Preview Test: INFS7901 Semester One Final Examination 2021

Test Information

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Description	Undertaking this online examination deems your commitment to UQ's academic integrity pledge as summarised in the following declaration: *"I certify that I have completed this examination in an honest, fair and trustworthy manner, that my submitted answers are entirely my own work, and that I have neither given nor received any unauthorised assistance on this examination".*
Instructions	You need to answer all of the questions in the Blackboard Test.
Timed Test	This test has a time limit of 2 hours and 10 minutes.This test will save and be submitted automatically when the time expires. Warnings appear when **half the time**, **5 minutes**, **1 minute**, and **30 seconds** remain. *[The timer does not appear when previewing this test]*
Multiple Attempts	Not allowed. This test can only be taken once.
Force Completion	This test can be saved and resumed at any point until the time has expired. The timer will continue to run if you leave the test.
	Your answers are saved automatically.

QUESTION 1

Consider the following ER schema for a MOVIES database.
Assume that MOVIES is a populated database. ACTOR is used as a generic term
and includes actresses. Given the constraints shown in the ER schema, respond
to the following statements with True or False..
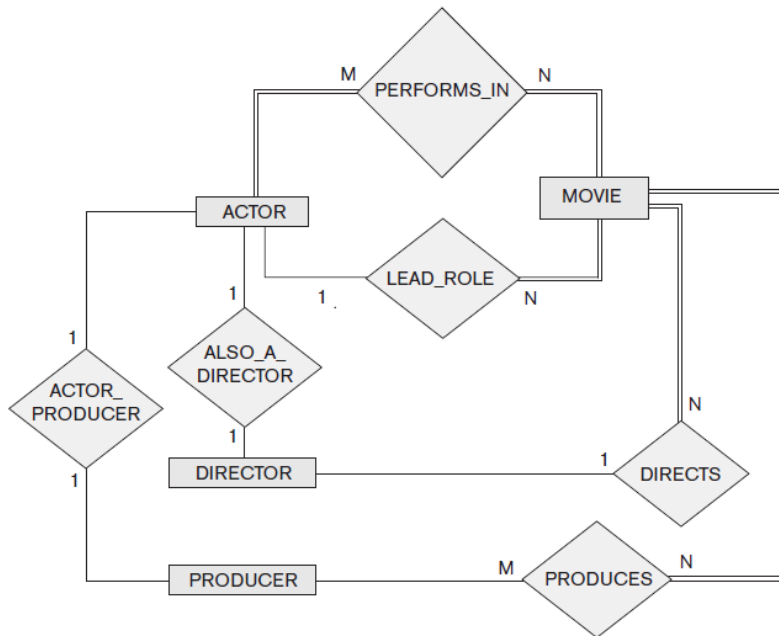
- ✓ There are no actors in the
database that have been in
no movies.

A. True

B. False

- ✓ Some actors might be
producers that have not
produced any movie.

- ✓ All the leading roles are
played by actors who are
also directors.

- ✓ There is no movie without a
leading role.

- ✓ A producer can be both a
director and an actor.

- ✓ There can be movies with
directors and producers
but with no actors.

- ✓ A movie must have multiple
producers.

- ✓ There can be a movie in
which multiple actors play
that are also directors in
other movies.

QUESTION 2

Consider the following schema. Map

- **Bank_BRANCH**, [2 marks]
- **LOANS** (the relation, not the entity LOAN), and [2 marks]
- **international bank** [2 marks]

into their corresponding schema e.g. Table1(A, B, C) B references Table2.B.

For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

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QUESTION 3

4 points   Save Answer

In relation R(ABCDEF) with the following functional dependencies (FDs)

- A -> B
- B->C
- D->E
- F->D

a) What are the candidate key(s)?

b) Is R BCNF? why or why not?

c) Which of the four FDs should be removed so that R becomes 3NF?

d) what is the closure of {AD}+?

Each 1 mark.

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QUESTION 4

3 points   Save Answer

Given R(ABCD) with functional dependencies:

- A -> B
- C ->D

decompose R and write the **final** resulting relations and **underline** primary keys.

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Consider the following relational schema, in which the students attend an online data science course website that offers courses in three levels of beginner, intermediate and advanced. The website then issues certificates for each course that a student passes. If a student does not pass the course, it won't be stored in the database.

- Student (sid, name, address)
- Course (cid, title, level)
- Certificate (**sid, cid**, date)
    - Certificate.sid references Student.sid
    - Certificate.cid references Course.cid

Course level can be basic, intermediate or advanced.

Write the following queries in SQL:

a. List the id of students whose name starts with letter A. [1mark]

b. List the id of students without any certificate. [1 mark]

c. List level and the total number of certificates issued for all the courses in that level. [1 mark]

d. List id and name of students that have certificates in all three beginner, intermediate and advanced levels (you can assume division is supported).[2 marks]

e. List pair of course names, and the number of students that have passed both. [2 marks]

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QUESTION 6

2 points Save Answer

What is the worst-case complexity of function3(A) in Python language where A is an array with length n assuming that the complexity of function2 is O(n)?

function3(A):
   if function2(A) == True:
      merge_sort(A)

  a. O(nlogn)

  b. O(n)

  c. O(n^2 logn)

  d. O(n^2)

QUESTION 7

4 points Save Answer

For each asymptotic comparison select if it is True or False:

- ∨ $T(A) = n^2 + 16^{log(n)}$ is   A. False
    faster than $T(B) = 2n^2$ B. True
    $+ n^3$

- ∨ $T(A) = n^2 / log(n)$ is
    faster than $T(B) =$
    $log(n^3)$

- ∨ $T(A) = n\ log(n)$ is faster
    than $T(B) = 4^{log(n)} +$
    n

- ∨ $T(A) = n\ log(n)$ is
    faster than $T(B) = n! /$
    $(n-2)!$

QUESTION 8

2 points   Save Answer

A student has designed a small DBMS to be deployed on low-memory mobile phones. Which of the following sorting algorithms is appropriate for "**order by**" operations on multiple columns in the implemented SQL?

○ selection sort

○ insertion sort

○ quick sort

○ merge sort

QUESTION 9

2 points   Save Answer

Match array [9 6 8 2 10 4] in its **fourth** iteration of sorting with the algorithm that **could be** sorting it.

| - ✔ | 2 6 8 9 10 4 | | A. selection sort |
| - ✔ | 2 4 6 9 10 8 | | B. insertion sort |

QUESTION 10

1 points   Save Answer

After the first iteration of QuickSort the array is **3 9 8 2**. Which item could have been selected as pivot?

○ 3

○ 9

○ 8

○ 2

1 points   Save Answer

Which one is a binary search tree?

○

○

QUESTION 12

List the nodes (in order) that will be visited if we search for **5** in the following binary search tree (BST)?

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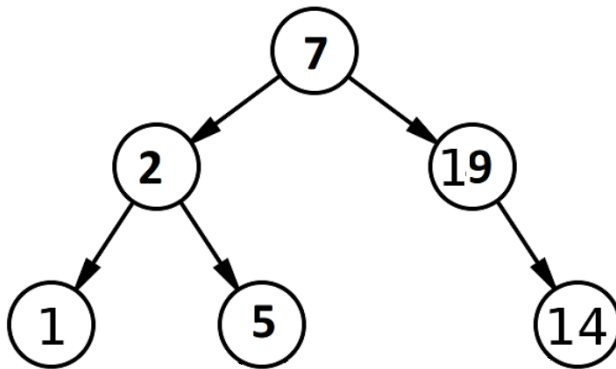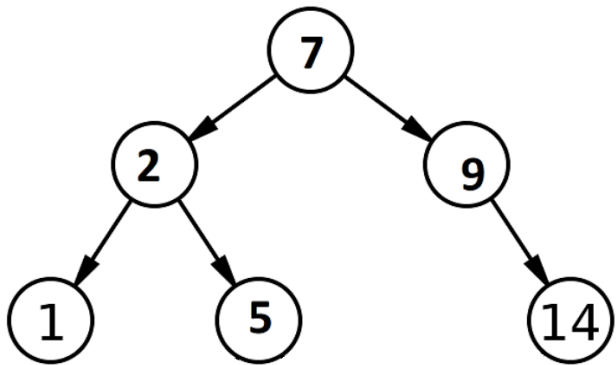
QUESTION 13

3 points   Save Answer

In the following binary search tree, we first **delete 3**. What will be the nodes that will be visited (in order) if now we **search** for **5**?

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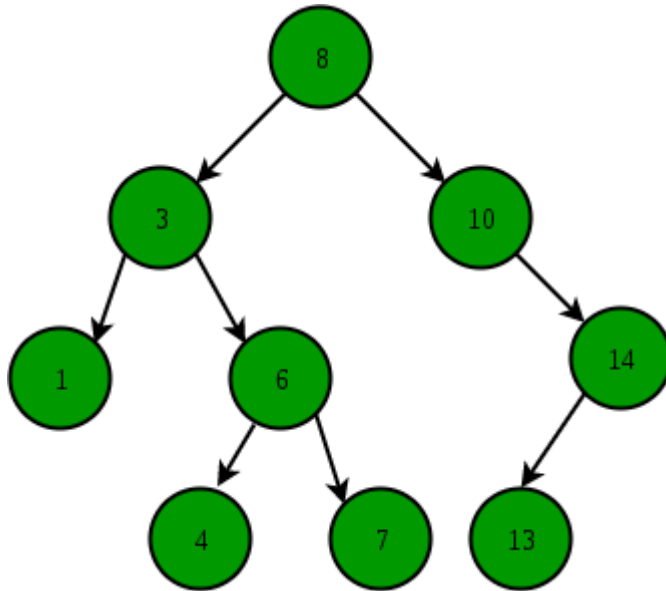
QUESTION 14

5 points   Save Answer

A hashtable with size 5 uses open addressing with quadratic probing.
If we insert:

15, 16, 25, 31 which values will be in indices of the hashtable (0, 1, 2, 3, 4)?

- ✔ 0   A. empty
- ✔ 1   B. 15
- ✔ 2   C. 16
- ✔ 3   D. 31
- ✔ 4   E. 25

QUESTION 15

2 points   Save Answer

In open addressing with **linear probing** , will we face a situation where there exists an empty index, but we can't insert a value into the hashtable?

◯ Yes

◯ No

QUESTION 16

In a hashtable of size 10 with linked-list chaining, we have inserted 100 values.

a) what is the load factor? [1 mark]

b) what is the worst case search complexity of such a hashtable? [1 mark]

c) If all the values that we insert are multiples of 10, what is the complexity of searching for numbers which are **not** multiples of 10? [1 mark]

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QUESTION 17

6 points Save Answer

Answer the following questions about indexing:

Given the schema below what kind of index will you design for each of the four frequent queries below?

- Customer(cid, cname, age)
- Product(pid, pname)
- Purchase(**cid**, **pid**, date, price)
  - Purchase.cid references Customer.cid
  - Purchase.pid references Product.pid

For each query, mention if the index

- is primary or secondary?
- uses tree or hash?
- is dense or sparse?

e.g. primary, using tree, sparse

1. (1.5 marks) select * from Customer where cname="John";

2. (1.5 marks) select * from Purchase where cid="Jane" and pid="P127";

3. (1.5 marks) select * from Customer where age > 80;

4. (1.5 marks) select * from Product where pid="P127";

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QUESTION 18

Consider schema STUDENT(sid, name, is_adult) and a very frequent query "select * from STUDENT where is_adult=True". We know that more than 98% of students are adults (is_adult=True).

Do you recommend creating a secondary (non-key) index for is_adult field on this relation? please support your yes/no answer in one sentence.

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Consider the following relational schema, in which the Purchase lists the products that customers buy.
- Customer(cid, cname, age)
- Product(pid, pname)
- Purchase(**cid**, **pid**, date, price)
    - Purchase.cid references Customer.cid
    - Purchase.pid references Product.pid

Write the following queries in relational algebra

For symbols you can either copy symbols from below or use their name

- Pi π
- Sigma σ
- Join ⋈
- Cartesian Product X

a) (1 mark) Find the id of all customers who are older than 50.

b) (2 marks) Find the name and age of all customers who are older than 30 and have purchased a product with pname="TV".

c) (5 marks) Write the **initial** and **optimised** query plan for query

"select customer.cname from customer, product, purchase where customer.age > 70 and product.pname="TV" and purchase.price > 1000 and product.pid=purchase.pid and customer.cid=purchase.cid" that lists names of older customers who have bought rather expensive TVs.

initial (1.5 marks)

optimised (3.5 marks)

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QUESTION 20

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Please use this space to specify any assumptions you have made in completing the exam and which questions those assumptions relate to. You may also include queries you may have made with respect to a particular question, should you have been able to 'raise your hand' in an examination room.

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