Final Exam

Score: 10.0/20.0

Raw Score (without penalties): 10.0

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Question 1

For Questions 1-3, consider the following DTD. (Note that it has been modified from the DTD used in the Midterm Exam.)

```
<!DOCTYPE Cities [
   <!ELEMENT Cities (City*)>
   <!ELEMENT City (Mayor, Neighborhood+
)>
   <!ATTLIST City Name CDATA #REQUIRED>
   <!ELEMENT Mayor (#PCDATA)>
   <!ELEMENT Neighborhood (Library | Bo
okshop)?>
   <!ATTLIST Neighborhood Name CDATA #R
EQUIRED>
   <!ELEMENT Library (#PCDATA)>
   <!ELEMENT Bookshop (#PCDATA)>
]>
```

Given an XML document “Cities.xml” conforming to this DTD, which of the following queries returns the names of all cities that have at least one neighborhood with a library?

0

- ✖ doc("Cities.xml")//City/Neighborhood[Library]/data(@Name)
- doc("Cities.xml")//City[Neighborhood/Library]/data(@Name)
- doc("Cities.xml")/Cities/City[Library]/data(@Name)
- doc("Cities.xml")/Cities/City/Neighborhood/Library

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Question 2

Given an XML document “Cities.xml” conforming to the DTD in Question 1, which statement describes what is returned by the following query in the XQuery language?

```
for $c in doc("Cities.xml")//City
let $l := count($c/Neighborhood)
let $b := count($c/Neighborhood/Booksho
```

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```
p)
where $l = $b
return $c/Mayor
```

1

- Always returns an empty result
- Returns the mayors of all cities where some neighborhood has a bookshop
- ✔ Returns the mayors of all cities where every neighborhood has a bookshop
- Returns every mayor

Question 3

Given an XML document conforming to the DTD in Question 1, which statement describes the result of applying the following XSLT stylesheet to the document? (Note: For brevity we omitted output formatting directives and details of the opening stylesheet element.)

```
<xsl:stylesheet>
```

```
<xsl:template match="Library|Bookshop">
  <Fun> <xsl:value-of select="parent::*
/data(@Name)" /> </Fun>
</xsl:template>
```

```
<xsl:template match="text()" />
```

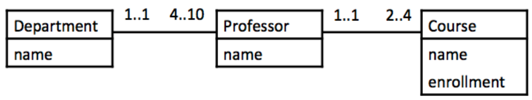
```
</xsl:stylesheet>
```

1

- Returns a single element “Fun” whose subelements are the names of all neighborhoods that have a library or a bookshop
- ✔ Returns the names of all neighborhoods that have a library or a bookshop, with each name in an element called “Fun”
- Returns the names of all cities that have at least one neighborhood with a library or a bookshop, with each name in an element called “Fun”
- Returns a copy of the input document with the “neighborhood” tag changed to a “Fun” tag for all neighborhoods that have a library or a bookshop

Question 4

This UML diagram captures relationships between departments, professors, and courses. For brevity we omitted names for the UML associations.



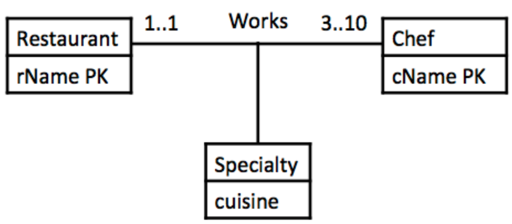
If there are 3 departments, what are the minimum and maximum number of courses possible?

0

- ✖ Minimum: 8, Maximum: 40
- Minimum: 16, Maximum: 40
- Minimum: 24, Maximum: 48
- Minimum: 24, Maximum: 120

Question 5

This UML diagram shows a Restaurant class, a Chef class, and an association Works between chefs and restaurants with an association class called Specialty.



Which of the following relational schemas could ***not*** be derived from the UML diagram using the UML-to-relational mapping techniques described in the video lectures?

0

- Restaurant(rName), Chef(cName), Works(rName, cName, cuisine)
- Restaurant(rName), Chef(cName, rName, cuisine)
- Restaurant(rName, cName, cuisine), Chef(cName)
- ✖ All three of these schemas could be derived

Question 6

Consider the following schema for a simplified movie-ratings database:

```
 Movie(title, director)       // title
 is a key
 Rating(person, title, score) // <pers
on,title> is a minimal key
```

Suppose there are three types of queries commonly asked on this database:

- Given a movie title, find the director of the movie
- Match each person with the directors of movies the person has rated
- Given a person, find the titles of all movies the person has rated

Which of the following indexes could ***not*** be useful in speeding up execution of one or more of the above queries?

0

- Index on Rating.person
- Index on Rating.title
- ✖ Index on Movie.title
- Index on Movie.director

Question 7

Consider the following declarations for tables Student and Party using standard SQL, including a tuple-based Check constraint in table Party. Assume attribute sName is a key for table Student. Do these table definitions ensure "referential integrity" from Party.guest to Student.sName, regardless of how the database is modified?

```
create table Student(sName)
create table Party(guest, check(guest i
n (select sName from Student)))
```

0

- ✖ Yes
- No

Question 8

Consider a table User(userID, <other attributes>), where userID may not contain NULL values, and the following general assertion using standard SQL. Does the assertion ensure that attribute userID is a key for table User, regardless of how the database is modified?

```
create assertion Key check (not exists
(select userID from User group by userI
D having count(*) > 1) )
```

1

- ✔ Yes
- No

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Question 9

Here are table declarations for three tables R(A), S(B), and T(C), including referential integrity in standard SQL.

```
 create table R (A primary key);
 create table S (B primary key referenc
es R(A) on update cascade)
 create table T (C primary key referenc
es S(B) on update cascade)
```

Let the initial contents of the tables be:

R(A) = { (1), (2), (3), (4), (5), (6) }

S(B) = { (1), (2), (4), (6) }

T(C) = { (1), (2), (6) }

Suppose we run the SQL modification command:

```
update R set A = A + 10 where A < 5
```

After execution of this command, and any resulting referential integrity actions, what is the answer for the following query:

```
select sum(C) from T
```

0

- 9
- 19
- 29

✖ 39

Question 10

Consider two tables R(A) and S(B). Let the initial contents of the tables be:

R(A) = { (1) }

S(B) = { (2), (2), (3) }

We specify two triggers using the SQL standard trigger language:

```
create trigger First
  after insert on R
  for each row
  update S set B = 3 where B = New.A
```

```
create trigger Second
  after update on S
  for each row
  update R set A = A+1
```

Now suppose we run the SQL modification command:

```
  insert into R values (2)
```

After execution of this command, and any resulting trigger activity, what are the final contents of relation R?

0

- { (1), (2) }
- ✖ { (2), (3) }
- { (1), (3) }
- { (3), (4) }

Question 11

Consider a table T(A) containing four tuples: { (1), (1), (2), (3) }. We have two possible triggers on table T, specified using the SQL standard trigger language:

```
create trigger RowLevel
  after update on T
  for each row
  insert into T values (0)
```

```
create trigger StatementLevel
  after update on T
  insert into T values (0)
```

Suppose just one of the two triggers is installed at a time. For three of the following SQL data modification commands, the final database state (after the modification and any resulting trigger activity) would differ depending which trigger is installed. For one of the commands, the final database state would be the same regardless of which trigger is installed. For which command does the choice of trigger make ***no*** difference?

0

- update T set A = A+1
- ✖ update T set A = A
- update T set A = 4 where A = 3
- update T set A = 0 where A = 1

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Question 12

For Questions 12-14, consider a table Bid(item,price). There are initially two tuples in Bid: (phone,10) and (laptop,20). We execute the following two transactions concurrently:

```
T1 - S1: update Bid set price = price +
 5
     S2: insert into Bid values (deskto
p,30)
```

```
T2 - S3: select sum(price) as s from Bi
d
     S4: select max(price) as m from Bi
d
```

Transaction T1 always executes with isolation level *Serializable*. Assume both transactions successfully commit, and the individual statements S1, S2, S3, and S4 within the transactions each execute atomically.

If transaction T2 also executes with isolation level *Serializable*, which of the following pairs of values for the sum (s) and max (m) ***cannot*** be returned by T2?

1

- s = 30, m = 20
- ✔ s = 30, m = 30
- s = 70, m = 30
- All three pairs could be returned

Question 13

This question uses the same tables and transactions specified in Question 12. If transaction T2 executes with isolation level *Read Committed*, which of the following pairs of values for the sum (s) and max (m) ***cannot*** be returned by T2?

0

- s = 30, m = 20
- ✖ s = 30, m = 30
- s = 40, m = 30
- s = 70, m = 30

Question 14

This question uses the same tables and transactions specified in Question 12. If transaction T2 executes with isolation level *Read Uncommitted*, which of the following pairs of values for the sum (s) and max (m) ***cannot*** be returned by T2?

1

- s = 30, m = 25
- s = 30, m = 30
- s = 40, m = 30
- ✔ s = 70, m = 25

Question 15

Consider the following schema for a simplified movie-ratings database:

```
  Movie(title, director)       // title
 is a key
  Rating(person, title, score) // <pers
on,title> is a minimal key
```

(The same schema was used in Question 6.) We list four views defined over this schema. Three of the views are non-updatable according to the SQL standard, while one of the views is updatable. Which one is the updatable view, according to the SQL standard?

0

- ✖ create view V as select person, avg(score) from Rating group by person
- create view V as select Movie.title, director, person, score from Movie, Rating where Movie.title = Rating.title
- create view V as select distinct(director) from Movie
- create view V as select title, director from Movie where title in (select title from Rating where score > 3)

Question 16

Consider the following schema for a simplified movie-ratings database:

```
  Movie(title, director)       // title
 is a key
  Rating(person, title, score) // <pers
on,title> is a minimal key
```

(The same schema was used in Questions 6 and 15.) Suppose we wish to execute the following query over this database:

```
   update Rating
   set score=5
   where person='Bob'
   and title in (select title from Movi
e where director='Jane')
```

Which of the following privileges is ***not*** needed for executing this query?

1

- update on Rating
- ✔ select on Rating(score)
- select on Rating(person)
- select on Rating(title)
- select on Movie(title)
- select on Movie(director)

Question 17

Consider a table T with owner Amy, and the following sequence of statements related to privileges on T. Each statement is prefaced with the user issuing it.

```
Amy:   grant select, insert, delete on
T to Bob with grant option
Amy:   grant select, insert, delete on
T to Carol with grant option
Bob:   grant select, insert on T to Da
vid
Carol: grant select, delete on T to Da
vid
Amy:   revoke select, insert, delete f
rom Bob cascade
```

What privileges on table T does David have after this sequence of statements?

1

- None
- select on T
- ✔ select, delete on T
- select, insert, delete on T

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Question 18

Suppose a labeled graph is encoded in a single table G(n1,n2,label). Each tuple in G specifies that there is a directed edge from node n1 to node n2 with the given label. For example, a graph with three nodes and three edges might contain the tuples (A,B,red), (B,C,blue), (A,C,red). Assume the encoded graph has no cycles. One of the following four queries computes the length of (i.e., the number of edges in) the longest path in the graph that contains red edges only. Which one?

1

- with recursive P(n1,n2,length) as (select n1,n2,1 from G where label='red' union select P.n1, G.n2, P.length+1 from P, G where P.n2 = G.n1) select max(length) from P
- with recursive P(n1,n2,length) as (select n1,n2,1 from G union select P.n1, G.n2, P.length+1 from P, G where P.n2 = G.n1 and G.label='red') select max(length) from P
- ✔ with recursive P(n1,n2,length) as (select n1,n2,1 from G where label='red' union select P.n1, G.n2, P.length+1 from P, G where P.n2 = G.n1 and G.label='red') select max(length) from P
- with recursive P(n1,n2,length) as (select n1,n2,1 from G union select P.n1, G.n2, P.length+1 from P, G where P.n2 = G.n1) select max(length) from P

Question 19

Consider the following fact table in an OLAP application:

```
   Flight(origin,destination,airline,pr
ice)
   // <origin,destination,airline> is a
 minimal key
```

and the following two views over this table:

```
  create view FlightCube
     select origin, destination, airlin
e, sum(price) as p from Flight
     group by origin, destination, airl
ine with cube
```

```
  create view FlightRollup
     select origin, destination, airlin
e, sum(price) as p from Flight
     group by origin, destination, airl
ine with rollup
```

Which of the following queries does ***not*** compute the total price of all flights with an origin of SFO?

1

- select sum(p) from FlightCube where origin = 'SFO' and destination is null and airline is null
- select sum(p) from FlightRollup where origin = 'SFO' and destination is null and airline is null
- select sum(p) from FlightCube where origin = 'SFO' and destination is not null and airline is not null
- ✔ select sum(p) from FlightRollup where origin = 'SFO' and destination is null and airline is not null

Question 20

Which of the following features would we ***least*** expect to find in a NoSQL system?

1

- Extreme scalability
- Simple processing based on key values
- ✔ Serializable multi-statement transactions
- Fault-tolerance