

I. Before Normalization:

Based on my ER Diagram in Assignment #1b.

<https://raw.githubusercontent.com/yuwen41200/php-guide/master/rdbms/practice1.png>

Underscored and bold font means primary keys.

Blue font means foreign keys.

$a \rightarrow b$ is a non-trivial functional dependency in the relation.

professor			
<u>id</u>	name	area	rank

$id \rightarrow name, area, rank$

leader	
<u>professor.id</u>	<u>project.id</u>

project				
<u>id</u>	sponsor	start_time	end_time	budget

$id \rightarrow sponsor, start_time, end_time, budget$

lab				
<u>id</u>	name	location	<u>professor.id</u>	<u>graduate_student.id</u>

$id \rightarrow name, location, professor.id, graduate_student.id$

graduate_student						
<u>id</u>	name	age	degree	program	<u>professor.id</u>	<u>address_book.student_id</u>

$id \rightarrow name, age, degree, program, professor.id, address_book.student_id$

graduate_application			
<u>graduate_student.id</u>	<u>course.id</u>	<u>address_book.student_id</u>	complete

$graduate_student.id, course.id \rightarrow address_book.student_id, complete$

$graduate_student.id \rightarrow address_book.student_id$

$course.id \rightarrow complete$

course					
<u>id</u>	year	name	timetable	syllabus	<u>professor.id</u>

$id \rightarrow year, name, timetable, syllabus, professor.id$

undergraduate_student						
<u>id</u>	name	age	class	program	professor.id	address_book.student_id

id → name, age, class, program, professor.id, address_book.student_id

address_book				
<u>student_id</u>	address	email	phone_number	line_id

student_id → address, email, phone_number, line_id

undergraduate_application			
<u>undergraduate_student.id</u>	<u>course.id</u>	address_book.student_id	complete

undergraduate_student.id, course.id → address_book.student_id, complete

undergraduate_student.id → address_book.student_id

course.id → complete

II. Normalization Process:

Relation **graduate_application** and **undergraduate_application** are not in BCNF.

Remove attribute **address_book.student_id** and **complete**

from relation **graduate_application** and **undergraduate_application**.

Merge attribute **complete** into relation **course**.

Other relations are already in BCNF.

III. After Normalization:

graduate_application	
<u>graduate_student.id</u>	<u>course.id</u>

undergraduate_application	
<u>undergraduate_student.id</u>	<u>course.id</u>

course						
<u>id</u>	year	name	timetable	syllabus	complete	professor.id

id → year, name, timetable, syllabus, complete, professor.id

Other relations are not modified.