Employee Performance Management System

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CPS510: Database Systems I

Section - 01

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Introduction

Description

In the world today, employees are the most significant assets of an organization, so managing them properly helps to ensure successful performance appraisal and bring benefits to the system. However, difficulties in managing a large repository of employee data manually pose many challenges. To be more specific, it can be time-consuming, error-prone, and especially problematic for security systems. Thanks to employee performance management systems, handling and organizing data becomes much easier. Generally, it is a systematic approach to evaluate the performance of employees through which the organization can align their goals and objectives with available resources.

Basic Function

An employee performance database management system has multiple beneficial uses for any company. From keeping track of all the employees within the company to storing evaluations of all employees, this system is necessary for a company to function efficiently. This DBMS has multiple functions including: listing/creating information about an employee, retrieving/updating the evaluation of an employee, finding which employees are in a certain department, displaying employees working under a certain manager, and many more.

To list information of an employee, searching for the employee_id or fullname (as long as there are no two employees with the same name) is the easiest way. The information listed will be the employee's id, fullname, current position, assessment, etc. To add a new employee to the database, a new employee_id needs to be created for that employee while adding the additional necessary information for the employee. To retrieve an employee's evaluation, search for the employee's id and display the result, and to update, search for the employee and replace the new evaluation with the old one. Finding employees working for a specific department requires searching for the department in the database and listing all employee ids associated with it. Similarly, the DBMS can search for a certain manager and display all employees working under them. A myriad amount of functions can be created for the employee database management system.

Expectations

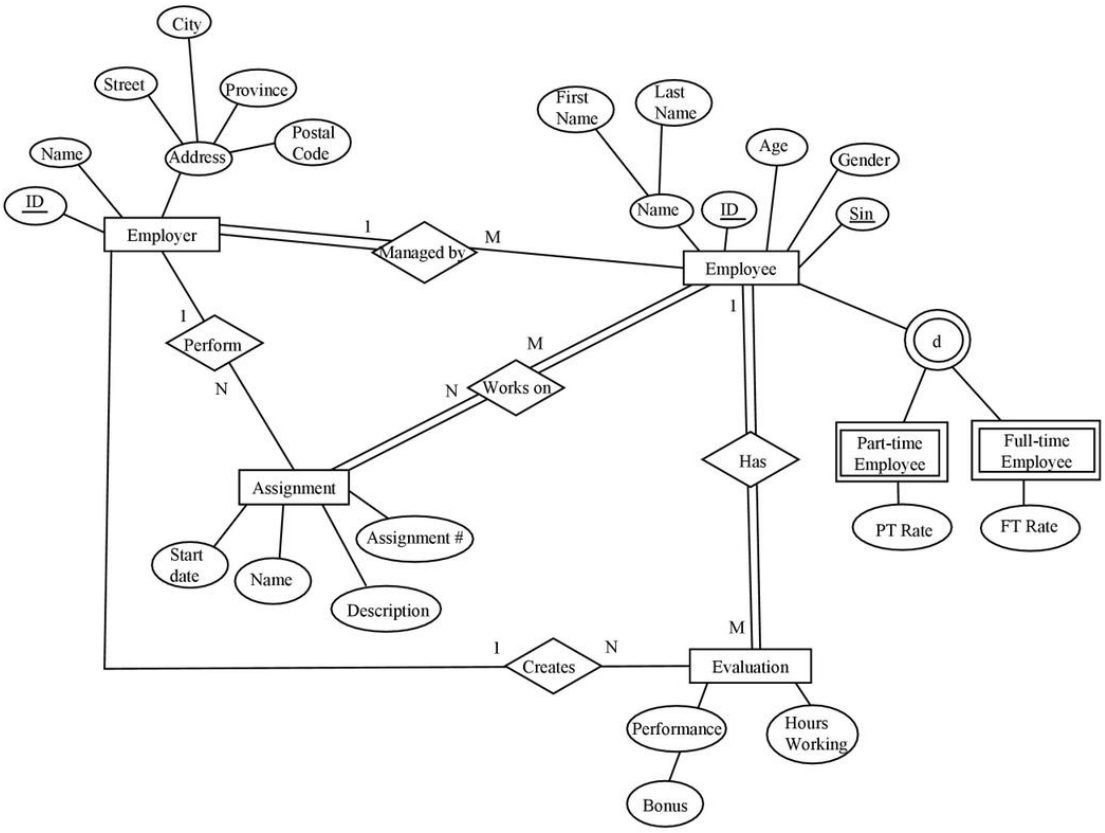
The information expected from the employee performance application could be segmented into three different database tables: employee's information, employee's assessment, employee's goals, and employer's signoff.

The employee's information table would store the employee's first and last name, identification number, position held, department, manager's name, and date of assessment. Of all the attributes, the employee's identification number is the primary key attribute because it is unique. As noted, storing an employee's information is the first crucial step to assessing their performance. Once the employee's information is recorded, the next step is to perform their assessment. The employee's assessment table would store the employee's identification number

along with assessment categories that they would be evaluated on, such as: communication, quality of work, integrity, initiative, and leadership. These criteria will be ranked in terms of "needs improvement, satisfactory, good, and excellent". And finally, the employee's goals and employer's signoff database table would contain the employee's identification number, employee's goals and achievements, and employer's comments/reviews.

In this case, the database table relationship could be one-to-many. This means each employee could have many assessments and goals created, and this might be semi annually or quarterly. The primary key field in the information table, employee's identification number, is designed to contain unique values. The foreign key field in the assessment and goals table is designed to allow multiple instances of the same value.

Entity-Relationship Diagram



Database Schema with Normalization & Functional Dependencies

Employer Table

```
CREATE TABLE Employer(
    EmployerID      NUMBER NOT NULL,
    EmployerName    VARCHAR2(50) NOT NULL
    StreetNo        NUMBER CHECK (StreetNo BETWEEN 1 AND 9999),
    StreetName      VARCHAR2(25) NOT NULL,
    City            VARCHAR2(25) NOT NULL,
    Province        VARCHAR2(2) NOT NULL,
    PostalCode      VARCHAR2(10) NOT NULL,
    PRIMARY KEY     (EmployerID)
);
```

- Functional dependencies for employer table:

EmployerID -> EmployerName, StreetNo, StreetName, City, Province, PostalCode, Address

This is not in 3NF. We first must make this 2NF into 3NF because as shown in the graph, there are non-candidate-key attribute that is transitively dependent on the candidate key. Now making it into 3NF, we have:

EmployerID -> EmployerName, PostalCode
PostalCode -> StreetNo, StreetName, City, Province

Employee Table

```
CREATE TABLE Employee(
    EmployeeID          NUMBER NOT NULL,
    EmployeeFirstName   VARCHAR2(25) NOT NULL,
    EmployeeLastName    VARCHAR2(25) NOT NULL,
    Age                 NUMBER CHECK (Age BETWEEN 18 AND 70),
    Gender              VARCHAR2(25) NOT NULL,
    SIN                 NUMBER NOT NULL,
    EmployeeType        VARCHAR2(25) NOT NULL,
    Rate                DECIMAL CHECK (Rate >= 14.35),
    EmployerID          NUMBER,
    PRIMARY KEY         (EmployeeID, SIN),
    FOREIGN KEY         (EmployerID) REFERENCES
Employer(EmployerID)
);
```

- Functional dependencies for employee table:

EmployeeID, SIN -> EmployeeFirstName, EmployeeLastName
EmployeeID, SIN -> Age
EmployeeID, SIN -> Gender

EmployeeID, SIN -> EmployeeType
EmployeeType -> Rate

This is not in 3NF. We must first make this into 2NF since there is partial dependency for the EmployeeID and sin. Now making it into 2NF, we have:

EmployeeID -> EmployeeFirstName, EmployeeLastName, Age, Gender, EmployeeType
SIN -> EmployeeType, Rate

Since as we can tell in our graph there is a transitively dependency, now we have transform our 2NF to 3NF:

EmployeeID -> EmployeeFirstName, EmployeeLastName, Age, Gender
SIN -> EmployeeType
EmployeeType -> Rate

Assignment Table

```
CREATE TABLE Assignment(
    AssignmentNo            NUMBER NOT NULL,
    AssignmentName          VARCHAR2(50) NOT NULL,
    AssignmentDescription   VARCHAR2(255),
    StartDate               DATE NOT NULL,
    EmployerID              NUMBER,
    EmployeeID              NUMBER,
    SIN                     NUMBER,
    PRIMARY KEY             (AssignmentNo, AssignmentName),
    FOREIGN KEY             (EmployeeID, SIN) REFERENCES
Employee,
    FOREIGN KEY             (EmployerID) REFERENCES Employer
);
```

- Functional dependencies for assignmnet table:

AssignmentNo, AssignmentName -> AssignmentDescription, StartDate

This is not in 2NF because there is no full dependency. Therefore, to transform it to 2NF, we get:

AssignmentNo -> StartDate
AssignmentDescription -> AssignmentDescription

This is then in 3NF because there is no non-candidate-key attribute that is transitively dependent on any candidate key.

Working PerformanceEvaluation

```
CREATE TABLE PerformanceEvaluation(
    WorkingHours        NUMBER CHECK (WorkingHours BETWEEN 1 AND
100),
    Assessment          CHAR NOT NULL,
    Bonus               NUMBER,
    EmployerID          NUMBER,
    EmployeeID          NUMBER,
    SIN                 NUMBER,
    PRIMARY KEY         (Assessment),
    FOREIGN KEY         (EmployerID) REFERENCES Employer,
    FOREIGN KEY         (EmployeeID, SIN) REFERENCES Employee
);
```

- Functional dependencies for Working PerformanceEvaluation table:

WorkingHours, Assessment -> Bonus

This is in 2NF because there is fully functional dependency. We cannot remove either working hours nor assessment. It is therefore also 3NF because there is no transitively dependency.

Database Queries (SQL & Relational Algebra)

SQL:

```
SELECT * FROM Employer
WHERE City = 'Toronto';
```

Relational Algebra:

$$\sigma_{city='Toronto'}(Employer)$$

SQL:

```
SELECT Gender, EmployeeType
FROM   Employee
WHERE  Gender = 'Male'
AND  EmployeeType = 'Partime';
```

Relational Algebra:

$\pi\ Gender, EmployeeType\ \sigma_{gender='Male'}(Employee)\ and_{EmployeeType='Partime'}(Employee)$

SQL:

```
SELECT * FROM Assignment
WHERE AssignmentNo = 1;
```

Relational Algebra:

$$\sigma_{AssignmentNo=1}(Assignment)$$

SQL:

```
SELECT EmployeeID, EmployeeFirstName
FROM   Employee
WHERE  EmployeeFirstName <> 'Sarah';
```

Relational Algebra:

$$\pi\ EmployeeID, EmployeeFirstName\ \sigma_{EmployeeFirstName \neq 'Sarah'}(Employee)$$

SQL:

```
SELECT DISTINCT EmployeeID
FROM  performanceevaluation
WHERE Assessment > 5
ORDER BY EmployeeID;
```

Relational Algebra:

$$\pi\ EmployeeID\ (\sigma_{Assessment>5}(\text{performanceevaluation}))$$

SQL to create views:

```
CREATE VIEW FemaleEmployees AS
SELECT Employee.EmployeeFirstName, Employee.EmployeeLastName,
Employee.Age, WorkingOn.AssignmentName
FROM Employee
FULL OUTER JOIN WorkingOn ON Employee.EmployeeID =
WorkingOn.EmployeeID
WHERE Gender = 'Female';

CREATE VIEW TopPerformmane AS
SELECT Employee.EmployeeFirstName, Employee.EmployeeLastName,
PerformanceEvaluation.WorkingHours, PerformanceEvaluation.Bonus
FROM PerformanceEvaluation
INNER JOIN Employee ON Employee.EmployeeID =
PerformanceEvaluation.EmployeeID
WHERE Assessment > 5;
```

UNIX Shell Implementation

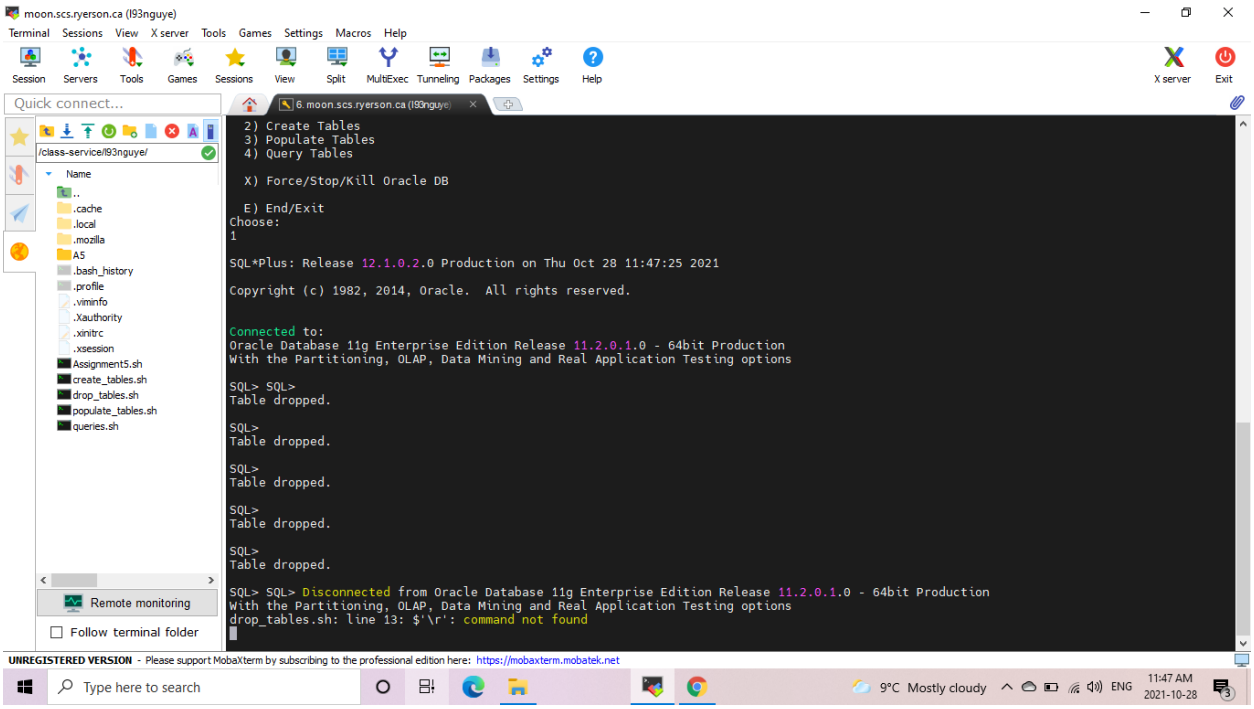


Figure 1: Drop Table

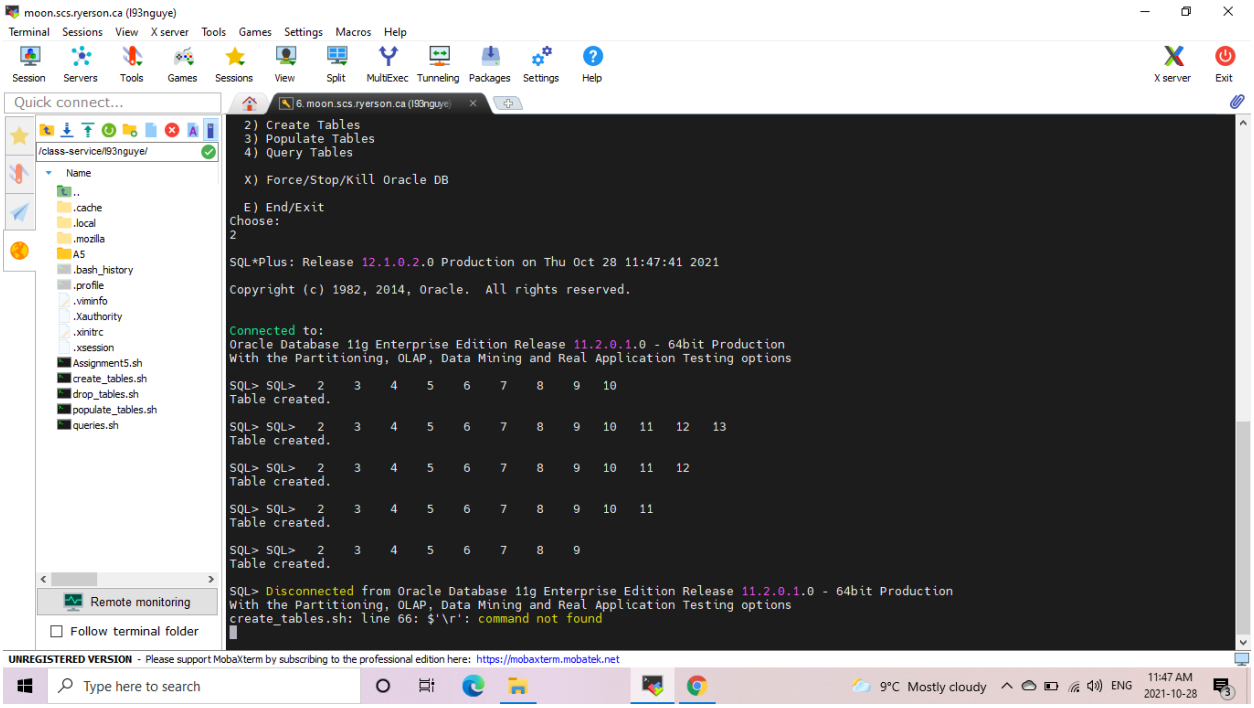


Figure 2: Create Table

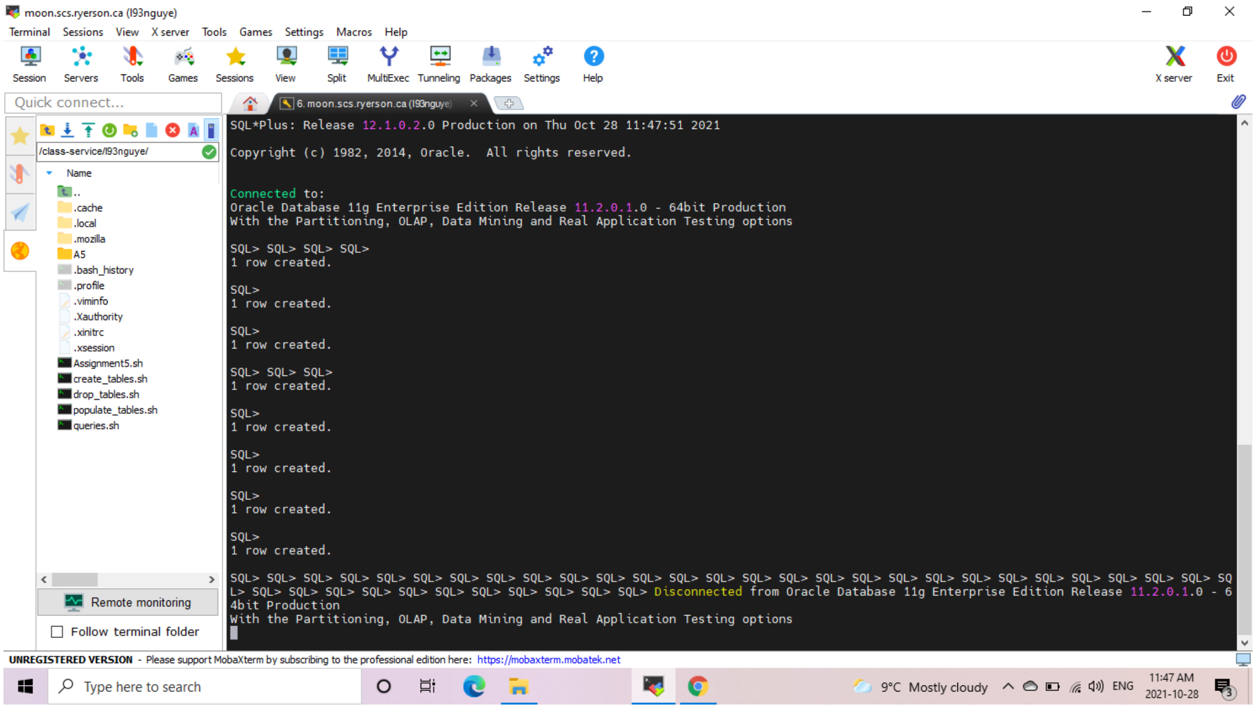


Figure 3: Populate Table

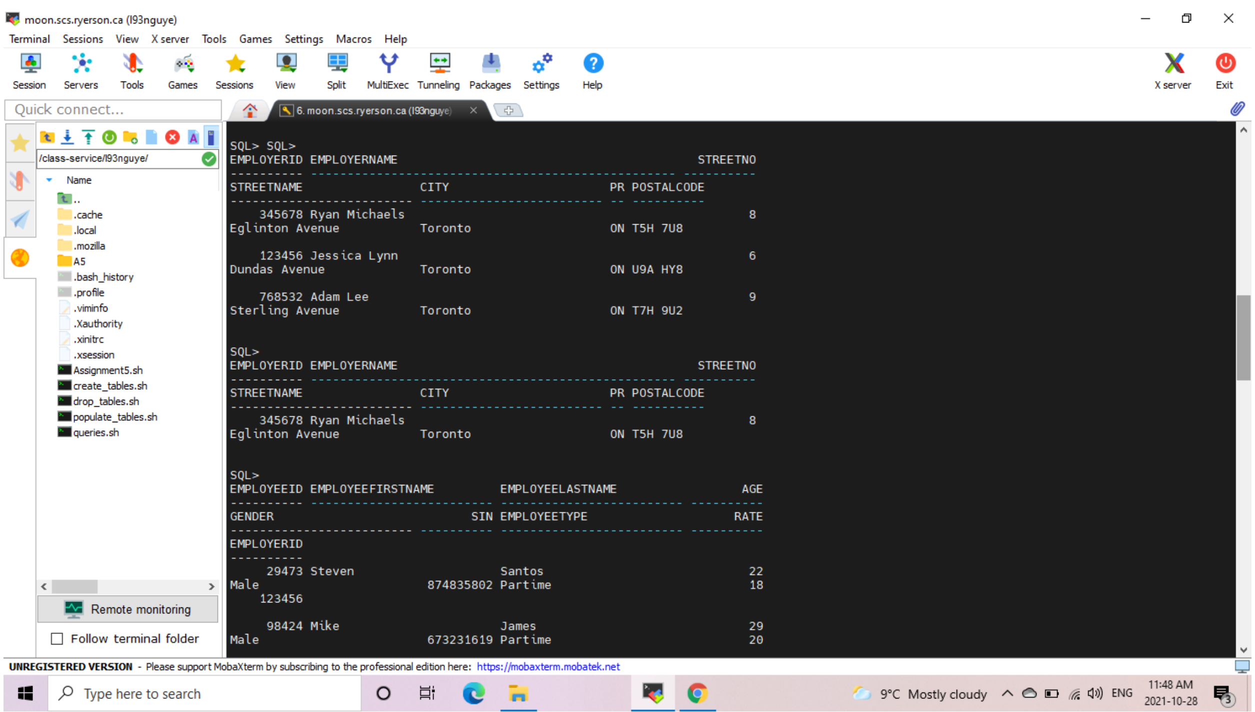


Figure 4: Queries

GUI

Web link: https://apex.oracle.com/pls/apex/employeedb/r/employee-performance-management-system/login?session=7076102400734

Test Username: tunglam030699@gmail.com
Test Password: tunglam030699

For this project, GUI for employee performance management system was created using Oracle Application Express (APEX)

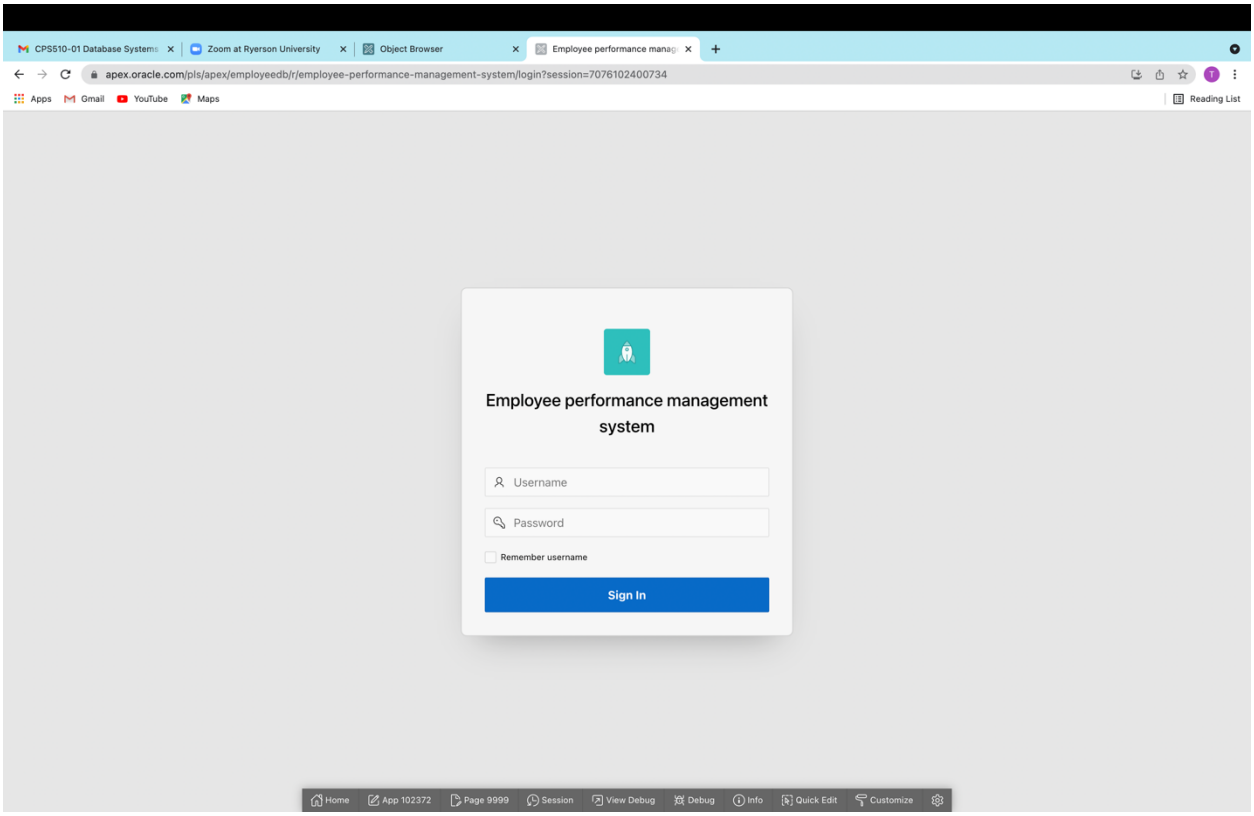


Figure 5: Login Page

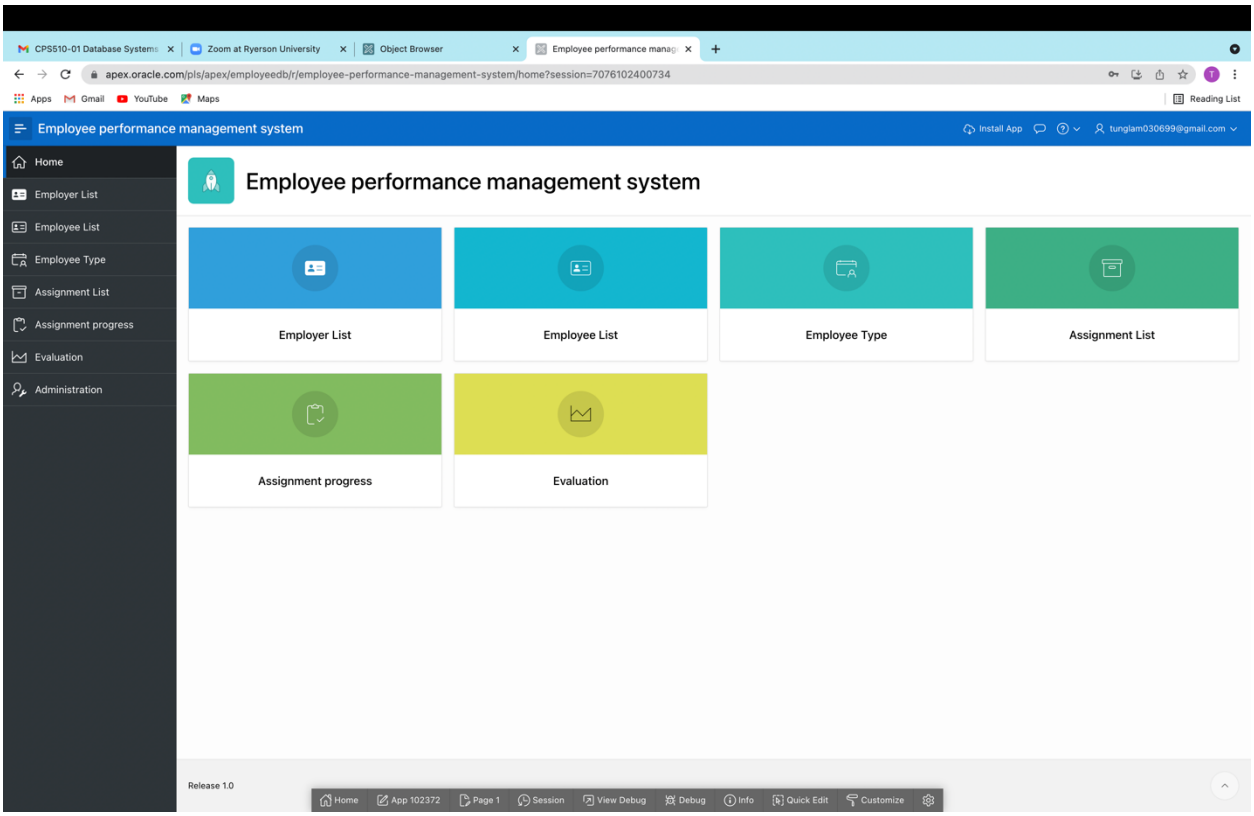


Figure 6: Dashboard

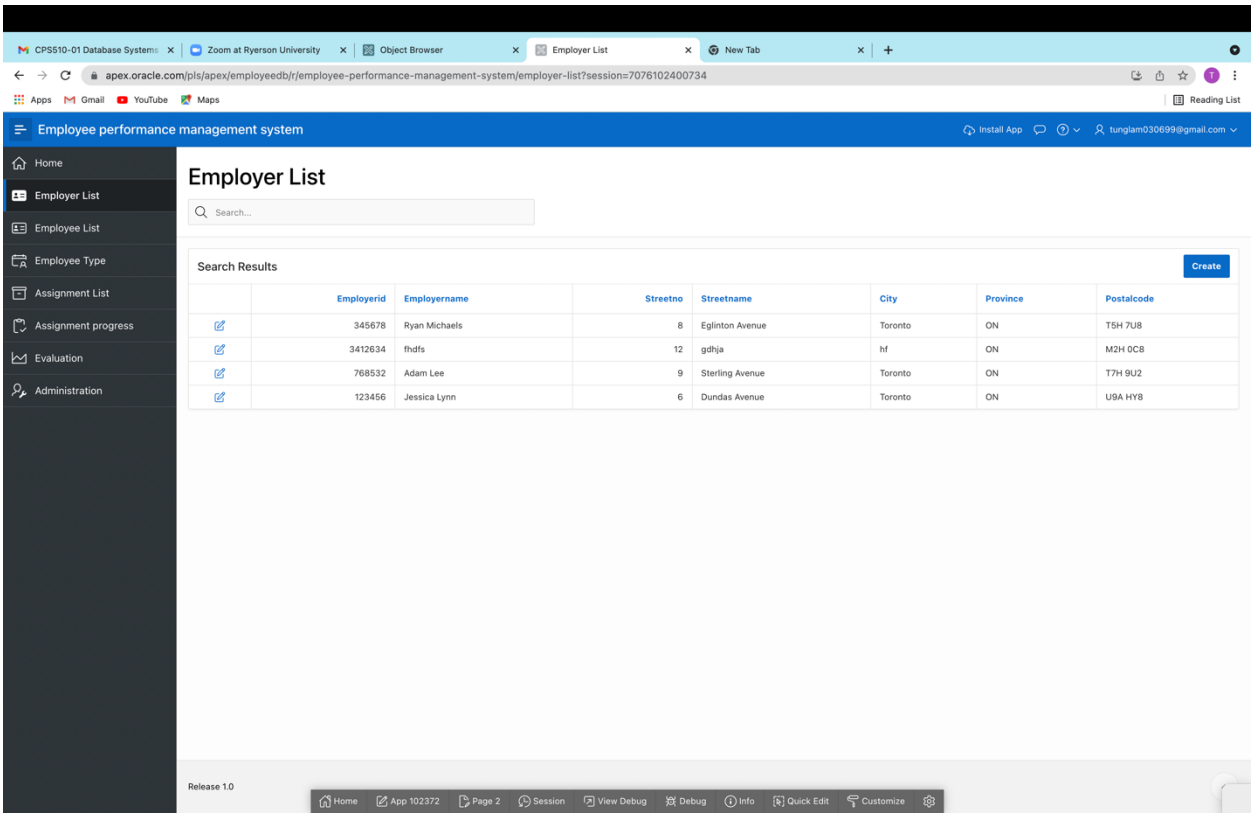


Figure 7: Employer List Page

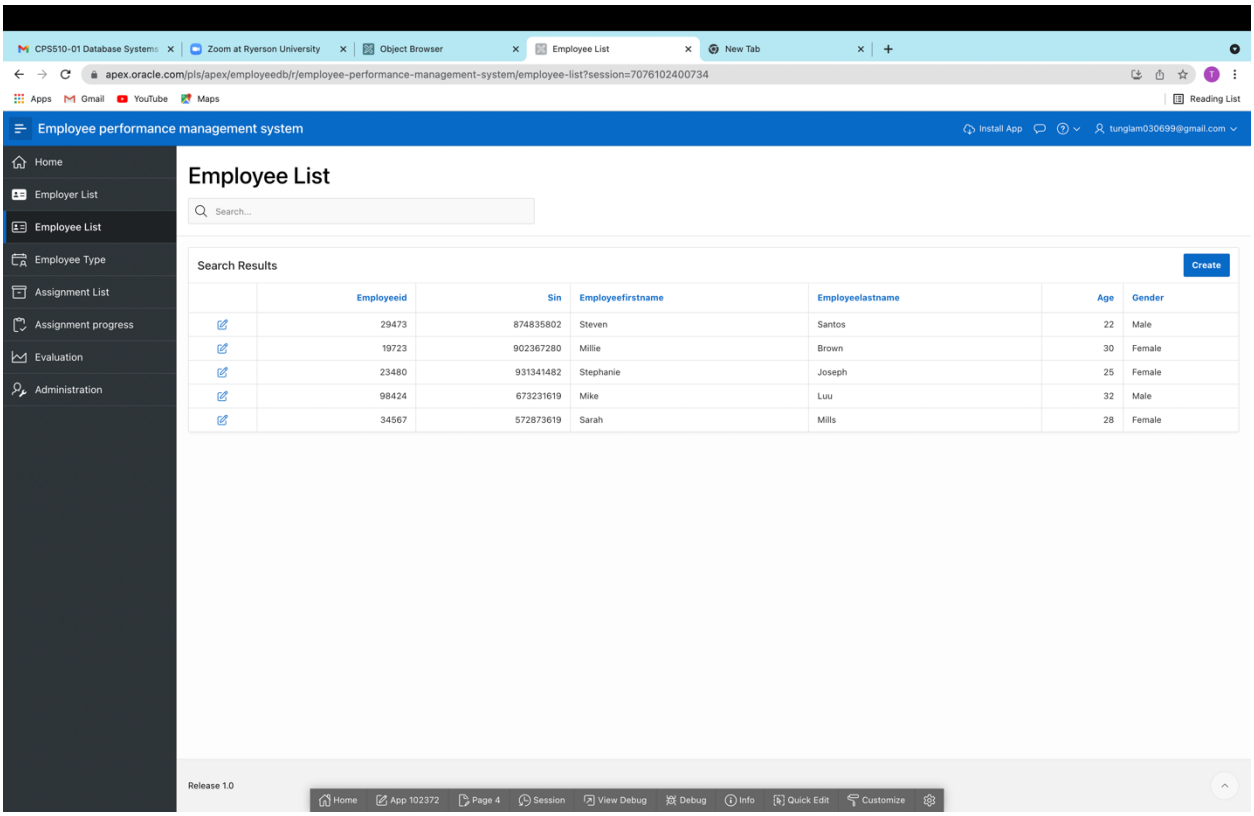


Figure 8: Employee List Page

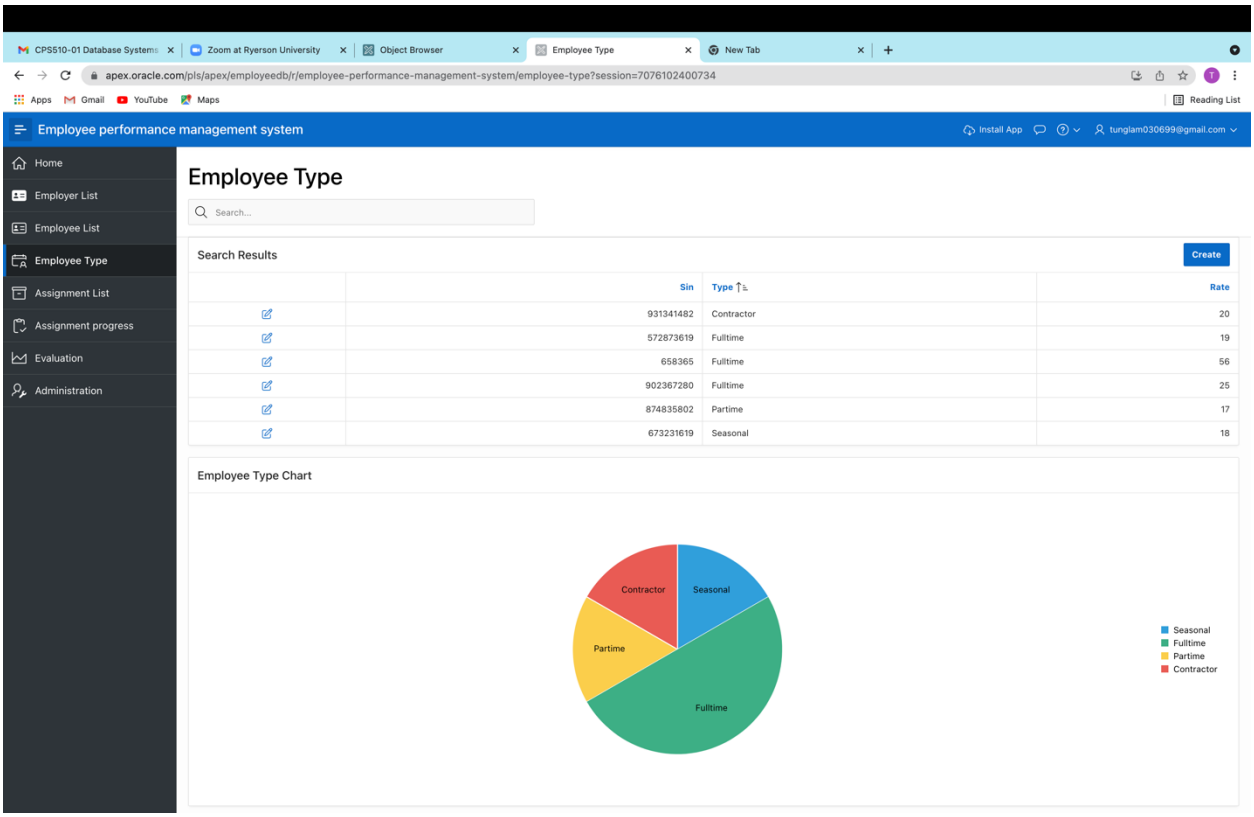


Figure 9: Employee Type Page

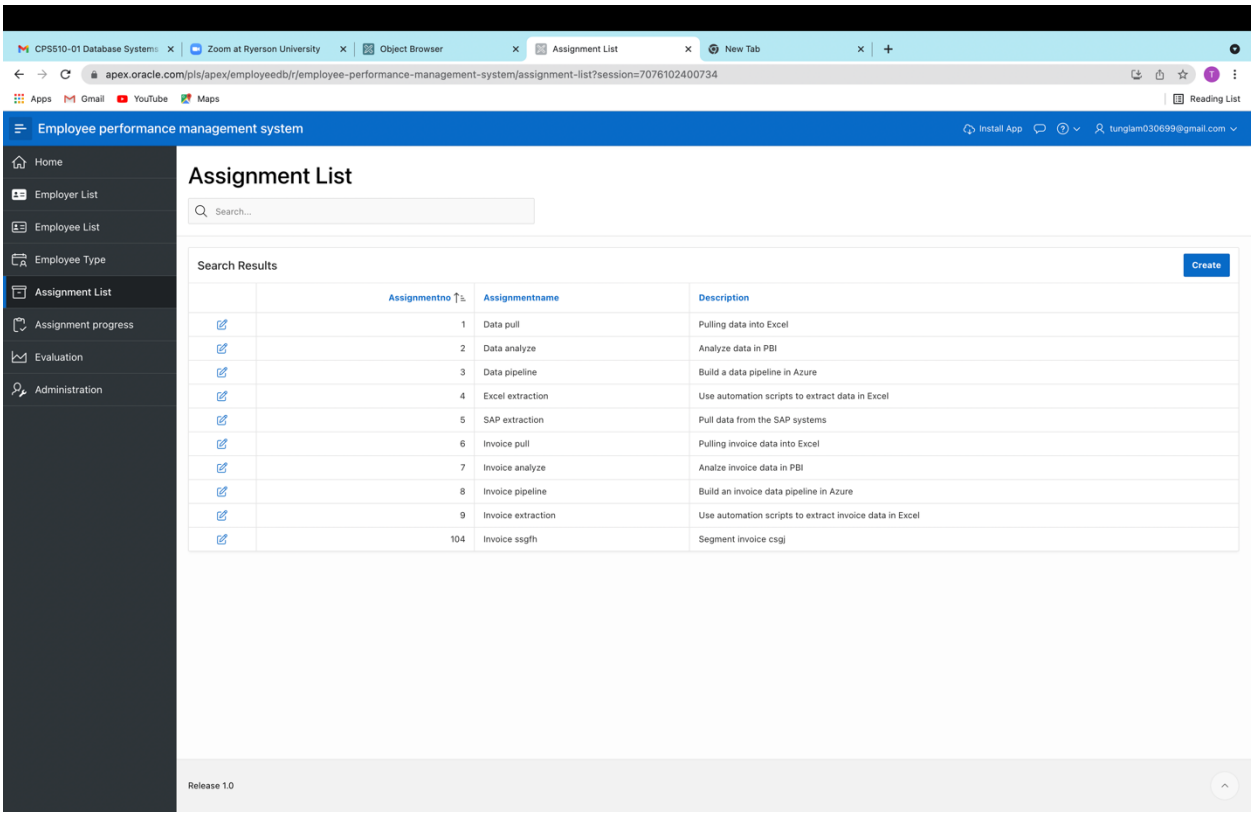


Figure 10: Assignment List

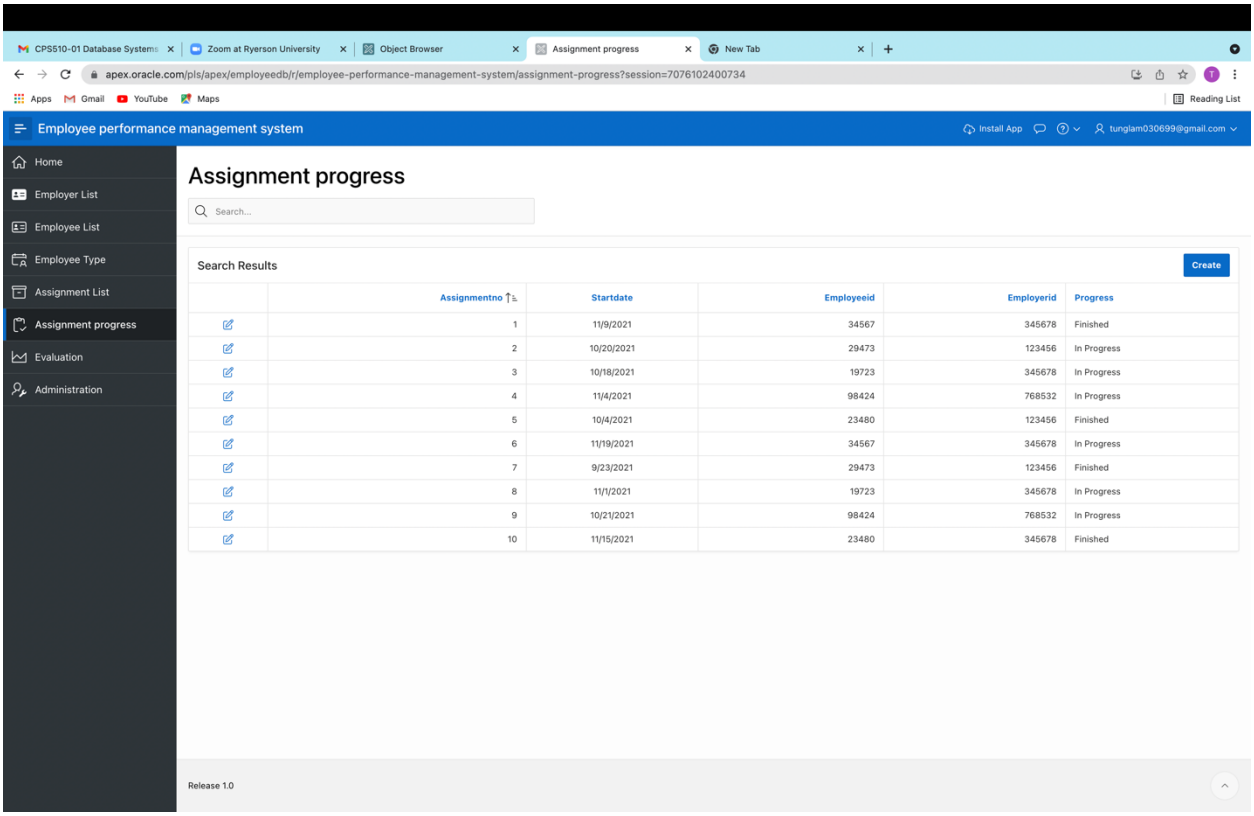


Figure 11: Assignment Progress

Conclusion

Working on this Employee Performance Management System has provided us with a solid foundation in all aspects of database design and implementation. Previously, we had not realized how important it was to represent data in a clear and concise way. With the theories we learned regarding entity-relationships diagrams, relational schema design, functional dependencies, normalization, etc., we were able to turn various pieces of data into a useful and accessible database.

On the technical side, we became accustomed to using SQL and the service provided by Oracle. Through this, we learned what it was like to create tables, drop tables, insert data and query information. Making a GUI using Oracle Application Express (APEX) also familiarized us with how a front-end interface connects and interacts with a back-end database.

This project also exercised our skills in teamwork, project management, and software development. In conclusion, it was a pleasure working on this database project since it truly allowed us to use the knowledge and skills acquired in this course.