

20IS603 Architecture of Intelligent Systems

```
if ( condition )  
then  
{ action };
```

Rule-based systems

Knowledge Representation

Rules and Facts

- Most commonly used type of knowledge representation
- Rule provides description of how to solve a problem - easy to create and understand
- Represented in the **IF-THEN** form called **production rules** or just **rules**
- Relates **information or facts in the IF** part to some **action in the THEN** part.

```
IF    the 'traffic light' is green  
THEN the action is go
```

```
IF    the 'traffic light' is red  
THEN the action is stop
```

Rule as Knowledge representation

- Any rule consists of two parts: the IF part, called the *antecedent* (premise or condition), and the THEN part, called the *consequent* (conclusion or action).

IF <antecedent>
THEN <consequent>

- The antecedent of a rule incorporates two parts: an *object* (linguistic object) and its *value*.
- The object and its value are linked by an *operator*.
- Can assign symbolic value or numerical value
- Rules can represent *relations, recommendations, directives, strategies and heuristics*

Rule as Knowledge representation

- Relation

```
IF    the 'fuel tank' is empty
THEN  the car is dead
```

- Recommendation

```
IF    the season is autumn
AND   the sky is cloudy
AND   the forecast is drizzle
THEN  the advice is 'take an umbrella'
```

- Directive

```
IF    the car is dead
AND   the 'fuel tank' is empty
THEN  the action is 'refuel the car'
```

Rule as Knowledge representation

- Strategy

```
IF    the car is dead
THEN  the action is 'check the fuel tank';
      step1 is complete
IF    step1 is complete
AND   the 'fuel tank' is full
THEN  the action is 'check the battery';
      step2 is complete
```

- Heuristics

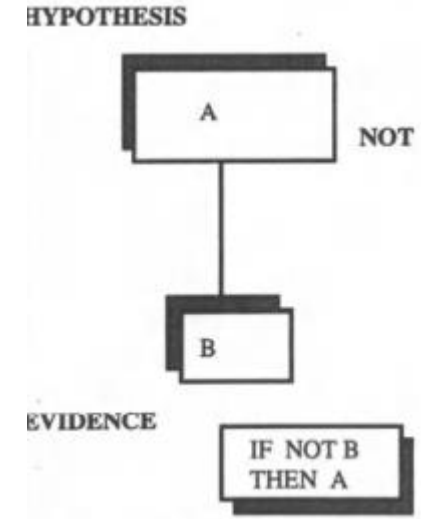
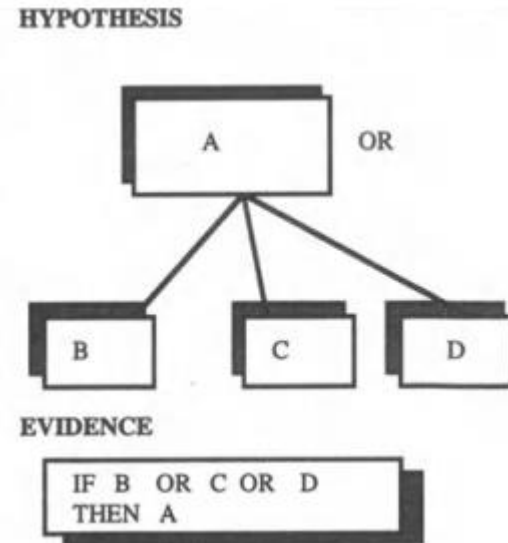
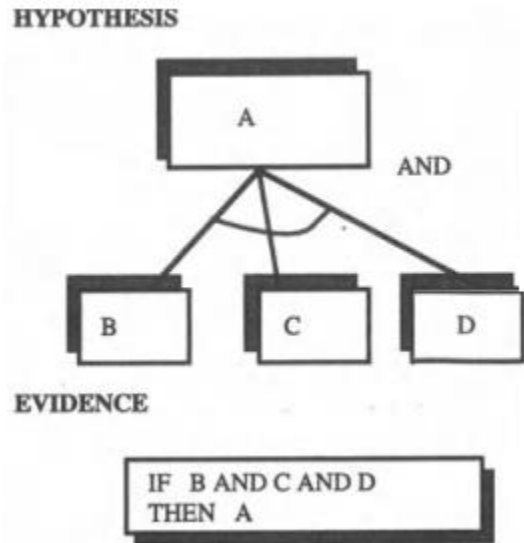
```
IF    the spill is liquid
AND   the 'spill pH' < 6
AND   the 'spill smell' is vinegar
THEN  the 'spill material' is 'acetic acid'
```

Facts as Knowledge representation

- **Unconditional statements** that are assumed to be correct at the time that they are used
- Facts can be
 - looked up from a database or from the Internet;
 - already stored in computer memory;
 - determined from sensors connected to the computer;
 - obtained by prompting the user for information;
 - derived by applying rules to other facts.
- Given the rule *if the tap is open then water flows* and the fact the tap is open, the derived fact water flows can be generated
- The collection of facts that are known to the system at any given time is called the **fact base**

Inference networks

- Graphical representation of production rules



Reasoning

- The process of drawing inferences or conclusions
- Moving from what is known (fact) to what is unknown (inference)

deduction: cause + rule \Rightarrow effect

abduction: effect + rule \Rightarrow cause

induction: cause + effect \Rightarrow rule

- Inferring a rule from a set of example cases of cause and effect is induction

Rule-based Systems

