Introduction to AI NCTU Spr2020 Written Assignment #1 Due 5/5/2020

1. For the two videos shown in our first class (one on Robot Mouse Races, and the other one Robothespian), describe their respective PEAS.

2. In a popular English word game, the goal is to convert a given English word to another given English word of the same length by changing one letter at a time. Each intermediate word needs to be in a standard dictionary. For example, if the initial word is DOG and the destination word is CAT, the following is a possible series of words:

DOG → DOT → HOT → HAT → CAT

Now you are given this set of two-letter English words as your dictionary:

{AN, AM, AS, AT, AX, BE, BY, GO, HE, HI, IT, IS, IN, IF, ME, MY, NO, OF, OH, OK, ON, OR, OX, SO, TO, UP, US, WE}

(a) Find a solution from AT to IN using breadth-first search (BFS). When expanding a node, generate its children in alphabetical order. Use no repeated state checking. Give separate lists of all the generated nodes and expanded nodes, both in the correct order.

(b) Explain why Hamming distance (the number of positions where the two words have different letters) can be used as an admissible heuristic for this problem. You need to provide a reasonable explanation.

(c) Repeat (a) using A* search with the heuristic in (b).

3. We have three variables X, Y, and Z. Their initial domains are digits {0, 1, …, 9}. Given the constraints $X=Y^2$ and $X=Z^3$, use AC-3 to update their domains to make them arc-consistent. Don't just show the results.

4. Consider the following cryptoarithmetic puzzle:

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  FIVE
- FOUR
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   ONE
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(a) Write down all the constraints. All the variables (symbols) should represent different digits

(b) Solve this puzzle by hand using backtracking with forward checking and the MRV, degree, and least-constraining-value heuristics. Note that solution may not be unique.

5. Starting from the game state of tic-tac-toe here:

X	O	X
O		
	X	

(a) Build the whole game tree until terminal states. Give the minimax values of all the nodes.

(b) Reorder the nodes for optimal α-β pruning. How many nodes need to be checked during minimax search?

6. A propositional KB contains these sentences:

A, B, $P \Rightarrow Q$, $L \wedge M \Rightarrow P$, $L \wedge B \Rightarrow M$, $A \wedge B \Rightarrow L$, $A \wedge P \Rightarrow L$

(a) Convert them into CNF.

(b) Use resolution to prove Q.