CS 275, Assignment 1

Read chapters 1 and 2 in the book and answer the following questions:

1. (Question 1 in chapter 1) Let $R_1 = \{(a,b),(c,d),(d,e)\}$ and $R_2 = \{(b,c),(e,a),(b,d)\}$.

   (a) Compute $R_2 \cup R_2$,

   (b) Compute $R_1 - R_2$,

   (c) Assume the scope of R_1 is $\{x,y\}$ and the scope of R_2 is $\{y,z\}$ compute:

      i. $R_{xy} \bowtie R_{yz}$,
      ii. $\pi_x R_{xy}$
      iii. $\sigma_{x=c}(R_{xy} \bowtie R_{yz})$,

2. (Question 5 chapter 2)

   The Zebra Problem: There are five houses in a row, each of a different color, inhabited by women of different nationalities. The owner of each house owns a different pet, serves different drinks, and smokes different cigarettes from the other owners. The following facts are also known:

   >   The Englishwoman lives in the red house
   >   The Spaniard owns a dog
   >   Coffee is drunk in the green house
   >   The Ukrainian drinks tea
   >   The green house is immediately to the right of the ivory house
   >   The Oldgold smoker owns the snail
   >   Kools are smoked in the yellow house
   >   Milk is drunk in the middle house
   >   The Norwegian lives in the first house on the left
   >   The Chesterfield smoker lives next to the fox owner
   >   The yellow house is next to the horse owner
   >   The Lucky Strike smoker drinks orange juice
   >   The Japanese smokes Parliament
   >   The Norwegian lives next to the blue house

   The Question: who drinks water and who owns the zebra?

   - Read the description of the zebra problem. Formulate the problem as a constraint problem: provide variables, and their domains. Then provide a formal specification of the first 5 constraints (that correspond to the first 5 conditions in the order of their appearance) only. Finally draw the full primal constraint graph.

- (extra credit) Model the zebra problem using the numberjack software package (http://4c110.ucc.ie/numberjack/) or minizinc (http://www.minizinc.org/). How difficult and time consuming was this experience? How far did you get? Did you learn from this experience? Provide the model.

3. (Question 6b chapter 2)

   - Provide two formulations for the Cryptarithmetic problem: HOCUS +POCUS = PRESTO as a constraint network. Provide the variables, domains and constraints.

   - Draw the primal and the dual constraint graphs for each formulation.

   - Discuss which formulation is superior, in your opinion.

   - (extra credit) Model one of the problem using the numberjack software package (http://4c110.ucc.ie/numberjack/) or minizinc (http://www.minizinc.org/). Provide the model and the solution output and report how much time it took you to model the problem and how much time it took to solve it.

4. (Question 7 chapter 2), Provide a detailed formulation of the circuit diagnosis problem in Figure 2.9 in the book. (Optional) Model the problem using the numberjack software package (http://4c110.ucc.ie/numberjack/) or minizinc (http://www.minizinc.org/).