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Underwater Surface Target detection using Sound Navigation and Ranging dataset to identify Mines with Machine Learning Prediction

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ABSTRACT: The discovery of rocks and minerals would have been very difficult past the development of the SONAR technique, which relays on certain parameters to be able to detect the obstacle or the surface is a rock or a mine. Machine learning has drawn the attention of a maximum part of the technology-related and based industries, by showing advancements in the predictive analysis. The main aim is to emanate a capable prediction representative, united by the machine learning algorithmic characteristics, which can figure out if the target of the sound wave is either a rock or a mine or any other organism or any kind of other body. This attempt is a clear-cut case study that comes up with a machine learning plan for the grading of rocks and minerals, executed on a huge, highly spatial, and complex SONAR dataset.

KEYWORDS: MACHINE LEARNING, PREDICTION, FEATURE SELECTION, CLASSIFIER, ROCKS.

I. INTRODUCTION

Proposed ML module using Machine learning which focuses on taking up contemporary techniques to process huge amounts of complex data with a lower expense. The abstract view of the proposed framework is to represent the prediction model created to determine the surface to be a rock or a mine based on factors or features. there is a lot to explore under the deep waters (seas and oceans), rocks and mines are two of those crucial natural resources, and this is very difficult to find these resources past the development of the SONAR technique, used to measure the depth of the sea or the ocean or the distances in the water. In a similar way, these sounds In this probe, after the pre-processing of the input, different machine learning classifiers are trained to check the achievement of classification.

II. NEED OF PROJECT

With the development of technology and the continuous growth of military power, countries around the world are shifting their military priorities to the ocean. Limited by the natural conditions of the ocean and the physical limits of human beings, it is obviously impossible to exploit mines solely by humans. Suppose there is a war going on between two countries, so a submarine of a country going underwater and an enemy country has placed some mines which are explosives that can damage vessels in the ocean to damage vessels of an enemy country. so submarine has to predict whether the object is mine or rock, as rocks are also present in the sea. The proposed system is doing job of predicting the object whether it is mine or rock beneath the ocean. Detecting rocks and minerals would have been very difficult before the development of the SONAR technique, which relies on certain parameters to be able to detect obstacles or whether the surface is rock or mine. Externally, the SONAR technique has mined rock and mineral discoveries that would otherwise be difficult. This technique exploits certain parameters that will help detect surface targets or obstacles such as rocks or mines.

Machine learning has attracted the attention of the majority of industry-related industries. and technology-based, showing advances in predictive analytics. The main goal is to generate a predictive representation that is able, united by



4344 characteristics of machine learning algorithms, to be able to determine whether the 4344 target of the sound wave is a rock or a mine or any living thing. other or any other type of object. . This effort is a case study that explicitly recommends machine learning design for rock and mineral classification, running on the massive, highly spatial, and complex SONAR dataset.

III. OBJECTIVES OF PROJECT

- TO IDENTIFY MINES PLANTED BY ENEMY UNDERWATER USING BINARY CLASSIFICATION.
- TO IMPLEMENT LOGISTIC REGRESSION TECHNIQUE AND PREDICT WHETHER THE OBJECT IS MINE OR A ROCK.
- TO BUILD A PREDICTION MODEL BASED ON HIGHLY SPATIAL AND COMPLEX SONAR DATASET.
- TO IMPROVE THE EXIT TIME WHEN A SUBMARINE DETECTS A MINE.

IV. TECHNICAL SPECIFICATION

Language: Python

Python is a high-level interpreted programming language for general purpose programming. Created by Guido van Rossum and first published in 1991, Python has a design philosophy of that emphasizes code readability, including meaningful use of whitespace.

Scikit-Learn:

ScikitLearn, also known as sklearn, is a python library for implementing machine learning and statistical models. Thanks to scikitlearn, we can implement different machine learning models for regression, classifier, clustering and statistical tools to analyze these models. It also provides dimensionality reduction, feature selection, feature extraction, aggregation techniques, and embedded datasets.

V. SOFTWARE IMPLEMENTATION

Dataset description:

The file "sonar.mines" contains 111 models obtained by bouncing back a sonar signal from a metal cylinder at different angles and under different conditions. The file "sonar.rocks" contains 97 samples obtained from rocks under similar conditions. The transmitted sonar signal is a frequency modulated cry, with increasing frequency. The dataset contains signals obtained from various angles, spanning 90 degrees for cylinders and 180 degrees for rocks. Each pattern is a set of 60 numbers from 0.0 to 1.0. Each number represents energy in a particular frequency band, built up over a certain period of time. The built-in opening for higher frequencies occurs later, because these frequencies are transmitted later in the chime time. A label associated with each record containing the characters "R" if the object is a rock and "M" if it is a mine (metal cylinder). The numbers in the label are in ascending order of the aspect angle, but they do not encode the angle directly.

Importing Dependencies:

1. **Numpy:** NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, Fourier transform, and matrices. Once NumPy is installed, import it in your applications by adding the import keyword. Once NumPy is imported and ready to use
 - NumPy is usually imported under the "np" alias
 - Create an alias with the "as" keyword while importing.
 - NumPy package can be referred to as "np" instead of numpy.
2. **Pandas:** Pandas is a Python library used for working with data sets. It has functions for analyzing, cleaning, exploring, and manipulating data. Pandas allows us to analyze big data and make conclusions based on

statistical theories. Pandas can clean messy data sets, and make them readable and relevant. Relevant data is very important in data science.

- 3. Scikit-Learn:** Scikitlearn (Sklearn) is the most useful and powerful library for machine learning in Python. It provides a wide range of efficient tools for machine learning and statistical modeling, including classification, regression, clustering, and dimensionality reduction through a consistent interface in Python. This library, mostly written in Python, is built on NumPy, SciPy and Matplotlib
- 4. Pickle:** Pickle in Python is mainly used for serialization and decoding of Python object structure. In other words, it is the process of converting a Python object to a stream of bytes in order to store it in a file/database, maintain program state across sessions, or transport data across a network. The selected byte stream can be used to recreate the original object hierarchy by splitting the stream. The whole process is similar to serializing objects in Java or .Net. The dump() method of the pickle module in Python, converts a Python object hierarchy into a byte stream. This process is also called as serialization. The converted byte stream can be written to a buffer or to a disk file.
- 5. Streamlit:** Streamlit is an open source application framework in the Python language. It helps us build web applications for data science and machine learning in a short time. It is compatible with major Python libraries like scikitlearn, Keras, PyTorch, SymPy (latex), NumPy, pandas, Matplotlib, etc. With Streamlit, there is no need for callbacks because widgets are treated like variables. Data caching simplifies and speeds up the compute pipeline. Streamlit monitors changes to the linked Git repository updates, and the application is automatically deployed to the shared link.

Splitting the dataset:

To test the accuracy of our model, we divide the SONAR dataset into two parts one training set and one test set and use the training set to train the model and the test set to test. model check. Then we can evaluate the performance of our model.

1. {x, y}- Here x is the feature matrix and y is the response vector to be divided.

2. Test size- This represents the ratio of the test data to the total provided. As in the example above, we set test data = 0.3 for 150 rows of x. It will output test data $150 * 0.3 = 45$ lines.

3. Random size- It is used to ensure that the distribution will always be the same. This is useful in situations where you want reproducible results.

Training the Model:

The SONAR dataset is used to train the predictive model because scikitlearn has a bunch of machine learning (ML) algorithms that have consistent interfaces for tuning, prediction accuracy, recall, etc.

A training model is a data set used to train an ML algorithm. It consists of sample output data and the corresponding set of input data affecting the output. The training model is used to run the input data through the algorithm to correlate the processed output with the sample output. The results of this correlation are used to modify the model.

This iterative process is called "modeling". The accuracy of the training dataset or the validation of the SONAR dataset is very important for the accuracy of the model.

Machine language model training is the process of feeding data to an ML algorithm to help identify and learn good values for all associated attributes. There are several types of machine learning models, the most common of which are supervised and unsupervised learning

Data collection

Collecting data to train an ML model is a fundamental step in the machine learning process. The predictions made by an ML system can only be as good as the data on the on which they were trained. Here are some problems that can arise when we collect data

- **Inaccurate data-** Incorrect data The data collected may not be relevant to the status of the issue mentioned.
- **Missing data-** Missing data Subdata may be missing. This can take the form of blank values in the column or missing images for certain prediction classes.
- **Data imbalance-** Data imbalance Some data classes or categories may have a disproportionately high or low number of matched samples. As a result, they run the risk of under-representation in the model.
- **Data bias-** Data bias Depending on how data, topics, and labels are chosen, the model may, for example, propagate inherent biases about gender, politics, age, or area. Data deviations are difficult to detect and eliminate.

Data pre-processing

Real-world raw data is often incomplete, inconsistent, and lacking certain behaviors or trends. They are also likely to contain many errors. So, after being collected, they are preprocessed into a format that the machine learning algorithm can use for model.

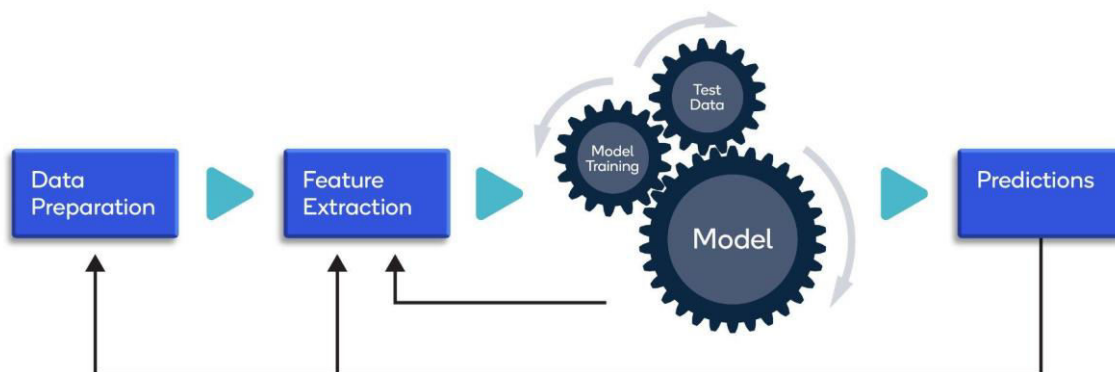


Fig.1 Data Pre-processing

Training and Test Data

1. **Training Data-** The observations in the training set form the test that the algorithm uses to learn. In supervised math problems, each observation consists of observed output variables and one or more observed input variables.
2. **Test Data-** A test set is a set of observations used to evaluate a model's performance using a performance measure. No observations from training set were included in the test set. If the test set contains examples from the training set, it is not easy to judge whether the algorithm has learned to generalize from the training set or just memorized it.

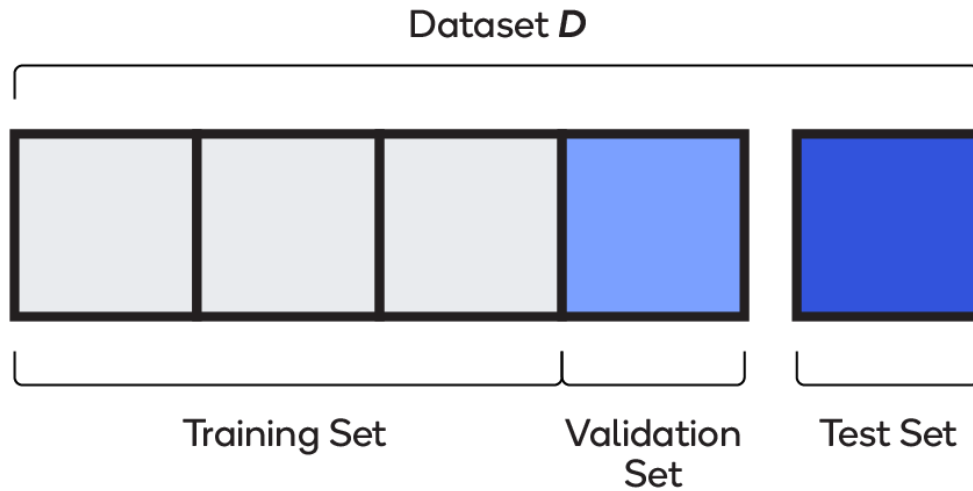


Fig.2 Training, Validation and Test

Model Evaluation

In the process, various evaluation metrics help to understand the performance of the machine learning model, as well as its strengths and weaknesses. Model evaluation is important for assessing the effectiveness of a model in the early stages of research, and it also plays a role in model follow-up.

Of all the different algorithms used in this step, the one that gives more accuracy to the input data is considered to be the best model because it predicts the outcome better. Accuracy is considered a key factor while solving various problems using machine learning. If the accuracy is high, the model's predictions on the given data are also as correct as possible.

There are several steps to solving an ML problem such as data set collection, problem definition, given data analysis, preprocessing, transformation, model training and evaluation. Although there are several steps, the evaluation step of an ML model is the most important step, as it gives us an idea of the model's prediction accuracy. Performance and usage of the ML model are decided based on precise end-stage measurements.

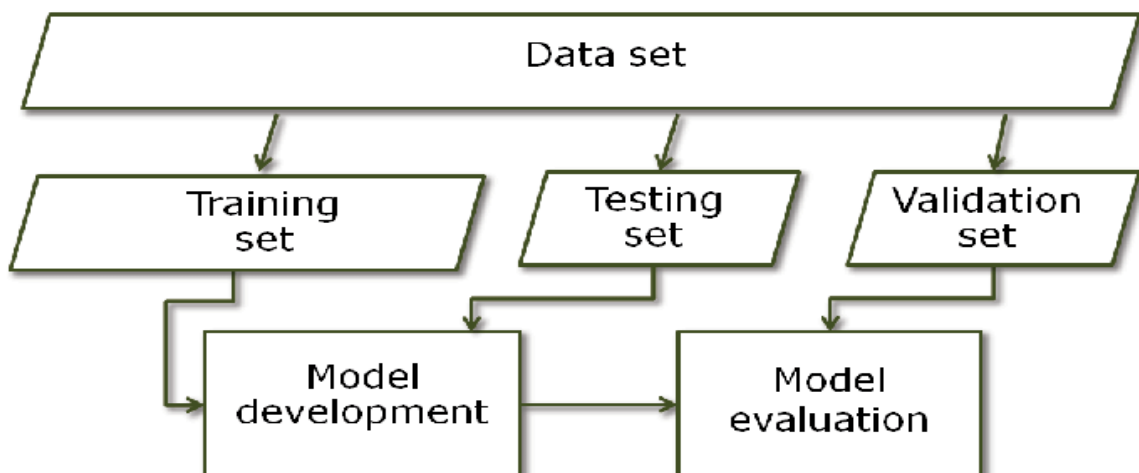


Fig.3 Model Evaluation

VI. ALGORITHM

Logistic Regression

Logistic regression is one of the most popular machine learning algorithms, belonging to supervised learning techniques. It is used to predict the categorical dependent variable using a certain set of independent variables. Logistic regression predicts the output of a categorical dependent variable. Therefore, the result must be a categorical or discrete value. It can be Yes or No, 0 or 1, true or false, etc. But instead of giving exact values like 0 and 1, it provides probability values between 0 and 1.

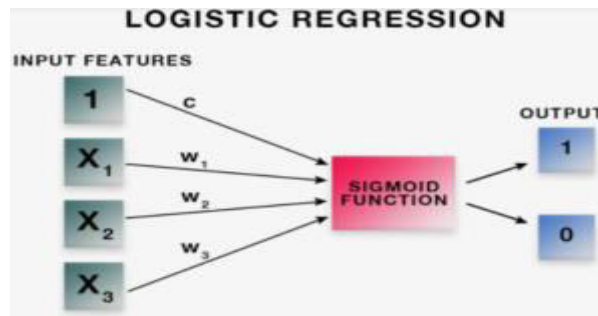


Fig. 4 Logistic Regression

Future scope

The sonar data has characteristics such as non-uniform resolution, noise, 4344 shadows, and inhomogeneity in intensity and reverberation, which 4344 makes processing difficult. Other issues include dual object detection, the appearance of audio sonar targets at different sizes and aspect ratios, and layer imbalance in order to predict the best possible outcome for a target of a rock or a mine

VII. CONCLUSION

Naval Defense's main interest is in analysis in the field of Machine Learning and training a computational machine with a plan for predictive classification of objects, based on the information it has obtained. The full prediction thumbnail, along with machine learning classifier features, is provided, which can include the target of the sound wave as a rock, or mine, or any other creature or any any other body type. The discovery and classification of underwater minerals, pipelines and cables, corals and docking stations are essential.

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