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**ODESSA NATIONAL ACADEMY OF
FOOD TECHNOLOGIES**

International Competition of
Student Scientific Works

BLACK SEA SCIENCE 2018

PROCEEDINGS



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Ministry of Education and Science of Ukraine
Odessa National Academy of Food Technologies

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Proceedings

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USING OF NLP TECHNOLOGIES FOR EVALUATING THE CRYPTOCURRENCY RATES

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Cryptocurrency mining is the process of adding new transactions to the blockchain that results in adding the new units of digital currency into existence and circulation. Due to the high innovativeness of this process, the status of cryptocurrencies as well as their mining in jurisdictions may vary worldwide.

Blockchain is a new way of storing and moving that data, where instead of being held all in one place, the information is atomized and spread over thousands of nodes across a network, all locked together with clever cryptography. The evaluation of the cryptocurrency rate is an important task, as it is a very dynamically developing area and requiring constant monitoring of rate.

Goal of the work is developing the algorithm for evaluating the rate of cryptocurrency, by means of sentiment analysis in order to determine the tune of the news feed.

The object of the study is the process of determining cryptocurrency rates using NLP technology from news sites.

The subject of the study is NLP methods for automated detection of cryptocurrency rates.

The author in his work explored the topical area (cryptocurrency sphere), collected the data into text corpus of news topics, completed data pre-processing for news titles and developed the Sentiment Analysis algorithm for evaluating the rate of cryptocurrency.

Introduction

Cryptocurrency is a brand-new notion, that said, it is less than a decade old. It has formed a completely new and rapidly-developing industry, thus, opened the path for all kinds of businesses in the corresponding sphere, for both: private entrepreneurs and major companies. Blockchain – the decentralized technology applied to cryptocurrency is absolutely

innovative and is changing the way people think, interact with each other and do business.

Factors such as unsettled market conditions and the young age of cryptocurrency as a notion provoke an extremely volatile and unstable price rate of the most popular representatives of the sphere. That is an advantage and disadvantage at the same time, because the profits of investors can very often reach great heights, although the risks are high, as well. The rate of cryptocurrency is not estimated by any entities or governments, on the contrary, it is affected by the demand and supply on the market. As a result, the price can sway up and down very frequently in a short lapse of time.

For the moment, there is a vast variety of trading bots that help investors predict the price and, eventually, increase their capital. Although, the problem is that they are based on specific strategies configured by traders, themselves, and are unable to analyze the price fluctuations based on certain news that directly affect the price. In fact, even rumors on the Internet can, in a certain way, influence cryptocurrency rate. What all trading bots lack is an implemented program that will process a huge data spectrum of cryptocurrency news titles. In this way, if the negative news appears on the Internet, for example, “China banned Bitcoin”, the trading bot would be able to predict that the price of Bitcoin is about to dip down.

The aim of graduate work is, basing on current knowledge of natural language processing technologies, develop a prototype software for evaluating the rate of cryptocurrency, by means of sentiment analysis that will cognize the tune of the news feed. In order to deal with this problem, it is necessary to explore the topical area, which is, the sphere of cryptocurrency; collect the data – text corpus of topics; complete data pre-processing and, eventually, develop the sentiment analysis algorithm.

1. Cryptocurrency and its role in the modern world

1.1 The notion of cryptocurrency and background to its establishment

It all started back in the year 2008. It was not the year of a release of the first-ever cryptocurrency. At first, it was just a white paper posted on the internet by certain Satoshi Nakamoto. The title was following: “Bitcoin: A Peer-to-Peer Electronic Cash System”. It is worthy of mention, that the ‘Electronic Cash System’ covered in this paper was not contemplated as a cryptocurrency, at that time. It was only a peer-to-peer version of electronic cash that presumed the cryptographic protection.

Basing on “The Collected Writings of Bitcoin Creator Satoshi Nakamoto” [1] Satoshi Nakamoto is the name used by the unknown person or persons who designed bitcoin and created its original reference implementation. As part of the implementation, they also devised the first blockchain database. In the process, they were the first to solve the double-spending problem for the digital currency. They were active in the development of bitcoin up until December 2010.

Gavin Andresen has said of Nakamoto's code: "He was a brilliant coder, but it was quirky".

1.1.1 “Bitcoin: a peer-to-peer Electronic Cash System”

This section includes the original interpretation of how Bitcoin works, taken from Satoshi Nakamoto’s White Paper [2] combined with some exterior speculations.

Originally, Bitcoin is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party. Transactions that are computationally impractical to reverse can protect sellers from fraud, and routine escrow mechanisms can easily be implemented to protect buyers. Bitcoin provides a solution to the double-spending issue using a peer-to-peer distributed timestamp to generate computational proof of the chronological order of transactions.

The Blockchain technology helped to solve the double-spending issue in an absolutely elegant way. Blockchain is a decentralized network, allocated among all ‘participants’ of the network. In rough order, the ‘participants’ (in Bitcoin network) can be divided in three basic categories: Sender, Receiver, Nodes. Consequently, the network works in the following way: Sender sends money to the receiver, while the nodes verify the correctness of the transaction, which is, whether the sender indeed had enough money to spend them and whether the receiver got the funds that were sent to him.

An electronic coin is a chain of digital signatures. Each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key of the next owner and adding these to the end of the coin. A payee can verify the signatures to verify the chain of ownership (Fig. 1.1).

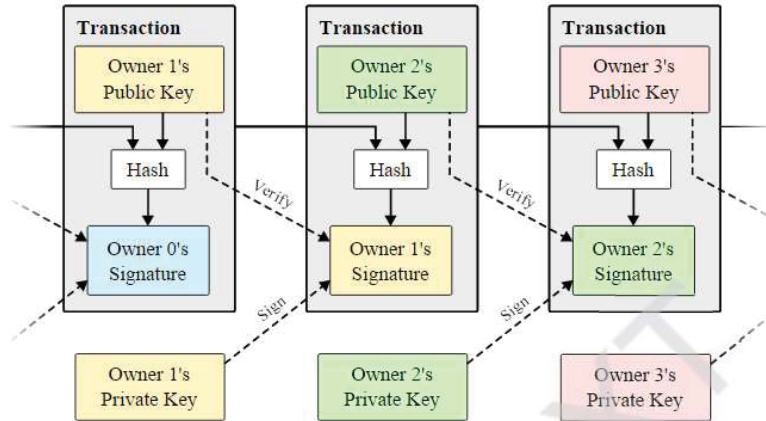


Fig. 1.1. Bitcoin Transaction from within

The proof-of-work involves scanning for a value that when hashed, such as with SHA-256, the hash begins with a number of zero bits. The average work required is exponential in the number of zero bits required and can be verified by executing a single hash.

Once the CPU effort has been expended to make it satisfy the proof-of-work, the block cannot be changed without redoing the work. As later blocks are chained after it, the work to change the block would include redoing all the blocks after it.

By convention, the first transaction in a block is a special transaction that starts a new coin owned by the creator of the block. This adds an incentive for nodes to support the network, and provides a way to initially distribute coins into circulation, since there is no central authority to issue them.

The incentive can also be funded with transaction fees. If the output value of a transaction is less than its input value, the difference is a transaction fee that is added to the incentive value of the block containing the transaction.

The incentive may help encourage nodes to stay honest. If a greedy attacker is able to assemble more CPU power than all the honest nodes, he would have to choose between using it to defraud people by stealing back his payments, or using it to generate new coins. He ought to find it more profitable to play by the rules, such rules that favour him with more new coins than everyone else combined, than to undermine the system and the validity of his own wealth.

1.2 The sphere of cryptocurrency from within

Now that, we have got the insight of the original idea of how cryptocurrency ought to work. Although, it is important to mark that it was not called cryptocurrency at the time Satoshi's white paper was written. By that point, it was called a system for electronic transactions that is not relying on trust.

In the year 2009, Bitcoin network has appeared on the Internet and first transactions were sent, correspondingly, the first blocks were mined. Then, little by little, people set sights on this radically new money system. Over its first years of existence, Bitcoin drew attention of thousands entrepreneurs and has increased dramatically – from \$0.7 to more than \$100 (While the current price is over \$10000.)

It stands to reason, that hundreds of IT specialists, amazed from the system and its algorithms, came up with ideas of building their own 'digital money systems', that, eventually, were called cryptocurrencies. The current number of cryptocurrencies is exceeding a thousand. Consequently, it turned into a multimillion industry.

All existing cryptocurrencies can be divided in two basic groups: Bitcoin and Altcoins. Altcoin (alternative coin) is any cryptocurrency coin, except Bitcoin. Among hundreds kinds of Altcoins, we can mark the most popular ones.

Ethereum is the second to Bitcoin cryptocurrency network, according to both: market capitalization and popularity. VitalikButerin is a Russian-Canadian programmer who came up with the idea of developing his own cryptocurrency. The success of Ethereum can be attributed to Vitalik, himself. His aim was not just to create a yet another cryptocurrency, but to use the knowledge of Bitcoin and expand the functionality. In this way, Ethereum is not only a network for providing money transactions, it also features so-called Smart Contracts. Smart Contract is a program that runs within Ethereum's blockchain. Anyone can build his own program and have it running on Ethereum's blockchain. It is better to give an example for a better insight of the opportunities that Smart Contracts open for both: developers and consumers. Programmers can build any program, let's say a Taxi application like 'Uber'. The only difference is that there would be no any entities that control the process or centralized servers running the program. Everything is autonomous and 'situated' on the blockchain. All you need, as a client, is to have some Ether tokens on your wallet. Taxi driver brings you to the destination and you walk out, without worrying that you did not pay, because program already did it. At the same time,

driver will not have any worries about the client who did not pay for the taxi. Ethereum with its smart contract brings people to the whole new level of autonomy.

Dash is an open source peer-to-peer cryptocurrency that aims to be the most user-friendly and most on-chain-scalable cryptocurrency in the world. The following information is taken from the official interpretation of Dash on Wikipedia [3]. On top of Bitcoin's feature set, it currently offers instant transactions (InstantSend) private transactions (PrivateSend) and operates a self-governing and self-funding model that enables the Dash network to pay individuals and businesses to perform work that adds value to the network. Dash's decentralized governance and budgeting system makes it a decentralized autonomous organization (DAO). Dash is the first decentralized autonomous organization powered by a Sybil proof decentralized governance and funding system. Decentralized Governance by Blockchain (DGBB), often referred to simply as the "treasury system" is a means of coming to consensus on proposed network changes and funding development of the Dash ecosystem. Ten percent of the block rewards go to this "treasury" in order to pay for projects that benefit Dash. Funding from the treasury system has been used to hire additional developers and other employees, to fund attendance at conferences, and to fund integrations with major exchanges and API providers.

1.2.1. The position of different countries concerning cryptocurrency

Cryptocurrency is an entirely new concept. The problem is that it does not fall under any submission of money, speaking about the legal field of different countries. As a matter of course, the first governments' impression to cryptocurrency was absolutely negative and it was considered as fake and surrogate money. However, as years passed the cryptocurrency sphere was developing swiftly and countries start noticing this 'fake money' in a more positive light. The information in this section is mostly based on Wikipedia webpage that states the position to cryptocurrency of different countries [4].

Japan was one of the first countries to declare laws, considering the most popular cryptocurrencies, such as Bitcoin. On 7 March 2014, the Japanese government, in response to a series of questions asked in the National Diet, made a cabinet decision on the legal treatment of bitcoins in the form of answers to the questions. The decision did not see bitcoin as currency nor bond under the current Banking Act and Financial Instruments and Exchange Law, prohibiting banks and securities companies from dealing in bitcoins. The decision also acknowledges that there are no

laws to unconditionally prohibit individuals or legal entities from receiving bitcoins in exchange for goods or services. Taxes may be applicable to bitcoins. In 2017, the country's government officially recognized bitcoin as a method of payment.

In the USA, Bitcoin is classified as a convertible decentralized virtual currency in 2013. The Commodity Futures Trading Commission, CFTC, classified bitcoin as a commodity in September 2015. Per IRS, bitcoin is taxed as a property. In September 2016, a federal judge ruled that "Bitcoins are funds within the plain meaning of that term".

The European Union has passed no specific legislation relative to the status of Bitcoin as a currency, but has stated that Value Added Tax is not applicable to the conversion between traditional (fiat) currency and bitcoin. In 2016 the European Parliament's proposal to set up a taskforce to monitor virtual currencies to combat money laundering and terrorism, passed by 542 votes to 51, with 11 abstentions, has been sent to the European Commission for consideration. The European Central Bank classifies bitcoin as a convertible decentralized virtual currency.

The government of Ukraine is currently working on cryptocurrency regulation. The corresponding law was proposed by Verkhovna Rada of Ukraine on 10th of October 2017. The legislation draft includes the itemized list of definitions, about such notions of cryptocurrency sphere as "Miner", "Blockchain", "Cryptocurrency exchange", etc. The law is announced to come into effect in three months after the introduction. Throughout this period, National Bank of Ukraine will be profoundly developing the proposed statute to make it possible to release the full set of laws related to cryptocurrency, including taxes, regulations, criminal and administrative sanctions. It may, however, take more than 3 months, but about half a year actually. So, there is a very high possibility that in Spring 2018, cryptocurrency in Ukraine will be fully legalized and regulated.

2. Development of method for evaluating the rate of cryptocurrency

2.1 Analysis of factors affecting the rate of cryptocurrency

As it was mentioned above, cryptocurrency is an absolutely new concept of money and it's not government or some other entity that defines its price. There are dozens of reasons affecting the rate of it. The aim of the graduate work is to automate and systematize the process of cryptocurrency rate estimation. So, first of all, it is necessary to determine the factors that are most relevant.

In a fully decentralized monetary system, there is no central authority that regulates the monetary base. Instead, currency is created by the nodes of a peer-to-peer network. The Bitcoin generation algorithm defines, in advance, how the currency will be created and at what rate. Any currency that is generated by a malicious user that does not follow the rules will be rejected by the network and thus is worthless.

Taking Bitcoin as an example, it is proper to mention that its value assessment is very similar to gold. That is to say, it has a finite supply and two main factors that estimate its price: Demand and supply. That means that the eventual price for which you buy your Bitcoins includes these two significantatives.

Finite supply (in Bitcoin) implies that the amount of all coins ever generated in the network cannot exceed 21 million. Bitcoins are created each time a user discovers a new block. The rate of block creation is adjusted every 2016 blocks to aim for a constant two-week adjustment period (equivalent to 6 per hour.) The number of Bitcoins generated per block is set to decrease geometrically, with a 50% reduction every 210,000 blocks, or approximately four years. The result is that the number of bitcoins in existence is not expected to exceed 21 million.

Demand and supply are two inseparable factors that are fully responsible for the eventual price for which one buys Bitcoins (excluding the fees of the exchange). However, if to consider them apart from each other we can discern 'Supply' as mining profitability and 'Demand', simply, as demand on the cryptocurrency market.

2.1.1 Mining profitability

As stated earlier, cryptocurrencies, such as Bitcoins, are mined. Mining industry is already a mature market, where everyone has his roles. Manufacturers of mining equipment aim to give their customers the best product for the best price. While miners (people who earn money by means of mining) seek the cheapest prices for electricity and mining equipment. Especially, this is the reason for such popularity of mining in Ukraine and Russia, because electricity is much cheaper there, rather than in Europe or USA.

Specifically, the 'prime cost' of mining defines the price of the entire coin. It is affected by many factors, but here are the most prevalent once:

- 1) Price of mining equipment
- 2) The 'balance' between mining complexity and the eventual price of the coin.

Price of mining equipment directly hinges on current mining profitability. In such manner, if mining difficulty has increased more than the rate of the coin – miners' profits decrease, so does the price for mining equipment. That means that the 'balance' between mining difficulty and the market price of the coin is the foremost factor.

The difficulty of mining increases along with the growing amount of transactions within the network. A continuous upward curve (Fig. 2.1) confirms the fact that Bitcoins popularity has grown significantly since 2009.

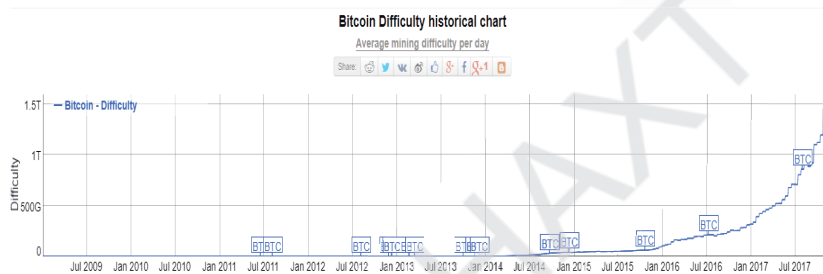


Fig. 2.1. Bitcoin's difficulty chart

The price chart (Fig. 2.2) looks similar to difficulty graph, at first glance. However, they are different. So, at some moments, a price can skyrocket, while difficulty – not. Mining is extremely profitable at such moments. Or, contrariwise, the price drops, while difficulty increases. At these moments mining becomes less profitable and the cost of mining equipment falls as well.



Fig. 2.2. Bitcoin's price chart

The profits of mining are one of the top two factors that are extremely important when dealing with the development of a program that calculates the price of cryptocurrency.

2.1.2 Cryptocurrency demand on the market

It is obvious, that there is no sense in mining a cryptocurrency that is not in the demand. At a certain point, Bitcoin is the most popular, due to both: market capitalization and price of a single coin.

As stated earlier, most cryptocurrencies are extremely volatile, meaning that their price changes very rapidly. The number one factor affecting the demand to cryptocurrency is the news feed, so the program must analyze the selection of news, basing on which it will be able to catch on the opinions among crypto holders. This is the solution to successful cryptocurrency rate estimation.

The best way to grasp the idea of how cryptocurrency is affected by certain news is to give some examples.

“China banned ICO.” Once this news spread on the Internet, the rates of two major cryptocurrencies, Bitcoin and Ethereum, have fallen notably. ICO (Initial Coin Offering) is a variety of crowdfunding. The main difference is that it is done autonomously on Ethereum's blockchain. It is obvious that this news has strongly affected the rate of Ethereum, itself, because the usability of ICO has decreased on the side of Chinese people, who make up a great part of users. However, Bitcoin's rate was impacted as well. And that's the main point – cryptocurrency sphere is so young and unsettled that any negative news can affect the most popular representatives of the sphere. Suchwise, Bitcoin's price was compromised as well.

“Japan has accepted Bitcoin in legal terms.” This is the example of how news can positively affect the price of the number one cryptocurrency. First of all, because the amount of transactions on the side of Japanese increases, due to enlarged cryptocurrency market in the country of Japan: more Bitcoin-related services, more stores accepting Bitcoin, etc. Secondly, because this news is a great possibility for crypto holders to enlarge their profits. That's why once it emerged on the Internet, traders started buying Bitcoins, expecting the price to skyrocket. Eventually, the whole event have resulted in great expansion growth of Bitcoin market.

2.2 An overview of existing cryptocurrency trading bots

Cryptocurrency trading bot is a program or set of programs that is used by traders to supremely automate the process of cryptocurrency trading with the aim to expand the trading profits. For the most part, trading bots are programs based on AI (Artificial Intelligence).

AI is a machine that learns from the collective wisdom of crowd. Since AI is taking over the hedge fund industry in the legacy financial

system, the rush of hedge funds into the cryptocurrency space is inevitably bringing AI trading technology into the crypto markets as well.

First of all, it is necessary to define the term of Bot. Bots are a unique form of AI. Bots use machine learning and data to improve themselves over time. As people interact with them and use them for more tasks, the bots learn, so to speak.

Some bots make the process easier by providing an up-to-date information to its users, in such way, help traders to stay in the loop all the time. In some ways, they are similar to an RSS or news feed for cryptocurrency updates.

Other bots offer additional tools and functions. For instance, a user can use a Bitcoin calculator with a standard financial calculator to do conversions, simply by interacting with a bot. The bot gives an opportunity to see recent trends to make informed predictions and see what other traders have been trading and how much.

Market making is yet another strategy that some trading bots carry out. The market maker is a firm, company or an individual that stands ready to buy and sell stock on a regular and continuous basis at a publicly quoted price. Market maker quotes both a buy and a selling price in a financial instrument or commodity held in inventory, hoping to make a profit on the bid-offer spread.

2.2.1 Cryptocurrency bots that are available on the Internet

There is a great variety of cryptocurrency bots on the Internet. All of them differ in price: some are quite expensive, while others are even free for the users. Trading bots vary greatly in the quality of the software developed for the trading cryptocurrency. Obviously enough, that free bots offer trading of less quality than those for which user should pay.

Haasbot (Fig. 2.3) is one of the most popular representatives of trading bots. HaasOnline Software is dedicated to providing advanced cryptocurrency related trading software to its customers. In order to use this software, a user should only pay in Bitcoins. The price varies from 0.12 BTC to 0.32 BTC, what is more, is that users are obliged to pay every three months.

This trading bot provides a big variety of features. Some of them are:

- Arbitrage trading. Users are given an opportunity to make profits from price differences between different linked cryptocurrency pairs.
- 24/7 trading. A bot is not a human, it doesn't need to sleep and rest. So, the trading is carried out 365 days a year.

- Fully programmable script bots. This allows programmers to use the Haasbot framework and develop fully customized bots that work exactly how they want them to.



Fig. 2.3. “Haasbot” interface

Cryptotrader (Fig. 2.4) is a trading bot that specializes in cloud trading. It is a good choice for novice users because they do not need to install any specific software on his/her PC. Everything is done by means of the internet, ‘in the cloud’. In this way, cryptotrader bot provides one of the easiest ways to start trading for beginners.



Fig. 2.4. “Cryptotrader” interface

2.2.2 Disadvantages of the existing cryptocurrency trading bots

As stated above, there is a wide abundance of cryptocurrency trading bots. Each of them is able to provide users with a certain variety of features, including arbitrage trading, 24/7 trading, etc. The best thing about every trading bot is that it is a program that does not imply human emotions, that very recently hinder traders from earning high profits. With

cryptocurrency bots, users are also given the possibility to set their own strategies and follow them.

However, the greatest disadvantage of existing trading bots is that a newcomer (a person who is absolutely new to the sphere, in our case it's the sphere of cryptocurrency) is unable to make use of them, due to the fact that he/she has no experience, thus he/she doesn't know when and how will a certain cryptocurrency react to market tendencies and the appearing news.

The existing trading bots can only be used by actual traders, who are able to come up with certain trading strategies and 'script' them in the software of the bot. So, still, it is people, not machines, who analyze the market, basing on the overall situation and specific news. What every trading bot requires is a kind of an exterior program, a function of which is to analyze the news feed and doing so take the gauge of the current situation on the cryptocurrency market.

The aim of the graduate work is to design an algorithm that would be able to:

- Estimate the overall situation on the cryptocurrency market.
- Analyze the direction in which the price of a certain cryptocurrency is moving.

All these features can work in the right way when and only when the program is supplied with algorithms, by means of which, it is able to read and analyze the newsfeed, namely the title of cryptocurrency-related news.

2.3 Algorithm for cryptocurrency rate estimation, by means of sentiment analysis

NLP is not yet developed enough. Although it is used in almost every application, nowadays, it is rarely performed at a high level. The work named "SentiStrength" [5] states that sentiment analysis is the task of identifying positive and negative opinions, emotions and evaluations in the text. Companies mostly use natural language processing applications, such as sentiment analysis, to identify opinions online to help them understand what customers think about their products and services. Sentiment analysis is exactly what will help solve the issue of estimating cryptocurrency rate by means of processing a huge data of cryptocurrency-related news and eventually get to know the sentiments of people, regulators, etc, considering the sphere of cryptocurrency, or specific representatives of it.

2.3.1 Introduction to sentiment analysis algorithm for processing cryptocurrency-related news titles

First and foremost, it is necessary to define the input and the output of the program – the steps between which the most significant part of the

program is executed. As stated earlier, the software will analyze the titles of news related to cryptocurrency, which will, basically, be the input of the program – a String variable, containing a certain news title. While, the output is an Integer variable that, in terms of the program, represents a contingent estimation of a certain cryptocurrency.

The following algorithm is inspired by the book of Thelwall M., Buckley K., Paltoglou G., Cai D., Kappas A. – “Sentiment strength detection in short informal text” [6]. In order to examine the sentiment analysis algorithm, it is proper to go through the steps of a program that are performed between input and output (Fig. 2.5).

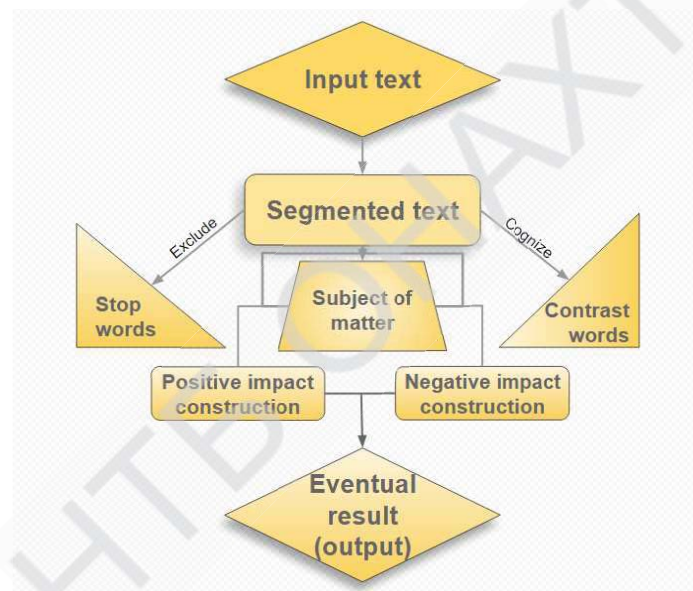


Fig. 2.5. Scheme of sentiment analysis algorithm

- Input text – a title of cryptocurrency-related news. Data that is to be analyzed by the program.
- The segmented text is the same piece of news, but it no longer contains commas, periods or any other punctuation marks. The goal of this stage is to furnish an array of split words all of which were found in the input text.
- Stop words are common words such as: For, on, to, as, with. In computing, “stop words” is a certain term that refers to words that are

filtered out before or after natural language processing language data (text). There is no one universal list of such words because every software is oriented on different functions. In case of sentiment analysis, most prepositions can be ignored, because it is the ‘keywords’ most that matter when you need to get the picture of the opinion stated in a certain message.

- Contrast words are prepositions such as: but, yet, however, although. In fact, this is the only type of prepositions that are never to be ignored when dealing with sentiments. These are linking words that are used when a sentence is composed of two parts with opposite ideas, thus, can be considered as two separate sentences with different premises. That is why it is important for the program to cognize these words before the text is analyzed on negative or positive message.

- A subject of the matter is a cryptocurrency, an exchange or a technology that is being discussed in the topic. For example: ‘CEX.IO’ (cryptocurrency exchange), ‘Blockchain’ – decentralized technology, Ether – cryptocurrency, Dash – cryptocurrency. The list of such words will be added to the database of the program in advance.

- Positive impact construction is a certain part of the sentence, a program should seek out, that brings a positive sense to the subject of matter.

- Negative impact construction is a certain part of the sentence, a program should seek out, that brings a negative sense to the subject of matter. It is important to note that a single piece of news, at one time, can carry positive and negative intention to different subjects of matter, or, on the other hand, can lack one of the constructions, as well. The only excluded case is when the news topic lacks both: positive and negative constructions. In case it happens, the program ignores the input text, because of it, in no case, affects some cryptocurrencies’ rates.

- The eventual result (output) is the displayed by program data that reveals two parameters: cryptocurrency (or cryptocurrencies) affected and a contingent, in terms of program, estimation rate.

2.3.2 Examples of how software processes input data

Let’s assume that program received the following input text: “Bitcoin skyrockets dramatically, while Ether dips down”. As stated earlier, the initial stage is text segmentation. It is provided in order to get rid of all punctuation in the text and lowercase the letters: “bitcoin skyrockets dramatically while ether dips down.” After this, the program checks the text for the stop words, but this specific example does not contain such. However, it has a contrast word “while”, which will be cast aside by the

program. The next stage is to single out the subjects of matter, two of which in the example are: “Bitcoin” and “Ether”. At this stage, the text is prepared to be analyzed for the semantic constructions. The positive is: “bitcoin skyrockets”, while the negative is: “ether dips down”. Basing on this, the program reveals following results: Bitcoin + 1; Ether – 1; The estimation is contingent, so it only reflects whether the news topic was negative or positive. However, after processing a big data of texts, these scores are calculated and provide authentic results.

Here is another example, which is less obvious. Input text: “Coinbase Halts Litecoin, Ether Trades as Prices Spike”. The stop word is “as”, which will further be ignored, by the program. This example does not contain any contrast words. Subjects of matter are “Coinbase” (cryptocurrency exchange), “Litecoin” (cryptocurrency), “Ether” (cryptocurrency). This title contains both negative and positive constructions, moreover, they refer to both cryptocurrencies at the same time. Positive impact construction: “prices spike”. Negative impact construction: “Coinbase halts Litecoin Ether”. The fact that cryptocurrency exchange prevents users from trading these two cryptocurrencies contains a negative message. However, their prices spike. So, the eventual result of the program is Ether +1; Litecoin +1; Ether -1; Litecoin -1.

Conclusion

Text mining is a special type of strategy and practice that applies the principles of data mining to text. It is an automated process that helps us to detect and reveal previously uncovered patterns of textual data. Sentiment analysis, on the other hand, helps us to extract the attitudes, moods, and opinions of individuals and groups from text data and content. In this work we used Sentiment Analysis for predicting the price of cryptocurrency.

Basing on distinguishing features of the notion of cryptocurrency, the sphere of it and existing helping tools, and sentiment analysis algorithm will help in the creation of software that will serve as a helping tool for existing cryptocurrency trading bots in predicting the price of cryptocurrency much more accurately, all by virtue of linguistic analysis.

In this work, the author analyzed the definition of cryptography, scope and legal aspects of different countries regarding cryptocurrencies. We described the factors influencing the growth rate of cryptocurrencies, and the existing software programs for the trading cryptocurrency.

In this work, we detailed presented an overview of the approaches to solving the problem. For each approach, the concept, the main characteris-

tics and the existing advantages and disadvantages of these approaches were given.

The main task was to develop an algorithm for assessing the crypto foreign exchange rate by analyzing the tone of news messages. This task was successfully completed and worked out in detail, examples of the future program work are given.

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