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The Application of Predictive Learning in Islamic Finance: A Review

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Abstract: **-** Incorporation of Predictive Learning in Islamic Finance is catching up as Islamic Finance has the potential and scope to improve decision making and risk management capabilities. This involves the application of Predictive Learning which is a field in Machine Learning that focuses on harnessing historical information to provide forecasts of the future changes ups and downside of the Islamic financial systems. Thus, this study aims to investigate the use of predictive learning in enhancing the Islamic finance and especially focuses on asset management, risk management, and ensuring compliance with Shariah principles. The paper reviews the role of such predictive models to forecast the behaviour of the market, enhance the portfolio returns and the risk of violating any of the Islamic finance regulations such as riba (interest) and gharar (in excess of uncertainties). The main idea is to explore the use of Predictive Learning Algorithm within Islamic Finance through relevant case studies and current research, the main advantage, and therefore present the advantages, disadvantages, and ethical implications. According to the results, it is found that the enhancement of the Islamic finance practices can be promising with the use of the predictive learning technology, however, more studies are needed to deal with data integrity, model explainability, and compatibility with Islamic ethical principles. In the end, this article that adds to the existing literature on technology and Islamic finance, engenders prospects for technology enhancement in Islamic finance.

Keywords: Predictive Learning, Islamic Finance, Machine Learning, Risk Management, Shariah Compliance, Financial Forecasting

1. INTRODUCTION

Islamic finance has grown immensely over the past few decades and has grown to be more and more appealing and essential to global investors. Indeed, at the core, Sharia prohibits the practice of riba in moneylending. It also forbids the practice of gharar, that is, or speculative involvement of anything uncertain in the cone of investment in association with haram, or forbidden, things. Despite fast growth in Islamic financial activities, Islamic financial institutions held a market share of just around 1.2 percent globally. Efforts are already progressing on improving the decision-making processes to be followed in Islamic financial institutions. Let us allow Islamic prediction learning, an up-coming learning in modern finance, to be reviewed if at all it will be properly applied in Islamic finance. Suppose prediction learning is to enable prediction of an Islamic financial institution's Sharia compliant risk-adjusted assets needed for Islamic investment and fund management (Kadi, 2022).

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Islamic finance is referred to as the financial transaction that is found to be procured in conformity with the Sharia law. Islamic finance was gradually grown much in the past few centuries and analysis has become the most increasing investment in terms of attractiveness and faith for global investors. The rather rapid growth of Islam Finance was during the last financial crisis that had exposed the weaknesses of the existing conventional financial system and attracted people to look for the way of this type of finance. Although Islamic finance has accomplished significant growth so far, the global share of Islamic financial institutions is around 1.2 %. Muslim commercial venture is formed under the provisions of Islamic law, and thus regulations include a ban on interest (riba), infinite risk (gharar), and investments in haram activities. Consequently, all its transactions are required to be asset-based, with the matter of establishing justice and equality in transactions assumed to be of prime importance for the issuer. With regard to global share and the recent growth of Islamic financial institutions, efforts are now under way to boost the decision-making processes to be followed by Islamic financial institutions. Indeed, there are steps underway and undercurrents to build up a sharia-compliant decision-making system. Therefore an exercise would be conducted to see whether predictive learning, a contemporary learning in today's finance, could be well inlined with Islamic finance. If it offers risk-calibrated Sharia-compliant predictions of asset allocation so necessary for investment fund management in Islamic finance terms, then that is the way to proceed with prediction learning.

1.1. Overview of Predictive Learning

Predictive learning is a broad approach toward anticipating an outcome by observing intrinsic patterns in data which can support predictions about possible consequences or trends in the future. The classifications of analytics' predictive learning techniques might include statistical methods or machine learning because machine learning falls within the scope of the former training program framework. Both learn from data and improve over time. Predictive learning techniques have mostly been used in various sectors, including finance. The success of predicting techniques applied in finance has motivated researchers from different disciplines to experience the same in the finance context (Ryll & Seidens, 2019). Predictive analytics entails methods that enable insights into the future rather than the past or present. Predictive analytics encompasses statistical and machine learning models as well as data mining techniques as they apply-both in the field of the past or current data to predict future outcomes. Therefore, it is indispensable today for a company wanting to extract the most possible from their data and improve its real-time decision-making capabilities. There are further applications in other sectors from finance, such as sports, where managers are increasingly using data to improve decisions before the match. In banking, it helps control fraud in economic transactions. Both of these approaches are carried out along with a detailed history of each customer transaction and include variables such as historical data and account attributes, all of which helps identify fraudulent behavior of the customer. In health insurance, predictive models study the individual or group's medical claim history and predict future costs. The civil education sector utilizes predictive learning to study gradually an individual learner's learning behavior and accordingly shape the curriculum personalized to weak subjects. Such applications indicate diverse application possibilities of predictive learning (Sghir et al., 2022). In various fields, predictive learning is heavily used and is highly appreciated in the time of big data. Also, many developing countries who are now adopting Islamic financial mechanisms could also take honey out of predictive learning in Islamic finance due to many advantages it holds across the sectors. The important growth of predictive learning within Islamic finance could be seen as one of the bridges that would neutralize current slants in Islamic finance. The present benefits underline a rapidly growing value for predictive learning in the financial landscape.

1.2. Importance of Predictive Learning in Islamic Finance

This article explores unique challenges and opportunities in which predictive learning can be integrated into Islamic finance. It brings a new perspective in the use of said technologies in banks and financial services by reason of different principles and operations. However, it is seen as another of the more similar problems as conventional finance has, following the vaccines from the global economic recession. Predictive analytics, the process of utilizing known results for developing or training a model that can uncover unknown results - can help IBFIs to some extent overcome these issues by modernizing risk management, refining operational efficiency, and putting in place better customer relationship management. Yet adaptive IVI systems must respect the different Shariah principles and ethical guidelines upon which such development materializes. The global Islamic financial services industry also underwent severe corrosion during the recession in the same way as did conventional finance in the same period. It caused huge losses to IBFIs mainly due to significant investments, particularly in the high-risk investment products, further bringing about the need to borrow some cross-cultural culturalization during the predictive learning methodologies. Nevertheless, the promise in predictive learning would be that, if developed with a dynamic acculturation with the Islamic cultural and philosophical world, it would wholly turn over the global financial firms and banking systems.

Islamic financial institutions are one of the fastest growing sectors of the banking sector that can change the transaction processing and provision of services to the marginalized through predictive learning. The fundamental tenets of Islamic finance are aligned with microfinance perspectives-knowledge that makes IBFIs the ideal organization to provide new financial products and services for the under-banked and unbanked. The same is bound to be said, more or less, about predictive learning within such a context. However, as is true of the foregoing, modern forms of technology can help in expanding traditional Islamic financial offerings in times of recession. Some Islamic financial institutions have been very successful in predictive learning implementation, and it is what this publication will delve in. This is better known in banking as predictive modeling or simply modeling and can do many things for IBFIs. However, using these tools also has different challenges. Despite a multitude of challenges, predictive learning in general could play a critical role in the modernization of Islamic finance.

2. Foundations of Islamic Finance

Islamic finance is understood as the financial transactions that comply with Islam or Sharia laws. Therefore, one of the core principles that govern Islamic modes of financing is the prohibition of interest (riba) (M Said & Elangkovan, 2014). Islamic finance pursues the purpose of conventional finance, which is the maximization of profit, but Islamic finance fights from a different source. This concept ensures that returns on investment are not the only prop that they have; rather, it ensures that investments are ethically justifiable. This is to say that it is not allowed to invest in businesses that are practiced in gambling, alcohol, or illegal activities like pornography. In addition, the institutions involved in a financing deal operate entirely on debt, while Islamic finance predominantly emphasizes agreements with respect to sharing of risks, whereby both the lender and the borrower share responsibilities for the risks that face that investment. This financial concept refers saying that it is the West that is interest-bearing and not Islam, which is profit-based.

Islamic finance aims justice and fairness in financial transactions. The principles of Islamic finance related to financial transactions as much relates to its rules about contracts, transparency, and even pricing, as to customer as well as employee treatment. Ominous practices of exploitation, through secrecy or misinformation, are accordingly eliminated. So, the financial transaction under Islamic contexts involves fiqih, "a branch of jurisprudence." Therefore, the decree of a product's legitimacy and trustworthiness should be to comply with the Sharia laws as interpreted by fiqhi. Thus, Islamic financial institutions always have a board of scholars in Islam and fiqih to meet such criteria. Islamic finance, since the mid-1990s, has grown exponentially. Here, we can identify this growth through Islamic banks, Islamic insurance, Islamic capital market, and even in sharia-compliant conventional financial products such as sukuk bonds, equity, and derivatives.

The foundation of Islamic finance has more or less been institutionalized, but a rather emergent critique applies this relevantly in the majority of today's world. Critiques came from Middle East grounds as the relevance of Islamic banking being mostly imitation of conventional banking. Some conjure up that even Islamic banking could not avoid the sub-prime crises as imitation of conventional banking does on the bank side. This could not be done away with, as globalization threatened to encompass the whole world, Islamic over inclusive global financial system parallel convention. Thus, innovation becomes a necessity, but this innovation must lie within the borders of the foundation on which Islamic banking rests. Predictive learning is one of those learning modalities in machine learning which could be an innovation. The primary objective of the paper is thus the discussion of the feasibility of incorporating predictive learning in the foundations of Islamic finance. The problem may be fairly theoretical without any presentation of the fundamentals of Islamic finance prior to taking up predictive learning.

2.1. Key Principles of Islamic Finance

Islamic finance is built on shara-based utopian principles from the divine revelations in the Qur'an and the Sunnah (sayings of the Prophet Muhammad SAW). Such principles form the base for the entire Islamic financial system and can be considered universal, applicable in a variety of diverse economic and cultural situations. But this kind of adaptation has often resulted in significant-theoretical and practical divide.

An other option to be sure of it is Islamic financees in a completely different system from the Conventional Financial for the reason being that the finance is actually dependent on some of Shari'ah-based economic and financial values that might define human actions-material and non-material activities. It is regulating what things relax business activities and what is not allowed; in some respects impose on the possible activities, becoming just to the society. Thus, on one hand, it is possible to have freedom in incorporating business activities, competition, and the profit motive, but on the other hand, it goes with moral and social dimensions of management (Said & Elangkovan, 2014).

The key principles of Islamic finance that ensure a socially responsible system are risk sharing, prohibition on riba or interest, prohibition on gharar or uncertainty, prohibition on haram or forbidden activities, ethical investments, ensuring equitable distribution of wealth, and transparency and accountability. The first three principles are regarded as the primary influences, whereas the latter four are supplementary.

Riba or interest is prohibited in Islam on moral as well as socio-economic grounds. This is closely related to the difference between both systems, Islamic and conventional. The differential over riba arises from anti riba-based aspects of profit and loss nature of Islamic financial and economic systems. Speculation, which primarily tends to deceive the society economically, emanates from gharar or uncertainty. Every business is risky when undertaking it; however, given a certain extent of risk can be acceptable with the practices, while rampant risk from uncertainties is negated- hence calculated risks are encouraged: everything that can lead to speculation can engage the customers in committing illegal acts with one another; even gambling, in itself a self-destructive and antisocial act, is haram. Gharar differs even more than uncertainty would in that it somehow refers to the notion of gambling.

These are the operational side of the Shari'a-compliant Islamic financial market, Islamic financial terms. These principles are put into effect by Islamic financial products. Sharia-compliant financial products are combinations of Shariah-compliant contracts or instruments. This while not only continuing the use of forbidden principles defines the permissible instruments as those that conform to shariah principles. Islamic finance has financial instruments that are more or less about partnership such as mudarabah and musharakah, lease-based like ijarah, and profit and loss instruments such as murabaha, bay‘ bi‘ ithman ajil, and istisna‘. Account to profit-sharing investment or PIA includes documents that can be termed as Shari'ah compliant other such as Sukuk, Takaful, and Islamic credit cards.

Takaful is a Shari'a-compliant alternative to the conventional insurance system. It follows what is referred to as a mutual guarantee principle by means of the use of three agreements: the takaful contract itself, an investment agreement, and an agency agreement. The asset bases of the takaful funds are built through the contribution from the participants, using the fund to invest in things that are Shari'ah permissible, with the profits earned from such investment being shared by the participants and the operators, but the losses taken by the participants. Sukuk are Islamic bond securities which are the equivalent of conventional bonds. Unlike those issuing debt instruments based on interest, Sukuk is created under ownership bad expectations in the underlying assets involved.

Trust is the groundwork of any financial system. Hence, neither can it become a matter of seeking or building trust by means of following ethics, and self-enforcement is not possible. That is why the financial system which is not subject to ethics is quite fragile-that is how shari'a compliant demonstration is in the islamic finance. It upholds as well transparency and accountability so that Islamic financial institutions can engage in suitable performance of their social responsibility. The main concern with the concerns would involve stakeholders assessing punishment against the firm. Hence, besides external auditors carrying out formal audits, also necessary is continuous supervision carried out by the internal shari'ah advisory council.

3. Predictive Learning Techniques

Predictive learning is a concept useful for application in the financial field. This discusses some high-level and practical positions to define significant terms, show practice which includes learning, cites real-life examples, as well as anecdotes. The algorithm list spans regression, classification, and clustering-this is due to being one of the best-known and widely used ML techniques. A precise overview should be given for each of these with the advantages and disadvantages of each and also their use in finance being adequately addressed in the example of predictive case studies.

The target in developing predictive models or supervised models is mostly to analyse a historical record of the expected outcome of some variables. Strategy should be interrupted if a high stock has more estimates since an insufficient data quality is converted in predictive models. More or less liquid stocks may be very well few, and asset management companies may have regenerated models over the hundreds of funds with only one firm with models of the covered stocks in the firm, and it is shared across the portfolios (Ryll & Seidens, 2019). The financial time series follow past behavior; thus, any change according to shock or event destroys the model. To cure this defect when the paradigm is broken due to rapid changes, predictive horizon should adjust to the change rate. Predictions over many horizons become unreliable. All predefined models must criticise or believe in the efficiency of the market. No model can say that it explained the whole market, but all models bring broad simplification. Financial "laws" usually reside in the history of observations. The modeling and predictive systems only explain past behavior but not a real understanding.

The financial restrictions on financial modeling poses further limitations. An excess in risk due to chancellor's very high security or model-overfitting cause colossal disasters. Multiple models that cannot have significantly higher returns due to budget dilution either create more models with the terms also repeated across units. Market dynamics stretch and shrink time scales. ML/AI tools are not the guarantee of creating better models; these are only additions to current modeling done. Approaches should be practical in matters-applying all early warning systems to all financial modeling pitfalls. They must also adjust to financial refocusing from generally accepted models for predictive learning designed in AI/ML. This is for the financial institutions which aim to adopt predictive learning techniques for innovative purposes.

The aim of the section is to provide an overview of the popular and important predictive learning techniques applied to repeated decision-making in various areas of the finance industry. The actual prediction of these uncertainties will significantly help put the case studies in perspective. Example results from the real world enlighten how they differ from anticipation of results. And it winds up on predictive learning techniques. Modeling should not be singing NRA praises but instead, it should be satisfied by modeling approaches, examples, and learned lessons from their application.

3.1. Machine Learning Algorithms in Finance

The financial world has been keenly interested in the development of predictive learning algorithms, which are playing an increasingly important role in the construction and progression of machine-learning algorithms.

It is on the point of predicting that these algorithms become more powerful as they get more complex and incorporate greater volumes of data-so this is where applications increase in finance (Ryll & Seidens, 2019). This paper discusses the implementation of these algorithms specifically for the financial world, which is notably impacted by predictive learning.

There are three main types of machine learning: supervised learning, unsupervised learning, and reinforcement learning, with each used for a different purpose. Financial data tends to be analyzed traditionally utilizing statistical approaches, although the rise of big data and the need to process this data swiftly and adequately has sparked an increased interest and application of machine learning algorithms in finance. These could, for example, assist financial institutions in themselves forecasting market trends, customer behavior, credit risks, and other areas-in most cases, enormously increasing the competitiveness of these organizations. One very well-known application is algorithmic trading, where trades are executed purely on predictions produced by algorithms. An investment strategy result that trades are initiated and closed extremely quickly-meaning within milliseconds, and often even within microseconds-which relies on algorithms using machine learning to process great amounts of data rapidly and with high accuracy. It has unique benefits in increasing complexity, efficiency, and lowering costs. However, precisely due to these attributes, it can lead to major economic disruptions because of algorithmic bias. So, therefore, matters of ethics should be considered in algorithm design and implementation but especially in Islamic finance, where Sharia compliance calls for additional safeguards. Machine learning combined with Islamic finance is having a notable effect on the innovation boundary, as many different algorithms inside classical finance might be put to test within the boundaries of an Islamic financial institution. Besides that, the algorithms also relate how much they can be further refined to be more accurate in predicting particular Islamic financial market data.

An ultimate purpose of this machine learning is probably the same kind of criticism and cynicism that can be possible for any tool: bias imbedded in training data would only get projected in the results; while the complexity of a deep-learning model makes it tough to balance it.

4. Case Studies

This part showcases a combination of case studies bearing the practical prerequisites of predictive learning in the context of Islamic financial practices. A variety from cases selected goes on to focus on Islamic financial institutions, too, where they have successfully embedded predictive learning into their operation. It examines the resilience directed to decision-making processes, risk assessment, or customer engagement strategies influenced by predictive models. This discussion should bring into the open the hurdles faced during implementation and the adaptive measures followed. In this way, real-world patterns or applications of predictive learning in Islamic finance shall be mirrored in readers' minds.

As the institutions and initiatives at the core of this story continue to be at early stages as well as being largely unknown to the public, little has been said about their historical background, except in ways about narrative empathy for how predictive learning implicates a human face in the lives of different stakeholders, such as employees, clients, and beneficiaries. Those who use nothing but well-known facts are utilized to underscore how predictive learning in these institutions or settings has significantly led to enhancement of financial inclusion and social benefits for the often ignored parts of society. Each case study, therefore, serves as a rhetorical narrative to inspire reflection on the lessons learned and encourage readers to move into considering what has been achieved, how replicable the successes and what can be improved.

The objective in writing this was not to scrutinize each case as much as to increase thinking and debate; at times, human capital or technology expertise have surely challenged the past successes of many cases. So, then, the cases demand of the readers themselves active brainstorming as to how such innovation of comparable opportunities can be realized under given strengths and settings. Let it now be known here that there has to be active participation from the part of people and perhaps collaboration between tech and finance professionals to ensure that innovative speed moves are matched with similar transformative journeys through such kind of narratives for the armatures. Thus, these cases may serve as the carefree spirit to those who want to be part of this kind of transformation.

Finally, equal importance signifies the necessity of relaying real-life implications when it comes to theoretical and other impartations of predictive learning in Islamic finance. There are numbers of case studies from traditional finance and philanthropy sectors with which practically nothing for applied Islamic finance can be said. Desired is to show the idea of changing effects of predictive learning that are essential for society overall (Rozzani, 2018).

4.1. Predictive Learning in Islamic Banking

These are few of the examples where predictive learning is gaining prevalence within Islamic banking. The increase in feasibility and affordability of predictive learning have caused much higher adoption of the predictive learning technology by Islamic banks. A few examples of predictive models applied in Islamic banks are Bank Muamalat Indonesia, which applies MRA technique to predict the best mix of the bank's funding and investment portfolios to maximize return in combination with minimum risk, being in compliance with the Sharia principles. This MRA model has been shown to be vastly superior to other models, and it can evaluate the previous month's portfolio mix. Bai al-Mudarabah is the most commonly used investment contract within an Islamic bank, where banks are performing the role of fund managers and they are entitled to a profit share from the depositors. An effective strategy on fund investment shall also be put forward in order to have an optimal ratio of expected return against risk. In contrast to the ordinary bank that might invest in non-compliant assets with interest, an Islamic bank should tie up its assets in compliance with Islamic jurisprudential principles.

Bank Syariah Mandiri employs MRA under the largest Indonesian bank from an Islamic perspective for best prediction portfolio mix of its funding and investment, according to Sharia law. The MRA is preferred as it is most outstanding in such types of portfolio selections as it accommodates both qualitative and quantitive criteria for portfolio selection. The performance of the MRA model in predicting such criteria was found to be well above standard linear programming. The model is able to calculate portfolios of the previous month so that it stands as an early warning system in case of large sudden changes. The potential of predictive learning among Islamic banks will become more significant since most of them are quite young and therefore less experienced in investments, something for saving themselves from possible future losses. What the MRA model means to Bank Syariah Mandiri-if nothing else-is that in this case adherence to Sharia can easily coexist with innovative efforts in predictive technology. (Anwar & Hasan Ali, 2018)

Bank Islam Malaysia Berhad (BIMB) works with Naïve Bayes predictive models on categorization of customers by their credit worthiness because the researchers realized that by the more method match, they have a bunch of filtering on the classification models and found that the best model has a very high prediction performance level compared to other models. The data of the customers are analyzed to improve the delivery of the service delivery of the Islamic bank and customer satisfaction. These services could then be personalized to each customer's profile, behavior, and needs through the use of predictive analytics models. Classification of customers into credit worthiness is the most common application of predictive learning in Islamic banks. This application is particularly useful to Islamic banks in granting credit in accordance with the Shariah principles and also in minimizing the risk of defaults.

Dubai Islamic Bank (DIB) uses logistic regression to manage credit risk models on personal finance, home finance, and auto finance products. This model also forecast the probability of accounts default according to the characteristic of the account at the approval stage. The model also provides additional benefits for implementing the performance of the product by improving the compliance over the high risk accounts to make sure that the account is not only in compliance with Sharia principles but also improve the data-driven strategy on Shariah compliance product in DIB by reducing default accounts and increasing the compliance of the key risk parameters. Besides managing credit risk against predictive models, compliance risk models are seen, especially in Anti-Money Laundering (AML) efforts. For a pulse, Islamic banks like conventional banks are supposed to comply with regulations related to AML. A predictive model framework based on transaction monitoring system can be documented at an essential level of Central Bank regulations and Shari'a guidelines. However, although it has been designed for conventional banks, but from the rules, the very basic ideas still can apply for the Islamic banks under Shari'a compliance. It is an attempt to identify suspects of money laundering within the financial transactions using predictive models such as decision tree, support vector machine, neural networks, among others. Finally, it will help investigation regarding the performance of predictive modelling in detecting money laundering based on the transaction information with a synthetic data set.

5. Challenges and Future Directions

The way to integrate predictive learning concepts within Islamic Finance- Significant challenges. The most basic barrier would be the regulatory constraints that Islamic Finance companies have to observe whenever they intend to use any new technology. However, whether the institution is Islamic or non-Islamic, privacy concerns emerge as data across all aspects of learning predictive technologies. Regulatory authorities may well restrict the extent to which predictive learning technology can be made overseas applicable, or even put stringent data-sharing obligations on the companies. Such challenges would remain challenging unless local regulatory bodies provide clear guidelines as to how an institution could exploit new technologies there (H. Omar and E. Yusoff,2019). Training and awareness programs could be of much help to Islamic financial institutions in overcoming such compliance barriers. Furthermore, the methodologies within predictive learning solutions should develop Sharia-compliant principles learned from academia in collaboration with industry partners.

With the interest placed on sustainability in most of the Islamic Finance paradigms, predictive learning technology developers would find it beneficial. The broader implementation scope of predictive learning in Islamic finance would also proceed through joint research programs involving industry partners directly. These collaborations will provide a support system in ensuring that any newly developed technique is easily applied for real-world implementations as opposed to purely theoretical developments. Particularly for Islamic financial institutions, the illustrated technology transfer gap is high, which is related to their relatively lower risk appetite and resistance to any fundamental changes to their daily-business mode. The possibilities of applying the principles of predictive learning in Islamic financial institutions are still quite feasible and can adapt to the institutions of such financial leanings, albeit the high preparatory work needed to convince such institutions to shift to implementing beneficial new technologies (Altawati and Fhema,2019).

Further training in awareness and programs must be initiated for finance professionals in implementing the technologies of predictive technology to attain a successful transformation. Educating finance specialists on the fundamentals of data-driven tech and means of optimizing their advantages would significantly increase adopting rates of the technology. This may be of particular significance to the Islamic financial institutions depending mainly on their in-house expertise with model development and not employing external consultants. These are the types of changes one could observe as predictive learning principles are likely to be wholly accepted in Islamic finance in a not-so-remote future that would bring value to operations efficiency and make the system that much more sustainable. For global economic growth, the viability of any of the changes proposed above will finally be molded into standard practices or into new systems that arise in the future.

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