INSY 4054 101 Emerging Technologies

Zhaozhi Li

February 10, 2021

Dr. Kambiz Saffari

Assignment One

Machine learning is becoming increasingly relevant. In the past, people learn to use machines; with machine learning, machines can learn to understand and better serve people. This technology will fundamentally change the way humans interact with machines and transform many industries. Neural networks are at the heart of machine learning. In this article, we will explore what a neural network is, how it works as well as the concepts of neurons and learning in machine learning.

A neural network, as the name suggests, is derived from biological neural networks. The idea is to build a “brain” using computer technology so that machines can learn and get better at some tedious tasks that humans either do not enjoy or cannot perform as well as machines. A neural network can perform many tasks such as image recognition and natural language processing. Engineers implement neural networks to build intelligent software and hardware such as virtual assistants and autonomous vehicles.

So how does a neural network work? According to James Chen, a neural network is “a set of algorithms designed to perform a specific task”. It has a multi-layer structure and takes inputs to produce outputs through a process. Inputs can be numbers, texts, images, audios, or videos, etc. Depending on the task, the inputs can be different from a neural network to another. Outputs can also be different. For instance, in a neural network designed for recognizing cats in images, the inputs could be images either with or without cats, and the outputs could be either yes or no for indicating whether cats are detected from the image inputs. This detection process may include multiple rounds of calculation. Each layer in a neural network is made up with interconnected nodes. These nodes are called neurons.

In a biological neural network, a neuron is a cell designed for transmitting information. A neuron in an artificial neural network works in a similar way. According to the video, it is “a thing that holds a number”. It is a function that accepts and processes data to produce a number. These neurons work together to perform the task that the neural network is designed for to produce outputs from inputs. For instance, in a neural network designed for recognizing images, each neuron produces a number that determines the brightness of a pixel in an image. By going through the multi-layer process in the neural network, neurons in each layer will accept inputs and calculate to

produce an output number and highlight pixels in the image. In doing so, the computer can detect if an object is present in a given image.

Finally, what does “learning” mean in machine learning? According to the video, it is the process of “finding the weights and biases”. Like humans, it takes some time for machines to acquire skills. The larger the training dataset is, the more accurate the outcome will be. A neural network created for detecting cats in images will require thousands to millions of cat images for machines to learn and understand what a cat should look like so that it can detect cats in any given image. The more we train the model, the better the neural network will be at performing the task that we assign.

Today, companies are investing in machine learning. Google has assembled a research team to explore machine learning’s applications and created the open-source library TensorFlow to allow developers to build machine learning products. Baidu has incorporated image recognition and natural language processing in its search engine, developed artificial intelligence semiconductor chips for processing big data and manufacturing intelligent home compliances and autonomous vehicles, and created the open-source library PaddlePaddle. ByteDance has deployed machine learning in its popular social media application TikTok, etc.

Neural networks are expected to become more commonly used in software applications and hardware products.

References

What is a Neural Network? Investopedia:
https://www.investopedia.com/terms/n/neuralnetwork.asp

But what is a Neural Network? YouTube:
https://www.youtube.com/watch?v=aircAruvnKk