COS 425: Database and Information Management Systems - Fall 06
Summary of relational operation properties- updated 10/5/06 2:14 pm

Selection $\sigma_P(R)$ for relation R and predicate P on attributes of R:
is the relation with the same schema as R that contains those tuples of R that satisfy P.
Candidate keys and foreign keys in R are preserved

Projection $\pi_S(R)$ for relation R and S a list of attributes from R:
is the relation containing all tuples formed by taking a tuple from R and keeping only the attributes listed in S.
In the formal definition, relations are *sets*, and so duplicates are removed.
In practice, duplicates are not removed unless explicitly requested.
If a candidate key or foreign key is projected (i.e. included in S) then the constraint is preserved.
If no candidate key is projected, the only key may be all attributes in S (in the set model).

Union $R \cup S$ for relations R and S on the same universe $D_1 \times D_2 \times \ldots \times D_k$, where D_i is the domain for the i^{th} attribute:
is the relation that includes any tuple in either R or S.
Formal model removes duplicates.
Candidate keys are not preserved.
A foreign key is preserved if it is a foreign key for both R and S using corresponding attributes and referencing the same relation.

Set difference R-S for relations R and S on the same universe:
is the relation that includes all tuples in R that are not in S.
constraints left as an exercise

Cross product $R \times T$ for relations R and T:
For $R \subseteq D_1 \times D_2 \times \ldots \times D_k$ and $T \subseteq S_1 \times S_2 \times \ldots \times S_m$,
$R \times T \subseteq D_1 \times D_2 \times \ldots \times D_k \times S_1 \times S_2 \times \ldots \times S_m$ and tuple
$(d_1, d_2, \ldots, d_k, s_1, s_2, \ldots, s_m) \in R \times T$ if and only if
$(d_1, d_2, \ldots, d_k) \in R$ and $(s_1, s_2, \ldots, s_m) \in T$
If attributes in positions $i_1, i_2, \ldots i_\alpha$ form a candidate key for R and attributes in positions $j_1, j_2, \ldots j_\beta$ form a candidate key for T, then the union of the attributes - positions $i_1, i_2, \ldots i_\alpha$, $k+j_1$, $k+j_2 \ldots k+j_\beta$ of $R \times T$ - form a candidate key for $R \times T$.
Foreign keys for each of R and T are preserved using corresponding attributes of $R \times T$.

Renaming operation $\rho(Q(L), E)$, where E is a relational algebra expression, Q is a new relation name and L is a list of (old name → new name) or (attribute position → new name) mappings of attributes of E:
defines relation Q as the relation expressed by E, but with attributes in the list L renamed according to the given mappings.
All constraints on the relation expressed by E are preserved with appropriate renaming of attributes.