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Networks and Systems – Databases

Practical 1:
Entity-Relationship (ER) model & Enhanced ER (EER) model

Note for Question 4*: Question 4* is given as optional and for your further training, for the case that you finish the other 3 Questions early enough during the practical.

Notation hint for the ER and EER models. We saw in the lecture that *primary keys* in the ER and EER modeling can be diagrammatically represented by underlined attribute names or by the tag {PK}. Similarly, a *foreign key* is usually diagrammatically represented by the tag {FK}. Whenever there are more than one foreign keys in an entity type, you can represent them by using the notation {FK1}, {FK2}, {FK3} etc. For simplicity, please use in the following the notation {PK} for primary keys. Whenever you have a composite primary key or a composite foreign key (i.e. a key consisting of more than one attributes), please write the tag {PK} or {FK} next to any of the attribute names that are contained in this primary/foreign key, respectively.

Question 1.
Temporary Employment Corporation (TEC) is looking for workers in computer manufacturing companies. TEC's manager gives you the following description of the business:

- TEC has a file of candidates who are willing to work.
- If the candidate has worked before, that candidate has a specific job history. Naturally, no job history exists if the candidate has never worked. Each time the candidate worked, one additional job history record is created.
- Each candidate has earned several (one or more) qualifications. Each qualification may be earned by more than one candidate. (For example, it is possible for more than one candidate to have earned a BA degree or a Microsoft Network Certification. And clearly, a candidate may have earned both a BA degree and a Microsoft Network Certification.)
- TEC also has a list of companies that request employees.
- Each time a company requests an employee, TEC makes an entry in the Openings folder. That folder contains an opening number, a company name, the required qualifications for that job, and a starting date.
- Each opening requires at least one specific qualification.
- When a candidate matches the qualification, (s)he is given the job and an entry is made in the Placement Record folder. That folder contains an opening number, a candidate number, and the date of placement. In addition, an entry is made in the job history for the candidate.
- An opening can be filed by many candidates and a candidate may fill many openings.

(a) Provide which entities would you use to describe the above business description of TEC.

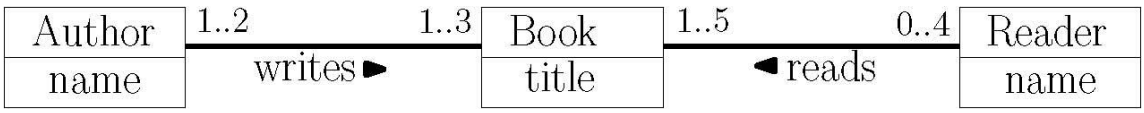
(b) Using the entities you provided in part (a), choose the appropriate attributes and the appropriate relationships to draw an ER diagram for TEC. Please identify in your diagram also the multiplicities of all relationships in your diagram. Also, please specify the primary and foreign keys for your entities.

(c) Modify the diagram you created in part (b) to an Enhanced Entity-Relationship (EER) diagram using the following extra information:

- A candidate can be either a Computer Scientist, or an Engineer, or both, or neither a Computer Scientist nor an Engineer. Every Computer Scientist has an extra attribute *Java-Experience* and every Engineer has an extra attribute *Matlab-Experience*.
- An opening can be of two types: either of monthly payment, or of hourly payment. Every monthly payment opening has an extra attribute *month-salary*. Every hourly payment opening has an extra attribute *hour-salary*. Furthermore, every monthly payment opening requires at least 2 qualifications, while every hourly payment opening requires at least 1 qualification.

Question 2.

Consider the following ER diagram.



(a) Suppose that in some real application there are 6 authors in total. Then, what is the *minimum* and what is the *maximum* number of books? What is the *minimum* and what is the *maximum* number of readers? Justify your answer.

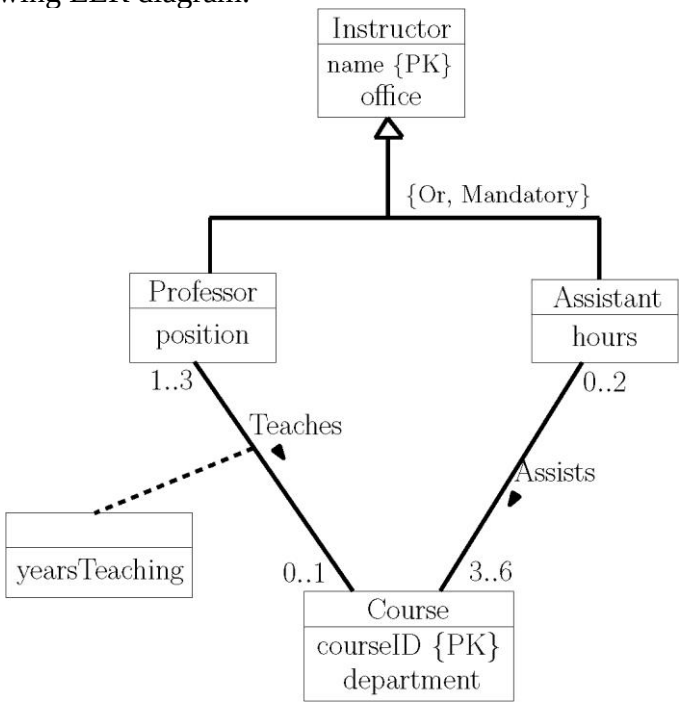
(b) Suppose now that there are 6 readers in total. Then, what is the *minimum* and what is the *maximum* number of books? What is the *minimum* and what is the *maximum* number of authors? Justify your answer.

Question 3.

(a) Consider a tiny social network containing high school students and their "crushes", i.e. their desired romantic relationships within their school. Every student may have a crush on at most one other student, while associated with each crush is the length of the time the crush has been going on. Students have a number, a grade and a gender, while names are unique within the school. Draw an ER diagram that models this information. Please make sure to capture the asymmetry and multiplicity of the crush relationship.

(b) Assuming that, within the school, boys have crushes only with girls and girls have crushes only with boys, how could you simplify the above diagram into an EER diagram using specialization?

Question 4*.
Consider the following EER diagram.



(a) What is the meaning of the participation constraint *Mandatory* and what of the disjoint constraint *Or* in the subclass-superclass relationship between Professor/Assistant and Instructor?

(b) According to the diagram, what is the *minimum* and what is the *maximum* number of instructors *for a given course*?

(c) According to the diagram, what is the *minimum* and what is the *maximum* teaching load (i.e. number of courses) for professors and what for assistants?

(d) Translate the above diagram to a relational schema. Note that there may be more than one different translations.

(e) Specify the primary keys for each relation in your solution to part (d).

(f) Does your solution to part (d) require any attributes to permit Null values?