Module 1: Getting Started

1. Introduction to Artificial Intelligence
   - History of AI
   - Applications of AI
   - AI in Computer Vision
   - AI Terminology
   - Why Deep Learning so popular

2. Numpy Refresher
   - Introduction to NumPy
   - Why do we need a special Library for Maths an DL
   - NumPy Basic Operations
   - Mathematical Functions
   - Reshape & Combine Array
   - Element-wise Operations
   - Linear Algebra
   - Array Statistics

3. Introduction PyTorch
   - Why PyTorch
   - Introduction to PyTorch
   - PyTorch Basics

4. What is inside an ML Algorithm
• Machine Learning Pipeline
• Solving ML Problems
• Gradient Descent
• Gradient Descent for Optimization

Assignment1: Implement ReLU, Softmax and Neuron using PyTorch

Assignment2: Implement Gradient Descent for two variables

Module 2 : Neural Networks

1. Feature Vectors 1-D to N-D
   • Feature Vectors and Normalization

2. Neural Network Basics
   • What is Neural Network
   • Loss Functions for Regression
   • Loss Functions for Classification
   • Types of Activation Functions
   • How does the network learn
   • Demystifying Neural Networks

3. Binary Classification using Perceptrons
   • Binary Classification using a Perceptron

4. PyTorch NN Module
   • Introduction to pyTorch NN Module
   • PyTorch NN Module
   • MLP using Functional API
   • MLP using Sequential API

5. Image Classification using Multilayer Perceptron
• MLP Classifier for Handwritten Digits (MNIST)

Assignment 3: Implement MSE and MAE

Module 3: Convolutional Neural Network

1. Convolution Operation
   • What is Convolution Operation
   • CNN Building Blocks
   • Layers in CNN

2. How to implement LeNet using PyTorch
   • How to implement LeNet
   • Implementing LeNet using PyTorch
   • LeNet with BatchNorm
   • Effects of Batch Normalization

3. Evaluation of Classification Performance
   • Performance Metrics for Classification
   • How to Implement Classification Metrics

4. Introduction to Torchvision
   • TorchVision Overview
   • Datasets
   • What are the different Transforms used to Train a Network
   • Different Models in TorchVision
   • Utils: Utility Functions in TorchVision
   • IO Operations in TorchVision
   • Ops module in TorchVision

5. Important CNN architectures
• Different CNN Architecture
• Pre-trained Models in Torchvision
• Pre-trained Classification Models in TorchVision

Assignment4: Implement CNN for Image Classification on CIFAR10 Dataset

Module 4: Deep Neural Networks

1. Optimization
   • What are Optimizers
   • Learning Rate Decay Methods
   • LR Scheduler

2. Training Deep Neural Networks
   • Step1: Data understanding
   • Step2: Data Preparation
   • Step3: Check Training Pipeline
   • Step4: Train the Model
   • Step5: Improve the Model
   • Check Training Pipeline

3. How to add Robustness to a model
   • Bias variance Tradeoff
   • How to prevent Overfitting
   • Training with Regularization

4. Data Loader with Image Folder
   • How to load Custom Datasets in PyTorch

5. GPU access on Azure
• How to get Microsoft Azure Pass
• Redeem Azure Pass
• Create an Instance on Azure
• Run Jupyter Notebooks on Azure
• Login to your instance using SSH
• How to stop your instance

Assignment5: Implement Adam Optimizer

Project1: Implement an Image Classifier from scratch

Module 5: Best Practices in Deep Learning

1. Troubleshooting Training with Tensorboard
   - Tensorboard Overview
   - Tensorboard Dashboard
   - Logging using Tensorboard
   - Sharing Tensorboard Logs

2. Leveraging Pre-Trained models
   - CNN Architectures(Recap)
   - Fine-Tuning and Transfer Learning
   - Fine-Tuning using ResNet

3. How to structure your project for scale
   - Introduction to py_modules Package
   - Motivation of Trainer Pipeline
   - Hands-on Trainer Pipeline

4. PyTorch Lightning
   - Introduction to PyTorch Lightning
Module 6: Object Detection

1. Object Detection overview
   - Introduction to Object Detection
2. Evaluation Metrics
   - Evaluation Metrics for Object detection
   - Compute Evaluation Metrics
3. Traditional Algorithms in Object Detection
   - Different Traditional Algorithms
   - Implement Non-Maximum Suppression
4. Two stage Object Detectors
   - Introduction to Two Stage Object Detectors
   - Faster RCNN using TorchVision
   - Understanding Faster RCNN
   - Faster RCNN Fine-tuning
   - Faster RCNN Fine-Tuning Training

Module 7: Single Stage Object Detectors

1. YOLO
   - Introduction to YOLO
2. Single Stage Multibox Detector (SSD)
   - Introduction to SSD
   - SSD with PyTorch Hub
3. RetinaNet
   - Introduction to RetinaNet
   - RetinaNet with Detectron2
4. How to create Custom Single Stage Detector
• Detector NN Architecture
• Generating Anchor Boxes
• Matching Predictions with Ground Truth
• Loss Function
• Experiment

Assignment6: Focal Loss Implementation

Project3: Number Plate Detection

Module 8 : Segmentation

1. Semantic Segmentation Architecture
   • Semantic Segmentation Architectures
   • Dilated Convolution
   • Transposed Convolution
   • Fully Convolution Network (FCN)
   • U-Net
   • SegNet
   • Deeolab

2. Evaluation Metrics for Semantic Segmentation
   • Dice Coefficient Metrics

3. LinkNet Architecture
   • Introduction to LinkNet Architecture

4. Soft-Dice Loss
   • Introduction to Soft-Dice Loss

5. FCN and DeepLab using TorchVision
   • FCN and DeepLabV3 using Torchvision

6. U-Net for MRI Abnormality Segmentation

7. Train your Model from scratch

8. Instance Segmentation
   • Instance Segmentation using Mask RCNN

Assignment7: LinkNet Architecture with VGG16

Project4: Kaggle competition on Semantic Segmentation
Module 9 : Pose Estimation

1. Dense Pose
   - Introduction to DensePose
   - DensePose Inference
   - DensePose Training
2. Create your own Gym Trainer
   - Squat Checker

Project5: Create an App of your choice

Module 10 : Azure Deployment and Cognitive Services

1. How to your App on Azure Cloud Instance
   - Virtual Machine Creation for Deployment
   - Naive Deployment
   - Robust Deployment
   - Deployment using Azure App Service
2. Introduction to Azure Cognitive Services
   - Azure Cognitive Services

Project6: Deploy your App on Azure using Github repository

Module 11 : LibTorch

1. Introduction to TorchScript
2. Introduction to LibTorch
   - LibTorch Installation
   - Introduction to LibTorch
• From PyTorch to LibTorch
• Training with Custom Dataset

3. Introduction to ONNX