MILITARY COLLEGE OF SIGNALS
MIDTERM EXAM
BESE 15-A
CPS 480 Database Systems

Instructor: A/P Dr. Imran Siddiqi **Time: 90 Minutes**
Max Marks: 30

Note: This question paper comprises **3** pages.

(3+5)

1. **a.** Briefly discuss the difference between:

i. Database schema and instances

Database schema refers to the overall structure of the database while instances are the actual contents of the database at a particular point in time. Schemas and instances are similar to variable declarations and variable values in programming languages respectively.

ii. Physical and logical data independence

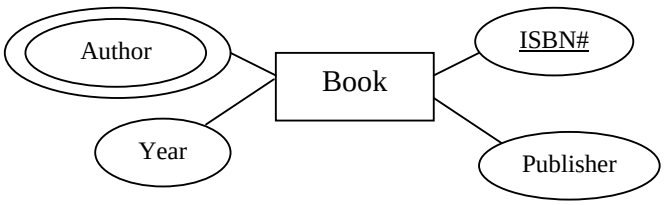
Physical data independence is the ability to modify the physical schema without affecting the logical schema. Logical data independence is the ability to modify the logical schema without affecting the application programs.

iii. Primary key and foreign key

Primary key is the candidate key chosen by the database designer to uniquely identify an entity in the entity set. Foreign key is an attribute or set of attributes in one (referencing) table that refers to a set of attributes in another (referenced) table. The attribute in the referencing table is the primary key in the referenced table

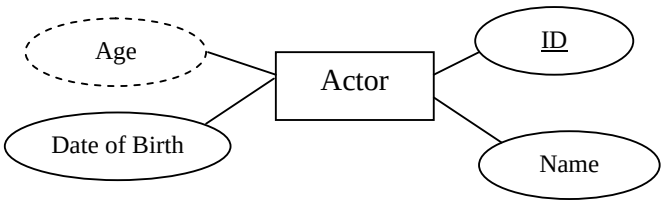
b. Convert the following *entity relationship diagrams* to relations. You need to show the relational schema for each relation.

i.



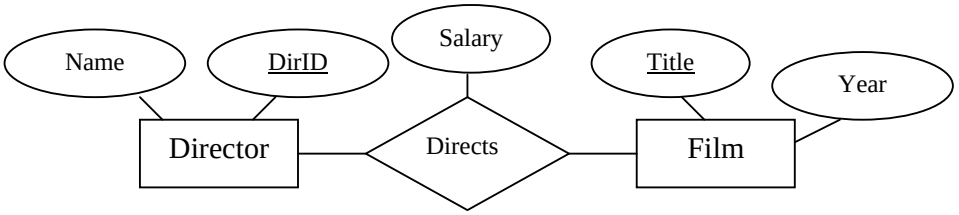
Book(ISBN#, Publisher, Year)
Authors (ISBN#, Author)

ii.



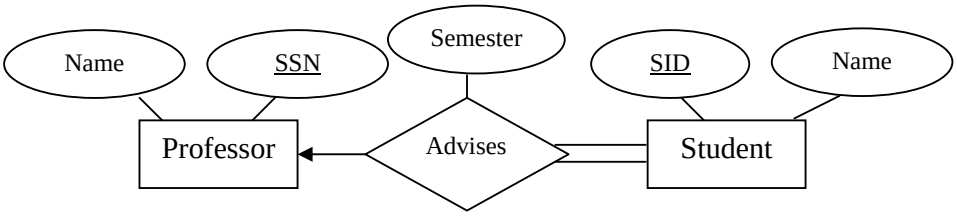
Actor(ID, Name, Data of Birth)

iii.



Director(DirID, Name)
Film (Title, Year)
Directs (DirID, Title, Salary)

iv.

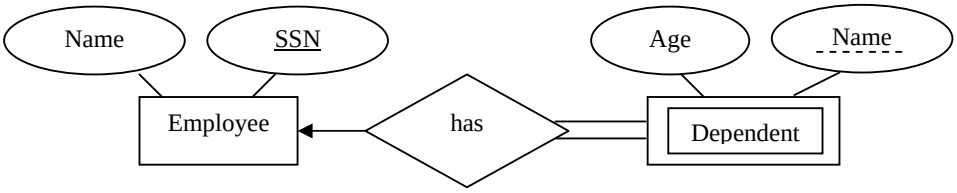


Professor (SSN, Name)
Student (SID, Name)
Advises (SSN, SID, Semester)

Another option is to omit the relation Advises and have:

Students (SID, Name, SSN, Semester)

v.



Employee(SSN, Name)
Dependent(SSN, Name, Age)

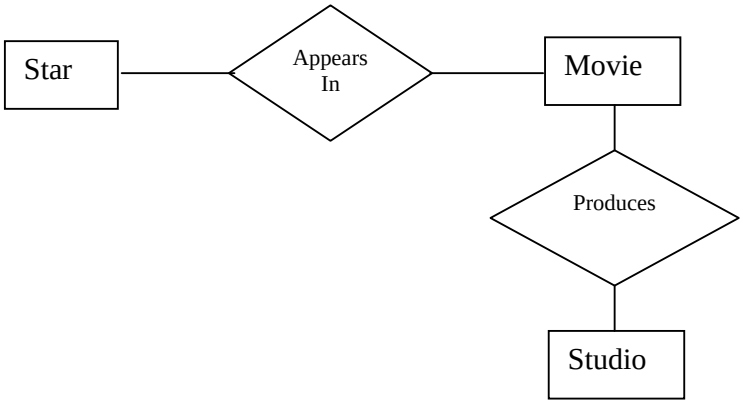
(2+7)

2. A simple movie database comprises five relations with the following relational schemas:

Movie (movieTitle, yearOfRelease, duration)

Star (<u>starName</u>, age, rating)
Studio (<u>studioName</u>, location)
Produces(studioName, <u>movieTitle</u>)
AppearsIn (<u>starName, movieTitle</u>)

a. Convert the given relational database to a simple Entity Relationship Diagram (Cardinalities and participation constraints are NOT required).



b. Formulate the following queries in relational algebra:

i. When was the movie 'Cast Away' released.

$$\pi_{\text{yearOfRelease}}(\sigma_{movieTitle='Castaway'}(Movie))$$

ii. Which stars of less than 20 years of age appeared in the movie 'Sword Fish'.

$$\pi_{\text{starName}}(\sigma_{age<20 \wedge movieTitle='Swordfish'}(Star \infty AppearsIn))$$

iii. Which stars do not appear in the movie 'Inception'

$$\pi_{\text{starName}}(Star) - \pi_{\text{starName}}(\sigma_{movieTitle='Inception'}(AppearsIn))$$

iv. Find the names of stars who appear in movies produced by a studio located in 'Califronia'.

$$\pi_{\text{starName}}(\sigma_{location='California'}(\text{Studio} \infty \text{AppearsIn} \infty \text{Produces}))$$

v. Find the titles and durations of the movies produced by 'Fox Studios'.

$$\pi_{\text{movieTitle, duration}}(\sigma_{StudioName='FoxStudios'}(\text{Produces}) \infty \text{Movie}))$$

vi. Find the names of stars who have appeared in all the movies released in the year 2010.

$$AppearsIn \div \pi_{movieTitle}(\sigma_{\text{yearOfRelease}=2010}(Movie))$$

vii. Find the age of the oldest star.

$$\pi_{age}(Star) - \pi_{age}(\sigma_{age<d.age}(star \times \rho_{d}(star)))$$

(4+3)

3. **a.** Given two relations ***R*** and ***S***, where ***R*** contains ***M*** tuples, ***S*** contains ***N*** tuples, and ***M*** >***N*** > **0**, give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by each of the following relational algebra expressions:

i. $R - S$

Min : M-N
Max : M

ii. $R \cup S$

Min : M
Max : M+N

iii. $R \cap S$

Min : 0
Max : N

iv. $R \bowtie S$

Min : 0
Max : MxN

b. Consider the following schema:

Suppliers(<u>sid</u>, sname, address)
Parts(<u>pid</u>, pname, color)
Catalog(<u>sid, pid</u>, cost)

Given the following relational algebra queries, state what they compute:

i. $\pi_{sname}(\pi_{sid}(\sigma_{color='red'}(Parts) \bowtie \sigma_{cost<100}(\text{Catalog})) \bowtie Supplier)$

Find the names of the suppliers who supply red parts costing less than 100.

ii. $\pi_{sid,pid}(\text{Catalog}) \div \pi_{pid}(\sigma_{color='red'}(\text{Parts}))$

Find the IDs of supplier who supply every red part.

iii. $\pi_{sid}(Supplier) - \pi_{sid}(\pi_{pid}(\sigma_{color='red'}(Parts)) \bowtie (\text{Catalog}))$

Find the IDs of suppliers who do not supply a red part.

(4+2)

4. Consider the following instances in a relational database:

P ***Patient***

patientID	***patientName***	***dateAdmitted***	***dateCheckedout***
P101	*Nicole*	*15-10-2010*	*18-10-2010*
P102	*Georges*	*25-10-2010*	-
P103	*Stockman*	*30-10-2010*	-

Doctor

doctorID	***doctorName***	***Specialization***
D501	*Claudie*	*Cardiology*
D502	*Nicolas*	*ENT*

Patient-Doctor

doctorID	***patientID***	***lastExaminationDate***
D501	*P101*	*17-10-2010*
D502	*P101*	*18-10-2010*
D501	*P102*	*26-10-2010*
D502	*P103*	*30-10-2010*

a. List the constraints that are violated (if any) if you try to:

i. Insert the tuple *('D501', 'P101', '18-10-2010')* in the relation ***Patient-Doctor***.
Violation of Primary Key constraint.

ii. Insert the tuple *('D501', 'P104', '25-10-2010')* in the relation ***Patient-Doctor***.
Violation of Foreign Key constraint.

iii. Insert the tuple *('D503','Claudie', 'Cardiology')* in the relation ***Doctor***.
No Violation.

iv. Delete the data for *'P101'* from the relation ***Patient***.
Violation of Foreing Key constraint. The respective rows in the Patient-Doctor Table should be deleted or set to a default value.

b. Can we place the attribute '*lastExaminationDate*' with ***Patient*** or ***Doctor***? If Yes/No, Why?

This attribute cannot be placed with any of the entity sets as the relationship between the entity sets is M:N.

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