



Unlimited Attempts Allowed

Available: Nov 16, 2022 13:00 until Nov 16, 2022 15:55

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.

Please upload the pdf version of your solution document. Only if you are having difficulty converting your word document into pdf, then upload the word file.

Final Exam for COMP9120. In case the images do not load properly in your browser, you can download those from here [Final - images.pdf](#)

(<https://canvas.sydney.edu.au/courses/46051/files/26955955?wrap=1>). [↓](https://canvas.sydney.edu.au/courses/46051/files/26955955/download?download_frd=1) (https://canvas.sydney.edu.au/courses/46051/files/26955955/download?download_frd=1)

Q1: For the upcoming Football world cup, the Qatar Football Federation is planning to create a database to store the information of every match and the associate teams. **8 marks**

- The world cup has many teams. Each team has a country, a coach, a captain, and a set of players. Note that a captain is also a player.
- Each player has a unique identification number, a name, and multiple skills. We also need to record each player's punishment record (e.g. red card or yellow card, monetary fine, match suspension etc). We will keep a description of the punishment and date the punishment was given.
- We will keep the name, contact number and years of experience of all match officials (i.e. referees). Note that one match official will manage at least one match in the tournament and each match is managed by multiple officials.
- We will record information about each stadium venues in which matches will be played. Each stadium has a name, location, and a seating capacity. Each stadium will host multiple matches of the tournament.
- Each match is played between two teams. For each match, we need to record the team's information, the match official's information who will officiate the match, match date, the stadium information in which the match will be played, and the number of goals scored by each team.

Your task is to create an ER diagram based on the above specification.

Q2: For the T20 cricket world cup, all teams are now in Australia. Each team will be staying at a specific hotel for the duration of the tournament. We assume that team members make their room reservations under their team ID. Consider the database consisting of the following tables which capture the information of the hotels and the teams staying at these hotels. We also record the booking dates at these hotels. Note that booking dates are inclusive in this case. For example, if we book a room from 2022-01-01 to 2022-01-03, then we must pay for 3 nights. **5 marks**

Hotel(Hotel_ID, Name, Address)

Room(Room_Number, Hotel_ID, Type, CostPerNight)

StayingAt(Hotel_ID, Team_ID, Room_Number, Date_From, Date_To)

Team(Team_ID, Team_Name, Team_Manager)

a)
select count(*) as count, Hotel.id
from

Write down the SQL expressions for the following queries:

- Find the total number of distinct Teams staying in the most expensive rooms at each Hotel (i.e. Hotel_ID)
- Find the total income lost from unoccupied rooms at each Hotel (i.e. Hotel_ID) on the world cup opening day, i.e. 2022-10-16.

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

Q3: This question is based on the following E-R diagram which describes the information kept on a Company. **7 marks**

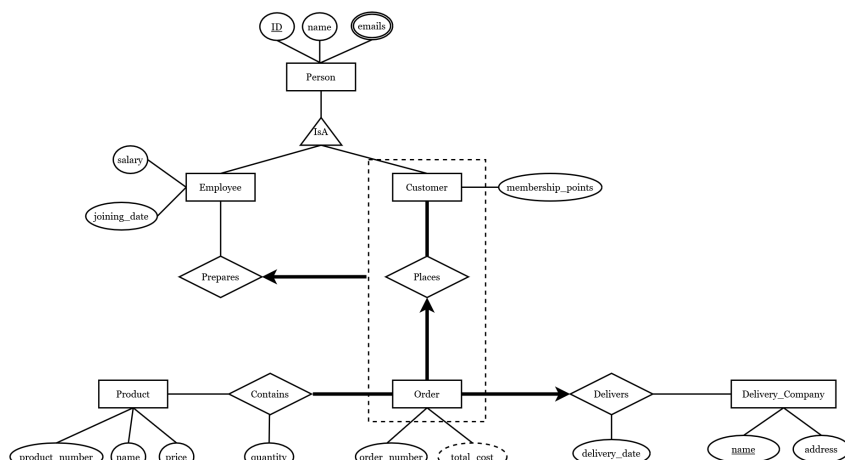
Translate the following E-R diagram into a relational model using the following **textual notation**. Each relation should be written in the form:

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.



Book(Title, Year, TypeOfBook, Publisher_ID)
Publisher(Publisher_ID, Publisher_Name, Address)
WrittenBy(Book Title, Book Year, Author_ID)
Author(Author_ID, Author_Name, CountryOfOrigin)

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.

$\pi_{title}(\sigma_{points=6 \wedge semester='2022-S2'}(courses))$ can be written as P[title] (S[points = 6 and semester = '2022-S2'] (courses))

Selection	σ	S	Union	\cup	U
Projection	π	P	Intersection	\cap	I
Cross-product	\times	X	Difference	-	D
Join	\bowtie	J	Rename	ρ	R
Conditional Join	\bowtie_{θ}	CJ	AND	\wedge	and
			OR	\vee	or

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

- a) Find the name of all Australian authors who have written a Book published by “Pearson” publisher or published a book in 2022.
- b) Find the name of all publishers who have not published any book in 2022.

Q5. Given the following relation:

4 marks

Truck-driving(driver, type-of-truck, date, amount-of-fuel, time-spent)

The rules for this relation is that a truck can only be used by one driver on a given date. A driver can use any number of trucks on any one day. The time-spent is the time spent by a driver on the truck on a given date. Amount-of-fuel is the quantity of fuel used by the driver on the truck on the given date.

- a) list all functional dependencies in the above relation
- b) find a candidate key for the relation using attribute closure. Show the proof. Zero marks for no proof.

Q6: Consider the following relation

4 marks

Student-info(ID, Name, DOB, Age, Degree-convenor, School, Semester, Subject, Grade)

with the key = (ID, Semester, Subject) and functional dependencies

ID --> (Name, DOB, Age, Degree-convenor, School),
DOB --> Age,
Degree-convenor --> School

- a) Is it in BCNF?
- b) If it is not, show a proof. Decompose your relation to be in BCNF with lossless-join decomposition. Show your work.

Q7. Assume that initially B=200

4 marks

Time

T1	T2	T3	T4
		A= 100	
		W(A)	
		B = B+2*A	
			R(B)
R(A)			A=B+50
B= A+100			
		W(B)	
	R(A)		
	B= A+ 200		
W(B)			
			W(A)
	W(B)		

- a) Is this schedule conflict-serializable? Explain your answer.
- b) Is this schedule serializable? Explain your answer.

Q8. Assume we have two relations

4 marks

A position number refers to a position type (e.g., supervisor). We would like to express an assertion that the total salary budget allocated to a position number is never exceeded. Write an ASSERTION using the CHECK clause which uses subqueries to implement this constraint.

- Q9. Consider a system where we monitor the performance of an airport luggage system. The main table is **Luggage(bagId, tkt, wgt, desk, date, eid)**

5 marks

Each row of this relation needs 64 bytes. This includes the 4-byte primary key **bagId**. There are 1,200,000 rows in the table. The occupancy load factor is 70%. This means that each page is 30% free. The database uses 1192 byte pages to storing both data and indexes. We earmark the first 200 bytes of each page for header data. We assume that records and index entries may not cross over pages.

a) How many bytes are needed to store just the relation above? Do not include indexes. Make sure you state any assumptions you make.

Your analysis determines that most of your queries involve searches over "desk", such as the following:

```
SELECT COUNT(*)
```

```
FROM Luggage
```

```
WHERE desk = 'United' AND wgt > 25;
```

- b) What do you believe the database should use as access path to process such queries? Give an estimate of the number of I/O required to process such query.
- c) Are there other alternatives? What is the effect this would have on the performance?

- Q10. Assume we have two relations **R(A,B,C)** and **S(C,D,E)**.

4 marks

The number of tuples in R is 65,000. S has tuples 20,000. One block would hold exactly 100 tuples of R or 50 tuples of S. One page contains exactly 1 block.

Estimate the cost of the natural join of R and S:

- a) Nested-loop join. Which order of the join would yield a minimal cost? Justify your answer.
- b) Block nest-loop join. Which order of the join would yield a minimal cost? Justify your answer.

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While the University is aware that the vast majority of students and staff act ethically and honestly, it is opposed to and will not tolerate academic dishonesty or plagiarism and will treat all allegations of dishonesty seriously.

Further information on academic honesty, academic dishonesty, and the resources available to all students can be found on the academic integrity pages on the current students website: <https://sydney.edu.au/students/academic-integrity.html> (<https://sydney.edu.au/students/academic-integrity.html>).

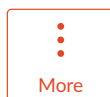
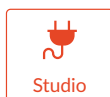
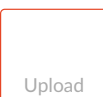
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Compliance statement

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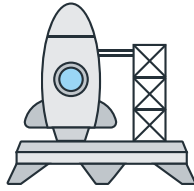
- I have read and understood the University of Sydney's [Academic Honesty in Coursework Policy 2015](https://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2012/254&RendNum=0) (<https://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2012/254&RendNum=0>).
- The work is substantially my own and where any parts of this work are not my own I have indicated this by acknowledging the source of those parts of the work and enclosed any quoted text in quotation marks.
- The work has not previously been submitted in part or in full for assessment in another unit unless I have been given permission by my unit of study coordinator to do so.
- The work will be submitted to similarity detection software (Turnitin) and a copy of the work will be retained in Turnitin's paper repository for future similarity checking. Note: work submitted by postgraduate research students for research purposes is not added to Turnitin's paper repository.
- Engaging in plagiarism or academic dishonesty in coursework will, if detected, lead to the University commencing proceedings under the [Academic Honesty in Coursework Policy 2015](https://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2012/254&RendNum=0) (<https://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2012/254&RendNum=0>) and the [Academic Honesty Procedures 2016](http://sydney.edu.au/policies/default.aspx?mode=glossary&word=Academic+honesty) (<http://sydney.edu.au/policies/default.aspx?mode=glossary&word=Academic+honesty>).
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- Engaging another person to complete part or all of the submitted work will, if detected, lead to the University commencing proceedings against me for potential student misconduct under the [University of Sydney \(Student Discipline\) Rule 2016](http://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2017/441&RendNum=0) (<http://sydney.edu.au/policies/showdoc.aspx?recnum=PDOCC2017/441&RendNum=0>).

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