

Evaluating the impact of COVID-19 on the monetary crisis by machine learning

Milad Mohseni

Department of Computer Science and Engineering, Islamic Azad University, Tabriz, Iran

Article Info

Article history:

Received Feb 1, 2023

Revised Mar 4, 2023

Accepted Apr 8, 2023

Keywords:

Business interaction

COVID-19

Data mining

Machine learning

Monetary crisis

Portfolio

ABSTRACT

In this study, machine learning is examined in relation to commercial machine learning's resilience to the COVID-19 pandemic-related crisis. Two approaches are used to assess the pandemic's impact on machine learning risk, as well as a method to prioritize sectors according to the crisis's potential negative consequences. I conducted the study to determine Santander machine learning's resilience. The data mining area offers prospects for COVID-19's future. A total of 13 machine learning demos were selected for its organization. The Hellweg strategy and the technique for order preference by similarity to ideal solution (TOPSIS) technique were utilized as direct request strategies. Parametric assessment of machine learning versatility in business was based on capital sufficiency, liquidity proportion, market benefits, and share in an arrangement of openings with a perceived disability, and affectability of machine learning's credit portfolio to monetary hazard. As a result of the COVID-19 pandemic, these enterprises were ranked according to their threat. Based on the findings of the research, machine learning worked the best for the pandemic. Meanwhile, machine learning suffered the most during the downturn. It can be seen, for example, in conversations about the impact of the pandemic on developing business sector soundness and managing financial framework solidity risk.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Milad Mohseni

Department of Computer Science and Engineering, Islamic Azad University

Tabriz Branch, Tabriz, Iran

Email: stu.m.mohseni@iaut.ac.ir

1. INTRODUCTION

Coronavirus and overall pandemic, has exacerbated an all-around critical circumstance. It has affected everyone's endurance, entire social orders' lifestyle, and the working of practically all aspects of the economy. Nobody expected the outcomes of the COVID-19 emergency. Governments had the opportunity to develop satisfactory investment funds to prepare for the following emergency after over a time of high and stable data mining development. In any case, the requirement for extra guide administrations to soothe the data mining pressing factors made by the COVID-19 blast and the resulting monetary emergency has been an issue for most nations throughout the planet [1]. Non-standard money-related strategy instruments are being utilized by and by. The tremendous size of crisis business help bundles has indeed shown that the weights of ongoing monetary calamities were met by normal citizens [2]. In the interim, certain nations ability to do enormous scope help programs is decreasing. The essential driver is a serious level of obligation [3]. Administrative specialists fixed capital sufficiency governs and presented liquidity necessities, just as creating plans to prevent worldwide monetary market emergencies from reoccurring [4]. The impacts of the COVID incited constriction were not considered in pressure tests performed to quantify credit establishments

protection from monetary stuns affecting explicit nations [5]. Without the monetary framework, it is hard to get back to the pre-pandemic degrees of the data mining movement [6].

The data mining area is a fundamental part of any economy; without it, it is hard to get back to pre-pandemic degrees of monetary movement. Even though machine learnings are presently preferable promoted over they were during the earlier two monetary emergencies, which were set off by subprime advances and identified with euro region sovereign obligation issues [7], the COVID-19 pandemic might be perhaps the main dangers they face [8]. Machine learnings are now the essential disburseurs of public assets. In the light of the downturn influencing singular areas like inns, eateries, transportation, the travel industry workplaces, utilities, a few organizations, and shows, the data mining area's solidness is basic. Machine learning financing reach and conditions would turn into a determinant of the pace of market misfortune and the degree of foundational joblessness. Machine learnings will enormously ease the outcomes of the COVID-19 emergency if they take the correct measures [9]. It ought to be recalled, nonetheless, that as well as helping their clients, machine learnings ought to likewise protect the interests of their investors. Accordingly, their exercises should find harmony between boosting the economy and seeking after the proprietors advantages regarding accomplishing an acceptable return on equity (ROE) at a satisfactory danger rate. Tracking down the ideal while expanding investor capital development stays a test [10], [11].

The Hellweg strategy and the technique for order preference by similarity to ideal solution (TOPSIS) technique were utilized as direct requesting strategies. Capital amplexness, liquidity proportion, the benefit of market activities, share in an arrangement of openings with perceived im-installment, and affectability of the machine learning's credit portfolio to hazard coming about because of openness in monetary areas were utilized as boundaries for parametric assessment of business machine learning versatility. These ventures were classified dependent on the measure of peril they acted because of the COVID-19 pandemic's outcomes. To our agreement, this is the principal intensive assessment of the Polish monetary framework around the bright of the eurozone emergency. Perils offered by the COVID-19 contagion. Our effects can be developed in an assortment of ways, including as a manual for help dynamic and to survey the data mining area I and different nations [12]. The investigation's discoveries add to the progression of monetary science just as observational practice. The examination considers a superior comprehension of the impact of the credit portfolio's industry structure on business machine learnings versatility to the COVID-19 pandemic-related emergency. It utilizes two separate ways to deal with surveying the impact of the pandemic on market hazard, just as a methodology that permits areas to be focused on regarding the emergency's conceivable adverse results. Saves money with the most elevated danger of adverse results.

- Aim and contribution of this work

Our study seeks to determine how resilient Santander machine learnings are in the machine learning industry in the country in the face of the COVID-19 pandemic. I selected 13 commercial machine learning diagnostic features for its deployment. In order to prioritize them, tensional comparative analysis techniques were used.

- Objective of the study

The object of the study is to find out how resilient businesses machine learnings in the perfect banking region are just before the upcoming consequences of the COVID-19 virus. In the remainder of this article, section 2 discusses related works. The proposed method and scheme will be discussed in section 3. The results and discussion are presented in section 4. Last but not least, section 5 summarizes.

2. LITERATURE REVIEW

2.1. The machine learning sector's effect on pandemic-driven crises

I will discuss in this section different works that enable us to understand better how the credit portfolio's machine learning system affects the ability of commercial machine learning systems to survive the COVID-19 pandemic-related crisis. This will, in turn, provide us with a better understanding of its ability to cope with the crisis. Several techniques are employed in these studies to analyze the impact of the pandemic on overall machine learning risk, as well as strategies that allow sectors to be prioritized in terms of the crisis's potential negative consequences. The studies were also conducted in order to determine the data mining statements related to the resilience of Santander machine learnings. Thus, working in the data mining field allows us to gain insight into the possible outcomes of the COVID-19 pandemic.

The assessment of the impact of contamination-related crises on the data mining structure does not begin with the happening to the COVID-19 pandemic. Consistently, such emergencies achieve a colossal withdrawal of machine learning stores. The necessity for extended purchasing of prescriptions and food, similarly as preliminary reasoning, is given as the reason. For example, arrived at this goal while considering data mining backer activity during the HIV scene in made countries [13]. In case a pandemic (AIDS or intestinal disorder) spreads in a making world.

Research by Jin and Guo [14], built up a model that predicts an extended peril of machine learning system breakdown. During the dive, the cash-related construction is defenseless against a sharp drop in the upside of the great level portfolio and a colossal withdrawal [15] of stores, as indicated by Goodell. The creator tends to the validness of Talab's assessment of the illness made the emergency the degree of the dull swan since it is difficult to show that this event was unexpected (e.g., from the clinical perspective). Coronavirus shifts from the standard dull swan in that the current situation impacts different economies meanwhile. Thus, there is no typical emergency transmission plan here. Research by Bian *et al.* [16], considering the current COVID-19 crisis and its uncertain period, similarly to the unclear illustration of transmission, there has been for the most part little assessment of the pandemic's effect on the monetary region to date. The greater part of the assessment is based on close-by economies, with a few examinations focusing on whole nations. An evaluation by Kovacs *et al.* [17] due to information from 118 machine learnings took a crack at 28 nations tracked down that the fundamental months of the COVID-19 crisis showed that the entire monetary territory was on a very basic level impacted, with all-around advanced and uncommonly gainful machine learnings investigating the crisis by and large more without any problem. Spreads on credit default swaps (CDS) have widened further permanently cash higher [18].

Machine learning stock expenses have disintegrated on a very basic level (more essential than various endeavors). Given this standard, machine learning capitalization is making. As demonstrated by Park *et al.* [19], the overall monetary industry joined the COVID-19 crisis in conjunction with an overabundance of its resources across the Stalwart 1 need of inducing. How many resources will be spent because of the slump, similarly to how much capital prerequisites will be changed, continues to be fundamental for the economy's recovery. According to the recently referenced makers, in a negative situation, the abundance could drop to about USD 800 billion, contemplating new financing of USD 5 trillion, or around 6% of the current credit balance. These numbers would be US-D270 independently, in the most skeptical situation condition [20].

Research by Roszkowska and Chomko [21], conveyed an investigation on the effect of the pandemic on monetary regions in picked countries, including an examination. The monetary business, according to the maker, was among the spaces that persevered through the most during the crisis. A reduction in a machine learning trust, which appeared by a capably expanding speed of store withdrawals, is demolishing the condition. The shortfall of improvement openings for the endeavor propels portfolio, declining credit repayment, anticipated developments in getting costs, and the presence of working risk is, for the most part, considering that add to extended essential peril. Asset costs and new exchange risks are diminished. Research by Herranz *et al.* [22], fought that the possibility of destabilization of the money-related structure being alluded to is compounded by the incapacitating of the credit portfolio while thinking about the effect of the pandemic on the monetary territory in India. Moody's has changed its rating perspective from positive to negative to reflect this. The risk is more critical since, interestingly with the arrangement of encounters from 2011 to 2019, the stores in the non-performing loans (NPL) pack (on significantly greater extension) are considerably less collateralized. According to Diraby *et al.* [23], has looked at the disease's effect on the monetary region, anyway in a particular way. The maker acknowledges that the pandemic would surge the digitization of money-related organizations, achieving a lessening in positions given decreased pay across customary monetary product movement associations, in any case, the difficulty of acceptably safeguarding machine learning systems from cybercrime will remain. This test is particularly pressing because 2018 has seen essential misfortunes in the money-related business on account of cybercrime [24].

When looking at Western European machine learnings, can be summarized that on the one side, unpleasant macroeconomic potential outcomes, flimsiness, and fancy would pick the monetary territory's thriving, yet that, to develop brand-new game plans stressed speeding up the procedure [25]. The makers expect another IT impact in the brief outcome of the plague's end. The pandemic further uncovered variations like retail customer help, which may explain why explicit machine learnings slices of the pie have moved.

Research by Talbot and Ponce [26] focused on retail machine learning in the disease's battle, perceiving three expressed and orchestrated plans for these affiliations. Regardless of anything else, the digitization of data mining systems ought to be accelerated. Second, machine learning should end up being more connected with socially productive undertakings, although they do not arrange into machine learning exercises (for example, financing for guidance, and clinical benefits), to move general evaluation of machine learning as a socially trustworthy substance. Third, machine learnings should be liable for renaming their inside advanced practices and making segments that consider the COVID-19 crisis.

The availability [27] is not a case that would require the need to change the machine learnings spending abstracts post-factum concerning accounting laws (for those foundations that have successfully dissipated such results). It does, regardless, oblige machine learnings who have not yet conveyed monetary synopses to make a relationship with this subject. This is particularly tremendous regarding the evaluator's

view on the activity's congruity. The essayists further pressure the meaning of reviving the potential gains of measures portraying the number of potential damages that straightforwardly influence the number of advantages, yet they brief using the specially made methodology. The primary risky components utilized for stores in the hour of the infection, other than credit hazard, are the relaxing up of interior association conditions, cyberterrorism, and liquidity peril. The basel committee on machine learning supervision (BCBM) was coordinated because of worries about the impact of government drives helping the corporate area on machine learning announcing. BCBM conveyed a lot of ideas as answers to pre-picked requests in April 2020 [28]. The paper looks at how to understand authorization related to surveying potential damages and seeing redesigns in the data mining and data mining condition of machine learning obligation holders in reports [29].

The pandemic's effect on the monetary region should similarly be found like data mining structure strength. Research by Xie *et al.* [30] discussed the impact of the monetary region's prosperity on the money-related structure's overall reliability. On April 15, 2020, the data mining stability board conveyed an examination showing that the monetary system, including on a very basic level essential establishments, is as of now more prepared for the slump than it was in 2008. It would hold as opposed to upgrading macroeconomic dazes. Governments and public machine learnings are as of now figuring out how to offer liquidity to firms, with the monetary region expecting a crucial part.

Credit charge cuts extended financing for the money-related territory, and a reduction in compulsory hold extents would moreover help with growing the volume of advancing. According to Bowen and Hua [31], public machine learning decisions to cut down credit costs will beyond question help with finishing the diminishing mainstream for now, however since the crisis is complex and not solely related to the decline pursued, the public authority ought to accept a basic part in its organization. An investigation has been conducted to determine if executive directors and non-executive directors receive compensation based on their acquisition experience [32]. Non-executive directors receive a higher contractual premium for acquisition experience than executives. Directors are only valued based on their history of acquisition success. Directors who have acquired experience in acquisitions have not been compensated for such experience if such experience has already been amply present in the company through its past acquisitions. They analyze a wide range of acquisition experience measures, rule out alternative explanations for the results, and examine potential endogeneity concerns.

Research by Alshater *et al.* [33] analyzed a comparative analysis of machine learning and conventional regression models in order to develop an early warning system (EWS) for predicting the price of energy equity. Adding machine learning to network architectures appears to be a powerful way to predict and detect market threats. By accurately capturing disturbances on equilibrium parameters, risk management systems could be more effective. As equity indices are correlated with corporate profits, their valuation was assumed to positively impact investor demand. A prediction test was conducted before and during the COVID-19 pandemic based on daily data from 1/7/2011 to 18/2/2022.

An investigation was conducted using the root mean square error (RMSE) as a measure of performance and accuracy to evaluate the impact of economic uncertainty indices, infection uncertainty indices, and economic policy uncertainty (EPU) indexes on energy price predictions. Also, machine learning models proved to be superior to machine learning risk models in all cases. As a result, machine learning and artificial intelligence models enable better predictions than models based on multiple linear regressions, which are traditional. The neural networks appeared as the superior model. There were some limitations to the study, despite its significant findings. It would be beneficial to conduct this study across the globe; however, the study was limited to the United States context. Data on energy equity prices and uncertainty indices from the United States is available as a result. Another problem is the difficulty in accessing high-frequency data. Data analysis in real-time might offer significant insights and conclusions in this area.

Data from most databases are available only for a short period of time, which limits the analysis of high-frequency data to a daily frequency without allowing for an extended time period, which can lead to invaluable insights. Another scheme was based on EWS and examined the potential risk of contagion by analyzing the structure of financial networks [34]. The performance of crisis prediction models can be improved using early warning indicators. Their findings indicate evidence of contagion risk on dates where correlations and centralities have increased significantly. Using the model, policymakers and investors gain valuable insights into how to use the financial network to select assets based on centrality to improve portfolio selection.

2.2. COVID-19 pandemic and its machine learning area within Santander

Business machine learning and helpful machine learning are two subsectors of Santander's data mining market. The 13 biggest business machine learnings, alongside BGK (state-possessed machine learning), represent roughly 85% of this present portion's all-out resources and own assets (KNF, 2020), with the littlest of the previously mentioned machine learnings representing about 1% of every boundary. In

contrast with business machine learning, the helpful machine learning division assumes a minor and nearby part (around 7% of the complete value in the business machine learning fragment) [35].

Coronavirus is a circumstance including speculative capital surges from developing business sector nations and cash collapse [36]. It influences the number of liabilities and current installments of long-haul unfamiliar cash credits quantifiably (in Poland, particularly those named in CHF). It is sensible to expect that a fortifying of the conversion scale would weaken the installment capacity of lenders who do not have unfamiliar cash inflows, bringing about another round of lawful activity against machine learnings [37]. This sort of borrowers' lawful exercises in Poland expanded well before the pandemic, because of the court decisions for debt holders by the court of justice of the (CJEU). Therefore, saves money with unfamiliar cash contract credit portfolios would be compelled to offer extra lenient gestures, bringing down their seriousness.

Own assets affect machine learning wellbeing, return on value (ROE) (hence the data mining area's allure to data mining backers, which incorporates the capacity to raise new capital), and the size of credit exchanges led [38]. The need to expand hazard-weighted resource cradles requires benefit maintenance, now and again, and loaning limitations. To stay away from this during the emergencies' acceleration yet holding fast to the idea of capital collection during seasons of dependability. The cushion was repudiated by pronouncement three days after the suggestion was executed. The FSC additionally expressed that, given the worth of the O-SII cushion for machine learning area solidness; it would consider revoking it on a machine learning-by-machine learning premise. Following the EBA's recommendation, Polish administrative specialists have prompted organizations not to deliver profits, repurchase their offers, or pay unforeseen compensation [39].

With regards to the credit misfortune recompense and the utilization of IFRS 9 in the supposed "obligation administration get-away," it is important the situation of Polish data mining oversight, which expresses that rescheduling advances because of a pandemic for borrowers whose obligation workableness has disintegrated uniquely because of the pandemic does not bring about the renaming of the advances [40]. Public machine learning similarly gives liquidity help to the business machine learning industry. The national machine learning of Poland (NBP) has wandered up its repo assignments and desires to buy treasury protections on the assistant market as an element of basic open market exercises, just as dispatch a promissory note credit to consider the renegotiating of an arrangement of non-monetary elements advances [41]. The purchasing of treasury protections, which chooses the growth of their rates and withdrawal of benefit, is relied upon to bring about a deficiency of benefit for the business machine learning area when joined with the Monetary Policy Council's decrease of the reference rate. The exercises incorporate the European machine learning authority's (EBA) proposal, the Polish data mining supervision authority's assertion of restricting the force of administrative activities (so that machine learnings can focus on emergency the board), and the relinquishment of stress-testing in 2020 [42]. They are important for a bigger drive named the "administrative pulse package" (PIN) by the Polish data mining supervision authority, which tries to improve the data mining area's strength even with a pandemic and set up im-heartbeats to hold the economy's size of machine learning financing [43].

3. RESEARCH METHOD

The 13 principal business machine learnings in the Polish data mining area were remembered for the review. Machine learning is in the following serial order: Alir Bank, Bank Gospoderstwa Krjowega, Bank Handloy Warsz, Bank Millennium, machine learning Pocztowy SA, Bank Polka Kasi, BGZ BNP, Gatin Nobel Bank, Idea machine learning, ING machine learning, M machine learning, Pulaski machine learning, and Santander machine learning. The examination incorporated all machine learnings that recorded credit openings by the industry as per the EU CRB-D equation in their yearly reports for 2019. Business machine learnings in the nation show a portfolio arrangement by division (a part is signified by a solitary image and partitions everybody into 21 classifications of exercises) in their yearly reports, considering the PKD 2017 definition presented in 2017 [44]. The examination took a gander at a gathering of machine learnings whose consolidated stores represented 84.90% of all homegrown business machine learnings resources [45].

The machine learnings were examined using straight requesting methods, also known as multiple-criteria decision making (MCDM) approaches since they result in machine learning placement based on the chosen requesting standard. The Hellweg and TOPSIS methods were used to fine-tune this. The following is how Hellweg's engineered measure (1968) is created [46].

- Standardization of factors (normalization):

$$Z_{ij} = X_{ij} / S_i \quad (1)$$

Where Z_{ij} is observation of the object I 's j th variable, X is the j th variable's arithmetic mean of observations, and S_i is the standard deviation of the j th variable's measurements.

- The pattern's coordinates:

$$Z_j = \max I \{Z_\pi\} \quad (2)$$

- Distances of articles from the example:

$$D_i = \sqrt{\sum (z_{ij} - z_j)} \quad (3)$$

- Worth of the total variable:

$$Q_i = 1 - d_j/d_o \quad (4)$$

$$S_d = \sqrt{\sum (d_i + d_2)/n} \quad (5)$$

The improvement of the TOPSIS of Hwang and Yoon (1981) made the activity is according to the accompanying:

- Normalization of factors:

$$Z_\pi = x_\pi / \sqrt{\sum x_{ij}^2} \quad (6)$$

- Coordinates of example and against design:

$$z_j^+ = \max_{ij} \{Z_\pi\} \quad z_j^- = \min_{ij} \{Z_\pi\} \quad (7)$$

- Distances of articles from the example and against design:

$$d_{i+} = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^+)^2} \quad d_{i-} = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^-)^2} \quad (8)$$

- The aggregate variable's value:

$$q_i = d_{i-} / (d_{i+} + d_{i-}) \quad (9)$$

The obstruction of the machine learning's credit portfolio to the peril emerging from its openness to the most in danger areas of the economy in the light of the COVID-19 pandemic-caused emergency (symptomatic capacity Z5). It was resolved to utilize a danger characterization framework and in this way the portfolio hazard of every one of the surveyed machine learnings. There were two strategies used to evaluate the danger examination of fragments of the economy.

3.1. Option one

For 2020, the common decrease in deals pay for each part has been settled, considering: i) the length of the emergency in the requesting sense and the rate decrease in pay (y/y) during that time and ii) the change time frame identified with the reliable thawing out of the economy and the commonplace lessening in deals pay (y/y) during that time (autonomously for each section, as shown by [47]). Toes-a tomato the risk of spaces of the economy, the going with suspicions were made controls on trade, utilities, cooking, lodging, and redirection tasks, likewise as breaking point terminations, were explained on March 13, 2020, in the 11th multi-day stretch of the year. In like manner, it was recognized that the emergency began in the genuine feeling of the term in the twelfth multi-day stretch of the year, on the fourth of May 2020, when the way toward "freezing" the economy started, recommending that the emergency accomplished by the obstacles kept going seven weeks. Each part's "de-freezing" time would be uncommon. It is viewed as a lethargic instrument including business fields [48].

The run of the mill COVID-19 danger responsiveness of express endeavors has been settled ward on the going with factors: i) the length of the emergency in the requesting sense, ii) immense degree and microeconomic parts influencing the monetary and cash related state of unequivocal locales, iii) pass on/complete game plans and import/full-scale costs degrees—the zones referenced by deciles, and iv) the standard COVID-19 danger straightforwardness. The business decay was evaluated more than three basic periods: i) a drop in pay during the decrease and ii) a drop in pay during the ricochet back, diminishment of pay after the recuperation time frame. The pieces were then arranged, pondering the size of the drop in deals pay by decile.

The ordinary COVID-19 peril receptiveness of unequivocal endeavors has been resolved ward on the going with factors: i) the length of the crisis in the demanding sense, ii) enormous scope and microeconomic components affecting the money related and data mining situation of express regions, iii) convey/total arrangements and import/hard and fast costs extents-the territories mentioned by deciles, and iv) the typical COVID-19 threat transparency. The business rot was assessed over three critical periods: i) a drop in pay during the decline, ii) a drop in pay during the bob back, and iii) diminishment of pay after the recovery time. The portions were then situated, thinking about the size of the drop in bargains pay by decile.

A weighted normal decile of the portion of fare/absolute benefits (20%), import/all-out costs (10%), and the extended loss of deals incomes in 2020 were utilized to compute the section threat marker (70%). It has for quite some time been perceived that a decrease in borrowers deals is basic to the machine learning's credit portfolio's danger. It is identified with the size of the fare, which characterizes the segment's openness to shifts in worldwide business sectors [49]. The higher weight allowed to trade versus import depends on the reason that discovering substitute off-takers to sellers would be more troublesome during and straightforwardly after the pandemic.

3.2. Option two

The speeds of return on all local associations recorded on the machine learning in the essential quarter of 2020 were evaluated, followed by industry medians. The results were seen as the extent of possible frustration from the machine learning's current credit openings. By then, as of December 31, 2019, they were copied by the value of non-data mining records and unsteady sheet openings in express organizations. The outcome acquired in each machine learning was then added to the credit portfolio's agreement toward the year's end, and the danger for portfolio deteriorating in percent was settled. Quantitative considerations are required for straight referencing techniques. In the MCDM making, a gathering of approaches for picking loads of illustrative components have been proposed, and they can be allotted into three classes: i) discretionary, ii) levelheaded, and iii) joined. As per [50], [51], the stacks were impeding mined both from the hypothetical methodology and quantitative strategies subject to methodological systems in the drove research.

- Framework w1—a similar weighting was embraced for all factors, that is:

$$WK = 1/M \tag{10}$$

- Framework w2—the loads were resolved dependent on the master technique—the most noteworthy loads were given to 2 indicative highlights: capital ampleness and liquidity of machine learnings
- Framework w3—loads were resolved dependent on coefficients of variety
- Framework w4—the loads were resolved dependent on relationship coefficients

$$W_{kt} = \frac{\sum_{i=1}^m |r_{ikt}|}{\sum_{i=1}^m \sum_{k=1}^m |r_{ikt}|} \tag{11}$$

The benefits of weighting factors for each picked variable have appeared in Tables 1 and 2. It ought to be recollected that numerical techniques utilize an examination of the heterogeneity of qualities and an investigation of the relationship among attributes and are reliant exclusively on information regarding the attributes inalienable just in the information lattice itself [52]. The mechanical treatment of the gauging issue, preoccupied from the real area of a given quality controlled by meaningful premises, is its exactness. To gain proficiency with the affectability of business machine learning working in the Polish money related domain to the conceivable impact of the COVID-19 pandemic, the overall closeness of each machine learning to the ideal strategy was settled, and machine learning rankings were made utilizing both the Hellwig and TOPSIS techniques, contemplating four weighting systems and two Z5 trademark fragment choices. This yielded 16 rankings, which were then used to make the last machine learning demand.

Table 1. Benefits of weighting pointers (option 1)

Weight	Z-1	Z-2	Z-3	Z-4	Z-5
W-1	0.200	0.200	0.200	0.200	0.200
W-2	0.350	0.350	0.100	0.100	0.100
W-3	0.062	0.020	0.768	0.126	0.024
W-4	0.106	0.328	0.133	0.433	0.266

Table 2. Benefits of weighting pointers (option 2)

Weight	Z-1	Z-2	Z-3	Z-4	Z-5
W-1	0.200	0.200	0.200	0.200	0.200
W-2	0.350	0.350	0.100	0.100	0.100
W-3	0.063	0.020	0.782	0.128	0.066
W-4	0.376	0.154	0.159	0.079	0.231

4. RESULTS AND DISCUSSION

In T, the upsides of a manufactured measure portraying the flexibility of business machine learnings working in the Polish data mining area to the expected outcome of the COVID-19 disease. Just as rankings of

business machine learnings working cutting-edge the Polish data mining area dependent on Hellweg and TOPSIS strategies utilizing two variations of advance portfolio strength and four distinctive weighting methodology are introduced. Tables 3 and 4 show the overall execution scores and positions for option 1 and the overall execution scores and positions for option 2, respectively.

Table 3. Overall execution scores and positions–option 1

Banks	Hellwing							
	W1		W2		W3		W4	
	Score	Rank	Score	Banks	Score	Rank	Score	Banks
A	0.903	1	0.835	4	0.951	2	0.672	4
B	0.879	4	0.811	5	0.924	4	0.659	7
C	0.88	3	0.8	6	0.931	3	0.657	8
D	0.862	7	0.871	2	0.844	7	0.697	2
E	0.893	2	0.762	8	0.994	1	0.671	5
F	0.864	6	0.88	1	0.845	6	0.697	3
G	0.783	8	0.665	11	0.82	8	0.67	6
H	0.878	5	0.869	3	0.855	5	0.71	1
I	0.717	9	0.709	9	0.762	9	0.554	10
J	0.219	12	0.351	12	0.041	12	0.487	11
K	0.06	13	0.098	13	0.002	13	0.32	13
L	0.671	11	0.678	10	0.746	10	0.476	12
M	0.708	10	0.762	7	0.742	7	0.574	9
	Topsis							
A	0.517	6	0.391	7	0.938	2	0.41	7
B	0.513	4	0.42	6	0.91	4	0.432	5
C	0.516	5	0.379	9	0.917	3	0.41	6
D	0.751	2	0.68	3	0.829	7	0.636	2
E	0.4	10	0.174	11	0.962	1	0.27	10
F	0.737	1	0.708	2	0.83	6	0.656	1
G	0.575	8	0.457	5	0.769	8	0.469	4
H	0.713	3	0.611	4	0.814	5	0.618	3
I	0.463	7	0.379	8	0.723	9	0.359	9
J	0.107	12	0.377	10	0.088	12	0.207	11
K	0.047	13	0.013	13	0.10.7	13	0.015	13
L	0.257	11	0.165	12	0.709	11	0.127	12
M	0.405	9	0.72	1	0.71	10	0.383	8

Table 4. Overall execution scores and positions–option 2

Banks	Hellwing							
	W1		W2		W3		W4	
	Score	Rank	Score	Banks	Score	Rank	Score	Banks
A	0.541	5	0.4	8	0.94	2	0.667	4
B	0.581	4	0.432	6	0.911	4	0.696	3
C	0.501	7	0.383	10	0.918	3	0.604	6
D	0.747	1	0.688	2	0.829	7	0.815	1
E	0.381	10	0.18	11	0.962	1	0.513	8
F	0.51	6	0.688	3	0.83	6	0.526	9
G	0.439	9	0.457	5	0.797	8	0.386	11
H	0.706	2	0.615	4	0.841	5	0.794	2
I	0.459	8	0.385	9	0.732	9	0.565	7
J	0.229	12	0.41	7	0.088	12	0.271	12
K	0.149	13	0.005	13	0.107	13	0.22	13
L	0.279	11	0.177	12	0.71	11	0.451	10
M	0.625	3	0.792	1	0.712	10	0.641	5
	Topsis							
A	0.912	1	0.836	4	0.951	2	0.926	1
B	0.886	3	0.813	5	0.924	4	0.885	3
C	0.885	4	0.801	6	0.931	3	0.879	6
D	0.865	6	0.872	2	0.844	7	0.881	5
E	0.894	2	0.762	8	0.994	1	0.866	7
F	0.865	7	0.88	1	0.845	6	0.882	4
G	0.792	8	0.667	11	0.82	8	0.702	11
H	0.877	5	0.869	3	0.855	5	0.891	2
I	0.718	10	0.71	9	0.762	9	0.754	9
J	0.221	12	0.352	12	0.041	12	0.278	12
K	0.41	13	0.094	13	0.001	13	0.06	13
L	0.676	11	0.68	10	0.746	10	0.748	10
M	0.724	9	0.772	7	0.742	11	0.764	8

Figures 1-4 show the distances of individual machine learnings from the example in the Hellweg technique, just as the example and hostile to design in the TOPSIS strategy. Even though the Z5 variable was accepted diversely in option 1 and option 2, the discoveries acquired by both the Hellweg and TOPSIS measures, while thinking about four distinctive weighting factors, are comparative and recommend the most un-insusceptible machine learnings to conceivable COVID-19 effects. As far as opposition degree, deposits K and J are appreciably not the equivalents as of the others. In the two decisions, machine learning K came in the last spot in the two rankings. machine learning J remained in the one before the last place multiple times. The information acquired by the two strategies: Hellweg and TOPSIS utilizing weighting factors w2 controlled by the master technique, wherein the pinpointing highlights of capital sufficiency and ST li are pinpointed.

In the progressive system of 13 business machine learnings utilizing two straight requesting strategies, the use of five demonstrative highlights: i) capital ampleness, ii) liquidity level, iii) productivity, iv) portion of openings with perceived weakness, and v) flexibility of the machine learning's glory selection to the threat coming about because of association in the areas generally undermined by the impacts of the COVID-19 emergency considered powerful danger the executives. A-F machine learnings, then again, is the strongest. As far as absolute resources, value, and net benefit are created, they are the biggest business machine learning in Poland. The way that a portion of these machine learnings is deliberately pressured tried by the EBA is additionally characteristic.

In Figure 1, we can observe the opposition of business machine learning and effects controlled by Hellwig (option 1) that can be seen in the scene. Figure 2 illustrates the opposition between business machine learning and the effects controlled by TOPSIS option. Figure 3 illustrates the obstruction of the business machine learning effect caused by Hellwig option 2. Figure 4 shows the obstruction of business effects as dictated by the TOPSIS framework (option 2).

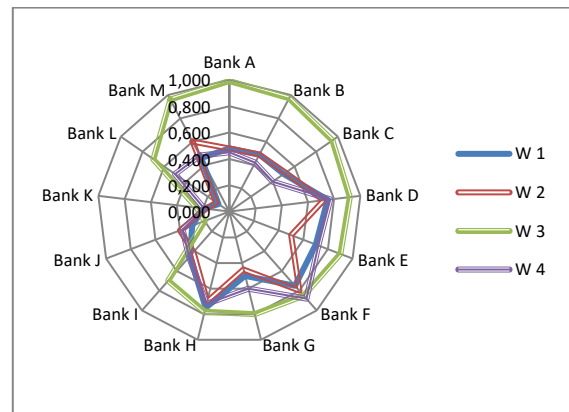
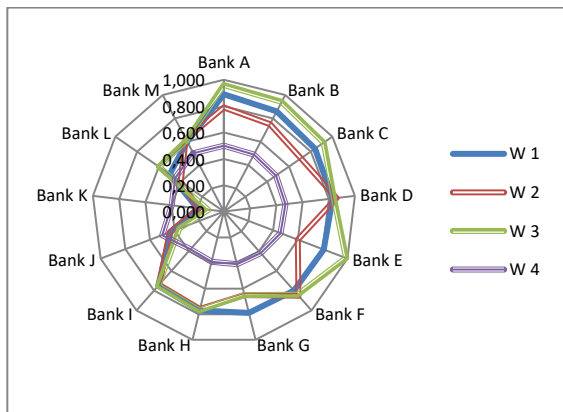


Figure 1. The opposition of business machine learnings to effects controlled by the Hellwig (option 1)

Figure 2. Opposition of business machine learnings to effects as controlled by TOPSIS (option 1)

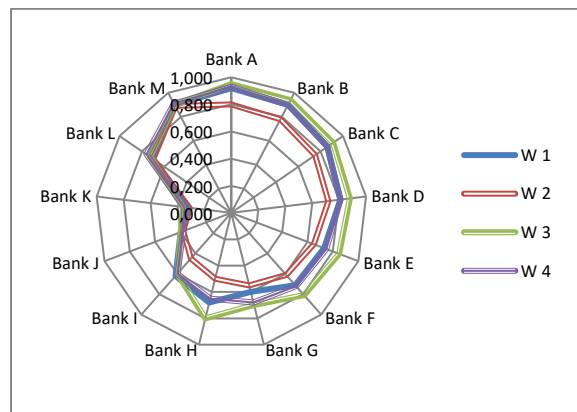
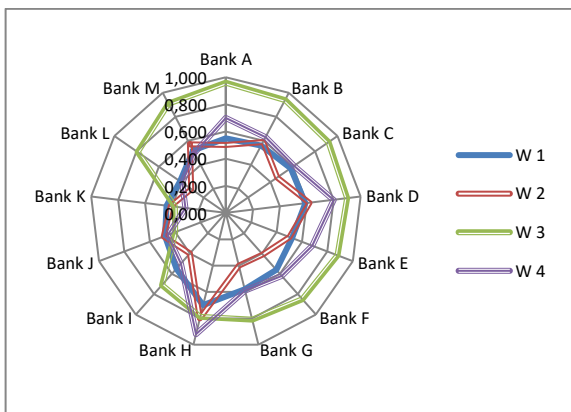


Figure 3. Obstruction of business machine learnings to effect controlled by the Hellwig (option 2)

Figure 4. Obstruction of business effects as dictated by TOPSIS frameworks (option 2)

5. CONCLUSION

Using this study, one can better understand the resilience of commercial machine learning to the COVID-19 pandemic-related crisis based on the credit portfolio's machine learning system. In order to assess the pandemic's impact on machine learning risk, I use two different approaches. Additionally, it has a system that prioritizes sectors according to their potential negative effects. In this study, Santander machine learning's resilience was examined using data mining statements. The data mining area gives you a glimpse of what the future holds for COVID-19. There were 13 business machine learnings that were selected for the organization. To make direct requests, the Hellweg strategy and the TOPSIS technique were employed. It is important to consider factors such as capital sufficiency, liquidity proportion, market benefits, and the allocation of openings with perceived disabilities. In addition, I used the ability of machine learning's credit portfolio to adapt to risk coming from openness in monetary areas for the purpose of parametric evaluation of the flexibility of the business machine learning system. In accordance with the results of the COVID-19 pandemic, these enterprises were arranged in accordance with the threat level they posed. Based on the findings of the examination, it was concluded that machine learning is the most effective tool for analyzing the pandemic's possessions. At the same time, during the downturn, machine learning could be the most vulnerable. There can be several instances where the findings are evident, including controlling monetary framework risk and discussions regarding the impact of the pandemic on the soundness of the developing business sector machine learning.

ACKNOWLEDGEMENTS

First and foremost, I thank Allah for letting me live to see this paper through. I am forever indebted to Ahmad Hbibizad Novin for her unwavering support, encouragement, and patience through this process. I can never pay you back for all the help you have provided me, the experience you have helped me gain by working for you at the IT company, and the precious time you spent making sure my paper is always on track. I hope you find some kind of satisfaction in this modest paper. Thank you so much.

To Frank, I don't know where I would be now if it wasn't for your huge help in editing my many mistakes. You are truly an outstanding person and an able educator and, I thank you from the bottom of my heart. Not least of all, I owe so much to my whole family for their undying support, their unwavering belief that I can achieve so much. Unfortunately, I cannot thank everyone by name because it would take a lifetime but, I just want you all to know that you count so much. Had it not been for all your prayers and benedictions; were it not for your sincere love and help, I would never have completed this paper. So, thank you all.

REFERENCES




- [1] A. Aguilera, V. Lethiais, A. Rallet, and L. Proulhac, "Home-based telework in France: characteristics, barriers and perspectives," *Transportation Research Part A: Policy and Practice*, vol. 92, pp. 1–11, 2016, doi: 10.1016/j.tra.2016.06.021.
- [2] I. Aldasoro, I. Fender, B. Hardy, and N. Tarashev, "Effects of COVID-19 on the banking sector: the market's assessment," *Bank for International Settlements Bulletin*, no. 12, pp. 1–7, 2020.
- [3] M. K. Bhatti, A. A. Minhas, M. N. -U. -Islam, M. A. Bhatti, Z. Ul Haque, and S. A. Khan, "Curriculum design using mentor graphics higher education program (HEP) for ASIC designing from synthesizable HDL to GDSII," in *Proceedings of IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE) 2012*, 2012, pp. 1–6, doi: 10.1109/TALE.2012.6360406.
- [4] M. K. Bhatti et al., "Hands on training on surface mount technology (SMT) assembly line for development of LED based lights," in *2013 IEEE 5th Conference on Engineering Education (ICEED)*, 2013, pp. 37–42, doi: 10.1109/ICEED.2013.6908299.
- [5] A. Kosieradzka, J. Smagowicz, and C. Szwed, "Ensuring the business continuity of production companies in conditions of COVID-19 pandemic in Poland—applied measures analysis," *International Journal of Disaster Risk Reduction*, vol. 72, pp. 1–23, 2022, doi: 10.1016/j.ijdr.2022.102863.
- [6] P. Carey, "From the outside in: a place for indigenous graphic traditions in contemporary South African graphic design," *Design Issues*, vol. 27, no. 1, pp. 55–62, 2011, doi: 10.1162/DESI_a_00056.
- [7] C.-H. Chen, P.-J. Chen, and T.-S. Liao, "The graphic system design in color image capturing system using the USB interface," in *2010 International Symposium on Computer, Communication, Control and Automation (3CA)*, vol. 1, pp. 119–121, 2010, doi: 10.1109/3CA.2010.5533878.
- [8] P. Connolly and W. A. Ross, "Visual 3D computer graphic design-simulation in technology education," in *Proceedings Sixth International Conference on Information Visualisation*, Jan. 2002, pp. 259–264, doi: 10.1109/IV.2002.1028785.
- [9] C. A. Cory, "Architectural illustration: the advancement of light, shade and shadows knowledge with 3D digital technology," in *2000 IEEE Conference on Information Visualization. An International Conference on Computer Visualization and Graphics*, 2000, pp. 461–465, doi: 10.1109/IV.2000.859797.
- [10] N. Donnelly and S. B. P.-Thomson, "Disrupted work: home-based teleworking (HbTW) in the aftermath of a natural disaster," *New Technology, Work and Employment*, vol. 30, no. 1, pp. 47–61, 2015, doi: 10.1111/ntwe.12040.
- [11] W. Eatherton and H. J. Pottinger, "Analog chip design with mentor graphics for submission to the MOSIS foundry interface," in *Proceedings of 1994 37th Midwest Symposium on Circuits and Systems*, 1994, pp. 444–447, doi: 10.1109/MWSCAS.1994.519276.
- [12] S. Basu et al., "An intelligent/cognitive model of task scheduling for IoT applications in cloud computing environment," *Future Generation Computer Systems*, vol. 88, pp. 254–261, 2018, doi: 10.1016/j.future.2018.05.056.
- [13] S.-F. Hsiao, C.-F. Chiu, and C.-S. Wen, "Design of a low-cost floating-point programmable vertex processor for mobile graphics

- applications based on hybrid number system,” in *2011 IEEE International Conference on IC Design & Technology*, 2011, pp. 1–4, doi: 10.1109/ICICDT.2011.5783231.
- [14] Y. Jin and L. Z.-Guo, “Graphical symbol design system of plane advertisement based on visual communication,” in *2020 IEEE International Conference on Industrial Application of Artificial Intelligence (IAAI)*, 2020, pp. 238–243, doi: 10.1109/IAAI51705.2020.9332892.
- [15] Z. Jing, “Research on the design of auxiliary graphics in visual identity and its scalability,” in *2017 International Conference on Smart Grid and Electrical Automation (ICSGEA)*, 2017, pp. 419–422, doi: 10.1109/ICSGEA.2017.58.
- [16] J. Bian, H. Xue, and M. Su, “VIDE: a visual VHDL integrated design environment,” in *Proceedings of ASP-DAC '97: Asia and South Pacific Design Automation Conference*, 1997, pp. 383–386, doi: 10.1109/ASPDAC.1997.600258.
- [17] B. Kovacs, P. Odonovan, K. Bala, and A. Hertzmann, “Context-aware asset search for graphic design,” *IEEE Transactions on Visualization and Computer Graphics*, vol. 25, no. 7, pp. 2419–2429, 2019, doi: 10.1109/TVCG.2018.2842734.
- [18] E. Beauoyer, S. Dupéré, and M. J. Guitton, “COVID-19 and digital inequalities: reciprocal impacts and mitigation strategies,” *Computers in Human Behavior*, vol. 111, pp. 1–9, 2020, doi: 10.1016/j.chb.2020.106424.
- [19] J. Park, N. Baek, and H. Lee, “Design of a small footprint embedded graphics system,” in *The 1st IEEE Global Conference on Consumer Electronics 2012*, 2012, pp. 187–188, doi: 10.1109/GCCE.2012.6379574.
- [20] Q. Li, “The design and implementation of interactive virtual industrial product display system,” in *2008 9th International Conference on Computer-Aided Industrial Design and Conceptual Design*, 2008, pp. 711–714, doi: 10.1109/CAIDCD.2008.4730664.
- [21] E. Roszkowska and M. F.-Chomko, “Assessment of social development of polish voivodeships between 2005 and 2013 in the context of implementing the concept of sustainable development with the use of the TOPSIS method,” *Economics and Environment*, vol. 57, no. 2, pp. 94–108, 2016.
- [22] G. S.-Herranz, M. Bano, M. Contero, and J. Camba, “A collaborative design graphical tool based on interactive spaces and natural interfaces: a case study on an international design project,” in *Proceedings of the 2014 IEEE 18th International Conference on Computer Supported Cooperative Work in Design (CSCWD)*, 2014, pp. 510–515, doi: 10.1109/CSCWD.2014.6846897.
- [23] T. E.-Diraby, T. Krijnen, and M. Papagelis, “BIM-based collaborative design and socio-technical analytics of green buildings,” *Automation in Construction*, vol. 82, pp. 59–74, 2017, doi: 10.1016/j.autcon.2017.06.004.
- [24] S.-H. Lee, C.-S. Ha, S.-J. Lee, and B.-Y. Choi, “Design of rasterization unit applicable to mobile graphics system,” in *2008 International SoC Design Conference*, 2008, pp. 7–8, doi: 10.1109/SOCD.2008.4815723.
- [25] S. Ke and L. Ruimin, “Furniture industry oriented computer-aided dragon and phoenix decoration graphic system,” in *2009 IEEE 10th International Conference on Computer-Aided Industrial Design & Conceptual Design*, 2009, pp. 1181–1183, doi: 10.1109/CAIDCD.2009.5375085.
- [26] D. Talbot and E. O.-Ponce, “Canadian banks’ responses to COVID-19: a strategic positioning analysis,” *Journal of Sustainable Finance & Investment*, vol. 12, no. 2, pp. 423–430, 2022, doi: 10.1080/20430795.2020.1771982.
- [27] K. C. Tseng and C.-H. Chu, “A novel systematic approach for product variant design using one-step quality function deployment,” in *2009 11th IEEE International Conference on Computer-Aided Design and Computer Graphics*, 2009, pp. 552–556, doi: 10.1109/CADCG.2009.5246840.
- [28] W. Pin and S. L.-zhi, “Design and realization of NC graphic programming system,” in *2010 Second World Congress on Software Engineering*, vol. 1, pp. 26–29, 2010, doi: 10.1109/WCSE.2010.54.
- [29] D. Wójcik and S. Ioannou, “COVID-19 and finance: market developments so far and potential impacts on the financial sector and centres,” *Tijdschrift voor Economische en Sociale Geografie*, vol. 111, no. 3, pp. 387–400, 2020, doi: 10.1111/tesg.12434.
- [30] X. Xie, H. Wang, and Z. Huang, “Implementation of a graphics design framework on the web,” in *Proceedings the Eighth Pacific Conference on Computer Graphics and Applications*, 2000, pp. 421–422, doi: 10.1109/PCCGA.2000.883975.
- [31] P. Bowen and L. Hua, “Analysis of computer graphic image design and visual communication design,” *Journal of Physics: Conference Series*, vol. 1827, no. 1, pp. 1–6, 2021, doi: 10.1088/1742-6596/1827/1/012141.
- [32] A. G. Birhanu, P. Geiler, L. Renneboog, and Y. Zhao, “Acquisition experience and director remuneration,” *Journal of International Financial Markets, Institutions & Money*, vol. 75, pp. 1–25, 2021, doi: 10.2139/ssrn.3659889.
- [33] M. M. Alshater, I. Kampouris, H. Marashdeh, O. F. Atayah, and H. Banna, “Early warning system to predict energy prices: the role of artificial intelligence and machine learning,” *Annals of Operations Research*, pp. 1–37, 2022, doi: 10.1007/s10479-022-04908-9.
- [34] A. Samitas, E. Kampouris, and D. Kenourgios, “Machine learning as an early warning system to predict financial crisis,” *International Review of Financial Analysis*, vol. 71, 2020, doi: 10.1016/j.irfa.2020.101507.
- [35] Z. Yang, S. Jiao, D. Zhang, and A. Gofuku, “A novel graphic interface design for the navigation of remotely controlled rescue robot,” in *2006 IEEE International Conference on Robotics and Biomimetics*, 2006, pp. 589–594, doi: 10.1109/ROBIO.2006.340266.
- [36] Z. Ying, “Product design for low-income group base on user-centered design,” in *2010 International Symposium on Computational Intelligence and Design*, 2010, pp. 6–9, doi: 10.1109/ISCID.2010.86.
- [37] Y. Pu, Y. Su, X. Wei, W. Qian, Z. Zhao, and D. Xu, “A system used for collecting and managing graphic elements of Yunnan heavy color painting,” in *2010 International Conference on Image Analysis and Signal Processing*, 2010, pp. 155–158, doi: 10.1109/IASP.2010.5476140.
- [38] P. Ralph *et al.*, “Pandemic programming: how COVID-19 affects software developers and how their organizations can help,” *Empirical Software Engineering*, vol. 25, no. 6, pp. 4927–4961, 2020, doi: 10.1007/s10664-020-09875-y.
- [39] C. Zhang, “A novel graphical UI design for futures trading,” in *2015 IEEE International Conference on Computer and Communications (ICCC)*, 2015, pp. 30–34, doi: 10.1109/CompComm.2015.7387535.
- [40] K. K. Himawan, J. Helmi, and J. P. Faggidae, “The sociocultural barriers of work-from-home arrangement due to COVID-19 pandemic in Asia: implications and future implementation,” *Knowledge and Process Management*, vol. 29, no. 2, pp. 185–193, 2022, doi: 10.1002/kpm.1708.
- [41] K. Pawlak and M. Kołodziejczak, “The role of agriculture in ensuring food security in developing countries: considerations in the context of the problem of sustainable food production,” *Sustainability*, vol. 12, no. 13, pp. 1–20, 2020, doi: 10.3390/su12135488.
- [42] V. Neiger and É. Schost, “Computing syzygies in finite dimension using fast linear algebra,” *Journal of Complexity*, vol. 60, 2020, doi: 10.1016/j.jco.2020.101502.
- [43] W. C. Tseng, C. C. Chen, C. C. Chang, and Y. H. Chu, “Estimating the economic impacts of climate change on infectious diseases: a case study on dengue fever in Taiwan,” *Climatic Change*, vol. 92, no. 1–2, pp. 123–140, 2009, doi: 10.1007/s10584-008-9437-6.

- [44] C. Lee, J. Suh, J. Baek, and Y. Choi, "Review of collision avoidance systems for mine safety management: development status and applications," *Tunnel and Underground Space*, vol. 27, no. 5, pp. 282–294, 2017, doi: 10.7474/TUS.2017.27.5.282.
- [45] S. Li *et al.*, "The role of oxidative stress and antioxidants in liver diseases," *International Journal of Molecular Sciences*, vol. 16, no. 11, pp. 26087–26124, 2015, doi: 10.3390/ijms161125942.
- [46] P. Y. Yuan and S. W. Cang, "Relationship between cold resistance of winter turnip rape varieties and their physiological characteristics," *Molecular Plant Breeding*, vol. 8, no. 2, pp. 335–339, 2010.
- [47] E. E. Başakın, Ö. Ekmekcioğlu, H. Çıtakoğlu, and M. Özger, "A new insight to the wind speed forecasting: robust multi-stage ensemble soft computing approach based on pre-processing uncertainty assessment," *Neural Computing and Applications*, vol. 34, no. 1, pp. 783–812, 2022, doi: 10.1007/s00521-021-06424-6.
- [48] F. J. R.-Ojeda, A. I. Rupérez, C. G.-Llorente, A. Gil, and C. M. Aguilera, "Cell models and their application for studying adipogenic differentiation in relation to obesity: a review," *International Journal of Molecular Sciences*, vol. 17, no. 7, pp. 1–26, 2016, doi: 10.3390/ijms17071040.
- [49] M. K.-Czarnecka, S. L. Piano, and A. Saltelli, "Quantitative storytelling in the making of a composite indicator," *Social Indicators Research*, vol. 149, no. 3, pp. 775–802, 2020, doi: 10.1007/s11205-020-02276-0.
- [50] M. Haberland, R. L. Montgomery, and E. N. Olson, "The many roles of histone deacetylases in development and physiology: Implications for disease and therapy," *Nature Reviews Genetics*, vol. 10, no. 1, pp. 32–42, 2009, doi: 10.1038/nrg2485.
- [51] X. Huang *et al.*, "A map of rice genome variation reveals the origin of cultivated rice," *Nature*, vol. 490, no. 7421, pp. 497–501, 2012, doi: 10.1038/nature11532.
- [52] R. G.-Bombarelli *et al.*, "Design of efficient molecular organic light-emitting diodes by a high-throughput virtual screening and experimental approach," *Nature Materials*, vol. 15, no. 10, pp. 1120–1127, 2016, doi: 10.1038/nmat4717.

BIOGRAPHY OF AUTHOR



Milad Mohseni    received the BA and M.Sc. degrees in computer architecture from the Science and Research Branch, Islamic Azad University (IAU), Tabriz, Iran, in 2015 and 2021, respectively. His research interests include cloud and non-volatile memory, the internet of thing (IoT), and computer architecture. He can be contacted at email: stu.m.mohseni@iaut.ac.ir.