

Assignment 1

This homework assignment is an individual assignment.

Wednesday, 28 September 2016, 23:55

Rules:

- *Honor system.* The work that you submit must be your own. It must not be copied from anyone else. By handing in a solution to this assignment you sign implicitly that are aware of the regulations of ITU and that you pledge that you live up to the university's expectations of scholarly conduct.
- Submit your work as a single PDF file with a file name that includes your name.
- Upload your work to `learnit.itu.dk`.
- Late hand-ins will not be considered.
- This assignment will be graded and contribute with 15% to your final grade.

Problem 1:

Consider a database to store information about a Research Organization. The database has the following properties:

- Every department has a title, and a unique department ID (`departmentID`).
- A department may have zero or more employees.
- Each employee belongs to exactly one department. We store the name of the employee and a unique employee ID for each employee (`employeeID`).
- Employees can be researchers or managers. For managers we store their annual bonus amount and for researchers their doctorate degree subject
- People work in projects. Each Project has a unique project ID (`projectID`).
- Every project has exactly one manager and zero or more researchers.
- A manager can manage one or more projects but a researcher must work on exactly one project.

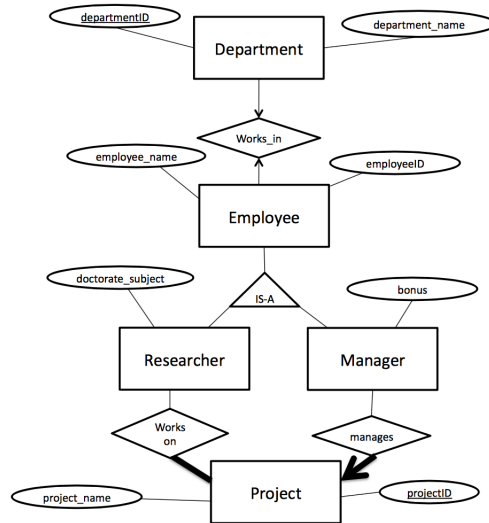


Figure 1: ER diagram with bugs

Given this description of the database and its constraints, we have created a mostly correct Entity-Relationship Diagram, shown in Figure 1.

Question 1: (10 points) Find and correct any mistakes in the given ER diagram. Specifically, number and list them, like, e.g.

1. delete: arrow, from x to y
2. change to bold line: thin line, from z to w
3. change to bold box: entity e

Question 2: (5 points) There may also be some missing element(s). If none, say none - otherwise, add them to the picture, and list them, numbered. E.g.

1. add: attribute a, to entity e
2. add: bold line, arrow, from c to d.
3. add: weak entity, f, with attributes

Question 3: (10 points) List and number all the bold lines and all the arrows that are in the final, corrected version of the diagram. E.g.

1. bold, line, from Department to Employee
2. thin, arrow, from x to y

Hints List your assumptions, if any. We will accept all reasonable assumptions.

Problem 2:

Consider a database for a Copenhagen art gallery. It records information about artists, paintings and exhibits. The constraints are exactly as shown in Figure 2. Paintings, Artists and Exhibitions have unique identifiers as shown in the Figure, with binary relationships among them as illustrated. To clarify:

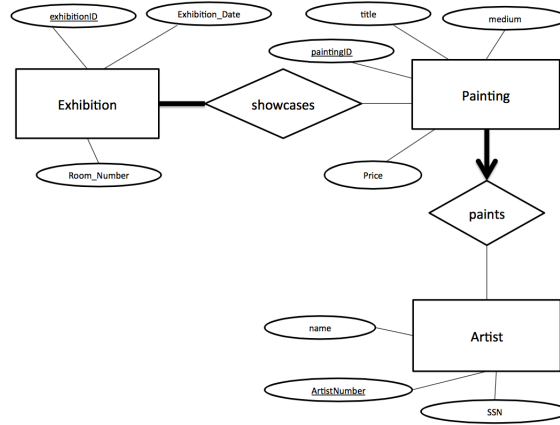


Figure 2: ER diagram for art exhibits

- The line from Exhibition to showcases, is thick.
- The arrow from Painting to paints, is also thick.
- No other lines, boxes, or diamonds, are thick.

Question 4: (20 points) Give the DDL statements, that correspond to the above ER diagram.

1. Use proper data types (well accept all reasonable choices).
2. Avoid syntax errors (well forgive missing semicolons).
3. Specify your decisions with respect to CASCADE deletions. (E.g., I decided to reject deletions in Exhibition, when there are still participating artists)
4. Without using CHECK statements, enforce as many as possible of the implied integrity constraints as you can.

Question 5: (5 points) Which of the implied integrity constraints of Figure 2 need CHECK statements to be enforced? List them all, or say none. For example, a (possibly, correct) answer could be: *thin line, from Painting to showcases*.

Problem 3:

Question 5: (10 points) Consider the following legal instance of a relational schema S with attributes ABC :

A	B	C
α	9	T
α	16	T
β	20	F
γ	4	T
γ	4	F

1. Which of the following dependencies are violated by this instance of S ? Answer with yes or no.

- (a) $A \rightarrow B$
 - (b) $B \rightarrow A$
 - (c) $C \rightarrow A$
 - (d) $AC \rightarrow B$
 - (e) $B \rightarrow AC$
2. By only observing the instance of S above, can you identify the functional dependencies that hold on schema S ?

Question 6: (20 points) For the next set of questions consider the relational schema $A(P, Q, R, S, T, U, V)$ and the set of functional dependencies FD:

$$P \rightarrow QS \quad (1)$$

$$Q \rightarrow R \quad (2)$$

$$PS \rightarrow TRV \quad (3)$$

$$QT \rightarrow UR \quad (4)$$

$$S \rightarrow V \quad (5)$$

1. Compute the minum cover of FD.
2. Which of the following functional dependencies can be deduced, from the above set of functional dependencies (Eq. (1)-(5))? Answer yes or no.
 - (a) $P \rightarrow R$
 - (b) $PS \rightarrow U$
 - (c) $QS \rightarrow U$
 - (d) $QST \rightarrow P$
3. Compute the attribute closure $\{Q\}^+$.
4. Compute the attribute closure $\{PS\}^+$.

Problem 4:

For the this problem consider the relational schema $\mathcal{R} = \{A, B, C, D, E, F, G, H\}$ and the set of functional dependencies FD:

$$A \rightarrow B$$

$$BD \rightarrow C$$

$$BE \rightarrow FG$$

$$CF \rightarrow GH$$

$$G \rightarrow HD$$

Question 7: (5 points) Compute the *canonical cover* of functional dependencies FD?

Question 8: (5 points) Which of the following functional dependencies can be deduced from the above set of functional dependencies FD and which can not?

1. $A \rightarrow C$
2. $AE \rightarrow F$
3. $CE \rightarrow F$
4. $BDE \rightarrow AG$

Question 9: (5 points) What is the attribute closure $\{B\}^+$ using the functional dependencies FD?

Question 10: (5 points) What is the attribute closure $\{A, D\}^+$ using the functional dependencies FD?