First-Order Logic

- **Term**: A logical expression that refers to an object.
  - example: `fatherof(john)`

- **Atomic Sentences**: Expressions that are not further decomposed.
  - example: `fatherof(john)`, `married(fatherof(john), motherof(john))`.

- **Complex Sentences**: Composed of one or more atomic sentences.
  - example: `brother(richard, john) ∨ brother(john, richard)`

- **Quantifiers, Variables**:
  - **Universal Quantification**: `∀x cat(x) → mammal(x)`
    - example: `∀x man(x) → mortal(x)`
  - **Existential Quantification**: `∃x sister(x, spot) ∧ cat(x)`
    - example: `∃x motherof(x, john)`

- **Functions**:
  - `fatherof` (father of)
  - `brotherof` (brother of)
  - `marriedto` (married to)

- **Properties**:
  - `is_red`, `is_round`, `is_prime`, `is_number`
  - `has_color`, `is_biggerthan`, `is_olderthan`, `is_older_than`
First-Order Logic

Syntax

AtomicSentence

⇒ Predicate

(term 1 ...)

| term = term

term ⇒ Function

(term 1 ...)

| constant | variable

Sentence

⇒ AtomicSentence

| Sentence Connective Sentence

| Quantifier Variable Sentence

| ¬ Sentence

| ( Sentence )

Application

Temporal Reasoning

▶ TMM – Time Map Manager (Brown, Yale, Honeywell, NASA)

▶ Specialized Temporal Reasoning System

▶ Reasoning about the ordering and extent of events and the resulting changes in the state of the world.

▶ Applied to very large problems – 10,000 activities.

▶ Scheduling for a circuit board manufacturing plant, science modules on Space Shuttle.

Semantic Web

▶ Syntactic Web vs Semantic Web

▶ HTTP://WWW.SEMANTICWEB.ORG

▶ Web Services

▶ Web Search, Electronic Commerce

▶ Ontologies, Description Logics

▶ HTML, XML

▶ Syntactic Web vs Semantic Web

Syntact