DEEP LEARNING WITH COMPUTER VISION & NLP TRAINING SYLLABUS

01. Introduction to Deep Learning
- Historical Context
- Advances in Related Fields
- Prerequisites

02. Artificial Neural Networks
- & Perceptron
- Neuron Feed Forward Neural Networks
- Overall Structure of a Neural Network
- Expressing the Neural Network in Vector Form
- Evaluating the output of the Neural Network
- Training the Neural Network
- Deriving Cost Functions using Maximum Likelihood
- Binary Cross Entropy
- Cross Entropy
- Squared Error
- Summary of Loss Functions
- Types of Units/Activation Functions/Layers
- Linear Unit
- Sigmoid Unit
- Softmax Layer
- Rectified Linear Unit (ReLU)
- Hyperbolic Tangent

03. Backpropagation
- Chain Rule of Differentiation
- Computing Gradients for Feedforward Networks
- Stochastic Gradient Descent with Backpropagation
- Issues with Backpropagation

04. Optimization Techniques
- Gradient Descent
- Stochastic Gradient Descent (SGD)
- Batch, Single & Mini-Batch Descent
- Challenges with SGD
- Algorithmic Variations on SGD
- Tricks and Tips for using SGD
- Adam and other Advanced Optimization Techniques

05. Convolutional Neural Networks (CNN)
- Introduction to Computer Vision and Image Processing
- Convolution Operation
- Pooling Operation
- Convolution-Detector-Pooling Building Block
- Transfer Learning with VGG, Inception, ResNet and EfficientNet architectures
- Object Detection with RCNN, Fast RCNN, YOLOv5 and EfficientDet
- Instance Segmentation with Mask RCNN
- Semantic Segmentation with Fully Convolutional Networks (FCN) and U-Net architectures
- Generative Models for Image Synthesis (GANs)

06. Recurrent Neural Networks (RNN)

- RNN Basics
- Training RNNs
- Bidirectional RNNs
- Gradient Explosion and Vanishing
- Gradient Clipping
- Long Short-Term Memory
- Attention Mechanisms
- Natural Language Processing:
    - NLP Basics
    - Word Embedding's
    - Recurrent Neural Networks for NLP
    - Convolutional Neural Networks for NLP
    - Attention Mechanisms for NLP
    - Transformer models for NLP

07. Generative Models

- Autoencoders
- Variational Autoencoders
- Generative Adversarial Networks (GANs)

08. Deep Learning Framework

- TensorFlow and Keras
- PyTorch
- History and Usage of Frameworks
- Architecture of each Framework
- How to choose a Framework and when

09. Introduction to Company Vision and Image Processing

- Overview of computer vision and its applications
- Image processing basics
- Color models and image representation
- Image filtering and transformations

10. Constructing Computer Vision & NLP Pipeline

- Text Pre-processing with NLTK and spaCy
- Part-of-Speech Tagging and Chunking
- Named Entity Recognition with spaCy and Stanford NLP
- Syntactic Parsing with Stanford Parser and SyntaxNet
- Sentiment Analysis with NLTK, TextBlob, and VADER
- Word Embeddings with Word2Vec, GloVe, and fastText

11. Constructing Computer Vision & NLP Pipeline (Contd…)

- Language Modeling with RNNs, LSTMs, and Transformers
- Attention Mechanisms for Sequence Modeling
- Transfer Learning with Pre-trained Language Models (BERT, GPT-2)
- Fine-Tuning Pre-Trained Language Models for Specific NLP Tasks
- Deploying NLP Model using Flask or other web Framework

12. Convolutional Neural Networks (CNN) for Image Classification

- Introduction to CNNs and their components
- Convolutional layers and filters
- Pooling layers
- Fully connected layers
- Activation functions
- Convolution-Detector-Pooling Building Block
- Training and optimizing CNNs
- Transfer learning with CNNs and popular pretrained models
- Object Detection and Instance Segmentation with RCNN, Fast RCNN, YOLOv5, EfficientDet, and Mask RCNN
- Semantic Segmentation with Fully Convolutional Networks (FCN) and U-Net architectures
- Generative Models for image Synthesis using GANs

13. Transfer Learning With VGG , Inception ResNet and EfficientNet Architectures

- Transfer learning and its advantages
- Pretrained CNN models
- VGG architecture and its variants
- Inception architecture and its variants
- ResNet architecture and its variants
- EfficientNet architecture and its variants

14. Object Detection With RCNN, Fast RCNN , YOLOv5 and EfficientDet

- Object detection and its applications
- RCNN and Fast RCNN architectures
- YOLOv5 architecture
- EfficientDet architecture

15. Instance Segmentation with Mask RCNN

- Instance segmentation and its applications
- Mask RCNN architecture and its components
- Training and optimizing Mask RCNN models
- Training and optimizing semantic segmentation models

16. Semantic Segmentation with Fully Convolutional Networks (FCN) and U-Net Architectures

- Semantic segmentation and its applications
- FCN architecture and its components
- U-Net architecture and its components
- Training and Optimizing Semantic Segmentation Models

17. Generative Models for Image Synthesis (GANs)

- Generative models and their applications
- GAN architecture and its components
- Training and optimizing GAN models
- Conditional GANs
  Progressive GANs

18. Deep Learning Computer Vision Frameworks

- TensorFlow 2.0 and Keras API
- PyTorch for Computer Vision
- ImageNet Dataset and Model Zoo
- Exploring Kaggle Kernels for State-of-the-Art Solutions
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19. Explainable AI and Ethics in Deep Learning

- The need for Explainable AI
- Interpreting and Visualizing Deep Learning models
- Addressing bias in Deep Learning
- Ethics in Deep Learning

20. Advanced Topics

- Reinforcement Learnin
- Meta-Learning
- Few-Shot Learning
- Multi-Task Learning
- Federated Learning

21. Real- World Applications & Case Studies

- Image and Video Processing
- Speech and Audio Processing
- Natural Language Processing
- Recommendation Systems
- Healthcare & Biomedical Applications