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### Hands On #1

Using the provided database schema, write relational algebra expressions to answer the following queries:

#### Database Schema:

1. **Students** (StudentID, Name, Age, Major)
2. **Courses** (CourseID, CourseName, Department)
3. **Enrollments** (StudentID, CourseID, Grade)
4. **Professors** (ProfessorID, Name, Department)
5. **Teaches** (ProfessorID, CourseID, Semester)

#### Queries:

1. Find all students who are majoring in 'Computer Science'. (use Selection)  
 $R1 = \text{Sigma\_Major} = \text{'Computer Science'}(\text{Students})$
2. List all distinct course names offered by the 'Mathematics' department. (use Projection)  
 $R1 = \text{Pi\_CourseName}(\text{Courses})$
3. Find the names of all students and the courses they are enrolled in. (use Natural join)  
 $R1 = \text{Students} \text{ Join } \text{Courses}$
4. Retrieve all students who have received a grade higher than 'B' in any course. (use Theta join)  
 $R1 = \text{Sigma\_Grade} > \text{'B'}(\text{Enrollments})$   
 $R2 = R1 \text{ Theta Join\_Enrollments.StudentID} = \text{Students.StudentID}(\text{Students})$
5. List all possible pairs of students and professors. (use Cartesian Product)  
 $R1 = \text{Students} \times \text{Professors}$
6. Find students who are enrolled in courses taught by Professor 'Smith' and also courses taught in the 'Fall' semester. (use Set Operations)  
 $R1 = \text{Pi\_StudentID}(\text{Pi\_CourseId}(\text{Sigma\_Name} = \text{'Smith'}(\text{Professors}) \text{ Join Teachers}) \text{ Join Enrollments})$   
 $R2 = \text{Pi\_StudentId}(\text{Pi\_CourseId}(\text{Sigma\_Semester} = \text{'Fall'}(\text{Teachers})) \text{ Join Enrollments})$   
 $R3 = R1 \text{ Intersection } R2$
7. Calculate the total number of courses each student is enrolled in. (use Extended Projection)  
 $R1 = \text{StudentId, Count}(\text{CourseId})$   
 $\rightarrow \text{TotalCourses}(\text{Gamma\_StudentId, Count}(\text{CourseId})(\text{Enrollments}))$
8. Rename the attributes of the **Professors** table to (ProfID, ProfName, Dept).  
 $R1 = \text{rho\_Profs}(\text{ProfID, ProfName, Dept.})(\text{Professors})$