1. Python Programming

Python Basics

- Python Intro
- Python Installation
- Python Syntax
- Python Comments
- Python Variables
- Python Data Types
- Python Numbers
- Python Casting
- Python Strings
- Python Booleans
- Python Operators
- Python User Input
- Python Output

Python Collections

- Python Lists
- Python Tuples
- Python Sets
- Python Dictionaries
- List Comprehensions
- Dictionary Comprehensions
- Set Comprehensions

Control Flow

- Python If Else
- Nested If
- Match Case
- While Loops
- For Loops
- Break
- Continue
- Pass

Functions

- Functions
- Arguments
- Keyword Arguments
- Default Arguments
- *args
- **kwargs

- Lambda Functions
- Recursion
- Scope

Modules

- Modules
- Packages
- Virtual Environment
- Pip
- Requirements.txt

Regular Expressions

- Regex Basics
- Pattern Matching

JSON

- JSON Parsing
- JSON Serialization

Date and Time

- datetime
- timedelta
- timezone

File Handling

- Read Files
- Write Files
- Append Files
- Delete Files

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2. Object Oriented Programming (OOP)

OOP Basics

- Classes
- Objects
- **init**()
- self
- Attributes

- Methods

OOP Concepts

- Encapsulation
- Inheritance
- Polymorphism
- Abstraction

Advanced OOP

- Method Overloading
- Method Overriding
- Class Variables
- Static Methods
- Class Methods
- Magic Methods
- Property Decorators

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3. NumPy

Introduction

- NumPy Intro
- NumPy Installation
- Creating Arrays

Array Operations

- Indexing
- Slicing
- Reshaping
- Flattening
- Iterating

Data Types

- NumPy Data Types
- Type Conversion

Array Manipulation

- Copy vs View
- Join

- Split
- Insert
- Delete
- Append
- Concatenate
- Stack

Searching & Sorting

- Search
- Sort
- Argsort
- Filter
- Where

Mathematical Operations

- Arithmetic Operations
- Broadcasting
- Universal Functions (ufuncs)

Statistical Functions

- Mean
- Median
- Mode
- Variance
- Standard Deviation
- Percentiles

Linear Algebra

- Matrix Creation
- Matrix Multiplication
- Dot Product
- Determinant
- Inverse
- Eigenvalues
- Eigenvectors
- SVD

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4. Pandas

Introduction

- Pandas Intro
- Installation
- Series
- DataFrame

Data Loading

- CSV
- Excel
- JSON
- SQL

Data Inspection

- head()
- tail()
- info()
- describe()

Selection

- loc[]
- iloc[]
- Filtering

Data Cleaning

- Missing Values
- Duplicates
- Outliers
- Data Formatting

Data Manipulation

- Sorting
- Merging
- Joining
- Concatenation
- GroupBy
- Aggregation

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5. Data Visualization

Matplotlib

- Line Plot
- Scatter Plot
- Bar Plot
- Pie Chart
- Histogram
- Subplots
- Annotations

Seaborn

- Distribution Plot
- Pair Plot
- Heatmap
- Box Plot
- Violin Plot

Plotly

- Interactive Charts
- Dashboards

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6. Statistics for AI

Descriptive Statistics

- Mean
- Median
- Mode
- Variance
- Standard Deviation

Probability

- Probability Basics
- Conditional Probability
- Bayes Theorem

Distributions

- Normal Distribution
- Binomial Distribution
- Poisson Distribution

Hypothesis Testing

- T-Test
- Z-Test
- Chi-Square Test
- ANOVA

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7. Machine Learning

Introduction

- AI
- ML
- DL
- Generative AI

Data Preprocessing

- Scaling
- Encoding
- Feature Engineering

Supervised Learning

- Linear Regression
- Logistic Regression
- KNN
- Naive Bayes
- Decision Trees
- Random Forest
- SVM
- Gradient Boosting
- XGBoost

Unsupervised Learning

- KMeans
- DBSCAN

- Hierarchical Clustering
- PCA

Model Evaluation

- Accuracy
- Precision
- Recall
- F1 Score
- ROC-AUC

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8. Deep Learning

Neural Networks

- Perceptron
- Activation Functions
- Loss Functions

Frameworks

- TensorFlow
- Keras
- PyTorch

Training

- Forward Propagation
- Backpropagation
- Gradient Descent
- SGD
- Adam Optimizer

CNN

- Image Classification
- Object Detection

RNN

- Sequence Models
- LSTM
- GRU

Transformers

- Attention Mechanism
- Self Attention
- Multi Head Attention

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9. Natural Language Processing (NLP)

NLP Basics

- Text Processing
- Tokenization
- Stemming
- Lemmatization

Feature Engineering

- Bag of Words
- TF-IDF
- Word2Vec
- FastText
- GloVe

NLP Models

- RNN
- LSTM
- Transformers

Libraries

- NLTK
- SpaCy
- Gensim

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10. Large Language Models (LLMs)

Foundation

- What is an LLM
- Transformer Architecture

- Attention Mechanism
- Positional Encoding

Popular Models

- OpenAI GPT Models
- Meta Llama
- Google Gemini
- Mistral AI Models

LLM Concepts

- Tokens
- Context Window
- Embeddings
- Temperature
- Top-K
- Top-P

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11. Hugging Face Ecosystem

Hugging Face Basics

- Transformers
- Datasets
- Tokenizers
- Pipelines

Model Usage

- Text Generation
- Summarization
- Translation
- Question Answering

Fine Tuning

- Trainer API
- PEFT
- LoRA
- QLoRA

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12. Prompt Engineering

Basics

- Zero Shot Prompting
- One Shot Prompting
- Few Shot Prompting

Advanced

- Chain of Thought
- Tree of Thoughts
- ReAct
- Self Consistency

Structured Output

- JSON Output
- Function Calling
- Tool Calling

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13. Embeddings & Vector Databases

Embeddings

- Sentence Embeddings
- Semantic Search

Vector Databases

- Pinecone
- Weaviate
- Chroma
- Milvus

Similarity Search

- Cosine Similarity
- Euclidean Distance

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14. Retrieval-Augmented Generation (RAG)

RAG Basics

- Retrieval
- Chunking
- Embeddings
- Vector Search

Advanced RAG

- Hybrid Search
- Reranking
- Parent Child Retrieval
- Graph RAG
- Multi Query Retrieval

Frameworks

- LangChain
- LlamaIndex
- Haystack

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15. AI Agents

Agent Basics

- Agent Architecture
- Tool Usage
- Memory

Frameworks

- LangChain Agents
- LangGraph
- CrewAI
- AutoGen

Agent Workflows

- Single Agent

- Multi Agent
- Autonomous Agents

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16. LangChain

Core Concepts

- Models
- Prompts
- Chains
- Memory
- Tools

Advanced

- Agents
- RAG
- LangSmith
- LangServe

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17. Fine Tuning LLMs

Fine Tuning

- Dataset Preparation
- Instruction Tuning
- Supervised Fine Tuning

Efficient Fine Tuning

- LoRA
- QLoRA
- PEFT

Evaluation

- BLEU
- ROUGE
- BERTScore

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18. Multimodal AI

Image Models

- Image Classification
- Object Detection
- Image Captioning

Generative Models

- GANs
- Diffusion Models

Vision Language Models

- CLIP
- BLIP
- GPT-4V Style Systems