Glitch Classification for Gravitational Wave Interferometry using Machine Learning Techniques

Name:	**Rita Abani**
Registration No./Roll No.:	19244
Institute/University Name:	IISER Bhopal
Program/Stream:	EECS
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1 Dataset description

LIGO data outsourced from the GravitySpy catalog from its various stations in Hanford and Livingston has been used for this project. The file contains metadata about 22 glitch classes spanning over 9 parameters from GPSTime, PeakFreq(Peak frequency), snr (Signal to noise ratio) etc.

2 Plans

Introduction
The detection of gravitational waves demands a thorough understanding of instrumental responses in the ecosystem of environmental noise. Hence of pertinent interest is the study of anomalous non Gaussian noise transients called 'Glitches'that mimic true gravitational wave signals.

Proposed exploration
The aim of the project would be to classify gravitational wave events or glitches using various machine learning models from the scikit learn library in python namely *K-nearest neighbours, Support Vector Machines, Random Forest and Decision Tree* and use the best model to plot or visualize the results. I expect the Random Forest classifier to perform the best owing to its properties of reducing bias error due to an aggregation of multiple decision trees (considering the multitude of data in classifying 22 types of glitches, this might play a major role). Out of the 9 parameters to describe a glitch, in this project I will mostly perform feature engineering with snr, bandwith, duration and the frequencies as the other columns in the dataset allude to the location and ID of the interferometers (which will not be of scientific relevance to the aim of the project at hand). To visualize the results, I am keen on exploring the utility of the *'ListedColormap' class of the Matplotlib library that is used to map numbers to colours.* Evaluation metrics that I am keen on exploring include *Accuracy, Precision, Recall, Support and Macro, Weighted measures of the F1 score.* The idea is to maximize train accuracy apart from augmenting other evaluation metrics so as to reduce the false alarm rate of Gravitational wave interferometers that might lead to enhanced detection confidence and improve instrumentation related setbacks.