Course Plan: Approx. Duration: 50 Hours, **Total Live Class:** 25, Watch Demo Class!

Facilities: Live Class, Separate Classroom, Recording Class Access for Lifetime, Certificate

Any Questions? +8801704265972 (Call/WhatsApp)

Course Instructor:

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Founder of aiQuest Intelligence & Study Mart

Master in Data Science (Major Machine Learning) at FAU Erlangen, Germany

www.aiquest.org

AiQuest.org – ML Module Summary

Module 01: Introduction to Data Science & AI

Module 02: Calculus & Linear Algebra for Machine Learning

Module 03: Basic Python

Module 04: Regression Algorithms

Module 05: Feature Engineering

Module 06: Statistics for Data Science

Module 07: Classification Algorithms

Module 08: ML Model Evaluation

Module 09: Unsupervised Learning **[Demo Class]**

Module 10: Hyperparameter Optimization

Module 11: Machine Learning for Time Series

Module 12: Deep Learning & Neural Networks

Let's get into the details.....

Module 01: Introduction to Data Science & Artificial Intelligence (01 - Class & 2.0 hours plan)

- Introduction to Data Science & Artificial Intelligence
- Detailed Explanation & Definition of –
  - Data, Information, Database, Data Warehouse
  - Machine Learning
  - Neural Networks
  - Supervised & Unsupervised Learning
  - Regression, Classification, Clustering
  - NLP, LLMs, & Generative AI
- Future of AI
- Job Market Research
- Data Science Tools

*Q&A: Questions & Answer Session!

Module 02: Linear Algebra for Machine Learning & AI (03 Hours)

- Basic Properties: Notation, Terminologies, Sets, Subsets, Scalars, Vectors, and Matrices
- Vector Spaces & Basis (Subspaces, Linear Independence, Dimension)
- Introduction to Norms
- Column Space, Row Space, Null Space
- Matrix Operations: Addition, Subtraction, Multiplication
- Rank, Trace, Transpose Matrix
- Identity, Diagonal, Sparse & Dense Matrix
- Determinant, Orthogonal, Singular, Non-singular Matrix
- Inverse Matrix, Alternative to Matrix Division
- Covariance and Symmetric Matrices
- Positive-Negative Definite Matrix, Positive Semi-Definite
- Basic Logarithmic Properties
- Linear Transformations
- Eigenvalues & Eigenvectors
- Matrix Reduction: Cramer's Rule, Gaussian Elimination

Module 02: Basic Python (02-Class & 5.0 hours plan)

- IDE Installation
- Variables & Data Types
- Loops & Control Flow
- Functions
- Data Structures
- Intro to -
  - Pandas
  - Numpy
  - Matplotlib & Seaborn
- Discussion on –
  - Scikit-learn, PyCaret
  - Keras, TensorFlow & Pytorch, Hugging Face

*Q&A: Questions & Answer Session!

*Assignment on 100 Basic Python problem-solving

*Quiz Exam (MCQ & Short Questions)

Module 03: Regression Algorithms (03 - Class & 6.0 hours plan)

1. **Linear Regression:**
   - Linear Equations
   - Lines: Straight, Curve
   - Terminologies: Slope/Gradient, Intercept
   - Regularizations:
     - L1 Regularization / Lasso
     - L2 Regularization / Ridge
   - Loss & Cost Functions:
     - MSE
     - MAE
     - RMSE
   - Coefficient of Determination/ R Squared Value/ Performance
   - In-depth Mathematical Intuition of the Least Square Method

- Polynomial Regression maths & implementation
- Implementing Everything with Python, Pandas, Numpy & Sklearn
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

2. **Gradient Descent:**
   - Differential Calculus Basics
   - Convex Vs. Non-convex Functions
   - Cost Function Derivatives
   - In-depth Mathematical Intuition of Gradient Descent for Regression
   - Implementing Regression with Gradient Descent with Python & Numpy
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

*Project on: Time Series Forecasting using Linear Regression, ARIMA & Prophet

3. **K-Nearest Neighbors Regressor (KNN):**
   - Distance Algorithms & Norms
     - Manhattan Distance / L1 Norm
     - Euclidean Distance / L2 Norm
     - Minkowski Distance
   - In-depth Mathematical Intuition of KNN Regressor
   - Implementing Everything with Python & Sklearn
     - Project
   - Complete the Assignment within the Deadline!
   - *Quiz Exam (MCQ & Short Questions)

Module 04: Feature Engineering (04 - Class & 8.0 hours plan)

1. **Categorical Data Encoding:**
   - Type of Variables
   - The measure of Central Tendency
   - NaN Handling

- Label Encoder
- One Hot Encoder
    - Dunny Variable Trap
    - Multicollinearity Problem
- Binary Encoding
- Mean Encoding
- Frequency Encoding
- Ordinal Encoding
- Implementing with Python & Pandas
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

2. **Feature Transformation / Data Scaling:**
   - Concepts of Scaling
   - Standardization / Z Score
       - Mean
       - Standard Deviation
       - Variance
   - Normalization
       - Min Max Normalization
       - Mean Normalization
   - Max Absulate Scaler
   - Robust Scaler
       - Q1
       - Q2
       - Q3
       - IQR
   - Power Transformation
   - Log Transformation
   - Implementing with Python & Pandas
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

3. **Text Data Preprocessing & Feature Extraction / Vectorizer:**
   - Tokenization:
     - Word tokens
     - Character tokens
     - Sentence tokens
     - Named entity tokens.
     - Part-of-speech (POS) tags
     - Sub-word tokens
   - Text Normalization:
     - Stemming
     - Lemmatization
   - Text Visualization
   - Vectorizer:
     - Bag of Words / Count Vectorizer
     - TF Idf Vectorizer:
       - Term Frequency
       - Inverse Document Frequency
     - Word2Vec
   - Implementation of Text Normalization with Python, NLTK & Gensim
   - Implementation of Vectorizer with Python, NLTK & Gensim
   - Complete the Assignment within the Deadline!
   - *Quiz Exam (MCQ & Short Questions)

4. **Feature Selection for High Dimensionality Reduction:**
   - Filter Methods
   - Wrapper Methods
   - Embedded Methods
   - Implementation of Everything with Python
   - We will also learn the mathematics of PCA step-by-step
   - Implementing PCA with Python
   - Linear discriminant analysis (LDA) concepts
   - Complete the Assignment within the Deadline!
   - *Quiz Exam (MCQ & Short Questions)

Module 06: Statistics for Data Science (01 Class & 2.5 Hour Plan)

- Central Tendency, Standard Deviation, Variance
- Skewness
- Data Distributions
- Probability Density Functions
- Probability Theory
- Hypothesis Testing
- Z Scores
- P Value
- Analysis of Variance – ANOVA
- When to use / Where to use?
- Boxplot Concepts
- Outlier Detection
- Implementation of Everything with Python
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

Module 07: Classification Algorithms (07 Class & 14 Hours Plan)

1. **Decision Tree:**
- Gini & Entropy
- Information Gain
- Tree Pruning
- Gini Index
- DT Classifier Vs. DT Regressor
- In-depth Mathematical Intuition of Decision Trees
- Implementing Decision Tree with Python, Tree & Sklearn
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

2. **Logistic Regression:**
   - Concept of Sigmoid
   - Probability function
   - In-depth Mathematical Intuition of Logistic Regression
   - Implementing Logistic Regression with Python & Sklearn
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

3. **Ensemble Learning:**
   - Ensemble Concepts
   - Bagging Vs. Boosting
   - Random Forest Classifier/Regressor
   - ExtraTreesClassifier
   - Gradient Boosting
   - Extreme Gradient Boosting (XGBoost)
   - Adaptive Boosting (AdaBoost)
   - CatBoost Classifier
   - Implementing Everything with Python Project
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

4. **KNN Classifier:**
   - Maths of KNN
   - We will learn the KNN Classifier and KNN Regressor in the Same Class.
   - Implementing Everything with Python
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

5. **Naïve Bayes:**
   - Simple Probability
   - Prior, Posterior, Likelihood
   - Bayes Theorem
   - Naive Bayes Classifiers
     - Gaussian Naive Bayes
     - Bernoulli Naive Bayes
     - Multinomial Naive Bayes
   - Maths
   - In-depth Mathematical Intuition of Naïve Bayes
   - Implementing Everything with Python
   - Project on Text Classification in NLP
   - Complete the Assignment within the Deadline!

   - *Quiz Exam (MCQ & Short Questions)

6. **Support Vector Machine (SVM):**
   - Hyperplane
   - Support Vectors
   - Hard Margin
   - Soft Margin
   - SVM Kernel Tricks
     - Radial Basis Function (RBF) Kernel
     - Linear Kernel
     - Sigmoid Kernel
     - Polynomial Kernel
- In-depth Mathematical Intuition of SVM
- Implementing Everything with Python
  - Project
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

Module 08: ML Model Evaluation & Cross-Validation (01 Class & 02 Hours Plan)

- Confusion Matrix
- Accuracy
- Precision
- Recall
- F1-Score
- Area Under the Curve (AUC)
- Receiver Operating Characteristics (ROC)
- Calculating R Squared Value for Regression
- Cross Validation:
  - KFold
  - Stratified KFold
  - Leave One Out
- Implementing Everything with Python
  - Project
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

Module 09: Unsupervised Learning (01 Class & 02 Hours Plan) [Watch Class]

- Unsupervised Learning Concepts
- Market Basket Analysis
- K-Means Cluster Algorithm
- Elbow Method for Optimal Cluster
- In-depth Mathematical Intuition of K-Means
- Implementing Everything with Python
  - Project
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

Module 10: Hyperparameter Optimization (01 Class & 02 Hours Plan)

- Concept of ML Model Optimization
- Pre-Pruning
- Post-Pruning
- Grid Search
- Random Search
- Bayesian Optimization
- Implementing Everything with Python
    - Project
- Complete the Assignment within the Deadline!

- *Quiz Exam (MCQ & Short Questions)

Module 11: Machine Learning for Time Series (01 Class & 02 Hours)

- Concepts of Stationary & Non-stationary Data
- Dynamic Time Warping Algorithm
- Autoregressive & Moving Average Model
- ARIMA, SARIMA, and Prophet Algorithm
- Project on Time Series
- *Quiz Exam (MCQ & Short Questions)

Module 12: Deep Learning & Neural Networks (04/05 Classes & 10 Hour Plan)

- Concepts of Perceptron
- Perceptron Vs. MLPs
- Neural Network Architecture
- Activation Functions
- Optimizer Algorithm (In-depth Maths):
    - Gradient Decent
    - Adam
    - AdaGrad
    - RMSProp
    - Adadelta
    - AMSGrad

- Momentum
- Nesterov Momentum (NAG)
- ANNs Architecture & Maths
- Convolutional Neural Network – CNNs Architecture & Maths
- RNN Architechtures & Maths
- Gated Model & LSTM Architectures & Maths
- In-depth Discussion (Mathematical Operations)
- Python Implementations and Project
- *Quiz Exam (MCQ & Short Questions)

Guidelines for Future Research / Jobs / Study Abroad:

- Qualification Testing
- Job Searching
- CV Making Formats
- Resource Sharing for Further Learning

- Final Quiz Exam

- Final Project Submission

Note: We will increase the number of classes if required. After completing this course, you will be able to understand everything that is mentioned in the module. You must submit all the assignments & projects to get a course certificate.

Contact Details:

Join Our Facebook Group: Join Now!

Call us: **+8801704265972** (Direct Call / WhatsApp)

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