

Chapter 7: Knowledge and Reasoning

[1] Describe Mario world using PEAS and ODESA description

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[2] Prove that the sentence $((P \vee H) \wedge \neg H) \Rightarrow P$ is valid, using truth table

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[3] Write the BNF for Propositional logic

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[4] Reasoning about rules and facts written in English can be tricky. Consider the following rule-based system for actions of a small reconnaissance robot. Suppose the following facts are true, in this order:

- F1: There is an object with branches to the right of you.
- F2: This object is 2 feet tall.
- F3: This object occupies 20 cubic feet.
- F4: This object is stationary.
- F5: Another object is moving towards you.
- F6: You hear speech from that object. (speech is not a loud noise.)

Assume all other facts mentioned in rules are false. Assume any new facts, when added, will be put at the front of the list of facts. Assume the rule-based system can result in the following actions, in this order:

- A1: Turn around.
- A2: Stop and wait.
- A3: Turn towards something.
- A4: Move a short distance forward.
- A5: Turn 20 degrees right.
- A6: Move a long distance forward.

Here are the rules:

- R1:** If you hear a loud noise in front of you, then turn around and move a long distance.
- R2:** If you want to hide, and there is a bush nearby, then turn towards the bush, and move a short distance.
- R3:** If you want to hide, and are beneath a bush, then stop and wait.
- R4:** If an object is moving towards you, and it is a person or vehicle, then hide.
- R5:** If an object is moving, and it is an animal, then stop and wait.
- R6:** If an object is an obstacle and you are moving, and the object is blocking your path, then turn right 20 degrees, and move short distance.
- R7:** Move forward a long distance. [notice no "if" part here]
- R8:** If an object has long branches, and the branches are moving, and it does not have wheels, then it is an animal.
- R9:** If an object makes irregular noises, then it is an animal.
- R10:** If an object makes regular noises, and it is moving, it is a vehicle.
- R11:** If an object has wheels, then it is a vehicle.
- R12:** If an object is stationary, and occupies more than 1 cubic foot, it is an obstacle.
- R13:** If an obstacle has branches, and is less than 3 feet tall, it is a bush.
- R14:** If an obstacle has branches, and is more than 3 feet tall, it is a tree.
- R15:** If an obstacle has no branches, it is a rock.
- R16:** If an animal has four branches in two pairs, and one pair supports the animal, it is a person.
- R17:** If an animal speaks, it is a person.

(a) List in order the rule invocations, successes, and failures with backward chaining. Assume conflict resolution based on the rule order given. Assume caching of proved facts, so once something is concluded it need never be figured out again.

(b) List in order the rules invoked with forward chaining, ignoring rule R7. Again, take rules in the order given,

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- [5] Define the following logical terms
- i. Model
 - ii. validity
 - iii. tautology
 - iv. Satisfiability
 - v. logical equivalence
 - vi. Entailment

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[6] Write an algorithm for Resolution

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[7] Use resolution to prove that $KB \models \alpha$ Where

$$KB = (B_{1,1} \Leftrightarrow (P_{1,2} \vee P_{2,1})) \wedge B_{1,1} \quad \alpha = \neg P_{1,2}$$

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Write a report on the following:

- 1 What is logic? Discussing different types of logical systems
- 2 What is meant by Inference, Soundness, and Completeness?
- 3 partial evaluation and its applications.
- 4 reasoning techniques : forward, backward, resolution,....