

C1. Artificial Intelligence (25 points)

- a) (9 points) Describe the algorithm for constructing a decision tree.
- b) (8 points) Given the following set of examples, what attribute is tested at the root of the decision tree constructed from this set? Show all your numerical computation (Two-digit accuracy should be sufficient.)

size	color	shape	class
big	blue	square	-
small	red	circle	-
big	red	square	+
big	blue	circle	+
small	red	square	-

The following log table may be useful.

x	$\log_2 x$
0.20	-2.32
0.25	-2.00
0.33	-1.60
0.40	-1.32
0.50	-1.00
0.60	-0.74
0.67	-0.58
0.75	-0.42
0.80	-0.32

- c) (8 points) What is overfitting, and what can be done to avoid it?

C2. Artificial Intelligence (25 points)

In many AI applications, knowledge of the world is represented in either first-order logic or semantic networks. Compare first-order logic representation with semantic networks (or frames). What are the advantages and disadvantages of each?

C3. Artificial Intelligence (25 points)

Assume you are developing a compiler for a machine with one register and the following instructions:

ONE: set the value of the register to 1.
 DOUBLE: double the contents of the register.
 ADD: Add one to the contents of the register.
 SUB: Subtract one from the contents of the register.
 DIVIDE: Divide the register content by 3.

The first four instructions can only be executed when the register's contents are not divisible by three. When the register's contents are divisible by three, the only available operation is DIVIDE.

The problem is, how to put a constant k into the register. You may assume the register begins with a value of 1.

QUESTION

(8 points) a) describe this as a search problem.

(9 points) b) Suppose that the costs of the operators on the register containing a number " n " are:

ONE: 1
 DOUBLE: n
 ADD: 1
 SUB: 1
 DIVIDE: $2n/3$

Also assume that you have a goal of getting the constant "7" in the register, and a heuristic function $h(n) = |7 - n|$. Draw the A* search tree (you may prune redundant paths). What path is actually found?

(8 points) c) A* does not terminate until a goal is selected for expansion. However, a path to a goal node might be reached long before that node is selected for expansion. Why not terminate as soon as the goal node is found? Illustrate your answer with an example.

C4. Artificial Intelligence (25 points)

Consider the problem of preparing a surprise date for one's sleeping sweetheart. The goal is to take out the GARBAGE, fix DINNER, and wrap a PRESENT. There are four possible actions: COOK, WRAP, CARRY, DOLLY. Cooking requires clean hands and achieves dinner. Wrapping requires quiet because the present is a surprise, and produces a present. Carrying effectively eliminates the garbage, but the intimate contact with the smelly container leaves one's hands unclean. The final action, dollying, also eliminates the garbage, but because of the noisy handtruck it also eliminates the quiet. Initially you have clean hands while the house has garbage and is quiet; all other propositions are false.

QUESTION

- (8 points) a) Describe the four actions in a POP/STRIPS style planning language.
- (8 points) b) Draw the plan assuming that you have first chosen to achieve DINNER and PRESENT.
- (9 points) c) Assume that the POP algorithm next chooses to achieve NOT GARBAGE using the operator DOLLY. Explain what occurs and what the final plan is.