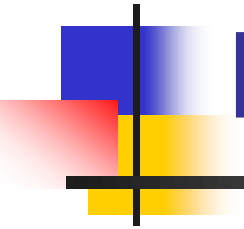
Deep Learning Using TensorFlow



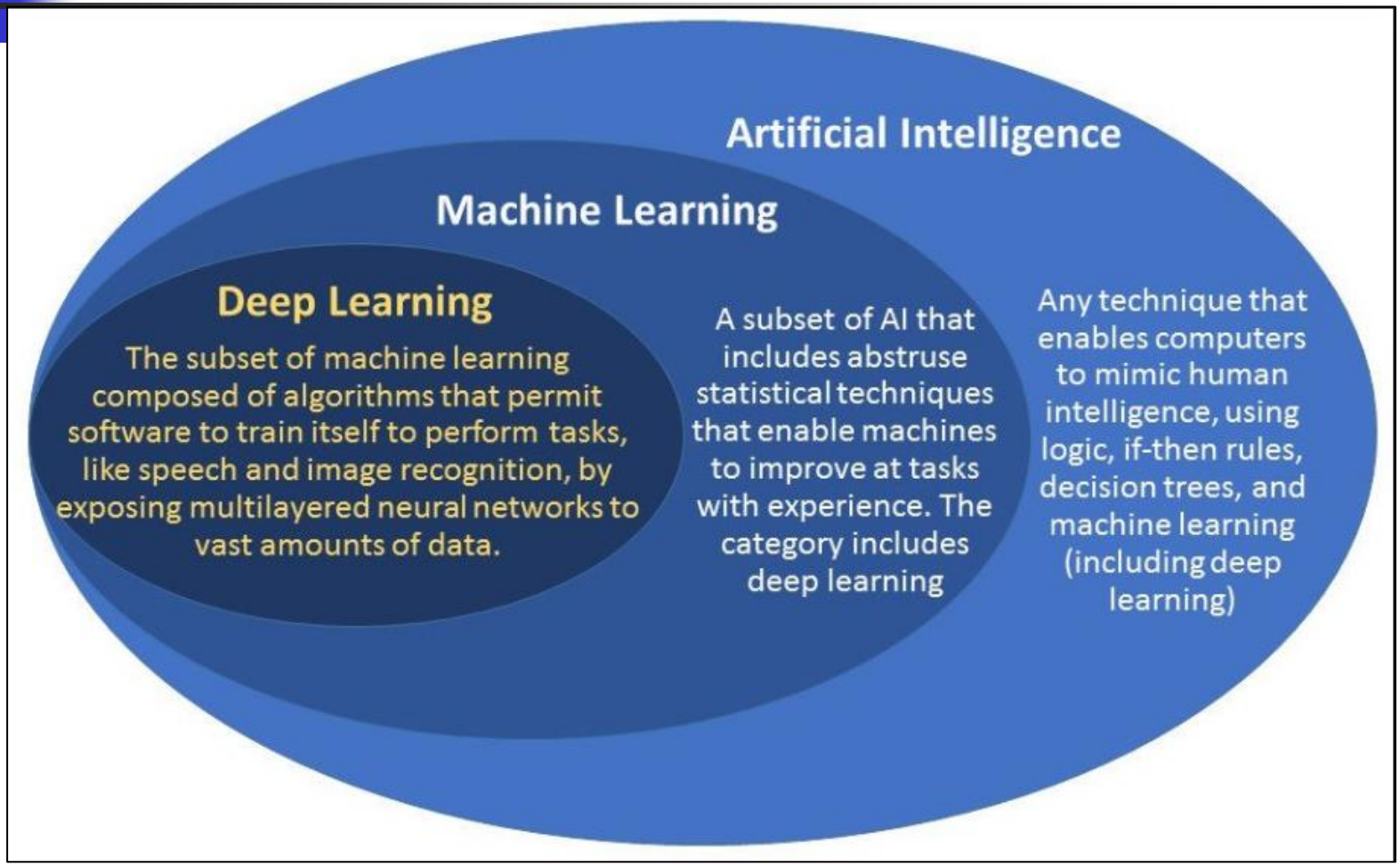
Dr. Ash Pahwa

1.2: Deep Learning

Autonomous Car Solves a Real World Problem

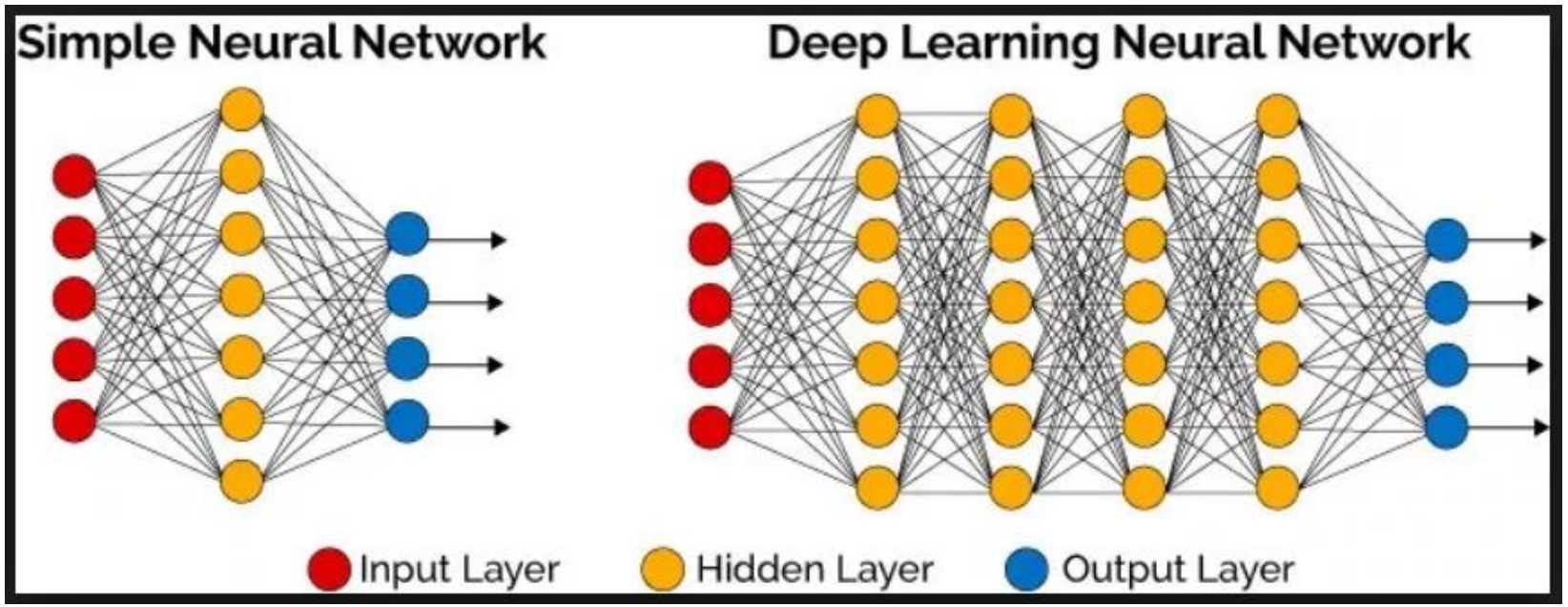
- A person dies every 23 seconds on roads

Artificial Intelligence



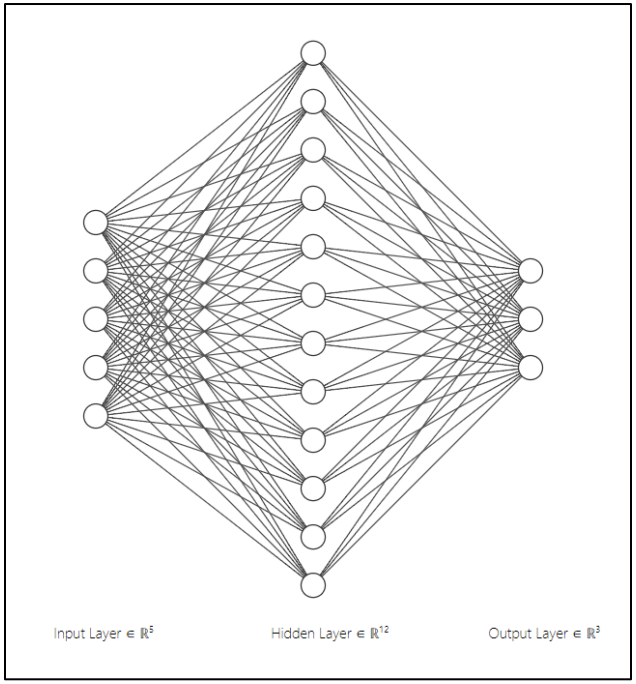
Deep Learning

- A Deep Neural Network (DNN) has multiple hidden layers



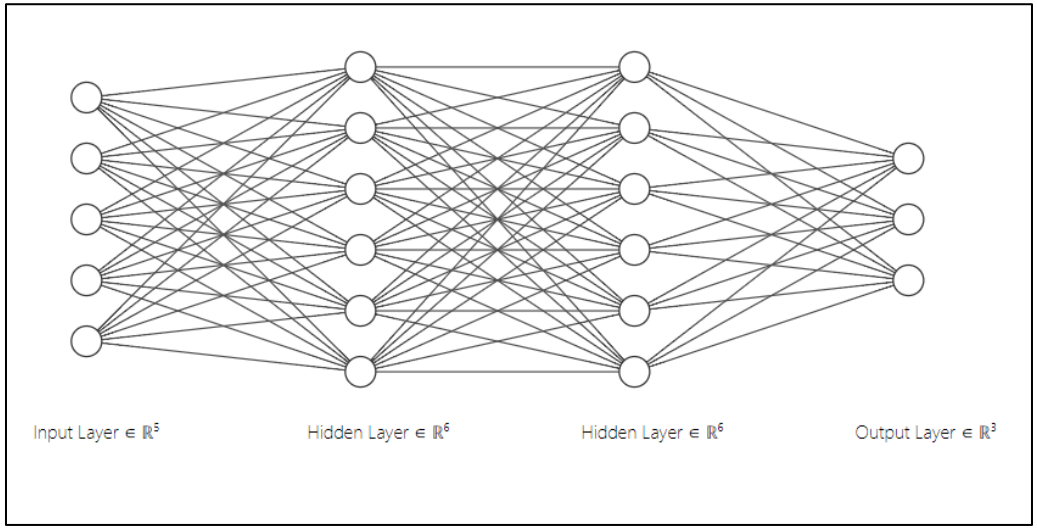
Shallow and Deep NN

Shallow Neural Network



Input layer: 5 nodes
Hidden layer: 12 nodes
Output layer: 3 nodes

Deep Neural Network

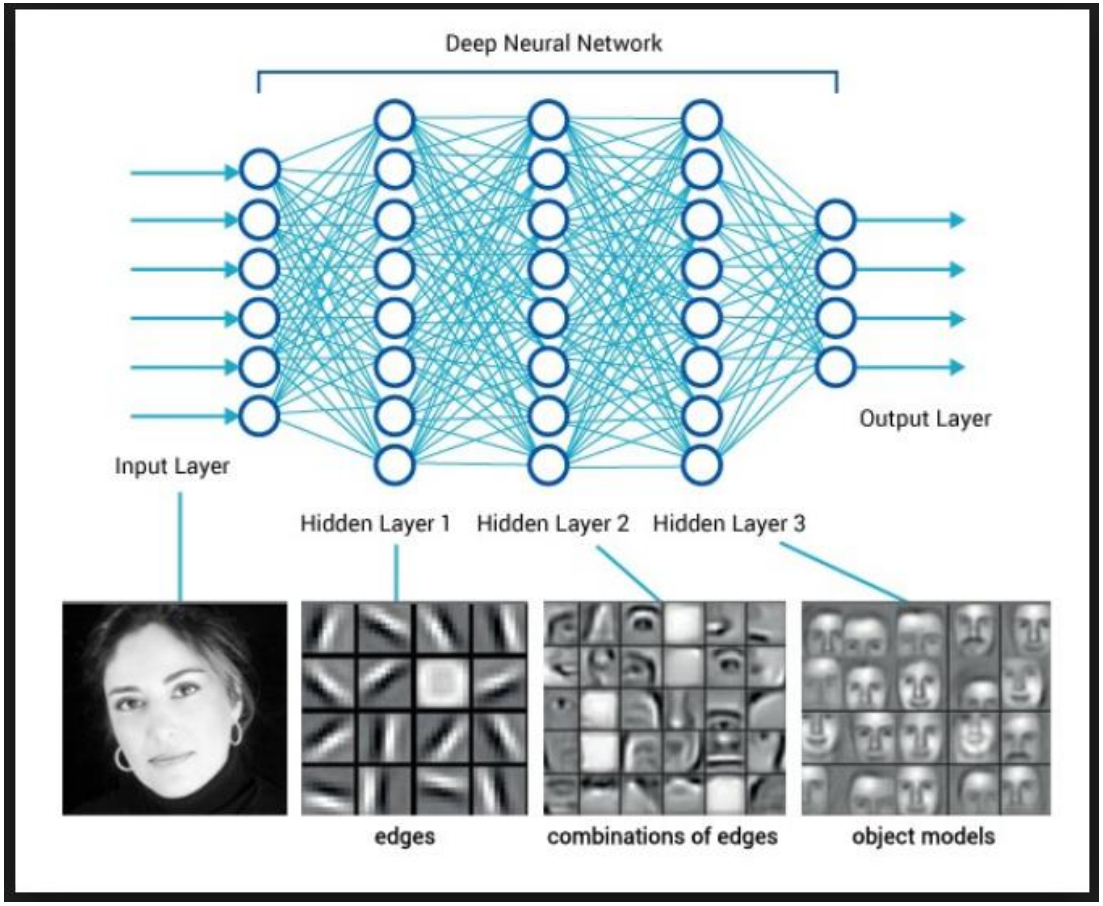


Input layer: 5 nodes
Hidden layer 1: 6 nodes
Hidden layer 2: 6 nodes
Output layer: 3 nodes

More layers usually provides more efficient and accurate representation of data

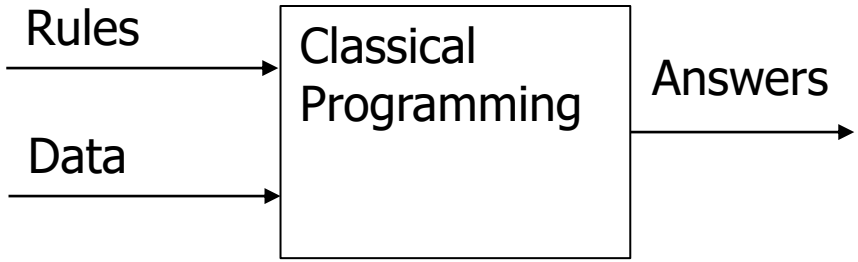
Deep Neural Network

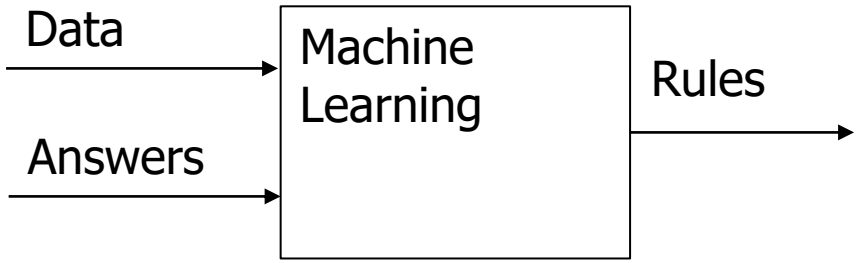
- Every layer of the DNN allows a more sophisticated build-up
  - From simple elements
  - To more complex ones



Problems that can use Neural Networks

- For simple problems we can define the rules
  - We can automate the process
  - Write software
- For complex problems
  - We cannot define the rules
  - Object recognition in an image
- To solve these types of problems
  - We provide data and the answers
  - System will create the rules

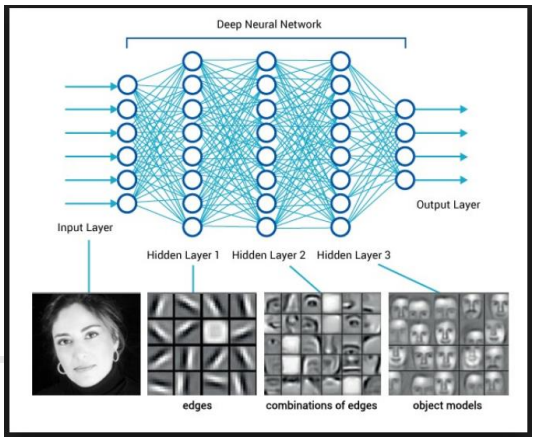




Main Applications of Deep Learning Neural Networks

- Image Recognition
  - Convolution Neural Networks
- Image Classification
  - Convolution Neural Networks
- Hand Writing Identification
- Speech Recognition
  - Long Short-Term Memory Networks

Backpropagation Algorithm:



- Conceptually the backpropagation algorithm is very simple

- Algorithm
  - Assign random values to all the weights of the NN
  - Take the first observed data
    - Forward Propagation: Compute Output
    - Compute error = $(Computed\ Output\ - Observed\ Output)^2$
    - Backpropagation: adjust weights to reduce error
    - Repeat forward, backward propagation, till error is minimized
  - Repeat the previous step for the next sample till all samples are processed
  - The final weights of the NN will be used for prediction