

CS 34800 Homework 4

Deadline for returning the HW: Monday February 27th, 2012 at the end of the CS 34800 class.

Instructions. Print the homework and mark the reply on the homework.

Return the hard copy of the homework marked with the replies to the instructor at the end of the class.

- 1) Let $R(D, E, F)$ be a relational schema. Determine for each of the following equalities whether the equality is true or false.
 - i. (points 5) $\Pi_{D,E}(\sigma_{(D > 10 \text{ AND } F=7)}(\Pi_{D,E,F}(\sigma_{(D > 15)}(R)))) = \Pi_{D,E}(\sigma_{(D > 15 \text{ AND } F=7)}(R))$
 - ii. (points 5) $\Pi_{D,E}(\sigma_{(D > 10 \text{ OR } F=7)}(\Pi_{D,E,F}(\sigma_{(D > 15)}(R)))) = \Pi_{D,E}(\sigma_{(D > 15 \text{ OR } F=7)}(R))$
- 2) Let $R(A, B, C, D)$ be a relation in which all columns are numeric, and let X and Y be subsets of the attributes of R .
 - i. (points 5) Let $E = \sigma_{(D > 10)}(\Pi_X R)$ be a relational algebra expression defined on relation R . Indicate when expression E is correct:
 - a. When X includes D
 - b. When X does not include D
 - c. Always
 - d. When X is the empty set
 - ii. (points 5) Consider expression E in point (2.i) and assume that E is correct. Which is the schema of E ?
 - a. $\{D\}$
 - b. X
 - c. $\{A, B, C\}$
 - d. $\{A, B, C, D\}$
 - iii. (points 5) Let $E' = \Pi_Y(\Pi_X R)$ be a relational algebra expression defined on relation R . Indicate when expression E' is correct:
 - a. When the intersection of X and Y is not empty
 - b. When X and Y are equal
 - c. When Y is a subset of X
 - d. Never
 - iv. (points 5) Consider expression E' in point (2.iii) and assume that E' is correct. Which is the schema of E' ?
 - a. X
 - b. Y
 - c. $X \cup Y$
 - d. $X \cap Y$

- 3) (points 10) Consider the following relational schema; the schema describes a database containing data about theses carried out by students of a master degree. Theses have supervisors and co-supervisors. The underlined attributes denote the primary keys of the relations; the attributes in boldface denote foreign keys. Attributes Supervisor# and Co-Supervisor# references relations Students.

Students(S#, FName, LName, Street, City, Phone#)

Theses(T#, Title, Topic, **Supervisor#**, **S#**, Evaluation)

Professors(Prof#, LName, Rank, Phone#)

Theses-Co-Supervisors(T#, **Co-Supervisor#**)

Based on the primary and foreign keys of the relations, answer the following questions:

- Can a professor supervise more than one thesis? Reply YES or NO
- Can a thesis have multiple supervisors? Reply YES or NO
- Can a thesis have multiple co-supervisors? Reply YES or NO
- Can a student have multiple master theses? Reply YES or NO

- 4) Consider the schema in question (3).

- a. (points 5) Consider the query “Retrieve the topic of the thesis by student Bob Rossi”.

Which of the following relational expressions are correct formulations of this query? In what follows the symbol $|X|$ denotes the join operator.

- a. $\Pi_{\text{Topic}}(\text{Theses}) \mid X \mid (\sigma_{(\text{FName} = \text{'Bob'} \text{ AND } \text{FName} = \text{'Rossi'})}(\text{Students}))$
- b. $\Pi_{\text{Topic}}(\text{Theses} \mid X \mid (\sigma_{(\text{FName} = \text{'Bob'} \text{ AND } \text{FName} = \text{'Rossi'})}(\text{Students})))$
- c. $\Pi_{\text{Topic}}(\sigma_{(\text{FName} = \text{'Bob'} \text{ AND } \text{FName} = \text{'Rossi'})}(\text{Theses} \mid X \mid \text{Students}))$
- d. Both (a) and (b)
- e. Both (b) and (c)
- f. Both (a) and (c)

- b. (points 5) Consider the query “Determine the Prof# of the professors that do not supervise any thesis”.

Which of the following relational expressions are correct formulations of this query? In what follows the symbol $|X|$ denotes the join operator.

- a. $\Pi_{\text{Prof\#}}(\text{Professors} \mid X \mid_{\text{Prof\#} \neq \text{Supervisor\#}} \text{Theses})$
- b. $\Pi_{\text{Prof\#}}(\text{Professors}) - \Pi_{\text{Supervisor\#}}(\text{Theses})$
- c. Both (a) and (b)
- d. None

- 5) Consider the schema in question (3).

- i. (points 5) Consider the following expression of the relational calculus:

$\{t.\text{FName}, t.\text{LName} \mid \text{NOT Students}(t) \text{ AND } t.\text{City} = \text{'Chicago'}\}$

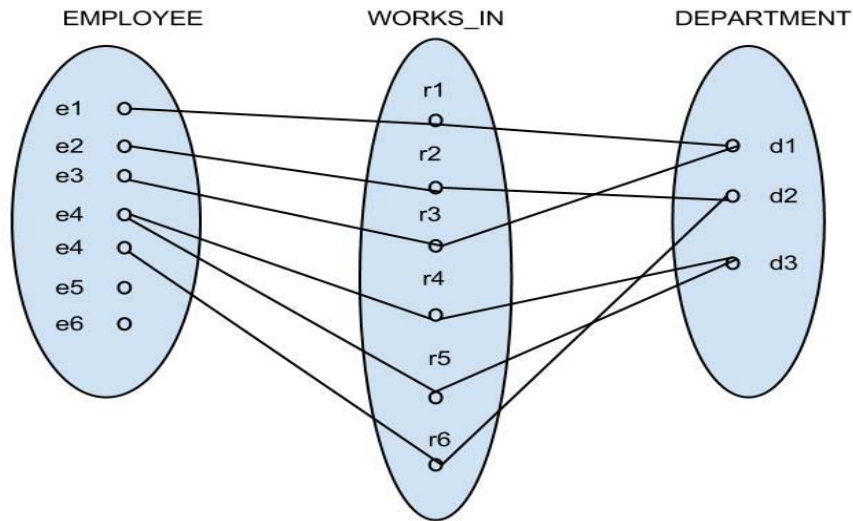
Is this expression safe? Reply YES or NO

- ii. (points 5) Consider the following expression of the relational calculus:

$\{t.\text{LName} \mid \text{Professors}(t) \text{ AND NOT } (t.\text{Rank} = \text{'Assistant'})\}$

Is this expression safe? Reply YES or NO

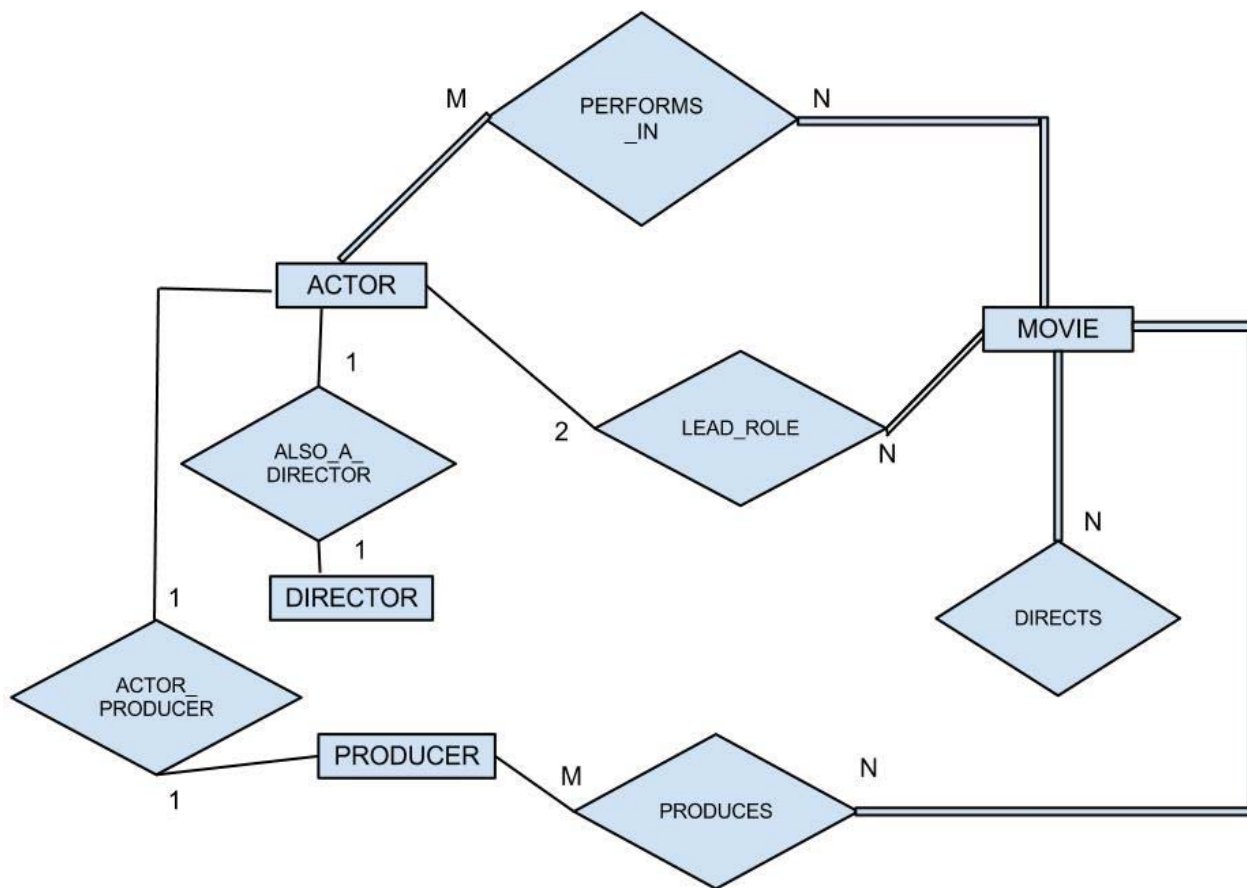
6) (points 10) Consider the following figure representing instances of a relationship between employees and the department that the employees work in.



Which of the following relationships are represented by the above figure?

- a) 1:1 Cardinality Ratio between EMPLOYEE and DEPARTMENT and total participation from EMPLOYEE and total participation from DEPARTMENT
- b) 1:N Cardinality Ratio between EMPLOYEE and DEPARTMENT and partial participation from EMPLOYEE and partial participation from DEPARTMENT
- c) M:N Cardinality Ratio between EMPLOYEE and DEPARTMENT and partial participation from EMPLOYEE and total participation from DEPARTMENT
- d) N:1 Cardinality Ratio between EMPLOYEE and DEPARTMENT and total participation from EMPLOYEE and total participation from DEPARTMENT

7) Consider the ER diagram for the MOVIES schema given below.



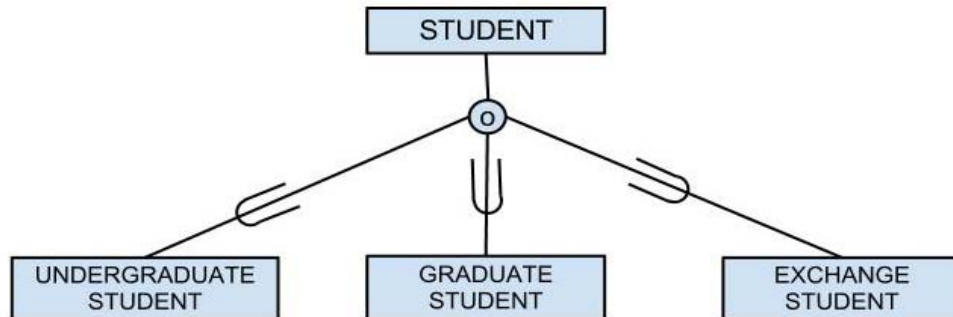
Assume that MOVIES is a populated database. ACTOR is used as a general term and includes actresses. Given the constraints shown in the ER schema, indicate whether the following statements are true or false.

- I) (points 5) A movie can have only a maximum of two lead actors.
 - a) True
 - b) False
- II) (points 5) Every director has been an actor in some movie
 - a) True
 - b) False
- III) (points 5) Every movie has an actor who performs in a lead role in the movie
 - a) True
 - b) False
- IV) (points 5) Every movie has only one producer.
 - a) True
 - b) False

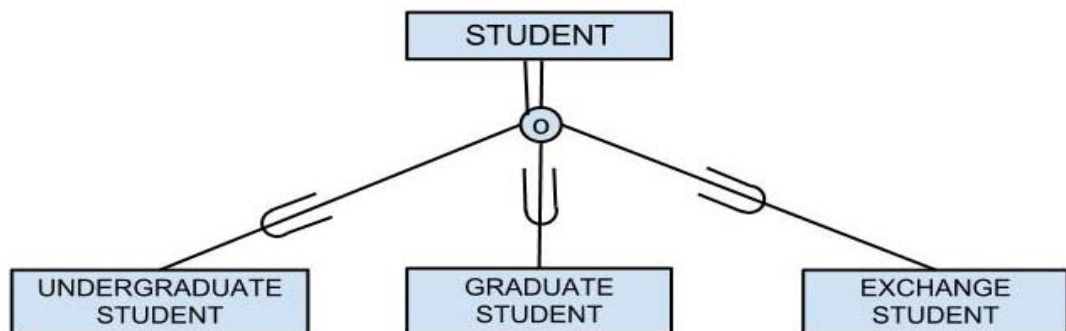
- 8) Consider a student database. The entity sets present are Undergraduate students, Graduate Students, Exchange Students. All these students have common characteristics such as name and student identification number. Also each category of students has unique characteristics. For example undergraduate students have an attribute class (freshman, sophomore etc), graduate students have a research area listed and exchange students have their foreign country listed. Also every student in the database belongs to one of these categories and every student can be only in one category.

(points 10) Which of the following ER diagrams can be used to model the above scenario?

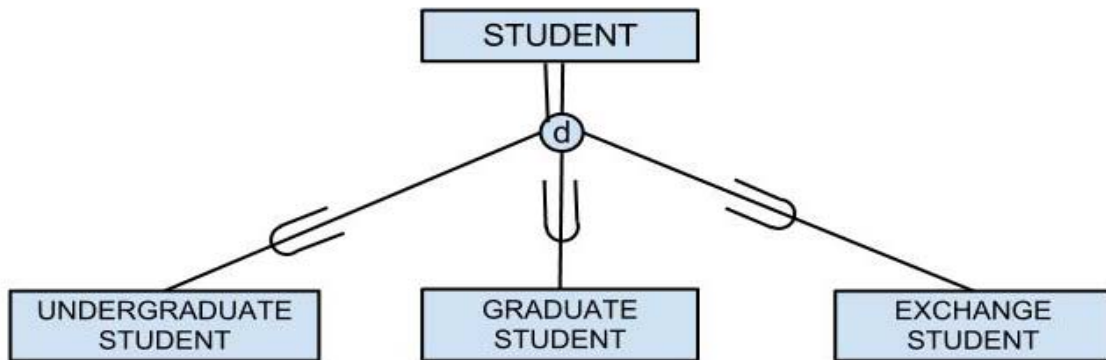
a)



b)



c)



d)

