23AM722 Deep Learning for Computer Vision 2-0-2-3

Prerequisites

- Basic knowledge of linear algebra, calculus, and probability theory.
- Basic programming skills in Python.

Course Objectives

This course provides an in-depth introduction to deep learning techniques for computer vision applications. Students will learn the fundamental concepts of neural networks, convolutional neural networks, and their applications in image recognition, object detection, and image segmentation. The course will also cover various deep learning architectures and optimization techniques for training deep neural networks.

Course Outcomes

CO	Description
CO1	Understand the design and usage of Convolutional Neural Networks.
CO2	Apply transfer learning and fine-tuning techniques to adapt pre-trained CNNs to new tasks.
CO3	Understand and apply neural networks for sequential models.
CO4	Understand deep learning frameworks, such as TensorFlow or PyTorch, to build and train CNNs for various computer vision tasks, such as image classification, object detection, semantic segmentation, and image generation.
CO5	Apply deep learning techniques to real-world computer vision problems and demonstrate the ability to design, train, and evaluate models on publicly available datasets.

Syllabus

Introduction to Deep Learning and Computer Vision: What is Deep Learning and Why is it Important, Overview of Computer Vision and Its Applications, History of Deep Learning and its Applications in Computer Vision. Introduction to Neural Networks: Biological Inspiration for Artificial Neural Networks, Basic Structure and Components of a Neural Network, Activation Functions and Loss Functions. Convolutional Neural Networks: Introduction to Convolutional Neural Networks (CNNs), Convolutional Layers, Pooling Layers, and Fully Connected Layers, Popular CNN Architectures (LeNet, AlexNet, VGG, ResNet, etc).

Training Convolutional Neural Networks: Data Pre-processing and Augmentation Techniques, Optimizers and Learning Rate Scheduling, Regularization Techniques (Dropout, L1/L2 Regularization. Object Detection: Object Detection and Localization Techniques, Popular Object Detection Architectures (RCNN, Fast RCNN, Faster RCNN, YOLO, etc.), Training Object Detection Models and Fine-tuning Pretrained Models. Semantic Segmentation: Introduction to Semantic Segmentation, Fully Convolutional Networks (FCN), Popular Semantic Segmentation Architectures (U-Net, SegNet, DeepLab, etc.)

Sequential models: RNN, LSTM, Encoder – Decoder Models, Attention Mechanism. Recent Trends in Deep Learning for Computer Vision: Spatial Transformers, Transformer Networks, Deep Generative Models: GANs, VAEs; GAN for Image Synthesis, Transfer Learning and Domain Adaptation, Introduction to GNN, Recent Advances and Future Directions in Deep Learning for Computer Vision.

Text Book / References

1. Goodfellow I, Bengio Y, Courville A. Deep learning. MIT press; 2016.
2. Patterson J, Gibson A. Deep learning: A practitioner's approach. " O'Reilly Media, Inc."; 2017.
3. Adrian Rosebrock. "Deep Learning for Computer Vision with Python." PyImageSearch, 2021.
4. Kaiming He, et al. "Deep Residual Learning for Image Recognition." CVPR, 2016.
5. Research Papers on Relevant Topics and Internet Resources

CO-PO Mapping

CO	Description	PO1	PO2	PO3	PO4	PO5	PO6
CO1	Understand the design and usage of Convolutional Neural networks.	3	1	-	-	-	-
CO2	Apply transfer learning and fine-tuning techniques to adapt pre-trained CNNs to new tasks.	1	1	3	-	-	1
CO3	Understand and apply neural networks for sequential models.	3	2	1	1	-	-
CO4	Understand deep learning frameworks, such as TensorFlow or PyTorch, to build and train CNNs for various computer vision tasks, such as image classification, object detection, semantic segmentation, and image generation.	3	3	-	3	-	-
CO5	Apply deep learning techniques to real-world computer vision problems and demonstrate the ability to design, train, and evaluate models on publicly available datasets.	-	3	3	2	1	2

Evaluation Pattern 70:30

- Midterm Exam - 20%
- Lab Assignments & Case Study – 50%
- End Semester Exam - 30%