INFS1200/7900 Module 4 Assignment

Due: 1 November 2021 @ 04:00 PM AEST

Weighting: 15%

	Full Name	Student ID
Group Member 1		
Group Member 2		

1. Overview

The purpose of this assignment is to test your ability to use and apply functional dependencies and normalisation in the database design process. You will gain experience in isolating problems with relational schema by determining the appropriate normal form and finding examples of potential anomalies in relation instances. Finally, you will generate an efficient database schema using both the BCNF and 3NF approach to normalisation.

This assignment can be completed either in groups of two or individually.

2. Submission

All submissions must be made through an electronic marking tool called Gradescope, which will also be used for providing feedback. You **must** record all your answers in the spaces provided in this document. Altering the format or layout of this document in any way will attract penalties**.**

All submissions must have the above boxes filled out in order to be identified. For students working in groups, submissions should be made by ONE team member only. Extra submissions will attract penalties.

3. Marking

The Module 4 assignment is worth **15 course marks** (of 60 course marks total for all four assignments).

4. Plagiarism

The University has strict policies regarding plagiarism. Penalties for engaging in unacceptable behaviour can range from cash fines or loss of grades in a course, through to expulsion from UQ. You are required to read and understand the policies on academic integrity and plagiarism in the course profile (Section 6.1).

If you have any questions regarding what is considered an acceptable level of collaboration with your peers, please see either the lecturer or your tutor for guidance. Remember that ignorance is not a defence!

5. Task

This assignment has been split into five sections which each examine a key topic covered in Module 4 of this course. Each section will have several questions with appropriate instructions to assist you in completing that question. You must complete **all** sections of this assignment and submit your answers using the boxes provided.

Section A – Anomalies & Functional Dependencies

Question 1

KFood is a restaurant in UQ which uses a database to store transactions related to customer purchases. A sample of a table from their database has been provided below. For simplicity, the attribute names have been simplified to single letters.

A	B	C	D	E	F
Grace	Chimeak	12.00	10/11/2021	1	1
Jack	Chimeak	12.00	12/11/2021	2	2
James	Tteokbokki	7.34	10/09/2021	3	4
Yeseul	Fried Chicken	18.60	18/09/2021	4	145
Grace	Chocolate Cake	25.65	10/11/2021	6	20
Xiaoming	Gimbap	10.12	18/09/2021	5	10

Based on the data above, provide a list of *all possible* <u>non-trivial</u> functional dependencies for this table. You do not need to justify your answers.

Note: For this question, non-trivial FD's with more than one attribute on the left-hand side should not be included. For example, the following two FD's should not be included:

$$\{Z\} \rightarrow \{Z\} \ 🚫 \qquad \{Z, Y\} \rightarrow \{Z\} \ 🚫$$

Additionally, all FD's with the same values on the left hand side must be simplified into one FD. For example:

$$\{Z\} \rightarrow \{X\}, \{Z\} \rightarrow \{W\} \ 🚫 \qquad\qquad \{Z\} \rightarrow \{X, W\} \ ✔$$

Question 2

BooksOnDemand has implemented a database system to record the books stocked in each store. The schema for their *Arrivals* table is provided below including a snapshot of some sample data.

ID	BookName	Author	StoreLocation	Quantity	Cost
70	Database Design	Hamish and Andy	Toowong	5	100
72	Poirot	Agatha Christie	Toowong	17	235
73	Poirot	Agatha Christie	St Lucia	17	235
74	Power Moves	Hamish and Andy	Inala	10	450
75	Database Design	Hamish and Andy	Inala	5	100
76	Power Moves	Hamish and Andy	Victoria Point	5	230

This table contains the following non-trivial functional dependencies:

{ID} → {BookName, Author, StoreLocation, Quantity, Cost}
{BookName} → {Author}
{BookName, Quantity} → {Cost}

Using the table above, you must provide a brief example and explanation of database operations that which would cause an insertion, modification and deletion anomaly. Your explanation should be brief and not exceed 50 words. An example of the format your answers should be written in can be seen on the next page.

Example format:

Insertion Anomaly:

Operation:

Explanation:

Modification Anomaly:

Operation:

Explanation:

Deletion Anomaly:

Operation:

Explanation:

SEE NEXT PAGE FOR SECTION B

Section B – Keys

For each of the questions in this section, you are required to list all possible candidate keys for the given schema based on the functional dependencies provided. You may wish to compute the closure of your key(s) to confirms they are valid. **Please list each key on a new line in ascending order.**

Question 1

R [A, B, C, D, E, F, G, H, I, J]

{D, E, F} → {A, B, C}

{E, F} → {D, C}

{D} → {G, H, I, J}

{J} → {E}

Candidate Key(s):

Question 2

R [A, B, C, D, E, F, G, H]

{A, B} → {E, F}

{E, F} → {A, B, D}

{D} → {G, H}

{G, H} → {B}

Candidate Key(s):

Question 3

R [A, B, C, D, E, F, G, H, I, J, K]

{A, B} → {G, J, K}

{E} → {D}

{H} → {F, I, J}

{D, C, F} → {B, E}
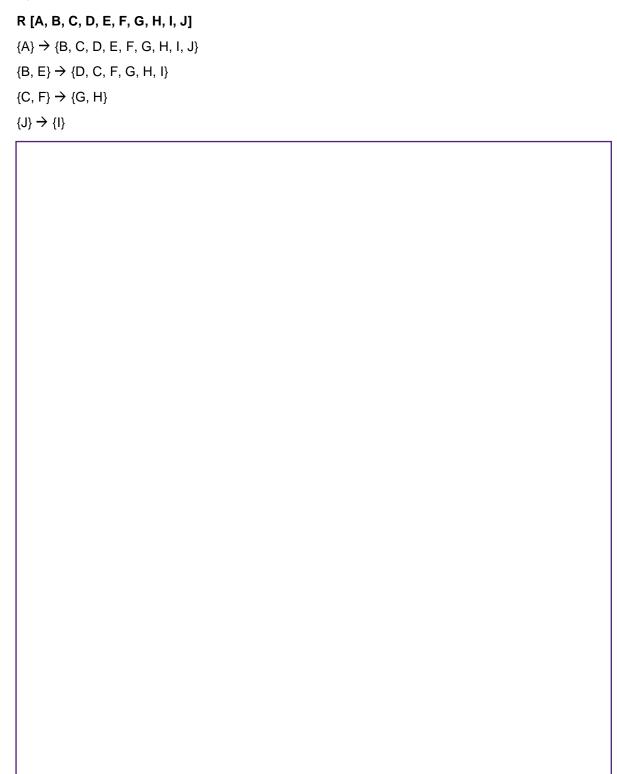
{K} → {C, A}

Candidate Key(s):

Section C – Highest Normal Form

For each question in this section, you are required to state and justify the highest normal form of the relation given a schema and functional dependencies. Your explanations should be brief and concise. *Hint*: It may be useful to identify the candidate keys for each relation.

Question 1

R [A, B, C, D, E]

{D, A} → {B, E, C}

{D} → {A}

Highest Normal Form:

Explanation:

Question 2

R [A, B, C, D, E, F, G, H]

{E, F} → {D, G, H}

{G, H} → {B}

Highest Normal Form:

Explanation:

Question 3

R [A, B, C, D, E, F, G, H, I]

{H, I, D} → {A, B, C, G, F, E}

{G} → {B, E}

{B} → {H, G}

{E} → {I, B}

Highest Normal Form:

Explanation:

Section D – BCNF Decomposition

For each question in this section, you are required to decompose the given relation into BCNF form and state any new relations created in the process with their functional dependencies and identify any functional dependencies which are fully lost during the decomposition. You must show your work using the **tree method** presented in tutorials. Consider the functional dependencies in the order presented in the question.

Question 1

R [A, B, C, D, E, F, G, H, I, J]

{A} → {B, C, D, E, F, G, H, I, J}

{B, E} → {D, C, F, G, H, I}

{C, F} → {G, H}

{J} → {I}

Question 2

R [A, B, C, D, E, F, G, H]

{A, D} → {E, F, G, H, B}

{B} → {A, D, G}

{G} → {H}

{H} → {G}

R [A, B, C, D, E, F, G, H]

{A, D} → {E, F, G, H, B}

Section E – 3NF Decomposition

Question 1

Based on the following relational schema and functional dependencies, find minimal cover for relation R with union.

R [A, B, C, D, E, F, G, H, I, J, K, L, M, N]

{A, B, C} → {D, E}

{D} → {A, B, C, G}

{N, M} → {G, H, I, J}

{C} → {K, G}

{L, A, D} → {F, M}

{H} → {M}

Question 2

The minimal cover has been provided below for a given relation with a set of functional dependencies. Using the minimal cover, normalise the relation to 3NF such that all functional dependencies and candidate keys are preserved. Your final answer must include any new relations created and their functional dependencies.

R [A, B, C, D, E, F, G, H]

{C} → {A, B, D, E}

{F} → {G, H}

{E} → {G}

Minimal Cover without Union: {

{C} → {A}, {C} → {B}, {C} → {D}, {C} → {E}, {F} → {G}, {F} → {H}, {E} → {G}

}

Question 3

Based on the following relational schema and functional dependencies, find minimal cover for relation R and then decompose R to 3NF such that all functional dependencies and candidate keys are preserved. Your final answer must include any new relations created and their functional dependencies.

R [A, B, C, D, E, F, G, H, I, J, K]

{K} → {J, I, H, G, F}

{F} → {A, B, C, D}

{B} → {A}

{I} → {J, K, G}

{F, B} → {K, D, E}

{B, C} → {A}