

NANYANG TECHNOLOGICAL UNIVERSITY**SEMESTER 1 EXAMINATION 2022-2023****SC2207/CZ2007 – INTRODUCTION TO DATABASES**

Nov/Dec 2022

Time Allowed: 2 hours

INSTRUCTIONS

1. This paper contains 4 questions and comprises 6 pages.
 2. Answer **ALL** questions.
 3. This is a closed-book examination.
 4. All questions carry equal marks.
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1. Consider a database comprising eight tables as shown below. The eight tables record information about pilots, student pilots, professional pilots, passengers, flights taken by passengers, aircrafts, flights flown by pilots, and whether a pilot is qualified to fly a particular type of aircraft. Keys are underlined.

PILOT(D#, age, salary)STUDENT-PILOT(D#, learning_license)PROFESSIONAL-PILOT(D#, professional_license)PASSENGER(P#, seat_preference)TRAVEL(P#, T#)AIRCRAFT(N#, type, year_built)FLIGHT(T#, D#, N#, depart_airport, arrive_airport, date, day_of_week)QUALIFIED(D#, N#, year qualified)

- (a) Construct an ER diagram corresponding to the eight tables. You may make suitable assumptions in order to construct the ER diagram.

(10 marks)

- (b) Using relational algebra, find pilots who have flown the most-flown flight routes on Fridays on aircrafts that are built after 2020. A flight route is defined by its departure airport and arrival airport.

(7 marks)

Question No. 1 continues on Page 2

- (c) Using relational algebra, find pilots who have flown at least 20 morning flights from Singapore to Dubai on aircrafts that are qualified by the largest number of pilots with qualifications done after 2020.
- (8 marks)
2. Consider relation R(A, B, C, D, E) with the following functional dependencies:
- $$A \rightarrow B, \quad BC \rightarrow D, \quad BD \rightarrow A, \quad CD \rightarrow E, \quad AB \rightarrow D$$
- (a) What is the key (not superkey) of R? Explain the steps in deriving the key.
- (5 marks)
- (b) Which functional dependencies violate the BCNF criteria? Apply a BCNF decomposition on R, and then verify whether your BCNF decomposition preserves all functional dependencies.
- (10 marks)
- (c) Verify whether R is in 3NF. If R is not in 3NF, apply a 3NF decomposition on R.
- (10 marks)
3. (a) Consider the following schema HOTEL, ROOM, BOOKING and GUEST in a DBMS. hotelNo is the primary key of the HOTEL relation and roomNo is the primary key of the ROOM relation. BOOKING stores details of room reservations and bookingNo is the primary key. GUEST stores guest details and guestNo is the primary key.
- HOTEL(hotelNo, hotelName, hotelType, hotelAddress, hotelCity, numRoom)
- ROOM(roomNo, hotelNo, roomPrice)
- BOOKING(bookingNo, hotelNo, guestNo, checkIn, checkOut, totalGuest, roomNo)
- GUEST(guestNo, firstName, lastName, guestAddress)

Question No. 3 continues on Page 3

- (i) Write an SQL statement to list full details of all hotels.
 - (ii) Write an SQL statement to list full details of all hotels in New York.
 - (iii) Write an SQL statement to list guests in New York in descending order.
- (3 marks)

- (b) Consider the following seven relations for a car-rental database system in a company:

CUSTOMER(Cust#, Cname, City)

RENTAL(Rental#, Rdate, Cust#, Time, Date, Hourly_rate)

RENTAL_CAR(Rental#, Car#, Driver#, Start_time, End_time, Amount_received)

CAR(Car#, Year, Model, Price, Depreciation, Last_service)

SERVICING(Garager#, Car#, Service_date)

GARAGE(Garage#, GAddress, Owner_name)

DRIVER(Driver#, DName, DAddress)

Write appropriate SQL DDL statements to define the database.

(7 marks)

- (c) Consider the following COMPANY database:

EMPLOYEE(Eid#, Name, Department, Bdate, Supervisor)

PROJECT(Project_no#, Project_name, Location, Controlling_dept)

EMP_PROJ(Eid#, Project_no#, Hours)

DEPENDENT (Eid#, Dependent_name, Relations hip, Bdate)

DEPARTMENT(Department_no#, Dependent_name, Manager)

Create triggers to do the following:

Question No. 3 continues on Page 4

- (i) Whenever an employee's project assignments are changed, check if the total hours per week spent on the employee's projects are less than 30 or greater than 40; if so, notify the employee's supervisor. You may assume that a procedure TELL_SUPERVISOR(ARGEid) has been created. This procedure looks for an employee whose Eid matches the procedure's AGREid argument and it notifies the supervisor of that employee.
- (ii) Whenever an employee is deleted, delete the PROJECT tuples and DEPENDENT tuples related to that employee.
- (8 marks)
- (d) Discuss the choice of primary index when you are creating an index on a relation. Compare the clustered versus unclustered indexes when you are creating an index on a relation.
- (7 marks)
4. (a) Specify the following queries in SQL on the database shown in Fig. 4a.
- (i) Retrieve course names of all courses that come under the department of 'cs' (computer science).
 - (ii) Retrieve names of all courses along with the names of the instructors taught during the fall of 2008.
 - (iii) For each section taught by Professor Anderson, retrieve the course number, semester, year, and number of students who took the section.
 - (iv) Retrieve the name and transcript of each junior student (Class = 1) majoring in mathematics (MATH). A transcript includes course name, course number, credit hours, semester, year, and grade for each course completed by the student.
 - (v) Write an SQL update statement: Insert a new course: <'Financial Accounting', 'fac4390', 5, 'BUSINESS'>
 - (vi) Write an SQL update statement: Insert a new section: <145, 'fac4390', 'Fall', '17', 'Hanif'>
 - (vii) Write an SQL update statement: Insert a new student: <'Robin', 34, 3, 'BUSINESS'>

Question No. 4 continues on Page 5

- (viii) Write an SQL update statement: Update the record for the student whose student number is 17 and change his class from 1 to 3.

(8 marks)

STUDENT				PREREQUISITE	
Name	Student number	Class	Major	Course number	Prerequisite number
Smith	17	1	CS	CS3380	CS3320
Brown	8	2	CS	CS3380	MATH2410
				CS3320	CS1310

COURSE				
Course name	Course number	Credit hours	Department	
Intro to Computer Science	CS1310	4	CS	
Data Structures	CS3320	4	CS	
Discrete Mathematics	MATH2410	3	MATH	
Database	CS3380	3	CS	

SECTION				
Section identifier	Course number	Semester	Year	Instructor
86	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

GRADE REPORT		
Student number	Section identifier	Grade
17	112	B
17	119	C
8	86	A
8	92	A
8	102	B
8	135	A

Figure 4a

- (b) How can the key and foreign key constraints be enforced by DBMS? Discuss the difficulty in implementing the enforcement technique. Can the constraint checks be executed in an efficient manner when updates are applied to the database?

(5 marks)

Question No. 4 continues on Page 6

- (c) Map the following relational data to JSON.

MEMBER

Name	Phone
Peter	7371
Jill	8719

LOAN

memberName	Date	Book
Peter	20220825	Asian gourmet
Peter	20220901	Western gourmet
Jill	20220910	Tight space gardening

(4 marks)

- (d) Map the following relational data to XML.

COUNTRY CLUB

Name	Phone	Age	Sports
Jackson	3333	46	Tennis
Mary	7777	52	Badminton

(4 marks)

- (e) Create a view that selects students in the STUDENTS table whose CGPA is higher than the average, then use the view to select students who are majoring in DSAI (Data Science and Artificial Intelligence). Output students' names and their class_ids.

STUDENTS(**Student_id**, Student_name, CGPA, major, class_id)

(4 marks)

END OF PAPER

CZ2007 INTRODUCTION TO DATABASES

SC2207 INTRODUCTION TO DATABASES

Please read the following instructions carefully:

- 1. Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**
2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.
3. Please write your Matriculation Number on the front of the answer book.
4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.