ES 203 Project

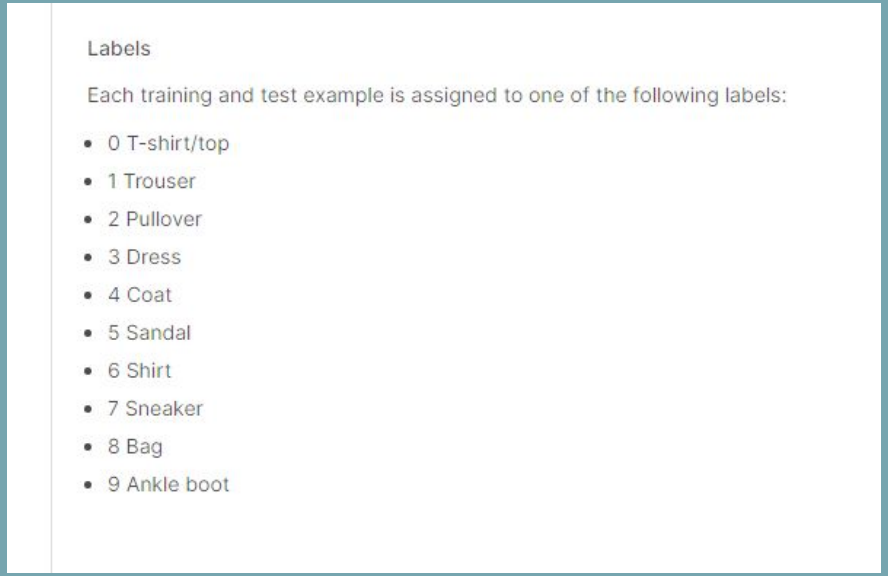
MNIST Fashion Image Classification

Koushik Chandra Chenna 19110122
Manas Mulpuri 19110093
Krishna Mohan P 19110130
Rohith Kumar Tumati 19110103

Course Instructor: Joycee Mekie
TA: Rajesh Kumar

About the MNIST Fashion Dataset

The dataset consists of a training set of 60,000 examples and a test set of 10,000 examples. Each example is a grayscale image of size 28x28. Each image has a label associated with one of the 10 classes shown in the figure.



Labels

Each training and test example is assigned to one of the following labels:

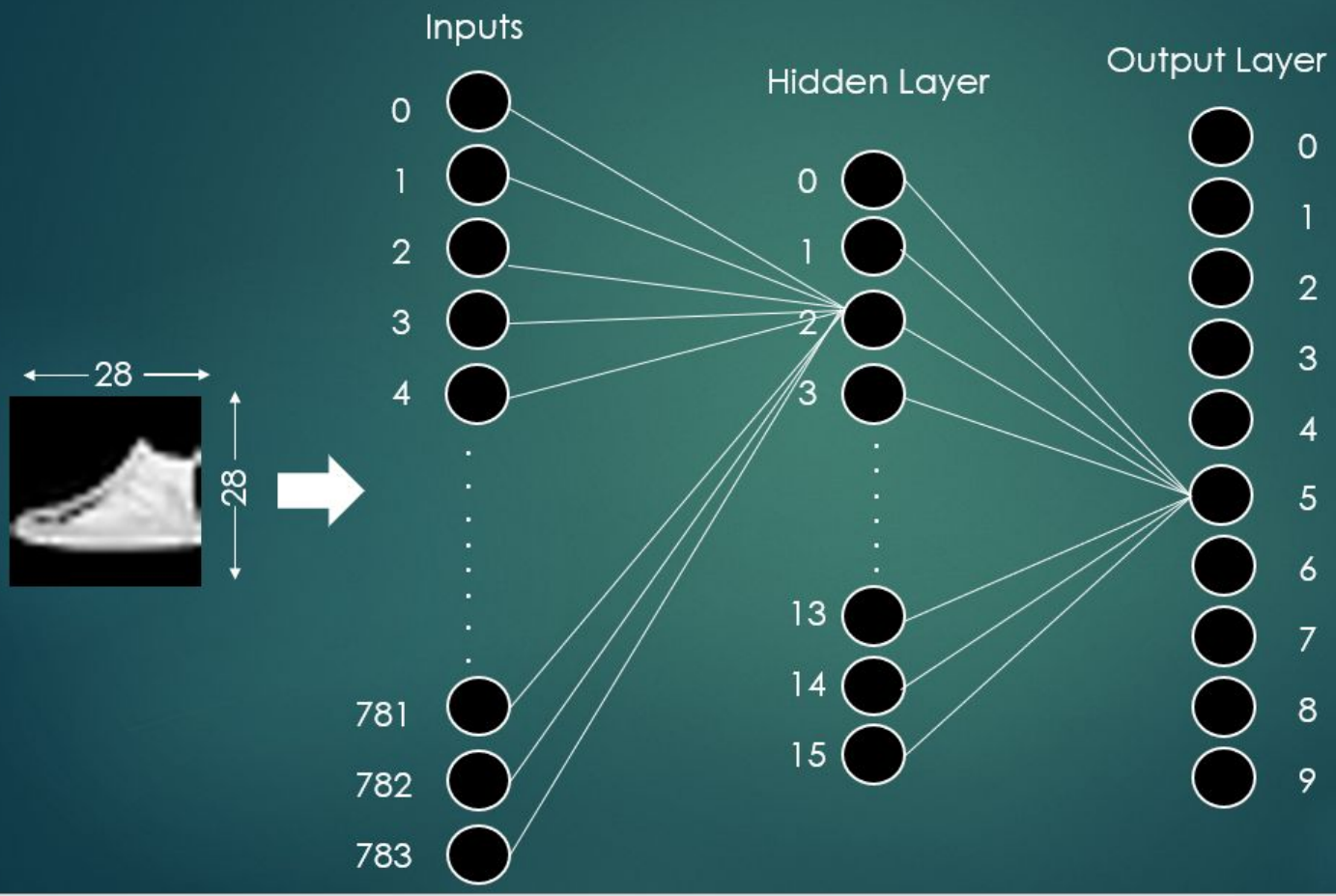
- 0 T-shirt/top
- 1 Trouser
- 2 Pullover
- 3 Dress
- 4 Coat
- 5 Sandal
- 6 Shirt
- 7 Sneaker
- 8 Bag
- 9 Ankle boot

About the project

In our project we are implementing a neural network in verilog to classify the images of the dataset. We have used the Multi-Layer Perceptron model.

Architecture of the model = 784x16x10

Multi Layer Perceptron Model

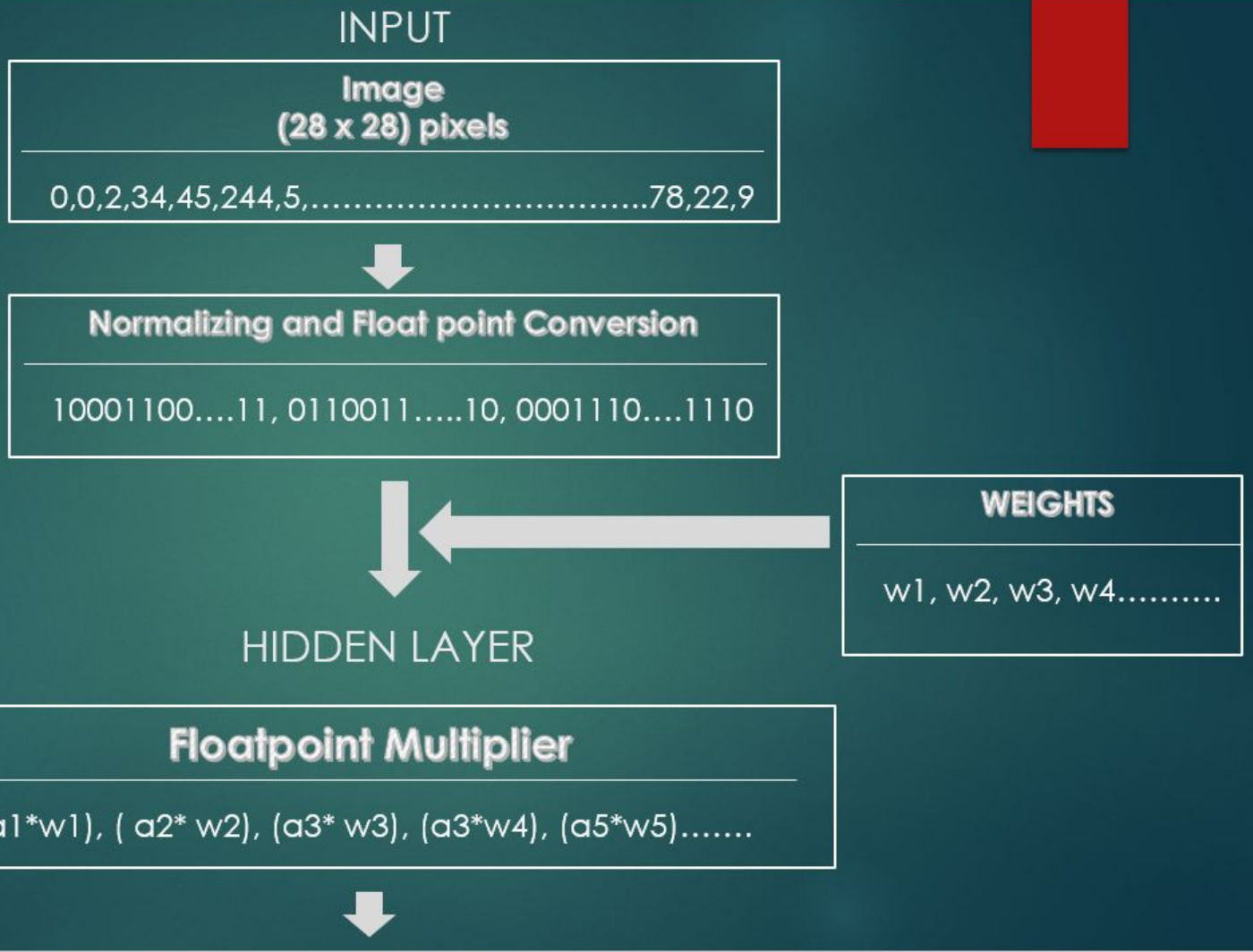


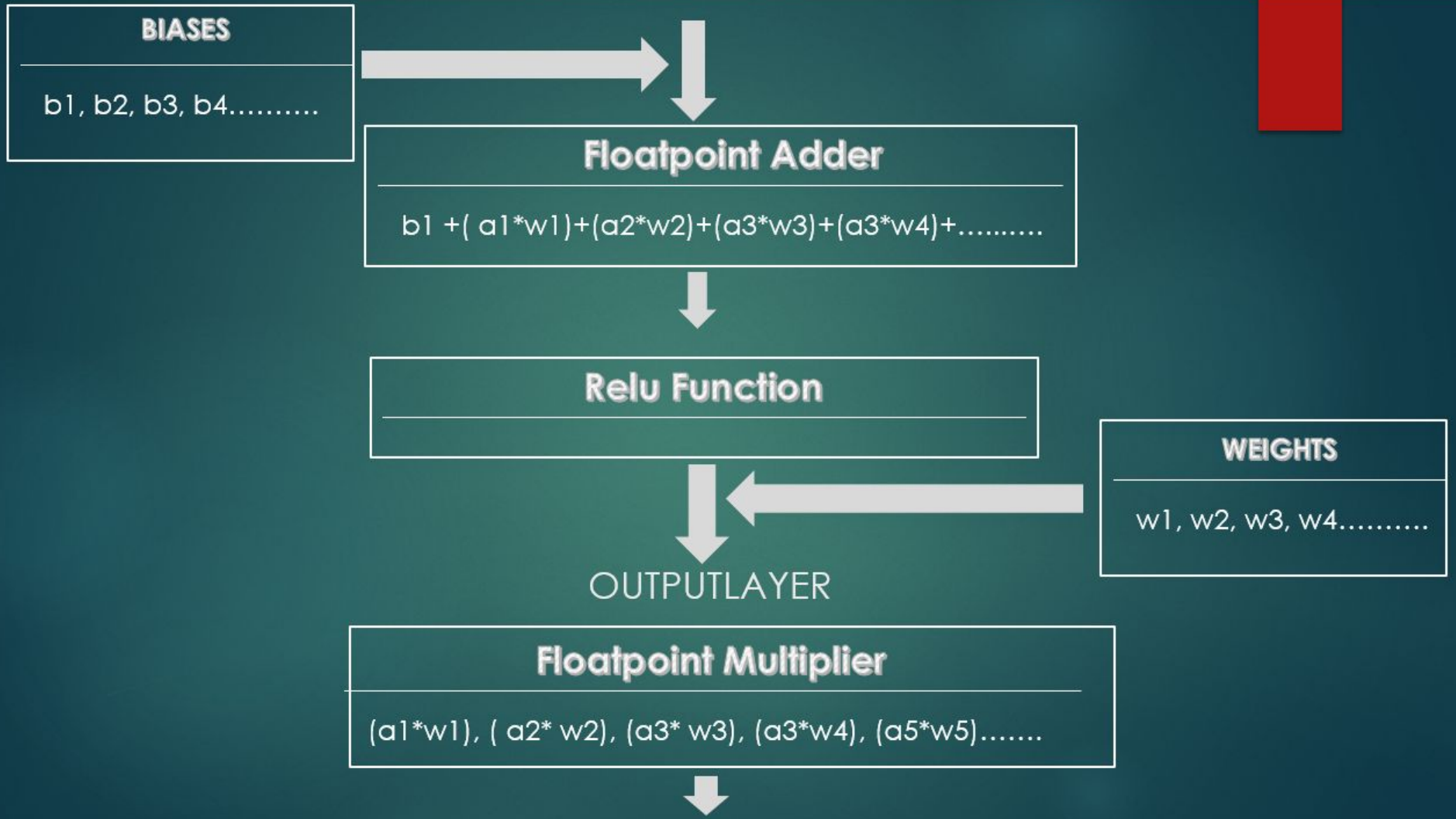
Single Precision Floating Point

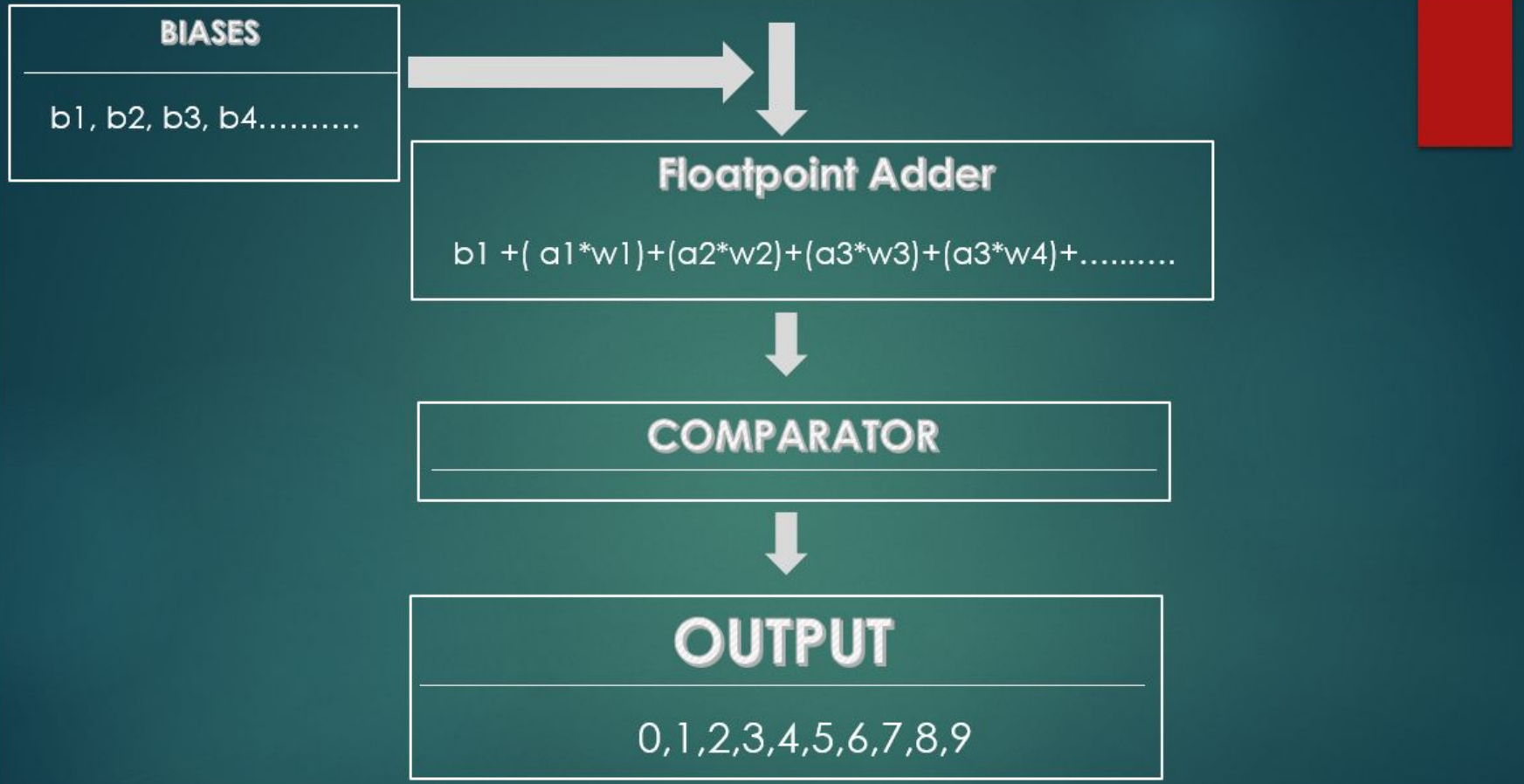
01000000111101011001111010000100

Float point also allows us to represent a wide range of numbers using less number of bits. And we have designed all modules according to the the float point representation(IEEE 754). Being 32 bit it also helps in maintaining accuracy.

WORKFLOW


INPUT
Image
(28 x 28) pixels
0,0,2,34,45,244,5,.....78,22,9
Normalizing and Float point Conversion
10001100....11, 0110011.....10, 0001110....1110
WEIGHTS
w1, w2, w3, w4.....
HIDDEN LAYER
Floatpoint Multiplier
(a1*w1), (a2* w2), (a3* w3), (a3*w4), (a5*w5).....


BIASES
b1, b2, b3, b4.....
Floatpoint Adder
b1 +(a1*w1)+(a2*w2)+(a3*w3)+(a3*w4)+.....
Relu Function
WEIGHTS
w1, w2, w3, w4.....
OUTPUTLAYER
Floatpoint Multiplier
(a1*w1), (a2* w2), (a3* w3), (a3*w4), (a5*w5).....


BIASES
b1, b2, b3, b4.....
Floatpoint Adder
b1 +(a1*w1)+(a2*w2)+(a3*w3)+(a3*w4)+.....
COMPARATOR
OUTPUT
0,1,2,3,4,5,6,7,8,9

Accuracy

Our model’s implementation in python gave an accuracy of 86.04%.

We have tested our model over 32 examples out of which we have received a correct output for 25 examples.

Accuracy = 78.125%

MODULES IMPLEMENTED

MLP MODEL

FLOAT POINT CONVERTER

FLOAT POINT ADDER

FLOAT POINT MULTIPLIER

ReLU FUNCTION

COMPARATOR

THANK YOU

We gratefully acknowledge the support of Prof.Joycee Mekie and Rajesh Kumar.