

# Mit 6.043 - Artificial Intelligence

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## 1 Reasoning: goal trees and rule-based expert systems

A **semantic net** is a representation in which:

- Lexically, there are nodes, links, and application-specific link labels
- Structurally, each link connects a tail node to a head node
- Semantically, the nodes and links denote application-specific entities

With constructors that:

- Construct a node
- Construct a link, given a link label and two nodes to be connected

With readers that:

- Produce a list of all links departing from a given node
- Produce a list of all links arriving at a given node
- Produce a tail node, given a link
- Produce a head node, given a link
- Produce a link label, given a link

A **Semantic tree** is a representation, that is a semantic net in which:

- certain links are called *\*branches\**. Each branch connects two nodes; the head node is called the *\*parent node\** and the tail node is called the *child node*
- One node has no parent; it is called the root node. Other nodes have exactly one parent
- Some nodes have no children, they are called *leaf nodes*. When two nodes are connected to each other by a chain of two or more branches, one is said to be the *ancestor*; the other is said to be the descendant

With constructors that:

- Connect a parent node to a child node with a branch links

With readers that:

- Produce a list of a given node's children
- Produce a given node's parent

A **goal tree** is a semantic tree in which: nodes represent goals and branches indicate how you can achieve goals by solving one or more subgoals. Each node's children corresponds to **immediate subgoals**; each node's parent corresponds to the **immediate supergoal**. The top node, the one with no parent, is the **root** goal.

Some goals are satisfied directly, without reference to any other subgoals. These goals are called **leaf goals**, and the corresponding nodes are called **leaf nodes**.

Because goal trees always involve *And* nodes, or *Or* nodes, or both. they are often called **And-Or trees**.

To determine whether a goal has been achieved, you need a testing procedure. The key procedure, *REDUCE*, channels action into the *REDUCE-AND* and the *REDUCE-OR*.

Goal trees enable introspective question answering:

- how: the immediate subgoal (downstream)
- why the immediate supergoal (downstream)

### 1.1 Eliciting expert systems features

- Heuristic of specific situations: it is dangerous to limit inquiry to office interviews
- Heuristic of situation comparison: ask a domain expert for clarification whenever the domain expert's behavior varies in situations that look identical to the knowledge engineer.
- You should build a system and see when it cracks. Helps identifying missing rules.