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PETROLEUM ENGINEERS ASSOCIATION
AN ISO 9001:2015 & MSME CERTIFIED COMPANY

5 DAYS COURSE ON **ARTIFICIAL INTELLIGENCE RESERVOIR SIMULATION & MODELING**



PROF. SHAHAB D. MOHAGHEGH

**WEST VIRGINIA UNIVERSITY & INTELLIGENT
SOLUTIONS, INC.**



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SUMMARY

Numerical Reservoir Simulation that has been used in petroleum industry in the past century is a “Bottom-Up” Reservoir Modeling. An original geological model of the reservoir (Bottom) is developed by the geologist experts and is used by reservoir engineers to match the history of the hydrocarbon production (Up). Using Artificial Intelligence for Reservoir Simulation and Modeling is a “Top-Down” Reservoir Modeling. The historical hydrocarbon production along with surface related operational conditions (Top) is used for Geo-Analytics (AI-based geological modeling) to model the geology of the reservoir (Down) for the production forecasting and optimization.

The requirement of Artificial Intelligence Reservoir Simulation and Modeling is the combination of expertise in Reservoir Engineering and expertise in Artificial Intelligence. In this short course information of Artificial Intelligence that is required for this new technology will be covered in detail. Development and results of the Artificial Intelligence Reservoir Simulation and Modeling has proven to be much faster and better than our traditional Numerical Reservoir Simulation to forecast and enhance oil and gas production. Artificial Intelligence that will seriously impact the future of our world, will also become the most important science and technology in Petroleum Engineering.

Artificial Intelligence Reservoir Simulation and Modeling is a full-field model that only uses facts and reality through actual field measurements and avoids any assumptions, interpretations, simplifications, preconceived notions, and biases. Since Artificial Intelligence Reservoir Simulation and Modeling follows AI-Ethics it avoids using “Hybrid Model” that includes data that is generated through mathematical equations. Unlike many other approaches that are currently used by petroleum service and vendor companies (Artificial General Intelligence), Artificial Intelligence Reservoir Simulation and Modeling incorporates the Science and Engineering Application of Artificial Intelligence instead of Artificial General Intelligence.

Artificial Intelligence Reservoir Simulation and Modeling uses “Explainable AI (XAI)” (not BlackBox) and generates AI-based Geological Model (Geo-Analytics), Fully Automated History Matching, Blind Validation Forecasting, and avoids using only Space-related reservoir layer characteristics ($k \cdot h$) for production allocations and uses both space and time to generate “AI-based Production Allocation”. Artificial Intelligence Reservoir Simulation and Modeling provides fantastic OpEx and CapEx Optimization for the full field reservoir.



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WHY ATTEND?

This course will demonstrate the power of Artificial Intelligence and the differences it can make for informed decision making when it comes to objectives such as infill location optimization and reservoir production and recovery optimization. Application of Artificial Intelligence in the oil and gas industry is the most fantastic technology in the Petroleum Engineering.

WHO SHOULD ATTEND?

This course is designed for engineers, geoscientist, and managers. Specifically, those involved with reservoir, completion, and production in operating and service companies. In general, those involved in planning, completion, and operation of hydrocarbon assets are the main target audience.

PREREQUISITES

- Basic knowledge of reservoir engineering
- Programming skills
- Mathematics and statistics
- Reservoir simulation fundamentals



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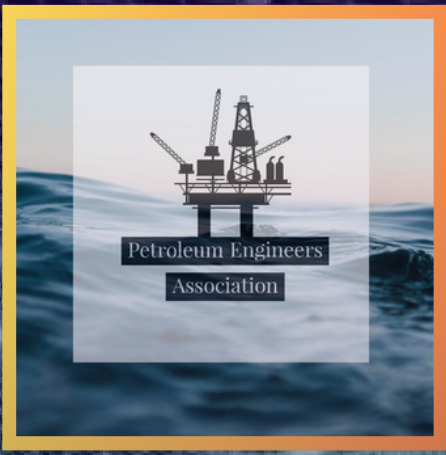
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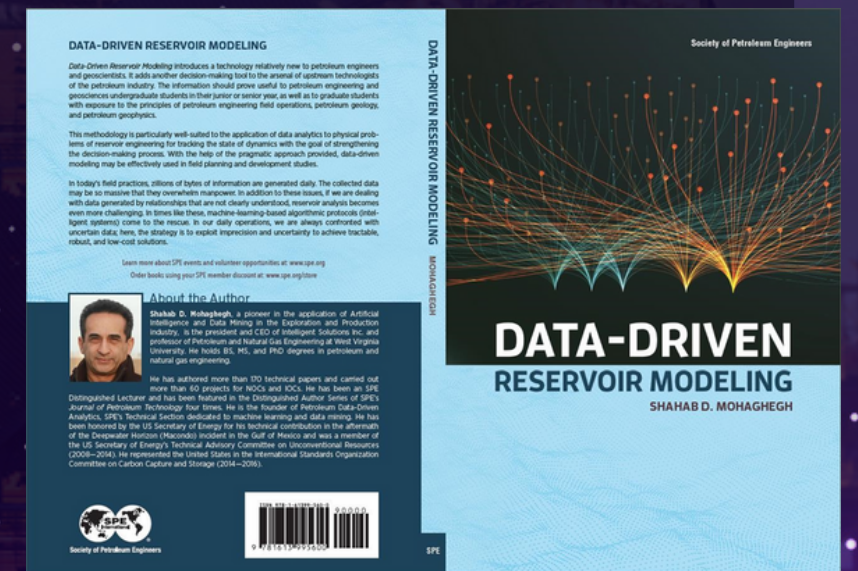
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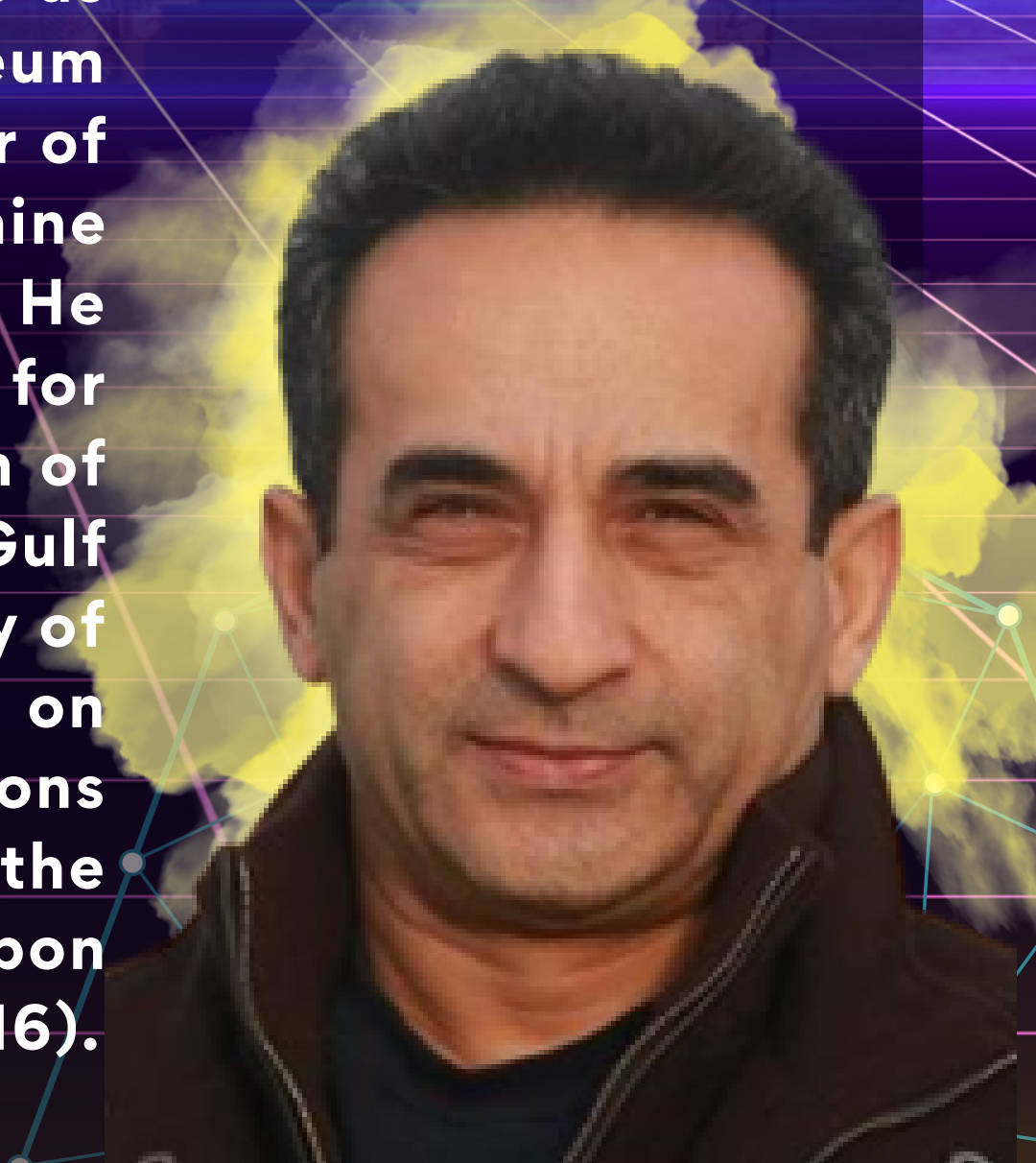
ABOUT THT INSTRUCTOR

Mr. Shahab D. Mohaghegh, a pioneer in the application of Artificial Intelligence and Machine Learning in the Exploration and Production industry, is Professor of Petroleum and Natural Gas Engineering at West Virginia University and the president and CEO of Intelligent Solutions, Inc. (ISI). He is the director of WVU-LEADS (Laboratory for Engineering Application of Data Science).

Including more than 30 years of research and development in the petroleum engineering application of Artificial Intelligence and Machine Learning, he has authored four books (Shale Analytics, Data Driven Reservoir Modeling, Application of Data-Driven Analytics for the Geological Storage of CO₂, Smart Proxy Modeling) more than 230 technical papers and carried out more than 60 projects for independents, NOCs and IOCs. He is a SPE Distinguished Lecturer (2007 and 2020) and has been featured four times as the Distinguished Author in SPE's Journal of Petroleum Technology (JPT 2000 and 2005). He is the founder of SPE's Technical Section dedicated to AI and machine learning (Petroleum Data-Driven Analytics, 2011). He has been honored by the U.S. Secretary of Energy for his AI-based technical contribution in the aftermath of the Deepwater Horizon (Macondo) incident in the Gulf of Mexico (2011) and was a member of U.S. Secretary of Energy's Technical Advisory Committee on Unconventional Resources in two administrations (2008-2014). He represented the United States in the International Standard Organization (ISO) on Carbon Capture and Storage technical committee (2014-2016).



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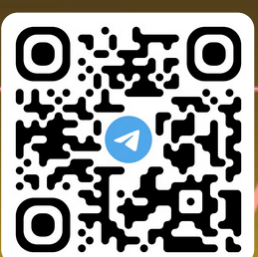
AGENDA

Day One: Artificial Intelligence & Machine Learning

- Brief History of Artificial Intelligence
- Definitions of Artificial Intelligence and Machine Learning
- Science and Engineering Application of Artificial Intelligence
- Modeling Physics using Artificial Intelligence
- Artificial Intelligence versus Traditional Statistics
- Ethics of Artificial Intelligence (AI-Ethics)
- Explainable Artificial Intelligence (XAI)

Day Two: Artificial Intelligence & Machine Learning

- Machine Learning Algorithms used for Artificial Intelligence
 - Artificial Neural Networks
 - Biology of Human Brain
 - Parallel, Distributed Information Processing
 - Mathematics Behind Neural Networks
 - Gradient Descent
 - Training, Calibration, and Validation
 - Data Handling
 - Different Types of Neural Networks
- Fuzzy Set Theory
 - Conventional Set Theory
 - Human Logic vs. Aristotelian Logic
 - Mathematics Behind Fuzzy Logic
- Evolutionary Computing
 - Darwinian Evolution Theory (Natural Selection)
 - Genetic Algorithm for Optimization

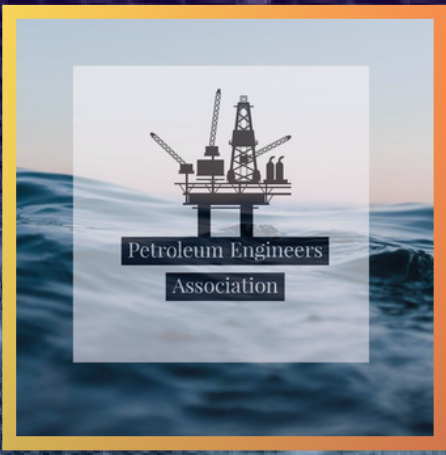


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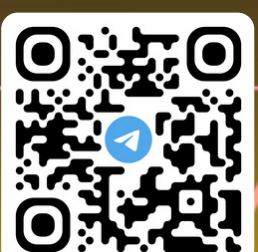
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Day Three: Artificial Intelligence Reservoir Simulation and Modeling

- Difference between Traditional Numerical Reservoir Simulation and Top-Down Modeling
- Top-Down Modeling (TDM) o Components of Top-Down Modeling (TDM)
 - o Data QC/QA
- Geo-Analytics – AI-based Geological Modeling o Dynamic Conductivity Map
 - o AI-based Spatial Distribution of Reservoir Characteristics
 - o Spatial Distribution of OOIP
 - o Spatial-Temporal Distribution of Remaining Reserves o Spatial-Temporal Distribution of Reservoir Pressure
- Development of Spatial-Temporal Database o Static and Dynamic Data o Resolution in Time and Space o Role of Offset Wells
- Automated History Matching o Training, Calibration, and Validation
 - o Testing TDM Forecasting through Blind Validation of the Top-Down Model (TDM) o Optimization of Machine Learning Topology

Day Four: Artificial Intelligence Reservoir Simulation and Modeling

- Top-Down Modeling (TDM) Production Allocation
- Field Development Planning and Reservoir Management o Forecasting Oil Production, GOR and WC o Choke Setting/Well-Head Pressure Optimization o Water/Gas Injection Optimization o Determination of Infill Locations o Uncertainty Analysis

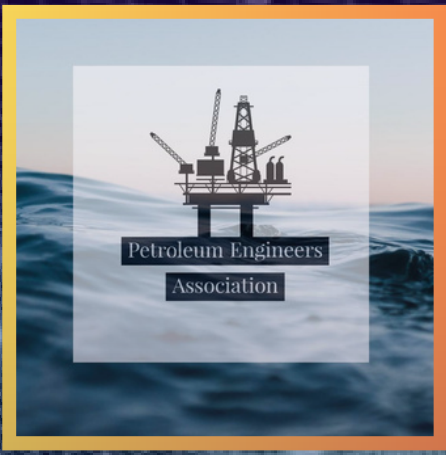


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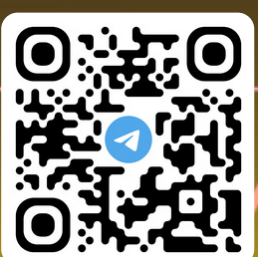
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Day Five: IImagine™ Software Application for TDM

- Explanation of the IImagine™ Software Application
- Tutorial of IImagine™ Software Application o Using an Actual Case Study
 - Data Handling o Geo-Analytics
 - Data Importing
 - Reservoir Delineation
 - Dynamic Mapping o Descriptive Analytics
 - Spatio-Temporal Dataset
 - Intelligent Data Patching
 - Well Biography
 - Key Performance Indicators (KPI) o Predictive Analytics
 - Model Development
 - History Matching
 - TDM Development
 - Prescriptive Analytics
 - Production Forecasting
 - Sensitivity Analysis
 - Operations Optimization
 - Infill Well Optimization
 - Injection Optimization



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