University of Science and Technology
Faculty of Computer Science and Information Technology

Artificial Intelligence (AI)

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Instructor : Diaa Eldin Mustafa Ahmed

Knowledge Representation (KR)

ARTIFICIAL INTELLIGENCE (AI) -

KNOWLEDGE REPRESENTATION SCHEMES

Ruchi Sharma

ruchisharma1701@gmail.com

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Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Quick Recall – AI Concepts

1. Artificial Intelligence deals with creating computer systems that can
   - ✓ simulate human intelligent behaviour in a particular domain
   - ✓ learn new concepts and tasks
   - ✓ reason & draw conclusions
   - ✓ learn from the examples & past related experience

2. A computer possessing artificial intelligence(an expert system) has two basic parts
   - ✓ Knowledge Base – containing the knowledge it uses
   - ✓ Inference-control unit – which facilitates the appropriate & contextual use of KB

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Knowledge Representation – Concept & Features

Knowledge representation is a method used to code knowledge in the knowledge base of an expert system.

An ideal knowledge representation scheme should

- ✓ have inferencing capability
- ✓ have a set of well defined syntax & semantics
- ✓ allow the knowledge engineer to express knowledge in a language (which can be inferred)
- ✓ allow new knowledge to be inferred from the basic facts already stored in the KB

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Knowledge Representation – Techniques/Schemes

Different knowledge representation schemes are used today among which the most common are

- ✓ *Semantic Networks*
- ✓ *Frames*
- ✓ *Propositional logic & FOPL*
- ✓ *Rule-based system*

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding Semantic Networks - Facts

- ✓ *A semantic network is a directed graph with labelled nodes & arrows. Nodes are commonly used for objects & the arrows for relations.*

- ✓ *The pictorial representation of objects, their attributes & relationships between them & other entities make them better than many other representation schemes.*

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding Semantic Networks – An example

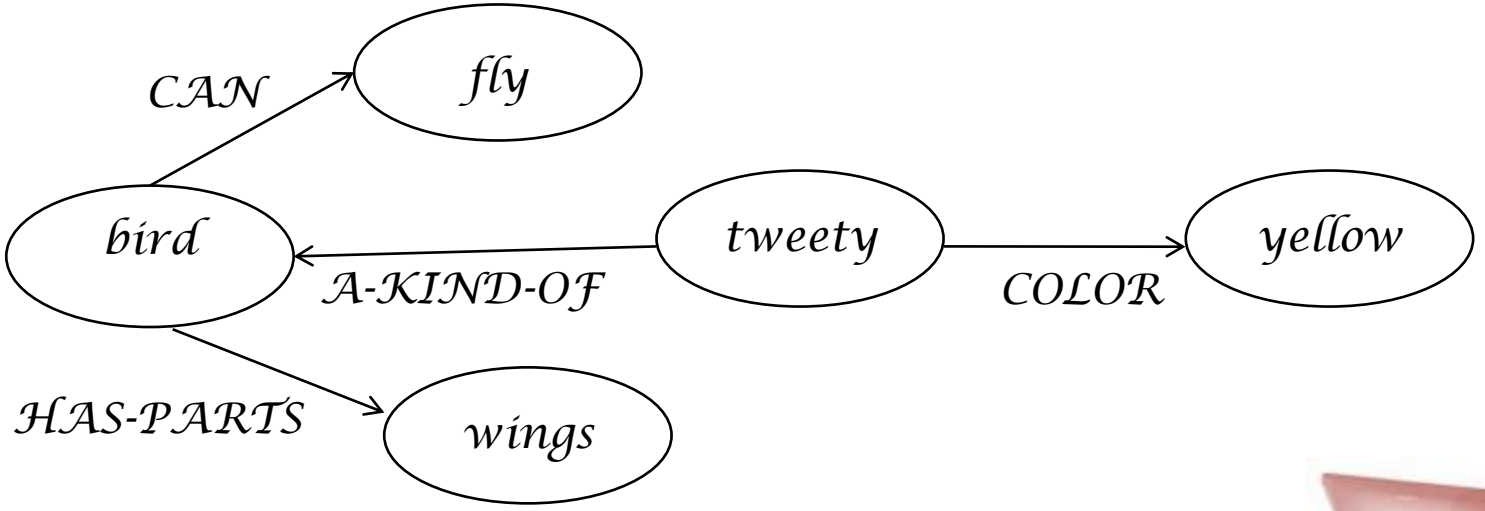
Let us make a semantic net with the following piece of information

"Tweety is a yellow bird having wings to fly."

Fact 1 : Tweety is a bird.

Fact 2 : Birds can fly.

Fact 3 : Tweety is yellow in color.



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Understanding Frames – Facts

- ✓ Frames are record-like structures that have slots & slot-values for an entity
- ✓ Using frames, the knowledge about an object/event can be stored together in the KB as a unit
- ✓ A slot in a frame
  - specify a characteristic of the entity which the frame represents
  - Contains information as attribute-value pairs, default values etc.

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding Frames - Examples

1. An example frame corresponding to the semantic net eg quoted earlier

   (Tweety

   (SPECIES (VALUE bird))

   (COLOR (VALUE yellow))

   (ACTIVITY (VALUE fly)))

2. Employee Details

   (Ruchi Sharma

   (PROFESSION (VALUE Tutor))

   (EMPID (VALUE 376074))

   (SUBJECT (VALUE Computers)))

Understanding Propositional Logic – Facts

- ✓ Symbolic logic is a formalized system of logic which employs abstract symbols of various aspects of natural language.
- ✓ Propositional logic is the simplest form of the symbolic logic, in which the knowledge is represented in the form of declarative statements called propositions.
- ✓ Each proposition, denoted by a symbol, can assume either of the two values – true or false.

  Eg

  P : It is raining.

  Q : The visibility is low.

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding Propositional Logic – Facts (Contd.)

- ✓ Propositions are also called formulas or well-formed-formulas(wffs)
- ✓ Formulas can be atomic or compound
  - Atomic formulas – elementary propositional sentences
  - Compound formulas – formed from the atomic formulas using logical connectives (^, V, !, ~, →)

  eg

  R : It is raining and the visibility is low.

Understanding Propositional Logic - Examples

1. If given the statements P, Q and S as :

   P : It is raining.

   Q : The visibility is low.

   S : I can't drive.

   Then, the statement "It is raining and the visibility is low, so I can't drive." will be formalized as

   $P \wedge Q \rightarrow S$

2. If given the statements P & Q as :

   P : He needs a doctor.

   Q : He is unwell.

   we can conclude

   $Q \rightarrow P$

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding First order predicate logic (FOPL)

- ✓ FOPL was developed to extend the expressiveness of propositional logic.
- ✓ It works by breaking a proposition into various parts & representing them as symbols.
- ✓ The symbolic structure includes
  - individual symbols - some constants as names
  - variable symbols – as x, y, a, b etc
  - function symbols – as 'product'
  - predicate symbols – as P, Q etc

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Given statements

P: Every bird can fly.

Q : Tweety is a bird.

R : Tweety can fly.

Using FOPL, lets define the following

B(x) for x is a bird.

F(x) for x can fly.

$P : \forall(x)\ ((B(x) \rightarrow F(X))$

$Q : B(TWEETY))$

$R : \forall(x)(B(x) \rightarrow F(x)) \wedge B(TWEETY) \rightarrow F(TWEETY)$

Understanding Rule-based System – Facts

- ✓ A Rule-based system represents knowledge in the form of a set of rules .
- ✓ Each rule represents a small chunk of knowledge relating to the given domain.
- ✓ A number of related rules along with some known facts collectively may correspond to a chain of inferences.
- ✓ An interpreter(inference engine) uses the facts & rules to derive conclusions about the current context & situation as presented by the user input.

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Understanding Rule-based System – Example

Suppose a rule-based system has the following statements

R1 : If A is an animal and A lays no eggs, then A is a mammal.

F1 : Lucida is an animal.

F2 : Lucida lays no eggs.

The inference engine will update the rule base after interpreting the above set as :

R1 : If A is an animal and A lays no eggs, then A is a mammal.

F1 : Lucida is an animal.

F2 : Lucida lays no eggs.

F3 : Lucida is a mammal.

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

Thank You

Ruchi Sharma ruchisharma1701@gmail.com http://www.wiziq.com/tutor-profile/376074-Ruchi

You will be expected to know

❑.

❑.

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❑.

❑.

Thank You

End