

Name: \_\_\_\_\_

Lastname: \_\_\_\_\_

Student No: \_\_\_\_\_

Group No: \_\_\_\_\_

Grade: \_\_\_\_\_ / 50

# EASTERN MEDITERRANEAN UNIVERSITY

DEPARTMENT OF  
COMPUTER  
ENGINEERING

## CMPE353/CMSE354 Final Examination

2022-2023 Fall Semester  
January 18, 2023

- This exam is composed of 30 multiple choice questions for a total of 50 points
- Time allowed: 120 minutes
- 14 pages, last page is for draft work

Prof. Dr. Ekrem Varoğlu

## PART A- SQL

For Q1 through Q5 consider the following schema definitions which stores data about patients, doctors and appointments made by patients with doctors.

The primary key attributes are underlined for each schema.

*patient* (*patient\_name*, *id*, *age*, *address*)  
*doctor* (*dr\_name*, *id*, *age*)  
*appointment* (*dr\_id*, *patient\_id*, *date*, *time*)

Q1) Consider the query below which finds the names of Dr. Wright's patients.

```
SELECT DISTINCT patient_name  
FROM R  
WHERE P
```

Which of the following correctly replaces R and P?

- a) R: patient natural inner join appointment natural inner join doctor, P: dr\_name="Wright"  
AND appointment.doctor\_id=doctor.id AND appointment.patient\_id=patient.id
- b) R: patient, doctor, appointment, P: dr\_name="Wright" AND appointment.dr\_id=doctor.id  
AND appointment.patient\_id=patient.id
- c) R: patient, doctor, P: dr\_name="Wright" AND patient.id=doctor.id
- d) R: patient, appointment, P: patient\_name="Wright" AND patient.id=appointment.patient\_id

Q2) Consider the query below which finds how many appointments each patient has.

```
SELECT A  
FROM appointment  
B
```

Which of the following correctly replaces A, and B?

- a) A: patient\_id, B: GROUP BY patient\_id
- b) A: count (\*), B: HAVING patient.id=appointment.patient\_id
- c) A: count (\*), B: GROUP BY patient\_id
- d) A: patient\_id, count (\*), B: GROUP BY patient\_id

Q3) Consider the query below which finds the ids of doctors who have an appointment with Mr.Sick.

```
SELECT DISTINCT dr_id  
FROM R  
WHERE patient_name= "Sick" AND id=patient_id
```

Which of the following correctly replaces R?

- a) R: patient, appointment
- b) R: appointment
- c) R: patient, doctor
- d) R: doctor, appointment

Q4) Consider the query below which finds the names of patients who have an appointment with at least one of the doctors that Mr. Sick has an appointment.

```
SELECT patient_name
FROM patient, appointment
WHERE id=patient_id AND P IN ( SELECT dr_id
                                FROM patient, appointment
                                WHERE patient_name= "Sick" AND id=patient_id)
```

Which of the following correctly replaces P?

- a) P: id
- b) P: patient\_id
- c) P: dr\_id
- d) P: dr\_id=patient\_id

Q5) Consider the query below deletes all patients of Dr. Best.

```
DELETE FROM A
WHERE patient_id IN (SELECT patient_id
                    FROM B, C
                    WHERE dr_name= "Best" AND dr_id=id)
```

Which of the following correctly replaces A, B and C?

- a) A: patient, B: doctor, C:appointment
- b) A: doctor, B:appointment , C: patient
- c) A: patient, B: patient, C:appointment
- d) A: patient, B: patient, C:doctor

## PART B- Relational Algebra

For Q6 through Q8 consider the following schema definitions which stores data about authors and the books they wrote. The primary key attributes are underlined for each schema. (the symbol  $\bowtie$  represents natural inner join operator)

*author* ( *id*, *name*, *age* )

*wrote* ( *id*, *isbn* )

*book* ( *isbn*, *title*, *year*, *publisher* )

Q6) Consider the relational algebra expression which finds the book titles written by “Jojo Moyes”.

$\Pi_{title}(R)$

Which of the following correctly replaces R?

- a)  $\sigma_{name="Jojo Moyes"}(author \bowtie book)$
- b)  $\sigma_{name="Jojo Moyes"}(author \bowtie wrote \bowtie book)$
- c)  $\sigma_{name="Jojo Moyes"}(author \bowtie wrote \bowtie book)$
- d)  $\sigma_{name="Jojo Moyes"}(author \bowtie book)$

Q7) Consider the relational algebra expression which finds the names of authors whose books have been published by Cambridge Press.

$OP1(OP2(author \bowtie wrote \bowtie book))$

Which of the following correctly replaces OP1 and OP2?

- a) OP1:  $\Pi_{name}$ , OP2:  $\sigma_{publisher="Cambridge Press"}$
- b) OP1:  $\sigma_{publisher="Cambridge Press"}$ , OP2:  $\Pi_{name}$
- c) OP1:  $\Pi_{publisher="Cambridge Press"}$ , OP2:  $\sigma_{name="Jojo Moyes"}$
- d) OP1:  $\sigma_{name="Jojo Moyes"}$ , OP2:  $\Pi_{publisher="Cambridge Press"}$

Q8) Consider the relational algebra expression given below which lists the IDs of authors and how many books they wrote.

$\rho_A \rho_B(\text{wrote})$

Which of the following correctly replaces A and B?

- a) A: count(title), B: id
- b) A: id, B: count(isbn)
- c) A: count(isbn), B: id
- d) A: id, B: count(title)

### **Part C – Entity-Relationship Design**

Consider the text below which describes the design of a database for a healthcare system using the Entity-Relationship (E-R) model.

- Patients are uniquely identified by an id number, and their names addresses and ages must be stored.
- Doctors are uniquely identified with a doctor's id. For each doctor, name, specialty, and years of experience must be stored.
- Medicines are produced by pharmaceutical companies. The names of the companies are unique. The phone number for each company is also stored.
- For each medicine, its name and formula is stored. Each medicine is made by a given pharmaceutical company, and the medicine name identifies a medicine uniquely from among the products of that company. Other companies may produce the same medicine with the same medicine name.
- Pharmacies have unique names and the address and phone number for each pharmacy must be stored. Each pharmacy sells several medicines and the same medicine is sold at different pharmacies. The price of a medicine may be different at different pharmacies.
- Pharmaceutical companies have contracts with pharmacies. A pharmaceutical company may have a contract with several pharmacies and a pharmacy may contract with several pharmaceutical companies. The start date, end date and text for each contract must be stored.
- Each patient has one doctor that s/he visits. However, doctors examine many patients. Medicines are prescribed by doctors. The date and quantity of a medicine prescribed by a doctor is stored. A doctor may prescribe several medicines and a medicine may be prescribed by more than one doctor. Several medicines may be used by a patient and the same medicine may be used by different patients. The database does not need to store which medicine is prescribed by which doctor to which patient.

Answer questions Q9-Q20 according to a database designed for the task described above. Assume that the database design will consider **minimum number of tables possible and the least possible repetition of data.**

Q9) The mapping cardinality for the relationship between medicine and pharmaceutical company entity sets is:

a) 1 to 1

b) 1 to many from pharmaceutical companies to medicines whose many side is total participation

c) 1 to many from pharmaceutical companies to medicines whose many side is partial participation

d) many to many

Q10) The primary key for the medicine entity set is:

a) medicine\_name

b) medicine\_name, formula

c) medicine\_name, pharma\_company\_name, pharmacy\_name

d) medicine\_name, pharma\_company\_name

Q11) How many generalizations/specializations are described in this design?

a) 0

b) 1

c) 2

d) 4

Q12) The contracts between pharmacies and pharmaceutical companies can best be modelled as a:

a) relationship with attributes

b) entity set

c) weak entity set

d) multivalued attribute

Q13) Which of the following best describes the relationship between pharmacies and pharmaceutical companies?

a) many to many relationship

b) identifying relationship

c) many to many relationship which involves relationship attributes

d) many to one relationship from pharmaceutical companies to pharmacies



Q14) Which of the following attribute types is the best way to store the address and telephone number for a pharmacy respectively?

- a) Composite-multi valued, composite-multivalued
- b) Composite-multi valued, simple-single valued
- c) Simple-single valued, composite-multivalued
- d) Composite-single valued, composite-single valued

Q15) The data between the pharmacies and the medicines they sell can best be stored in a table whose columns are:

- a) Pharmacy\_name, medicine\_name
- b) Pharmacy\_name, medicine\_name, price
- c) Pharmacy\_name, medicine\_name, pharma\_company\_name, price
- d) Pharmacy\_name, medicine\_name, pharma\_company\_name

Q16) If we are to minimize data repetition, which of the following is the best way to represent the doctor for each patient?

- a) The dr\_id must be stored as an attribute in the table which stores patients' data
- b) A separate table which stores the patient\_id and the dr\_id must be used
- c) The patient\_id must be stored as an attribute in the table which stores doctors' data
- d) The patient table must be modeled as a weak entity set and the primary key must be constructed using the patient\_id and dr\_id

Q17) If we are to minimize data repetition and possibility of null values, the data regarding doctors and the medicines they prescribed can best be stored in a table whose columns are:

- a) dr\_id, medicine\_name, pharma\_company\_name, date, quantity
- b) dr\_id, medicine\_name, date, quantity
- c) dr\_id, medicine\_name, quantity
- d) dr\_id, medicine\_name, date

Q18) Suppose the following change is now made in your requirements: *The price of a medicine is same at every pharmacy*. How is this change represented in your E-R design in order to avoid data repetition and redundant use of tables?

- a) The price of the medicine can now be stored in the pharmaceutical company entity set.
- b) The price of the medicine can now be stored in the pharmacy entity set.
- c) The price of the medicine can now be stored in the medicine entity set.
- d) The price of the medicine can now be stored in the relationship set between entity sets medicine and pharmacy.

Q19) Suppose the following change is now made in your requirements: *The date of the last visit of a patient to his/her doctor should be stored.* How is this change represented in your E-R design in order to avoid data repetition and redundant use of tables?

- a) The date attribute must be stored in the patient entity set
- b) The date attribute must be stored in the doctor entity set
- c) The date attribute must be stored in the relationship set representing the relationship between doctors and patients as a relationship attribute
- d) The date attribute must be stored as a multivalued attribute

Q20) Suppose the following change is now made in your requirements: *Several phone numbers will be stored for each patient. The type of the phone (mobile, home, work) will also be stored for each phone number.* How is this change represented in your E-R design in order to avoid data repetition, null values and redundant use of tables?

- a) a multivalued attribute to store the phone numbers will be included in the entity set patient
- b) generalization/specialization must be used to represent different phone types
- c) a composite multivalued attribute to store the phone number and a composite valued attribute to store the type of each phone number will be included in the entity set patient
- d) an entity set phone with attributes phone\_no and phone\_type which has a one to many relationship between patient and phone will be included in the design

## Part D – Relational Database Design and Normalization

Q21) Consider the set of functional dependencies

$F = \{A \rightarrow BC, C \rightarrow DE, EF \rightarrow AC, A \rightarrow D, E \rightarrow ABC, F \rightarrow A, DF \rightarrow AE, D \rightarrow BE\}$  that hold for the relational schema  $R = (A, B, C, D, E, F)$ .

How many of the following statements are true?

- i) Attribute B in  $A \rightarrow BC$  is extraneous
- ii) Attribute C in  $A \rightarrow BC$  is extraneous
- iii) Attribute D in  $C \rightarrow DE$  is not extraneous
- iv) Attribute E in  $C \rightarrow DE$  is not extraneous
- v) Attribute F in  $EF \rightarrow AC$  is extraneous

- a) 2                      b) 5                      c) 4                      **d) 3**

Q22) Consider the set of functional dependencies  $F = \{A \rightarrow BC, C \rightarrow D, ED \rightarrow B, DF \rightarrow C\}$  that hold for the relational schema  $R = (A, B, C, D, E, F)$ .

How many of the following decompositions of R into R1 and R2 is/are lossless join decomposition?

- i)  $R_1 = (A, B, C), R_2 = (C, D, E, F)$
- ii)  $R_1 = (A, C, D), R_2 = (B, D, E, F)$
- iii)  $R_1 = (A, B, C, D), R_2 = (A, E, F)$
- iv)  $R_1 = (A, C, D, F), R_2 = (A, B, D, E, F)$

- a) **2**                      b) 4                      c) 3                      d) 1

Q23) Consider the set of functional dependencies  $F = \{A \rightarrow B, C \rightarrow D\}$  that hold for the relational schema  $R = (A, B, C, D)$ .

Which of the following Armstrong's Axioms can be used in the given order to show that  $AC \rightarrow BD$  is in  $F^+$ ?

- a) augmentation, pseudo-transitivity
- b) augmentation, augmentation, transitivity**
- c) reflexivity, augmentation, transitivity
- d) union, decomposition, transitivity

For Questions Q24-Q26 Consider the set of functional dependencies

$F = \{CE \rightarrow A, C \rightarrow A, C \rightarrow B, AB \rightarrow C, A \rightarrow B, B \rightarrow A\}$  that hold for the relational schema  $R=(A,B,C,E)$ .

Q24) How many of the following functional dependencies is/are in  $F^+$  ?

- i)  $B \rightarrow E$       ii)  $AE \rightarrow C$       iii)  $C \rightarrow ABE$       iv)  $ABC \rightarrow E$       v)  $E \rightarrow A$

- a) 4      b) 3      c) 5      d) 1

Q25)  $(ABE)^+ = ?$

- a) ABE      b) AB      c) ABCE      d) ABC

Q26) How many of the following statements is/are true?

- i) ABE is a super-key for R.  
ii) ABE is a candidate key for R.  
iii) CE is a super-key for R.  
iv) CE is a candidate key for R.

- a) 4      b) 3      c) 2      d) 1

Q27) Consider the set of functional dependencies  $F = \{C \rightarrow AB, C \rightarrow B, A \rightarrow B, C \rightarrow A\}$  that hold for the relational schema  $R=(A,B,C)$ .

The Canonical cover  $F_c$  of is ?

- a)  $F_c = \{C \rightarrow A, A \rightarrow B\}$   
b)  $F_c = \{C \rightarrow B, A \rightarrow B\}$   
c)  $F_c = \{C \rightarrow A, A \rightarrow B, C \rightarrow B\}$   
d)  $F_c = \{C \rightarrow A, C \rightarrow B, C \rightarrow C\}$

Q28) Consider the set of functional dependencies  $F = \{AB \rightarrow CD, C \rightarrow D\}$  that hold for the relational schema  $R=(A,B,C,D)$ . AB is a candidate key for R.

Which of the following is true?

- a) R satisfies BCNF.  
b) R satisfies 3NF.  
c) R satisfies both 3NF and BCNF.  
d) R does not satisfy 3NF or BCNF.

Q29 ) Which of the following is always true?

- a) A schema which satisfies 3NF satisfies BCNF.
- b) A schema which satisfies BCNF satisfies 2NF.
- c) A schema which satisfies BCNF satisfies 4NF.
- d) A schema which satisfies 3NF satisfies 4NF.

Q30) How many of the following statements are true?

- i) BCNF decomposition always guarantees lossless join decomposition.
- ii) BCNF decomposition always guarantees dependency preservation.
- iii) 3NF decomposition always guarantees lossless join decomposition.
- iv) 3NF decomposition always guarantees dependency preservation.
- v) Functional dependencies is a generalization of the notion of a key.

- a) 4                      b) 5                      c) 3                      d) 2

\*\*\* BLANK SHEET FOR DRAFT WORK – DO NOT SEPARATE FROM THE QUESTION BOOKLET- not graded! \*\*\*