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Coursework

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Abstract

The goal of this project is to construct a database system with an emphasis on data visualization, ER diagrams, and normalization. Normalization improves data integrity by eliminating unnecessary information. ER diagrams, which visually show the relationships between data objects, simplify database design.

Patterns and trends can be found in data visualization by using Python tools such as Matplotlib and Seaborn. These elements work together to provide a strong foundation for efficient data handling and analysis.

Acknowledge

My heartfelt gratitude goes out to my students for their passion and commitment, which were invaluable to our effort. I am also grateful to my coworkers for their insightful criticism and encouragement. I also thank MySQL Workbench, Visual Paradigm, and Python modules like Pandas and Matplotlib for their invaluable use in the development of this project.

Introduction

Effective data management is crucial in today's world. I'm working on a database system with three important parts for my assignment. Normalization ensures that the data is accurate and helps to clean it up by eliminating duplicates. The ER diagram illustrates how the related data aid several database design components. I'll utilize Matplotlib and other Python utilities.
I'll be able to identify patterns and trends in the data by using Seaborn to make charts and graphs. By concentrating on these areas ER diagrams, data visualization, and normalization. I hope to create a robust and effective framework that facilitates data usage and understanding.

Normalization

Reducing redundancy and enhancing data integrity can be achieved by database organization, known as normalization. Normalization also simplifies the database design to achieve the optimal structure composed of atomic elements (i.e. elements that cannot be broken down into smaller parts). (Ian, 2017)

It has three different parts:

1) First Normal Form(1NF)
2) Second Normal Form(2NF)
3) Third Normal Form(3NF)

1NF

Fees(1NF)

Class	Amount
Nursery	1500
KG	2000
1	2500
2	3000
3	3500
4	4000
5	4500
6	5000
7	5500
8	6000
9	6500
10	7000

Payment Table(1NF)

StudentID	Amount	Payment Dat
101	5500	4/10/2080
102	6500	4/10/2080
103	5500	4/5/2080

Subject Table(1NF)

SubjectID	Subj	ClassID
1	Mathem atics	10
2	Scienc	10
3	English	9
4	Social Studies	9

Subject Table(1NF)

SubjectID	Subj	ClassID
1	Mathem atics	10
2	Scienc	10
3	English	9
4	Social Studies	9

Teachers Table (1NF)

TeacherID	Teacher Na	Date of Bi	Gende	Address	Phone	Salary
1	Ashok Aryal	9/5/1980	Male	Tansen-8, Palpa, Lumbini	9867389098	40000
2	Basanta Poudel	4/25/1975	Male	Bhairahawa-1, Rupandehi, Lumbini	9876787887	45000
3	Lekhnath Panta	1/28/1985	Male	Butwal-12, Rupandehi, Lumbini	9856788993	60000
4	Roman Shrestha	6/2/1990	Male	Butwal-12, Rupandehi, Lumbini	9843678567	55000
5	Ritika Banjade	5/11/1992	Female	Tansen-8, Palpa, Lumbini	9841678939	50000

Attendance Table(1NF)

AttendanceID	Student Nam	Date	Status
1	Rajesh Acharya	7/1/2023	Present
2	Sita Sharma	7/2/2023	Absent
3	Asha Rai	7/3/2023	Present
4	Rajesh Rai	7/1/2023	Present
5	Sita Sharma	7/2/2023	Present
6	Asha Sharma	7/3/2023	Absent

Result of Exam Table(1NF)

ResultID	Student Nam	Subject	Date of Exa	Score
1	Rajesh Acharya	Mathematics	6/15/2023	85
2	Sita Sharma	Science	6/20/2023	78
3	Asha Rai	Nepali	6/25/2023	92
4	Sita Sharma	Sanskrit	6/15/2023	78
5	Asha Sharma	English	6/20/2023	90
6	Asha Sharma	Mathematics	6/25/2023	65

Events Table(1NF)

EventID	Event Name	Date	Location
1	Annual Day	8/10/2023	School
2	Sports Day	9/20/2023	Sports
3	Science Fair	10/15/2023	Science Lab
4	Parent-Teacher Meeting	7/30/2023	School Auditorium

Library Records Table(1NF)

RecordID	Student Nam	Book Titl	Author	Issue Date	Return Date
1	Asha Rai	Java the complete reference (12th edition)	Herbert Schildt	7/5/2023	7/20/2023
2	Sita Sharma	Spidering HACKS	Tara Calishain	6/30/2023	7/10/2023
3	Asha Sharma	Windows System Programming	Johnson M. Hart	7/10/2023	7/25/2023
4	Asha Sharma	C# in Depth	Jon Skeet	7/15/2023	7/25/2023

2NF

By removing partial dependencies, the second Normal Form (2NF) guarantees that non-prime characteristics entirely rely on the whole composite key.

Single-attribute key tables are automatically in 2NF.

Fees Table(2NF)

ClassID	Class	Amount
1	Nursery	1500
2	KG	2000
3	1	2500
4	2	3000
5	3	3500
6	4	4000
7	5	4500
8	6	5000
9	7	5500
10	8	6000
11	9	6500
12	10	7000

Payment Table(2NF)

PaymentID	StudentID	Amount	PaymentDat
1	101	5500	4/10/2080
2	102	6500	4/10/2080
3	103	5500	4/5/2080

Subject Table(2NF)

SubjectID	Subject	Clas
1	Mathematics	10
2	Science	10
3	English	9
4	Social Studies	9

Teacher Table(2NF)

TeacherID	Teacher Nam	Date of	Gender	Address	Phone	Salary
1	Ashok Aryal	9/5/1980	Male	Tansen-8, Palpa, Lumbini	9867389098	40000
2	Basanta Poudel	4/25/1975	Male	Bhairahawa-1, Rupandehi,	9876787887	45000
3	Lekhnath Panta	1/28/1985	Male	Butwal-12, Rupandehi,	9856788393	60000
4	Roman Shrestha	6/2/1990	Male	Butwal-12, Rupandehi,	9843678567	55000
5	Ritika Banjade	5/11/1992	Female	Tansen-8, Palpa, Lumbini	9841678939	50000

Student Table(2NF)

StudentID	Student Nam	Date of	Gender	Address
1	Ramesh Acharya	3/15/2005	Male	Butwal-10, Rupandehi,
2	Sita Sharma	6/20/2006	Female	Taulihawa-5, Kapilvastu,
3	Asha Rai	11/10/2004	Female	Siddharth nagar-12, Lumbini

Attendance Table(2NF)

AttendanceID	StudentID	Date	Status
1	1	7/1/2023	Present
2	2	7/2/2023	Absent
3	3	7/3/2023	Present
4	4	7/1/2023	Present
5	5	7/2/2023	Present
6	6	7/3/2023	Absent

Result of Exam Table(2NF)

ResultID	StudentID	SubjectID	Date of Exam	Score
1	1	1	6/15/2023	85
2	2	2	6/20/2023	78
3	3	3	6/25/2023	92
4	2	4	6/15/2023	78
5	3	5	6/20/2023	90
6	3	6	6/25/2023	65

Event Table(2NF)

EventID	Event Name	Date	Location
1	Annual Day	8/10/2023	School Grounds
2	Sports Day	9/20/2023	Sports
3	Science Fair	10/15/2023	Science Lab
4	Parent-Teacher Meeting	7/30/2023	School Auditorium

Library Record Table(2NF)

RecordID	StudentID	Book Title	Author	Issue Date	Return Date
1	1	Java the complete reference (12th	Herbert Schildt	7/5/2023	7/20/2023
2	2	Spidering	Tara Calishain	6/30/2023	7/10/2023
3	3	Windows System Programming	Johnson M. Hart	7/10/2023	7/25/2023
4	4	C# in Depth	Jon Skeet	7/15/2023	7/25/2023

3NF

There are no transitive dependencies and 2NF appears in the Three Normal Forms; all non-key attributes depends only on the primary key.

Fees Table(3NF)

ClassID	Class	Amount
1	Nursery	1500
2	KG	2000
3	1	2500
4	2	3000
5	3	3500
6	4	4000
7	5	4500
8	6	5000
9	7	5500
10	8	6000
11	9	6500
12	10	7000

Payment Table(3NF)

PaymentID	StudentID	Amount	PaymentDat
1	101	5500	4/10/2080
2	102	6500	4/10/2080
3	103	5500	4/5/2080

Subject Table(3NF)

SubjectID	Subject	ClassID
1	Mathematics	10
2	Science	10
3	English	9
4	Social Studies	9

Teacher Table(3NF)

TeacherID	Teacher Nam	Date of Birt	Gender	Address	Phone	Salary
1	Ashok Aryal	9/5/1980	Male	Tansen-8, Palpa, Lumbini	9867389038	40000
2	Basanta Poudel	4/25/1975	Male	Bhairahawa-1, Rupandehi, Lumbini	9876787887	45000
3	Lekhnath Panta	1/28/1985	Male	Butwal-12, Rupandehi, Lumbini	9856788993	60000
4	Roman Shrestha	6/2/1990	Male	Butwal-12, Rupandehi, Lumbini	9843678567	55000
5	Ritika Banjade	5/11/1992	Female	Tansen-8, Palpa, Lumbini	9841678939	50000

Student Table(3NF)

StudentID	Student Nam	Date of	Gender	Address
1	Ramesh Acharya	3/15/2005	Male	Butwal-10, Rupandehi,
2	Sita Sharma	6/20/2006	Female	Taulihawa-5, Kapilvastu,
3	Asha Rai	11/10/2004	Female	Siddharth nagar-12, Lumbini

Guardian Table

GuardianID	StudentID	Guardian Nam	Guardian Phon
1	1	Gita Acharya	9847011111
2	2	Ram Sharma	9816412121
3	3	Hari Rai	9867066700

Attendance Table(3NF)

AttendanceID	StudentID	Date	Status
1	1	7/1/2023	Present
2	2	7/2/2023	Absent
3	3	7/3/2023	Present
4	4	7/1/2023	Present
5	5	7/2/2023	Present
6	6	7/3/2023	Absent

Result of Exam Table(3NF)

ResultID	StudentID	SubjectID	Date of Exam	Score
1	1	1	6/15/2023	85
2	2	2	6/20/2023	78
3	3	3	6/25/2023	92
4	2	4	6/15/2023	78
5	3	5	6/20/2023	90
6	3	6	6/25/2023	65

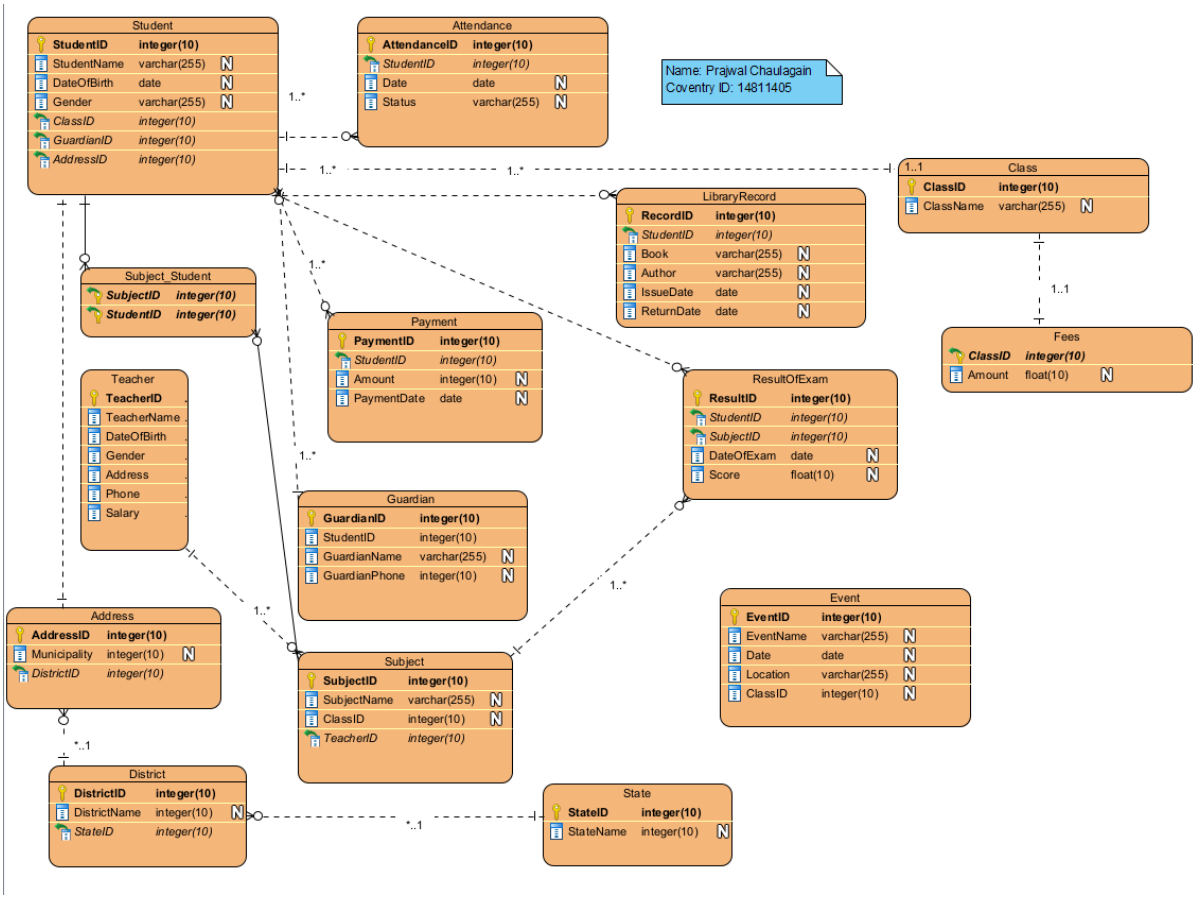
Event Table(3NF)

EventID	Event Name	Date	Location
1	Annual Day	8/10/2023	School Grounds
2	Sports Day	9/20/2023	Sports
3	Science Fair	10/15/2023	Science Lab
4	Parent-Teacher Meeting	7/30/2023	School Auditorium

Library Record Table(3NF)

RecordID	StudentID	Book Title	Author	Issue Date	Return Date
1	1	Java the complete reference (12th	Herbert Schildt	7/5/2023	7/20/2023
2	2	Spidering	Tara Calishain	6/30/2023	7/10/2023
3	3	Windows System Programming	Johnson M. Hart	7/10/2023	7/25/2023
4	4	C# in Depth	Jon Skeet	7/15/2023	7/25/2023

Explaining the ER Diagram



An entity-relationship is a visual representation of an information system that illustrates the relationships between the entities in a database.For New Horizon Boarding Secondary School, The ER diagram includes entities like Student, Teacher, Subject, Exam Result, Payment, Guardain, Event, Library Record, and Attendence. Each of these entities, such as a student or a subject, represents a unique component of the system and is defined by specific attributes, like StudentID, Student Name, and DateOfBirth for the Student entity. (Nishadha & Creately, 2024)

SQL Queries

Programming languages like SQL (Structure Query Language) are used to manage relational databases. It enables the storage, retrieval, updating, entry, and analysis of data in tables. This make SQL essential for data management and analysis tasks. (Vaitkun, 2022)

```
5  CREATE TABLE IF NOT EXISTS Guardian (
6      GuardianID INT PRIMARY KEY,
7      GuardianName VARCHAR(100),
8      GuardianPhone VARCHAR(15)
9  );
0
```

sult Grid | Filter Rows: | Export: | Wrap Cell Conter

Field	Type	Null	Key	Default	Extra
GuardianID	int	NO	PRI	NULL	
GuardianName	varchar(100)	YES		NULL	
GuardianPhone	varchar(15)	YES		NULL	

```
11  DESCRIBE Guardian;
12  SELECT * FROM Guardian;
13
```

Result Grid | Filter Rows:

GuardianID	GuardianName	GuardianPhone
1	Gita Acharya	9847011111
2	Ram Sharma	9816412121
3	Hari Rai	9867066700
NULL	NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Student (
    StudentID INT PRIMARY KEY,
    Name VARCHAR(50),
    DateOfBirth DATE,
    Gender VARCHAR(10),
    Address VARCHAR(100),
    GuardianID INT,
    FOREIGN KEY (GuardianID) REFERENCES Guardian(GuardianID)
);
```

Result Grid | Filter Rows: | Edit: | Export/Import:

StudentID	Name	DateOfBirth	Gender	Address	GuardianID
101	Ramesh Acharya	2005-03-15	Male	Butwal-10, Rupandehi, Lumbini	1
102	Sita Sharma	2006-06-20	Female	Taulihawa-5, Kapilvastu, Lumbini	2
103	Asha Rai	2004-11-10	Female	Siddharthanagar-12, Lumbini	3
104	Rita Rai	2007-01-25	Female	Butwal-14, Rupandehi, Lumbini	4
NULL	NULL	NULL	NULL	NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Teacher (
    TeacherID INT PRIMARY KEY,
    Name VARCHAR(100) NOT NULL,
    DateOfBirth DATE,
    Gender VARCHAR(10),
    Address VARCHAR(255),
    Phone VARCHAR(15),
    Salary DECIMAL(10, 2)
);
```

esult Grid | Filter Rows: | Export: | Wrap Cell Cc

Field	Type	Null	Key	Default	Extra
TeacherID	int	NO	PRI	NULL	
Name	varchar(100)	NO		NULL	
DateOfBirth	date	YES		NULL	
Gender	varchar(10)	YES		NULL	
Address	varchar(255)	YES		NULL	
Phone	varchar(15)	YES		NULL	
Salary	decimal(10,2)	YES		NULL	

```sql
DESCRIBE Teacher;
SELECT * FROM Teacher;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

TeacherID	Name	DateOfBirth	Gender	Address	Phone	Salary
1	Ashok Aryal	1980-05-09	Male	Tansen-8, Palpa, Lumbini	9867389098	40000.00
2	Basanta Poudel	1975-04-25	Male	Bhairahawa-1, Rupandehi, Lumbini	9876787887	45000.00
3	Lekhnath Panta	1985-01-28	Male	Butwal-12, Rupandehi, Lumbini	9856788993	60000.00
4	Roman Shrestha	1990-06-02	Male	Butwal-12, Rupandehi, Lumbini	9843678567	55000.00
NULL	NULL	NULL	NULL	NULL	NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Subject (
    SubjectID INT PRIMARY KEY,
    SubjectName VARCHAR(100) NOT NULL
);
```

Result Grid | Filter Rows: | Export: | Wrap

Field	Type	Null	Key	Default	Extra
SubjectID	int	NO	PRI	NULL	
SubjectName	varchar(100)	NO		NULL	

```sql
DESCRIBE Subject;
SELECT * FROM Subject;
```

Result Grid | Filter Rows:

SubjectID	SubjectName
1	Mathematics
2	Science
3	English
4	Social Studies
NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Fee (
    Class VARCHAR(10) PRIMARY KEY,
    Amount DECIMAL(10, 2)
);
```

Result Grid | Filter Rows: | Edit:

Class	Amount
1	3000.00
10	8400.00
2	3600.00
3	4200.00
4	4800.00
5	5400.00
6	6000.00
7	6600.00
8	7200.00
9	7800.00
KG	2400.00
Nurs...	1800.00
NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Payment (
    PaymentID INT PRIMARY KEY,
    StudentID INT,
    Amount DECIMAL(10, 2) NOT NULL,
    PaymentDate DATE,
    FOREIGN KEY (StudentID) REFERENCES Student(StudentID)
);
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Field	Type	Null	Key	Default	Extra
PaymentID	int	NO	PRI	NULL	
StudentID	int	YES	MUL	NULL	
Amount	decimal(10,2)	NO		NULL	
PaymentDate	date	YES		NULL	

```sql
CREATE TABLE IF NOT EXISTS Payment (
    PaymentID INT PRIMARY KEY,
    StudentID INT,
    Amount DECIMAL(10, 2),
    PaymentDate DATE,
    FOREIGN KEY (StudentID) REFERENCES Student(StudentID)
);
```

Result Grid | Filter Rows: | Edit: | Export/Import:

PaymentID	StudentID	Amount	PaymentDate
1	101	5500.00	2023-07-10
2	102	6500.00	2023-07-10
3	103	5500.00	2023-07-05
4	104	6500.00	2023-08-01
NULL	NULL	NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS Attendance (
    AttendanceID INT PRIMARY KEY,
    StudentID INT,
    Date DATE,
    Status VARCHAR(10),
    FOREIGN KEY (StudentID) REFERENCES Student(StudentID)
);
```

Result Grid | Filter Rows: | Edit: | Export/Import:

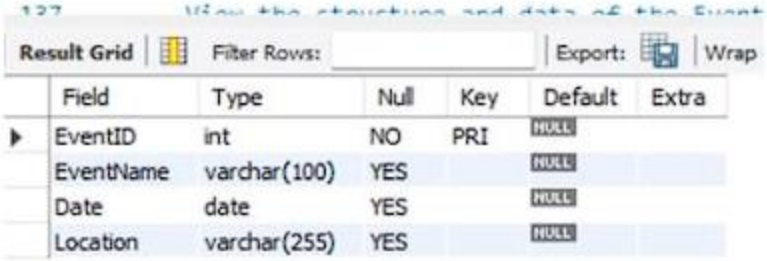
AttendanceID	StudentID	Date	Status
1	101	2023-07-01	Present
2	102	2023-07-02	Absent
3	103	2023-07-03	Present
4	104	2023-08-01	Present
NULL	NULL	NULL	NULL

```
72 • CREATE TABLE IF NOT EXISTS ExamResult (
73       ResultID INT PRIMARY KEY,
74       StudentID INT,
75       SubjectID INT,
76       DateOfExam DATE,
77       Score INT,
78       FOREIGN KEY (StudentID) REFERENCES Student(StudentID),
79       FOREIGN KEY (SubjectID) REFERENCES Subject(SubjectID)
80   );
```

Result Grid | Filter Rows: | Edit: | Export/Import:

	ResultID	StudentID	SubjectID	DateOfExam	Score
▶	1	101	1	2023-06-15	85.00
	2	102	2	2023-06-20	78.00
	3	103	3	2023-06-25	92.00
	4	104	4	2023-08-01	88.00
*	NULL	NULL	NULL	NULL	NULL

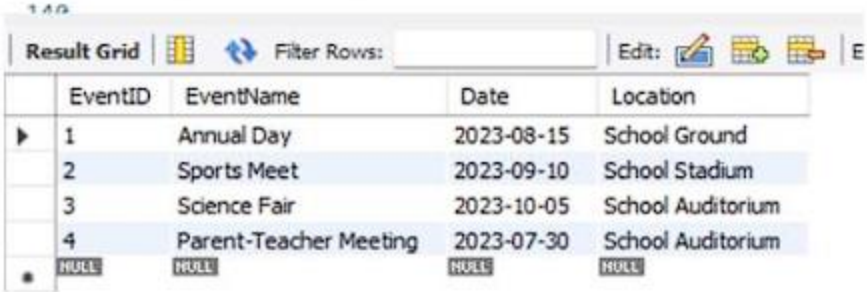
```sql
CREATE TABLE IF NOT EXISTS Event (
    EventID INT PRIMARY KEY,
    EventName VARCHAR(100),
    Date DATE,
    Location VARCHAR(255)
);
```



Result Grid | Filter Rows: | Export: | Wrap

Field	Type	Null	Key	Default	Extra
EventID	int	NO	PRI	NULL	
EventName	varchar(100)	YES		NULL	
Date	date	YES		NULL	
Location	varchar(255)	YES		NULL	

```sql
DESCRIBE Event;
SELECT * FROM Event;
```



Result Grid | Filter Rows: | Edit: | E

EventID	EventName	Date	Location
1	Annual Day	2023-08-15	School Ground
2	Sports Meet	2023-09-10	School Stadium
3	Science Fair	2023-10-05	School Auditorium
4	Parent-Teacher Meeting	2023-07-30	School Auditorium
NULL	NULL	NULL	NULL

```sql
CREATE TABLE IF NOT EXISTS LibraryRecords (
    RecordID INT PRIMARY KEY,
    StudentID INT,
    BookTitle VARCHAR(100),
    Author VARCHAR(50),
    IssueDate DATE,
    ReturnDate DATE,
    FOREIGN KEY (StudentID) REFERENCES Student(StudentID)
);
```

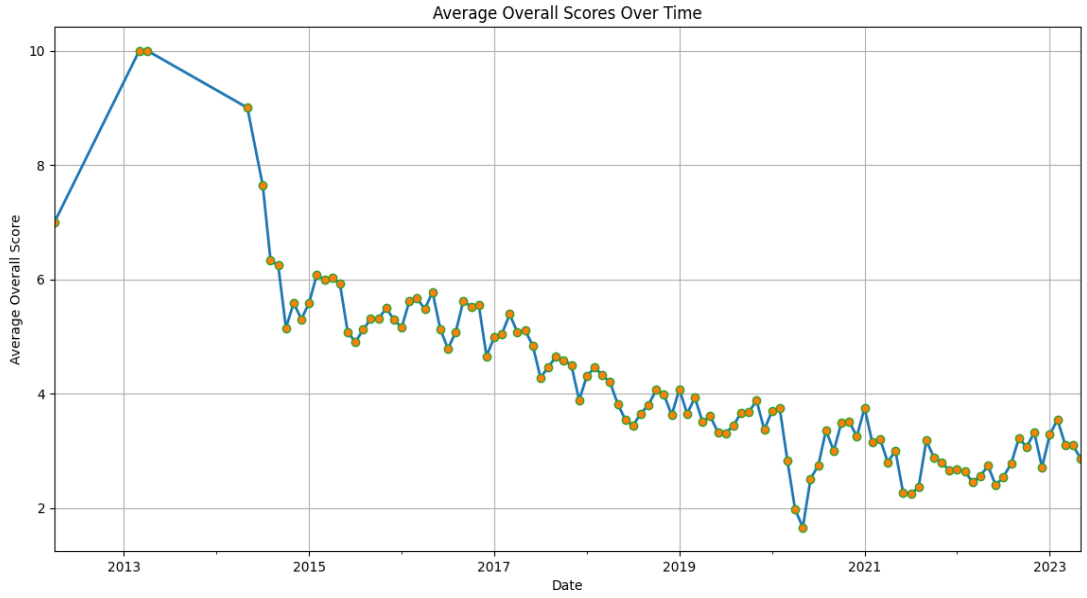
Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

RecordID	StudentID	BookTitle	Author	IssueDate	ReturnDate
1	101	Mathematics for Class 10	John Doe	2023-06-10	2023-06-24
2	102	Science for Class 9	Jane Smith	2023-06-15	2023-07-01
3	103	English Grammar	Michael Johnson	2023-06-20	2023-07-05
4	104	Social Studies Book	Emily Davis	2023-08-01	2023-08-15
5	102	Up from Slavery	Booker T. Washington	2023-07-11	2023-07-20
6	101	The Book of HACKER SCHOOL	Peter Krumins	2023-07-01	2023-07-14
7	102	Pragmatic Thinking & Learning	Andy Hunt	2023-06-25	2023-07-03
8	103	Data Mining Concepts and Techniques	Jiawei Han and Micheline Kamber	2023-07-07	2023-07-16
NULL	NULL	NULL	NULL	NULL	NULL

Data Visualization

We cleaned up the AirlineReview.csv dataset by filling in or removing missing values and then created several visualizations to analyze the data. The line graphs showed how the Overall Score changed over time, while the bar graph compared the number of reviews for each airline. The histogram displays the distribution of Overall Scores, and the box-whisker plot highlights score variations across different airlines. Lastly, the pie chart illustrates the proportion of reviews for each airline, giving us insights into market share and review distribution.

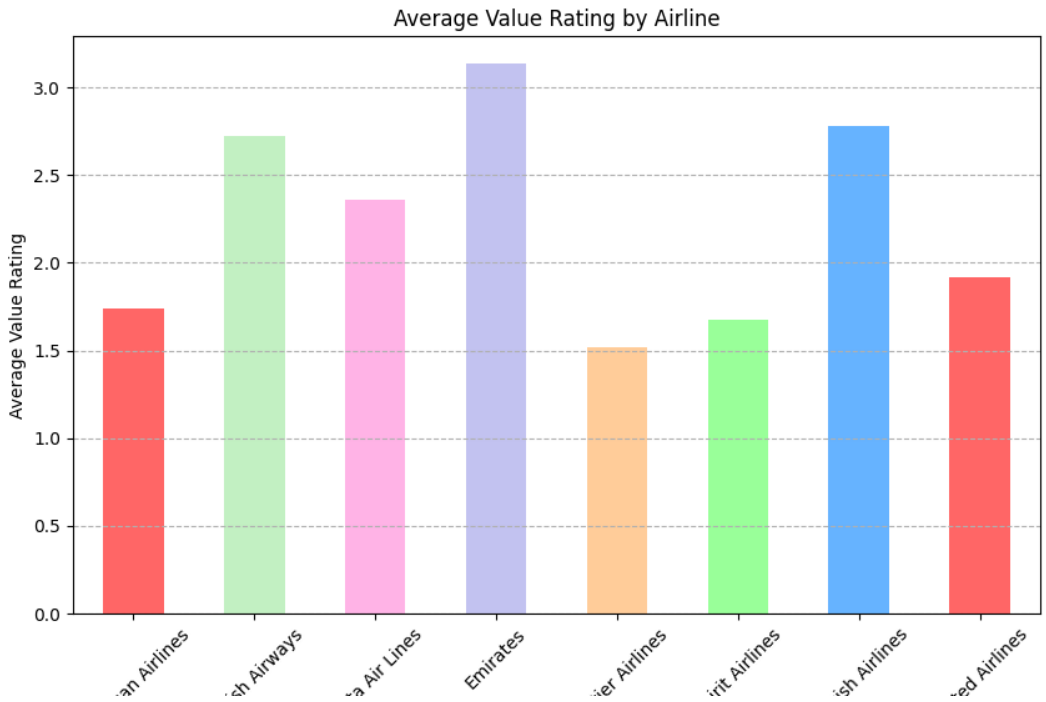
1. Line graph




```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from dateutil import parser


link = r'C:\java\New folder\AirlineReviews.csv.zip'
airline_reviews = pd.read_csv(link)

# Convert 'DateFlown' to datetime format for time series analysis
airline_reviews['DateFlown'] = pd.to_datetime(airline_reviews['DateFlown'], errors='coerce')
```

```python
# Average Overall Scores Over TimeAverage Overall Scores Over Time
monthly_avg_scores = airline_reviews.groupby(airline_reviews['DateFlown'].dt.to_period('M'))['OverallScore'].mean().dropna()

(variable) monthly_avg_scores: Series[Any]

monthly_avg_scores.plot(kind='line', marker='o', color='#1f77b4', linestyle='-', linewidth=2, markerfacecolor='#ff7f0e', markeredgecolor='#2ca02c')
plt.title('Average Overall Scores Over Time')
plt.xlabel('Date')
plt.ylabel('Average Overall Score')
plt.grid(True)
plt.show()
```

2. Bar Graph



```python
# Create the bar graph
# Select 8 airlines to compare
selected_airlines = airline_reviews['AirlineName'].value_counts().nlargest(8).index
df_selected = airline_reviews[airline_reviews['AirlineName'].isin(selected_airlines)]

# Calculate average ValueRating by airline
avg_value_ratings = df_selected.groupby('AirlineName')['ValueRating'].mean()

# Define individual colors for each bar
colors = ['#ff6666', '#c2f0c2', '#ffb3e6', '#c2c2f0', '#ffcc99', '#99ff99', '#66b3ff']

# Plotting the bar graph
plt.figure(figsize=(10, 6))
avg_value_ratings.plot(kind='bar', color=colors)
plt.title('Average Value Rating by Airline')
plt.xlabel('Airline')
plt.ylabel('Average Value Rating')
plt.xticks(rotation=45)
plt.grid(axis='y', linestyle='--')
plt.show()
```

3. Histography

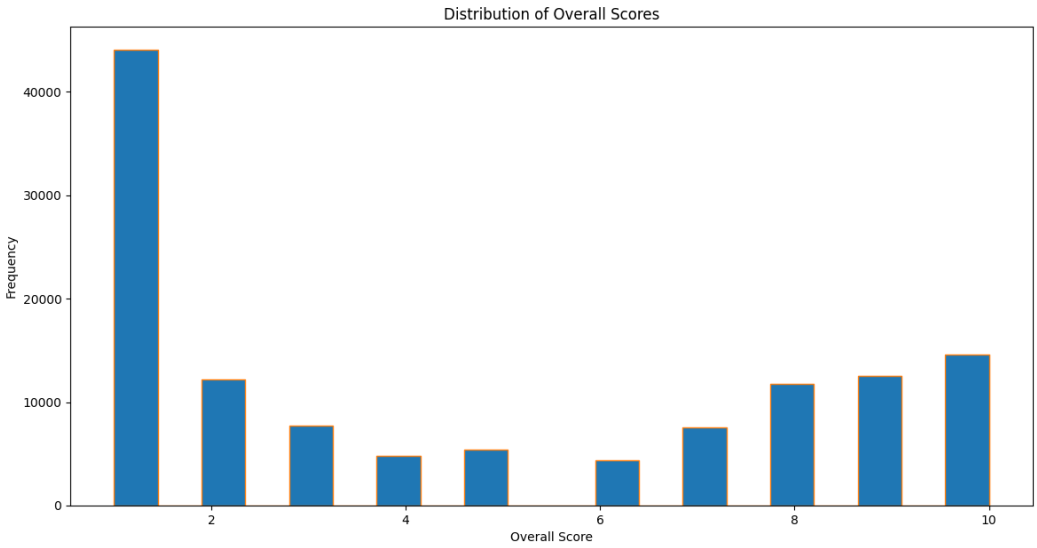
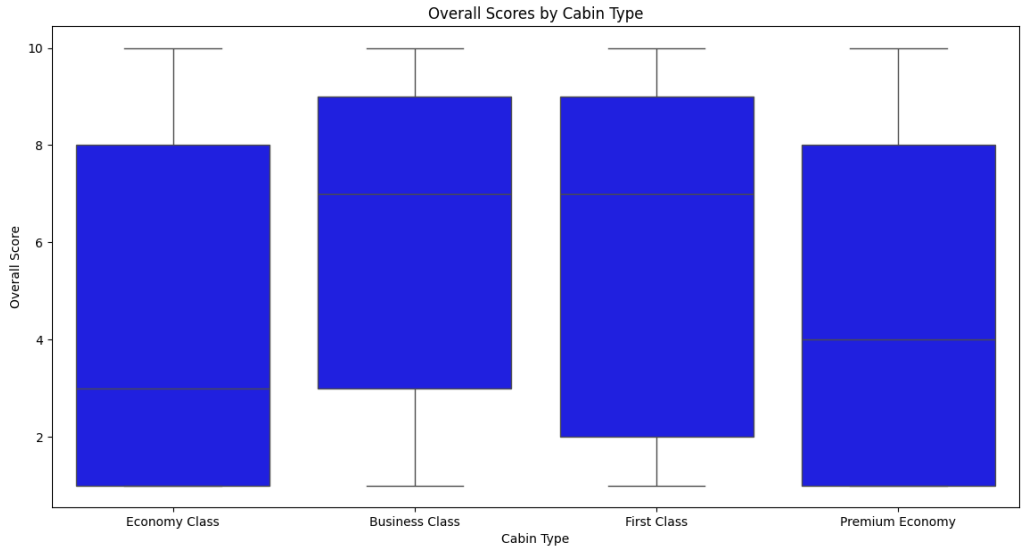


Figure 1 Histography code

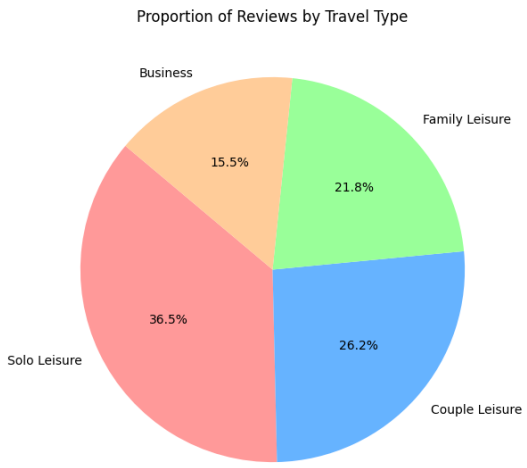
```
# Distribution of Overall Scores
plt.figure(figsize=(14, 7))
airline_reviews['OverallScore'].dropna().plot(kind='hist', bins=20, color='#1f77b4', edgecolor='#ff7f0e')
plt.title('Distribution of Overall Scores')
plt.xlabel('Overall Score')
plt.ylabel('Frequency')
plt.show()
```

4. Box-whisker plot




```
# Overall Scores by Cabin Type
plt.figure(figsize=(14, 7))
sns.boxplot(data=airline_reviews, x='CabinType', y='OverallScore',color="Blue")
plt.title('Overall Scores by Cabin Type')
plt.xlabel('Cabin Type')
plt.ylabel('Overall Score')
plt.show()
```

5. Pie Chart




```
69  # Proportion of Reviews by Travel Type
70  travel_type_counts = airline_reviews['TravelType'].value_counts()
71
72    (variable) travel_type_counts: Series[int]
73  travel_type_counts.plot(kind='pie', autopct='%1.1f%%', startangle=140, colors=['#ff9999', '#66b3ff', '#99ff99', '#ffcc99'])
74  plt.title('Proportion of Reviews by Travel Type')
75  plt.ylabel('')
76  plt.show()
```

Conclusion

The job also required fixing the New Horizon Institute's database system. Visual Paradigm was used in this project's normalization process for its thorough design and organization. MySQL Workbench was used to run database queries, which made effective data management possible. Python packages like Pandas and Matplotlib's Pyplot were used for data visualization. Pandas was utilized for data analysis and manipulation, while Matplotlib's Pyplot allowed for the production of a number of intelligent visual representations of the data.

Reference

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