

CS221 Fall 2018 - 2019 Homework 6

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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: Warmup

- (a) We let the variable $X_1, X_2, \dots, X_m \in 0, 1$ to be whether or not we press button $j = 1, \dots, m$

Let the constraint for bulb $i = 1, \dots, n$ be

$$f_i(T) = \mathbb{1}[(-1)^{\sum_{j \in 1, \dots, m} X_j \mathbb{1}[\text{bulb}_i \in T_j]} = 0]$$

Scope of each constrain is all variables X_1, X_2, \dots, X_m

- (b) i There are 2 consistent assignments for this CSP, namely $X_1 = 1, X_2 = 0, X_3 = 1$ and $X_1 = 0, X_2 = 1, X_3 = 0$.
- ii Let D be the original domain, the call stack of backtrack() is as follow
- backtrack($\emptyset, 1, D$)
 - backtrack($\{X_1 = 0\}, 1, D$)
 - backtrack($\{X_1 = 0, X_3 = 0\}, 1, D$)
 - backtrack($\{X_1 = 0, X_3 = 0, X_2 = 0\}, 0, D$)
 - backtrack($\{X_1 = 0, X_3 = 0, X_2 = 1\}, 1, D$)
- iii backtrack($\emptyset, 1, D$)
- backtrack($\{X_1 = 0\}, 1, \text{Domain}_1 = \{1\}, \text{Domain}_2 = \{1\}, \text{Domain}_3 = \{0\}$)
 - backtrack($\{X_1 = 0, X_3 = 0\}, 1, \text{Domain}_1 = \{1\}, \text{Domain}_2 = \{1\}, \text{Domain}_3 = \emptyset$)
 - backtrack($\{X_1 = 0, X_3 = 1, X_2 = 0\}, 1, \text{Domain}_1 = \{1\}, \text{Domain}_2 = \emptyset, \text{Domain}_3 = \emptyset$)

Problem 2: Handling n-ary factors

- (a) For each variable X_i we introduce an auxiliary variable A_i which keeps track of the sum of all variables before X_i . The domain of A_i is a tuple which first element is possible value of sum ($\{0, 1, 2, 3, 4, 5, 6\}$) and second element is possible value of X_i ($\{0, 1, 2\}$) denoting the value to be included to the sum at this step. The constraint for A_i and X_i is that the second element of the tuple by A_i must be consistent with value of X_i . In addition, for two consecutive steps we ensure that the sum of 2 elements in the tuple of A_i to be equal to the first element of the tuple of the next step A_{i+1} . The final step we will have a variable 'result' which is consistent with the sum of all X_i and we add one more constraint that its value is $\leq K$.

Problem 3: Course Scheduling

(c) My profile

```
# Unit limit per quarter. You can ignore this for the first
# few questions in problem 2.
minUnits 3
maxUnits 6

# These are the quarters that I need to fill. It is assumed that
# the quarters are sorted in chronological order.
register Aut2019
register Win2019

# Courses I've already taken
taken CS103
taken CS106B
taken CS107
taken CS109
taken CS140
taken CS145
taken CS161

# Courses that I'm requesting
request CS224N
request CS221
request CS228
request CS229
request CS246
request CS223A
```

The best schedule the course scheduler found is

| Quarter | Units | Course |
|---------|-------|--------|
| Aut2019 | 4 | CS229 |
| Win2019 | 4 | CS246 |

I think this a a reasonable academic schedule ahead.