Midterm Review I
CMSC 362
Marmorstein
Due Feb. 27, 2009

Relational Algebra

Suppose we have a database with the schema:

Animals(genus : string, species : string, num_legs : integer, carnivorous : boolean)
ZooValues(genus: string, species: string, price: float)

1. **(5 pts)** Write a relational algebra query that lists the genus and species of all animals with fewer than 6 legs.

2. **(5 pts)** Write a relational algebra query that lists the genus and species of all carnivorous animals.

3. **(5 pts)** Write a relational algebra query that lists the species and price of all animals with more than 4 legs that cost more than $4000.00 .

4. **(5 pts)** Write a relational algebra query which lists the genus and species of all the animals in the database. Keep in mind that not all of the animals may be in the Animals table.

5. **(5 pts)** Write a relational algebra query which prints the genus and species of all the carnivorous animals in the Animals table which do not appear in the ZooValues table.

Tuple Relational Calculus

6. **(5 pts)** Give a tuple relational calculus expression which lists all tuples representing animals with fewer than 8 legs and which cost at least $20,000.00.

7. **(5 pts)** Is the relational calculus expression { t | t is not in ANIMALS } a safe expression? Justify your answer.

Functional Dependencies

8. **(10 pts)** Suppose that we have the following functional dependencies:

{Genus, Species} -> {num_legs, carnivorous}
{Species} -> {Genus}

Answer the following with "True" or "False":

a. {Genus} -> {Species} must also hold in this database.

b. {Species} -> {num_legs} must hold in this database.

c. {Genus, num_legs} -> {carnivorous} must hold in this database.

d. {Species, num_legs} -> {Species} must hold in this database.

e. {Species, num_legs} -> {carnivorous} must hold in this database.

Normal Forms

9. **(5 pts)**

Decompose the table shown below into first normal form.

Unit	Officers	Call sign 1	Call sign 2
Adam-12	Malloy and Reed	KAX-1100	ACB-12
Squad-51	Gage and DeSoto	KMG-365	NULL

10. **(20 pts)** Decompose the following table into 3NF:

Assume the following non-trivial FDs (as well as all the trivial ones, of course):

{State}->{Governor}
{City, State} -> {Mayor, Governor}

City	State	Mayor	Governor
New York	New York	Bloomberg	Paterson
Farmville	Virginia	Newman	Kaine
Richmond	Virginia	Jones	Kaine

SQL Queries

11. **(10 pts)** Given the schema:

    State(<u>name</u> : string, population : integer, governor : string)

Write an SQL query that finds the number of rows in the STATES database for which the attribute population is less than 1 million and prints the name of the state and the name of its governor.

12. **(10 pts)** Given the schema:

    Salaries(<u>job</u>: string, salary: float, benefits: boolean)
    Employee(<u>last</u> : string, <u>first</u> : string, job: string, part_time : boolean)

Write an SQL query that finds the average salary of employees who have benefits -- dropping the highest and lowest salaries.

13. **(10 pts)** Using the schema from the previous problem, write an SQL query that lists the names of all **full-time** employees who make at least $50,000 and have benefits.