Post-fire Debris Flow Likelihood Prediction

Project By : Alejandro Hohmann, Bhanu Muvva, Chunxia Tong
Advisor : Dr. Daniel Roten, Dr. Ilkay Altintas
UC San Diego JACOBS SCHOOL OF ENGINEERING

Statement

Abstract

Debris Flows are a distinct type of landslide that suddenly occur without warning. Debris Flows often occur after rain events and the burn scars left behind by wildfires increase their likelihood. Given the increasing frequency of extreme weather events, it is critical to predict Debris Flows and take precautionary action before they occur. This project builds upon prior research of predicting Debris Flows using additional geological features and more advanced machine learning techniques. The project also includes an intuitive interface for decision makers to access these probability estimates.

Prior Work

Staley et al. (2016) Model

Features:

- 15-minute rainfall accumulation
  - multiplied by subsequent features
- Proportion of watershed with slope > 23°
- Difference Normalized Burn Ratio
  - Change in landscape from pre-fire to post-fire
- Soil Erodibility Factor

Performance:

Test Set Performance (IMW)	Logistic Regression (Staley)
Accuracy	0.6258
Precision	0.3544
Recall	0.7671
F1	0.4848
AUC	0.7178

Problem and Solution

Problem

- ❖ Training on SoCal inserts bias into predictive model
- ❖ Imbalanced class, 20% observations with DF, means a model that always predicts NO-FLOW would be correct 80% of the time
- ❖ Decision Makers need fast and accessible predictions; typically don't have the capacity to calculate Logistic Regression outputs

Proposed Solution

- ❖ Implement random splitting between training and testing sets
- ❖ Train models with additional features and architectures to achieve better performance
- ❖ Build an intuitive user interface that is publicly accessible

Metrics

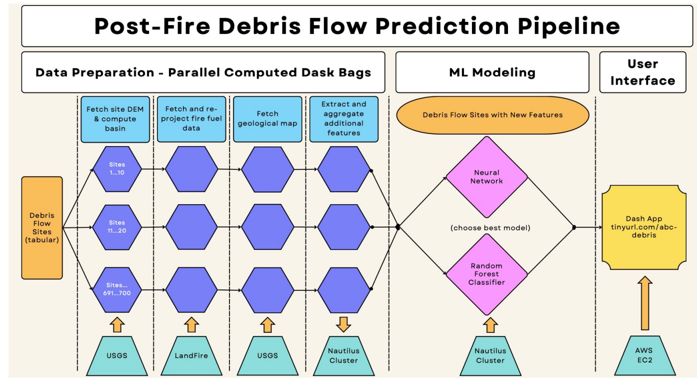
Accuracy:
Overall proportion correctly classified

Precision:
Proportion of positively classified that are actually correct

Recall:
Proportion of actual positives that are correctly classified (true positive rate)

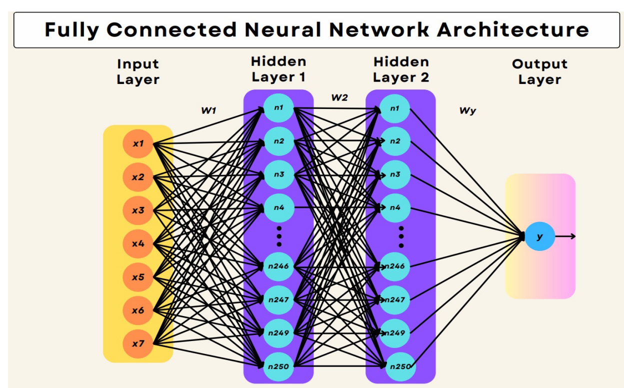
F1 Score:
Harmonic mean between Precision and Recall

AUC:
True Positive Rate vs False Positive Rate at varying classification thresholds

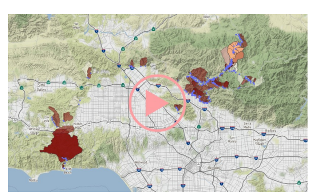


Model Comparison Performance Metrics

Test Set Performance	Logistic Regression (SoCal)	Logistic Regression (Random-Split)	Neural Network (Random-Split)
Accuracy	0.6258	0.8007	0.8745
Precision	0.3544	0.5200	0.7143
Recall	0.7671	0.2364	0.6264
F1	0.4848	0.3250	0.6731
AUC	0.7178	0.8476	0.9217



User Interface



Github Repository

https://github.com/gojandrooo/DSE-Capstone

Conclusion

- New model that works better at scale with greater predictive power of Debris Flows with using new features.
- The User Interface is a demo of what can be a great visualization tool for decision makers for swift action when rain events are in the forecast.