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Estimation of slope failure based on the support vector machine and decision tree methods

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Abstract: For the past decades, the estimation of slope failure using machine learning (ML) methods has become a new trend among researchers. Slope failure is one of the geo-hazard phenomena in which a slope fails because of the soil or rock's decreased self-retainability due to rainfall or an earthquake. This failure may give a severe impact on human beings or the environment. The prediction of slope failure is a complex real-world problem because

it involves with the geometric and physical factors such as lithology, presence of rainfall, topography and also weathering. Conventionally, the prediction of a slope failure can be conducted using traditional methods such as the finite equilibrium method (FEM) and limit equilibrium method (LEM). However, these methods have their own limitations, including the process are taking a longer time and quite tedious. Furthermore, with such a large number of assumptions, LEM cannot guarantee its efficiency in dealing with varying geometry or material variations. FEM is also criticized due to its inefficiency for small probability levels despite a large amount of computational power required. Thus, the prediction of slope failure using ML methods acts as an alternative method to the conventional methods. The current study applies two widely used ML methods: support vector machine (SVM) and decision tree (DT) for the prediction of slope failure for the soil slope. A number of 148 slope cases extracted from the previous studies is used as the case study for the development of prediction models with six input parameters, namely "unit weight, cohesion, internal friction angle, slope angle, slope height and pore pressure ratio," and factor of safety (FOS) as the output parameter. The slope cases data were divided into 80% training dataset and 20% testing dataset for both SVM and DT models. The prediction results were validated based on the statistical analysis and it shows that the SVM model gives higher efficiency than the DT model with 97% accuracy.

Keywords: Slope failure, support vector machine, machine learning, decision tree