Propositional Logic Intro, Syntax

CPSC 322 – Logic 1

Textbook §5.0 – 5.2

Lecture Overview

1. Recap
2. Logic Intro
3. Propositional Definite Clause Logic: Syntax

Forward Planning

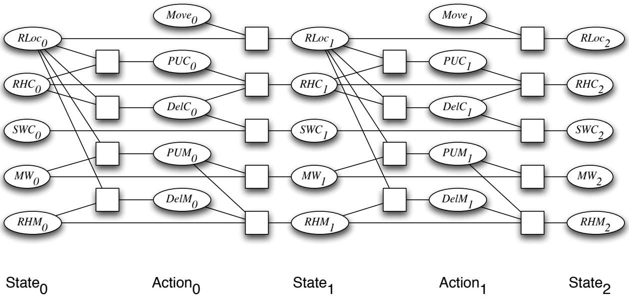
Idea: search in the state-space graph.

- The nodes represent the states
- The arcs correspond to the actions: The arcs from a state s represent all of the actions that are legal in state s.
- A plan is a path from the state representing the initial state to a state that satisfies the goal.

Planning as a CSP

- We don't have to worry about searching forwards if we set up a planning problem as a CSP
- To do this, we need to "unroll" the plan for a fixed number of steps
  - this is called the horizon
- To do this with a horizon of k:
  - construct a variable for each feature at each time step from 0 to k
  - construct a boolean variable for each action at each time step from 0 to $k-1$.

CSP Planning: Robot Example



The constraints shown represent the preconditions of actions and the effects of actions.

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Logic: A more general framework for reasoning

- Let's now think about how to represent a world about which we have only partial (but certain) information
- Our tool: propositional logic
- General problem:
  - tell the computer how the world works
  - tell the computer some facts about the world
  - ask a yes/no question about whether other facts must be true

Why Propositions?

We'll be looking at problems that could still be represented using CSPs. Why use propositional logic?

- Specifying logical formulae is often more natural than constructing arbitrary constraints
- It is easier to check and debug formulae than constraints
- We can exploit the Boolean nature for efficient reasoning
- We need a language for asking queries that may be more complicated than asking for the value of one variable
- It is easy to incrementally add formulae
- Logic can be extended to infinitely many variables (using logical quantification)
- This is a starting point for more complex logics (e.g., first-order logic) that do go beyond CSPs.

Representation and Reasoning System

Definition (RSS)

A Representation and Reasoning System (RRS) is made up of:

- syntax: specifies the symbols used, and how they can be combined to form legal sentences
- semantics: specifies the meaning of the symbols
- reasoning theory or proof procedure: a (possibly nondeterministic) specification of how an answer can be produced.

Using an RRS

1. Begin with a task domain.
2. Distinguish those things you want to talk about (the ontology).
3. Choose symbols in the computer to denote propositions
4. Tell the system knowledge about the domain.
5. Ask the system whether new statements about the domain are true or false.

Propositional Definite Clauses

- Propositional Definite Clauses: our first representation and reasoning system.
- Two kinds of statements:
  - that a proposition is true
  - that a proposition is true if one or more other propositions are true
- To define this RSS, we'll need to specify:
  - syntax
  - semantics
  - proof procedure

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Definition (knowledge base)

A knowledge base is a set of definite clauses

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Do any of these statements *mean* anything? Syntax doesn't answer this question.