EEP 568: Deep Learning for Big Visual Data

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Course Outlines

1. Basics of Machine Learning (course introduction, learning paradigms, training loss functions, performance metrics)
2. Traditional Supervised Machine Learning and Applications (linear/polunomial regression, logistic regression, classification trees/random forest, SVM)
3. Multilayer Perceptrons and Backpropagation Learning (neural networks structures and learning mechanisms, MLP applications)
4. Convolution Neural Networks (from MLPs to CNNs, various CNNs for image classifications, transfer learning of CNNs)
5. Practical Usage of CNNs (few shot learning, metric learning, face identification and verification, long tailed recognition, unsupervised domain adaptation)
6. Image Object Detection and Multi-Object Tracking (two-stage and one-stage detector, faster RCNN, Yolo, CenterNet, Tracking by Detection, Hungarian Assignment)
7. Image Segmentation and Human Pose Estimation (semantic segmentation, instance segmentation, 2D human pose estimation, 3D pose estimation)
8. Transformers for Large Language Models and Visual Applications (self-attention, transformer encoder and decoder, BERT, decoder based large language models, ChatGPT, finetuning of LLMs, Vision transformer, Detection Transformer)
9. Generative Adversarial Networks (generator and discriminator, conditional GANs, style GANs, and CycleGan)
10. Diffusion Models for Image/Video Generation (DDPM, latent diffusion, text conditioned diffusion, diffusion transformer)

Grading Policy and Objectives

- **Grading Policy:** 5 biweekly individual/group homework assignments (20% each), Google Colab deep learning projects with real data and handwritten analytical questions
- **Learning Objectives:** Providing students with the fundamental skills and hands-on experience in applying the deep learning theories learned to various image/video/radar/lidar processing applications based on cloud based CPU/GPU computing resources. The course also involves biweekly projects using provided real-world training and testing data, and analytical derivation assignments, for students' deep learning designs and report writing.