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The Open University of Sri Lanka

B. Sc. Degree Programme – Level 05

Department of Mathematics and Computer Science

Final Examination - 2009/2010

CSU3278: Database Management Systems – Paper I

Duration: Two and half hours

Date: 16.05.2010 Time: 9.30 am - 12.00 noon

Answer FOUR Questions ONLY.

1.

i. "*Development of a database is a process*". Comment on this statement.

ii. Briefly describe the types of database systems according to the number of users, the database site location(s) and the expected type and extent of use.

iii. State three different *users* in a database system and briefly describe their role.

iv. State *four* functions of a database system.

2.

i. Why do you think the design of a database system is important?

ii. State four drawbacks of conventional file systems.

iii. Clearly explain how a computerized file system could overcome the drawbacks stated in part ii).

iv. What do you mean by Structural and data dependence in the context of file systems?

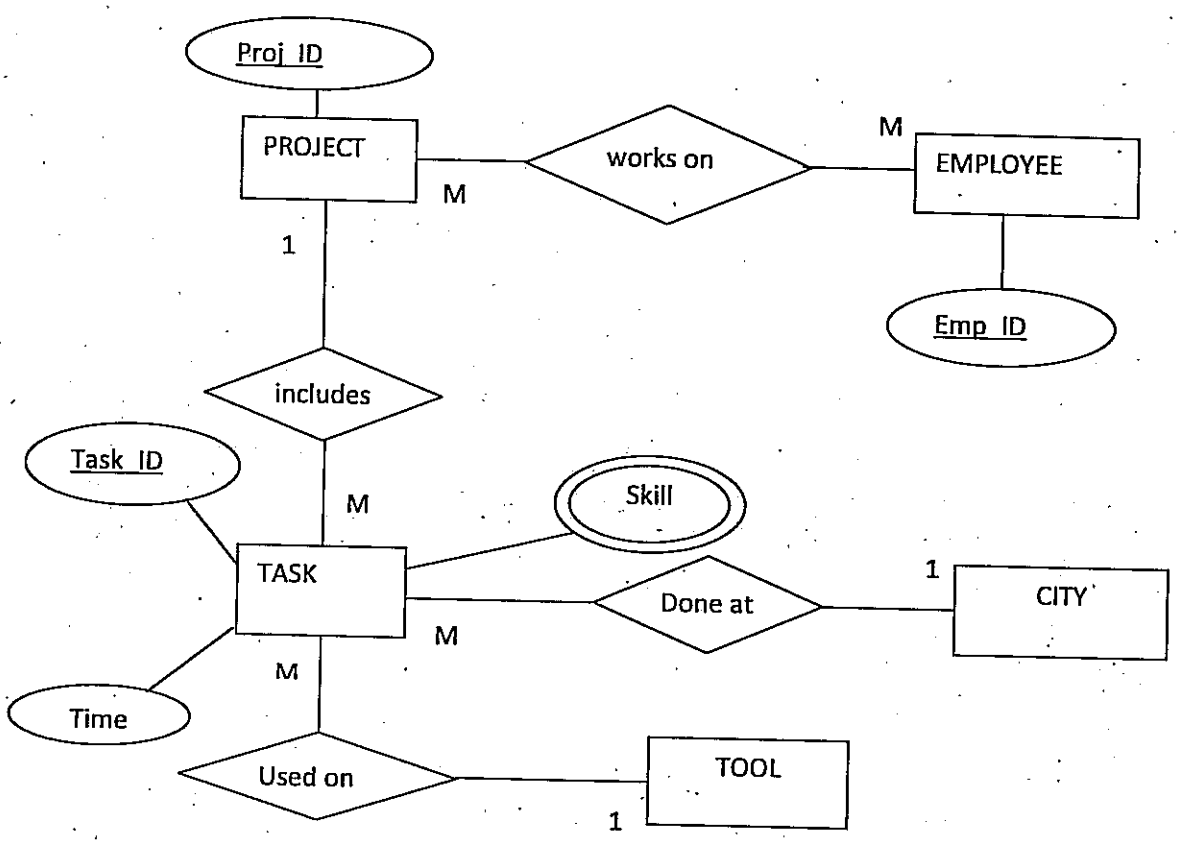
3.

i.

a. What do you mean by a data model?

b. Briefly describe the characteristics of the *relational data model.*

ii.



How would you modify the above diagram to account for the following facts? Draw a new diagram (or partial diagrams) that show the modifications you would make.

a. There are two kinds of tasks – physical ones and intellectual ones. Tools are used on physical tasks (although not all physical tasks require their use), but never on intellectual ones. Additionally, employees may be assigned to various tasks, of either or both types. The date on which an employee is scheduled to begin work on a task to which he has been assigned needs to be stored, and a task may have one or more employees assigned to it.

b. Projects may be broken into *phases*, which are identified by numbers (e.g. Project A may have Phases 1, 2 and 3; Project B might have no phases; Project C might have Phases 1, 2, 3 and 4; and so on). Each phase has a scheduled start date and length (in weeks) and an estimated cost (in thousands of dollars).

4.

Draw the ER diagram for the following scenario:

An engineering company would like to store information about its departments, projects and staff. There are many departments where administrative and technical staff work. The technical staff only can be allocated to projects and those projects are always organized into phases. Phases can have other phases as pre-requisites and can also be pre-requisites for other phases. The information about the staff's dependents should also be stored, and only a single staff is associated to a dependent.

The technical staff can work in more than one project; however the non-researchers, who are all technical staff, can participate in only a single project at a time. It is important to record the date when a technical staff starts to work on a project and what is his/her role in that project (roles can differ from project to project).

The information to be stored about departments is: department-id, name and location. About staff, it is important to know: id, name, address, telephone-numbers, date-of-birth. For projects, project-id, start-date, aims, its phases. For researchers, their list of publications and qualifications and for technical staff, their qualifications. About phases it is important to store phase-number and objective. For dependents, it is their names.

5.

i. What is the minimal normal form that a relation must satisfy? Provide a definition for this normal form.

ii. Describe the characteristics of a table that violates the first normal form (1NF) and then describe how such a table is converted to 1NF.

iii. Describe the characteristics of a table in the second normal form (2NF).

iv. Examine the table shown below and answer the questions.

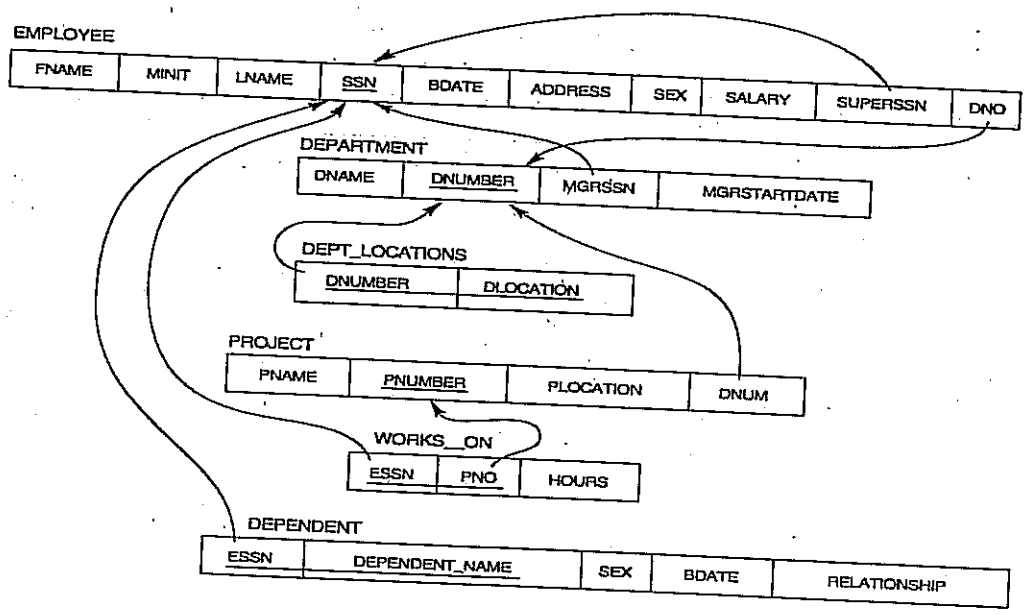
branchNo	*branchAddress*	*telNos*
B001	8 Jefferson Way, Portland, OR 97201	503-555-3618, 503-555-2727, 503-555-6534
B002	City Center Plaza, Seattle, WA 98122	206-555-6756, 206-555-8836
B003	14 – 8th Avenue, New York, NY 10012	212-371-3000
B004	16 – 14th Avenue, Seattle, WA 98128	206-555-3131, 206-555-4112

a. Why is this table not in 1NF?

b. Describe and illustrate the process of normalizing the data shown in this table to third normal form (3NF).

c. Identify the primary, secondary and foreign keys in your 3NF relations.

6. Write MySql commands to achieve the following tasks.



i. Retrieve the names of employees in department number 5 who work more than 10 hours per week on the 'ProductX' project.

ii. For each project, list the project name and the total hours per week (by all employees) spent on that project.

iii. Retrieve the names of employees who do not work on any project.

iv. Find the names and addresses of employees who work on at least one project located in Houston but whose department has no location in Houston.

v. List the last names of department managers who have no dependents.

vi. Find the details of those employees whose salary is between $ 1000 and $2000.

vii. Find the details of those employees whose salary is higher than the average salary of all employees.

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CSU3278: Database Management Systems – Paper II

Duration: Two and half hours

Date: 16.05.2010 Time: 1.00 pm – 3.30 pm

Answer FOUR Questions ONLY.

1.

i. State whether the following statements are true or false with proper justifications.

a. *The relationship between a supertype and a subtype is one-to-many.*

b. *A subtype is a subset of a supertype.*

c. *A primary key constraint must reference one or more columns in a single table.*

d. *Tables may be joined using any column in either table.*

e. *User views are important because they provide physical data independence.*

ii. Explain the distinctions among the terms *primary key, candidate key*, and *superkey.*

iii. We can convert any weak entity set to a strong entity set by simply adding appropriate attributes. Then, why do we have weak entity sets?

iv. What is the difference between controlled redundancy and uncontrolled redundancy? Illustrate with an example.

2.

Read the following case study which describes the data requirements for the EasyDrive School of Motoring.

The EasyDrive School of Motoring was established in Colombo in 1992. Since then, the School has grown steadily and now has several offices in most of the main cities of Sri Lanka. Each office has a Manager (who tends also to be a Senior Instructor), several Senior Instructors, Instructors, and administrative staff. The Manager is responsible for the day-to-day running of the office.

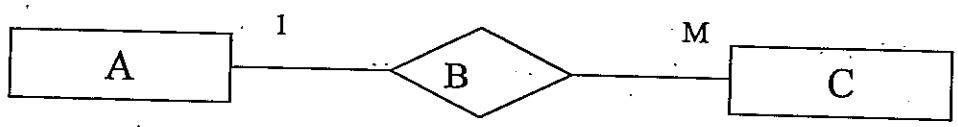
Clients must first register at an office and this requires that they complete an application form, which records their personal details. A client may request individual lessons or book a block of lessons. An individual lesson is for one hour, which begins and ends at the office. A lesson is with a particular Instructor in a particular car at a given time. Lessons can start as early as 8am and as late as 8pm. After each lesson, the Instructor records the progress made by the client and notes the mileage used during the lesson. The School has a pool of cars, which are adapted for the purposes of teaching. Each Instructor is allocated to a particular car.

Once ready, a client applies for a driving test date. To obtain a full driving license the client must pass both the practical and theoretical parts of the test. If a client fails to pass, the Instructor must record the reasons for the failure.

i. Identify the main entities of the *EasyDrive* School of Motoring.
ii. Identify the main relationships between the entities described in part i) and represent each relationship as an ER diagram.
iii. Determine the connectivity constraints for each relationship described in part ii). Represent the connectivity for each relationship in the ER diagrams created in part ii).
iv. Identify the attributes and associate them with an entity or relationship. Represent each attribute in the ER diagrams created in part iii).
v. Determine candidate and primary key attributes for each (strong) entity.
vi. Represent the data requirements of the EasyDrive School of Motoring as a single ER diagram. State any assumptions necessary to support your design.

3.

i.



a. What are the existence and cardinality for the C to A relationship?

b. Substitute A: person and B: manages and C: project in the above ER diagram. Suppose that someone told you that the following three facts are true. Are these consistent with the diagram? Answer yes or no for each of the three facts. If your answer is no, then explain why it is inconsistent.

Fact1: Mackenzie manages the White project.

Fact2: Lindsey manages the Brown and Black projects.

Fact3: Joe doesn't manage any projects.

ii. Suppose we want to store information about cities, countries, and rivers. Develop an entity-relationship diagram for a database containing the following information:

- For each country (e.g. USA, Germany), we want to store the name and the population. Countries are uniquely identified by their name. We also want to store the capital city of the country. Each country has exactly one capital city.
- For each city, we want to store the name, the state, the population, and the country in which the city lies. We assume that cities are uniquely identified by name and state together. There can be cities with the same name in different states. Also, each city lies in a uniquely determined country.
- For each river, we want to store the name and the length. We also want to store through which countries the river flows. We assume here that every river is uniquely identified by its name (which is probably not true, but do not worry about this). A river must flow through at least one country, but can flow through many countries.

It is possible that there are countries without rivers (at least without rivers in our database). However, you must specify keys and cardinalities. Specify additional constraints, if any.

4.

A company maintains a group of restaurants. Each restaurant is located at a particular street address and has a number of different sections (waiting area, bar, smoking, non-smoking, party room, etc.). Each section contains a number of tables and each table has various seating capacities (2, 4, 6, etc.). Each restaurant maintains its own list of menu items that it serves to customers. Menu items are grouped by category (Appetizer, side dish, entrée, etc.) and include a brief description and a price. The company assigns a customer and his or her companions to a table noting the exact date and time and number of people. Once seated, the group will be waited on by one of the restaurant staff who will then take their orders (based upon the menu items) and serve the food once it is prepared. For each item ordered, we need to keep track of the menu item and the quantity.

It is needed to retain the name, job title, home address, telephone number and social security number of each member of the staff.

a. Create an E-R model with entities, attributes, identifiers and relationships to provide data storage that accommodates the above description of the restaurant business.

b. Write down, in English language, a list of "Relationship Sentences" for each relationship.

c. Once the E-R model has been created, convert the E-R model to a set of relations indicating key attributes and foreign keys.

5.

Consider the following relational schema of a library database.

BOOK {BookId, Titel, PublisherName}
PUBLISHER {Name, Address, Phone}
BOOK_AUTHORS {BookId, AuthorName}
BOOK_COPY {BookId, Branch_Id, No_of_Copies}
BOOK_LOAN {BookId, BranchId, CardNo, DateOut, DueDate}
LIBRARY_BRANCH {BrachId, BranchName, Address}
BORROWER {CardNo, Name, Address, Phone}

Retrieve the following information using MySql statements.

i. How many copies of the book titled *The Lost Tribe* are owned by the library branch whose name is "Sharpstown"?

ii. How many copies of the book titled *The Lost Tribe* are owned by each library branch?

iii. Retrieve the names of all borrowers who do not have any books checked out.

iv. For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today, retrieve the book title, the borrower's name, and the borrower's address.

v. Retrieve the names of all borrowers who have more than five books checked out.

vi. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

vii. For each book authored by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central".

6.

i. Describe what is meant by transitive dependency and describe how this type of dependency relates to 3NF. Provide an example to illustrate your answer.

ii. Consider the following relation and perform the normalizations:

Shipping (ShipName, ShipType, VoyageID, Cargo, Port, Date)

Hint: Date is the date the ship arrives in the given Port

With the functional dependencies:

ShipName → ShipType

VoyageID → ShipName, Cargo

ShipName, Date → VoyageID, Port

a. Identify the candidate keys.

b. Normalize to 2NF

c. Normalize to 3NF

d. Normalize to BCNF

iii. Consider the following and obtain relations in 1NF and then 3NF with appropriate reasoning.

Parts				
Cust ID:				Form #:
Name:				
Part #	Desc	# Used	Price	Total
Subtotal				
Labor ID	Desc	Price		
	Subtotal			
Subtotal				
Tax rate:				
Tax:				
Total:				