One-Day Workshop on

Machine Learning Techniques for Rock Mechanics Applications

conducted by

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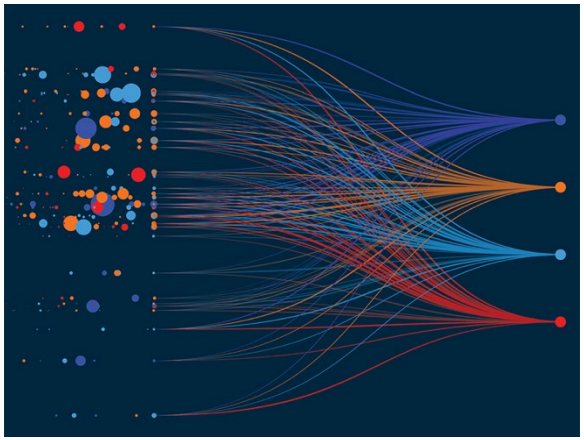
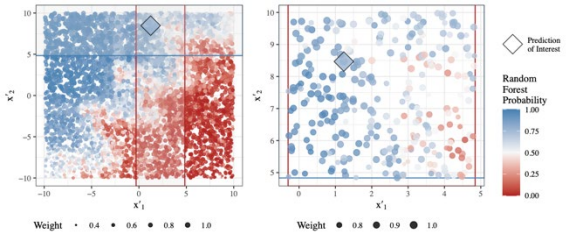


December 3, 2023
The course will be taught in
a hotel in Colombo, Sri Lanka
Information on the exact venue will be provided around the end of October 2023.

Course fee: US$ 150

OBJECTIVES

Earth presents a multifaceted and intricate environment shaped by a multitude of factors that challenge our scientific comprehension and approach. Among these, the domain of rock mechanics stands out as a particularly intricate realm, characterised by substantial uncertainties and remarkable heterogeneity. Tackling phenomena, such as rock bursts, slope failures, and weathering, require careful consideration of influential variables including rock properties, environmental dynamics, and external influences. Understanding these processes involves complex modelling and simulation, supported by theories, computational resources, and strategic maneuvering. In parallel, the realm of artificial intelligence has witnessed a resounding surge across various scientific domains, and rock mechanics is no exception. The utilisation of machine learning techniques to comprehend the challenges posed by rock properties and behaviours has emerged as a transformative avenue, yielding dependable insights that traditionally require tedious labour and computational tools. The application of machine learning in rock mechanics offers the dual advantage of unravelling hidden patterns within factors and forecasting hazards associated with rock properties and mechanics, thereby enabling timely and effective mitigation strategies. In the context of these advancements, a foundational understanding of data preparation, adeptness in deploying machine learning algorithms, and interpretation of results has emerged as an indispensable tool for professionals in the rock mechanics domain. This workshop sought to shed light on the pathways toward acquiring and honing these essential skills, enabling attendees to navigate the complexities of rock mechanics with confidence using advanced techniques.



LEARNING GOALS

- Develop a solid grasp of fundamental machine-learning concepts.
- Exploring diverse avenues for integrating machine learning into challenges within rock mechanics.
- Master data preprocessing techniques employ a range of machine-learning algorithms, discern suitable models, conduct thorough performance analyses, and interpret outcomes in the context of rock mechanics.
- Apply advanced methodologies such as hyperparameter tuning to enhance and refine the results.

COURSE CONTENT

Part 1: Lecture- Introduction to Machine Learning and its Applications in Rock Mechanics (Duration: 03 hours)

The session begins with the elucidation of machine learning, encompassing its definition and pivotal principles. An overview of various categories of machine-learning algorithms, including supervised, unsupervised, and deep learning, is provided. Notably, emphasis is placed on algorithms tailored for managing small datasets, such as the Random Forest algorithm, as well as those designed to handle incomplete data (such as XGBoost). Subsequently, the session ventures into the realm of practical implementation by introducing online computing

instances. The utilisation of tools such as Google Colab will be explored as a means to apply tangibly to machine-learning algorithms. Finally, the focus shifts to the application of machine learning within the domain of rock mechanics. Real-world use cases in which machine learning has been employed in rock mechanics are discussed, shedding light on the potential advantages and obstacles inherent in integrating machine learning techniques into rock engineering practices.

Part 2: Interactive Coding Session- Prediction of Mechanical Properties of Rock using Machine Learning (Duration: 02 hours)

During this interactive session, participants will have the opportunity to apply diverse machine learning models to predict the mechanical properties of rocks, including the uniaxial compressive strength (UCS). Participants will gain the ability to comprehend the process of working with limited datasets and extract significant yet reliable insights through the use of machine learning models.

Part 3: Group Coding Session- Prediction of Rock Burst in Underground Openings and Roof Collapses in Coal Mines (Duration: 02 hours)

In this group coding session, participants will be provided with a dataset related to predicting rock bursts in underground openings and roof collapses in coal mines from reputed journals. Participants will work in groups to process the data, apply a chosen machine-learning model, and explain the outcomes through a presentation.

Medium of Instruction:

The medium of instruction will be **English.**

Course Notes and Important Notices:

All presentations, datasets, and accompanying code notebooks will be made available shortly prior to the event. To ensure a seamless experience, it is recommended that participants **bring their laptops**, as they will engage in individual hands-on work with datasets sourced from reputable, peer-reviewed journal articles.

Who Should Attend:

This short course is designed for professionals in civil, mining, and geo-engineering, particularly those engaged in rock-related environments. It is also highly valuable for decision-makers and safety engineers involved in underground and surface excavations. The course is especially advantageous for projects dealing with extensive or limited datasets concerning the working environment, with the aim of enhancing the comprehension, interpretation, and prediction of rock-related phenomena. Additionally, postgraduate students with a keen interest in applying innovative techniques in the field of rock mechanics will find this course extremely beneficial.

Time Schedule:

09:00 – 12:00	Introduction Lecture
12:00 – 13:00	Lunch
13:00 – 15:00	Interactive Coding Session
15:00 - 15:30	Tea break
15:30 - 17:30	Group Coding Session

Narrative Biography of Mr. Brinthan:

Mr. Brinthan Kanesalingam is a postgraduate student at the University of Moratuwa. He received his B.Sc. Honours degree from the Department of Earth Resources Engineering and is currently pursuing his postgraduate studies within the same department. His expertise lies in the application of machine learning and image processing techniques across a spectrum of Earth-related phenomena, including mining, rock mechanics, mineral processing, material characterisation, and petroleum engineering. His current research focuses on the application of deep learning and digital image processing techniques to study the nano- and micro-

structures that occur naturally. Additionally, his pursuit extends to X-ray microanalysis, where he employs simulations and computational decision-making approaches for the automatic characterisation of spectroscopy outcomes.

His research findings have been published in conferences and journals, including ISERME, ICSUSL, WorldCUR, IGARSS, and Minerals. He serves as a reviewer for conferences such as RocScience 2023 (Toronto, Canada). He is delivering invited guest lectures on "Artificial Intelligence and Application in Rock Mechanics". He secured full scholarships to participate in both WorldCUR-BUR 2023 at the University of Warwick, United Kingdom, and the International Summer School in Global Just Transition: Equity in Net Zero at Newcastle University, Newcastle upon Tyne, United Kingdom. He presented his scholarly findings to an international audience.

Narrative Biography of Dr. Jayawardena:

Dr. Chulantha Jayawardena is a senior lecturer at the Department of Earth Resources Engineering, and a former Director of the Undergraduate Studies at the Faculty of Engineering, University of Moratuwa. He is a B.Sc Engineering graduate from the same department and has a PhD in Neotectonics from the University of Wollongong, Australia. He is keen to integrate image processing and machine learning with rock mechanics, where most of its applications are currently handled by traditional testing and evaluation methods. Dr. Chulantha is currently working with research students to understand the heterogeneous complex surfaces of weathered rocks through remotely sensed images, and the utilisation of machine learning algorithms and models to forecast the mechanical properties of rocks.

Registration Conditions:

The course fee must be paid in full by the registration deadline of October 15, 2023. The course fee includes course notes, lunch, and refreshments for morning and afternoon tea/coffee breaks. The number of applicants for each course is limited and acceptance will be on a first-come, first-served basis. If the course is canceled, then the full short course fee will be refunded. **No refund will be given after October 15, 2023. Non-arrivals at the course will be liable to pay the full course fee and no refund will be given. However, substitutions will be allowed.**

Registration Form
Workshop on Application of Machine Learning Techniques for Rock Mechanics Problems
December 3, 2023

Name: _____

Title: _____

Organisation: _____

Mailing Address: _____

_____

Telephone Number: _____

Fax Number: _____

E-mail address: _____

Registration Fee: **US$ 150**

I have read and agree to the conditions of entry as stipulated in this brochure.

Signature :_____ Date: _____

Methods of Payment:

Option 1: Wire transfer: The name of the bank, swift code, routing number & account number will be provided later upon receiving the completed Registration form.

Option 2: Through Western Union—needed information will be provided later upon receiving the completed Registration form.

Option 3: Through MoneyGram—needed information will be provided later upon receiving the completed Registration form.

Registration for the Workshop on Machine Learning Techniques for Rock Mechanics Applications also can be done by visiting the website: www.SLRMES.org