

# **PREDICTION OF AVALANCHE FORECASTING**

**A Mini Project Report**

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**BACHELOR OF TECHNOLOGY**  
In  
**INFORMATION TECHNOLOGY**

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(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

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**2022-2023**

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**CERTIFICATE**

This is to certify that the project report entitled “ **PREDICTION OF AVALANCHE FORECASTING**” is a bonafide record of work carried out by **G. NARESH BABU(19481A1282), M. KRISHNA KUMARI(19481A1266),M. BHANU PRAKASH(19481A1275), R. DEEPIKA SANTHOSHI(19481A12A3)** under the guidance and supervision of Ms.T.INDRA DEEPIKA,M.Tech Assistant Professor, in the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in InformationTechnology of **Jawaharlal Nehru Technological University Kakinada, Kakinada** during the academic year 2022-23.

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## **ABSTRACT**

An avalanche (also called a snowslide) is an event that occurs when a cohesive slab of snow lying upon a weaker layer of snow fracture and slides down a steep slope. Avalanches are typically triggered starting zone from mechanical failure in the snow pack (slab avalanche) when the forces of the snow exceed its strength but sometimes only with an gradual widening (loose snow avalanche). After initiation, avalanche usually accelerate rapidly and grow in mass and volumes has certain more snow. If the avalanche moves fast enough, some of the snow may mix with the air forming a powder snow avalanche. Here we are considering the parameters of snow density, wind, Air temperature & forest density values we predict weather the avalanche occurs or not.

### **KEYWORDS:**

- 1.SLOPE
- 2.SNOW DENSITY
- 3.FOREST DENSITY
- 4.AIR TEMPERATURE
- 5.WIND

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# **CHAPTER 1**

## **INTRODUCTION**



## 1.INTRODUCTION

### 1.1 OVERVIEW

Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of Computer Program that can change when expose new data. Machine learning involves computer to get trained using given data set, and used this training to predict the properties of a given new data. Basics of Machine Learning, and implementation of an simple machine learning algorithm using python. Python community has developed many modules to help for those implement machine learning. In this paper We built a web application which can predicts the range of avalanche. It is done by building a machine learning model using the best algorithm and integrating it into the flask application.

### 1.2 AVALANCHE

An avalanche (also called an snowslide) is an event that occurs when the cohesive slab of snow lying upon a weaker layer of snow fractures and slides down a steep slope. Avalanches are typically triggered in a starting zone from a mechanical fail snowpack (slab avalanche) when the forces of the snow exceed its strength but in sometimes only with gradual widening (loose snow avalanche). After initiate, the avalanche usually accelerate rapidly and grow in mass and volume as they entrain more snow. If the avalanches move fast enough, some of the snow may mix with a air forming a powder snow avalanche, which is a type of gravity current. Slide rock or debris, behaving in a similar way to snow, are also referred to many avalanches. The loads on the snowpack may be only due to gravity, in which case failure result either from weakening in the snowpack or increased load due to precipitation.

Avalanches initiated by this process are known as spontaneous of many avalanches. Avalanches can also be triggered by other loading conditions such as a human or biological related activities. Seismic activity may also trigger the failure in the snowpack and avalanches.

Although primarily composed of flowing snows and air, large avalanches have the capability to entrain ice, rocks, tree, and other surficial material. However, they are distinct from slush flows which have a higher water content and more laminar flow, mudslides which have greater fluidity, rock slides which are often ice free, and sera

collapses during an icefall. Avalanches are not rare or random events and are a mag endemic to any mountain range that accumulates a standing snowpack. Avalanches are most common during winter or spring but glacier movements may cause ice and snow avalanches at any time of year. In mountainous terrain avalanches are among the most serious objective natural hazards to life and property, with their destructive capability resulting from their potential to carry enormous masses of snow at the ma high speed.

### **1.3 EXISTING SYSTEM**

The word Avalanche refers to snow and ice. It means a mass of snow, ice, rocks, slush falling rapidly down a mountain. Snow avalanches are the most destructive natural hazards threatening human life, ecosystems, built structures in, mountain regions. Each year avalanche kills more than 150 people worldwide. If the person buried under an avalanche more than 15 minutes then there is no chance for a live So, the life of the people in that region is difficult to live.

### **1.4 DISADVANTAGES**

- 1)User should have the idea on all the parameters and units of each parameter.
- 2)Previously for predicting avalanche they used many parameters to calculate the avalanche. So, it is a time taking process.
- 3)As u refer a paper where there got the accuracy of 65%

## 1.5 PROPOSED SYSTEM

### 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. 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. Decision trees are commonly used in operations research, specifically in decision analysis, to help identify a strategy most likely to reach a goal, but are also a popular tool in machine learning.

A decision tree is a flowchart-like structure in which each internal node represents a "test" on an attribute (e.g. whether a coin flip comes up heads or tails), each branch represents the outcome of the test, and each leaf node represents a class label (decision taken after computing all attributes). The paths from root to leaf represent classification rules. In decision analysis, a decision tree and the closely related influence diagram are used as a visual and analytical decision support tool, where the expected values (or expected utility) of competing alternatives are calculated.

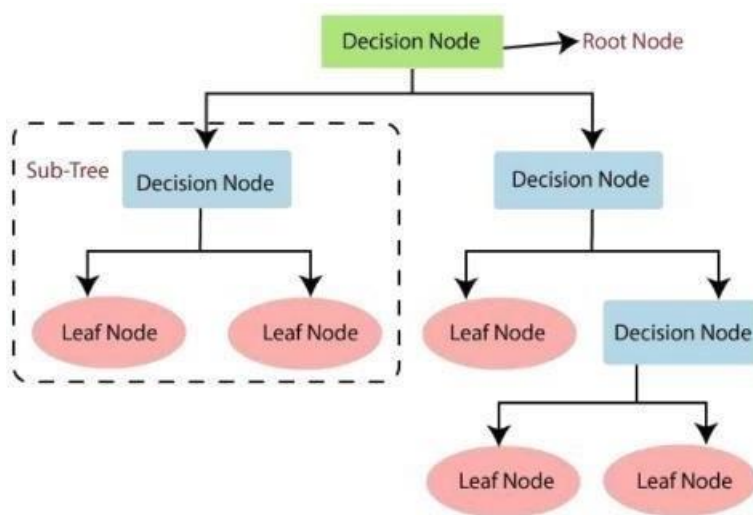
A decision tree consists of three types of nodes:

Decision nodes – typically represented by squares

Chance nodes – typically represented by circles

End nodes – typically represented by triangles

Decision trees are commonly used in operations research and operations management. If, in practice, decisions have to be taken online with no recall under incomplete knowledge, a decision tree should be paralleled by a probability model as a best choice model or online selection model algorithm. Another use of decision trees is as a descriptive means for calculating conditional probabilities. Decision trees, influence diagrams, utility functions, and other decision analysis tools and methods are taught to undergraduate students in schools of business, health economics, and public health, and are examples of operations research or management science methods.



**Sample decision tree**

## 1.6 ADVANTAGES

- Perfect prediction of the avalanche occurrence using parameters
- Very accurate performance calculations.
- Extremely easy interface.
- Straight forward results.

## **CHAPTER-2**

# **REQUIREMENT ANALYSIS**

## 2. REQUIREMENT ANALYSIS

### 2.1 FUNCTIONAL REQUIREMENTS

Functional requirement defines a function of a system or its component, where a function is described as a specification of behaviour between original weather data values and predicted weather data values and find the accuracy of avalanche .

### 2.2 NON FUNCTIONAL REQUIREMENTS

In the systems engineering, a non-functional requirements that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours. They are contrasted with functional requirements that defines specific behaviour or functions. The non-functional requirements can be considered as quality attributes of a system performance.

#### 2.2.1 Usability

The system is designed such that it is used to predict whether the avalanche occurs or not.

#### 2.2.2 Efficiency

In this system the perfect prediction of the avalanche occurrence using parameters .

#### 2.2.4 Reliability

The system perform accurately from the dataset.

#### 2.2.5 Documentation

Everything that is done for designing our system is documented in an understandable manner.

## 2.3 SOFTWARE REQUIREMENT SPECIFICATIONS

- Editor: Jupiter Notebook
- Language: python
- HTML
- Flask & Pickle



## 2.4 HARDWARE REQUIREMENT SPECIFICATIONS

- System : intel i3 or above
- Hard Disk : 128GB or above
- RAM : 4GB or above

# **CHAPTER 3**

## **SYSTEM DESIGN**

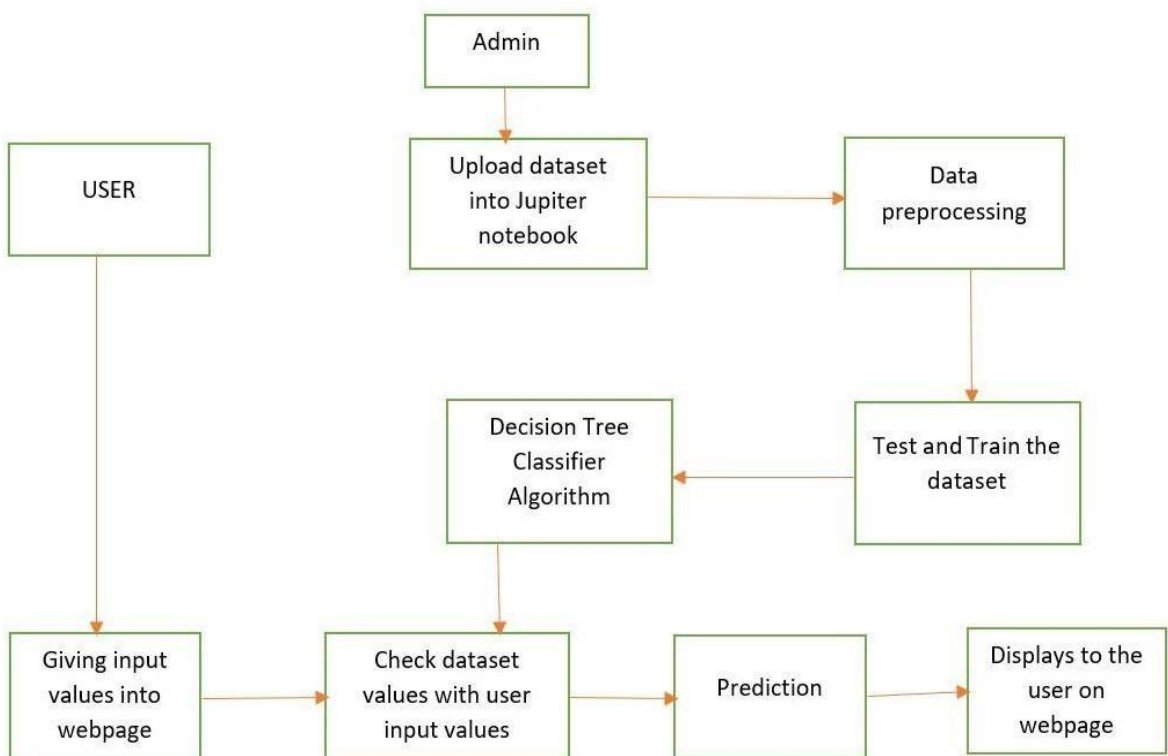


### 3.SYSTEM DESIGN

#### 3.1 SYSTEM ARCHITECTURE

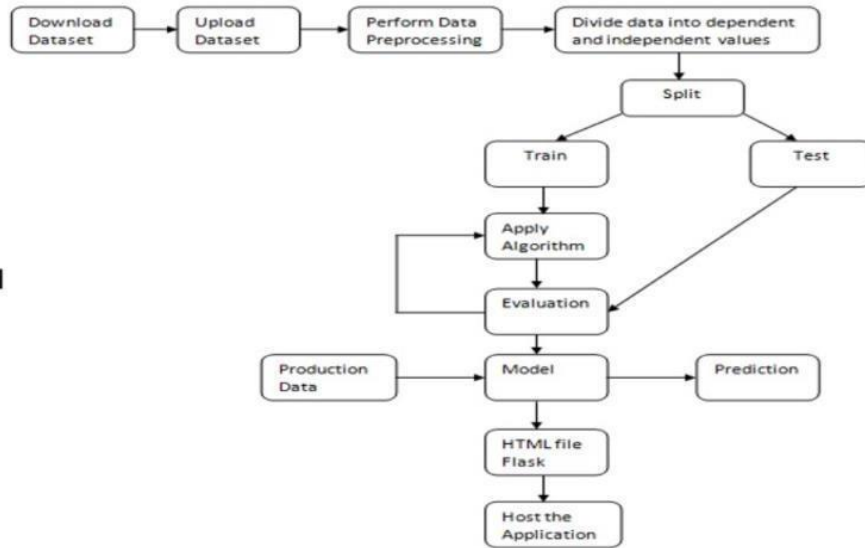
An architecture is the fundamental organization of a system embodied its components, their relationships to each other and the environment, and the principles governing its design and evolution. To be more precise the technologies methods and how everything is arranged to form a complete product is what the architecture of a system refers to.

#### BLOCK DIAGRAM



**Fig:3.1.1. Architecture Diagram for the proposed system**

### 3.2 FLOW DIAGRAM



**Fig:3.2.Flow Diagram**

### 3.3 UML DIAGRAMS

The UML consists of a number of graphical elements that combine to form diagram. Because it is a language the UML has need for combining these elements. The purpose of the diagram is to present multiple views of a system and this set of multiple views is called a model. The most important diagram of UML is class diagram.

#### 3.3.1 USECASE DIAGRAM

To provide a basis for planning the technical contents of iterations, an architectural view called the use-case view is used. There is only one use-case view of the system, which illustrates the use cases and scenarios that encompass architecturally significant behaviour, classes, or technical risks. The use-case view is refined and considered in iteration initially. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well. The use cases are represented by either circles or ellipses. The purpose of the use case diagrams is simply to provide the high level view of the system and convey the requirements in laypeople's terms for the stakeholders. Additional diagrams and documentation can be used to provide a complete functional and technical view of the system.

A use case diagram in the Unified Modelling Language (UML) is a type of behavioural diagram defined by and created from a Use-case analysis. Use case diagrams give a graphic

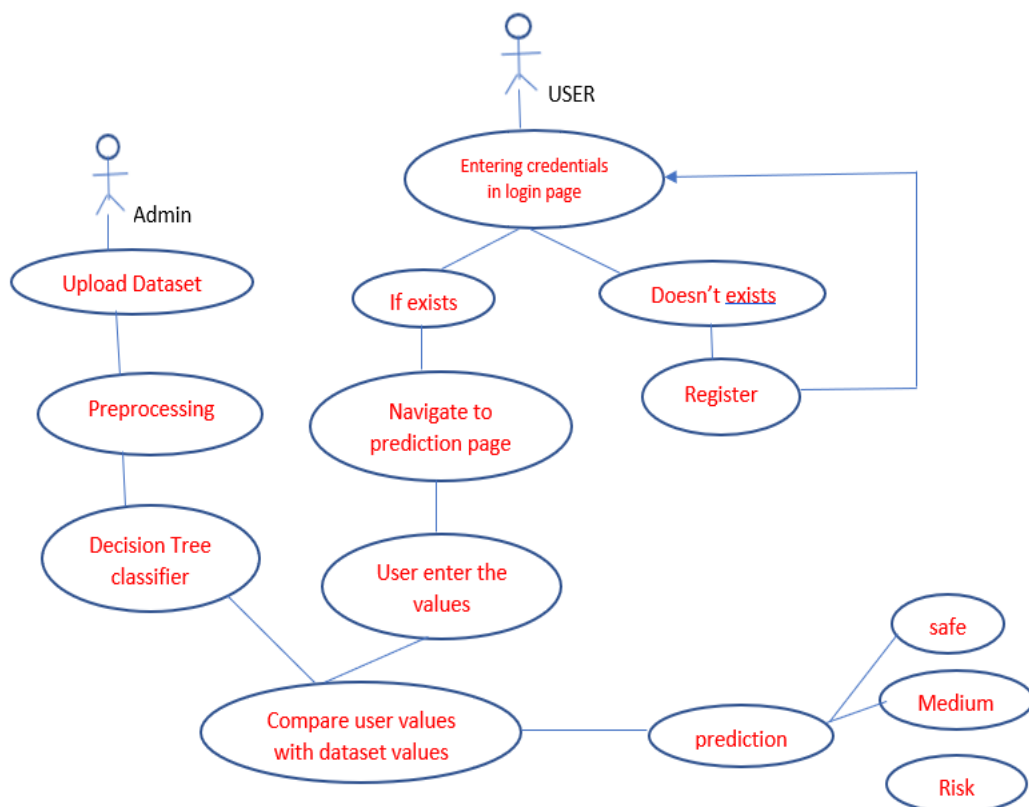
overview of the actors involved in a system, different functions needed by those actors and how these different functions interact. It's a great starting point for any project discussion because you can easily identify the main factors involved and the main processes of the system.

### Actor:

Actor is something external to the system and interacts with the system. Actor may be a human being, device or some other software system. For Online project management system, actors are User, database admin.

### Use - Case:

A use-case represents sequence of actions performed by the system that yields an observable result of value for a particular actor. Use-case represents a functional requirement of a system.



**Fig:3.3.1.Use case Diagram for prediction of Avalanche Forecasting**

**Purpose of Use Case Diagram:** Use case diagrams are typically developed in the early stage of development and people often apply use case modelling for the following purposes:

- Specify the context of a system.
- Capture the requirements of a system.
- Validate a systems architecture.
- Drive implementation and generate test cases.
- Developed by analysts together with domain experts.

### 3.3.2 CLASS DIAGRAM

Class diagrams are the main building block of any Object oriented solution. It shows the classes in a system, attributes, and operations of each class and the relationship between each class. In most modelling tools, a class has three parts. Name at the top, attributes in the middle and operations or methods at the bottom. In a large system with many related classes, classes are grouped together to create class diagrams. Different relationships between classes are shown by different types of arrows.

A class diagram contains a rectangle for each class. It is divided into three parts.

- The name of the class.
- The names and types of the fields.

The names, return types, and parameters of the methods.

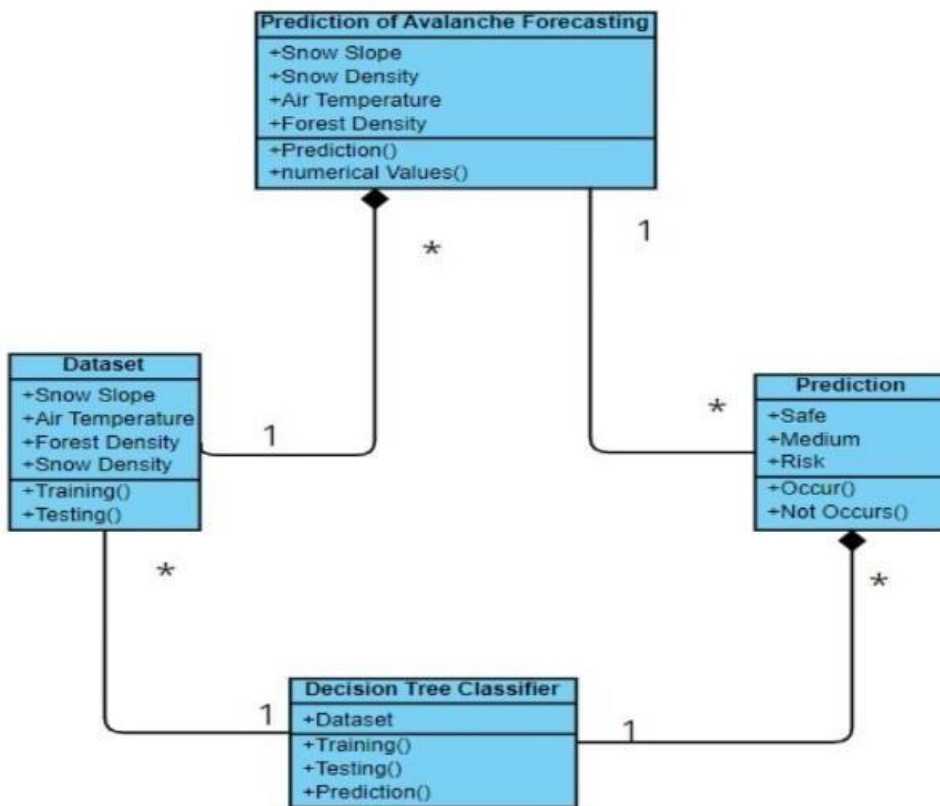


Fig:3.3.2.Class Diagram for prediction of Avalanche Forecasting

### 3.3.3 ACTIVITY DIAGRAM

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system.

The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc.

Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.

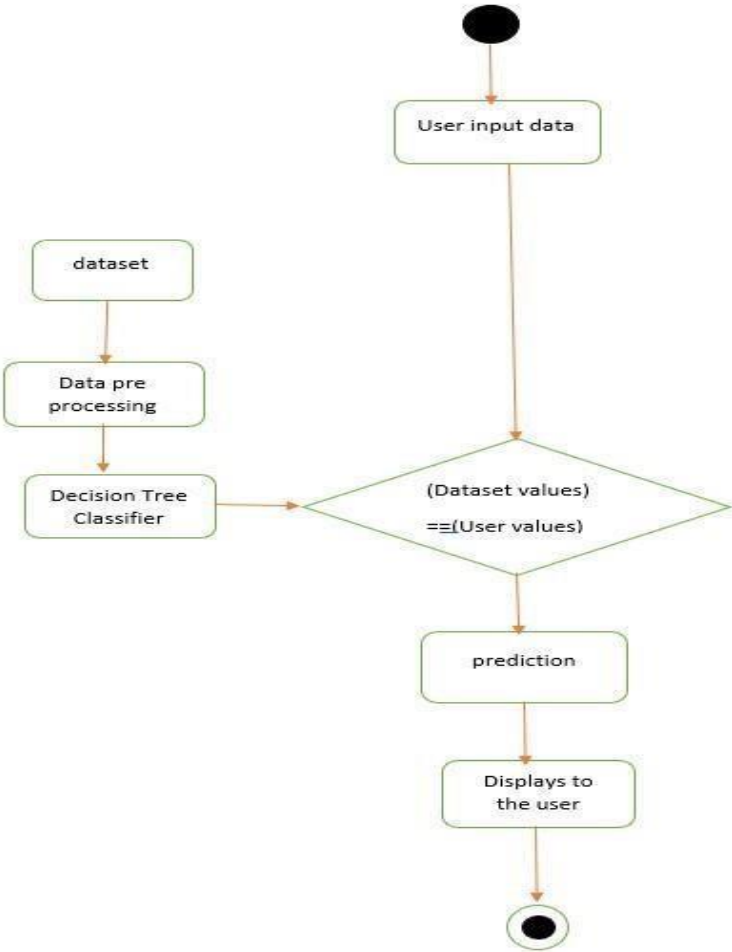


Fig:3.3.3.Activity Diagram for prediction of Avalanche Forecasting

## **CHAPTER-4 IMPLEMENTATION**

## 4.IMPLEMENTATION

### 4.1 TECHNOLOGY DESCRIPTION

The Python **pandas** written for the Python programming language for data manipulation analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series.

We can install the pandas library using the pip installer with the help of the following syntax:

**pip install pandas or pip3**

The same procedure will be followed in order to install other python libraries such as numpy, matplotlib , seaborn and pickle.

#### Features of pandas:

1. In the following Python project, we will utilize the following features of pandas in order to identify the avalanche occurrence:
2. Handling of data: The pandas library provides a really fast and efficient way to manage and explore data.
3. Alignment and indexing: Having data is useless if you don't know where it belongs and what it tells about. Therefore, labeling of data is of utmost importance.
4. Handling missing data: Data is very crude in nature and one of the many problems associated with data is the occurrence of missing data or value.

#### Features of numpy:

It is one of the fundamental library of python , which has advanced math functions and a package of scientific computing with python. It is useful for linear algebra, Fourier Transformation and other various complex Mathematical functions. Numpy can also be used as efficient multidimensional container of generic data.

#### Feature of matplotlib:

It helps to deal with data analyzing and is a numerical library. Matplotlib can be used in Python Scripts ,Python and Python Shell. It tries to make easy things possible. In this we can generate plots, Histograms, Power spectra etc ....

#### Features of seaborn:

Seaborn is built on top of Python's core visualization library Matplotlib. It meant to serve as a complement, and not a replacement.



Seaborn is a library that uses Matplotlib underneath to plot graphs. It will be used to **visualize random distributions**

Steps to import the required modules.

- First of all, we have to import the pandas and numpy along with matplotlib, seaborn and pickle.

Step1: To import the required modules

```
import pandas as pd import numpy
as np import matplotlib.pyplot as plt
import seaborn as sns import pickle
```

Step 2: Performing Decision tree algorithm using using the above python libraries

For the following step, we have to perform Decision tree algorithm with the help of Python libraries. The same can be observed in the following snippet of code.

## 4.2 CODE IMPELMANTATION

```
import os os.environ['PATH']
=
os.environ['PATH']+';'+os.environ['CONDA_PREFIX']+r"\Library\bin\graphviz"
from sklearn.externals.six import StringIO from IPython.display import Image
from sklearn.tree import export_graphviz import pydotplus dot_data = StringIO()
export_graphviz(dt, out_file=dot_data,
filled=True, rounded=True,special_characters=True)
graph = pydotplus.graph_from_dot_data(dot_data.getvalue()) Image(graph.create_png())
```

Code:

```
import numpy as np
from flask import Flask, request, render_template
import pickle

app = Flask(__name__)
model = pickle.load(open('project.pkl', 'rb'))

@app.route('/') def
home():
    return render_template('project.html')

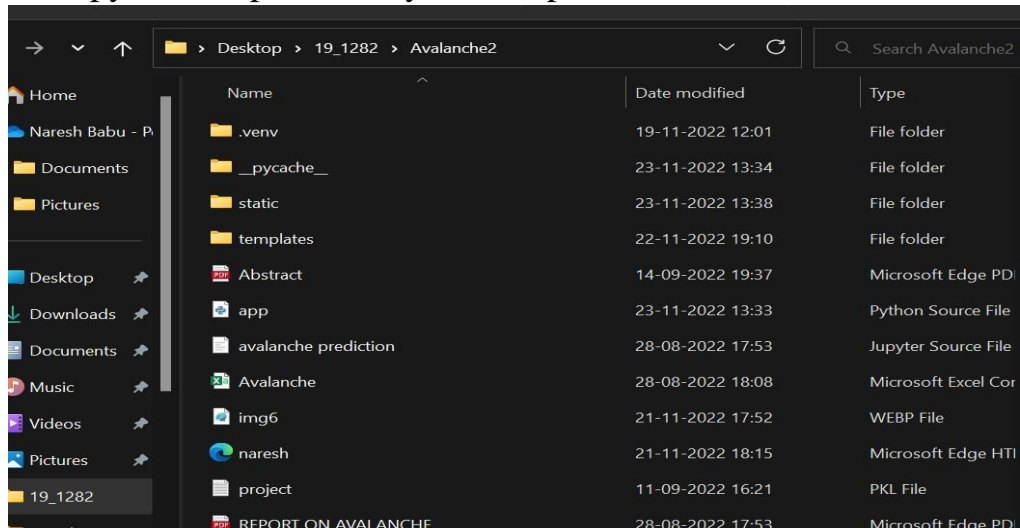
@app.route('/predict1', methods=['POST', 'GET']) def
predict1():
    test=[int(x) for x in request.form.values()]
    print("bharath")
    print(test)
    x_test=np.array([[1,2,3,4,5,6]])#some      initialisation
    valuesif(test[4]==2):
        x_test[0][0]=0
        x_test[0][1]=0
        elif(test[4]==0):
            _test[0][0]=1
            x_test[0][1]=0 else:
                x_test[0][0]=0
    x_test[0][1]=1
    x_test[0][2]=int(test[0])
    x_test[0][3]=int(test[1])
    x_test[0][4]=int(test[2])
    x_test[0][5]=int(test[3])

    prediction = model.predict(x_test)
    print(prediction) output=prediction[0]
    if(output==0):
        returnrender_template('project.html',
        prediction_text='Therewill be no avalanche:{ }safe'.format(output))
    else if(output==1):
        return render_template('project.html', prediction_text='There will be moderte
        avalanche.you can vacate your place if you want { }-moderate'.format(output))
    else:
        return render_template('project.html', prediction_text='Avalanche is strong.. It is
        necessary to vacate your places:{ }-high'.format(output))

if __name__ == "__main__":
    app.run(debug=True)
```

### 4.3 EXECUTION PROCESS

- Copy the file path from your computer



- Open Anaconda prompt and type “cd File location “(project file)  
Run your python app file “python filename.py”

```
(base) PS C:\Users\Naresh> cd C:\Users\Naresh\Desktop\Avalanche
(base) PS C:\Users\Naresh\Desktop\Avalanche> python app.py
C:\Users\Naresh\anaconda3\lib\site-packages\sklearn\base.py:310: UserWarning: Trying to unpickle estimator DecisionTreeC
lassifier from version 0.22.1 when using version 0.24.2. This might lead to breaking code or invalid results. Use at you
r own risk.
  warnings.warn(
* Serving Flask app "app" (lazy loading)
* Environment: production
  WARNING: This is a development server. Do not use it in a production deployment.
  Use a production WSGI server instead.
* Debug mode: on
* Restarting with watchdog (windowsapi)
C:\Users\Naresh\anaconda3\lib\site-packages\sklearn\base.py:310: UserWarning: Trying to unpickle estimator DecisionTreeC
lassifier from version 0.22.1 when using version 0.24.2. This might lead to breaking code or invalid results. Use at you
r own risk.
  warnings.warn(
* Debugger is active!
* Debugger PIN: 223-953-560
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

```
warnings.warn(
* Debugger is active!
* Debugger PIN: 223-953-560
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

# Home page

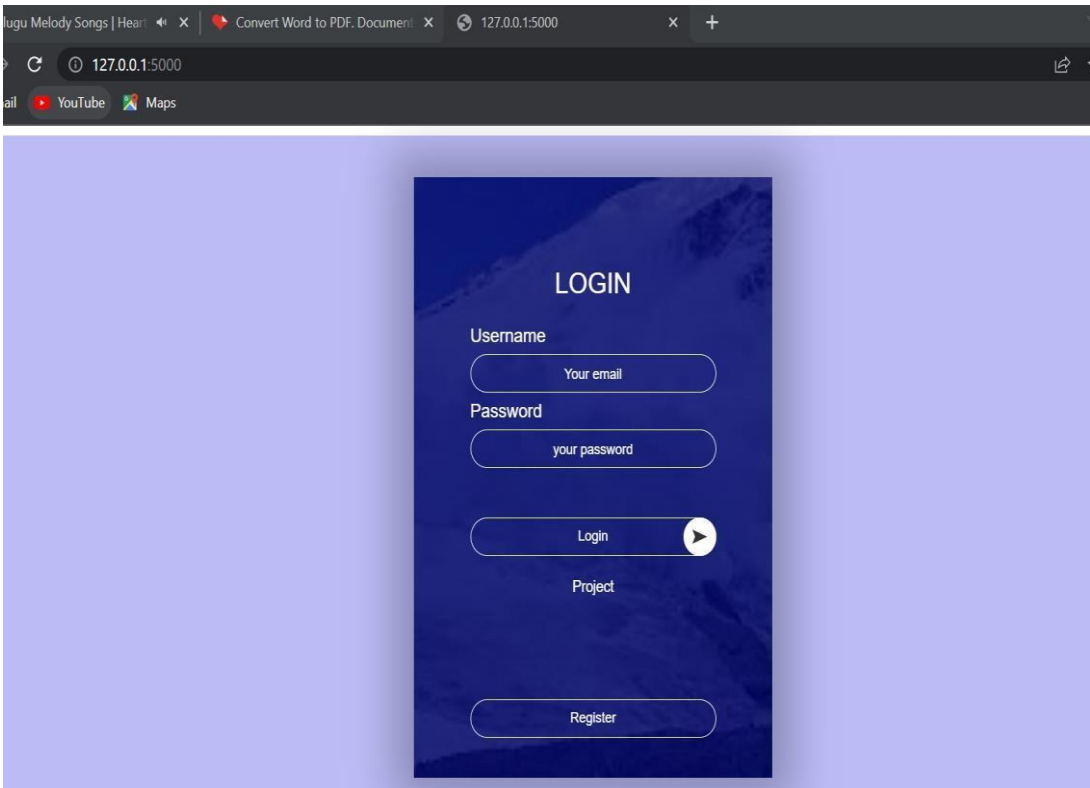


Fig:4.3.1:Home page

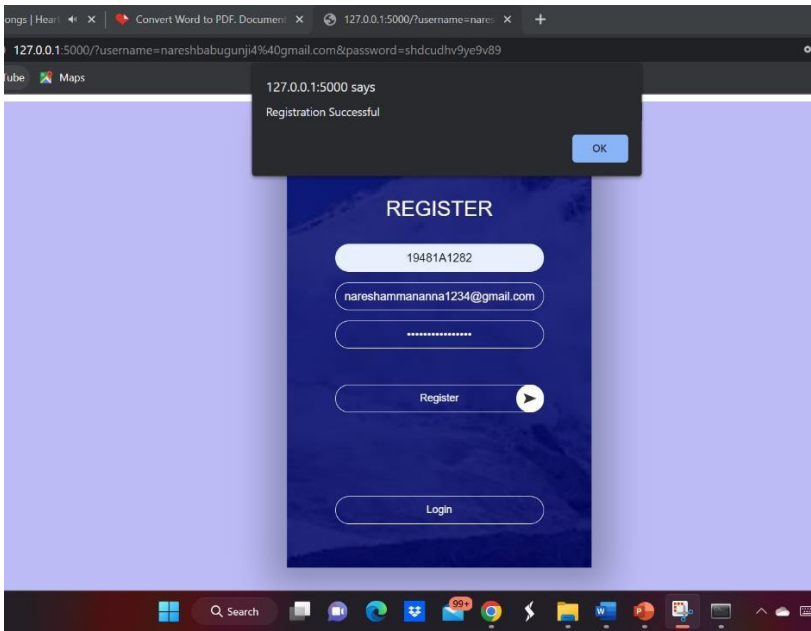
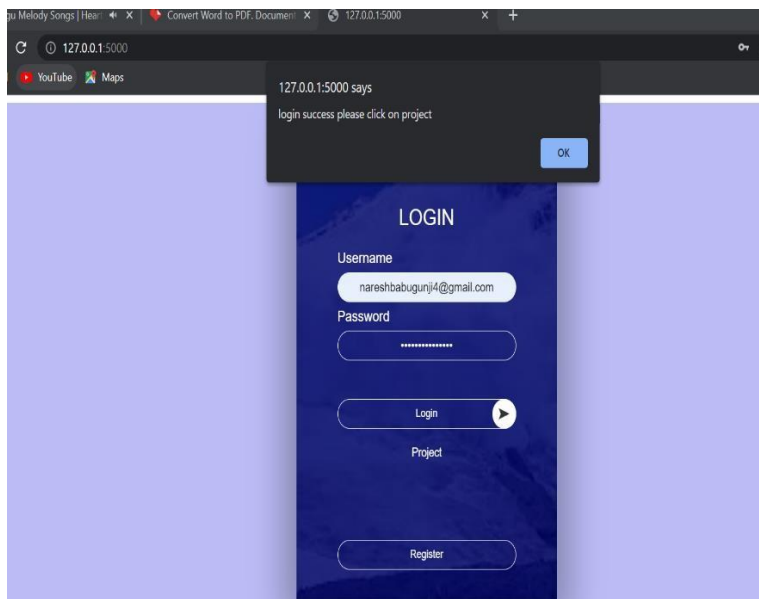


Fig:4.3.2:Registration page



**Fig:4.3.3.Login Page**

**Avalanche Prevention**

*Predicting Avalanche Formation*

Slope:

Snow Density:

Air Temperature :

Wind:

Forest Density:

{{prediction\_text}}

**Prediction page**

# CHAPTER 5

## TESTING

## 5.TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the software system meets its requirements and user expectations and does not fail in an unacceptable manner.

### 5.1 DATA COLLECTION

In this project we have built the dataset by using parameters that cause the avalanche those 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=( $<20$ ),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= (-10 to 8) ,High=( $<-10$  and  $>8$ )in celcius).

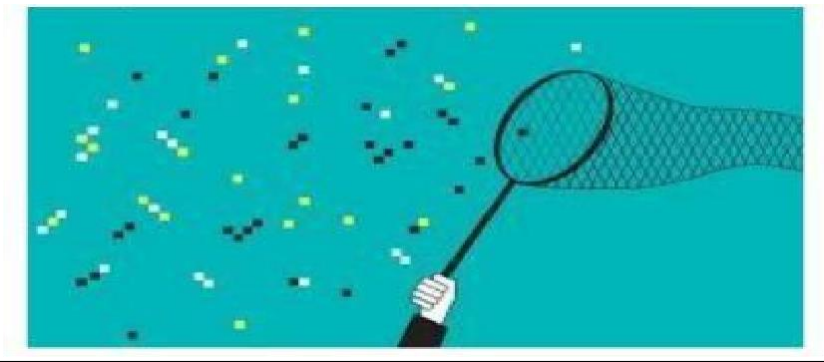
For Wind(low( $<10$ ), medium=(11-20),High=( $>30$ )in mph).

### 5.2 DATA PREPROCESSING

Data preprocessing is a process of preparing the raw data and making it suitable for a machine learning model. It is the first and crucial step while creating a machine learning model.

When creating a machine learning project, it is not always a case that we come across the clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put in a formatted way. So for this, we use data preprocessing task.

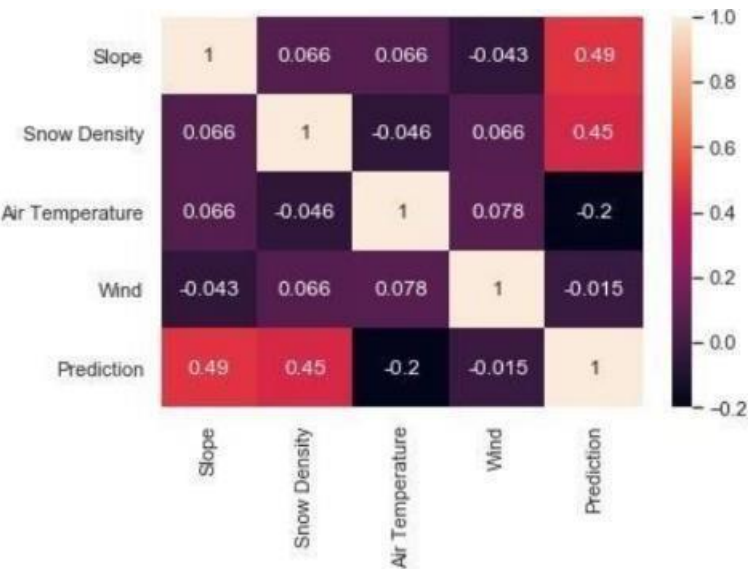
A real-world data generally contains noises, missing values, and maybe in an unusable format which cannot be directly used for machine learning models. Data preprocessing is required tasks for cleaning the data and making it suitable for a machine learning model which also increases the accuracy and efficiency of a machine learning model.



Separating useful data

5.3 DATA ANALYSIS

Data Analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data.



Correlation



## 5.4 DATA VISUALIZATION

Data visualization is **the graphical representation of information and data**. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data.



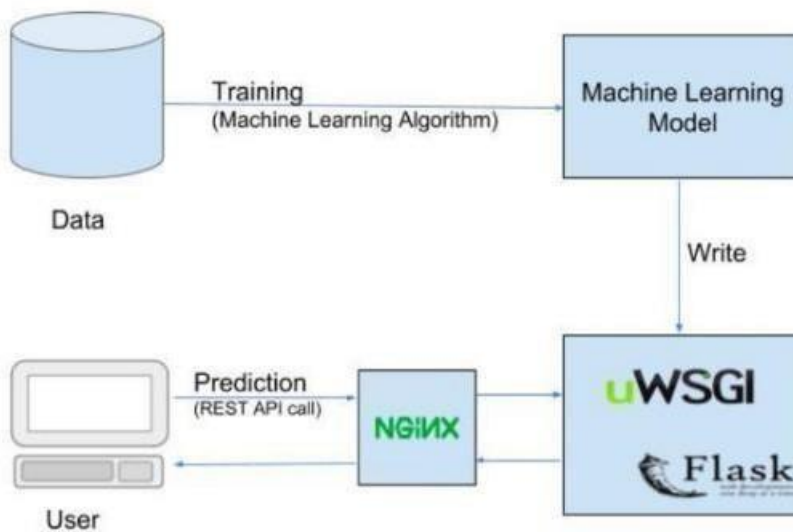
## 5.5 SPLITTING DATA INTO TRAIN AND TEST

Train/Test is **a method to measure the accuracy of your model**. It is called Train/Test because you split the the data set into two sets: a training set and a testing set. 80% for training, and 20% for testing. You train the model using the training set. You test the model using the testing set.



## 5.6 MODEL DEPLOYMENT USING FLASK

Machine learning model deployment is **the process of placing a finished machine learning model into a live environment where it can be used for its intended purpose**. Models can be deployed in a wide range of environments, and they are often integrated with apps through an API so they can be accessed by end users.



Flask is used for **developing web applications using python**, implemented on Werkzeug and Jinja2. Advantages of using Flask framework are: There is a built-in development server and a fast debugger provided.

## **CHAPTER 6**

# **SCREENSHOTS**

## 6.SCREENSHOTS

**Avalanche Prevention**

*Predicting Avalanche Formation*

Slope:

Snow Density:

Air Temperature :

Wind:

Forest Density:

{{prediction\_text}}

**Fig:6.1. Avalanche Prediction Page**

**Avalanche Prevention**

*Predicting Avalanche Formation*

Slope:

Snow Density:

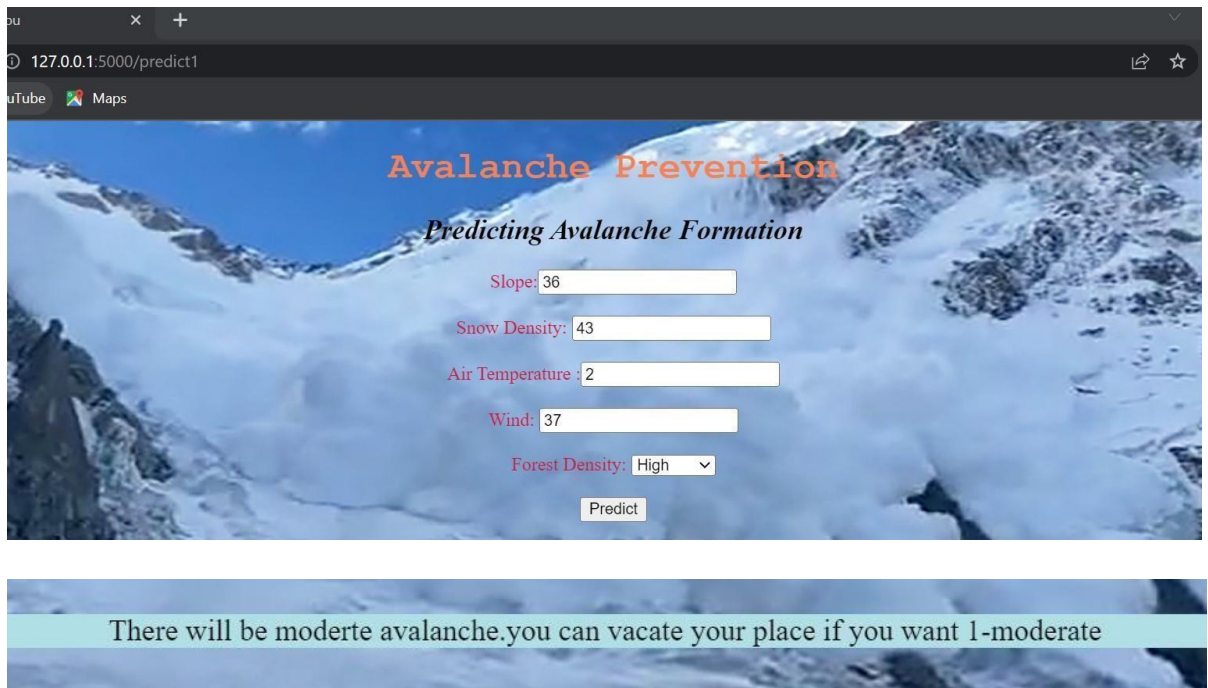
Air Temperature

Wind:

Forest Density:

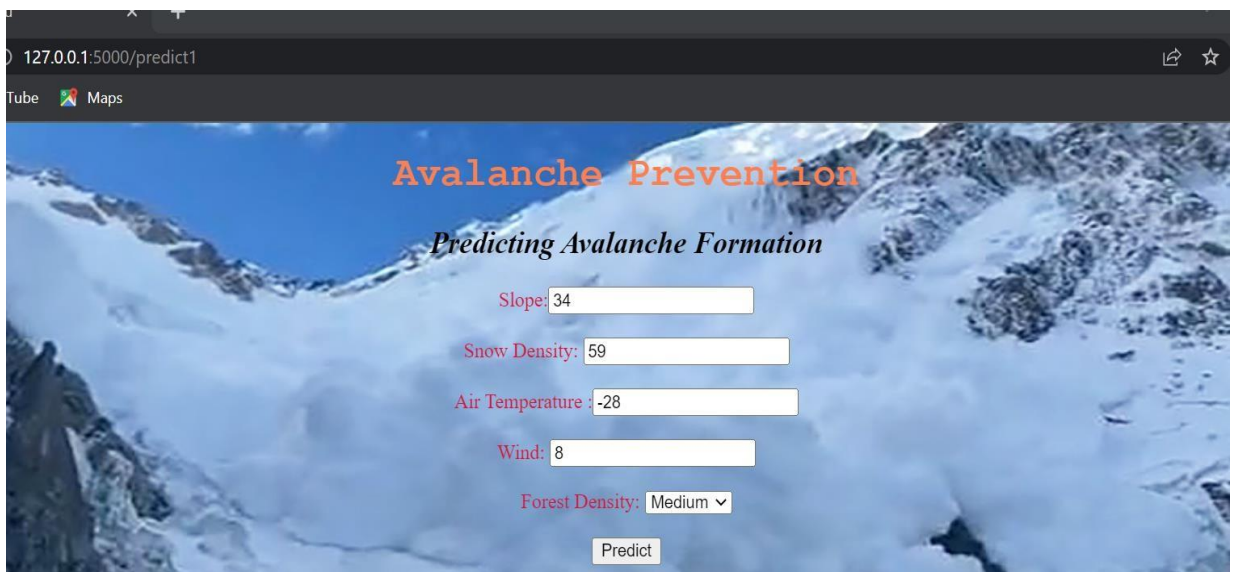
There will be no avalanche:0-safe

- For checking output for first case we given parameter values as [Slope=4, Snow Density=13, Air Temperature=3, Wind=16 and Forest Density="high"]



The screenshot shows a web browser window with the URL `127.0.0.1:5000/predict1`. The page has a background image of a snowy mountain slope. The title is "Avalanche Prevention" in orange, and the subtitle is "Predicting Avalanche Formation" in black. The input fields are: Slope: 36, Snow Density: 43, Air Temperature: 2, Wind: 37, and Forest Density: High (dropdown menu). A "Predict" button is at the bottom. Below the form, a light blue banner contains the text: "There will be moderte avalanche.you can vacate your place if you want 1-moderate".

- For checking output for Second case we given parameter values as [Slope=36, Snow Density=43, Air Temperature=2, Wind=37 and forest density="high"]



The screenshot shows the same web application with the URL `127.0.0.1:5000/predict1`. The input fields are: Slope: 34, Snow Density: 59, Air Temperature: -28, Wind: 8, and Forest Density: Medium (dropdown menu). A "Predict" button is at the bottom.

- For checking output for third case we given parameter values as [Slope=34, Snow Density=59, Air Temperature=-28, Wind=8 and forest density="medium"].

# **CHAPTER 7**

# **CONCLUSION**

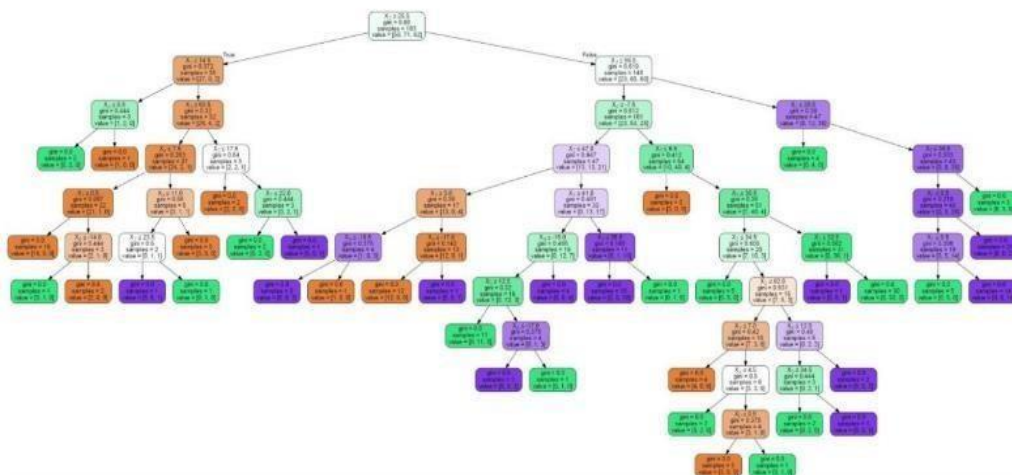


## 7.CONCLUSION

In this project we used Decision tree algorithm for classifying parameters such as temperature, forest density, slope, snow density, wind in terms of the day, month and year. The results show how these parameters have influenced the weather observed in these months over the study period. Given enough data the observed trend over time could be studied and important deviations which show changes in climatic patterns identified. Decision trees prove as an effective method of Decision making in Avalanche prediction. As, decision trees are ideal for multiple variable analyses, it is particularly important in current problem-solving task like avalanche forecasting.

This work is important to disaster management studies because the variation in terms of slope, snow density, forest density and wind can be studied using this decision tree algorithm techniques.

In this we have used gini index as our criterion to get the maximum information split and by going down the tree the we have divide as per the maximum information gain,



This is our output Decision tree with different decision nodes and leaf nodes and with the most important root node, which is the deciding factor.

# **CHAPTER 8**

## **FUTURE ENHANCEMENT**



## 8.FUTURE ENHANCEMENT

As our model is able to predicts range of avalanche happens in the future, people who are living around that area can able to vacate before it happening. There is an infinite amount of variability and complexity that can be introduced to such a model. The purpose as seen by the author is not to have a definitive answer to where hazard and risk exist, but to give the user a tool to better understand the spatial variability of terrain, weather and snowpack and therefore avalanche potential. The accuracy of the resulting tool will depend greatly on the amount of information available but more so on the critique of people who work with avalanches on a daily basis in the lower mainland. Hopefully, a more robust model can be developed and validated by comparing predictions to avalanche observations taken from the field.

## **CHAPTER 9**

# **BIBILOGRAPHY**

## 9.BIBILOGRAPHY

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# **CHAPTER 10**

## **PROJECT WORK MAPPING WITH PROGRAMME OUTCOMES**

## Program Outcomes (POs)

### Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions, component, or software to meet the desired needs.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend

and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

PSO1: Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2: Design and develop web sites, web apps and mobile apps.

### PROJECT PROFORMANCE

Classification of Project	Application	Product	Research	Review

**Note: Tick Appropriate category.**

Project Outcomes	
Course Outcome (CO1)	Identify and analyse the problem statement using prior technical knowledge in the domain of interest.
Course Outcome (CO2)	Design and develop engineering solutions to complex problems by employing systematic approach.
Course Outcome (CO3)	Examine ethical, environmental, legal and security issues during project implementation.
Course Outcome (CO4)	Prepare and present technical reports by utilizing different visualization tools and evaluation metrics.

### Mapping table

IT2522 : MINI PROJECT															
Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO 1	PSO 2
CO1	3	3	1					2	2	2				1	1
CO2	3	3	3	3	3			2	2	2		1		3	3
CO3	2	2	3	2	2	3	3	3	2	2	2			3	
CO4	2		1		3				3	3	2	2		2	2

**Note: Map each project outcomes with POs and PSOs with either 1 Or 2 or3 based on level of mapping as follows:**

- 1-Slightly (Low) mapped
- 2-Moderately (Medium) mapped
- 3-Substantially (High) mapped