VITMAB04 – Databases

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21 October 2021 – 3rd tutorial: Relational Algebra I.

1. Consider the following relation schemata.

   PRODUCT (MANUFACTURER, MODEL, TYPE)

   PC (MODEL, CPU, RAM, DISK, OPTICAL, PRICE)

   LAPTOP (MODEL, CPU, RAM, DISK, SCREEN, PRICE)

   PRINTER (MODEL, ISCOLOUR, TYPE, PRICE)

   Answer the following with relational algebra expressions.

   a) Which PC models have a CPU faster than 1.5GHz?
   b) Which manufacturers make laptops that have a disk drive larger than 1000 gigabytes?
   c) List the model number and price of all products of manufacturer 'B' irrespective of their type.
   d) Which manufacturers make laptops but not PCs?
   e) Which manufacturers make at least two distinct laptop or PC models that have a CPU faster than 3GHz? (Model numbers are unique.)
   f) List the manufacturers of laptops and PCs with CPUs faster than 3GHz.
   g) List manufacturers that make at least one laptop model that matches that hardware configuration of a PC by the same manufacturer.
   h) List manufacturers that make at least one PC model that matches that hardware configuration of a laptop by the same manufacturer.

2. Consider the following Starfleet database schema.

   STARSHIP (NAME, YEAR, SPECIES): *name, year of starting service, designed by species;*

   WORKER (WNAME, WID, DOB): *name and Starfleet ID of worker, date of birth;*

   SERVES (WID, SNAME, RANK): *which worker on what ship serves in what rank.*

   List the name of workers that serve on the ship of Captain Catherine Janeway.

3. Consider the following relations.

   LIKES (PERSON, MEAL)

   SELLS (RESTAURANT, MEAL)

   VISITS (PERSON, RESTAURANT)

   Using relational algebra, list all meals that <u>every</u> visitor likes at restaurants that sell them.

Some theoretical exercises, for fun.

4. Consider relations r and s of schema $R(A, B)$ and $S(B, C)$. The number of rows in relation r is n_r and in s it is n_s. What is the minimum and maximum number of rows in the natural join of r and s, if
   a) A is a key of R,
   b) B is a key of R,
   c) B is a key of both R and S,
   d) A is a key of R, B is a key of S?

   Formulate your answers as functions of n_r and n_s.

5. **Proposition:** If the cardinality of attribute A is smaller than the number of elements of the domain of A, then A cannot be a (simple) key.

   Show that the above Proposition is true or false.