

CS 561 Midterm Exam 1 (Spring 2016)

1) [10%] True/False (1% each)

- a) F
- b) T
- c) F
- d) T
- e) F
- f) F
- g) F
- h) F
- i) T
- j) T

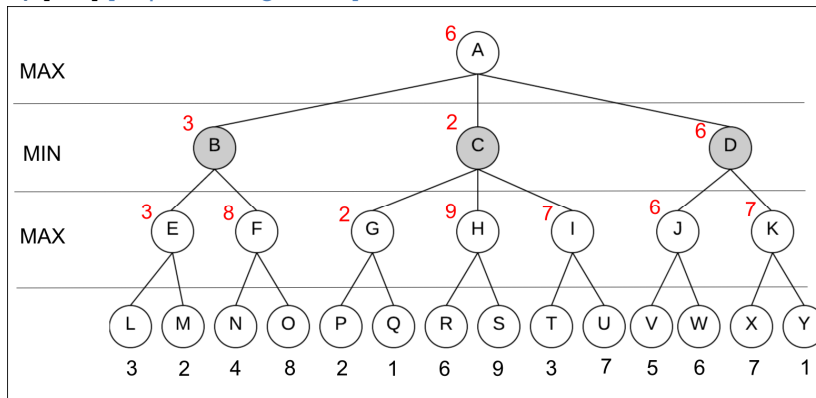
Note: e) In a task environment in which all actions (including no action) give the same, equal reward, every agent is rational.

2) [30%] Search

- a) [5%] Nodes Removed: A C B E D F G [No partial credit]
[5%] Solution: A C E G [No partial credit]
- b) [5%] Nodes Removed: A B G [No partial credit]
[5%] Solution: A G [No partial credit]
- c) [5%] Nodes Removed: A B E C E G [No partial credit]
[5%] Solution: A C E G [No partial credit]

3) [10%] Game Playing

- a) [4%] [-1 per wrong value]



- b) [2%] D-J-W (or: A-D-J-W) [No partial credit]
- c) [4%] [1 per correct value, -1 per wrong node]
O-H-I-Y (or O-H-R-S-I-T-U-Y)

4) [20%] Constraint Satisfaction problem

a) [8%]

Variables & Domains: ABCDRXYZ [3%]

A 0
BC 123456789 [1% for B,C]
DR 0123456789 [1% for D,R]
XYZ 01 [1% for X,Y,Z]

Constraints: [5%]

X=C [1%]
Y+2B=10X+R [1%] (accepted alternative form: $Y+B+B = XR$)
Z+2A=10Y+A [1%] (accepted alternative form: $Z+A+A = YA$)
2D=10Z+B [1%] (accepted alternative form: $D+D = ZB$)
Alldiff(A,B,C,D,R) - "A,B,C,D,R are all different" [1%]

Accepted alternative:

Variables & Domains: [1%]
ABCDR 0123456789
XYZ 01

Constraints: [7%]

X=C [1%]
Y+2B=10X+R [1%]
Z+2A=10Y+A [1%]
2D=10Z+B [1%]
Alldiff(A,B,C,D,R) [1%]
A=0 [1%]
B!=0, C!=0 [1%]

b) [1%] [No partial credit]

Arc-consistency between X and C on $C=X$: **X=1**
Arc-consistency between Y and Z on $Z=10Y$: **Y=0 and Z=0**

c) [7%] After arc consistency, we get

B 6 8 [2%]
C 1 [1%]
D 3 4 [2%]
R 2 6 [2%]

If the domains are wrong, the following rules give partial credit for B-D-R:

- B even OR $B > 5$ [1%]
- $D < 5$ [1%]
- R even [1%]

d) [4%]

A=0, B=6, C=1, D=3, R=2

A=0, B=8, C=1, D=4, R=6

[2% per correct solution, -1% per wrong solution]

5) [20%] Heuristic design

A. [4%] $M \times N \times 4 \times (V_{\max} + 1)$

(If the answer involves position ($M \times N$): 1%, direction (4): 1%, velocity: 1%, final correct formula: full credit)

B. [2%] Maximum branching factor: 3.

[2%] When stopped, the agent can turn left, turn right, or go fast.

C. [2%] Yes

[2%] No (Manhattan distance is not admissible because the agent can travel faster than 1 square per move.

For example, the agent could travel a straight-line distance of 16 through 8 actions: FFFFSSSS)

[2%] Yes

[2%] Yes (Current velocity is admissible because the agent needs to be stationary at the exit square, thus requires at least (current velocity) SLOW actions)

(Note: a heuristic function is said to be admissible if it never overestimates the cost of reaching the goal, i.e. the cost it estimates to reach the goal is not higher than the lowest possible cost from the current point in the path.)

D. [2%] No. (An inadmissible heuristic will not change completeness.)

E. [2%] Yes. (An inadmissible heuristic does not imply optimality, so a suboptimal solution could be found.)

6) [10%] AI Applications

1. b 2. c 3. c 4. a 5. c [2% each]