

# Using Rules

## Chapter 6

# Logic Programming

(Definite) logic program:

$A \leftarrow B_1, B_2, \dots, B_m$       program clause (Horn)

head      body

$\leftarrow A_1, A_2, \dots, A_n$       goal clause

# Logic Programming

PROLOG (Alain Colmerauer 1972):

apartmentpet(X) :- pet(X), small(X)

pet(X) :- cat(X)

pet(X) :- dog(X)

dog(X) :- poodle(X)

small(X) :- poodle(X)

poodle(fluffy)

pet(mittens)

?- apartmentpet(X)

# Forward vs. Backward Reasoning

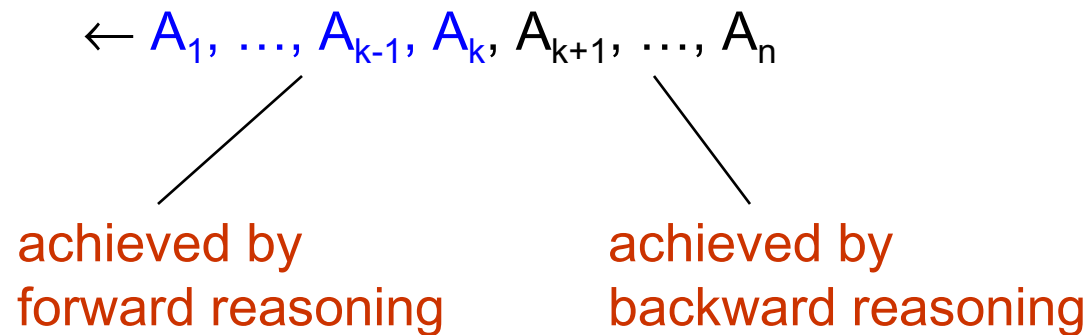
- Forward: from the **start states**.
- Backward: from the **goal states**.

# Forward vs. Backward Reasoning

- Forward rules: to encode knowledge about **how to respond to certain input.**
- Backward rules: to encode knowledge about **how to achieve particular goals.**

# Forward vs. Backward Reasoning

Combining forward and backward reasoning



# Production Systems

Working memory:

$\{A(1), A(2), B(2), B(3), B(4), C(5)\}$

Rule memory:

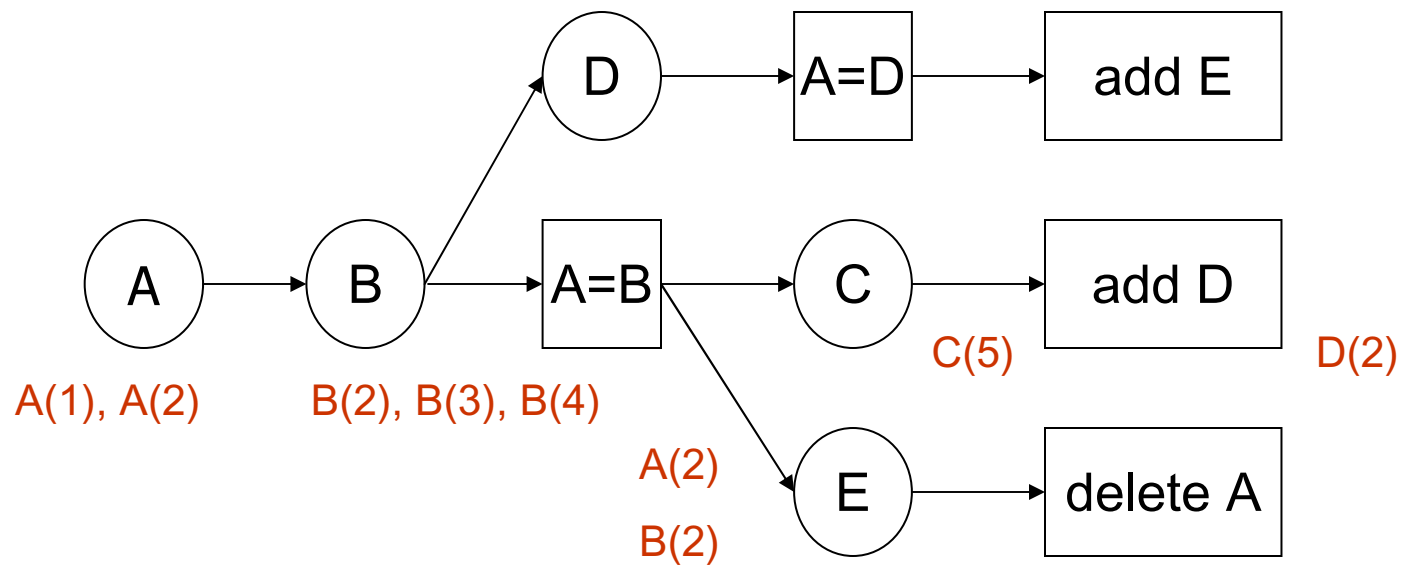
$A(x) \wedge B(x) \wedge C(y) \Rightarrow \text{add } D(x)$

$A(x) \wedge B(y) \wedge D(x) \Rightarrow \text{add } E(x)$

$A(x) \wedge B(x) \wedge E(x) \Rightarrow \text{delete } A(x)$

# Production Systems

RETE network (Forgy, 1982)



# Production Systems

## Conflict resolution:

### Preferences based on rules:

Specificity of rules

Physical order of rules

### Preferences based on objects:

Importance of objects

Position of objects

### Preferences based on states:

Evaluation of states

# Pattern Matching

ELIZA (Weizenbaum, 1966):

Person: Men all are alike.

ELIZA: In what way?

Person: They're always bugging us about something or other.

ELIZA: Can you think of specific example?

Person: Well, my boyfriend made me come here.

ELIZA: Your boyfriend made you come here.

Person: He says I'm depressed much of the time.

ELIZA: I am sorry to hear you are depressed.

Person: It's true. I am unhappy.

ELIZA: Do you think coming here will help you not to be unhappy?

# Pattern Matching

ELIZA (Weizenbaum, 1966):

Person: I need some help, that much seems certain.

ELIZA: What would it mean to you if you got some help?

Person: Perhaps I could learn to get along with my brother.

ELIZA: Tell me more about your family.

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# Pattern Matching

ELIZA (Weizenbaum, 1966):

(X me Y) → (X you Y)  
(I remember X) → (Why do you remember X just now?)  
(My {family-member} is Y) → (Who else in your family is Y?)  
(X {family-member} Y) → (Tell me more about your family)

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Person: My brother is mean to me.

ELIZA: Who else in your family is mean to you?

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