Grad. Comp. Exam: Artificial Intelligence (Spring 2013) Student ID: _____

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

1. (25 pts) On search:
   (a) Discuss two reasons for why hill climbing might not yield an optimal solution.
   (b) Discuss why uniform-cost search is optimal.
   (c) A* is guided by the sum of two functions, discuss the two functions.

2. (35 pts) On Reasoning:

   (a) Which of the following are HORN clauses?

      i. $C \wedge D \Rightarrow B$

      ii. $B \vee \neg C \vee \neg D$

      iii. $A \Rightarrow B$

      iv. $B \vee \neg C \vee D$

   (b) Use first order logic to express the following statements in CNF with predicates: $politician(x)$, $citizen(x)$, $fools(x, y)$, and $issue(x)$:

      i. George and Helen are politicians.

      ii. Alice, Bob and George are citizens.

      iii. Politicians can fool all citizens on some issues and can fool some citizens on all issues but cannot fool all citizens on all issues.

   (c) From the obtained CNF clauses, select a pair that is eligible for resolution, apply resolution, and infer another clause. If a pair of clauses eligible for resolution does not exist, discuss the reason.

   (d) Show your steps in applying resolution to prove that: "Alice can be fooled on some issue."

3. (15 pts) On Planning:

   (a) Enumerate and describe the elements of a STRIPS operator.

   (b) Propose a set of STRIPS operators for describing the tasks of a vacuum cleaner.

4. (25 pts) On decision-tree learning:

   (a) Discuss the three stopping criteria for learning a decision tree.

   (b) Consider we measure the accuracy of the tree while it is being learned from a data set ("training set") and plot accuracy (y axis) vs. number of tree nodes (x axis), draw a sample plot and discuss the behavior of the curve in your plot.

   (c) Use an example to illustrate why higher information gain is preferred in selecting an attribute to be in a tree node.