Spam Classification of SMSs using Machine Learning Techniques

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Background

The advent of machine learning has revolutionized the way we approach text classification, particularly in the Short Message Service (SMS) domain. This research explores different machine learning algorithms and techniques to analyze their effects on sentiment recognition, specifically if an SMS message is undesirable. An undesired message that could possibly be malicious is called . The goal is to apply and analyze sophisticated machine learning techniques to classify SMS content into Spam, or not Spam (Ham) and analyze the effects that every single technique has and if it is suitable to implement in a day-day application.

Methods

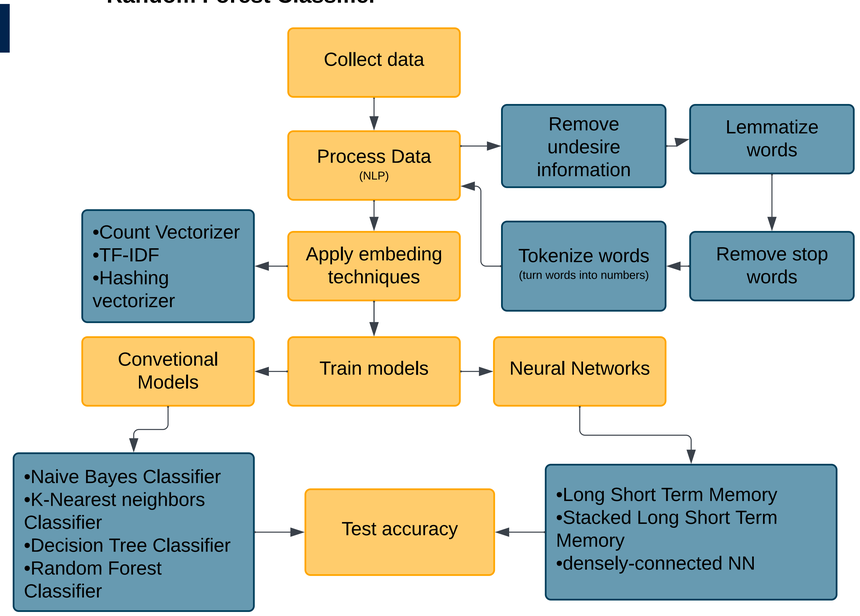
- **Software libraries, tools, and languages**
  - For the project, we used **Jupyter Notebook** and **Visual Studio Code** as the **IDE** and code **editor**, respectively. The primary language was **Python**, and we utilized **Pandas** for data management, **NumPy** for mathematical operations, **matplotlib** for plotting, and **scikit-learn** and **Tensorflow** for machine learning. Additionally, we employed NLP techniques and specific **NLP** tokenization techniques using **NLTK's 'TweetTokenizer'** and **'WordNet'** virtual dictionary.
- **Data collection**
  - Data was collected from the UCI machine learning repository and a paper by Mishra, S, & Soni. The second dataset is simplified by removing the 'URL', 'PHONE', and 'EMAIL' columns, as the focus is on NLP techniques without external information.
- **Natural Language Processing (NLP) techniques**
  NLP techniques preprocess human language, like English, into a computer-readable format, such as numbers. These numbers are then used in a machine-learning model to make predictions:
  - **Tokenization***: The process involves using the 'TweetTokenizer' from NLTK to turn sentences into a list of words, which are then converted into numbers for computer processing.
  - **Lemmatization:** The lemmatization of a word is the process by which a word is converted to its base form, this process uses a pontificated process that analyzes the word's morphology using vocabulary from a dictionary. The library **NLTK** provides the functions to lemmatize words, and also uses the virtual dictionary '**WordNet'.**
  - **Word Stop removal:** This step consisted in removing all the stop words, from the sentences such as "the", "a" or "an", this was done to focus on the more meaningful text.
  - **Tokenization*(continued):** After the words were lemmatized and the stop words were removed, the remaining words were turned into numbers, for example. The word "hello" = 1, and "book" = 2, this would be repeated with all words. After every word was assigned a number, all sentences were rewritten with their respective word-to-number translation
  - **Padding:** After the tokenization and the lemmatization, the sentences need to be converted to lists of the same length, a padding algorithm was provided by the **TensorFlow** library
  - **Embedding:** The process of embedding is the process to give sentiment to words and thus sentences, there are several techniques to give sentiment to words, and a handful of them were applied to observe their effects during the training. The techniques that were applied were:
    - **Count Vectorizer**
    - **TF-IDF**
    - **Hashing vectorizer**

Methods (continued)

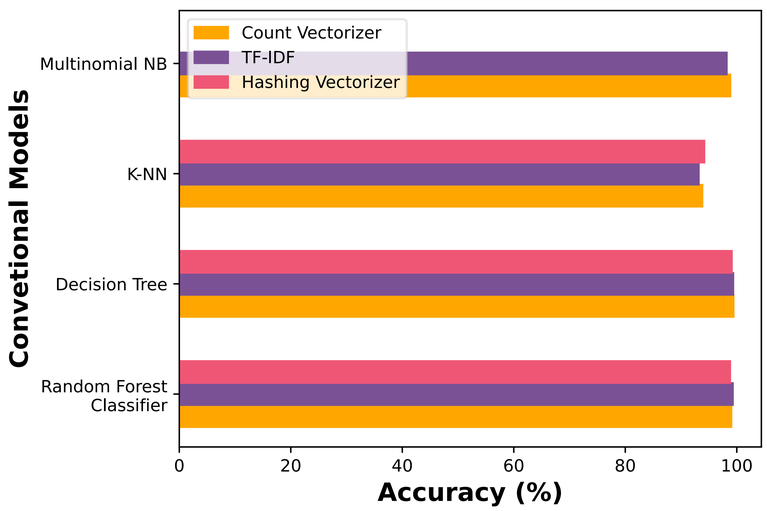
- **Model selection and training**
  Once the Text Preprocessing was done, the next step was to train models. A pool of Machine-learning models and some deep-learning techniques were chosen during this research.

ML Algorithms:
- **Naive Bayes Classifier**
- **K-Nearest neighbors Classifier**
- **Decision Tree Classifier**
- **Random Forest Classifier**

DL algorithms:
- **Long Short Term Memory (Recurrent Neural Network)**



Results



Conclusion

~~(Analyze and interpret your results and how it supports your hypothesis. You can also state any sources of error or limitations you encountered. You can state your conclusion in bullet format if necessary.)~~

Future Work

~~(You can state any future procedures or ideas that would help your experiment reach its goal or further advance it.)~~

References

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