

Homework 04

Problem 1. (3.0pts) A robot in a lumber yard learns to discriminate Oak wood from Pine wood. It learns a decision tree classifier from the examples shown aside.

No.	Density	Grain	Hardness	Class
1	Heavy	Small	Hard	Oak
2	Heavy	Large	Hard	Oak
3	Heavy	Small	Hard	Oak
4	Light	Large	Soft	Oak
5	Light	Large	Hard	Pine
6	Heavy	Small	Soft	Pine
7	Heavy	Large	Soft	Pine
8	Heavy	Small	Soft	Pine

- a) (2.0pts) Build a decision tree using the ID3 Decision Tree Induction algorithm
b) (1.0pt) Classify these new examples as Oak or Pine using the decision tree above.

[Density=Light, Grain=Small, Hardness=Hard]

[Density=Light, Grain=Small, Hardness=Soft]

Problem 2. (2.0pts) Consider the following training dataset, in which **Transportation** is the target attribute. Show calculations to choose an attribute for the root node of the ID3 decision tree

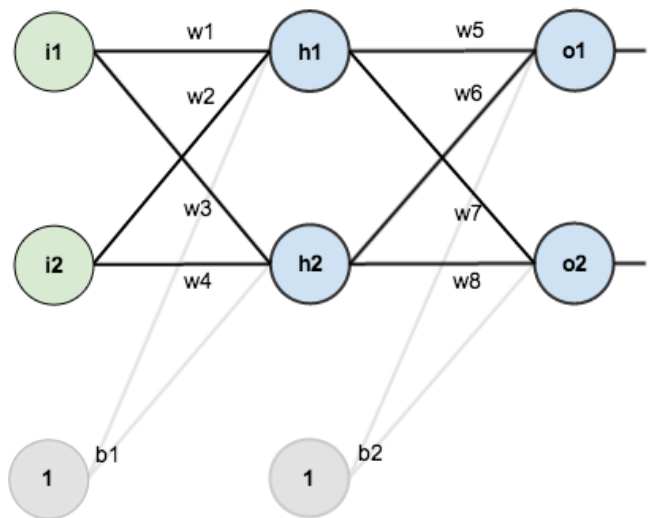
Gender	Car Ownership	Travel Cost	Income Level	Transportation
Male	0	Cheap	Low	Bus
Male	1	Cheap	Medium	Bus
Female	1	Cheap	Medium	Train
Female	0	Cheap	Low	Bus
Male	1	Cheap	Medium	Bus
Male	0	Standard	Medium	Train
Female	1	Standard	Medium	Train
Female	1	Expensive	High	Car
Male	2	Expensive	Medium	Car
Female	2	Expensive	High	Car

Problem 3. (2.0pts) Consider the data set shown aside. A and B are numerical attributes and Z is a Boolean classification.

A	B	Z
1	2	T
2	1	F
3	2	T
1	1	F

- Let P be the perceptron that has two input neurons for the two attributes, A and B, and one bias of constant value 1. The corresponding weights are $w_A = 2$, $w_B = 1$, and $w_o = -4.5$ (for bias). What is the total error after training one epoch?
- Provide your analysis to find a set of weights and a threshold that categorizes all this data correctly.

Problem 4. (3.0pts) Given a neural network with two inputs, two hidden neurons, two output neurons, as shown below. Additionally, in the hidden and output layers, each of which will include a bias that has a constant output value of 1.



- Learning rate 0.5
- Input values: i1=0.05 i2=0.10
- Target values: t1=0.01 t2=0.99
- Bias values: b1=0.35 b2=0.60
- Initial weight: w1=0.15 w2=0.20 w3=0.25 w4=0.30
 w5=0.40 w6=0.45 w7=0.50 w8=0.55

Present all calculations required to perform the backpropagation once (i.e. one forward pass and one backward pass) on the given neural network in the following cases

- Ignore all biases
- Take into account all biases