Task 1. Will the conversion to BCNF be dependency preserving in any case? Proof your statement and give a reasoning for choosing BCNF design.

A relation schema R is in BCNF with respect to a set F of functional dependencies if for all functional dependencies in F+ of the for

$\alpha \rightarrow \beta$

where $\alpha \subseteq R$ and $\beta \subseteq R$, at least one of the following holds:

$\alpha \rightarrow \beta$ is trivial (i.e., $\beta \subseteq \alpha$)

α is a superkey for R

It is not always possible to achieve both BCNF and dependency preservation.

Consider a schema:

dept_advisor(s_ID, i_ID, department_name)

With function dependencies:

i_ID→dept_name

s_ID, dept_name→i_ID

dept_advisor is not in BCNF

i_ID is not a superkey.

Any decomposition of dept_advisor will not include all the attributes in

s_ID, dept_name→i_ID

Thus, the composition is NOT be dependency preserving

Task 2. Given table in 1NF, convert to 3NF if PK is {UnitID, StudentID}:

UnitID	StudentID	Date	Tutor ID	Topic	Room	Grade	Book	TutEmail
U1	St1	23.02.03	Tut1	GMT	629	4.7	Deumlich	tut1@fhbb.ch
U2	St1	18.11.02	Tut3	Gln	631	5.1	Zehnder	tut3@fhbb.ch
U1	St4	23.02.03	Tut1	GMT	629	4.3	Deumlich	tut1@fhbb.ch
U5	St2	05.05.03	Tut3	PhF	632	4.9	Dümmlers	tut3@fhbb.ch
U4	St2	04.07.03	Tut5	AVQ	621	5.0	SwissTopo	tut5@fhbb.ch

Transitive dependency:

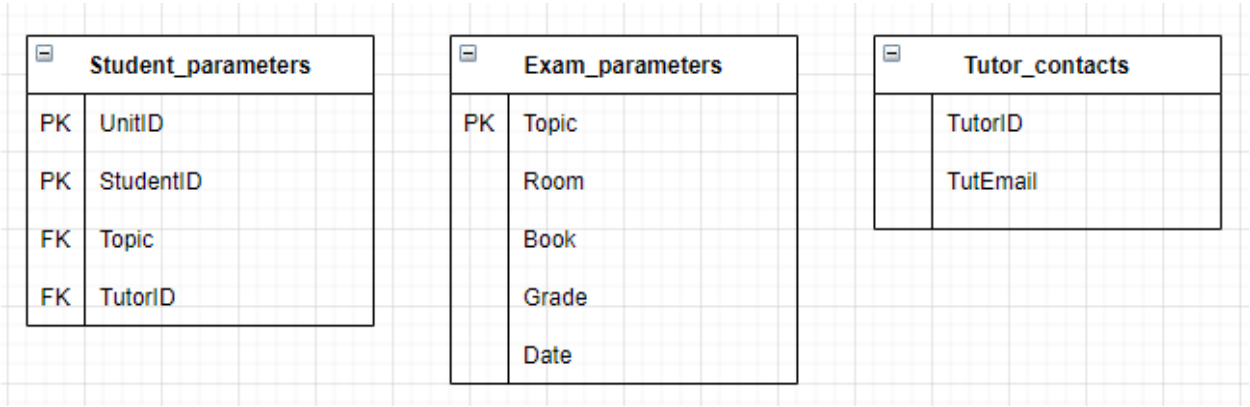
TutorID -> TutEmail;

Topic -> Room;

Topic -> Book;

Topic -> Grade;

Topic -> Date;

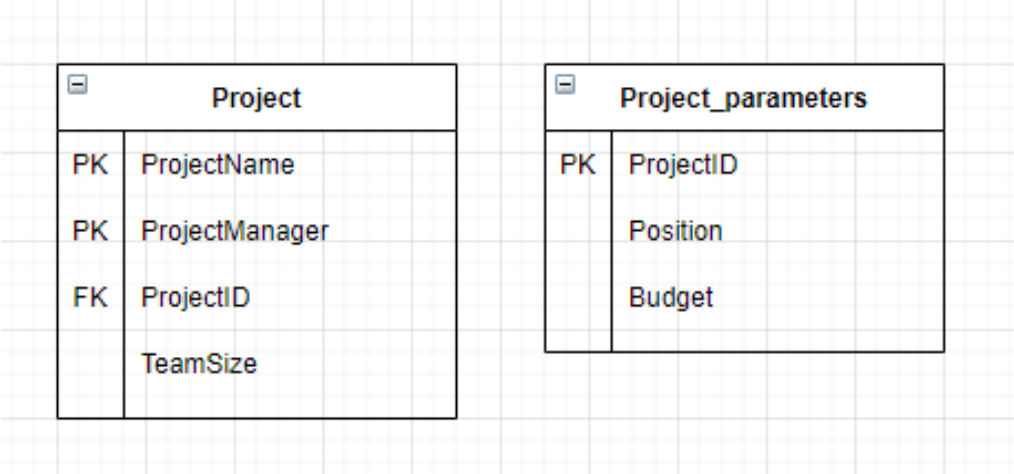


Task 3. Given table in 1NF, convert to 2NF if PK is {ProjectName, ProjectManager}, use decomposition:

ProjectName	**ProjectManager**	Position	**Budget**	TeamSize
Project1	Manager1	CTO	1 kk $	15
Project2	Manager2	CTO2	1.5 kk $	12

ProjectName -> Position;

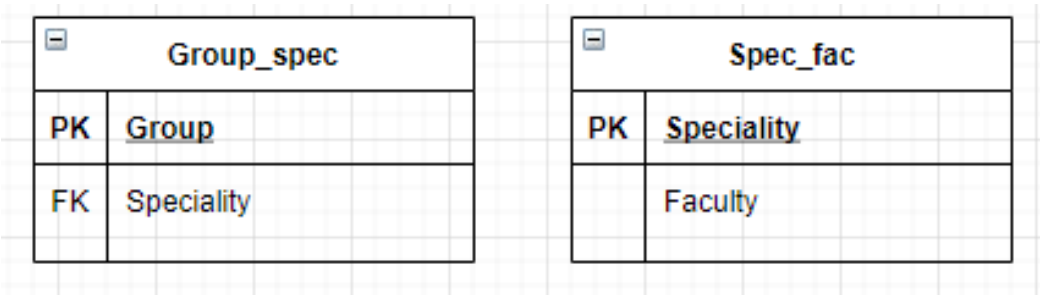
ProjectName -> Budget;



Task 4. Given table, convert to 3NF if PK is Group, use decomposition:

Faculties have a number of specialities, each speciality consists of a set of particular groups.

Group	Faculty	Speciality
g1	f1	s1
g2	f2	s2



Task 5. Given table, convert to BCNF if PK is {ProjectID, Department}, use decomposition:

Curator depends on projectID and related departments, teamSize directly relates to project and related departments, ProjectGroupsNumber depends on TeamSize.

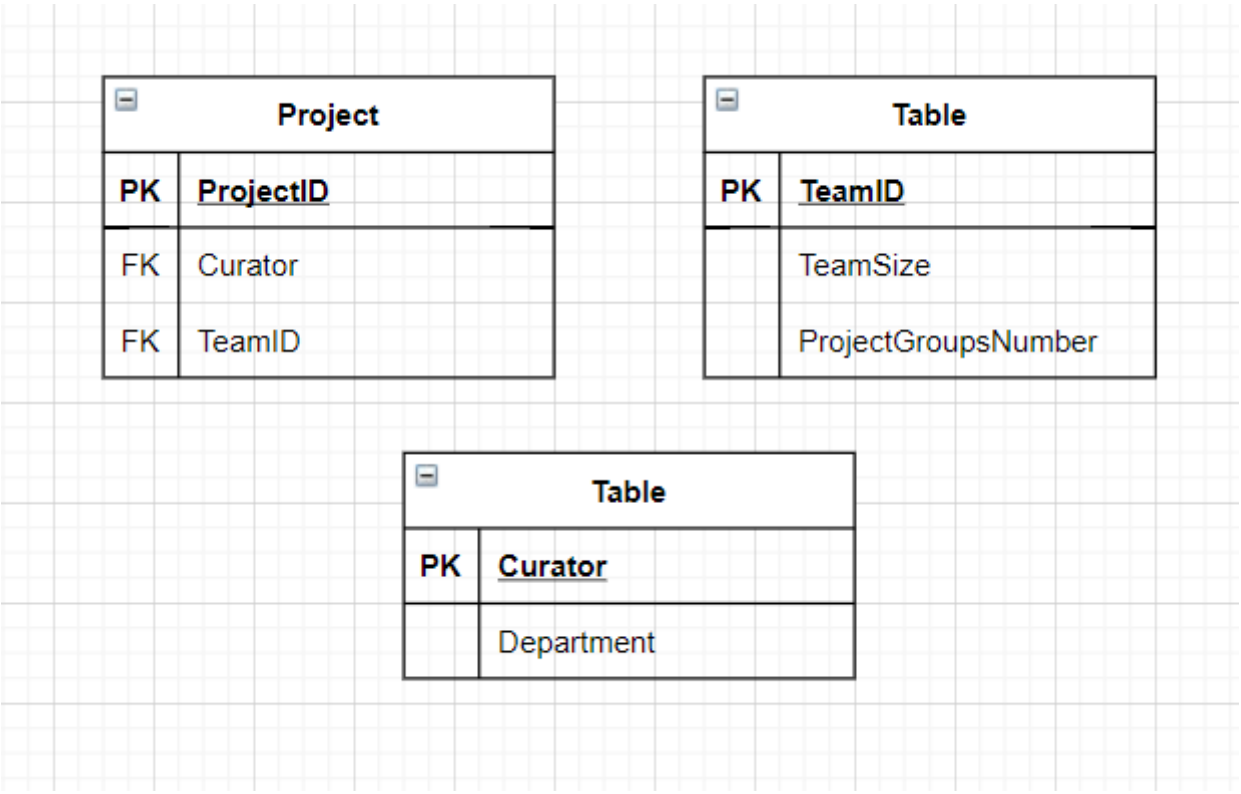
ProjectID	Department	Curator	TeamSize	ProjectGroupsNumber
p1	d1	e1	100	5
p2	d2	e2	120	6

ProjectID -> Curator;

Department -> Curator;

ProjectID -> teamSize;

TeamSize -> ProjectGroupsNumber;



Task 6. List the three design goals for relational databases, and explain why each is desirable. Give an example of both desirable and undesirable types of decompositions.

For relational databases, atomicity of data is important, uniqueness in attributes in all tables, as well as reducing the number of transitive dependencies, but primary and secondary keys are also needed to preserve logical relationships.