Q1. [5 pts] For which of the following will you always find the same solution, even if you re-run the algorithm multiple times?
Assume a problem where the goal is to minimize a cost function, and every state in the state space has a different cost.

- ☒ Steepest-ascent hill-climbing, each time starting from a different starting state
- ☑ Steepest-ascent hill-climbing, each time starting from the same starting state
- ☒ Stochastic hill-climbing, each time starting from a different starting state
- ☒ Stochastic hill-climbing, each time starting from the same starting state
- ☒ Both steepest-ascent and stochastic hill climbing, so long as you always start from the same starting state
- ☒ Both steepest-ascent and stochastic hill climbing, each time starting from a different starting state
- ☒ No version of hill-climbing will guarantee the same solution every time

Of these algorithms, only steepest-ascent hill-climbing, each time starting from the same starting state can always find the same solution even if we re-run the algorithm multiple times. Because every step in this algorithm is deterministic.

Q2.

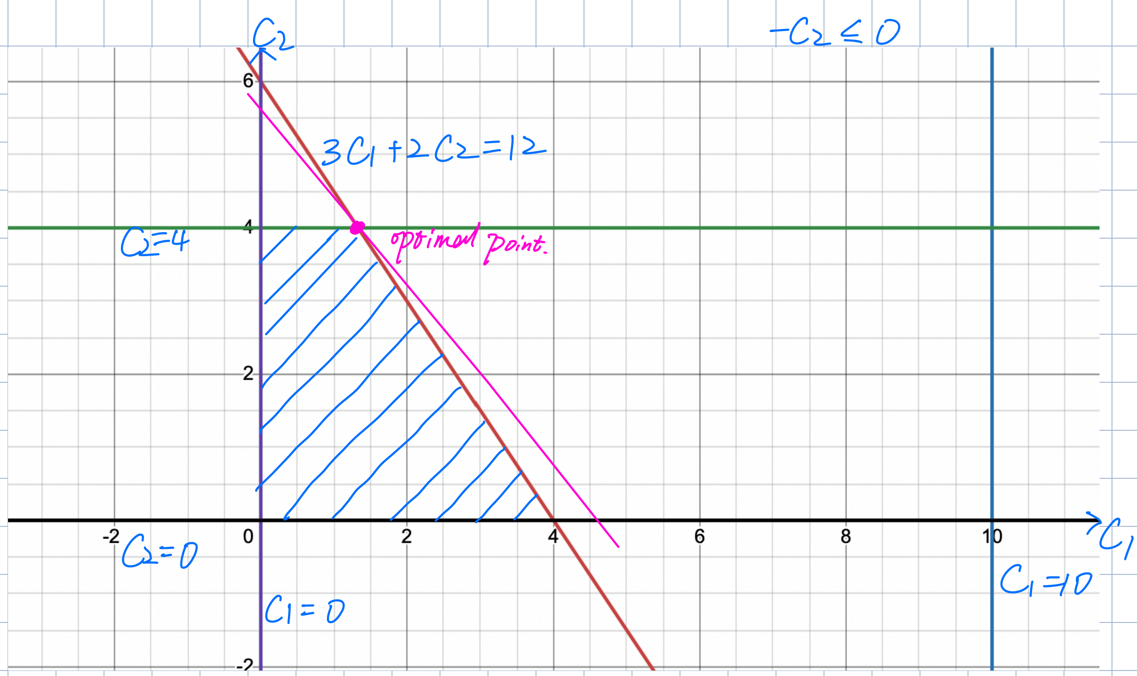
(a)

$$\max_{C_1, C_2} \; 500C_1 + 400C_2 \quad \text{s.t.} \quad 3C_1 + 2C_2 \le 12,\; 0 \le C_1 \le 10,\; 0 \le C_2 \le 4$$

$$\Rightarrow \min_{C_1, C_2} \; -500C_1 - 400C_2 \quad \text{s.t.} \quad \begin{aligned} 3C_1 + 2C_2 &\le 12 \\ C_1 &\le 10 \\ C_2 &\le 4 \\ -C_1 &\le 0 \\ -C_2 &\le 0 \end{aligned}$$

$$\Rightarrow \min_{C_1, C_2} \begin{bmatrix} -500 \\ -400 \end{bmatrix}^T \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} \quad \text{s.t.} \quad \begin{bmatrix} 3 & 2 \\ 1 & 0 \\ 0 & 1 \\ -1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} \leq \begin{bmatrix} 12 \\ 10 \\ 4 \\ 0 \\ 0 \end{bmatrix}$$

(b)



(c) C_1: $\frac{4}{3}$ $\quad C_2$: 4 $\quad$ Total Profit: $\frac{4}{3} \times 500 + 4 \times 400 = \frac{6800}{3} \approx 2266.67\$$

Q3

(a) V_i for Class i

$D(V_i)$ for the domain of V_i

A for Professor A, B for Professor B, C for Professor C

Variables: V_1, V_2, V_3, V_4, V_5

Domains: $D(V_1) = \{A, C\}$

$D(V_2) = \{A\}$

$D(V_3) = \{B, C\}$

$D(V_4) = \{B, C\}$

$D(V_5) = \{A, B\}$

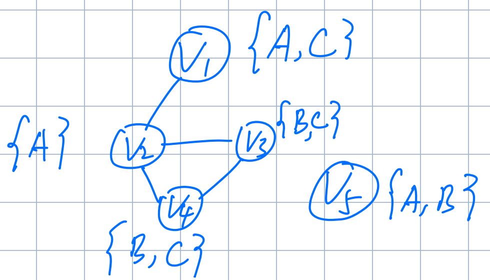
Constraints: $\{ V_1 \neq V_2,$

$V_2 \neq V_3,$

$V_2 \neq V_4,$

$V_3 \neq V_4 \}$

(b)



(c)

V_1	V_2	V_3	V_4	V_5
C	A	B	C	A
C	A	B	C	B
C	A	C	B	A
C	A	C	B	B