Homework 2: Chapters 6 - 9

The following exercises are due at the beginning of class on Tuesday, November 2. Some of these problems may take a while to solve, so I recommend that you work on this assignment over the course of multiple days.

1. *[10 pts.]* Do Exercise 1 from Ch. 6 in the book (p. 127).
2. *[15 pts.]* Do Exercise 2 from Ch. 6 in the book (p. 127).
3. *[10 pts.]* Under what conditions will the auctioneer receive a higher price for a good if they use a Vickrey auction as opposed to a first-price sealed-bid auction?
4. *[15 pts.]* Consider the following deals that are under consideration by three self-interested agents (a_1, a_2, and a_3). Each deal is specified in terms of three numbers, each of which represents the utility of the deal to one of the agents. That is, deal $d=(d_1,d_2,d_3)$ has utility d_1 for agent a_1, d_2 for agent a_2, and d_3 for agent a_3. The fallback position (the one that occurs if the agents cannot reach a deal), has the following utilities for the agents (13, 5, 7).

   > A=(20,30,20)
   > B=(15,10,75)
   > C=(15,15,15)
   > D=(20,7, 5)
   > E=(50, 25, 25)

   a) Are all of these deals individually rational for all agents? If not, which ones are irrational for which agents?
   b) Which of these deals maximize social welfare? There may be more than one.
   c) Which of these deals are Pareto efficient? There may be more than one.
5. *[10 pts.]* Consider a task-oriented negotiation domain in which there are two agents, the set of tasks T={a,b,c,d,e}, and the cost function is defined as follows: c({a})=4, c({b})=3, c({c})=5, c({d})=3, c({e})=2. The cost of performing a set of tasks together is simply the sum of doing the tasks individually, except that if a and c are performed together, they sum to 6 (not 9), and if b and d are performed together, they sum to 4 (not 6). Assume that in the encounter <{a,b},{c,d,e}> agent A_1 has proposed deal δ_1=<{b,d},{a,c,e}> and agent A_2 has proposed deal δ_2=<{b,d,e},{a,c}>. If both agents are using the Zeuthen strategy, which agent should concede on the next round? Show your work, including the cost and utilities of both deals to the agents, as well as the measure of each agent's willingness to risk conflict.
6. *[15 pts.]* Translate the following first-order predicate logic sentences into KIF. You may wish to refer to http://logic.stanford.edu/kif/dpans.html for details on KIF's syntax.
   a. In(2,4) $\wedge$ Facing(north) $\wedge$ ¬Dirt(2,4)
   b. $\exists$ x,y NearAgent(x,y) $\wedge$ SampleAt(x,y)
   c. $\forall$x,c,u TakesClass(x,c) $\vee$ AttendsUniversity(x,u) $\Rightarrow$ Student(x)
7. *[10 pts.]* Using the KQML language, describe how you would implement the Contract Net protocol. For details on the language, you may wish to refer to: http://www.cs.umbc.edu/kqml/kqmlspec/spec.html
8. *[15 pts.]* Compare and contrast partial global planning with plan merging.