2nd Midterm Exam

Tuesday April 8
75 minutes == 75 points
open book and notes

1. *15 points*
   Use resolution to prove that $(S \vee R)$ is entailed by the following set of propositional expressions:

   1. $\neg(\neg Q) \wedge Z$
   2. $\neg W$
   3. $(\neg W \wedge Q \Rightarrow (\neg P)$
   4. $(W \wedge Z) \Rightarrow S$
   5. $Q \Rightarrow (S \vee P)$
   6. $(P \wedge Q) \Rightarrow R$

2. *20 points*

   (a) Write the following sentences in predicate calculus:

   1. Every student has taken at least one computer science course.
   2. A student has taken at most one computer science course.
   3. Every student has been in every building on campus.
   4. There is a student who has been in every room of at least one building on campus.
   5. Every student has been in at least one room of every building on campus.

   (b) transform the expressions you wrote in part (a) to CNF.
   (c) Does 5 entail 3? If yes, prove it by resolution (adding additional expressions if needed). If not, explain why not.

3. *10 points*

   Specify if each of the following expressions represents correctly the corresponding English statement. If not explain why not and correct it.

   1. Every cat owner loves all animals.
      $\forall xz[\exists y cat(y) \rightarrow owns(x, y)] \rightarrow loves(x, z)$

2. No person would harm a cat.

$\forall xy person(x) \wedge cat(y) \wedge \neg harm(x, y)$

4. *15 points*

You are given the following pairs of clauses where upper case letters indicate constants, lower case letters indicate variables, functions, or predicates. Consider each pair independently of the others. In each pair variables with the same name are meant to be the same variable.

For each of the pairs specify if they can be resolved. If yes show the results of the unification process, if not explain why.

1. p(B, C, x, z, f(A, z, B)) and not p(y, z, y, C, w)
2. r(f(y), y, x) and not r(x, f(A), f(v))
3. q(f(A,x), x) and not q(f(z,f(z,D)), z)

5. *15 points*

Show the backed-up up values for all the nodes in the following game tree and show the branches that are pruned by alpha-beta. For each branch pruned, explain briefly why alpha-beta can prune it. Follow the convention used in the textbook to examine the branches in the tree from left to right.