This handout includes space for every question that requires a written response. Please feel free to use it to handwrite your solutions (legibly, please). If you choose to typeset your solutions, the `README.md` for this assignment includes instructions to regenerate this handout with your typeset LATEX solutions.

0.a

For my CSP, I define a variable for each switch $X_1, \ldots, X_m$, where X_i is the state of switch i. The domain of X_i is $\{0, 1\}$ where $0 = $ off and $1 = $ on.

Constraints:

- We create one constraint for each light bulb j, where j ranges from 1 to n

- Each light bulb starts as off (0)

- A light is on if it has been toggled an odd number of times

- Each lightbulb is an element of T_j, and it is controlled by a set of switches X_j

- Scope: $\{X_i \mid i \in T_j\}$

- Expression: $\left(\sum_{\{i : i \in T_j\}} X_i \right) \bmod 2 == 1$

0.b

i. Two satisfying assignments: $(0, 1, 0)$ and $(1, 0, 1)$

ii. Backtracking without forward checking:

1. backtrack({})

2. backtrack($\{X_1 : 0\}$)

3. backtrack($\{X_1 : 0, X_3 : 0\}$)
   try X_2:
   - try 0: $X_1 \oplus X_2 = 0$ (conflict)
   - try 1: $X_1 \oplus X_2 = 1$, $X_2 \oplus X_3 = 1$
     backtrack($\{X_1 : 0, X_3 : 0, X_2 : 1\}$) - solution: $(0, 1, 0)$

4. backtrack($\{X_1 : 0, X_3 : 1\}$)
   try X_2:
   - try 0: $X_1 \oplus X_2 = 0$
   - try 1: $X_1 \oplus X_2 = 1$, $X_2 \oplus X_3 = 0$

5. backtrack($\{X_1 : 1\}$)

6. backtrack($\{X_1 : 1, X_3 : 0\}$)
   try X_2:
   - try 0: $X_1 \oplus X_2 = 1$
   - try 1: $X_1 \oplus X_2 = 0$, $X_2 \oplus X_3 = 0$

7. backtrack($\{X_1 : 1, X_3 : 1\}$)
   try X_2:
   - try 0: $X_1 \oplus X_2 = 1$, $X_2 \oplus X_3 = 1$
     backtrack($\{X_1 : 1, X_3 : 1, X_2 : 0\}$) - solution: $(1, 0, 1)$

iii. Backtracking with forward checking:

1. backtrack({})

2. backtrack($\{X_1 : 0\}$)
   $X_2 \to \{1\}$

3. backtrack($\{X_1 : 0, X_3 : 0\}$)
   $X_2 \to \{1\}$
   backtrack($\{X_1 : 0, X_3 : 0, X_2 : 1\}$) - solution: $(0, 1, 0)$

4. backtrack($\{X_1 : 1\}$)
   $X_2 \to \{0\}$

5. backtrack($\{X_1 : 1, X_3 : 1\}$)
   $X_2 \to \{0\}$
   backtrack($\{X_1 : 1, X_3 : 1, X_2 : 0\}$) - solution: $(1, 0, 1)$

2.d

Yes, my profile.txt generates a reasonable schedule. It abides by the max units counts and assigns a course for both quarters using my preferred courses.

Profile.txt minUnits 3 maxUnits 10

register Aut2026 register Win2027

request CS106A request CS105 request CS101

Schedule

Quarter Units Course

Aut2026 5 CS105

Win2027 5 CS106A

3.a

I would change factor A to increase the number of total residents. The constraints are in play to ensure the health and well-being of the residents. Without them, they could become overworked and that would lead to medical errors that would harm patients. It is best to prioritize safety standards.