Today 9/26

- Review
- Knowledge-Based Agents
- Break
- Propositional logic

Review

- We studied search because it facilitates the creation of agents that can reason about hypothetical (future) states of the world.
- But... we haven’t said much of anything about how those states should be represented.
- Or about how these future (successor) states can be generated from current states
### Knowledge-Based Agents

- A knowledge-base is simply a repository of things you know represented in some useful way.
- A knowledge-based agent is one that chooses its actions at least in part on the basis of the contents of its knowledge-base.

### Knowledge Representation

- A knowledge representation is a formal scheme that dictates how an agent is going to represent its knowledge.
  - Syntax: Rules that determine the possible strings in the language.
  - Semantics: Rules that determine a mapping from sentences in the representation to some particular state of affairs.

### Reasoning

- The knowledge base can't be a simple table.
  - It has to be set up so that an agent can conclude facts about the world that are not already represented in the knowledge base.
  - In other words, it has to reason about unseen worlds
Wumpus World Description

- Percepts: Breeze, Glitter, Smell
- Actions: Left, Right, Forward, Back, Shoot, Grab, Release
- Goals: Get the gold, get back to the start, (avoiding the Wumpus, and the pits).
Wumpus World

- Environment
  - One Wumpus
  - One or more pits
  - Squares adjacent to pits have a breeze
  - Squares adjacent to the Wumpus have a stench
  - Glitter is detected only in squares with the gold

Start: Percept [None]
Lots of different logics
Some differ primarily in their syntax
More importantly they differ in how they view the world

Propositional logic
First order logic (predicate calculus)
Probability theory
Admin/Break

- The quiz...
  - There were three clear categories of folks
    - Those who relied on their recollection of the lectures
    - Those who read the book (carefully)
    - Those who did both
  - I’ll give back the quiz and the first HW on Thursday

Quiz 2

- Scheduled for Oct 19.
- Covers chapters ...7,8,9, 13 and 14.

Propositional Logic

- Atomic Propositions
- That are true or false
- Connectives to form sentences that receive truth conditions based on a compositional semantics
Inference

- Simple Compositional semantics
- Modus ponens
- Resolution
- Model-Checking

Compositional Semantics

- The semantics of a complex sentence is derived from the semantics of its parts

\[ A \lor B \]

Compositional Semantics

- Syntactic Manipulations
  - And elimination
  - And introduction
  - Or introduction
  - Double negation removal
Compositional Semantics

- And introduction
- You know
  \[ A \]
  \[ B \]
- You can add
  \[ A \land B \]

Modus Ponens

- You know
  \[ A \]
- What can you conclude?
  \[ A \rightarrow B \]
  \[ B \]

Inference

- Why?
  - Because if \( A \) implies \( B \) and you know \( A \) then you know \( B \)
  - (Wrong)
  - Because the truth table for the \( \rightarrow \) connective has \( B \) being true for all the entries where \( A \rightarrow B \) is true and \( A \) is true (right).
Resolution

- You know
  \[ A \lor B \]

- What can you conclude?
  \[ \neg B \lor C \]
  \[ A \lor C \]

Inference

- Inference must be a purely formal, syntactic, mechanical, dumb, physical (preferably fast) process

Modeling Wumpus World

- Environmental state
- No stench in 1,1

  \[ \neg S_{1,1} \]
Modeling Wumpus World

- Long term rules of the world
  - Breezes are found in states adjacent to pits
  - Stenches are found in states adjacent to Wumpi
  - No stench means no Wumpus nearby
- For example...
  \[-S_{1,1} \rightarrow \neg W_{1,1} \land \neg W_{2,1} \land \neg W_{1,2}\]

Alternative Schemes

- Wumpi cause stenches

  \[W_{1,1} \rightarrow S_{1,1} \land S_{1,2} \land S_{2,1}\]

  \[S_{1,1} \rightarrow W_{1,1} \lor W_{1,2} \lor W_{2,1}\]

  Causal rule

  Diagnostic rule

Inference in Wumpus World
Limitations

- Can we represent...
  - The breeze or stench rules with all their implications?
  - A pit, two pits, some pits, no pits?
  - A wumpus...

Next time

- Finish Chapter 7, start on 8