

FINAL PROJECT REPORT – DATABASE SYSTEMS

University Admissions s Test Score Analytics System

Course: Databases

Project Title: University Admissions C Test Score Analytics System

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1. Project Description:

This project designs and implements a relational database system for analyzing U.S. universities based on admissions rates, SAT/ACT test scores, income distributions, and ranking information. The system supports analytical queries through normalized tables, stored procedures, and views, enabling flexible and efficient data analysis.

2. Changes Since Phase I

Since Phase I, the database design has been revised to improve normalization, reduce redundancy, and better support analytical queries.

a. Unification of Exam Score Tables

In Phase I, SAT and ACT scores were stored in separate tables with multiple score columns.

In Phase II, these structures were replaced by ExamScores, ExamTypes and ScoreTypes table. Exam scores are now represented using ExamType from ExamTypes table, ScoreType from ScoreTypes table, Percentile, and ScoreValue.

This change eliminated repeating attributes and ensured compliance with Third Normal Form (3NF).

b. Normalization of Income Distribution Data

Previously, income distribution data was stored as multiple percentage columns. In the final design, this data was normalized into the IncomeDistributions table, where each income bracket is stored as a separate row.

This structure simplifies aggregation and comparison across institutions.

c. Central Role of the Institutions Table

The Institutions table was restructured to serve as the central entity of the database.

This approach improves referential integrity and simplifies join operations.

d. Removal of Redundant Attributes

Several redundant or derived attributes present in Phase I were removed. Derived values such as averages are now calculated using queries, views, or aggregate functions rather than being stored directly.

e. Addition of Stored Procedures and Views

Phase I included only basic table structures.

In Phase II, stored procedures and views were added to support dynamic queries and summarized outputs, as required by the project guidelines.

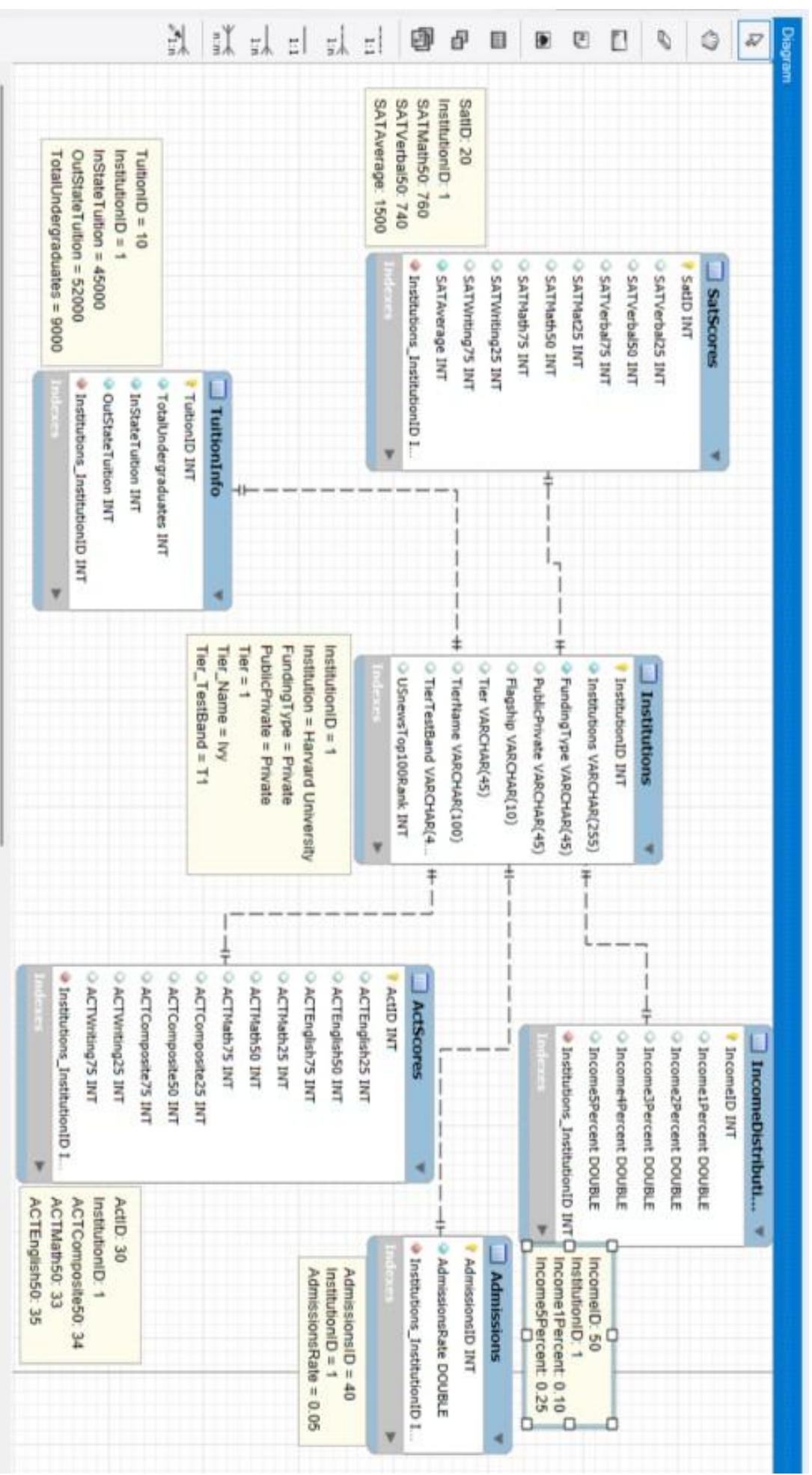
f. Improved Relationship Structure

The final ER diagram clearly defines one-to-many relationships between institutions and related entities such as exam scores and income distributions.

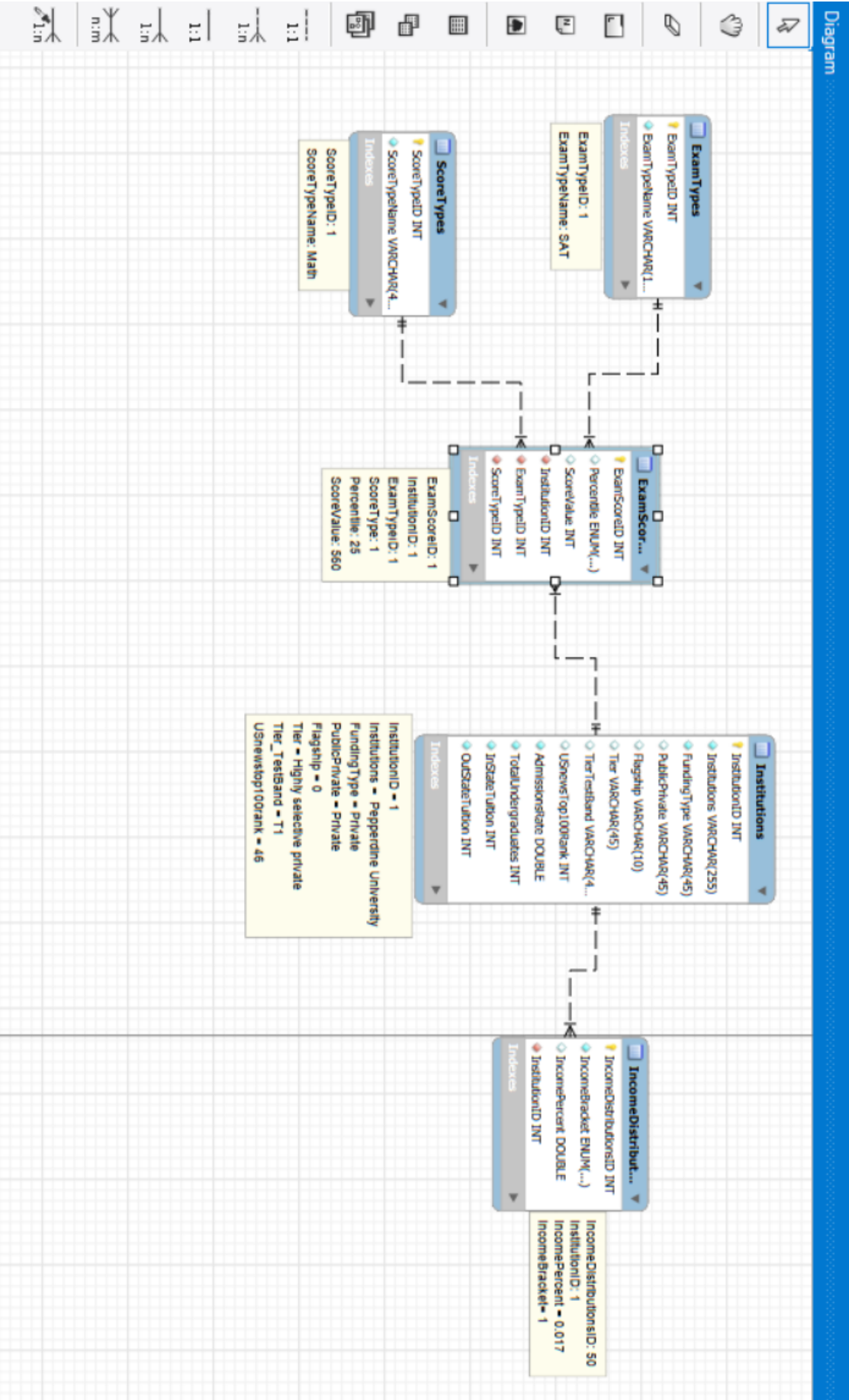
Overall, the database evolved from a partially normalized structure to a fully normalized relational design that supports efficient querying and future extension.

ER DIAGRAM:

First diagram:



Last Diagram :



3. Data Loading Process

The dataset used in this project was obtained from Kaggle:

<https://www.kaggle.com/datasets/alexsciences/university-test-scores>

The data was originally provided as a CSV file containing admissions rates, SAT/ACT test scores, income distribution percentages, and ranking information for U.S. universities.

The database was loaded in multiple steps. First, the raw CSV file was imported into MySQL using the **MySQL Workbench Table Data Import Wizard** to create a staging table (university_test_scores).

Before loading the final tables, preprocessing was performed using SQL to handle missing values, convert non-numeric fields (e.g., "NA") into NULL, and cast text-based numeric attributes into appropriate data types.

Custom **INSERT ... SELECT** SQL scripts were developed to:

- Populate the Institutions table with unique institution records
- Normalize exam score data into the ExamScores table
- Transform income distribution percentages into the IncomeDistributions table

All rows from the original dataset were successfully uploaded into the database. No data was excluded.

4. If you did not use MySQL Workbench on Windows, describe the exact software/hardware platform you used.

We used MySQL Workbench on Windows.

5. User's Guide – Views and Stored Procedures

Stored Procedure: GetInstitutionExamScores

This stored procedure retrieves all exam score records belonging to a specified institution. The institution name is provided as an input parameter, and the procedure returns the exam type, score type, percentile, and score value. It performs JOIN operations across normalized tables and is primarily intended for analytical and reporting purposes.

Stored Procedure: GetTopInstitutionsByScore

This stored procedure retrieves the institutions with the highest exam scores for a selected exam type, score type, and percentile. The user can also specify how many institutions will be returned (Top-N query). This procedure supports comparative performance analysis across institutions and demonstrates the use of parameterized queries, sorting, and limiting in SQL.

Stored Procedure: InsertExamScore

This stored procedure inserts a new exam score record into the ExamScores table. Rather than requiring users to manually supply foreign-key identifiers, it accepts human-readable input such as institution name, exam type, and score type. These values are internally mapped to their corresponding IDs using lookup tables, improving data-entry usability while maintaining referential integrity within the normalized database schema.

View: vw_AllExamScores

This view combines data from the ExamScores, Institutions, ExamTypes, and ScoreTypes tables into a single logical dataset. It presents each exam score together with the institution name, exam type, score type, percentile, and score value. The view simplifies reporting by providing a denormalized perspective over the normalized relational structure.

View: vw_AvgExamScoresByInstitution


This view calculates the average exam score for each institution, grouped by exam type, score type, and percentile. It supports analytical reporting by allowing users to compare institutional SAT/ACT performance and demonstrates the use of aggregation over normalized relational data.

6. Outputs of Selected Stored Procedures and Views


Output of Stored Procedure: GetInstitutionExamScores

```
11  #1. GetInstitution :
12
13  • SELECT Institutions
14    FROM Institutions
15    LIMIT 5;
16
17  • CALL GetInstitutionExamScores('Alabama State University');
```


Result Grid

 Filter Rows:

Export:

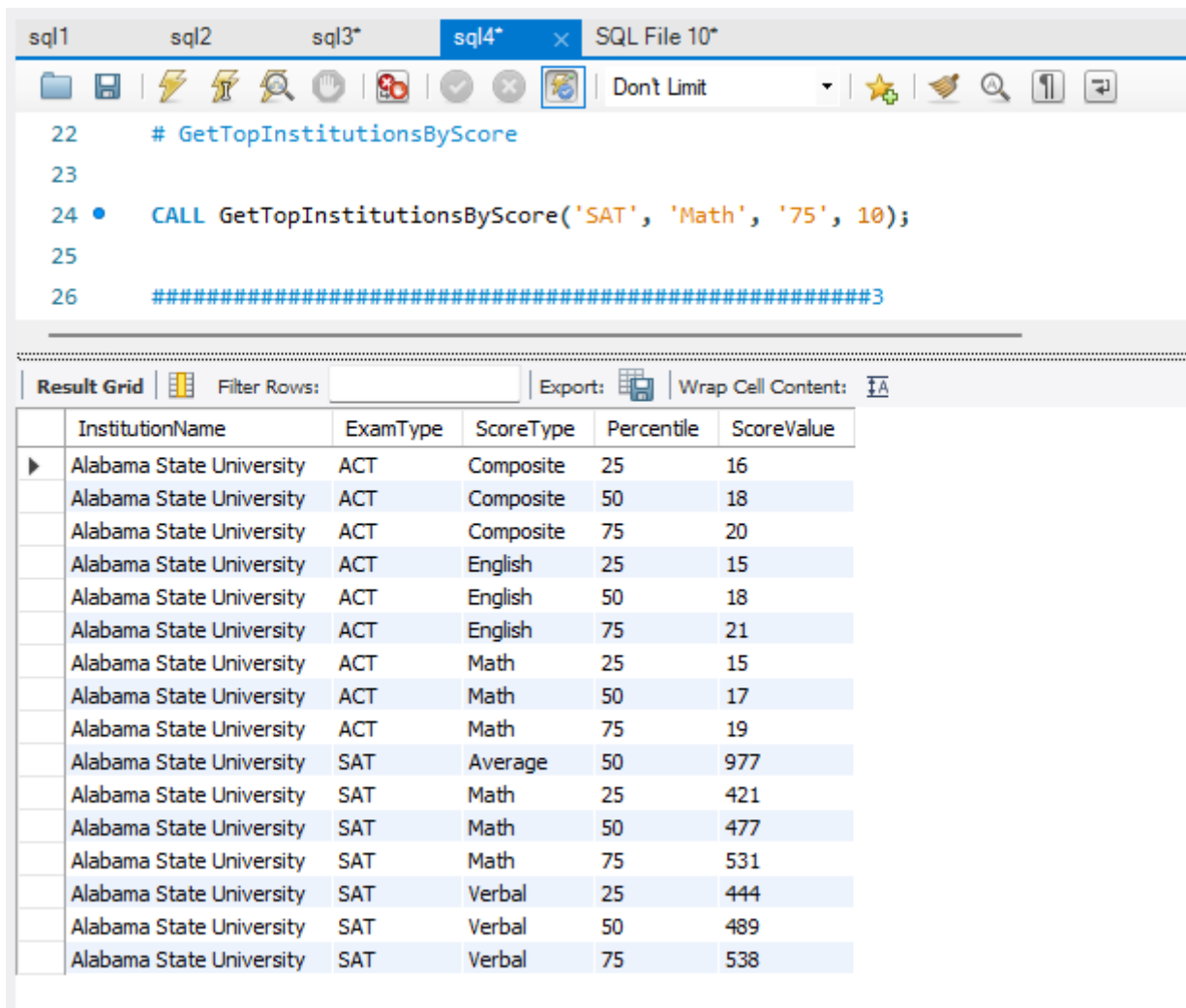


Wrap Cell Content:



	InstitutionName	ExamType	ScoreType	Percentile	ScoreValue
▶	Alabama State University	ACT	Composite	25	16
	Alabama State University	ACT	Composite	50	18
	Alabama State University	ACT	Composite	75	20
	Alabama State University	ACT	English	25	15
	Alabama State University	ACT	English	50	18
	Alabama State University	ACT	English	75	21
	Alabama State University	ACT	Math	25	15
	Alabama State University	ACT	Math	50	17
	Alabama State University	ACT	Math	75	19
	Alabama State University	SAT	Average	50	977
	Alabama State University	SAT	Math	25	421
	Alabama State University	SAT	Math	50	477
	Alabama State University	SAT	Math	75	531
	Alabama State University	SAT	Verbal	25	444
	Alabama State University	SAT	Verbal	50	489
	Alabama State University	SAT	Verbal	75	538

Output of Stored Procedure: GetTopInstitutionsByScore



The screenshot shows a SQL IDE with a toolbar and a query editor. The query editor contains the following SQL code:

```
22 # GetTopInstitutionsByScore
23
24 • CALL GetTopInstitutionsByScore('SAT', 'Math', '75', 10);
25
26 #####3
```

Below the query editor is a "Result Grid" tab. The grid displays the results of the stored procedure call. The columns are InstitutionName, ExamType, ScoreType, Percentile, and ScoreValue. The results show 18 rows of data for Alabama State University, categorized by ExamType (ACT, SAT) and ScoreType (Composite, English, Math, Verbal).

	InstitutionName	ExamType	ScoreType	Percentile	ScoreValue
▶	Alabama State University	ACT	Composite	25	16
	Alabama State University	ACT	Composite	50	18
	Alabama State University	ACT	Composite	75	20
	Alabama State University	ACT	English	25	15
	Alabama State University	ACT	English	50	18
	Alabama State University	ACT	English	75	21
	Alabama State University	ACT	Math	25	15
	Alabama State University	ACT	Math	50	17
	Alabama State University	ACT	Math	75	19
	Alabama State University	SAT	Average	50	977
	Alabama State University	SAT	Math	25	421
	Alabama State University	SAT	Math	50	477
	Alabama State University	SAT	Math	75	531
	Alabama State University	SAT	Verbal	25	444
	Alabama State University	SAT	Verbal	50	489
	Alabama State University	SAT	Verbal	75	538

.Output of Stored Procedure: InsertExamScore

```
sql1  sql2  sql3*  sql4*  SQL File 10*
[Icons] | Don't Limit
25
26 #####3
27 # InsertExamScore
28
29 • SELECT Institutions
30 FROM Institutions
31 LIMIT 1;
32
33 • CALL InsertExamScore(
34     'Alabama A & M University',
35     'SAT',
36     'Math',
37     '75',
38     780
39 );
40
41 • SELECT *
42 FROM ExamScores es
43 JOIN Institutions i ON es.InstitutionID = i.InstitutionID
44 JOIN ExamTypes et ON es.ExamTypeID = et.ExamTypeID
45 JOIN ScoreTypes st ON es.ScoreTypeID = st.ScoreTypeID
46 ORDER BY es.ExamScoreID DESC
47 LIMIT 1;
```

sql1

sql2

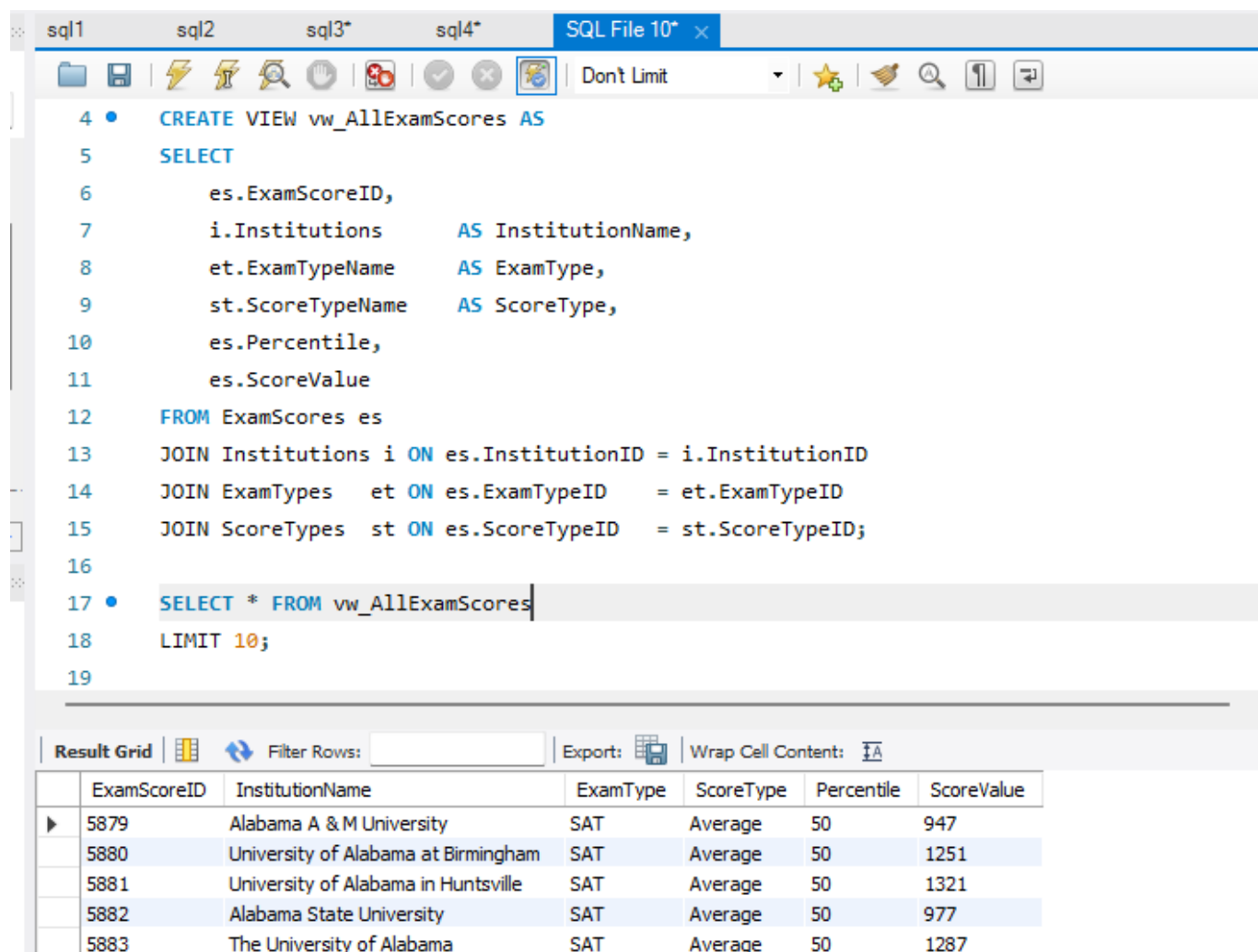
sql3*

sql4*

SQL File 10*

<

Output of View Procedure: vw_AllExamScores

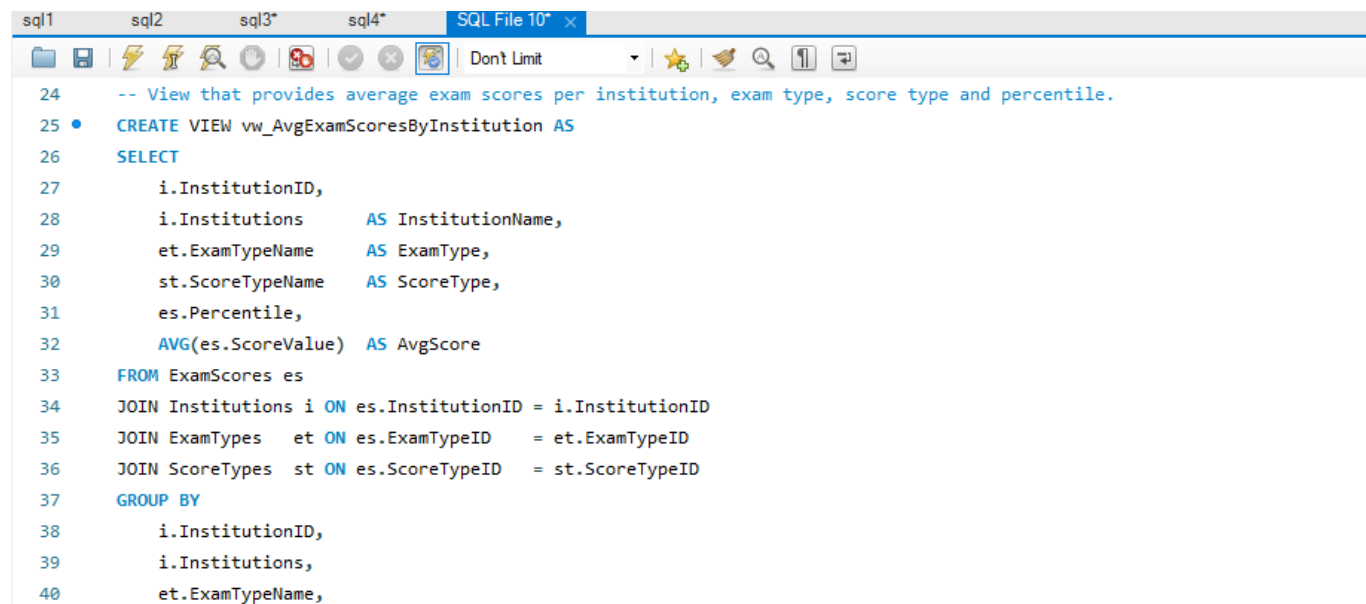


```
4 • CREATE VIEW vw_AllExamScores AS
5 SELECT
6     es.ExamScoreID,
7     i.Institutions      AS InstitutionName,
8     et.ExamTypeName     AS ExamType,
9     st.ScoreTypeName    AS ScoreType,
10    es.Percentile,
11    es.ScoreValue
12 FROM ExamScores es
13 JOIN Institutions i ON es.InstitutionID = i.InstitutionID
14 JOIN ExamTypes   et ON es.ExamTypeID   = et.ExamTypeID
15 JOIN ScoreTypes  st ON es.ScoreTypeID  = st.ScoreTypeID;
16
17 • SELECT * FROM vw_AllExamScores
18 LIMIT 10;
19
```

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

	ExamScoreID	InstitutionName	ExamType	ScoreType	Percentile	ScoreValue
▶	5879	Alabama A & M University	SAT	Average	50	947
	5880	University of Alabama at Birmingham	SAT	Average	50	1251
	5881	University of Alabama in Huntsville	SAT	Average	50	1321
	5882	Alabama State University	SAT	Average	50	977
	5883	The University of Alabama	SAT	Average	50	1287

Output of View Procedure: vw_AvgExamScoresByInstitution





```
24 -- View that provides average exam scores per institution, exam type, score type and percentile.
25 • CREATE VIEW vw_AvgExamScoresByInstitution AS
26 SELECT
27     i.InstitutionID,
28     i.Institutions      AS InstitutionName,
29     et.ExamTypeName     AS ExamType,
30     st.ScoreTypeName    AS ScoreType,
31     es.Percentile,
32     AVG(es.ScoreValue) AS AvgScore
33 FROM ExamScores es
34 JOIN Institutions i ON es.InstitutionID = i.InstitutionID
35 JOIN ExamTypes   et ON es.ExamTypeID   = et.ExamTypeID
36 JOIN ScoreTypes  st ON es.ScoreTypeID  = st.ScoreTypeID
37 GROUP BY
38     i.InstitutionID,
39     i.Institutions,
40     et.ExamTypeName,
```

```

41      st.ScoreTypeName,
42      es.Percentile;
43
44 • SELECT *
45 FROM vw_AvgExamScoresByInstitution
46 ORDER BY AvgScore DESC
47 LIMIT 10;
48

```

Result Grid   Filter Rows: Export:  Wrap Cell Content: 

	InstitutionID	InstitutionName	ExamType	ScoreType	Percentile	AvgScore
▶	145	University of Chicago	SAT	Average	50	1554.0000
	291	Harvard University	SAT	Average	50	1553.0000
	791	Stanford University	SAT	Average	50	1553.0000
	298	Massachusetts Institute of Technology	SAT	Average	50	1553.0000
	695	Rice University	SAT	Average	50	1553.0000
	270	Johns Hopkins University	SAT	Average	50	1553.0000

vw_AvgExamScoresByInstitution... x

7. System Limitations and Suggested Improvements

Limitations

1. Single-source dataset: The database is built from one public Kaggle dataset, so the system is limited to the coverage, accuracy, and update frequency of that source.
2. Missing/NULL values: Some institutions do not provide complete SAT/ACT percentiles or income bracket percentages. These are

stored as NULL, which can reduce the completeness of certain analyses.

3. No historical tracking: The dataset represents a snapshot in time. The schema does not track changes across years (e.g., ranking or tuition trends over time).
4. Limited domain scope: The system focuses on U.S. institutions and a predefined set of attributes (admissions, test scores, income distribution, tuition). Other relevant factors (e.g., graduation rates, employment outcomes) are not included.

Suggested Improvements

1. **Add time dimension (Year/Semester):** Introduce a time-based structure to store historical changes in rankings, tuition, admissions rates, and scores to enable trend analysis.
2. **Data validation and cleansing layer:** Implement preprocessing scripts (Python/ETL) to standardize naming, handle outliers, and improve data consistency before loading.
3. **Expand the dataset:** Integrate additional sources (e.g., official government/education datasets) to increase coverage and reliability.
4. **Advanced indexing and query optimization:** Add composite indexes based on common query patterns (e.g., (ExamType, ScoreType, Percentile, InstitutionID)) and analyze query plans for improvement.

8. FULL RELATIONAL TABLE SPECIFICATION (SQL DDL)

```
1 • SET FOREIGN_KEY_CHECKS = 0;
2
3 • DROP TABLE IF EXISTS ExamScores;
4 • DROP TABLE IF EXISTS IncomeDistributions;
5 • DROP TABLE IF EXISTS ExamTypes;
6 • DROP TABLE IF EXISTS ScoreTypes;
7 • DROP TABLE IF EXISTS Institutions;
8
9 SET FOREIGN_KEY_CHECKS = 1;
10
11 • CREATE TABLE ExamTypes (
12     ExamTypeID TINYINT PRIMARY KEY,
13     ExamTypeName VARCHAR(10) NOT NULL
14 );
15
16 • CREATE TABLE ScoreTypes (
17     ScoreTypeID TINYINT PRIMARY KEY,
18     ScoreTypeName VARCHAR(45) NOT NULL UNIQUE
19 );
20
21 • CREATE TABLE Institutions (
22     InstitutionID INT AUTO_INCREMENT PRIMARY KEY,
23     Institutions VARCHAR(255) NOT NULL,
24     FundingType VARCHAR(45),
25     PublicPrivate VARCHAR(45),
```

```

26     Flagship          VARCHAR(10),
27     Tier              VARCHAR(45),
28     TierTestBand      VARCHAR(45),
29     USNewsTop100Rank  INT,
30     AdmissionsRate    DOUBLE,
31     TotalUndergraduates INT,
32     InStateTuition    INT,
33     OutStateTuition   INT
34 );
35
36 • ○ CREATE TABLE IncomeDistributions (
37     IncomeDistributionsID INT AUTO_INCREMENT PRIMARY KEY,
38     InstitutionID        INT NOT NULL,
39     IncomeBracket        TINYINT NOT NULL, -- 1..5
40     IncomePercent        DOUBLE,
41     FOREIGN KEY (InstitutionID)
42         REFERENCES Institutions(InstitutionID)
43 );
44
45 • ○ CREATE TABLE ExamScores (
46     ExamScoreID  INT AUTO_INCREMENT PRIMARY KEY,
47     Percentile   ENUM('25','50','75') NOT NULL,
48     ScoreValue   INT,
49     InstitutionID INT NOT NULL,
50     ExamTypeID   TINYINT NOT NULL,

```

```

51     ScoreTypeID  TINYINT NOT NULL,
52
53     FOREIGN KEY (InstitutionID)
54         REFERENCES Institutions(InstitutionID),
55     FOREIGN KEY (ExamTypeID)
56         REFERENCES ExamTypes(ExamTypeID),
57     FOREIGN KEY (ScoreTypeID)
58         REFERENCES ScoreTypes(ScoreTypeID)
59 );
60

```


9. SQL CODES OF THE SYSTEM

Insertations:

```
1 • INSERT INTO ExamTypes (ExamTypeID, ExamTypeName)
2 VALUES
3 (1, 'SAT'),
4 (2, 'ACT');
5
6 • INSERT INTO ScoreTypes (ScoreTypeID, ScoreTypeName)
7 VALUES
8 (1, 'Math'),
9 (2, 'Verbal'),
10 (3, 'Writing'),
11 (4, 'Composite'),
12 (5, 'Average'),
13 (6, 'English'); -- ACT English için
```

```

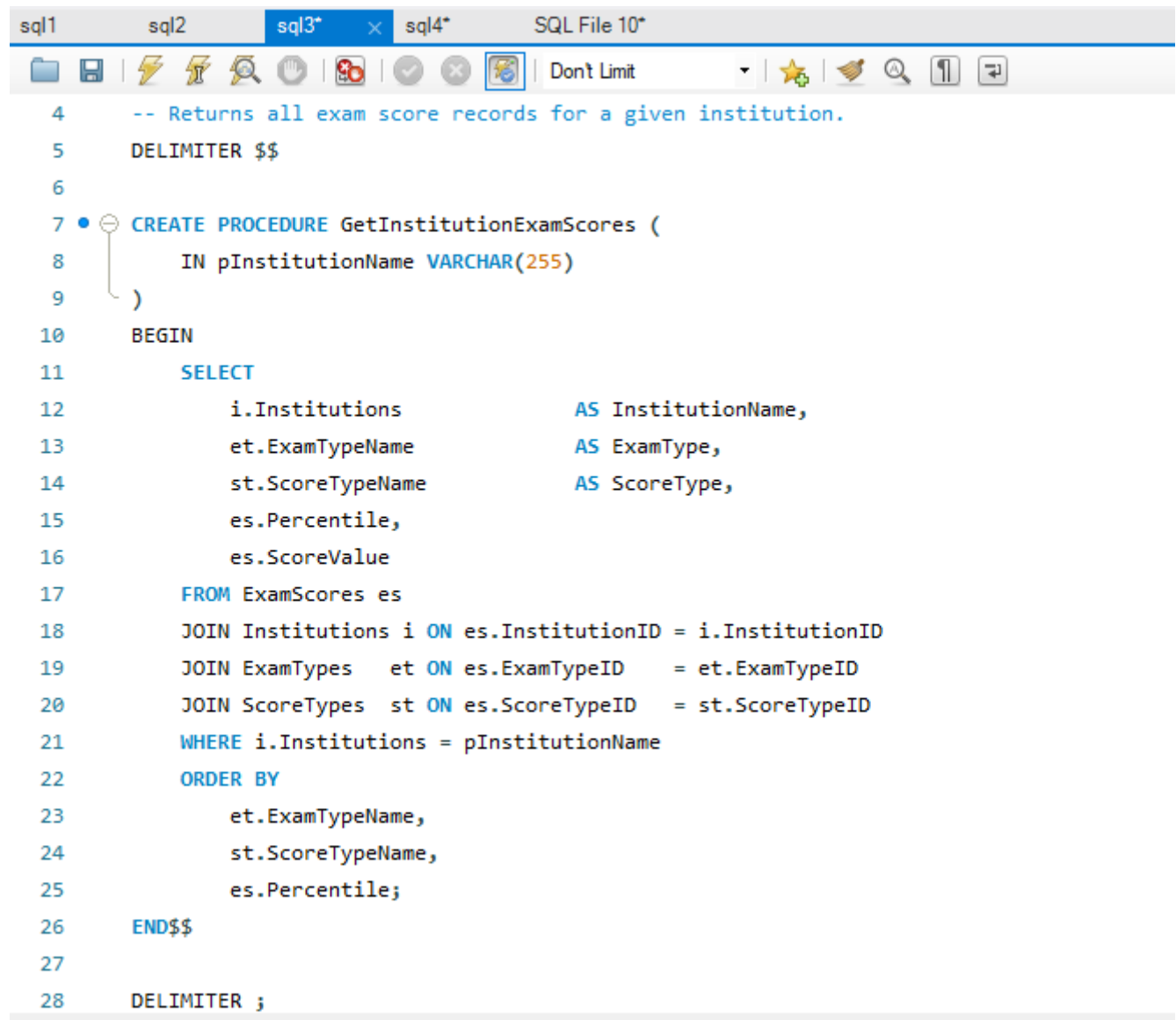
25 ● ○ INSERT INTO Institutions (
26     Institutions,
27     FundingType,
28     PublicPrivate,
29     Flagship,
30     Tier,
31     TierTestBand,
32     USNewsTop100Rank,
33     AdmissionsRate,
34     TotalUndergraduates,
35     InStateTuition,
36     OutStateTuition
37 )
38 SELECT
39     uts.Institution,
40     uts.Funding_Type,
41     uts.`Public/Private`,
42     uts.Flagship,
43     uts.Tier,
44     uts.Tier_TestBand,
45     ○ CASE
46         WHEN uts.USnewsTop100Rank = 'NA' OR uts.USnewsTop100Rank IS NULL
47         THEN NULL
48         ELSE CAST(uts.USnewsTop100Rank AS SIGNED)
49     END,
50     uts.Admissions_Rate,
51     uts.Total_Undergraduates,

```

```
58 ● ○ INSERT INTO IncomeDistributions (  
59     InstitutionID,  
60     IncomeBracket,  
61     IncomePercent  
62 )  
63     SELECT i.InstitutionID, 1, uts.Income_1_Percent  
64     FROM university_test_scores uts  
65     JOIN Institutions i ON i.Institutions = uts.Institution  
66     WHERE uts.Income_1_Percent IS NOT NULL  
67  
68     UNION ALL  
69     SELECT i.InstitutionID, 2, uts.Income_2_Percent  
70     FROM university_test_scores uts  
71     JOIN Institutions i ON i.Institutions = uts.Institution  
72     WHERE uts.Income_2_Percent IS NOT NULL  
73  
74     UNION ALL  
75     SELECT i.InstitutionID, 3, uts.Income_3_Percent  
76     FROM university_test_scores uts  
77     JOIN Institutions i ON i.Institutions = uts.Institution  
78     WHERE uts.Income_3_Percent IS NOT NULL  
79  
80     UNION ALL  
81     SELECT i.InstitutionID, 4, uts.Income_4_Percent  
82     FROM university_test_scores uts  
83     JOIN Institutions i ON i.Institutions = uts.Institution  
84     WHERE uts.Income_4_Percent IS NOT NULL
```

```
94 ● ⊖ INSERT INTO ExamScores (  
95     ExamTypeID,  
96     ScoreTypeID,  
97     InstitutionID,  
98     Percentile,  
99     ScoreValue  
100 )  
101  
102 -- SAT VERBAL  
103 SELECT et.ExamTypeID, st.ScoreTypeID, i.InstitutionID, '25',  
104        CAST(uts.SAT_Verbal_25 AS UNSIGNED)  
105 FROM university_test_scores uts  
106 JOIN Institutions i  ON i.Institutions  = uts.Institution  
107 JOIN ExamTypes  et  ON et.ExamTypeName = 'SAT'  
108 JOIN ScoreTypes st  ON st.ScoreTypeName = 'Verbal'  
109 WHERE uts.SAT_Verbal_25 REGEXP '^[0-9]+$'  
110  
111 UNION ALL  
112 SELECT et.ExamTypeID, st.ScoreTypeID, i.InstitutionID, '50',  
113        CAST(uts.SAT_Verbal_50 AS UNSIGNED)  
114 FROM university_test_scores uts  
115 JOIN Institutions i  ON i.Institutions  = uts.Institution  
116 JOIN ExamTypes  et  ON et.ExamTypeName = 'SAT'  
117 JOIN ScoreTypes st  ON st.ScoreTypeName = 'Verbal'  
118 WHERE uts.SAT_Verbal_50 REGEXP '^[0-9]+$'
```

Stored Prodedures SQL Codes:



The screenshot shows a SQL IDE with a toolbar at the top containing icons for file operations, execution, and search. The toolbar also includes a dropdown menu set to 'Don't Limit'. The main editor area displays SQL code for a stored procedure named 'GetInstitutionExamScores'. The code is as follows:

```
4  -- Returns all exam score records for a given institution.
5  DELIMITER $$
6
7  CREATE PROCEDURE GetInstitutionExamScores (
8      IN pInstitutionName VARCHAR(255)
9  )
10 BEGIN
11     SELECT
12         i.Institutions          AS InstitutionName,
13         et.ExamTypeName         AS ExamType,
14         st.ScoreTypeName        AS ScoreType,
15         es.Percentile,
16         es.ScoreValue
17     FROM ExamScores es
18     JOIN Institutions i ON es.InstitutionID = i.InstitutionID
19     JOIN ExamTypes et ON es.ExamTypeID = et.ExamTypeID
20     JOIN ScoreTypes st ON es.ScoreTypeID = st.ScoreTypeID
21     WHERE i.Institutions = pInstitutionName
22     ORDER BY
23         et.ExamTypeName,
24         st.ScoreTypeName,
25         es.Percentile;
26 END$$
27
28 DELIMITER ;
```

```
sql1    sql2    sql3    x    sql4*    SQL File 10*
[Icons] | Don't Limit | [Icons]

1  DELIMITER $$
2  DELIMITER ;
3
4  -- Returns all exam score records for a given institution.
5  DELIMITER $$
6
7  ● ○ CREATE PROCEDURE GetInstitutionExamScores (
8      IN pInstitutionName VARCHAR(255)
9  )
10 BEGIN
11     SELECT
12         i.Institutions          AS InstitutionName,
13         et.ExamTypeName         AS ExamType,
14         st.ScoreTypeName        AS ScoreType,
15         es.Percentile,
16         es.ScoreValue
17 FROM ExamScores es
18 JOIN Institutions i ON es.InstitutionID = i.InstitutionID
19 JOIN ExamTypes et ON es.ExamTypeID = et.ExamTypeID
20 JOIN ScoreTypes st ON es.ScoreTypeID = st.ScoreTypeID
21 WHERE i.Institutions = pInstitutionName
22 ORDER BY
23     et.ExamTypeName,
```

```
sql1  sql2  sql3  x  sql4*  SQL File 10*
[Icons]  Dont Limit  [Icons]

24      st.ScoreTypeName,
25      es.Percentile;
26  END$$
27
28  DELIMITER ;
29
30  #####
31  -- Returns the top N institutions with the highest exam scores for a given exam type, score type, and percentile.
32
33
34  DELIMITER $$
35
36  ● CREATE PROCEDURE GetTopInstitutionsByScore (
37      IN pExamTypeName  VARCHAR(10),
38      IN pScoreTypeName VARCHAR(45),
39      IN pPercentile    ENUM('25','50','75'),
40      IN pLimitN        INT
41  )
42  BEGIN
43      SELECT
44          i.Institutions      AS InstitutionName,
45          et.ExamTypeName    AS ExamType,
46          st.ScoreTypeName   AS ScoreType,
47          es.Percentile,
48          es.ScoreValue
49      FROM ExamScores es
50      JOIN Institutions i ON es.InstitutionID = i.InstitutionID
51      JOIN ExamTypes   et ON es.ExamTypeID   = et.ExamTypeID
52      JOIN ScoreTypes  st ON es.ScoreTypeID  = st.ScoreTypeID
53      WHERE et.ExamTypeName = pExamTypeName
54             AND st.ScoreTypeName = pScoreTypeName
55             AND es.Percentile = pPercentile
56      ORDER BY es.ScoreValue DESC
57      LIMIT pLimitN;
58  END$$
59
60  DELIMITER ;
61
62  ● CALL GetTopInstitutionsByScore('SAT', 'Math', '75', 10);
63
64  #####
65
66
67  DELIMITER $$
68
69  ● CREATE PROCEDURE InsertExamScore (
```

```
sql1  sql2  sql3  x  sql4*  SQL File 10*
[Icons] | Don't Limit
70      IN pInstitutionName VARCHAR(255),
71      IN pExamTypeName   VARCHAR(10),
72      IN pScoreTypeName  VARCHAR(45),
73      IN pPercentile     ENUM('25','50','75'),
74      IN pScoreValue     INT
75  )
76  BEGIN
77      DECLARE vInstitutionID INT;
78      DECLARE vExamTypeID   TINYINT;
79      DECLARE vScoreTypeID  TINYINT;
80
81      -- InstitutionID bul
82      SELECT InstitutionID INTO vInstitutionID
83      FROM Institutions
84      WHERE Institutions = pInstitutionName
85      LIMIT 1;
86
87      -- ExamTypeID bul
88      SELECT ExamTypeID INTO vExamTypeID
89      FROM ExamTypes
90      WHERE ExamTypeName = pExamTypeName
91      LIMIT 1;
92
```



```
sql1  sql2  sql3  x  sql4*  SQL File 10*
[Icons]  Don't Limit

93      -- ScoreTypeID bul
94      SELECT ScoreTypeID INTO vScoreTypeID
95      FROM ScoreTypes
96      WHERE ScoreTypeName = pScoreTypeName
97      LIMIT 1;
98
99      -- Insert işlemi
100      INSERT INTO ExamScores (
101          ExamTypeID,
102          ScoreTypeID,
103          InstitutionID,
104          Percentile,
105          ScoreValue
106      )
107      VALUES (
108          vExamTypeID,
109          vScoreTypeID,
110          vInstitutionID,
111          pPercentile,
112          pScoreValue
113      );
114      END$$
115
116      DELIMITER ;
117
118
```