



## INFS1200/INFS7900 INTRODUCTION TO INFORMATION SYSTEMS SEMESTER 2, 2009

### Sample MSE (Middle Semester Exam) (7 Questions for 20%)

Please bring you Student ID & writing implements  
(Close book exam)

Scheduled Date of MSE: Monday 21/09/09  
Location: 08-139 (Lecture theatre)  
Perusal Time: 10:00 – 10:10am  
Work Time: 10:10 – 11:40pm

### Question 1 (DFD)

The context and level 0 Data Flow Diagrams are given for the specification below.

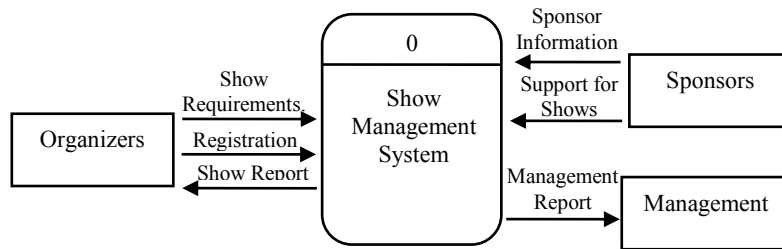


Figure 1. Context Diagram

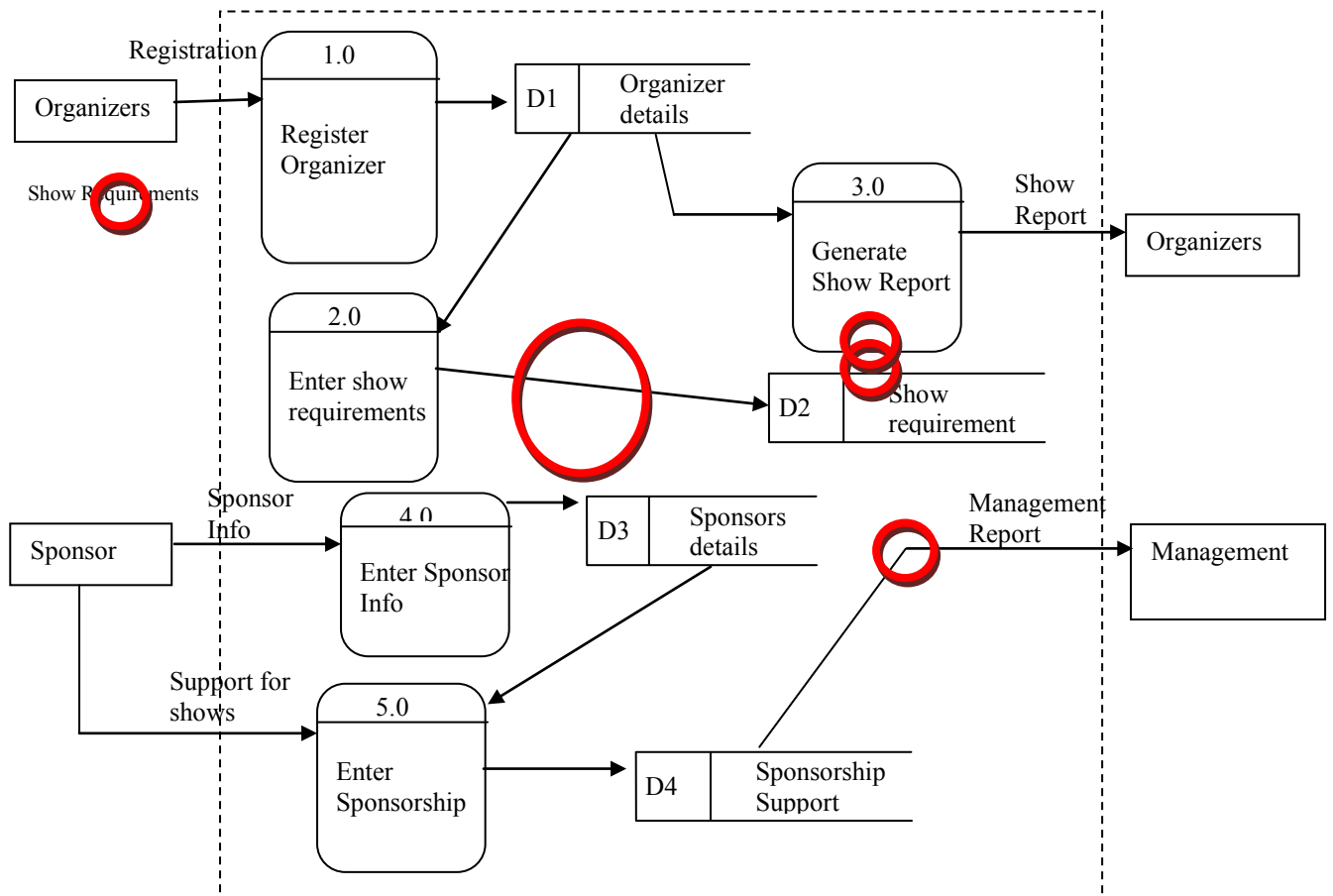


Figure 2. Level 0 Data Flow Diagram

**Universe of Discourse:**

In order to register, organizers must provide their organization name, address, telephone(s), fax, email and web address, name of a contact person, and his/her telephone.

One organizer may organize multiple shows. Each show is described by a unique catchy name, its start and end dates, target audience (in terms of age group), preferred area (Brisbane suburb), and number of expected attendees.

Most shows also have one or more sponsors. The system must have the ability to record general data about sponsors such as their name, address, telephone(s), fax, email and web address, name of a contact person, and his/her telephone. Some of the more prominent sponsoring bodies support several shows. It is important to record the value of sponsorship for each sponsor against each show that it supports.

The system must produce a show reports based on show information for organizers. Furthermore, the management is to be provided with a financial report of sponsorships

The context diagram is correct, but the level 0 diagram has several errors. Circle and number those errors on the diagram, and then explain what the errors are in the space below.

**Q1 Answer:**

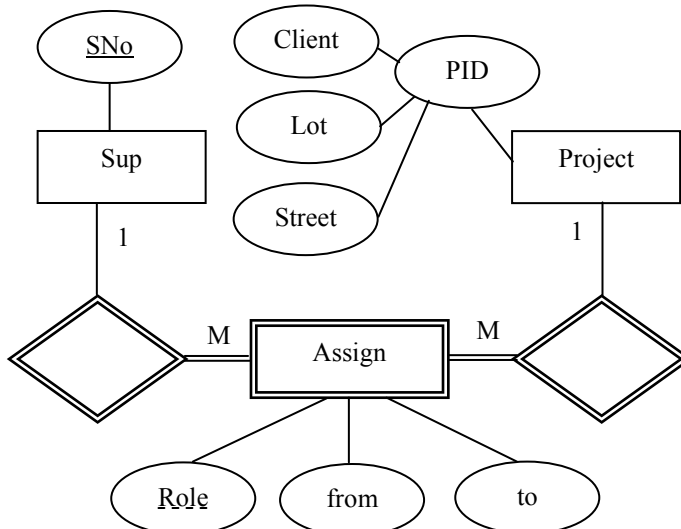
1. DFD is not balanced. Input from Organizers on “Show Requirement” is not shown in level 0, but shown in context
2. DFD rule violation. No data store can have only input data flows and no output data flows. D2 does not have output data flows
3. UoD requirement not mapped correctly. Show requirements is data which will be needed to perform processes 3.0 and 5.0
4. DFD rule violation. No data flow can go directly from a data store to an external entity. A process must be included between the two
5. DFD rule violation. Data Flows not labelled.

**Question 2 (ER)**

Assume that the specification below has been obtained from a user of an information system. You are to construct a conceptual model of the database using the Entity Relationship Model. You can assume that the specification below is complete and contains all of the information that is needed to construct the model. Do not include any additional concepts of your own, over and above what is given in the specification. You may use either variant of the ER diagram notation, however, do not mix the notations as it leads to ambiguity which may be penalized.

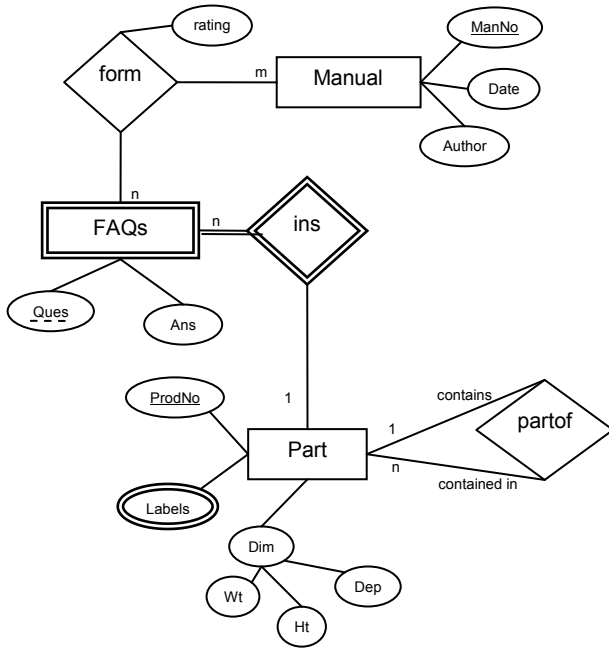
The database is about housing projects managed by a building company. The company employs many supervisors and manages many projects. A supervisor is identified by a supervisor number. Every project is identified by the client last name, lot number, and street. A building supervisor can be assigned to several projects. Projects will have several supervisors during various phases of building. A supervisor can be assigned to the same project under different roles (e.g. slab-supervisor, frame-supervisor etc. ). The from and to date is recorded for each role given to a supervisor in any project.

**Q2 Answer:**



### Question 3 (ER to Relational Mapping)

Map the following ER schema into a relational database schema and specify all primary keys and foreign keys. Use the following notation: Attribute(s) that form the primary key should be underlined (do not underline other candidate keys). Do not show the schema in progress after each step. Only give the final relational database schema.



#### Q3 Answer:

Manual [ManNo, Date, Author]  
 Part [ProdNo, Wt, Ht, Dep, ProdNoPartof]  
 Faqs [ProdNo, Ques, Ans]  
 Form [ProdNo, Ques, ManNo, Rating]  
 Label [ProdNo, Labels]

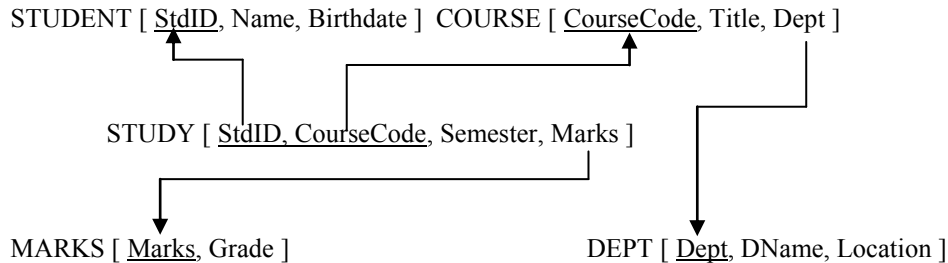
#### Foreign Keys:

Part [ProdNoPartof] references Part [ProdNo]  
 Faqs [ProdNo] references Part [ProdNo]  
 Form [ProdNo, Ques] references Faqs [ProdNo, Ques]  
 Form [ManNo] references Manual [ManNo]  
 Label [ProdNo] references Part [ProdNo]

### Question 4. Relational Schema and Constraints

The schema and instances for a relational database are given below. The primary keys are underlined, and referential integrity constraints are represented by directed arcs from each foreign key to the primary key of the relation it references.

The domain of attribute “BirthDate” consists of valid dates in the format “DD/MM/YYYY”. (DD for Day, MM for Month and YYYY for year e.g. 27/01/1975). The domain of attribute “Grade” consists of integers between 2 and 7.



STUDENT

<u>StdID</u>	Name	Birthdate
303428	John	3/02/1975
303099	Susan	14/09/1964
803427	Cholena	26/11/1980

COURSE

<u>CourseCode</u>	Title	Dept
INFS1200	Intro to Inf Sys	CSEE
INFS7900	Intro to Inf Sys	InfEnv

STUDY

<u>StdID</u>	<u>CourseCode</u>	Semester	Marks
303428	INFS1200	1	68
303099	INFS7900	2	83
803427	INFS1200	2	74

DEPT

<u>Dept</u>	DName	Location
CSEE	Computer Science and Electrical Engineering	St Lucia
InfEnv	Information Environments	Ipswich
Econ	Economics	St Lucia

MARKS

<u>Marks</u>	Grade
81	6
68	4
83	7
74	5

Assume that the following operations are done on the *initial* instances as shown above. Operations from one part of the question do not affect those appearing in other parts of the question.

**Q4 Answers:**

a) Insert the tuple <39908765, Sarah, 19/01/1971> into relation "STUDENT".

Does this operation violate an integrity constraint? Write either "yes" or "no": No

If yes, state the type of constraint violated: \_\_\_\_\_

and briefly describe how the constraint was violated: \_\_\_\_\_

b) Insert the tuple <"ECO7800", "Macro Economics", "Econ"> into relation "COURSE".

Does this operation violate an integrity constraint? Write either "yes" or "no": NO

If yes, state the type of constraint violated: \_\_\_\_\_

and briefly describe how the constraint was violated: \_\_\_\_\_

c) Insert the tuple <5, "1"> into relation "MARKS".

Does this operation violate an integrity constraint? Write either "yes" or "no": YES

If yes, state the type of constraint violated: Domain Constraint

and briefly describe how the constraint was violated: Domain for Grade is integers between 2 and 7

d) Insert the tuple <303428, null, 89, 7> into relation "STUDY".

Does this operation violate an integrity constraint? Write either "yes" or "no": Yes

If yes, state the type of constraint violated: Entity Integrity

and briefly describe how the constraint was violated: Value of CourseCode cannot be null as it is part of the key of this relation

e) Delete the tuple <"INFS1200," "Intro to Inf Sys", "CSEE"> from "COURSE"

Does this operation violate an integrity constraint? Write either "yes" or "no": Yes

If yes, state the type(s) of constraint(s) violated: Referential Integrity

and briefly describe how the constraint was violated: This tuple is currently referenced in the STUDY relation

### Question 5 RDB Concepts

5-1. Tick all correct answers

The relational model requires that no two tuples can have the same combination of values for all their attributes. This constraint is called:

- a. Domain Constraint
- b. Referential Integrity Constraint
- c. Key Constraint
- d. Entity Integrity Constraint

EMPLOYEE [SSN, Name, Salary, Bdate, Address] is:

- a. A relation schema
- b. A database state
- c. A data definition statement
- d. An instance of a relational database
- e. None of the above

Redundant values in tuples can cause

- a. Wastage of storage space
- b. Inefficient queries
- c. Inconsistent data
- d. Loss of information
- e. All of the above

In a relation R [A, B, C, D], A and {BD} are the candidate keys

- a. A can be a primary key
- b. C is a prime attribute
- c. B is unique in every tuple of R
- d. D can be a foreign key

5-2. The schema and instance of the database represent two distinct concepts. Associate each with the relevant characteristics in the table below.

Characteristics	Circle Schema OR Instance here	
Data in the database	Schema	<input checked="" type="radio"/> Instance
Specified during database design	<input checked="" type="radio"/> Schema	Instance
Time variant i.e. changes with time	Schema	<input checked="" type="radio"/> Instance
Defined in the DBMS system catalog	<input checked="" type="radio"/> Schema	Instance
Created through data update operations	Schema	<input checked="" type="radio"/> Instance
Does not change frequently	<input checked="" type="radio"/> Schema	Instance

Answer: See above.

## Question 6. Functional Dependency Algorithms

6-1. Given FD sets F and G, what does it mean if  $F^+$  equals  $G^+$ ?

**Q6-1A:** It means all FDs (functional dependencies) in F are derivable from FDs in G, and vice versa. The  $F^+$  is the closure of F, means all derivable FDs of F are included in the  $F^+$ .

6-2. Given FDs  $F = \{WA \rightarrow B, AX \rightarrow B, W \rightarrow X, Y \rightarrow A\}$ , which FD of this set is redundant?

**Q6-2A:**  $WA \rightarrow B$  is redundant since  $W \rightarrow X$  (given) and  $AX \rightarrow B$  (Given) so  $WA \rightarrow B$  (pseudo transitivity).

6-3. Given FDs  $F = \{XW \rightarrow Y, YZ \rightarrow A, AW \rightarrow Y, Y \rightarrow Z\}$ , what attributes are functionally dependent upon attribute W?

**Q6-2A:** {W}

6-4. For relation  $R = (ABXYZ)$  and FD  $F = \{A \rightarrow B, X \rightarrow Y\}$ , find the candidate key for R

**Q6-4A:** {AXZ}

6-5. Given the following relation  $R = XYZ$ .

X	Y	Z
x1	y1	z1
x2	y1	z2
x3	y2	z1
x4	y3	z2
x5	y4	z3

Which of the following is correct?

- A. There is no FDs amongst X, Y and Z.
- B. FDs can be found from this table are  $X \rightarrow Y, X \rightarrow Z, XY \rightarrow Z, XZ \rightarrow Y, YZ \rightarrow X$ .
- C. FDs can be found from this table are  $Y \rightarrow X, Z \rightarrow X, XY \rightarrow Z, XZ \rightarrow Y, YZ \rightarrow X$ .
- D. Both B & C.

**Q6-5A:** B

## Question 7. Normalization Algorithms

- 7-1. Given  $F$  as a set of FDs and a relation  $R$ , if  $R$  is decomposed into a number of relations with their primary and foreign keys defined, what is the lossless join?
- A. Attributes of any FD in  $F$  must either appear directly on one of the relational tables in the decomposition of  $R$  or can be inferred from the dependencies that appear in some relational tables decomposed from  $R$ .
  - B.** If the  $R$  can always be joined back based on the foreign key linkages of the decomposed relations.
  - C. Some FDs in  $F$  are lost due to the join of the relations that form  $R$ .

ANSWER: B.

- 7-2. Consider the relationships between 3NF and BCNF:
- A. The BCNF is defined based on the 3NF with one more restriction that non-key attributes cannot determine any key attribute.
  - B. A 3NF relational table is already in BCNF.
  - C. A BCNF relational table is already in 3NF.
  - D. A & C are both true.

ANSWER: C. (A is wrong because BCNF is not defined based on 3NF.)

- 7-3. If every determinant of FDs of a relation  $R$  is a super key of  $R$ , It is at:

ANSWER: BCNF

- 7-4. Given  $R=(TAXYZ)$ , FD  $F=\{TZ \rightarrow X, T \rightarrow A, TX \rightarrow YZ\}$ , what the highest level of normal form is this relation at?

ANSWER: R is at 1NF.

- (1) The candidate keys are  $TZ, TX$  since  $(TZ)^+ = R$  and  $(TX)^+ = R$ .
- (2) However, there is a partial dependency between non-key attribute  $A$  and the candidate key  $TZ$  and  $TX$ , such that  $A$  is partially dependent on the candidate key  $TX$  and  $TZ$  because  $T \rightarrow A$ .
- (3) So,  $R_1 = (TXYZ), R_2 = (TA)$

- 7-5. Given  $R=ABCDE$ , FD  $F=\{ED \rightarrow C, EC \rightarrow BA, E \rightarrow D\}$ , what the highest level of normal form is this relation at?

ANSWER: R is in BCNF

- (1) The candidate key  $E$ , since  $(E)^+ = R$ .
- (2) The FDs of  $F$  can be converted into  $F' = \{E \rightarrow ABCD\}$

**Proof:**

- $E \rightarrow D$  (Given), and  $E \rightarrow ED$  (Adding  $E$  to the both side),  $ED \rightarrow C$  (Given), then  $E \rightarrow C$  (Transitivity).

**Similarly:**

- $E \rightarrow C$  (just derived above),  $E \rightarrow EC$  (Adding  $E$  to the both side),  $EC \rightarrow BA$  (Given), then  $E \rightarrow BA$ . (Transitivity).

Since  $E \rightarrow BA$  (derived),  $E \rightarrow C$  (derived),  $E \rightarrow D$  (Given), then  $E \rightarrow ABCD$  (merge the righthand side).

- 7-6. Given  $R=ABC$ , FD  $F=\{B \rightarrow C, A \rightarrow C, A \rightarrow B\}$ , does which one of the following decompositions preserve FDs?
- A.  $AB, AC$
  - B.  $AB, BC$
  - C.  $AC, BC$
  - D. None of above

ANSWER: B. because  $A \rightarrow C$  is derivable.