CS315A: Fundamentals of Database Systems

Mid-Sem: Marks = 50

20th February, 2019, 1:00-2:00pm

Q1: [5 marks] Consider the following relation, where the primary key is underlined.

Flights(Fno, Src, Dst, Dep, Arr)

Write a relational algebra query with basic relational algebra operators to enlist (flight numbers of) all possible connecting flights from one city to another, having one stop and proper flight arrival and departure timing (i.e., departure after arrival).

Q2: [5 marks] Consider the following schema for an office payroll system, where the primary keys are underlined and the foreign keys are italicized.

Person(pid, fname, lname)
Employee(*pid*, desig, salary)

Write a SQL query to update the salary of all employees to the average salary for their designation.

Q3: [10 marks] Consider a relation $R = (A, B, C, D)$. For which of the following sets of FDs is R in BCNF? Mention all correct answers.

1. $\{ AC \rightarrow D, D \rightarrow A, D \rightarrow B, D \rightarrow C \}$
2. $\{ ABC \rightarrow D, ACD \rightarrow B, D \rightarrow C, BCD \rightarrow A \}$
3. $\{ AD \rightarrow C, BC \rightarrow A, BD \rightarrow C, CD \rightarrow B \}$
4. $\{ AC \rightarrow B, A \rightarrow D, C \rightarrow A, D \rightarrow B \}$

Q4: [5 marks] Consider a system with the following disk specifications:

- Rotational Speed = $7200rpm$
- Seek Time = $4ms$
- Data stored per track = $150KB$
- Size of file $A = 2KB$
- Number of disk blocks per track = 300

What is the *average access time* to read file A from disk under sequential and random I/O configuration?

Q5: [10 marks] Consider the relation $r(A, B, C, D, E)$ and its functional dependencies, where the primary key is underlined.

$$AB \rightarrow CDE; A \rightarrow C; BC \rightarrow D$$

Identify the highest form of the relation and improve if possible. Justify the steps.

Q6: [10 marks] Consider a relation $R(A,B,C,D,E)$ with functional dependencies

$$AB \rightarrow C; BC \rightarrow D; CD \rightarrow E; DE \rightarrow A; AE \rightarrow B$$

Find the total number of *superkeys* in the relation.

Q7: [5 marks] Consider the relation $R(A,B,C,D)$ with dependencies

$$AB \rightarrow C; ABC \rightarrow D; AC \twoheadrightarrow B$$

Among 2NF, 3NF, BCNF, and 4NF, identify the highest form the relation is in. Justify.