Additional Relational Algebraic Operations

The basic set operations, which provide a very limited data manipulation facility, have been supplemented by the definition of the following operations : PROJECTION, SELECTION, JOIN and DIVISION. These operations are represented by the symbols **π, σ, ⋈, ÷** respectively. Projection and selection are unary operations where as join and division are binary operations.

Projection(**π**):- The projection of a relation is defined as a projection of all its tuples over some set of attributes, i.e. it yields vertical subset of the relation. The projection operation is used to either reduce the number of attributes in the resultant relation or to reorder attributes. In the first case the arity (degree) of relation is reduced.

Following figure shows the projection of the relation PERSONNEL on the attribute Names

PERSONNEL

ID	**Names**
101	Jones
103	Smith
104	Lalan
106	Byron
107	Even
110	Drew
112	Smith

Names
Jones
Smith
Lalan
Byron
Even
Drew
Smith

We can define the projection of tuple t_i over the attribute A, denoted $t_i[A]$ or $\pi_A(t_i)$, as (a) , where 'a' is the value of tuple t_i over the attribute A. Similarly we define the projection of a relation 'T', denoted by T[A] or $\pi_A[T]$, on the attribute A.

Selection(σ):- This is an operation that selects only some of the tuples of the relation. The selection operation yields a horizontal subset of a given relation i.e. the action is defined over the complete set of attribute names but only a subset of the tuples are included in the result relation, the specified selection condition or predicates must be satisfied by it. The selection operation is sometimes known as restriction operation.

Ex:- Suppose we want to find the employees in the relation PERSONNEL which is given below with an Id less than 105. The result of selection will be as follows.

PERSONNEL

ID	Names
101	Jones
103	Smith
104	Lalan
106	Byron
107	Even
110	Drew
112	Smith

Result of selection

ID	Names
101	Jones
103	Smith
104	Lalan

For a given relation P and a predicate expression B, the selection of those tuples of relation P that satisfy the predicate B is a relation R written as

$$R = \sigma_B(P)$$

The above relation could be read as "select those tuples t from P in which the predicate B(t) is true".

JOIN(⋈):- The 'join' operation allows the combining of two relations to form a single new relation. The tuples from the operand relations that participate in the operation and contribute to the result is related.

Ex:- Suppose we want to respond to the query "Get product number of assignments whose development team have a chief programmer". This requires first computing the Cartesian product of the ASSIGNMENT(Emp#, Prod#, Job#) and JOB_FUNCTION(Job#, Title) relations. And then it is followed by selecting those tuples where the attribute title has the value chief programmer and the value of the attribute Job# in ASSIGNMENT and JOB_FUNCTION are the same. The required result, shown below is obtained by projecting these tuples on the attribute Prod#. The operations are specified below.

$$(\pi_{Prod\#}(\sigma_{title='chiefprogrammer' \wedge ASSIGNMENT.JOB\#=JOB\_FUNCTION.JOB\#}(ASSIGNMENT \times JOBFUNCTION)))$$

ASSIGNMENT

Emp#	Prod#	Job#
107	HEAP1	800
101	HEAP1	600
110	BINS9	800
103	HEAP1	700
101	BINS9	700
110	FM6	800
107	B++	800

JOB_FUNCTION

JOB#	TITLE
1000	CEO
900	PRESIDENT
800	MANAGER
700	CHIEF PROGRAMMER
600	ANALYST

(ASSIGNMENT) x (JOB_FUNCTION)

Emp#	Prod#	Job#	Title
107	HEAP1	800	MANAGER
101	HEAP1	600	ANALYST
110	BINS9	800	MANAGER
103	HEAP1	700	CHIEF PROGRAMMER
101	BINS9	700	CHIEF PROGRAMMER
110	FM6	800	MANAGER
107	B++	800	MANAGER

DIVISION(÷):- In the given relation P and Q which are shown below the result of dividing P by Q is the relation R and it has two tuples. For each tuple in R its product with the tuples of Q must be in P. In our example (a1, b1) and (a1, b2) must both be tuples in P the same is true for (a5, b2):

P

A	B
a1	b1
a1	b2
a2	b1
a3	b1
a4	b2
a5	b1
a5	B2

Q

B
b1
b2

R(Result)

A
a1
a5

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