

Lecture Notes 16

Predicate Calculus

- Proposition – Logical statement that may or may not be true
- Symbolic logic – Used in formal logic to express propositions, relationships between propositions, and how new propositions can be inferred from others
- First-Order Predicate Calculus – Symbolic logic used in logic programming
- Compound term – One element of a mathematical relation
- Atomic Proposition – Simplest proposition consisting of compound terms
- Functor – Names a relation, and provides ordered list of parameters
- Compound Proposition – Contains more than one atomic proposition
- \neg – Negation
- \cap – Conjunction
- \cup – Disjunction
- \equiv – Equivalence
- \supset – Implication $a \supset b$ is “ a implies b ”
- \subset – Implication $a \subset b$ is “ b implies a ”
- $\forall X.P$ – Universal (For all X , P is true)
- $\exists X.P$ – Existential (There exists a value of X , such that P is true)
- Clausal Form – $B_1 \cup B_2 \cup \dots \cup B_n \subset A_1 \cap A_2 \cap \dots \cap A_m$
- Antecedent – Right hand side of clausal form
- Consequent – Left hand side of clausal form
- Resolution – Inference rule with that allows inferred propositions
 $T \subset P$
 $Q \subset T$
 With resolution:
 $Q \subset P$
- Unification – Process of determining useful values for variables
- Instantiation – Variables that are temporarily set to values
- Horn clause – Restriction of the form of clause
 $b \subset a_1 \cap a_2 \cap \dots \cap a_n$

Prolog

- Declarative Semantics – Describes the simple way to determine the meaning of statement
- Declarative Programing – Describes what the solution is, not how to compute it
- Conjunctions – Multiple terms that are separated with logical AND
- Goals (or queries) – Propositions in Prolog
- Subgoal – A goal in a compound proposition
- Bottom-up Resolution (or Forward Chaining) – Build up rules from the base facts

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- Top-down Resolution (or Backward Chaining) – Start with ultimate goal and work down to find matching prepositions
- Depth-First Search Strategy – Find a solution for the first subgoal before moving on
- Breadth-First Search Strategy – Work on all subgoals in parallel
- :- Used for \subset (or \leftarrow)
- Case sensitive names
 - Uppercase – Variables
 - Lowercase – Constants and Names
- Pattern-Directed Invocation – Automatic unification of two variables used in place of a goal
`append([], Y, Y).`
`append([A|B], Y, [A|W]) :- append(B, Y, W).`
- Search Strategy – Done Depth First
- Backtracking – Traversing back up the tree to attempt a different instantiation
- Fail – Forces backtracking
- Cut (!) – Freezes a choice once found

Problems with Logic Programming

- Occur Check Problem – Variable not checked if used in the term
- Closed-World Assumption – Anything cannot be proved true is assumed false
- Negation as Failure – `not(X)` succeeds when `X` fails
- Nonmonotonic Reasoning – More information can reduce number of things that can be proved
- Horn Clauses can't express all of logic
- Control Information is required in Logic