**Normalization Justification Document**

**Project: Online-Examination-System**  
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**1. Introduction**

Relational database normalization is a systematic process to organize tables and their relationships to minimize redundancy and avoid undesirable characteristics like update anomalies. For this project’s logical model, we ensure our schema meets Third Normal Form (3NF), thereby improving data integrity, consistency, and maintenance.

**2. Tables & Attributes**

| **Table** | **Primary Key** | **Attributes** |
| --- | --- | --- |
| **INSTRUCTOR** | InstructorID | FullName, Email, Password |
| **STUDENT** | StudentID | FullName, Email, Password, Program |
| **EXAM** | ExamID | Title, Subject, StartTime, EndTime, InstructorID (FK) |
| **QUESTION** | QuestionID | ExamID (FK), QuestionText, QuestionType, Marks |
| **ANSWEROPTION** | OptionID | QuestionID (FK), OptionText, IsCorrect |
| **STUDENTANSWER** | (StudentID, QuestionID) | OptionID (FK), AnswerText, AnsweredAt |
| **RESULT** | ResultID | StudentID (FK), ExamID (FK), Score, SubmittedAt |

**3. First Normal Form (1NF)**

**Rule:**

* Tables must have a primary key and atomic (indivisible) attribute values.

**Validation:**

* All tables have properly defined primary keys (single-column or composite).
* All columns store single, atomic values with no repeating groups or arrays.
* All text fields (QuestionText, OptionText, AnswerText) store single values, not lists.

**Conclusion:** The database schema is fully compliant with First Normal Form (1NF).

# 4. Second Normal Form (2NF) Analysis

**Rule:**

* Must be in 1NF and no non-key attribute depends on only part of the primary key.

**Validation:**

* Tables with single-column primary keys (Instructor, Student, Exam, Question, AnswerOption, Result) automatically satisfy 2NF.
* StudentAnswer has composite key (StudentID, QuestionID). All attributes (OptionID, AnswerText, AnsweredAt) depend on the complete key, not just part of it.

**5. Third Normal Form (3NF)**

**Rule:**

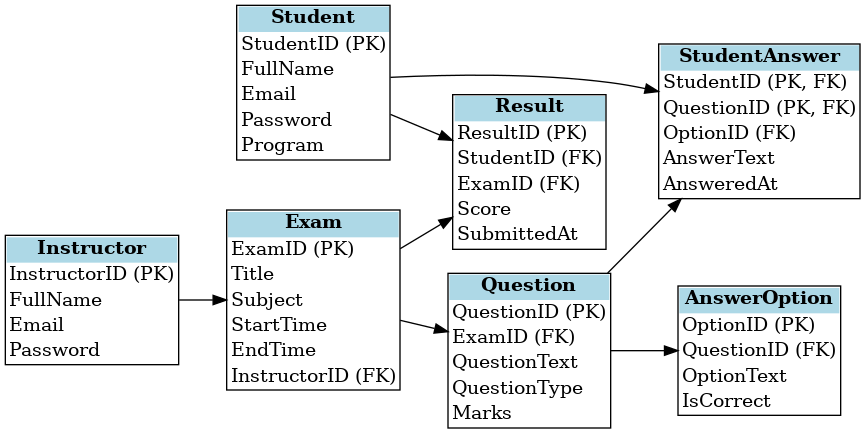
* No transitive dependencies: non-key attributes must depend only on the primary key, not on other non-key attributes.

**Validation:**

* **Instructor** table contains only attributes directly dependent on InstructorID with no transitive dependencies.
* **Student** table contains only attributes directly dependent on StudentID with no transitive dependencies.
* **Exam** properly references InstructorID as a foreign key rather than duplicating instructor information.
* **Question** references ExamID as a foreign key instead of duplicating exam details.
* **AnswerOption** only contains data specific to each option, with QuestionID as a foreign key.
* **StudentAnswer** uses a composite primary key and properly references other entities via foreign keys.
* **Result** stores only score information with appropriate foreign keys to Student and Exam, avoiding duplication of student or exam data.

**Conclusion:** The database schema is fully compliant with Third Normal Form (3NF) as all non-key attributes are directly dependent on their respective primary keys, with proper normalization through foreign key relationships.

1. **ER Diagram**

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