Qualifying Exam — Artificial Intelligence
Open Book and Note

August 21, 2006

Note: There are 4 questions for 100 points.

1. (15 points) Let

$$P = \begin{cases} p & \leftarrow & p,\ not\ q. \\ q & \leftarrow & not\ s. \\ s & \leftarrow & not\ q. \\ p & \leftarrow & not\ s. \end{cases}$$

Compute the answer set(s) (a.k.a stable model(s)) of P.

2. (15 points) Let P be a logic program and let M be an answer set of P. Let a be an arbitrary element in M. Is M an answer set of the program $P \cup \{a \leftarrow\}$? Justify your answer.

3. (35 points) A student would like to devise a study plan based on the required courses of his/her major and their prerequisites. A *valid study plan* is an ordered list of courses specifying the order of courses that the student should take so that all pre-requisites of a course are taken before the course is taken. This problem can be represented by a planning problem.

(a) Select an action representation of your choice and describe how you would represent this problem as a planning problem.

(b) Suppose that in a school, a student needs to take five courses $c_1, \ldots, c_5$ to complete his study; the pre-requisites are given by $c_1 < c_2$, $c_2 < c_5$, and $c_3 < c_4$ ($c < c'$ says that c is a pre-requisite of c'). Using your representation in part (a), provide a valid study plan for the student. Justify your answer.

4. (35 points) A school admission committee studies the performance of the students and comes to the following observations:

- A student with high GPA in high school but low grade in English will complete his/her freshman year with the probability of 0.6.
- A student with high GPA in high school and good grade in English will complete his/her freshman year with the probability of 0.9.
- A student with low GPA in high school and low grade in English will complete his/her freshman year with the probability of 0.05.

- A student with low GPA in high school but high grade in English will complete his/her freshman year with the probability of 0.4.
- If a student does not drop out after the first year, he/she will complete his/her college study with the probability of 0.85.

Do the following.

(a) Represent the findings as Bayesian network;

(b) John just graduated. Compute the probability that John had a good GPA in high school but low grade in English. Provide the steps used in your computation.