VITMAB04 – Databases – Tutorial 2

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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 relation schemata.

Student

Name	University	Program	Year
Jodie Whittaker	KCL	Informatics	2011
Peter Capaldi	KCL	Mech. Eng.	2007
Matt Smith	UCL	MBA	2009
David Tennant	Imperial	Informatics	2004
Pete Tong	Birkbeck	MBA	2010
Paul McGann	York	Teacher	2011

StarUniversity

University	Founded
Exeter	1955
York	1963
Imperial	1907
Birkbeck	1823
KCL	1829

Person

Name	City
Jodie Whittaker	Budapest
Peter Capaldi	London
Matt Smith	Oxford
David Tennant	Cambridge
Pete Tong	New York
Paul McGann	Debrecen
Johnny Bravo	Budapest

Construct the relational algebra expressions that answer the following queries.

a) Which are the non-star universities?

b) Which students do not attend any star university?

Assume that a student attends one university at a time.

c) Which programs are taught at a minimum of 2 universities?

d) Which programs are taught at only one university?

e) Which is the oldest star university?

f) Which programs are taught at star and non-star universities?

g) Who are the informatics students from Budapest?

h) Which cities do star university students come from?

i) Which students were admitted before 2005 or attend a non-star university?

4. 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.

5. Show that every theta-, equi- and natural join expression can be rewritten using only $\times$, π and σ.

6. From the relations above, repeating any combination of the known relational algebra operators any number of times, can we obtain the below tuples? If yes, show the expression, if no then prove it's not possible!

a) (Jodie Whittaker, Budapest, Matt Smith, UCL, Oxford)

b) (Jodie Whittaker, Budapest, Harvard)

7. Construct a relational algebra expression to find the
    a) smallest element of a set;
    b) the first element greater than the smallest element of the set (i.e. the second smallest).

8. 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
    c) *A* is a key of *R*,
    d) *B* is a key of *R*,
    e) *B* is a key of both *R* and *S*,
    f) *A* is a key of *R*, *B* is a key of *S*?

    Formulate your answers as functions of n_r and n_s.

9. **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.

10. Transform the ER model from Exercise 2 of Practice 1 to a relational schema.