**Syllabus**

***Deep Learning Fundamentals***

***Stage One: Neural Networks***

**Introduction:**

1 – State-of-the-art Examples in Deep Learning

2 – Who this Course is for?

3 – Tools: Tensorflow 2.0 and Keras, Python

4 – Relationship between Tensorflow and Keras

5 – Do I need OpenCV?

**What is Deep Learning:**

1 – A Not Very Short Intro to Neural Networks

2 – Difference Between Deep Learning and Legacy Algorithms

3 – History of Deep Learning

4 – How ‘Deep’ is Deep?

**Image Fundamentals:**

1 – Pixels

2 – Image Channels

3 – Image Coordinate System

4 – Image Drawing in Python

5 – RGB and BGR

6 – Image as ‘numpy’ Array

7 – Image Operations

**Image Classification Basics:**

1 – What is Image Classification?

2 – Terminology

3 – The Semantic Gap

4 – Types of Learning:

* Supervised Leaning
* Unsupervised Learning
* Semi-supervised Learning
* Reinforcement Learning

5 – Deep Learning Mindset:

* Gather Your Data
* Split Your Data
* Train Your Algorithm
* Test and Evaluate

6 – What if My Training Goes Wrong?

**videos**

**Datasets for Image Classification:**

1 – MNIST

2 – Animals: Dog, Cat and Panda

3 – CIFAR-10 and CIFAR-100

4 – Kaggle: Dogs vs Cats

5 – SMILES

6 – CALTECH-101

7 – Kaggle: Facial Expressions

8 – Stanford Cars and Drones

9 – Adience

10 – Mini ImageNet

11 – ImageNet

**Configuring Your Development Environment:**

1 – Python Virtual Environment

2 – Keras and Tensorflow 2.0

3 – MxNet

4 – OpenCV, scikit-image, scikit-learn and More

5 – Cloud-based Platforms

6 – How to Structure Your Projects?

**Your First Image Classifier:**

1 – Working With Image Datasets

2 – Introduction to ‘Animal’ Dataset

3 – Start Your Own Deep Learning Toolkit

4 – A Basic Image Processor

5 – Working with Image Loader

6 – KNN: Your Very First Simple Classifier

7 – Recognizing KNN Hyper-Parameters

8 – Let’s get Pythonized: Developing KNN

9 – KNN Result

10 – Pros and Cons of KNN

**Parameterized Learning:**

1 – Introduction to Linear Classification (L.C.)

2 – Gang of Four: Components of Parameterized Learning (P.L.)

3 – Linear Classification: From Images to Labels

4 – Advantages of P.L. and L.C.

5 – Hands on: A Simple Linear Classifier with Python

6 – What Are Loss Functions?

7 – Multi-Class SVM Loss

8 – Cross-Entropy Loss and Soft-max Classifiers

**Optimization Methods and Regularization:**

1 – Gradient Descent: Vanilla

2 – Optimization Surface and Loss Landscape

3 – What is ‘Gradient’ in Gradient Descent?

4 – Convex Problem

5 – The Bias Trick

6 – Gradient Descent in Python: Pseudocode and Implementation

7 – Stochastic Gradient Descent (SGD)

8 – Mini-Batch SGD

9 – Implementing SGD in Python

10 – Extensions to SGD:

* Momentum
* Nesterov’s Implementation
* Adam

11 – Regularization:

What is Regularization?

Updating Weight and Loss Function with Regularization

Types of Regularization

**Neural Network Fundamentals:**

1 – Introduction to Neural Networks

2 – Perceptron Algorithm

3 – Forwardpropagation or Backpropagation?

4 – Multi-layer Networks with Keras

5 – Neural Network Components

6 – Weight Initialization

7 – Random Initialization

8 – Tunning Neural Networks: Learning Rate and Batch Size

9 – Normal and Uniform Distributions:

* Lecun
* He et. al
* Glorot / Xavier

**Convolutional Neural Networks:**

1 – What Do We Mean by Convolution?

2 – Convolution vs. Cross-Correlation

3 – The Role of Convolution in Deep Learning

4 – Implementing Convolution in Python

5 – What is CNN?

6 – Building Blocks of CNN:

* Types of Layers
* Convolutional Layer
* Activation Layer
* Pooling Layer
* Fully-connected Layer
* Batch Normalization
* Dropout

7 – Common CNN Architectures

8 – Translation, Rotation and Scaling in CNNs

**Training Your First CNN:**

1 – Keras Considerations and Configurations

2 – Converting Images to Arrays

3 – Applying Pre-Processing

4 – Introduction to ShallowNet

4 – ShallowNet with Animal Dataset

5 – ShallowNet with CIFAR-10

**Saving and Loading Models:**

1 – Keras Considerations and Configurations

2 – Converting Images to Arrays

3 – Applying Pre-Processing

4 – Introduction to ShallowNet

4 – ShallowNet with Animal Dataset

5 – ShallowNet with CIFAR-10