CONCEPT

Machine Learning in Oil and Gas: Upstream Data, Production Forecasting and Predictive Maintenance

31 May – 4 June 2027
London - Central London four-star



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Ref: 599_17833 **Date:** 31 May – 4 June 2027 **Location:** London - Central London four-star **Fees:** 25300 SAR

Introduction:

Machine learning in oil and gas often stalls between promising pilots and trusted field use: well logs, seismic, production histories and equipment records sit in separate systems, models leak information across wells, and engineers cannot explain predictions to asset teams. This Core Concept course takes petroleum engineers, geoscientists and upstream data teams through subsurface, production and rotating equipment use cases, from data quality and feature engineering to validation, explainability and governance. Participants finish with an ML Use-Case Proposal, complete with a data plan and validation design, for a case field.

Course Objectives:

- Assess upstream data sources, formats and quality issues to judge whether a field dataset can support a machine learning use case
- Engineer well log features and train classification and regression models that predict lithofacies, porosity and permeability from core-calibrated labels
- Build and compare decline analysis, rate forecasting and virtual flow metering models against physics-based baselines
- Detect anomalies and estimate remaining useful life on electrical submersible pumps, pumps and compressors from sensor signatures
- Design leakage-free validation, explainability checks and drift monitoring that an asset team can sign off
- Produce an ML use-case proposal with a data plan, validation design and pilot criteria for a case field

Target Audience:

- Petroleum and reservoir engineers responsible for forecasts, reserves inputs and field development studies
- Geoscientists and petrophysicists who interpret well logs, core and seismic attributes
- Production and surveillance engineers accountable for well performance, allocation and waterflood monitoring
- Reliability and maintenance engineers who look after artificial lift and rotating equipment
- Upstream data scientists and data managers who prepare subsurface and operations data for analytics

Course Outline:

Day 1: Upstream Data Landscape and Use-Case Screening

- Upstream Data Types: Well Logs, Core, Seismic, Well Tests and Production Histories
- Well Log and Seismic File Formats: LAS, DLIS and SEG-Y Structures
- SCADA and Process Historian Time Series: Tags, Sampling Rates and Data Gaps
- OSDU Data Platform Concepts for Cross-Discipline Subsurface Data Sharing
- ML Use-Case Screening Matrix: Value, Data Readiness and Physics Coverage

Day 2: Subsurface Feature Engineering and Supervised Learning

- Depth Alignment, Log Splicing and Bad-Hole Flagging for Training Sets
- Well Log Feature Engineering: Normalisation, Rolling Windows and Derived Petrophysical Curves
- Random Forest and Gradient Boosting for Lithofacies Classification
- Porosity and Permeability Regression with Core-Calibrated Labels
- Seismic Attribute Clustering with Self-Organising Maps at Overview Level

Day 3: Production Forecasting, Virtual Flow Metering and Reservoir Surveillance

- Arps Decline Curve Baseline Versus ML-Assisted Decline Fitting
- LSTM and Gradient Boosting Models for Multi-Well Rate Forecasting
- Data-Driven Virtual Flow Meter Design Against Physics-Based Well Models
- Well Test Periods as Ground Truth for Flow Model Calibration
- Waterflood Surveillance Analytics: Water Cut, Pressure and Injector-Producer Connectivity

Day 4: Predictive Maintenance, Validation Pitfalls and Model Governance

- Isolation Forest and Autoencoder Anomaly Detection on ESP, Pump and Compressor Signatures
- Remaining Useful Life Estimation and Maintenance Alert Threshold Tuning
- Blocked Cross-Validation by Well and Time to Prevent Spatial and Temporal Leakage
- SHAP Explainability and Physics Plausibility Checks for Engineering Sign-Off
- NIST AI Risk Management Framework Functions Applied to MLOps and Drift Monitoring

Day 5: Case Field Study: ML Use-Case Proposal and Validation Design

- Case Field Data Pack Review: Logs, Production History and Equipment Records
- Use-Case Selection and Value Case for the Case Field
- Data Plan Drafting: Sources, Quality Gates, Labelling and Ownership
- Validation Design: Holdout Wells, Acceptance Metrics and Pilot Criteria
- ML Use-Case Proposal Presentation and Peer Challenge

Skills You Will Gain:

- Upstream Data Quality Assessment
- Well Log Feature Engineering
- Facies and Petrophysical Property Prediction
- ML-Assisted Production Forecasting
- Virtual Flow Metering
- Rotating Equipment Anomaly Detection
- Spatial and Temporal Model Validation
- Model Explainability and Drift Governance

Why Attend This Course:

- Return with an ML Use-Case Proposal, data plan and validation design for a case field, ready to adapt to your own asset
- Spot leakage between wells and time periods before an optimistic model reaches a field development decision
- Explain model predictions to reservoir, production and maintenance colleagues in engineering terms they can challenge
- Compare subsurface, production and equipment use cases with engineers and data specialists from other operators and service companies

Conclusion:

Field data only creates value when models are built on clean, well-aligned inputs, validated without leakage and trusted by the engineers who act on them. The course moves from upstream data types, formats and platforms, through well log features and supervised facies and property prediction, to production forecasting, virtual flow metering and surveillance, then to predictive maintenance, validation pitfalls, explainability and governance. The final day applies this to a case field and produces an ML Use-Case Proposal with a data plan and validation design.