U-4 → Knowledge

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* Knowledge -

→ 1) Simple Relational Knowledge -

- simplest way of storing fact which uses relational method.
- set of objects → set all sequentially & automatically.
- small procedure for inference.
- define inference engines.

→ 2) Inheritable Knowledge -

- relational knowledge → correlation associated values attribute.
- organized into hierachy of classes
- inherit values from being all members of class.
- class must be arranged in a generalization.

* Inferential Knowledge -

- useful form of inference, represent knowledge as formal logic.

set of rules -

- Define require fact
- Additional statement is varified, true or false.
- logic provides a powerful structure in relationships.

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Procedural knowledge -

- explain different - different way in program.
- differs from propositional knowledge.
- involves knowing how to do something.
- follow implicit learning.

Adv → properties specific knowledge specified.
→ extended logical inferend is possible.

Disadv → consistency → all deduction are not always correct.
→ completness → all cases are not easy to represent.

Predicate Logic → represent inferentble knowledge.
→ powerful structure → describe rel^n among values
→ combined with some powerful languages → ISA hierachy

Production Rules → representing procedural knowledge
→ specify what to do when.
→ hard to reasoning with method.

Inheritable knowledge → rel^n knowledge attributes & corresponding values.
→ property inheritance
→ boxed nodes.
→ values can be objects with attributes.
→ arrows - point from object to its value.

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* Propositional logic -

→ is declarative (pieces of syntax corresponds to facts).
→ allows partial/disjunctive/negated inference.
→ compositional.
→ contexual independent.

- Drawbacks of Propositional logic -
→ very expressive power.
→ world ~~into~~ without reflecting the structure & without modeling.
→ some knowledge is hard or impossible to encode.

- Syntax for Propositional Logic.
→ It defines allowable sentences in model.

* Calculus symbols -
1) Symbol → P, Q, R is
→ represent a relation in a domain.

2) True symbols → True, False.

3) Connectives → ∧, ∨, ¬, →, ↔, ≡

* Calculus Sentence -
1) Propositional symbol & true symbol →
2) Atomic sentence → consists of proposition symbol.
3) complex → simpler sentences using logical connectives.

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Connectives -

a) AND connective → ∧
b) OR connective → ∨
c) NOT connective → ¬
d) IF connective → ⇒ (If-then)
e) BICONDITIONAL connective → ⇔

Wumpus World Agent -

- classical artifical intelligence problem used to demonstrate aspects.
- computer game → agent has to explore a cave made up from series of interconnected rooms.
- If one of rooms in cave, wumpus would kill agent if he entered.
- rooms → contains pits, agent die if any other room is visited.
- locate gold → hidden → return to start without getting killed.

PEAS description.

- Performance measure -
  Gold : +1000 Death : -1000.
  -1 per step ; -10 for using arrow.
- Environment :-
  square adjacent to wumpus → smelly
  square adjacent to pit are breezy
  glitter if gold in same square
  shooting kills wumpus. If screams.
  shooting uses only arrow.
  grabbing picks up gold in same square.
  releasing drops gold in same square.
  You bump if you walk into wall
- Actuators -
  Left turn, right turn, forward, grab, release, shoot.
- sensors
  stench, breeze, glitter, bump, scream.

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Inference Rules.

1) Modus Ponens. $\frac{\alpha \Rightarrow \beta, \alpha}{\beta}$

$\alpha \Rightarrow \beta$
α are given then sentence β can be inferred.

2) And - elimination -
conjunction any conjuncts can be inferred.

$\frac{\alpha \wedge \beta}{\alpha}$

3) Unit resolution $[P \vee Q, \neg Q \vdash P]$:
disjunction of literals & a literal and produce new clause.

Rule is $\frac{l_1 \vee \dots \vee l_k, m}{l_1 \vee \dots \vee l_{i-1} \vee l_{i+1} \dots \vee l_k}$

4) Resolution - generalized to full resolution rule,

$\frac{l_1 \vee l_2 \neg l_2 \vee l_3}{l_1 \vee l_3}$

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Forward & Backward Chaining.

Horn clause -

→ knowledge base contains simple restricted clauses.

→ disjunction of literals of which is most one is positive.

- one positive literal.
- one positive literal → definite literal.
- positive literal → HEAD of clause
- negative literal → BODY of clause.
- definite clause → no negative literals → fact.
- Inferencing with HORN clause → forward & backward chaining methods are used.

Forward Chaining Method -

- concept → general concept of data-driven reasoning in
  ↳ function of attention starts with known data.
- used within an agent to derive conclusions from incoming percepts.
- determining single proposition symbol q (the query) is entailed.
- starts from know facts (positive literals) in knowledge base.
- premises of an implication → conclusion added to set of known facts

Properties → inference is application of modus ponens.
→ is complete (each symbol inferred during process).

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Backward Chaining

→ works backwards from query
→ algorithm finds implication in knowledge base.
→ Backward chaining works down graph until it reaches set of known facts
→ form of goal-directed reasoning.
→ cost is equal to or less than linear in size of knowledge base
→ order of clauses by backward chaining algorithm.

Reasoning for both
→ Availability of data
→ complexity of problem
→ speed of reasoning.

WALKSAT algorithm.

→ random walk algorithm. → satisfiability.

characteristics.
1) Local search algorithm.
2) evaluation → min-conflict heuristic of minimizing number of unsatisfied clauses.
3) balances b/w greediness & randomness.
4) more useful when we expect a solution.
5) Incomplete algorithm.
6) Local Search algorithm → can't always detect satisfiability

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First Order logic -

- Has well defined syntax & semantics.
- 3 things to represent world model.

1) Objects → Nouns & nounphrases in natural languages.

2) Relations → association among objects or projectries.

3) Function → apply function on objects.

- **Properties -**

- ability to respect facts about some or all objects.
- enables to represent law & rules extracted from real world.
- useful language representation in mathematics, philosophy & AI field.
- more realistic manner rather than just true or false.
- makes ontological commitment.

- Variations → Temporal → facts hold at some times & Lower order.
  → High Order → relations & functions to by first logic as objects.

- Characteristics → epistemological commitments → ability to show possible state of knowledge.
  → probability theory → assign degree of probability of sentences ranging from 0 to 1.