CHAPTER 28

Neural Network Foundations

Building on the inspiration of the biological neuron, the artificial neural network (ANN) is a society of connectionist agents that learn and transfer information from one artificial neuron to the other. As data transfers between neurons, a hierarchy of representations or a hierarchy of features is learned, hence the name deep representation learning or deep learning.

The Architecture

An artificial neural network is composed of

- An input layer
- Hidden layer(s)
- An output layer

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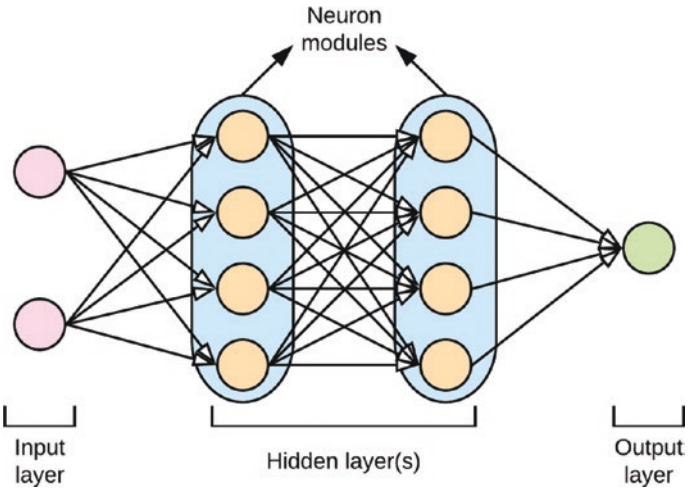

Figure 28-1. *Neural network architecture*

The input layer receives information from the features of the dataset, after which some computation takes place, and information that captures the learned patterns of the data is propagated across the hidden layer(s) with hopes to improve the learned patterns.

The hidden layer(s) is where the workhorse of deep learning occurs. The hidden layer(s) can consist of multiple neuron modules as shown in Figure 28-1. Each hidden network layer learns a more sophisticated set of feature representations. The decision on the number of neurons in a layer (network width) and the number of hidden layers (network depth) which forms the network topology is a design choice when training deep learning networks. The techniques for training a deep neural network are discussed in the next chapter.

CHAPTER 29

Training a Neural Network

This chapter gives an overview of the techniques for training a deep neural network. Here, we briefly discuss

- How learned information flows through a neural network
- The role of the cost function at the output layer of the network
- One-hot encoding and the softmax activation function for determining class membership at the output layer of a classification problem
- The backpropagation algorithm for improving the learned parameters of the network
- Activation functions that enable the neural network to learn non-linear patterns

In this chapter, as we discuss the methods involved in training a neural network, we will use the example of a classification problem with two possible outputs. In designing a neural network, the number of neurons in the input layer is typically the number of features of the dataset, while the number of neurons in the output layer is the number of classes in the target variable that the neural network is learning to classify.

As illustrated in Figure 29-1, the dataset features are the inputs to the neural network, while the classes in the target variable determine the number of output neurons. In this example, the network learns two classes, 0 and 1.

E. Bisong, *Building Machine Learning and Deep Learning Models on Google Cloud Platform*,
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