TECHNICAL
EDUCATION
ACADEMY

School of Computer Science

COURSE PROGRAMME

000615

ITSP006 – Data Science and Machine Learning in Oil and Gas

In the rapidly evolving technological landscape, data science and machine learning have emerged as transformative forces across a multitude of industries.



Learn from the Best in the Business!

Course overview

Intermediate level

Why take this course

In the rapidly evolving technological landscape, data science and machine learning have emerged as transformative forces across a multitude of industries. The oil and gas industry, traditionally slower to adopt such advancements, is now actively integrating these technologies to enhance operational efficiency and exploration efforts. In response to this growing demand, we have designed a comprehensive training course tailored specifically for professionals in the oil and gas industry who seek to harness the power of data analysis and machine learning in their projects and operations.

The course begins with an introduction to Python, one of the most widely-used programming languages in data science. It emphasizes its industry-specific applications, teaching participants to write efficient Python programs and use its libraries such as NumPy, Pandas, Matplotlib, and SciPy for numerical operations, data input/output, scientific plotting, and interpolation respectively.

The second module dives deeper into data analysis and visualization, honing in on techniques essential for the oil and gas industry. Participants will become proficient in managing data cleansing, creating various visualizations, handling missing data, and interactive plotting using tools such as Plotly.

The third module focuses on production data analysis and forecasting. Here, participants will learn to conduct time-series analysis, visualizing production data, identifying and eliminating outliers, and performing decline curve and uncertainty analyses. These skills are vital in maximizing the efficiency and predictability of production operations in the oil and gas sector.

The course then proceeds to explore the applications of machine learning, both for lithofacies classification and well log synthesis. Participants will be introduced to the workflow of creating and evaluating classification and regression models, enabling them to classify lithofacies and predict well logs effectively.

Finally, the eighth module provides a comprehensive introduction to machine learning fundamentals, touching upon critical concepts such as supervised and unsupervised learning, dimensionality reduction, and explainable machine learning. Practical workshops are woven into this module, allowing participants to put their knowledge into practice by reconstructing wireline logs using random forests and performing outlier detection and clustering.

Upon completion, participants will not only have a solid foundation in Python programming and data analysis but will also understand how to implement machine learning models in their oil and gas operations and projects. This course, thus, provides an excellent opportunity for industry professionals such as petrophysicists, geologists, engineers, IT personnel, and project managers, to upgrade their skills and knowledge in line with industry trends, enhancing both their individual capabilities and their organization's competitive edge.

Course overview — continued

Who it is for and how it helps

This course is specifically designed for a diverse range of professionals in the oil and gas industry who are keen to enhance their understanding of data science and machine learning, and their practical applications in the sector. The target audience includes but is not limited to:

- Petrophysicists: Professionals who specialize in the study of physical and chemical rock properties and their interactions with fluids.

- Geologists: Experts involved in studying the solid and liquid matter that constitutes the Earth and other terrestrial planets.

- Production Engineers: Specialists who oversee and optimize the production of hydrocarbons in oil and gas operations.

- Reservoir Engineers: Engineers responsible for optimizing the production of oil and gas via proper well placement, production rates, and enhanced oil recovery techniques.

- IT Personnel: Those who manage and ensure the efficient use of IT resources within the organization.

- Petroleum Engineers: Experts who design and develop methods for extracting oil and gas from deposits below the Earth's surface.

- Project Engineers and Managers: Professionals who oversee oil and gas projects, ensuring they are completed safely, within budget, and on time.

- Computer Programmers: Individuals responsible for writing, testing, and maintaining the code that makes up computer software.

- Additionally, this course is also apt for any individuals who are interested in learning Python programming, data science, machine learning, and their potential applications in the oil and gas industry.

What you will learn

- Write Effective Python Programs: Leverage Python's capabilities for numerical operations, data handling, and scientific plotting, specifically tailored for the oil and gas industry
- Analyze and Visualize Data: Execute advanced techniques for oil and gas data analysis and visualization, including managing missing data issues and creating interactive plots
- Forecast Production Data: Perform time-series analysis of production data, visualizing it effectively, identifying and eliminating outliers, and undertaking decline curve and uncertainty analyses
- Apply Machine Learning for Classification: Develop lithofacies classification models using machine learning, understand how to read and visualize well log data and lithofacies, utilize classifiers in Scikit-Learn, and evaluate classifier performance with cross-validation
- Apply Machine Learning for Regression: Use regression for well log synthesis, learn about regressors in Scikit-Learn, and evaluate regressor performance with cross-validation
- Understand Machine Learning Fundamentals: Grasp the basic concepts and types of machine learning, use Python's scikit-learn for machine learning tasks, apply supervised learning with

Course overview — continued

regression, and perform hands-on tasks such as reconstructing wireline logs using random forests
- Use Unsupervised Learning Techniques: Learn the basics of unsupervised learning for dimensionality reduction, clustering, and outlier detection, with a focus on practical applications like outlier detection and clustering of wireline logs
- Interpret Machine Learning Models: Understand the basics of explainable machine learning to interpret predictions made by machine learning models and ascertain the importance of different variables
- This knowledge and skillset will empower participants to use Python, data science techniques, and machine learning effectively in their roles within the oil and gas industry, enhancing both operational efficiency and strategic decision-making capabilities

Curriculum

Modules 01–05

01 Python Programming for Industry Applications

- Fundamentals of Python Programming
- Leveraging NumPy for Numerical Operations
- Optimizing Loop Processes with List Comprehension
- Creating Scientific Plots with Matplotlib
- Mastering Data Input and Output with NumPy and Pandas
- An Introduction to Interpolation with SciPy

02 Advanced Techniques for Oil and Gas Data Analysis and Visualization

- Techniques for Data Loading, Cleansing, and Preparation
- Using Pandas for Advanced Data Analytics
- Creating Data Visualizations (Bar Graphs, Pie Charts, Box Plots, KDE Plots)
- Interactive Plotting with Plotly
- Handling Missing Data Issues in Oil and Gas Industry

03 Production Data Analysis and Forecasting

- Time-Series Analysis of Production Data
- Visualization Techniques for Production Data
- Outlier Detection and Elimination in Production Data
- A Comprehensive Guide to Decline Curve Analysis
- Uncertainty Analysis in Decline Curve Analysis

04 Machine Learning for Lithofacies Classification

- Introduction to Classification Modeling Workflows
- Reading and Visualizing Well Log Data and Lithofacies
- A Guide to Classifiers in Scikit-Learn
- Evaluating Classifier Performance with Cross-Validation

05 Machine Learning for Well Log Synthesis

- Introduction to Regression Modeling Workflows

Curriculum

Modules 05–06 · Module 05 — continued

- Reading Well Log Data and Visualizing Lithofacies
- An Overview of Regressors in Scikit-Learn
- Evaluating Regressor Performance with Cross-Validation

06 Machine Learning Fundamentals

- Introduction to Machine Learning: Foundations and Types
- Python Scikit-learn: Unveiling Pipelines and Workflows
- Supervised Learning with Regression: From Linear to Random Forest Regression
- Hands-On Workshop: Reconstructing Wireline Logs Using Random Forests
- Unsupervised Learning: Dimensionality Reduction, Clustering, and Outlier Detection
- Hands-On Workshop: Outlier Detection and Clustering of Wireline Logs
- Explainable Machine Learning: Deciphering the 'Black Box' of Machine Learning Models

Joining the programme

Contact the Academy and quote course code 000615 to confirm dates, delivery format, prices and enrolment terms.

Training for your team

Tell us your business goals, the roles and number of participants, and your preferred dates and location. This will help us discuss the right training option.

Preparing for the programme

The published programme does not specify any prerequisites. Contact us before enrolling to confirm how to prepare.

Discuss your training needs

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