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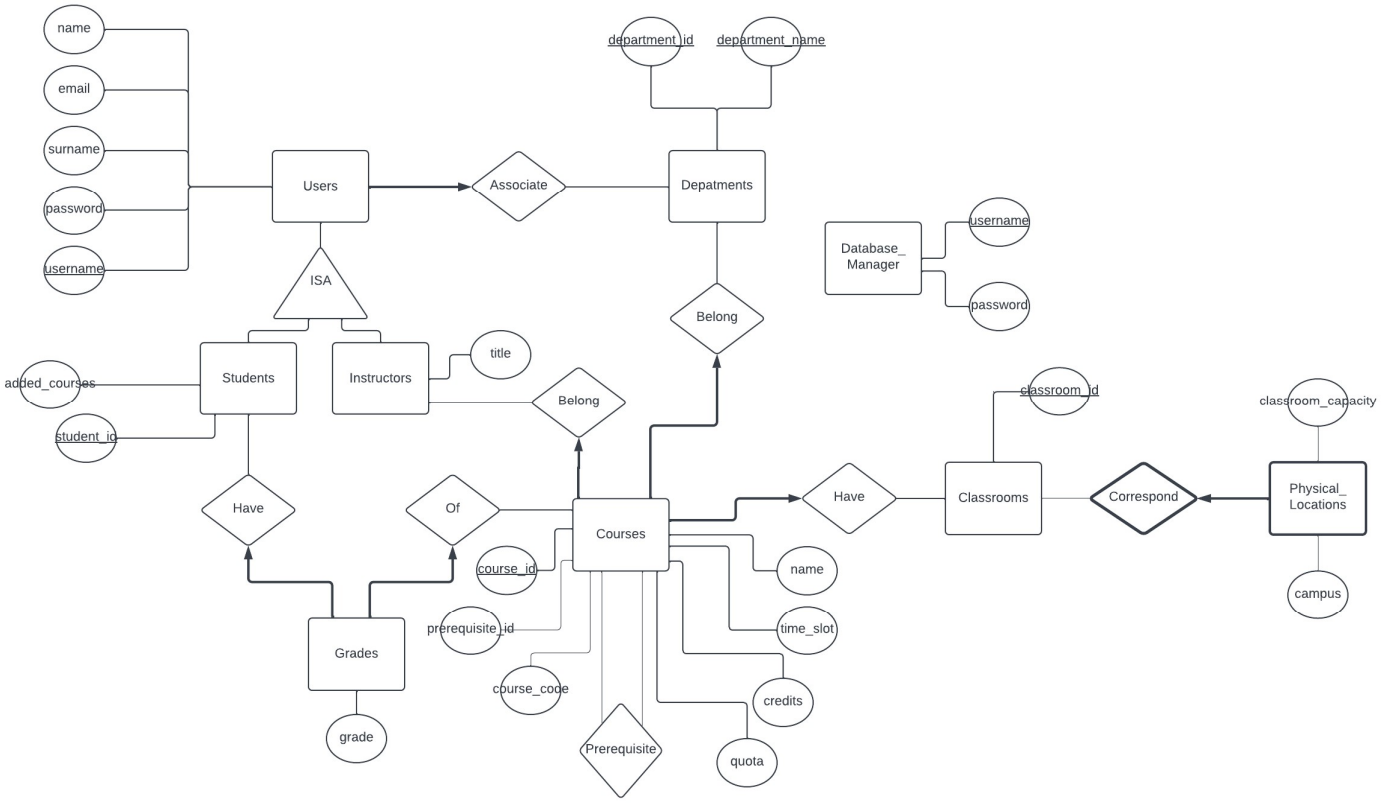
PART 1



PART 2

Database_Manager (<u>username:</u> string, password: string)

Users (<u>username</u>: string, name: string, surname: string, email: string, password: string, department_id: string)

Students (<u>username</u>: string, student_id: integer, added_courses: list)

Instructors (<u>username:</u> string, title: string)

Grades (grade: real, <u>student_id</u>: integer, <u>course_id:</u> string)

Departments (<u>department_id</u>: string, department_name: string)

Courses (<u>course_id:</u> string, name: string, department_id: string, course_code: integer, prerequisite_id: string, quota: integer, classroom_id: string, credits: integer, time_slot: integer, instructor_username: string)

Classrooms (<u>classroom_id</u>: string)

Physical_Locations (<u>classroom_id</u>: string, classroom_capacity: integer, campus: string)

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PART 3

Database_Manager (username: string, password: string) (U, P)

U → UP (U is the primary key)

This relation is in BCNF form as each left-hand side of FDs contains a key. (U)

User (username: string, name: string, surname: string, email: string, password: string, department_id: string) (U, N, S, E, P, D)

U → UNSEPD (U is the primary key)

U → D (Each user is associated with exactly one department)

This relation is in BCNF form as each left-hand side of FDs contains a key. (U)

Students (username: string, student_id: integer, added_courses: list) (U, S, A)

U → USA (U is the primary key)

S → USA (Student ID is unique for each student → S is a key)

This relation is in BCNF form as each left-hand side of FDs contains a key. (U, S)

Instructors (username: string, title: string) (U, T)

U → UT (U is the primary key)

This relation is in BCNF form as each left-hand side of FDs contains a key. (U)

Grades (grade: real, student_id: integer, course_id: string) (G, S, C)

SC → GSC (SC is the primary key)

This relation is in BCNF form as each left-hand side of FDs contains a key. (SC)

Departments (department_id: string, department_name: string) (I, N)

I → IN (I is the primary key)

N→ IN (Department name is unique for each department → N is a key)

This relation is in BCNF form as each left-hand side of FDs contains a key. (U, N)

Courses(course_id: string, name: string, department_id: string, course_code: integer, prerequisite_id: string, quota: integer, classroom_id: string, credits: integer, time_slot: integer, instructor_username: string) (I, N, D, C, P, Q, A, K, T, U)

I → INDCPQAKTU (I is the primary key)

N → INDCPQAKTU (Course name is unique for each course → N is a key)

C → INDCPQAKTU (Course code is unique for each course → C is a key)

AT → INDCPQAKTU (Classroom and time slot are decisive for each course → AT is a key)

U → D (Each instructor has a unique department)

This relation is not in BCNF form as there is an FD that does not contain a key on its left-hand side. (U → D)
This relation is not in 3NF form either as right hand side of an FD is not part of some key. (U → D)

We decided not to decompose this relation because if we did, each time we wanted to reach D from U we would need to join courses, instructors and users table. This would be quite inefficient for computational reasons.

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Classrooms(classroom_id: string) (I)

I → I

This relation is in BCNF form as each left-hand side of FDs contains a key. (I)

Physical_Locations(classroom_id: string, classroom_capacity: integer, campus: string) (I, N,C)

I → INC

This relation is in BCNF form as each left-hand side of FDs contains a key. (I)