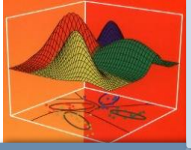


MIAI 504
NEURAL NETWORKS & DEEP LEARNING

Dr. Zein Al Abidin IBRAHIM
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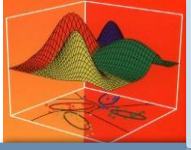


Course Outline (1/3)

Outline

Part 1: Neural Networks Foundations

- Machine Learning recap
- Artificial neuron and perceptron models
- Single-layer perceptrons
- Multi-Layer Perceptrons (MLPs)
- Forward propagation and loss functions
- Backpropagation and gradient-based learning

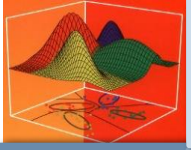


Course Outline (2/3)

Outline

Part 2: Deep Learning Fundamentals

- Deep Neural Networks (DNNs)
- Activation functions
- Weight initialization
- Optimization algorithms
- Regularization techniques
- Normalization and training stability

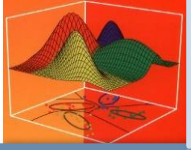


Course Outline (3/3)

Outline

Part 3: Deep Learning Architectures

- Convolutional Neural Networks (CNNs)
- CNN training and transfer learning
- Recurrent Neural Networks (RNNs)
- LSTM, BiLSTM and GRU
- Attention mechanisms
- Introduction to Transformers



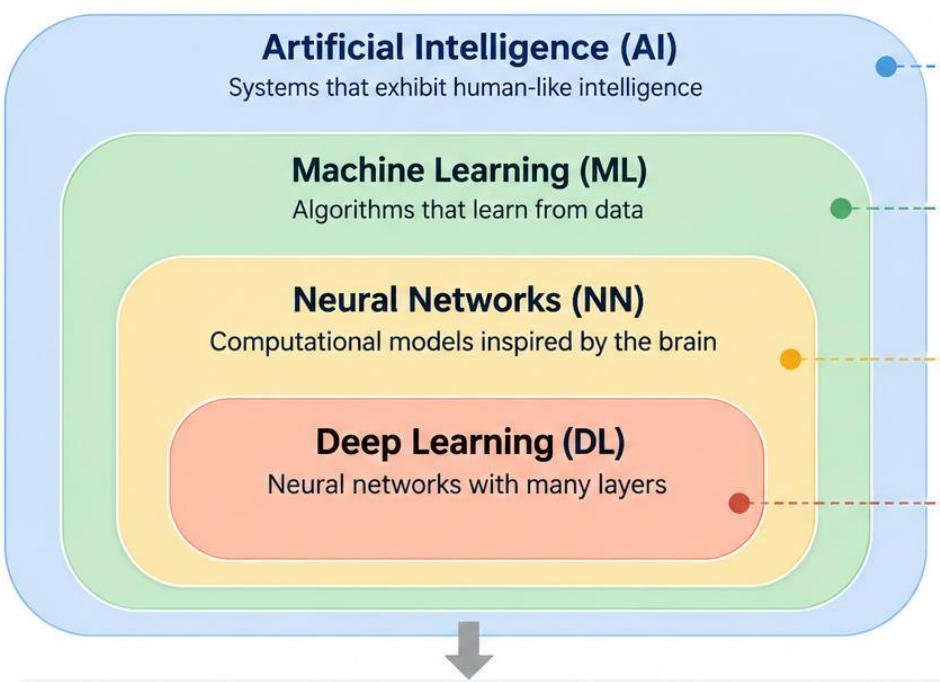
Learning Outcomes

- Design and analyze neural-network architectures.
- Perform forward propagation and derive backpropagation gradients.
- Select suitable activation functions, loss functions and optimizers.
- Apply regularization and normalization to improve generalization and training.
- Design and train CNNs for computer-vision tasks.
- Explain sequence models, attention and the basic Transformer architecture.
- Implement and evaluate deep-learning models using PyTorch.

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Neural networks & deep learning?

Where Does Deep Learning Fit?



Artificial Intelligence
Broad field aiming to build intelligent systems that can perceive, reason, plan and make decisions.

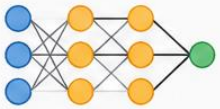
Machine Learning
Subset of AI that uses data to learn patterns and improve performance on a task.

Neural Networks
A family of machine learning models composed of interconnected neurons (layers) that can learn complex functions.

Deep Learning
Neural networks with many layers, capable of learning hierarchical representations from large amounts of data.

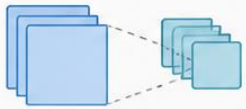
Examples of Deep Learning Architectures

Multi-Layer Perceptron (MLP)



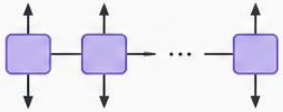
Tabular data, classification, regression

Convolutional Neural Network (CNN)



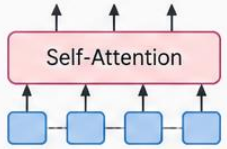
Computer vision, image processing

Recurrent Neural Network (RNN)



Sequential data, time series, language

Transformer

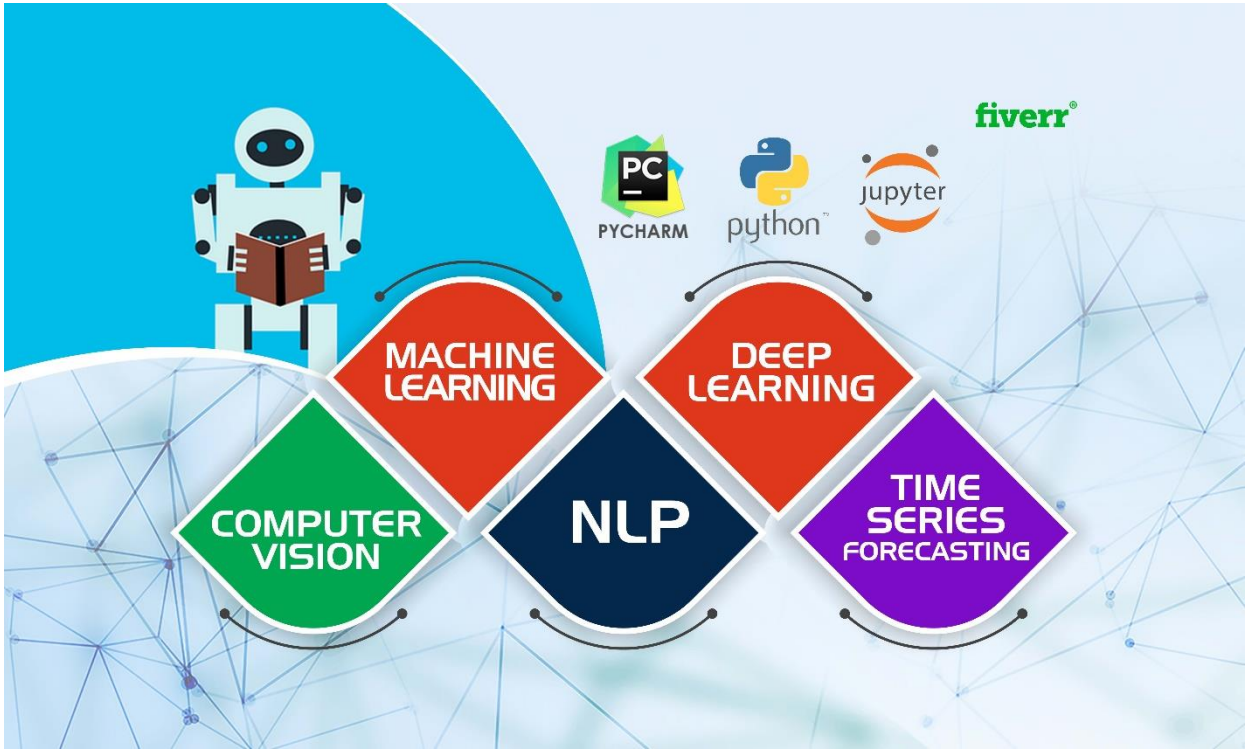


Natural language processing, multimodal learning

Course Evaluation

Outline

- Course:
  - Lectures + Practical exercises
  - Lab
- Evaluations:
  - Final
  - Project



Development Environments

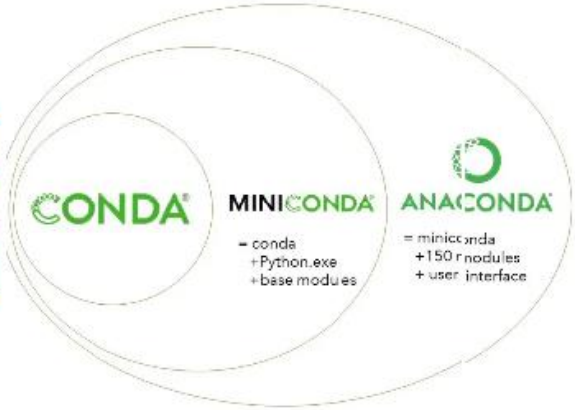
- Python-based Development Environment



Development Environments

- Python Packages manager





Installation	Python		Anaconda (Miniconda)
	pip	virtualenv	Conda
Purpose	Package Management	Virtual Environments	Package Management Virtual Environments
Usage	All purposes		Data Analysis/Data Science

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Development Environments

- Python Well-Known Libraries



Development Environments

- Python Well-Known cloud services







Google Cloud Platform











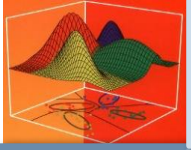
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Feature	Google Colab	Amazon SageMaker	Microsoft Azure	IBM Watson Studio	Paperspace Gradient
Libraries and Frameworks	TensorFlow, PyTorch, Keras	TensorFlow, PyTorch, MXNet, Scikit-learn	TensorFlow, PyTorch, Keras, CNTK	TensorFlow, PyTorch, Keras, scikit-learn	TensorFlow, PyTorch, fast.ai
Compute Resources	CPU, GPU (limited), TPU (limited)	CPU, GPU, P3, P4, Inf1 (Inferentia)	CPU, GPU, FPGA, TPU	CPU, GPU	CPU, GPU
Free Tier Availability	Yes	Yes	Yes	Yes	No
Notebooks and IDEs	Jupyter Notebooks	Jupyter Notebooks, IDE	Jupyter Notebooks, Azure ML Studio	Jupyter Notebooks, IDE	Jupyter Notebooks, Web-based IDE
Data Storage and Management	Google Drive	Amazon S3, Amazon EBS	Azure Blob Storage, Azure SQL DB	IBM Cloud Object Storage	Paperspace Volumes
AutoML and Model Deployment	Yes (limited)	Yes	Yes	Yes (limited)	No
Integration with ML Services	TensorFlow Extended (TFX)	Amazon SageMaker Components	Azure Machine Learning	Watson Machine Learning	-
Collaboration and Sharing	Yes	Yes	Yes	Yes	Yes
Security and Compliance	-	VPC, IAM, KMS, Encryption	Azure AD, Role-Based Access Control	IBM Cloud Identity and Access Management	-

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Cloud Service	Libraries	CPU	GPU	TPU	Free Time	Other Features
Colab	TensorFlow, PyTorch, Keras, Scikit-learn, etc.	2 cores	1 NVIDIA Tesla K80	1 TPUv2	12 hours per session	Integrated with Google Drive and GitHub, supports Jupyter notebooks
Sagemaker	TensorFlow, PyTorch, MXNet, Scikit-learn, etc.	Up to 96 vCPUs	Up to 8 NVIDIA V100	No	250 hours per month for the first 2 months	Supports distributed training, hyperparameter tuning, model deployment, etc.
Azure	TensorFlow, PyTorch, Scikit-learn, ONNX, etc.	Up to 128 vCPUs	Up to 4 NVIDIA V100	No	100 hours per month for the first 12 months	Supports automated machine learning, MLOps, Azure Databricks, etc.
Watson	TensorFlow, PyTorch, Scikit-learn, etc.	Up to 56 vCPUs	Up to 8 NVIDIA V100	No	50 hours per month	Supports natural language processing, computer vision, speech recognition, etc.
Gradient	TensorFlow, PyTorch, Keras, Scikit-learn, etc.	Up to 96 vCPUs	Up to 8 NVIDIA V100	No	6 hours per session	Supports Jupyter notebooks, Paperspace, Kubernetes, etc.
Oracle	TensorFlow, PyTorch, MXNet, Scikit-learn, etc.	Up to 64 vCPUs	Up to 2 NVIDIA V100	No	300 hours for the first 30 days	Supports data science projects, model catalog, AutoML, etc.
Databricks	TensorFlow, PyTorch, Scikit-learn, Spark MLlib, etc.	Up to 64 vCPUs	Up to 8 NVIDIA V100	No	14 days trial	Supports Apache Spark, Delta Lake, MLflow, etc.

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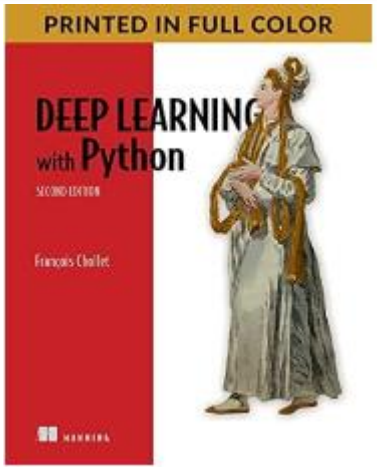


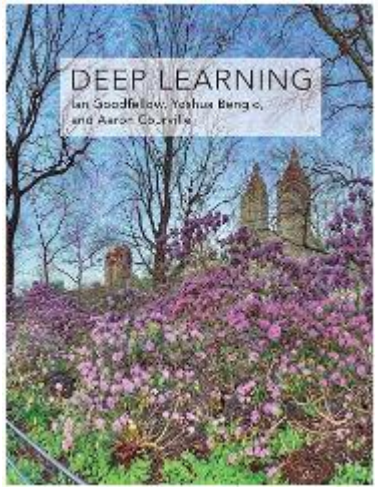
ML Communities

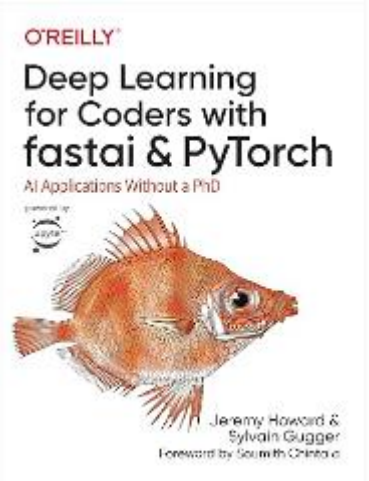
- Kaggle → Competitions
- Hugging Face → NLP
- Github
- Google AI Platform
- Microsoft Azure
- OpenAI
- nVIDIA
- H2O.ai
- AWS
- Fotor
- TensorFlow

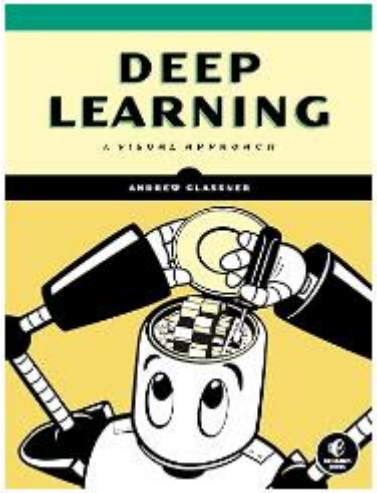
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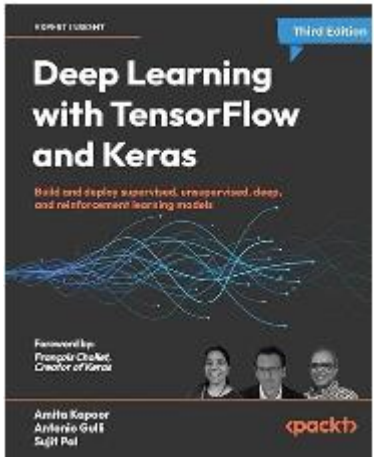
References

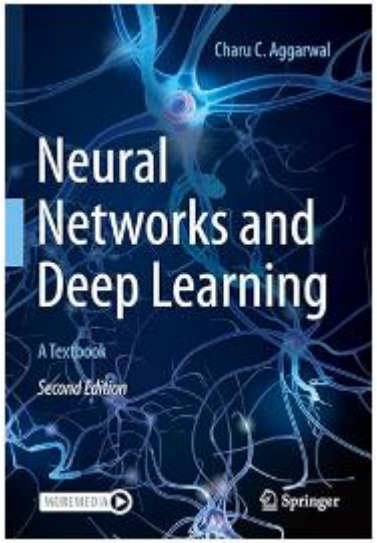




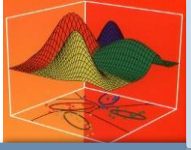








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End of Lecture !

This is the end of the lecture!

Do you have any question ?



The end !

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