

Overview

Complete the following problems. You should turn in a carefully written solution showing your work and **explaining your answer**. Formatting relational algebra in L^AT_EX or other tools is likely time consuming if you're not used to it. You may turn in a handwritten assignment if you wish, but it should be exceedingly neat and clear. The graders will take off points for hard to read handwriting or poor organization.

Collaboration policy: As with all non-programming assignments in this course, you may collaborate on the homework assignments to the extent of formulating ideas as a group, but you may not collaborate in the actual writing of solutions. *In particular, you may not work from notes taken during collaborative sessions.* You *must* cite all sources, including others in the class from whom you obtained ideas. You may not consult any materials from any previous offerings of this course or from any other similar course offered elsewhere. You are required to completely understand any solution that you submit, and, in case of any doubt, you must be prepared to orally explain your solution to me. *If you have submitted a solution that you cannot verbally explain to me, then you have violated this policy.*

Problem 1

Suppose that we have the following database schema, representing computer technology for sale. A “PC” here is used to mean a desktop or a laptop computer.

```
Manufacturers(model_no, company, device_type)
Smartphones(model_no, speed, ram, price)
PCs(model_no, speed, ram, hd, price)
```

In the above, `device_type` is a string that contains either “smartphone” or “PC”.

Write relational algebra for the following queries. You may only use basic relational algebra operations as defined in section 6.1.1, and the “additional” relational algebra operations in section 6.1.3. For this problem, you *may not use* the “extended” relational algebra operations defined in 6.1.4.

- a) What PC models have a speed of at least 3.00? (That number is understood to be in GHz).
- b) Which companies make PCs with a hard disk (hd) of at least 1000? (That number is understood to be in GB).
- c) Find the model number and price of all products (of either type) made by company “Samsung”.
- d) Find those companies that make PCs, but not smartphones.
- e) Find those hard-disk sizes that occur in two or more PCs.
- f) Find those pairs of smartphone models that have both the same speed and the same RAM. A pair should be listed only once; e.g. list (i, j) but not (j, i) .
- g) Find those companies with at least two different devices (PC or smartphone) with speeds of at least 3.00.

h) Find the company that makes the device (PC or smartphone) with the highest speed. If there's a tie for fastest device and different companies make those devices, report both (or more) such companies.

(Thanks to Ullman and Widom.)

Problem 2

Complete exercise 6.14, parts a through d, in your textbook. You may use any relational algebra operations defined in 6.1.1 through 6.1.4.