

# CampusX Deep Learning for Computer Vision(DLCV) Course Syllabus

## 1. Introduction to Computer Vision and Visual Cortex

- \* Overview of computer vision and its applications
- \* Understanding the human visual system
- \* Key historical milestones in the field of computer vision

## 2. What Are Images and Pixels?

- \* Fundamentals of digital images
- \* Understanding pixels and color models (RGB, Grayscale)
- \* Image types and formats explained

## 3. Convolution and Edge Detection Techniques

- \* Introduction to convolution operations
- \* Edge detection filters (Sobel, Canny, Prewitt)
- \* Practical examples in Python using OpenCV

## 4. Padding, Strides, and Spatial Arrangement in Convolution

- \* Definitions and purposes of padding and strides
- \* How convolution changes spatial dimensions
- \* Implementation tips in deep learning frameworks

## 5. Working with Convolution on RGB Images

- \* Handling multiple channels in convolutions
- \* Challenges and considerations for RGB data
- \* Case studies of RGB image processing

## 6. Understanding and Building Convolutional Layers

- \* Anatomy of convolutional layers
- \* Designing convolutional layers in deep learning models
- \* Hands-on coding session with TensorFlow/Keras

## 7. Pooling Mechanisms: Max and Average Pooling

- \* The role of pooling in feature reduction
- \* Comparative analysis of max pooling vs. average pooling
- \* Implementing pooling layers in neural networks

## 8. Optimizing CNN Training: Techniques and Practices

- \* Effective strategies to improve CNN training
- \* Batch normalization and dropout techniques
- \* Using callback functions and checkpoints

## 9. Case Study: LeNet Architecture (1998)

- \* In-depth review of LeNet's design and impact
- \* Step-by-step walkthrough of the architecture
- \* Implementation of LeNet in a modern framework

## 10. Diving into Large Scale Image Recognition with ImageNet

- \* Challenges and solutions in large-scale image datasets
- \* Key achievements and lessons from ImageNet competitions
- \* Impact on the advancement of deep learning

## 11. Techniques in Data Augmentation for Vision Models

- \* Importance of data augmentation in training robust models
- \* Various data augmentation techniques and their implementations
- \* Case study: Improving model performance using augmented datasets

## 12. Implementing Convolutional Layers with Keras

- \* Basic to advanced convolutional network constructions using Keras
- \* Tips for optimizing model architecture
- \* Practical coding session

## 13. Breakthrough with AlexNet: Architecture and Innovations

- \* Analysis of AlexNet and its groundbreaking performance
- \* Key innovations introduced with AlexNet
- \* AlexNet vs. previous models: a comparative study

## 14. Deep Dive into VGGNet Architecture

- \* Exploration of VGGNet design and functionality
- \* Hands-on session: Building VGGNet from scratch
- \* Discussion on the scalability and adaptability of VGGNet

## 15. Introduction to Residual Networks (ResNet)

- \* Understanding the concept of residual learning
- \* ResNet architecture and variants
- \* Practical applications and performance analysis

## Advanced Topics Sessions

## 16. Transfer Learning and Applications

- \* Fundamentals of transfer learning
- \* Practical demonstrations using pre-trained models
- \* Applications in real-world scenarios

## 17. Introduction to Object Detection: From R-CNN to YOLO

- \* Evolution of object detection frameworks
- \* Comparative study: R-CNN, Fast R-CNN, Faster R-CNN, and YOLO
- \* Implementing YOLO for real-time object detection

## 18. Semantic and Instance Segmentation: Techniques and Applications

- \* Distinction between semantic and instance segmentation
- \* Review of leading methods like Mask R-CNN
- \* Application cases in autonomous vehicles and medical imaging

## 19. Advanced Topics: GANs for Image Synthesis and Editing

- \* Introduction to Generative Adversarial Networks (GANs)
- \* Use cases in image generation and photo editing
- \* Hands-on GAN training session

## 20. Special Topics: Recent Breakthroughs and Research Directions

- \* Latest innovations and research in computer vision
- \* Emerging technologies and their potential impacts
- \* Future directions and career opportunities in computer vision

## 21. Project: Building Blocks of a Self-Driving Car - Vision-Based Navigation Systems

- \* Design and implementation of computer vision systems for self-driving cars
- \* Focus on real-time object detection, lane tracking, and traffic sign recognition
- \* Final presentation of a simulated autonomous driving scenario