

**DOKUZ EYLÜL UNIVERSITY**  
**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**STUDYING AND ANALYZING BLOCKCHAIN-  
BASED PROJECTS USING ON-CHAIN  
ANALYSIS**

**by**  
**Abdul Razak ZAKIEH**

**June, 2022**  
**IZMIR**

# **STUDYING AND ANALYZING BLOCKCHAIN- BASED PROJECTS USING ON-CHAIN ANALYSIS**

**A Thesis Submitted to the  
Graduate School of Natural and Applied Sciences of Dokuz Eylül University  
In Partial Fulfilment of the Requirements for the Degree of Master of  
Science in Computer Engineering**

**by  
Abdul Razak ZAKIEH**

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IZMIR**

## M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled “**STUDYING AND ANALYZING BLOCKCHAIN-BASED PROJECTS USING ON-CHAIN ANALYSIS**” completed by **ABDUL RAZAK ZAKIEH** under the supervision of **ASSOC. PROF. DR. SEMIH UTKU** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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# **STUDYING AND ANALYZING BLOCKCHAIN-BASED PROJECTS USING ON-CHAIN ANALYSIS**

## **ABSTRACT**

The fast pace of creating new cryptocurrencies makes it hard or even impossible to know which one of them best suits an investor's needs. Increasingly, investors are starting to need a decision support system with which they can determine which cryptocurrencies are suitable for investment and which ones are not. In this research, an investment decision support system was developed. The system allows investors to understand what they need and offers them cryptocurrencies that suit their preferences. On-chain parameters instead of off-chain ones were used for efficiency where we defined and determined the most important on-chain features. In the developed system, a set of on-chain features is asked of investors, and individual weights are calculated for the selected features using the Analytic Hierarchy Process (AHP) algorithm. Using the calculated weights and the investor's preferences, the system gives different recommendations for each investor. Based on the answers of our focus group of cryptocurrency experts and investors, the most important on-chain features to be considered for investment were concluded. Historical cryptocurrencies data were analyzed in this study. It was found that about 39 percent of the cryptocurrencies disappeared from the market, and only about 10 percent existed for more than 1000 days. The correlation between some of the parameters and the price was studied. It was found that a strong negative Spearman correlation exists with the maximum supply and total supply, and a medium positive Spearman correlation with volume over 24 hours exists too. Finally, attempts to classify investment-risky cryptocurrencies were done.

**Keywords:** Blockchain, cryptocurrencies, on-chain analysis, decision support system.

# ON-CHAIN ANALİZİ KULLANARAK BLOKZİNCİR TABANLI PROJELERİ İNCELEME VE ANALİZ ETME

## ÖZ

Yeni kripto para birimlerinin oluşumundaki hızlı değişim, hangi yeni para biriminin yatırımcının ihtiyaçlarına en uygun olduğunu belirlemeyi zor hatta imkansız hale getirmektedir. Günümüzdeki yeni para biriminin oluşumundaki hızlı değişimler sebebiyle yatırımcıların, hangi kripto para birimlerinin yatırıma uygun, hangilerinin uygun olmadığını belirleyebileceği bir karar destek sistemine ihtiyacı giderek artmaktadır. Bu çalışmada, yatırımcılar için bu soruna çözüm getirmesini düşündüğümüz bir karar destek sistemi geliştirilmiştir. Sistem, yatırımcıların neye ihtiyaç duyduklarını anlama ve onlara tercihlerine uygun kripto para birimleri sunma prensibine göre kurgulanmıştır. Verimlilik için en önemli zincirli (on-chain) özellikleri tanımladığımız ve belirlediğimiz zincir dışı parametreler yerine zincirli parametreler kullanılmıştır. Geliştirilen sistemde yatırımcılardan bir dizi zincirli öznelik istenmekte ve seçilen öznelikler için Analitik Hiyerarşi Süreci (AHP) algoritması kullanılarak bireysel ağırlıklar hesaplanmaktadır. Sistem hesaplanan ağırlıkları ve yatırımcı tercihlerini kullanarak, her yatırımcıya özel farklı önerilerde bulunmaktadır. Zincirli özellikler için Kripto para birimi uzmanları ve yatırımcılardan oluşan bir odak grubunun yanıtlarına dayanarak, yatırım için dikkate alınması gereken en önemli zincirli özellikler belirlenmiştir. Bu çalışmada geçmişe yönelik kripto para birimleri verileri analiz edilmiştir. Kripto para birimlerinin yaklaşık %39'unun piyasadan kaybolduğu ve 1000 günden fazla bir süredir sadece %10'unun var olduğu sonucuna ulaşılmıştır. Bazı parametreler ve fiyat arasındaki korelasyon, maksimum arz ve toplam arz ile güçlü negatif Spearman korelasyonunun olduğu ve 24 saat boyunca hacim ile orta pozitif Spearman korelasyonunun da bulunduğu belirlenmiştir. Çalışmamızda ayrıca, yatırım riskli kripto para birimleri için sınıflandırma çalışmaları gerçekleştirilmiştir.

**Anahtar kelimeler:** Blok zincir, kripto para birimleri, zincir üzerinde analiz, karar destek sistemi.

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## **CHAPTER ONE**

### **INTRODUCTION**

Blockchain is a peer-to-peer technology that saves data into an immutable digital record, called a ledger. Blockchain-based applications are distributed and decentralized where a consensus protocol is used to establish the trust between the peers to eliminate the need for having a third party. The name blockchain originates from the chain of blocks in the system. Each block has data and hash of its previous block; thus, the blocks are connected like a chain. Researchers used blockchain technology in many fields. (Tasatanattakool & Techapanupreeda, 2018) talked about the financial applications of Blockchains, like Bitcoin and Ripple, and the non-financial applications like Hyperledger, Election Voting, and Smart Contracts. (Alladi, Chamola, Parizi, & Choo, 2019) made a review about the blockchain applications in industry and industrial IoT. (Agbo, Mahmoud, & Eklund, 2019) did a review on blockchain studies in the healthcare field. (MyungSong, JongwookSung, & TaehoPark, 2019) discussed the uses of blockchain in the traceability of supply chains. Though researchers try to use blockchain technology in various applications, the most common use is financial applications. The technologies beyond blockchains, cryptography, and distributed computing are old but the emergence of blockchain started with Bitcoin (Nakamoto, 2008). Bitcoin is a cryptocurrency that uses blockchain technology to make transactions between two parties without having a third party, a bank for example, as an intermediate (Nakamoto, 2008). As there is no centralized authority that controls the price of a cryptocurrency, its success depends only on the market. Several market-related parameters have roles in affecting the price of a crypto-currency. There are two types of parameters: on-chain and off-chain. On-chain parameters are the ones we can acquire from the blockchain itself like circulating supply, total supply, and market cap. On the other hand, off-chain parameters are the ones that affect the cryptocurrency, but we cannot obtain them from the chain itself. Tweets, social influencers, and the cryptocurrency development team are examples of off-chain parameters.

In this study, we developed a decision support system to provide an investor with the most suitable cryptocurrencies according to their preferences. The developed system uses on-chain parameters. For this reason, we defined the off-chain and on-chain determined. We determined the most important on-chain features and defined them as well by creating a focus group consisting of experts in the blockchain and cryptocurrency fields.

## **1.1 Problem Definition**

There are more than 10,000 cryptocurrencies in the market (Number of cryptocurrencies worldwide from 2013 to April 2022, 2022), and deciding which one of them is a good investment opportunity is a hard task. For that reason, we decided to make a system that helps investors rate cryptocurrencies according to their preferences. We do not aim to predict price and our main purpose is to make a decision support system that helps investors choose the cryptocurrencies they believe in from the significantly increasing number of cryptocurrencies available. The second objective of this study is to analyze the historical data of the cryptocurrencies and try to determine the most important on-chain feature affecting the price.

## **1.2 Motivation**

To provide investors with personalized suggestions, we have to make a decision support system. By going through the previous studies which made decision support systems for cryptocurrencies, we found the following problems:

- The previous decision-making systems we studied did not support new cryptocurrencies or cryptocurrencies without their historical data.
- Most of the previous decision support systems used off-chain parameters or very limited on-chain parameters.
- All the decision-making systems we found provided investors with non-personalized suggestions, meaning the suggestions are the same for all investors.

For the previous reasons and to fill in the research gap we decided to use the on-chain parameters since they represent a cryptocurrency better than off-chain data and try to rate cryptocurrencies according to the preferences of investors instead of predicting price or giving a general recommendation.

### **1.3 Outline**

The thesis is organized as follows. The literature review is presented in Chapter 2. A brief description of the cryptocurrencies, their history, and types, and a description of off-chain and on-chain parameters are in Chapter 3. The developed investment decision support system and its components are explained in Chapter 4. The analysis of historical data and a try to detect risky cryptocurrencies are detailed in Chapter 5. The conclusion of the research and the future works are in Chapter 6.

## **CHAPTER TWO**

### **RELATED WORKS**

Understanding cryptocurrencies and predicting their price has been the main interest of researchers. In (Werner, Lawrenz, & Rausch, 2020), researchers studied the anonymity of cryptocurrencies by analyzing PIVX which is a cryptocurrency based on Bitcoin. (Mikhaylov, 2020) tried to predict sustainable growth by analyzing the cryptocurrency's open innovative market. Predicting the price of a cryptocurrency drew the attention of researchers as well. (McNally, Roche, & Caton, 2018) attempted to predict the price of Bitcoin using a Bayesian optimized recurrent neural network (RNN) and a Long Short-Term Memory (LSTM) network.

Other researchers studied the relationship between social media and the price of a cryptocurrency. (Lamon, Nielsen, & Redondo, 2017) studied the effect of news headlines and tweets on the price of Bitcoin, Ethereum, and Litecoin by assigning labels to news headlines and tweets and then making predictions based on the generated labels.

(Lansky, 2016) analyzed the price development of 1278 cryptocurrencies between 2013 and 2016 from the length of existence, biggest price drops, and highest price increase point of view. During the analysis, they found that there was a duplication in the name and symbol attributes in some cryptocurrencies. From the length of existence point of view, 53.83% of the studied cryptocurrencies became extinct. More than 50% of the extinct cryptocurrencies, existed for less than 24 weeks. By studying the top 10 cryptocurrencies having the highest marketcap at that time and experienced at least a 10% drop from their maximum price, they concluded that the “price bubble from 2013 and 2014”, “failure of the concept of national cryptocurrencies” and “overcoming a cryptocurrency by a new cryptocurrency with a higher degree of innovation” were the main reasons of the price drop. On the other hand, making the same analysis on the cryptocurrencies having the highest marketcap and experienced at least a 10% increase in their minimum price, they found that the main reasons behind an increase in price

were bringing a significant technology innovation, offering a decentralized service useful to users and a foundation managing and promoting cryptocurrencies.

(Hayes, 2015) used a regression model to determine the factors that give a cryptocurrency its value. The result was that coins' mining difficulty; rate of unit production; and the cryptologic algorithm have the main role in determining the value. In other words, we can say that the increased rate in circulating supply is the main reason for detecting the cryptocurrency price according to the results.

(Renterghem, 2017) tried to detect the factors that affect the price of a Bitcoin and found that the number of transactions is one of the most important factors. In addition, they concluded that the social indicators play a role in short-term price prediction.

Building recommendation systems is important to help users make better decisions. In (Murugan, 2021), the researcher used the prices of cryptocurrencies to build a cryptocurrency portfolio recommendation system where an association rule mining algorithm was used. The built system used historical closing prices for each cryptocurrency and the increase or decrease in it which was calculated as a percentage of the previous day's closing price. Each transaction in the created dataset was built using the cryptocurrencies that have changed at least by a specific percent on a specific day. Using the Apriori algorithm, frequent cryptocurrencies were located then rules were generated and the cryptocurrencies with positive correlation were considered. The top-k rules were taken by considering the antecedent and consequent of the generated rules. For each cryptocurrency, the top-k cryptocurrencies were calculated using the Apriori algorithm again to obtain the most common cryptocurrencies in each industry. The two generated top-k cryptocurrencies datasets were used to determine the relative order of the cryptocurrencies by applying the generated rules to the frequent itemsets.

Analytic Hierarchy Process (AHP) (Saaty, 1988) is a multi-criteria decision-making algorithm that was used in decision support systems widely. AHP and a discrete-event simulation tool were used to recommend a blockchain protocol that can be used for



the storing of electronic health records (Alexander Garrido, López, & Beltrán Álvarez, 2021).

AHP has been also used to assist users in product selection as researchers did (Amroush, 2013). The given suggestions were personalized, i.e., each user got the most suitable suggestions to them.

In (Böyükaslan & Ecer, 2021), a Fuzzy Full Consistency Method-Bonferroni model was used to identify the most important drivers to consider while investing in cryptocurrencies. They used twenty-three drivers classified into five main aspects: functionality, financial, legal infrastructure, technology, and security. They first determined the features and then asked four experts to evaluate them. After that, they applied a Fuzzy Full Consistency Method-Bonferroni model (FUCOM-F) to each driver and derived its weight. Out of the twenty-three drivers used, it was found that “strong electronic encryption” and “use of digital signature” are the most important features driving investors to use cryptocurrencies.

(Gupta, Gupta, Mathew, & Sama, 2020) prioritized the main intentions behind investment in cryptocurrencies. A structured questionnaire was used to collect data from cryptocurrency investors from different countries then a fuzzy analytical framework and analytical hierarchy process (AHP) were applied to get each intention's weight. Eight intentions were studied: social influence, financial literacy, facilitating conditions, performance expectancy, effort expectancy, perceived trust, perceived usefulness, and social support. They found that “social influence” is the most influencing factor driving people to use cryptocurrencies followed by “facilitating conditions” and “perceived usefulness”.

(Chiang, et al., 2021) made a cryptocurrency investment decision support system. Using a Recurrent Neural Network (RNN) and a Long Short-Term Memory (LSTM) with daily cryptocurrency prices as an input, future prices were predicted. Three technical indices (Relative Strength Index, Williams %R, and Psychological Line)

were applied to the predicted data with a fuzzy reasoning module. Finally, the calculated indices were used to get an investment decision.

(Aljinović, Marasović, & Šestanović, 2021) proposed a multicriteria decision model to provide the best cryptocurrency portfolio. Daily return, standard deviation, value-at-risk, conditional value-at-risk, volume, market capitalization, and attractiveness of nine cryptocurrencies from January 2017 to February 2020 were used in their study. The researchers considered marketcap and volume over 24 hours as a measure of liquidity. Expected daily return, standard deviation, value-at-risk (VaR), and conditional value-at-risk (CVaR) were calculated using the daily closing prices. The number of Tweets related to a cryptocurrency was used as a measure of its attractiveness. The studied cryptocurrencies were Bitcoin, Dash, Ethereum Classic, Ethereum, Litecoin, Monero, Neo, Stellar, and Ripple. The seven selected criteria and weighting process were done by twelve experts. Their developed recommendation system put Bitcoin in the first place, followed by Ethereum, Litecoin, Ripple, Dash, and Ethereum Classic.

To the best of our knowledge, most of the previous work used off-chain parameters to predict price whereas off-chain parameters give short-term price prediction (Renterghem, 2017). (Hayes, 2015) and (Renterghem, 2017) pointed to the importance of two on-chain parameters, circulating supply and volume. (Böyükaslan & Ecer, 2021) used 23 features whereas all of them were off-chain ones and the system they built was to get the most important features attracting investors, but they did not build a system to help investors choose suitable cryptocurrencies out of the enormous existing ones in the market. (Chiang, et al., 2021) gave a non-personalized decision to investors and their system required historical data to make a recommendation. Since it requires historical data, their system cannot be used to evaluate newly created cryptocurrencies. For the same reason, (Aljinović, Marasović, & Šestanović, 2021) research cannot be used to evaluate new cryptocurrencies and only two on-chain parameters were used: volume and market cap. (Murugan, 2021) used historical prices as well to make portfolio recommendations where previously prices are required and the historical price itself is not an indicator of success for a particular cryptocurrency.

Table 2.1 Comparison between the literature and the decision support we developed

	(Amroush, 2013)	(Mikhaylov, 2020), (Werner, Lawrenz, & Rausch, 2020), (McNally, Roche, & Caton, 2018), (Lamon, Nielsen, & Redondo, 2017) (Lansky, 2016), (Hayes, 2015) and (Renterghem, 2017)	(Murugan, 2021)	(Böyükaslan & Ecer, 2021) and (Gupta, Gupta, Mathew, & Sama, 2020)	(Chiang, et al., 2021)	(Aljinović, Marasović, & Šestanović, 2021)	Our Decision Support System
Feature							
A decision support system	✓	X	✓	X	✓	✓	✓
Personalized decisions	✓	X	X	X	X	X	✓
On-chain Parameters	X	X	X	X	X	Partially	✓
Support newly cryptocurrencies	X	X	X	X	X	X	✓
Work without historical data	✓	X	X	X	X	X	✓
Notes	Not cryptocurrency-related	Analyzing prices, and cryptocurrencies	Portfolio recommendations based on Historical Prices	Understanding intentions and drivers for investing in cryptocurrencies	-	-	-

Table 2.1 compares some of the references and their features and shows the features of the decision support system we are going to develop. Our main research will be on the investment decision support system which will have the features we mentioned in Table 2.1: personal recommendations, on-chain parameters, and the ability to evaluate newly created cryptocurrencies by making the system not using historical data. Before talking about the investment system, we will talk about cryptocurrencies, their types, and the parameters that affect a cryptocurrency in the next chapter.



## **CHAPTER THREE**

### **CRYPTOCURRENCIES**

#### **3.1 What is Cryptocurrency?**

Blockchain technology dates to 1991 when Stuart Haber and W. Scott Stornetta worked on time-stamping digital documents (Haber & Stornetta, 1990). Their work was the base of blockchains where they time-stamped the document itself and it was impossible to tamper with the stamp. They used hash functionalities to send a document's hash instead of the document itself, digital signatures to uniquely identify the owner, and linking. Linking, which was used to prevent tampering with timestamps, was the process of including data from the previously issued certificate in the certificate being issued. The last idea they discussed was distributed trust in which a list of clients sign and time-stamp the document. Having a list of clients signing a document, make it hard to fake a timestamp because all of those clients have to agree to fake it.

Cryptocurrencies are digital assets that use the blockchain and cryptography to enable peer-to-peer transactions securely (Härdle, Harvey, & Reule, 2020). Bitcoin is the first cryptocurrency that was introduced by Satoshi Nakamoto in 2008 (Nakamoto, 2008). According to Nakamoto, Bitcoin is an electronic representation of cash in which transactions are done peer-to-peer without the need for a third party. A digital signature and a distributed timestamp server were used as the basis of Bitcoin, like what was done by (Haber & Stornetta, 1990) by timestamping documents. In the Bitcoin network, transactions are hashed into a publicly recorded continuous chain of hash-based proof-of-work blocks. As the chain of blocks gets longer, it becomes impractical for attackers to tamper with the transactions as long as the majority of the nodes in the network are not attackers (Nakamoto, 2008).

### 3.2 Types of Cryptocurrencies

Many cryptocurrencies are available these days and we can categorize most of them into seven classes (Härdle, Harvey, & Reule, 2020).

1. Cryptocurrencies designed as transaction mechanisms like Bitcoin, Litecoin, Bitcoin Cash, Bitcoin SV, Chia, and Dogecoin. Those cryptocurrencies are referred to as stores of value and their main function is storing the value and making it sent directly from one account to another.
2. Distributed Computation Token. Those are the tokens that are built to be used to run a smart contract. ETH is the token used on the Ethereum network to run smart contracts on it. ICP on Dfinity and EOS on EOS.IO are also examples of distributed computation tokens.
3. Utility token is the third type, and it represents a digital asset by itself. Some utility tokens are used in governance. For instance, UNI token holders govern the Uniswap Protocol. Another example is the RARI token which empowers its holders to interact with the Rari marketplace protocol. Other utility tokens can be used to reward users such as FileCoin and Helium.
4. Security tokens represent financial assets like stocks and bonds. tZero and Overstock are examples of this type of token.
5. Fungible (replaceable by another identical item; mutually interchangeable) tokens are tokens built on other blockchain networks like the tokens built on Ethereum using Ethereum Request for Comments (ERC)-20 standard.
6. Nonfungible tokens are not interchangeable tokens which means the tokens are not equals and each one is unique. Ethereum's ERC-721 is one of the most used protocols to produce those tokens.
7. Finally, stablecoins are tokens collateralized with fiat currency, real assets, or cryptocurrencies. USDT, Fedcoin, Digix Gold, and MakerDAO are examples of stablecoins.

### **3.3 Parameters Affecting a Cryptocurrency**

Unlike the traditional currencies that can be controlled by governments and banks, cryptocurrencies are supposed to be decentralized where no one can control the price, hypothetically. However, the price of a cryptocurrency depends on many parameters. The parameters can be divided into two types based on whether the parameter is in the cryptocurrency's blockchain or not: off-chain parameters and on-chain parameters.

#### **3.3.1 *Off-chain Parameters***

Off-chain parameters are the parameters that are not saved in the cryptocurrency blockchain yet affect the price. Examples of off-chain parameters are the news, Tweets, rumors over social media, the story behind the cryptocurrency, the team handling the cryptocurrency, and their reputation. In January 2021, a Tweet by Elon Musk raised the price of Bitcoin cryptocurrency by 14%, and a Tweet also by the same person decreased the price of the same cryptocurrency by 7% in June 2021. Another example of an off-chain parameter is the number of market pairs a cryptocurrency can be exchanged at.

The effect size of off-chain parameters is related to the cryptocurrency itself and its on-chain parameters where some cryptocurrencies are hard to get affected by off-chain parameters or the effect is low.

#### **3.3.2 *On-chain Parameters***

The on-chain parameters are the data we can extract from the cryptocurrency blockchain. Due to the lack of resources regarding on-chain parameters, we constructed a focus group of experts consisting of 15 individuals with over 10-year of experience in IT and blockchain; and most of them are also master's degree holders. This focus group, which participated in several meetings, answered questionnaires, and responded to open-ended questions, helped us with understanding and selecting

the most important on-chain features. Following, we list most of the on-chain parameters:

1. **Circulating Supply:** The number of tokens that are available in the market and can be used by people. The circulating supply is represented by the token name itself. For example, Bitcoin's current circulating supply is 19,009,718.00 BTC.
2. **Total Supply:** The number of tokens that have been created without counting any burned (deleted) tokens.
3. **Max Supply:** The maximum amount of tokens that will ever exist. Bitcoin has a max supply of 21,000,000 BTC whereas Ethereum for example has no limit. To understand the concept of circulating supply, total supply, and max supply we will talk about three examples with mentioning some values at the time of writing this paragraph: Bitcoin, Ethereum, and XRP. Bitcoin's max supply is 21,000,000 BTC, meaning that there will be no more than that number of BTC. Out of those 21 million BTCs, 19,009,718 BTCs have been created and this number is the total supply. All that total supply is available for people in public, which means the circulating supply is also 19,009,718 BTCs. Ethereum has no maximum supply. The number of created tokens minus the burned ones is 120,348,596.75 ETHs and all of them are available to the public so its circulating supply equals its total supply. Our last example is XRP. It has a maximum of 100,000,000,000 XRPs and 99,989,613,982 of them have been created (total supply). Out of the total supply, only 48,135,209,660 XRPs are available to the public which is 48% of the total supply.
4. **The rate of creating new tokens and whether it is fixed or not and if it is controlled by an algorithm or manually.**
5. **Who acquire newly created tokens** can be considered also an on-chain parameter whether it is defined in the cryptocurrency's code.
6. **The whales' percentage** where a whale is an account holds more than 1% of the circulating supply.
7. **Large holders' percentage.** A large holder is an account holding between 0.1% and 1% of the currently available tokens, circulating supply.



8. **Holding time** is also an on-chain parameter we can use to decide whether to consider a cryptocurrency or not. Having a high percentage of different holders keeping their tokens for more than 1 year is a good indicator.
9. **Halving** or **burning** is reducing the total supply by deleting tokens. Reducing the total supply might lead to an increase in the token's price.
10. **Market Cap**: The total value of the market of a cryptocurrency which equals its circulating supply multiplied by its price.
11. **Volume over 24 hours** which is the value of cryptocurrencies traded in the last 24 hours.
12. **Total Staked**: Staking cryptocurrencies is a process that involves committing crypto assets to support a blockchain network and confirm transactions in a proof-of-stake blockchain. The total value staked is the percentage of circulating supply being staked by users.
13. **Staking Reward** is the reward stakers get and is represented as a percentage.
14. **Unstaking Condition**
15. **Staking time** is the minimum staking time where the staked tokens cannot be withdrawn before it. For example, Ethereum 2.0 blockchain has a staking time of 365 days while Terra's staking time is 21 days.
16. **Total Value Locked**: Total value of locked tokens to get loans or for other purposes.
17. **Date Added**: The date the token was created. Older tokens tend to be more trusted and stable while newer ones are less trustable with a high tendency to change their price.

### 3.4 Summary

In this chapter, we talked about the history of cryptocurrencies and blockchain technology. We explained the different classes of cryptocurrencies and then mentioned the two types of parameters affecting a cryptocurrency: off-chain and on-chain. Due to the lack of resources regarding on-chain parameters, together with the focus group

of experts, we discussed and defined the most important ones. In the next chapter, we discuss the investment decision support system we did that uses the previously explained on-chain parameters.



## CHAPTER FOUR

### INVESTMENT RECOMMENDATION SYSTEM

#### 4.1 Narrowing Down The On-chain Parameters

The chain has many important parameters and narrowing them down to the most important ones was a hard task to do. We did not use all the on-chain parameters for three reasons. First, we did not want to have a long list of features where some of them according to the experts are not important or even misleading. We wanted to build a platform that helps users select what suits them based on meaningful and important features. For example, the user might think that total supply or circulating supply by itself is important while in fact, it is not. The percentage of total supply circulating (circulating supply / total supply) is more important than total supply and circulating supply. The reason is that this value represents the proportion of available tokens in the market whereas its complement represents the tokens held by the token's creators and can be controlled manually by them. Therefore, instead of giving the user the choice of selecting max supply or total supply only, the system lets the users select the percentage of total supply circulating. The second reason for narrowing down the list of on-chain parameters is that having too many parameters for the user to select from is overwhelming. The last reason is the difficulty of obtaining all the on-chain parameters efficiently.

Having in mind the previous reasons and the experts' advice we select the 10 most important on-chain parameters. The selected parameters are Circulating Supply, Market Cap, Volume over 24 hours, Percent of Total Supply Circulating, Total Staked, Staking Reward, Whales Percentage, Total Value Locked, Number of Market Pairs, and Date Added. While the number of market pairs is not an on-chain parameter, it is an important one and has a role in giving a cryptocurrency trust, so we believe it is useful to add it to the system.

$$\text{Percent of total supply} = \frac{\text{circulating supply}}{\text{total supply}} \quad (4.1)$$

## 4.2 Technical Specifications

**Back End** The backend is developed using PHP programming language and Laravel framework.

**Front End** HTML, CSS, JavaScript, jQuery, and Bootstrap were used to develop the front end of the system.

**Database** The cryptocurrencies' data, users' information, selections, and answers are stored in a relational database in the MySQL database management system.

## 4.3 System Architecture

The recommendation system we built is a web application and it has four main steps as we can see in Figure 4.1. The web application allows the user to interact with the built system and get cryptocurrencies that suit the users' preferences dynamically.

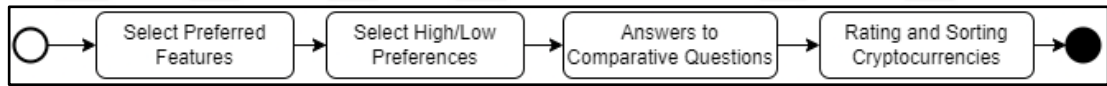
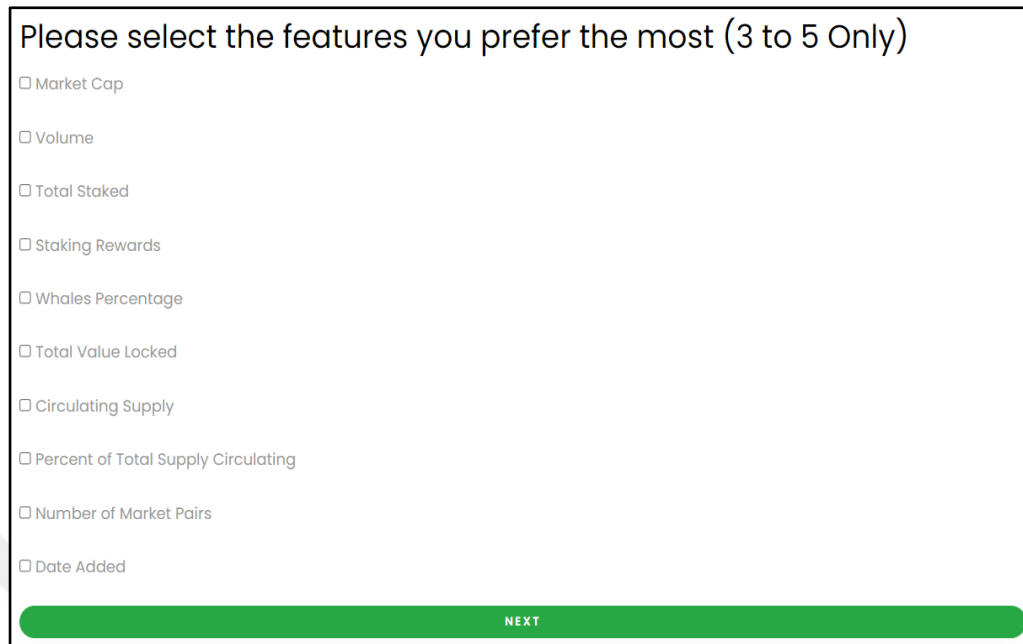


Figure 4.1 The investment recommendation system components

### 4.3.1 *Selecting Preferred Features*

In this step, users are asked to select their preferred features out of the 10 ones we determined earlier. Figure 4.2 shows the selecting preferred features user interface.



Please select the features you prefer the most (3 to 5 Only)

- ☐ Market Cap
- ☐ Volume
- ☐ Total Staked
- ☐ Staking Rewards
- ☐ Whales Percentage
- ☐ Total Value Locked
- ☐ Circulating Supply
- ☐ Percent of Total Supply Circulating
- ☐ Number of Market Pairs
- ☐ Date Added

NEXT

Figure 4.2 Selecting preferred features user interface

#### ***4.3.2 Selecting High/Low Preferences***

The second step in the decision support system asks the investors whether they prefer a high or low value for each feature they selected in step 1. For instance, an investor might prefer a high staking reward (to earn a high reward themselves) while another investor might prefer a low staking reward (thinking that the price of such cryptocurrency will drop when collecting the high rewards). Figure 4.3 shows the high/low selection interface for three selected features.

Please select whether you like high value or low value of each of the selected features:

Market Cap

☐ HIGH ☐ LOW

Volume

☐ HIGH ☐ LOW

Percent of Total Supply Circulating

☐ HIGH ☐ LOW

[NEXT](#)

Figure 4.3 The high/low selection interface for three randomly selected features

### 4.3.3 *Answers to Comparative Questions*

Three investors might have the same selected features and high/low preferences, assuming feature1 and feature2. Nevertheless, the first investor might prefer feature1 to feature2 and the second investor might prefer feature2 to feature1. The third investor might consider feature1 and feature2 as having the same importance. Therefore, each one of those users must have different recommended cryptocurrencies in which to invest. To understand what investors prefer exactly and give them the most suitable cryptocurrencies, they must answer a set of comparative questions. The questions are designed to make the investors compare pairs of selected features. Figure 4.4 shows the page of dynamically generated comparative questions, for three features. Investors can select whether they consider two features the same, or one of them is better than

the other on a scale from 2 to 9 times. The number of generated questions can be calculated from (2) where n is the number of selected features.

$$\text{Number of questions} = \frac{(n*(n-1))}{2} \quad (4.2)$$

**Total Questions: 3**

**High Volume vs. Low Market Cap**

High Volume More Important      High Volume = Low Market Cap      Low Market Cap More Important

Low Market Cap 3 times more important

**High Percent of Total Supply Circulating vs. Low Market Cap**

High Percent of Total Supply Circulating More Important      High Percent of Total Supply Circulating = Low Market Cap      Low Market Cap More Important

Low Market Cap = High Percent of Total Supply Circulating

**High Percent of Total Supply Circulating vs. High Volume**

High Percent of Total Supply Circulating More Important      High Percent of Total Supply Circulating = High Volume      High Volume More Important

High Percent of Total Supply Circulating 3 times more important

**SAVE**

Figure 4.4 Dynamically generated comparative questions for three randomly selected features

#### 4.3.4 Rating and Sorting Cryptocurrencies

The decision support system uses the selected features, high/low preferences, the answers to comparative questions, and the value of each selected feature to rate each cryptocurrency. Figure 4.5 shows the steps of the rating process.

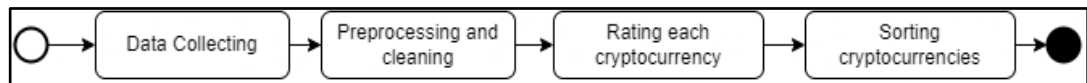


Figure 4.5 The steps of the cryptocurrencies rating process

#### *4.3.4.1 Data Collecting*

As we mentioned earlier, we want to use on-chain parameters in our study rather than off-chain since the on-chain parameters are directly extracted from the chain of the cryptocurrency and that makes them more reliable and important than the off-chain ones. Manual extraction of the on-chain parameters from the chain itself is both hard and time and resources consuming process. The main reasons are the huge chain length and the thousands of chains we have nowadays. For example, Bitcoin's chain size is 383.445 GB (Blockchain Size (MB), 2021). Consequently, we gathered data from different resources that either analyse the chain directly or use other resources that provide those data. We used four different resources to gather the required parameters. We used CoinMarketCap<sup>1</sup> to extract circulating supply, total supply, volume 24h, market cap, and date added. Staking Rewards<sup>2</sup> was used to extract staking rewards and total staked values. DefiLlama<sup>3</sup> was used to get the total value locked and finally, IntoTheBlock<sup>4</sup> was used to get the whales' percentage.

#### *4.3.4.2 Preprocessing*

We noticed that some crypto projects have non-logical data. We reasoned this for either wrong data or the project itself being a fraud. We made a list of criteria for those

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<sup>1</sup> <https://coinmarketcap.com/>

<sup>2</sup> <https://www.stakingrewards.com/>

<sup>3</sup> <https://defillama.com/>

<sup>4</sup> <https://www.intotheblock.com/>



projects, and we skipped any project that had at least one of them. The criteria we put are:

- A circulating supply bigger than the total supply
- 100% whales
- Zero circulating supply
- Total value stacked more than 100%

In addition, we skipped any cryptocurrency that has a missing value in a feature the user is interested in.

#### 4.3.4.3 Rating Each Cryptocurrency

The core of the decision support system is the rating model. The rating model is used because we want the investor to have the cryptocurrencies sorted according to their compliance with the parameters the user selected. Equation (3) is the equation we developed to calculate the rating for a specific cryptocurrency.

$$rating = \sum_{k=1}^n L_k \cdot W_k \quad (4.3)$$

$n$  is the number of selected features and  $W_k$  is the weight of selected feature number  $k$ .  $L_k$  depends on whether the investor prefers a high or low value for  $k^{th}$  selected feature and it is defined in (4.4).

$$L_k = \begin{cases} \frac{k^{th} \text{ feature value}}{\text{maximum value of } k^{th} \text{ feature}}, & \text{high value preference} \\ 1 - \frac{k^{th} \text{ feature value}}{\text{maximum value of } k^{th} \text{ feature}}, & \text{low value preference} \end{cases} \quad (4.4)$$

Each feature value was divided by its maximum value to normalize it. As a result, the final rating is between zero and one. Using the Analytic Hierarchy Process (AHP) (Saaty, 1988), the weights  $W_k$  of each selected feature were calculated. We used the dynamically generated comparative questions to calculate the AHP matrix that we use later to find the weight of each feature. The weight calculation depends on the answers

provided by the user. Those answers to the comparative questions might provide inconsistency due to the user's insufficient knowledge or not being careful when answering the questions. We considered any answer with a consistency rate above 0.1 as an inconsistent answer. We calculate consistency rate (CR) using (4.5), whereas consistency index (CI) can be calculated using (4.6), and RI is the mean randomness indicator of order n (N & J, 2017) (Geng, et al., 2017). n is the number of rows in the coefficient matrix and  $\lambda_{max}$  is the maximum eigenvalue of it. We ask the users to select 3 to 5 features, as a result, n is either 3, 4, or 5 and RI is 0.58, 0.9, or 1.12 respectively. The values of RI for n between 1 and 15 are shown in Table 4.1.

$$CR = \frac{CI}{RI} \quad (4.5)$$

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4.6)$$

Table 4.1 Randomness indicator of order n

N	RI
1	0
2	0
3	0.58
4	0.9
5	1.12
6	1.24
7	1.32
8	1.41
9	1.46
10	1.49
11	1.51
12	1.54
13	1.56
14	1.57
15	1.59

Using randomly selected features and randomly answered questions, Figure 4.6 shows the calculated weights by the system for each one by using the AHP algorithm.

Low Market Cap	High Volume	High Percent of Total Supply Circulating
0.42857142857143	0.14285714285714	0.42857142857143

Figure 4.6 Calculated weights by the system for three randomly selected features with random answers to the comparative questions

#### 4.3.4.4 Sorting the Cryptocurrencies According to the Rate

After we applied the rating equation (4.3) to each cryptocurrency in the previous step, we sort the cryptocurrencies according to the calculated rate descending and display the results to the investor. Figure 4.7 shows an example of recommended cryptocurrencies using High Volume, High Market Cap, and High Percentage of Total Supply Circulating features with equal importance while Figure 4.8 shows recommendations based on the same features but Low Volume instead of High Volume.

#	Name	Date	Rate
1	Bitcoin	2022-04-21	81.684724824409
2	Tether	2022-04-21	69.070916181826
3	Ethereum	2022-04-21	57.09123229755
4	USD Coin	2022-04-21	37.29399574604
5	BNB	2022-04-21	37.107292998437

Figure 4.7 Recommended cryptocurrencies using High Volume, High Market Cap, and High Percentage of Total Supply Circulating features with equal importance

#	Name	Date	Rate
1	Bitcoin	2022-04-21	84.981941842257
2	Ethereum	2022-04-21	74.178568639806
3	BNB	2022-04-21	68.59018444711
4	Cardano	2022-04-21	67.117257544086
5	TerraUSD	2022-04-21	67.108083656873

Figure 4.8 Recommended cryptocurrencies using Low Volume, High Market Cap, and High Percentage of Total Supply Circulating features with equal importance

#### 4.3.5 Rating According to All Users' Answers

To benefit from the wisdom of the public and gain a general rating, we wanted to rate the cryptocurrencies using all the experts' answers. We thought of three ways to achieve this goal. The first one is applying the AHP algorithm to the average of answers and then rating the cryptocurrencies. The second one is calculating the weights of the features using AHP for each answer then collecting the average of those weights and utilizing them to calculate final rates. The last method is gathering the rates for each answer independently and then calculating the final rate for each cryptocurrency by calculating the average of its rates. The first and second methods require the selected features to be the same among all the answers but the third one does not. We tested the first method on 20 answers with 6 fixed features. Despite those 19 answers being inconsistent, the average of the answers gave a consistency rate of 0.13, which is close to consistency. That is the reason we concluded that this method would give the wrong rating. We used the third method in the system since the selected features are not the same for each user and it gave more accurate ratings. Figure 4.9 shows the top 10 rated cryptocurrencies according to all users' answers on 01-January-2022. We can notice that the top cryptocurrency got a rate of 43.23 out of 100. The reason for getting low ratings for the top cryptocurrencies is having different preferences for cryptocurrencies that might contradict each other. Some

investors would like to get the risky cryptocurrencies to invest in, while others would prefer less risky ones. New cryptocurrencies with some conditions might get the interest of some investors and old ones could be the best choice for others and so on. As a result, we can conclude that rating cryptocurrencies based on all investors' answers using any method would be ineffective.

**Rates based on average of users' ratings on 2022-01-01**

#	Name & date	Rate
1	Fantom	43.233655184911
2	Polygon	39.455253886065
3	Cardano	35.622530640603
4	Tezos	33.173711878892
5	Polkadot	31.979311633059
6	Cosmos	31.897734096912
7	Solana	31.748945904277
8	Elrond	31.634808270176
9	Swarm	31.538611810835
10	Algorand	30.738625970669

Figure 4.9 Ratings according to all experts' answers

#### 4.4 Clustering Cryptocurrencies

Whereas AHP provides an efficient way to assist users in choosing the cryptocurrencies that suit their preferences, not all users can select the parameters and answer the questions effectively. In this case, a user might have a preferred cryptocurrency and would like to find other cryptocurrencies having the same characteristics. In this scenario, clustering is the solution. Clustering is grouping data into groups where the group members have similar features. K-means (Lloyd, 1982) (MacQueen, 1967) is the algorithm that was used to cluster. It uses the average squared

distance between data to make clusters. To initialize the algorithm, we used k-means++ (Arthur & Vassilvitskii, 2006) for selecting centers of clusters to speed up the convergence. We clustered the cryptocurrencies we have into five clusters based on the features we have after normalizing each one of them by dividing its value by the maximum value it has. In our system, we used the PHP-ML library to perform clustering operations.

Selecting the number of clusters was done using the Elbow method. We calculated the Within-Cluster Sum of Square (WCSS) while varying the number of clusters from 1 to 30. As we can notice in Figure 4.10, the value of WCSS stopped changing significantly where the number of clusters equalled 5, which is called the elbow point. As a result, the optimum number of clusters is 5.

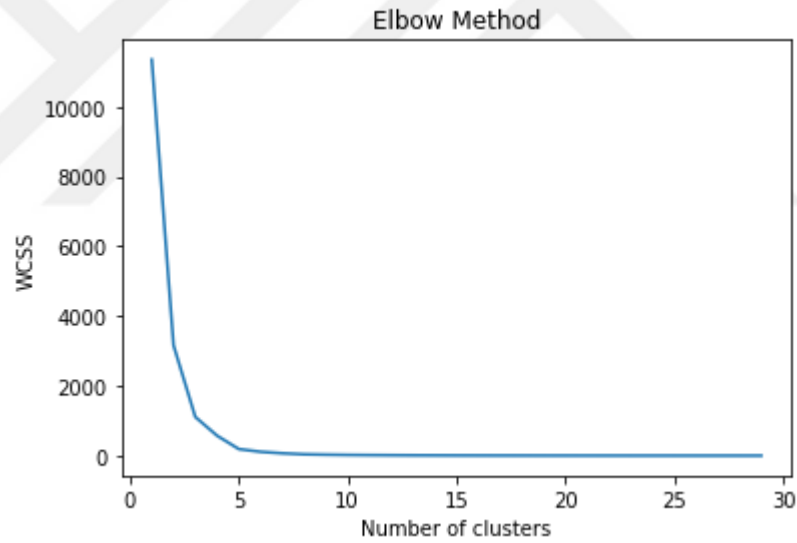


Figure 4.10 The Within-Cluster Sum of Square value for the number of clusters between 1 and 30 for the studied cryptocurrencies

The result of clustering all cryptocurrencies on 01-January-2022 using Market Cap, Volume 24h, Num Market Pairs, Percent of Total Supply Circulating, TVL, Staking Reward, Total Staking Percentage, and Whales Percentage are shown in Appendix A, Table A.1, and the same clustering process on cryptocurrencies on the same date while skipping cryptocurrencies having at least a missing value is shown in Appendix A,

Table A.2 where only 143 cryptocurrencies have no missing value in all the parameters.

Clustering the cryptocurrencies using only Market Cap, Volume 24h, Num Market Pairs, and Percent of Total Supply Circulating on the same date, we got the result shown in Appendix A, Table A.3.

#### **4.5 Recommendation System Experiments and Results**

We tried the system with six fixed features. Out of 20 answers, the consistency rate for each answer is above 0.1 except for one that equals 0.0762. The next lowest consistency rate was 0.2513 and the maximum one was 1.86. That is the reason we changed the system to let the investor select 3 to 5 features only where the number of questions is 3 to 10 and as a result; the chance of receiving inconsistent answers was reduced. When we let investors select 3 to 5 features instead of six, we attained 15 consistent answers out of 21, which means the range of features is better than having six fixed ones or even letting users select more than 5 features. The lowest consistency rate was zero and the maximum one was 0.73.

The group of experts tested the system in which each one of them selected the features they preferred and answered the generated comparative questions. The experts found in the top 10 cryptocurrencies a number in which they already invest. They investigated those in the top 10 list which they do not invest in, and they reported that those cryptocurrencies matched their preferences although they were not aware of their existence before.

By analyzing the selected features by the experts, we noticed that the most selected feature is High Volume, followed by High Total Staked and High Percent of Total Supply Circulating. Those three features make up about 50% of the total selected features. The least selected features are Low Total Staked, Low Whales Percentage, and Low Number of Market Pairs. We can also see that Low Total Value Locked, Low Staking Reward, Low Volume, and Low Date Added were not selected at all. Figure 4.11 shows the histogram of selected features by the group of experts.

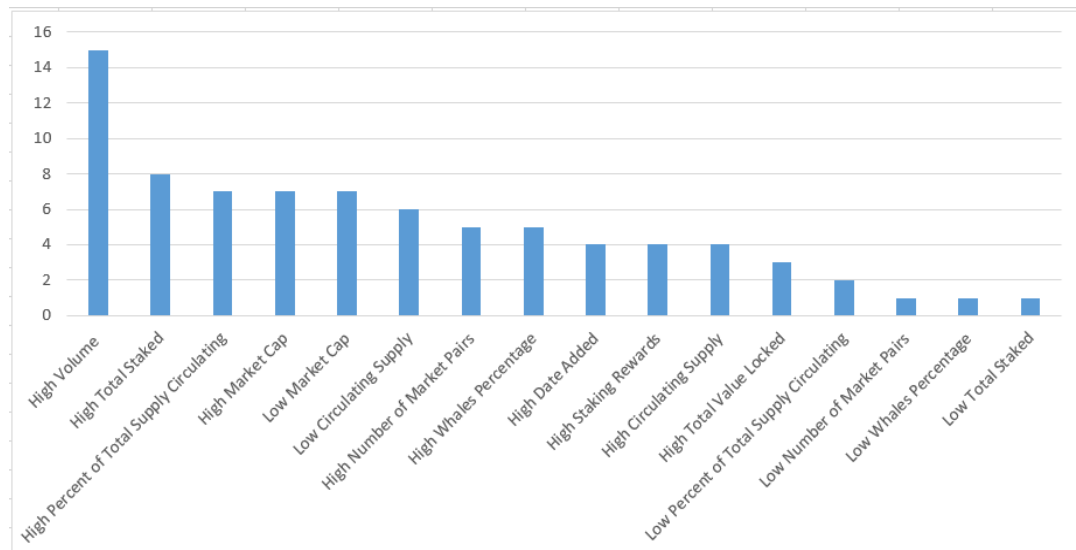


Figure 4.11 The histogram of selected features by the group of experts



## **CHAPTER FIVE**

### **ANALYZING HISTORICAL DATA**

#### **5.1 Collecting Historical Data**

We were able to obtain the data from 2013 till 2022-01-01 from CoinMarketCap history API. Unfortunately, the historical data contains only volume 24, market cap, max supply, total supply, circulating supply, and price. The number of market pairs is available since 10-May-2019 only.

#### **5.2 Statistical Analysis**

By analyzing the historical data, we noticed that some cryptocurrencies disappeared from the market. Disappeared in this case means the cryptocurrency is out of the market and in a few cases it has changed its name, symbol, or both. Out of 15349 unique name–symbol combinations, only 9310 left, which means about 39.34% of the cryptocurrencies disappeared. For the disappeared cryptocurrencies between 2013 and January 2022, Figure 5.1 shows the Pareto chart which plots the distribution of the disappeared cryptocurrencies' lifetime in descending order of frequency, with a cumulative line on a secondary axis as a percentage of the total. The lifetime of a cryptocurrency was calculated by measuring the difference between the first day the coin appeared in the market and the last day it did. We notice that 40% of the disappeared cryptocurrencies have a lifetime less than 80 days and about 75% of them have a lifetime less than one year.

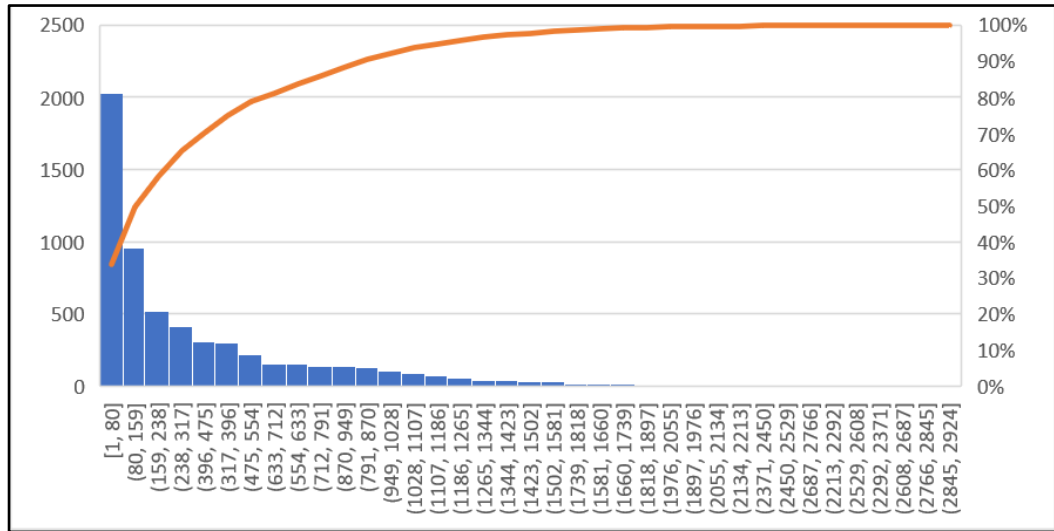


Figure 5.1 Pareto Chart for Disappeared Cryptocurrency till 01-Feb-2022

Figure 5.2 shows the same calculations but for the cryptocurrencies still in the market till 01-02-2022. We can notice from the figure that approximately 10% of the existing cryptocurrencies have been in the market for more than 1000 days.

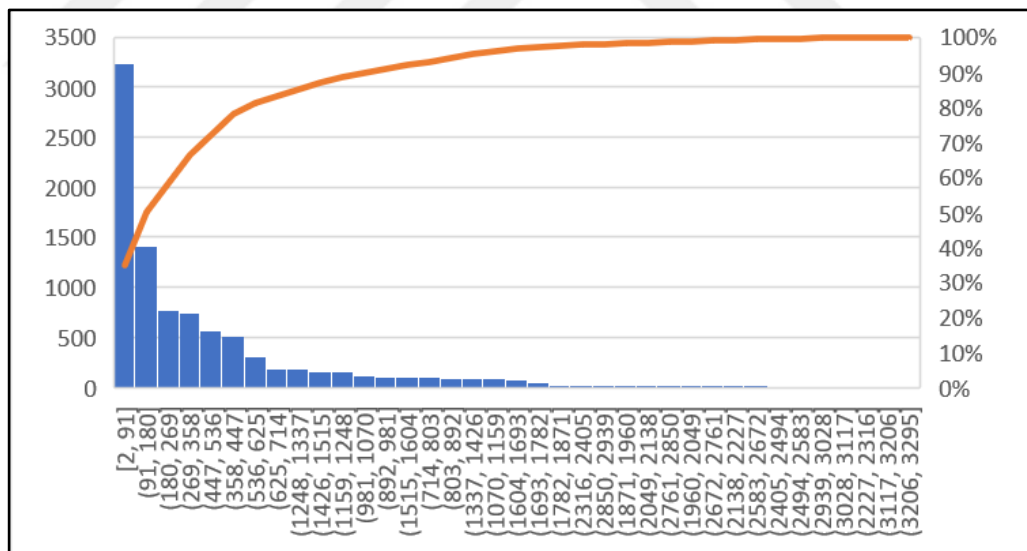


Figure 5.2 Pareto Chart for existing Cryptocurrency till 01-Feb-2022

To measure the importance of parameters and their effect on the price, we calculated the correlation between the price and Max Supply, Total Supply, Circulating Supply, Volume over 24 hours, and Percentage of Total Supply Circulating on the data from 1-January 2020 till 1-January-2022. We applied Pearson, Kendall Tau, and Spearman

correlations. Pearson measures a linear relationship between the parameters (price and other parameters in our study). On the other hand, Kendall Tau and Spearman do not require a linear relationship between the parameters. Table 5.1 shows the Pearson, Kendall Tau, and Spearman correlations between price and the parameters we mentioned earlier. We can notice that there is no linear (Pearson) correlation between the price and the other parameters. For the Kendall Tau correlation, medium negative correlation between the maximum supply and total supply and price and a weak positive correlation between the volume and the price. According to Spearman correlation, we can notice that there are:

1. Strong negative relationship between maximum supply and price
2. Strong negative relationship between total supply and price
3. Medium positive relationship between the volume over 24 hours and the price.

Table 5.1 Pearson, Kendall Tau, and Spearman Correlation between price and maximum supply, total supply, circulating supply, volume over 24 hours, and percentage of total supply circulating

Correlation Method \ Parameter	Maximum Supply	Total Supply	Circulating Supply	Volume over 24 hours	Percentage of Total Supply Circulating
<b>Pearson</b>	-0.0014	-0.00137	-0.00042	0.003622	0.002523
<b>Kendall Tau</b>	-0.47424	-0.46843	-0.0148	0.277538	0.091687
<b>Spearman</b>	-0.63634	-0.63254	0.003756	0.400218	0.129029

We did the same correlation experiments between the mean and standard deviation of price and the mean and standard deviation of maximum supply, total supply, volume over 24 hours, and percentage of total supply circulating. The correlation results between the mean of price and other parameters are shown in Table 5.2 and the correlation results between the standard deviation of price and other parameters are shown in Table 5.3.

Table 5.2 Correlation between the mean of price and other statistical parameters

Parameter Correlation Method	Mean of maximum supply	The standard deviation of maximum supply	Mean of the total supply	The standard deviation of the total supply	Mean of volume over 24 hours	The standard deviation of volume over 24 hours	Mean of the percentage of total supply circulating	The standard deviation of the percentage of total supply circulating
<b>Pearson</b>	-0.00428	-0.00107	-0.00436	-0.00106	0.093518	0.003707	0.006006	-0.00221
<b>Kendall Tau</b>	-0.54445	0.086909	-0.55059	0.107187	0.230387	0.204656	0.207434	0.229588
<b>Spearman</b>	-0.705676073	0.111224509	-0.7153579	0.142794417	0.341034186	0.306165597	0.278058293	0.301093875

Table 5.3 Correlation between the standard deviation of price and other statistical parameters

Parameter Correlation Method	Mean of maximum supply	The standard deviation of maximum supply	Mean of the total supply	The standard deviation of the total supply	Mean of volume over 24 hours	The standard deviation of volume over 24 hours	Mean of the percentage of total supply circulating	The standard deviation of the percentage of total supply circulating
<b>Pearson</b>	-0.00213	-0.00014	-0.00215	-0.00015	0.009016	0.000133	-0.00324	-0.0013
<b>Kendall Tau</b>	-0.53146	0.124285	-0.53893	0.139707	0.231982	0.219081	0.221607	0.254326
<b>Spearman</b>	-0.69011	0.158276	-0.70099	0.184614	0.344127	0.32804	0.297305	0.332416

We interpret the standard deviation as the fluctuation. For example, the standard deviation for the price is the fluctuation of price. We can notice that the Spearman correlation has the highest values. For the mean price Spearman correlation with other parameters, there is a strong negative correlation with the mean of maximum supply and the mean of total supply. The mean price's Spearman correlation with mean of volume over 24 hours and standard deviation of volume over 24 hours have near medium value. The same degree of Spearman correlation exists between the standard deviation of price and the previously mentioned parameters.

### 5.3 Predicting Risky Cryptocurrencies

#### 5.3.1 Data Preparation

We noticed that some cryptocurrencies share either name or symbol. To avoid confusion, we represented each cryptocurrency by its name and symbol combined with an underscore. The libraries we used, Keras, Numpy, PyPlot, and SikitLearn, do not support null values. As a result, we filled null values with the mean value of its column. For the max supply values, null represents an infinity, but we cannot process infinity while doing the classification, and filling the null values with the mean value is wrong. We fixed this problem by replacing null values within the maximum max supply multiplied by one thousand. Finally, we normalized the values using the mean normalizer defined by equation (5.1).

$$\text{Normalized value} = \frac{(\text{value} - \text{mean value})}{(\text{standard deviation})} \quad (5.1)$$

For the training, data were split as 80% for training and 20% for testing. Due to limitations in the resources, we could not process all the data, so we processed the historical data from 2013 to 2020. The split was random for all the classifiers except the LSTM one.

### 5.3.2 Classification

We used seven different classifiers to determine whether a cryptocurrency is risky or not. In our experiments, we considered the cryptocurrency that disappeared as a risky one and the one that is still in the market as not risky. We did not say that the prediction is going to disappear or not because saying that a cryptocurrency is going to disappear is impossible to predict logically due to many parameters affecting such a prediction. The input of the classifiers contains the normalized and cleaned historical data of the parameters: Price, Maximum Supply, Total Supply, Circulating Supply, Volume over 24 hours, Market Cap, and Percentage of Total Supply Circulating. For the metrics, we used four metrics precision, recall, accuracy, and f1-score as defined by equations (5.2), (5.3), (5.4), and (5.5) respectively. The one we considered to choose the best classifier is the f1-score because the classes (risky and not risky) are imbalanced.

$$Precision = \frac{True\ Positive}{True\ Positive + False\ Positive} \quad (5.2)$$

$$Recall = \frac{True\ Positive}{True\ Positive + False\ Negative} \quad (5.3)$$

$$Accuracy = \frac{True\ Positive + True\ Negative}{True\ Positive + False\ Positive + True\ Negative + False\ Negative} \quad (5.4)$$

$$F1 = 2 \times \frac{Precision * Recall}{Precision + Recall} \quad (5.5)$$

Different classifiers from the Sikit-learn library with their default configurations were used. The used classifiers are Logistic Regression, Support Vector Machines, Decision Trees, Random Forests, Naïve Bayes, and K-Nearest Neighbor. The results of those classifiers are shown in Figure 5.3.

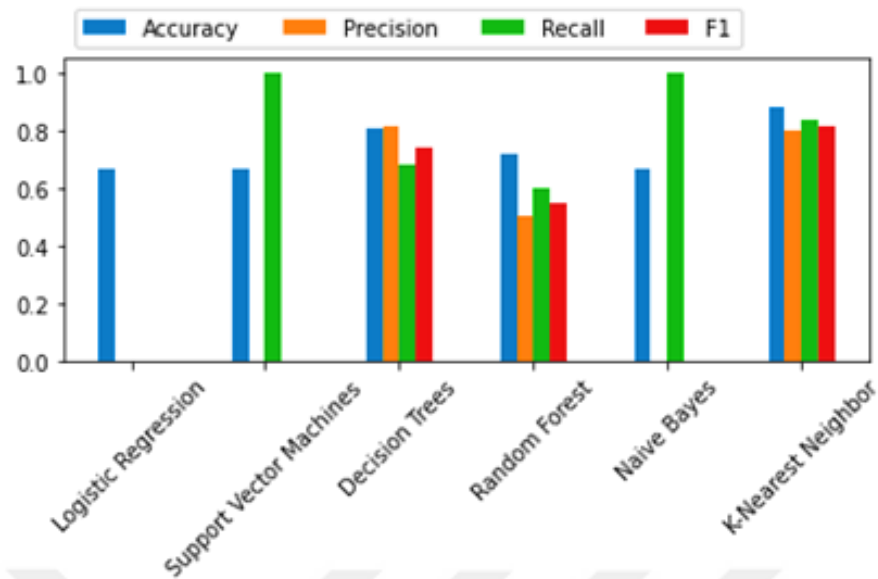


Figure 5.3 The classification results using Logistic Regression, Support Vector Machines, Decision Trees, Random Forests, Naïve Bayes, and K-Nearest Neighbor classifiers on the Test Dataset

We used also Long-Short Term Memory (LSTM) to classify the cryptocurrencies. We gathered each unique symbol–name pair to form a time stream. As a result, the longest time stream was Bitcoin’s with a length of 2801 days. LSTM does not accept variable time series, so we padded every coin’s series with leading zeros. Each added padding day consists of 7 zeros, for 7 features. We tried different combinations of architectures and all of them gave the same metrics. Figure 5.4 shows the LSTM architecture we built and Table 5.4 has the metrics for the LSTM model. We tried the model with 1 LSTM layer and 2 LSTM layers each of them having 8, 16, 32, 64, 128, and 256 units. The same applied to hidden layers where we tried 2, 3, 4, 5, 6, and 7 hidden layers each of them starts with neurons equal to the LSTM units and the next layer will have half of those neurons. The output is one neuron with Softmax as an activation function to get 0 or 1 classification where 0 represents not risky cryptocurrency and 1 represents risky one. In the hidden layers, we did tests with Tanh and ReLu as an activation function and both gave the same results.



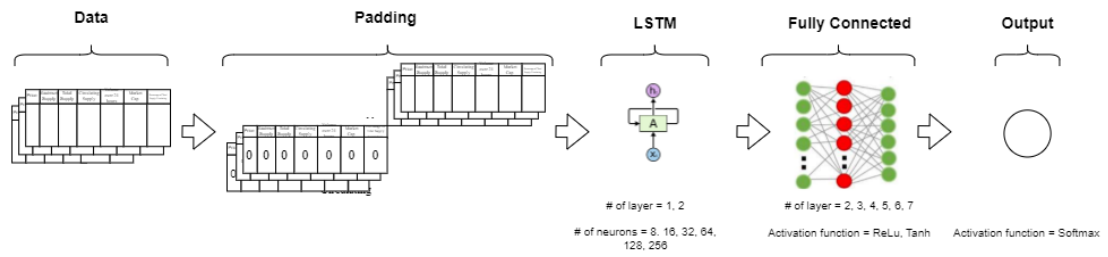


Figure 5.4 The developed LSTM architecture to classify the cryptocurrencies

Table 5.4 Metrics for the LSTM classifier

Precision	Recall	F1-score	Accuracy
1	0.356554	0.525676	0.356554

### 5.3.3 Results

The classes are imbalanced, so we considered the F1-Score as the main metric. We notice that the best classifier is the K-Nearest Neighbour with an F1-Score equals 80% approximately, followed by Decision Trees, LSTM, and Random Forests.

## 5.4 Summary

In this chapter, we described the analytics we did on the historical data of cryptocurrencies in addition to trying to classify the cryptocurrencies as risky or not risky ones. All the experiments we did in this chapter were side experiments and we had no time to complete working on them since the investment recommendation system was our main research.

## **CHAPTER SIX**

### **CONCLUSION AND FUTURE WORKS**

#### **6.1 Conclusion**

In this research, we discussed blockchain technology and its applications. We then talked about cryptocurrencies as the financial use of blockchain and the huge number of cryptocurrencies we have nowadays. We talked about the different classes of cryptocurrencies and then the factors affecting a cryptocurrency: off-chain and on-chain parameters. With the help of our focus group of experts, we defined seventeen on-chain features and pointed out the difference between off-chain and on-chain ones, and doing that filled the gap in research regarding on-chain parameters. We described the investment decision support system we built, our main research, that allows the investors to rate cryptocurrencies according to dynamically selected on-chain features. The system we built gets the features preferences from the investors, the high/low preferences for each selected preferred feature, and then answer the dynamically generated questions that compare the pairs of selected features. The recommendation system uses the answers to the comparative questions and applies the AHP algorithm to them to calculate a weight for each selected feature. Using the weights and the rating equation we developed, the system calculates the rate for each cryptocurrency then it displays the recommendations to the investor by sorting the cryptocurrencies by their calculated rate. Each investor will be given different recommended cryptocurrencies according to the features and the answers they provide to the system. Out of the 17 on-chain features we defined, the system has the most important 8 ones, a feature we called Percentage of Total Supply Circulating, and the off-chain parameter, the number of market pairs. Those ten parameters that we used in the system, were obtained from four different resources. The data were cleaned and normalized before applying the rating algorithm to them. The investment recommendation system we built, or investment decision support system, can be used with newly created cryptocurrencies, does not require historical data, provide personalized recommendations, and uses the on-chain parameters to provide better recommendations. The focus group of experts

tested the system and some of them reported that some cryptocurrencies in the top-10 recommended cryptocurrencies are interesting to invest in, and they were not aware of their existence. The rating model we developed can be easily used with any similar system that has many features and personal recommendations needed.

Using the answers of our focus group of experts, out of the ten on-chain features we put in the system, we found that High Volume, High Total Staked, and High Percent of Total Supply Circulating were the most used features for investment opportunities detection. We also tried to get general recommendations using those answers by applying the rating algorithm using each answer separately and then getting the average rate for each cryptocurrency that appeared in the different recommendations.

The clustering algorithm K-means was applied also to categorize the cryptocurrencies into different groups. Using the elbow method, it was found that cryptocurrencies can be categorized into 5 groups at the date of the experiment. This categorization is helpful to find the group of cryptocurrencies like a cryptocurrency in mind. However, clustering the huge number of cryptocurrencies, more than 5000, into 5 groups only is not efficient and as a result, the results will not be useful to the investors.

While analyzing the historical data between 2013 and January 2022, we found that about 39.34% of the cryptocurrencies disappeared. We noticed that 40% of the disappeared cryptocurrencies had a lifetime less than 80 days and about 75% of them had a lifetime less than one year. We noticed also that only approximately 10% of the existing cryptocurrencies have been in the market for more than 1000 days.

Measuring the correlation between the price and other parameters for the data between 1 January 2020 and 1 January 2022, we found that there is no linear correlation, but we found a strong negative Spearman correlation between maximum supply and price, a strong negative Spearman correlation between total supply and price, and medium positive relationship between the volume over 24 hours and the

price. Doing the same correlation measurement between the standard deviation/mean of the price we found a strong negative correlation with the mean of maximum supply and the mean of total supply. We found also that the Spearman correlation with mean of volume over 24 hours and standard deviation of volume over 24 hours have near medium value.

We tried to classify a cryptocurrency whether it is risky or not by training different classifiers on the historical dataset and considering a disappeared cryptocurrency as risky and the existing cryptocurrency as not risky. The best classifier was the K-Nearest Neighbour with a score of about 80%. We also tried an LSTM architecture since we can consider the historical data of a cryptocurrency as a time series. The result of the LSTM was not too good, and it has to be improved in future work. We believe that using an RNN model, LSTM for example, is better and more logical than the linear classical classifiers and we encourage further future studies to be done on it.

## **6.2 Future Works**

The investment recommendation system we built uses AHP. In the future, we are going to use Fuzzy AHP instead of AHP to give investors more accurate recommendations since the Fuzzy AHP algorithm considers human error during answering the comparative questions.

Further studies on the correlation of our system's rating with price are planned as well. These studies will also try to predict the changes in cryptocurrencies by knowing the best set of features and their weights.

The focus of our research was the investment decision system. The analytics and classification of risky cryptocurrencies were done as side experiments, and we did not have time to improve them. Improving the classifiers we built to detect risky cryptocurrencies can be done by taking into account the imbalance problem and solving it using sampling to get better results. Tuning the classifiers parameters can also be done where we used the default settings provided by the library for each

classifier, except for the LSTM one. We can also use the classifiers with statistical data for each cryptocurrency instead of all the cryptocurrency's historical data, which may lead to better results.



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## **APPENDICES**

### **Appendix A**

This appendix contains the results of classifying cryptocurrencies using k-means.



Table A.1 Clustering all cryptocurrencies on 01-January-2022 using Market Cap, Volume 24h, Num Market Pairs, Percent of Total Supply Circulating, Total Value Locked, Staking Reward, Total Staking Percentage, and Whales Percentage

Cluster #	Cryptocurrencies
1	UBIX.Network
2	Wabi
3	<p>Polygon, Binance USD, Chainlink, Uniswap, FTX Token, Axie Infinity, UNUS SED LEO, The Graph, Gala, Curve DAO Token, Bitcoin SV, Amp, Chiliz, KuCoin Token, Huobi Token, Nexo, Compound, IoTeX, SushiSwap, Celsius, Audius, Gnosis, Dogelon Mars, Perpetual Protocol, Telcoin, Storj, UMA, Ontology, Neutrino USD, Celer Network, NuCypher, CEEK VR, Ultra, Cartesi, Swipe, Dusk Network, MediBloc, Constellation, aelf, Orchid, Civic, Status, Band Protocol, Origin Protocol, Huobi BTC, Liquity USD, Rally, Frax Share, Illuvium, Tribe, HUSD, Keep Network, Rocket Pool, Bitpanda Ecosystem Token, Alchemix, Veritaseum, HedgeTrade, LUKSO, Radicle, Orion Protocol, Ontology Gas, Tether Gold, Augur, Orbs, Electroneum, Numeraire, Propy, Alien Worlds, Verasity, MVL, Centrality, TrueFi, API3, Aavegotchi, IDEX, Uquid Coin, Syntropy, Balancer, QuarkChain, MovieBloc, Liquity, ARPA Chain, Kin, DerivaDAO, Sentinel, QuickSwap, DODO, Aergo, bZx Protocol, WHALE, BarnBridge, Grid+, Contentos, Loom Network, Cortex, KeeperDAO, Rarible, Cocos-BCX, cVault.finance, DIA, Akropolis, district0x, Bella Protocol, NULS, RAMP, Bluzelle, Sentinel Protocol, BitMart Token, Measurable Data Token, Waltonchain, Refereum, Metronome, Bytom, Selfkey, NFTX, Tellor, Mithril, Fusion, LATOKEN, SOLVE, DigixDAO, Frontier, BOSAGORA, Maple, CoinEx Token, AMO Coin, Dock, dForce, Cream Finance, Hegic, mStable USD, Gifto, AirSwap, pNetwork, VITE, Ultiledger, BitForex Token, Reserve, USDK, The Midas Touch Gold, Quantstamp, NEST Protocol, GamerCoin, TokenClub, ERC20, QASH, Decimated, 0Chain, Santiment Network Token, Nebulas, Cardstack, BitKan, TE-FOOD, APY.Finance, SHPING, FOAM, Arcblock, Ambrosus, Aventus, TrueChain, Raiden Network Token, Morpheus Labs, Huobi Pool Token, Atomic Wallet Coin, Dentacoin, BaaSid, Tokenomy, BnkToTheFuture, Lambda, YF Link, Mysterium, Moeda Loyalty Points, YOYOW, ARMOR, EasyFi, Graviton, Decentr, LuaSwap, Plasma Finance, High Performance Blockchain, Matrix AI Network, All Sports, SwftCoin, PieDAO DOUGH v2, VestChain, Ripio Credit Network, CyberVein, Big Data Protocol, Pluton, Autonio, CyberMiles, Swerve, Pillar, Bibox Token, PumaPay, Egretia, Hydro Protocol, Caspian, SIRIN LABS Token, IoT Chain, Carbon, HitChain, Zap, VINchain, Open Platform, Time New Bank, YEE, Ruff, CPChain, DAEX, Medicalchain, Amon, Acute Angle Cloud, Global Social Chain, Cryptaur, Odyssey, ShowHand, Howdoo, yAxis, Skrumble</p>

	<p>Network, Auctus, Game.com, Flixxo, DMM: Governance, adbank, AppCoins, MediShares, Tripio, Moneytoken, Spectre.ai Utility Token, Kcash, Scry.info, XMax, Bezant, DomRaider, DAV Coin, eosDAC, Primas, Hashgard, FlypMe, ChatCoin, Equal, PHI Token, DATA, GeoDB, Enigma, Tap, Patientory, Bob's Repair, PayPie, CoinFi, Indexed Finance, Debitum, Faceter, NEXT, TigerCash, Sakura Bloom, Starbase, ContentBox, Delphy, EDUCare, OneRoot Network, Jetcoin, NeuroChain, Friendz, GoldMint, HashCoin, AidCoin, Gems , Blockpass, Content Neutrality Network, Molecular Future, Niobium Coin, Bounty0x, Zeusshield, PlayGame, UpToken, Rivetz, HOQU, Maecenas, Tokenbox, EchoLink, DATx, Sentinel Chain, COVA, SkinCoin, Cobinhood, Aeron, Ormeus Coin, Rate3, Cosmo Coin, BoutsPro, BlockMesh, MicroMoney, Bigbom, Elysian, Italian Lira, TrueDeck, PAYCENT, AI Doctor, DecentBet, Lition, Opus, EnterCoin, Blocktix, Truegame, Devery, HeartBout, TRAXIA, WABnetwork, Fire Lotto, Biotron, BTC Lite, InvestDigital, ArbitrageCT, Kind Ads Token, Ccore, Bitnation, IGTOKEN, Scanetchain, Webcoin, Joint Ventures, DOWCOIN, Compound Dai, sBTC, Silent Notary, QuiverX, Index Cooperative, ABCC Token, PoolTogether, tBTC, DigiFinexToken, Bone, Pantos, Akropolis Delphi, Shiba Inu, Wrapped Bitcoin, Aave, Quant, TrueUSD, Bancor, Livepeer, renBTC, SwissBorg, Polymath, Chromia, Dent, Aragon, Function X, Frax, Rari Governance Token, StormX, Utrust, Gemini Dollar, Enzyme, Metal, TrustSwap, Ampleforth, sUSD, DFI.Money, Wrapped NXM, Harvest Finance, Rai Reflex Index, Morpheus.Network, Hoge Finance, CargoX, YIELD App, Bread, Sentivate, BTU Protocol, Invictus Hyperion Fund, LikeCoin, BLOCKv, BABB, Bankera, Pickle Finance, Internxt, IQeon, 88mph, OAX, CoinPoker, Dovu, Crypterium, TenX, Monetha, GAMB, AMLT, Digix Gold Token, Cappasity, HEROCoin, BOLT, NANJCOIN, Lympo, Cred, VIDY, carVertical, 1World, Essentia, OST, WePower, Xaurum, DAOstack, SnowSwap, Wings, Humaniq, CoTrader, Patron, Hydro, Upfiring, DMarket, MyWish, U Network, ShipChain, Everex, ATLANT, MobileGo, Remme, Substratum, Omnitudo, SophiaTX, Dether, Electrify.Asia, Minereum, IHT Real Estate Protocol, Etherparty, IXT, Ink Protocol, Blockmason Credit Protocol, Swarm City, GoNetwork, Agrello, Zilla, ZPER, InvestFeed, EvenCoin, Bela, Privatix, MyBit, ELTCOIN, XOVBANK, Datarius Credit, Aigang, Dai, Fantom, Decentraland, Loopring, Maker, yearn.finance, 0x, Golem, PAX Gold, Request, iExec RLC, NKN, SingularityNET, DeFi Pulse Index, Kryll, Dragonchain, 0xBitcoin, Covesting, VIBE, NaPoleonX, KickToken, Lendingblock, SunContract, Genesis Vision, FintruX Network, Neurotoken, Vetri, NFTX Hashmasks Index, Playkey, FuzeX, MetaMorph, Rentberry, Lunyr, Sociall, Ren, Maincoin</p>
4	<p>Ethereum, BNB, Solana, USD Coin, Cardano, Polkadot, Avalanche, Dogecoin, Crypto.com Coin, NEAR Protocol, TerraUSD, Litecoin, Algorand, Cosmos, Bitcoin Cash, Stellar, TRON, VeChain, Bitcoin BEP2, Filecoin, Elrond, Theta Network, Ethereum</p>

	<p>Classic, Harmony, Monero, Tezos, IOTA, PancakeSwap, EOS, Stacks, BitTorrent, Kusama, THORChain, Enjin Coin, Zcash, eCash, Arweave, Neo, Basic Attention Token, Waves, Dash, Holo, NEM, Ravencoin, Secret, Pax Dollar, Theta Fuel, OMG Network, Velas, Decred, BORA, Zilliqa, WAX, Qtum, Ankr, ICON, Voyager Token, Kava, Syscoin, Horizen, Revain, Siacoin, Flux, Bitcoin Gold, Synthetix, Nervos Network, IOST, SKALE Network, Hive, Ocean Protocol, DigiByte, Nano, Fei USD, Fetch.ai, WINKLink, OriginTrail, XYO, JUST, Phantasma, DigitalBits, Keep3rV1, Chrono.tech, Lisk, Mdex, Reef, Bitcoin Standard Hashrate Token, VeThor Token, Energy Web Token, Verge, Conflux, Bitcoin Diamond, Ardor, ASD, Polkastarter, Lido stETH, BitTorrent (new), Wrapped BNB, Convex Finance, COUNOS X, Spell Token, Symbol, Venus BNB, DeFiChain, LINK, yOUCash, NXM, Decentralized Social, Metahero, UFO Gaming, WhiteCoin, Persistence, OpenDAO, Akash Network, Origin Dollar, Orbit Chain, Starlink, RMRK, Kyber Network Crystal v2, JOE, Pundi X (New), Sapphire, Humanscape, XSGD, Sun (New), KardiaChain, Unibright, Venus BTC, Prometheus, Divi, BakeryToken, Stratis, HyperDAO, Circuits of Value, Pirate Chain, Sologenic, MaidSafeCoin, MXC, CRYPTO20, GXChain, Steem, Badger DAO, Metadium, Ark, Dawn Protocol, SOMESING, Handshake, Venus ETH, Presearch, RSK Infrastructure Framework, Ergo, Vectorspace AI, Safe, TomoChain, Biswap, USDX [Kava], Rakon, XeniosCoin, Ellipsis, Proton, Sport and Leisure, Standard Tokenization Protocol, Telos, PEAKDEFI, ABBC Coin, FUNToken, PolySwarm, RFOX, STASIS EURO, Decentral Games, IRISnet, Terra Virtua Kolect, LCX, Dero, Wanchain, Swarm, Everipedia, RichQUACK.com, STAKE, Solanium, Adventure Gold, Celo Dollar, LTO Network, Venus USDC, Zenon, ScPrime, BitShares, CertiK, SpiritSwap, ankrETH, ssv.network, Beefy Finance, Alpha Quark Token, Hoo Token, Moss Coin, Komodo, MimbbleWimbleCoin, ONUS, Hifi Finance, Travala.com, HUNT, Thunder Token, Streamr, TROY, Kleros, GMT Token, BinaryX, Ampleforth Governance Token, Freeway Token, MARINADE STAKED SOL, Carry, Haven Protocol, TokenPocket, MonaCoin, Shiden Network, Alpaca Finance, Civilization, Elastos, Ambire AdEx, Hacken Token, FIO Protocol, Darma Cash, TABOO TOKEN, Venus XVS, ApeSwap Finance, Maro, Mobius, Position Exchange, Rainicorn, Aion, EverRise, Ooki Protocol, Splintershards, Smooth Love Potion, Firo, Revolution Populi, CONUN, Vai, Venus BUSD, Energi, Newscrypto, RChain, Aurox, Assemble Protocol, Adshares, Glitch, Gas, Groestlcoin, Flamingo, FLETA, Valobit, Beam, Steem Dollars, PlanetWatch, Dego Finance, Apollo Currency, Edgeware, Bytecoin, Polkadex, Bounce Finance Governance Token, Vesper, Burger Swap, Switcheo, Aeternity, PAC Protocol, SORA, FirmaChain, VerusCoin, v.systems, MileVerse, Smartlands Network, ForTube, Unifi Protocol DAO, Mirrored iShares Gold Trust, BASIC, Aragon Court, AnimalGo, DEXTools, New BitShares, VIDT Datalink, MATH, Wirex Token, Super Zero Protocol, KARMA, ZEON, DogeBonk, MetaPets, VideoCoin, PIVX, Exeedme, GoChain, Mirrored</p>
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<p>ProShares VIX, Epic Cash, Galaxy Heroes Coin, AstroSwap, WaykiChain, ProximaX, Nimiq, Venus USDT, Neutrino Token, TerraKRW, Oxen, Auto, Electra Protocol, ICHI, ReddCoin, Cellframe, Nexus, Wing Finance, BUX Token, Ariva, Peony, BEPRO Network, Student Coin, Namecoin, Vertcoin, EpiK Protocol, GameZone, Counterparty, GameCredits, Soda Coin, GMCoin, Unisocks, POA Network, Rubic, Ferrum Network, DxChain Token, saffron.finance, ADAPad, Muse, CUTcoin, ASTA, GYEN, DeHub, TEMCO, DSLA Protocol, Validity, Gameswap, SparkPoint, Doge Dash, Particl, Nash, Banano, Mint Club, Grin, #MetaHash, O3 Swap, K21, Nestree, Zano, MCDEX Token, Numbers Protocol, Opacity, Life Crypto, Medacoin, Peercoin, Belt Finance, Lotto, Spartan Protocol, Navcoin, Curate, Oxbull.tech, Mogul Productions, ChainX, HAPI, Xaya, LBRY Credits, KCCPAD, HyperCash, Neblio, Kromatika, unFederalReserve, Infinity PAD, Poolz Finance, Cindicator, Niftyx Protocol, Ondori, BigONE Token, Shopping, GoCrypto Token, BIDR, CoinMerge (ERC20), WOOF, Mirrored Invesco QQQ Trust, Mirrored Apple, Venus SXP, Callisto Network, Goldcoin, UniCrypt, Sonar, SafeCoin, Degenerator Meme, Mirrored iShares Silver Trust, Infinitecoin, RING X PLATFORM, USDJ, Pacoca, Factom, Mirrored Tesla, Ignis, Obyte, Minter Network, ETHPad, CumRocket, Phoenix Global (new), Mirrored Microsoft, Lamden, FREEdom Coin, Quantum Resistant Ledger, Mirrored Amazon, Bitcoin 2, EOS Force, Cashaa, RioDeFi, Project WITH, FIBOS, Mirrored Alibaba, Lith Token, Nitro Network, Pundi X NEM, Metaverse ETP, DuckDaoDime, Gate, Venus LINK, TrustVerse, Venus LTC, JulSwap, DOGGY, Finxflo, Tranche Finance, Safex Token, Nxt, Mirrored United States Oil Fund, Birake, Aidos Kuneen, Stakenet, Mirrored Netflix, SafeMoon Inu, Modifi, DEEPSPACE, ExNetwork Token, STARSHIP, Lightning, Decentral Games ICE, AnRKey X, ZeroSwap, Venus Reward Token, Wagerr, Enecuum, Phantasma Energy, Vidya, DECOIN, MicroPets, Vidulum, Signum, Florin, Eden, SONM (BEP-20), Global Coin Research, Dotmoovs, Asch, Jigstack, Unicly CryptoPunks Collection, Binamon, Mirrored Twitter, Receive Access Ecosystem, Tiger King, FairGame, CyberFi Token, Growth DeFi, APIX, YUMMY, UpBots, Venus DOT, Binemon, Swop, SuperLauncher, Green Ben, DeFi Yield Protocol, Litecoin Cash, ZooKeeper, Empty Set Dollar, Rainbow Token, SALT, FortKnoxster, TFL.io, Genaro Network, Rupiah Token, CoinMerge (BEP20), YUSRA, Pepe Cash, Bird.Money, RocketX, Plian, 1-UP Platform, CryptoBlades, Rotharium, Diamond, Viberate, Graphlinq Protocol, Carboncoin, UniLayer, Nafter, Chainge, Blocknet, Monolith, StakeCubeCoin, NFT Index, Wownero, Project Pai, Hiveterminal Token, Gulden, Onooks, HorusPay, Hakka.Finance, Pawthereum, Idena, WOWswap, Venus DAI, ClinTex CTi, Float Protocol (Bank), Skycoin, CACHE Gold, EvidenZ, Einsteinium, Ubiq, Cyclone Protocol, Credits, BOX Token, Raze Network, CumStar, Monavale, Achain, Insights Network, Ryoshi Token, Kambria, MASQ, Ghost, Rhythm, Metrix Coin, S4FE, xRhodium, LiquidApps, ZBG</p>
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	<p>Token, GENRE, YAM V3, Crypton, Polis, HTMLCOIN, Unicly Hashmasks Collection, bitCNY, Hedget, Vanilla Network, Massnet, Breezecoin, DeepOnion, Helmet.insure, Reward Hunters Token, Xfinance, OctoFi, EUNO, Monero Classic, Iconic Token, BitcoinZ, Quark, SpaceChain, INT, HashBX, Whiteheart, BillionHappiness, Spore, Unistake, WebDollar, NewYorkCoin, Dynamic, Gridcoin, ColossusXT, Etho Protocol, 42-coin, Rune Shards, MoonSwap, DeFi Degen Land, Crust Shadow, OTOCASH, Safex Cash, Loser Coin, Viacoin, Ycash, Trittium, Garlicoin, ASKO, Edgeless, Redpanda Earth, Conceal, Aeon, THEKEY, Tycoon, 8PAY, SmartCash, CRD Network, Public Index Network, PhoenixDAO, Elamachain, disBalancer, FYDcoin, Unicly Mystic Axes Collection, Lanceria, AGA Token, TurtleCoin, Education Ecosystem, xSuter, Teloscoin, Rune, BitCore, BOOM, QuickX Protocol, TransferCoin, Shadows, Feathercoin, AXPR, Vexanium, Fatcoin, Inex Project, EOSDT, SIMP Token, Lightning Bitcoin, NextDAO, eBoost, EXRNchain, Unitrade, UniMex Network, X-CASH, Emercoin, Treat DAO [old], BlackCoin, Ditto, SHIBAVAX, Primecoin, Governor DAO, Eminer, LinkEye, CryptoZoon, SoMee.Social [OLD], MIR COIN, PWR Coin, Master Contract Token, Neural Protocol, AtromG8, MakiSwap, Sumokoin, Props Token, yieldwatch, Mind Music, STATERA, Xensor, Bitspawn, Jade Currency, CryptoFranc, CHADS VC, Davinci Coin, UnlimitedIP, Dimecoin, Bismuth, Bean Cash, Mcashchain, Digitex, Wolf Safe Poor People, e-Gulden, 1X2 COIN, Myriad, DigitalNote, REVIVAL, PotCoin, AMEPAY, World Token, TERA, Curecoin, Cajutel, Lead Wallet, CloakCoin, Perth Mint Gold Token, FujiCoin, EarnX, PANTHEON X, SYNC Network, 8Bit Doge, Golff, BitcoinHD, SEEN, iEthereum, Omni, Add.xyz, BankerDoge, HempCoin, Denarius, OtterClam (New), Stealth, PEPS Coin, Royale Finance, Antiample, Dragon Kart, PIXEL, ADAMANT Messenger, TurtleNetwork, MarsX, DFSocial Gaming, USDX [Lighthouse], Ethereum Gold Project, Aryacoin, Doki Doki Finance, ZUSD, Ryo Currency, Karbo, Evedo, Ixcoin, Lethan, Basis Cash, KanadeCoin, Krios, CVCoin, eXPerience Chain, Cheems, I/O Coin, Venus BCH, Name Change Token, SakeToken, SureRemit, Scala, Waves Community Token, Polyient Games Governance Token, Cornichon, PieDAO DEFI++, Atlas Protocol, OKCash, NFTLootBox, Bitcoin Plus, BOMB, BlackHat, ADA BOY, Non-Fungible Yearn, Veil, Argon, Phore, Multiplier, SINOVATE, Ravencoin Classic, The ChampCoin, LanaCoin, Lobstex, Bitcoin Atom, Modern Investment Coin, Signature Chain, Step Finance, MONK, Spaceswap MILK2, Memetic / PepeCoin, Global Cryptocurrency, Origin Sport, StakedZEN, Sharder, ZClassic, Blockchain Cuties Universe Governance, Bitswift, Scorum Coins, Relite Finance, TokenPay, VeriCoin, BitTube, Netbox Coin, Kangal, WeTrust, X8X Token, MonetaryUnit, Pinkcoin, Phoenixcoin, Avaxtars Token, MoonTrust, Pepemon Pepeballs, xSigma, Endor Protocol, ChessCoin, Keep4r, 1Million Token, MicroBitcoin, Crown, WeOwn, Digital Fitness, GHOSTPRISM, Typerium, CannabisCoin, pEOS, Litex, TotemFi, Banca, Node Runners, Seigniorage Shares,</p>
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	<p>Nuco.cloud, Wrapped Gen-0 CryptoKitties, LocalCoinSwap, RED, Vipstar Coin, Zoracles, BeatzCoin, The Corgi of PolkaBridge, DAPS Coin, Dynamix, Digital Reserve Currency, Ubex, Oikos, CryptoSoul, Terracoin, VIG, CryptEx, Dracula Token, Dogeswap, Origo, Fera, 0xcert, Azbit, TetraHedra, Parachute, Coinsbit Token, Motocoin, Golos Blockchain, \$LONDON, Orbitcoin, Spaceswap SHAKE, OLXA, Pascal, Pigeoncoin, Chonk, PetroDollar, Donut, NIX, Bitgear, Beaxy, bAlpha, iDealCash, Project Inverse, yTSLA Finance, Naka Bodhi Token, Zebi Token, Orient Walt, ZumCoin, BUZZCoin, ESBC, Atmos, Rise, Ceres, Qwertycoin, NuShares, AstroTools, Kobocoin, QUINADS, renDOGE, Nexalt, Limitless VIP, Datamine FLUX, DAOventures, Bitcoin Confidential, Beacon, XcelToken Plus, Freicoin, Trollcoin, Sether, Power Index Pool Token, Base Protocol, Pancake Bunny, FairCoin, Woodcoin, Maxcoin, Arqma, LYNC Network, Pylon Finance, CoinDeal Token, Iridium, GeoCoin, Azuki, NativeCoin, Hush, Xiotri, ZrCoin, Zennies, CafeSwap Token, HYCON, Zeepin, PirateCash, MotaCoin, AudioCoin, Vox.Finance, BitCapitalVendor, TENT, Curio, Wolf Safe Poor People (Polygon), ION, Bitcoin Green, Emerald Crypto, Nerva, Titan Coin, Catex Token, Actinium, Blue Whale EXchange, MoonTools, Aitra, Ethereum Gold, MMOCoin, Wrapped Basic CryptoKitties, CryptoBonusMiles, StrongHands, Novacoin, PluraCoin, Qbao, DogeCash, GoldenPyrex, Shadow Token, Alt.Estate token, Bitgesell, Tornado, ATC Coin, Stox, RMPL, Blackburn, Zero Utility Token, Expanse, Waifu Token, Masari, Blizzard Network, Pakcoin, EDC Blockchain, Chronologic, Swap, KnoxFS (New), Cryptonite, DoYourTip, Yearn Secure, Goose Finance, DopeCoin, MODEL-X-coin, uPlexa, Netko, Synergy, LunchMoney, HEAT, SIBCoin, SmileyCoin, ExclusiveCoin, Peseta Digital, Ether Zero, EtherGem, JustBet, DOGEFI, CREA, Squirrel Finance, AiLink Token, Phoneum, BitcoinPoS, reflect.finance, Swing, Stipend, MemeCoin Factory, Switch, GoByte, Birdchain, BlueCoin, Solaris, BiblePay, Bitstar, TrezarCoin, GlobalBoost-Y, Po.et, Unicly Chris McCann Collection, PengolinCoin, Ronin Gamez, Blue Protocol, TagCoin, CROAT, Unicly Doki Doki Collection, SOAR.FI, Decentralized Machine Learning, Escroco Emerald, 2GIVE, Zetacoin, Eternity, srnArt Gallery, Noir, Qrkita Token, Ritocoin, SmartCoin (SMC), PYRO Network, Bata, DeFi Bids, Heron Asia, Cyber Movie Chain, BZEdge, Innova, Rapids, AquariusCoin, Energo, Megacoin, StrongHands Masternode, SnodeCoin, XTRABYTES, Tendies, CheesecakeSwap Token, Digitalcoin, Themis, Rubies, Cryptojacks, MidasProtocol, SORA Validator Token, Scrypta, Collective, PKG Token, Connectome, PoSW Coin, x42 Protocol, Chi Gastoken, Meridian Network, ZCore, Wrapped Virgin Gen-0 CryptoKitties, LUXCoin, YVS.Finance, Depth Token, Cubiex, Innovative Bioresearch Coin, Decentrahub Coin, ICE ROCK MINING, ANON, Webflix Token, MojoCoin, Crypto Sports, Anoncoin, Evil Coin, InsaneCoin, Boosted Finance, SHIELD, NestEGG Coin, Fireball, Transcodium, JavaScript Token, ATBCoin, Block-Logic, Gaj Finance, Phantomx, CoinAlpha, AllSafe,</p>
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	<p> Bolivarcoin, Beetle Coin, DMScript, megaBONK, BitWhite, GoldBlocks, Bitblocks, Helix, Opal, Membrana, Infinity Esaham, YENTEN, Akroma, Kurrent, PayCoin, Rope, BitcoiNote, CUE Protocol, Ormeus Cash, Bitcloud, Litecoin Plus, ITO Utility Token, UBU Finance, Yocoin, Island Coin, Defis, Cheesecoin, NevaCoin, SafeInsure, Rimbit, NFX Coin, Unicly Genesis Collection, SwiftCash, Axe, ImageCoin, BitCash, Gentarium, SiaCashCoin, Eroscoin, GCN Coin, SteepCoin, HeroFi (ROFI), Startcoin, Arbidex, PegNet, Payfair, BitBlocks Finance, BLOC.MONEY, CyberMusic, Rupee, Fivebalance, Worldcore, EUNOMIA, SuperCoin, BitSend, Coin2.1, Dreamcoin, Micromines, Waletoken, ALL BEST ICO, Bitradio, FNB Protocol, GlobalToken, Herbalist Token, Universal Currency, Civitas, ProxyNode, GuccioneCoin, ZeusNetwork, SF Capital, Photon, Gravity, Nasdacoins, VoteCoin, ParallelCoin, Merebel, PostCoin, BitRewards, PureVidz, FantasyGold, Cryptrust, Ratecoin, Energycoin, Xuez, FidexToken, Yield Stake Finance, Arion, Onix, ICOBID, Global Currency Reserve, CashHand, Digital Money Bits, IQ.cash, StarterCoin, Mchain, Commercium, BBSCoin, Unify, Theresa May Coin, Adzcoin, PosEx, Bionic, Backpacker Coin, Bitcoin Incognito, Grimm, Desire, Veles, Cream, MedicCoin, Digiwage, CaluraCoin, Bridge Protocol, ETHplode, Castle, FuzzBalls, Paypex, GenesisX, Bitcoin CZ, DNotes, Plus-Coin, Decentralized Asset Trading Platform, Dynamite, Kush Finance, Carebit, HyperAlloy, Centurion, Citadel, TajCoin, AceD (old), BERNcash, Ether Kingdoms Token, Netrum, FUZE Token, Provoco Token, Impleum, Narrative, CPUchain, Pyrk, Zayedcoin, X-Coin, GeyserCoin, Fox Trading, Halving Token, Bitcoin Zero, ParkByte, SpreadCoin, Zenswap Network Token, Moontography, Neuromorphic.io, SparksPay, Tourist Token, AmsterdamCoin, MktCoin, BowsCoin, EDRCoin, Yearn Finance Bit, GravityCoin, iBTC, BLAST, Atheios, TravelNote, Bitcoin Adult, Donu, SCRIV NETWORK, Havy, YoloCash, ImageCash, Knekted, PolypuX, Californium, Acoin, Bitcoin Token, Datacoin, Boolberry, HyperQuant, Ultragate, Eurocoin, Zealium, Dollarcoin, Arepacoins, Spectrum, Nyerium, SkyHub Coin, GoHelpFund, Luna Coin, Bonpay, Thore Cash, MustangCoin, SongCoin, ARbit, Gossip Coin, Kemacoin, Gold Poker, BitCoal, Ignition, WXCOINS, Litecred, Apollon, Kalkulus, Mobile Crypto Pay Coin, MarteXcoin, APR Coin, SafeCapital, Semux, Martkist, Panda Yield, Neutron, DistX, Rigel Finance, Prime-XI, Blakecoin, Independent Money System, IFX24, Cabbage, SovranoCoin, Exosis, Quebecoin, CCUniverse, Dash Green, Electrum Dark, Veltor, CREDIT, PAXEX, Vivid Coin, Comet, VectorAI, Italo, ROIyal Coin, PLNcoin, SpeedCash, Ragnarok, SocialCoin, High Voltage, STRAKS, iBank, Streamit Coin, Guider, Nekonium, Newton Coin Project, Dinero, Cannation, Wild Beast Block, XDNA, Simple Software Solutions, Coinonat, Compound Coin, Diligence, Iconic, Save and Gain, MNPCoin, Galactrum, MoX, Bulleon, PlatinumBAR, Storeum, SONO, Staker, PonziCoin, Innovative Bioresearch Classic, GET Protocol, PRIZM, SAFE DEAL, Lendefi, Bitcoin, Tether, XRP, Helium, Powerledger, </p>
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	Strike, Kava Lend, MixMarvel, MANTRA DAO, PERL.eco, GNY, Era Swap, ELYSIA, PolkaBridge, Polkamarkets, ROOBEE, CoverCompared, Stream Protocol, ILCOIN, TrueFeedBack, ACA Token, Streamity, Ink, Smartshare, Auxilium, Savix, Crypto Kombat, Natmin Pure Escrow, DraftCoin, FUTURAX, Concoin, PECULIUM (old), PARSIQ, Hiblocks, Coreto, Verso, Cryptonovae, Graft, BoatPilot Token, Klimatas
<b>5</b>	Other cryptocurrencies



Table A.2 Clustering all cryptocurrencies on 01-January-2022 using Market Cap, Volume 24h, Num Market Pairs, Percent of Total Supply Circulating, Total Value Locked, Staking Reward, Total Staking Percentage, and Whales Percentage while skipping any cryptocurrency that have at least one missing value

Cluster #	Cryptocurrencies
1	Ethereum
2	Wabi
3	Olympus v2
4	Polygon, Axie Infinity, Aave, The Graph, yearn.finance, IoTeX, SushiSwap, 0x, SwissBorg, Ontology, Cartesi, Dusk Network, Origin Protocol, Illuvium, Orbs, API3, IDEX, Akropolis, NULS, Bytom, Fusion, Dock, Remme, Bela, Livepeer, DODO, Fantom, Sentinel, Neutrino USD, Atomic Wallet Coin, Band Protocol, Curve DAO Token
5	BNB, Solana, Cardano, Polkadot, Avalanche, Cosmos, Internet Computer, Elrond, Tezos, Flow, Kusama, Oasis Network, Waves, Mina, Secret, Decred, WAX, Kava, Synthetix, SKALE Network, Hive, Phantasma, Persistence, Akash Network, Divi, Ark, Telos, PEAKDEFI, Switchero, e-Money, Hydra, Particl, Peercoin, ChainX, Callisto Network, Tachyon Protocol, Minter Network, Blocknet, OKCash, Veil, Datamine, Rapids, Tendies, Savix, FireStarter, Terra, Lisk, Wagerr, Unification, Stake DAO, Starname, NEAR Protocol, IRISnet, CertiK, v.systems, HTMLCOIN, DeFiChain, Mirror Protocol, LTO Network, Stafi, Harmony, PIVX, Stacks, Zilliqa, Beefy Finance, Nexus, Tritium, Bitcoin Green, Algorand, PancakeSwap, Ardor, Edgeware, Phore, TokenPay, Pinkcoin, Crypto.com Coin, TRON, THORChain, IOST, TomoChain, Aion, FLETA, ReddCoin, Nxt, BlackCoin, CloakCoin, EOS, Celo, NEM, 1inch Network, Qtum, ICON, COTI, HEX, Kyber Network Crystal v2, STAKE, Energi, MANTRA DAO, InsurAce, Validity, Navcoin, Neblio, Enecuum, ChangeNOW Token, SmartCash, Wanchain, Thorstarter, Kalamint

Table A.3 Clustering the cryptocurrencies using Market Cap, Volume 24h, Num Market Pairs, Percent of Total Supply Circulating on 1-January-2022

Cluster #	Cryptocurrencies
1	Bitcoin, Tether
2	Solana, Avalanche, NEAR Protocol, Uniswap, Stellar, Ethereum Classic, Arweave, Nexo, Compound, SushiSwap, WAX, Dogelon Mars, Perpetual Protocol, Telcoin, Synthetix, UMA, Celer Network, NuCypher, Fetch.ai, DigitalBits, Energy Web Token, aelf, Status, Convex Finance, DeFiChain, yOUCash, Metahero, Keep Network, Rocket Pool, Persistence, Orbit Chain, Sun (New), KardiaChain, Sologenic, Numeraire, Badger DAO, SOMESING, IDEX, Syntropy, ABBC Coin, QuarkChain, IRISnet, Terra Virtua Kolekt, Dero, Solanium, CertiK, DerivaDAO, HUNT, BarnBridge, Freeway Token, Cortex, KeeperDAO, Hacken Token, district0x, FIO Protocol, Bluzelle, Mobius, Revolution Populi, CONUN, Newscrypto, Aurox, Assemble Protocol, NFTX, Adshares, Gas, PlanetWatch, FirmaChain, v.systems, MileVerse, ForTube, Unifi Protocol DAO, MATH, pNetwork, Super Zero Protocol, KARMA, ZEON, Ultiledger, MetaPets, VideoCoin, Exeedme, Student Coin, GMCoin, DxChain Token, ASTA, Gameswap, SparkPoint, Doge Dash, Nash, Numbers Protocol, Opacity, Life Crypto, Medacoin, Poolz Finance, TE-FOOD, APY.Finance, UniCrypt, Arcblock, Aventus, Lamden, Lith Token, Huobi Pool Token, Gate, TrustVerse, Finxflo, DEEPSPACE, ExNetwork Token, Lightning, AnRKey X, ZeroSwap, MicroPets, BaaSid, Florin, Eden, Dotmoovs, Jigstack, Binamon, APIX, Mysteryum, DeFi Yield Protocol, RocketX, Plian, LuaSwap, UniLayer, Nafter, Hakka.Finance, WOWswap, ClinTex CTi, Raze Network, CumStar, Ripio Credit Network, CyberVein, Rhythm, Big Data Protocol, ZBG Token, GENRE, NANJCOIN, INT, HashBX, Egretia, DeFi Degen Land, Crust Shadow, Carbon, HitChain, Conceal, THEKEY, Tycoon, PhoenixDAO, Open Platform, Ruff, Fatcoin, Lightning Bitcoin, Unitrade, Medicalchain, MIR COIN, Amon, AtromG8, Global Social Chain, Props Token, Bitspawn, Jade Currency, Howdoo, UnlimitedIP, Digitex, REVIVAL, Lead Wallet, Royale Finance, Dragon Kart, PIXEL, Moneytoken, Spectre.ai Utility Token, XMax, KanadeCoin, Atlas Protocol, NFTLootBox, Ravencoin Classic, DAV Coin, eosDAC, Primas, FlypMe, WeOwn, Equal, Digital Fitness, TotemFi, Nuco.cloud, RED, Zoracles, The Corgi of PolkaBridge, Dynamix, Bob's Repair, Origo, Fera, Parachute, PayPie, Motocoin, Debitum, Faceter, OLXA, Beaxy, Project Inverse, ContentBox, Delphy, Atmos, AstroTools, DAOventures, XcelToken Plus, Freicoin, Pancake Bunny, IXT, NativeCoin, Hush, HYCON, Zeepin, Catex Token, Blue Whale EXchange, MoonTools, MMOCoin, MODEL-X-coin, SmileyCoin, Niobium Coin, EtherGem, AiLink Token, MemeCoin Factory, SOAR.FI, HOQU, Qrkita Token, DeFi Bids, Heron Asia, Rapids, Energo, Themis, Collective, PoSW Coin, Webflix Token, Boosted Finance, CoinAlpha,

	<p>BitWhite, Membrana, Infinity Esaham, Ormeus Cash, Island Coin, Opus, Blocktix, Startcoin, Devery, Coin2.1, Gravity, BitRewards, IQ.cash, Bridge Protocol, Plus-Coin, Dynamite, Kush Finance, Ether Kingdoms Token, Zenswap Network Token, Moontography, AmsterdamCoin, MktCoin, Yearn Finance Bit, SCRIV NETWORK, YoloCash, Knekted, PolypuX, GoHelpFund, Bonpay, Thore Cash, DistX, Italo, STRAKS, Nekonium, MNPCoin, Neo, Chiliz, Swipe, MediBloc, Orchid, Civic, Symbol, Akash Network, Humanscape, BakeryToken, HyperDAO, Safe, Proton, Sport and Leisure, Standard Tokenization Protocol, RFOX, Ampleforth Governance Token, Position Exchange, Measurable Data Token, BOSAGORA, DEXTools, ProximaX, Wing Finance, Ariva, BEPRO Network, TEMCO, Banano, K21, Sonar, Ambrosus, Raiden Network Token, Morpheus Labs, DuckDaoDime, Modifi, 0xBitcoin, SALT, TFL.io, Bird.Money, Rotharium, Graphlinq Protocol, Idena, Insights Network, Kambria, MASQ, LiquidApps, HTMLCOIN, VINchain, 8PAY, SmartCash, Education Ecosystem, Shadows, Feathercoin, SIMP Token, Eminer, yieldwatch, Mcashchain, Skrumble Network, MediShares, SEEN, DFSocial Gaming, SureRemit, xSigma, ChatCoin, Patientory, Azbit, Electrify.Asia, Naka Bodhi Token, QUINADS, Arqma, NeuroChain, PirateCash, ION, Qbao, Shadow Token, Alt.Estate token, JustBet, Solaris, Maecenas, Tokenbox, Innova, XTRABYTES, YVS.Finance, ZPER, Block-Logic, Yocoin, BitCash, Bitradio, ZeusNetwork, ArbitrageCT, Kind Ads Token, Halving Token, Neuromorphic.io, IGTToken, Semux, Rigel Finance, PAXEX, Polygon, VeChain, BORA, SKALE Network, CEEK VR, OriginTrail, JUST, Propy, PEAKDEFI, Aergo, Moss Coin, WHALE, Shiden Network, Maro, RChain, Tellor, Smartlands Network, New BitShares, Quantstamp, LBRY Credits, BIDR, Nitro Network, JulSwap, Venus Reward Token, DECOIN, BnkToTheFuture, SuperLauncher, High Performance Blockchain, HorusPay, Vexanium, MakiSwap, Scala, BlackHat, Hydro, MoonTrust, LocalCoinSwap, CoinFi, OneRoot Network, Vox.Finance, GoNetwork, MidasProtocol, Chi Gastoken, Cosmo Coin, Worldcore, Bionic, Bitnation, Innovative Bioresearch Classic, Bitcoin Standard Hashrate Token, Alchemix, GXChain, XeniosCoin, Telos, LTO Network, ARPA Chain, Valobit, BUX Token, Santiment Network Token, Oxbull.tech, Ignis, Decentral Games ICE, Growth DeFi, Cappasity, Unistake, Bismuth, Cajutel, Tripio, SakeToken, Global Cryptocurrency, Depth Token, megaBONK, CUE Protocol, Exosis, Quebecoin, Dusk Network, Spell Token, JOE, Vectorspace AI, Splintershards, Frontier, Kryll, Gifto, BASIC, Nestree, Mogul Productions, OAX, WebDollar, carVertical, Lanceria, UniMex Network, CryptoZoon, Vipstar Coin, Bitgear, Ceres, MotaCoin, ATBCoin, Eroscoin, Donu, Newton Coin Project, Secret, Zilliqa, WhiteCoin, Presearch, LCX, Swarm, FLETA, Vesper, O3 Swap, Niftyx Protocol, SpaceChain, CHADS VC, SYNC Network, BankerDoge, Neurotoken, Avaxtars Token, Zebi Token, Base Protocol, LunchMoney, UpToken, HeroFi (ROFI), FantasyGold, Cryptrust, Decentralized Asset Trading Platform,</p>
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	<p>Cosmos, Nebulas, Kromatika, Obyte, TrueChain, FairGame, Pawthereum, Float Protocol (Bank), CyberMiles, Reward Hunters Token, Lendingblock, BOOM, Odyssey, Add.xyz, Aryacoin, eXPerience Chain, GeoCoin, smArt Gallery, Universal Currency, EDRCoin, Kleros, BinaryX, Project WITH, Vidya, Asch, CyberFi Token, UpBots, AXPR, Essentia, ADAMANT Messenger, Sharder, Substratum, Truegame, Staker, Ankr, RSK Infrastructure Framework, PolySwarm, Thunder Token, Elastos, MCDEX Token, GoCrypto Token, Cashaa, Vanilla Network, e-Gulden, DAOstack, OtterClam (New), Vetri, Ether Zero, Ronin Gamez, Xuez, Dinero, Litecoin, Quant, Decentralized Social, Hoo Token, Ooki Protocol, ICHI, DeHub, TokenClub, Lympo, Evedo, CVCoin, Expanse, EUNOMIA, Tourist Token, Decentraland, Storj, Mdex, Ark, Travala.com, CryptoBlades, pEOS, RMPL, Netrum, Crypto.com Coin, Nervos Network, Wolf Safe Poor People (Polygon), Datarius Credit, Ryoshi Token, CannabisCoin, HeartBout, Scanetchain, Aave, Xaya, Binemon, Ubex, Ethereum Gold, FuzeX, Metadium, Selfkey, Zano, Crypterium, TERA, Kurrent, Enjin Coin, 0x, ASD, Helmet.insure, Monolith, Rakon, NaPoleonX, CryptEx, Lunyr, BitCapitalVendor, Coinonat,</p>
3	<p>Ethereum, BNB, USD Coin, Cardano, Polkadot, Dogecoin, Shiba Inu, Binance USD, Wrapped Bitcoin, TerraUSD, Dai, Algorand, Fantom, Bitcoin Cash, TRON, Bitcoin BEP2, Filecoin, Elrond, Theta Network, Harmony, Monero, Tezos, UNUS SED LEO, IOTA, PancakeSwap, EOS, Stacks, BitTorrent, Kusama, THORChain, Loopring, Maker, Bitcoin SV, Zcash, eCash, Basic Attention Token, Waves, Dash, TrueUSD, yearn.finance, Holo, NEM, Ravencoin, IoTeX, Pax Dollar, Theta Fuel, OMG Network, Velas, Bancor, Decred, Livepeer, Qtum, renBTC, ICON, Voyager Token, Kava, Syscoin, Horizen, Revain, Siacoin, Flux, Bitcoin Gold, SwissBorg, Ontology, IOST, Neutrino USD, Hive, Ren, Ocean Protocol, DigiByte, Polymath, Chromia, Golem, Nano, Fei USD, Dent, WINKLink, XYO, Aragon, Phantasma, PAX Gold, Keep3rV1, Function X, Request, Chrono.tech, Lisk, Reef, VeThor Token, Verge, Conflux, iExec RLC, Bitcoin Diamond, Ardor, NKN, Polkastarter, Lido stETH, BitTorrent (new), Wrapped BNB, Frax, Huobi BTC, Counos X, Venus BNB, LINK, NXM, Liquity USD, UFO Gaming, HUSD, Rari Governance Token, OpenDAO, Origin Dollar, Starlink, RMRK, Kyber Network Crystal v2, Pundi X (New), Sapphire, XSGD, Unibright, StormX, Venus BTC, Tether Gold, Prometheus, Divi, Stratis, Circuits of Value, Augur, Pirate Chain, Utrust, Electroneum, SingularityNET, MaidSafeCoin, MXC, CRYPTO20, Steem, Gemini Dollar, Dawn Protocol, Handshake, Venus ETH, Centrality, Ergo, DeFi Pulse Index, Aavegotchi, TomoChain, Enzyme, Biswap, USDX [Kava], Ellipsis, Metal, TrustSwap, Ampleforth, FUNToken, STASIS EURO, Decentral Games, sUSD, Wanchain, Everipedia, RichQUACK.com, DFI.Money, STAKE, Adventure Gold, Celo Dollar, Venus USDC, Zenon, ScPrime, BitShares, SpiritSwap, ankrETH, ssv.network, Beefy Finance, Wrapped NXM, Alpha Quark Token, Harvest Finance, Komodo, MimbbleWimbleCoin, ONUS, Hifi</p>

Finance, Rai Reflex Index, Streamr, TROY, Loom Network, GMT Token, MARINADE STAKED SOL, Carry, Haven Protocol, TokenPocket, MonaCoin, cVault.finance, Alpaca Finance, Civilization, Akropolis, Ambire AdEx, Morpheus.Network, Darma Cash, TABOO TOKEN, Venus XVS, ApeSwap Finance, NULS, Sentinel Protocol, Rainicorn, Aion, EverRise, Smooth Love Potion, Waltonchain, Firo, Hoge Finance, Refereum, Vai, Venus BUSD, Energi, Metronome, Bytom, Glitch, CargoX, Groestlcoin, Flamingo, Mithril, Beam, Steem Dollars, Fusion, YIELD App, LATOKEN, DigixDAO, Dego Finance, Apollo Currency, Bread, Edgeware, Bytecoin, Sentivate, Polkadex, Bounce Finance Governance Token, Burger Swap, Switcheo, AMO Coin, Aeternity, Dock, PAC Protocol, SORA, VerusCoin, BTU Protocol, mStable USD, Mirrored iShares Gold Trust, Aragon Court, AnimalGo, Invictus Hyperion Fund, VIDT Datalink, Wirex Token, DogeBonk, LikeCoin, PIVX, GoChain, Mirrored ProShares VIX, Epic Cash, Galaxy Heroes Coin, AstroSwap, WaykiChain, Nimiq, Venus USDT, Neutrino Token, TerraKRW, Oxen, Auto, Electra Protocol, ReddCoin, Cellframe, Nexus, Reserve, Peony, USDK, BLOCKv, The Midas Touch Gold, Namecoin, BABB, Vertcoin, EpiK Protocol, GameZone, Counterparty, GameCredits, Soda Coin, Unisocks, POA Network, Rubic, Ferrum Network, saffron.finance, ADAPad, Muse, CUTcoin, GYEN, DSLA Protocol, Dragonchain, Validity, Particl, Mint Club, Grin, #MetaHash, Bankera, Peercoin, Belt Finance, Lotto, Spartan Protocol, Navcoin, Curate, ChainX, HAPI, BitKan, KCCPAD, HyperCash, Neblio, UBIX.Network, Wabi, unFederalReserve, Infinity PAD, Cindicator, Ondori, BigONE Token, Shopping, Pickle Finance, Internxt, CoinMerge (ERC20), WOOF, Mirrored Invesco QQQ Trust, IQeon, Mirrored Apple, Venus SXP, Callisto Network, Goldcoin, SafeCoin, Degenerator Meme, Mirrored iShares Silver Trust, Infinitecoin, RING X PLATFORM, USDJ, Pacoca, Factom, Mirrored Tesla, Minter Network, ETHPad, CumRocket, 88mph, Phoenix Global (new), Mirrored Microsoft, FREEdom Coin, Quantum Resistant Ledger, Mirrored Amazon, Bitcoin 2, EOS Force, RioDeFi, FIBOS, Mirrored Alibaba, CoinPoker, Pundi X NEM, Metaverse ETP, Venus LINK, Venus LTC, DOGGY, Tranche Finance, Safex Token, Nxt, Mirrored United States Oil Fund, Birake, Aidos Kuneen, Stakenet, Mirrored Netflix, SafeMoon Inu, STARSHIP, Wagerr, Enecuum, Dovu, Phantasma Energy, Vidulum, Tokenomy, Signum, SONM (BEP-20), Global Coin Research, Covesting, Unicly CryptoPunks Collection, Mirrored Twitter, YF Link, Receive Access Ecosystem, Tiger King, TenX, Monetha, GAMB, YUMMY, Venus DOT, Swop, Green Ben, Litecoin Cash, Moeda Loyalty Points, ZooKeeper, PECULIUM (old), Empty Set Dollar, Rainbow Token, FortKnoxster, Genaro Network, AMLT, Rupiah Token, CoinMerge (BEP20), YUSRA, Pepe Cash, 1-UP Platform, Diamond, Viberate, VIBE, Digix Gold Token, Carboncoin, Chainge, Blocknet, StakeCubeCoin, NFT Index, Wownero, All Sports, Project Pai, Hiveterminal Token, Gulden, Onooks, Venus DAI, Skycoin, CACHE Gold, EvidenZ, Einsteinium, Ubiq,

Cyclone Protocol, Credits, BOX Token, Monavale, VestChain, Achain, Ghost, Metrix Coin, S4FE, HEROCoin, xRhodium, YAM V3, Crypton, BOLT, Polis, Unicly Hashmasks Collection, bitCNY, Hedget, Massnet, Breezecoin, DeepOnion, Swerve, Xfinance, OctoFi, EUNO, Monero Classic, Iconic Token, BitcoinZ, Quark, Whiteheart, BillionHappiness, Spore, NewYorkCoin, Dynamic, KickToken, Gridcoin, ColossusXT, Etho Protocol, 42-coin, Rune Shards, Cred, MoonSwap, OTOCASH, Safex Cash, Loser Coin, VIDY, SIRIN LABS Token, SunContract, Viacoin, Ycash, Trittium, Garlicoin, ASKO, Edgeless, IoT Chain, Redpanda Earth, 1World, Aeon, CRD Network, Public Index Network, Elamachain, disBalancer, FYDcoin, Unicly Mystic Axes Collection, AGA Token, Time New Bank, TurtleCoin, xSuter, Teloscoin, Rune, BitCore, QuickX Protocol, TransferCoin, Inex Project, EOSDT, NextDAO, eBoost, EXRNchain, X-CASH, Emercoin, Treat DAO [old], BlackCoin, Ditto, SHIBAVAX, Primecoin, Governor DAO, LinkEye, OST, SoMee.Social [OLD], PWR Coin, Master Contract Token, Neural Protocol, Sumokoin, Mind Music, STATERA, Xensor, CryptoFranc, WePower, Davinci Coin, Dimecoin, Bean Cash, Xaurum, yAxis, Wolf Safe Poor People, Auctus, 1X2 COIN, Myriad, DigitalNote, Genesis Vision, PotCoin, AMEPAY, World Token, adbank, AppCoins, Curecoin, CloakCoin, Perth Mint Gold Token, FujiCoin, EarnX, SnowSwap, PANTHEON X, 8Bit Doge, Wings, Golff, BitcoinHD, iEthereum, Omni, HempCoin, Denarius, Stealth, PEPS Coin, Antiample, TurtleNetwork, MarsX, USDx [Lighthouse], Ethereum Gold Project, Doki Doki Finance, FintruX Network, ZUSD, Ryo Currency, Karbo, Ixcoin, Lethean, Basis Cash, Krios, Humaniq, Cheems, I/O Coin, Venus BCH, Name Change Token, Waves Community Token, Polyient Games Governance Token, Cornichon, PieDAO DEFI++, OKCash, Bitcoin Plus, Bezant, BOMB, CoTrader, ADA BOY, Non-Fungible Yearn, Veil, Patron, Argon, Phore, Multiplier, SINOVATE, The ChampCoin, LanaCoin, Lobstex, Bitcoin Atom, Modern Investment Coin, Signature Chain, Step Finance, MONK, Spaceswap MILK2, Upfiring, Memetic / PepeCoin, Origin Sport, StakedZEN, ZClassic, Blockchain Cuties Universe Governance, Bitswift, Scorum Coins, Relite Finance, TokenPay, Hashgard, VeriCoin, BitTube, Netbox Coin, Kangal, WeTrust, X8X Token, MonetaryUnit, Pinkcoin, Phoenixcoin, Pepemon Pepeballs, Endor Protocol, ChessCoin, Keep4r, 1Million Token, MicroBitcoin, Crown, DMarket, GHOSTPRISM, Typerium, MyWish, U Network, DATA, ShipChain, Everex, ATLANT, Litex, Banca, Node Runners, MobileGo, Seigniorage Shares, Wrapped Gen-0 CryptoKitties, Remme, BeatzCoin, DAPS Coin, Digital Reserve Currency, Omnitudo, Oikos, CryptoSoul, Terracoin, VIG, Dracula Token, Dogeswap, SophiaTX, 0xcert, TetraHedra, Coinsbit Token, Golos Blockchain, \$LONDON, Dether, Orbitcoin, Spaceswap SHAKE, Pascal, Pigeoncoin, Chonk, PetroDollar, Donut, NIX, bAlpha, iDealCash, yTSLA Finance, Orient Walt, ZumCoin, BUZZCoin, ESBC, Rise, Minereum, Qwertycoin, NuShares, EDUCare, Maincoin, Kobocoin, renDOGE, Nexalt, Limitless



VIP, Datamine FLUX, Bitcoin Confidential, Beacon, IHT Real Estate Protocol, Trollcoin, Sether, Power Index Pool Token, Etherparty, FairCoin, Woodcoin, Maxcoin, LYNC Network, Pylon Finance, CoinDeal Token, Iridium, Azuki, Xiotri, ZrCoin, Zennies, CafeSwap Token, AudioCoin, NFTX Hashmasks Index, TENT, Curio, Bitcoin Green, Emerald Crypto, Nerva, Titan Coin, Actinium, Ink Protocol, Aitra, Wrapped Basic CryptoKitties, CryptoBonusMiles, StrongHands, Novacoin, PluraCoin, DogeCash, GoldenPyrex, Blockmason Credit Protocol, Bitgesell, Tornado, ATC Coin, Stox, Blockburn, Zero Utility Token, Waifu Token, Swarm City, Masari, AidCoin, Blizzard Network, Pakcoin, Playkey, EDC Blockchain, Chronologic, Swap, KnoxFS (New), MetaMorph, Cryptonite, DoYourTip, Yearn Secure, Goose Finance, Molecular Future, DopeCoin, uPlexa, Netko, Synergy, HEAT, SIBCoin, ExclusiveCoin, Peseta Digital, Agrello, DOGEFI, CREA, Squirrel Finance, Phoneum, BitcoinPoS, reflect.finance, Swing, Stipend, Switch, GoByte, Birdchain, BlueCoin, BiblePay, PlayGame, Bitstar, TrezarCoin, GlobalBoost-Y, Po.et, Unicly Chris McCann Collection, PengolinCoin, Blue Protocol, TagCoin, CROAT, Unicly Doki Doki Collection, Decentralized Machine Learning, Escroco Emerald, 2GIVE, Zetacoin, Eternity, Noir, Ritocoin, SmartCoin (SMC), PYRO Network, Bata, Rentberry, EchoLink, Cyber Movie Chain, BZEdge, AquariusCoin, Megacoin, StrongHands Masternode, SnodeCoin, Tendies, CheesecakeSwap Token, Digitalcoin, Rubies, Cryptojacks, SORA Validator Token, Scrypta, Aeron, PKG Token, Connectome, x42 Protocol, Meridian Network, ZCore, Wrapped Virgin Gen-0 CryptoKitties, LUXCoin, Rate3, Zilla, Cubiex, Innovative Bioresearch Coin, Decentrahub Coin, ICE ROCK MINING, ANON, MicroMoney, MojoCoin, Crypto Sports, Anoncoin, Evil Coin, InsaneCoin, SHIELD, NestEGG Coin, Fireball, Transcodium, JavaScript Token, Gaj Finance, Phantomx, AllSafe, Bolivarcoin, Beetle Coin, DMScript, GoldBlocks, Bitblocks, Helix, Opal, YENTEN, Akroma, PayCoin, Rope, BitcoiNote, PAYCENT, AI Doctor, Bitcloud, Litecoin Plus, ITO Utility Token, DecentBet, UBU Finance, Sociall, EnterCoin, Defis, Cheesecoin, NevaCoin, SafeInsure, NFX Coin, Unicly Genesis Collection, SwiftCash, InvestFeed, Axe, ImageCoin, Gentarium, SiaCashCoin, GCN Coin, SteepCoin, Arbidex, PegNet, Payfair, BitBlocks Finance, WABnetwork, BLOC.MONEY, CyberMusic, Rupee, Fivebalance, SuperCoin, BitSend, EvenCoin, Dreamcoin, Micromines, Waletoken, ALL BEST ICO, FNB Protocol, Bela, GlobalToken, Herbalist Token, Civitas, ProxyNode, GuccioneCoin, Privatix, SF Capital, Photon, Nasdacoin, VoteCoin, BTC Lite, ParallelCoin, Merebel, PostCoin, PureVidz, Ratecoin, Energycoin, MyBit, FidexToken, Yield Stake Finance, Arion, ELTCOIN, Onix, ICOBID, Global Currency Reserve, CashHand, Digital Money Bits, StarterCoin, Mchain, commercium, BBSCoin, Unify, Theresa May Coin, Adzcoin, PosEx, BackPacker Coin, Bitcoin Incognito, Grimm, Desire, Veles, Cream, MedicCoin, Digiwage, CaluraCoin, ETHplode, Castle, FuzzBalls, Paypex, GenesisX, Bitcoin CZ,

	<p> DNNotes, XOVBANK, Carebit, HyperAlloy, Centurion, Citadel, TajCoin, AceD (old), BERNcash, FUZE Token, Provoco Token, Impleum, Narrative, CPUchain, Pyrk, Zayedcoin, X-Coin, GeyserCoin, Fox Trading, Bitcoin Zero, ParkByte, SpreadCoin, SparksPay, BowsCoin, GravityCoin, iBTC, BLAST, Atheios, TravelNote, Bitcoin Adult, Havy, ImageCash, Aigang, Californium, Acoin, Bitcoin Token, Datacoin, Boolberry, HyperQuant, Ultragate, Eurocoin, Zealium, Dollarcoin, Arepaco, Spectrum, Nyerium, SkyHub Coin, Luna Coin, MustangCoin, SongCoin, ARbit, Gossip Coin, Kemacoin, Gold Poker, BitCoal, Ignition, WXCoin, Litecred, Apollon, Kalkulus, Mobile Crypto Pay Coin, MarteXcoin, APR Coin, SafeCapital, Martkist, Panda Yield, Neutron, Prime-XI, Blakecoin, Independent Money System, IFX24, Cabbage, SovranoCoin, CCUniverse, Dash Green, Electrum Dark, Veltor, CREDIT, Vivid Coin, Comet, VectorAI, ROIyal Coin, PLNcoin, SpeedCash, Ragnarok, SocialCoin, High Voltage, iBank, Streamit Coin, Guider, Cannation, Wild Beast Block, XDNA, Simple Software Solutions, Compound Coin, Diligence, Iconic, Save and Gain, Galactrum, MoX, Bulleon </p>
4	<p> Axie Infinity, Klaytn, Flow, Gala, Kadena, OKB, Gnosis, Toncoin, ECOMI, Frax Share, Anchor Protocol, Ethereum Name Service, Anyswap, Coin98, MOBOX, DAO Maker, Wilder World, PlatON, MX TOKEN, Seedify.fund, Orbs, BioPassport Token, Throne, Alien Worlds, Sovryn, DeversiFi, Veracity, Voxies, Mirror Protocol, Clover Finance, SafePal, Balancer, Zelwin, AllianceBlock, Toko Token, ZB Token, dKargo, Tranchess, Automata Network, Kin, Cratos, Shapeshift FOX Token, Fuse Network, Rarible, Karura, Cobak Token, ZKSwap, Bittrue Coin, StarTerra, PolkaFoundry, Stratos, Cream Finance, Hegic, Marlin, Ternoa, Hot Cross, Manchester City Fan Token, S.S. Lazio Fan Token, Zigcoin, Hamster, Tarot, vEmpire DDAO, Dacxi, Xeno Token, e-Money, Hydra, NEST Protocol, FC Porto Fan Token, HoDooi.com, FaraLand, Darwinia Network, Etherisc DIP Token, 0Chain, Convergence, Newton, dHedge DAO, Deri Protocol, Skey Network, SHPING, DAFI Protocol, Atletico De Madrid Fan Token, Seascope Crowns, ProBit Token, mStable Governance Token: Meta (MTA), Kattana, LABS Group, Sylo, Trabzonspor Fan Token, Kryptomon, Dogs Of Elon, apM Coin, Linker Coin, AS Roma Fan Token, ARMOR, BiFi, Razor Network, Graviton, ThreeFold, Chronicle, BlockBank, AXIS Token, Bitcoin Private, Revolve Games, PieDAO DOUGH v2, ALLY, VeriDocGlobal, Shard, Metaverse Dualchain Network Architecture, IG Gold, Kalata, Ares Protocol, Tokes, ODIN PROTOCOL, Adora Token, OceanEx Token, Valencia CF Fan Token, Kineko, BLink, DAEX, Kaby Arena, VAULT, Peanut, Genesis Worlds, APYSwap, WinStars.live, YOU COIN, DMM: Governance, B-cube.ai, Omlira, Honest, Clube Atlético Mineiro Fan Token, ParkinGo, Snetwork, Tadpole Finance, YFDAI.FINANCE, Mochi Market, Bunicorn, Tapmydata, SafeBlast, İstanbul Başakşehir Fan Token, Chainswap, Sint-Truidense Voetbalvereniging Fan Token, TheForce Trade, Natus Vincere Fan Token, Nuggets, BitScreener Token, Rublix, Gourmet Galaxy, Young </p>

	<p>Boys Fan Token, Ethverse, Swace, WorkQuest Token, Professional Fighters League Fan Token, GoWithMi, Shield Protocol, SparkPoint Fuel, Alliance Fan Token, DPRating, Jarvis+, Starbase, Skyrim Finance, Yield Protocol, Arata, Lepricon, Hertz Network, Font, keyTango, AFEN Blockchain, NeoWorld Cash, Digital Insurance Token, Phoenix Token, Pivot Token, Indorse Token, Ethereum Yield, IONChain, UGAS, GoldMint, MesChain, BITTO, Datamine, Blockpass, Zeusshield, Melalie, Alphr finance, Novara Calcio Fan Token, Finminity, CryptoFlow, SkinCoin, MEET.ONE, DINGO TOKEN, Ormeus Coin, Gene Source Code Chain, Showcase, Bigbom, Secure Pad, LassoCoin, Baguette Token, MoneroV , ZINC, Ccore, Bitcashpay (old), Feellike, Celeum, Sparkle Loyalty, Asura Coin, FinNexus, Argus, OREO, Curve DAO Token, 1inch Network, WOO Network, APENFT, GateToken, Moonriver, Ultra, Casper, Dvision Network, HEX, MobileCoin, Hathor, Mask Network, GlitzKoin, Radicle, inSure DeFi, Bifrost (BFC), Ontology Gas, Uquid Coin, Beta Finance, CUDOS, Phala Network, Strong, SIX, BitMart Token, AirSwap, SingularityDAO, Quiztok, Lattice Token, Visor.Finance, Valor Token, Juggernaut, Revomon, Pawtocol, Dfyn Network, Tachyon Protocol, Pallapay, Ispolink, NerveNetwork, TriumphX, Anchor Neural World, Lambda, Furucombo, Gather, Zynecoin, Swingby, EasyFi, Hord, Idle, Olyseum, TOP, Hyve, SaTT, PolkaWar, OG Fan Token, AAX Token, DEXA COIN, Folgory Coin, Autonio, UREEQA, Burency, Portion, DiFy.Finance, TradeStars, Polkalokr, Curio Governance, Link Machine Learning, Acute Angle Cloud, TOKPIE, SonoCoin, DRIFE, AICHAIN, ODUWA, Insured Finance, KeyFi, Unification, Gravity Finance, Tolar, Manna, Graviocoin, Berry Data, Plair, Q DAO Governance token v1.0, Green Satoshi Token, Kuende, VNT Chain, Defis Network, Apollon Limassol, HashCoin, DACSEE, FansTime, BarterTrade, Wolves of Wall Street, ZeuxCoin, SBank, Deutsche eMark, Italian Lira, Matrexcoin, Lition, BidiPass, Fire Lotto, Arionum, FirstCoin, Shivers, Aeryus, Bitvolt, The Sandbox, Huobi Token, XDC Network, WazirX, MyNeighborAlice, Constellation, Boba Network, KILT Protocol, Linear, DeRace, AIOZ Network, Klever, Boson Protocol, QuickSwap, Litentry, DIA, Pangolin, Maple, DXdao, MahaDAO, UniLend, AntiMatter Governance Token, FOAM, Wall Street Games, DeepBrain Chain, Govi, Public Mint, OIN Finance, Duck DAO (DLP Duck Token), Matrix AI Network, Vabble, LOCGame, Pillar, Zenfuse, Crownny, 2crazyNFT, PERI Finance, PlotX, Etherland, Lucid Lands, PolkaDomain, Yellow Road, 4THPILLAR TECHNOLOGIES, ETHA Lend, Heart Number, Coin Artist, VikkyToken, BonFi, DeHive, Mrweb Finance, Silver Stonks, Trinity Network Credit, 2local, CorionX, EtherInc, MenaPay, Golden Goose, KoHo Chain, TRAXIA, Aditus, Alchemint Standards, Hedera, Oasis Network, Celsius, Band Protocol, Everscale, Braintrust, Trust Wallet Token, HedgeTrade, Decentral Games [Old], Centrifuge, API3, Aleph.im, Saito, Contentos, Unify, AXEL, PowerPool, StackOs, dForce, ZIMBOCASH, Lossless, ShareToken, ChainGuardians, MultiVAC, Smart MFG, QASH, Router Protocol, Signata,</p>
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	<p>Safe Haven, Galatasaray Fan Token, CWV Chain, Leverj Gluon, Equalizer, Blockzero Labs, Bibox Token, Trumpcoin, Snowball, QChi, MintMe.com Coin, VNX, LINKA, 8X8 PROTOCOL, HeroFi, Bobo Cash, ZENZO, Fluity, DFSocial Gaming [old], OptiToken, Renewable Electronic Energy Coin, Cryptobuyer, Celo, Origin Protocol, Render Token, YooShi, Alchemy Pay, Wrapped NCG (Nine Chronicles Gold), Bloomzed Loyalty Club Ticket, TrueFi, AVINOC, bZx Protocol, SifChain, Tokenlon Network Token, Observer, Polychain Monsters, suterusu, Nord Finance, King Shiba, Konomi Network, Databroker, CBC.network, Bonded Finance, BHPCoin, The Crypto Prophecies, Impossible Finance, Effect Network, Footballcoin (XFC), RigoBlock, CPChain, Game.com, Flixxo, Smaugs NFT, Falconswap, Benchmark Protocol, Aluna.Social, Rogue West, MIB Coin, SolanaSail Governance Token, Robust Token, NEXT, ZUM TOKEN, Kuai Token, EventChain, COVA, Rapidz, Elysian, Bitzeny, UChain, SuperFarm, Vulcan Forged PYR, Hxro, Venus, Cyclub, Samoyedcoin, RAMP, Drep [new], Dora Factory, MILC Platform, GamerCoin, Earneo, Cardstack, Bridge Mutual, Don-key, Blocery, Xend Finance, 1irstcoin, QLC Chain, Landshare, SwiftCoin, Horizon Protocol, PumaPay, Enigma, Color Platform, BlitzPick, Space Cow Boy, Ethereum Stake, SOTA Finance, Content Neutrality Network, Coinsuper Ecosystem Network, Sentinel Chain, SPINDLE, Uptrennd, 4NEW, The Currency Analytics, Internet Computer, FTX Token, Mina, Radio Caca, MetisDAO, Orion Protocol, Cocos-BCX, AhaToken, Levolution, Idavoll Network, NFT, Kalmar, QuadrantProtocol, ChangeNOW Token, MurAll, ACoconut, Method Finance, Penta, Cobinhood, Terra, Amp, COTI, PlayDapp, Ethernity Chain, DAD, SOLVE, BitForex Token, CONTRACOIN, Agoras: Currency of Tau, DeFiner, Cryptocean, UCA Coin, Bistroot, SmartMesh, RealTract, Cat Token, BiShares, Merculet, PHI Token, Sakura Bloom, ARAW, Injective, Alpha Finance Lab, Bitpanda Ecosystem Token, MVL, Misbloc, Dogey-Inu, Centaur, FedoraCoin, HiCoin, Kcash, Scry.info, Alphacat, Ormeus Ecosystem, Eureka Coin, Thingschain, SeChain, Tribe, BSCPAD, MovieBloc, Offshift, InsurAce, Pendle, Atari Token, Bitball Treasure, Abyss, OneLedger, Oddz, Unido EP, DinoSwap, Hydro Protocol, Raven Protocol, Caspian, Zap, Darwinia Commitment Token, Playcent, BonusCloud, DomRaider, Typhoon Network, Savix, TrustDAO, KZ Cash, Powerledger, PARSIQ, Hiblocks, Coreto, Verso, Cryptonovae, Ink, Friendz, Smartshare, Graft, BoatPilot Token, Klimatas, Chainlink, Sentinel, MixMarvel, ELYSIA, ILCOIN, Bounty0x, DraftCoin, Concoin, The Graph, KuCoin Token, Strike, ROOBEE, TrueFeedBack, ACA Token, Streamity, Auxilium, XRP, Helium, MANTRA DAO, PERL.eco, Era Swap, PolkaBridge, Natmin Pure Escrow, Audius, Bella Protocol, GNY, Polkamarkets, CoverCompared, Stream Protocol, Crypto Kombat, FUTURAX, Kava Lend, VITE, YOYOW, GET Protocol, Cryptaur, SAFE DEAL, Lendefi, Cartesi, PRIZM, Rimbit,</p>
5	Other cryptocurrencies