CMSC 636 Neural Nets and Deep Learning
Spring 2022, Instructor: Dr. Milos Manic, http://www.people.vcu.edu/~mmanic
Homework 1

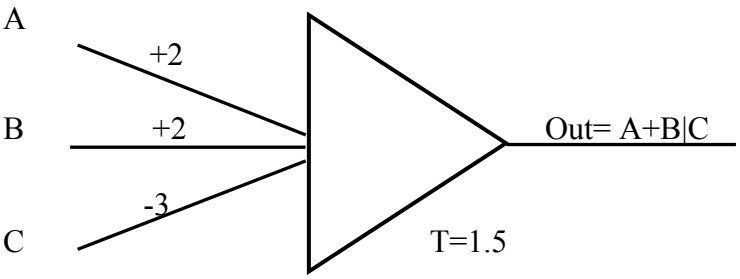
Student certification:
Team member 1:
Print Name: Samah Ahmed Date: 15 Feb 2022
I have contributed by doing the following: solve question 1.2 and install Python.
Signed: Samah
Team member 2:
Print Name: Maher Al Islam Date: 15 Feb 2022
I have contributed by doing the following: Solve question 1.3 and installed Perl
Signed: Maher
Team member 3:
Print Name: Md Touhiduzzaman Date: 15 Feb 2022
I have contributed by doing the following: solve question 1.4
Signed: Md Touhiduzzaman

Homework No. 1
Due Wednesday, Feb. 16, 2022, noon
1.1 Getting to know you (1 pts)
Please include:
●Full name, student ID, and email address you want to be used for sending graded assignments back,
●Short info on your background,
●Your interests/expectations from this course.

Samah Ahmed V00888037 ahmedss5@vcu.edu	-2015, B.Sc Computer Science from King Khalid University. -2016, intern teacher in middle school. -2021-now, M.Sc in computer Science at VCU	Everyone who is interested in computer science should be familiar with the term "Neural Network". As a result, I'm taking this course to broaden my knowledge in the field and increase my chances of finding a suitable job when I return to my home country.
Maher Al Islam V00965559 alislamm@vcu.edu	I completed my B.Sc (in EEE) from University of Dhaka, Bangladesh. I came to USA for my higher studies (Ph.D). I am working with Dr. Sherif (ECE) and Dr. Fung (CS) in cyber-physical systems and networks security.	I wish to learn about implementation of Neural network and deep learning to train dataset and predict outcome which is very much needed in my research.
Md Touhiduzzaman V0999788 touhiduzzamm@vcu.edu	- PhD student at CS department, VCU - BSc in CSE, class of 2016,	I am mostly practical implementation & usage-oriented person. I want to

	Bangladesh University of Engineering & Technology (BUET) - Entrepreneur by profession - Co-Founder of Durbin Labs Ltd. & Durbin Healthtech Ltd. - Started PhD in search of academia-industry collaboration on network security & machine learning	learn as much as possible about machine learning and neural network in this course to apply in my research works as well as delegate those to my affiliated industries.

1.2. McCulloch-Pitts neurons (4 pts)
Provide a solution for the neuron below (provide weight set and a threshold). The functionality is Out = A+B|C
(A OR B AND NOT C).
Please do not provide results by trial and error. Instead, please use an analytical approach as described in
Session 3).
Start with the neuron definition (net and output). Please consider the unipolar hard threshold activation function.
Draw the threshold function. Explain and discuss.
Hint: Compose a truth table (use below example to start). Consider all possible cases for the input pattern. Consider
possible ranges of values for weights and threshold. Possible inputs/outputs in case of unipolar hard activation function
are 0 & 1.

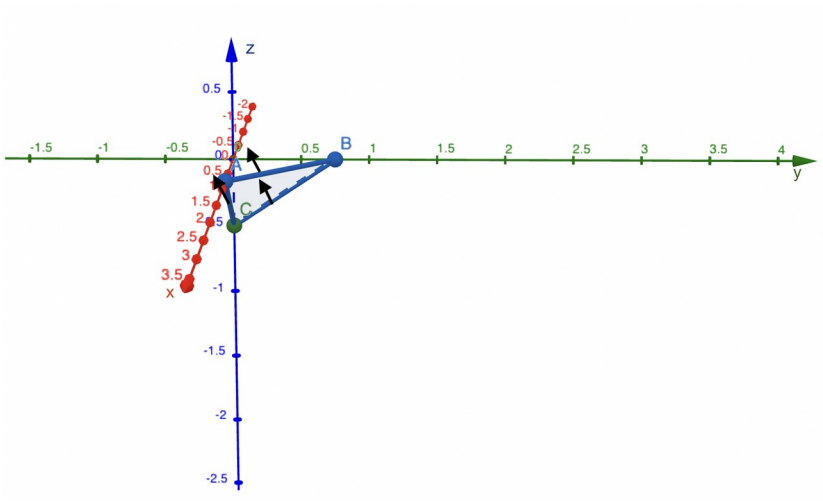


Out= A + B | C
2A + 2B -3C >= 1.5
Range = (0, 1]

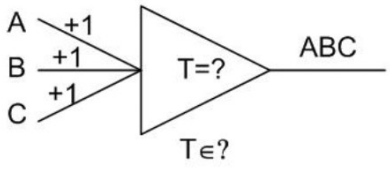
A	B	C	Out= A + B | C	inequalities	Possible output
0	0	0	0	0 < T; T = 1.5	0 < T
0	0	1	0	Wc < T	+1 < T
0	1	0	1	Wb >= T	+2 >= T

0	1	1	0	Wb + Wc < T	-1 < T
1	0	0	1	Wa >= T	+2 >= T
1	1	0	1	Wa + Wb >= T	+4 >= T
1	0	1	0	Wa + Wc < T	-1 < T
1	1	1	0	Wa + Wb + Wc < T	+1 < T

The function graph:
A >= 0.75
B >= 0.75
C >= -0.5



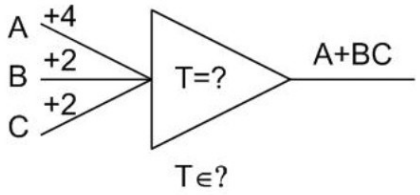
1.3. McCulloch-Pitts neurons (4 pts)
Inspect the two neurons below (ABC and A+BC) and consider unipolar hard threshold activation function. Hint:
start with the tables similar to the one used in previous task.
●What makes these neurons different (they both have 3 inputs)?
●What is the possible range of thresholds for the following McCulloch-Pitts neurons?



Rang = (2,3]

A	B	C	Out= A B C	inequalities	Possible output
0	0	0	0	0 < T; T = 2.5	0 < T
0	0	1	0	Wc < T	+1 < T
0	1	0	0	Wb < T	+1 < T

0	1	1	0	Wb + Wc < T	+2 <T
1	0	0	0	Wa < T	+1 < T
1	1	0	0	Wa + Wb < T	+2 < T
1	0	1	0	Wa + Wc < T	+2 < T
1	1	1	1	Wa + Wb + Wc >= T	+3 >= T



Rang = (0, 1]

A	B	C	Out= A + B C	inequalities	Possible output
0	0	0	0	0 < T; T = 2.5	0 < T
0	0	1	0	Wc < T	+2 < T
0	1	0	0	Wb < T	+2 < T
0	1	1	1	Wb + Wc >= T	+4 >= T
1	0	0	1	Wa >= T	+4 >= T
1	1	0	1	Wa + Wb >= T	+6 >= T
1	0	1	0	Wa + Wc >= T	+6 >= T
1	1	1	1	Wa + Wb + Wc >= T	+ 8 >= T

Because the first neuron is AND and the second is A OR B AND C, the two neurons are distinct. Even though the two neurons have the same number of inputs, their weights differ, resulting in different outputs.

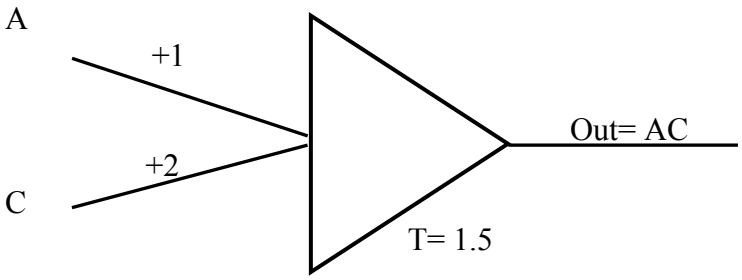
1.4 Design McCulloch-Pitts neuron, which implements the following truth table (5 pts):

A	B	C	out
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Using Karnaugh maps minimization:

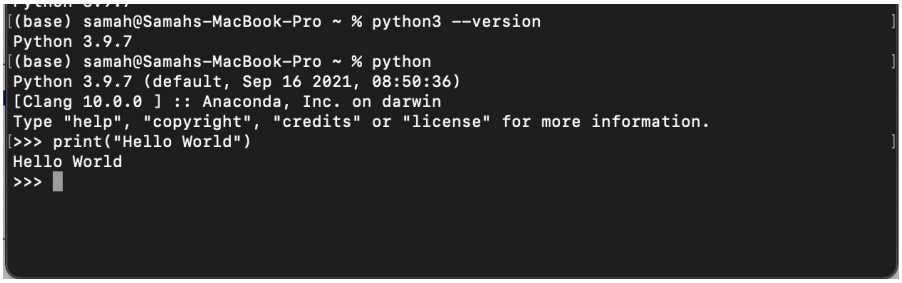
AB C	00	01	11	10
0	0	0	0	0
1	0	0	1	1

The Boolean expression = A and C



A	B	C	Out=A and C	inequalities	Possible output
0	0	0	0	0 < T; T= 2.5	0 < T
0	0	1	0	Wc < T	+2 < T
0	1	0	0	Wb < T	0 < T
0	1	1	0	Wb +Wc < T	+2 < T
1	0	0	0	Wa < T	+1 < T
1	0	1	1	Wa + Wc >= T	+3 >= T
1	1	0	0	Wa + Wb < T	+2 < T
1	1	1	1	Wa + Wb + Wc >= T	+3 >= T

1.5 Python and Perl installation (1 pts)



Perl (command line)