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Paper Authors

K. Sravani, N. Uma,J. Renna Princy,M. Kalipriya,G. Naga Pavani

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AVALANCHE FORECASTING USING MACHINE LEARNING

[1]K. Sravani, [2]N. Uma,[3]J. Renna Princy,[4]M. Kalipriya,[5]G. Naga Pavani, M. Tech(Ph.D.)
[1]Student, [2]Student, [3]Student, [4]Student, [5]Assistant Professor
[1]Department of Computer Science and Engineering
[1]KKR & KSR Institute of Technology and Sciences, Vinjanampadu, Guntur, India

Abstract
The main theme is to predict the range of the snow whether it is wet avalanche, dry slab avalanche, dry avalanche and loose avalanche. This project is about predicting the range of the snow based on the parameters like wind, air. It is a complex process which involves the to predict probably to speculate certain specifications that are changing constantly. We predict the output using the Decision Tree algorithm. We apply this algorithm to the dataset. Dataset is formed by studying, the factors affecting avalanche. By put in application the Decision Tree algorithm we will be able to predict the output. Using this we can save the lives of the people who live in the snow regions. In this the user should enter the values of the required specifications.

Keywords: Avalanche forecasting, Weather conditions, Decision tree algorithm, Decision nodes, Chance nodes, End nodes

Introduction
Avalanche forecasting is the daily instance of the avalanche hazard for a given region. Avalanche problems are an extension of the danger scale and use four factors to give a more nuanced description of the days avalanche conditions. 1. The type of the potential avalanche 2. The location of that avalanche in the terrain 3. The likelihood of triggering it 4. The potential size of the avalanche. Generally there are various types of avalanche they are loose snow avalanche, slab avalanche, powder snow avalanche, wet snow avalanche, dry snow avalanche. Loose snow avalanches are general on steep slopes and are visible after a fresh snowfall. Loose snow avalanche in turn could cause a slab avalanche, which are characterized by a fall of a large block of ice down the slopes. Powder snow avalanche is a type of avalanche where snow grains are largely or completely suspended and moved by air in a state of fluid turbulence. Wet snow avalanches are caused by snow loosing its strength after becoming damp, moist or saturated with water. Most avalanche professionals make a hard distinction. Dry snow avalanches occur when stress increases with the additional weight of new snow or wind blown snow. Wet snow avalanches occurs with the decrease of the strength with the addition of liquid water from warm air temperatures, sunshine or rain. In this paper we describe about the web application which predicts the range of the snow by building the machine learning model using the Decision Tree algorithm. Other specifications, such as human or biologically related activities, can also cause avalanches. Tectonic activity may also cause snowpack fault and avalanches. Large avalanches can enable ice, rocks, trees, and other surficial material despite being primarily composed of flowing snow and air.They differ from slush flows, which have a more water content and a more laminar flow, mudslides, which have more fluidity, rock slides, which are often ice free, and serac comes crashing down while in an icefall. Avalanches are not unordinary or irregular occurrences; they are widespread to any mountain pass with a standing snowpack. Avalanches are mostly occurs in the winter and spring, but ice and snow avalanches can occur at any time of year due to alpine motion.

Literature Review

P. Bartelt and M. Lehning. 2002. A physical snowpack model for avalanche warning in Switzerland. Part I is a numerical model. Cold Regulation Science and Technology, 35(3), pp. 123-145. The snow cover simulation A detailed model of snow microstructure and metamorphism is included in SNOWPACK. SNOWPACK describes the complex texture of snow using four primary microstructure parameters: grain size, bond size, dendricity, and sphericity. Rate equations are developed for each parameter to predict the evolution in time as a function of the environmental conditions. The rate equations are founded on theoretical considerations such as mixture theory as well as empirical relationships.

Brabec, B., and R. Meister. 2001. A nearest-neighbor model for forecasting regional avalanches. Glaciol. Ann., 32, pp. 130-134. This paper describes the application of nearest-neighbor algorithms to the task of regional avalanche forecasting in Switzerland. The model's database is made up of snow and weather data from 60 manual meteorological stations, as well as classically approximated avalanche-hazard layers.

R.E. Davis, K. Elder, D. Howlett, and E. Bouzaglou. 1999. Regression and classification trees were used to relate cyclone and meteorological conditions to dry slab accident action at Este, Utah, and Moose Mountain, California. Cold Regulation Science and Technology, 30(1-3), pp. 79-90. Hurricane loop factors largely influence slab avalanche response in terms of packing in starting zones. Wind velocity and snow supply relative to terrain regulate redistributing wealth and therefore possible future trying to load of avalanche slopes. Winter weather deformation in relatively close layers may modify the amount of old snow involved in slab avalanches as well as the percentage of bond formation between both the slab and the old snow surface.

I. Guyon, J. Weston, S. Barnhill, and V. Vapnik. 2002. Support vector machines are used to select genes for cancer classification. 389-422 in Mach. Learn., 46(1-3). DNA micro-arrays now allow scientists to simultaneously screen several thousand genes to determine whether they are active, hyperactive, or expressionless in ordinary or cancerous tissue. Because all these innovative micro-array devices generate massive quantities of raw data, different analysis methods must be developed to determine regardless of wether cancer skin cells have distinct gene expression signatures from normal or other types of tumors tissues. We address the problem of picking a small portion of genes from broad patterns of data on gene expression recorded on DNA micro-arrays in this paper. We construct a model using obtainable training sets from leukaemia and normal patients.

J. Heierli, R.S. Purves, A. Felber, and J. Kowalski. 2004. In avalanche forecasting, nearestneighbor interpretations are validated. Glaciol. Ann., 38, pp. 84-88. This paper investigates the advantages and disadvantages of various understandings of nearest neighbours models. Verification methods based on measures and distributions are decided to apply to categorial, probabilistic, and informative explanations of nearest neighbours used organisationally throughout avalanche forecasting in Glasgow and Switzerland..
J. Glaciol., 26(94), 75-84. friends and family is then used to formulate predictions about the likely avalanches that will result. Avalanche forecasting is traditionally done using a combination of predetermined diagnosis for snow and meteorological conditions and inductive logic to make actual forecast decisions. The scientific method's inductive logic predominates, with regular use of iterative process and redundancy to reduce decision uncertainties. The mental processes at work are more holistic than analytical. Basic information hypothesis can be used rational way to organise give information for minimal level entropy and to optimise

inductive reasoning. Recognizing these principles provides an opportunity to improve the application and teaching of traditional forecasting techniques.

C. McCollister, K.W. Birkeland, K. Hansen, R. Aspinall, and R. Comey. 2003. Using historical avalanche data to investigate multi-scale spatial patterns, Wyoming's Jackson Hole Ski Area. Cold Regulation Science and Technology, 37(3), 299-313. Daily weather and avalanche data are recorded and archived by many ski resorts, backcountry avalanche centres, highway department managers, and helicopter ski operations. This paper describes a probabilistic method for avalanche forecasters that combines a Geographical Information Systems (GIS) with a customised climatological nearest neighbours approach Obled, C., and W. Good. 1980. Recent advances in avalanche forecasting using multivariate statistical methodological approaches: an epistemological evaluate but some tools to the Parsenn zone (Davos, Switzerland). Glaciol. J., 25(92), 315-346. To address the complex challenge of forecasting avalanche activity, multivariate classification methods have been tested. The theoretical background for each approach is briefly discussed, and the main benefits and disadvantages are discussed. The first method involves performing a simple regression techniques on a survey of avalanche days versus a test of nonavalanche days.

Background Work:

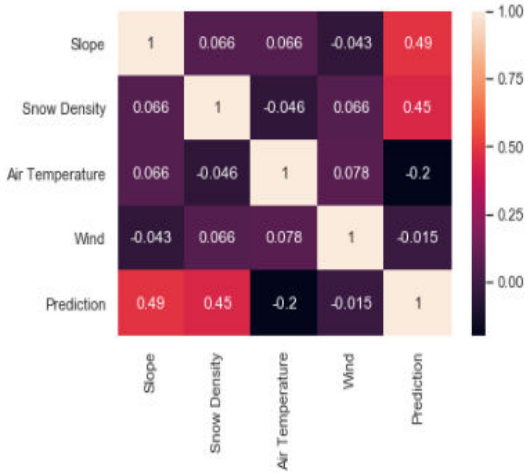
An occurrence of Avalanches can be predicted by using the weather conditions of that area. Slope, snow density, forest density, air temperature, wind are the parameters used to predict avalanche. We use the Machine Learning Algorithms to know whether Avalanche occurs or not. We are using the Decision Tree Algorithm to Solve this Problem.

In this project we have built the dataset by getting the range for each parameters. For Slope (low=(0-30),Moderate=(30-35), High=(above30)in degrees). For Snow density (low = (<20),Moderate(20-50),High(>50)in meters). For Forest Density ((if the less no. of trees=High), (if the no. of trees Medium=Moderate), (if the no. of trees high=Low)). For Air Temperature (low = (-10to8), High = (<-10 and >8) in celcius). For Wind (low (<10), medium = (11-20), High = (>30) in mph).

Data preprocessing can be done in 5 steps

Importing Libraries and Reading the Dataset

Checking for missing values and removing the poorly correlated variables.



Separating independent and dependent variables Performing the label encoding on categorical variables. Splitting the dataset for training and testing.

Methodology:

Decision Tree Algorithm

Decision tree is considered as the powerful solution to the classification problems and applied in many real world applications. Many data mining techniques are used for weather forecasting in the present scenario, with various levels of accuracy. From the Above literature it reveals that there are works which are carried out considering Rulebased Methods, Neural Networks, and Memory based reasoning, Naïve Bayes, Bayesian Belief Networks, and Support Vector Machines. But none of them have attempted identify for Decision tree using data sets hence in this work an attempt is made to predict future weather forecast.

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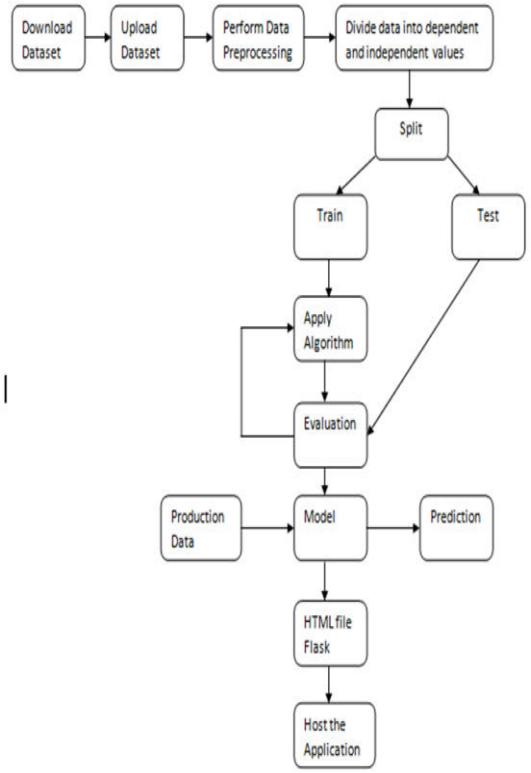
A decision tree is a decision support tool that uses a tree-like model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. It is one way to display an algorithm that only contains conditional control statements.

System Architecture:

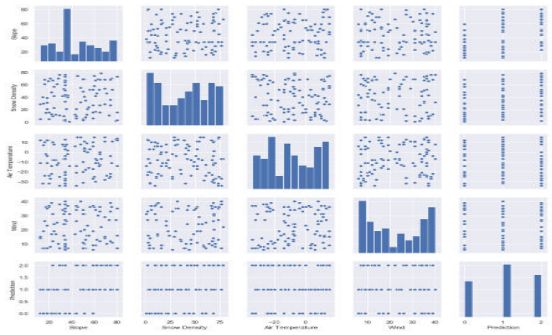
Architecture consists of nodes and components which are interlinked together to provide the complete information of the idea behind the development.



Results:

In this project we have built the dataset by using parameters that cause the avalanche, hose parameters includes slope, forest density, air temperature, wind, snow density. We are getting the range for each parameters.

For Slope(low=(0-30), Moderate=(30-35), High=(above 30) in degrees). For Snow density(low=(50) in meters). For Forest Density((if the less no.of trees =High), (if the no.of trees Medium=Moderate), (if the no. of trees high=Low)). For Air Temperature(low=(-10 to 8), High=(<-10 and >8)in celcius). For Wind(low(30)in mph



The model is able to predict avalanche with good accurency for the provided parameters.

On giving the input [slope:35, snow density:23, air temperature:25, wind:25, forest density: low], the output generated is 1- Moderate that indicates "There will be moderate avalanche you can vacate if you want".

On giving the input [slope:52, snow density:25, air temperature :-19, wind:30, forest density:high] ,the output generated is **2 – High** that indicates **"**There will be strong Avalanche. It is necessary to vacate your places**"**.

On giving the input [slope:25, snow density:20, air temperature:20, wind:25, forest density: medium], the output generated is **0 – Safe** that indicates **"**There will be no avalanche".

Conclusion:

We have used one of the finest algorithm named decision tree algorithm for differentiating the things like wind, water, snow and many more such things. The findings show how these variables impacted the climate reported in these months during the study period. With enough data, the identified tendency placed above a white time could be studied, and significant deviations indicating changes in weather patterns

could be identified. Decision trees prove to be an effective decision-making method in avalanche prediction. Because decision trees are perfect for multivariable analyses, they are especially useful in current problem-solving tasks such as avalanche forecasting. This work is important for emergency management studies because it allows the variation in slope, snow density, forest density, and wind to be studied. Using techniques from the decision tree algorithm. In this case, we used the Gini index as our set of criteria to determine the maximum information split, and we divided the tree based on the maximum information gain.

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