Text Similarity

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# Introduction

The textsimilarity Python package contains functionality for text pre-processing and similarity matching between a predefined corpus of words or short phrases and target words or short phrases. This package uses large pre-trained natural language models that provide contextual and semantic text embeddings which allow for text comparison. This package has modules and classes which allow these language models from the transformers library to be loaded and used for comparison without having to think about the complexity of what an embedding is or how to use them. Additionally, the text cleaning functionality provides a convenient way to correct spelling errors and check for profanity before applying the similarity comparison. This package wraps supporting packages, modules, and methods for ease of use and simplicity.

To install this package, you can use the following command:

pip install git+https://github.com/NalaniKai/TextSimilarity

Examples of using this package can be found here: <https://github.com/NalaniKai/TextSimilarity/blob/35fdb51be58899ece17d8d7c3941b4c65d945d5a/examples/examples.ipynb>

# Use Cases & Users

Software engineers often have limited knowledge with machine learning and are sometimes required to apply intelligence to the product they are working on. In the scenario where they are working with textual data and need to apply similarity matching, the textsimilarity package is a good starting point because the package is simple and easy to use without requiring any background knowledge of natural language modelling.

One example use case is when a product has different filters to apply to a given search. For Nordstrom Rack, the textsimilarity package could be used to show the most relevant filters when a customer types in a search query. Figure 1 below shows a customer typing in “shoes” on the left. Given a predefined corpus of filters, textsimilarity could be used to rank the similarity of each filter to the provided query and then show the filters with the highest rankings. In Figure 1, the query “shoes” returns the filters “heel height” and “heel shape.” Changing the query to “jacket” on the right, the filters change to “neck style” and “sleeve length.”

Graphical user interface, application, website, Teams

Description automatically generated

Figure 1: Nordstrom Rack search provides different filter options based on the provided search query.

Another example where textsimilarity can be used is to match a search query to different image titles. Figure 2 demonstrates the similarity in image titles to the query “Korean food.”

Graphical user interface, application

Description automatically generated

Figure 2: Search query “Korean food” brings up images with similar titles such as “Korean BBQ Food.”

# Software Modules & Components

The textsimilarity package has three modules which are separated by functionality and purpose:

* clean\_text
* text\_models
* rankers

The clean\_text module has a CleanText class which loads supporting dictionaries and instances once during initialization. This class contains the methods spelling\_correction() which corrects spelling errors and determine\_text\_profanity() which provides insight into whether a text contains profanity. The clean\_text class also has one private method \_calculate\_jaccard\_distance() which is a helper method for spelling\_correction().

The text\_models module has a BertBaseModel class which loads a pre-trained BERT model. The class contains two private methods for tokenizing the data and retrieving the text embeddings from the model.

The rankers module has a CosineSimilarityRanker class which contains the private methods \_get\_embeddings\_dict() which loads all text embeddings from a predefined corpus into a dictionary on object instantiation for quick access during runtime and the \_calculate\_cosine\_similarity() private method which calculates the similarity between two texts. This class contains one public method rank\_on\_similarity() which is called to get the ranked list of predefined texts based on the given target text.

# Design Decisions

The textsimilarity package was designed to be extremely simple for ease of use and to quickly enable users to compare text. For example, the BertBaseModel class in the text\_models module has pre-set parameters for initialization, so users don’t need to worry about specifying the parameters to get started. Given this simplicity, Figure 3 demonstrates how a text corpus can be ranked by a target text in just a few lines of code. In this example, a corpus must be specified as a list of texts, the text\_models and rankers modules must be imported, a model and ranker instance must be created, and then the corpus can be ranked based on the given input text. Using the textsimilarity package, a user can easily compare text without having to deal with tokenization, embeddings, or similarity metrics to compare vectors.

Text

Description automatically generated

Figure 3: Example of ranking a text corpus based on a given target text query.

Principles of abstraction and information hiding are leveraged throughout the package to reduce complexity and make both maintenance and modification easier. The private method \_calculate\_jaccard\_distance() in the CleanText class hides the input transformations needed to use nltk’s jaccard\_distance() method in the distance module and also hides the algorithm used to support spelling correction. Additionally, code that uses spelling\_correction() would remain functional when changes are made to any supporting functionality for spelling\_correction() because the method call and expected output would remain the same.

The design decision to have the CosineSimilarityRanker take in a language model as an input parameter also allows the language model complexity to remain abstracted from the user by calling the private methods in the model. This way the user does not have to think about tokenization or about what an embedding is.

Another design decision was to separate the functionality into three separate modules. The clean\_text module is separate because if a user already knows their text data is clean or if the data had already been pre-processed, then the user can save time and not use the functionality provided in the module. They can instead go straight to using the text\_models and rankers modules like in Figure 3. Having separate modules for the cleaning text, language models, and rankers also follows the principle of encapsulation which enables easier maintenance, extensibility, and discoverability. The separation and naming provide a clear sense of the functionality each module contains and reduces the amount of data shared across components.

# Comparison to Existing Package

The textsimilarity package is like the semantic\_sh package <https://github.com/KeremZaman/semantic-sh> which also enables text to text similarity using large pre-trained natural language models; however, the design approaches between the two packages are different. The semantic\_sh package has only one module with one class which has all the functionality including loading text models, ranking a list of text based on a target text and removing stop words which is a text cleaning/pre-processing step. In contrast the textsimilarity package separates the functionality of loading models, ranking, and text cleaning into different modules which makes textsimilarity cleaner, easier to extend, and easier to modify. For instance, the textsimilarity package has more text cleaning capability built in with spelling correction and profanity checking. By having a separate module, additional text cleaning capability can easily be added in a cleaner manner. On the other hand, making changes to semantic\_sh likely requires more time and effort. This is because everything in semantic\_sh in in one .py file so there is more scrolling required to scan the code. Additionally, there are calls to methods within methods that call other methods which adds cognitive load to those trying to extend or modify the code. Further, all supporting packages and modules will be loaded regardless of whether they are used since all functionality is specified in the same file.

The textsimilarity package also differs from the semantic\_sh module because there is a text\_models module which is structured to have a separate class per model type and currently only supports BERT based models from the transformers library. The semantic\_sh module on the other hand supports fasttext, glove, word2vec, and BERT models from the transformers library and loads the specified model in the same class. The separate class approach allows for more clarity in the model being created; however, this could lead to more duplication. The single class approach could provide more simplicity in having one class when there are only a few models, but as the number of models grows this approach makes the code harder to maintain because more if-else statements are required to check for the model type and to make the appropriate assignments. This makes the code harder to debug, maintain, and modify because the methods are longer and it becomes harder to quickly understand what the code is doing.

The semantic\_sh class contains functionality such as saving the state of the object, loading the state of an object, adding text to be compared, and comparing two text strings together rather than comparing a text string to an entire list. These functionalities would also be good to add to the textsimilarity package in CosineSimilarityRanker because they are directly applicable to the use cases the package was built for.

# Extensibility

The textsimilarity package was designed to be easily extensible. This can be done through adding more classes and/or more methods. Additional text cleaning and pre-processing functionality can be added as new methods in the CleanText class. For instance, removing stop words and removing special characters could be two methods to extend the functionality. Additional models and rankers can also be added in the text\_models and rankers modules as their own classes. The current BertBaseModel and CosineSimilarityRanker classes are simple and compact so a base class could be created for more structure if additional model and rankers were to be added. The classes could also be extended by adding methods such as comparing two text strings, adding text to the corpus, saving the state of the ranker instance, and loading the state of the ranker instance. Furthermore, the clean\_text and text\_models modules could also be extended to support other languages besides English.