Artificial Intelligence Fullstack
[Course]
Week 16 – Deep Learning –TF - Core Foundation
[See examples / code in GitHub code repository]

It is not about Theory, it is 20% Theory and 80% Practical –
Technical/Development/Programming [Mostly Python based]

DL | What is Deep Learning – DL ?

Deep learning is an <u>artificial intelligence (AI)</u> method that teaches computers to process data in a way inspired by the human brain. Deep learning models can recognize complex pictures, text, sounds, and other data patterns to produce accurate insights and predictions. You can use deep learning methods to automate tasks that typically require human intelligence, such as describing images or transcribing a sound file into text.

Deep learning is a machine learning technique that enables computers to learn from experience and understand the world in terms of a hierarchy of concepts. The key aspect of deep learning is that these layers of concepts enable the machine to learn complicated concepts by building them out of simpler ones. If we draw a graph showing how these concepts are built on top of each other, the graph is deep with many layers. Hence, the 'deep' in deep learning.

Reference:
https://aws.amazon.com/what-is/deep-learning/
https://www.ibm.com/think/topics/deep-learning
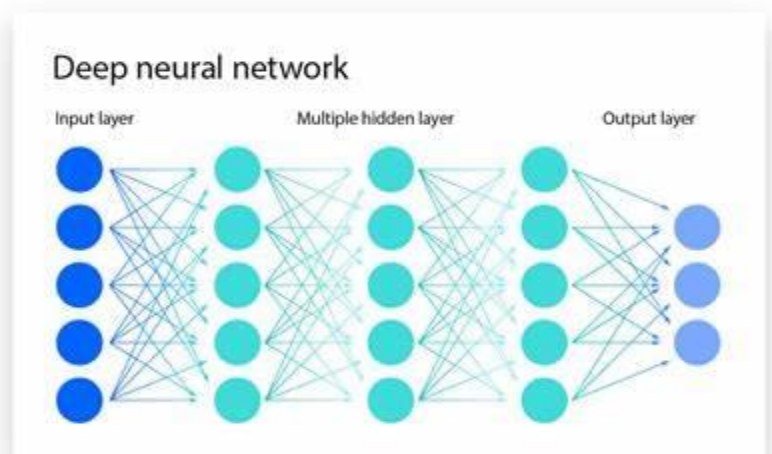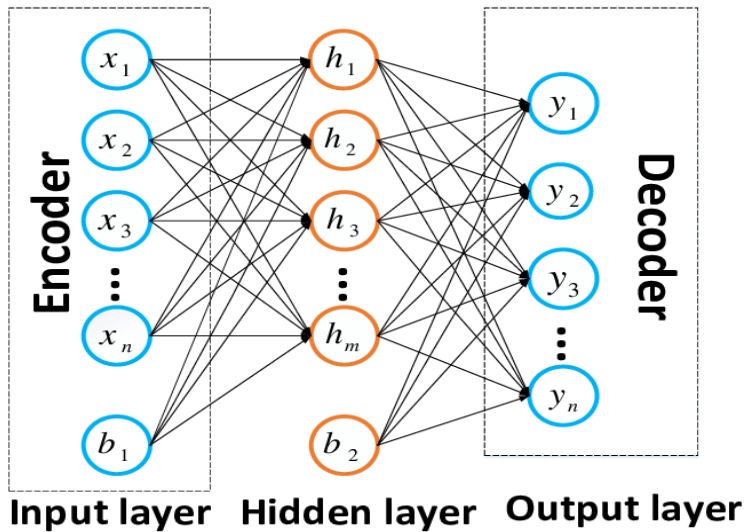https://deepai.org/machine-learning-glossary-and-terms/deep-learning

DL | What is Neural Network ?

Neural networks are machine learning models that mimic the complex functions of the human brain. These models consist of interconnected nodes or neurons that process data, learn patterns, and enable tasks such as pattern recognition and decision-making.

Input layer **Hidden layer** **Output layer**

Deep neural network

Input layer   Multiple hidden layer   Output layer

Reference:
https://www.ibm.com/think/topics/neural-networks/
https://www.geeksforgeeks.org/neural-networks-a-beginners-guide/
https://becominghuman.ai/cheat-sheets-for-ai-neural-networks-machine-learning-deep-learning-big-data-sci
pdf-f22dd900d2d7

DL | Deep Learning Examples

Deep Learning Example in Image Recognition
- ❑ **Self-driving cars:**
- ❑ **Facial recognition software:**
- ❑ **Image classification apps:**

Deep Learning Example in Text Processing
- ❑ Deep learning is a driving force in (Text Processing) NLP:
- ❑ **Chatbots and virtual assistants:**
- ❑ **Machine translation:**
- ❑ **Text summarization and generation:**

Deep Learning Example in Speech Recognition
- ❑ **Voice-to-text software:**
- ❑ **Automated phone systems:**

Deep Learning Example in Recommender Systems
- ❑ **Personalized recommendations:**
- ❑ **Improved customer experience:**

Real-World Use Case of Deep Learning
- ❑ **Drug Discovery**
- ❑ **Drug target identification:**
- ❑ **Drug development and optimization:**

Scientific Discovery
- ❑ **Astronomy and space exploration:**
- ❑ **Physics and materials science:**

Cybersecurity
- ❑ **Cyber threat detection:**
- ❑ **Fraud prevention:**

Content Creation
- ❑ **Generative art and music:**
- ❑ **Marketing and advertising:**

Deep learning is transforming the field of robotics:
- ❑ **Object recognition and manipulation:**
- ❑ **Autonomous navigation:**

Reference:
https://www.geeksforgeeks.org/deep-learning-examples/

python

DL | Tensorflow vs SK Learn

Scikit-Learn and TensorFlow are both designed to help developers create and benchmark new models, so their functional implementations are quite similar with the key distinction that **Scikit-Learn is used in practice with a wider scope of models** as opposed to **TensorFlow's implied use for for neural networks.**

Reference:
https://www.springboard.com/blog/data-science/scikit-learn-vs-tensorflow/
https://www.educba.com/scikit-learn-vs-tensorflow/
https://www.geeksforgeeks.org/scikit-learn-vs-tensorflow-which-one-should-you-choose/
https://www.simplilearn.com/scikit-learn-vs-tensorflow-article

DL | TensorFlow - An end-to-end platform for machine learning

The core components of Tensorflow are Tensors and Computation graphs (or Data flow graphs) . Tensorflow is just a framework for expressing operations as computation graphs. Tensorflow then divides the graph into many Subgraphs which are independent of each other and these Subgraphs are executed in parallel, of course this is one of the major feature of TensorFlow which contributed a lot to its large scale adaption. Tensorflow has another important feature , it provides a wide range of ready-made mathematical tools which can be used to solve various problems. These mathematical tools are also computation graphs, once they are added into your program they are treated as Subgraphs because they become part of the computation graph you are going to build.

TensorFlow Architecture

Reference:

https://www.devopsschool.com/blog/what-is-tensorflow-and-use-cases-of-tensorflow-2/
https://medium.com/buzy-developers/a-beginner-introduction-to-tensorflow-part-2-6b4dc25ea51

Ops:
 https://www.tensorflow.org/api_docs/cc/namespace/tensorflow/ops

Kernels:
https://mohamed-elrefaey-77102.medium.com/deciphering-kernels-in-machine-learning-a-comprehensive-guide-across-frameworks-500f7b989b3d

Tensor:
https://www.geeksforgeeks.org/introduction-tensor-tensorflow/

DL | TensorFlow – Basic - Libraries & extensions

Libraries & extensions
Explore libraries to build advanced models or methods using TensorFlow, and access domain-specific application packages that extend TensorFlow.

Search	FILTER BY: ☐ DATA PREPARATION ☐ MODEL BUILDING ☐ DEPLOYMENT ☐ MLOPS ☐ RESPONSIBLE AI

TensorFlow Addons
Extra functionality for TensorFlow, maintained by SIG Addons.

View docs >

View GitHub   1.7k ★ 610 ⑂

TensorFlow Agents
A library for designing, testing, and implementing reinforcement learning algorithms.

View docs >

View GitHub   2.6k ★ 706 ⑂

TensorFlow Compression
A library to build ML models with end-to-end optimized data compression built in.

View docs >

View GitHub   783 ★ 245 ⑂

TensorFlow Data Validation
A library to analyze training and serving data to compute descriptive statistics, infer schemas, and detect anomalies.

View docs >

TensorFlow Decision Forests
State-of-the-art algorithms for training, serving and interpreting models that use decision forests for classification, regression and ranking.

View docs >

Dopamine
A research framework for fast prototyping of reinforcement learning algorithms.

https://www.tensorflow.org/resources/libraries-extensions

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DL | TensorFlow – Basic - TensorFlow.js

TensorFlow.js is a library for machine learning in JavaScript Develop ML models in JavaScript, and use ML directly in the browser or in Node.js.

How it works

Run existing models

Use off-the-shelf JavaScript models or convert Python TensorFlow models to run in the browser or under Node.js.

Retrain existing models

Retrain pre-existing ML models using your own data.

Develop ML with JavaScript

Build and train models directly in JavaScript using flexible and intuitive APIs.

https://www.tensorflow.org/js

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DL | TensorFlow – Basic - LiteRT

LiteRT (short for Lite Runtime), formerly known as TensorFlow Lite, is Google's high-performance runtime for on-device AI. You can find ready-to-run LiteRT models for a wide range of ML/AI tasks, or convert and run TensorFlow, PyTorch, and JAX models to the TFLite format using the AI Edge conversion and optimization tools.

Key features

Optimized for on-device machine learning: LiteRT addresses five key ODML constraints: latency (there's no round-trip to a server), privacy (no personal data leaves the device), connectivity (internet connectivity is not required), size (reduced model and binary size) and power consumption (efficient inference and a lack of network connections).

❑ Multi-platform support: Compatible with Android and iOS devices, embedded Linux, and microcontrollers.

❑ Multi-framework model options: AI Edge provides tools to convert models from TensorFlow, PyTorch, and JAX models into the FlatBuffers format (.tflite), enabling you to use a wide range of state-of-the-art models on LiteRT. You also have access to model optimization tools that can handle quantization and metadata.

❑ Diverse language support: Includes SDKs for Java/Kotlin, Swift, Objective-C, C++, and Python.

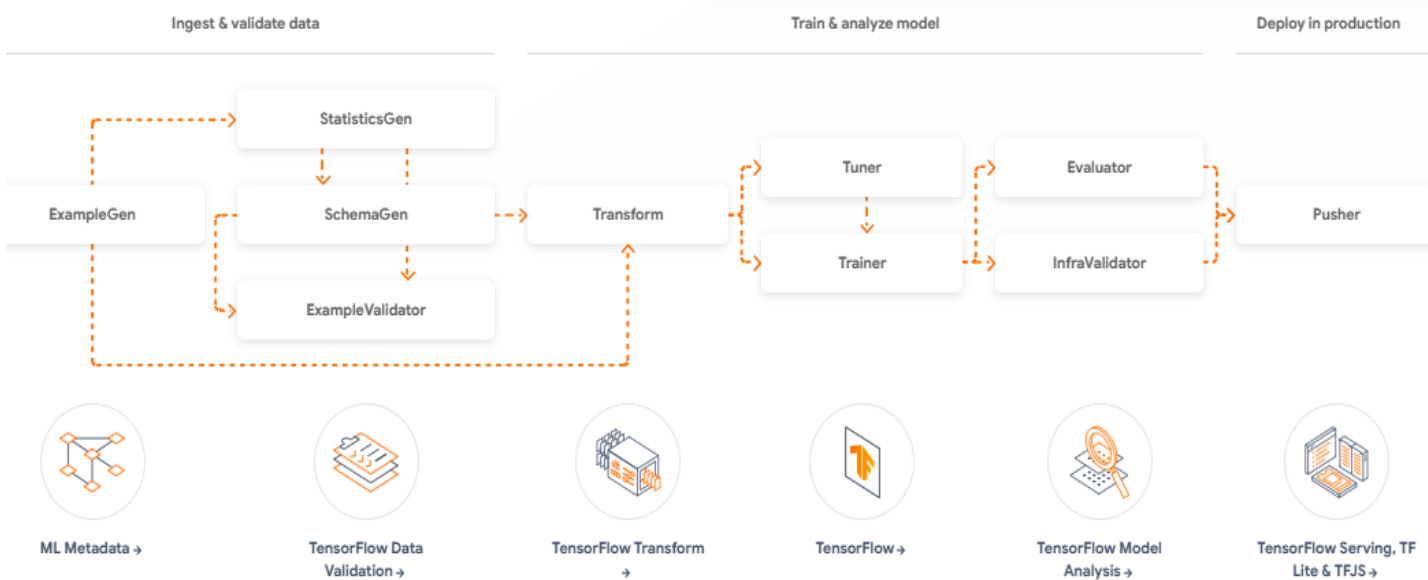❑ High performance: Hardware acceleration through specialized delegates like GPU and iOS Core ML.

https://ai.google.dev/edge/litert

DL | TensorFlow - TFX

TFX is an end-to-end platform for deploying production ML pipelines
When you're ready to move your models from research to production, use TFX to create and manage a production pipeline.
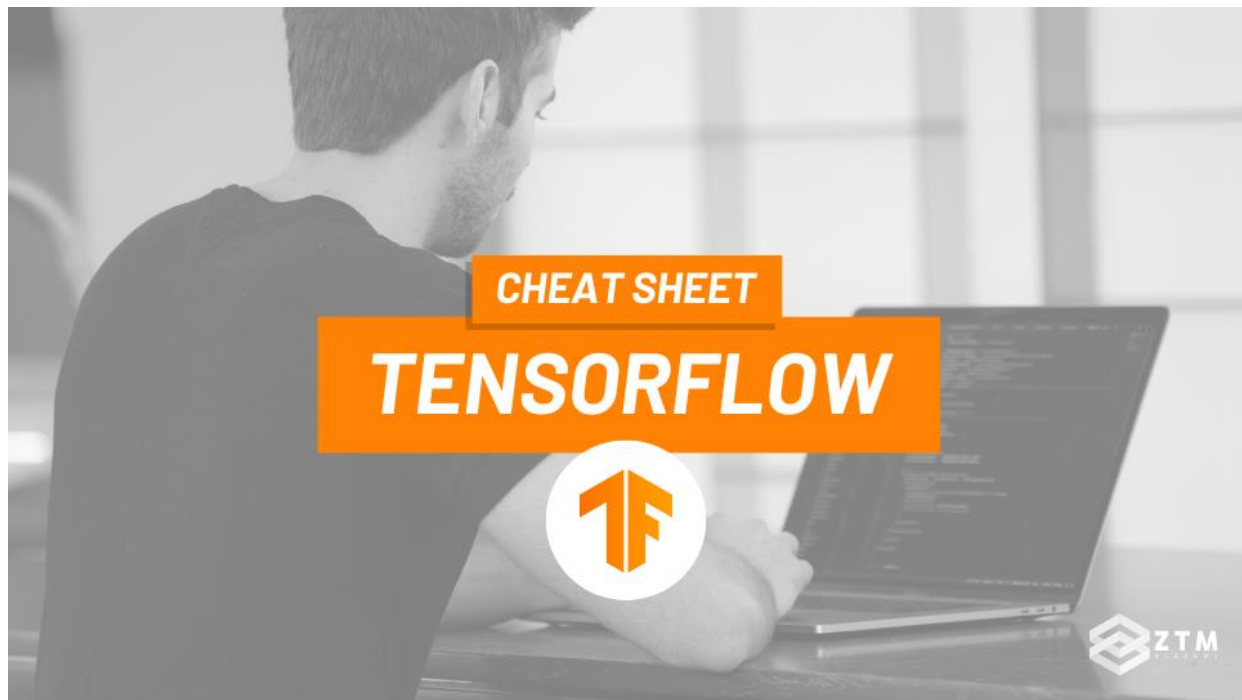
How it works

A TFX pipeline is a sequence of components that implement an ML pipeline which is specifically designed for scalable, high-performance machine learning tasks. Components are built using TFX libraries which can also be used individually.

Ingest & validate data	Train & analyze model	Deploy in production

StatisticsGen

ExampleGen → SchemaGen → Transform

ExampleValidator

Tuner

Trainer

Evaluator

InfraValidator

Pusher

ML Metadata →

TensorFlow Data Validation →

TensorFlow Transform →

TensorFlow →

TensorFlow Model Analysis →

TensorFlow Serving, TF Lite & TFJS →

Reference:
https://www.tensorflow.org/tfx

DL | TensorFlow – cheat sheet

DL| Simple Test Case - Core - Exercise

See code here: https://github.com/ShahzadSarwar10/FULLSTACK-WITH-AI-BOOTCAMP-B1-MonToFri-2.5Month-Explorer/blob/main/Week7/Case7-2-TF-CommuSumRandom.py

You should be able to analyze – each code statement, you should be able to see trace information – at each step of debugging. "DEBUGGING IS BEST STRATEGY TO LEARN A LANAGUAGE." So debug code files, line by line, analyze the values of variable – changing at each code statement. BEST STRATEGY TO LEARN DEEP.

Let's put best efforts.
Thanks.
Shahzad – Your AI – ML Instructor

Exercises

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Thank you - for listening and participating

❑**Questions / Queries**

❑**Suggestions/Recommendation**

❑**Ideas…..?**

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