SIT-215: Forward Chaining

Weather Forecasting System

Recapping of Lecture Week-1

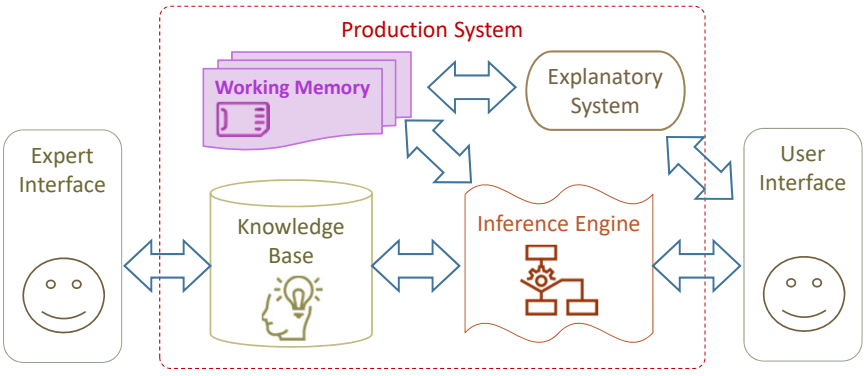
Production System

- A rule-based system can:
  1) Identify a pattern and draw a conclusion about what this means (i.e., interpret the pattern)
  2) Identify a pattern and infer new patterns from this
  3) Identify a pattern and advise a course of action, or take an action as a result

- The simplest rule-based Expert Systems are ***Production Systems***
- Comprised of a set of productions, or rules of the form

IF *<antecedent>* **THEN** *<consequent>*

Rule-based Expert Systems



Reasoning with Rules: Forward Chaining

Expert System is initialised with one or more knowledge bases, then

LOOP:

- User initiates the system by providing one or more facts to inference engine,
- The initial facts are added to working memory
- Inference engine reviews working memory and selects matching rule
- Corresponding patterns get saved to past memory
- Consequent of matching rule is added to working memory, or executed (if it is an action rule)

UNTIL: No rules match facts, or END pattern is reached

Conflict Resolution Strategies

- Firing more than one rule at a time can cause a *conflict set*
- Common conflict resolution strategies:
  - **Ordered**–The rule with highest precedence fires while the others are ignored
  - **Weighted**– Rules have strengths, so rule with highest strength fires
  - **Temporal**– Rules have an age, so fire oldest or perhaps youngest rules

Forward Chaining

- Method of deriving a particular goal from:
  - given knowledge base
  - given set of inference rules

Example of forward chaining

Fact

- A hair dryer is a machine

Rules

- IF X is power driven THEN X needs a power source
- IF X is a machine THEN X has a power cord
- IF X is a machine THEN X is power driven

Question

- Does hair dryer need a power source?

Example of forward chaining

Fact

- A hair dryer is a machine
- A hair dryer has a power cord

Rules

- IF X is power driven THEN X needs a power source
- ~~IF X is a machine THEN X has a power cord~~
- IF X is a machine THEN X is power driven

Question

- Does hair dryer need a power source?

Example of forward chaining

Fact

- A hair dryer is a machine
- A hair dryer has a power cord
- A hair dryer is power driven

Rules

- IF X is power driven THEN X needs a power source
- ~~IF X is a machine THEN X has a power cord~~
- ~~IF X is a machine THEN X is power driven~~

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Example of forward chaining

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- A hair dryer is a machine
- A hair dryer has a power cord
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- IF X is power driven THEN X needs a power source
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Question

- Does hair dryer need a power source?

Example of forward chaining

Fact

- A hair dryer is a machine
- A hair dryer has a power cord
- A hair dryer is power driven
- A hair dryer needs a power source

Rules

- ~~IF X is power driven THEN X needs a power source~~
- ~~IF X is a machine THEN X has a power cord~~
- ~~IF X is a machine THEN X is power driven~~

Question

- Does hair dryer need a power source?

Example # 2: Weather Forecasting System

Suppose we have developed the following rules for our weather forecasting system.

Rule-1:

- **IF** <we suspect temperature is less than 20 degree> **AND** <there is humidity in the air>
- **THEN** <there is chance of rain>

Rule-2:

- **IF** <Sun is behind the clouds> **AND** <air is very cold>
- **THEN** <we can conclude temperature is less than 20 degree>

Rule-3:

- **IF** <air is very heavy>
- **THEN** <there is humidity in the air>

Example # 2: Weather Forecasting System

Suppose we have been given the following facts:

- Sun is behind the clouds
- Air is very heavy and cool

Problem: conclude the chance of rain using the forward chaining

Example # 2: Weather Forecasting System

Rule, premise	Status	Working Memory
1.1: We suspect temperature is less than 20	Unknown	a) Sun is behind the clouds (fact) b) Air is very heavy and cool (fact)
1.2: There is humidity in the air	Unknown	a) Sun is behind the clouds b) Air is very heavy and cool
2.1: Sun is behind the clouds	True	a) Sun is behind the clouds b) Air is very heavy and cool
2.2: Air is very cool	True Then: Fire Rule	a) Sun is behind the clouds b) Air is very heavy and cool **c) Temperature is less than 20**

Example # 2: Weather Forecasting System

Rule, premise	Status	Working Memory
1.1: We suspect temperature is less than 20	True	a) Sun is behind the clouds b) Air is very heavy and cool ***c) Temperature is less than 20***
1.2: There is humidity in the air	Unknown	a) Sun is behind the clouds b) Air is very heavy and cool ***c) Temperature is less than 20***
3.1: Air is very heavy	True Then: Fire Rule	a) Sun is behind the clouds b) Air is very heavy and cool c) Temperature is less than 20 **d) There is humidity in the air**

Example # 2: Weather Forecasting System

Rule, premise	Status	Working Memory
1.1: We suspect temperature is less than 20	True	a) Sun is behind the clouds b) Air is very heavy and cool ***c) Temperature is less than 20*** ***d) There is humidity in the air***
1.2: There is humidity in the air	True Then: Fire Rule	a) Sun is behind the clouds b) Air is very heavy and cool c) Temperature is less than 20 d) There is humidity in the air **e) There are chances of rain**