COMS2002A: DATABASE FUNDAMENTALS

SEMESTER 1, 2023

LAB 6 – NORMALIZATION OF TABLES

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INTRODUCTION

In this lab, we'll be going through normalization exercises. Please ensure you have done through the lecture resource for Unit 6.

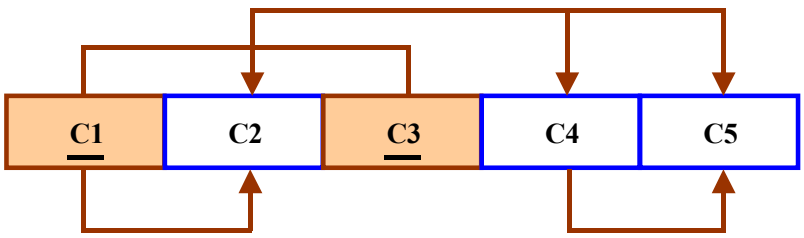
The first part of this lab will take you through some exercises. In Part 2, you are given some questions to answer.

PART 1

QUESTION 1:

Given the dependency diagram shown in Figure 1 answer the following questions.

FIGURE 1: Dependency Diagram for Question 1



a. Identify and discuss each of the indicated dependencies.

SOLUTION

C1 → C2 represents a *partial dependency*, because C2 depends only on C1, rather than on the entire primary key composed of C1 and C3.

C4 → C5 represents a *transitive dependency*, because C5 depends on an attribute (C4) that is not part of a primary key.

C1, C3 → C2, C4, C5 represents a set of proper functional dependencies, because C2, C4, and C5 depend on the primary key composed of C1 and C3.

b. Create a database whose tables are at least in 2NF, identify all the dependencies that exist in the tables. Also show the dependency diagrams for each table.

The normalisation results are shown in Figure 1b.

Figure 1b: The Dependency Diagram for Question 1b

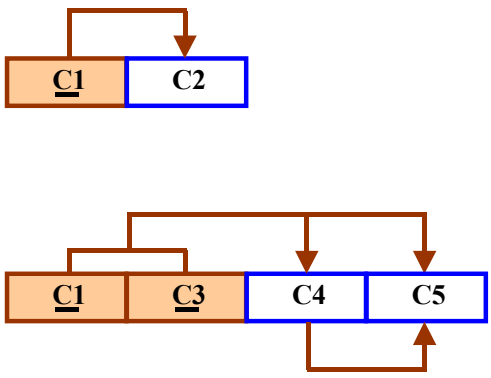


Table 1

Primary key: C1
Foreign key: None
Normal form: 3NF

Table 2

Primary key: C1 + C3
Foreign key: C1 (to Table 1)
Normal form: 2NF, because the table exhibits the transitive dependencies C4 → C5

Table 1

C1 → C2 now represents a functional dependency, because C2, depends on the primary key, C1.

Table 2

C1, C3 → C4, C5 represents a set of proper functional dependencies, because C4 and C5 depend on the primary key composed of C1 and C3.

C4 → C5 represents a *transitive dependency*, because C5 depends on an attribute (C4) that is not part of a primary key.

c. Create a database whose tables are at least in 3NF, identify all the dependencies that exist in the tables. Also show the dependency diagrams for each table. The normalisation results are shown in Figure 1c.

Figure 1c: The Dependency Diagram for Question 1c

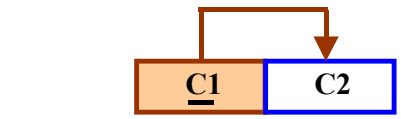


Table 1
Primary key: C1
Foreign key: None
Normal form: 3NF

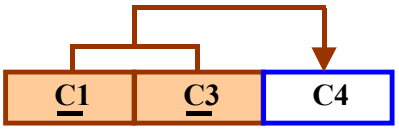


Table 2
Primary key: C1 + C3
Foreign key: C1 (to Table 1)
C4 (to Table 3)
Normal form: 3NF

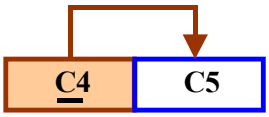


Table 3
Primary key: C4
Foreign key: None
Normal form: 3NF

Table 1

C1 → C2 represents a functional dependency, because C2, depends on the primary key, C1.

Table 2

C1, C3 → C4 represents a functional dependency, because C4 depends on the primary key composed of C1 and C3.

Table 3

C4 → C5 now represents a functional dependency, because C5 depends on the primary key, C4.

QUESTION 2:

a. Using the INVOICE table structure shown in Table 1, write the relational schema, draw its dependency diagram and identify all dependencies (including all partial and transitive dependencies).

   You can assume that the table does not contain repeating groups and that any invoice number may reference more than one product. You can assume that any given product is supplied by a single vendor but a vendor can supply many products. (*Hint*: This table uses a composite primary key.)

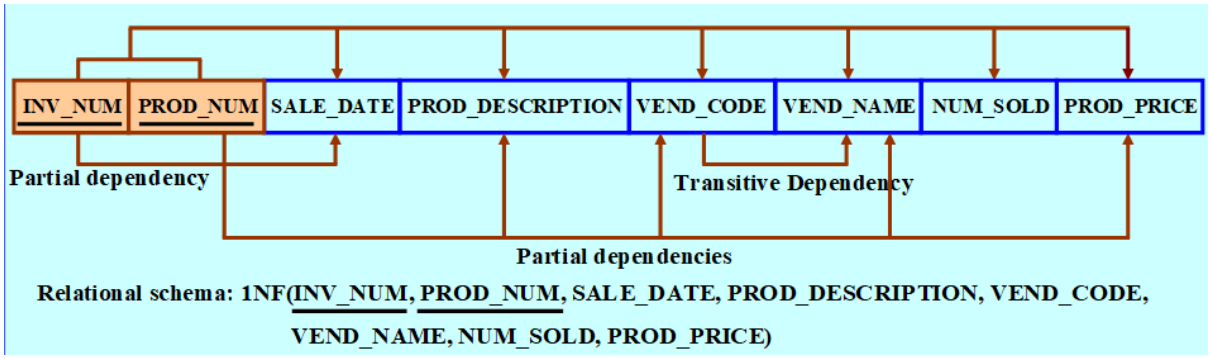
Table 1: Sample INVOICE Records

Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value	Sample Value
INV_NUM	211347	211347	211347	211348	211349
PROD_NUM	AA-E3422QW	QD-300932X	RU-995748G	AA-E3422QW	GH-778345P
SALE_DATE	15-Jan-2019	15-Jan-2019	15-Jan-2019	15-Jan-2019	16-Jan-2019
PROD_DESCRIPTION	Rotary sander	0.25-cm. drill bit	Band saw	Rotary sander	Power drill
VEND_CODE	211	211	309	211	157
VEND_NAME	NeverFail, Inc.	NeverFail, Inc.	BeGood, Inc.	NeverFail, Inc.	ToughGo, Inc.
NUM_SOLD	1	8	1	2	1
PROD_PRICE	€34.46	€2.73	€31.59	€34.46	€69.32

SOLUTION

The Solution is shown in Figure 2a

Figure 2a: Solution to Question 2a



INV_NUM, PROD_NUM → SALE_DATE, PROD_DESCRIPTION, VEND_CODE, VEND_NAME, NUM_SOLD, PROD_PRICE (Functional dependency)

INV_NUM → SALE_DATE (Partial Dependency)

PROD_NUM → PROD_DESCRIPTION, VEND_CODE, VEND_NAME, PROD_PRICE (Transitive Dependency)

b. Using the initial dependency diagram drawn in Question 2a, remove all partial dependencies, draw the new dependency diagrams, and identify the normal forms for each table structure you created. (*Hint*: Your actions should produce three dependency diagrams.)

Table 1:

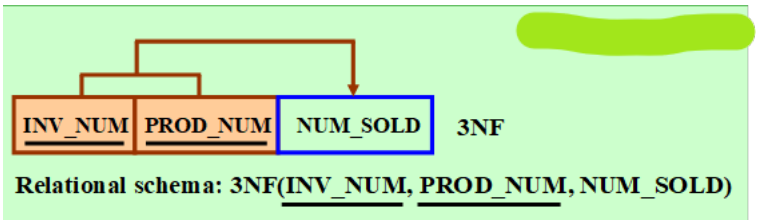


Table 2:

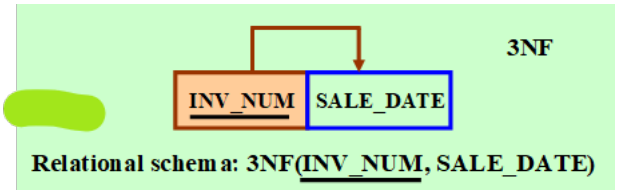
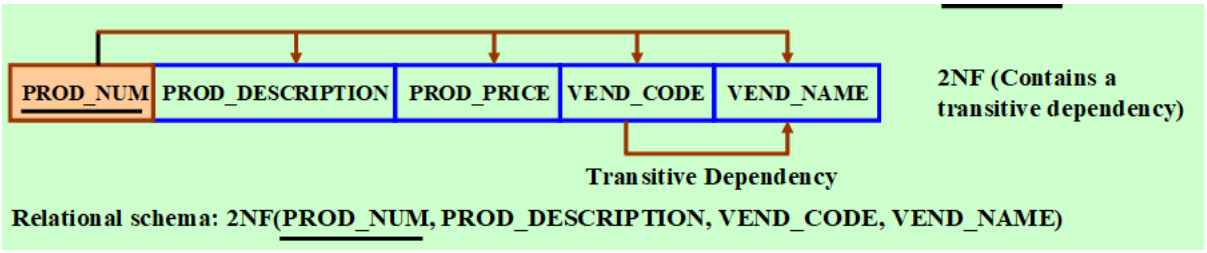
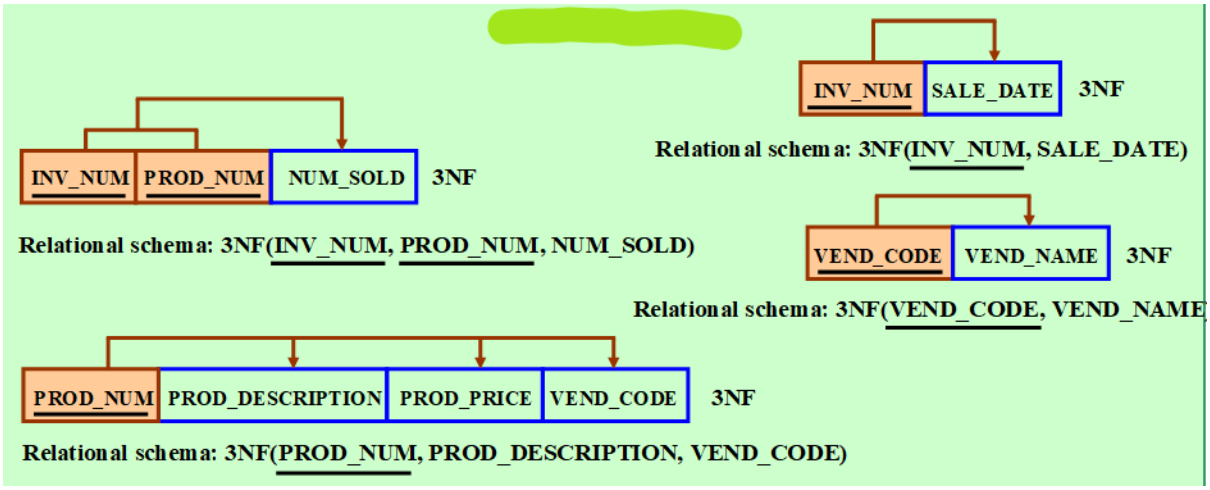


Table 3:



c. Using the table structures you created in 2b, remove all transitive dependencies, and draw the new dependency diagrams. Also identify the normal forms for each table structure you created.

SOLUTION: After removing all transitive dependencies, you'll now have 4 table structures. All the table structures are in 3NF because they do not contain any partial or transitive dependencies.



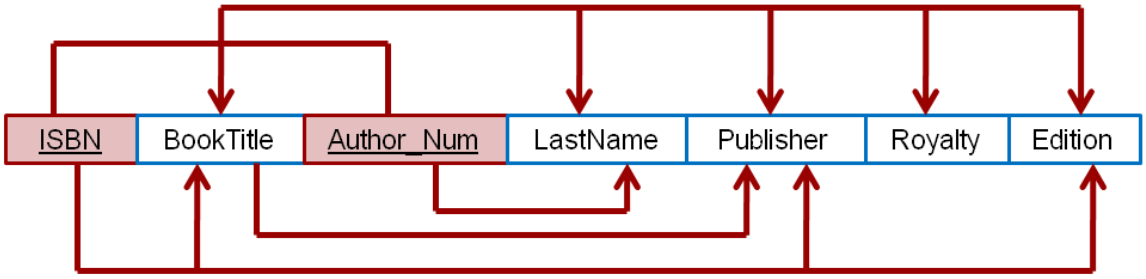
PART 2

ANSWER THE FOLLOWING QUESTIONS

QUESTION 1

The dependency diagram in Figure Q1 indicates that authors are paid royalties for each book that they write for a publisher. The amount of the royalty can vary by author, by book, and by edition of the book.

Figure Q1: Book royalty dependency diagram



a. Based on the dependency diagram, write out all the dependencies shown and specify the type of dependency it is.

b. Based on the dependency diagram, create a database whose tables are at least in 2NF, showing the dependency diagram for each table.

c. Create a database whose tables are at least in 3NF, showing the dependency diagram for each table.

QUESTION 2

a. Using the STUDENT table structure shown in Table Q2, write the relational schema, draw its dependency diagram, and identify all dependencies (including all transitive dependencies).

b. Using the initial dependency diagram drawn in Question 2a, normalise the structure to meet the 3NF requirements to the greatest extent possible. If you believe that practical considerations dictate using a 2NF structure, explain why your decision to retain 2NF is appropriate. If necessary, add or modify attributes to create appropriate determinants and to adhere to the naming conventions.

Table Q2: Sample STUDENT Records

Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value	Sample Value
STU_NUM	211343	200128	199876	198648	223456
STU_LNAME	Stephanos	Smith	Jones	Ortiz	McKulski
STU_MAJOR	Accounting	Accounting	Marketing	Marketing	Statistics
DEPT_CODE	ACCT	ACCT	MKTG	MKTG	MATH
DEPT_NAME	Accounting	Accounting	Marketing	Marketing	Mathematics
DEPT_PHONE	4356	4356	4378	4378	3420
COLLEGE_NAME	Business Admin	Business Admin	Business Admin	Business Admin	Arts & Sciences
ADVISOR_LNAME	Grastrand	Grastrand	Gentry	Tillery	Chen
ADVISOR_OFFICE	T201	T201	T228	T356	J331
ADVISOR_BLDG	Torre Building	Torre Building	Torre Building	Torre Building	Jones Building
ADVISOR_PHONE	2115	2115	2123	2159	3209
STU_GPA	3.87	2.78	2.31	3.45	3.58
STU_HOURS	75	45	117	113	87
STU_CLASS	UG1	UG2	UG3	UG3	UG1

SUBMISSION:

1. Answer these questions and submit your solution as a pdf document on Gradescope – Lab 6. Note that you can write neatly by hand and take a picture/scan. You can also use Microsoft word or any package of your choice.

2. Although this submission is required, this lab will be graded via the Quiz assessment for the Normalization unit. Therefore, when taking the Quiz for Unit 6, ensure you have your solutions for this lab with you.