

ICT330
Database Management Systems

Tutor-Marked Assignment

July 2020 Semester Presentation

TUTOR-MARKED ASSIGNMENT (TMA)

This assignment is worth **18 %** of the final mark for **ICT330, Database Management Systems**.

The cut-off date for this assignment is **Sunday, 23 August 2020, 2355hrs**.

Note to Students:

You are to include the following particulars in your submission: Course Code, Title of the TMA, SUSS PI No., Your Name, and Submission Date.

Answer all questions. (Total 100 marks)

Question 1

Learning Objective:

Construct conceptual (ER diagram) and logical models from a statement requirement to solve common design problems

Deli-Very is a food delivery service provider. It employs part-time staff to perform its deliveries. The details of each delivery staff, that is, the staff id, a first and last name, and contact as well as the number of deliveries performed and the delivery details are tracked.

Customers can place their order from any one of the many food establishments registered with it. A registered food establishment has one or more outlets, and each outlet offers the same menu at the same prices. Deli-Very takes a cut from each food order. The cut ranges from 10% to 35%, depending on how long the food establishment has been with Deli-Very. The cut is not reflected on the food order, and is incurred by the food establishment.

Customers must register before placing orders. The required details for registration are a valid email and a telephone number. Upon a successful registration, the customer is assigned customer id. To make payments by card, customers can add a card details: number and type.

If payment for a food order is made by card, a payment code is recorded. If payment is by cash, a payment status reflects **complete** only when the delivery staff submits the cash collected for the food order to Deli-Very. Otherwise, the payment status reflects **Pending**.

An example of a delivery order is shown in Figure Q1. Note that a delivery order includes the following details:

- Food establishment name e.g., Cindy's Kitchen.
- The outlet at which the food order is placed.
- The food order reflects the outlet address and telephone number.
- The customer who places the order.
Only the customer name is reflected in the food order.
- Delivery address, that is, the location the food order is delivered to.
- One or more item ordered.
- The details of each item ordered include an item code, item name, unit price and the quantity ordered.
- Total for all items ordered.

- A promotion, if applicable, for a discount on the food item total.
From time to time, Deli-Very offers promotions for discount on the total. Each promotion has a promotion code, a fixed discount percent and a validity period.
- Delivery charge is distance dependent.
- Total incurred for the food items which includes discount, if applicable, and the delivery charge.
- Payment mode.
The payment mode is card if payment is already paid with a card, and cash if payment is by cash. Cash is collected by the delivery staff.
- The delivery staff details
Only the first name and staff id of the staff are shown on the food order.
- The expected delivery date and time.
- Deli-Very hotline for customer to feedback on the delivery service.

Cindy's Kitchen	
123 Lavender South Road S123456	
Tel: 6123-4567	
Customer: Tom Tan	
Deliver to: 456 Lavender North	
Items	
C120 Chicken Cutlet Set	\$15.90 x 2
V101 Ceasar Salad	\$ 9.90 x 1
Item Total	\$41.70
Discount	\$ 6.25
Promo code: 15OnUs	
Delivery charge	\$ 3.50
Total	\$38.95
By Cash	
Delivered by: Jack (sd123)	
Expected delivery: 1-Aug-2020 12.30 pm	
Deli-Very Hotline: 6222-1111	

Figure Q1

Construct a conceptual (ER) model from the statements of requirements to represent the data model for the Club Gourmet. In your ER model, provide the relevant:

- (a) Entities, with entities name, relevant attributes and identifier. (10 marks)
- (b) Relationships with maximum and minimum cardinalities and relationship name. (10 marks)

Question 2

Learning Objective:

Discuss table structures according to normalisation principles.

The Institute of Dental Health caters to both subsidised and unsubsidised patients, offering services such as scaling, extraction and braces. Subsidised patients get a discount on some of the offered services and disposables, and the discount is dependent on the age group that the patient belongs to.

The institute has a large team of dentists, and the designation of the dentist e.g., associate consultant, determines the consultation rate. On the institute's website, dentists are listed according to their designation.

At any one visit, a patient sees only one dentist. One or more services may be performed, and the cost of service and/or disposables incurred is the prevailing cost minus a discount, if the patient is subsidised and the service and/or disposables is a discountable item. Each cost incurred is reflected on the patient's bill. A payment status records whether the bill has been paid. You are given the Visit table.

Visit(patientId, patientName, dateOfBirth, isSubsidised, dentistId, dentistName, designation, consultationRate, visitDate, itemCode, cost, isDiscountable, itemCostIncurred, paymentStatus)

- (a) Formulate and list the functional and multi-valued dependencies. (8 marks)
- (b) Draw a dependency graph and propose candidate key(s) for the table. (3 marks)
- (c) Normalise the table to BCNF and 4NF by applying **the BCNF approach**. Show how you apply the steps to arrive at the tables and at each iteration, explain whether each derived table is already in BCNF and 4NF (if applicable). Indicate also whether each MVD is subsumed. (8 marks)
- (d) Assemble your 4NF tables and constraints clearly.
Give each table in this form:
TABLE-NAME(col-name₁, col-name₂, ..., col-name_n)
- indicate (PK) against the primary key and
 - indicate (FK) against the foreign keys, if any.

State the referential integrity constraint(s), if any, **together with the correct table** in this form:

TABLE-NAME_x.col-name_{x1} ...col-name_{xn} must exist in
TABLE-NAME_y.col-name_{y1}...col-name_{yn}

(6 marks)

Question 3

Learning Objectives:

Apply database processing concepts to solve the information requirements of organisations.

Formulate SQL statements to implement and query database systems

Implement business rules via views, stored procedures and triggers

Refer to Figure Q3 for the database tables for the election year 2020 in country X. The tables contain sample data for four of the thirty contested divisions.

Party				Division					Candidate					
abbreviation	name	yearFormed		divisionId	seat	voters	rejected		id	name	dateOfBirth	candidacyId	party	
1	JPP	Justice Progress Party	1957	1	A1	2	81232	549	1	A111111A	Mohamed Faisal	1990-01-01...	1	OPP
2	OPP	One People Party	1954	2	A2	1	31294	491	2	A1111112A	Chia Hon Huat	1999-07-16...	1	OPP
3	TWP	Together We Party	2020	3	B1	1	29192	325	3	A1111113A	Nurul Ahmad	1955-02-06...	2	TWP
				4	C1	3	129821	738	4	A1111114A	Tan Chin Siong	1960-03-12...	2	TWP
candidacyId	divisionId	voteObtained	sampleVotesPer100											
1	1	52551	65						5	A222221A	Peter Thiagu	1970-04-17...	3	OPP
2	2	27112	35						6	A222222A	Ravi Pillay	1973-05-19...	4	JPP
3	3	12541	40						7	B111111B	Goh Hong Hui	1965-08-09...	5	OPP
4	4	18252	60						8	B1111112B	Koh Li Choo	1969-09-23...	6	JPP
5	5	14002	49						9	B1111113B	Ng Tiong Keng	1958-10-30...	7	TWP
6	6	4324	14						10	C111111C	Mohamed Azhar	1984-11-01...	8	OPP
7	7	9324	37						11	C1111112C	Loganathan	1997-07-07...	8	OPP
8	8	59482	45						12	C1111113C	Kelvin Ong	1995-04-17...	8	OPP
9	9	69518	55						13	C1111114C	Vigneswari Menon	1992-03-26...	9	JPP
									14	C1111115C	Lee Wei Zhong	1994-02-04...	9	JPP
									15	C1111117C	Abirami Raj	1991-01-19...	9	JPP

Figure Q3

Party, all columns required	
abbreviation	A value that is exactly 3 characters long
name	A value that is at most 25 characters long
yearFormed	A value between 1954 and the year based on today's date.
Division, all columns required	
divisionId	A value that is exactly 2 characters long. It starts with a letter followed by a digit.
seat	A value between 1 and 6
voters	A value that is at least 10000. The count of eligible voters in the division.
rejected	A non-negative value. The count of rejected votes in the division.
Candidacy, all columns required	
candidacyId	An auto-generated value starting with 1 and an increment of 1
divisionId	The division of the candidacy.
votesObtained	A non-negative value.
sampleVotesPer100	A non-negative value.
Candidate, only party is not required	
id	A value that is exactly 9 characters long It starts and ends with a letter with digits in between,
name	A value that is at most 30 characters long
dateOfBirth	All candidates must be at least 21 years old at time of application.
party	The party of the candidate. Null if candidate is running independently.
Foreign key constraints	
Minimum cardinality between Party and Candidate is 1:N, M:O with delete set null and update	

cascaded.
Minimum cardinality between Candidacy and Candidate is 1:N, M:M with delete disallowed and update cascaded.
Minimum cardinality between Division and Candidacy is 1:N, M:M with delete and update cascaded.

Table Q3

- (a)
- Derive and construct both the ERD and the logical model from the tables in Figure Q3 and their description in Table Q3. (4 marks)
 - Implement a function, `getAge` which when given two dates – a birthdate and a date, computes and returns the age of a person on that date. The function must consider whether the birthday has passed. (2 marks)
 - Refer to the description of tables in Table Q3, and implement the tables using the appropriate SQL statements. Your SQL statement may assume that the function in part ii) is available. List the SQL statements in the order that they should be executed. (4 marks)
 - Formulate SQL statements to populate the tables with the sample data shown in Figure Q3. List the SQL statements in the order that they should be executed. (2 marks)

(b) Write SQL statements for each task:

- Display the details of all candidates in descending order of age and in alphabetical order of party. Assume the ages of candidates are computed using 18 July 2020 as today's date. You can also assume that the function in part Q3(a)(ii) is available for use in this query.

	id	name	dateOfBirth	candidacyID	party	age
1	A1111113A	Nurul Ahmad	1955-02-06 ...	2	TWP	65
2	B1111113B	Ng Tiong Keng	1958-10-30 ...	7	TWP	61
3	A1111114A	Tan Chin Siong	1960-03-12 ...	2	TWP	60
4	B1111111B	Goh Hong Hui	1965-08-09 ...	5	OPP	54
5	B1111112B	Koh Li Choo	1969-09-23 ...	6	JPP	50
6	A2222221A	Peter Thiagu	1970-04-17 ...	3	OPP	50
7	A2222222A	Ravi Pillay	1973-05-19 ...	4	JPP	47
8	C1111111C	Mohamed Azhar	1984-11-01 ...	8	OPP	35
9	A1111111A	Mohamed Faisal	1990-01-01 ...	1	OPP	30
10	C1111117C	Abirami Raj	1991-01-19 ...	9	JPP	29
11	C1111114C	Vigneswari Menon	1992-03-26 ...	9	JPP	28
12	C1111115C	Lee Wei Zhong	1994-02-04 ...	9	JPP	26
13	C1111113C	Kelvin Ong	1995-04-17 ...	8	OPP	25
14	C1111112C	Loganathan	1997-07-07 ...	8	OPP	23
15	A1111112A	Chia Hon Huat	1999-07-16 ...	1	OPP	21

(2 marks)

- List the details of divisions which candidates under the age of 25 contested in. Use subquery without any join.

	divisionId	seat	voters	rejected
1	A1	2	81232	549
2	C1	3	129821	738

(3 marks)

- (iii) Create a view, winners, to contain the winning parties for each division and the number of seats in each division.

	divisionId	seat	party
1	A1	2	OPP
2	A2	1	JPP
3	B1	1	OPP
4	C1	3	JPP

(6 marks)

- (iv) Display the total number of seats won by each party in ascending order of seats won for parties with 3 seats or fewer. You may use the view defined in Q3(iii),

	abbreviation	name	Total seats won
1	TWP	Together We Party	0
2	OPP	One People Party	3

(4 marks)

- (c)
- (i) Write a trigger called `checkSeatsLimit` that ensures that the number of candidates in a candidacy cannot exceed the number of seat in a division the candidacy is for. Assume that the operation(s) that causes this trigger to execute involves only one row in the table that the trigger is defined on.
- (ii) Write **ONE (1)** or more SQL statements to test your trigger.

(8 marks)

Question 4

Learning Objectives:

Explain and apply concurrency controls, security and recovery measures.

Demonstrate the basic techniques of concurrency control and ACID

- (a) Refer to Figure Q4 (a) for the partial steps for “Make Dental Appointment”.

- | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. Get a dentist 2. Get a free appointment slot 3. Update appointment slot with patient id |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|

Figure Q4 (a)

Suppose several concurrent processes are performing “Make Dental Appointment”. Consider various circumstances and discuss whether the following event can happen:

- Lost update
- Deadlock

Apply an appropriate example/scenario including the interleaving steps if an event can arise or provide a reason if it is not possible for an event to happen.

(8 marks)

- (b) Discuss and describe **TWO (2)** ways how database administrator can secure the personal data in a dental appointment database. (2 marks)
- (c) Given the scenarios described by the transaction log in Figure Q4(c), explain what the database recovery procedure will do for transactions T1 to T4.

Record Pointer	Transaction ID	Reverse Pointer	Forward Pointer	Time	Type of Operation	Table	Row ID	Before Image	After Image
1	T1	0	2	12:01:32	Start				
2	T1	1	6	12:01:36	Insert	Dentist	S12		S12, ...
3	T2	0	4	12:01:55	Start				
4	T2	3	5	12:02:01	Update	Appointment	25	25, null, ...	25, p02, ...
5	T2	4	0	12:02:24	Insert	Reminder	132		132, p02, ...
6	T1	2	0	12:03:41	Commit				
7	T3	0	8	12:04:23	Start				
8	T3	7	11	12:05:00	Update	Appointment	18	18, p15, ...	18, null, ...
Checkpoint									
9	T4	0	10	12:35:33	Start				
10	T4	9	12	12:35:36	delete	Appointment	19	19, null, ...	
11	T3	8	0		Rollback				
12	T4	10	0	12:35:33	Commit				
Crash!									

Figure Q4 (c)

(10 marks)

---- END OF ASSIGNMENT ----