CS4725/CS6705

Chapters 7-9: Logical agents

Logical agents: introduction

- We will be spending very little time this year on Chapters 7-9, which deal with logical agents.
- This is an important subarea of AI, but we will be focusing on other topics.
- These slides are meant to give you a general overview of logical agents.

Knowledge-based agents

- Using logic to *represent* knowledge and to *reason*
- A knowledge base (KB) is a set of sentences expressed in some knowledge representation language.
- We have access to TELL and ASK actions, to add new sentences to the KB and to query the KB.

Knowledge-based agents

- General algorithm for the agent:
  - Tell the KB what it perceives
  - Ask the KB what action it should perform

    (This recommendation might be based on extensive reasoning about the state of the world, the effects of actions, etc.)
  - Tell the KB that it is executing an action (so that the effects of this action can be recorded in the KB)

Logic

- To use a logical language for representation and reasoning, we need to define:
  - The syntax
    - How do we express sentences?
  - The semantics
    - What do the sentences mean?

Inference

- We want our logical agents to perform *inference*:
  - deriving new sentences from a given set of sentences
- Desirable qualities of inference algorithms:
  - **Sound / truth-preserving**: Any sentences it derives are actually entailed by the knowledge base
  - **Complete**: It is capable of deriving any sentence that is entailed.
- Chapters 7-9 focus on designing agents that perform inference in propositional logic and first-order logic.

Examples of assertions and queries in first-order logic

- Assertions:
  - Tell(KB, King(John))
  - Tell(KB, Person(Richard))
  - Tell(KB, $\forall x$ King(x) $\Rightarrow$ Person(x))
- Queries:
  - ASK(KB, King(John)) --- should return *true*
  - ASK(KB, Person(John)) --- should also return *true*
  - ASK(KB, $\exists x$ Person(x))
    - Returns *true*, but it is more helpful for it to return examples of such an x (a substitution list – e.g., {x = John}, {x = Richard})
    - Textbook uses the notation ASKVARS(KB, Person(x)) for this query.