**TUTORIAL for Lecture Week 10**

**INFORMAL DESIGN GUIDELINES AND FUNCTIONAL DEPENDENCIES**

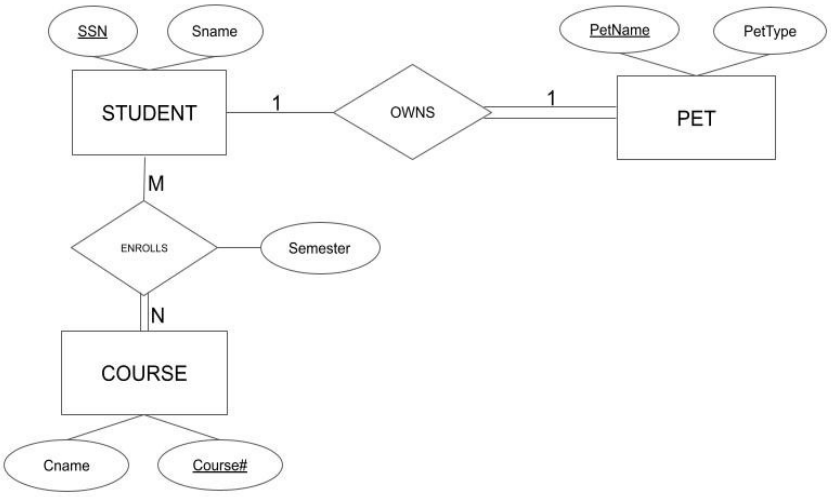
**(Prof. Sham Navathe- Lecture on Oct 24, 2023)**

This tutorial includes questions on three topics:

1) Informal Guidelines for Relational Design
2) Functional Dependencies, Closure and Equivalence
3) Minimum cover of FDs.

**Q1. ABOUT INFORMAL DESIGN GUIDELINES:**

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




A. Suppose that only 30% of the students own a pet. The relational design for this schema was done by mapping into the following table:

STUDENT_PET (Student_Ssn, Sname, Petname, Pettype)

i) What informal guideline(s) is/are violated by this design?
ii) What type of problem would be caused in this table?
iii) Propose a correct design that will eliminate null values.
iv) List the functional dependencies present in the relation STUDENT_PET .
v) List the functional dependencies in your correct design. Can you say that functional dependencies are preserved in the correct design but the nulls are eliminated?
vi) If the OWNS relationship type was modified to be One-to-many , allowing a student to own multiple pets, would your design above change? Why or why not?

B. Suppose the ENROLLS relationship type was mapped into the following table:

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

i) What informal guideline(s) are being violated here?

ii) Due to the violation of these guidelines, Insertion, deletion and update anomalies will be present. Give one example of each anomaly.

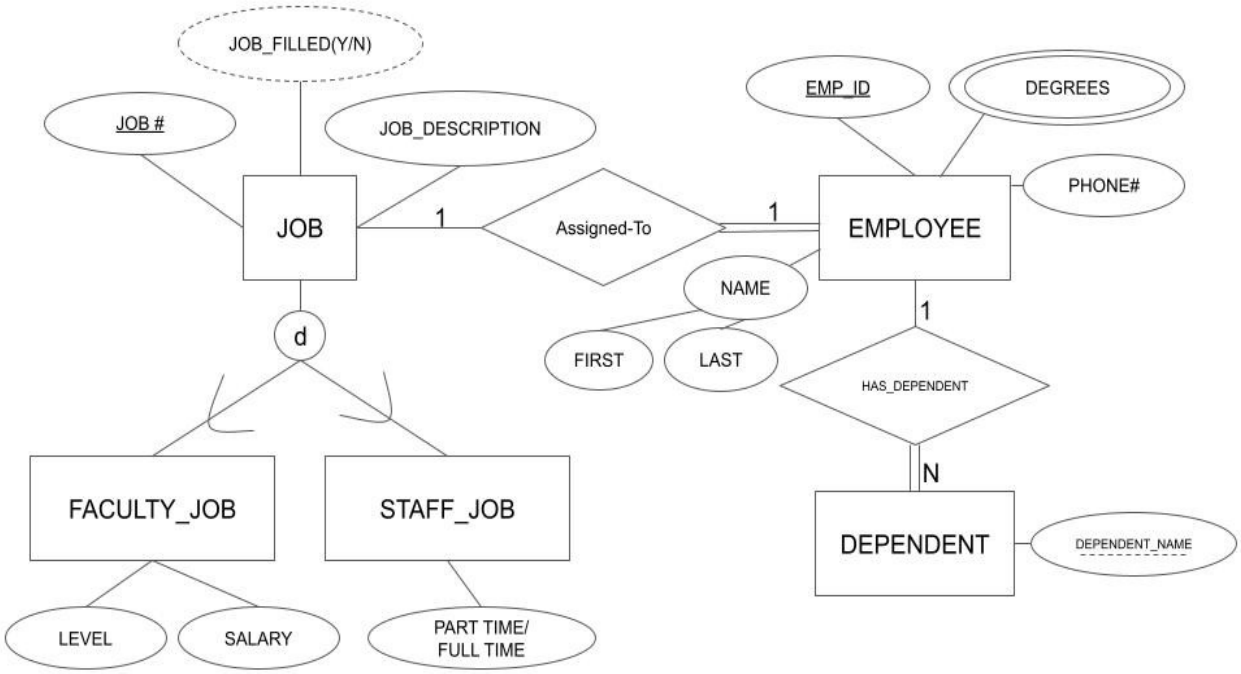
iii) Propose a correct design that will eliminate these anomalies.

iv) List the functional dependencies present in the relation ENROLLS.

v) List the functional dependencies in your correct design. Can you say that functional dependencies are preserved in the correct design but the anomalies are eliminated?

vi) If each student was allowed to take only one course per semester, would you still maintain your design? Give a proper explanation.

**C. Consider the EER schema below and answer the following questions:**




**C1. About relational design based on the JOB Super-entity type**

i) Show a possible design where the super entity type JOB and the sub-entity types FACULTY_JOB and STAFF_JOB are all accommodated in one table called JOBS.

ii) If only 10% of jobs are faculty jobs and 90% jobs are staff jobs, what potential problem exists?

iii) Propose a design where null values will not occur and jobs will have a discriminating attribute that defines it as a faculty or staff job.

**C2. About the ASSIGNED_To relationship type:**

Suppose there are 1000 Jobs in the populated database and a table was stored as:

JOB_ASSIGNMENT (Job#, Job_Description, Emp_id, Degree, Phone#)

80% of jobs have been filled and 50% of employees have two degrees.

i) Assume that this table has been populated with the 1000 jobs announced including those that have been filled. What is the nature of redundancy in the above design?

ii) How many tuples will get stored in the JOB_ASSIGNMENT table?

iii) How many null values will get stored?

iv) How many duplicate values will get stored?

v) Assuming that the JOB table is stored as follows:
JOBS (Job#, Job_description, Job_type).
Propose a proper design that takes care of the Assigned-to relationship type and the multivalued attribute Degrees correctly and point out the estimated number of tuples in each table.

vi) List the functional dependencies in your correct design. Can you say that functional dependencies among the attributes in the original EER schema are preserved in the correct design?

**Q2. ABOUT CLOSURES of attributes and equivalence of sets of FDs :**

1. Consider the relation: $R(A, B, C, D)$

with $F = \{A \rightarrow BCD, C \rightarrow D\}$

What are the closures of attributes A, B, C, D?

2. Consider the set of FDs :

$G = \{ A \rightarrow BC, C \rightarrow D\}$.

Compute the closures of attributes A, B, C, D in the set G.

Are F and G equivalent?

3. Consider the set of FDs:

$H = \{ A \rightarrow BD , A \rightarrow C\}$

Compute the closures of attributes A, B, C, D in the set H.

Are F and H equivalent?

## Q3. About Minimum Cover of FDs

**Find the minimum cover for the set G of f.d.s:**

G: **{ A → C, AC → D, AD→ B, CD → EF, E→F }**

Show your work step by step and explain how you arrive at the final min cover.

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