

Name:

Section (315/415):

MIDTERM EXAM - 600.315/415 - Database Systems

Date: October 28, 2010, In class

The total number of points in this exam is 74 for both 600.315 and 600.415 students, although the difficulty of questions differ. If you work at approximately 1 minute per point, you should finish on time.

Question 1 - Relational Algebra (5 points)

Express the following query in the Relational Algebra. The tables that are used in this (and following) questions are found on your supplementary handout.

- List the names and EID's of all employees who are certified to fly *every* aircraft in HopAir's fleet with a cruising range greater than 2000 miles.

Question 2 - Relational Algebra (5 points)

- (a) (5 points) **600.315 only:** List all airport codes in the database for which there does *not* exist a nonstop flight from BWI that arrives before 1159.
- (b) (5 points) **600.415 only:** List the CityName and airport code for all airports in the database for which there does *not* exist a nonstop flight from either Maryland or Virginia that arrives before 1159.

Question 3 - Tuple Relational Calculus (5 points)

Express the following query in Tuple Relational Calculus:

- A customer wants to fly from BWI to SFO either nonstop or exactly 1 connection (e.g. a flight from BWI to DEN and another flight from DEN to SFO). List all 1 or 2-flight options from BWI to SFO including their departure time from BWI and their arrival time in SFO.

Question 4 - Relational Algebra (5 points)

Express the following query in the relational algebra.

- (5 points) **600.315 only:** List the aircraft names and ID numbers of all aircraft capable of flying nonstop from BWI to some airport in California (you can limit your search to nonstop airport pairs stored in the database).
- (5 points) **600.415 only:** List the aircraft names and ID numbers of all aircraft **not** capable of flying nonstop from BWI to some airport in California (you can limit your search to nonstop airport pairs stored in the database).

Question 5 - SQL (25 points)

Express the following queries in SQL:

- (a) (5 points) List the names and EID's of all employees who are certified to fly *every* aircraft in HopAir's fleet with a cruising range greater than 2000 miles.
- (b) (5 points) For all aircraft with a cruising range more than 1000 miles, list the name of the aircraft and the average salary and average age of all pilots certified to fly the aircraft.

- (c) (5 points) **600.315 only:** For each pilot who is certified to fly more than 3 aircraft, list the name and EID of the pilot and the *maximum* cruising range of the plane he or she is certified to fly.
- (cc) (5 points) **600.415 only:** For each pilot who is certified to fly more than 3 aircraft, list the name and EID of the pilot and the *maximum* cruising range of the plane he or she is certified to fly, as well as the name of this kind of aircraft.
- (d) (5 points) **600.315 only:** Find the names and age of all employees whose weekly salary is less than the most expensive nonstop flight between BWI and Toledo, Ohio.
- (dd) (5 points) **600.415 only:** Find the names and age of all employees whose weekly salary is less than the most expensive nonstop flight in the entire database between Maryland and any airport in Ohio.

- (e) (5 points) **600.315 only:** List all city/state pairs in the database for which there does *not* exist a nonstop flight from BWI that arrives before 1159. [Note that cities can have more than one airport].
- (ee) (5 points) **600.415 only:** List all city/state pairs in the database for which there does *not* exist a nonstop flight from either Maryland or Virginia that arrives before 1159. [Note that cities can have more than one airport]

Question 6 - QBE (15 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.

- (a) (5 points) **600.315 only:** A customer wants to fly from BWI to SFO on exactly 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 3-flight options from BWI to SFO including their departure time from BWI, their arrival time in SFO and both the airport codes and CityName of the first city where the flights connect.
- (aa) (5 points) **600.415 only:** A customer wants to fly from BWI to SFO on 2 or 3 connecting flights (see 6a above). 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 CityName of the first city where the flight connects.

FLIGHTS	<u>FLNO</u>	FromCode	ToCode	DepTime	ArrTime	Price	Distance

RESULTS							

- (b) List the name and salary of all employees who are certified to fly an aircraft with a cruising range that greater than the nonstop distance between BWI and some airport in California (you can limit your search to nonstop airport pairs stored in the database).

FLIGHTS	<u>FLNO</u>	FromCode	ToCode	DepTime	ArrTime	Price	Distance

CODE_NAMES	<u>Code</u>	CityName	StateName

EMPLOYEES	<u>EID</u>	EName	Age	WeeklySalary

AIRCRAFT	<u>AID</u>	AName	CruisingRange

CERTIFIED_TO_FLY	<u>EID</u>	<u>AID</u>

(c) (5 points) **600.315 only:** List the airport code of cities in California (and their associated CityNames) which are possible to reach from BWI with 2 flights (one connection) but for which HopAir offers no nonstop flights.

(cc) (5 points) **600.315 only:** List the flight number of all nonstop flights from an airport in Maryland to an airport in California which could possibly be piloted by an employee who is less than 23 years old or makes less than 20,000 a year.

FLIGHTS	<u>FLNO</u>	FromCode	ToCode	DepTime	ArrTime	Price	Distance

CODE_NAMES	<u>Code</u>	CityName	StateName

EMPLOYEES	<u>EID</u>	EName	Age	WeeklySalary

AIRCRAFT	<u>AID</u>	AName	CruisingRange

CERTIFIED_TO_FLY	<u>EID</u>	<u>AID</u>

Question 7 - Functional Dependencies (8 points)

Consider the instance of the relation $r(A,B,C)$:

A	B	C
1	2	fever
2	6	cold
3	2	fever
6	4	healthy

State whether the following Functional Dependencies are satisfied by the relation above (circle yes or no).

FD	Satisfied?
$A \rightarrow B$	Yes / No
$B \rightarrow A$	Yes / No
$C \rightarrow B$	Yes / No
$C \rightarrow A$	Yes / No
$BC \rightarrow A$	Yes / No
$A \rightarrow ABC$	Yes / No
$B \rightarrow ABC$	Yes / No

List a possible Candidate Key for r , given the values in the instance above:

Question 8 - Lossless Join Decomposition (6 points)

Consider the following table $T1$, and a potential decomposition into $T2$ and $T3$:

T

A	B	C
a1	100	c1
a2	200	c2
a3	300	c3
a4	200	c4

T2

A	B
a1	100
a2	200
a3	300
a4	200

T3

B	C
100	c1
200	c2
300	c3
200	c4

Based on just the information above, is the decomposition into $T2$ and $T3$ a lossless join decomposition? **Yes** or **No** (circle one)

If yes, briefly state why. If no, very briefly state why and give a tuple that demonstrates that decomposition is not lossless.