Homework 2

Due date: Monday, Feb 12 11:00 am (morning of Exam 2)

Submit your solutions to Canvas. You may type your answers in a digital file, or upload a scanned/photographed copy of your handwritten homework

The textbook problems are from Russell and Norvig's AI book **3rd edition**

Ch 6: CSP

1. Problem 6.2
2. Problem 6.9 — From textbook
3. Problem 6.11
4. This constraint satisfaction problem is a simplified version of Sudoku in a 4x4 matrix. The goal is to fill in each cell in the matrix with a number between 1 and 4 in such a way that no number is repeated on the same column or on the same row. To save you time, some cells have already been filled in with a value. The remaining ones have been named with a letter for easy reference. These letters, A, B, C, D, E, F and G, are the variables in the constraint satisfaction problem.

2	A	3	B
4	C	1	2
1	D	E	F
3	G	4	1

Variables: A, B, C D, E, F, and G.

Domain: The domain of each variable is {1, 2, 3, 4}.

Constraints: There is a constraint between each pair of cells P and Q that belong to the same column or to the same row of the matrix stating that the values assigned to the two cells cannot be equal.

Answer the questions below as if you were an agent following the CSP algorithms we studied in class.

a) Fill in the table below (some values are provided as examples to guide you. For instance, A has two remaining values, 1 and 4, and it has constraints with four other variables B, C, D, G.):

Variable	A	B	C	D	E	F	G
Remaining values	1, 4			2, 3, 4			
# of constraints with other variables	four			five			

b) Using the Minimum Remaining Values (MRV) heuristic, list the variable that the CSP search algorithm will select next. If there are ties, list all the variables that have the same MRV.

c) If the above was a tie, use the degree heuristic (i.e., variable with the most constraints on remaining variables) to break the tie. What variable would be selected? If a tie still remains, provide a systematic way to deal with the tie so that only one variable is selected. Explain your work.

d) Starting from the following possible values, use forward checking to propagate constraints. Show the propagation of just one constraint at a time neatly on a separate row in the table below, until no more constraints can be propagated. An example is provided on the 3rd row. You may not need all the rows provided here.

Constraint Propagation	A	B	C	D	E	F	G
Possible values	1, 4	4	3	2, 3, 4	2	3, 4	2
Constraint between: *A and B*	1	4	3	2, 3, 4	2	3, 4	2
Constraint between: _____							
Constraint between: _____							
Constraint between: _____							
Constraint between: _____							
Constraint between: _____							
Constraint between:							
Constraint between:							

Ch 7: Logical Agents

5. Problem 7.4 (parts a,b,c,i, j)
6. Problem 7.10   From textbook
7. Problem 7.18
8. Convert each of the following sentences to clausal form.

   a) $P \Rightarrow Q$

   b) $(L \wedge M) \Rightarrow P$

   c) $(B \wedge L) \Rightarrow M$

   d) $(A \wedge B) \Rightarrow L$

   e) A

   f) B

Use **resolution** to prove the sentence Q (that is, prove that Q is true) from the 6 clauses above. Show your work. *Hint:* Remember that the first step of the process is to negate the sentence that you want to prove.

Ch 8: First Order Logic

9. Problem 8.10
10. Problem 8.11   From textbook
11. Problem 8.20
12. Problem 8.23

Ch 9: Inference from First Order Logic

13. Problem 9.9   From textbook
14. Problem 9.6 and 9.13a