Deep Learning for Image Processing and Transformers:
Pothole Detection and Traffic Data Collection

Course Overview

Introduction :

- **Start your Image Processing and Transformer journey today**

What You'll Learn :

- **Learning Deep Learning Concepts and Tensor Flow**
- **Exploring Computer Vision, Image Processing,**
- **Explore different models, datasets, documents, and ecosystems.**
- **Pothole Detection and Traffic Data Collection using YOLO**
- **Transformers, HuggingFace,**

Highlights :

- **Course Duration   - 10 days (80 Hours)**
- **Number of Modules - 27**

Prerequisites:

- **Basic understanding of Python programming and Machine Learning**
- **Familiarity with Computer Vision concepts is recommended**

NOTE :
- **The hands-on labs will provide practical experience with setting up**
- **Hands-on Approach**
- **This course can be customized based on the audience's prior knowledge and specific areas of interest.**

SECTION 1 - DEEP LEARNING USING TENSOR-FLOW 2.0

MODULE 1 : Deep Learning basics for Computer Vision

- **Introduction to Deep Learning for Computer Vision**
- **Machine Learning Basics**
- **Understanding Classification Metrics**
- **Introduction to Deep Learning Topics**
- **Understanding a Neuron**
- **Understanding a Neural Network**

MODULE 2 : Introduction to Tensor Flow 2.0

- **Introduction To Tensor-Flow**
- **How to define Tensor**
- **Operations on Tensors**
- **Variable and Variable Type Tensors**
- **Introducing Google Colab**
- **Tensorflow basic syntax**
- **What is Tensor flow?**
- **Tensor Flow code-basics**
- **Graph Visualization**
- **Constants, Placeholders, and Variables**
- **Tensor flow and basic operations**

MODULE 3 :Neural Networks

- **Introduction to Perceptron**
- **History of Neural networks**
- **Activation functions**
  - **a) Sigmoid**
  - **b) Relu**
  - **c) Softmax**
  - **d) Leaky Relu**
  - **e) Tanh**

MODULE 4 :Deep Learning Networks

- What is a deep learning network?
- Why Deep Learning Networks
- How Deep Learning Works
- Feature Extraction
- Working of Deep Network
- Training using Backpropagation

MODULE 5 :Artificial Neural Network (ANN)
- What is artificial neural network?
- Machine Learning Vs Artificial Neural Networks
- History of ANN
- Building Blocks
- Network Topology
- Evaluating the ANN

SECTION 2 - CONVOLUTIONAL NEURAL NETWORK

MODULE 6 : Convolutional Neural Network
- **What is Convolution?**
- **Convolution on Color Images**
- **CNN Architecture**
- **CNN Code Preparation**
- **CNN - MNIST**

MODULE 7 : Working with images and CNN Building Blocks

- **Introduction - Working with Images**
- **Reshaping understanding**
- **Sampling and Quantization**
- **Working with images - Filtering**

MODULE 8 : CNN Architectures and Transfer Learning

- **CNN Architecture and LeNet Case Study**
- **GPU vs CPU**
- **Transfer Learning Principles and Practice**

SECTION 3 - COMPUTER VISION

MODULE 9 : Introduction to Computer Vision
- Introduction to Computer Vision
- Applications
- Recent Research in Computer Vision
- Introduction to Segmentation
- Why transfer learning?
- Basic Terminologies

MODULE 10 :Mathematics for Computer Vision
- Linear Algebra
- Calculus
- Probability Theory
- Aligning RGB channel,

MODULE 11 : Introduction to OpenCV

- Introduction to OpenCV
- Image basics with Numpy
- Open an Image with Matplotlib
- Get familiar with RGB channels
- Differences between Matplotlib and OpenCV

SECTION 4 - IMAGE PROCESSING

MODULE 12 : Image Features
- **Feature Detection**
- **Feature descriptors**
- **Model fitting**

MODULE 13 : Lighting
- **Photometry**
- **Lightness**

MODULE 14 : Image Classification
- **Introduction to Image Classification**
- **Image Classification with KNN**

MODULE 15 : Image Processing
- **What is a digital image?**
- **Manipulating Images**
- **Manipulating Images One Pixel At a Time**

SECTION 6 - SEMANTIC SEGMENTATION

MODULE 16 : Semantic Segmentation
- Semantic Segmentation
- The Segmentation process
- U-Net Architecture

MODULE 17 : Image Segmentation
- Image Segmentation Overview
- Upsampling Methods
- Encoder
- Decoder

MODULE 18 :Object Tracking

- Introduction to Object Tracking
- Optical Flow
- Optical Flow Coding
- Overview of various Tracking API Methods

MODULE 19 :Object Detection

- Object Detection and Sliding Windows
- R-CNN
- Fast R-CNN
- Faster R-CNN

SECTION 8 - YOLO

MODULE 20 : YOLO

- Introduction to YOLO v3
- YOLO Weights Download
- YOLO v3 with Python

SECTION 9 - TRANSFORMER CONTENT

MODULE 21 : Transformer

- Introduction to transformers
- Introduction to Hugging Face transformers
- IMDB project Implementation
- Why are Transformers unique?
- A Developer's View of Transformers

MODULE 22 : Fine-Tuning

- **Text classification (e.g. spam detection, sentiment analysis)**
- **Named entity recognition**
- **Text summarization**
- **Machine translation**
- **Question-answering**
- **Generating text**
- **Masked language modeling**

MODULE 23 : Transformers In-Depth

- **Named Entity Recognition (NER) and POS Tagging**
- **Seq2Seq and Neural Machine Translation**
- **Question-Answering**

SECTION 8 - POTHOLE DATASET

MODULE 24 : Understanding the Datasets
- **Introduction to Datasets**
- **Data Exploration and Visualization**

MODULE 25 : Pothole Detection
- **Problem Definition**
- **Data Preprocessing for Pothole Detection**
- **Building a CNN for Pothole Detection**
- **Training and Evaluating the Pothole Detection Model**
- **Improving Model Performance**

MODULE 26 : Traffic Data Collection
- **Problem Definition**
- **Data Preprocessing for Traffic Data Collection**
- **Building a CNN for Traffic Data Collection**
- **Training and Evaluating the Traffic Data Collection Model**
- **Improving Model Performance**

MODULE 27 : Deploying the Models

- **Introduction to Model Deployment**
- **Deploying the Pothole Detection Model**
- **Deploying the Traffic Data Collection Model**