CS141 **Introduction to AI** **Professor Meinolf Sellmann**

Homework 0
Warmup

Due: 5:00pm on Monday 2/4/08

This first homework is just meant to get you to start thinking about some problems and ideas that will come up in the course.

Don't forget to turn in the collaboration policy!

Review Section
Please select all the times when you could come to the weekly review session:

	Wed.	Thu.
5-6pm		
6-7pm		
7-8pm		

How would you most like to use this time? (Review material, go over homeworks, practice problems, etc.)

Problem 0.1

The Tower of Hanoi puzzle was invented in 1883. You are given three pegs and three disks which are initially stacked in increasing size on the left peg. The object of the puzzle is to recreate the stack on the right peg while observing two restrictions: you can only move one disk at a time, and a larger disk can never be placed on top of a smaller disk.

a) What are the possible states after 2 moves? after 3 moves?

b) What is the optimal (i.e. fewest number of moves) solution?

c) Argue that your solution is optimal?

d) Are there other optimal solutions (i.e. same number as moves as your first solution)?

Solution:

We can represent the tower as a comma delimited list of numbers. The smaller the number the smaller the disk, so the initial state would be (1 2 3, ,)

a) **Two moves: (1 2 3, ,), (2 3, 1,), (2 3, , 1), (3, 1, 2), (3, 2, 1)**
Three moves: (2 3, 1,), (2 3, , 1), (1 3, 2,), (1 3, , 2), (3, 1 2,), (3, , 1 2), (3, 2, 1), (3, 1, 2), (123, ,)

b) **(1 2 3, ,) -> (2 3, , 1) -> (3, 2, 1) -> (3, 1 2,) -> (, 1 2, 3) -> (1, 2, 3) -> (1, , 2 3) -> (, , 1 2 3)**

c) **The only ways for us to get 3 from the left peg to the right from disk arrangements (3, 1 2,) or (1 2, 3,). From part (a), we see that (3, 1 2,) can be reached in 3 steps, and no fewer. (1 2, 3,) cannot be reached as quickly. So, so we know, when we have arrangement (, 1 2, 3), we cannot have made fewer than 4 moves. Because the two steps of moving the 3 are symmetric, we need only consider the shorter path, through (3, 2 1,). We now need to get the 2 onto the right peg. We need to get into position (1, 2, 3) or (2, 1, 3); (1, 2, 3) is reachable in one move. That brings us to (1, , 2 3), which is one move away from the solution, (, , 1 2 3). This is somewhat "hand-wavy"; a complete proof could be done by fully enumerating all possible moves.**

d) **No. We know there is only one quickest way to get 3 onto the right peg from part (a), and, due to symmetry, that no longer way of getting 3 to the right peg will yield a better solution. From the (, 1 2, 3) position, we could (but won't) construct a tree showing all possible combinations of the next three moves, which would show only one sequence that leads us to the goal.**

Problem 0.2

Solve the following Sudoku puzzle. The rules are simple. Every row, every column and every one of the 9 3x3 boxes (as outlined by the thicker lines) must contain the numbers 1 - 9.

		4	8	3		2		
6						3	7	
	7	8	6	2			1	5
				6	3			1
	8			9			4	
7			4	8				
8	9			4	6	1	5	
	5	6						4
		7		1	8	6		

If you want to read more about Sudoku, Wikipedia has a good article: http://en.wikipedia.org/wiki/Sudoku

Solution:

5	1	4	8	3	7	2	6	9
6	2	9	1	5	4	3	7	8
3	7	8	6	2	9	4	1	5
9	4	5	2	6	3	7	8	1
2	8	3	7	9	1	5	4	6
7	6	1	4	8	5	9	2	3
8	9	2	3	4	6	1	5	7
1	5	6	9	7	2	8	3	4
4	3	7	5	1	8	6	9	2

Problem 0.3

A new disease has been discovered, but the test for it, while accurate, is very expensive. A doctor is trying to determine if people have the disease by only looking at a few symptoms. He has data from his last few patients who have taken the expensive test. Here are the results:

	Cough	*TummyAche*	*SoreThroat*	*Chills*	*HasDisease*
PatientA	*no*	*no*	*yes*	*yes*	*no*
PatientB	*yes*	*yes*	*no*	*no*	*no*
PatientC	*yes*	*yes*	*yes*	*no*	*yes*
PatientD	*no*	*no*	*yes*	*no*	*no*
PatientE	*no*	*yes*	*yes*	*yes*	*yes*

Now Patient F walks into the doctor's office and has the following symptoms:

	Cough	*TummyAche*	*SoreThroat*	*Chills*
PatientF	*no*	*yes*	*yes*	*no*

Do you think Patient F has the disease? why? (Hint: Your answer should be more than one word long)

Solution: Everyone who has the disease has both a sore throat and a tummy ache, but nobody with both of those symptoms doesn't have the disease. Since Patient F has both symptoms, I think Patient F has the disease.