Overview of the IITM BS Degree Helper AI Bot Database

This document serves as the foundational knowledge base for the IITM BS Degree Helper AI Bot. The bot is designed to assist students by providing quick answers and explanations related to the various aspects of their BS degree program at IIT Madras (IITM). Whether you are seeking to clarify concepts from different subjects, understand grading equations, or inquire about academic guidelines, this document holds the data that powers the AI bot.

Purpose of the AI Bot Database

The database is structured to include the following categories of information, which the AI bot can reference to provide accurate and contextually relevant responses to user queries:

1. **Subject-specific Knowledge**: Detailed explanations, key formulas, and commonly asked questions related to various BS degree subjects.
2. **Grading Systems and Policies**: Clear and concise information on how grades are calculated, including subject-specific grading formulas and the overall GPA calculation at IITM.
3. **Academic Guidelines and Procedures**: Information regarding course registration, examinations, academic calendar, and general IITM academic policies.
4. **FAQs and Query Templates**: A list of frequently asked questions and responses, as well as specific phrases related to grading and academic queries that the bot will recognize for more efficient communication.

Document Structure

- **Subject-wise Information**: Topics and key concepts for each subject.
- **Grading Guidelines**: Clear guidelines on grading formulas, GPA calculations, and exam patterns.
- **General Academic Information**: Procedures related to course registration, exams, and other academic affairs.
- **Bot Query Templates**: Predefined queries and responses for common student concerns.

Mathematics for Data Science I

Course Overview:
This course introduces functions (straight lines, polynomials, exponentials, and logarithms) and discrete mathematics (basics, graphs) through various examples. Students will explore the use of abstract mathematical structures to model real-world situations.

Weekly Topics:

- **Week 1: Set Theory**
    - Number system, Sets and their operations, Relations and functions: Types of relations and functions.
- **Week 2: Rectangular Coordinate System & Straight Lines**
    - Slope of a line, Parallel and perpendicular lines, Representations of a line, General equations of a line, Straight-line fit.
- **Week 3: Quadratic Functions**
    - Quadratic functions, Minima, maxima, vertex, and slope, Quadratic equations.
- **Week 4: Algebra of Polynomials**
    - Addition, subtraction, multiplication, and division, Graphs of Polynomials (X-intercepts, multiplicities, end behavior, and turning points), Graphing & polynomial creation.
- **Week 5: Functions**
    - Horizontal and vertical line tests, Exponential functions, Composite functions, Inverse functions.
- **Week 6: Logarithmic Functions**
    - Properties, Graphs, Exponential equations, Logarithmic equations.
- **Week 7: Sequences and Limits**
    - Function of one variable, Graphs, and Tangents, Limits for sequences, Limits for functions of one variable, Limits, and Continuity.
- **Week 8: Derivatives, Tangents, and Critical Points**
    - Differentiability and the derivative, Computing derivatives, L'Hopital's rule, Derivatives, tangents, and linear approximation, Critical points (local maxima and minima).
- **Week 9: Integral of a Function of One Variable**
    - Computing areas under a curve, Derivatives, and integrals for functions of one variable.
- **Week 10: Graph Theory**

    - Representation of graphs, Breadth-first search (BFS), Depth-first search (DFS), Applications of BFS and DFS, Directed Acyclic Graphs (DAG), Complexity of BFS and DFS, Topological sorting.

- **Week 11: Graph Theory Algorithms**
    - Longest path, Transitive closure, Matrix multiplication, Dijkstra's algorithm, Bellman-Ford algorithm, Floyd-Warshall algorithm, Minimum cost spanning trees, Prim's algorithm, Kruskal's algorithm.
- **Week 12: Revision**

Graded Assignments:

- Weekly graded assignments.

Exams:

- **Quiz 1**: February 23, 2025
- **Quiz 2**: March 16, 2025
- **End Term**: April 13, 2025 (Exams must be attended in person at designated centers.)

Eligibility Criteria:

- **Final Exam Eligibility**: Average of the best 5 out of the first 7 weekly assignment scores >= 40/100 AND attendance in one of the two quizzes.
- **Final Grade Eligibility**: Attending the end term exam.

Final Course Score Calculation (T):

- **GAA**: Average score in the first 10 weekly graded assignments.
- **Qz1**: Score in Quiz 1 (0 if not attempted).
- **Qz2**: Score in Quiz 2 (0 if not attempted).
- **F**: Score in the final exam.

Grading Formula:
$T = 0.1GAA + \max(0.6F + 0.2\max(Qz1, Qz2), 0.4F + 0.2Qz1 + 0.3Qz2)$

Statistics for Data Science I Course Details:

Course Overview: The students will be introduced to large datasets and various insights one can glean from them. Basic concepts of probability will also be introduced, leading to a discussion on random variables.

Course Topics:

- **WEEK 1**: **Introduction and Types of Data**
    - Types of data
    - Descriptive and Inferential statistics
    - Scales of measurement
- **WEEK 2**: **Describing Categorical Data**
    - Frequency distribution of categorical data
    - Best practices for graphing categorical data
    - Mode and median for categorical variable
- **WEEK 3**: **Describing Numerical Data**
    - Frequency tables for numerical data
    - Measures of central tendency: Mean, median, mode
    - Quartiles and percentiles
    - Measures of dispersion: Range, variance, standard deviation, IQR
    - Five number summary
- **WEEK 4**: **Association Between Two Variables**
    - Association between two categorical variables: Using relative frequencies in contingency tables
    - Association between two numerical variables: Scatterplot, covariance, Pearson correlation coefficient, Point bi-serial correlation coefficient
- **WEEK 5**: **Basic Principles of Counting and Factorial Concepts**
    - Addition rule of counting
    - Multiplication rule of counting
    - Factorials
- **WEEK 6**: **Permutations and Combinations**
- **WEEK 7**: **Probability**
    - Basic definitions of probability

    - Events and properties of probability
- **WEEK 8**: **Conditional Probability**
    - Multiplication rule
    - Independence
    - Law of total probability
    - Bayes' theorem
- **WEEK 9**: **Random Variables**
    - Random experiment, sample space, and random variable
    - Discrete and continuous random variable
    - Probability mass function
    - Cumulative density function
- **WEEK 10**: **Expectation and Variance**
    - Expectation of a discrete random variable
    - Variance and standard deviation of a discrete random variable
- **WEEK 11**: **Binomial and Poisson Random Variables**
    - Bernoulli trials
    - Independent and identically distributed random variables
    - Binomial random variable, Expectation and variance of a binomial random variable
    - Poisson distribution
- **WEEK 12**: **Introduction to Continuous Random Variables**
    - Area under the curve
    - Properties of pdf
    - Uniform distribution
    - Exponential distribution

Graded Assignments:

- Weekly graded assignments every week.

Exam Details:

- **Quiz 1**: February 23, 2025
- **Quiz 2**: March 16, 2025

- **End Term**: April 13, 2025
  (These exams must be attended in person at designated centers.)

Eligibility Criteria:

- **Final Exam Eligibility**: Average of the best 5 out of the first 7 weeks' weekly assignment scores ≥ 40/100 and attendance in one of the two quizzes.
- **Final Grade Eligibility**: Attending the end term exam.

Final Course Score Calculation (T):

- **GAA**: Average score in the first 10 weekly graded assignments.
- **Qz1**: Score in Quiz 1 (0 if not attempted).
- **Qz2**: Score in Quiz 2 (0 if not attempted).
- **F**: Score in final exam.

Formula:
T = 0.1GAA + max(0.6F + 0.2max(Qz1, Qz2), 0.4F + 0.2Qz1 + 0.3Qz2)

Bonus Marks:

- **Total Bonus Marks for Extra Activity**: 5 marks (3.75 marks for weekly extra activity, 1.25 marks for quality of activity as per instructor's discretion).
- **Extra Activity Deadlines**:
  - **Extra Activity 1**: Release - February 21, 2025, Submission - March 5, 2025, Peer Review - March 9, 2025.
  - **Extra Activity 2**: Release - February 21, 2025, Submission - March 5, 2025, Peer Review - March 9, 2025.
  - **Extra Activity 3**: Release - March 7, 2025, Submission - March 19, 2025, Peer Review - March 23, 2025.
  - **Extra Activity 4**: Release - March 21, 2025, Submission - April 2, 2025, Peer Review - April 6, 2025.

Computational Thinking Course Details:

Course Overview: The students will be introduced to various programming concepts using illustrative examples. These examples will be solved almost entirely manually, allowing for close inspection and a deep understanding of each concept being discussed.

Course Topics:

- **WEEK 1**: **Variables, Initialization, Iterators, Filtering, Datatypes, Flowcharts, Sanity of Data**
    - Variables and initialization
    - Iterators and filtering
    - Understanding datatypes
    - Drawing and understanding flowcharts
    - Checking the sanity of data
- **WEEK 2**: **Iteration, Filtering, Selection, Pseudocode**
    - Iteration and filtering techniques
    - Using selection statements
    - Writing pseudocode
    - Finding the maximum and minimum values
    - The AND operator
- **WEEK 3**: **Multiple Iterations (Non-Nested), Three Prizes Problem, Procedures, Parameters, Side Effects, OR Operator**
    - Understanding multiple iterations
    - Solving the three prizes problem
    - Defining procedures and parameters
    - Understanding side effects in procedures
    - Using the OR operator
- **WEEK 4**: **Nested Iterations, Birthday Paradox, Binning**
    - Nested iterations
    - Understanding the birthday paradox
    - Using binning in data processing
- **WEEK 5**: **List, Insertion Sort**
    - Working with lists in programming
    - Implementing the Insertion Sort algorithm

- **WEEK 6**: **Table, Dictionary**
    - Understanding and using tables
    - Working with dictionaries
- **WEEK 7**: **Graph, Matrix**
    - Introduction to graphs and matrices
    - Operations on graphs and matrices
- **WEEK 8**: **Adjacency Matrix, Edge-Labelled Graph**
    - Understanding adjacency matrices
    - Working with edge-labelled graphs
- **WEEK 9**: **Backtracking, Tree, Depth First Search (DFS), Recursion**
    - Introduction to backtracking algorithms
    - Understanding trees and implementing DFS
    - Working with recursion
- **WEEK 10**: **Object-Oriented Programming, Class, Object, Encapsulation, Abstraction, Information Hiding, Access Specifiers**
    - Introduction to OOP concepts
    - Understanding classes and objects
    - Concepts of encapsulation and abstraction
    - Access specifiers and information hiding
- **WEEK 11**: **Message Passing, Remote Procedure Call (RPC), Cache Memory, Parallelism, Concurrency, Polling, Preemption, Multithreading, Producer Consumer, Atomicity, Consistency, Race Condition, Deadlock, Broadcasting**
    - Understanding message passing and RPC
    - Concepts of cache memory, parallelism, and concurrency
    - Exploring multithreading, polling, and preemption
    - Handling race conditions, deadlocks, and broadcasting
- **WEEK 12**: **Top-Down Approach, Bottom-Up Approach, Decision Tree, Numerical Prediction, Behaviour Analysis, Classification**
    - Understanding top-down and bottom-up approaches
    - Implementing decision trees for numerical prediction
    - Behaviour analysis and classification algorithms

Graded Assignments:

- Weekly graded assignments every week.

Exam Details:

- **Quiz 1**: February 23, 2025
- **Quiz 2**: March 16, 2025
- **End Term**: April 13, 2025
  (These exams must be attended in person at designated centers.)

Eligibility Criteria:

- **Final Exam Eligibility**: Average of the best 5 out of the first 7 weeks' weekly assignment scores ≥ 40/100 and attendance in one of the two quizzes.
- **Final Grade Eligibility**: Attending the end term exam.

Final Course Score Calculation (T):

- **GAA**: Average score in the first 10 weekly graded assignments.
- **Qz1**: Score in Quiz 1 (0 if not attempted).
- **Qz2**: Score in Quiz 2 (0 if not attempted).
- **F**: Score in final exam.

Formula:
$T = 0.1GAA + \max(0.6F + 0.2\max(Qz1, Qz2), 0.4F + 0.2Qz1 + 0.3Qz2)$

Programming in Python Course Details:

Course Overview: This will be the first formal programming course for students in this program. The goal of the course is to introduce Python programming, which is used throughout the program, with a focus on basic problem solving and algorithmic skills.

Course Topics:

- **WEEK 1**: **Introduction to Algorithms**
    - Introduction to basic algorithms and problem-solving strategies
- **WEEK 2**: **Conditionals**
    - Understanding and implementing conditional statements (if, else, elif)
- **WEEK 3**: **Conditionals (Continued)**
    - Advanced conditional operations and nested conditionals
- **WEEK 4**: **Iterations and Ranges**
    - Introduction to loops (for, while) and ranges in Python
- **WEEK 5**: **Iterations and Ranges (Continued)**
    - Advanced loop operations and range manipulations
- **WEEK 6**: **Basic Collections in Python**
    - Introduction to lists, tuples, and sets
- **WEEK 7**: **Basic Collections in Python (Continued)**
    - Working with collections: adding, removing, and accessing elements
- **WEEK 8**: **Basic Collections in Python (Continued)**
    - Further exploration of collection methods and advanced usage
- **WEEK 9**: **File Operations**
    - Reading from and writing to files in Python
- **WEEK 10**: **File Operations (Continued)**
    - Advanced file operations: handling file exceptions and working with different file types
- **WEEK 11**: **Module System in Python**
    - Understanding and using Python modules and libraries
- **WEEK 12**: **Basic Pandas and Numpy Processing of Data**
    - Introduction to data manipulation and analysis using Pandas and Numpy

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Graded Assignments:

- Weekly graded assignments every week.

Exam Details:

- **Quiz 1**: February 23, 2025
- **Quiz 2**: No Quiz 2
- **End Term**: April 13, 2025
  (These exams must be attended in person at designated centers.)

OPPE (Online Programming Practical Exam) Details:

- **OPPE 1**: Sunday, March 2, 2025
- **OPPE 2**: Sunday, April 6, 2025
  (You will be allocated one of the 3 slots by the team. Please keep yourself free on these dates.)

Eligibility Criteria:

Bonus Eligibility:

- Bonus will be applicable only if you complete the **SCT (System Compatibility Test)**. Attendance in mock tests alone will not earn you the bonus.

Eligibility for OPPE1:

- Complete the **SCT exam** to be eligible for **OPPE1**.

Eligibility for OPPE2:

- You need to meet the following conditions:
  - **Average of the best 5 scores** out of the first 7 weekly programming assignments (GrPA) ≥ 40/100
  - **Average of the best 5 scores** out of the first 7 weekly assessments (objective and programming) ≥ 40/100

Eligibility for End Term Exam:

- Average of the best 5 scores out of the first 7 weekly assessments (objective and programming) ≥ 40/100.

Eligibility to Obtain the Final Course Grade:

- **Attending the End Term exam**
- **Minimum score of 40/100** in one of the programming exams (OPPE1, OPPE2).

Final Course Score Calculation (T):

- **GAA1**: Average score in the best 10 objective assignments out of the first 11 graded objective assignments.
- **GAA2**: Average score in the best 10 programming assignments out of the first 11 graded programming assignments.
- **Qz1**: Score in Quiz 1 (0 if not attempted).
- **PE1**: Score in OPPE1 (0 if not attempted).
- **PE2**: Score in OPPE2 (0 if not attempted).
- **F**: Score in final exam.

Formula:
T = 0.1 GAA1 (objective) + 0.1 GAA2 (programming) + 0.1 Qz1 + 0.4 F + 0.25 max(PE1, PE2) + 0.15 min(PE1, PE2)
(Note: The final score is capped at 100.)

Additional Constraints:

- **Absent in OPPE1/OPPE2 and ET**: Grade: **U** (Fail), Outcome: Student needs to repeat the course.
- **Absent in OPPE1/OPPE2, Present in ET (Score ≥ 35)**: Grade: **I_OP** (Incomplete OPPE), Outcome: Complete the OPPE alone in the next term.
- **Absent in OPPE1/OPPE2, Present in ET (Score < 35)**: Grade: **U** (Fail), Outcome: Student needs to repeat the course.
- **Present in Both OPPE1/OPPE2, but Score < 40/100 in OPPE1/OPPE2**: Grade: **I_OP** (Incomplete OPPE), Outcome: Complete the OPPE in the next term.
- **Present in Both OPPE1/OPPE2, but Score < 40/100 in any component**: Grade: **U** (Fail), Outcome: Student needs to repeat the course.
- **Absent in OPPE1/OPPE2, Present in ET**: Grade: **I_BOTH**, Outcome: Complete both ET and OPPE in the next term.
- **Present in OPPE1/OPPE2, Score > 40/100 but Absent in ET**: Grade: **I** (Incomplete), Outcome: Complete the ET alone in the next term.