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INFSCI 2711 "Database Analysis and Design" — Example I for Midterm Exam —

Instructions

- Since you have elected not to have a midterm exam, this is an example for the first half of the final exam covering conceptual design.
- There will be 1 hour and 30 minutes time to work on the exercises.
- In the multiple-choice questions, exactly one answer is correct.
- The exam will be open book — you can use all your notes, books, etc.
- You are not allowed to use notebooks or other portable computers except a pocket calculator (devices that do not have Oracle or Oracle Designer or similar programs on them).
- Since it turned out to be difficult to find all FDs (in Exercise 4a), the real exam will probably have multiple-choice questions to determine whether given FDs are correct or what the meaning of given FDs is.
- When I developed this exam, I did not teach UML or reverse engineering. The real exam will probably have exercises on those topics, too. They will be contained in another example exam to be distributed later.

Exercise 1 (ER Model) 14 Points

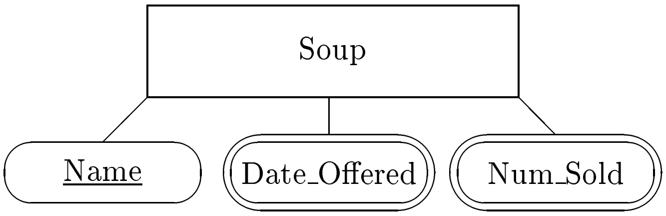
Consider a small cafeteria/canteen which offers each day a soup (soup of the day). They want to keep track of which kind of soup was offered on which day, and also how many cups of soup were sold. The same soup might be offered on different days, but each day only one soup is offered. For each day, only one number should be stored (the total number of cups sold). There may be soups in the database which were not yet offered.

Which of the following ER-schemas are correct and which are not? If a schema is incorrect, please give an explanation.

- A schema counts as incorrect already if it is too general, i.e. allows database states which correspond to no legal state in the real world. In such a case, additional constraints would be needed.
- A schema counts as incorrect also if it contains redundant data.
- Of course, a schema is incorrect also if it cannot answer the questions: “Which soup was sold on which day?” and “How many cups were sold on which day?”
- Of course, also ER-model syntax errors are possible.
- However, bad style alone does not qualify a solution as wrong. If you wish, you can comment on the style, but only exceptional remarks will earn extra credit.

Each subexercise is worth two points. If you are unsure about your answer, you can give an explanation what are the critical issues. You might then get at least one of the two points, but you might also lose a point.

a) This solution has an entity for every kind of soup and uses multivalued attributes to store when a soup was offered and how often it was sold.



☐ Correct
☐ Wrong, Reason: ______________________________

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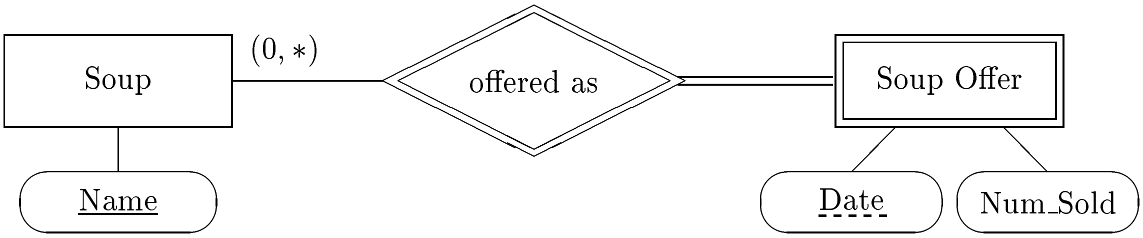
b) This solution has an entity for every kind of soup uses a weak entity to model the sales:



☐ Correct
☐ Wrong, Reason: ______________________________

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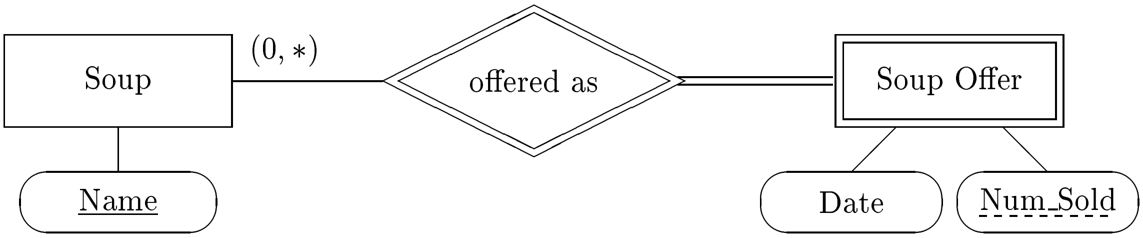
c) This is very similar to b), but the key for the weak entity is different:



☐ Correct
☐ Wrong, Reason: ______________________________

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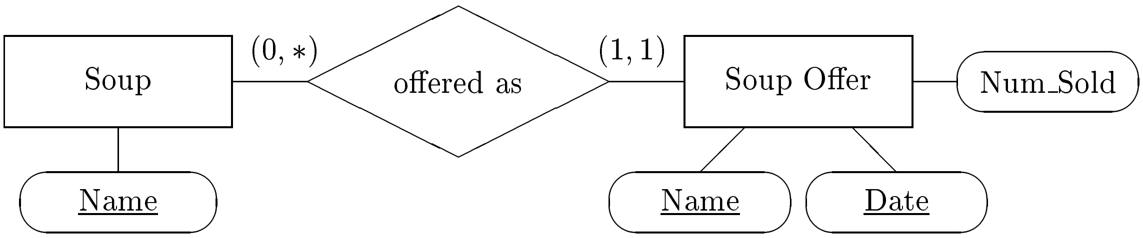
d) This is again similar, but it does not use a weak entity:



☐ Correct
☐ Wrong, Reason: ______________________________

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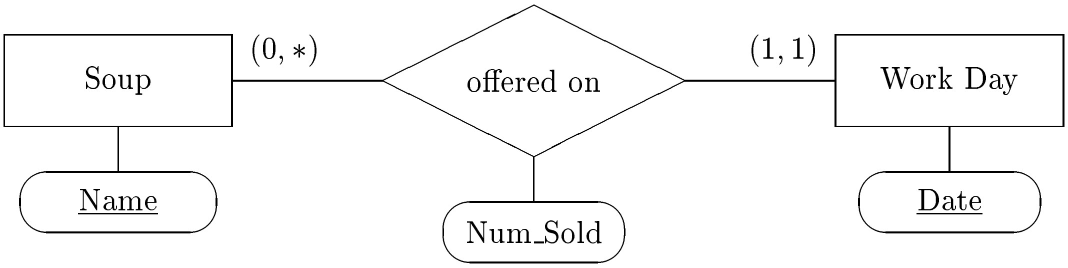
e) This solution uses an entity for work days (i.e. when the canteen/cafeteria was open) and a relationship attribute for the number of copies sold:



☐ Correct
☐ Wrong, Reason: ______________________

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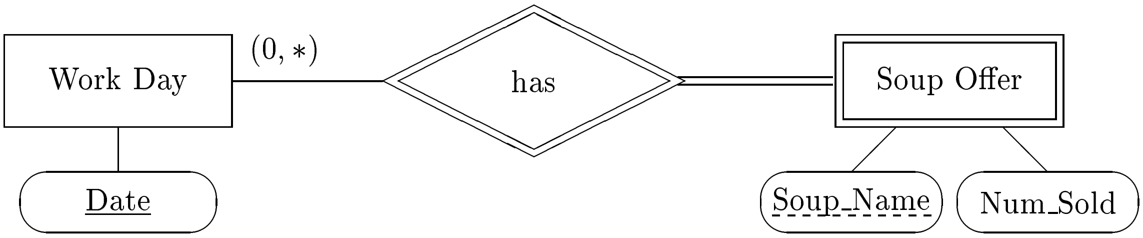
f) This again uses a weak entity, but this time the date is the master entity:



☐ Correct
☐ Wrong, Reason: ______________________

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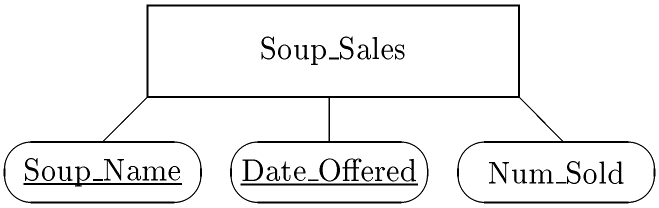
g) Finally, here is a solution with only one entity and without multivalued attributes:



☐ Correct
☐ Wrong, Reason: ______________________

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Exercise 2 (ER Design, Oracle Designer Notation) 12 Points

Please develop an Entity-Relationship diagram in Oracle Designer notation for a video rental service:

- About customers, we store first name, last name, phone number and social security number. All attributes are required.
- Some films which are often requested exist in multiple copies. I.e. there can be several video cassettes which contain the same film. Every video cassette has a unique identifying number.
- We want to store which customer borrowed which cassette on which day, and also when he/she brought the cassette back. The return date is an optional attribute: It is null as long as the customer still has the cassette. We want to store historical information, i.e. also previous lending events.
- About films, we want to store the title and the year, which together uniquely identify the film. In addition, we want to store the director (optional attribute).

Exercise 3 (Oracle Designer) 8 Points

a) Oracle Designer supports weak entities.

- ☐ True.
- ☐ False.

b) There can be several diagrams which show only a subset of the entities, but there must be one diagram which shows the global schema (all entities and relationships).

- ☐ True.
- ☐ False.

c) All cardinalities which Oracle Designer supports are automatically translated into constraints for the relational schema.

- ☐ True.
- ☐ False.

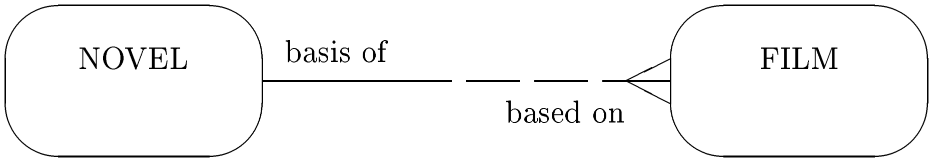
d) Oracle Designer can translate ER-schemas automatically into relational schemas, however you can (and often should) change the relational schema manually afterwards.

- ☐ True
- ☐ False.

e) Oracle Designer stores the design data in a relational database (which must be an Oracle database).

- ☐ True.
- ☐ False.

f) Consider this relationship:



Which of the two entities has mandatory participation in the relationship?

- ☐ NOVEL
- ☐ FILM
- ☐ None
- ☐ Both

g) [2 Points] There are patterns for automatically generated English sentences which describe the cardinalities. Which two sentences would be generated for the relationship in f)?

1. ____

   ____

2. ____

   ____

Exercise 4 (FDs, BCNF) 4+1+2+4+2+0=13 Points

Consider the relation:

`FAMILY_DATA(CHILD, CHILD_BORN, MOTHER, MOTHER_BORN, FATHER, FATHER_BORN, MARRIAGE_YEAR)`

- We assume that every person is uniquely identified by his/her name which is entered into the columns `CHILD`, `MOTHER`, `FATHER`.
- `CHILD_BORN`, `MOTHER_BORN`, `FATHER_BORN` are the year of birth of the corresponding person.
- We assume that each two persons can marry only once. (So we don’t consider the case that they divorce and later marry again. This can be seen as a continuation of the first marriage.)
- However, the same person can marry again, e.g. if the spouse died. But let us assume that two marriages in one year are impossible.
- Of course, the same husband and wife can have more than one child, also more than one per year (e.g. twins).

a) [4 Points] Please list all functional dependencies which hold for this relation (except trivial and implied ones). There is space for 8 FDs, but this does not mean that there have to be that many. Listing trivial FDs counts as an error. Also, listing too many implied dependencies might count as an error, but I will be generous with this (you need one implied dependency for b).

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________

b) [1 Point] Name one FD which is implied by the ones you have listed:

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c) [2 Points] List all minimal keys of the relation. There is space for three, but there might be less (i.e. only one or two):

1. ____
2. ____
3. ____

d) [4 Points] Is the relation in BCNF?

- ☐ Yes.
- ☐ No.

If you checked "No" name one FD which violates BCNF (there might be multiple violations, but one example is enough):

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Also give a decomposition of the relation into relations which are in BCNF. Note that if there were multiple violations, it might be necessary to split more than once:

1. ____
2. ____
3. ____
4. ____

e) [2 Points] Independent of whether the relation is in BCNF or not and the result of the decomposition, do you feel that there might be a better set of relations to store the information in the given relation?

1. ______________________________

2. ______________________________

3. ______________________________

f) [This question is optional and gives one extra point.] What knowledge about the relation have you used in e) which was not expressed by the FDs?

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