CS161: FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

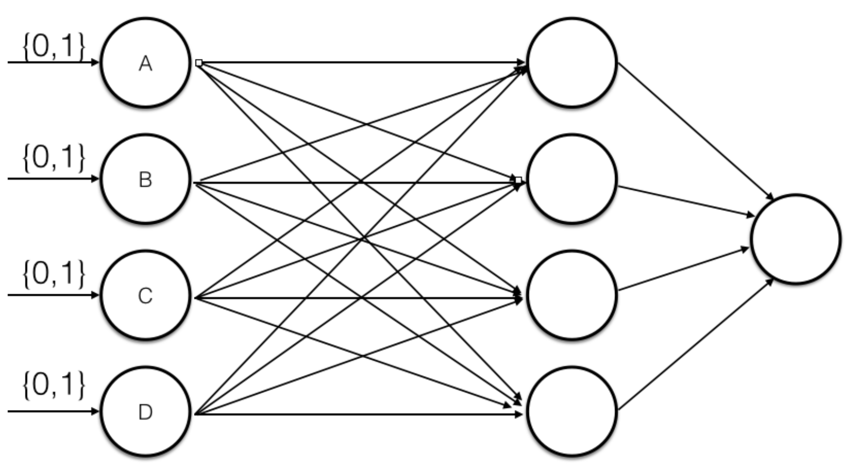
Spring 2022
Assignment 9 – Due 11:55pm, Friday, June 3

Please submit your solution on Bruinlearn. The submission should be a formatted PDF file with some pictures, named hw9.pdf

1. (35 pts) Consider the table below which represents a dataset by listing each unique example with the number of times it appears in the dataset. Construct the decision tree learned from this data by finding the most discriminating attribute at each step. Show precisely how you decided on the most discriminating attribute at each step by computing the expected entropies of the remaining attributes.

Example	Input Attributes			Class	#
	A	B	C	D	
$\mathbf{x}_1$	t	t	t	Yes	1
$\mathbf{x}_2$	t	t	f	Yes	6
$\mathbf{x}_3$	t	f	t	No	3
$\mathbf{x}_4$	t	f	f	No	1
$\mathbf{x}_5$	f	t	t	Yes	1
$\mathbf{x}_6$	f	t	f	No	6
$\mathbf{x}_7$	f	f	t	Yes	2
$\mathbf{x}_8$	f	f	f	No	2

2. (35 pts) Create a two layer neural network that uses the step function to implement $(A \vee \neg B) \oplus (\neg C \vee D)$, where $\oplus$ is the XOR function. You can either use the network structure provided below or another structure you construct. After drawing your network, clearly show the weights and activation function for each node. Assume values of $\{0, 1\}$ for each input variable. Note that solutions with more than two layers will not receive credit.



3. (30 pts) Consider the Arithmetic Circuit (AC) below and suppose the parameters have the following values: $\theta_a = .9$, $\theta_{b|a} = .2$, $\theta_{b|\bar{a}} = .5$, $\theta_{c|a} = .7$ and $\theta_{c|\bar{a}} = .4$. Consider three pieces of evidence: $\mathbf{e}_1 = \bar{a}, c$; $\mathbf{e}_2 = \bar{a}, \bar{c}$ and $\mathbf{e}_3 = \bar{a}$.

   (a) (10 pts) Evaluate the AC under each piece of evidence. That is, compute the two circuit outputs under each evidence.

   (b) (10 pts) What do the two circuit outputs represent for each piece of evidence $\mathbf{e}_1$, $\mathbf{e}_2$ and $\mathbf{e}_3$?

   (c) (10 pts) Using the numbers obtained in the first part, compute $Pr(\bar{b}|\mathbf{e}_1)$, $Pr(\bar{b}|\mathbf{e}_2)$ and $Pr(\bar{b}|\mathbf{e}_3)$.