+----------+--------------+--------------+-------------------+
| RID   | RType    | RouteFinding | Connectivity | AssignedTo        |
+-------+----------+--------------+--------------+-------------------+
| RTR1  | Border   | Static       | Edge         | Brore01wNET_TRACK |
| RTR10 | Exterior | Static       | Backbone     | Brore03yNET_SAT   |
| RTR9  | Exterior | Static       | Edge         | Povebos04zNET_CIV |
| RTR12 | Exterior | Static       | Edge         | Brore01wNET_TRACK |
| RTR13 | Exterior | Static       | Backbone     | Zebetis04zNET_CIV |
+-------+----------+--------------+--------------+-------------------+
5 rows in set (0.00 sec)

+-------+----------+--------------+-----------------+-------------------+
| RID   | RType    | RouteFinding | Connectivity    | AssignedTo        |
+-------+----------+--------------+-----------------+-------------------+
| RTR24 | Interior | Dynamic      | Port Forwarding | Povebos04zNET_CIV |
| RTR26 | Interior | Dynamic      | Port Forwarding | Trerth05uNET_DEF  |
| RTR11 | Exterior | Dynamic      | Port Forwarding | Trerth01wNET_CIV  |
| RTR21 | Interior | Dynamic      | Port Forwarding | Povebos04zNET_CIV |
| RTR15 | Exterior | Dynamic      | Backbone        | Trerth01wNET_CIV  |
+-------+----------+--------------+-----------------+-------------------+
5 rows in set (0.00 sec)

mysql>
```

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT (XCoord - YCoord) AS 'XY Diff'
4  FROM Site
5  LIMIT 3;
6
7  SELECT MAX(XCoord) FROM Site ;
8
9  SELECT XCoord
10 FROM Site
11 WHERE XCoord BETWEEN 20 AND 30 LIMIT 3;
12
13 SELECT XCoord
14 FROM Site
15 WHERE XCoord IN(20,30) LIMIT 3;
16
```

Line 14, Column 10 Tab Si

MySQL 8.0 Command Line Client

```
+---------+
| XY Diff |
+---------+
|      -1 |
|    -157 |
|    -116 |
+---------+
3 rows in set (0.00 sec)

+-------------+
| MAX(XCoord) |
+-------------+
|          98 |
+-------------+
1 row in set (0.00 sec)

+--------+
| XCoord |
+--------+
|     21 |
|     27 |
+--------+
2 rows in set (0.00 sec)

Empty set (0.00 sec)

mysql>
```

There are no Sites that have an XCoord of 20 or 30

- Use of expression in SELECT
- Use of function in SELECT
- Use comparison operator in WHERE
- Use of set of attribute in WHERE

SELECT Statement

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT COUNT(*) AS RtrCount, AssignedTo
4  FROM Router
5  GROUP BY AssignedTo
6  LIMIT 3;
7
8  SELECT COUNT(*) AS RtrCount, RType, AssignedTo
9  FROM Router
10 GROUP BY AssignedTo
11 HAVING RType = 'Border'
12 LIMIT 3;
```

Line 6, Column 8 Tab Size: 4 SQL

RType Must be included because it is the basis for the Having clause.

MySQL 8.0 Command Line Client

```
+----------+-------------------+
| RtrCount | AssignedTo        |
+----------+-------------------+
|        3 | Brore01wNET_TRACK |
|        3 | Brore03yNET_SAT   |
|        4 | Trerth01wNET_CIV  |
+----------+-------------------+
3 rows in set (0.00 sec)

+----------+--------+-------------------+
| RtrCount | RType  | AssignedTo        |
+----------+--------+-------------------+
|        3 | Border | Brore01wNET_TRACK |
|        3 | Border | Brore06vNET_SURV  |
|        4 | Border | Trerth05uNET_DEF  |
+----------+--------+-------------------+
3 rows in set (0.00 sec)
```

- Use of GROUP BY
- Use of GROUP BY and HAVING

The use of Group By and Having are used for summary information

SELECT Statement (Subquery)

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT RID, RType,
4   (SELECT NetStatus AS Status
5      FROM Network
6      WHERE NetName = 'Brore01wNet_TRACK') AS NetInfo
7  FROM Router
8  WHERE AssignedTo = 'Brore01wNet_TRACK';
```

Line 10, Column 1 Tab Size: 4 SQ

MySQL 8.0 Command Line Client

```
+-------+----------+---------+
| RID   | RType    | NetInfo |
+-------+----------+---------+
| RTR1  | Border   | OFFLINE |
| RTR12 | Exterior | OFFLINE |
| RTR23 | Border   | OFFLINE |
+-------+----------+---------+
3 rows in set (0.00 sec)

mysql>
```

Router				
RID	RType	~~RouteFinding~~	~~Connectivity~~	AssignedTo

Network							
NetName	~~NetType~~	~~Bandwidth~~	~~OptimumBW~~	~~MaxBW~~	~~MinBW~~	~~CSwitched~~	NetStatus

SELECT Statement (Subquery=Join)

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  SELECT RID, RType, Network.NetStatus
4  FROM Router
5  JOIN Network ON Network.NetName = Router.AssignedTo
6  WHERE AssignedTo = 'Brore01wNet_TRACK';
7
```

Line 6, Column 24 Tab Size: 4

All Subqueries can be restated as JOINS

MySQL 8.0 Command Line Client

```
+-------+----------+-----------+
| RID   | RType    | NetStatus |
+-------+----------+-----------+
| RTR1  | Border   | OFFLINE   |
| RTR12 | Exterior | OFFLINE   |
| RTR23 | Border   | OFFLINE   |
+-------+----------+-----------+
3 rows in set (0.00 sec)

mysql>
```

Router				
RID	RType	~~RouteFinding~~	~~Connectivity~~	AssignedTo

Same Data

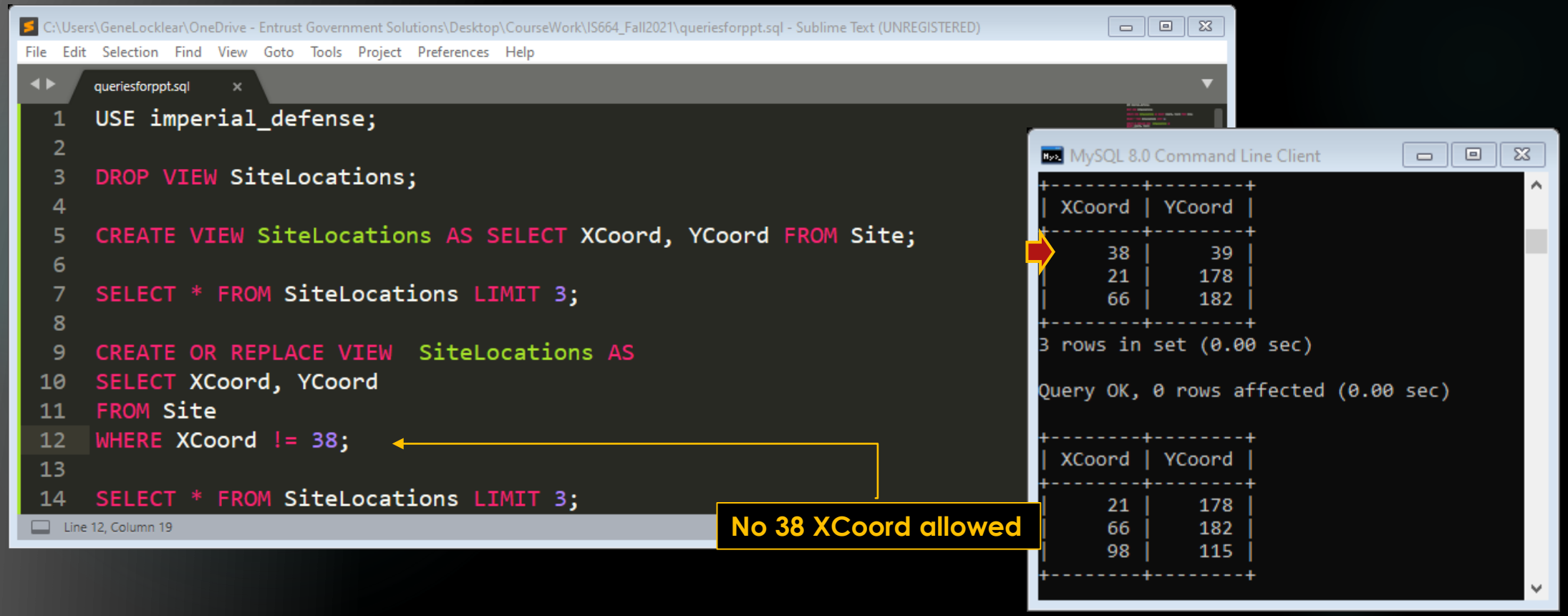
Network							
NetName	~~NetType~~	~~Bandwidth~~	~~OptimumBW~~	~~MaxBW~~	~~MinBW~~	~~CSwitched~~	NetStatus

Views

- A **view** is a **SELECT** statement that is stored in the database as a database object.
- The tables referenced in the **SELECT** statement are known as the **base tables** of the view.
- A view can be used anywhere a table would normally be used.
- Although a view behaves like a virtual table, it doesn't store any data.
- The benefits of using a view are:
  - **Design Independence**
    - Views can limit the exposure of tables to external users and applications.
  - **Data Security**
    - Views can restrict access to the data in a table by using the SELECT statement to only include specified columns.
  - **Simplified Queries**
    - Views can be used to hide the complexity of retrieval operations.
  - **Updatability**
    - With certain restrictions, views can be used to update, insert, and delete data from the base table.

CREATE OR REPLACE or DROP a View

- To alter a view use the **CREATE OR REPLACE VIEW** statement to replace the existing view with a new one.
- To delete a view from the database, use the **DROP VIEW** statement.



Updateable Views

- An **updateable view** is a view that can be used in an **INSERT**, **UPDATE**, or **DELETE** statement to update the data in the base table.
- Views have several major restrictions:
  - The SELECT statement cannot include a **DISTINCT** clause.
  - The SELECT statement cannot include aggregate functions.
  - The SELECT statement cannot include a **GROUP BY** or **HAVING** clause.
  - The SELECT statement cannot include calculated columns.
  - The view cannot include the **UNION** operator.

- If a view isn't updateable, it is known as a **read-only view**.
  - Cannot used calculated columns.
  - Update on a single base table at a time.

Updateable Views

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queriesforppt.sql

```
4
5  CREATE VIEW SiteLocations AS SELECT SiteName, XCoord, YCoord FROM Site;
6
7  SELECT * FROM SiteLocations LIMIT 3;
8
9  UPDATE SiteLocations SET XCoord = 138 WHERE SiteName = "Eap246e1";
10
11 SELECT SiteName, XCoord, YCoord
12 FROM Site
13 WHERE SiteName = "Eap246e1";
14
```

Line 9, Column 35

MySQL 8.0 Command Line Client

```
+----------+--------+--------+
| SiteName | XCoord | YCoord |
+----------+--------+--------+
| Eap246e1 |     38 |     39 |
| Eaw99q12 |     21 |    178 |
| Far00113 |     66 |    182 |
+----------+--------+--------+
3 rows in set (0.00 sec)

Query OK, 1 row affected (0.01 sec)
Rows matched: 1  Changed: 1  Warnings: 0

+----------+--------+--------+
| SiteName | XCoord | YCoord |
+----------+--------+--------+
| Eap246e1 |    138 |     39 |
+----------+--------+--------+
1 row in set (0.00 sec)

mysql>
```

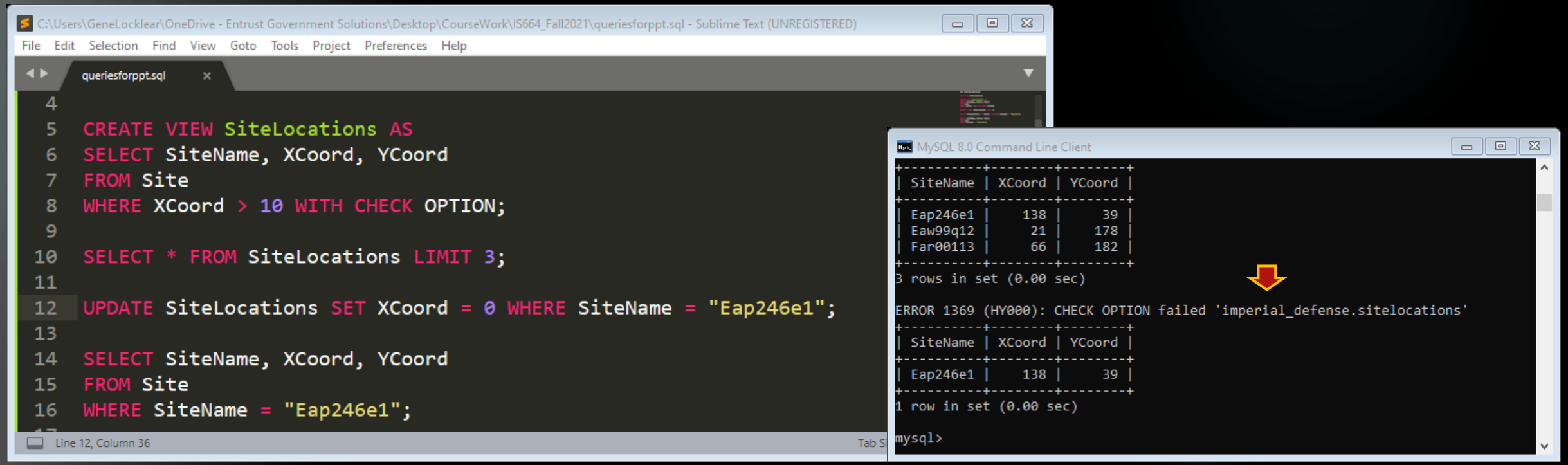
Updateable Views (Update Base Table)

- The **INSERT** statement can be used to **insert rows into a base table** through a view.
  - Name the view in the INSERT clause.
  - Both the view and the INSERT statement must include all of the columns from the base table that require a value.
  - If the view uses more than one base table, an INSERT statement can only insert data into one of them.
- The **DELETE** statement can be used to **delete rows from a base table** through a view.
  - Name the view in the DELETE clause.
  - View must be based on a **single** table.
- Must include all attribute in base table...be cautious of Foreign Key constraints.

Updateable Views (Check Option)

- If a **WITH CHECK OPTION** clause **is not** include when a view is created, a change made to the view can cause the modified rows to longer be included in the view.

- If a **WITH CHECK OPTION** clause **is** included, then an error will occur, if an attempt is made to modify a row such that it would not longer be included in the view.



Indexes

- An **index** speeds up joins and searches by providing a way for MySQL to go directly to a row rather than having to search through all the rows until it finds the one needed.
- By default, MySQL creates indexes for the **Primary Keys**, **Foreign Keys**, and **Unique Keys** of a table.
  - **This is, in most all cases, sufficient.**
- However, you may want to create indexes for other columns that are used frequently in search conditions or joins.
- Avoid creating indexes on columns that are updated frequently.
  - Slows down insert, update, and delete operations.
- Index handling is unique to the DBMS because it is a memory management concept.
  - **https://dev.mysql.com/doc/refman/8/en/create-index.html**

Indexes

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queriesforppt.sql

```
1  USE imperial_defense;
2
3  CREATE INDEX site_Stat ON Site(SiteStatus);
4  DESCRIBE Site;
5
6  DROP INDEX site_Stat ON Site;
7  DESCRIBE Site;
8
```

Line 6, Column 21

MySQL 8.0 Command Line Client

```
+------------+---------------------------+------+-----+---------+-------+
| Field      | Type                      | Null | Key | Default | Extra |
+------------+---------------------------+------+-----+---------+-------+
| SiteName   | varchar(25)               | YES  | UNI | NULL    |       |
| SiteID     | varchar(25)               | NO   | PRI | NULL    |       |
| SiteStatus | enum('ONLINE','OFFLINE')  | NO   | MUL | NULL    |       |
| XCoord     | int                       | YES  |     | NULL    |       |
| YCoord     | int                       | YES  |     | NULL    |       |
+------------+---------------------------+------+-----+---------+-------+
5 rows in set (0.00 sec)

Query OK, 0 rows affected (0.01 sec)
Records: 0  Duplicates: 0  Warnings: 0

+------------+---------------------------+------+-----+---------+-------+
| Field      | Type                      | Null | Key | Default | Extra |
+------------+---------------------------+------+-----+---------+-------+
| SiteName   | varchar(25)               | YES  | UNI | NULL    |       |
| SiteID     | varchar(25)               | NO   | PRI | NULL    |       |
| SiteStatus | enum('ONLINE','OFFLINE')  | NO   |     | NULL    |       |
| XCoord     | int                       | YES  |     | NULL    |       |
| YCoord     | int                       | YES  |     | NULL    |       |
+------------+---------------------------+------+-----+---------+-------+
5 rows in set (0.00 sec)

mysql>
```

MUL is the first column of the non-unique index