Graduate Comprehensive Exam: Artificial Intelligence (Spring 2001)

Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

1. (20 pts) Draw a semantic network that represents the following:
   
   (a) John is a student
   (b) Jane is a student
   (c) A student is a person
   (d) Every student has a GPA
   (e) John’s GPA is 3.9
   (f) Each person has two eyes
2. (40 pts) Logical Reasoning

(a) Given the following sentence:

\[ \text{Person}(x) \Rightarrow \text{Understand}(x, \text{Computers}) \]

**explain** what each of the following sentences can infer:

i. \( \neg \text{Person}(\text{Micky}) \)
ii. \( \text{Understand}(\text{Mary}, \text{Computers}) \)
iii. \( \neg \text{Understand}(\text{Mary}, \text{Computers}) \)

(b) Given the following sentences:

i. \( \text{On}(B, A) \)
ii. \( \text{On}(A, \text{Table}) \)
iii. \( \forall x \forall y[\text{On}(x, y) \Rightarrow \text{Above}(x, y)] \)
iv. \( \forall x \forall y \forall z[\text{Above}(x, y) \land \text{Above}(y, z) \Rightarrow \text{Above}(x, z)] \)

convert them into clauses and prove \( \text{Above}(B, \text{Table}) \) by **resolution**. Show all necessary substitutions.
3. (40 pts) Search algorithms

(a) Discuss an advantage that iterative deepening search has over:
   i. depth-first search
   ii. breadth-first search

(b) Devise a sample graph that illustrates depth-first and uniform-cost (branch and bound) searching algorithms can yield different solution paths from start node A to goal node G:
   i. draw the graph with nodes A and G and at least five other nodes
   ii. show the visiting order for depth-first search
   iii. show the solution path and its cost found by depth-first search
   iv. show the visiting order for uniform-cost (branch and bound) search
   v. show the solution path and its cost found by uniform-cost search

(c) State and explain two main problems of hill-climbing.