

# COMMUNITY WASTE MANAGEMENT AND RECYCLING INCENTIVE SYSTEM



NAME: FEVEN ARAYA(20027)  
PROFESSOR : DR. BHASKAR, VIDHYACHARAN

# AGENDA

- 👍 Introduction
- 📋 Entities and Attributes
- 🔗 Enhanced Entity- Relationship Diagram
- MDB SQL Queries and Mathematical Notations
- ↗ Conclusion

# INTRODUCTION

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**Purpose:** Initiate sustainable waste management within the community.

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**Engagement:** Involve residents in effective waste segregation and recycling.

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**System:** Utilize a smart tracking system for optimized collection and processing.

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**Incentives:** Reward eco-friendly practices to encourage community participation.

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**Goal:** Build a legacy of environmental responsibility and stewardship.

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**Model-** Enhanced Entity Relationship- Diagram

## SCENARIO

1. A User selects Waste Type, which can be Organic Waste, Recyclable Waste, or Hazardous Waste for disposal.
2. The selected Waste Type is disposed of in the corresponding Bin, which could be an Organic Bin, Recyclable Bin, or Hazardous Bin.
3. The User sets a Collection Schedule for the preferred waste collection.
4. The Collection Schedule assigns a Vehicle for collecting the waste.
5. The Vehicle is operated by Collection Crew members.

6. The Bin is collected by the Collection Crew and, if necessary, sorted by Sorting Staff.
7. The Bin undergoes Processing, which includes a type, method, duration, and time.
8. The Processing activity processes the waste at the Waste Processing Facility.
9. The Facility Manager oversees operations at the Waste Processing Facility.
10. The Waste Processing Facility sends out Notifications, which may include Feedback Notifications and Reminder Notifications.
11. The Reward System is notified by Notifications and provides rewards to the User.

# ENTITIES AND ATTRIBUTES

1. **User** (UserID(PK), Fname, Mname, Fname, Street, Apt\_no, City, State, Zip, Birth\_date, Ssn, Sex)
2. **CollectionSchedule**(ScheduleID(PK), Date, Time, Frequency, Zone, UserID(FK), NextCollectionDate)
3. **Vehicle** ( VehicleID(PK), Type, Capacity, ServiceDate, AssignedDrivers, ScheduleID(FK))
4. **Worker** ( WorkerID(PK), WorkerFname, WorkerMname, WorkerLname, Salary, Birthdate, HireDate, YearsofService, Qualification)- **SUPERCLASS**
  - **CollectionCrew** (WorkerID, Route, VehicleID(FK))- **SUBCLASS**
  - **SortingStaff** (WorkerID, Shift, BinID(FK))- **SUBCLASS**
  - **FacilityManager**( WorkerID, Budget, FacilityID(FK))- **SUBCLASS**
5. **WasteType** (WasteID(PK), Description, Instruction, WasteTypeCategory, UserID(FK))- **SUPERCLASS**
  - **HazardousWaste**(WasteID, HandlingProcedures)- **SUBCLASS**
  - **RecyclableWaste**(WasteID, RecyclableMaterial)- **SUBCLASS**
  - **OrganicWaste**(WasteID, DecompositionRate)- **SUBCLASS**

# ENTITIES AND ATTRIBUTES

6. **Bin( BinID (PK) Street, City, State, Zip, Capacity, WasteID(FK))- SUPERCLASS**

- **HazardousBin (BinID, HazardousMaterialType)- SUBCLASS**
- **RecyclableBin(BinID, RecycleMaterialType) - SUBCLASS**
- **OrganicBin(BinID, CompostableMaterialType)- SUBCLASS**

7. **Processing( ProcessingType(PartialKey), Date, Method, StartTime, EndTime, Duration, BinID(FK))**

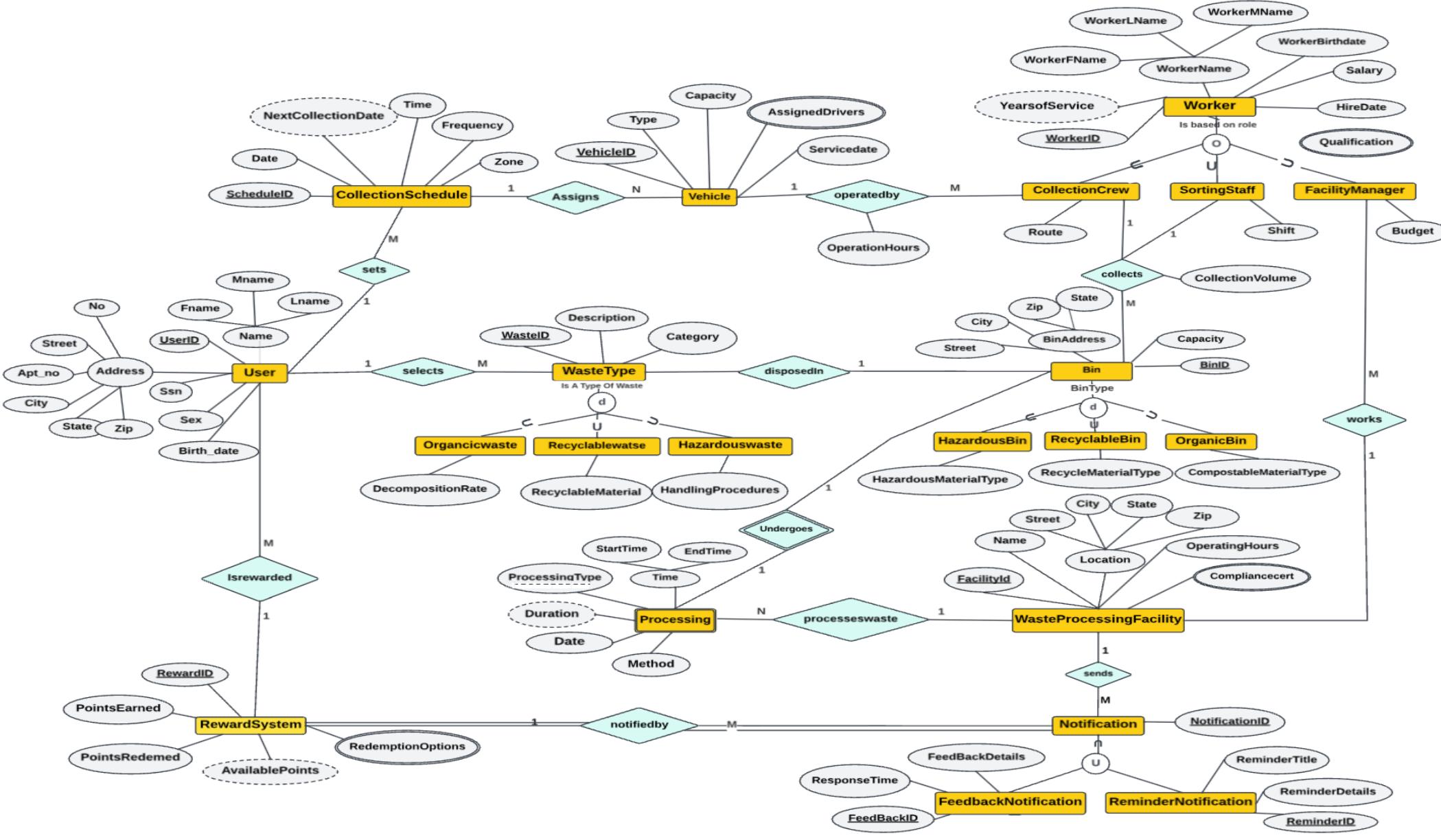
8. **WasteProcessingFacility( FacilityID(PK), Name , City, State, Zip, OperatingHours, ComplianceCert)**

9. **Notification ( NotificationID(PK), FeedBackID, ReminderID, FacilityID(FK))-CATEGORY(UNION)**

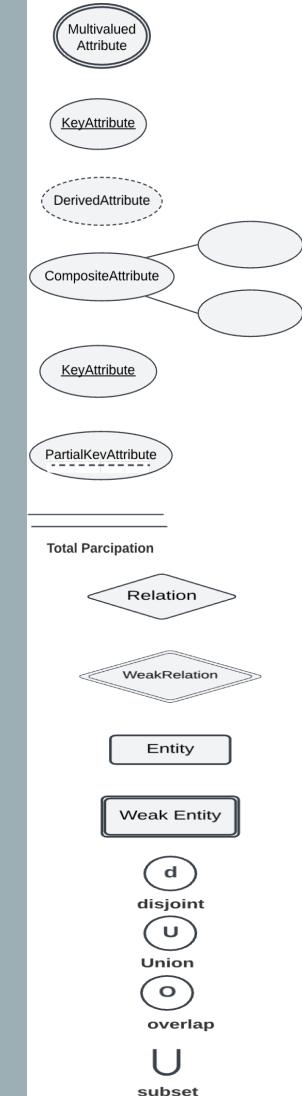
- **FeedbackNotification( FeedbackID, feedBackDetails, ResponseTime)- SUPERCLASS**
- **ReminderNotification( ReminderID, ReminderTitle, ReminderDetails)- SUPERCLASS**

10. **RewardSystem(RewardID(PK), PointsEarned, PointsRedeemed, AvailablePoints, RedemptionOptions, NotificationID(FK))**

# ENHANCED ENTITY-RELATIONSHIP DIAGRAM



## LEGENDS



# TABLES

```
MariaDB [20027af]> select * from Worker;
```

WorkerID	WorkerFName	WorkerMname	WorkerLname	Salary	Birthdate	HireDate	YearsofService	Qualification	WorkerType
1	John	A	Smith	50000.00	1980-05-15	2020-02-10	2	Bachelor of Science, Master of Arts	CollectionCrew
2	Jane	B	Doe	55000.00	1985-08-20	2019-03-22	3	Bachelor of Engineering, Master of Arts	SortingStaff
3	Robert	C	Johnson	60000.00	1975-12-10	2018-01-05	4	Bachelor of Engineering, Master of Business Administration	FacultyManager
4	Michael	D	Brown	52000.00	1990-03-25	2021-06-15	1	Bachelor of Arts, Master of Business Administration	CollectionCrew
5	Sarah	E	Williams	54000.00	1988-11-30	2017-05-12	4	Bachelor of Science, Master of Business Administration	SortingStaff
6	David	F	Miller	58000.00	1979-07-18	2019-11-08	2	High School Diploma, Bachelor of Science	FacultyManager
7	Emily	G	Jones	51000.00	1992-09-03	2022-03-20	0	High School Diploma	CollectionCrew
8	Christopher	H	Davis	53000.00	1991-02-12	2020-08-30	1	Bachelor of Arts, Ph.D. in Engineering	SortingStaff
9	Maria	I	Wilson	62000.00	1972-04-28	2015-12-10	6	Ph.D. in Engineering	FacultyManager
10	William	J	Lee	51000.00	1993-12-08	2022-01-25	0	High School Diploma	CollectionCrew
11	Amanda	K	Anderson	56000.00	1987-06-02	2016-08-05	5	Bachelor of Science	SortingStaff
12	Daniel	L	Moore	59000.00	1977-03-17	2017-02-18	4	Master of Business Administration	FacultyManager
13	Olivia	M	Taylor	50000.00	1994-10-22	2022-06-10	0	High School Diploma	CollectionCrew
14	Matthew	N	Clark	52000.00	1990-08-15	2021-09-14	1	Bachelor of Arts	SortingStaff
15	Sophia	O	White	61000.00	1973-01-12	2014-04-05	7	Ph.D. in Environmental Science	FacultyManager
16	Feven	A	Araya	50000.00	1980-05-15	2020-02-10	2	Bachelor of Science, Master of Arts	CollectionCrew

```
16 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from User;
```

UserID	Fname	Mname	Lname	Street	Apt_no	City	State	Zip	Birth_date	Ssn	Sex
16	John	A	Doe	123 Main St	101	Los Angeles	California	12345	1990-01-01	111-22-3333	M
17	Jane	B	Smith	456 Elm St	202	New York	New York	23456	1992-02-02	222-33-4444	F
18	Alice	C	Johnson	789 Oak St	303	Chicago	Illinois	34567	1993-03-03	333-44-5555	F
19	Bob	D	Brown	101 Pine St	404	Houston	Texas	45678	1991-04-04	444-55-6666	M
20	Carol	E	White	202 Birch St	505	Phoenix	Arizona	56789	1988-05-05	555-66-7777	F
21	David	F	Black	303 Cedar St	606	Philadelphia	Pennsylvania	67890	1987-06-06	666-77-8888	M
22	Eva	G	Green	404 Spruce St	707	San Antonio	Texas	78901	1989-07-07	777-88-9999	F
23	Frank	H	Hall	505 Maple St	808	San Diego	California	89012	1985-08-08	888-99-0000	M
24	Grace	I	Lee	606 Walnut St	909	Dallas	Texas	90123	1984-09-09	999-00-1111	F
25	Henry	J	Park	707 Cherry St	1010	San Jose	California	01234	1983-10-10	000-11-2222	M
26	Isabel	K	Adams	808 Peach St	1111	Austin	Texas	12340	1982-11-11	123-45-6789	F
27	Jacob	L	Knight	909 Plum St	1212	Jacksonville	Florida	23450	1981-12-12	234-56-7890	M
28	Laura	M	Bishop	111 Berry St	1313	San Francisco	California	34560	1990-06-13	345-67-8901	F
29	Michael	N	Carter	222 Grape St	1414	Columbus	Ohio	45670	1989-05-14	456-78-9012	M
30	Natalie	O	Dixon	333 Melon St	1515	Fort Worth	Texas	56780	1988-04-15	567-89-0123	F

```
15 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from CollectionSchedule;
```

ScheduleID	Date	Time	Frequency	Zone	UserID	NextCollectionDate
11	2023-12-10	08:00:00	Daily	Zone A	25	2023-12-11
12	2023-12-15	14:30:00	Monthly	Zone B	16	2024-01-15
13	2023-12-20	10:00:00	Weekly	Zone C	26	2023-12-27
14	2023-12-25	09:45:00	Monthly	Zone A	17	2024-01-25
15	2023-12-30	13:15:00	Weekly	Zone B	27	2024-01-06
16	2024-01-05	11:30:00	Monthly	Zone C	18	2024-02-05
17	2024-01-10	08:00:00	Weekly	Zone A	28	2024-01-17
18	2024-01-15	14:30:00	Monthly	Zone B	19	2024-02-15
19	2024-01-20	10:00:00	Weekly	Zone C	29	2024-01-27
20	2024-01-25	09:45:00	Monthly	Zone A	20	2024-02-25

```
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from Vehicle;
```

VehicleID	Type	Capacity	ServiceDate	AssignedDrivers	ScheduleID
11	Truck	5000	2023-12-10	Driver1, Driver2	12
12	Van	3000	2023-12-15	Driver3	14
13	Truck	5000	2023-12-20	Driver4	16
14	Car	1500	2023-12-25	Driver5, Driver6	18
15	Van	3000	2023-12-30	Driver7	20
16	Truck	5000	2024-01-05	Driver8	11
17	Car	1500	2024-01-10	Driver9, Driver10	13
18	Van	3000	2024-01-15	Driver11	15
19	Truck	5000	2024-01-20	Driver12	17
20	Car	1500	2024-01-25	Driver13, Driver14	19

```
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from WasteType;
```

WasteID	Description	Instruction	WasteTypeCategory	UserID
1	Chemical Waste	Handle with care and use protective gear	Hazardous	25
2	Paper Waste	Recycle with paper products	Recyclable	16
3	Food Waste	Compost in a designated bin	Organic	26
4	Medical Waste	Handle with extreme care and dispose of as per health regulations	Hazardous	17
5	Metal Waste	Recycle with metal products	Recyclable	27
6	Garden Waste	Compost in a designated bin	Organic	18
7	Electronic Waste	Dispose of at electronic waste collection points	Hazardous	28
8	Plastic Waste	Recycle with plastic products	Recyclable	19
9	Wood Waste	Can be used for composting or woodworking	Organic	29
10	Paint Waste	Dispose of according to hazardous waste regulations	Hazardous	20
11	Glass Waste	Recycle with glass products	Recyclable	30
12	Textile Waste	Donate or recycle old textiles	Recyclable	21
13	Yard Waste	Compost yard waste	Organic	22
14	Batteries	Dispose of at battery recycling centers	Hazardous	23
15	Aluminum Cans	Recycle aluminum cans	Recyclable	24
16	Kitchen Scraps	Compost kitchen scraps	Organic	25
17	Electrical Appliances	Dispose of at electronic waste collection points	Hazardous	16
18	PET Bottles	Recycle PET bottles	Recyclable	26
19	Leaves and Grass	Compost leaves and grass	Organic	17

```
19 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from CollectionCrew;
+-----+-----+-----+
| WorkerID | Route    | VehicleID |
+-----+-----+-----+
|      1   | Route 1  |       16  |
|      4   | Route 2  |       11  |
|      7   | Route 3  |       17  |
|     10   | Route 4  |       12  |
|     13   | Route 5  |       18  |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [20027af]> select * from SortingStaff;
+-----+-----+-----+
| WorkerID | Shift          | BinID |
+-----+-----+-----+
|      2   | Morning Shift  |       1  |
|      5   | Evening Shift |       4  |
|      8   | Night Shift   |       7  |
|     11   | Morning Shift |      10  |
|     14   | Evening Shift |      13  |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [20027af]> select * from FacilityManager;
+-----+-----+-----+
| WorkerID | Budget        | FacilityID |
+-----+-----+-----+
|      3   | 100000.00    |       1  |
|      6   | 120000.00    |       2  |
|      9   | 90000.00     |       3  |
|     12   | 110000.00    |       4  |
|     15   | 130000.00    |       5  |
+-----+-----+-----+
5 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from HazardousWaste;
```

WasteID	HandlingProcedures
1	Handle with care and use protective gear
4	Handle with extreme care and dispose of as per health regulations
7	Dispose of according to hazardous waste regulations
10	Handle with care and use protective gear
13	Handle with extreme care and dispose of as per health regulations
16	Dispose of according to hazardous waste regulations

6 rows in set (0.000 sec)

```
MariaDB [20027af]> select * from RecyclableWaste;
```

WasteID	RecyclableMaterial
2	Recycle with paper products
5	Recycle with metal products
8	Recycle with plastic products
11	Recycle with paper products
14	Recycle with metal products
17	Recycle with plastic products

6 rows in set (0.000 sec)

```
MariaDB [20027af]> select * from OrganicWaste;
```

WasteID	DecompositionRate
3	Compost in a designated bin
6	Compost in a designated bin
9	Can be used for composting or woodworking
12	Compost in a designated bin
15	Compost in a designated bin
18	Can be used for composting or woodworking

6 rows in set (0.000 sec)

```
MariaDB [20027af]> select * from Bin;
```

BinID	Street	City	State	Zip	Capacity	WasteID
1	123 Main St	Los Angeles	California	90001	100	1
2	456 Elm St	Dallas	Texas	75001	150	2
3	789 Oak St	Jacksonville	Florida	32004	200	3
4	101 Pine St	New York City	New York	10001	120	1
5	202 Maple St	Chicago	Illinois	60007	180	2
6	303 Cedar St	Philadelphia	Pennsylvania	19019	90	3
7	404 Walnut St	Atlanta	Georgia	30301	130	1
8	505 Birch St	Seattle	Washington	98001	110	2
9	606 Redwood St	Boston	Massachusetts	02101	160	3
10	707 Sequoia St	Phoenix	Arizona	85001	140	1
11	808 Aspen St	Detroit	Michigan	48001	70	2
12	909 Cedar St	Columbus	Ohio	43001	200	3
13	1010 Pine St	Charlotte	North Carolina	27006	220	1
14	1111 Oak St	Richmond	Virginia	22001	180	2
15	1212 Elm St	Baltimore	Maryland	21201	250	3
16	1313 Maple St	Denver	Colorado	80001	120	1
17	1414 Birch St	Portland	Oregon	97001	190	2
18	1515 Redwood St	Las Vegas	Nevada	89001	110	3
19	1616 Walnut St	Milwaukee	Wisconsin	53001	170	1
20	1717 Sequoia St	Minneapolis	Minnesota	55001	130	2

```
20 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from HazardousBin;
+-----+
| BinID | HazardousMaterialType |
+-----+
|    1 | Toxic Waste
|    2 | Chemical Waste
|    4 | Hazardous Materials
|   12 | Chemical Waste
|   14 | Radioactive Materials
|   16 | Biological Hazard
|   18 | Toxic Substances
+-----+
7 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from RecyclableBin;
+-----+
| BinID | RecycleMaterialType |
+-----+
|    3 | Paper
|    5 | Plastic
|    7 | Glass
|    9 | Metal
|   11 | Cardboard
|   13 | Electronics
|   15 | Glass
|   17 | Plastic
+-----+
8 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from OrganicBin;
+-----+
| BinID | CompostableMaterialType |
+-----+
|    6 | Food Waste
|    8 | Yard Waste
|   10 | Organic Debris
|   19 | Kitchen Scraps
|   20 | Leaves and Branches
+-----+
5 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from Processing;
```

ProcessingType	Date	Method	StartTime	EndTime	Duration	BinID
1	2023-12-10	Recycling	08:00:00	10:30:00	02:30:00	1
1	2023-12-14	Recycling	09:30:00	11:15:00	01:45:00	3
1	2023-12-20	Incineration	15:00:00	16:45:00	01:45:00	6
1	2023-12-24	Composting	11:00:00	12:15:00	01:15:00	8
2	2023-12-12	Incineration	14:00:00	16:30:00	02:30:00	2
2	2023-12-18	Recycling	08:30:00	10:00:00	01:30:00	5
2	2023-12-26	Recycling	07:45:00	09:30:00	01:45:00	9
3	2023-12-16	Composting	10:45:00	12:00:00	01:15:00	4
3	2023-12-22	Recycling	09:15:00	11:30:00	02:15:00	7
3	2023-12-28	Incineration	14:15:00	16:00:00	01:45:00	10

```
[10 rows in set (0.000 sec)]
```

```
MariaDB [20027af]> select * from WasteProcessingFacility;
```

FacilityID	Name	City	State	Zip	OperatingHours	ComplianceCert
1	Green Recycle Hub	Sacramento	CA	12345	9:00 AM - 5:00 PM	RecycleCert123, HealthSafetyCert456
2	Eco Waste Solutions	Austin	TX	23456	8:00 AM - 4:00 PM	EnviroCert789, WasteHandlerCert101
3	Urban Recycling Center	Chicago	IL	34567	10:00 AM - 6:00 PM	ComplianceCert202, SafetyCert303
4	Clean Energy Processors	Miami	FL	45678	9:30 AM - 5:30 PM	EnergyCert404, QualityCert505
5	Eco-Friendly Disposal	Seattle	WA	56789	7:30 AM - 3:30 PM	EcoCert606, HealthCert707
6	Renewable Waste Management	Denver	CO	67890	8:30 AM - 4:30 PM	RenewCert808, SafetyCert909
7	Sustainable Waste Services	Boston	MA	78901	9:00 AM - 5:00 PM	SustainCert010, EnviroHealthCert111
8	Advanced Recycling Plant	San Francisco	CA	89012	8:00 AM - 4:00 PM	AdvancedCert212, QualityAssuranceCert313
9	EcoMax Waste Handlers	Las Vegas	NV	90123	10:00 AM - 6:00 PM	MaxCert414, ComplianceMaxCert515
10	GreenTech Recycling Facility	New York	NY	01234	9:30 AM - 5:30 PM	TechCert616, HealthComplianceCert717

```
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from Notification;
+-----+-----+-----+-----+
| NotificationID | FeedBackID | ReminderID | FacilityID |
+-----+-----+-----+-----+
| 1 | 1 | 1 | 1 |
| 2 | 2 | 2 | 1 |
| 3 | 3 | 3 | 2 |
| 4 | 4 | 4 | 2 |
| 5 | 5 | 5 | 3 |
| 6 | 6 | 6 | 3 |
| 7 | 7 | 7 | 4 |
| 8 | 8 | 8 | 4 |
| 9 | 9 | 9 | 5 |
| 10 | 10 | 10 | 5 |
+-----+-----+-----+
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from RewardSystem;
```

RewardID	PointsEarned	PointsRedeemed	AvailablePoints	RedemptionOptions	NotificationID
1	1000	100	900	10% discount on electronics	1
2	2000	200	1800	Free shipping on next order	2
3	3000	300	2700	VIP access to sale events	3
4	4000	400	3600	Double points on next purchase	4
5	5000	500	4500	Free eco-friendly tote bag	5
6	6000	600	5400	Complimentary product sample pack	6
7	7000	700	6300	Priority customer support	7
8	8000	800	7200	Extended warranty on products	8
9	9000	900	8100	Invitation to exclusive webinars	9
10	10000	1000	9000	Early bird access to new products	10

```
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from FeedbackNotification;
```

FeedBackID	FeedBackDetails	ResponseTime
1	Waste processing efficiency improved by 10% this month.	2023-12-05 00:26:44
2	Achieved 95% recycling rate, exceeding our target.	2023-12-05 00:26:44
3	New sorting technology has reduced processing time by 20%.	2023-12-05 00:26:44
4	Energy consumption in waste processing reduced by 15% this quarter.	2023-12-05 00:26:44
5	High purity of recycled materials achieved through better processing.	2023-12-05 00:26:44
6	Waste processing facility now operating at full capacity with minimal downtime.	2023-12-05 00:26:44
7	Significant reduction in carbon emissions due to optimized waste processing.	2023-12-05 00:26:44
8	Increased user participation in recycling programs following reward system implementation.	2023-12-05 00:26:44
9	Successful conversion of 60% of waste to reusable materials this month.	2023-12-05 00:26:44
10	Effective management of hazardous waste materials observed.	2023-12-05 00:26:44

```
10 rows in set (0.000 sec)
```

```
MariaDB [20027af]> select * from ReminderNotification;
```

ReminderID	ReminderTitle	ReminderDetails
1	Waste Processing Complete	Remind reward system to allocate points for processed waste.
2	Waste Processed	Notify reward system: waste processing done, time to award points.
3	Rewards for Waste Processing	Processed waste. Update reward system to give out points.
4	Points for Processed Waste	Waste processing completed. Trigger points distribution.
5	Waste Processing Rewards	Inform reward system: Waste processed, allocate points.
6	Allocate Points	Waste successfully processed. Update reward system for point allocation.
7	Reward Update	Waste processing finished, remind to update user points.
8	Waste-to-Points Reminder	Processed waste ready, prompt reward system for point distribution.
9	Points for Processing	Waste processing task completed. Time to award user points.
10	Waste Processed: Reward Time	Notify reward system: Waste processed, allocate rewards.

```
10 rows in set (0.000 sec)
```

# 5 BASIC COMMANDS

5 MATHEMATICAL NOTATIONS

1. Retrieves all rows from the RewardSystem table where the value in the PointsEarned column greater than 5000, resulting in a list of rewards with earned points exceeding this threshold.

```
MariaDB [20027af]> SELECT * FROM RewardSystem WHERE PointsEarned > 5000;
+-----+-----+-----+-----+-----+
| RewardID | PointsEarned | PointsRedeemed | AvailablePoints | RedemptionOptions           | NotificationID |
+-----+-----+-----+-----+-----+
|      6 |       6000 |         600 |        5400 | Complimentary product sample pack |          6 |
|      7 |       7000 |         700 |        6300 | Priority customer support       |          7 |
|      8 |       8000 |         800 |        7200 | Extended warranty on products   |          8 |
|      9 |       9000 |         900 |        8100 | Invitation to exclusive webinars|          9 |
|     10 |      10000 |        1000 |        9000 | Early bird access to new products|         10 |
+-----+-----+-----+-----+-----+
5 rows in set (0.000 sec)
```

$\sigma_{\text{PointsEarned} > 5000}(\text{RewardSystem})$

2. Retrieve WorkerID from three different tables—CollectionCrew, SortingStaff, and FacilityManager—into a single list, appending a literal string to each ID indicating the department it originates from. It uses the UNION operator to ensure that all WorkerIDs are unique in the final result set, removing any duplicates.

```
MariaDB [20027af]> SELECT WorkerID, 'CollectionCrew' AS Department FROM CollectionCrew
-> UNION
-> SELECT WorkerID, 'SortingStaff' FROM SortingStaff
-> UNION
-> SELECT WorkerID, 'FacilityManager' FROM FacilityManager;
+-----+-----+
| WorkerID | Department |
+-----+-----+
|      4   | CollectionCrew |
|     10   | CollectionCrew |
|      1   | CollectionCrew |
|      7   | CollectionCrew |
|     13   | CollectionCrew |
|      2   | SortingStaff    |
|      5   | SortingStaff    |
|      8   | SortingStaff    |
|     11   | SortingStaff    |
|     14   | SortingStaff    |
|      3   | FacilityManager |
|      6   | FacilityManager |
|      9   | FacilityManager |
|     12   | FacilityManager |
|     15   | FacilityManager |
+-----+-----+
15 rows in set (0.000 sec)
```

$$\begin{aligned} &\pi_{\text{WorkerID}, \text{'CollectionCrew'}} \rightarrow \text{Department} (\text{CollectionCrew}) \\ \cup \\ &\pi_{\text{WorkerID}, \text{'SortingStaff'}} \rightarrow \text{Department} (\text{SortingStaff}) \\ \cup \\ &\pi_{\text{WorkerID}, \text{'FacilityManager'}} \rightarrow \text{Department} (\text{FacilityManager}) \end{aligned}$$

3. Retrieve the total earned points and redemption options for rewards in the RewardSystem table where the redemption options include the word 'discount'. It then orders the results in descending order of net points, displaying the highest net points reward with a discount option of "10% discount on electronics".

```
MariaDB [20027af]> SELECT RewardID, SUM(PointsEarned) As NetPoints ,RedemptionOptions
-> FROM RewardSystem
-> WHERE RedemptionOptions LIKE '%discount%'
-> ORDER BY NetPoints DESC;
+-----+-----+
| RewardID | NetPoints | RedemptionOptions           |
+-----+-----+
|       1 |      1000 | 10% discount on electronics |
+-----+-----+
1 row in set (0.000 sec)
```

$$\tau_{NetPoints \text{ DESC}} \left( \pi_{RewardID, SUM(PointsEarned) AS NetPoints, RedemptionOptions} : \left( \sigma_{RedemptionOptions \text{ LIKE } \%discount\%} (RewardSystem) \right) \right)$$

4. Calculate the average duration in seconds for different processing methods in the Processing table, considering only methods with a total duration exceeding 5 hours (18000 seconds). It then orders the results in descending order of average duration in seconds, displaying "Incineration" and "Recycling" as the methods with the highest average durations.

```
MariaDB [20027af]> SELECT Method, ROUND(AVG(TIME_TO_SEC(Duration)), 2) AS AvgDurationSeconds
-> FROM Processing
-> GROUP BY Method
-> HAVING SUM(TIME_TO_SEC(Duration)) > 18000
-> ORDER BY AvgDurationSeconds DESC;
+-----+-----+
| Method | AvgDurationSeconds |
+-----+-----+
| Incineration | 7200.00 |
| Recycling | 7020.00 |
+-----+-----+
2 rows in set (0.001 sec)
```

$$\tau_{\text{AvgDurationSeconds DESC}}(\sigma_{\text{TotalDurationSeconds} > 18000}(\mathcal{G}_{\text{Method}; \text{AVG}(\text{Duration}) \rightarrow \text{AvgDurationSeconds}}(\text{Processing})))$$

5. Retrieve details from the WasteProcessingFacility table, specifically for facilities located in 'Chicago', and renames the columns for clarity and to prevent ambiguity in attribute names. It uses aliasing by referring to WasteProcessingFacility as f, allowing for concise notation and resolving any potential conflicts with similar column names in other tables or subqueries

```
MariaDB [20027af]> SELECT
->     f.FacilityID AS FID,
->     f.Name AS FacilityName,
->     f.City AS FacilityCity,
->     f.State AS FacilityState,
->     f.Zip AS PostalCode,
->     f.OperatingHours AS HoursOfOperation,
->     f.ComplianceCert AS Certifications
-> FROM
->     WasteProcessingFacility AS f
-> WHERE
->     f.City = 'Chicago ';
```

FID	FacilityName	FacilityCity	FacilityState	PostalCode	HoursOfOperation	Certifications
3	Urban Recycling Center	Chicago	IL	34567	10:00 AM - 6:00 PM	ComplianceCert202, SafetyCert303

1 row in set (0.000 sec)

$\pi_{\text{FacilityID} \rightarrow \text{FID}, \text{Name} \rightarrow \text{FacilityName}, \text{City} \rightarrow \text{FacilityCity}, \text{State} \rightarrow \text{FacilityState}, \text{Zip} \rightarrow \text{PostalCode}, \text{OperatingHours} \rightarrow \text{HoursOfOperation}, \text{ComplianceCert} \rightarrow \text{Certifications}}(\sigma_{\text{City}='Chicago'}(\text{WasteProcessingFacility}))$

# 5 INTERMEDIATE COMMANDS

1 MATHEMATICAL NOTATION

1. Retrieve data from the "User" and "CollectionSchedule" tables using a natural join, which combines rows where the values in the common columns match. It selects the "UserID," "Fname," and "Lname" from the "User" table and the "Date" and "Time" from the "CollectionSchedule" table, providing a list of users along with their scheduled collection dates and times.

```
MariaDB [20027af]> SELECT User.UserID, User.Fname, User.Lname, CollectionSchedule.Date, CollectionSchedule.Time
-> FROM User
-> NATURAL JOIN CollectionSchedule;
+-----+-----+-----+-----+-----+
| UserID | Fname | Lname | Date   | Time   |
+-----+-----+-----+-----+-----+
|    25  | Henry  | Park  | 2023-12-10 | 08:00:00 |
|    16  | John   | Doe   | 2023-12-15 | 14:30:00 |
|    26  | Isabel | Adams | 2023-12-20 | 10:00:00 |
|    17  | Jane   | Smith | 2023-12-25 | 09:45:00 |
|    27  | Jacob  | Knight | 2023-12-30 | 13:15:00 |
|    18  | Alice  | Johnson | 2024-01-05 | 11:30:00 |
|    28  | Laura  | Bishop  | 2024-01-10 | 08:00:00 |
|    19  | Bob    | Brown  | 2024-01-15 | 14:30:00 |
|    29  | Michael | Carter | 2024-01-20 | 10:00:00 |
|    20  | Carol  | White  | 2024-01-25 | 09:45:00 |
+-----+-----+-----+-----+-----+
10 rows in set (0.000 sec)
```

$$\pi_{\text{User.UserID}, \text{User.Fname}, \text{User.Lname}, \text{CollectionSchedule.Date}, \text{CollectionSchedule.Time}}((\text{User} \bowtie \text{CollectionSchedule}))$$

2. Use across join between the "RecyclableWaste" and "RecyclableBin" tables combines every row from the "RecyclableWaste" table with every row from the "RecyclableBin" table, resulting in a Cartesian product of all possible combinations.

WasteID	RecyclableMaterial	BinID	RecycleMaterialType
2	Recycle with paper products	3	Paper
5	Recycle with metal products	3	Paper
8	Recycle with plastic products	3	Paper
11	Recycle with paper products	3	Paper
14	Recycle with metal products	3	Paper
17	Recycle with plastic products	3	Paper
2	Recycle with paper products	5	Plastic
5	Recycle with metal products	5	Plastic
8	Recycle with plastic products	5	Plastic
11	Recycle with paper products	5	Plastic
14	Recycle with metal products	5	Plastic
17	Recycle with plastic products	5	Plastic
2	Recycle with paper products	7	Glass
5	Recycle with metal products	7	Glass
8	Recycle with plastic products	7	Glass
11	Recycle with paper products	7	Glass
14	Recycle with metal products	7	Glass
17	Recycle with plastic products	7	Glass
2	Recycle with paper products	9	Metal
5	Recycle with metal products	9	Metal
8	Recycle with plastic products	9	Metal
11	Recycle with paper products	9	Metal
14	Recycle with metal products	9	Metal
17	Recycle with plastic products	9	Metal
2	Recycle with paper products	11	Cardboard
5	Recycle with metal products	11	Cardboard
8	Recycle with plastic products	11	Cardboard
11	Recycle with paper products	11	Cardboard
14	Recycle with metal products	11	Cardboard
17	Recycle with plastic products	11	Cardboard
2	Recycle with paper products	13	Electronics
5	Recycle with metal products	13	Electronics
8	Recycle with plastic products	13	Electronics
11	Recycle with paper products	13	Electronics
14	Recycle with metal products	13	Electronics
17	Recycle with plastic products	13	Electronics
2	Recycle with paper products	15	Glass
5	Recycle with metal products	15	Glass
8	Recycle with plastic products	15	Glass
11	Recycle with paper products	15	Glass
14	Recycle with metal products	15	Glass
17	Recycle with plastic products	15	Glass
2	Recycle with paper products	17	Plastic
5	Recycle with metal products	17	Plastic
8	Recycle with plastic products	17	Plastic
11	Recycle with paper products	17	Plastic
14	Recycle with metal products	17	Plastic
17	Recycle with plastic products	17	Plastic

3. Retrieve all rows from the Notification table and combines them with matching rows from the RewardSystem table using a right join based on the NotificationID column, resulting in a result set that includes all rows from the RewardSystem table and matching rows from the Notification table.

RewardID	PointsEarned	PointsRedeemed	AvailablePoints	RedemptionOptions	NotificationID	NotificationID	FeedBackID	ReminderID	FacilityID
1	1000	100	900	10% discount on electronics	1	1	1	1	1
2	2000	200	1800	Free shipping on next order	2	2	2	2	1
3	3000	300	2700	VIP access to sale events	3	3	3	3	2
4	4000	400	3600	Double points on next purchase	4	4	4	4	2
5	5000	500	4500	Free eco-friendly tote bag	5	5	5	5	3
6	6000	600	5400	Complimentary product sample pack	6	6	6	6	3
7	7000	700	6300	Priority customer support	7	7	7	7	4
8	8000	800	7200	Extended warranty on products	8	8	8	8	4
9	9000	900	8100	Invitation to exclusive webinars	9	9	9	9	5
10	10000	1000	9000	Early bird access to new products	10	10	10	10	5

10 rows in set (0.000 sec)

4. This SQL query in MariaDB performs a left join between the User and WasteType tables, matching them on the UserID field. It results in a list showing each user with their associated waste type(s), including users without a corresponding waste type entry.

```
[MariaDB [20027af]> Select User.UserID , User.Fname ,User.Mname, User.Lname,WasteType.WasteID,WasteType.Description
[   -> from User
[   -> Left Join WasteType ON User.UserID= WasteType.UserID;
+-----+-----+-----+-----+-----+-----+
| UserID | Fname | Mname | Lname | WasteID | Description      |
+-----+-----+-----+-----+-----+-----+
|    16  | John   | A     | Doe   |      2 | Paper Waste
|    16  | John   | A     | Doe   |     17 | Electrical Appliances
|    17  | Jane   | B     | Smith |      4 | Medical Waste
|    17  | Jane   | B     | Smith |     19 | Leaves and Grass
|    18  | Alice  | C     | Johnson |     6 | Garden Waste
|    19  | Bob    | D     | Brown  |     8 | Plastic Waste
|    20  | Carol  | E     | White  |    10 | Paint Waste
|    21  | David  | F     | Black  |    12 | Textile Waste
|    22  | Eva    | G     | Green  |    13 | Yard Waste
|    23  | Frank  | H     | Hall   |    14 | Batteries
|    24  | Grace  | I     | Lee    |    15 | Aluminum Cans
|    25  | Henry  | J     | Park   |      1 | Chemical Waste
|    25  | Henry  | J     | Park   |    16 | Kitchen Scraps
|    26  | Isabel | K     | Adams  |      3 | Food Waste
|    26  | Isabel | K     | Adams  |    18 | PET Bottles
|    27  | Jacob  | L     | Knight |      5 | Metal Waste
|    28  | Laura  | M     | Bishop |      7 | Electronic Waste
|    29  | Michael | N    | Carter |      9 | Wood Waste
|   30   | Natalie | O     | Dixon  |     11 | Glass Waste
+-----+-----+-----+-----+-----+-----+
19 rows in set (0.000 sec)
```

5. The SQL query retrieves a combined list of details about waste processing by joining two tables, Processing and WasteProcessingFacility, on their common BinID and FacilityID fields. It displays the type of processing, the date it occurred, the method used, along with the facility's ID, name, operating hours, and compliance certifications for each processing record.

```
MariaDB [20027af]> select Processing.ProcessingType, Processing.Date, Processing.Method, WasteProcessingFacility.FacilityID,WasteProcessingFacility.Name,
    WasteProcessingFacility.OperatingHours, WasteProcessingFacility.ComplianceCert
    -> From Processing INNER JOIN WasteProcessingFacility ON Processing.BinID= WasteProcessingFacility.FacilityID;
+-----+-----+-----+-----+-----+-----+
| ProcessingType | Date      | Method     | FacilityID | Name                  | OperatingHours | ComplianceCert
+-----+-----+-----+-----+-----+-----+
| 1 | 2023-12-10 | Recycling | 1 | Green Recycle Hub | 9:00 AM - 5:00 PM | RecycleCert123, HealthSafetyCert456
| 1 | 2023-12-14 | Recycling | 3 | Urban Recycling Center | 10:00 AM - 6:00 PM | ComplianceCert202, SafetyCert303
| 1 | 2023-12-20 | Incineration | 6 | Renewable Waste Management | 8:30 AM - 4:30 PM | RenewCert808, SafetyCert909
| 1 | 2023-12-24 | Composting | 8 | Advanced Recycling Plant | 8:00 AM - 4:00 PM | AdvancedCert212, QualityAssuranceCert313
| 2 | 2023-12-12 | Incineration | 2 | Eco Waste Solutions | 8:00 AM - 4:00 PM | EnviroCert789, WasteHandlerCert101
| 2 | 2023-12-18 | Recycling | 5 | Eco-Friendly Disposal | 7:30 AM - 3:30 PM | EcoCert606, HealthCert707
| 2 | 2023-12-26 | Recycling | 9 | EcoMax Waste Handlers | 10:00 AM - 6:00 PM | MaxCert414, ComplianceMaxCert515
| 3 | 2023-12-16 | Composting | 4 | Clean Energy Processors | 9:30 AM - 5:30 PM | EnergyCert404, QualityCert505
| 3 | 2023-12-22 | Recycling | 7 | Sustainable Waste Services | 9:00 AM - 5:00 PM | SustainCert010, EnviroHealthCert111
| 3 | 2023-12-28 | Incineration | 10 | GreenTech Recycling Facility | 9:30 AM - 5:30 PM | TechCert616, HealthComplianceCert717
+-----+-----+-----+-----+-----+
+
10 rows in set (0.000 sec)
```

# ADVANCED COMMANDS

1 MATHEMATICAL NOTATION

1. Use a three-way join that retrieves data from the "CollectionSchedule" and a derived table "vcc" that combines information from the "Vehicle" and "CollectionCrew" tables. It matches rows where the "ScheduleID" in both tables are equal, providing details about collection schedules and the associated vehicles, drivers, and routes.

```
MariaDB [20027af]> SELECT CS.*, VCC.*
```

```
-> FROM CollectionSchedule CS
-> INNER JOIN (
->     SELECT V.*, CC.WorkerID, CC.Route
->     FROM Vehicle V
->     LEFT JOIN CollectionCrew CC ON V.VehicleID = CC.VehicleID
-> ) AS VCC ON CS.ScheduleID = VCC.ScheduleID;
```

ScheduleID	Date	Time	Frequency	Zone	UserID	NextCollectionDate	VehicleID	Type	Capacity	ServiceDate	AssignedDrivers	ScheduleID	WorkerID	Route
11	2023-12-10	08:00:00	Daily	Zone A	25	2023-12-11	16	Truck	5000	2024-01-05	Driver8	11	1	Route 1
12	2023-12-15	14:30:00	Monthly	Zone B	16	2024-01-15	11	Truck	5000	2023-12-10	Driver1, Driver2	12	4	Route 2
13	2023-12-20	10:00:00	Weekly	Zone C	26	2023-12-27	17	Car	1500	2024-01-10	Driver9, Driver10	13	7	Route 3
14	2023-12-25	09:45:00	Monthly	Zone A	17	2024-01-25	12	Van	3000	2023-12-15	Driver3	14	10	Route 4
15	2023-12-30	13:15:00	Weekly	Zone B	27	2024-01-06	18	Van	3000	2024-01-15	Driver11	15	13	Route 5
16	2024-01-05	11:30:00	Monthly	Zone C	18	2024-02-05	13	Truck	5000	2023-12-20	Driver4	16	NULL	NULL
18	2024-01-15	14:30:00	Monthly	Zone B	19	2024-02-15	14	Car	1500	2023-12-25	Driver5, Driver6	18	NULL	NULL
20	2024-01-25	09:45:00	Monthly	Zone A	20	2024-02-25	15	Van	3000	2023-12-30	Driver7	20	NULL	NULL
17	2024-01-10	08:00:00	Weekly	Zone A	28	2024-01-17	19	Truck	5000	2024-01-20	Driver12	17	NULL	NULL
19	2024-01-20	10:00:00	Weekly	Zone C	29	2024-01-27	20	Car	1500	2024-01-25	Driver13, Driver14	19	NULL	NULL

```
10 rows in set (0.001 sec)
```

2. Use a five-way join that retrieves data from multiple tables, including "RewardSystem," "Notification," "User," "Processing," and "WasteProcessingFacility," and performs several nested joins to link these tables together. It combines information about rewards, notifications, users, processing facilities, and processing methods, creating a comprehensive dataset with various attributes.

```
MariaDB [20027af]> SELECT
->   RN.RewardID, RN.PointsEarned, RN.PointsRedeemed, RN.AvailablePoints,
->   RN.NotificationID, RN.FeedBackID, RN.ReminderID, RN.FacilityID,
->   UP.Ssn, UP.Sex,
->   WPF.Name, WPF.City, WPF.State, WPF.Zip,
->   P.ProcessingType, P.BinID
-> FROM
-> (
->   SELECT
->     RS.RewardID, RS.PointsEarned, RS.PointsRedeemed, RS.AvailablePoints,
->     N.NotificationID, N.FeedBackID, N.ReminderID, N.FacilityID
->   FROM
->     RewardSystem RS
->     INNER JOIN Notification N ON RS.NotificationID = N.NotificationID
-> ) AS RN
-> LEFT JOIN
-> (
->   SELECT
->     U.UserID, U.Ssn, U.Sex, P.ProcessingType, P.BinID
->   FROM
->     User U
->     INNER JOIN Processing P ON U.UserID = P.BinID
-> ) AS UP ON RN.RewardID = UP.UserID
-> LEFT JOIN WasteProcessingFacility WPF ON RN.FacilityID = WPF.FacilityID
-> LEFT JOIN Processing P ON WPF.FacilityID = P.BinID;
```

RewardID	PointsEarned	PointsRedeemed	AvailablePoints	NotificationID	FeedBackID	ReminderID	FacilityID	Ssn	Sex	Name	City	State	Zip	ProcessingType	BinID
1	1000	100	900	1	1	1	1	NULL	NULL	Green Recycle Hub	Sacramento	CA	12345	1	1
2	2000	200	1800	2	2	2	1	NULL	NULL	Green Recycle Hub	Sacramento	CA	12345	1	1
3	3000	300	2700	3	3	3	2	NULL	NULL	Eco Waste Solutions	Austin	TX	23456	2	2
4	4000	400	3600	4	4	4	2	NULL	NULL	Eco Waste Solutions	Austin	TX	23456	2	2
5	5000	500	4500	5	5	5	3	NULL	NULL	Urban Recycling Center	Chicago	IL	34567	1	3
6	6000	600	5400	6	6	6	3	NULL	NULL	Urban Recycling Center	Chicago	IL	34567	1	3
7	7000	700	6300	7	7	7	4	NULL	NULL	Clean Energy Processors	Miami	FL	45678	3	4
8	8000	800	7200	8	8	8	4	NULL	NULL	Clean Energy Processors	Miami	FL	45678	3	4
9	9000	900	8100	9	9	9	5	NULL	NULL	Eco-Friendly Disposal	Seattle	WA	56789	2	5
10	10000	1000	9000	10	10	10	5	NULL	NULL	Eco-Friendly Disposal	Seattle	WA	56789	2	5

10 rows in set (0.001 sec)

3. The SQL query successfully performs a three-way join between the SortingStaff, Bin, and Processing tables, matching records by BinID. It presents a consolidated view that includes the worker ID, shift times, bin details, waste IDs, and processing information, revealing both the staffing and processing activities for each bin location, with nulls displayed for any bins without processing records.

```
5 rows in set (0.001 sec)

MariaDB [20027af]> SELECT StaffBin.WorkerID, StaffBin.Shift, StaffBin.BinID, StaffBin.Street, StaffBin.City, StaffBin.State, StaffBin.Zip, StaffBin.WasteID,
p.ProcessingType, p.Date, p.Method
-> FROM (
->     SELECT ss.WorkerID, ss.Shift, ss.BinID, b.Street, b.City, b.State, b.Zip, b.Capacity, b.WasteID
->     FROM SortingStaff ss
->     INNER JOIN Bin b ON ss.BinID = b.BinID
-> ) AS StaffBin
-> LEFT JOIN Processing p ON StaffBin.BinID = p.BinID;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| WorkerID | Shift      | BinID | Street       | City        | State       | Zip        | WasteID    | ProcessingType | Date        | Method      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      2 | Morning Shift |     1 | 123 Main St  | Los Angeles  | California  | 90001     | 1          | 1           | 2023-12-10   | Recycling   |
|      5 | Evening Shift |     4 | 101 Pine St   | New York City | New York   | 10001     | 1          | 3           | 2023-12-16   | Composting  |
|      8 | Night Shift   |     7 | 404 Walnut St | Atlanta     | Georgia    | 30301     | 1          | 3           | 2023-12-22   | Recycling   |
|     11 | Morning Shift |    10 | 707 Sequoia St | Phoenix    | Arizona    | 85001     | 1          | 3           | 2023-12-28   | Incineration |
|     14 | Evening Shift |    13 | 1010 Pine St   | Charlotte  | North Carolina | 27006     | 1          | NULL        | NULL        | NULL        |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)
```

$$\Pi_{WorkerID, Shift, BinID, Street, City, State, Zip, WasteID, ProcessingType, Date, Method} \left( (SS \bowtie_{SS.BinID=B.BinID} B) \bowtie_{StaffBin.BinID=P.BinID} P \right)$$

4. Use a four-way join in nested query made by a combination of inner and left outer joins involving the "User," "WasteType," "Bin," and "Processing" tables. It retrieves user information along with the description of waste types associated with users and, if available, the corresponding processing type from bins. The subquery is used to link waste types with processing information.

```
MariaDB [20027af]> SELECT U.UserID, U.Fname, U.Lname, WT.Description, Subquery.ProcessingType
--> FROM User AS U
--> INNER JOIN WasteType AS WT ON U.UserID = WT.UserID
--> LEFT OUTER JOIN (
-->     SELECT B.WasteID, B.BinID, P.ProcessingType
-->     FROM Bin AS B
-->     INNER JOIN Processing AS P ON B.BinID = P.BinID
--> ) AS Subquery ON WT.WasteID = Subquery.WasteID;
```

UserID	Fname	Lname	Description	ProcessingType
16	John	Doe	Paper Waste	2
16	John	Doe	Paper Waste	2
16	John	Doe	Paper Waste	1
16	John	Doe	Electrical Appliances	NULL
17	Jane	Smith	Medical Waste	NULL
17	Jane	Smith	Leaves and Grass	NULL
18	Alice	Johnson	Garden Waste	NULL
19	Bob	Brown	Plastic Waste	NULL
20	Carol	White	Paint Waste	NULL
21	David	Black	Textile Waste	NULL
22	Eva	Green	Yard Waste	NULL
23	Frank	Hall	Batteries	NULL
24	Grace	Lee	Aluminum Cans	NULL
25	Henry	Park	Chemical Waste	1
25	Henry	Park	Chemical Waste	3
25	Henry	Park	Chemical Waste	3
25	Henry	Park	Chemical Waste	3
25	Henry	Park	Kitchen Scraps	NULL
26	Isabel	Adams	Food Waste	1
26	Isabel	Adams	Food Waste	1
26	Isabel	Adams	Food Waste	2
26	Isabel	Adams	PET Bottles	NULL
27	Jacob	Knight	Metal Waste	NULL
28	Laura	Bishop	Electronic Waste	NULL
29	Michael	Carter	Wood Waste	NULL
30	Natalie	Dixon	Glass Waste	NULL

26 rows in set (0.001 sec)

5. Use four-way join that combines data from the "CollectionSchedule," "Vehicle," "CollectionCrew," and "Worker" tables. It retrieves information about collection schedules, vehicles, assigned drivers, and workers, linking them through their respective foreign keys.

## CONCLUSION

- The EER diagram effectively displayed the entire waste management and recycling incentives system.
- Superclass and subclass relationships used in the diagram.
- Successful utilization of various relationships (disjoint, overlap, category).

## Future directions

- Expanding the database to include additional waste types
- Integrating more environmental features
- Encouraging more collaboration and feedback for ongoing improvement and sustainability.

# REFERENCES

- *Introduction to enhanced entity relationship (EER) model*: EdrawMax. Edrawsoft. (n.d.).  
<https://www.edrawsoft.com/article/what-is-eer-diagram.html>
- Riyana, J. (2021, April 18). *Drawing ER and EER diagrams & relational mapping*. Medium.  
<https://medium.com/nerd-for-tech/drawing-er-and-eer-diagrams-mapping-4965e2b3cc3e>

**THANK YOU!**