Module 3

Tools in AI Development and deep learning

▼ What are some cluster-based AI solutions for managing large datasets?

- Hadoop

- Spark

- multi-agent systems

▼ Tensorflow

- developed by Google

- an open source ecosystem of tools, libraries, and community resources

- As of March 2020, Tensorflow is used by 15,000+ companies including DeepMind, Apple, and Uber

- Tensorflow Lite allows simple deployment on almost any device, including ARM devices

- has an advantage in hardware utilization: using GPUs, CPUs and TPUs (Tensor Processing Units, specialized ASIC chips to accelerate AI apps), and new forms of neuromorphic chips

- Since Tensorflow version 2.0, Keras can be used inside Tensorflow directly

- like PyTorch, both frameworks operate on tensors and view any model as a directed acyclic graph (DAG)

- you describe a graph statically before a model can run

- allows you to manually fine-tune every operation to run on a specific device, enabling unlimited manual parallelism

- has a clear advantage for deployment of inference

- important to consider what type of compute device you will use for training: your CPU or GPU?

▼ Keras

- an open-source ANN library supported by Tensorflow's core library since 2017

▼ PyTorch

- developed by Meta

- used by Twitter

- a major Tensorflow competitor

- more beginner-friendly than Tensorflow and known for being quick, simple and effective

- is Torch library's Python counterpart written in Lua

- more transparent modeling process than Tensorflow

- uses a "define-by-run" mode by default

- you can define, change and execute nodes without special session interfaces or placeholders

  - this makes debugging easier because you can use Python debugging tools like pdb or PyCharm debugger or Print() statements

- has declarative data parallelism (models can be easily parallelized over batch dimension)

▼ Apache's mxNet

a framework used by AWS, Microsoft and Intel for tasks like speech and handwriting recognition, NLP and forecasting

▼ Deeplearning4j

an open-source DL framework developed by Eclipse written primarily for Java and Java Virtual machine (JVM)

▼ Use of R for ML?

- for use in statistical analysis and machine learning

- it is graphically based and is preferred by statisticians and for work in bioengineering, bioinformatics, and biomedical statistics

- it is well suited to machine learning tasks such as regression, classification, and decision tree formation.

▼ Scala for ML

- Scala is a core language of Apache Spark

- is being utilized in deploying machine learning solutions in the world of big data

▼ Apache Spark

- a comprehensive data platform that provides functionalities for big data processing and machine learning analysis through its MLLIB library

▼ Lisp, Prolog, and Haskell for GOFAI (Good Old Fashioned AI)

- Lisp, Prolog, and Haskell are all logic-based languages that are well-suited for symbolic programming.

- They are common go-tos for development of GOFAI (Good Old Fashioned AI) systems that utilize symbol manipulation.

▼ An ANN in Python will typically have what components?

- an input layer

  - takes input data as a matrix and passes it on after multiplying the input by a set of weights

  - these input parameters are often initialized randomly, or sometimes restored from a previous network checkpoint

- an activation function

  - is nonlinear

  - determines if a neuron has been activated

  - examples: ReLU, Tanh, and sigmoid (easy for beginners)

- feedforward propagation

- your code will iterate through the matrices given as input data

- in each iteration, you will loop over the input data as a certain number of times, calculating the derivative (the rate of change of a function with respect to a variable) of the activation function

- backpropagation and loss function

  - a loss function that helps you readjust the input weights and biases by comparing the predicted values (output) from the previous iteration with the actual received value

  - the goal is to minimize the loss function over each iteraction (improve prediction performance)

  - backpropagation is used to adjust the neuron weights by working backwards

  - backpropagation uses an Error Weighted Derivative formula determined by the activation function

▼ How many typical iterations for ANN training process?

is iterated upon no less than 10,000 times and sometimes more depending on the use-case

▼ After training, you can use the model for inference. Explain.

Inference is when the model/function is applied to new examples (for which we do not know the correct output value) and therefore we want the model to generate estimates of this value for us.

▼ Why does the use of Tensorflow often result in higher-dimensional (more layers and nodes) ANNs?

Tensorflow allows you to process much larger matrices

▼ What is the distinction made between ML and deep learning algorithms?

- During training, a ML algorithm learns a function from data, selecting it from a set of possible functions.

- In deep learning, a neural network uses a divide-and-conquer strategy to learn a function wherein each neuron learns a simple function and the complete function is built by combining the simpler functions.

▼ Deep learning has been influenced by two major periods of research. What are they?

- threshold logic units (early 1940s to mid-1960s) and connectionism (early 1980s to mid-1990s)

- The first period concentrated on whether computational models based on artificial neurons could learn logical relations.

- The second period is characterized by two developments: Hopfield networks and the backpropagation algorithm. Hopfield wrote about a network that could act as an associative memory, which is particularly useful for pattern completion and error correction. The popularization of the backpropagation algorithm in addition to the employment of differentiable activation functions which enabled the algorithm to work helped bring the field closer to training deeper neural networks.

- Connectionism refers to the idea that intelligent behavior can result from the interactions of large amounts of simple processing units.

▼ What is distributed representation and how does it enable deep learning?

- In neural networks that utilize this representation, each concept is represented by the activation of many neurons.

- Within a deep neural network, each hidden layer learns a representation that is an abstraction over the outputs of the previous layer.

- The sequence of abstractions enables a neural network to learn complex mappings.