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Homework 3

Problem 1

1. **Initial Sate**: Empty planar map

**Goal State**: Colored map such that no two adjacent regions are the same color

**Successor Function**: Coloring an empty region

**Cost Function**: Number of regions colored

1. **Initial State:** Room with suspended bananas from the ceiling

**Goal State:** Room with no bananas suspended from the ceiling

**Successor Function:** Stack crate, move crates, climb on crates, climb off crates, remove bananas when on crates, move crates to next tile

**Cost Function:** Number actions performed

1. **Initial State:** Unlabeled records

**Goal State:** Record with “illegal input record” message

**Successor Function:** Process record

**Cost Function:** Number of records processed

1. **Initial State:** Three empty jugs

**Goal State:** A jug with one gallon of water

**Successor Function:** Fill jug, empty jug to another, empty jug to the ground

**Cost Function:** Number of jug actions taken

Problem 2

1. **BFS**: 12, 10, 13, 9, 11, 7, 5, 8, 4, 6, 14, 2, 15, 16, 1, 3, 17, 18, 21, 19, 23, 20, 24, 25, 22, 26, 27, 28, 29, 30

**DFS**: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 20, 22, 24, 23, 25, 26, 28, 30

**IDS**: 0: 12

1: 12, 10, 13

2: 12, 10, 9, 13, 11

3: 12, 10, 9, 7, 11, 13

4: 12, 10, 9, 7, 5, 8, 11, 13

5: 12, 10, 9, 7, 5, 4, 8, 14, 11, 13

6: 12, 10, 9, 7, 5, 4, 6, 8, 14, 15, 16, 11, 13

7: 12, 10, 9, 7, 5, 4, 6, 2, 8, 14, 15, 16, 17, 18, 11, 13

8: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 8, 14, 15, 17, 16, 18, 11, 13

9: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 8, 14, 15, 16, 17, 18, 11, 13

10: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 23, 8, 14, 15, 17, 16, 18, 11, 13

11: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 23, 20, 24, 25, 8, 14, 15, 17, 18, 16, 11, 13

12: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 20, 24, 25, 22, 26, 27, 8, 14, 15, 17, 18, 16, 11, 13

13: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 20, 22, 23, 25, 26, 27, 28, 29, 8, 14, 15, 17, 18, 16, 11, 13

14: 12, 10, 9, 7, 5, 4, 6, 2, 1, 3, 21, 19, 20, 22, 24, 23, 25, 26, 27, 28, 29, 30, end

1. Starting from 12: 12, 10, 13, 9, 11, 7, 5, 8, 4, 6, 14, 2, 15, 16, 1, 3

Starting from 30: 30, 28, 29, 26, 27, 25, 23, 24, 20, 21, 19, 22, 3, 1, 2

They meet at node 1 at depth 7.

1. **Back of homework packet**
   1. The heuristic is dismissible because from each cluster the lowest cost path taken is greater than or equal to the heuristic estimate.

Shortest Path Start Node Shortest Path Length >=? Heuristic T/F

A: 3 7 3 **True**

B: 6 10 4 **True**

C: 9 14 5 **True**

D: 14 12 5 **True**

F: 23 4 2 **True**

E(!30): 28 1 1 **True**

30 0 0 **True**

* 1. The heuristic is consistent if for every node N and each successor P of N, the estimated cost of reaching the goal from N is no greater than the step cost of getting to P plus the estimated cost of reaching the goal from P.
     1. h(N) <= c(N,P) + h(P)
     2. h(G) = 0

Check all closest paths, all other paths will have a greater number on right hand side

Cluster A: N=3, P=21 -> h(3) <=? c(3,21) + h(21) -> 3 <= 1 + 2 **TRUE**

Cluster B: N=6, P=2 -> h(6) <=? c(6,2) + h(2) -> 4 <= 1 + 3 **TRUE**

Cluster C: N=9, P=7 -> h(9) <=? c(9,7) + h(7) -> 5 <= 1 + 4 **TRUE**

Cluster D: N=14, P=8 -> h(14) <=? c(14,8) + h(8) -> 5 <= 1 + 4 **TRUE**

Cluster E: N=23, P=25 -> h(23) <=? c(23,25) + h(25) -> 2<= 1 + 1 **TRUE**

h(30) = 0 **TRUE**

* 1. A\* Search Algorithm minimize f(n) = g(n) + h(n)

g(n) = length of path from start to n

h(n) = heuristic approximation

* 1. **Back of homework packet**

Problem 3:

**Back of homework packet**

Problem 4:

**Back of homework packet**

Problem 5

1. Unbiased estimator for Y|T=1 => ∑Ni=1 (Ti\*Yi) /(p)

Unbiased estimator for Y|T=0 => ∑Ni=1 ((1-Ti)\*Yi) /(1-p)

ATE unbiased estimator = 1/N [∑Ni=1 (Ti\*Yi) /(p) - ∑Ni=1 ((1-Ti)\*Yi) /(1-p)

1. p = µ(Xi)

Unbiased estimator for Y|T=1 => ∑Ni=1 (Ti\*Yi)/(µ(Xi))

Unbiased estimator for Y|T=0 => ∑Ni=1 ((1-Ti)\*Yi) /(1-(µ(Xi)))

ATE unbiased estimator = 1/N [∑Ni=1 (Ti\*Yi)/(µ(Xi)) - ∑Ni=1 ((1-Ti)\*Yi) /(1-(µ(Xi)))]

1. The regret bound is the additional errors that a random person would make in comparison to an expert(doctor) when determining what person to give the a prescription to. The regret bound is a function of the number of mistakes an expert will make.