Artificial Neural Networks

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TensorFlow

https://www.guru99.com/what-is-tensorflow.html

What is TensorFlow?

- An open-source end-to-end platform for creating Machine Learning applications.
- It is a symbolic math library that uses dataflow and differentiable programming to perform various tasks focused on training and inference of deep neural networks.
- Allows developers to create machine learning applications using various tools, libraries, and community resources.

- Currently, the most famous deep learning library in the world is Google's TensorFlow.
- Uses machine learning in all of Google's products to improve the search engine, translation, image captioning or recommendations.

History of TensorFlow

- Deep learning started to outperform all other machine learning algorithms when giving a massive amount of data.
- Google started working on these algorithms to improve the quality of its services.
  - Gmail
  - Photo
  - Google search engine
- They built a framework called Tensorflow to let researchers and developers work together on an AI model.
- It was first publicly available in late 2015, while the first stable version appeared in 2017.
- Open source under Apache Open Source license.

How Does it Work?

- TensorFlow enables you to build dataflow graphs and structures to define how data moves through a graph by taking inputs as a multi-dimensional array called Tensor.

- It allows you to construct a flowchart of operations that can be performed on these inputs, which goes at one end and comes at the other end as output.

TensorFlow Architecture

- TensorFlow architecture works in three parts:
  - Data preprocessing
  - Model building
  - Training and Estimation

- It is called TensorFlow because it takes input as a multi-dimensional array, also known as tensors.
- You can construct a sort of flowchart of operations (called a Graph) that you want to perform on that input.
- The input goes in at one end, and then it flows through this system of multiple operations and comes out the other end as output.

- This is why it is called TensorFlow because the tensor goes in it flows through a list of operations, and then it comes out the other side.

Where can TensorFlow run?

- TensorFlow hardware, and software requirements can be classified into Development Phase, and Inference Phase.
- Model is trained in the development phase. Training is usually done on your PC or laptop. Also, it could be trained on online platforms e.g. Google Colab.
- Once training is done, TensorFlow can be run on many different platforms. You can run it on
  - Desktop running Windows, macOS or Linux
  - Cloud as a web service
  - Mobile devices like iOS and Android
- You can train it on multiple machines then you can run it on a different machine, once you have the trained model.

Where can TensorFlow run? (cont.)

- The model can be trained and used on GPUs as well as CPUs.
- GPUs were initially designed for video games.
- In late 2010, Stanford researchers found that GPU was also very good at matrix operations and algebra so that it makes them very fast for doing these kinds of calculations.
- Deep learning relies on a lot of matrix multiplication.
- TensorFlow is very fast at computing the matrix multiplication because it is written in C++.
- Although it is implemented in C++, TensorFlow can be accessed and controlled by other languages mainly, Python.

- TensorBoard is also an important feature of TensorFlow which enables to monitor graphically and visually what TensorFlow is doing.

TensorFlow Components - Tensor

- TensorFlow's name is directly derived from its core framework Tensor and all its computations involve tensors.
- A tensor is a vector or matrix of n-dimensions that represents all types of data. All values in a tensor hold identical data type with a known (or partially known) shape. The shape of the data is the dimensionality of the matrix or array.
- A tensor can be originated from the input data or the result of a computation.
- In TensorFlow, all the operations are conducted inside a graph. The graph is a set of computation that takes place successively. Each operation is called an op node and are connected to each other.
- The graph outlines the ops and connections between the nodes. However, it does not display the values. The edge of the nodes is the tensor, i.e., a way to populate the operation with data.

TensorFlow Components - Graphs

- TensorFlow makes use of a graph framework. The graph gathers and describes all the series computations done during the training.
- It can run on multiple CPUs or GPUs and even mobile operating system
- The portability of the graph allows to preserve the computations for immediate or later use. The graph can be saved to be executed in the future.
- All the computations in the graph are done by connecting tensors together
- A tensor has a node and an edge. The node carries the mathematical operation and produces an endpoints outputs. The edges explain the input/output relationships between nodes.

Why is TensorFlow Popular?

- TensorFlow is the best library of all because it is built to be accessible for everyone.
- TensorFlow library incorporates different APIs to built at scale deep learning architecture like CNN or RNN.
- TensorFlow is based on graph computation; it allows the developer to visualize the construction of the neural network with Tensorboad. This tool is helpful to debug the program.
- Tensorflow is built to be deployed at scale. It runs on CPU and GPU.

Installation of TensorFlow

- Visit https://www.tensorflow.org/install

- TensorFlow is tested and supported on the following 64-bit systems.
  - Python 3.8–3.11
  - Ubuntu 16.04 or later
  - Windows 7 or later (with C++ redistributable)
  - macOS 10.12.6 (Sierra) or later (no GPU support)
  - WSL2 via Windows 10 19044 or higher including GPUs (Experimental)

- Install TensorFlow with Python's pip package manager.
  - pip install --upgrade pip # Requires the latest pip
  - pip install tensorflow # Current stable release for CPU and GPU

Google Colab

- No install necessary
  - Run the TensorFlow tutorials directly in the browser with Colaboratory.
  - Google research project created to help disseminate machine learning education and research.
  - It's a Jupyter notebook environment that requires no setup to use and runs entirely in the cloud.

TensorFlow 2 quickstart for beginners

- https://www.tensorflow.org/tutorials/quickstart/beginner

Thank You