COMP9120 Final Exam

50 Possible Points

2022/6/17

Attempt 1

IN PROGRESS
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Unlimited Attempts Allowed
2022/6/17 to 2022/6/17

Details

This is a take-home exam with 10 questions. You should read the questions, and write your answers in a word document. You should attempt all questions and follow the instructions for each question carefully. When you have finished you should upload your answer document.

Final Exam for COMP9120. In case the images do not load properly in your browser, you can download those from here Final Exam - Images.pdf (https://canvas.sydney.edu.au/courses/42139/files/23463763?wrap=1) (https://canvas.sydney.edu.au/courses/42139/files/23463763/download?download_frd=1)

Q1: The Science library of University of Sydney has decided to create a new database for the library, and you have been hired to design the database. Your task is to draw an ER diagram based on the following information given to you by the librarian: **8 marks**

- The library keeps information about book authors, their names (which are unique), country of birth, and types of book they publish. Note that one author can publish more than one type of books e.g. programming, algorithms etc.
- For each book, it records the name of the authors, the year it was published, its unique title, edition number, and name of the publisher. Library stores multiple editions of the same book.
- Books are classified into groups, for example, Computer Science, Electrical Engineering, Biological Science etc; a book may belong to more than one group. Each group is identified by a name (like those just given) that describes the group.
- The library keeps information about its members. For each member, the library keeps that member’s unique name, address, phone number, email address, and the groups of books that the member tends to borrow.
- One member can borrow multiple books at the same time. For this, library records the members’ information , book information, borrow date and expected return date.

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Employee(EmployeeID, Name, Address, Salary)

Customer(CustomerID, Name, PhoneNumber)

PurchaseOrder(OrderID, EmployeeID, CustomerID, Date)

PurchaseItem(ItemID, OrderID, ItemName, ItemCost)

Write down the SQL expressions for the following queries:

a) Find all the customers' name who have placed the highest number of orders.

b) Find the total number of orders such that the total cost of items in each of those orders is over $200.

Note that you are allowed to use VIEW to answer any of these queries.

Q3: Suppose you have a file with 1000 pages, and you have three buffer pages. Suppose that we are using external merge-sorting algorithm to sort the file. **4 marks**

a) How many runs will you produce in the first pass?

b) How many passes will it take to sort the file completely?

c) Minimum how many buffer pages do you need to sort the file completely in just two passes?

Q4: This question is based on the following E-R diagram which describes the information kept on a hospital. **5 marks**

Translate the following E-R diagram into a relational model using the following **textual notation**. Each relation should be written in the form:

Name(attribute 1, attribute 2, …) PK=(attribute list), FK=(attribute list->parent relation),...

An 'attribute list' is one or more, comma-separated attribute names. Each relation must have a primary key (PK) defined. A relation can have zero or more FKs specified.

For example: Enrolment(studentId, courseId, mark) PK=(studentId, courseId), FK=(studentId->Student, courseId->Course)

Do not write this relational model in SQL DDL syntax, use the above convention to describe your model.

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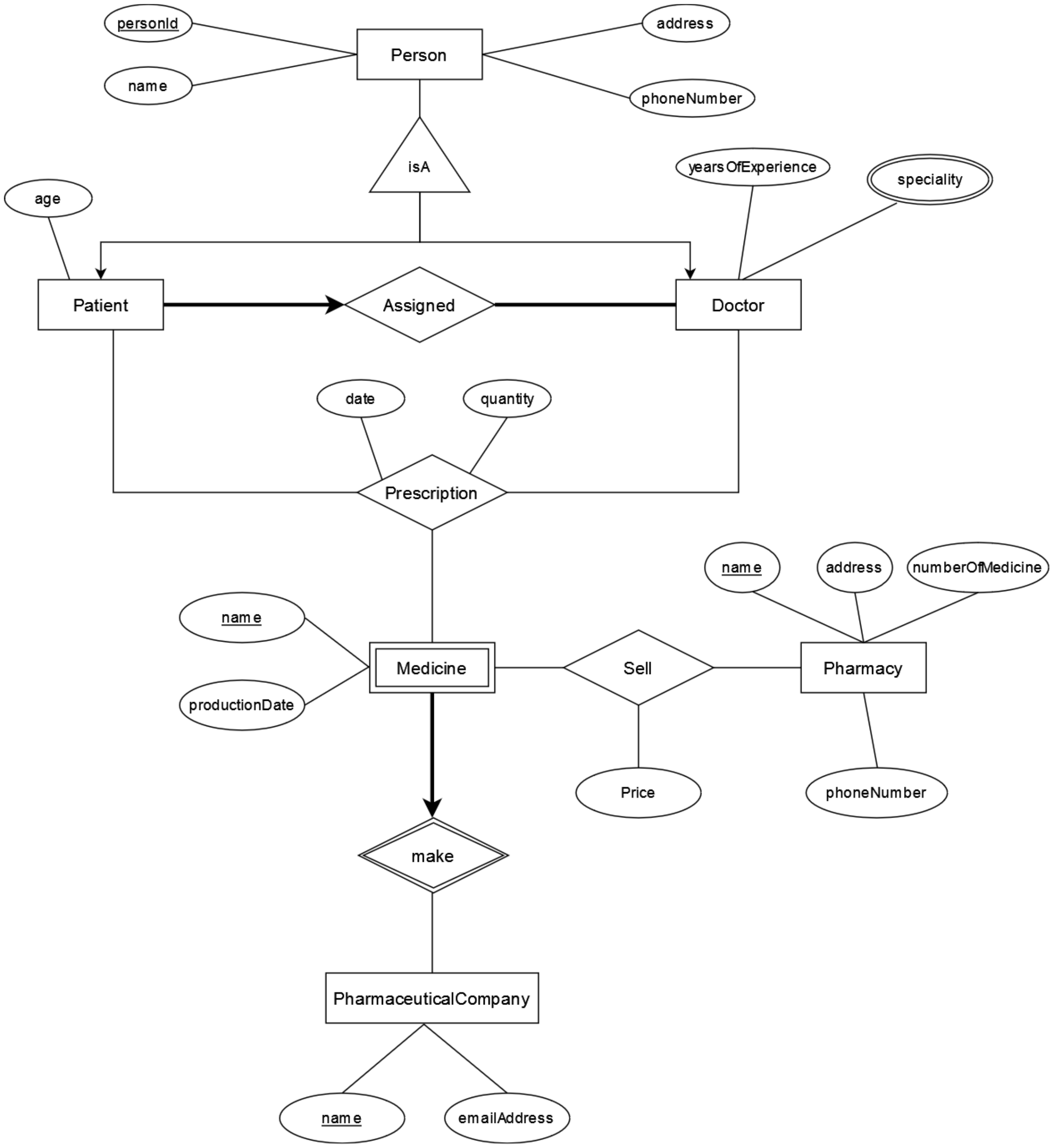

Q5: Consider the database consisting of the following relations: **6 marks**

Manufacturer(ManufacturerName, HQAddress, Country)

Car(Make, ModelNum, ManufacturerName,Type)

Dealer(DealerName, DAddress)

Sell(DealerName, Make, ModelNum)

In case you cannot type the usual RA Greek letters easily, you should use the following convention. Operator parameters should be enclosed in square brackets.

$\pi_{title}(\sigma_{points=6 \wedge semester = \text{'2021-S2'}}(courses))$ can be written as P[title] (S[points = 6 and semester = '2021-S2'] (courses))

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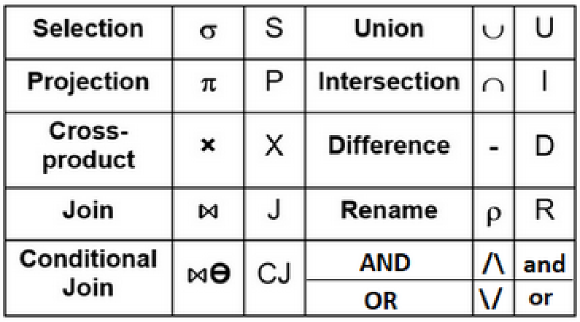

Selection	σ	S	Union	∪	U
Projection	π	P	Intersection	∩	I
Cross-product	×	X	Difference	-	D
Join	⋈	J	Rename	ρ	R
Conditional Join	⋈θ	CJ	AND	∧	and
			OR	∨	or

Write down the Relation Algebra (RA) expressions for the following queries:

a) Find the addresses of dealers that sell at least one make of car manufactured by a company incorporated in Australia.

b) Find all dealers who do not sell any car manufactured by “Toyota”.

Q6: Consider the relation schema and the following functional dependencies. **4 marks**

Project(ProjectID, ProjectTitle, ProjectBudget, ProjectDescription, ProjectManager)

ProjectID → ProjectTitle, ProjectBudget

ProjectBudget, ProjectManager → ProjectDescription

ProjectTitle → ProjectManager

ProjectDescription → ProjectID

Your task is to find all the candidate keys of the above relation and explain the reasoning of your candidate key using F+ calculation.

Q7: Determine whether the following schedule is conflict serializable or not; justify your answer by drawing the precedence graph. **4 marks**

R1(A), W1(B), W5(F), R2(F), R3(E), R2(C), R2(G), W4(D), R1(E), W2(A), W4(B), W5(G), W3(C), R3(D)

If the schedule is conflict serializable, please also give a conflict equivalent serial schedule.

Suppose that a phone book has 1000 disk pages. Each page can contain 625 names and the associated phone number. You may consider that the phone book is **4**

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a) perform a linear search for a particular name in the phone book.

b) perform a binary search for a particular name in the phone book.

c) perform a B^+ index search for a particular name in the phone book if an index is prepared giving the name of the first entry on each page of the phone book.

Q9: Consider a car dealership where multiple salespeople may sell a car. Assume we have the following relation: **5 marks**

AUTO_SALE(Car_id, Date_purchased, Salesperson_id, Commission, Discount) and therefore {Car_id, Salesperson_id} is the primary key.

The domains of the attributes are as follows: Car_id: INT, Date_purchased: DATE, Salesperson_id: INT, Commission: REAL, Discount: REAL

Assume we only have the following additional functional dependencies:

Date_purchased-> Discount

Salesperson_id -> Commission

a) Is this relation in 1NF, 2NF, or 3NF? Why or why not?

b) How would you successively normalize it to 3NF?

Q10. Assume we require a natural join between two relations **Agent(AID, PID, totalSales)** and **Property(PID, address, askingPrice, bid, bid-type).** **4 marks**

Also, assume that the number of tuples in ***Agent*** is 500 and 10,000 tuples in ***Property.*** : Assume each block can hold up to 50 tuples of **Property**. Assume that a block can hold up to 100 tuples of **Agent**.

Agent $\bowtie$ **Property**

a) Estimate the number of I/Os required to perform the *nested loop join* when (i) **Agent** is the outer relation and (ii) **Property** is the outer relation.

b) Estimate the number of I/Os required to perform the *block-nested loop* join when (i) **Agent** is the outer relation and (ii) **Property** is the outer relation.

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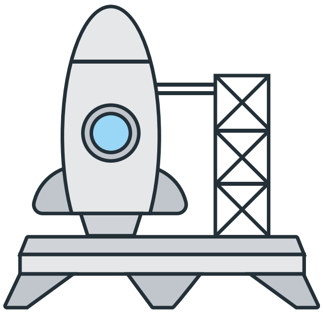

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