

Minimal Keyword Extractions for General and Bio Medical Documents: A Survey

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Abstract

The most crucial information is contained in keywords, which are index terms. The task of identifying a limited selection a list of words, phrases, or keywords that can be extracted from a document can be used to convey the meaning of the document is known as automatic keyword extraction. Text interpretation methods like TF-IDF, RAKE, YAKE, Key BERT can help you get the information you need from a single document or a stack of papers. In topical years, a specialized field of artificial neural networks research in deep learning, has outperformed contemporary statistical and NLP techniques in a variety of situations, allowing these methods to be applied to challenges including machine translation, keyword extraction, and summarization. Deep learning algorithms for keyword and key phrase extraction were investigated in this work

Keywords:

Key phrases, Key words, Deep learning, RNN.

With the development of the Internet, computers and computers systems are freed from the limitation of working locally, defense systems, electronic devices, land, air and sea in a wide range of vehicles, such as smart home systems, has found use. However, from many sources data compiled mostly in text format processing and interpretation problems arose it.

The problem is more than predefined statistical methods. made it important. Machine translation, keyword and key phrase extraction, linking documents, title problems such as text tracking, text summarization, text mining solved in the field.Many studies on text interpretation has. For example, Social networks are rich in text.Particular,Social networks, keyword search, classification and text analysis for a wide variety of applications such as clustering requiresWide variety of search and classification While there are well-known applications for scenarios, social networks richer in both text and links has structure. Most of the work in the field is either purely text Uses content or link structure only [1].

1. Introduction

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2. Literature Survey

The growth of the biomedical literature has led to increased interest in applying text interpretation techniques to biomedical text to address the information overload faced by field experts [7]. Many tasks, such as creating daily news tags, assigning keywords to a rapidly increasing number of scientific articles, summaries of documents, translating two different languages, establishing links between documents, which are done with high costs, can be carried out with automatic systems at a low cost. This study includes the keyword/key phrase extraction/assignment problem, statistical, NLP and graphic-based methods developed to solve the problem, machine learning methods, deep learning methods and Recurrent Neural Networks (RNN), results sections, respectively.

Key-Wording/Key-Expression Extraction/Assignment

Digital, where thousands of books and publications are produced every day. It has become a problem to reach the information sought in the world. For this reason, information extraction and summary extraction from texts operations have become important [12].

Technologies using text analytics are grouped into eight groups:

- A. Semantic Information Extraction
- B. Topic detection and Tracking
- C. Encapsulation
- D. Indexing
- E. Clustering
- F. Interconnection
- G. Data exploration and analysis

Within the text, Semantic Information Retrieval software detects relevant phrases and relationships. The topic tracking system works by maintaining user profiles and predicts other documents of interest to the user based on the documents viewed by the user. Keyword extraction is studied under the topic tracking. The summarization process creates short articles describing the basic principles of the subject in less time than long documents. Categorization categorizes documents into predefined headers. In clustering, unlike categorization headers are not predefined. Concept Linking, unlike traditional linking methods, establishes concept-based

relationships between documents. Information visualization is the visual presentation of data Question Answering Systems. Since keywords and key phrases are the smallest units that define the whole text, they can be used in information extraction, title tracking, summary extraction, categorization, clustering, information visualization, concept linking.

The International Encyclopedia of Information and Library Science [5] defines a keyword as "A word that succinctly and accurately describes the subject or the general framework of the subject". Both single words (keyword) and phrases (key phrase) can be called keywords. Manning and Schmutz had this to say about the statements in their book *Fundamentals of Statistical Natural Language Processing: Words don't just happen in an ancient order. Languages have restrictions on word order. But words in a sentence are not simply strung together as conversational strings like beads on a necklace. Rather, words are organized into phrases. One of the key ideas is that certain word groups act as components* [11].

In another study, keywords were defined as an important group of words that provide a high level of disclosure to the readers of the content of an article [9]. For example, identifying keywords from a large amount of online news data is very useful so that it can give a brief summary of news articles. Keywords are used in academic articles to give the reader an idea about the content of the article. In a textbook, it is helpful for readers to identify and retain the main points in mind about a particular chapter, keywords of a text.

Since it represents the main theme, they can be used as a similarity measure for text aggregation [12]. While Kaur et al. defined keywords as words showing the most important data [8], Chen et al. defined it as short text fragments [15]. Lott stated that keywords are widely used in search engines and document databases to find information and determine whether two text pieces are related to each other [9], Meng... stated that keywords provide information that can be used for document understanding and categorization [12].

Keywords are words that provide information about the content of a text or text document. Key phrases, on the other hand, are phrases that consist of more

than one word, such as phrases, and provide information to the user about the content of the text or document. Automatic keyword and keyword generation can be done in two approaches shown in Fig 1. The method of assigning keywords from a previously created controlled dictionary is advantageous in that it is simple and consistent.

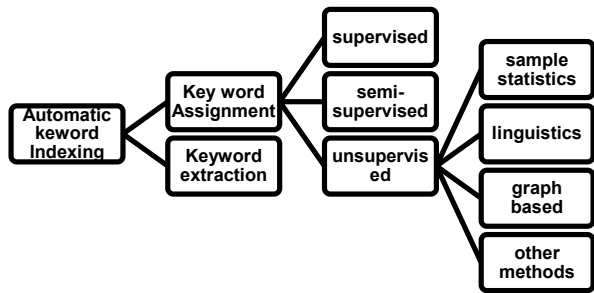


Figure 1 Classification of keyword extraction methods

But creating an accurate controlled dictionary is a difficult and time-consuming process. New words that are not in the dictionary can never be found. The second method, which determines the most important words in the document as keywords, is advantageous in terms of not creating a dictionary, but it cannot be stable [15].

3. Methods

3.1 Statistics, NLP and Graphic Based

Methods

One of the most basic approaches to use text mining to provide commercial value is to use keyword extraction. It can automatically determine the document's most representative phrases. These identifiers could be used in a variety of applications. They can also be used to summarize a lengthy document's underlying idea in only a few words. They're also useful for indexing and categorizing documents as metadata. They can also be used to group papers that are similar. For example, to display relevant adverts on a web site, we could collect buzzwords from the page, discover advertisements that match these terms, and display them.

All algorithms follow a similar process for keyword extraction, as demonstrated in Fig 2. Resist words,

punctuation, and division into terms are removed from a document while pre - processing step. Keywords, such as words or phrases, are chosen as candidates.

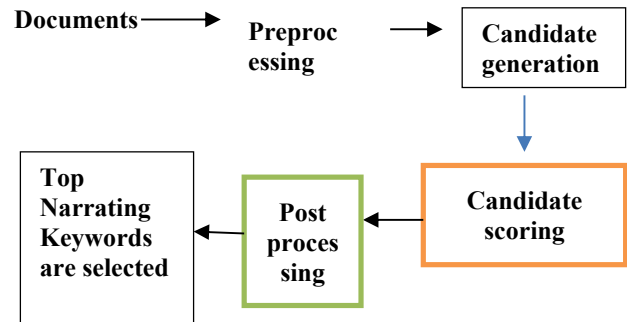


Fig 2: Unsupervised Key Phrase Extraction Pipeline

Then, using some methodology, an evaluation was made to each candidate keyword. The top keywords are chosen, then post-processing is initiated, such as minimizing near-duplicates. Finally, the module creates a list of the top N ranking keywords. Technique with no guidance for key phrase extractions:

1. TF-IDF
2. RAKE
3. YAKE
4. Key BERT

TF-IDF Algorithm

The TF-IDF was used extensively in the fields of data capture and text mining to analyze the relation

Step 1: INPUT: ((document name+Keywords+word count sum of counts for keywords), No. of keywords and documents (i.e. papers respectively))

Step 2:

✓ $Term\ frequency(words) = count(words)$

✓ $inverse\ documnet\ frequency(words) = \log\left(\frac{total\ documents}{no.\ of\ documnets\ containing\ words}\right)$

✓ **By multiplying two quantities. $TF - IDF = TF(words) * IDF(words)$**

Step 3: OUTPUT: Final Ranking: Pick the top N keywords and sort them in lowest to highest based on their TF-IDF ratings among each word in a set of

documents. They're needed for tasks like identifying core keywords (keywords) from documents, computing similar degrees across texts, and generating search engine rankings, among others. [21]

Rapid Automatic Keyword Extraction (RAKE) Algorithm

One of RAKE's main points is that keywords usually consist of several words, but they rarely include punctuation, stop words, and perhaps other phrases with only minimal lexical value, as seen in Fig 4. In this part, the author mostly discussed the word's juxtaposition and co-occurrence. [16]

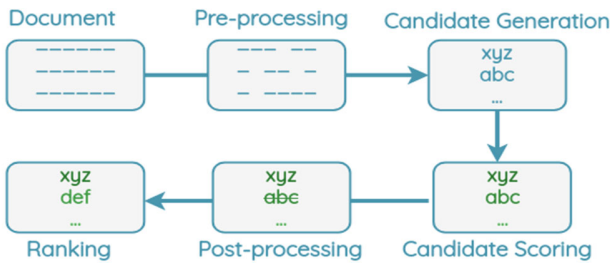


FIG 4: working of RAKE

If RAKE's stop regular expression isn't large enough, it will treat continuous long paragraph as a phrase, producing in extraordinarily long phrases. In multi-word formulations, stop-words may be overlooked. For example, if "good" is on the stop word collection, a brand entitled "Good Day" might well be disregarded.

YAKE Algorithm:

Using Text Features, an unsupervised strategy for automatic keyword extraction has been developed. It does not require training on a specific collection of documents, nor does it rely on dictionaries, external corpora, text size, language, or domain. It is compared against ten state-of-the-art un-supervised approaches to highlight the strengths and significance of that concept. shown in Table 1 (TF.IDF, KP-Miner, RAKE, Text Rank, Single Rank, Expand Rank, Topic Rank, Topical PageRank, Position Rank and Multi partite Rank), and one supervised method (KEA).

Step 1 INPUT: document name + the size of the window (w) +n-gram+ de-duplication threshold+

language Text. i.e Preprocessing and generation of the candidate

Step 2

For candidate scoring:

1. Casing of words=
$$\frac{\max(\text{count}(\text{Word is capital}), \text{count}(\text{word is acronym}))}{1 + \log(\text{count}(\text{words}))}$$
2. Position of words=
$$\log\left(3 + \text{median}(\text{sentence}(\text{words}))\right)$$
3. frequency of words =
$$\frac{\text{counts of words}}{\text{mean}(\text{counts}) + \text{standard deviation}(\text{counts})}$$
4. relatedness(words) =
$$1 + (WR1 + WL1) * \left(\frac{\text{count}(w)}{\text{max count}}\right) + PL1 + PR1$$

where, WR1 = (number of distinctive words on right) /

Step 3: Now we do COSINE similarity between

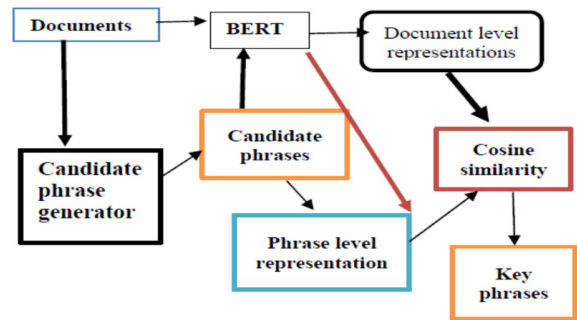


FIG 6: Working of Key BERT[14]

(aggregate words on right)

WL1 = (number of distinctive words on left) / (aggregate words on left)

PL1 = (aggregate words on left) / (utmost count)

PR1 = (aggregate words on right) / (utmost count)

5. candidate word occurs with different sentences(w) =
$$\frac{\text{number of sentences } w \text{ occurs in}}{\text{total sentences}}$$

Step 3: A single score S is created by combining five features (words):

$$\text{score}(w) = \frac{\text{relatedness} * \text{positon}}{\text{casing} + \left(\frac{\text{frequency}}{\text{relatedness}}\right) + \left(\frac{\text{different}}{\text{relatedness}}\right)}$$

Keyword score:

$$S(kw) = \frac{\text{product}(\text{scores of words in key word})}{1 + (\text{sum of scores of words}) * \text{count}(\text{keywords})}$$

Step 4: Post-processing

Step 5 Output:Final Ranking: list of keywords along with their scores, sort the keywords in ascending order and take the top N keywords as the output.

Experimental results carried out on top of twenty datasets show in the table - that their methods outperform state-of-the-art algorithms on a variety of datasets of various sizes, languages, and domains. [yake.inesctec.pt] [20]

Despite the developments, multilingual web tools for extracting keywords from single papers are clearly lacking. Yake! is a unique feature-based multilingual keyword extraction system that works with texts of various length, domains, and languages.

Keyword Extraction with BERT Algorithm

Key BERT is a minimal and easy to use key word extraction technique which makes use of BERT Embedding's to create KEYWORDS and KEYPHRASES for a document and these key words and key phrases are expected to be very similar to the contents of the document. The basic working flow of keyword extraction with BERT is shown in FIG 6.

Step 1: Documents are passed to the BERT model (Devlin et al., 2019) it will get document level representation.

Step 2: We also have a candidate phrases which generates candidate phrase generator from the document, each of these candidate phrases again u can pass it to the BERT MODEL and get a phrase level representation. It means we have document level representation and phrase level representation for various candidate phrases.

document level representation and phrase level representation and then rank most similar phrases will get our key phrases.

Step 4: The idea is that how can we generate key phrases which are different from each other and they are much important to the document. Here we use Sentence transformer model as Key BERT model [14]

In NLP, these algorithms used to extract some types of assets. it is possible to find word types (places, people, etc.). The range of techniques developed, the simple automatically from natural language queries extends to processing. In addition, linguistic analysis techniques, used, among other techniques, for processing text. Stapley et al., from a Medline collection, Co-occurrence of *Saccharomyces cerevisiae* gene took it out. The query they do automatically generates gene aliases was created to include Additionally, received document set by the user with a MeSH term can be filtered showed in figure 7. From these co-occurrence data, common and based on individual incidence statistics, each gene difference measurements of the pair are made [17].

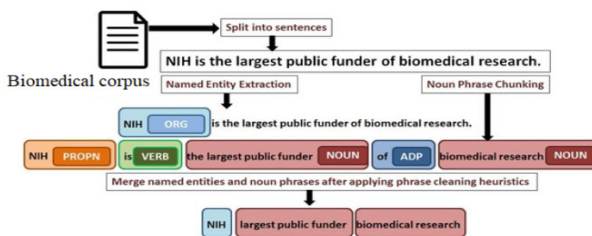


Fig 7 Extraction of Key words

3.2 DEEP LEARNING METHODS:

Artificial neural networks take inputs of a certain size and produces large output. such as natural language processing connected and previous entries must be kept in memory cases, deep learning methods are used. In an algorithm proposed by Sarkar et al. such as key phrase extraction problem, classification problem multi-layered not by considering it as a sorting problem using a multilayer perception (MLP) model. has been removed. tftdf, in addition to location properties, expression length, word length, connection properties between phrases used[18]. In another study, Convolutional Neural Network (Convolutional Neural Network - CNN) based CopyCNN method has been proposed [22]. Secret key expressions in this method for inference, existing keywords in the text have been removed. Then the copying mechanism was used. More successful importance mechanism and place in the model to get results information has been added.

Another of the deep learning methods such as CNN, MLP RNN is used in natural language processing. a neural network; input layer, hidden layers and output layer. consists of Recurring in RNN and the network itself There is a feeding structure. That is, in the neural network neurons connect to each other over time. It information from a network that worked before the runtime can receive. Memory flow is provided in this way. Memory in keyword/phrase extraction It enabled the widespread use of RNN. A Simple RNN

Structure Fig:8A simple neural network has both the inputs from the previous forward propagation. From current state inputs with activation is fed. Information from hidden units is sent to RNN. It gives information about the previous situation. Machine translation, news head line extraction, key phrase sequence-to – sequence model is used in many problems

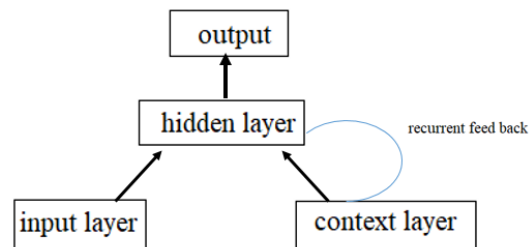


Fig: 8 RNN Structure [10]

such as extraction. Seq-to-seq model will produce more than one output from more than one input time is the RNN model used. Apart from that, a dichotomy about whether the comment is positive or negative. sequence-to-one in classification problems, generating multiple outputs to an input such as image title one-to-sequence models is used. The seq-to-seq RNN model in Figure 2 seen [14]. The seq-to-seq model consists of two RNN networks. consists of Encoder and Decoder

Memory formed during back propagation of RNN. vanishing and exploding slope caused by transmission Long-Short-Term, proposed as a solution to the problems Memory (Long Short-Term Memory - LSTM) and Gated Recurrent Unit (GRU) versions are available. These two models are used in natural

language processing problems. frequently used. GRU runtime and memory in terms of performance. LSTM is an older method and it is easier to set its parameters.

Copy RNN suggested by Meng et al. model seq-to-seq RNN encoder and decoder RNN networks replaced with bidirectional GRU and forward GRU, respectively [12]. By adding an importance mechanism to the solver network performance is increased. secret key phrases A copying mechanism was used to produce it. It mechanism, location information of words, importance of words used to calculate the vector.

In text summation by Nallapati et al. Another model unidirectional GRU proposed for use of encoder consisting of GRU decoder with importance mechanism has a structure [19]. Encoder tf, tdf, element of sentence (Part of Speech), named entity recognition - NER) information as vector in the input layer. takes. Thanks to the diversity of information used in the introduction model Feature-Rich Encoder (words large vocabulary It's named trick - words-lvt). Rich in Figure 9 Featured Encoder model is shown.

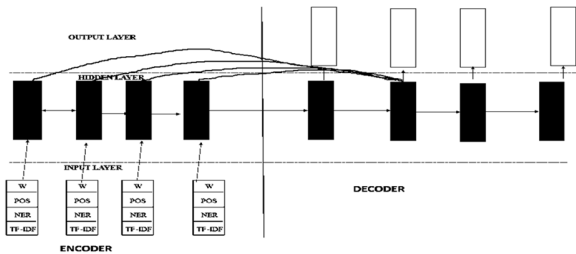


Fig 9: Feature Rich Encoder

In the LSTM-CNN based hybrid model, in which the two deep learning networks given in Figure 10 are used together in the encoder, the expression vector produced after the words pass through the CNN network, which is called the expression solver, is sent to the input layer of LSTM [19].

4. Results and Discussion:

It can come to a conclusion with a finer-grained study for different datasets which are available publicly of different languages in different domains. For example, PubMed dataset contains 12183284 Documents, Time spent to run YAKE algorithm 0.17 msto extract top 20 keywords in terms of relevance are annotated in the text and Time spent to run RAKE algorithm 0.47 ms to extract top 20 keywords in terms of relevance are annotated in the text and Time spent to run KEYBERT algorithm 0.16ms to extract top 20 keywords in terms of relevance are annotated in the text. Hybrid models takes more time when compared toSpecializedtechnique's.

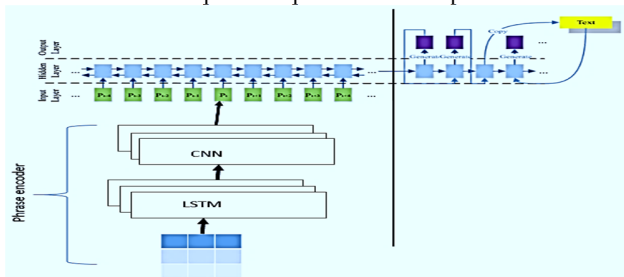


Fig 10: LSTM CNN Hybrid Model [19]

The results are shown in Fig: 11 for different datasets like PubMed, SemEval 2010, Nguyen 2007.YAKE and KEYBERT returns the best results in their respective phrases. An improvement in the performance of latest methods will always be a major improvement above futuristic solutions.

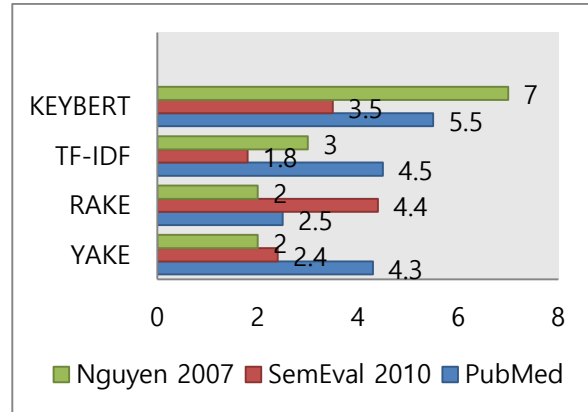


Fig 11:Effectiveness of different method for different domain and different languagesResult accuracy for Deep Learning Models

We have used reviews from various social media plat forms like tweeter, YouTube, Instagram to form training and testing dataset. These datasets are cleaned for the further processing

Table-1 Statistics of used datasets:

Dataset	Positive Reviews	Negative Reviews	Neutral Reviews	Total Reviews
Tweeter	3778	2941	3302	10,021
You tube	6013	5286	8929	20,228
Instagram	5686	5314	-	11,000

Table 2. Performance Matrix-I

Algorithm name	Training accuracy	Testing accuracy
Recurrent Neural Network	87.4	87.01
LSTM	92	82
CNN	93	84
LSTM-CNN	95.1	85.73

Table 3. Performance matrix-II

Methods	Accuracy	Precision	Recall	F-measure
Recurrent Neural Network	83	81	75	86
LSTM	87	85	80	88
CNN	90	79	87	89.1
LSTM-CNN	93	91	86	90

5. Conclusion:

Quickly get the most summary information about a document. keywords we can acquire, the amount of data exponentially It is an important problem that needs to be solved nowadays. Keyword/phrase extraction to make sense of many texts used to solve the problem. Information extraction, title follow-up is a step in summary extraction problems. Keywords to news texts and scientific articles together The main situation to be solved in the assignment problems appears as. In this study, the literature for the keyword/phrase studies were examined, used for key phrase extraction Deep learning methods are classified categorically. In order to better understand the methods, the studies are grouped under 3 separate headings, deep learning based keyword and keyword generation methods architectural details were examined.

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