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CS 1555 Assignment 4

Assume the following relational database schema along with its cardinalities that supports a cell phone company, P Mobile. Refer to HW2 for more details on the schema (e.g., constraints such as primary key, foreign key, unique, and not null):

– CUSTOMERS = (SSN, fname, lname, cell\_pn, home\_pn, street, city, zip, state, free\_min, DOB, free\_SMS)

– RECORDS (from\_pn, to\_pn, start\_timestamp, duration, type)

– STATEMENTS (cell\_pn, start\_date, end\_date, total\_minutes, total\_SMS, amount\_due)

– PAYMENTS (cell\_pn, paid\_on, amount\_paid)

– DIRECTORY (pn, fname, lname, street, city, zip, state)

– Cardinalities of the relations:

| r(CUSTOMERS) | = 50

| r(RECORDS) | = 500

| r(STATEMENTS) | = 120

| r(PAYMENTS) | = 150

| r(DIRECTORY) | = 1000

**π σ ⋈**

1. Write the arity, expected min cardinality, expected max cardinality, and the relational algebra expression to answer each of the following queries:
   1. Calculate the max duration of phone calls in August 2019, that were originated from Pennsylvania.

**f MAX duration(**

**σstart\_timestamp>=’8-1-2019’ ^ start\_timestamp<’9-1-2019’ Records ⋈Records.from\_pn = Directory.pn (σstate = ‘Pennsylvania’ Directory)**

**)**

**Arity = 1**

**CardinalityMAX = CardinalityMIN = 1**

* 1. Calculate the average amount of payments due for the month of November 2019 for each zip code (i.e., sum up all customers on the same zip code into a single amount for that zip code). **[Assuming all payments are due on the last day of the month.]**

**zip f average amount\_due (Customers \* (σend\_date=’11-30-2019’ Statements))**

**Arity = 2**

**CardinalityMAX = 50 (Every Customer lives in a different zip code)**

**CardinalityMIN = 1 (All Customers live in the same zip code)**

* 1. List the first and last names of customers who have more than one cell phone.

**Πfname, lname (σ count\_cell\_pn>1 (fname, lname f COUNT cell\_pn))**

**Arity = 3**

**CardinalityMAX = 25 (Every Customer has exactly 2 cell\_pn)**

**CardinalityMIN = 0 (Every Customer has only 1 cell\_pn)**

* 1. List the last names of customers whom none of their family members is a customer of P Mobile. That is, customers whose family members are customers in other companies. Recall that people with the same last name are relatives that belong to the same family. **[Assuming every Customer and their family members are in the directory and everyone in the directory is a customer of a cellphone company]**

**Πlname (**

**σcount\_fname=1 (lname f COUNT fname (Customers)) \***

**σcount\_fname>1 (lname f COUNT fname (Directory))**

**)**

**Arity = 1**

**CardinalityMAX = 50 (Condition met by every P Mobile customer)**

**CardinalityMIN = 0 (Condition not met by any P Mobile customer)**

* 1. Find the charges of the customer whose cell phone number is 412-987-6543 in the period between January 1st 2019 until now, assuming a flat rate of 25 cents per minute and 5 cents per SMS (without adding any tax or plan fees).

**R1 🡨 σcell\_pn=4129876543 ^ start\_date>=’1-1-2019’ Statements**

**FSUM cost (⍴(Πtotal\_minutes\*25 (σtype = ‘call’ R1), cost) U (⍴(Πtotal\_SMS\*5 (σtype = ‘SMS’ R1), cost)))**

**Arity = 1**

**CardinalityMAX = CardinalityMIN = 1**

* 1. \* List the first name, last name and phone number of all customers who owe more than $90. Note that people may have skipped more than one payment.
  2. \* Find the first and last name of the customer who made the longest phone call between June 1st, 2019 and August 31st 2019.

1. Given relation R with attributes A, B, C, D and relation S with attributes D, E, F provide:

– an instance of relation R with 13 tuples,

– an instance of relation S with 7 tuples, and

– an instance of relation R full-outer-join(R.D = S.D) S,

such that relation R \* S has 5 tuples, and relation R right-outer-join(R.D = S.D) S has 7 tuples.

Feel free to assume any type for attributes A, B, C, D, E, F in your relation instances/examples. You do not need to provide R \* S or R right-outer-join(R.D = S.D) S.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **R.A** | **R.B** | **R.C** | **R.D** | **S.D** | **S.E** | **S.F** |
| **1** | **2** | **3** | **1** | **1** | **4** | **5** |
| **4** | **5** | **6** | **2** | **2** | **7** | **8** |
| **7** | **8** | **9** | **3** | **3** | **0** | **9** |
| **1** | **3** | **5** | **4** | **4** | **7** | **9** |
| **7** | **9** | **11** | **5** | **5** | **13** | **15** |
| **0** | **2** | **4** | **6** | **NULL** | **NULL** | **NULL** |
| **6** | **8** | **10** | **7** | **NULL** | **NULL** | **NULL** |
| **2** | **3** | **4** | **8** | **NULL** | **NULL** | **NULL** |
| **7** | **6** | **5** | **9** | **NULL** | **NULL** | **NULL** |
| **8** | **9** | **10** | **10** | **NULL** | **NULL** | **NULL** |
| **0** | **9** | **8** | **11** | **NULL** | **NULL** | **NULL** |
| **5** | **6** | **7** | **12** | **NULL** | **NULL** | **NULL** |
| **4** | **3** | **2** | **13** | **NULL** | **NULL** | **NULL** |
| **NULL** | **NULL** | **NULL** | **NULL** | **14** | **99** | **45** |
| **NULL** | **NULL** | **NULL** | **NULL** | **15** | **12** | **34** |

**R: S: R ]⋈[R.D=S.D S:**

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **C** | **D** |
| **1** | **2** | **3** | **1** |
| **4** | **5** | **6** | **2** |
| **7** | **8** | **9** | **3** |
| **1** | **3** | **5** | **4** |
| **7** | **9** | **11** | **5** |
| **0** | **2** | **4** | **6** |
| **6** | **8** | **10** | **7** |
| **2** | **3** | **4** | **8** |
| **7** | **6** | **5** | **9** |
| **8** | **9** | **10** | **10** |
| **0** | **9** | **8** | **11** |
| **5** | **6** | **7** | **12** |
| **4** | **3** | **2** | **13** |

|  |  |  |
| --- | --- | --- |
| **D** | **E** | **F** |
| **1** | **4** | **5** |
| **2** | **7** | **8** |
| **3** | **0** | **9** |
| **4** | **7** | **9** |
| **5** | **13** | **15** |
| **14** | **99** | **45** |
| **15** | **12** | **34** |