Cartesian Product

- R×S
- set of all pairs of inputs
- each from r combined with each from 2

Union

- R∪S
- set union with duplicate elimination
- bag union (commutative but not idempotent)
- require compatible schema between R and S

Difference

- R-S, R\S
- each from R, which is not in S
- set difference
- bag: element multiplicity of R minus multiplicity min(R,S)

Projection

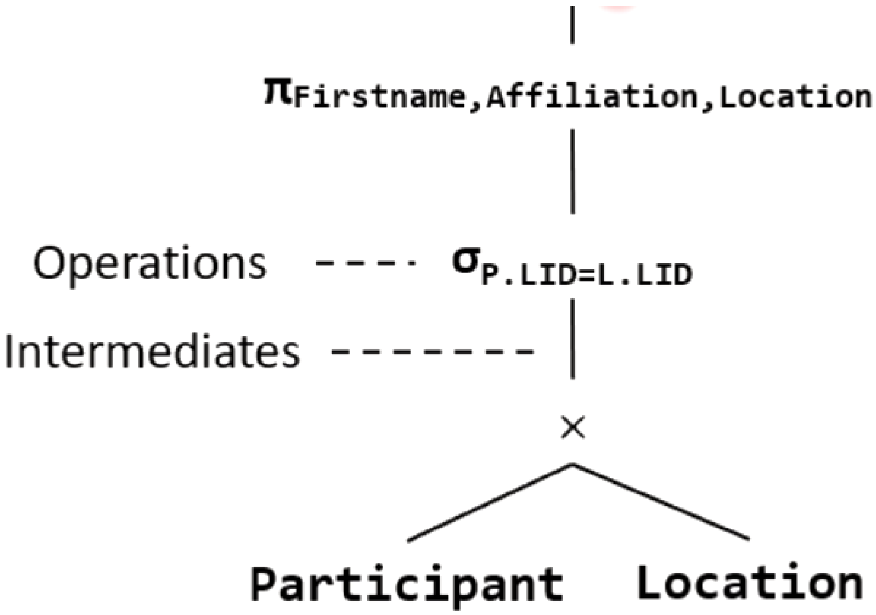
- $\pi(R)$
- set: selection of attributes with duplicate elimination
- bag: selection of attribute
- extended projection
  - arithmetic expressions
    - new columns based on computation
  - duplicate occurences

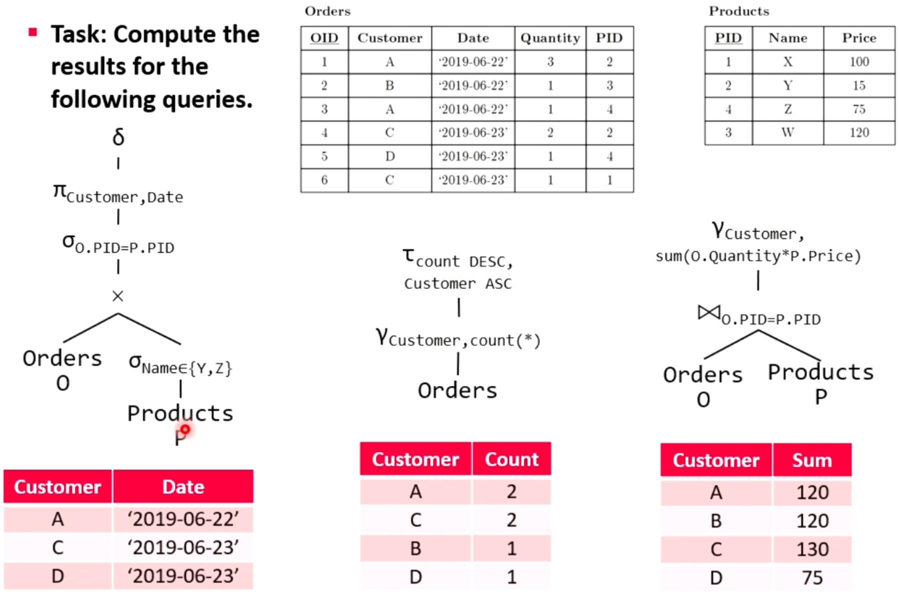
Selection (restriction)

- $\sigma(R)$
- selection of tuples satisfying condition
  - equivalent in set/bag

Composition of Complex Queries

- relational algebra expressions can be represented as data flow graph tree
  - leaf...tables
  - root/top...result

- 

- 

  - **Task: Compute the results for the following queries.**

  Orders

OID	Customer	Date	Quantity	PID
1	A	'2019-06-22'	3	2
2	B	'2019-06-22'	1	3
3	A	'2019-06-22'	1	4
4	C	'2019-06-23'	2	2
5	D	'2019-06-23'	1	4
6	C	'2019-06-23'	1	1

  Products

PID	Name	Price
1	X	100
2	Y	15
4	Z	75
3	W	120

Customer	Date
A	'2019-06-22'
C	'2019-06-23'
D	'2019-06-23'

Customer	Count
A	2
C	2
B	1
D	1

Customer	Sum
A	120
B	120
C	130
D	75

[[Relational Algebra]]