Rutgers University
CS440: Introduction to Artificial Intelligence, Spring 2017
Kostas Bekris

Homework 4: James Carroll and Joel Carrillo

Decision Making under Uncertainty and Learning

1. Question 1

    (a) Starting with an arbitrary discount of 0.4 and values (0, 0, 0, 0), it took one millisecond and five iterations to find the optimal policy of: Action 2 at State 1; Action 2 at State 2; Action 3 at State 3; and Action 1 at State 4.

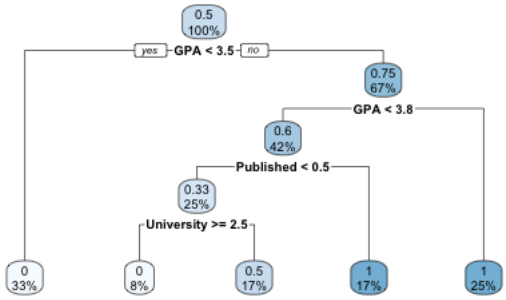
    The optimal utility at the respective states are 0.14690304000000004, 0.39942144000000007, 1.1707264, and 0.43098624000000013. The method was repeatedly applying the Bellman equation to find the policy that maximizes the utility function. Intermediate values:

    i. Policy [0, 0, 0, 0] Values [0, 0, 1, 0]
    ii. Policy [0, 0, 0, 0] Values [0, 0.32, 1, 0.36]
    iii. Policy [0, 1, 0, 0] Values [0.1152, 0.3456, 0.144, 0.3744]
    iv. Policy [1, 1, 2, 0] Values [0.129024, 0.393728, 1.14976, 0.426816]
    v. Policy [1, 1, 2, 0] Values [0.14690304, 0.39942144, 1.1707264, 0.43098624]

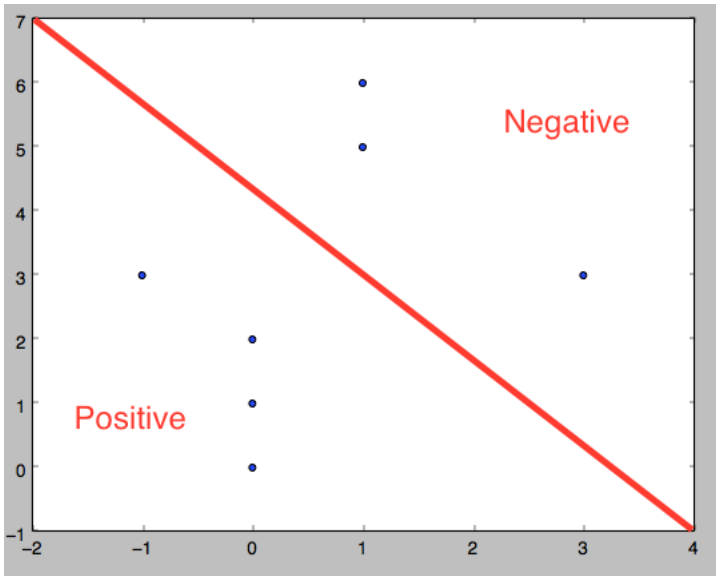
2. Question 2

    (a) Yes.

    (b) Gain(GPA) $= I(\frac{p}{p+n}, \frac{n}{p+n})$ - Remainder(GPA)
    $I(\frac{6}{6+6}, \frac{6}{6+6}) = I(\frac{1}{2}, \frac{1}{2}) = 1$
    Gain(GPA) $= 1$ - $\sum_{i=1}^{v} \frac{p_i+n_i}{p+n} I(\frac{p_i}{p_i+n_i}, \frac{n_i}{p_i+n_i})$
    Gain(GPA) $= 1$ - $[\frac{4}{12}I(0,1) + \frac{5}{12}I(\frac{3}{5}, \frac{2}{5}) + \frac{3}{12}I(1,0)]$
    Gain(GPA) $= 1$ - $\frac{4}{12} * 0 + \frac{5}{12} * (0.9710) + \frac{3}{12} * 0 = 0.5954$
    Gain (Pub) $= 1$ - $[\frac{7}{12}I(\frac{3}{7}, \frac{4}{7}) + \frac{5}{12}I(\frac{3}{5}, \frac{2}{5}))] = 0.0207$



(c) Yes, because the information gain for GPA is highest, Publications is second-highest, and so forth.



3. Question 3

4. Question 4

5. Question 5