EAST WEST UNIVERSITY
Department of Computer Science and Engineering
B.Sc. in Computer Science and Engineering Program
Practice problem, Fall 2024 Semester

Course: CSE 302 Database Systems
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1. Consider the following information about a university database:

- Professors have an SSN, a name, an age, a rank, and a research specialty.
- Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget.
- Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).
- Each project is managed by one professor (known as the project's principal investigator).
- Each project is worked on by one or more professors (known as the project's co-investigators).
- Professors can manage and/or work on multiple projects.
- Each project is worked on by one or more graduate students (known as the project's research assistants).
- When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.
- Departments have a department number, a department name, and a main office.
- Departments have a professor (known as the chairman) who runs the department.
- Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job.
- Graduate students have one major department in which they are working on their degree.
- Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.

Design and draw an ER diagram that captures the information about the university. Use only the basic ER model here; that is, entities, relationships, and attributes. Be sure to indicate any key and participation constraints.

2. Consider the following partial ER model.

Transform the ER model into relational schemas. Assume that the specialization is Total Specialization, i.e., each entity in the Person entity set must be a member of a lower-level entity set. The ellipses are the attributes of the entity set.
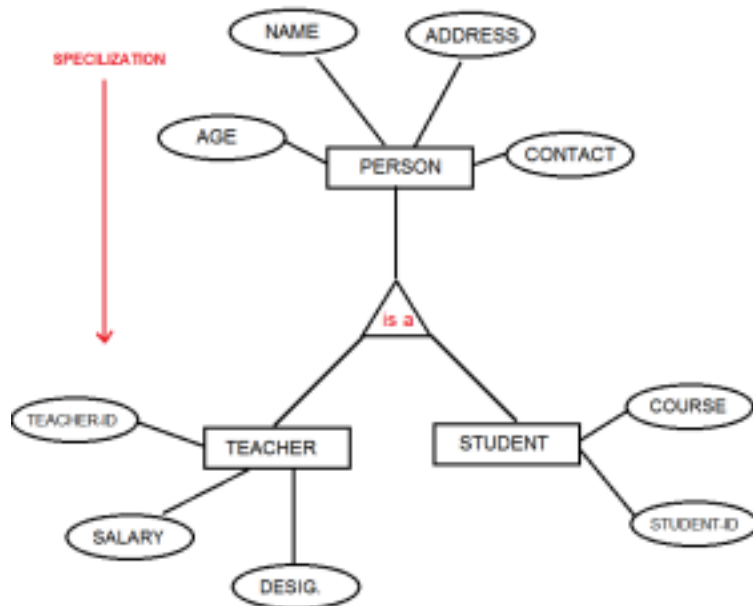
3. Convert the ER diagram in figure-1 to tables in relational model. Find the minimum number of tables required to represent the given ER diagram in relational model. Add justifications where necessary.
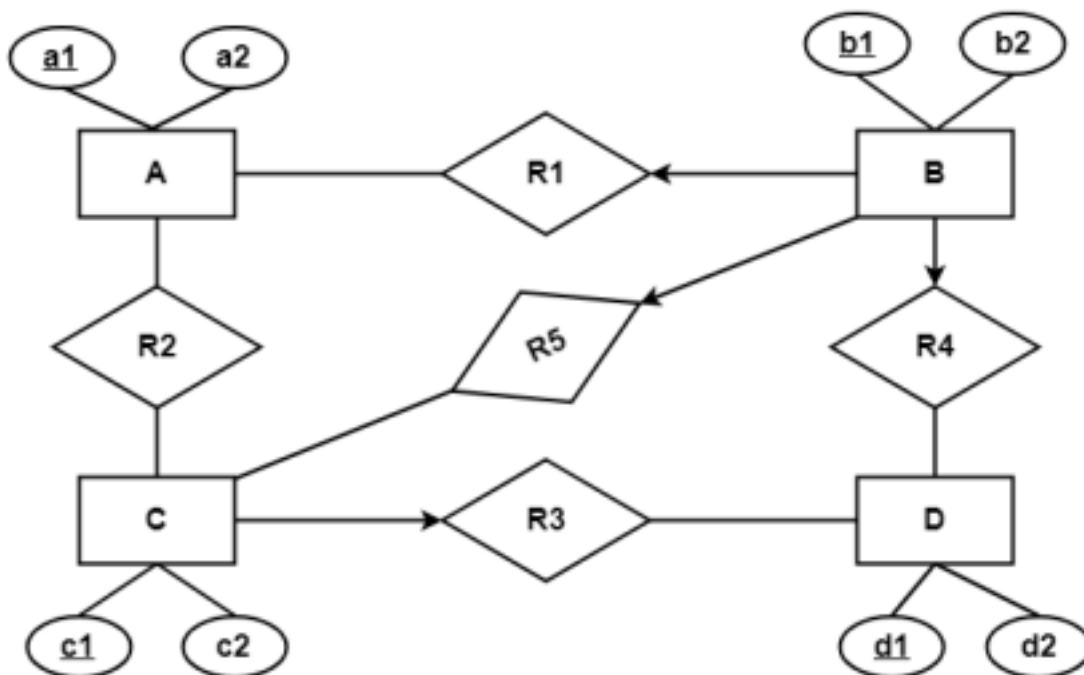
4. Consider the following set F of functional dependencies on the relation schema
R (A, B, C, D, E):

$$AB \rightarrow C$$
$$DE \rightarrow C$$
$$B \rightarrow D$$

a) List all candidate keys of the relation R.
b) Is R in BCNF? Why or why not? If not, Indicate all BCNF violations for R.
c) If not then find BCNF decomposition of R.
d) For your decomposition, state whether it is dependency preserving and explain why.
e) Is R in 3NF? Why or why not? If not, Indicate all 3NF violations for R.

5. Suppose a relational schema R(P, Q, R), and set of functional dependency as following
F : { P → QR, Q → R, P → Q, PQ→ R }
Find the canonical cover Fc (Minimal set of functional dependency).