ΠΜΣ547 ΘΕΜΕΛΙΩΣΗ ΒΑΣΕΩΝ ΔΕΔΟΜΕΝΩΝ
Εαρινό Εξάμηνο 2008-2009
Δεύτερη Σειρά Ασκήσεων

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ΑΣΚΗΣΕΙΣ

1. Queries in the constraint database model presented in the papers

   > P. C. Kanellakis, G. M. Kuper, P. Revesz. Constraint Query Languages. Journal of Computer and System Sciences, vol. 51, no. 1, pp. 26-52, 1995
   >
   > Bart Kuijpers, Jan Paredaens and Luc Vandeurzen. Semantics in spatial databases. Lecture Notes in Computer Science vol. 1358, 1998.

   Consider the example constraint database representing geographical information about Belgium in the paper by Kuijpers et al. cited above (see Fig. 1 and 4 in the paper). Express the following queries in the relational calculus and evaluate them using quantifier elimination as discussed in the paper by Kanellakis et al.

   - Find all cities of Belgium that are north-east of Liege; give the names of the cities and their position on the map.
   - Find all cities that lie on a river; give the names of the cities and the names of the rivers they lie on.
   - Compute the geometry of the part of Belgium which lies south of Liege and the cities that lie in it; give the geometry, the names of the cities and their position on the map.

2. Queries in the model of constraint databases with indefinite information as presented in the paper

   > M. Koubarakis. Database Models for Infinite and Indefinite Temporal Information. Information Systems, Vol. 19, No. 2, March 1994, pages 141-173.

   Let us consider the following planning database used by a medical laboratory for keeping track of patient appointments for the year 2009.

   $$\begin{gathered} treatment(x, y, t_1, t_2) \leftarrow x = Smith,\ y = Chem1,\ t_1 = \omega_1,\ t_2 = \omega_2 \\ treatment(x, y, t_1, t_2) \leftarrow x = Smith,\ y = Chem2,\ t_1 = \omega_3,\ t_2 = \omega_4 \\ treatment(x, y, t_1, t_2) \leftarrow x = Smith,\ y = Radiation,\ t_1 = \omega_5,\ t_2 = \omega_6 \\ \omega_1 \geq 0,\ \omega_2 \geq 0,\ \omega_3 \geq 0,\ \omega_4 \geq 0,\ \omega_5 \geq 0,\ \omega_6 \geq 0, \\ \omega_2 = \omega_1 + 1,\ \omega_4 = \omega_3 + 1,\ \omega_6 = \omega_5 + 2,\ \omega_2 \leq 91,\ \omega_3 \geq 91,\ \omega_4 \leq 182, \\ \omega_3 - \omega_2 \geq 60,\ \omega_5 - \omega_4 \geq 20,\ \omega_6 \leq 213 \end{gathered}$$

   Let us assume that the set of rationals $\mathcal{Q}$ is our time line. The year 2009 is assumed to start at time 0 and every interval $[i, i+1)$ represents a day in 2009 (for $i \in \mathcal{Z}$ and $i \geq 0$). Time intervals will be represented by their endpoints.

They will always be assumed to be of the form $[B, E)$ where B and E are the endpoints.

The above database represents the following information:

(a) There are three scheduled appointments for treatment of patient Smith. This is represented by the three tuples in the relation *treatment*.

(b) Chemotherapy appointments must be scheduled for a single day. Radiation appointments must be scheduled for two consecutive days. This information is represented by constraints $\omega_2 = \omega_1 + 1,\ \omega_4 = \omega_3 + 1$, and $\omega_6 = \omega_5 + 2$.

(c) The first chemotherapy appointment for Smith should take place in the first three months of 2009 (i.e., days 0-91). This information is represented by the constraints $\omega_1 \geq 0$ and $\omega_2 \leq 91$.

(d) The second chemotherapy appointment for Smith should take place in the second three months of 2009 (i.e., days 92-182). This information is represented by constraints $\omega_3 \geq 91$ and $\omega_4 \leq 182$.

(e) The first chemotherapy appointment for Smith must precede the second by at least two months (60 days). This information is represented by constraint $\omega_3 - \omega_2 \geq 60$.

(f) The radiation appointment for Smith should follow the second chemotherapy appointment by at least 20 days. Also, it should take place before the end of July (i.e., day 213). This information is represented by constraints $\omega_5 - \omega_4 \geq 20$ and $\omega_6 \leq 213$.

Express the following queries in the calculus and algebra query languages of the above paper. Compute the answers to these queries using the algebra; show all the steps of your evaluation carefully.

- Is it certain that the first chemotherapy appointment of Smith will take place in the 2nd month of 2009?
- Find all information about patient appointments that can possibly start on January 15, 2009.

3. Ασκήσεις 6.8, 6.9, 6.11 και 6.13 (α) του βιβλίου.