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Please read this disclaimer before proceeding:

22AI001

AI in Blockchain

Batch/Year: 2022-2026/IV

Created by:

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Course Objectives

Course Objectives

❀ To acquire knowledge in Blockchain Technologies.

❀ To Understand how block chain and AI can be used to innovate.

❀ To explain Cryptocurrencies and AI.

❀ To develop applications using blockchain.

❀ To understand the limitations and future scope of AI in Blockchain.
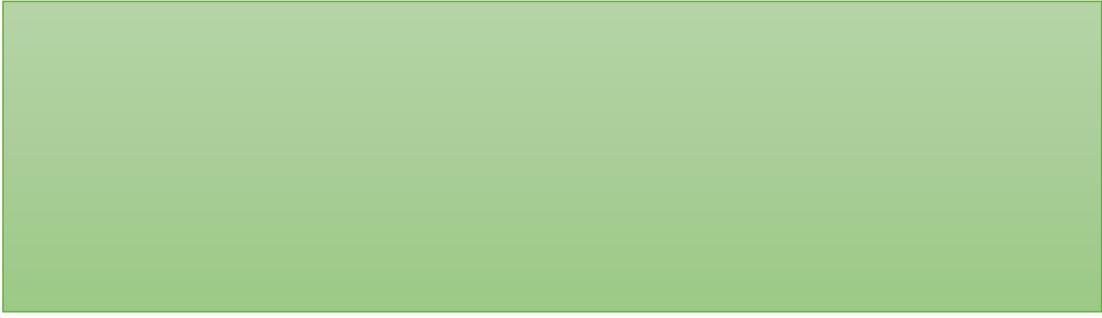
PRE REQUISITES

Prerequisites

Basics of Cryptography

Syllabus

SYLLABUS

22AI001	AI in BLOCK CHAIN	L	T	P	C
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OBJECTIVES:
- To acquire knowledge in Blockchain Technologies.
- To understand how block chain and AI can be used to innovate.
- To elaborate Cryptocurrencies and AI.
- To develop applications using blockchain.
- To understand the limitations and future scope of AI in Blockchain.

UNIT I	INTRODUCTION TO BLOCKCHAIN	9

Overview – Blockchain vs Distributed Ledger Technology vs Distributed Databases – Public vs private vs permissioned blockchains – Privacy in blockchains – Blockchain platforms - Hyperledger – Hashgraph, Corda – IOTA - Consensus Algorithms – Building DApps with blockchain tools.

UNIT II	BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE	9

Introduction to the AI landscape - AI and Blockchain driven Databases – Centralized vs Distributed data – Blockchain data – Big data for AI analysis – Global databases – Data Management in a DAO - Benefits of combining blockchain and AI – Aicumen Technologies -Combining blockchain and AI to humanize digital interactions.

UNIT III	CRYPTOCURRENCY AND AI	9

Bitcoins – Ethereum - Role of AI in cryptocurrency – cryptocurrency trading – Making price predictions with AI – Market making – future of cryptocurrencies.

UNIT IV	DEVELOPING BLOCKCHAIN PRODUCTS	9

Development Life Cycle of a DIApp – Designing a DIApp – Developing a DIApp – Testing – Deploying – Monitoring – Implementing DIApps.

UNIT V	LIMITATIONS AND FUTURE OF AI WITH BLOCKCHAIN	9

Technical Challenges – Business Model Challenges – Scandals and Public perception – Government Regulation – Privacy Challenges for Personal Records – Convergence of AI with Blockchain – Future – Enterprise.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students will be able to:
- **CO1**: Acquire knowledge in Blockchain Technologies.
- **CO2**: Understand how block chain and AI can be used to innovate.
- **CO3**: Elaborate Cryptocurrencies and AI.
- **CO4**: Develop applications using blockchain.
- **CO5**: Understand the limitations and future scope of AI in Blockchain.
- **CO6**: Elaborate the various applications of AI in Blockchain.

TEXT BOOKS:
1. Ganesh Prasad Kumble, Anantha Krishnan, "Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies", Packt Publications, 2020.
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015.

REFERENCES:
1. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017.

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Course Outcomes

Course Outcomes

CO#	COs	K Level
CO1	Acquire knowledge in Blockchain Technologies	K1
CO2	Understand how block chain and AI can be used to innovate.	K2
CO3	Explain Cryptocurrencies and AI.	K2
CO4	Develop applications using blockchain.	K4
CO5	Understand the limitations and future scope of AI in Blockchain.	K4
CO6	Elaborate the various applications of AI in Blockchain.	K4

Knowledge Level	Description
K6	Evaluation
K5	Synthesis
K4	Analysis
K3	Application
K2	Comprehension
K1	Knowledge

CO – PO/PSO Mapping

CO – PO /PSO Mapping Matrix

CO #	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS0 3
CO1	3	3	2	1	1	-	-	-	2	-	-	2	3	2	-
CO2	3	2	2	2	2	-	-	-	2	-	-	2	3	2	-
CO3	3	3	2	2	2	-	-	-	2	-	-	2	3	2	-
CO4	3	2	2	2	2	-	-	-	2	-	-	2	3	3	-
CO5	3	2	2	2	2	-	-	-	2	-	-	2	3	2	-
CO6	2	2	1	1	1	-	-	-	2	-	-	2	3	2	-

Lecture Plan

Unit III

Lecture Plan – Unit 3 –Cryptocurrency and AI

Sl. No.	Topic	Number of Periods	Proposed Date	Actual Lecture Date	CO	Taxonomy Level	Mode of Delivery
1	Bitcoins & Ethereum	1	29.08.2025	29.08.2025	CO3	K2	Chalk & Talk
2	Role of AI in cryptocurrency	1	29.08.2025	29.08.2025	CO3	K2	Chalk & Talk
3	cryptocurrency trading	1	01.09.2025	01.09.2025	CO3	K2	Chalk & Talk
4	cryptocurrency trading	1	02.09.2025	02.09.2025	CO3	K2	Chalk & Talk
5	Making price predictions with AI	1	03.09.2025	03.09.2025	CO3	K3	Chalk & Talk
6	Making price predictions with AI	1	05.09.2025	05.09.2025	CO3	K3	Chalk & Talk
7	Market making	1	05.09.2025	05.09.2025	CO3	K2	Chalk & Talk
8	Market making	1	06.09.2025	06.09.2025	CO3	K3	Chalk & Talk
9	future of cryptocurrencies	1	06.09.2025	06.09.2025	CO3	K3	Chalk Talk &ICT Tools

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Activity Based Learning

Activity Based Learning

one person would serve as a centralized service (such as Visa or Mastercard) that would approve transactions on the network of the people in the room. Then in the next phase of the activity we would have everyone in the room be miners and transactors. We would contrast this by broadcasting the transaction to everyone in the room and determining if the transaction was valid. This would show a fundamental concept that is the decentralized nature of the blockchain.

Each table that is their own mining node would have a few roles: recorder, verifier, roller. The recorder enters new transactions. The verifier checks previous transactions to verify that the parties have enough funds in order to make the proposed transaction. The roller rolls dice trying to get them all to be 1's. This simulates the proof of work aspect of bitcoin mining.

Lecture Notes – Unit 3

UNIT 3

3.1 The role of AI in cryptocurrency

Cryptocurrencies have enabled users across the globe to carry out commercial operations in a personal capacity as well as in an institutional capacity. This has reduced dependencies across the value chain, and has disintermediated the role of the stakeholders.

Cryptocurrencies such as Bitcoin, Ethereum, and Ripple (under some constraints) have enabled a large number of people to disintermediate or explore new white spaces in the economy, including concepts such as Non-Fungible Tokens (NFTs), an Initial Coin Offering (ICO), and a Decentralized Autonomous Organization (DAO).

AI, on the other hand, has been utilized in the Banking, Financial Services, and Insurance (BFSI) industry to reduce operational risks across borders, thereby leading to effective profit-making among institutions.

The convergence of both technologies can be mutually beneficial to AI and to the cryptocurrencies.

Emerging need for cryptocurrency in the world with the following table of contrasts:

Fiat currency	Cryptocurrency
Most of these are minted by the government under the Fractional reserve banking or quantitative easing models.	Minted by the miners or validator nodes under a voted scheme of the network fee model.
Not all fiat currencies are in digital form, hence difficult to trace and appropriate taxes.	Most cryptocurrencies are digital, with transparent transactions, and this helps pave the way for ideal tax compliance.
Usually regulated by a national-level federal bank through active monetary policies.	Cryptocurrencies are decentralized. Hence, it is challenging to regulate them all of them by a country.
Money transfers and settlements may take days.	Monetary transfers are near-immediate, followed by finality within a few minutes.
Digital money may not be highly secure, due to centralization, and hence are vulnerable to cyber threats.	Effective in managing consistency. Hackers may not be able to hack all the nodes hosting the open ledger.
May not be highly volatile compared to cryptocurrencies.	Highly volatile compared to traditional currencies and money markets, due to speculation.

3.2 Cryptocurrency trading

Trading cryptocurrencies has become a global alternative to wealth creation, apart from offering liquidity in the space for users in the respective blockchain platforms.

Several entities, ranging from small crypto exchanges to billion-dollar hedge funds, offer wealth management services both directly and indirectly for their clients, in the form of trading services. With well over 2,000 cryptocurrencies floating on multiple blockchains, and access to purchase, use, and trade, the holding of cryptocurrencies has never been easier over the internet.

With the highest market capitalization of all the cryptocurrencies crossing 500 billion US Dollars (USD) in 2018, cryptocurrency has been regarded as an alternative wealth creation medium in the long term.
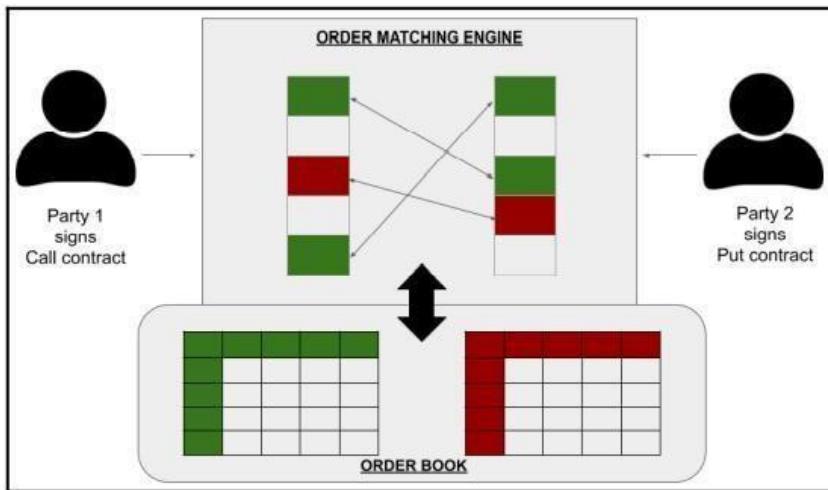
Fig 6.1: Working illustration of cryptocurrency trading in a decentralized exchange

The preceding diagram is a generic demonstration of how two users in a cryptocurrency exchange perform trading to buy or sell tokens. Party 2 is willing to sell a cryptocurrency or a token at a predetermined cost on a particular date and at a particular time.

This information, along with the number of tokens the party is willing to sell, is mentioned when placing a PUT option. Similarly, Party 1 is interested in purchasing the corresponding cryptocurrency asset for a desired rate that is placed in a CALL option. Both options are received by a matching engine, which is an algorithm run by every exchange to help parties execute the trade based on identifying mutually agreeable buy and sell prices.

Hence, matching engines are efficient and effective enough to perform the best trade in a short period of time.

Issues and special considerations

Although there has been an impressive growth in wealth creation using cryptocurrency trading, the market is still inefficient due to the following reasons:

- Difficulty determining sharp volatilities in the market
- Lack of an intelligent order-matching engine that allows users to estimate the right values for their holdings
- Inability to calculate predictable risks due to mixed responses in the market
- Weak cybersecurity strategy in protecting wallets from attacks, leading to more than a billion USD worth of crypto being lost to hacking

Benefits of AI in crypto trading

Several AI techniques such as Machine learning (ML) and Deep Learning (DL) based on quantitative (time series and so on) and non-quantitative (news, social reputation, and so on) data can be applied in the field of crypto trading.

The benefits are that it can help investments toward more success, with a sharper ability to detect anomalies in trading trends, react quickly without human intervention to critical situations using trading bots, and establish an aggregated signal that represents the emotions of buyers and sellers.

Also, the application of AI can bring remarkable security enforcements in password generation, detecting physical characteristics such as iris, retina, and other biometric identities to protect wallets organized and managed by the cryptocurrency exchanges or hedge funds. This means that user funds are also safe from anomalies in logins.

3.3 Making price predictions with AI

Traditional markets, as well as the cryptocurrency market, are considered efficient if the growth of market capitalization increases gradually over time. One dimension of the market that deserves more attention in making margins has always been price prediction. Predictive

analytical concepts have been put into practice in traditional markets for money making through algorithmic trading.

Several timestamped datasets serve as an input to a model that is able to classify whether a stock or a cryptocurrency price has increased or decreased based on dynamics such as news, announcements, and also reactions of the market to any regulatory actions made to a specific cryptocurrency.

Issues with price prediction

The top two issues with regard to price prediction of cryptocurrencies are detailed as follows:

Unable to adjust the algorithms to crypto market sentiments

Unable to maintain and measure liquidity

There is a growing application of AI techniques such as neural networks in predicting the price of a publicly traded cryptocurrency. In contrast to price prediction in stock markets, crypto markets are highly volatile, with various attributes such as technical advancements, announcements, and emerging competition affecting the price with relatively higher sensitivity. Hence, ML may not be effective in these scenarios.

Although the data features used to train models are similar to traditional stock markets, the preceding factors are considered while choosing DL techniques. We will explore the application of an artificial Recurrent Neural Network (RNN) in an architecture generally called Long Short-Term Memory (LSTM).

The following diagram is a representation of an LSTM cell, along with a depiction of how functions are applied to it:
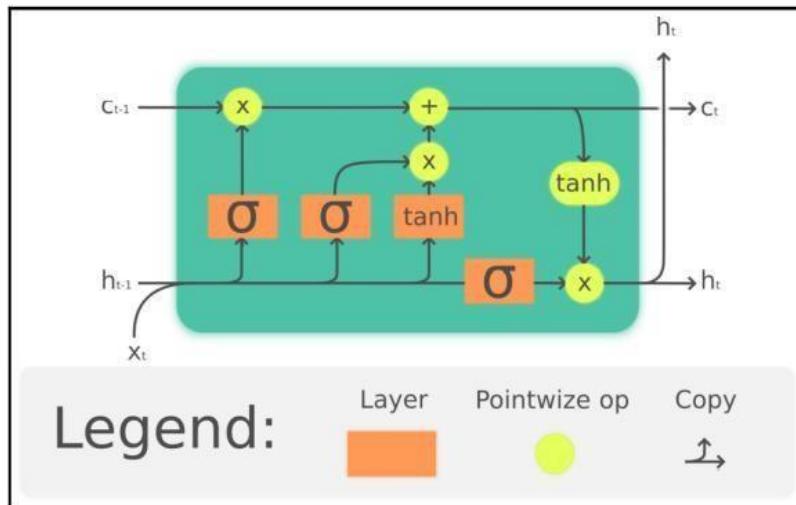
Fig 6.2: The repeating module in an LSTM cell contains four interacting layers

With the LSTM approach, the cryptocurrency trading data is grouped under basic common attributes such as open price, close price, high price, low price, and volume, detailed as follows:

- Open Price refers to the price of the cryptocurrency at the beginning of the day.
- Close Price refers to the price of the cryptocurrency at the end of the day.
- High Price refers to the highest value recorded versus the USD on that particular day.
- Low Price refers to the lowest value recorded versus the USD on that particular day.
- Volume refers to the total number of units traded on that particular day.

The preceding five attributes can be extracted for any given day from most of the cryptocurrency exchanges through the OpenAPI specification. The extracted information can be pruned into a dataset based on different styles preferred by individuals or tools. Generally, the dataset has to be split into three parts: 60% of the data points for

training, 20% for validation, and 20% for testing. The LSTM model has a unique capability of identifying the patterns while processing the data, and also forgets any unnecessary information in the dataset. This information is now fed into the LSTM cells, along with the necessary activation functions, through multiple gates.

An example of the application of LSTM in price prediction of cryptocurrencies.

The following example is the work of Abhinav Sagar, a research assistant at Vellore Institute of Technology (VIT) (https://github.com/abhinavsagar/Cryptocurrency Price-Prediction). The model is comprised of the three basic layers: an input layer, a hidden layer, and an output layer. So, the neural network will be composed of these layers with a linear activation function. The model is compiled using Adam as the optimizer and Mean Squared Error (MSE) as the loss function.

The following graph shows the output from the LSTM-based price prediction algorithm for Bitcoin:
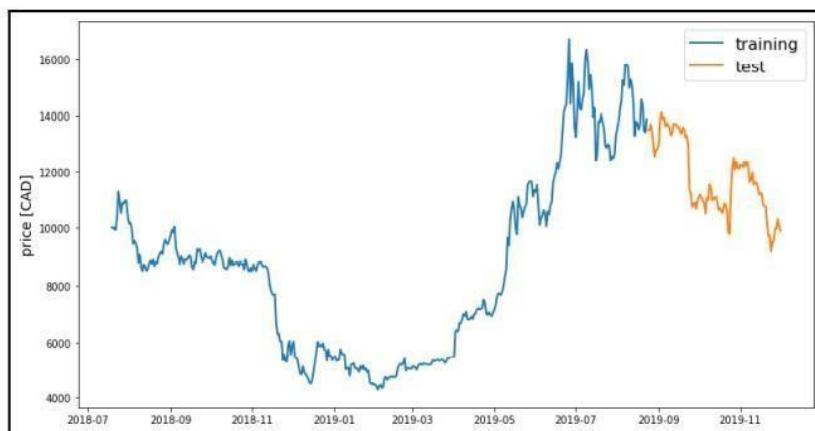

Fig 6.3: Cryptocurrency line plot based on the dataset

The following graph compares the predicted price values of Bitcoin with the actual price of the Bitcoin over the same timeline:
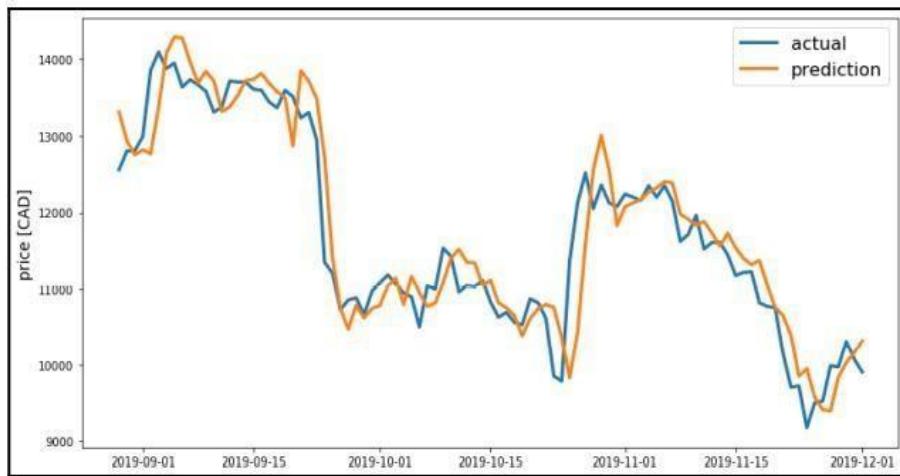
Fig 6.4: Actual versus predicted prices by applying the LSTM model

Benefits of AI in prediction

The application of classification models and predictive analytical practices on transactional data can offer traders well-trained decisions and help achieve efficiency. It can also help traders reap profits from better market making, notably in crypto trading, which runs 24/7 globally, similar to traditional high-frequency markets such as Foreign Exchange (Forex).

Introduction to time series

A time series is a series of data points indexed over time, graduating at discrete levels versus the price of a cryptocurrency.

This idea is not novel or exclusively applicable to cryptocurrencies. In fact, tick databases exist in the traditional finance industry.

This approach has been borrowed by the crypto industry to leverage the benefits of applying quantitative finance (also referred to as algorithmic trading) to reap higher rewards in crypto.

The following graph represents a price time series of the Bitcoin cryptocurrency from one of its longest rallies in the market:
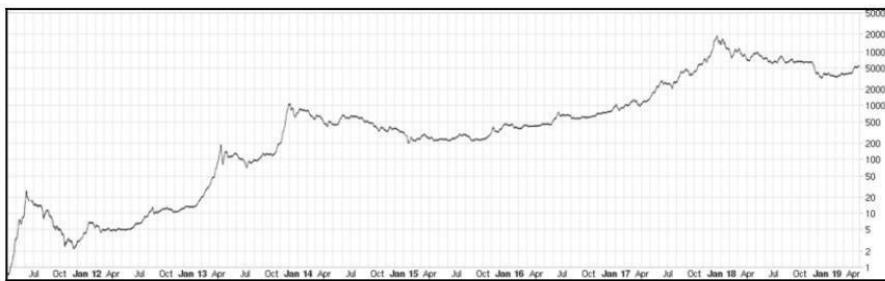

Fig 6.5: Time series information of Bitcoin price versus USD in logarithmic scale, before the crash happened

Time series are generally stored in the form of tick data and are represented in the form of charts. Data obtained from the time series can also be used to analyze non-quantitative price trends of commodities.

Application of AI in time-series forecasting.

Time-series forecasting with ARIMA Since cryptocurrency prices are affected by various factors, it is not easy to analyze and predict prices using simple ML models. Hence, the ARIMA model is used to predict the price.

Consider the time-series example of Bitcoin, as depicted in the previous diagram. We cannot attribute changes to one single parameter and develop a linear regression model that satisfies our requirement of price prediction independently. Hence, ARIMA is widely used so that we can apply the model, make a note of the error in prediction, retest the

model after making the necessary changes, and calculate the MSE again. Generally, ARIMA models provide reasonable price prediction with an error rate ranging from 3% to 5%. The key advantage of ARIMA is that the model is fairly simple to calibrate, and this encourages data scientists to drastically reduce the mean error between the expected values and predicted values of cryptocurrency prices.

The following graph is a sample output from a calibrated ARIMA model to predict Bitcoin prices:
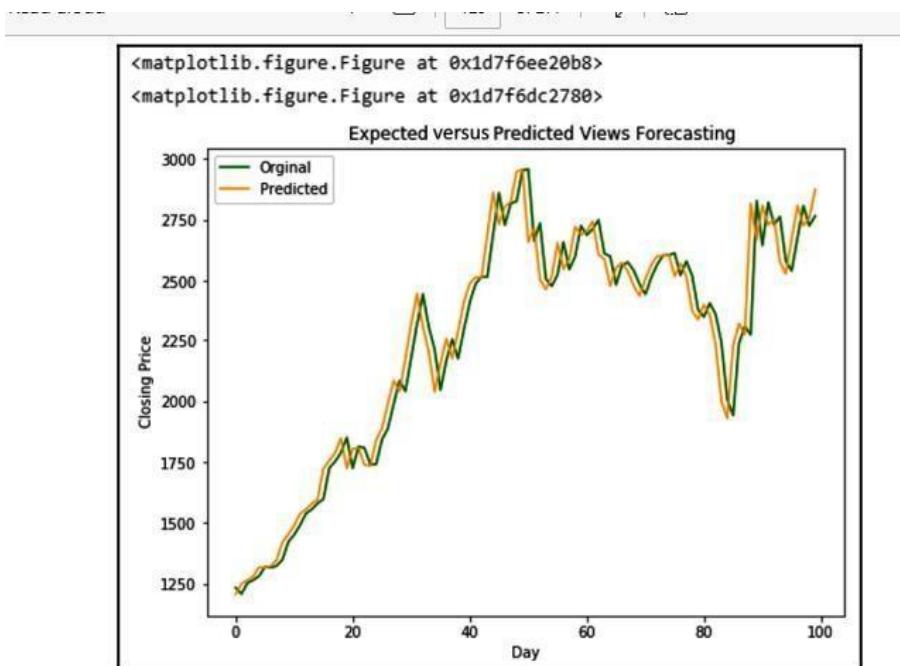
Fig 6.6: Bitcoin price prediction using ARIMA

Applications of algorithmic or quant trading in cryptocurrency

Did you know that a significant number of trade calls happening around the world are not made by humans? Instead, they are programmed and automated to a certain extent by operations.

This type of trading involves a keen eye on profits over a large number of calls, resulting in good profits over a very short term. This

called algorithmic trading. As the name suggests, the trade calls made by these machines are optimized to look at profits that humans cannot sense by reading charts and reports. These calls take place in a split sub-second and are predicted to take over finance as we know it.

Basic applications of algorithms optimized to make profits in cryptocurrencies

Arbitrage

The term arbitrage refers to the practice of leveraging different prices of the same asset in two different locations in order to profit from the difference in the economic values of the asset in trade transactions. Simply put, arbitrage is a trading strategy that exploits the different economic values of the same asset in two or more markets. You can buy it in the market where the price is cheaper and sell it to markets with higher demands.

How does arbitrage work?

Arbitrage trading in crypto works the same as it does in traditional markets. Traders must quickly buy and sell an asset across platforms whenever they notice a price inefficiency. The only difference is that cryptocurrency arbitrage traders focus on crypto assets like Bitcoin or Ethereum (ETH).

Another distinction between traditional and crypto exchange arbitrage is that the latter can target centralized exchanges (CEXs) and decentralized exchanges (DEXs). In conventional markets, arbitrage traders only have access to CEXs with institutional market makers.

DEXs are a new innovation in the field of DeFi (decentralized finance). Instead of relying on centralized market makers, these blockchain-based

exchanges use a technology called "liquidity pools." Anyone with a crypto wallet can supply tokens to these pools for peer-to-peer trading. Since liquidity pools run on smart contract codes, there are no centralized authorities facilitating trades.

DEXs aren't as regulated or liquid as CEXs, which means they usually present more arbitrage opportunities for crypto traders. Also, DEXs rely on arbitrage trades to balance the token pairs in their liquidity pools. As arbitrage traders adjust the supply of tokens in a trading pair, they naturally help balance the quoted price.

Types of crypto arbitrage strategies

There are several ways crypto arbitrageurs can profit off of market inefficiencies. Some of them are:

- **Cross-exchange arbitrage:** This is the basic form of arbitrage trading where a trader tries to generate profit by buying crypto on one exchange and selling it on another exchange.

- **Spatial arbitrage:** This is another form of cross-exchange arbitrage trading. The only difference is that the exchanges are located in different regions. For example, you could capitalize on the difference in the demand and supply of bitcoin in America and South Korea using the spatial arbitrage method.

- **Triangular arbitrage:** This is the process of moving funds between three or more digital assets on a single exchange to capitalize on the price discrepancy of one or two cryptocurrencies. For example, a trader can create a trading loop that starts with bitcoin and ends with bitcoin.

A trader could exchange bitcoin for ether, then trade the ether for Cardano's ADA token and, lastly, convert the ADA back to bitcoin. In this example, the trader moved their fund between three crypto trading pairs – BTC/ETH → ETH/ADA → ADA/BTC. If there are discrepancies in any of the prices of the three crypto trading pairs, the trader will end up with more bitcoin than they had at the beginning of the trade. Here, all the transactions are executed on one exchange. Therefore, the trader does not need to withdraw or deposit funds across multiple exchanges.

- **Decentralized arbitrage:** This arbitrage opportunity is common on decentralized exchanges or automated market makers (AMMs), which discover the price of crypto trading pairs with the help of automated and decentralized programs called smart contracts. If the prices of crypto trading pairs are significantly different from their spot prices on centralized exchanges, arbitrage traders can swoop in and execute cross-exchange trades involving the decentralized exchange and a centralized exchange.

- **Statistical arbitrage:** This combines econometric, statistical and computational techniques to execute arbitrage trades at scale. Traders that use this method often rely on mathematical models and trading bots to execute high-frequency arbitrage trades and maximize profit. Trading bots are automated trading mechanisms that execute a high volume of trades at record time based on predefined trading strategies.

The history of arbitrage dates back to 650 BC (http://www.sfu.ca/~poitras/EQF_ ARB%24%24.pdf), wherein it was a common practice to buy silver coins at a cheaper price in Persia and sell them at a premium in Greece.

It is important to note that the strategy is not novel to cryptocurrencies. Arbitrage was applicable to traditional financial instruments dating back to as early as the 1980s in modern finance. It is actively pursued as a trading strategy, even today.

Bitcoin—often referred to by its ticker symbol, Bitcoin (BTC)—is listed across more than 100 exchanges (https://coinmarketcap.com/currencies/bitcoin/markets/), with slight differences in prices at different exchanges. In the following screenshot, you may observe two different prices for Bitcoin across multiple exchanges:

You can view the preceding screenshot at the following site: https://coinhills.com/.

You can simply apply basic math to understand the potential opportunity to profit USD 2 if there is a way to instantaneously purchase Bitcoins in exchange 1 and sell the same bitcoins to trading users in exchange 2. However, it is naive to assume that both the transactions can occur near-instantly in order to profit from this trade. If this trade can be achieved successfully, a crypto/fiat arbitrage has been successfully established. However, it is important to remember that fiat withdrawals from exchanges depend on the ease of business in the respective

countries. Hence, we need to understand that these trades may not always be instantly profitable.

Algorithms have been developed to enable instantaneous arbitrage transactions between two kinds of cryptocurrency. Assume that 1 BTC costs 50 Ethers (ETH) in exchange 1. Assume that the same quantity of 1 BTC costs 60 ETH in exchange 2. Algorithmic trading in this scenario would identify the best-fitting cryptocurrency trade pairs that can return maximum profits and execute the trade, thereby profiting 10 ETH in less than a few seconds. If such a trade can be achieved successfully, a crypto/crypto arbitrage has been successfully established.

San Francisco Open Exchange (SFOX) is a YCombinator-backed trading platform that has been serving more than 175,000 traders since 2015. The platform has a gross transaction value of nearly 11 billion USD over the course of years, exploring arbitrage opportunities for its customers across more than 20 markets.

SFOX offers industry-leading algorithmic trading, such as the following:

Tortoise:

An optimized order routing suitable for trading lower numbers of bitcoins, but comparatively slower than the rest of the algorithms.

Hare: Better price goals than Tortoise without any compromise in speed.

Gorilla: Optimized to execute large trade orders with suitable controls on market fluctuations to make sure that the market does not move.

Polar Bear: Optimized to execute hidden orders optimized for price, triggered by the best limit set by the user. Once the algorithm identifies the best price in the order book, it will immediately execute the order at that price without going too deep into the order book. Although there are well-supported algorithms suitable for arbitrage, it does not always ensure a low-risk trading strategy.

Algorithms must also be efficient enough to capture opportunities in a split second to make up for the total fees for all the trades carried out across multiple exchanges in different markets, as these are considered as the hidden margin costs by some experts.

Disadvantages of crypto arbitrage trading

- **Arbitrage opportunities are time-sensitive:** The key feature of a successful arbitrage trade is speed. Countless arbitrage traders globally have advanced software programs ready to make a profit. If an arbitrage trader isn't fast enough, there's a good chance many others already took advantage of the price discrepancy. New traders should expect to face fierce competition for arbitrage opportunities.

- **Risk of slippage:** "Slippage" refers to a significant deviation in the quoted price you wanted to buy or sell an asset. This phenomenon tends to occur on small and illiquid exchanges or with small-cap tokens. If an arbitrage trader can't close their trades quickly on a chosen exchange, there's a risk the final sale price will nullify their trade setup.

- **Foreign exchange rates:** Spatial arbitrage traders must factor fiat exchange rates into their expected profit. While crypto prices may seem elevated in other regions, consider how much it'll cost to transfer the host country's fiat into your desired currency.

- **Trading fees:** Every exchange charges different rates for buying, selling, and transferring crypto and fiat currency. Arbitrage traders must carefully study their preferred platforms' fee schedules before implementing a strategy.

- **Tax implications:** In most countries, arbitrage trading is subject to short-term capital gains taxes. Even if an arbitrage trader is

successful, they'll have to report their profits to tax authorities. Remember to double-check your region's tax rate for crypto investing before getting involved in arbitrage trading.

3.4 Market making

Market making is a crucial process in the crypto trading business, with the important goal of offering liquidity to cryptocurrencies in the market.

- <u>Liquidity</u> describes the extent to which an asset can be bought and sold quickly, and at stable prices.
- In simple terms, it is a measure of how many buyers and sellers are present, and whether transactions can take place easily. Usually, liquidity is calculated by taking the volume of trades or the volume of pending trades currently on the market.
- High levels of liquidity arise when there is a significant level of trading activity and when there is both high supply and demand for an asset, as it is easier to find a buyer or seller.
- If there are only a few market participants, trading infrequently, it is said to be an illiquid market or to have low liquidity.

Why is market liquidity so important?

Market liquidity is important for a number of reasons.

In a liquid market, a seller will quickly find a buyer without having to cut the price of the asset to make it attractive.

- An asset's liquidity is also a key factor in determining the spread that a leveraged trading provider can offer.
- High liquidity means that there are a large number of orders to buy and sell in the underlying market. This increases the probability that the highest price any buyer is prepared to pay and the lowest price any seller is happy to accept will move closer together. In other words, the bid-offer spread will tighten.

- If a market is illiquid, it could mean that there is a much wider spread.

Why is the spread important?

The bid-ask spread illustrates the difference between the offered buyer price and the offered seller price. The higher the number of traders and market makers in a market, the stronger the competition and the more narrow the spreads. A narrow bid-ask spread is favourable because if spreads are too high, the chances of successful transactions are greatly diminished. This can happen, for example, if demand in the market is much higher than supply.

What are market makers?

- Market makers are firms or individuals that provide liquidity to the market by buying and selling cryptocurrencies to traders, investors and market participants around the world.
- They buy cryptocurrencies from sellers who are looking to part with them and sell them to buyers who are looking to acquire them.
- In this way, they help to facilitate trade and ensure that there is always someone on the other side of a trade.
- Market makers are important because they help to reduce the volatility of prices and provide a source of liquidity to the market.

Why are market makers important?

Maintain liquidity in the market

- Market makers are important because they help to maintain liquidity in the market.
- By posting buy and sell orders for various cryptocurrencies on exchanges, this helps to create liquidity in the market and enables traders to buy and sell cryptocurrencies more easily.
- They actively place orders for earning profits, reducing the spread, and maintaining liquidity.

Reduce market volatility

- In addition to providing liquidity, market makers also help to reduce volatility in the market. By constantly posting buy and sell orders, they help to absorb fluctuations in demand and supply, which can help to smooth out price movements. This is especially important in the crypto market, which is known for its high volatility.

Components of a healthy market

The following factors are the main components that contribute to a healthy market for tokens.

1. Liquidity

- A token has healthy liquidity when a seller can quickly find a buyer or vice versa, without having a huge price difference for the token. The sellers do not need to cut their prices and the buyers will not have to pay an increased amount to secure the token they want.
- Without liquidity, large buy or sell orders can potentially cause a drastic price movement in the market. This makes the price of the token highly volatile and might deter investors from entering the market. Market makers can enter at such points to provide the necessary liquidity to help stabilize the token price in such liquidity crunch events.

2. Bid-Ask spread

- For the transaction to be carried out, there has to be an agreement on the offered buyer price and the offered seller price. The difference between the highest bid price and the lowest ask price is known as the bid-ask spread.
- Generally, a narrow bid-spread is favored as it represents a healthy market with steady flow of transactions. Market Makers can create that impression of immediacy by buying and selling large amounts of a particular token in order to not leave any

buyers or sellers hanging in the market. This ensures the smooth running of financial markets which can attract speculators and investors to the market, adding to the favorable market conditions.
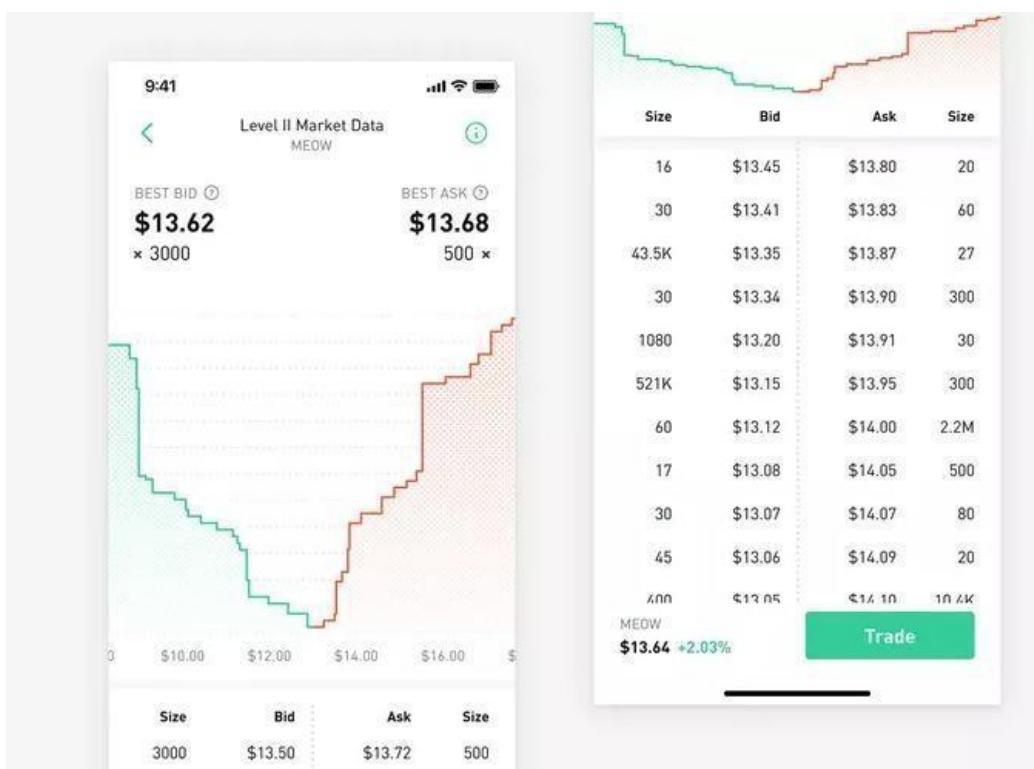
3. Depth of Order Books

- An order book lists the number of shares being bid on or offered at each price point, or market depth. This consolidated information serves as a tool to visualise a real-time list of outstanding orders for a particular token and represent the interests of buyers and sellers.

- This gives sophisticated investors a glimpse into supply and demand depth while exposing any order imbalances and resistance zones. Market makers can help to promote a healthy order book by ironing out order imbalances and providing depth to both supply and demand sides.

Order Book

- An order book is an electronic list of buy and sell orders for a security or other instrument organized by price level.

- Order books are used by almost every exchange for various assets like stocks, bonds, currencies, and even cryptocurrencies.

- These lists help improve market transparency as they provide information on price, availability, depth of trade, and who initiates transactions.

- There are three parts to an order book: buy orders, sell orders, and order history.

- An order book is dynamic, meaning it's constantly updated in real-time throughout the day.

- Depth of Market (DOM) is organized in a list of prices and shows the numbers of pending buy and sell orders corresponding to each price level.

- Traders can forecast whether the price will move up or down through the trend of DOM, and thus, determine the timing to buy or sell.
- **Buy orders** contain buyer information including all the bids, the amount they wish to purchase.
- **Sell orders** resemble buy orders, but instead include all the offers (or asking prices) or where people are willing to sell.
- Market order **histories** show all the transactions that have taken place in the past.

Let's explore this in detail, as follows: buying parties in the markets place a bid (the bid) for purchasing a particular crypto asset. A seller with an intent to sell the same type of crypto asset may place their asking price (the ask) for the asset. Usually, the values from the buyer and seller do not match because the buyers usually quote for less value

and the sellers quote for more value. This can create a gap between the expectations between both parties, thereby creating a spread. When the disagreement on the mutual price grows, the spread value widens and creates an illiquid token or cryptocurrency. Illiquid tokens are basically non-tradeable since expectations are not matched.

Hence, lower trade volumes create a slowdown for the token and reduce the market capitalization of the respective token. This is detrimental to the business. Hence, there is a need for liquidity providers who can help both buyers and sellers meet in the middle. Market makers address this problem by acquiring huge tokens and offering liquidity to traders across multiple markets. The following diagram is helpful for you to understand the market-making cycle:
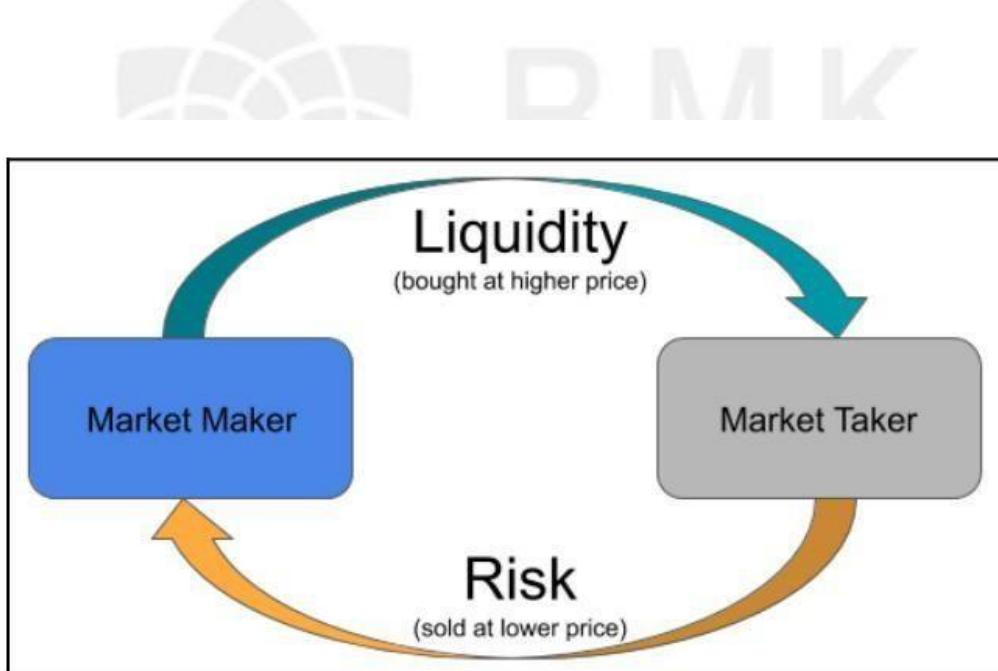

Fig 6.8: Generic illustration of a market-making cycle

Simply put, market making is a process of buying the tokens of an ICO wholesale and offering them a retail value for smaller investors. The revenue model for market makers is constructed by buying tokens in

bulk at lower prices and selling at higher prices to takers in the future. Again, market making is not a novel concept for cryptocurrencies.

This is a huge operational business applied to almost every traditional financial instrument across multiple markets. Although this model is fairly profitable in traditional finance, it is a huge challenge to identify the liquidity demands in the crypto trading landscape as there are more than 1,000 cryptocurrencies actively traded without borders or time zones.

Hence, it has been imperative to apply some of the DL techniques such as evolutionary algorithms to identify all possible scenarios where liquidity may be in demand for a particular targeted list of cryptocurrencies.

What are the benefits of crypto market making?

- **Higher liquidity:** by having enough liquidity available in the token, investors and founders can invest or liquidate their positions more easily
- **Higher trading volume:** higher liquidity potentially attracts more interest and trading in the token due to lower transaction costs and market impact
- **Lower probability of price manipulation:** higher liquidity makes it more difficult to manipulate the price of a token since more capital is needed to move prices
- **Higher interest in the token project:** more people trading in the token and possible listing on bigger exchanges create more interest and discussion around the token project
- **Easier listing on major crypto exchanges:** more reputable crypto exchanges are more likely to list a token on their platform knowing that there is a market maker committed in providing liquidity 24/7

Issues and special considerations

One of the major issues faced by market makers is that the captured data lacks full context in traditional systems.

Benefits of AI in trading data

The application of AI on semi-structured data from blockchain transactions can pave the way for better analysis and provide deeper insights into making efficient trade decisions. Real-time high throughput from multiple blockchains can be analyzed by applying AI models to make informed decisions across different blockchain realms.

3.5 The future of cryptocurrencies in India

India has long been one of the few developing countries with an uncertain position on cryptocurrencies. A circular from the Reserve Bank of India (RBI) dated February 12, 2018 advised all the banks and RBI-regulated institutions against supporting any individual or entities involved in virtual currencies.

This was considered as a blanket ban on all activities pertaining to cryptocurrencies, although exchanges in India were unable to support deposits or withdrawals associated with bank accounts.   On March 6, 2020, the Honorable Supreme Court of India's verdict quashed the RBI circular, thereby striking down RBI's ban on financial institutions rendering services to these exchanges and traders alike (https://main.sci.gov.in/supremecourt/2018/19230/ 19230_2018_4_1501_21151_Judgement_04-Mar-2020.pdf).

Although this is a temporary relief to the crypto trading industry and a role model to many other developing countries and economies, there are larger uncertainties looming around the ecosystem. At the time of writing, RBI has reportedly filed a review petition to challenge the verdict given by the country's Apex court.

It is also notable that Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations are to be updated in order to support these businesses without harming the country's economy. Striking a balance between regulations and empowering the industry with the right education could help India blossom in this industry and emerge as a global leader of the next wave of the digital economy. Until then, such uncertainties in India remain open.

Assignment

Toppers:

Analyze the role of miners in the cryptocurrency ecosystem.

Above Average:

Investigate the regulatory challenges facing cryptocurrencies in different countries.

Average:

Explore the potential applications of blockchain technology beyond cryptocurrencies.

Below Average:

Evaluate the scalability issues facing popular cryptocurrencies like Bitcoin and Ethereum.

Slow Learers:

Investigate the concept of stablecoins and their role in mitigating the volatility of cryptocurrencies.

Part A – Q & A

Unit 3

1. **Write a note on Cryptocurrency trading (CO3,K1)**

Trading cryptocurrencies has become a global alternative to wealth creation, apart from offering liquidity in the space for users in the respective blockchain platforms.

2. **Issues in cryptocurrency trading (CO3,K1)**
   - Difficulty determining sharp volatilities in the market
   - Lack of an intelligent order-matching engine that allows users to estimate the right values for their holdings
   - Inability to calculate predictable risks due to mixed responses in the market
   - Weak cybersecurity strategy in protecting wallets from attacks, leading to more than a billion USD worth of crypto being lost to hacking

3. **Benefits of AI in crypto trading (CO3,K1)**

Ability to detect anomalies in trading trends, react quickly without human intervention to critical situations.

The application of AI can bring remarkable security enforcements in password generation, detecting physical characteristics such as iris, retina, and other biometric identities to protect wallets organized and managed by the cryptocurrency exchanges or hedge funds.

4. **What are the issues with price prediction (CO3,K1)**

The top two issues with regard to price prediction of cryptocurrencies are detailed as follows:

Unable to adjust the algorithms to crypto market sentiments Unable to maintain and measure liquidity

5. **How the cryptocurrency trading data is grouped? (CO3,K1)**

   Open price, close price, high price, low price, and volume

6. **Define open Price (CO3,K1)**

   It refers to the price of the cryptocurrency at the beginning of the day.

7. **Define Close Price (CO3,K1)**

   It refers to the price of the cryptocurrency at the end of the day.

8. **Define High Price (CO3,K1)**

   It refers to the highest value recorded versus the USD on that particular day.

9. **Differentiate fiat currency and Cryptocurrency (CO3,K1)**

Fiat currency	Cryptocurrency
Most of these are minted by the government under the Fractional reserve banking or quantitative easing models.	Minted by the miners or validator nodes under a voted scheme of the network fee model.
Not all fiat currencies are in digital form, hence difficult to trace and appropriate taxes.	Most cryptocurrencies are digital, with transparent transactions, and this helps pave the way for ideal tax compliance.
Usually regulated by a national-level federal bank through active monetary policies.	Cryptocurrencies are decentralized. Hence, it is challenging to regulate them all of them by a country.
Money transfers and settlements may take days.	Monetary transfers are near-immediate, followed by finality within a few minutes.
Digital money may not be highly secure, due to centralization, and hence are vulnerable to cyber threats.	Effective in managing consistency. Hackers may not be able to hack all the nodes hosting the open ledger.
May not be highly volatile compared to cryptocurrencies.	Highly volatile compared to traditional currencies and money markets, due to speculation.

10. **Define Low Price (CO3,K1)**

    It refers to the lowest value recorded versus the USD on that particular day.

11. Define Volume (CO3,K1)

Volume refers to the total number of units traded on that particular day.

12. Benefits of AI in prediction (CO3,K1)

The application of classification models and predictive analytical practices on transactional data can o**ffer traders well-trained decisions and help achieve efficiency.**

It can also **help traders reap profits from better market making**, notably in crypto trading, which runs 24/7 globally, similar to traditional high- frequency markets such as Foreign Exchange (Forex).

13. Define time series (CO3,K1)

A time series is a series of data points indexed over time, graduating at discrete levels versus the price of a cryptocurrency.

Time series are generally stored in the form of tick data and are represented in the form of charts. Data obtained from the time series can also be used to analyze non-quantitative price trends of commodities.

14. Define Arbitrage (CO3,K1)

The term arbitrage refers to the practice of leveraging different prices of the same asset in two different locations in order to profit from the difference in the economic values of the asset in trade transactions.

15. List the industry-leading algorithmic trading offered by SFOX **(CO3,K1)**

Tortoise:

An optimized order routing suitable for trading lower numbers of bitcoins, but comparatively slower than the rest of the algorithms.

Hare: Better price goals than Tortoise without any compromise in speed.

Gorilla: Optimized to execute large trade orders with suitable controls on market fluctuations to make sure that the market does not move.

Polar Bear: Optimized to execute hidden orders optimized for price, triggered by the best limit set by the user.

16. **Define Market making (CO3,K1)**

Market making is a crucial process in the crypto trading business, with the important goal of offering liquidity to cryptocurrencies in the market.

17. **What is the issue in market making (CO3,K1)**

One of the major issues faced by market makers is that the captured data lacks full context in traditional systems.

18. **List the benefits of AI in trading data (CO3,K1)**

The application of AI on semi-structured data from blockchain transactions can pave the way for better analysis and provide deeper insights into making efficient trade decisions.

Real-time high throughput from multiple blockchains can be analyzed by applying AI models to make informed decisions across different blockchain realms.

19. **Define liquidity (CO3,K1)**

Liquidity is the degree to which an asset can be quickly bought or sold without notably affecting the stability of its price.

Liquidity describes the extent to which an asset can be bought and sold quickly, and at stable prices.

20. **Why Market liquidity is important? (CO3,K1)**

High liquidity means that there are a large number of orders to buy and sell in the underlying market. This increases the probability that the highest price any buyer is prepared to pay and the lowest price any seller is happy to accept will move closer together. In other words, the bid-offer spread will tighten.

21. Define spread in cypto trading **(CO3,K1)**

The term **"spread"** means the difference between the bid price at which traders are selling and the slightly lower actual price, while traders wanting to buy are charged the ask price, which is slightly higher than the market price. The spread between the price traders receive and the market price is the market maker's profit.

22. **Why is the spread important? (CO3,K1)**

The bid-ask spread illustrates the difference between the offered buyer price and the offered seller price. The higher the number of traders and market makers in a market, the stronger the competition and the more narrow the spreads. A narrow bid-ask spread is favourable because if spreads are too high, the chances of successful transactions are greatly diminished.

23. **What are market makers? (CO3,K1)**

Market makers are employed to ensure sufficient liquidity and efficient trading on financial markets.

Market makers are firms or individuals that provide liquidity to the market by buying and selling cryptocurrencies to traders, investors and market participants around the world.

24. **Why are market makers important? (CO3,K1)**

Maintain liquidity in the market

Market makers are important because they help to maintain liquidity in the market.

By posting buy and sell orders for various cryptocurrencies on exchanges, this helps to create liquidity in the market and enables traders to buy and sell cryptocurrencies more easily.

They actively place orders for earning profits, reducing the spread, and maintaining liquidity.

25. **What is order book? (CO3,K1)**

- An order book is an electronic list of buy and sell orders for a security or other instrument organized by price level.

- Order books are used by almost every exchange for various assets like stocks, bonds, currencies, and even cryptocurrencies.
- These lists help improve market transparency as they provide information on price, availability, depth of trade, and who initiates transactions.
- There are three parts to an order book: buy orders, sell orders, and order history.

26. What are the benefits of crypto market making? (CO3,K1)

Higher liquidity: by having enough liquidity available in the token, investors and founders can invest or liquidate their positions more easily

Higher trading volume: higher liquidity potentially attracts more interest and trading in the token due to lower transaction costs and market impact

Part B Questions

Q. No.	Questions	CO Level	K Level
1	**Explain the role of AI in cryptocurrency**	CO3	K2
2	**Explain cryptocurrency trading**	CO3	K2
3	**Explain price prediction of cryptocurrency with AI**	CO3	K2
4	**Explain market making in detail**	CO3	K2
5	**What are some emerging trends and developments in the cryptocurrency space, and how might they impact the future of finance?**	CO3	K2
6	**How do smart contracts contribute to the functionality and applications of certain cryptocurrencies?**	CO3	K2
7	**Explain the process of initial coin offerings (ICOs) and how they are used to fund cryptocurrency projects.**	CO3	K2
8	**What are the potential advantages and disadvantages of using cryptocurrencies for transactions?**	CO3	K2

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9	What are some notable examples of cryptocurrencies other than Bitcoin, and what sets them apart?	CO3	K2
10	What are the major types of consensus mechanisms used in cryptocurrencies, and how do they differ?	CO3	K2
11	How do cryptocurrency wallets work, and what are the different types of wallets available?	CO3	K2
12	What role do miners play in the security and consensus of a cryptocurrency network?	CO3	K2
13	How does blockchain technology enable the functioning of cryptocurrencies?	CO3	K2
14	What are the key characteristics of a decentralized cryptocurrency?	CO3	K2
15	What is cryptocurrency, and how does it differ from traditional fiat currency?	CO3	K2

Supportive online Certification courses (NPTEL, Swayam, Coursera, Udemy, etc.,)

Sl. No.	Courses	Platform
1	Blockchain Basics	Coursera
2	DeFi Decentralized Finance	Coursera
3	Blockchain	NPTEL
4	Blockchain and its Applications	NPTEL

Real time Applications in day to day life and to Industry

Unicsoft developed solution combining natural language processing, sentiment analysis and machine learning algorithms (LSTM) to predict prices for cryptocurrency

Chalenge

The client came to us with the startup idea to develop an AI model for analyzing the cryptocurrency market. As he has already built an algorithm for cryptocurrency auto-trading, he decided to add cryptocurrency price prediction feature to it as well.

The solution combines natural language processing, sentiment analysis, and machine learning algorithms (LSTM) to predict prices for cryptocurrency. It crunches huge amounts of data and tells you which cryptocurrencies to invest in and attempts to maximize your returns.

The product brings value to:

Private traders who want to receive hints from the system of artificial intelligence and a forecast on the trend of cryptocurrency prices;
Professional companies that need to evaluate a comprehensive forecast for the whole real-time cryptocurrency market,

Technology&Tools

portfolio management, investments, risk management, etc.

Sentiment Analysis

Predictive Analytics

Natural Language Processing

Crypto

Sklearn

Python

NLP

Jupyter Notebook

The Solution

Unicsoft dedicated team was in charge of developing a cryptocurrency price prediction solution based on LSTM models and sentiment analysis of crypto forums and channels. The model provides the prediction of 4 type of price: 'Open', 'High', 'Low', 'Close' for every cryptocurrency individually.

The processes of price prediction model is recomputed constantly by AI Engine, potentially in a constant update loop. The model works in real time.

The model accepts any number of input parameters (the network architecture allows you to add many technical market characteristics of a selected cryptocurrency), and gives a forecast at specified prices ('Open', 'High', 'Low', or 'Closed') at the output. The architecture also provides a simple way to add new parameters to the line of the forecast in the future: for example, the forecast of the Volume of funds for this cryptocurrency or another indicator. No significant code changes will be required: flexible parameters are already embedded in the solution.

At present, the models work with a time step of one day, and make forecasts for 7 days ahead (forecast interval is adjustable); however, the solution can be applied to hourly input data and the forecast horizon set in hours. The solution was deployed in Python, Jupyter Notebook deployed for demo purposes. All documentation and the code was delivered to the customer on time and according to the initial requirements.

The main challenges were:

Research and selection of the optimal model architecture for cryptocurrency price prediction within this solution;

Improving prediction quality, optimizing time and resources for model training and real-time prediction. In the result the client received a model with 73% – 90% accuracy of prediction.

Content Beyond Syllabus

Best Crypto Prediction Site

Crypto prices can go up and down in the blink of an eye, which makes it difficult to predict where prices will be in the future.

However, with the help of technical analysis, crypto prediction sites were born with the purpose of assisting in forecasting future price movements.

CryptoPredictions.com

CryptoPredictions.com is a great crypto prediction site for those who are looking for an easy-to-use crypto prediction site.

It begins with a search for crypto assets that you are interested in, then it will take you to a page purely for cryptocurrency price predictions for that particular coin.

Key Features:

- Price predictions for up to 5 years
- Updates every 5 minutes if they have a market cap
- Over 14,000 coins (altcoins, memecoins)
- Detailed analysis of each cryptocurrency
- Up-to-date news and events affecting the market
- Community forum to interact with other investors
- Wide variety of technical indicators and charting tool.

2. WalletInvestor

WalletInvestor is the best crypto prediction site because it offers the most direct features that you'll need to forecast a crypto price prediction.
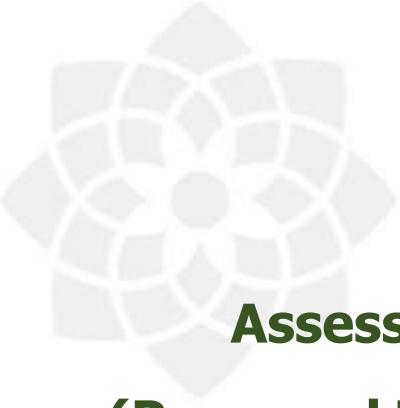
The forecasts of WalletInvestor are shown day-by-day, every 2 weeks.

It also shows several descriptive graphs to help you figure out trends such as time series plots by year, month, and week.

Key Features:

- Shows day-by-day, every two weeks forecasts
- More than 3800 digital assets are available
- Offers a wide range of technical indicators and charting tools
- Descriptive graphs to help figure out trends such as time series plots by year, month, and week

Assessment Schedule
(Proposed Date & Actual Date)

Assessment Tool	Proposed Date	Actual Date	Course Outcome
Assessment I	14.08.2025	14.08.2025	CO1, CO2
Assessment II	23.09.2025	23.09.2025	CO3, CO4
Model	28.10.2025	28.10.2025	CO1, CO2, CO3, CO4, CO5
End Semester Examination	20.11.2025	20.11.2025	CO1, CO2, CO3, CO4, CO5

Prescribed Text Books & Reference

Sl. No.	Book Name & Author	Book
1	Ganesh Prasad Kumble, Anantha Krishnan, "Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies", Packt Publications, 2020. (unit 1-5)	Text Book
2	Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015. (unit 5)	Text Book
3	Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017	Reference Book
4	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands- On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018	Reference Book

Mini Project Suggestions

Toppers:

Design a system that sends notifications to users when the price of a selected cryptocurrency reaches a certain threshold, allowing them to make timely investment decisions**.**

Above Average:

Develop a platform that aggregates news articles, blog posts, and social media updates related to cryptocurrencies from various sources for users to stay informed.

Average:

Build a tool that enables users to convert between different cryptocurrencies or between cryptocurrencies and fiat currencies.

Below Average:

Create an application that allows users to track their cryptocurrency investments by entering their holdings and viewing their portfolio's current value and performance.

Slow Learners:

Develop a web or mobile application that fetches real-time prices o various cryptocurrencies and displays them in a user-friendly interface**.**

Thank you