ECS289F — Homework 2

Out Friday, 1/22/10; due in class Friday, 1/27/10

Problem 1. Give an example of a relational calculus query Q, a database instance I, and a D where $\mathsf{adom}(I) \cup \mathsf{adom}(Q) \subseteq D \subseteq \mathbb{D}$ such that $[\![Q]\!]^{I/D}$, $[\![Q]\!]^{I/\mathsf{adom}(I) \cup \mathsf{adom}(Q)}$, and $[\![Q]\!]^{\mathbb{D}}$ are all *distinct*.

Problem 2. Prove that the relational algebra is domain-independent (as asserted without proof in class).

Problem 3. Denote by SPC ("select-project-cross product") the fragment of the relational algebra where $-$ and $\cup$ are disallowed. Prove that any SPC expression E can be rewritten equivalently in *normal form*

$$\pi_{i_1,\ldots,i_k}(\{c_1\} \times \cdots \times \{c_m\} \times \sigma(P_1 \times \cdots \times P_n)),$$

where σ is shorthand for a sequence of selection operators (of either type $\sigma_{i=j}$ or $\sigma_{i=c}$). For example, if R and S are binary predicates, the SPC query

$$\pi_1(\sigma_{2=b}(R)) \times \sigma_{1=2}(\pi_{2,1}(S) \times \{d\})$$

may be written in normal form as

$$\pi_{2,4,3,1}(\{d\} \times \sigma_{2=b}(\sigma_{3=4}(R \times S))).$$