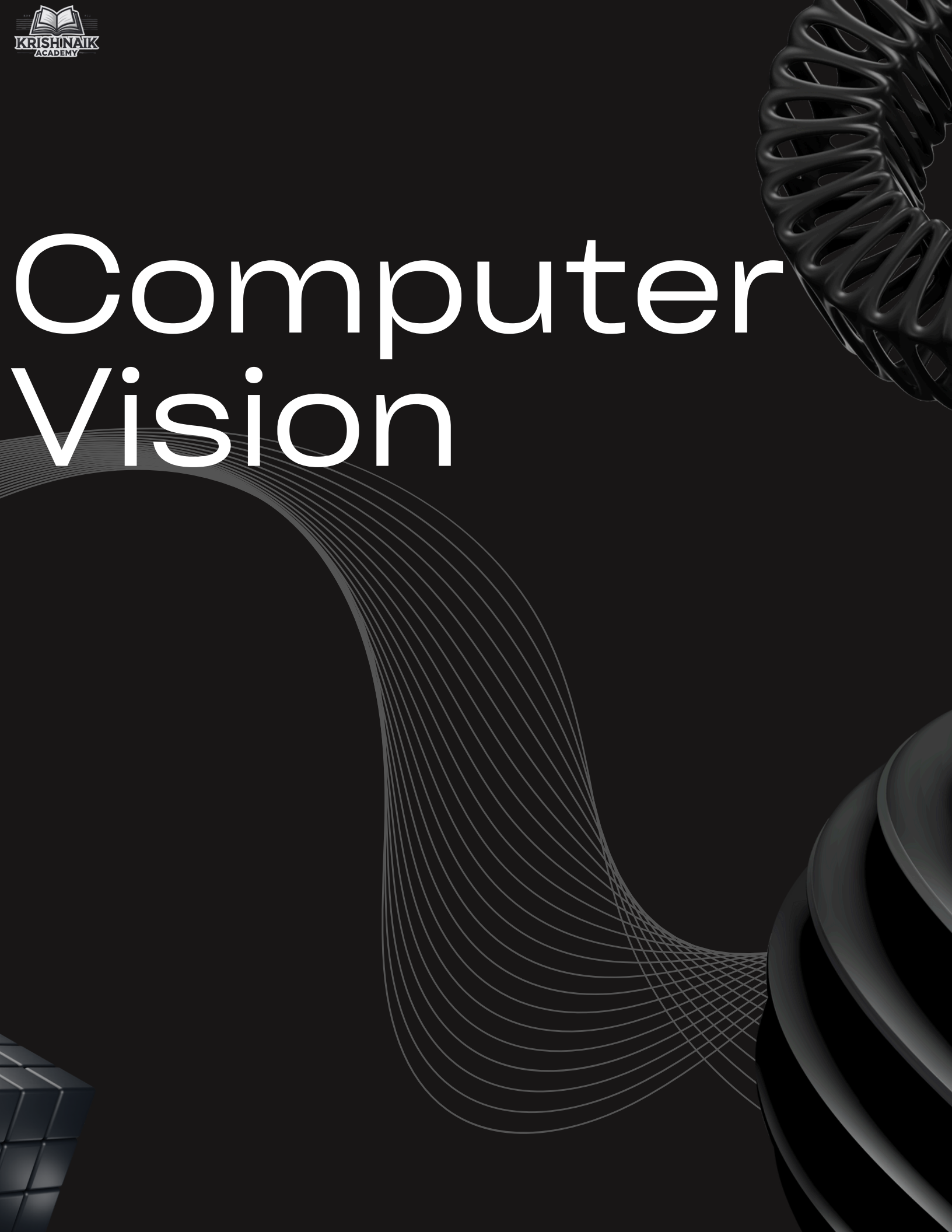
KRISHNAIK ACADEMY

Computer Vision



Computer Vision

This course is designed to equip you with a deep understanding of computer vision, by mastering image processing, neural networks, and advanced models, you will gain the ability to analyze, interpret, and manipulate visual data.

Learning Objectives

- Develop a strong foundation in image processing and deep learning for computer vision.
- Understand and implement Convolutional Neural Networks (CNN) for image classification.
- Apply advanced object detection techniques like YOLO and Faster RCNN.
- Explore vision transformers and how attention mechanisms enhance computer vision tasks.
- Master segmentation methods for precise image analysis using models like Unet and DeepLab.
- Implement and evaluate real-time object tracking systems with algorithms like SORT and DeepSORT.

Course Information

Prerequisites

The Computer Vision course is an advanced program and requires previous competence in the following areas:

Programming Fundamentals : Proficiency in Python, especially with libraries like NumPy, Pandas, and OpenCV.

Basic Machine Learning Concepts : Familiarity with supervised and unsupervised learning, and experience in training foundational machine learning models.

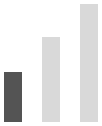
Neural Network Basics : A foundational understanding of neural networks, covering topics like neurons, layers, activation functions, and backpropagation, will help you follow advanced concepts taught in the course.

The course is designed to be completed over a duration of approximately four months, allowing for a thorough exploration of advanced computer vision concepts while providing ample time for hands-on practice and application.

Estimated Time

4 months 6hrs/week*

Required Skill Level



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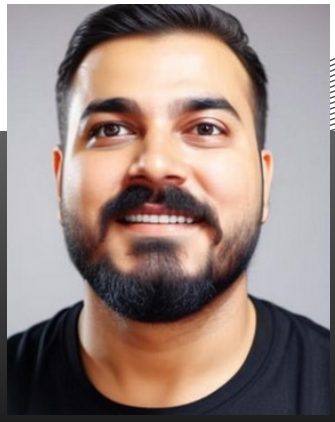
Course Instructors

Our course is led by two seasoned experts in AI, machine learning, and computer vision, bringing together a wealth of real-world experience and deep technical knowledge to guide your learning journey.

Krish Naik : Krish Naik is a seasoned AI engineer with over 15 years of experience in machine learning, deep learning, and computer vision. His expertise includes advanced generative AI techniques, model development, and implementation of AI solutions across diverse use cases. Krish's extensive industry background ensures learners gain a grounded understanding of cutting-edge ML and AI technologies.

Monal Kumar : An expert in computer vision and a full-stack data scientist, Monal Kumar brings extensive industry experience, particularly in live deployments of AI solutions. With a strong background in end-to-end project development and specialization in computer vision, Monal's insights will help you navigate both the technical and practical aspects of AI-driven visual solutions.

Monal Kumar
Data Scientist
Linkedin



Krish Naik
Chief AI Engineer
Linkedin

Module 1

Computer Vision Introduction

This module introduces the foundational concepts of computer vision and image processing. You'll explore the basics of deep learning and how it applies to image data, including the structure of images, color models, and key image transformations like scaling, cropping, and rotating. By the end of this module, you'll understand how to manipulate images and apply initial classification techniques, setting the stage for more advanced methods in later modules.

Topics	
Foundations of Image Processing	Understanding Pixels, Image Types, EXIF
Color Models	Color Models, Color Thresholding, Image Classification
Image Manipulation and Transformation	Image Scaling, Aspect Ratio, Crop, Image Flip, Rotate
Image Features	Contours, Contours Processing

Module 2

DL - Computer Vision I

This module dives into the fundamentals of deep learning applied to computer vision, focusing on neural networks. You'll learn about the essential components of neural networks, including neurons, layers, activation functions, and backpropagation. The module also covers the basic techniques for image classification, helping you understand how deep learning can be used to recognize simple patterns in visual data through digit recognition tasks with a vanilla neural network.

Topics	
Deep Learning Concepts	Types of Learning, Understanding Image Data Variation: occlusion, scale variation, illumination, noise, background & other
Neural Network Fundamentals	Components of Neural Network
Core Mechanisms of Neural Networks	Activation Function, Loss Function, Optimizer, Forward Propagation, Backpropagation, Learning Rate
Hands-on Practice	Digit Recognition with Vanilla Neural Network

Module 3

DL - Computer Vision II

In this module, you'll delve into Convolutional Neural Networks (CNN), the cornerstone of modern computer vision. You'll explore why CNNs outperform traditional neural networks in image tasks and learn about key components like filters, pooling, and dense layers. By the end, you'll have a solid understanding of CNN architecture and its applications, and you'll be able to implement your own CNN model for basic image recognition tasks using architectures like LeNet.

Topics	
Introduction to CNNs	Convolution Neural Network, Why CNN is Better than ANN, Components of CNN, Input Data
Core CNN Operations	Convolution Layer, Convolve Function, Filters (Kernels), Kernel Size, Stride, Padding, Feature Map, Channels
Activation and Pooling	Activation Function, Why to Use Activation Function, Pooling Layer, Max + AVG Pooling, 1x1 Convolution
Network Architecture	Flattening, Fully Connected Layer (Dense Layer), Dropout, Batch Normalization, Softmax

Module 3

DL - Computer Vision II

Topics	
Training Mechanisms	Loss Function, Optimizer, Forward Propagation, Backpropagation
Output and Predictions	Output

Module 4

DL - Computer Vision III

This module focuses on advanced CNN architectures that have shaped the field of deep learning in computer vision. You'll explore key models like AlexNet, VGGNet, GoogLeNet, ResNet, and MobileNet, which revolutionized the way visual tasks are tackled. Understanding these architectures will give you the knowledge to choose and implement state-of-the-art models for various image classification challenges, optimizing for accuracy, efficiency, and scale.

Topics	
Early CNN Architectures	LeNet, AlexNet, VGGNet
Advanced and Deeper Networks	ResNet, Inception-v3
Efficient and Mobile-Friendly Architectures	DenseNet, MobileNet

Module 5

DL - Computer Vision IV - Computer Vision with Attention

This module introduces the concept of attention mechanisms in computer vision, particularly through Vision Transformers (ViT). You'll learn how transformers, originally designed for NLP, are transforming vision tasks by capturing relationships across an entire image. The module also covers ConvNeXt, a hybrid approach combining CNNs and transformers, providing you with cutting-edge techniques to enhance model performance in visual tasks.

Topics	
Introduction to Transformers in Vision	Why Use Transformers to Solve Vision Tasks, Vision Transformers (ViT)
Input Processing and Representation	Input Representation, Positional Encoding, Class Token
Core Transformer Mechanisms	Multi-Head Self-Attention, Feed-Forward Network, Layer Normalization, Residual Connections
Model Architecture	Encoders, Output Head

Module 6

DL - Computer Vision V - Object Detection

In this module, you will learn the intricacies of object detection, a key technique for identifying objects within an image. You'll explore both two-stage (e.g., Faster RCNN) and single-stage (e.g., YOLO) detectors, along with techniques like Region Proposal Networks (RPN) and anchor boxes. By the end, you'll have the skills to build and fine-tune object detection models for real-world applications, such as autonomous vehicles and security systems.

Topics	
Introduction to Object Detection	What is Object Detection, Classification, Regression
Core Components of Object Detection	Selective Search, Region Proposal Network, CNN - Feature Extractor, Pre-trained Backbones, Feature Pyramid Network, RoI Pooling, Anchor Boxes, Bounding Box Regression & Classification Head
Object Detection Algorithms	Two-Stage Detectors : RCNN, Fast RCNN, Faster RCNN. Single-Stage Detectors : YOLO, Object Detection using YOLOv5 & YOLOv11
Advanced Detection Methods	Non-Maximum Suppression, Advanced Loss Functions

Module 6

DL - Computer Vision V - Object Detection

Topics	
Hands-On	Creating Our Own Object Detection Algorithm

Module 7

DL - Computer Vision VI - Segmentation

This module explores segmentation, which focuses on classifying individual pixels in an image to distinguish objects and regions. You'll dive into semantic segmentation using models like Unet and DeepLab, and explore instance segmentation techniques such as MaskRCNN. Through hands-on practice, you'll learn to implement these techniques for tasks like medical imaging and scene understanding, making your models capable of high-precision visual analysis.

Topics	
Introduction to Segmentation	What is Segmentation, Semantic Segmentation, Instance Segmentation
Core Concepts in Segmentation	Downsampling, Upsampling/Transposed Convolution, Skip Connections, Atrous Convolutions, Conditional Random Fields, Loss Functions (Softmax with Cross-Entropy, Dice Loss), Evaluation Metrics
Popular Architectures & Framework	Unet, DeepLab v3, MaskRCNN, MMDetection
Practical Implementation	Implementing Unet from Scratch, Popular Datasets to Get Started

Module 8

DL - Computer Vision VII - Object Tracking

This module covers object tracking, a dynamic task in computer vision that focuses on following objects as they move through video frames. You'll explore methods like filter-based tracking, CNN-based tracking, and advanced algorithms such as SORT and DeepSORT. By mastering object tracking, you'll be able to apply your skills in areas like surveillance, sports analytics, and autonomous driving, where tracking objects in real time is crucial.

Topics	
Introduction to Object Tracking	What is Object Tracking
Tracking Methods	Filter-Based Tracking, CNN-Based Tracking
Key Algorithms in Object Tracking	Kalman Filter, SORT, DeepSORT , Re-ID
Hands-On	Using YOLO and ByteSort to Track Objects

Module 9

PRO Module - Generative Models for Vision Applications

This module dives into generative AI models specialized for vision applications, including cutting-edge tools such as CLIP, SAM2, Stable Diffusion, and CycleGAN. You'll explore how these models are used for tasks like text-to-image generation, segmentation, style transfer, and more. By mastering these techniques, you'll be able to create and manipulate visual content with precision and apply these skills in fields like digital art, automated content creation, and synthetic data generation for training other models.

Topics	
Introduction to Generative AI	Overview of Generative AI in Vision Applications in Image Synthesis, Style Transfer, and Segmentation
Key Models and Techniques	CLIP, SAM, Stable Diffusion, CycleGAN
Hands-On	• Text-to-Image Generation for Creative Media • Image Segmentation for Data Labeling • Style Transfer and Domain Adaptation for Synthetic Data