

Assignment 4: Planning

Question 1

Consider the following Crypt-arithmetic problems, where all letters represent a different digit and the resulting sum is correct. **Write out all variables, domains and constraints of the problem.**

- (a) SATURN + URANUS = PLANETS
- (b) YES + SEND + ME + MORE = MONEY

Question 2

Consider the following set of edges between nodes. Find a coloring using colors red, blue, and green such that no two adjacent nodes are assigned the same color.

$$\{(a, b), (a, d), (b, c), (b, d), (b, g), (c, g), (d, e), (d, f), (d, g), (f, g)\}$$

- (a) Define a CSP for this problem. Clearly define the variables, domains, and constraints.
- (b) Draw the binary constraint graph for this CSP.
- (c) Find at least one solution to the CSP.

Question 3

Consider a block stacking robot with the following actions:

- Stack(x, y)
 - Preconditions: Clear(y), Holding(x)
 - Effects: armEmpty, On(x, y), ¬Clear(y), ¬Holding(x)
- Unstack(x, y)
 - Preconditions: Clear(x), On(x, y), armEmpty
 - Effects: ¬armEmpty, ¬On(x, y), Clear(y), Holding(x)
- Pickup(x)
 - Preconditions: Clear(x), On(x, TABLE), armEmpty
 - Effects: ¬armEmpty, ¬On(x, TABLE), Holding(x)
- Putdown(x)

- Preconditions: $\text{Holding}(x)$
- Effects: $\text{armEmpty}, \text{On}(x, \text{TABLE}), \neg\text{Holding}(x)$

Create a plan for each of the initial state/goal pairs below Assume armEmpty is in initial state and the table has infinite space

(a) TODO

(b) TODO

(c) TODO

Question 4

Consider the following simple planning problem in which the objective is to interchange the values of two variables $v1$ and $v2$

- Initial State: $\text{Value}(v1, 3), \text{Value}(v2, 5), \text{Value}(v3, 0)$
- Goal State: $\text{Value}(v1, 5), \text{Value}(v2, 3)$
- Actions:
 - $\text{Assign}(V, W, X, Y)$
 - Preconditions: $\text{Value}(V, X), \text{Value}(W, Y)$
 - Effects: $\text{Value}(V, Y), \neg\text{Value}(W, X)$