Module 3 Summary: Relational Algebra and Relational Calculus

Z2004 Database Management Systems · Lectures L10–L14 · Dr. Innocent Nyalala

1. Fundamental Relational Algebra Operators

Selection ($\sigma_p(R)$) filters rows, Projection ($\pi_A(R)$) chooses columns while eliminating duplicates, Cartesian Product ($R \times S$) pairs rows, and set operations ($\cup, \cap, -$) require union compatibility (same arity and compatible domains). Natural join ($R \bowtie S$) equals $\pi_{\text{cols}}(\sigma_{\text{shared equal}}(R \times S))$.

2. Relational Division ($R(X,Y) \div S(Y)$)

Division answers "find all X related to *every* Y in S":

$$R \div S = \pi_X(R) - \pi_X\big((\pi_X(R) \times S) - R\big).$$

Tuple Relational Calculus (TRC) $\{t \mid P(t)\}$ and Domain Relational Calculus (DRC) provide declarative equivalents sharing the exact expressive power of basic relational algebra (Codd's Theorem).