ICS 321 Spring 2013
Algebraic and Logical Query Languages (ii)

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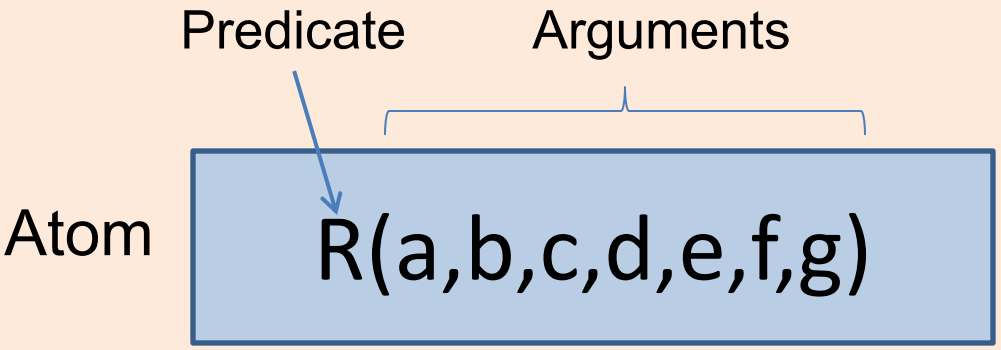
Datalog : Database Logic

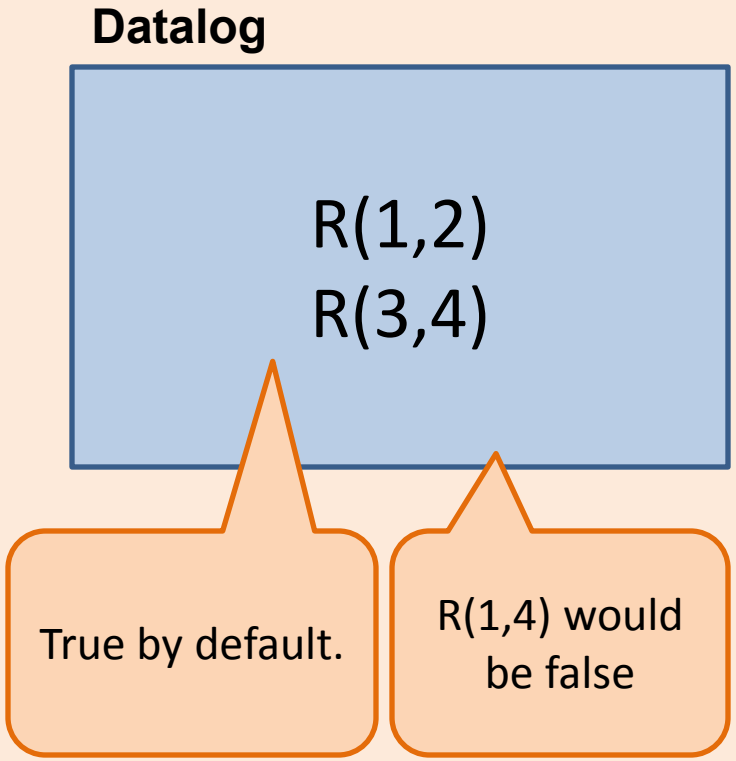


- A (relational) **atom**
  - Consists of a predicate and a list of arguments
  - Arguments can be constants or variables
  - Takes on Boolean value (true or false)
- A relation R can be represented as a predicate R
  - A tuple <a,b,c,d,e,f,g> is in R iff the atom R(a,b,c,d,e,f,g) is true.

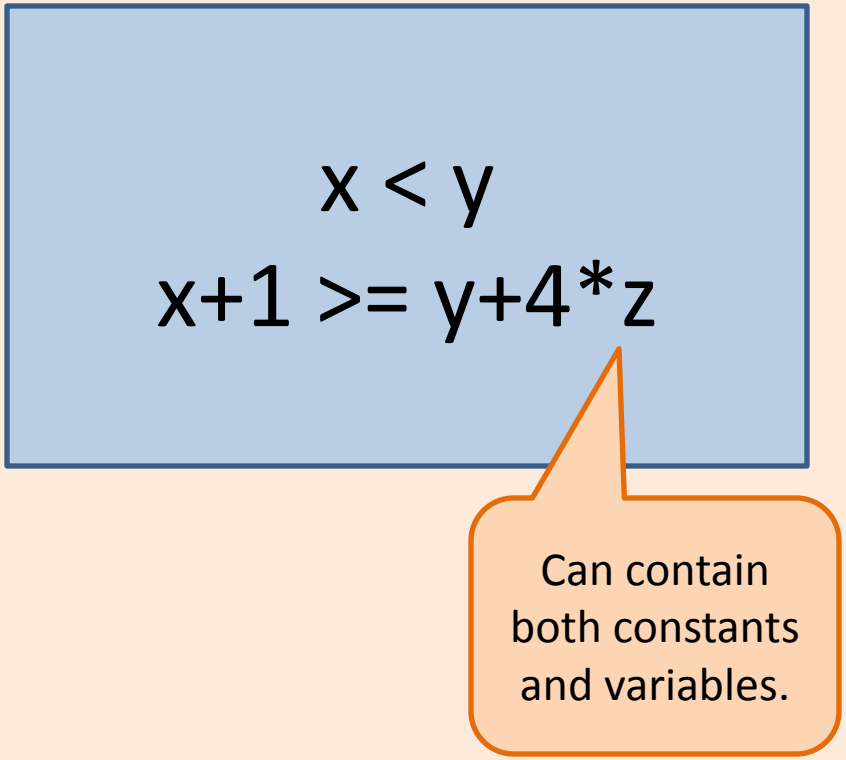
Example: tables in datalog

R

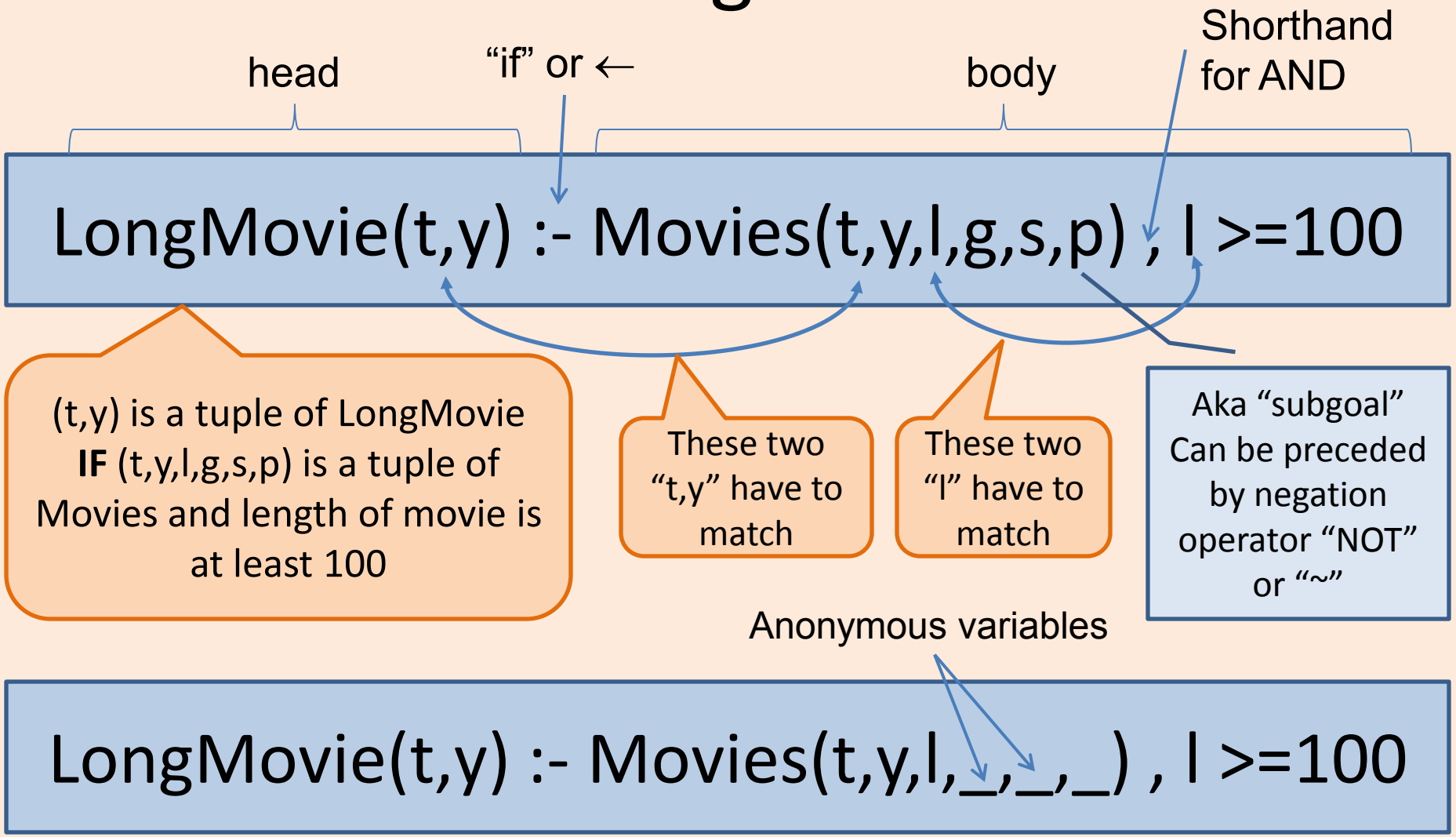
A	B
1	2
3	4



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

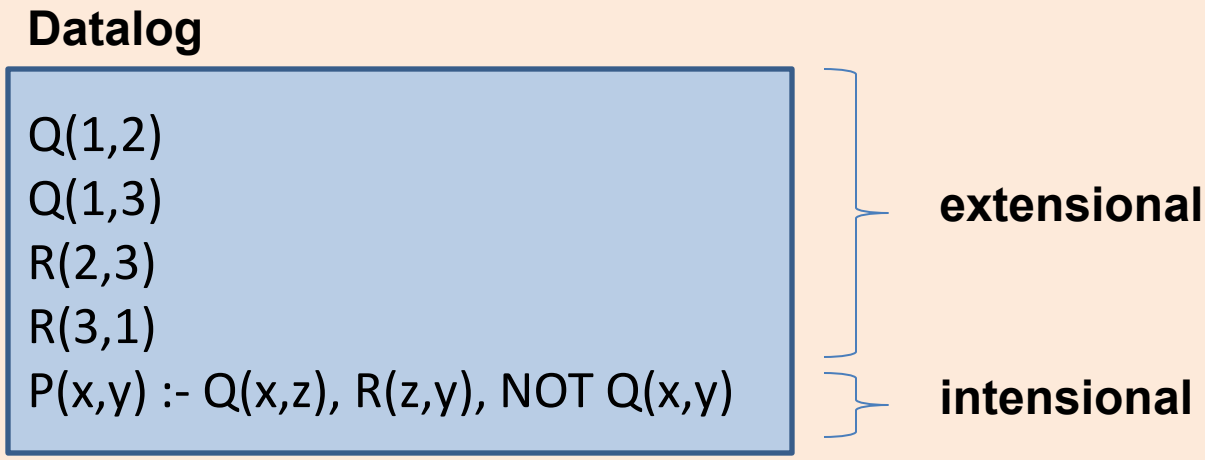
Datalog

```
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)
```