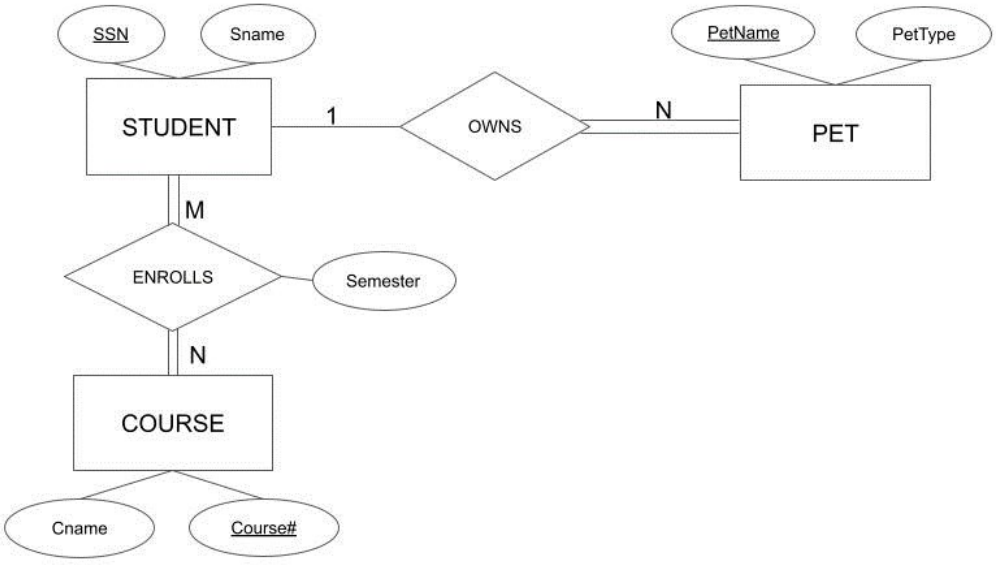
TUTORIAL for Lecture Week 11 (QUESTIONS ONLY)

NOMALIZATION in Relational Database Design

(Prof. Sham Navathe- Lecture on Oct 31, 2023)

Q1. CONSIDER THE FOLOWING ER SCHEMA about students, courses they enroll in and the pets they have.



A. Consider a table created from this schema :
STUDENT_PET (Student_Ssn, Sname, Petname, Pettype)
Suppose 70% students own a pet and we are tolerating 30% nulls in the last two columns for students that do not own a pet.

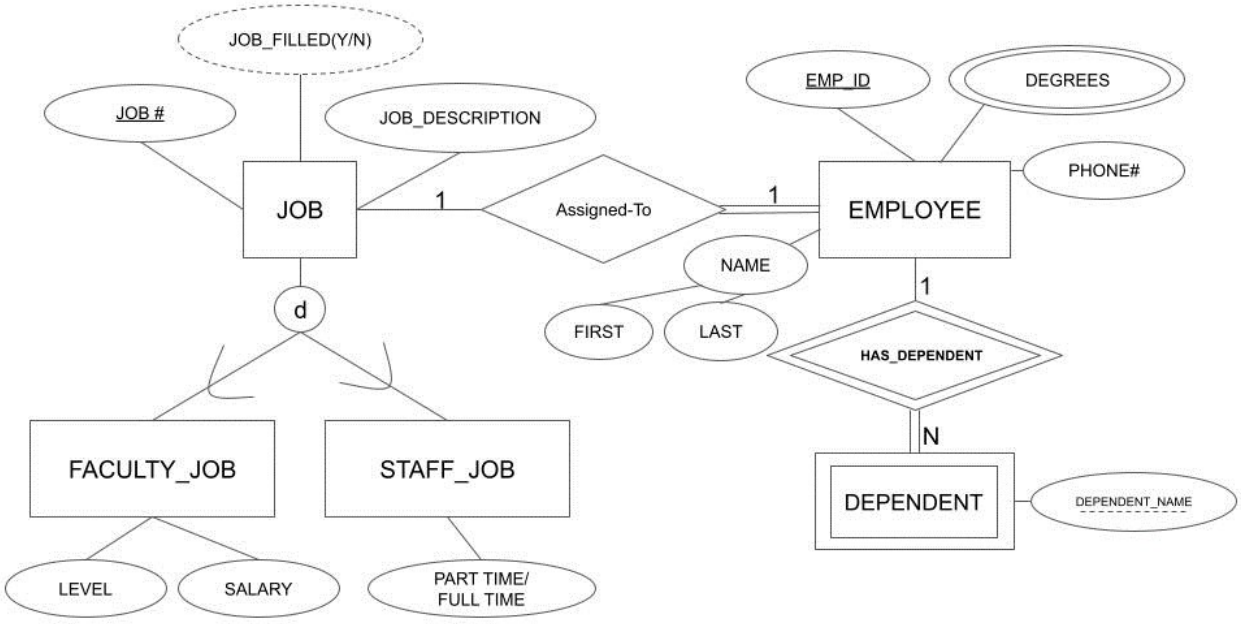
i) What are the functional dependencies in this table?
ii) Is this a good design? What is/are the keys of this table?.
iii) Can Petname be considered a candidate key ?
iv) What normal form is this table in? Do you approve of this design?
v) Consider decomposing it into
STUDENT1 (Student_Ssn, Sname)
PET (Petname, Pettype, Student_SSN)
What FDs are present? Does this design meet BCNF? Is this a better design?

B. Suppose the ENROLLS relationship type was mapped into the following table with primary key (SSN, Course#)

ENROLLS (SSN, Course#, Student_name, Cname, Semester)

i) What are the FDs in this table?
ii) What normal form is it in? Why?
iii) Do successive decomposition of this table.
iv) Test and justify that the result is in BCNF
v) Now suppose we introduce an FD Semester → Course#. Does the design remain in BCF? If not, convert it into BCNF.

Q2. Consider the EER schema below about Employees and Dependents and answer the following questions:



2A. Suppose the designer designed the following table for Employees:

EMPLOYEE (Empid, Phone#, Degrees)

i) What are the FDs in this table?
ii) What normal form is it in?
iii) Show two possible first normalizations of this table – one that may have redundancy and one that will avoid any redundancy. Show the FDs in each case.

2B. Suppose the designer proposed the design of the Employee and Dependent information as a nested relation:

EMP_NESTED (Empid, Phone#, (Degree), (Dependent_name))

i) What normal form is this design in?

ii) Suppose the following table EMP_FLAT was presented to you as a relational design:

Empid	Phone#	Degree	Dependent_name
101	6146	BS	Peter
101	6146	MS	Mary
102	6234	Mtech	Jill
102	6234	PhD	Janet
102	6234	<null>	John

What are the problems with this design?

iii) How will you convert this to a proper design?

iv) Justify that your final design meets BCNF.

Q3. SUCCESSIVE NORMALIZATION

Consider the following relation:

REFRIG_MODELS (Model#, Option_type, Option_Listtprice, Model_color, Discount%, Quantity, Sticker_price)

It refers to an inventory of Refrigerators at an appliance store. It includes options available on refrigerators (e.g. – ice maker, soda-water maker) that are sold and the list-prices and discounted prices etc.

The known f.d.s:

FD1:Model# → Model_color;

FD2:Option_type→ Option_Listprice;

FD3:Model#, Option_type → Quantity, Sticker_price;

FD4: Model_color → Discount%

Argue **using the generalized definition of the BCNF** that this relation is not in BCNF; further argue why it is not even in 3NF by the generalized definition of 3NF. Finally point out which dependency (or dependencies) violate the 2NF. Carry out successive normalization until you reach a BCNF design.

Q4. NON-ADDITIVE BINARY DECOMPOSITION

Consider the following set of functional dependencies F in the STUDENT relation (it has obvious meaning of data related to students who enrolled in courses and received a grade):

STUDENT (**Stud_SSN, Course_no, Grade, Course_name, Stud_name, Course_Instr)**

F: { FD1: (Stud_SSN, Course_no) → Grade, Course_name, Stud_name, Course_Instr;

FD2: Stud_SSN → Stud_name;

FD3: Course_no → Course_name, Course_Instr }

The designer proposed to decompose this relation into

STUDENT1 (Stud_SSN, Course_no, Stud_name, Grade) and

COURSE (Course_no, Course_name, Course_Instr)

i) Apply the Non-additive join (NJB) test to determine if this decomposition is lossless
ii) What are the highest normal forms the above relations are in?
iii) Normalize the design further if possible.

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