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Machine learning and Deep learning course plan

Get started with your ML engineering journey

Overview

This workshop plan aims to provide a comprehensive introduction to machine learning and deep learning concepts within 35 hours. It's designed for individuals with a basic understanding of programming and statistics who want to learn the fundamentals and explore practical applications.

Keywords: Machine learning, Deep learning, Computer vision, Pytorch

Learning objectives

- Understand fundamental machine learning and deep learning concepts
- Apply ML methods to real-words problems and evaluate the performance
- Optimize the main tradeoffs such as overfitting, and computational cost vs accuracy
- Structure a deep learning project for reproducibility and collaboration

Computational requirements

- CUDA-enabled GPU with at least <16>GB of VRAM
    - E.g. NVIDIA GeForce RTX 4070 Ti Super
- At least 1.5*<16>GB of computer memory (i.e. RAM)
- Hard disk: 512GB SSD (it should be large enough to accommodate for your datasets)
- Example

Timetable

- [3hrs] Thursday August 8th
- [4hrs] Thursday August 15th
- [4hrs] Monday August 19th
- [4hrs] Thursday August 22nd
- [4hrs] Monday August 26th
- [4hrs] Thursday August 29th
- [4hrs] Monday September 2nd
- [4hrs] Thursday September 5th
- [4hrs] Monday September 9th

Plan

0. Kaggle competition team prep and set up

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   a. Understand the problem
   b. Understand the data
   c. Set up collaboration framework
   d. Setting up the development environment
      i. Orange Data mining
      ii. Miniconda

1. Introduction to Machine learning
   a. Definition & Types of ML
   b. Applications of ML
   c. The importance of data in ML
   d. Introduction to Overfitting and Underfitting
   e. Bias-variance tradeoff
2. Introduction to deep learning
   a. Neural networks: common architectures (CNN, Transformer, MLP) and common building blocks
   b. Backpropagation & Gradient descent
   c. Loss functions
   d. Popular optimization algorithms: SGD, RMSProp, Adam
3. Computer vision
   a. Classification
   b. Segmentation
   c. Object detection
   d. Keypoints detection
4. Training computer vision classification model
   a. Data preprocessing
   b. Data augmentation
   c. Regularization
   d. Hyperparameter tuning
5. Tricks and Tools for efficient training and inference
   a. Streamlining training routine with *Pytorch lightning*
   b. Logging with *wand* (and *MLflow*)
   c. Exporting trained models with ONNX
   d. Structuring an ML project w/ *cookiecutter* and *datargs*
   e. Deploying with LitServe
6. Traditional supervised ML
   a. Regression and Classification: linear and logistic regression
   b. Other algorithms: SVM, Decision trees, K-nn, Ridge regression
   c. Evaluation metrics
   d. Cross-validation
7. Traditional unsupervised machine learning
   a. Clustering algorithms (K-means, Hierarchical Clustering) and evaluation
   b. Dimensionality reduction (PCA, t-SNE)
   c. Matrix factorization for recommender systems
8. Explainable AI
   a. What is it? Why does it matter?
   b. Overview of some techniques