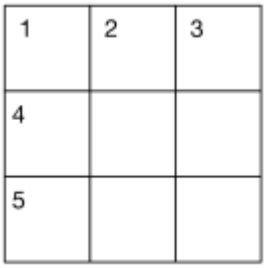
Assignment3: choose to one of the two following problems to solve

Problem 1:

Consider the crossword puzzle shown in the figure: a crossword puzzle to be solved with six words.



You must find six three-letter words: three words read across (*1-across, 4-across,5-across*) and three words read down (*1-down,2-down,3-down*). Each word must be chosen from the list of 18 possible words: {add, age, aid, aim, air, are, arm, art, bad, bat, bee, boa, dim, ear, eel, eft, lee, oaf} Try to solve it yourself, first by intuition, then by hand using first domain consistency and then arc consistency.

There are at least two ways to represent the crossword puzzle as a constraint satisfaction problem.

The first is to represent the word positions (*1-across,4-across*, etc.) as variables, with the set of words as possible values. The constraints are that the letter is the same where the words intersect. The second is to represent the nine squares as variables. The domain of each variable is the set of letters of the alphabet,{a,b,…,z}. The constraints are that there is a word in the word list that contains the corresponding letters. For example, the top-left square and the center-top square cannot both have the value a, because there is no word starting with aa.

1. Give an example of pruning due to domain consistency using the first representation (if one exists).
2. Give an example of pruning due to arc consistency using the first representation (if one exists).
3. Are domain consistency plus arc consistency adequate to solve this problem using the first representation? Explain.
4. Give an example of pruning due to domain consistency using the second representation (if one exists).
5. Give an example of pruning due to arc consistency using the second representation (if one exists).
6. Are domain consistency plus arc consistency adequate to solve this problem using the second representation?
7. Which representation leads to a more efficient solution using consistency-based techniques? Give the evidence on which you are basing your answer.

Note: you have to write the python code to solve this puzzle.

Problem2:

Consider a scheduling problem, where there are five activities to be scheduled in four time slots. Suppose we represent the activities by the variables A, B, C, D, and E, where the domain of each variable is {1,2,3,4} and the constraints are A>D, D>E, C≠A, C>E, C≠D, B≥A, B≠C, and C≠D+1.

[Before you start this, try to find the legal schedule(s) using your own intutions.]

1. Show how backtracking solves this problem. To do this, you should draw the search tree generated to find all answers. Indicate clearly the valid schedule(s). Make sure you choose a reasonable variable ordering. To indicate the search tree, write it in text form with each branch on one line. For example, suppose we had variables X, Y, and Z with domains t, f and constraints X≠Y and Y≠Z. The corresponding search tree is written as:

X=t Y=t failure
  Y=f Z=t solution
    Z=f failure
X=f Y=t Z=t failure
    Z=f solution
  Y=f failure

[Hint: It may be easier to write a program to generate such a tree for a particular problem than to do it by hand.]

2. Show how arc consistency solves this problem. To do this you must
    1. draw the constraint graph;
    2. show which elements of a domain are deleted at each step, and which arc is responsible for removing the element;
    3. show explicitly the constraint graph after arc consistency has stopped; and
    4. show how splitting a domain can be used to sove this problem.