Assignment 7
(**Due date: 11/12/2009, Thursday, in class**)

Your name:	Grade:

Important notice on how to submit and grade this assignment:

- Provide your solutions in the **same order** as the questions appear on the assignment; otherwise, **missed or misplaced** solutions will **NOT** be graded.
- **How to Grade:**
  - The total score for the assignment is **100** points.
  - **An extra 5%** will be added to the **TYPEWRITTEN** submissions.
  - **3 points will be deducted** from your total score if you **missed any ONE** of the following (this is a *cumulative penalty*, e.g., 9 points will be taken for 1 missed name and 2 missed required blank lines):
    - **Your name** and **assignment number** on the top of each solution sheet/paper,
    - At least **one blank line** between solutions of adjacent questions.

Provide very brief answers to the following Artificial Intelligence questions (check lecture slides and other materials/links on the course website). Provide your brief answers to the following questions in ***your own*** words (do NOT use copy-paste; borrowing short phrases and part of a sentence in the original articles is OK).

1. How do you define Artificial Intelligence (check McCarthy's and Wiki's websites)?

2. Briefly describe the following AI research branches (check McCarthy's and Wiki's):

   a. Logical AI

   b. Inference

   c. Knowledge Representation

   d. (Machine) Learning

   e. Expert System

3. What is Turing Test (check Wiki link)? Using an example (i.e., The Imitation Game in Turing Test 50 Years Later) to clarify your understanding of Turing Test. Briefly describe that example.

4. What is John Searle's Chinese Room?

5. Briefly describe Strong AI and Weak AI? Which is your point (for, against one of them)? Why?

6. How does AI define mundane tasks and expert tasks? Give one example for each of them.

7. The following IF-THEN rules are proposed for a simple alarming system:

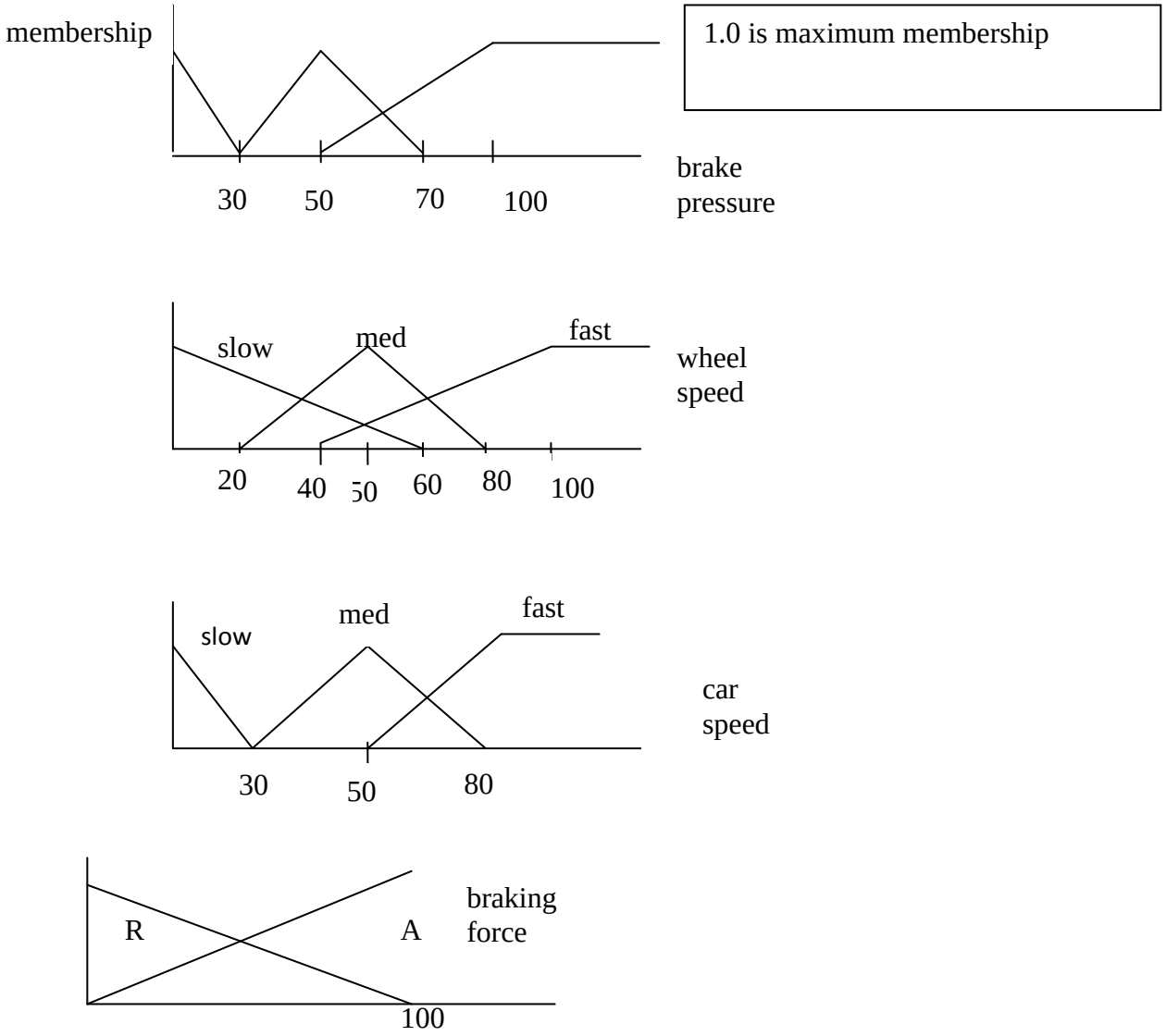
- R1: IF smoky AND hot THEN ADD fire
- R2: IF alarm_beeps THEN ADD smoky
- R3: IF alarm_beeps THEN ADD ear_plugs
- R4: IF fire THEN ADD switch_on_sprinkers
- R5: IF smoky THEN ADD poor_visibility

For the hypothesis *switch_on_sprinkers* outline how this could be proved through **(1) forward chaining** and **(2) backward chaining**. Assume that current facts include: *alarm_beeps* and *hot*. Then **explain briefly the differences** between forward and backward chaining.

8. Fuzzy Systems. The rules are:

- R1: If brake pressure is Medium, then brake
- R2: If brake pressure is high AND car speed is fast AND wheel speed is fast, then brake
- R3: FI brake pressure is high AND car speed is fast AND wheel speed is slow, then release the brake
- R4: If brake pressure is low then release the brake

The memberships are as follows:



Compute the braking force when wheel speed = 60, car speed = 50, brake pressure = 50.

8. Represent the following facts in the language of predicate logic:

- Every apple is either green or yellow.
- No apple is blue.
- If an apple is green then it is tasty.
- Every man likes a tasty apple.

9. Suppose we have created a very simple diagnostic expert system in which we have the following rules:

- R1: IF coughing THEN ADD smoky.
- R2: IF wet AND NOT raining THEN ADD burst_pipe.
- R3: IF NOT coughing AND alarm_rings THEN ADD burglar.
- R4: IF smoky AND hot THEN ADD fire.

If we start off with a vague feeling that something is wrong (the possibilities are *fire, burst_pipe,* and *burglar,* which would be the hypotheses given to the expert system). We also assume that (1) the system has been provided with no initial facts, and (2) we can directly ask the user (of the expert system) questions (such as whether it is hot, whether the user is coughing, whether it is wet, whether it is raining, and whether the alarm is ringing).

Describe how a simple backward chaining interpreter in the expert system could be used to go through the possible conclusions by asking the user questions. Provide a complete interaction with this tiny system and explain why you have come to the conclusion(s) (with brief backward chaining description).

10. What is inductive reasoning? Provide an example of inductive reasoning.

11. What is deductive reasoning? Provide two examples of deductive reasoning, one of which is valid and sound, another one is valid but not sound.

12. Briefly describe the architecture of expert systems and how an expert system simulates the performance of human experts.

13. (**for bonus**) A golf coach needed to select his team of five players from eight who were finalists for his team. The players are Art, Bob, Chuck, Dan, Ed, Fred, George, and Hal. Due to ability under various conditions, temperament, and team morale the following conditions must be met in the team selection.

- *If Dan is on the team, then Fred must also be on the team.*
- *Hal and Ed cannot both be on the team.*
- *George and Chuck cannot be on the team unless both are on the team.*
- *Art cannot be on the team if Dan is on the team.*

a. Transcribe the above selection-condition statement by using **propositional logic** representation .

b. Answer the following questions with the help of the above statements' logic representations:

1) Which of the following team selections conforms to the requirements of team membership?
   a. Art, Bob, Chuck, Ed, and George
   b. Art, Bob, Chuck, Dan, and Fred
   c. Dan, Ed, Fred, George, and Hal
   d. Art, Bob, Chuck, Dan, and Ed
   e. Dan, Ed, Fred, George, and Hal

2) If Dan is on the team, which of the following must occur?
   a. Fred and Art must be on the team.
   b. Fred will not be on the team.
   c. Art will be on the team.
   d. Fred must be on the team and Art must not be on the team.
   e. Hal and Ed will also be on the team.

3) Which of the following is the *largest* number of players (or player) the coach can select whose selection would not require either the inclusion or exclusion of at least one other player?
    a. Bob
    b. Fred
    c. Fred and Art
    d. Bob and Hal
    e. Fred and Bob

4) If the coach selects Dan, Hal, George, and Chuck, which of the following lists all the players who could not be chosen for the fifth player?
    a. Fred and Art
    b. Art, Bob, and Ed
    c. Fred, Bob, and Ed
    d. Art and Bob
    e. Fred, Art, and Ed

14. (**for bonus**) Represent the following statements in **first-order-logic** in the space under each statement. You may need to *define and explain* the corresponding symbols (for example, BrotherInLaw(x, y)—x is brother-in-law of y (here x, y are variables); or you may use a simpler but not so logically correct form, A = BrotherInLaw(B) for the first one of the following statements. Either way, the definition should be direct and natural and the reader should understand it in a straight way):

- A is the brother-in-law of B.
- C is the sister-in-law of E.
- F and G have a daughter named H. (F is the father, G the mother.)
- E is the sister of B. They have no other siblings.
- Neither A nor C have any siblings.
- H is married to D and they have a son named I.
- D is the child of C.

From the above statements and their corresponding FOL representations, answer the following questions:

a. A is married to
    a. E.
    b. C.
    c. G.
    d. H.
    e. None of these.

b. I's grandfather is
    a. A.
    b. B.
    c. C.
    d. D.
    e. None of these.

c. The mother-in-law of H is
    a. E.
    b. C.
    c. G.
    d. A.
    e. B.

d. Which of the following has no blood relative mentioned?
    a. A.
    b. B.
    c. C.
    d. D.
    e. I.