CS221 Fall 2018 Homework [scheduling]

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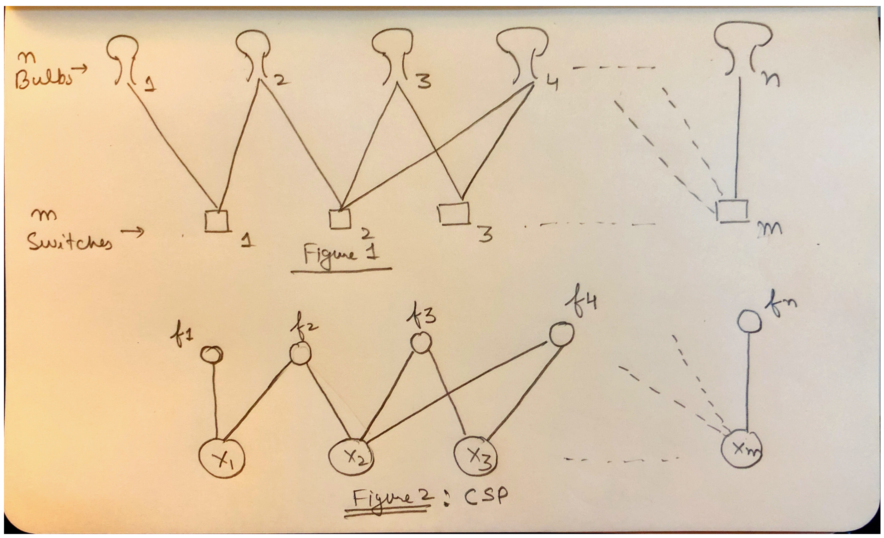
By turning in this assignment, I agree by the Stanford honor code and declare that all of this is my own work.

Problem 0

(a) The problem statement can be visualised as below:



Variables: The variables for the CSP are the m switches, $X_1, X_2 ... X_m$. The domain of these variables are Domains $\epsilon\{0, 1\}$, 0 being the "off" state for a switch and 1 being the "on" state.
Constraints: The constraints or the factors are created among a bulb and it's controlling switch(es). For example, from above Figure 1, if switch 1 controls bulb 1 and bulb 2, and switch 2 controls bulb 2 and bulb 3, a factor corresponding to bulb 1 would have switch 1 value as it's parameter (be dependent on switch 1) and bulb 2 would have values of both switch 1 and switch 2 as it's parameters. Since T_j (for each button $j = 1, ...m$) defines every set of light bulbs a switch controls, factor f_k (for each light bulb $k = 1, ...n$) would depend on variable j if k in T_j. The value of this factor should return an odd number, so that even numbers render the state of the bulb to be "off" and last number makes the bulb "on".

$$f_k(X_1[k \text{ in } T_1], X_2[k \text{ in } T_2], ...X_m[k \text{ in } T_m])$$
$$= sum(X_1[k \text{ in } T_1], X_2[k \text{ in } T_2], ...X_m[k \text{ in } T_m])\%2 == 1$$

Table 1: Table depicting unigram costs assigned to words

x1	x2	x3	t1(x)	t2(x)	**Consistency**
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	0	0
1	0	1	1	1	1
1	1	0	0	1	0
1	1	1	0	0	0

(b) (a) For finding consistent assignments, we draw the table for finding values of t_1 and t_2. From the Table 1, we can see that there are two consistent solutions for x_1, x_2, x_3, one being $\{0, 1, 0\}$ and other being $\{1, 0, 1\}$, respectively.

(c) For fixed variables X_1, X_2, X_3, backtrack will be called in following ways:

$$backtrack(\phi, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 0\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 0, x_3 : 0\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 0, x_2 : 1, x_3 : 0\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 0, x_3 : 1\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 1\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 1, x_3 : 0\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 1, x_3 : 1\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 1, x_2 : 0, x_3 : 1\}, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$

Therefore, backtrack algorithm is called 9 times.

(d) When lookahead is enabled (AC3):

$$backtrack(\phi, 1, \{x_1 : [0, 1], x_2 : [0, 1], x_3 : [0, 1]\})$$
$$backtrack(\{x_1 : 0\}, 1, \{x_1 : [0], x_2 : [1], x_3 : [0]\})$$
$$backtrack(\{x_1 : 0, x_3 : 0\}, 1, \{x_1 : [0], x_2 : [1], x_3 : [0]\})$$
$$backtrack(\{x_1 : 0, x_2 : 1 x_3 : 0\}, 1, \{x_1 : [0], x_2 : [1], x_3 : [0]\})$$
$$backtrack(\{x_1 : 1\}, 1, \{x_1 : [1], x_2 : [0], x_3 : [1]\})$$
$$backtrack(\{x_1 : 1, x_3 : 1\}, 1, \{x_1 : [1], x_2 : [0], x_3 : [1]\})$$
$$backtrack(\{x_1 : 1, x_2 : 0 x_3 : 1\}, 1, \{x_1 : [1], x_2 : [0], x_3 : [1]\})$$

Therefore, backtrack algorithm with AC3 is called 7 times.

Problem 2

(a) (your solution)

(b) (your solution)