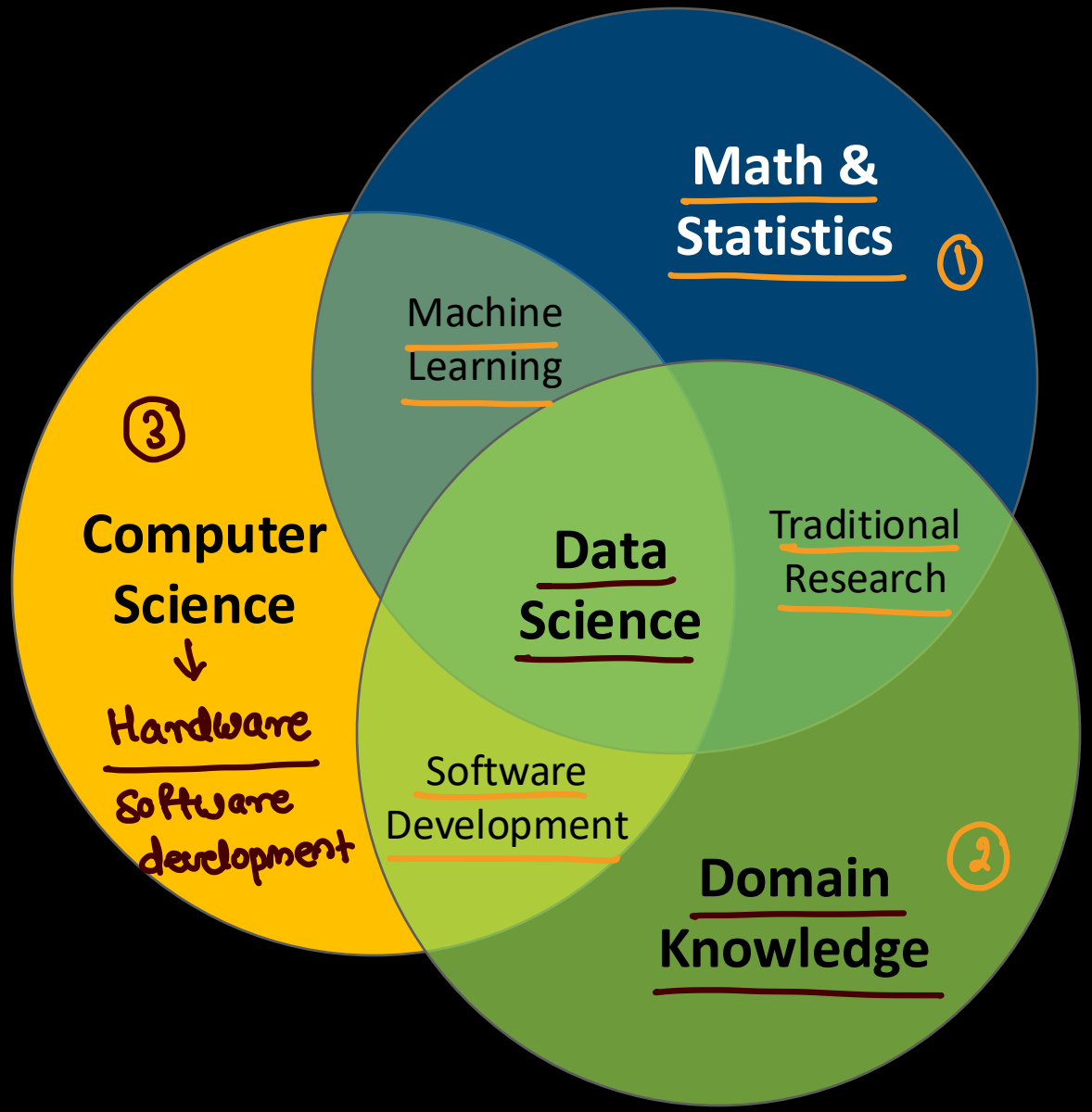
Mastering Generative AI

Data Science

- collection
- organization
- preprocessing
- analysis



Relationship

Cognitive thinking ↑

Artificial Intelligence
- A technique which enables machine to mimic human behavior

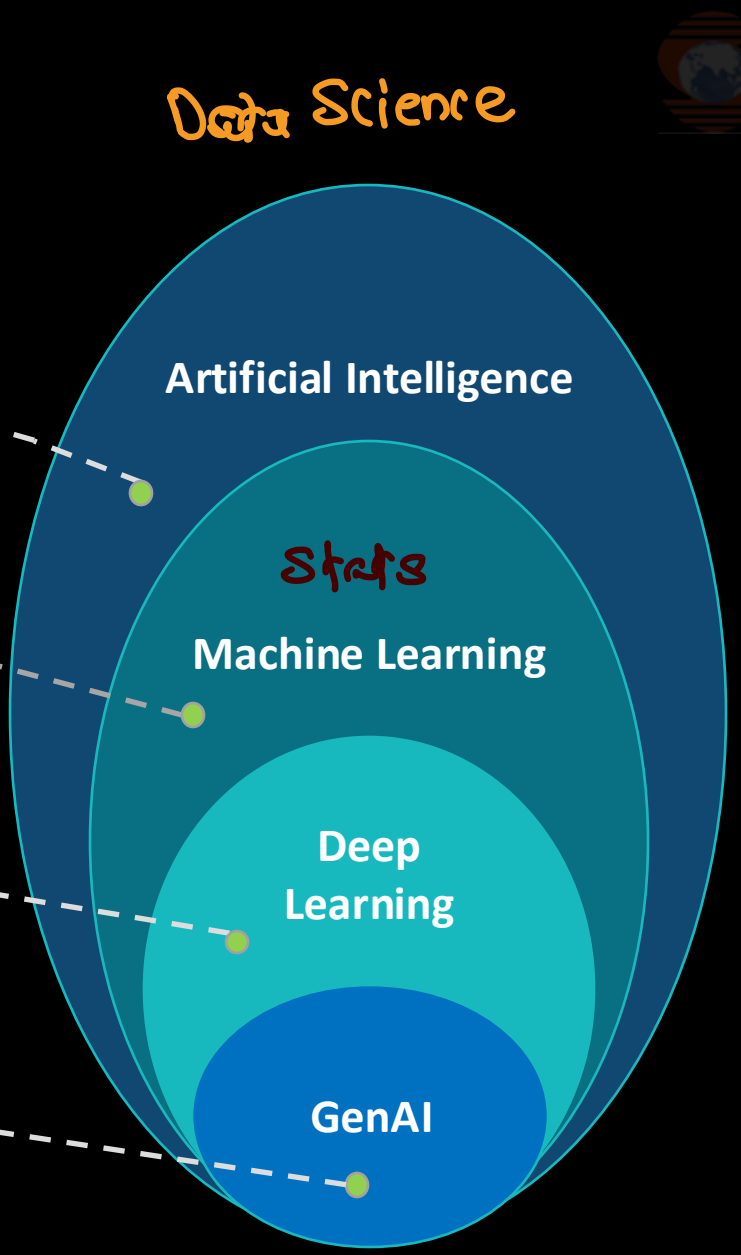
Machine Learning
- Subset of AI which uses statistical methods to enable machines to improve the experience

Deep Learning
- Subset of ML which makes the computation of multi-layer neural network feasible

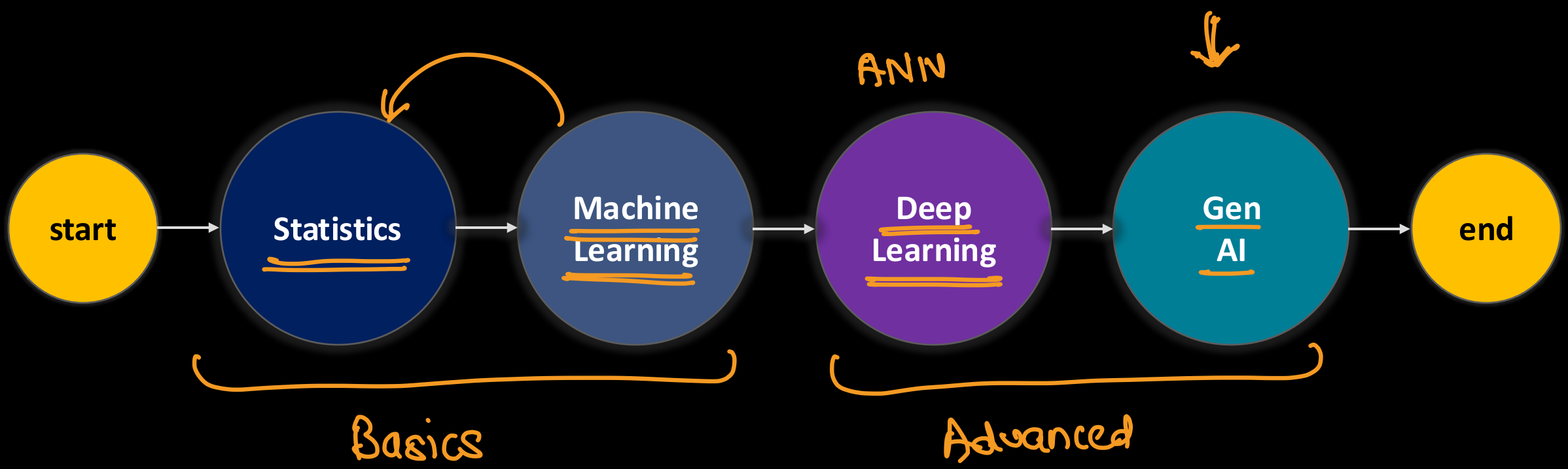
BNN → ANN ← CNN, RNN

Generative AI
- Subset of AI that can created new content like text, images and music

data → structured → database
semi-structured → csv/ json
unstructured → image / audio / video / text



Course Journey



Course Contents – Statistics

types / introduction

Statistics Foundation

Gaussian, normal, uniform

Distributions

raw facts, Sample, Sampling methods

Data & Sampling

checking hypothesis < accepted / rejected

Hypothesis Testing

parameterized

non-parameterized

relationship → correlation analysis

Central tendency, variations, skewness

Measures in Statistics

simple, coditional probability

Probability

pictorial

charts / diagrams / tables / dashboard

Data Visualization

data analysis

- tableau
- python + libraries

random

relationship between variables / columns / features / dimensions

Correlation Analysis

Course Contents – Machine Learning

Introduction
- what / why / how ?

Regression & Classifcation
- prediction → value / class
- label
- Reg: simple / polynomial
- classification: knn / DT
- Ensemble: RF / GB

Supervised learning

ML Foundation
- types ← supervised, unsupervised, reinforcement

Dimensionality Reduction
- PCA
- reducing higher dimensions to lower dimensions

Unsupervised learning

Data Preprocessing
- missing data, labelling, shuffling, scaling.
- scrubbing / wrangling

Clustering
- grouping : KMeans

Feature Engineering
- feature selection / feature Extraction
  - filter / wrapper / Embedding

End-to-End Pipeline
- MLOps → DevOps

Data Collection
- primary
  - scraping
- secondary
  - Kaggle

Course Contents – Deep Learning → traditional AI

neural architecture → ANN vs BNN

Introduction to DL

ANN vs CNN vs RNN

Unstructured

Complex data / huge scale of data

ML vs DL

Natural language Programming

NLP

ANN / CNN / RNN — LSTM, GRU

Neural Network Types

Encoder & Decoder, self attention

Transformers

Google — tensorflow lite , Meta — pytorch mobile

TensorFlow & Pytorch

using Existing solution to solve another problem

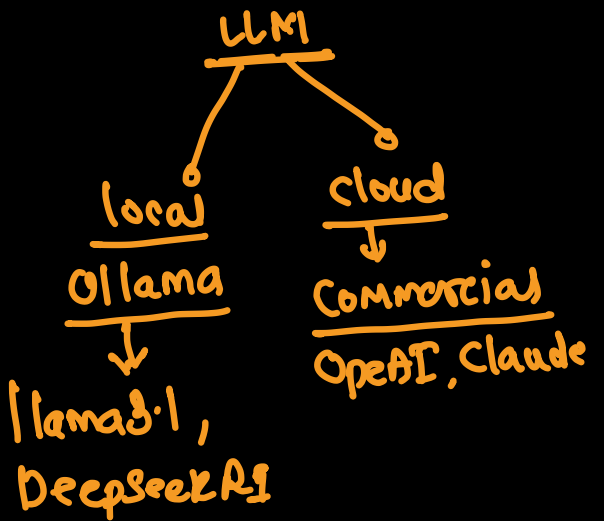
Transfer Learning

Course Contents – Generative AI

- Traditional AI vs GenAI
- Text and Audio Generation (LLMs and audio → whisper)
- Large Language Models (tokenizer, LLMs & SLMs, architecture.)
- RAG & Agentic RAG (reduce halucination)
- Prompt Engineering (how/techniques ***)
- Agentic RAG (langGraph / CrewAI)
- Embeddings & Vector DB (numeric conversion → vector; → Chroma)
- Fine Tuning LLM (huge Resources → LoRA / QLoRA)
- Stable Diffusion & VAE (generating images → img2img, text2img)
- MCP (model context protocol)

Libraries

- **Statistical Calculations** — numpy, pandas, stats
- **Data Visualization** — matplotlib, plotly, seaborn
- **Machine Learning** — sci-kit Learn
- **Deep Learning** — tensorflow, pytorch
- **Generative AI** — langChain, transformers (Huggingface)
  - agentic AI → langGraph, crewAI
  - vector DB → chroma



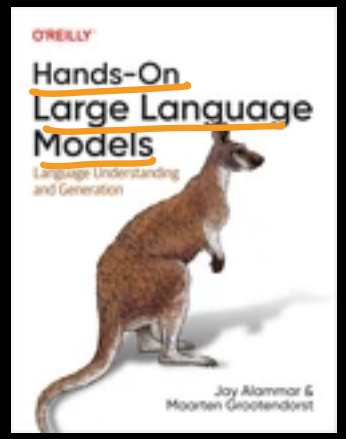
Cornerstone Projects

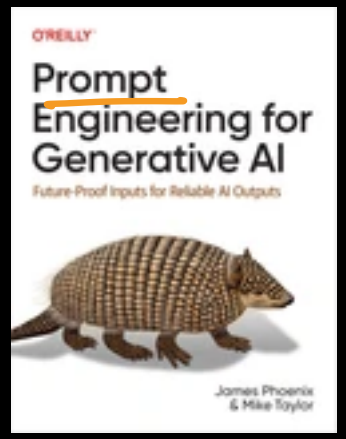
- **Machine Learning**
  - Predicting Housing Prices
  - Customer Churn Prediction
- **Natural Language Processing (NLP)**
  - Sentiment Analysis on Movie Reviews
  - News Topic Classification
- **Deep Learning**
  - Image Classification (Cats vs Dogs)
  - Object Detection (YOLO)
- **Content Generation**
  - AI Resume and Cover Letter Generator
  - **Blog Article Generator with SEO Optimization**
- **RAG**
  - Chat With PDF, SQL and CSV
  - MCQ generation using PDF
  - Hotel reservation conversational chat bot
- **Agentic RAG**
  - Automated Travel Advisor
  - Financial Analyst
- **Multi-modal Application**
  - AI generated Mock Interview
  - AI Code Assistant
  - YouTube video translation (caption generation + translation)

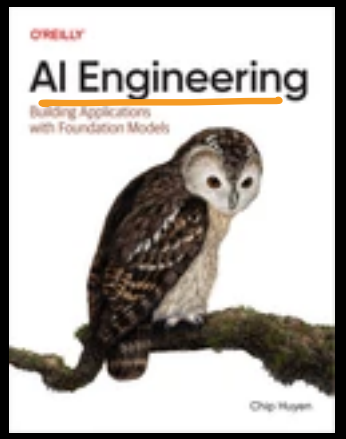
Pre-requisites

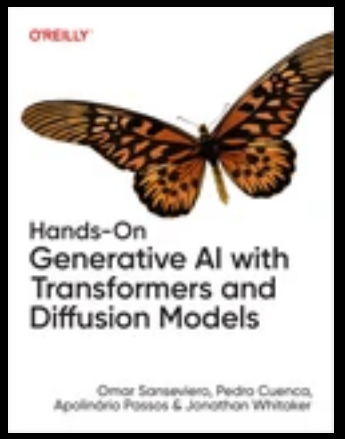
- Programming Language : python, JS
- Development Environment
  - Local Machine with good configuration and GPU → Jupyter Notebook
  - Google Colaboratory
- LLM
  - Local → ollama → llama3.1 / mistral / phi4
  - Commercial → OpenAI / claude
- Dedication ☺
- Willingness to learn new thins ☺

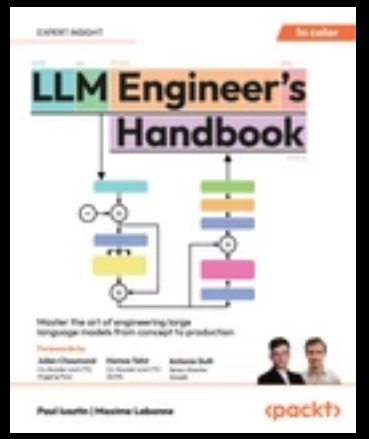
Books

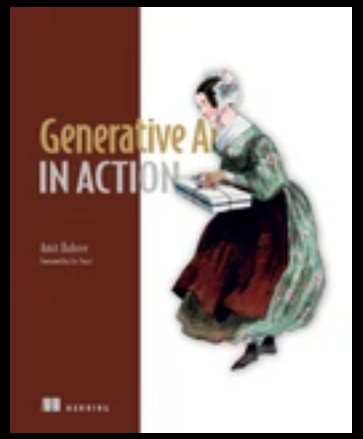

O'REILLY
Hands-On Large Language Models
Language Understanding and Generation
Jay Alammar & Maarten Grootendorst

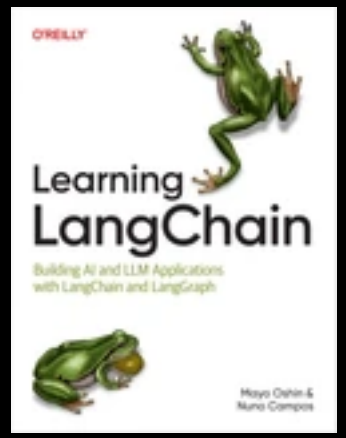

O'REILLY
Prompt Engineering for Generative AI
Future-Proof Inputs for Reliable AI Outputs
James Phoenix & Mike Taylor

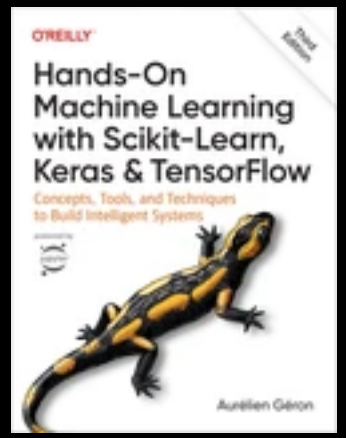

O'REILLY
AI Engineering
Building Applications with Foundation Models
Chip Huyen

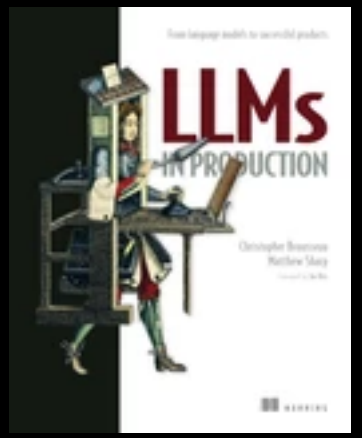

O'REILLY
Hands-On Generative AI with Transformers and Diffusion Models
Omar Sanseviero, Pedro Cuenca, Apolinário Passos & Jonathan Whitaker

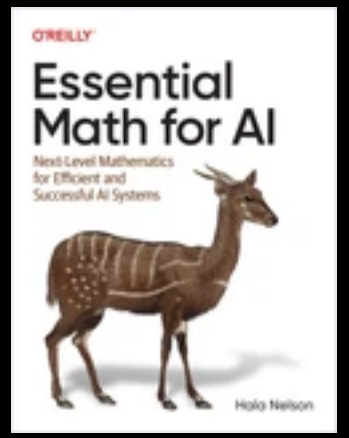

LLM Engineer's Handbook
packt

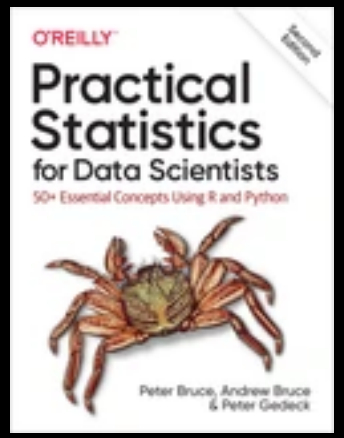

Generative AI IN ACTION
MANNING

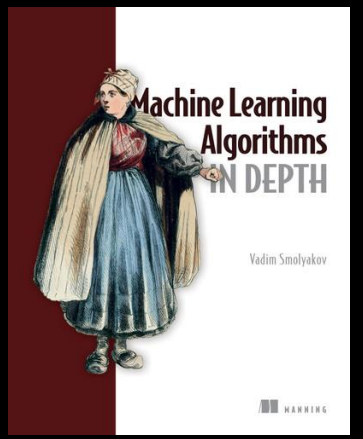

O'REILLY
Learning LangChain
Building AI and LLM Applications with LangChain and LangGraph
Mayo Oshin & Nuno Campos


O'REILLY
Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow
Concepts, Tools, and Techniques to Build Intelligent Systems
Aurélien Géron


LLMs IN PRODUCTION
MANNING


O'REILLY
Essential Math for AI
Next-Level Mathematics for Efficient and Successful AI Systems
Hala Nelson


O'REILLY
Practical Statistics for Data Scientists
50+ Essential Concepts Using R and Python
Peter Bruce, Andrew Bruce & Peter Gedeck


Machine Learning Algorithms IN DEPTH
Vadim Smolyakov
MANNING

About Instructor

- More than 18+ years of experience
- Associate Technical Director at Sunbeam and a Freelance Developer working with real world projects with overseas clients
- Developed numerous mobile applications on iOS and Android platforms
- Developed various websites using LAMP, MEAN and MERN stacks
- Languages I love: C, C++, Python, JavaScript, TypeScript, PHP, Go
- Pursuing PhD in Computer Application (Machine Learning)

Rules and regulations

- The class will begin at 9:00 pm every day (Please join at least 5 minutes before)
- The classes will be conducted from Monday to Thursday
- Every second Friday, a Question Answer Session will be conducted which will be optional. Recording of this class will also be made available through the portal.
- When you are having the doubts, write them down somewhere
- To avoid the class disturbance, at the end of the theoretical discussion, we will spend time taking the questions all at once
- All the classes will be recorded and will be available in the student's portal next day around 10am
- All the source code will be shared in a GitHub repository