Relational Algebra

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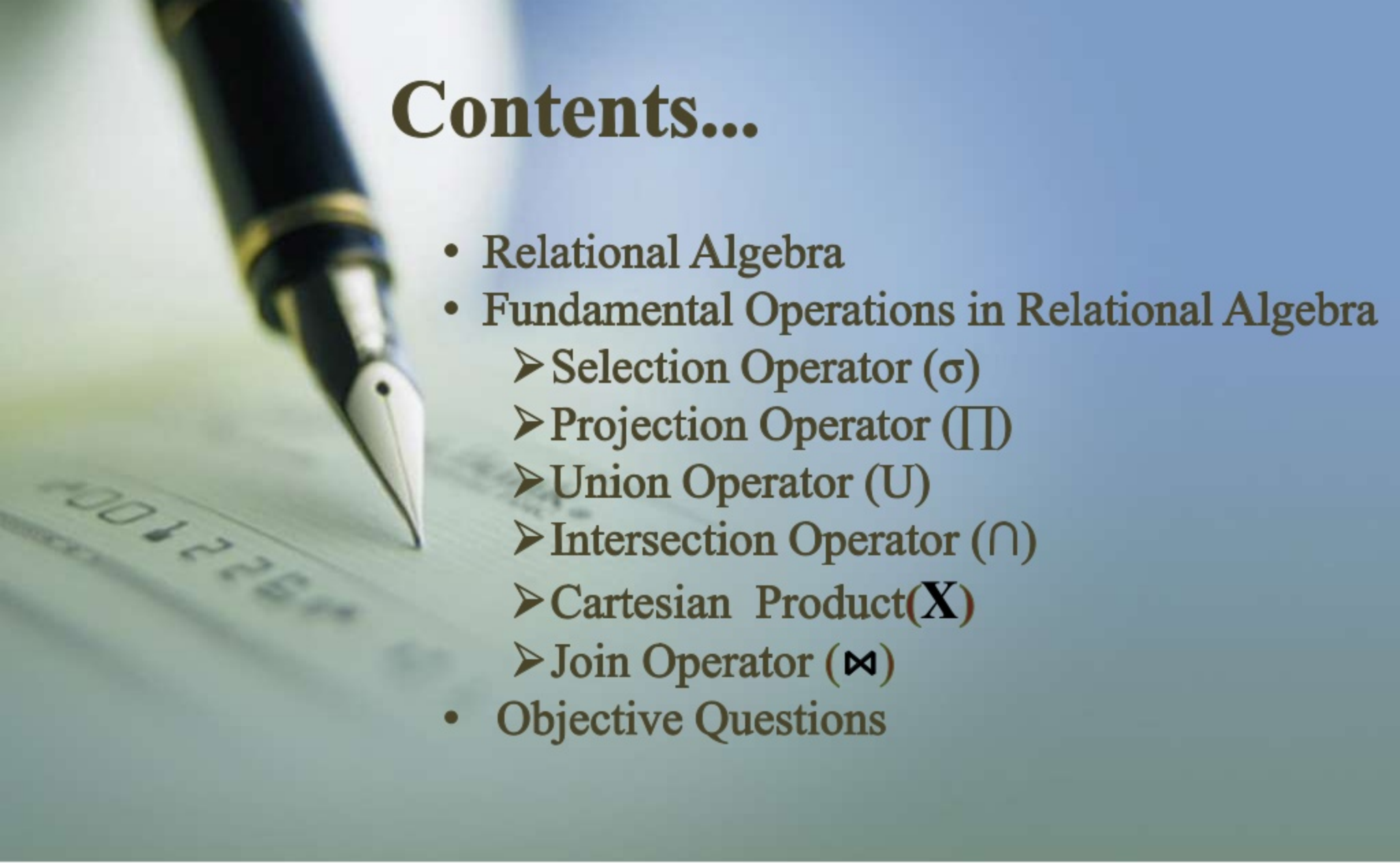

Contents...

- Relational Algebra
- Fundamental Operations in Relational Algebra
  - Selection Operator (σ)
  - Projection Operator (∏)
  - Union Operator (U)
  - Intersection Operator (∩)
  - Cartesian Product(X)
  - Join Operator (⋈)
- Objective Questions

Relational Algebra

- Relational algebra is a widely used procedural query language.
- It collects instances of relations as input and gives occurrences of relations as output.
- It uses various operation to perform this action.
- Relational algebra operations are performed recursively on a relation.
- The output of these operations is a new relation, which might be formed from one or more input relations.

Fundamental Operations in Relational Algebra

- Selection Operator (σ)
- Projection Operator (∏)
- Union Operator (∪)
- Intersection Operator (∩)
- Cartesian Product (X)
- Join Operator (⋈)

Selection Operator (σ)

- The SELECT operation is used for selecting a subset of the tuples according to a given selection condition.
- Sigma(σ)Symbol denotes it.
- It is used as an expression to choose tuples which meet the selection condition.
- Select operation selects tuples that satisfy a given predicate.

Projection Operator (∏)

- The projection eliminates all attributes of the input relation but those mentioned in the projection list.
- The projection method defines a relation that contains a vertical subset of Relation.
- This helps to extract the values of specified attributes to eliminates duplicate values.
- (∏) The symbol used to choose attributes from a relation.
- This operation helps you to keep specific columns from a relation and discards the other columns.

SELECTION & PROJECTION Example

Person

ID	Name	Address	Hobby
1123	John	123 Main	Stamps
1123	John	123 Main	Coins
5556	Mary	7 Lake Dr	Hiking
9876	Bart	5 Pine St	Stamps

σ Hobby ='stamps'(Person)

ID	Name	Address	Hobby
1123	John	123 Main	Stamps
9876	Bart	5 Pine St	Stamps

$\prod$ Name, Hobby(Person)

Name	Hobby
John	Stamps
John	Coins
Mary	Hiking
Bart	Stamps

UNION Operator (U)

- UNION is symbolized by ∪ symbol.
- It includes all tuples that are in tables A or in B.
- It also eliminates duplicate tuples.
- So, set A UNION set B would be expressed as:

  The result <- A ∪ B

- For a union operation to be valid, the following conditions must hold -R and S must be the same number of attributes.
- Attribute domains need to be compatible.
- Duplicate tuples should be automatically removed.

UNION Example

A

A	1
B	2
D	3
F	4
E	5

B

A	1
C	2
D	3
E	4

A U B

A	1
B	2
C	2
D	3
E	5
F	4
E	4

Intersection Operator (∩)

- An intersection is defined by the symbol ∩
- For Ex. A ∩ B
- It defines a relation consisting of a set of all tuple that are in both A and B. However, A and B must be union-compatible.

Intersection Example

A

A	1
B	2
D	3
F	4
E	5

B

A	1
C	2
D	3
E	4

$A \cap B$

A	1
D	3

Cartesian Product(X)

- This type of operation is helpful to merge columns from two relations.
- Generally, a Cartesian product is never a meaningful operation when it performs alone.
- However, it becomes meaningful when it is followed by other operations.
- Cartesian Product operation denoted by **X**.

Cartesian Product Example

A

A	1
B	2
D	3
F	4
E	5

B

A	1
C	2
D	3
E	4

A X B

A	1	A	1
A	1	C	2
A	1	D	3
A	1	E	4
B	2	A	1
B	2	C	2
B	2	D	3
B	2	E	4
D	3	A	1
D	3	C	2
D	3	D	3
D	3	E	4

F	4	A	1
F	4	C	2
F	4	D	3
F	4	E	4
E	5	A	1
E	5	C	2
E	5	D	3
E	5	E	4

Join Operation

- Join operation is essentially a Cartesian product followed by a selection criterion.
- Join operation denoted by ⋈.
- JOIN operation also allows joining variously related tuples from different relations.
- Types of JOIN:

  Various forms of join operation are:

  - Inner Joins:
    - Theta join
    - EQUI join
    - Natural join
  - Outer join:
    - Left Outer Join
    - Right Outer Join
    - Full Outer Join

JOIN Operation Example

A

Col a	Col b
A	1
B	2
D	3
F	4
E	5

B

Col a	Col b
A	1
C	2
D	3
E	4

$A \bowtie B$

A.Col a = B.Col a

A	1	A	1
D	3	D	3
E	5	E	4

$A \bowtie B$

A.Col b = B.Col b

A	1	A	1
B	2	C	2
D	3	D	3
F	4	E	4

Objective Questions

1. Who is the father of DBMS?

Ans :- Edgar. F. Codd.

2. Which is used to denote the selection operation in relational algebra?

Ans :- Sigma (Greek)

3. How is the left outer join symbol represented in relational algebra?

a) ⟕

b) ⟗

c) ⟖

d) ⋈

Ans :- (a) ⟕.

Thank You!