MIDTERM EXAM - 601.415/615 - Databases

Name:

Date: Thursday, November 5, 2020, 3-4:30 PM

The total number of points in this exam is 76 for 601.415/615 students. If you work at approximately 1 minute per point, you should finish on time. All of the programming problems are no worth 6 points (for 6 minutes on average), with 14+ minutes to spare at the end for review and extra time.

Relational Algebra Shortcuts:

⋈ -> JOIN	π -> PI
⋊ -> RIGHT JOIN	ρ -> RHO
⋉ -> LEFT JOIN	σ -> SIGMA
∩ -> INTERSECT	∪ -> UNION
− -> MINUS or just -	^ -> AND or just ^

Relational Calculus Shortcuts:

∃ -> EXISTS	∄ -> NEXISTS
¬ -> NOT	∈ -> IN

QBE Shortcut: ¬ -> NOT

Questions 1-3 - Relational Algebra (18 points)

1. (6 points) List the name, age and EID of employees who are certified to fly *all* aircraft (AID) in the database that have a cruising range greater than 3000 miles. Answer in RELATIONAL ALGEBRA.

   Relational Algebra Shortcuts:

        i.   ⋈ -> JOIN, ⋊ -> RIGHT JOIN, ⋈ -> LEFT JOIN, ∩-> INTERSECT,
               − -> MINUS, π -> PI, ρ -> RHO, σ -> SIGMA, ∪ -> UNION

Answer:

2. (6 points) List the names and age of all pilots who have *never* had a maintenance issue on a flight where they were the pilot. Answer in RELATIONAL ALGEBRA.

    Relational Algebra Shortcuts:

    i. ⋈ -> JOIN, ⋉ -> RIGHT JOIN, ⋈ -> LEFT JOIN, ∩-> INTERSECT,
        − -> MINUS, π -> PI, ρ -> RHO, σ -> SIGMA, ∪ -> UNION

Answer:

3. (6 points) For all employees, list pairs of the Employee Name and the aircraft (Aircraft name and AID) that they are *not* certified to fly. If John Smith is not certified to fly 93 aircraft in the database then there should be 93 rows for John Smith in the answer (with the employee name and aircraft name and AID listed for each row). Every employee should be included, even if they are not certified to fly any aircraft, but your table will omit employees who are certified to fly all aircraft. You don't need to use an outer join. Answer in RELATIONAL ALGEBRA.

Relational Algebra Shortcuts:

   i.   ⋈ -> JOIN, ⋉ -> RIGHT JOIN, ⋊ -> LEFT JOIN, ∩-> INTERSECT,
        − -> MINUS, π -> PI, ρ -> RHO, σ -> SIGMA, ∪ -> UNION

Answer:

Question 4 - Tuple Relational Calculus (6 points)

4. (6 points) list all directed city pairs (e.g. BWI,DEN) and their distance where there is a direct flight between those cities listed in the database under 2000 miles and there is at least 1 flight listed that on that route that has flown using a Boeing 787.

   Answer in the TUPLE RELATIONAL CALCULUS.

   Relational Calculus Shortcuts:

   i. ∃ -> EXISTS, ∄ -> NEXISTS, ¬ -> NOT, ∈ -> IN, ^->AND or ^, V->OR or V

Answer:

Question 5 - SQL (24 points)

5a. (6 points) How many total miles has Jason Eisner flown as a pilot of an Embraer 135 flight in the database? Answer in SQL.

Answer:

5b. (6 points) Which type of aircraft has had the most total unresolved maintenance issues in the entire database (e.g. Embraer 135, where Resolved=False)?
ANSWER IN SQL.

Answer:

5c. (6 points) Which pilot has flown the most total miles on a flight
that has either started or ended in Maryland? List their name, age and total
miles.
ANSWER IN SQL.

Answer:

5d. (6 points) For all city pairs in a given direction (e.g. from BWI to DEN) and more than 5000 miles, list the lowest direct price listed in the database for that route (you don't need to include connections). Answer in SQL

Answer:

Question 6 - QBE (18 points)

Express the following queries in QBE. To simplify your work, table shells have been provided. Just fill in the appropriate cells with variables/values.

6a. (6 points) Find all 2-flight connections between BWI and SFO that have a total combined flight distance under 3200 miles. List the first flight number, 2nd flight number, name of connecting city and total distance in your answer.
QBE Shortcut: ⌐ -> NOT

FLIGHTS	FLNO	FromCode	ToCode	DepTime	ArrTime	Price	Distance

CODE_NAMES	Code	CityName	StateName

EMPLOYEES	EID	EName	Age	Salary

AIRCRAFT	AID	AName	CruisingRange

CERTIFIED_TO_FLY	EID	AID

RESULT				

Conditions

6b. (6 points) A customer wants to fly from BWI to SFO on 2 or 3 connecting flights (e.g. a flight from BWI to ORD, another from ORD to DEN and another flight from DEN to SFO). List all 2 or 3-flight options from BWI to SFO including their departure time from BWI, their arrival time in SFO and both the airport codes and name of the first city where the flight connects. ANSWER IN QBE

QBE Shortcut: ⌐ -> NOT

FLIGHTS	FLNO	FromCode	ToCode	DepTime	ArrTime	Price	Distance

CODE_NAMES	Code	CityName	StateName

EMPLOYEES	EID	EName	Age	Salary

AIRCRAFT	AID	AName	CruisingRange

CERTIFIED_TO_FLY	EID	AID

RESULT					

Conditions

6c. (6 points) List the flight number of all nonstop flights from a city in Maryland to a city in California which could possibly be piloted by an certified employee who is less than 23 years old or makes less than 20,000 a year.

QBE Shortcut: ⌐ -> NOT

FLIGHTS	FLNO	FromCode	ToCode	DepTime	ArrTime	Price	Distance

CODE_NAMES	Code	CityName	StateName

EMPLOYEES	EID	EName	Age	Salary

AIRCRAFT	AID	AName	CruisingRange

CERTIFIED_TO_FLY	EID	AID

RESULT				

Conditions

Question 7 - Functional Dependencies (10 points)

(5 points) Consider the relation r(A,B,C,D,E) with given functional dependencies:

    AB->C
    B->D
    CD->E
    D->C

	Derivable from FD's above (type YES/NO) You **don't** need to give a justification or derivation.
B -> C ?	
A -> C?	
AB -> A?	
ABD -> E?	
ABC -> D?	
AB -> E?	
AC -> E?	
A -> E?	
B -> E?	
C -> E?	

7b (5 points) List at least one candidate key for r (informally show your work):