**CECS 451**
**Assignment 10**
**Total: 22 Points**

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General Instruction

- I recommend you can write your answer using LaTeX.
- Submit uncompressed file(s) in the Dropbox folder via BeachBoard (Not email or in class).

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1. Consider the $101 \times 3$ 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) (4 points) Compute the utility of each action as a function of $\gamma$.
   (b) (4 points) Draw the utility of each action for the range $0 \leq \gamma \leq 1$ using `Matlab` of your familiar numerical analysis software.
   (c) (2 points) For $\gamma = \frac{1}{2}$, which action is recommend? Why?

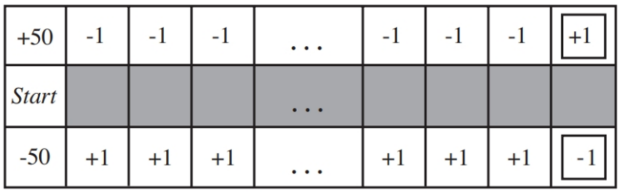


Figure 1: $101 \times 3$ world

2. Consider the following data set comprised of three binary input attributes ($A_1$, $A_2$, and $A_3$) and one binary output:
   (a) (2 points) Compute $Gain(A_1)$.
   (b) (2 points) Compute $Gain(A_2)$.
   (c) (2 points) Compute $Gain(A_3)$.

| **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. (6 points) 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.