Homework 2
CS4100/5100, Fall 2014

Your Name:

1. (AIMA problem 6.2) Consider the problem of placing k knights on an $n \times n$ chessboard such that no two knights are attacking each other, where k is given and $k \leq n^2$.

a. (5 pts) Choose a CSP formulation. In your formulation, what are the variables?

b. (5 pts) What are the possible values of each variable?

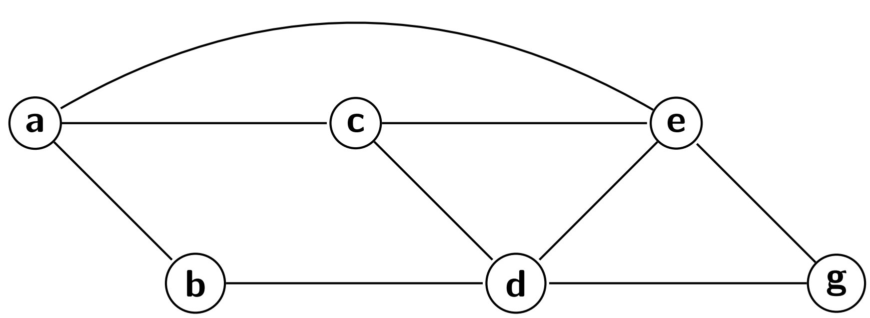
c. (5 pts) What sets of variables are constrained, and how?

d. (10 pts) Now consider the problem of putting *as many knights as possible* on the board without any attacks. Explain how to solve this with local search by defining appropriate ACTIONS and RESULT functions and a sensible objective function.

2. Consider the three coloring problem (red, blue, green) for the graph below.

a. (8 pts) Manually run backtracking with forward checking on this graph. Expand variables in alphabetical order. Use the LCV heuristic to choose value ordering. Initially, set the variable a to RED. Write down the domains for all variables (after pruning by forward checking) at each step. What is the final solution found?

b. (8 pts) Suppose node a has been assigned the color red and node b has been assigned the color blue. Run constraint propogation (*i.e.* AC-3) on this graph. What are the domains for the remaining free variables?



3. (AIMA problem 6.12) (5 pts) What is the worst-case complexity of running AC-3 (constraint propogation) on a tree-structured CSP?

4. (Bishop [1])

a	b	c	$p(a,b,c)$
0	0	0	0.192
0	0	1	0.144
0	1	0	0.048
0	1	1	0.216
1	0	0	0.192
1	0	1	0.064
1	1	0	0.048
1	1	1	0.096

a. (5 pts) Consider three binary variables, $a, b, c \in \{0.1\}$ having the joint distribution shown above. Show by direct evaluation that this distribution has the property that a and b are dependent variables so that $p(a,b) \neq p(a)p(b)$, but that they become independent when conditioned on c, so that $p(a,b|c) = p(a|c)p(b|c)$.

b. (5 pts) Evaluate the distributions $p(a)$, $p(b|c)$, and $p(c|a)$ corresponding to the joint distribution given in in the table above. Hence show by direct evaluation that $p(a,b,c) = p(a)p(b|c)p(c|a)$.

[1] Christopher Bishop, *Pattern Recognition and Machine Learning*, Springer 2006