CS360 Homework 11

Breadth-First and Depth-First Search

1) A 4-neighbor gridworld is given below. In which order does depth-first search (with a sensible node pruning strategy) expand the cells when searching from s to g? Ties are broken in lexicographic order. That is, A1 is preferred over A2 and B1, and A2 is preferred over B1.

	A	B	C	D	E
1					s
2	■	■		■	
3	g			■	
4				■	
5					

2) Compare the advantages and disadvantages of breadth-first and depth-first search and discuss to which degree pruning of tree nodes is important for them.

3) Does depth-first search always terminate if there is a path of finite length from the start to the goal? Why?

Constraint Satisfaction

4) Consider the two formulations of the N-Queens problem as a constraint satisfaction problem from the slide set (Constraint Satisfaction, slide 9). Compare these two formulations in terms of the size and branching factor of the state space and the depth of the search tree.

5) In the crossword puzzle, we have a grid with blocked and unblocked cells and a dictionary of words. We want to assign a letter to each unblocked cell so that each vertical or horizontal contiguous segment of unblocked cells form a word that appears in the dictionary. An example of a solved crossword puzzle is given below[1].

[1] `http://www.americanshakespearecenter.com/v.php?pg=684`

A	D	I	M	■	R	I	P	S	■	F	A	T
C	U	T	E	■	E	T	A	T	■	A	L	E
D	E	S	D	E	M	O	N	A	■	I	A	N
C	L	A	U	D	I	O	■	T	U	R	N	S
■	■	■	S	E	T	■	T	E	R	M	■	■
A	S	W	A	N	■	P	E	N	N	A	M	E
D	I	I	■	■	H	A	L	■	■	I	M	S
O	R	L	A	N	D	O	■	E	D	D	I	E
■	■	D	I	A	S	■	A	S	U	■	■	■
S	T	O	M	P	■	P	R	A	N	C	E	D
E	R	A	■	P	E	T	R	U	C	H	I	O
L	I	T	■	E	L	S	A	■	A	I	N	T
L	O	S	■	R	I	D	S	■	N	A	S	H

Formulate this puzzle as a constraint satisfaction problem. Describe the variables, their domains and the constraints. (Bonus question: Try to come up with a second formulation of this puzzle as a constraint satisfaction problem.)

6) Suppose you have a search problem defined by more or less the usual stuff:

- a set of states S;
- an initial state s_{start};
- a set of actions A including the $NoOp$ action, that has no effect;
- a transition model $Result(s, a)$ (that determines the successor state when action a is executed in state s);
- a set of goal states G.

Unfortunately, you have no search algorithms! All you have is a CSP solver.

(a) Given some time horizon T, explain how to formulate a CSP such that (1) the CSP has a solution exactly when the problem has a solution of length T steps; (2) the solution to the original problem can be "read off" from the variables assigned in CSP solution. Your formulation must give the variables, their domains, and all applicable constraints expressed as precisely as possible. You should have at least one variable per time step, and the constraints should constrain the initial state, the final state, and consecutive states along the way.

(b) Explain how to modify your CSP formulation so that the CSP has a solution when the problem has a solution of length $\leq T$ steps, rather than exactly T steps.