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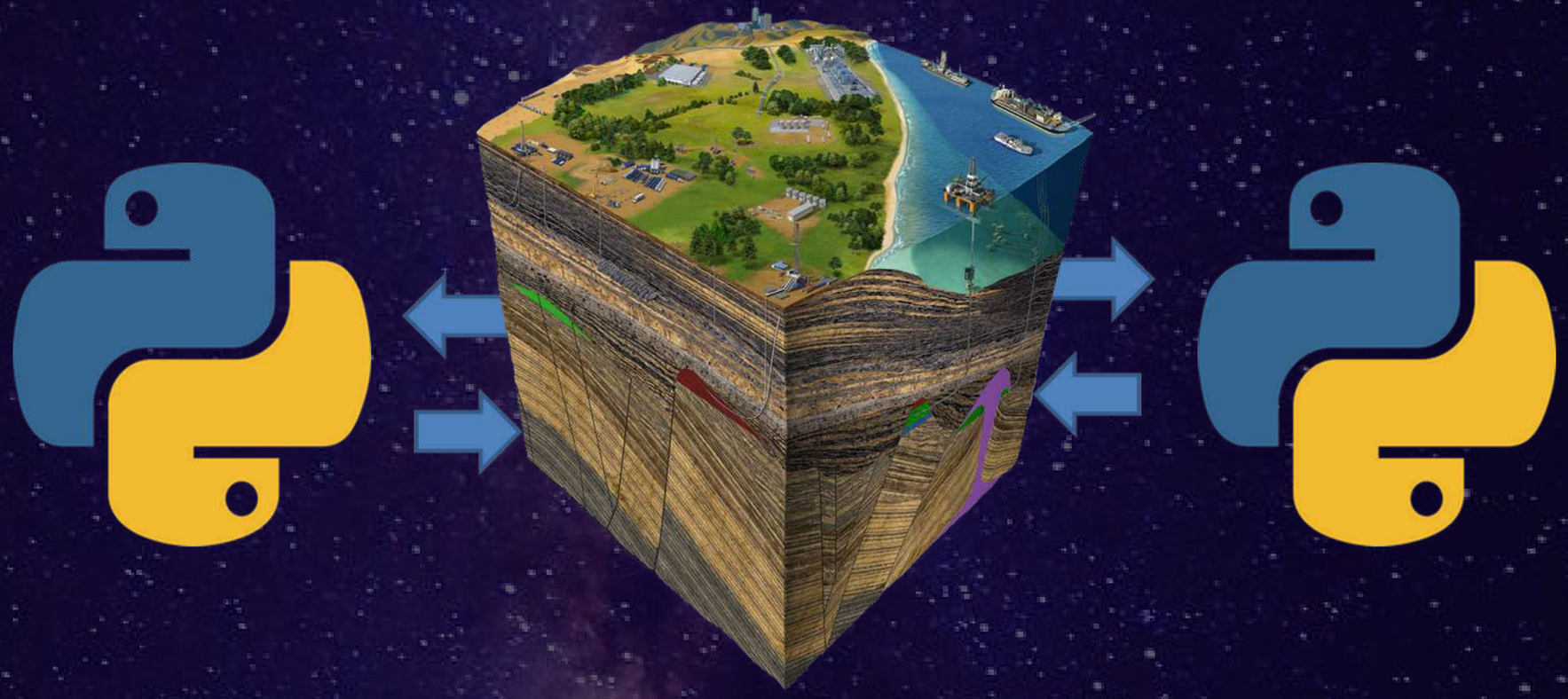
PETROLEUM ENGINEERS ASSOCIATION

ACCREDITED

ISO 9001:2015

2 Weeks Practical Training On

Machine Learning For Reservoir & Production Engineering



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OVERVIEW:

Participants will delve into fundamental AI concepts, explore machine learning techniques, delve into deep learning and neural networks, engage in real-world AI project development.

This course will initially highlight the principles and applications of petroleum reservoir engineering data. Throughout the course, participants will engage in hands-on activities, projects, and exercises to reinforce the concepts covered in each module.

By the end of the course, attendees will have gained a solid understanding of how Python and machine learning can be applied to various aspects of petroleum engineering, from data analysis to prediction and optimization. The order and depth of each module can be adjusted based on the duration of the course and the prior knowledge level of the participants.
Additionally, including interactive elements, real-world case studies, and practical exercises will enhance the learning experience and ensure that participants can apply the concepts effectively in their roles.

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WHO SHOULD ATTEND

- Petroleum / Reservoir / Production Engineers: engineers with a desire to automate processes, analyze large datasets, optimize operations, and make data-driven decisions using programming and machine learning techniques would be the primary audience. This includes engineers involved in reservoir modeling, production optimization, drilling engineering, and more.

- Technical Managers: Managers overseeing technical teams could benefit from understanding the capabilities of Python and machine learning to guide decisionmaking and project planning in the petroleum industry.

- Students and Researchers: Students studying petroleum engineering or related fields could use this course to enhance their technical skills and gain a competitive advantage in the job market. Researchers interested in applying machine learning to solve industry challenges could also benefit.

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PREREQUISITES

BASIC KNOWLEDGE OF PETROLEUM ENGINEERING:

Participants should have a foundational understanding of petroleum engineering principles, terminology, and industry practices. Familiarity with concepts such as reservoir engineering, production operations, will be beneficial.

BASICS OF MATHEMATICS AND STATISTICS (PREFERABLE):

A fundamental grasp of mathematics and statistics is essential for comprehending the algorithms and concepts involved in machine learning. Participants should be comfortable with concepts such as linear algebra, probability, and basic statistical analysis.

PROGRAMMING SKILLS (PREFERABLE, BUT NOT REQUIRED):

The course will provide introductory programming content, enabling participants to grasp the fundamentals of coding and effectively use Python for machine learning applications.

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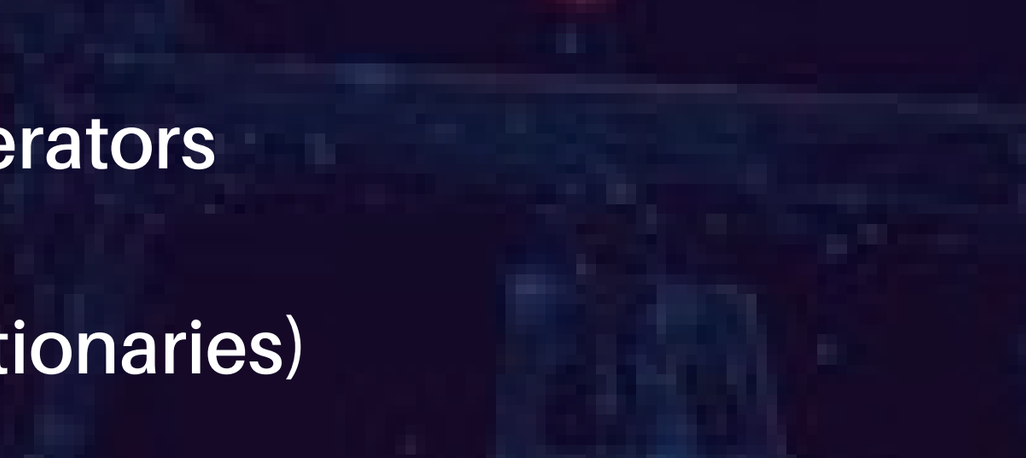
COURSE OUTLINES

MODULE 1: PETROLEUM ENGINEERING DATA & PYTHON OVERVIEW

- Integrated Production System & Data Integration
- Subsurface Engineering Data
- Data Mining & Analytics
- Python for Oil & Gas Industry
- Data Pre-processing
- Python Data Types & Basic Python Functions
  - Variables, Expressions, and Statements
  - Values and Data Types
  - Statements, Expressions & Operators
  - Lists, Indexing & Slicing
  - Data Containers (Lists and Dictionaries)
  - Creating Functions
- Complex Data Structures & Control Flow
  - Dictionaries
  - Data Loops: For & While Loops
- Conditional (IF) Statements



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MODULE 2: PYTHON DATA ANALYSIS & VISUALIZATIONS

- Python Tools & Package Options
- Anaconda Navigator
- Python IDEs (VS Code, Spyder, Jupyter Notebook, etc.)
- Python Libraries
- Data Analysis, Manipulation & Visualizations
  - NumPy
  - Pandas
  - Matplotlib
  - SciPy
  - Seaborn
- Python Machine Learning Libraries
  - Scikit-learn
  - Tensorflow
  - Keras
  - Pytorch
- Descriptive Statistics
  - Histograms
  - Bar Plots
  - Scatter Plots
  - Pie Charts
  - Box Plots
  - Bubble Chart
  - Violin Plot
  - Heat Map
  - Tree Map

- Scikit-learn Machine Learning Algorithms
- Workflow of the Machine Learning Model
- Deploy Machine Learning Models as Interactive APIs

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MODULE 3: PYTHON & MACHINE LEARNING

- Python Libraries for Oil & Gas
  - NeqSim: PVT Modeling
  - GemPy: 3D Geological Modeling
  - Pyscal: Rel-Perm & Cap-Pressure
  - Lasio: Log Reading & Visualizations
  - XTGeo: Subsurface Reservoir Modelling
  - DeepField: Reservoir Simulation
  - Psapy: Production System Analysis
  - PySand: Sand Management
- Overview of Machine Learning
- Supervised and Unsupervised Learning
- Classification and Regression Algorithms
- Unsupervised Learning
  - K-Mean Clustering using Scikit-learn
  - Clustering Oil Wells based on Petrophysical Properties
  - Lithofacies Clustering
  - Electrofacies Grouping
  - K-Nearest Neighbors
  - Random Initialization
  - Choosing the Number of Clusters
  - Hierarchal Clustering and Dendrogram
  - Hierarchal Cluster for Water Cut

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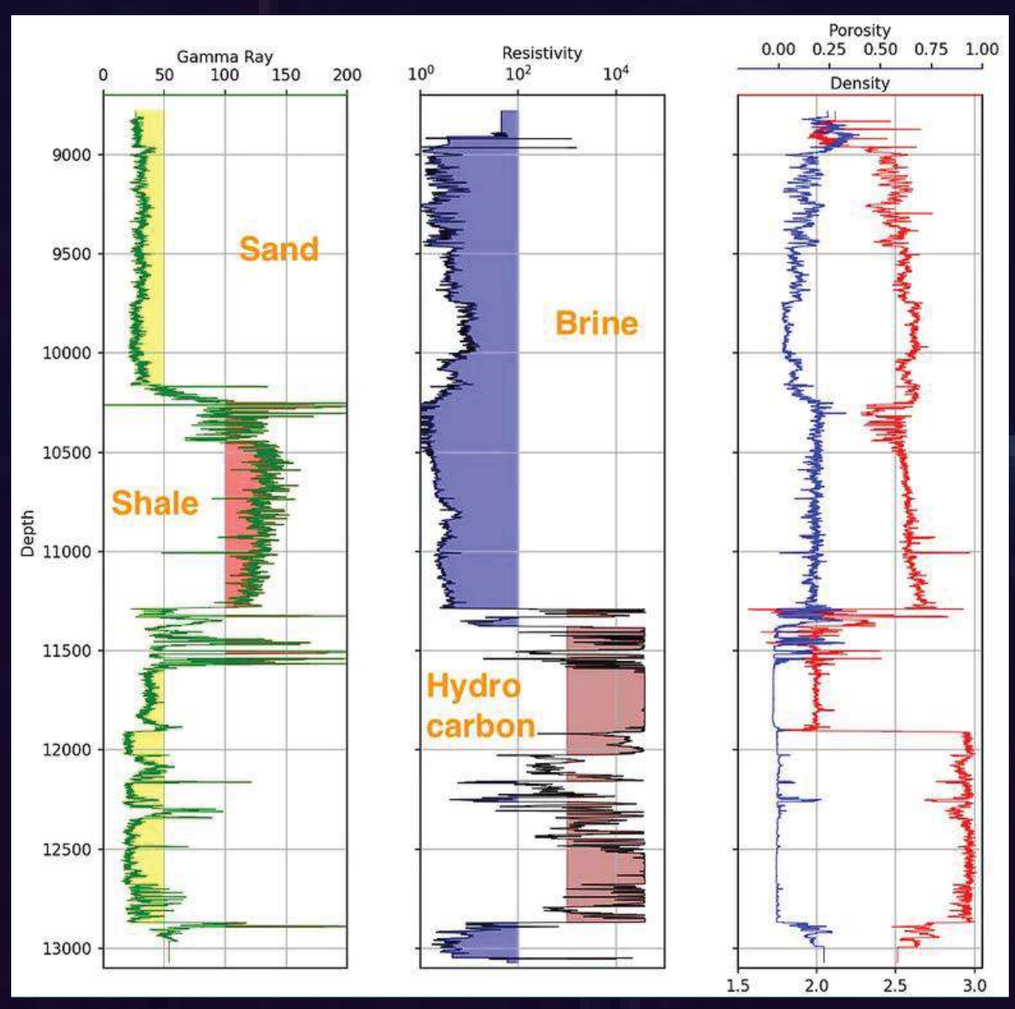
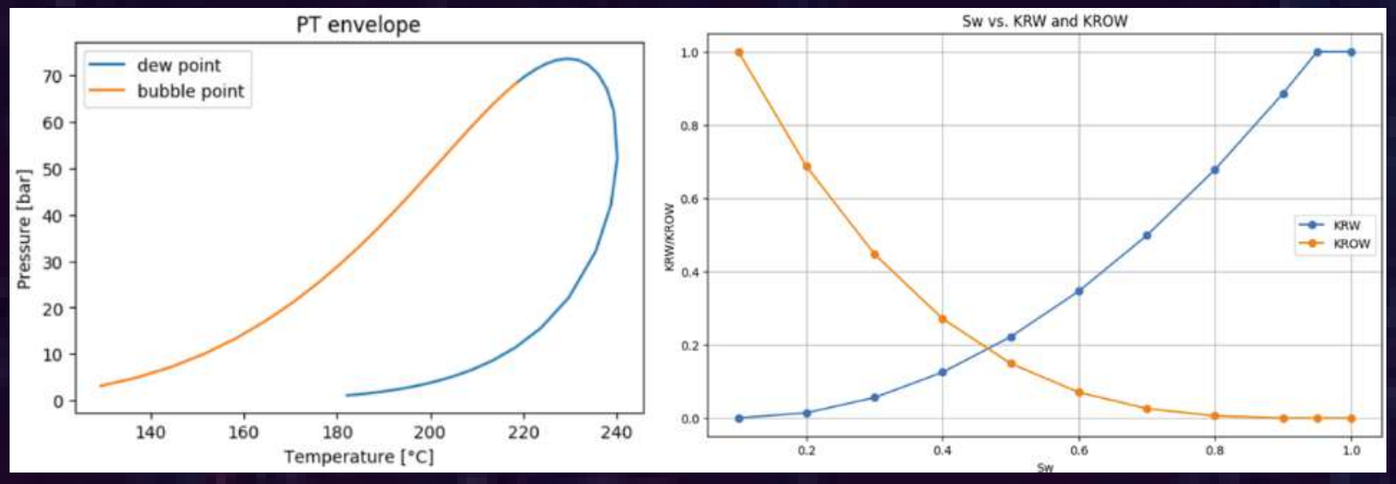
- Classification Techniques
  - Logistic Regression
  - Support Vector Machines (SVM)
  - Decision Tree
  - Random Forest
- Supervised Learning





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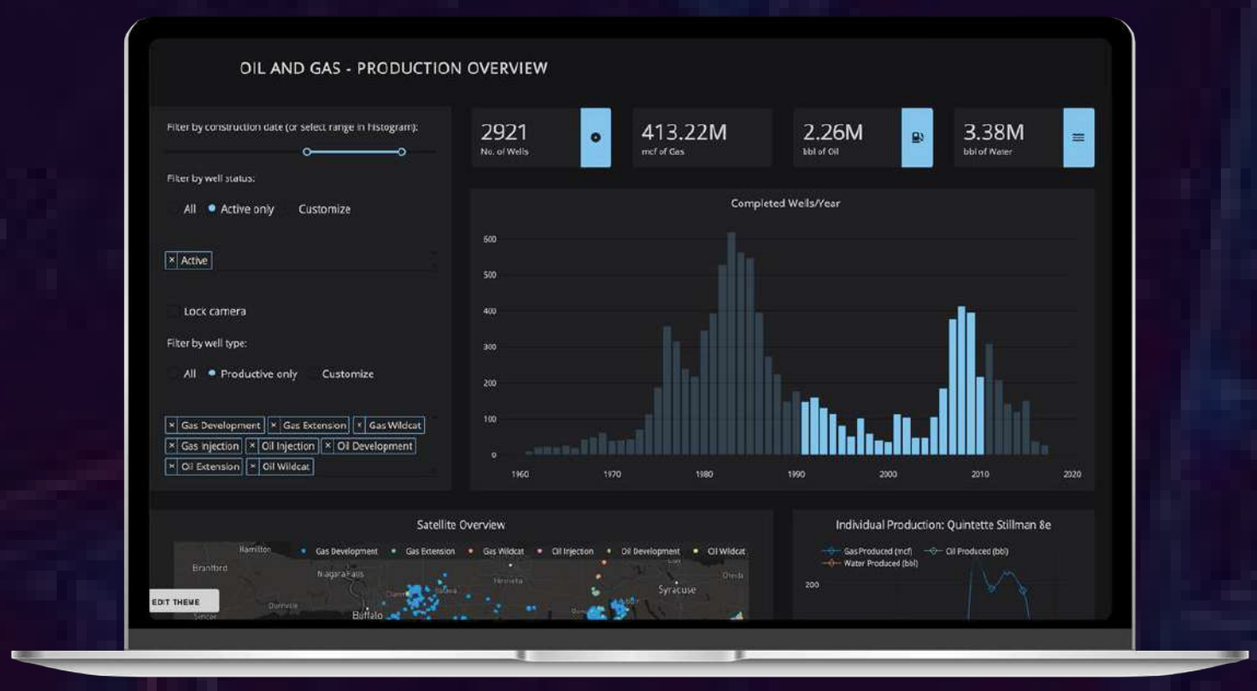
MODULE 4: ARTIFICIAL NEURAL NETWORKS (ANN)

- Overview of Artificial Neural Networks (ANN)
- Model Evaluation and Validation
- Neural Network Architecture & Components
- Activation Functions in Neural Networks
- Back-propagation & Optimization Algorithms
- ANN Model Validation & Testing
- Under-fitting vs Over-fitting
- Bias-Variance Trade-off
- Analysis & Prediction of Reservoir Fluid Properties
- Prediction of PVT Data using Machine Learning Techniques
- Permeability Measurement Techniques
- Permeability Prediction Techniques
- Applications of Artificial Neural Networks for Core-Calibrated Permeability
- Predictions using the Petrophysical Data.



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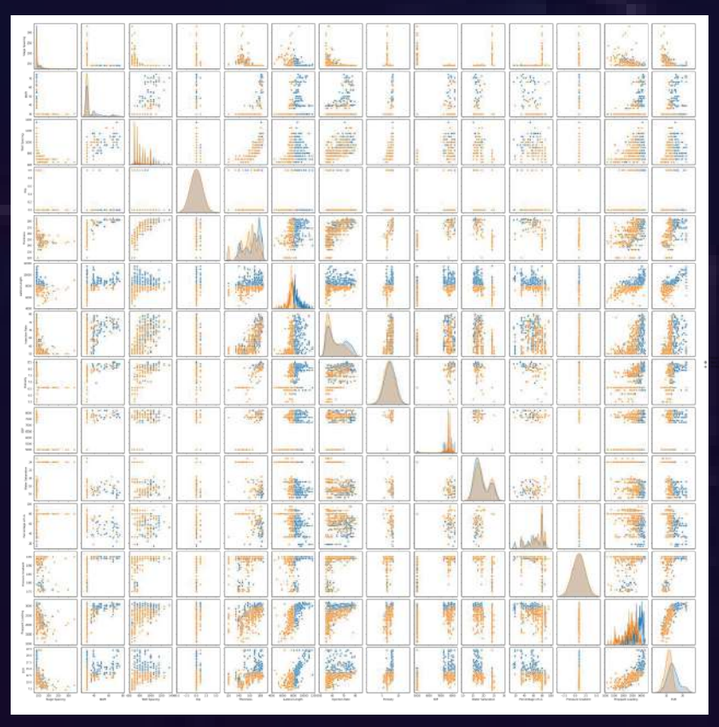
MODULE 5: MACHINE LEARNING & PYTHON DASHBOARDING

- Python Web-Based Dashboarding Libraries:
  - Streamlit
  - Dash (Plotly)
  - Panel (Anaconda)
- Production Analysis Dashboards
- Core & PVT Data Dashboards
- Case Studies and Examples
- Streamlit Library



  - Designing Dynamic Python Applications with Streamlit
  - Interactive Web Applications & Dashborads
  - Streamlit Layout Features
  - State Management and Dynamic Interactions with Streamlit
- Useful Tools for Efficient Coding
- Setting Up Your Development Environment: Anaconda Distribution
- Introduction to Python Programming Basics
- Hands-on Practice: Python Basics using Jupyter Notebook
- Visualizing and Presenting Data Insights
- Artificial Neural Networks: Definitions, Architectures, Types, Training, and Validation.
- Python Project 1: Create Dashboard for Nodal Analysis & Vertical Lift Performance (VLP) Calculations
- Machine Learning Project 2: Drilling Data Optimization

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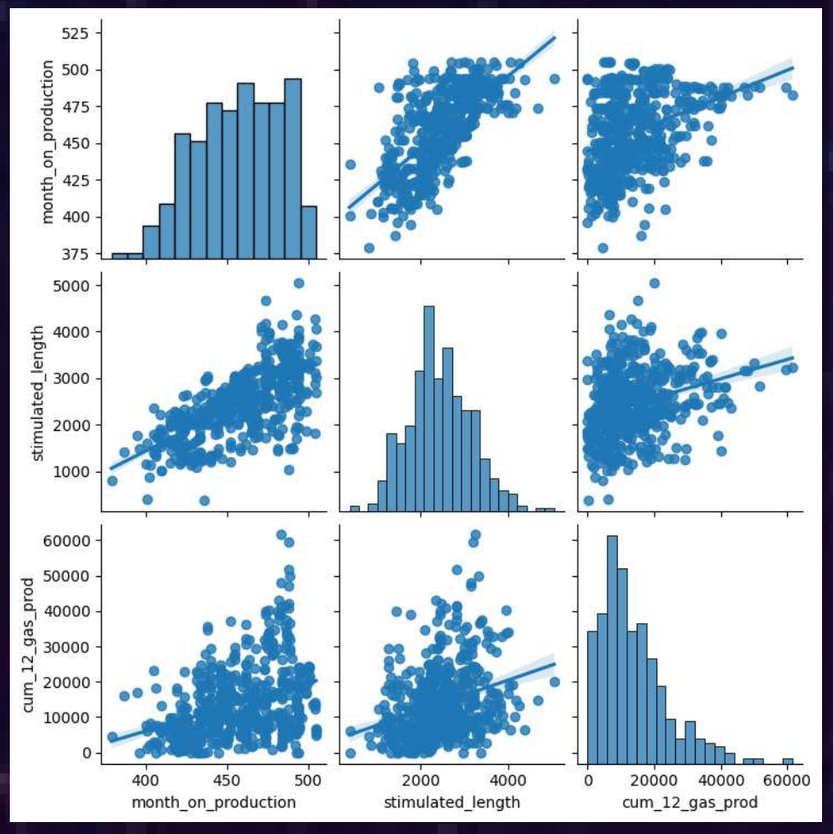
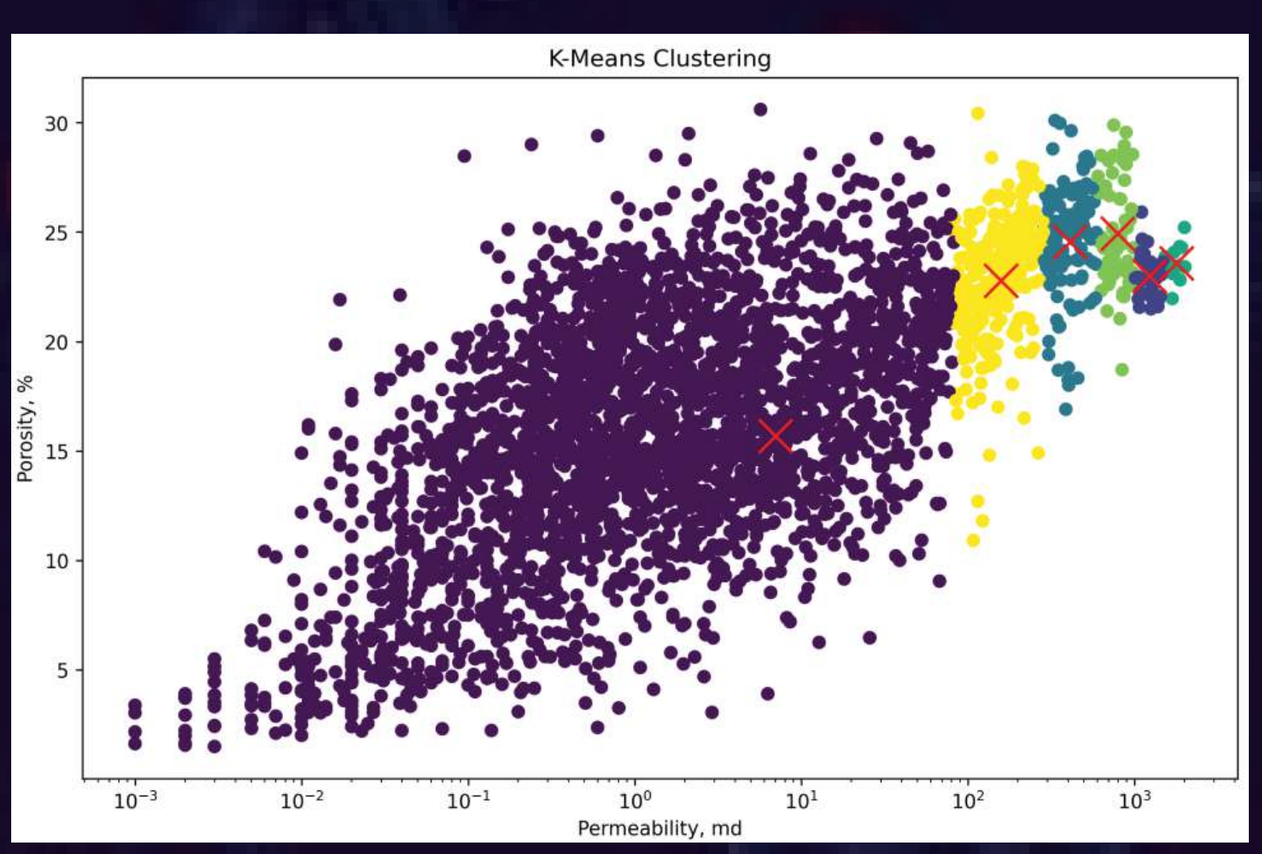
MODULE 6: APPLICATIONS OF MACHINE LEARNING IN THE PETROLEUM INDUSTRY

- Machine Learning Applications in the Petroleum Industry
- Machine Learning Projects in Various Petroleum Engineering Aspects
- Machine Learning Workflows
- Deep Learning Python Libraries Tensorflow & PyTorch
- Case Studies and Examples





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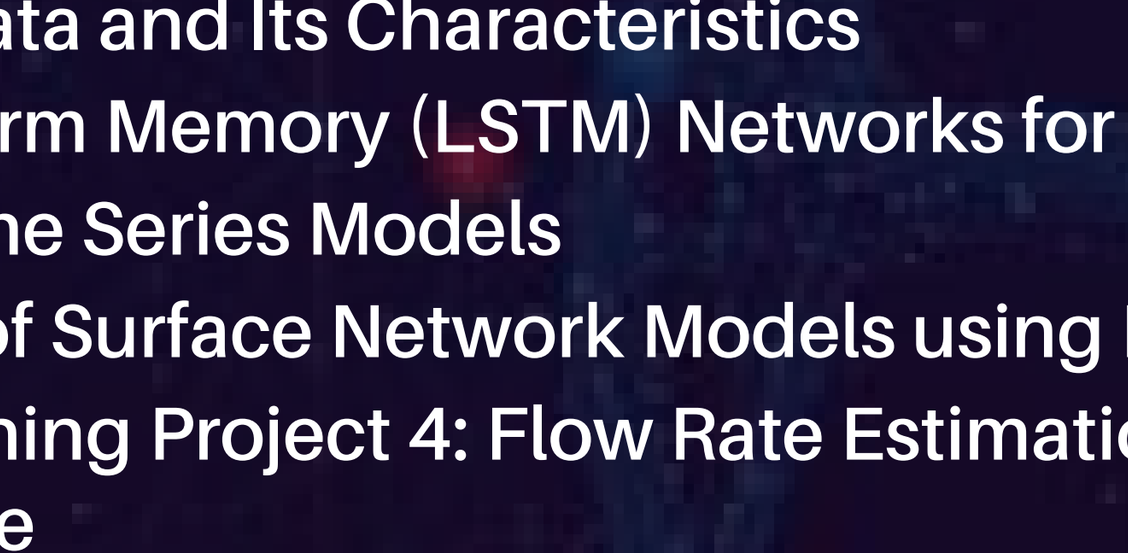
MODULE 7: PYTHON PROGRAMMING TOOLS

- Machine Learning Project 3: Pump Intake Pressure Estimation using Regression Techniques
- Hands-on Project: Data Analysis with Real Petroleum Industry Data
- Handling Data from Various Sources: Files and Formats
- Data Cleaning and Preprocessing Techniques
- Estimating Missing Data and Data Transformation Methods

MODULE 8: DATA & TIME SERIES ANALYSIS

- Time Series Analysis
- Time Series Data and Its Characteristics
- Long Short-Term Memory (LSTM) Networks for Time Series
- Evaluating Time Series Models
- Optimization of Surface Network Models using Machine Learning
- Machine Learning Project 4: Flow Rate Estimation from Pump Intake Pressure
- Simple Model Dashboard: Create Simple Data Input Dashboard uses the Trained Model and Generates the Outputs.



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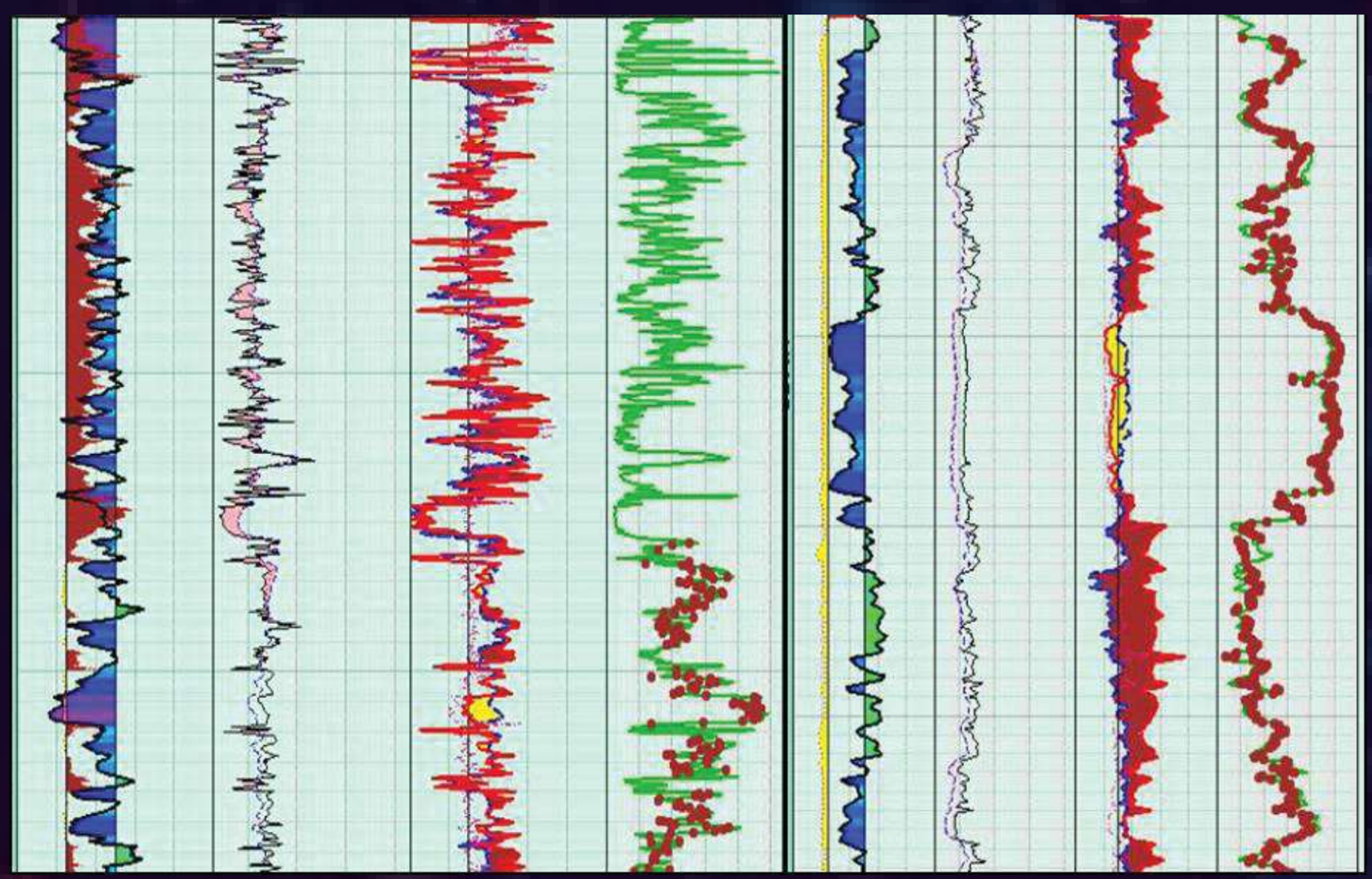
MODULE 9: MACHINE LEARNING PROJECTS (REGRESSION)

- Introduction to Regression Machine Learning Methods.
- Machine Learning Project 5: Learning for Oil Properties Estimation: Oil FVF or Viscosity
- Classification Machine Learning Methods.
- Machine Learning Project 6: Decline Curve Analysis (DCA) & prediction.
- Machine Learning Project 7: Well Logging Analysis Dashboard & Core-calibrated Permeability Predictions.



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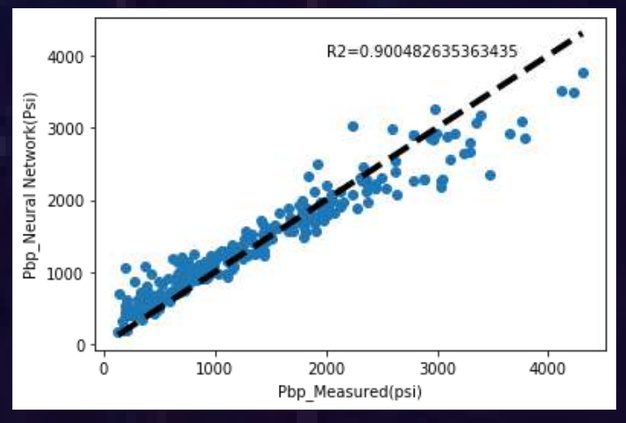
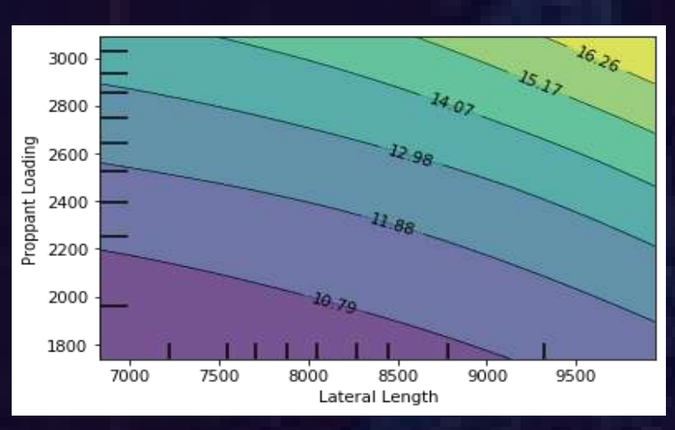
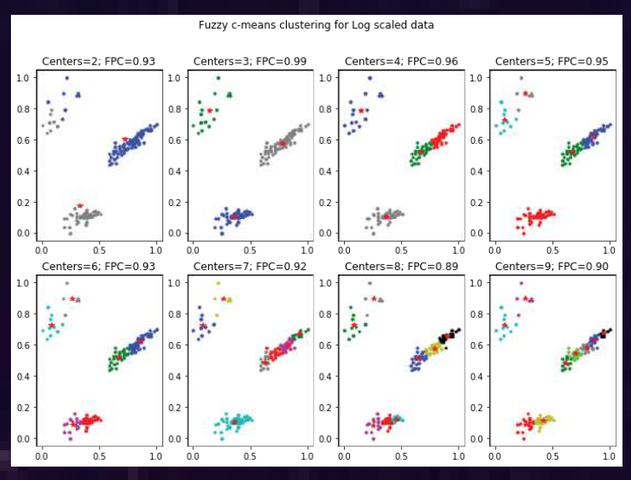
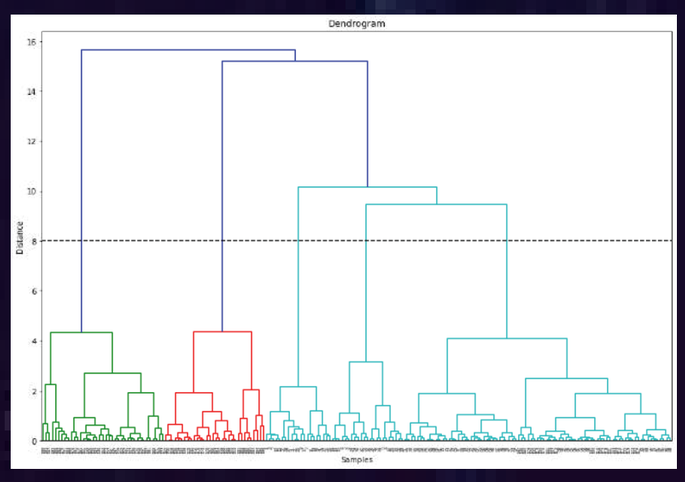
MODULE 10: MACHINE LEARNING PROJECTS (CLASSIFICATION) & TIME SERIES ANALYSIS

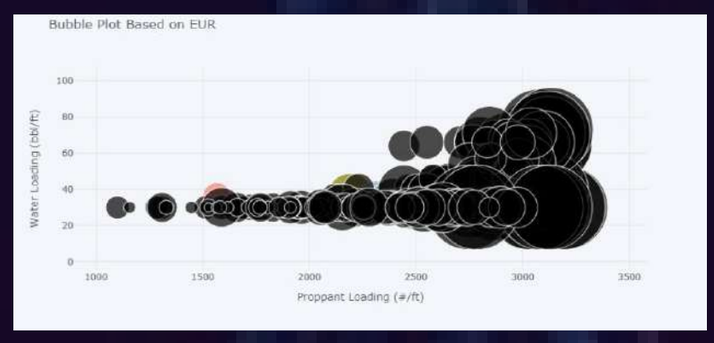
- Machine Learning Project 8: Rock Typing & Hydraulic Flow Units (HFU) Prediction.
- Machine Learning Project 9: Flow Assurance & Scale Formation rediction using Classification Techniques
- Machine Learning Project 10: Predicting Production Performance using Time series

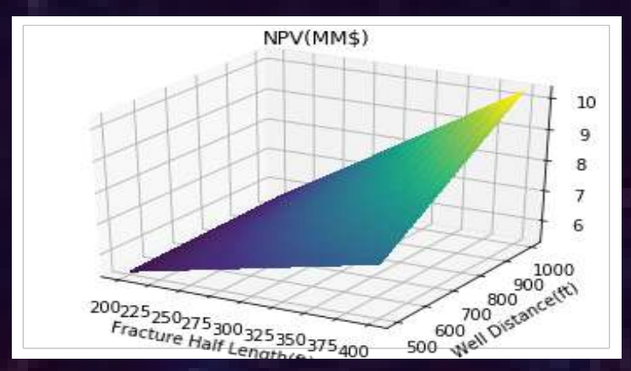


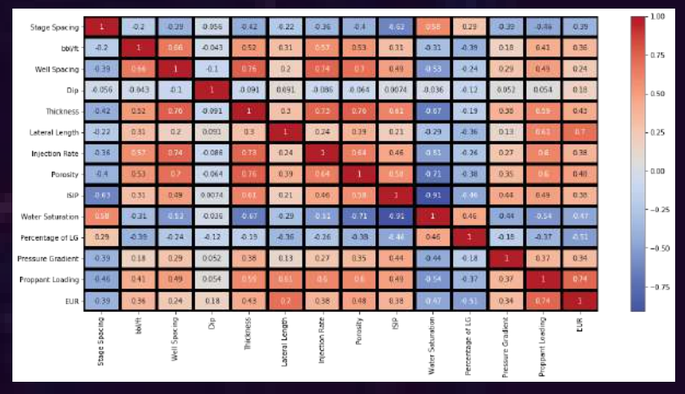












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