MES'S WADIA COLLEGE OF ENGINEERING, PUNE

Honors* in Artificial Intelligence and Machine Learning Fourth year of Engineering

410302: Machine learning Laboratory

NAME OF STUDENT:	**CLASS: BE**
SEMESTER/YEAR: VII	**ROLL NO:**
DATE OF PERFORMANCE:	**DATE OF SUBMISSION:**
EXAMINED BY: Dr. N. F. Shaikh	**EXPERIMENT NO: 01**

TITLE: Creation & Visualization of ANN

AIM/PROBLEM STATEMENT: Creating & Visualizing Neural Network for the given data. (Use python)
Note: download dataset using Kaggle.
    Keras, ANN visualizer, graph viz libraries are required.

OBJECTIVES:

- To understand the different models of neural network for solving non-linear functions
- To understand the different visualization techniques for neural network

OUTCOMES:
- Select the appropriate type of neural network architecture and apply respective non-linear function to the architecture.

PRE-REQUISITES:-
1. Knowledge of python programming
2. Basic knowledge of machine learning and neural networks

THEORY:

What are neural networks?
Neural networks, also known as artificial neural networks (ANNs) or simulated neural networks (SNNs), are a subset of machine learning and are at the heart of deep learning algorithms. Their name and structure are inspired by the human brain, mimicking the way that biological neurons signal to one another.

• Artificial neural networks (ANNs) are comprised of node layers, containing an input layer, one or more hidden layers and an output layer.

• Each node, or artificial neuron, connects to another and has an associated weight and threshold.

• If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network.

• Otherwise, no data is passed along to the next layer of the network.

Deep neural network
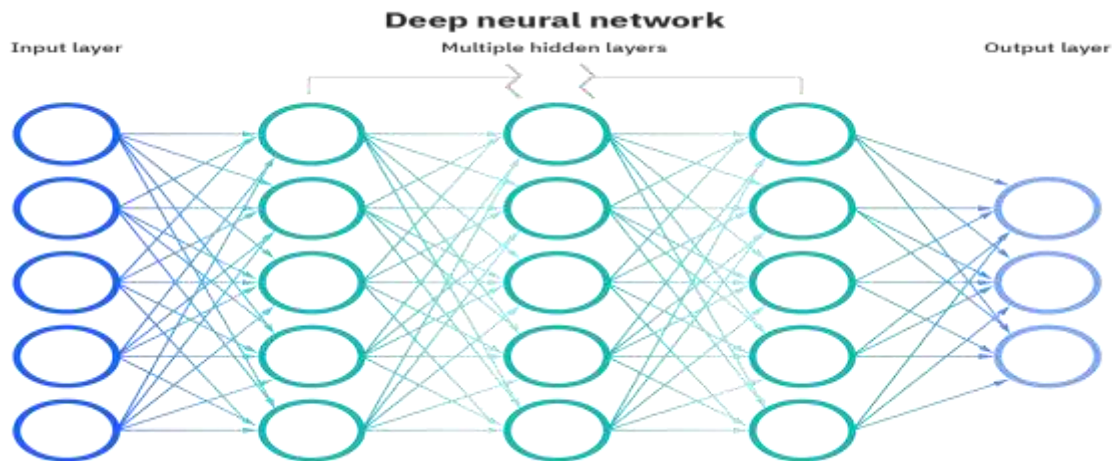
Neural networks rely on training data to learn and improve their accuracy over time. However, once these learning algorithms are fine-tuned for accuracy, they are powerful tools in computer science and artificial intelligence, allowing us to classify and cluster data at a high velocity. Tasks in speech recognition or image recognition can take minutes versus hours when compared to the manual identification by human experts. **One of the most well-known neural networks is Google's search algorithm.**

How do neural networks work?
Think of each individual node as its own linear regression model, composed of input data, weights, a bias (or threshold), and an output. The formula would look something like this:

$\Sigma w_i x_i + bias = w_1 x_1 + w_2 x_2 + w_3 x_3 + bias$

$output = f(x) = 1$ if $\Sigma w_1 x_1 + b >= 0$; 0 if $\Sigma w_1 x_1 + b < 0$

• Once an input layer is determined, weights are assigned. These weights help determine the importance of any given variable, with larger ones contributing more significantly to the output compared to other inputs.
• All inputs are then multiplied by their respective weights and then summed. Afterward, the output is passed through an activation function, which determines the output.
• If that output exceeds a given threshold, it "fires" (or activates) the node, passing data to the next layer in the network. This results in the output of one node becoming in the input of the next node.
• This process of passing data from one layer to the next layer defines this neural network as a feedforward network.

For more information, please refer https://www.ibm.com/cloud/learn/neural-networks
Case studies: (for reference purpose)
https://www.kdnuggets.com/2018/10/simple-neural-network-python.html
https://heartbeat.comet.ml/building-a-neural-network-from-scratch-using-python-part-1-6d399df8d432

Visualizing Artificial Neural Networks (ANNs)
ANN Visualizer is a python library that enables us to visualize an Artificial Neural Network using just a single line of code. It is used to work with Keras and makes use of python's graphviz library to create a neat and presentable graph of the neural network you're building.
With advances in deep learning, one can now visualise the entire deep learning process or just the Convolutional Neural Network you've built.
We are going to build simple neural network using keras and then use ANNvisualizer to visualize our neural network.
Jason Brownlee has produced some great work on http://machinelearningmastery.com/. One of his example was building simple neural network using Keras.

Installation
We will need 3 libraries for this demo
   • keras
   • ANNvisualizer
   • Graphviz

The library can be installed using the commands below:
pip3 install keras
pip3 install ann_visualizer
pip install graphviz

Create a new file called **index.py** copy-and-paste the code into the file
To generate the visualization, you need to follow the below command structure:

ann_viz(model, view=True, filename="network.gv", title="MyNeural Network")
   • model – Your Keras sequential model
   • view – If set to true, it opens the graph preview after the command has been executed
   • filename – Where to save the graph. (it's saved in a '.gv' file format)
   • title – The title for the visualized ANN
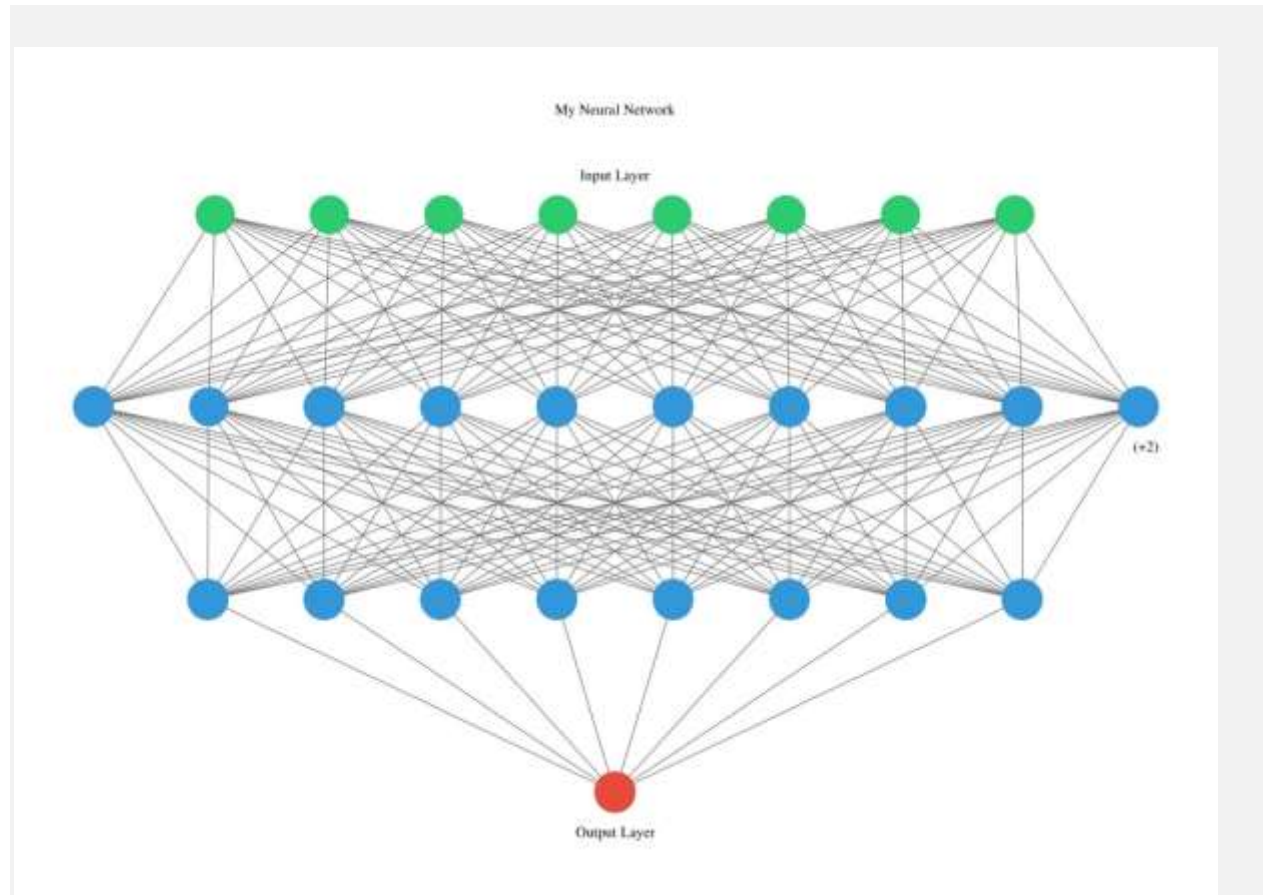The above code easily creates your a neural network model in Keras.

Let's tie it **ann_viz()** together into this code.
from ann_visualizer.visualize import ann_viz;

ann_viz(model, title="My first neural network")

Run index.py using:
python3 index.py

Below is an example of what the final visualization looks like:

Questions:

1. What do you mean by Perceptron? What are the different types of Perceptrons?
2. What is ANNs and how do they work?
3. What are the types of Neural Networks?
4. What is the role of the Activation functions in Neural Networks? List down the names of some popular Activation Functions used in Neural Networks
5. What is the use of Keras, ANN visualizer and graph viz?