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CS 1555

Assignment #3: Relational Algebra

* Assume the following relational database schema that supports a cell phone company, *P\_Mobile*, that was used in HW2 and shown below:
  + 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)

1. Assuming that the relations CUSTOMERS and PAYMENTS have 10 and 17 tuples, respectively, find the arity and cardinality of the following relations: (For those whose accurate values can not be determined, give the min and max values)
   1. Arity: 1

Cardinality: min(0), max(10)

* 1. Arity: 1

Cardinality: min(0), max(17)

* 1. Arity: 14

Cardinality: 17

* 1. Arity: 15

Cardinality: 17

1. Optimize the following relational algebra expression to be more efficient. Please explain your answers.
   1. Πtotal\_minutes,total\_SMS (σcity=’philidelphia’ (σcell\_pn(STATEMENTS) - σcell\_pn(CUSTOMERS)))
   2. By first selecting and combining the columns that are relevant, which are the cell\_pn columns in the tables STATEMENTS and CUSTOMERS, I am able to cut down the amount of cells to look at from the beginning, rather than looking at all the tuples and columns of the two tables.
2. Write the relational algebra expression to answer each of the following queries in nesting notation. You can use any date format: `2020-01-30' or `01-30-2020'.
   1. List the first and last names of customers who live in Pittsburgh.
      1. Πfname,lname (σcity = ‘Pittsburgh’ (CUSTOMERS))
   2. Retrieve the phone numbers of customers who made calls to people in Pittsburgh.
      1. Πfrom\_pn(σto\_pn = ‘Pittsburgh’ (RECORDS x CUSTOMERS))
   3. List the SSNs of all customers that have ever paid more than 100 in a single payment, and have ever had an amount due more than 50.
      1. ΠSSN(σamount\_paid > 100 ^ amount\_due > 50 (STATEMENTS x CUSTOMERS))
3. Write the relational algebra expression to answer each of the following queries in sequence notation:
   1. List only once every pair of cell phone numbers which use the same number of SMS in July 2019.
   2. Find the SSNs of all customers who received calls from people in Pennsylvania, where they have at least one call duration more than 20.
      1. B1 🡨 CUSTOMERS x RECORDS
      2. B2 🡨 σcity = ’Pittsburgh’ ^ duration > 20 (B1)
      3. RSLT 🡨 ΠSSN (B3)
   3. List the SSNs for all customers that live in Pittsburgh city and received calls from New York state, but never made calls to New York state.