# ICS 321 Data Storage & Retrieval

# Algebraic and Logical Query Languages (ii)

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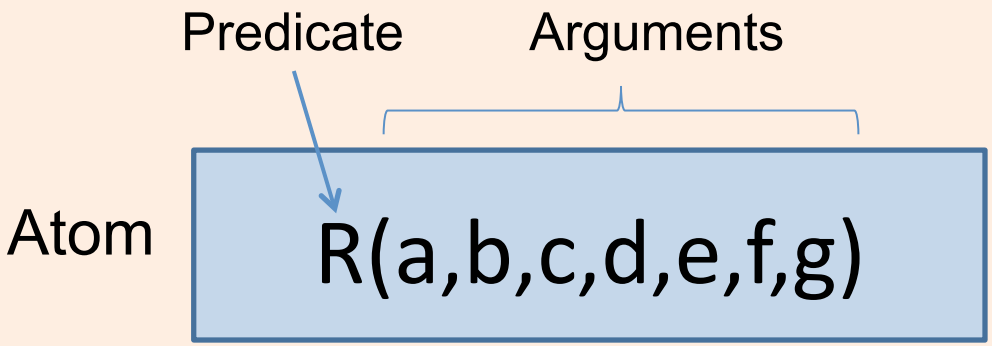
# Datalog : Database Logic

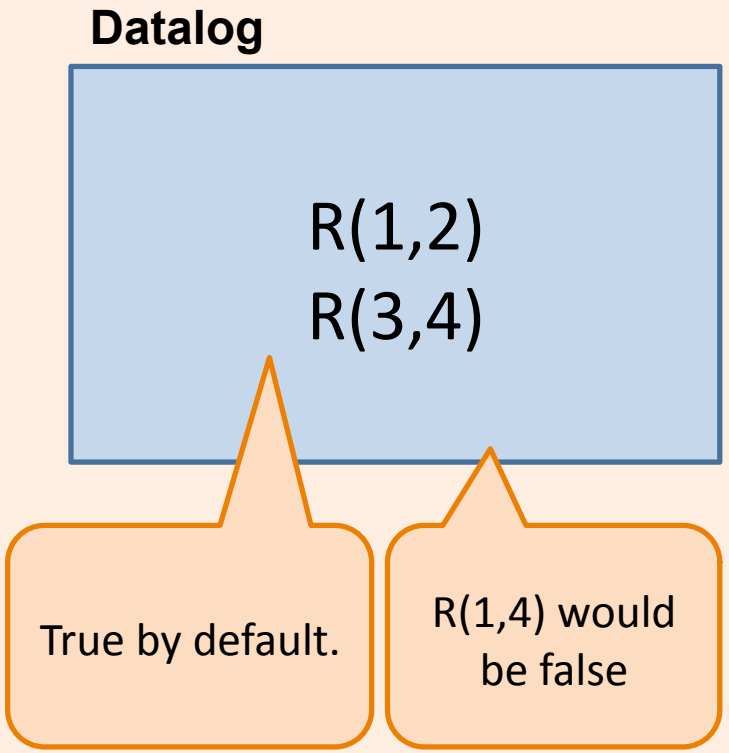



- A (relational) **atom**
  - Consists of a predicate and a list of arguments
  - Arguments can be constants or variables
  - Takes on Boolean value (true or false)
- A relation R can be represented as a predicate R
  - A tuple <a,b,c,d,e,f,g> is in R iff the atom R(a,b,c,d,e,f,g) is true.

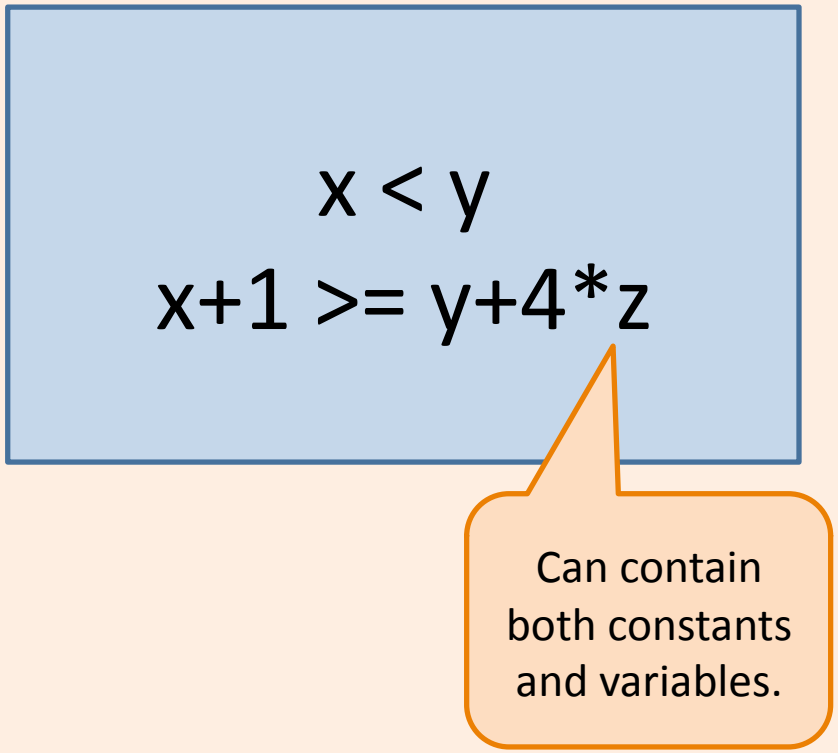
# Example: tables in datalog

**R**

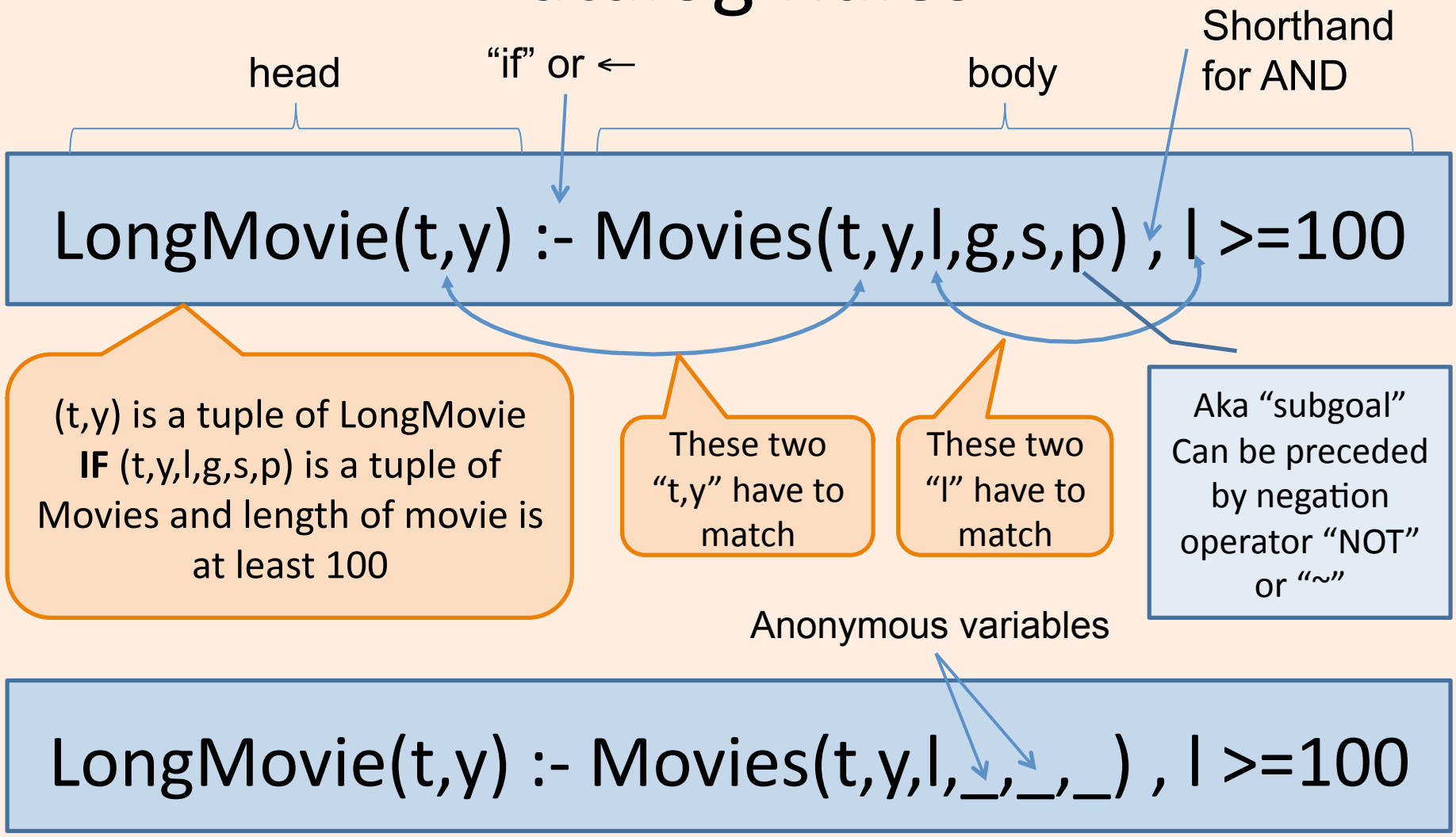
| A | B |
|---|---|
| 1 | 2 |
| 3 | 4 |



# Arithmetic Atoms



# Datalog Rules



# Safety Condition for Datalog Rules

Every **variable** that appears anywhere in the rule **must** appear in some **nonnegated, relational subgoal** of the body

- Without the safety condition, rules may be underspecified, resulting in an infinite relation (not allowed).
- Examples
  - LongMovie(t,y) :- Movies(t,y,l,_,_,_) , l >=100
  - P(x,y) :- Q(x,z), NOT R(w,x,z), x<y

# Alternative Interpretation: Consistency

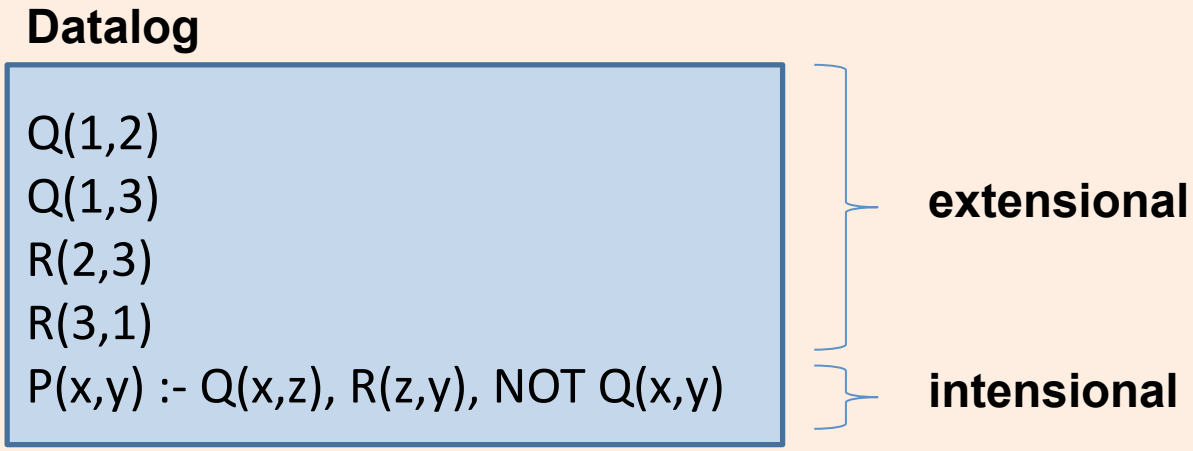
**Datalog**

```
Q(1,2)
Q(1,3)
R(2,3)
R(3,1)
P(x,y) :- Q(x,z), R(z,y), NOT Q(x,y)
```

- For each consistent assignment of nonnegated, relational subgoal,
- Check the negated, relational subgoals and the arithmetic subgoals for consistency

| Q(x,z) | R(z,y) | Consistent? | NOT Q(x,y) | Head |
|---|---|---|---|---|
| (1,2) | (2,3) | Yes | false | |
| (1,2) | (3,1) | No, z=2,3 | | |
| (1,3) | (2,3) | No, z=2,3 | | |
| (1,3) | (3,1) | Yes | true | P(1,1) |

# Intensional vs Extensional




- Extensional predicates – relations stored in a database
- Intensional predicates – computed by applying one or more datalog rules

# What about bag semantics ?

- Datalog still works if there are no negated, relational subgoals.
- Treat duplicates like non-duplicates

**Datalog**

```
R(1,2)
R(1,2)
S(2,3)
S(4,5)
S(4,5)
H(x,z) :- R(x,y), S(y,z)
```

| R(x,y) | S(y,z) | Consistent? | Head |
|---|---|---|---|
| (1,2) | (2,3) | Yes | H(1,3) |
| (1,2) | (4,5) | No, y=2,4 | |
| (1,2) | (4,5) | No, y=2,4 | |
| … | … | … | … |

# Example 1

**Datalog**

```
Answer(x,y) :- A(x,y)
Answer(x,y) :- B(x,y)
```

# Example 2

**Datalog**

```
Answer(x,y) :- A(x,y), B(x,y)
```

# Example 3

**Datalog**

```
Answer(x,y) :- A(x,y), NOT B(x,y)
```

# Example 4

**Datalog**

```
Answer(x,y) :- A(x,y), x > 10, y = 200
```

# Example 5

**Datalog**

```
Answer(x) :- A(x,y)
```

# Example 6

**Datalog**

```
Answer(w,x,y,z) :- A(w,x), B(y,z)
```

# Example 7

**Datalog**

```
Answer(w,x,y) :- A(w,x), B(x,y)
```

# Example 8

**Datalog**

```
Answer(w,x,z) :- A(w,x), B(y,z), x>y
```

# Example 9

**Datalog**

```
Path(x,y) :- Edge(x,y)
Path(x,z) :- Edge(x,y), Edge(y,z)
```