9.2 n-ary Relations and Their Applications

n-ary Relations

Definition: Let $A_1, A_2, ..., A_n$ be sets. An *n-ary relation* on these sets is a subset of $A_1 \times A_2 \times ... \times A_n$. The sets $A_1, A_2, ..., A_n$ are called the *domains* of the relation, and n is called its *degree*.

Primary Key

Definition: A domain of an n-ary relation is called a *primary key* when the value of the n-tuple from this domain determines the n-tuple.

Composite Key

Definition: Combinations of domains can also uniquely identify n-tuples in an n-ary relation. When the values of a set of domains determine an n-tuple in a relation, the Cartesian product of these domains is called a *composite key*.

Selection

Definition: Let R be an n-ary relation and C a condition that elements in R may satisfy. Then the *selection operator* S_C maps the n-ary relation R to the n-ary relation of all n-tuples from R that satisfy the condition C.

Projection

Definition: The *projection* $P_{i_1 i_2, ..., i_m}$ where $i_1 < i_2 < ... < i_m$, maps the n-tuple $(a_1, a_2, ..., a_n)$ to the m-tuple $(a_{i_1}, a_{i_2}, ..., a_{i_m})$, where $m \leq n$.

Join

Definition: Let R be a relation of degree m and S a relation of degree n. The *join* $J_p(R, S)$, where $p \leq m$ and $p \leq n$, is a relation of degree $m + n - p$ that consists of all $(m + n - p)$-tuples $(a_1, a_2, ..., a_{m-p}, c_1, c_2, ..., c_p, b_1, b_2, ..., b_{n-p})$, where the m-tuple $(a_1, a_2, ..., a_{m-p}, c_1, c_2, ..., c_p)$ belongs to R and the n-tuple $(c_1, c_2, ..., c_p, b_1, b_2, ..., b_{n-p})$ belongs to S.

9.2 pg. 589 # 7

The 3-tuples in a 3-ary relation represent the following attributes of a student database: student ID number, name, phone number.

a Is student ID number likely to be a primary key?

Yes because a student ID number is unique in a system.

b Is name likely to be a primary key?

No because multiple students can have the same name.

c Is phone number likely to be a primary key?

No because we can have students that have the same phone number, such as two siblings having the same home phone number.

9.2 pg. 589 # 9

The 5-tuples in a 5-ary relation represent these attributes of all people in the United States: name, Social Security number, street address, city, and state.

a Determine a primary key for this relation.

Social security number because it is unique.

b Under what conditions would (name, street address) be a composite key?

When we do not have people that has the same street address and have the same names.

c Under what conditions would (name, street address, city) be a composite key?

Same as above because many people can live in the same city.

9.2 pg. 590 # 11

What do you obtain when you apply the selection operator S_C, where C is the condition Destination = Detroit, to the database in Table 8?

Table 8 Flights

Airline	Flight_number	Gate	Destination	Departure_time
Nadir	122	34	Detroit	08:10
Acme	221	22	Denver	08:17
Acme	122	33	Anchorage	08:22
Acme	323	34	Honolulu	08:30
Nadir	199	13	Detroit	08:47
Acme	222	22	Denver	09:10
Nadir	322	34	Detroit	09:44

{(Nadir, 122, 34, Detroit, 08:10), (Nadir, 199, 13, Detroit, 08:47), (Nadir, 322, 34, Detroit, 09:44)}

9.2 pg. 590 # 13

What do you obtain when you apply the selection operator S_C, where C is the condition (Airline = Nadir) $\vee$ (Destination = Denver), to the database in Table 8?

{(Nadir, 122, 34, Detroit, 08:10), (Acme, 221, 22, Denver, 08:17), (Nadir, 199, 13, Detroit, 08:47), (Acme, 222, 22, Denver, 09:10), (Nadir, 322, 34, Detroit, 09:44)}

9.2 pg. 590 # 17

Display the table produced by applying the projection $P_{1,4}$ to Table 8.

Airline	Destination
Nadir	Detroit
Acme	Denver
Acme	Anchorage
Acme	Honolulu

9.2 pg. 590 # 19

Construct the table obtained by applying the join operator J_2 to the relations in Tables 9 and 10.

Table 9 Part_needs

Supplier	Part_number	Project
23	1092	1
23	1101	3
23	9048	4
31	4975	3
31	3477	2
32	6984	4
32	9191	2
33	1001	1

Table 10 Part_inventory

Part_number	Project	Quantity	Color_code
1001	1	14	8
1092	1	2	2
1101	3	1	1
3477	2	25	2
4975	3	6	2
6984	4	10	1
9048	4	12	2
9191	2	80	4

Supplier	Part_number	Project	Quantity	Color_code
23	1092	1	2	2
23	1101	3	1	1
23	9048	4	12	2
31	4975	3	6	2
31	3477	2	25	2
32	6984	4	10	1
32	9191	2	80	4
33	1001	1	14	8