

Assignment 1

Due Monday, February 20 at 11:59pm

General Instructions

- Feel free to talk to other members of the class in doing the homework. You should, however, write down your solutions yourself. *List the names of everyone you worked with at the top of your submission.*
- Keep your solutions brief and clear.
- Please use Piazza if you have questions about the homework but do not post answers. Feel free to use private posts or come to the office hours.

Homework Submission

- We DO NOT accept late homework submissions.
- We will be using Compass for collecting the homework assignments. Please submit your answers via [Compass](#). Hard copies are not accepted.
- Contact the TAs if you are having technical difficulties in submitting the assignment; attempt to submit well in advance of the due date/time.
- The homework must be submitted in **pdf** format. Scanned handwritten and/or hand-drawn pictures in your documents won't be accepted.
- Please do not zip the answer document (PDF) so that the graders can read it directly on Compass. You need to submit one answer document, named as **hw1_netid.pdf**.
- Please see the [assignments](#) page for more details. In particular, we will be announcing errata, if any, on this page.

Question 1. Short Questions (10 points)

Provide a short answer (4–5 sentences at most) for each of the following questions. You may use figures if necessary.

1. Consider the relation Person (Name, SSN, Age, Address, Gender). How many keys does the relation Person have? How did you arrive at your answer?
2. All relationships involving a weak entity set can be ignored while translating an ER diagram to a relational model. Justify or prove otherwise.
3. The expressiveness of ER models would reduce if we do not allow relationships to have attributes. Justify or prove otherwise.
4. It is possible to transform a multiway relationship to multiple binary relationships without using weak entity sets. Justify or prove otherwise.
5. The reason why we prefer to combine the relation corresponding to an entity set A , with the relation corresponding to a relationship B —where B is a many-one relationship from A to another entity set—is because we want to improve the efficiency of queries involving A .

Question 2. ER Models (45 points)

Consider the following information about a database of a university.

- Departments have a department number, department name, and many research areas.
- Professors have an SSN, a name, an age, a rank and a main research area.
- Projects have a project number, a sponsor name, a starting date, an ending date and a budget.
- Graduate students have an SSN, a name, and an age. They major in a single department.
- Graduate students can either be an MS or a PhD. PhD students need to determine their speciality/main research area.
- All PhD students have a professor as an advisor.
- Each project is managed by one professor.
- Each project is worked on by one or more professors, and one or more graduate students.
- Graduate students can work on multiple projects.
- Every department has a head, who is a Professor.

- Professors can work in one or more departments. For each department they work in, there is an associated time percentage.
- Graduate students have one major department in which they are working towards their degree
- Each graduate student has another senior graduate student as a mentor.

Design and draw an ER diagram that captures the aforementioned information. Indicate the key of each entity, as well as the multiplicity of your relationships. You are free to use annotation tools such as Mac Preview or Microsoft PowerPoint to draw the ER diagrams. Please do not include scanned pictures. You may want to check out draw.io.

Note: state your assumptions clearly. Since there are many correct answers, your ER diagram will be evaluated considering your assumptions.

Question 3. Relational Model (45 points)

1. Convert the ER model from the previous question to a relational model.
2. Which approach did you use to convert the subclass entity set? Show us alternative schema designs.
3. Compare between all the designs you came up with in part 2. Talk about scenarios when each alternative would be a better choice in comparison to the rest.