DBMS PROJECT

Bus Transport Management System

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Year : Second Year IT

Subject : DBMS

VJTI

A SOLO PROJECT

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PROBLEM STATEMENT

A regional transportation authority requires a Bus Transport Management System to efficiently manage its fleet of buses, routes, and stops. The system aims to optimize bus operations, improve passenger experience, and enhance overall service reliability.

First Problem

Route Management:

- Define and maintain routes connecting various locations.
- Specify the start and end points for each route. Maintain timings of first bus and last bus.

Second Problem

Bus Management:

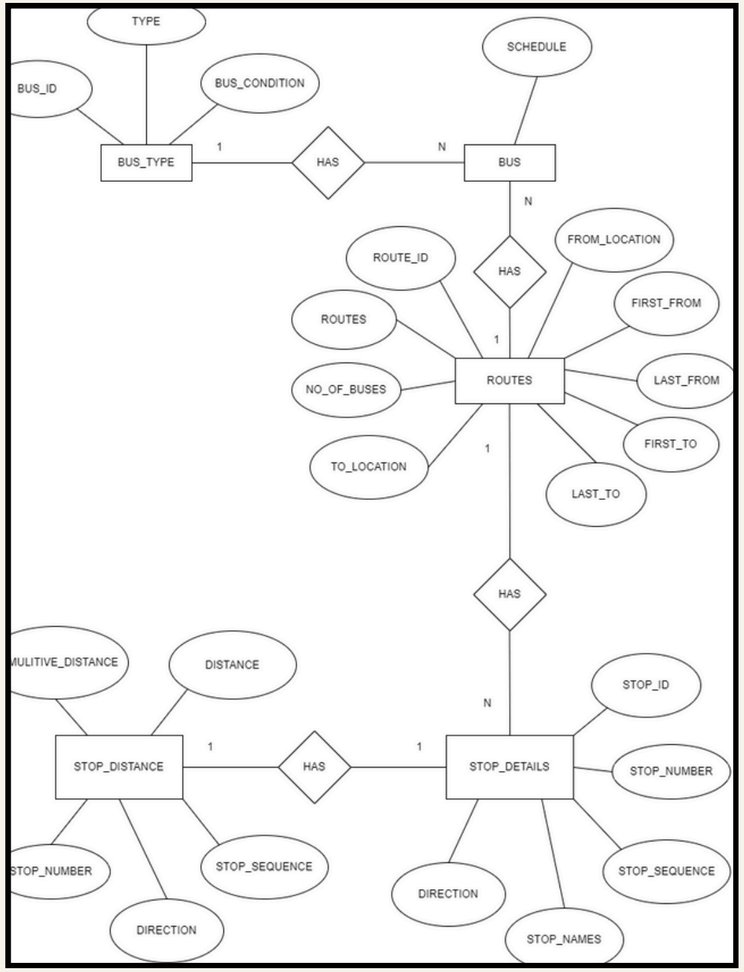
- Maintain a fleet of buses.
- Assign buses to specific routes .
- Schedule buses for regular service on designated routes.

Third Problem

Stop Management:

- Establish and manage stops along each route .
- Record stop names, numbers for accurate location identification.

DATA MODEL


TYPE
BUS_ID
BUS_CONDITION
BUS_TYPE
1
HAS
N
BUS
SCHEDULE
N
ROUTE_ID
HAS
FROM_LOCATION
FIRST_FROM
ROUTES
1
ROUTES
NO_OF_BUSES
LAST_FROM
FIRST_TO
TO_LOCATION
1
LAST_TO
HAS
MULITIVE_DISTANCE
DISTANCE
N
STOP_ID
STOP_DISTANCE
1
HAS
1
STOP_DETAILS
STOP_NUMBER
STOP_NUMBER
STOP_SEQUENCE
DIRECTION
DIRECTION
STOP_SEQUENCE
STOP_NAMES

DATABASE DESIGN

Entites & Attributes

- **bus_type** (Bus_id (PK), type , bus_condition)
- **bus** (Bus_id (FK), Route_id (FK) , Schedule)
- **routes** (Route_id (PK) , Route , From_location , To_location , First_from , Last_from , First_to , Last_to)
- **stop_details** (Stop_id (PK) , Route_id (FK), Stop_sequence , Stop_name , Stop_number)
- **stop_distance** (Stop_id (PK) , Route_id (FK), Stop_sequence , Distance , Cumulative_distance)

Relationships

- bus_type have many bus
- routes have many bus
- routes have many stops
- bus has one bus_type
- bus has one route
- stops have many routes

Normalization

- First Normal Form (1NF): This is the most basic level of normalization. In 1NF, each table cell should contain only a single value, and each column should have a unique name. The first normal form helps to eliminate duplicate data and simplify queries.
- Second Normal Form (2NF): 2NF eliminates redundant data by requiring that each non-key attribute be dependent on the primary key. This means that each column should be directly related to the primary key, and not to other columns.
- Third Normal Form (3NF): 3NF builds on 2NF by requiring that all non-key attributes are independent of each other. This means that each column should be directly related to the primary key, and not to any other columns in the same table.
- Boyce-Codd Normal Form (BCNF): BCNF is a stricter form of 3NF that ensures that each determinant in a table is a candidate key. In other words, BCNF ensures that each non-key attribute is dependent only on the candidate key.

DATA QUERIES

CREATE QUERY

```
| bus_type | CREATE TABLE `bus_type` (
  `bus_id` int(11) NOT NULL,
  `type` varchar(50) DEFAULT NULL,
  `bus_condition` varchar(50) DEFAULT NULL,
  PRIMARY KEY (`bus_id`)
```

INSERT QUERY

```
MariaDB [shweta]> insert into bus_type
    -> values (4,"Electric Bus","AC");
```

UPDATE QUERY

```
MariaDB [shweta]> update bus_type
    -> set bus_condition= "NON-AC"
    -> where bus_id=4;
```

DELETE QUERY

```
MariaDB [shweta]> delete from bus_type
    -> where bus_id=4;
```

GROUP BY

```
MariaDB [shweta]> SELECT Route_id
    -> FROM stop_details
    -> WHERE Stop_Sequence > 35
    -> GROUP BY Route_id;
+-----------+
| Route_id  |
+-----------+
|         1 |
|         2 |
|         4 |
|         6 |
+-----------+
```

AVERAGE , HAVING

```
MariaDB [shweta]> SELECT Route_id
    -> FROM stop_distance
    -> GROUP BY Route_id
    -> HAVING AVG(Distance) > (SELECT AVG(Distance) FROM stop_distance);
+-----------+
| Route_id  |
+-----------+
|         1 |
|         2 |
|         3 |
|        15 |
|        16 |
+-----------+
```

SORT BY , JOIN , LIMIT

```
MariaDB [shweta]> SELECT b.*, r.Route, sd.*
    -> FROM bus b
    -> INNER JOIN routes r ON b.Route_id = r.Route_id
    -> INNER JOIN stop_details sd ON b.Route_id = sd.Route_id
    -> WHERE b.bus_id > 2
    -> ORDER BY b.Route_id, b.schedule DESC, sd.Stop_Sequence DESC
    -> LIMIT 5;
+--------+----------+----------+-------+---------+----------+-----------+---------------+---------------------------+-------------+
| bus_id | Route_id | schedule | Route | Stop_id | Route_id | Direction | Stop_Sequence | Stop_Name                 | Stop_Number |
+--------+----------+----------+-------+---------+----------+-----------+---------------+---------------------------+-------------+
|      3 |       11 | MS       |  1204 |     516 |       11 | UP        |             6 | MANGALDAS MARKET          |       16081 |
|      3 |       11 | MS       |  1204 |     522 |       11 | DOWN      |             5 | PT.PALUSKAR CHOWK         |       16176 |
|      3 |       11 | MS       |  1204 |     515 |       11 | UP        |             5 | PRINCESS STREET           |       16186 |
|      3 |       11 | MS       |  1204 |     521 |       11 | DOWN      |             4 | S.K.PATIL GARDEN          |       16192 |
|      3 |       11 | MS       |  1204 |     514 |       11 | UP        |             4 | MARINE LINES RAILWAY STATION |       16139 |
+--------+----------+----------+-------+---------+----------+-----------+---------------+---------------------------+-------------+
```

VIEW

```
MariaDB [shweta]> CREATE VIEW `bus_info_view` AS
    -> SELECT
    ->     b.Route_id AS Route_id,
    ->     r.Route AS Route,
    ->     r.From_location AS From_location,
    ->     r.To_location AS To_location,
    ->     b.bus_id AS bus_id,
    ->     b.schedule AS schedule,
    ->     bt.type AS bus_type,
    ->     bt.bus_condition AS bus_condition
    -> FROM
    ->     bus b
    -> JOIN
    ->     routes r ON b.Route_id = r.Route_id
    -> JOIN
    ->     bus_type bt ON b.bus_id = bt.bus_id;
```

View is used to join contents of table bus_type , bus , routes

```
MariaDB [shweta]> select * from bus_info_view;
+----------+-------+--------------------------+-----------------------------+--------+----------+---------------+---------------+
| Route_id | Route | From_location            | To_location                 | bus_id | schedule | bus_type      | bus_condition |
+----------+-------+--------------------------+-----------------------------+--------+----------+---------------+---------------+
|        1 |    10 | Colaba Depot             | Bandra Recl. B.Stn.         |      1 | MS       | Single Decker | Non-AC        |
|        2 |    61 | Colaba Depot             | TATA Power Centre (Chembur) |      1 | MS       | Single Decker | Non-AC        |
|        3 |   250 | M.Phule Market           | World Trade Center          |      1 | MS       | Single Decker | Non-AC        |
|        4 |  1030 | R.C.Church               | Kamla Nehru Park            |      1 | MS       | Single Decker | Non-AC        |
|        5 |  1030 | R.C.Church               | Mahatma Phule Market        |      1 | MS       | Single Decker | Non-AC        |
|        6 |  1030 | R.C.Church               | Kamla Nehru Park            |      1 | MS       | Single Decker | Non-AC        |
|        7 |  1080 | Chh.Shivaji Maharaj Ter. | Kamla Nehru Park            |      1 | MS       | Single Decker | Non-AC        |
|        8 |  1144 | Chh.Shivaji Maharaj Ter. | Ahilyabai Holkar Chowk      |      1 | MS       | Single Decker | Non-AC        |
|        9 |  1157 | Chh.Shivaji Maharaj Ter. | N.C.P.A.                    |      2 | MS       | Double Decker | AC            |
|       10 |  1167 | Chh.Shivaji Maharaj Ter. | Gate Way of India           |      2 | SUN      | Double Decker | AC            |
|       11 |  1204 | Pt. Paluskar Chowk       | Mangaldas Market            |      3 | MS       | Midi bus      | Non-AC        |
|       12 |  1387 | Backbay Depot            | Chh.Shivaji Maharaj Ter.    |      2 | MS       | Double Decker | AC            |
|       13 |  1387 | Backbay Depot            | Chh.Shivaji Maharaj Ter.    |      2 | SUN      | Double Decker | AC            |
|       14 |  1390 | Chh.Shivaji Maharaj Ter. | Geeta Nagar                 |      3 | FW       | Midi bus      | Non-AC        |
|       15 |  8879 | Dr.S.P.M. Chowk          | Dr.S.P.M. Chowk             |      2 | MS       | Double Decker | AC            |
|       16 |  8879 | Dr.S.P.M. Chowk          | Dr.S.P.M. Chowk             |      2 | SUN      | Double Decker | AC            |
+----------+-------+--------------------------+-----------------------------+--------+----------+---------------+---------------+
```

TRIGGERS AND PROCEDURES

- Update trigger is used in table bus_type which keeps record of old as well as new update
- Insert , update , delete triggers are implemented on routes table to keep record of the inserted values , updated old as well as new and deleted values
- Insert , update , delete triggers are implemented on stop_details table to keep record of the inserted values , updated old as well as new and deleted values
- Procedure is implemeted to calculate fare between the stops

IMPLEMENTATION

- Trigger on bus_type table

```
MariaDB [shweta]> select * from bus_type_changes;
+-----------+--------+-----------------+-----------------+---------------+---------------+---------------------+
| change_id | bus_id | old_type        | new_type        | old_condition | new_condition | updated_at          |
+-----------+--------+-----------------+-----------------+---------------+---------------+---------------------+
|         1 |      3 | Midi bus        | Electric bus    | non-ac        | non-ac        | 2024-05-04 16:09:35 |
|         2 |      3 | Electric bus    | Midi bus        | non-ac        | non-ac        | 2024-05-04 16:10:22 |
|         3 |      1 | Single Decker   |                 | non-ac        |               | 2024-05-10 22:26:37 |
|         4 |      1 |                 | Single Decker   |               | non-ac        | 2024-05-10 22:31:23 |
|         5 |      1 | Single Decker   | Electric Decker | non-ac        | non-ac        | 2024-05-10 23:10:30 |
|         6 |      1 | Electric Decker | Single Decker   | non-ac        | non-ac        | 2024-05-10 23:10:50 |
|         7 |      1 | Single Decker   | Single Decker   | non-ac        | ac            | 2024-05-12 13:28:00 |
|         8 |      1 | Single Decker   | Single Decker   | ac            | non-ac        | 2024-05-12 13:28:10 |
|         9 |      1 | Single Decker   | Single Decker   | non-ac        | ac            | 2024-05-12 13:29:46 |
|        10 |      1 | Single Decker   | Single Decker   | ac            | non-ac        | 2024-05-12 13:29:53 |
|        11 |      1 | Single Decker   | Non-AC          | non-ac        | non-ac        | 2024-05-16 23:22:19 |
|        12 |      1 | Non-AC          | Single Decker   | non-ac        | non-ac        | 2024-05-16 23:23:02 |
+-----------+--------+-----------------+-----------------+---------------+---------------+---------------------+
```

- Procedure output

```
MariaDB [shweta]> call calculate_fare(12,"DHOBI GHAT ; DR.AMBEDKAR NAGAR","BADHWAR PARK","UP",true);
+-----------------+
| calculated_fare |
+-----------------+
|            6.00 |
+-----------------+
```

- **Trigger on routes table**

```
MariaDB [shweta]> select * from audit_log;
```

log_id	table_name	action	user_id	timestamp	values_before_change	values_after_change
1	routes	INSERT	root@localhost	2024-05-04 20:45:03	NULL	Route_id=17, Route=1234, no_of_Buses=5, From_location=ABC Bus Stop, First_from=08:00:00, Last_from=20:00:00, To_location=XYZ Bus Stop, First_to=08:30:00, Last_to=21:00:00
2	routes	UPDATE	root@localhost	2024-05-04 20:45:36	Route_id=17, Route=1234, no_of_Buses=5, From_location=ABC Bus Stop, First_from=08:00:00, Last_from=20:00:00, To_location=XYZ Bus Stop, First_to=08:30:00, Last_to=21:00:00	Route_id=17, Route=1234, no_of_Buses=8, From_location=ABC Bus Stop, First_from=08:00:00, Last_from=20:00:00, To_location=XYZ Bus Stop, First_to=08:30:00, Last_to=21:00:00
3	routes	DELETE	root@localhost	2024-05-04 20:46:22	Route_id=17, Route=1234, no_of_Buses=8, From_location=ABC Bus Stop, First_from=08:00:00, Last_from=20:00:00, To_location=XYZ Bus Stop, First_to=08:30:00, Last_to=21:00:00	NULL
4	routes	UPDATE	root@localhost	2024-05-12 13:10:11	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=11, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
5	routes	UPDATE	root@localhost	2024-05-12 13:10:22	Route_id=1, Route=11, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
6	routes	UPDATE	root@localhost	2024-05-12 13:16:16	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
7	routes	UPDATE	root@localhost	2024-05-12 13:18:10	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
8	routes	UPDATE	root@localhost	2024-05-12 13:19:17	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
9	routes	UPDATE	root@localhost	2024-05-12 13:19:35	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00
10	routes	UPDATE	root@localhost	2024-05-12 13:21:44	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00	Route_id=1, Route=10, no_of_Buses=1, From_location=Colaba Depot, First_from=06:30:00, Last_from=20:40:00, To_location=Bandra Recl. B.Stn., First_to=07:30:00, Last_to=22:05:00

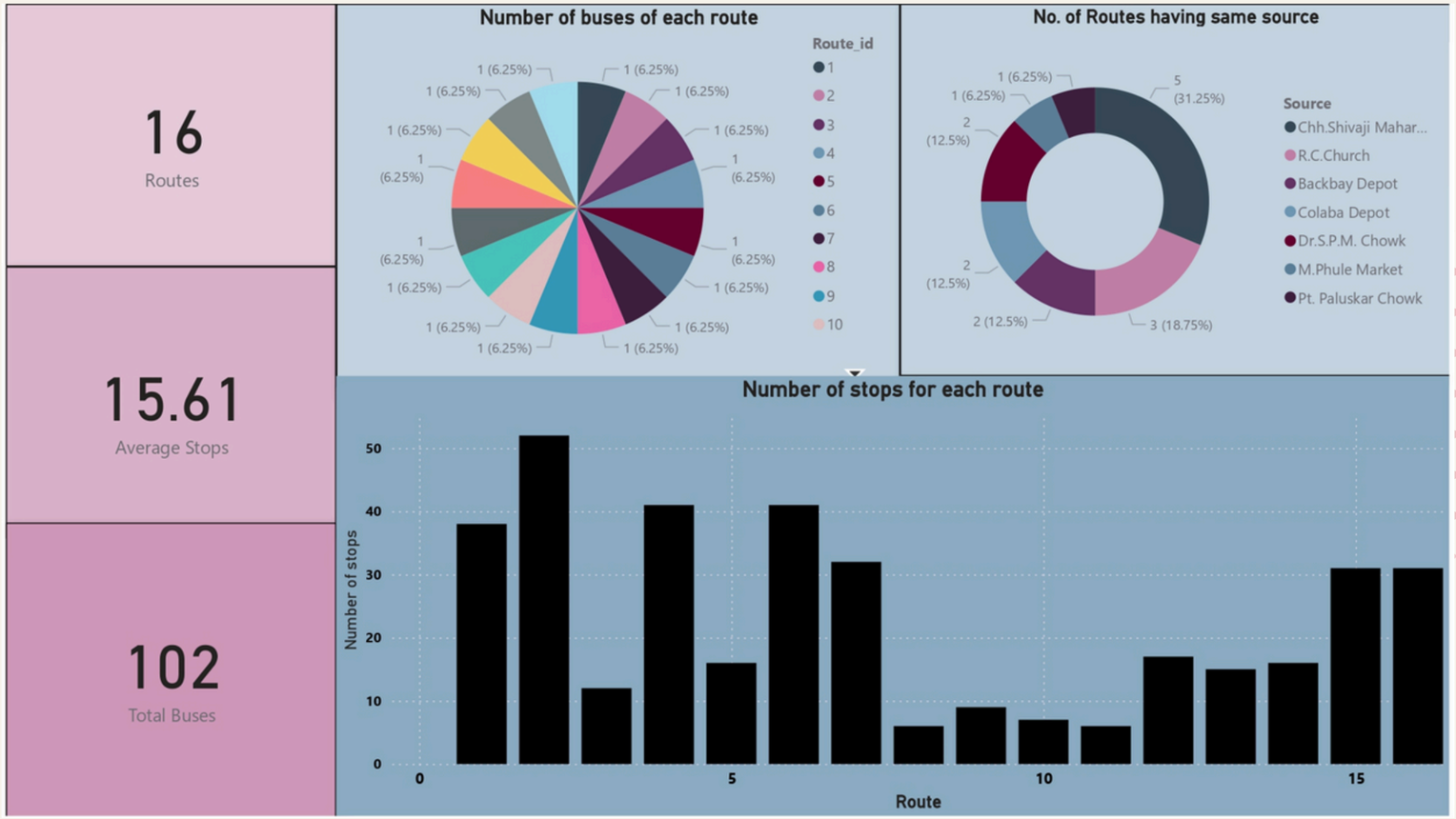
- **Trigger on stop_details table**

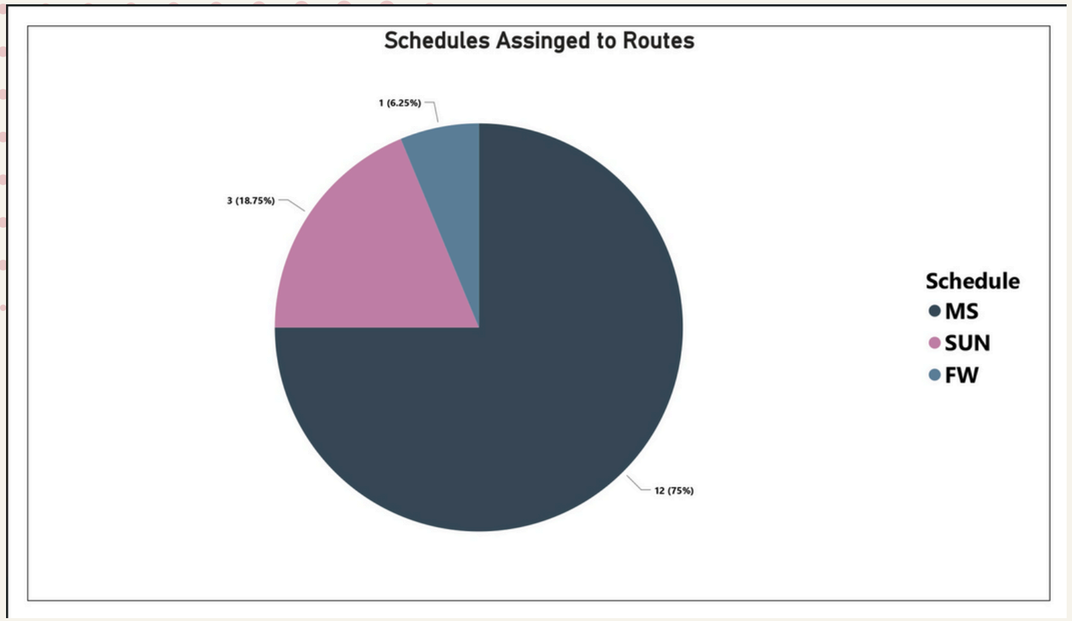
```
MariaDB [shweta]> select * from audit_stop_details;
```

audit_id	event_type	event_time	user	stop_id	route_id	direction	stop_sequence	stop_name	stop_number	old_stop_sequence	old_stop_name	old_stop_number
1	UPDATE	2024-05-06 20:05:41	root@localhost	684	16	UP	30	SHWETA	1149	30	OLD CUSTOM HOUSE	1149
2	UPDATE	2024-05-06 20:08:11	root@localhost	684	16	UP	30	OLD CUSTOM HOUSE	1149	30	SHWETA	1149

VISUALIZATION AND REPORT GENERATION

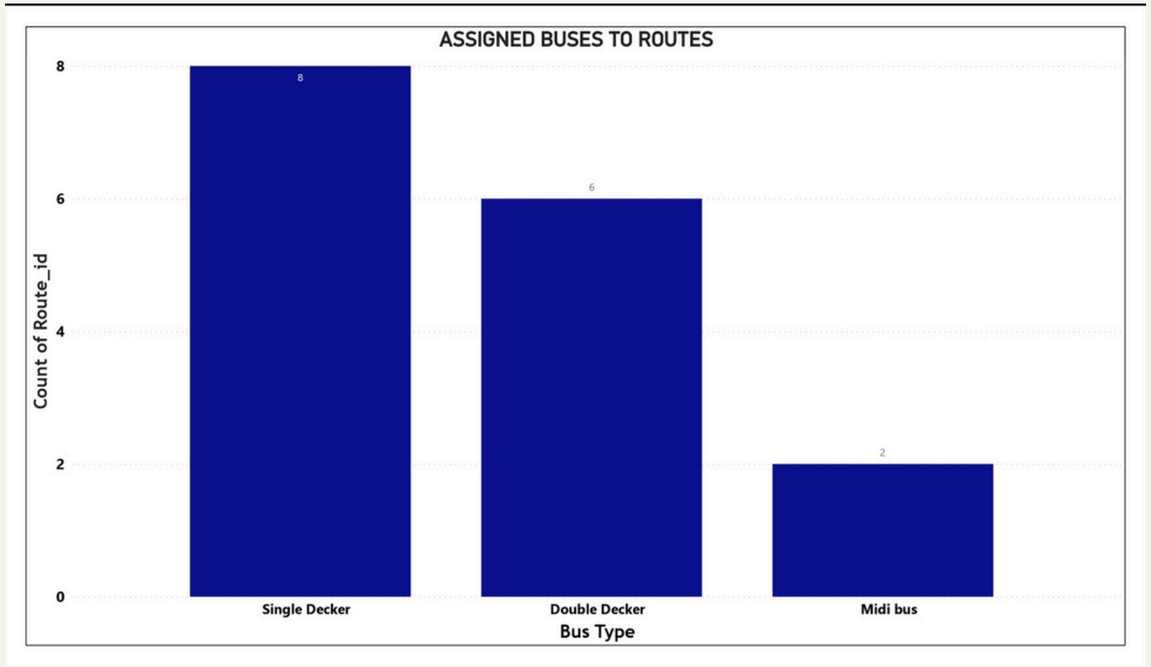
- It has total of 16 stops
- Average number of stops is 15
- Total of 102 buses are at work
- Number of Buses running on rach route are shown
- Routes having same source destination are shown
- Number of stops for each route is shown





Schedules assigned to routes based on its working days

Buses assigned to the routes based on types (single decker , double decker, midi bus)



THANK YOU