Relational Algebra as a Constraint Language

Two ways to express constraints.
1. If R is an expression of relational algebra, then \( R = \emptyset \) is a constraint that says "The value of R must be empty," or equivalently "There are no tuples in the result of R".
2. If R and S are expressions of relational algebra, then \( R \subseteq S \) is a constraint that says "Every tuple in the result of R must also in the result of S." Of course the result of S may contain additional tuples not produced by R.

Referential Integrity Constraints

**Problem:** Assert that a value appering in one context also appers in another, related context. If any value v as component in attribute A of some tuple in one relation R must appear in a particular component (say for attribute B) of some tuple of another relation S.

**Expression:** \( \pi_A(R) \subseteq \pi_B(S) \), or equivalently, \( \pi_A(R) - \pi_B(S) = \emptyset \)

E.g.
Movie(title, producerC#)
MovieExec(name, cert#)

**Constraint:** Every producerC# in Movie table must appear in the cert# of MovieExec.

**Solution:** \( \pi_{\text{producer}}(\text{Movie}) \subseteq \pi_{\text{cert#}}(\text{MovieExec}) \)
Key Constraints

Problem: Express algebraically the constraint that a certain attribute or set of attributes is a key for a relation. No two tuples of relation R agree on attribute A but not agree on attribute B and C.

Expression: \( \sigma_{R_1.A = R_2.A \land R_1.B \neq R_2.B \land R_1.C \neq R_2.C} (R_1 \times R_2) = \emptyset \)

Analysis: R1 and R2 are relations renamed from R. Find all the violate tuples using \( \sigma_{R_1.A = R_2.A \land R_1.B \neq R_2.B \land R_1.C \neq R_2.C} (R_1 \times R_2) \). And then assert the constraint by equating the result to \( \emptyset \).

Other Constraints

Permit Value: MovieStar(name, gender)
The only legal values for the gender attribute of MovieStar are 'F' and 'M'.
\[ \sigma_{\text{gender} \neq 'F' \land \text{gender} \neq 'M'} (\text{MovieStar}) = \emptyset \]

In general you can select the violate tuple set and assert it to \( \emptyset \).