CSC3170 Introduction to Database Systems (Fall 2020)

Assignment 2

Please answer all the questions below (total 100 marks) and submit your solution to the blackboard before **11:59 pm November 7, 2020.**

Note: Write the following queries in relational algebra. **Note that some of these queries may not be expressible in standard relational algebra taught in the lectures. For such queries, explain why they cannot be expressed.**

Part 1 Consider a database:

Customer (sid, name, career)

Commodity (cid, title)

Price (sid, cid, HKD)

Details:

• Sid of Price is a foreign key referring to sid of Customer.

• Cid of Price is a foreign key referring to cid of Commodity.

1. (5 marks) Find the name of customers who have bought the commodity with cid “c1”.

Πname(𝜎cid=”c1”(Price) ⋈ Customer)

2. (5 marks) Find the sid of customers who have bought the commodity entitled “milk”. Πsid(Price⋈𝜎title=”milk”(Commodity))

3. (5 marks) Find the sid of customers who have bought two hamburgers.

N/A. This query cannot be expressed since there is no operator for “count”.

4. (10 marks) Find the sid of customers who have bought both the commodity entitled “milk” and the commodity entitled “bread”.

Πsid(Price⋈𝜎title=”milk”(Commodity))Πsid(Price⋈𝜎title=”bread”(Commodity))

5. (10 marks) Find the sid of customers who have bought the commodity entitled “milk” or the commodity entitled “hamburger”.

Πsid(Price⋈𝜎title=”milk” or title=”hamburger”(Commodity))

6. (10 marks) Find the sid and names of customers who did not buy the commodity entitled “milk”.

Πsid,name(Customer)- Πsid,name(Customer)⋈ Πsid(Price⋈𝜎title=”milk”(Commodity))

Part 2 Consider a database:

Creature (name, category, status)

FoodChain (predator, food, percentage)

Details:

• The values of status in Creature can be:

Carnivores,

Herbivores,

Omnivorous,

Saprophagous.

• Predator of FoodChain is a foreign key referring to name of Creature.

• Food of FoodChain is a foreign key referring to name of Creature.

1. (5 marks) Find the predator(s) whose foods are all known in Creature.( For a predator if the percentages of its foods sum up to 100%, we say that its foods are all known.)

N/A. This query cannot be expressed since there is no operator for “sum”.

2. (10 marks) List the name of each creature which eats any of the predators of the creature “frog”.

𝜌 (𝐹(𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 → 𝑓𝑜𝑜𝑑), Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 (𝜎𝑓𝑜𝑜𝑑="frog"(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛))) Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟(Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟,𝑓𝑜𝑜𝑑(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛) ⋈ 𝐹)

3. (10 marks) List the name of each creature which eats all the predators of the creature “bird”.

Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟,𝑓𝑜𝑜𝑑(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛) ∕

𝜌 (𝑃(𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 → 𝑓𝑜𝑜𝑑), Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 (𝜎𝑓𝑜𝑜𝑑="bird"(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛)))

4. (15 marks) Find food(s) which are eaten by exactly three predators.

𝜌 (𝐴(𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 → 𝑝, 𝑓𝑜𝑜𝑑 → 𝑓), 𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛) , ρ(𝐵, 𝐴) , ρ(𝐶, 𝐴) , ρ(D, 𝐴)

𝜌 (𝐷, 𝜎(𝐴.𝑓=𝐵.𝑓)∧(𝐵.𝑓=𝐶.𝑓)∧(C.𝑓=D.𝑓)∧((𝐴.𝑝𝐵.𝑝)∧(𝐵.𝑝≠𝐶.𝑝)∧(C.𝑝≠D.𝑝)∧ (𝐴.𝑝≠C.𝑝) ∧ (𝐴.𝑝≠D.𝑝) ∧(𝐵.𝑝≠D.𝑝))((𝐴 × 𝐵 × 𝐶× D))

𝜌 (𝐸, 𝜎(𝐴.𝑓=𝐵.𝑓)∧(𝐵.𝑓=𝐶.𝑓)∧(𝐴.𝑝≠𝐵.𝑝)∧(𝐵.𝑝≠𝐶.𝑝)∧(𝐴.𝑝≠𝐶.𝑝)(𝐴 × 𝐵 × 𝐶))

Π𝐴.𝑓(E) − Π𝐴.𝑓(D)

5. (15 marks) List the name of each predator which eats all creatures except itself.

𝜌(𝑃(name → 𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟), Π𝑛𝑎𝑚𝑒 (𝐶𝑟𝑒𝑎𝑡𝑢𝑟𝑒))

𝜌(𝐹(name → 𝑓𝑜𝑜𝑑), Π𝑛𝑎𝑚𝑒 (𝐶𝑟𝑒𝑎𝑡𝑢𝑟𝑒))

𝜌 (𝐴, σpredator=food(𝑃 × 𝐹))

𝜌 (𝐶, (𝐴 ∪ Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟,𝑓𝑜𝑜𝑑(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛)) ∕ 𝜌(𝐵(𝑛𝑎𝑚𝑒 → 𝑓𝑜𝑜𝑑), Π𝑛𝑎𝑚𝑒(𝐶𝑟𝑒𝑎𝑡𝑢𝑟𝑒)))

C − Π𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟 (𝜎𝑝𝑟𝑒𝑑𝑎𝑡𝑜𝑟=𝑓𝑜𝑜𝑑(𝐹𝑜𝑜𝑑𝐶h𝑎𝑖𝑛))