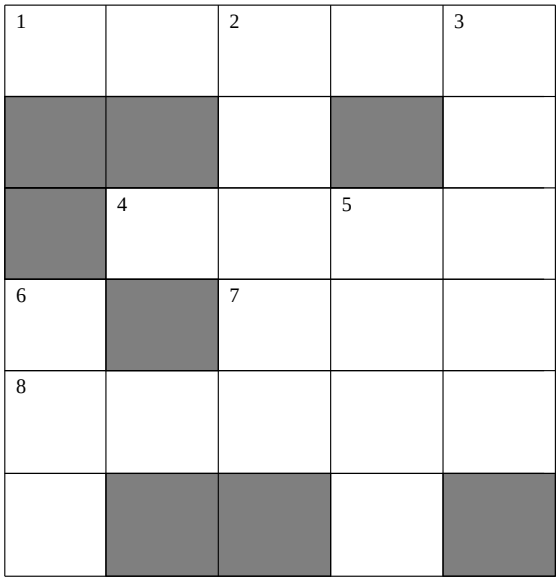
Rina Dechter, Spring-2007

ICS 275, Assignment 7

This homework is based on Chapters 9, 10 and 13. It will count twice compared with regular homeworks.

1. (question 2 chapter 9 and question 3 chapter 10) Consider the crossword puzzle:



Word List

aft	laser
ale	lee
eel	line
heel	sails
hike	sheet
hoses	steer
keel	tie
knot	

   (a) Is the crossword puzzle an acyclic constraint network? Justify your answer.

   (b) Consider the (primal) constraint graph of the problem and an ordering that has a minimum induced-width.
   a. Create the set of cliques that will be generated by tree-clustering and provide one tree-decomposition.
   b. Using the tree of cliques you created generate the actual constraint for each cliques so that the original problem is equivalent to the tree-structured problem. State explicitly the join-tree you created.
   c. Apply CTE (show the messages schematically).
   d. Compare the performance of adaptive-consistency, JTC and CTE for this problem.

   (c) Suppose you want to solve the crossword puzzle using the cycle-cutset scheme. Discuss the approach. Can you bound the complexity of the cycle-cutset scheme for problems having this constraint graph? Compare with previous approaches.

   (d) Bound the complexity of solving problems having this constraint graph using the the non-separable-components method.

(e) What are the best time-space guarantees you can get for this instance of the crossword puzzle. What are the best time/space guarantees you can provide for a crossword puzzle of size nxn.

(f) In your opinion, which of the methods you have learned in the constraint class is best suited for cross-word puzzles?

2. (question 3 chapter 9) Consider the graph problem in Figure 9.7a of chapter 9 and assume that all the constraints are binary "not-equal" constraints and all the domains of the variables have the values $\{1, 2\}$ except the domain of B is $\{1, 2, 3\}$. a. Generate a tree-decomposition. b. Apply CTE to this problem fully (show the messages exactly).

3. (question 4, chapter 9) Consider a grid problem with 9 variables and binary constraints. Describe a join-tree decomposition created by JTC.

   (a) What is the tree-width, hyper-width and separators of your decomposition.

   (b) What is the time and space complexity of CTE on the decomposition.

   (c) Show schematically how adaptive-tree-consistency will work on this problem. What would be the time and space complexity?

4. Question 5 chapter 9

5. (question 2 chapter 10) Prove that deciding the consistency of a constraint network having nonseprable components of size at most r can be solved in time exponential in r while in linear space.

6. question 5 chapter 10.

7. (question 2 chapter 13). The combinatorial auction problem was described in chapter 13 and in exercise 13 of chapter 5. Provide one way of formulating this problem as a constraint optimization problem. Demonstrate your formulation over a small problem (5 variables). Discuss the pros and cons of solving this problem by Branch and Bound algorithms vs bucket elimination.

8. Answer question 4 chapter 13.

9. Question 6 chapter 13.