**Module 1 Notes**

* **Deep Learning** – supervised learning method, enables systems to provide a solution based on previous learned examples. Basic ANN is error-based learning. Deep learning has many hidden layers.

Deep learning is a subfield of ML that deals with algorithms inspired from the biological structure and functioning of a brain to aid machines with intelligence.

* **Fully Connected Network** – takes many data inputs, manipulates them using a particular transformation, then generates a list of outputs. Any input value can affect an output value.
* **Gradient Descent** – key technique in determining convergence towards a solution. Iterative optimization for finding local minimum value from a differentiable function.
* **Convolutional Neural Network (CNN)** – network with many hidden layers. Convolutional operation in certain layers transforms images into smaller representations, using a kernel/filter. CNNs nodes can share the same filter, so they can share the same weights and biases. CNNs reduce the number of parameters and apply the same shared weight. The first convolutional layer will learn the most important and applicable features, such as object edges. Uses a softmax function for classification. In feedforward neural networks, each input is independent of other inputs, they make predictions based only on the current input, and they do not remember previous input.
* **Pooling Layers** – reduce the size and dimensionality of a layer prior to a convolutional layer. Pooling layers help model learn the rough location of features. Pooling layers reduce the size of input data and helps reduce model overfitting. Combines the output of node clusters into a single new node.
* **Max pooling** - maximum value of a group of neurons is used as the input for the next node in a subsequent layer. Max pooling is good for noise reduction.
* **Recurrent Neural Networks (RNN)** – predict output based on current input and previous hidden state. Previous hidden state will capture the contextual information that the network has seen so far. Previous hidden state acts as memory. Capable of learning long sequence-update rules. RNNs are good for time series data and other data that have sequential format.
* **Long Short-Term Memory (LSTM)** - modification to the RNN layer that allows for signals from deeper in the past to make their way to the present
* **TensorFlow** – end-to-end machine learning framework. First step is to perform exploratory data analysis. In this step, try to understand the data (data types, attributes, preprocessing, etc.). Next step is to find an efficient way to consume the data (tf.data, tensorflow-datasets, Keras). The purpose of the pipeline is to produce a batch of data from the datasets.
* Four main types of deep networks – fully connected, convolutional neural, recurrent neural, and Transformer.
* **Keras** – submodule in TensorFlow. Provides “Layer” objects that encapsulate various common functionality that repeatedly happens in neural networks. Provides several high-level model-building APIs.

Table

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