Assignment 10

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1 Consider the 101 x 3 world shown in Figure 1. In the start state the agent has a choice of two deterministic actions, Up or Down, but in the other states the agent has one deterministic action, Right. Assuming a discounted reward function.

(a) Compute the utility of each action as a function of γ.

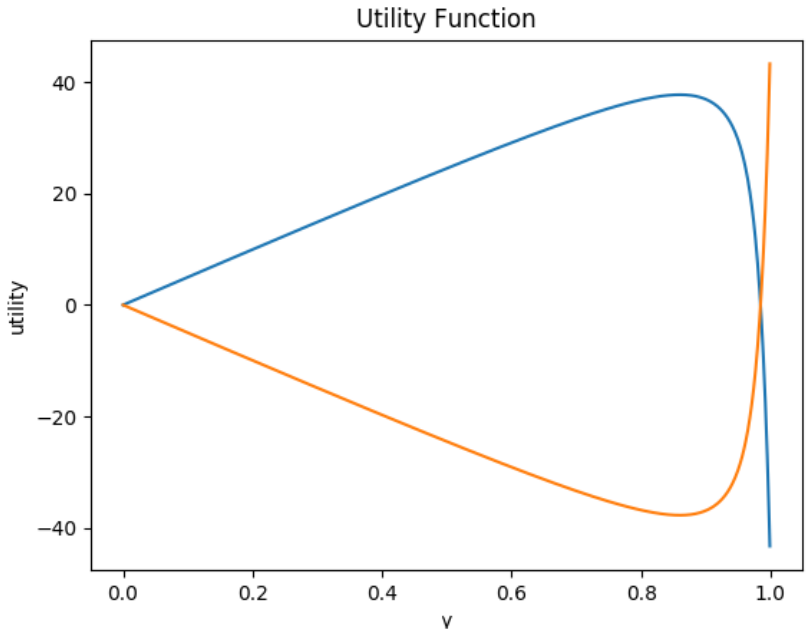
Answer: UP: $U = \sum_{t=0}^{101} \gamma^t R(S_t)$
$= 0 + \gamma^1 R(S_1) + \sum_{t=2}^{100} \gamma^t R(S_t) + \gamma^{101} R(S_{101})$
$= 50\gamma - \sum_{t=2}^{100} \gamma^t + \gamma^{101}$
$= 50\gamma - \gamma^2 \frac{1-\gamma^{99}}{1-\gamma} + \gamma^{101}$
DOWN: $U = \sum_{t=0}^{101} \gamma^t R(S_t)$
$= 0 + \gamma^1 R(S_1) + \sum_{t=2}^{100} \gamma^t R(S_t) + \gamma^{101} R(S_{101})$
$= -50\gamma + \sum_{t=2}^{100} \gamma^t - \gamma^{101}$
$= -50\gamma + \gamma^2 \frac{1-\gamma^{99}}{1-\gamma} - \gamma^{101}$

(b) Draw the utility of each action for the range $0 \leq \gamma \leq 1$ using **Matlab** of your familiar numerical analysis software.

Answer: See below.

(c) For $\gamma = \frac{1}{2}$, which action is recommend? Why?

Answer: UP is recommended because uitility of UP is greater than utility of DOWN according to (b).



1. (b)

+50	-1	-1	-1	...	-1	-1	-1	+1
Start				...				
-50	+1	+1	+1	...	+1	+1	+1	-1

Figure 1: 101×3 world

2 Consider the following data set comprised of three binary input attributes (A_1, A_2, and A_3) and one binary output:

(a) Computer $Gain(A_1)$.

Answer: $Gain(A_1) = B(\frac{2}{5}) - \frac{4}{5}B(\frac{2}{4}) - \frac{1}{5}B(\frac{0}{1}) = 0.1710$

(b) Computer $Gain(A_2)$.

Answer: $Gain(A_2) = B(\frac{2}{5}) - \frac{3}{5}B(\frac{2}{3}) - \frac{2}{5}B(\frac{0}{2}) = 0.4200$

(c) Computer $Gain(A_3)$.

Answer: $Gain(A_3) = B(\frac{2}{5}) - \frac{2}{5}B(\frac{1}{2}) - \frac{3}{5}B(\frac{1}{3}) = 0.0200$

Example	A_1	A_2	A_3	Output y
$\mathbf{x}_1$	1	0	0	0
$\mathbf{x}_2$	1	0	1	0
$\mathbf{x}_3$	0	1	0	0
$\mathbf{x}_4$	1	1	1	1
$\mathbf{x}_5$	1	1	0	1

Figure 2: Example data set

3 Consider the XOR function of three binary input attributes (A_1, A_2, and A_3), which produces the value 1 if and only if an odd number of the three input attributes has value 1. Draw a minimal-sized decision tree for the three-input XOR function.