Admission Counseling System Database Documentation

1 Introduction to the Mini-World

The mini-world for this database revolves around a centralised Admission Counseling System, designed to manage the complex process of counselling and seat allocation for students who have appeared for various competitive examinations. These exams could include JEE (Joint Entrance Examination), NEET (National Eligibility cum Entrance Test), GATE (Graduate Aptitude Test in Engineering), UPSC (Union Public Service Commission), and other international, national or state-level entrance exams.

This system centralises the operations of admission counselling, seat allocation, record management, and quota distribution for educational institutions or government positions. The database ensures efficient management of student data, seat allocation, institute records, making the overall admission or selection process seamless and transparent.

The mini-world for this database revolves around a centralised Admission Counseling System, designed to manage the complex process of counselling and seat allocation for students who have appeared for various competitive examinations, including JEE, NEET, GATE, UPSC, SAT and other national and state-level entrance exams.

In our exploration of our course algorithms and analysis (AAD), we were particularly inspired by the Gale-Shapley algorithm, which earned a Nobel Prize for its revolutionary approach to matching theory. This algorithm's ability to create stable matches—ensuring that no two entities would prefer each other over their current assignments—has transformed fields ranging from economics to social sciences.

Drawing from these principles, our Admission Counseling System seeks to optimise seat allocation by ensuring that students are matched effectively with their preferred institutions and programs. By centralising operations for admission counselling, seat allocation, record management, and quota distribution, we aim to enhance the transparency and efficiency of the selection process.

This innovative system not only simplifies the complexities of competitive admissions but also establishes a benchmark for future advancements in educational methodologies.

2 Purpose of the Database

The primary purpose of the Admission Counseling System database is to:

- Manage Student Data: Store details of students who have appeared for competitive exams, including their scores, ranks, preferences, and other relevant data.
- Facilitate Seat Allocation: Automate the allocation of seats based on merit, reservation policies, and availability across various institutions or government departments.
- Handle Institute/Department Data: Manage data related to participating institutions (colleges, departments, etc.), including the courses or positions available, seat matrices, and reservation quotas.
- Track Multiple Rounds of Counseling: Organise and manage counselling across several rounds, ensuring that seats or positions are allocated, reallocated, or surrendered efficiently.
- Payment Verification: Track fees payment process for students or candidates securing their seats/positions.

3 Users

3.1 Students/Candidates

- Actor Type: Naïve/Parametric Users
- Role: Individuals who have qualified in exams like JEE, NEET, UPSC, etc.
- Permissions: Limited to their personal data and counselling information. Cannot view or modify data of other candidates or influence the allocation process.

3.2 Institution/Department Administrators

- Actor Type: Sophisticated Users
- Role: Representatives from educational institutions or government departments.
- Permissions: Can only manage data and seats related to their institution or department. Cannot see other institutions' data or make changes to the allocation rules.

3.3 Counseling Committee Officials

- Actor Type: Highly Sophisticated Users
- Role: Officials responsible for managing and overseeing the entire process.
- Permissions: Have full visibility and control over the counselling process, including the ability to adjust rules, quotas, and allocation results. Cannot access technical aspects of the system or make unauthorised changes to user data.

3.4 Parents/Guardians

- Actor Type: Casual Users
- Role: Observers for student-related counselling.
- Permissions: Read-only access to their ward's information, with no ability to edit or submit data.

3.5 System Administrators

- Actor Type: DBA/System Analysts
- Role: Technical staff responsible for system maintenance and functionality.
- Permissions: Full access to all system components for technical maintenance. Cannot modify user data or interfere with the seat allocation process unless for troubleshooting purposes.

4 Applications of the Database

The database supports a wide range of applications, including:

- Seat/Position Allocation System: Automates the allocation of seats (for education) or positions (for government jobs) to candidates based on merit, preferences, and quota systems.
- Counselling Dashboard: Allows candidates to register, submit preferences for courses or positions, and track their status across multiple rounds of counselling.
- Institution/Department Portal: Provides a platform for institutions and departments to manage seat/position availability, update seat matrices.
- Quota Management: Handles distribution of seats/positions across various quotas (e.g., General, SC/ST, OBC, PwD) in a structured manner.
- Payment Tracking: Manages the collection and tracking of seat acceptance fees or other payments.

5 Assumptions

- Students can have multiple categories depending upon the exam.
- In preference both student id and program both make up keys.
- Every program must be offered by at least one institute, An institute will offer at least one program.
- There will be only one attempt for each exam.
- At least one student passes each exam.
- If a payment tuple exists for some student and exam some amount has been paid in form of fees.
- If the student withdraws for a round then he cannot participate for any subsequent rounds.
- A student can accept multiple seats from different exams in the same institute for the same program.

6 Entities

6.1 Strong Entities

6.1.1 Student

Attributes:

- Student_ID (Primary Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - INT
- Name (Composite)
  - NULL/NOT NULL: Cannot be NULL
  - FirstName: MAX 30 characters, VARCHAR
  - MiddleName: MAX 30 characters, VARCHAR
  - LastName: MAX 30 characters, VARCHAR
- Gender
  - NULL/NOT NULL: Cannot be NULL
  - CHAR(1), Domain: [M, F, N]
- Date of Birth
  - NULL/NOT NULL: Cannot be NULL
  - DATE
- Exams given by a student (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Age (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Email

  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Phone
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Address (Composite)
  - NULL/NOT NULL: Cannot be NULL
  - Street: MAX 50 characters, VARCHAR
  - City: MAX 30 characters, VARCHAR
  - State: MAX 30 characters, VARCHAR
  - ZIP: INT
- Qualification (MVA)
  - NULL/NOT NULL: Can be NULL
  - MAX 150 characters, VARCHAR, MAX 20 elements

Description: Represents each student participating in the counselling process.

6.1.2 Institute

Attributes:

- Name (Primary Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - MAX 30 characters, VARCHAR
- Location (Composite)(Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - Block No.: MAX 10 characters, VARCHAR
  - Street: MAX 50 characters, VARCHAR
  - City: MAX 30 characters, VARCHAR

  - State: MAX 30 characters, VARCHAR
  - ZIP: INT
- Type (Engineering, Medical, Business) (MVA)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 150 characters, VARCHAR, MAX 10 elements
- Ranking
  - NULL/NOT NULL: Can be NULL
  - INT
- Parent_Institute_Name (Foreign Key)
  - NULL/NOT NULL: Can be NULL
  - MAX 30 characters, VARCHAR
- Number_of_seats (category wise)(MVA) (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT, MAX 20 elements
- Total_no_of_seats (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT

Description: Represents the institutes that offer seats for students.

6.1.3 Program

Attributes:

- Program_ID (Primary Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - INT
- Name
  - NULL/NOT NULL: Cannot be NULL

  - MAX 30 characters, VARCHAR

- Duration
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Degree (B.Tech, M.Tech, etc.)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Number_of_seats (category wise)(MVA) (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 20 elements, INT
- Total_no_of_seats (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT

Description: Represents different programs (courses) offered by institutes.

6.1.4 Exam

Attributes:

- Name_of_Exam (Primary Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - MAX 30 characters, VARCHAR
- Type
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Date of examination
  - NULL/NOT NULL: Cannot be NULL
  - Date

Description: Represents different exams taken by students, including their types and timing.

6.2 Weak Entities

6.2.1 Preference (Weak Entity)

Attributes:

- Student_ID (Foreign Key/Partial Key)
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Priority (Partial Key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - INT
- Institute_Name (Foreign Key)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Program_ID (Foreign Key)
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Name of Exam (Foreign Key/Partial key)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR

Description: Represents the program choices made by a student. This entity is weak because it depends on both the Student and the Program entities for its identification.

6.2.2 Counselling Round

Attributes:

- Round_ID (Partial_key)
  - NULL/NOT NULL: Cannot be NULL
  - Unique

  - INT

- Name of Exam (Foreign Key)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Round_Number
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Start_Date
  - NULL/NOT NULL: Cannot be NULL
  - DATE
- End_Date
  - NULL/NOT NULL: Cannot be NULL
  - DATE

6.2.3 Special Counselling Round (Subclass)

Additional Attributes:

- Round_ID (Partial_Key, Foreign Key referencing Round_ID in Counselling Round)
  - NULL/NOT NULL: Cannot be NULL
  - Unique
  - INT
- Name of Exam (Foreign Key)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Eligibility_Criteria
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR

- Special_Quota_Seats
  - NULL/NOT NULL: Cannot be NULL
  - INT

Description: Represents special rounds of counselling conducted for reserved seats or special categories. Inherits all attributes from the Counselling Round entity and adds attributes related to eligibility and quotas.

7 Relationships Between Entities

7.1 Gives Exam

Entities Involved: Student, Exam
Cardinality: Many-to-Many (A student can give multiple exams, also an exam can be given by many students.) (m:n)
Participation Constraints:

- Total Participation(Student): Every student must have given at least one exam (Total participation of the student).
- Total Participation(Exam): An exam needs to be given by at least one student.

Description: This relationship captures the information about which exams the students have given.
Relationship Attributes:

- Category
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Category_rank
  - NULL/NOT NULL: Cannot be NULL
  - INT
- Rank
  - NULL/NOT NULL: Cannot be NULL
  - INT

7.2 Offers Program

Entities Involved: Institute, Program
Cardinality: Many-to-Many (An institute can offer multiple programs, a program can be offered by multiple institutes.) (m:n)
Participation Constraints:

- Total Participation (Program): Every program must be offered by at least one institute.
- Total Participation (Institute): An institute will offer at least one program.

Relationship Attributes:

- No_of_seats (MVA) (General, SC, ST, OBC etc)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 150 characters, VARCHAR, MAX 20 elements
- Total_number_of_seats (Derived Attribute)
  - NULL/NOT NULL: Cannot be NULL
  - INT

Description: This relationship describes which programs are offered by each institute. It represents the courses available to students at a particular institute during the counselling and admission process.

7.3 Is for (Identifying Relationship for Counselling Round Weak entity)

Entities Involved: Counselling Round, Exam
Cardinality: Many-to-One (A exam can participate in multiple rounds of counselling, and each round is for a specific exam.)(m:1)
Participation Constraints:

- Total Participation(Exam): Every exam must have at least one counselling round.
- Total Participation(Counselling Round): Every counselling round will be for a specific exam.

Description: This relationship connects each Counselling Round to a specific Exam, ensuring that every counselling round is directly tied to an exam. This is identifying relationships for the Counselling round.

7.4 Has Preference (Identifying Relationship for Preference Weak entity)

Entities Involved: Student, Preference
Cardinality: One-to-Many (Each student has multiple preferences, and each preference Each Preference is associated with one Student)
Participation Constraints:

- Partial Participation (Student): A student may or may not fill preference.
- Total Participation (Preference): Each preference entry must be tied to at least one student, meaning no preference can exist independently without an associated student.

Description: This relationship records the preferences of students regarding the programs and institutes they wish to enrol in based on the exam. This is the identifying relationship for Preference.

7.5 Higher Degree Relationship (n greater than 3)

7.5.1 Eligibility For Admission

Entities Involved: Student, Program, Institute, Exam
Cardinality: Many-to-Many-to-Many-to-Many

- Each Student may qualify for multiple Programs at different Institutes based on their Exam score.
- Each Program may be offered by multiple Institutes and can be open to multiple Students who qualify based on Exam results.
- Each Institute may offer multiple Programs that students can qualify for through their Exam performance.
- Each Exam is associated with multiple Students, and passing it can qualify them for different Programs at multiple Institutes.

Participation Constraints:

- Partial Participation(Student): Not all students will qualify for programs at all institutes by giving various exams.
- Partial Participation (Program): Not all programs may be eligible by at least one student.

- Partial Participation (Institute): Some institutes may not be eligible for even a single student.
- Total Participation (Exam): Every exam is associated with some students, and it qualifies them for various programs at multiple institutes.

7.5.2 Payment

Entities Involved: Student, Institute, Program, Exam
Cardinality: One-to-One-to-One-to-Many

- A student can make only one payment for each exam.
- A student can make payment to only one institute for each exam.
- A student can make payment for only one program for each exam.
- A student can make multiple payments to the same institute for one program through different exams.

Participation Constraints:

- Partial Participation (Student): Not all students make a payment
- Partial Participation (Institute): Not all institutes may receive a payment.
- Partial Participation (Program): Not all programs may receive a payment.
- Partial Participation (Exam): There may be an exam through which nobody accepts a seat.

Relationship Attributes:

- Payment_Date: The date the payment was made
  - NULL/NOT NULL: Cannot be NULL
  - Date
- Amount: The amount paid
  - NULL/NOT NULL: Cannot be NULL
  - INT

7.5.3 Seat Allotted

Entities Involved: Student, Counselling Round, Institute, Program
Cardinality: Many-to-Many-to-One-One:

- Seats can be allocated to multiple students for each program in the same institute in each Counselling round.
- Same seat can be alloted to the same student in multiple counselling rounds.
- In the same counselling round a student can be allotted only one program in a single institute.

Participation Constraints:

- Partial Participation(Student): A student may not be allocated a seat in any Counselling round.
- Partial Participation(Counselling Round): No student may be allotted in some counselling round.
- Partial Participation(Institute): No seat of an institute may be allocated to any student
- Partial Participation(Program): No seat of any program may be allocated to any student

Relationship Attributes:

- Seat_status
  - NULL/NOT NULL: Cannot be NULL
  - MAX 30 characters, VARCHAR
- Documents Required(MVA)
  - NULL/NOT NULL: Cannot be NULL
  - MAX 150 characters, VARCHAR, MAX 20 elements

7.6 Self-Referencing Relationship (Same Entity in Distinct Roles)

7.6.1 Affiliated With

Entities Involved: Institute (Supervisor), Institute (Subordinate)
Cardinality: One-to-Many (An institute may have multiple subordinate institutes, but a subordinate institute can have only one parent institute.)
Participation Constraints:

- Partial Participation (Supervisor): Not every institute may be a parent institute.
- Total Participation (Subordinate): Every subordinate institute must be connected to exactly one parent institute.

Description: This self-referencing relationship models the hierarchy of institutes, where some institutes are subordinate to a parent institute.

8 Functional Requirements

The system manages student admissions to programs after the exams. This database will support operations for retrieving, analysing, modifying, and updating information related to the admission process.

Tables we have:

- Student
- Institute
- Program
- Exam
- Counselling_Round
- Preference
- Gives_exam
- Offers_Program
- Is_for
- Has_preference

- Eligibility_For_Admission
- Payment
- Seat_Allocated
- Affiliated_with

8.1 Retrieval Operations

8.1.1 Queries

Selection: Retrieve complete data tuples based on certain conditions.

- Retrieve the complete data of students registered for a specific exam (e.g., "Retrieve all data of students who have taken the JEE Exam").
- Retrieve details of all institutes offering a specific program, e.g., "Retrieve all institutes offering the Computer Science program."

Example:

- Query: "Get all students of Counselling Round 1 who have given JEE"
- Query: "Get all programs offered by a institute"

Projection: Search the database by particular attributes.

- Retrieve only the names and rankings of institutes in a specific city (e.g., "Names and rankings of institutes in New Delhi").
- List email and phone numbers of students who have registered preferences.

Example:

- Query: "Get student ranks across all exams they've taken"
- Query: "Get all student names who are male and have given JEE"

Aggregate Functions: Use functions like SUM, MAX, MIN, AVG to retrieve summary information.

- Find the maximum number of seats offered in any program.
- Retrieve the average payment amount made by students for a particular round.

Example:

- Query: Calculate average rank of admitted students per institute
- Query: Total amount of fee received by a institute

Search: Perform partial text match queries.

- Search for all student names containing the substring "Ali" (e.g., "Ali" will match "Alice" and "Alison").
- Find programs with names containing "Eng" (e.g., "Engineering," "Environmental Engineering").

Example:

- Query: "Search for institutes by partial name match and show their programs."
- Query: "Search for students by partial first name"

8.1.2 Analysis Reports

- Report the number of students qualified for each program at each institute based on their exam scores.
- Report the total number of payments made for each institute.
- Analysis 1: "Generate institute-wise admission statistics."
- Analysis 2: "Track round-wise seat allocation status."

8.2 Modification Operations

8.2.1 Insertion:

Insert new data into the database with integrity checks.

- Add a new program to an existing institute, ensuring the total seat capacity does not exceed the specified maximum limit.

Example:

- Query: "Insert a new student into the Student table"
- Query: "Insert a new program into the Program table"

8.2.2 Update:

Modify existing data in the database.

- Modify the total number of seats available for a program based on changes in institute regulations.

Example:

- Query: "Update the seat status of a student after each student makes changes"
- Query: "Update the payment status of a student when he completely pays the fee"

8.2.3 Deletion:

Remove data from the database.

- Delete a student's preference if they choose to withdraw from the counselling process.
- Remove an institute's program if it no longer meets accreditation standards.

Example:

- Query: "Delete the entry of student from PREFERENCE table if the seat status is withdrawn"
- Query: "Delete the entry of program from the PROGRAM table if the program is not being offered anymore in any college"