**FINAL EXAM**

**INFSCI 2710, Fall 2022**

8 problems, graded out of **100** points.

***1.* [20 pts]** Multiple Choice Grid *(Each multiple choice question may have MORE THAN ONE correct answer)*

*Multiple Choice Grid (10 questions)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | A | B | C | D |
| 2 | A | B | C | D |
| 3 | A | B | C | D |
| 4 | A | B | C | D |
| 5 | A | B | C | D |
| 6 | A | B | C | D |
| 7 | A | B | C | D |
| 8 | A | B | C | D |
| 9 | A | B | C | D |
| 10 | A | B | C | D |

*Multiple Choice Questions (up to 2 points each, each circled wrong answer, or missed right answer will cost you a point)*

*Circle one answer for each question in the grid provided above.*

**1. You can combine aggregate functions and attribute names in the select list \_\_\_\_\_\_A\_\_\_\_\_** a. a. if the attributes are in the groupping list

1. if the attributes are not in the groupping list
2. if the attributes are numeric
3. none of above

**2. A many-to-many relationship can connect \_\_\_\_A\_\_\_\_\_\_**

1. two strong entity sets
2. a strong and a week entity sets
3. two weak entity sets
4. none of above

**3. A table is in BCNF if \_\_A\_\_**

1. a left side in each non-trivial functional dependency for that table is a candidate key
2. a right side in each non-trivial functional dependency for that table is a candidate key
3. it has no functional dependencies
4. none of above

**4. A table is in 3NF if \_ AC\_\_\_**

1. it has only trivial functional dependencies
2. a right side in each non-trivial functional dependency for that table is a candidate key
3. a right side in each non-trivial functional dependency for that table is a part of a candidate key d.
4. none of above

**5. A buffer manager is \_\_\_\_\_D\_\_\_\_\_\_**

1. speeding up access to data located on disk
2. ensuring consistency property of a transaction
3. ensuring isolation property of a transaction
4. none of above

**6. An index is \_\_\_\_A\_\_\_\_\_\_\_**

1. speeding up access to data located in the main memory
2. ensures durability property of a transaction
3. speeding up access to data located on the disk
4. none of above

**7. WAL protocol \_\_\_\_\_C\_\_\_\_\_\_**

1. speeding up access to data located on the disk
2. ensures isolation property of a transaction
3. ensures durability property of a transaction
4. none of above

**8. A schedule is serializable if \_\_\_\_C\_\_\_\_\_\_**

1. it is recoverable
2. it is concurrent
3. it is equivalent to a serial schedule
4. none of above

**9. A schedule is recoverable if \_\_\_\_C\_\_\_\_\_\_**

1. it is equivalent to a serial schedule
2. it is cascadeless
3. it is serializable
4. none of above

**10. A strict two-phase locking protocol ensures \_\_\_\_\_B\_\_\_\_\_**

1. durability
2. serializability
3. atomicity
4. none of above

1. **[12 pt]** Considerthe following relations ***Account:***

|  |  |  |  |
| --- | --- | --- | --- |
| ***acc\_number*** | ***c\_name*** | ***c\_age*** | ***balance*** |
| A1 | Dan Brown | 35 | 1000 |
| A2 | Bill Evans | 40 | 1000 |
| A3 | Dan Brown | 40 | 1000 |
| A4 | Mel Gibbson | 40 | 1000 |
| A5 | Bill Evans | 35 | 1000 |
| A6 | Mel Gibbson | 40 | 1000 |

Please, answer the following questions (for each of the following questions consider grouping only by a single attribute):

* 1. What is the single attribute you have to group by to obtain a group with the largest number of tuples?

***Your answer to question 2.1:***  ***balance***

* 1. What is the number of tuples in the group from the question 2.1?

***Your answer to the question 2.2:*** 6

* 1. What is the single attribute you have to group by to obtain a group with the smallest number of tuples?

***Your answer to the question 2.3: acc\_number***

* 1. What is the number of tuples in the group from the question 2.3?

***Your answer to the question 2.4:***  **1**

* 1. What is the single attribute (except *balance* attribute) you have to group by to obtain the largest total balance in a group?

***Your answer the question 2.5: c\_age***

* 1. What is the total balance in the group from the question 2.5?

***Your answer the question 2.6: 4000，2000***

* 1. What is the single attribute you have to group by to obtain the smallest total balance in a group?

***Your answer the question 2.7: acc\_number***

* 1. What is this smallest total balance in the group from the question 2.7?

***Your answer the question 2.8: 1000***

1. **[10 pt]** Consider the following tables:

***department:***

|  |  |  |
| --- | --- | --- |
| *depname* | *budget* | *dmgr* |
| software | 4000 | 1111 |
| hardware | null | null |
| sale | 2000 | 2222 |

***employee:***

|  |  |  |
| --- | --- | --- |
| *eid* | *ename* | *depname* |
| 1111 | Jones | null |
| 2222 | Smith | sale |
| 3333 | Brown | software |

Plot a result table for each of the following SQL queries:

select sum(D.budget)

from department D

***result:***

|  |
| --- |
| Sum(D.budget) |
| 6000 |

select sum(D.budget)

from employee E, department D where E.depname = D.depname and D.dmgr = 1111

***result:***

|  |
| --- |
| Sum(D.budget) |
| 4000 |

select count(E.depname)

from employee E

***result:***

|  |
| --- |
| Count(E.depname) |
| 2 |

1. **[14 pt]** Check if the relational schemas R1, R2, R3, R4 specified below are in (a) BCNF

(b) 3NF

R1(A,B,C,D,E)

Functional dependencies: { CD->BE, B -> C, B ->DA}

R2(A,B,C,D,E)

Functional dependencies: {CD->BE, B->D}

R3(A,B,C,D,E)

Functional dependencies: {CD->BE, B->CA}

R4(A,B,C,D,E)

Functional dependencies: { CD->ABE, B->A}

Your answer should be represented as the following table (please, do not provide any explanation, each answer should be either “yes”, or “no”):

|  |  |  |
| --- | --- | --- |
|  | BCNF ? | 3NF ? |
| R1 | NO | NO |
| R2 | NO | NO |
| R3 | NO | NO |
| R4 | NO | YES |

1. **[6 pt]** Consider a relation R(A,B,C, D, E, F) and the following functional dependencies that hold on R: AB->C, C->D, EF -> C. Consider the following decompositions of R:

(a) R1(C,B,A), R2(D,E,F,A)

(b) R1(E,F,C), R2(B,A,F,D)

(c)R1(A,B,C,D), R2(C,E,F)

Which of the above decompositions are lossless-join? Your answer should be represented in the following table (please, do not provide any explanation, each answer should be either “yes”, or “no”):

|  |  |
| --- | --- |
|  | **Lossless-join decomposition? (yes/no)** |
| (a) | NO |
| (b) | NO |
| (c) | NO |

1. **[18 pt]** Consider the following B+ trees

|  |  |
| --- | --- |
| **(a)** | **(d)** |
|  | 10    20    30    35    40 |
| **(b)**    10      30 |  |
| **(c)**            45          10    20    42      45 | **(f)** |

For each of above B+-trees specify *d* and indicate if the tree has been built correctly. Your answer should be represented as the following table (please, do not provide any explanation):

|  |  |  |
| --- | --- | --- |
|  | *d* | Correct (yes/no) |
| **(a)** | **2.5** | **No** |
| **(b)** | **3.5** | **Yes** |
| **(c)** | **2** | **No** |
| **(d)** | **4** | **Yes** |
| **(e)** | **1** | **Yes** |
| **(f)** | **3** | **Yes** |

1. **[10 pts]** Consider the following concurrent schedule S with transactions T1 and T2 (time is flowing from top to bottom):

|  |  |
| --- | --- |
| T1 | T2 |
| R(B);  B : = B+100;  W(B);      R(A);    A : = A-100;    W(A);      Commit | R(B);      B : = B+100;      W (B);    Commit |

|  |  |
| --- | --- |
|  | **Your Answer (yes/no)** |
| Is the schedule S serializable? | **Yes** |
| Is the schedule S recoverable? | **No** |
| Is the schedule S cascadeless? | **No** |

1. **[10 pt]** Assume that, after a crash, the log contains the following records:

<T1 start>

<T1 update, A, 200,600>

<T2 start>

<T2 update, C, 50,100>

<T1 update, B, 300,200>

<T3 start>

<T4 start>

<T3 update, D, 400,200>

<T5 starts>

<T4 update, E, 800,900>

<T5 update, D, 200,100>

<T2 commit>

<T4 update, F,150,250>

<T4 commit>

1. Which transactions (T1-T5) will be redone during the recovery?

***Answer:\_\_\_\_T2,T4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1. Which transactions (T1-T5) will be undone during the recovery?

***Answer:\_\_\_\_\_T1,T3,T5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1. What will be the value of data items ‘C’ after the recovery algorithm has finished?

***Answer:\_\_\_100\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1. What will be the value of data items ‘B’ after the recovery algorithm has finished?

***Answer:\_\_\_300\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1. What will be the value of data items ‘E’ after the recovery algorithm has finished?

# Answer:\_\_\_\_900\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_