

REWRITE RULES

Commutative & Associative Laws

$R \times S = S \times R$	$R \cap S = S \cap R$	$R \bowtie_C S = S \bowtie_C R$
$R \times (S \times T) = (R \times S) \times T$	$R \cap (S \cap T) = (R \cap S) \cap T$	But $R \bowtie_C (S \bowtie_C T) \neq (R \bowtie_C S) \bowtie_C T$ in general
$R \bowtie S = S \bowtie R$	$R \cup S = S \cup R$	(only if needed attributes exist)
$R \bowtie (S \bowtie T) = (R \bowtie S) \bowtie T$	$R \cup (S \cup T) = (R \cup S) \cup T$	

Selection Splitting

$\begin{aligned} \sigma_{C_1} \text{ AND } \sigma_{C_2}(R) &= \sigma_{C_1}(\sigma_{C_2}(R)) \\ &= \sigma_{C_2}(\sigma_{C_1}(R)) \\ &= \sigma_{C_1}(R) \cap \sigma_{C_2}(R) \end{aligned}$ $\begin{aligned} \sigma_{C_1} \text{ OR } \sigma_{C_2}(R) &= \sigma_{C_1}(R) \cup \sigma_{C_2}(R) \\ \sigma_C(R \cup S) &= \sigma_C(R) \cup \sigma_C(S) \\ \sigma_C(R - S) &= \sigma_C(R) \cap \sigma_C(S) \end{aligned}$	<p>Where needed attributes exist in R or S:</p> $\begin{aligned} \sigma_C(R \bowtie S) &= \sigma_C(R) \bowtie S = R \bowtie \sigma_C(S) \\ &= \sigma_C(R) \bowtie \sigma_C(S) \end{aligned}$ $\begin{aligned} \sigma_C(R \bowtie_D S) &= \sigma_C(R) \bowtie_D S = R \bowtie_D \sigma_C(S) \\ \sigma_C(R \times S) &= \sigma_C(R) \times S = R \times \sigma_C(S) \\ \sigma_C(R \cap S) &= \sigma_C(R) \cap S = R \cap \sigma_C(S) \\ &= \sigma_C(R) \cap \sigma_C(S) \end{aligned}$
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Projection Rules

$$\begin{aligned} \pi_L(R \cup_B S) &= \pi_L(R) \cup_B \pi_L(S) \\ \pi_L(\sigma_C(R)) &= \pi_L(\sigma_C(\pi_M(R))) \\ \text{where } M &= L \cup \text{attributes}(C) \end{aligned}$$

Join/Product Rules

$$\begin{aligned} R \bowtie_C S &= \sigma_C(R \times S) \\ R \bowtie S &= \pi_L(\sigma_C(R \times S)) \\ \text{where } C & \text{ equates fields and } L \text{ selects} \end{aligned}$$

Rules on Duplicates

$$\begin{aligned} \delta(R \times S) &= \delta(R) \times \delta(S) & \delta(R \bowtie_C S) &= \delta(R) \bowtie_C \delta(S) \\ \delta(R \bowtie S) &= \delta(R) \bowtie \delta(S) & \sigma_C(\delta(R)) &= \delta(\sigma_C(R)) \\ \delta(R \cap_B S) &= \delta(R) \cap_B S = R \cap_B \delta(S) = \delta(R) \cap_B \delta(S) \end{aligned}$$

Rules on Grouping

$$\begin{aligned} \delta(\gamma_L(R)) &= \gamma_L(R) & \gamma_L(R) &= \gamma_L(\pi_M(R)) \text{ if } L \subseteq M \\ \gamma_L(R) &= \gamma_L(R\delta(R)) \text{ if } \gamma_L \text{ is duplicate-impervious (e.g., MIN, MAX)} \end{aligned}$$