Midterm Exam

Score: 0.0/18.0

Raw Score (without penalties): 17.0

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Question 1

Consider the following DTD:

```
<!DOCTYPE CityInfo [
   <!ELEMENT CityInfo (Government, Neighborhood+)>
   <!ATTLIST CityInfo Name CDATA #REQUIRED>
   <!ELEMENT Government (Mayor, Assistant)>
   <!ELEMENT Mayor (#PCDATA)>
   <!ELEMENT Assistant (#PCDATA)>
   <!ELEMENT Neighborhood (Library | Bookshop)?>
   <!ATTLIST Neighborhood Name CDATA #REQUIRED>
   <!ELEMENT Library (#PCDATA)>
   <!ELEMENT Bookshop (#PCDATA)>
]>
```

In an XML document that conforms to this DTD, what are the minimum and maximum possible number of Mayor elements?

1

- minimum 0, maximum 1
- minimum 0, maximum any-number
- ✔ minimum 1, maximum 1
- minimum 1, maximum any-number

In an XML document that conforms to this, what are the minimum and maximum possible number of Library elements?

1

- minimum 0, maximum 1
- ✔ minimum 0, maximum any-number
- minimum 1, maximum 1
- minimum 1, maximum any-number

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Question 2

Consider the following XML Schema:

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
 <xs:element name="PassengerInfo">
   <xs:complexType>
     <xs:sequence>
       <xs:element name="Name" type="xs:string" maxOccurs="2"/>
       <xs:element name="Seat" type="xs:string"/>
       <xs:choice>
         <xs:element name="Meal" type="xs:string"/>
         <xs:element name="Snack" type="xs:string" maxOccurs="2"/>
       </xs:choice>
     </xs:sequence>
   </xs:complexType>
 </xs:element>
</xs:schema>
```

In an XML document that conforms to this XML Schema, what are the minimum and maximum possible number of Name elements?

0

- minimum 0, maximum 1
- ✖ minimum 0, maximum 2
- minimum 1, maximum 2
- minimum 2, maximum 2

In an XML document that conforms to this XML Schema, what are the minimum and maximum possible number of Snack elements?

1

- minimum 0, maximum 1
- ✔ minimum 0, maximum 2
- minimum 1, maximum 2
- minimum 2, maximum 2

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Question 3

Consider the following three relations:

- Car(model, year, serial, color)
- Makes(maker, model)
- Owns(owner, serial)

A tuple in Car represents a specific car of a

given model, made in a given year, with a serial number and color. A tuple in Makes specifies that a maker company makes cars of a certain model. A tuple in Owns specifies that an owner owns the car with a given serial number. Keys are represented by underlining; [owner,serial] together are a key for Owns.

Consider the relational algebra expression:

$$\pi_{owner}\,(Owns \bowtie \sigma_{color="red"}\,Car \bowtie \sigma_{maker="Toyota"}\,Makes)$$

Which of the following phrases describes what this expression computes?

1

- ✔ All owners of a red car made by Toyota
- All owners of more than one car, where at least one car is red and at least one is made by Toyota
- All owners of a red car, a car made by Toyota, or one of each
- All owners of a red car, a car made by Toyota, or a red car made by Toyota

Consider the relational algebra expression:

$$\pi_{owner}\,\sigma_{owner=o2 \wedge serial \neq s2}\,(Owns \times \rho_{Owns(o2,s2)}\,Owns)$$

Which of the following phrases describes what this expression computes?

1

- All owners of at least one car
- All owners who have the latest model of a car
- All owners where some other owner owns the same car (i.e., same serial number)
- ✔ All owners of more than one car

Which of the following relational algebra expressions computes "*All companies that made at least one car in the year 2010*"?

1

- $\pi_{maker}\,(Makes \times \sigma_{year=2010}\,Car)$
- ✔ $\pi_{maker}\,(Makes \bowtie \sigma_{year=2010}\,Car)$
- $(\pi_{maker}\,Makes) \bowtie (\sigma_{year=2010}\,Car)$
- $\pi_{maker}\,\sigma_{year=2010}\,(Makes \times Car)$

Which of the following relational algebra expressions computes "*The latest year of any*

car in the database"?

1

- $\pi_{year}\, \sigma_{year>y2}\, (Car \times \rho_{Car(m2,y2,s2,c2)}\, Car)$
- $\pi_{year}\, \sigma_{year<y2}\, (Car \times \rho_{Car(m2,y2,s2,c2)}\, Car)$
- $\pi_{year}\, Car - \pi_{year}\, \sigma_{year>y2}\, (Car \times \rho_{Car(m2,y2,s2,c2)}\, Car)$
- ✔ $\pi_{year}\, Car - \pi_{year}\, \sigma_{year<y2}\, (Car \times \rho_{Car(m2,y2,s2,c2)}\, Car)$

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Question 4

Consider two SQL tables R and S.

- In both tables R and S, attribute A is a key and attribute B is not a key.
- No attributes are permitted to contain NULL values.
- Neither table is empty.
- Do not make any other assumptions about the data.

Decide if the two queries are equivalent, i.e., if they are guaranteed to produce the same answer on all possible states of the database.

```
Q1: select A from R
Q2: select R.A from R, S where R.A = S.
A
```

1

- Queries Q1 and Q2 are equivalent
- ✔ Queries Q1 and Q2 are not equivalent

Decide if the two queries are equivalent, i.e., if they are guaranteed to produce the same answer on all possible states of the database.

```
Q1: select max(A) from R
Q2: select A from R where A >= all (sel
ect A from R)
```

1

- ✔ Queries Q1 and Q2 are equivalent
- Queries Q1 and Q2 are not equivalent

Decide if the two queries are equivalent, i.e., if they are guaranteed to produce the same answer on all possible states of the database.

```
Q1: select B from R
Q2: select B from R group by B
```

1

- Queries Q1 and Q2 are equivalent
- ✔ Queries Q1 and Q2 are not equivalent

Decide if the two queries are equivalent, i.e., if they are guaranteed to produce the same answer on all possible states of the database.

```
Q1: select A from R where exists (selec
t * from S where S.A = R.A)
Q2: select A from R intersect select A
from S
```

1

- ✔ Queries Q1 and Q2 are equivalent
- Queries Q1 and Q2 are not equivalent

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Question 5

The **db-class** portal uses a relational DBMS to manage student assignment scores. Consider the SQL table **Scores(sID, aID, timestamp, score)**. A row in this table corresponds to a single submission from student sID for assignment aID, at a given timestamp with a given score. The only minimal key for the table is the three attributes [sID,aID,timestamp]. Which of the following SQL statements returns the sIDs of all students who have submitted some assignment more than 10 times?

1

- select distinct sID from Scores where count(*) > 10
- select distinct S1.sID from Scores S1, Scores S2 where count(*) > 10 and S1.aID = S2.aID
- ✔ select distinct sID from Scores group by sID, aID having count(*) > 10
- select distinct sID from Scores where count(distinct timestamp) > 10 group by sID, aID

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Question 6

Let relation R(A,B,C,D,E) satisfy the following functional dependencies:

A→D, C→AB, DB→E

Which one of the following functional dependencies also is guaranteed to be satisfied by R?

1

- ✔ C→E
- D→E
- A→E
- A→B

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Question 7

Consider a relation R(A,B,C,D,E) with functional dependencies A→B, BC→E, and D →A. Which one of the following is a key for R?

1

- AC
- AD
- BC
- ✔ CD

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Question 8

Here is an instance of a relation R(A,B,C):

A	B	C
4	2	1
5	2	3
5	1	3
5	2	1
4	2	3

Just one of the following multivalued dependencies is satisfied by this instance of R. Which one?

1

- C↠B
- ✔ B↠C
- C↠A
- A↠B

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Question 9

Consider a relation R(A,B,C,D) with functional dependencies A→B and B→C. Just one of the following decompositions could result from the Boyce-Codd Normal Form (BCNF) decomposition algorithm as presented in this class. Which one?

1

- R1(A,B), R2(A,C,D)
- R1(B,C), R2(A,C,D)
- R1(A,C), R2(B,C), R3(B,D)
- ✔ R1(A,B), R2(A,C), R3(A,D)

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Question 10

Consider a relation R(A,B,C) with functional dependency AB→C and multivalued dependency C↠B. We are interested in whether R is in Boyce-Codd Normal Form (BCNF) and/or Fourth Normal Form (4NF). Choose one of the following:

1

- Relation R is in neither BCNF nor 4NF
- ✔ Relation R is in BCNF but not 4NF
- Relation R is in 4NF but not BCNF
- Relation R is in both BCNF and 4NF