Relational Algebra Equivalences

- Allow us to choose different join orders and to `push' selections and projections ahead of joins.
- Rules on joins, cross products and union
  \[ R \bowtie S = S \bowtie R \]
  \[ (R \bowtie S) \bowtie T = R \bowtie (S \bowtie T) \]
  \[ R \times S = S \times R \]
  \[ (R \times S) \times T = R \times (S \times T) \]
  \[ R \cup S = S \cup R \]
  \[ R \cup (S \cup T) = (R \cup S) \cup T \]

Rules: Selects

\[ \sigma_{p_1 \land p_2}(R) = \sigma_{p_1} [ \sigma_{p_2}(R) ] \]
\[ \sigma_{p_1 \lor p_2}(R) = [ \sigma_{p_1}(R) ] \cup [ \sigma_{p_2}(R) ] \]
Rules: Project

Let: \( X = \) set of attributes
\( Y = \) set of attributes
\( XY = X \cup Y \)

\[ \pi_{xy}(R) = \pi_x[\pi_y(R)] \]
**Rules: \( \sigma + \bowtie \) combined**

Let \( P \) = predicate with only R attribs  
\( Q = \) predicate with only S attribs  
\( M = \) predicate with only R,S attribs

\[
\sigma_p (R \bowtie S) = [\sigma_p(R)] \bowtie S \\
\sigma_q (R \bowtie S) = R \bowtie [\sigma_q(R)]
\]

**More Rules**

Let \( x = \) subset of R attributes  
\( z = \) attributes in predicate \( P \)  
( subset of R attributes)

\[
\pi_x[\sigma_p(R)] = \pi_x\{\sigma_p[\pi_{xz}(R)]\}
\]
More Rules

Let \( x \) = subset of R attributes
\( y \) = subset of S attributes
\( z \) = intersection of R, S attributes

\[
\pi_{xy} (R \bowtie S) = \pi_{xy} \{ [\pi_{xz} (R) \bowtie [\pi_{yz} (S) ] ] \}
\]