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PINEAPPLE EDUCATION
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PROFESSIONAL AI & MACHINE LEARNING PROGRAM | CAREER-FOCUSED CURRICULUM

Learning Roadmap

A visual path through the complete 10-module AI & Machine Learning curriculum.

6 Months	10 Modules	Projects + Career Prep
Program Duration	Complete Curriculum	Applied Learning

01 Foundations & Career Orientation
Foundation | 1 Week

02 Python & Data Analysis for AI
Programming & Analysis | 4 Weeks

03 Mathematics & Statistics for ML
Mathematical Foundations | 2 Weeks

04 Machine Learning
Core Algorithms | 4 Weeks

05 Deep Learning
Neural Networks & Vision | 4 Weeks

06 NLP & Generative AI
Language Models & LLMs | 3 Weeks

07 MLOps & Deployment
Production Skills | 1 Week

08 Real-World Projects
Applied Practice | 2 Weeks

09 Interview Preparation
Career Readiness | 1 Week

10 Capstone Project
End-to-End Delivery | 2 Weeks

Tools & Technologies

Python · NumPy · Pandas · Matplotlib · Seaborn · SQL · Scikit-learn · XGBoost · TensorFlow · Keras · PyTorch · Hugging Face · LangChain · FastAPI · Streamlit · Docker · MLflow · Git & GitHub · Google Colab · Jupyter

Career Pathways

Machine Learning Engineer · AI Engineer · Data Scientist · NLP / GenAI Developer · Computer Vision Engineer · MLOps Engineer

01

MODULE 01

Foundations & Career Orientation

DURATION: 1 WEEK

Foundation-level orientation to AI and machine learning, essential computing concepts, software setup, and career readiness.

Topics Covered

- Introduction to AI, ML, DL & Generative AI
- AI vs Data Science vs Data Analytics
- AI/ML Career Paths & Job Roles
- ML Project Life Cycle (CRISP-DM)
- Data Life Cycle
- Types and Categories of Data
- Structured vs Unstructured Data
- Common Data File Formats (CSV, Excel, JSON, XML, Parquet)
- Real-World AI Use Cases
- Responsible AI & Ethics Basics
- Software Installation and Environment Setup

Software to Install

- Python (Anaconda)
- Visual Studio Code
- Jupyter Notebook
- Google Colab
- MySQL or PostgreSQL
- Git and GitHub
- Kaggle Account

Assignment

- Install and verify all required software
- Create and configure a GitHub account
- Download and organize practice datasets from Kaggle
- Write a one-page note on an AI use case in any industry

LEARNING OUTCOME

Understand the AI/ML landscape, set up a professional working environment, and map a clear career path before moving into hands-on modules.

02

MODULE 02

Python & Data Analysis for AI

DURATION: 4 WEEKS

Practical Python programming for data handling, analysis, visualization, and reusable analytical workflows.

Python Basics

Variables | Data Types | Operators | Strings | Lists | Tuples | Dictionaries | Sets | Type Casting | Input and Output

Control Flow

IF | ELIF | ELSE | For and While Loops | Break | Continue | Pass | List and Dict Comprehensions

Functions

User-Defined Functions | Arguments & Keyword Arguments | Lambda Functions | Map | Filter | Reduce | Generators | Decorators (Basics)

Object-Oriented Programming (OOP)

Classes | Objects | Constructors | Inheritance | Polymorphism | Encapsulation

File Handling

Read Files | Write Files | CSV Files | Excel Files | JSON Files

Exception Handling

Try | Except | Finally | Raise

Environment & Packaging

pip | Virtual Environments | Conda | requirements.txt | Modules and Packages

02

MODULE 02 | CONTINUED

Python & Data Analysis for AI

DURATION: 4 WEEKS

Core analytical libraries and SQL for numerical work, data manipulation, visualization, and exploratory analysis.

NumPy

- Arrays
- Indexing and Slicing
- Broadcasting
- Vectorization
- Mathematical Operations
- Linear Algebra Routines

Pandas

- Series
- DataFrame
- Indexing (loc / iloc)
- Merge and Join
- GroupBy
- Pivot
- Missing Values
- Data Cleaning
- Date-Time Handling

Matplotlib

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

Seaborn

- Heatmap
- Pairplot
- Boxplot
- Violin Plot
- Distribution Plots

SQL for ML Data Access

- SELECT
- WHERE
- GROUP BY
- HAVING
- INNER / LEFT JOIN
- Subqueries
- CTE
- Window Functions
- Python + SQL Connectivity

Exploratory Data Analysis (EDA)

- Data Profiling
- Outlier Detection
- Correlation Analysis
- Feature Distributions
- Data Storytelling

ANALYTICAL WORKFLOW

Load -> Clean -> Explore -> Visualize -> Explain

03

MODULE 03

Mathematics & Statistics for ML

DURATION: 2 WEEKS

Mathematical and statistical foundations required to understand how models learn, evaluate relationships, and support evidence-based decisions.

Linear Algebra

- Scalars
- Vectors
- Matrices
- Matrix Operations
- Dot Product
- Determinant and Inverse
- Eigenvalues & Eigenvectors
- SVD (Introduction)

Calculus for ML

- Derivatives
- Partial Derivatives
- Gradients
- Chain Rule
- Gradient Descent
- Loss Surfaces

Probability

- Basic Probability
- Conditional Probability
- Bayes' Theorem
- Random Variables
- Normal Distribution
- Binomial Distribution
- Poisson Distribution
- Expectation and Variance

Descriptive Statistics

- Mean
- Median
- Mode
- Variance
- Standard Deviation
- Percentiles
- Quartiles
- Skewness and Kurtosis

Inferential Statistics

- Sampling
- Central Limit Theorem
- Confidence Intervals
- Hypothesis Testing
- p-value
- t-test
- Chi-Square Test
- ANOVA
- Correlation
- Regression Analysis
- A/B Testing

WHAT THIS MODULE SUPPORTS

Understand the mathematics behind ML algorithms. Summarize data with the right measures. Compare groups and relationships responsibly, and communicate evidence clearly.

04

MODULE 04

Machine Learning

DURATION: 4 WEEKS

Core supervised and unsupervised learning algorithms, feature engineering, model evaluation, and tuning using industry-standard tools.

ML Fundamentals

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning (Intro)
- Bias-Variance Tradeoff
- Overfitting & Underfitting
- Train-Test Split
- Cross-Validation

Data Preprocessing & Feature Engineering

- Missing Value Treatment
- Encoding Categorical Data
- Feature Scaling
- Outlier Handling
- Feature Selection
- Dimensionality Reduction (PCA)
- Imbalanced Data (SMOTE)

Regression Algorithms

- Linear Regression
- Multiple Regression
- Polynomial Regression
- Ridge
- Lasso
- ElasticNet

Classification Algorithms

- Logistic Regression
- K-Nearest Neighbors
- Naive Bayes
- Support Vector Machines
- Decision Trees

Ensemble Learning

- Bagging
- Random Forest
- Boosting
- AdaBoost
- Gradient Boosting
- XGBoost
- LightGBM

04

MODULE 04 | CONTINUED

Machine Learning

DURATION: 4 WEEKS

Clustering, evaluation metrics, hyperparameter optimization, and specialized applications with hands-on practice.

Unsupervised Learning

K-Means | Hierarchical Clustering | DBSCAN | PCA | Anomaly Detection

Model Evaluation

MAE | MSE | RMSE | R-Squared | Accuracy | Precision | Recall | F1-Score | ROC-AUC | Confusion Matrix

Model Optimization

GridSearchCV | RandomizedSearchCV | Scikit-learn Pipelines | Hyperparameter Tuning | Model Selection

Specialized Topics

Recommendation Systems | Time Series Forecasting | ARIMA Basics | Model Explainability (SHAP)

Hands-On Practice

- House price prediction using regression models
- Customer churn classification with ensemble methods
- Customer segmentation using clustering
- End-to-end ML pipeline with evaluation report

MACHINE LEARNING OUTCOME

Select, train, evaluate, and tune the right model for a business problem, and explain the result with the right metrics.

05

MODULE 05

Deep Learning

DURATION: 4 WEEKS

Neural network fundamentals, modern frameworks, computer vision, and sequence modelling for complex, unstructured data.

Neural Network Foundations

Perceptron | Artificial Neural Networks (ANN) | Activation Functions | Loss Functions | Forward & Backpropagation | Optimizers (SGD, Adam, RMSprop) | Dropout | Batch Normalization | Weight Initialization

Frameworks & Training Practice

TensorFlow | Keras | PyTorch | Tensors and Autograd | Training Loops | Callbacks & Early Stopping | Google Colab GPU

CNN & Computer Vision

Convolution and Pooling | CNN Architectures (LeNet, VGG, ResNet) | Image Classification | Data Augmentation | Transfer Learning | Object Detection (YOLO Intro) | Image Segmentation (Intro)

Sequence Models

RNN | LSTM | GRU | Sequence Prediction | Time Series with Deep Learning

Advanced Topics

Autoencoders | GANs (Introduction) | Hyperparameter Tuning | Model Compression (Intro)

DEEP LEARNING OUTCOME

Design, train, tune, and evaluate neural networks for images, sequences, and tabular data using TensorFlow/Keras and PyTorch.

06

MODULE 06

NLP & Generative AI

DURATION: 3 WEEKS

Natural language processing, transformer architectures, and practical Generative AI application development.

NLP Fundamentals

- Text Cleaning
- Tokenization
- Stemming
- Lemmatization
- Stop Words
- POS Tagging
- Bag of Words
- TF-IDF
- N-grams

Classic NLP Applications

- Text Classification
- Sentiment Analysis
- Named Entity Recognition (NER)
- Topic Modeling
- Spam Detection

Word & Sentence Embeddings

- Word2Vec
- GloVe
- Sentence Embeddings
- Semantic Similarity

Transformers & LLMs

- Attention Mechanism
- Transformer Architecture
- BERT
- GPT
- Hugging Face Transformers
- Fine-Tuning Basics
- LoRA (Introduction)

Generative AI Applications

- Prompt Engineering
- LLM APIs
- Vector Databases (FAISS, Chroma)
- Retrieval-Augmented Generation (RAG)
- LangChain
- AI Agents (Intro)
- Chatbot Development

Responsible & Safe AI

- Hallucinations
- Bias and Fairness
- Guardrails
- LLM Evaluation
- Data Privacy

GENERATIVE AI OUTCOME

Build and evaluate NLP pipelines and LLM-powered applications such as chatbots and document Q&A systems.

07

MODULE 07

MLOps & Deployment

DURATION: 1 WEEK

Turning trained models into reliable, shareable applications with versioning, containerization, and monitoring basics.

Model Packaging

- Pickle
- Joblib
- ONNX (Introduction)
- Model Versioning

Serving Models as APIs

- REST API Basics
- Flask
- FastAPI
- Request & Response Validation

Web Apps & Demos

- Streamlit
- Gradio
- Hugging Face Spaces

Containers & Cloud

- Docker Basics
- Cloud Overview (AWS, Azure, GCP)
- Deploying on Cloud

Tracking & Automation

- Git and GitHub
- MLflow
- DVC (Introduction)
- GitHub Actions (CI/CD Basics)

Monitoring

- Model Monitoring
- Data Drift
- Retraining Strategy

DEPLOYMENT OUTCOME

Take a trained model from notebook to a live application with versioning, containerization, and basic monitoring in place.

08

MODULE 08

Real-World Projects

DURATION: 2 WEEKS

Applied portfolio work designed to reinforce modelling, deployment, insight generation, and presentation skills.

01	**House Price Prediction** Regression	02	**Customer Churn Prediction** Classification
03	**Credit Card Fraud Detection** Banking & Finance	04	**Loan Default Risk Model** Banking & Finance
05	**Movie Recommendation System** Media & Entertainment	06	**Sales Demand Forecasting** Retail & Time Series
07	**Image Classification with CNN** Computer Vision	08	**Sentiment Analysis on Reviews** NLP
09	**Document Q&A Chatbot** Generative AI (RAG)	10	**Deployed ML Web App** MLOps & Deployment

Project Standards

- Version-control every project on GitHub with a clear README
- Document the problem, data, method, results, and limitations
- Present findings in clear business language

PORTFOLIO PRACTICE

Projects span finance, retail, e-commerce, healthcare, banking, media, and generative AI to build a diverse, job-ready portfolio.

09

MODULE 09

Interview Preparation

DURATION: 1 WEEK

Structured preparation for technical interviews, business case discussions, portfolio presentation, resume development, and mock interviews.

Technical Preparation

- Python Coding Questions
- SQL Interview Questions
- Statistics & Probability Questions
- Machine Learning Theory
- Deep Learning Questions
- NLP & Generative AI Questions
- ML System Design (Basics)
- MLOps Questions

Career Readiness

- Case Studies
- Resume Building
- LinkedIn & GitHub Profile
- Mock Interviews
- Portfolio Presentation Practice
- Explain Projects in Business Language

INTERVIEW GOAL

Help learners explain not only which algorithms and tools they used, but also the business problem, data, method, result, limitations, and recommended next action.

10

MODULE 10

Capstone Project

DURATION: 2 WEEKS

A complete end-to-end AI/ML project integrating data preparation, modelling, deployment, business insights, and professional documentation.

01 **Problem Definition & Data Collection**
CAPSTONE STAGE

02 **Data Cleaning & Preprocessing**
CAPSTONE STAGE

03 **EDA & Feature Engineering**
CAPSTONE STAGE

04 **Model Building & Evaluation**
CAPSTONE STAGE

05 **Optimization & Explainability**
CAPSTONE STAGE

06 **Deployment (API / Web App)**
CAPSTONE STAGE

07 **Final Presentation**
CAPSTONE STAGE

08 **GitHub Documentation**
CAPSTONE STAGE

Capstone Domains (Choose One)

Healthcare | Finance & Banking | Retail & E-commerce | NLP / Generative AI | Computer Vision | Time Series Forecasting

PROGRAM OUTCOME

A portfolio-ready AI/ML case from raw data to deployed model, final presentation, and documented project workflow.