Lab work 1

Database Design. Introduction to SQL.

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Goal: Perform a subject area analysis for a University Database.

Task:

Provide a description of the future Database according to the following plan:

1. Describe at least 7 tables to store in the Database.
2. Describe attributes for each table in the Database.
3. Make sure that the Database has 5 constrained attributes.
4. Describe relations between entities in the Database.
5. Describe 2 access rights groups in the Database.
6. Provide 10-15 queries for the Database.

1. What tables does the Database store?

1. The Database includes the following tables:

1. **faculties** – What's the info about the faculties?
2. **departments** – What departments are there within the faculties?
3. **deans** – Who are the head administrators managing the faculties and departments?
4. **educational_programs** – Which programs are offered in each department?
5. **courses** – What courses can students take in the programs?
6. **semesters** – When do the semesters for these courses start and end?
7. **teacher_subject_semesters** – Which teachers are assigned to which subjects in specific semesters, and what roles do they have?
8. **subjects** – What subjects are included in the courses?
9. **teachers** – Who are the teachers for the subjects?
10. **students** – Who are the students taking these subjects?
11. **groups** – What student groups are formed for the subjects?
12. **student_groups** – Which students are in which groups?
13. **buildings** – Where are the buildings located?

14. **classrooms** – What are the classrooms for the scheduled subjects?

15. **schedule** – When and where do the classes happen?

16. **assignments** – What assignments are given to the groups?

17. **exams** – What exams do students have to take?

18. **lab_works** – What lab work are students assigned?

19. **quizzes** – What quizzes do students have to complete?

20. **attendance** – How is attendance tracked for students in subjects?

21. **clubs** – What clubs can students join?

22. **students_clubs** – Which students are in which clubs?

2. What attributes does each table have?

2. Each table contains the following attributes:

1. **faculties:**
   - **id:** What's the faculty ID?
   - **name:** What's the faculty name?
   - **description:** What's the faculty description?

2. **departments:**
   - **id:** What's the department ID?
   - **faculty_id:** Which faculty does this department belong to?
   - **name:** What's the department name?
   - **description:** What's the department description?

3. **deans:**
   - **id:** What's the dean's ID?
   - **name:** What's the name of the dean?
   - **surname:** What's the dean's surname?
   - **patronymic:** What's the dean's patronymic?
   - **gender:** What's the gender of the dean?
   - **birth_date:** When was the dean born?
   - **nationality:** What's the dean's nationality?
   - **citizenship:** What's the dean's citizenship?
   - **department_id:** Which department does the dean belong to?
   - **phone_number:** What's the dean's phone number?
   - **email:** What's the dean's email address?
   - **experience:** How many years of experience does the dean have?
   - **education:** What's the dean's educational background?
   - **position:** What's the title or position of the dean?
   - **address:** What's the address of the dean?
   - **created_at:** When was this dean's record created?
   - **updated_at:** When was this dean's record last updated?

4. **educational_programs:**
   - **id:** What's the program ID?

- **faculty_id:** Which faculty does this program belong to?
- **department_id:** Which department does this program belong to?
- **name:** What's the program name?
- **description:** What's the program description?
- **type:** What's the type of program?
- **credits:** How many credits does this program have?
- **study_duration:** How long is the program?

5. **courses:**
   - **id:** What's the course ID?
   - **educational_program_id:** Which educational program does this course belong to?
   - **name:** What's the course name?
   - **description:** What's the course description?
   - **year_of_study:** What's the year of study for this course?
   - **price:** What's the course price?

6. **semesters:**
   - **id:** What's the semester ID?
   - **course_id:** Which course does this semester belong to?
   - **start_date:** When does the semester start?
   - **end_date:** When does the semester end?
   - **semester_half:** What's the semester half?

7. **subjects:**
   - **id:** What's the subject ID?
   - **educational_program_id:** Which educational program does this subject belong to?
   - **semester_id:** Which semester does this subject belong to?
   - **name:** What's the subject name?
   - **description:** What's the subject description?
   - **credits:** How many credits does this subject have?
   - **lecture_hours:** How many lecture hours does this subject have?
   - **lab_hours:** How many lab hours does this subject have?

8. **teachers:**
   - **id:** What's the teacher ID?
   - **educational_program_id:** Which program does this teacher belong to?
   - **semester_id:** Which semester does this teacher belong to?
   - **name:** What's the teacher's name?
   - **surname:** What's the teacher's surname?
   - **patronymic:** What's the teacher's patronymic?
   - **gender:** What's the teacher's gender?
   - **birth_date:** When was the teacher born?
   - **nationality:** What's the teacher's nationality?
   - **citizenship:** What's the teacher's citizenship?
   - **phone_number:** What's the teacher's phone number?
   - **email:** What's the teacher's email address?
   - **experience:** How many years of experience does the teacher have?
   - **education:** What's the teacher's educational background?

- **position:** What's the teacher's position?
- **iin:** What's the teacher's national ID number?
- **address:** What's the teacher's address?
- **created_at:** When was this teacher record created?
- **updated_at:** When was this teacher record last updated?

9. **teacher_subject_semesters:**
   - **id:** What's the record ID?
   - **teacher_id:** Which teacher is assigned to the subject and semester?
   - **subject_id:** Which subject is this for?
   - **semester_id:** Which semester is this assignment for?
   - **role:** What's the teacher's role (lecture or lab)?

10. **students:**
    - **id:** What's the student ID?
    - **semester_id:** Which course does this student belong to?
    - **name:** What's the student's name?
    - **surname:** What's the student's surname?
    - **patronymic:** What's the student's patronymic?
    - **gender:** What's the student's gender?
    - **birth_date:** When was the student born?
    - **nationality:** What's the student's nationality?
    - **citizenship:** What's the student's citizenship?
    - **phone_number:** What's the student's phone number?
    - **email:** What's the student's email?
    - **iin:** What's the student's national ID number?
    - **address:** What's the student's address?
    - **created_at:** When was this student record created?
    - **updated_at:** When was this student record last updated?

11. **groups:**
    - **id:** What's the group ID?
    - **semester_id:** Which course does this group belong to?
    - **name:** What's the group name?
    - **student_count:** How many students are in this group?
    - **created_at:** When was this group record created?
    - **updated_at:** When was this group record last updated?

12. **student_groups:**
    - **student_id:** Which student belongs to this group?
    - **group_id:** Which group is the student assigned to?

13. **buildings:**
    - **id:** What's the building ID?
    - **name:** What's the building's name?
    - **description:** What's the building's description?
    - **address:** What's the building's address?
    - **floors:** How many floors does the building have?

14. **classrooms:**

- **id:** What's the classroom ID?
- **building_id:** Which building does this classroom belong to?
- **name:** What's the classroom's name?
- **description:** What's the classroom's description?
- **floor:** What floor is the classroom located on? (Must not exceed the building's total floors)
- **capacity:** How many people can fit in the classroom?

15. **schedule:**
   - **id:** What's the schedule ID?
   - **student_group_id:** Which student group is scheduled for this time?
   - **teacher_id:** Which teacher is responsible for this schedule?
   - **subject_id:** What subject is being taught during this schedule?
   - **classroom_id:** Which classroom is assigned to this schedule?
   - **start_datetime:** When does this scheduled session start?
   - **end_datetime:** When does this scheduled session end?
   - **created_at:** When was this schedule record created?
   - **updated_at:** When was this schedule record last updated?

16. **assignments:**
   - **id:** What's the assignment ID?
   - **student_group_id:** Which student group is this assignment for?
   - **teacher_id:** Which teacher assigned this task?
   - **subject_id:** What subject is the assignment related to?
   - **name:** What's the assignment name?
   - **description:** What's the assignment description?
   - **deadline_date:** What's the assignment deadline date?
   - **created_at:** When was this assignment record created?
   - **updated_at:** When was this assignment record last updated?

17. **exams:**
   - **id:** What's the exam ID?
   - **student_id:** Which student took this exam?
   - **subject_id:** Which subject is this exam related to?
   - **exam_type:** What type of exam is this (midterm, final)?
   - **mark:** What mark did the student receive for this exam?
   - **date:** When was the exam held?
   - **created_at:** When was this exam record created?
   - **updated_at:** When was this exam record last updated?

18. **lab_works:**
   - **id:** What's the lab work ID?
   - **student_id:** Which student completed this lab work?
   - **subject_id:** Which subject does this lab work relate to?
   - **assignment_id:** Which assignment does this lab work relate to?
   - **lab_work_number:** What's the number of this lab work (1st, 2nd, etc.)?
   - **mark:** What's the mark for this lab work?
   - **created_at:** When was this lab work record created?
   - **updated_at:** When was this lab work record last updated?

19. **quizzes:**
    - **id:** What's the quiz ID?
    - **student_id:** Which student took this quiz?
    - **subject_id:** Which subject does this quiz relate to?
    - **lab_work_id:** Which subject does this quiz relate to?
    - **quiz_number:** What's the quiz number (1st, 2nd, etc.)?
    - **mark:** What's the mark for this quiz?
    - **created_at:** When was this quiz record created?
    - **updated_at:** When was this quiz record last updated?

20. **attendance:**
    - **id:** What's the attendance record ID?
    - **student_id:** Which student is this attendance record for?
    - **subject_id:** Which subject is this attendance record for?
    - **total_lessons:** How many total lessons were held?
    - **attended_lessons:** How many lessons did the student attend?
    - **created_at:** When was this attendance record created?
    - **updated_at:** When was this attendance record last updated?

21. **clubs:**
    - **id:** What's the club ID?
    - **name:** What's the club's name?
    - **description:** What's the club's description?
    - **president_student_id:** Who's the president or head of the club (student ID)?
    - **founded_date:** When was the club founded?
    - **created_at:** When was this club record created?
    - **updated_at:** When was this club record last updated?

22. **students_clubs:**
    - **id:** What's the membership record ID?
    - **student_id:** Which student is a member of this club?
    - **club_id:** Which club does this membership record refer to?
    - **join_date:** When did the student join the club?
    - **role:** What role does the student have in the club (e.g., member, vice president)?
    - **created_at:** When was this membership record created?
    - **updated_at:** When was this membership record last updated?

3. What constrained attributes does the Database has?

3. Constrained attributes of each table:

1. **faculties:**
    - **name:** The character limit is between 5 and 100 characters.
    - **description:** The character limit is between 20 and 500 characters.

2. **departments:**
   - **name:** The character limit is between 5 and 100 characters.
   - **description:** The character limit is between 20 and 500 characters.

3. **deans:**
   - **name:** The character limit is between 2 and 100 characters.
   - **surname:** The character limit is between 2 and 100 characters.
   - **patronymic:** The character limit is between 2 and 100 characters.
   - **gender:** Must be one of the following: MALE, FEMALE, OTHER.
   - **birth_date:** Must be a valid date, and the dean's age must be between 30 and 70 years.
   - **phone_number:** Must be a valid phone number format (e.g., +[country code][number], 10-15 digits).
   - **email:** Must be a valid email format (e.g., number@iitu.edu.kz).
   - **experience:** Must be a number between 5 and 40 years.
   - **education:** The character limit is between 10 and 250 characters.
   - **position:** The position can be Dean, Professor, or Head of Department.
   - **iin:** Must be exactly 12 digits (assuming a national ID number).
   - **address:** The character limit is between 10 and 100 characters.

4. **educational_programs:**
   - **name:** The character limit is between 5 and 100 characters.
   - **description:** The character limit is between 20 and 500 characters.
   - **type:** The type can only be BACHELOR, MASTER, or DOCTORAL STUDY.
   - **study_duration:** The program can last from 1 to 4 years.

5. **courses:**
   - **name:** The character limit is between 5 and 100 characters.
   - **description:** The character limit is between 20 and 500 characters.
   - **year_of_study:** The year of study can be 1, 2, 3, or 4.
   - **price:** The price can vary between $100 and $10,000.

6. **semesters:**
   - **semester_half:** The semester half can be 1 or 2.

7. **subjects:**
   - **name:** The character limit is between 5 and 50 characters.
   - **description:** The character limit is between 20 and 250 characters.

8. **teachers:**
   - **name:** The character limit is between 2 and 100 characters.
   - **surname:** The character limit is between 2 and 100 characters.
   - **patronymic:** The character limit is between 2 and 100 characters.
   - **gender:** Must be one of the following: MALE, FEMALE, OTHER.
   - **birth_date:** Must be a valid date, and the teacher's age must be between 25 and 70 years.
   - **phone_number:** Must be a valid phone number format (e.g., +[country code][number], 10-15 digits).
   - **email:** Must be a valid email format (e.g., number@iitu.edu.kz).
   - **experience:** Must be a number between 1 and 45 years.
   - **education:** The character limit is between 10 and 250 characters.
   - **position:** The position can be Lecturer, Professor, or Academic.
   - **iin:** Must be exactly 12 digits (assuming a national ID number).
   - **address:** The character limit is between 10 and 100 characters.

9. **teacher_subject_semesters:**
   - **role:** Must be one of the following: lecturer, lab instructor
10. **students:**
    - **name:** The character limit is between 2 and 100 characters.
    - **surname:** The character limit is between 2 and 100 characters.
    - **patronymic:** The character limit is between 2 and 100 characters.
    - **gender:** Must be one of the following: MALE, FEMALE, OTHER.
    - **birth_date:** Must be a valid date, and the student's age must be between 17 and 50 years.
    - **phone_number:** Must be a valid phone number format (e.g., +[country code][number], 10-15 digits).
    - **email:** Must be a valid email format (e.g., number@iitu.edu.kz).
    - **iin:** Must be exactly 12 digits (assuming a national ID number).
    - **address:** The character limit is between 10 and 100 characters.
11. **groups:**
    - **name:** The character limit is between 10 and 20 characters.
    - **student_count:** The student limit is between 2 and 60.
12. **student_groups:**
    - Nothing to constrain.
13. **buildings:**
    - **name:** The character limit is between 5 and 100 characters.
    - **description:** The character limit is between 20 and 500 characters.
    - **address:** The character limit is between 10 and 100 characters.
    - **floors:** The number of floors must be between 1 and 50.
14. **classrooms:**
    - **name:** The character limit is between 5 and 100 characters.
    - **description:** The character limit is between 20 and 200 characters.
    - **floor:** The classroom floor must be between 1 and the number of floors in the building.
    - **capacity:** The number of people must be between 5 and 100.
15. **schedule:**
    - Nothing to constrain.
16. **assignments:**
    - **name:** The character limit is between 5 and 40 characters.
    - **description:** The character limit is between 15 and 100 characters.
17. **exams:**
    - **exam_type:** Must be one of the following: midterm, final.
    - **mark:** Must be between 0 and 100.
18. **lab_works:**
    - **lab_work_number:** The lab work number must be between 1 and 10 (e.g., 1st, 2nd, etc.).
    - **mark:** The mark for this lab work must be between 0 and 100.
19. **quizzes:**
    - **quiz_number:** The quiz number must be between 1 and 10 (e.g., 1st, 2nd, etc.).
    - **mark:** The mark for this quiz must be between 0 and 100.
20. **attendance:**
    - **total_lessons:** The number of total lessons must be between 1 and 50.
    - **attended_lessons:** The number of attended lessons must be between 0 and the total lessons.

21. **clubs:**
    - **name:** The character limit is between 5 and 100 characters.
    - **description:** The character limit is between 20 and 500 characters.
    - **founded_date:** Must be a valid date in the past.
22. **students_clubs:**
    - **join_date:** Must be a valid date in the past.
    - **role:** Must be one of the following: member, vice president.

4. What relations between tables does the Database have?

4. Relations between tables:

1. **faculties:**
    - faculties - departments (one-to-many)
2. **departments:**
    - departments - deans (one-to-one)
    - departments - educational_programs (many-to-many)
3. **deans:**
    - No relations
4. **educational_programs:**
    - educational_programs - courses (one-to-many)
    - educational_programs - subjects (many-to-one)
    - educational_programs - teachers (many-to-many)
5. **courses:**
    - courses - semesters (one-to-many)
6. **semesters:**
    - semesters - subjects (one-to-many)
    - semesters - teachers (many-to-many)
    - semesters - students (many-to-one)
    - semesters - groups (many-to-one)
7. **subjects:**
    - subjects - teachers (one-to-many)
    - subjects - schedule (one-to-many)
    - subjects - assignments (one-to-many)
    - subjects - exams (one-to-many)
    - subjects - quizzes (one-to-many)
    - subjects - lab_works (one-to-many)
    - subjects - attendance (one-to-many)
8. **teachers:**
    - teachers - teacher_subject_semesters (one-to-many)
    - teachers - schedule (many-to-many)

- teachers - assignments (many-to-many)

9. **teacher_subject_semesters:**
   - No relations

10. **students:**
    - students - student_groups (one-to-many)
    - students - exams (one-to-many)
    - students - quizzes (one-to-many)
    - students - lab_works (one-to-many)
    - students - attendance (one-to-many)
    - students - clubs (one-to-one)
    - students - students_clubs (one-to-many)

11. **groups:**
    - groups - student_groups (one-to-many)

12. **student_groups:**
    - student_groups - schedule (one-to-many)
    - student_groups - assignments (one-to-many)

13. **buildings:**
    - buildings - classrooms (many-to-one)

14. **classrooms:**
    - classrooms - schedule (one-to-many)

15. **schedule:**
    - No relations.

16. **assignments:**
    - assignments - lab_works (one-to-one)

17. **exams:**
    - No relations.

18. **lab_works:**
    - lab_works - quizzes (one-to-one).

19. **quizzes:**
    - No relations.

20. **attendance:**
    - No relations.

21. **clubs:**
    - clubs - students_clubs (one-to-many)

22. **students_clubs:**
    - No relations.

5. What access rights groups does the Database have?

5. Access rights groups of the Database:

- **User Group 1:** Students
- **User Group 2:** Teachers
- **User Group 3:** Deans

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1. **faculties:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
2. **departments:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
3. **deans:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
4. **educational_programs:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
5. **courses:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
6. **semesters:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
7. **subjects:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
8. **teachers:**
   - Students - ro (read-only)
   - Teachers - rw (read-write)
   - Deans - rw (read-write)
9. **teacher_subject_semesters:**
   - Students - ro (read-only)
   - Teachers - ro (read-only)
   - Deans - rw (read-write)
10. **students:**
    - Students - rw (read-write)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

11. **groups:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

12. **student_groups:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

13. **buildings:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

14. **classrooms:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

15. **schedule:**
    - Students - ro (read-only)
    - Teachers - rw (read-write)
    - Deans - rw (read-write)

16. **assignments:**
    - Students - ro (read-only)
    - Teachers - rw (read-write)
    - Deans - rw (read-write)

17. **exams:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

18. **lab_works:**
    - Students - ro (read-only)
    - Teachers - rw (read-write)
    - Deans - rw (read-write)

19. **quizzes:**
    - Students - ro (read-only)
    - Teachers - rw (read-write)
    - Deans - rw (read-write)

20. **attendance:**
    - Students - ro (read-only)
    - Teachers - rw (read-write)
    - Deans - rw (read-write)

21. **clubs:**
    - Students - ro (read-only)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

22. **students_clubs:**
    - Students - rw (read-write)
    - Teachers - ro (read-only)
    - Deans - rw (read-write)

6. What are potential queries for the Database?

6. The Database may have the following queries:

1. **List all students from the first-year course.**
2. **List all students from foreign countries.**
3. **List all students who failed the Mathematics exam.**
4. **List the top 5 students from the first-year Cyber Security course based on GPA.**
5. **List all students with an average GPA above 90% in their current course.**
6. **List all students who attended less than 80% of their lessons.**
7. **List all teachers with more than 5 years of experience.**
8. **List all classrooms on the 3rd floor of a building.**
9. **List all subjects scheduled for group IT2-2404SE on Monday.**
10. **List all courses and semesters that include Mathematics for Software Engineering.**
11. **List all courses that include C++ programming.**
12. **List the top 5 groups from the second-year course based on the average GPA of students.**
13. **List all students from IT2-2406SE who completed laboratory works but received low scores on quizzes.**
14. **List all professors at the university.**
15. **List all DOCTORAL educational programs.**

Thank you for your time!