University of Asia Pasific

Department of Computer Science and Engineering

Course Title: Database System Lab

Course Code: CSE 212

Project Name: Crypto Market Analysis Database

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Group Members:

1. Rafnan Jubaer (23101008)
2. Md.Asif Ahmed (23101009)
3. Md.Osman Goni (23101012)
4. Nizam Uddin Chowdhury Provat (23101019)
5. Arannamoy Mondal (23101024)

Submitted to:

Nadeem Ahmed
Assistant Professor
CSE,UAP

Project Overview: Crypto Market Analysis Database
 This database is designed to analyze the global cryptocurrency market, tracking market growth, blockchain network type, blockchain token type, market dominance, user adoption, r, brokerages, and controversies. It enables insights into crypto performance, geographical trends, and industry players.

Detailed Table Breakdown

1. **BLOCKCHAIN_ACCESS_TYPE**
   - *Purpose:* Classifies blockchain networks by access level. Like as: Public, Private, Consortium
   - *Columns:*
     - TYPE (Primary Key): Public/Private/Hybrid/Consortium.
     - DESCRIPTION: Explanation of the access type.
2. **BLOCKCHAIN_TOKEN_TYPE**
   - *Purpose:* Categorizes crypto tokens (e.g., Stablecoin, NFT).
   - *Columns:*
     - TYPE (PK): Token type name.
     - DESCRIPTION: Token characteristics.
3. **CONSENSUS_ALGORITHM_TYPE**
   - *Purpose:* Lists consensus mechanisms (PoW, PoS, etc.).
   - *Columns:*
     - TYPE (PK): Algorithm name.
     - DESCRIPTION: How the algorithm works.
4. **BLOCKCHAIN_NETWORK_TYPE**
   - *Purpose:* Defines network layers (Layer-1, Layer-2 ,Sidechain, etc.).
   - *Columns:*
     - TYPE (PK): Network type.
     - DESCRIPTION, EXAMPLES, KEY_FEATURES.
5. **HASH_ALGO_NAME**
   - *Purpose:* Hash algorithms used in consensus mechanisms.
   - *Columns:*
     - NAME (PK), CONSENSUS_ALGORITHM_TYPE (FK to CONSENSUS_ALGORITHM_TYPE).
     - Hardware requirements, pros/cons, energy efficiency.
6. **CRYPTO**
   - *Purpose:* Core table storing cryptocurrency details.
   - *Columns:*
     - SYMBOL (PK), Name, Price History, Supply Metrics.
     - Foreign Keys: Links to blockchain types, consensus, token type, etc.

7. **CRYPTO_CURRENCY_PERFORMANCE_METRICS**
   - *Purpose:* Technical performance data (TPS, fees, energy use).
   - *Columns:*
     - SYMBOL (FK to CRYPTO), Transaction speed, hash rate, users**.**
8. **TOTAL_USER_DISTRIBUTION**
   - *Purpose:* Tracks global crypto adoption by region/year.
   - *Columns:*
     - YEAR (PK), User counts per continent, total market cap.
9. **MARKET_DOMINANCE**
   - *Purpose:* Yearly dominance % of each cryptocurrency.
   - *Columns:*
     - SYMBOL+YEAR (PK), Price extremes, market cap, dominance %.
10. **COUNTRY**
    - *Purpose:* Country-wise crypto regulations and economic data.
    - *Columns:*
      - COUNTRY_CODE (PK), Crypto status (Accepted/Banned), GDP, education rate.
11. **ACCEPTED_COUNTRY**
    - *Purpose:* Details on countries where crypto is legal. Like as : USA, UAE, SGP
    - *Columns:* Restrictions, ATM count, year of regulation change.
12. **BANNED_COUNTRY**
    - *Purpose:* Details on countries where crypto is illegal.
    - *Columns:* Restrictions, ATM count, year of regulation change.
13. **USER_AMOUNT_IN_BANNED_COUNTRY**
    - *Purpose:* Tracks the total crypto users in banned regions.
    - *Columns:* Year, country, estimated user count.
14. **ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO**
    - *Purpose:* Popular cryptocurrencies per country/year.
    - *Columns:* YEAR+COUNTRY_CODE+CRYPTO_SYMBOL (PK), user percentage.
15. **BLOCK_REWARD_EMISSION_TYPE**
    - *Purpose:* Manage crypto mining rewards and halving events.
    - *Columns:* Emission type (e.g., Halving), block reward, historical data.
16. **REWARD_DETAILS**
17. **BLOCK_REWARD_EMISSION**
18. **HFT_AMF_FIRMS**
19. **ETF_INVESTMENT_TYPE:**
20. **CRYPTO_ETF**
    - ***Purpose:* Track institutional players (HFT firms, ETFs).**
    - ***Columns:* Company details, ETF types, assets under management.**
21. **BROKERAGE**
    - *Purpose:* Cryptocurrency exchanges and their market impact.
    - *Columns:* HQ location, user base, market share, controversies (hacks, lawsuits)
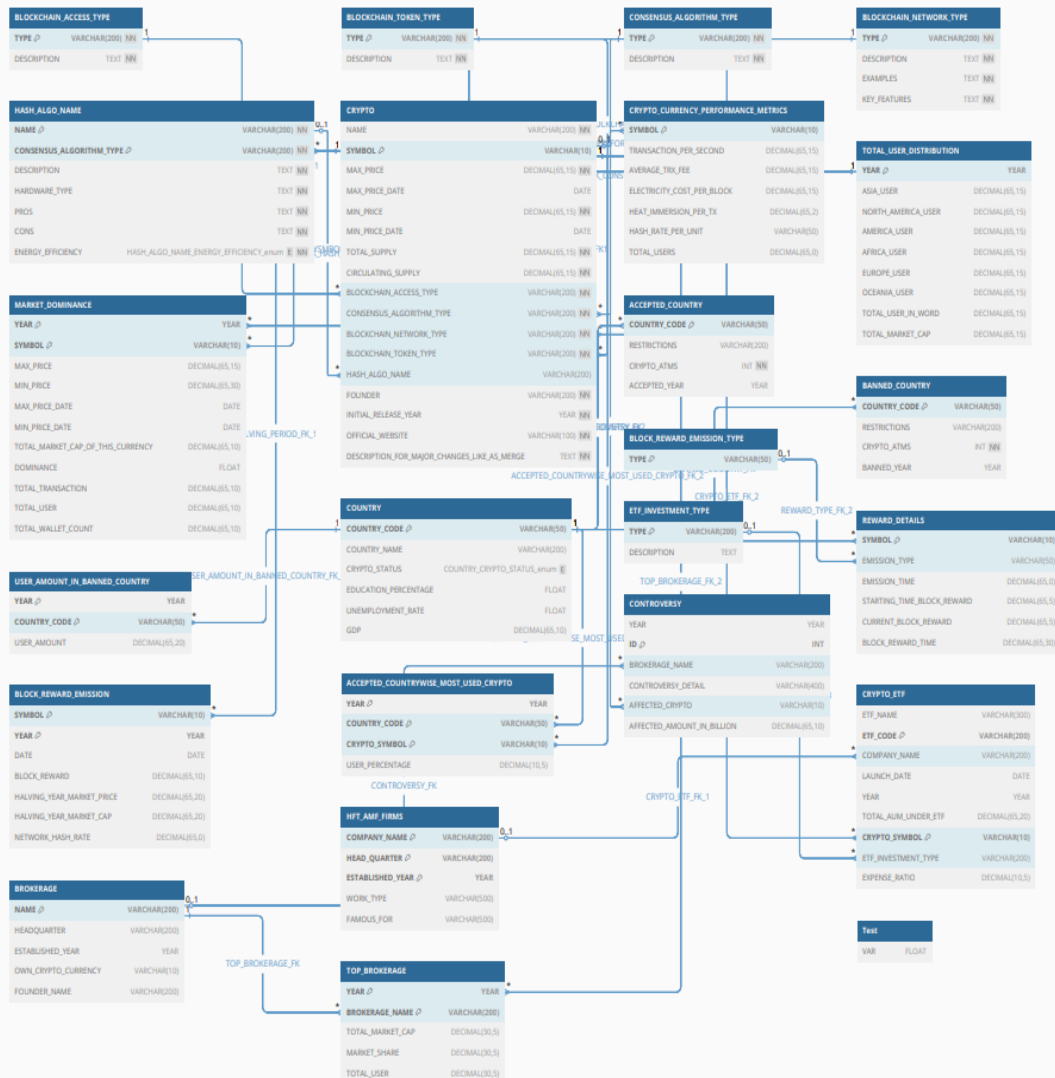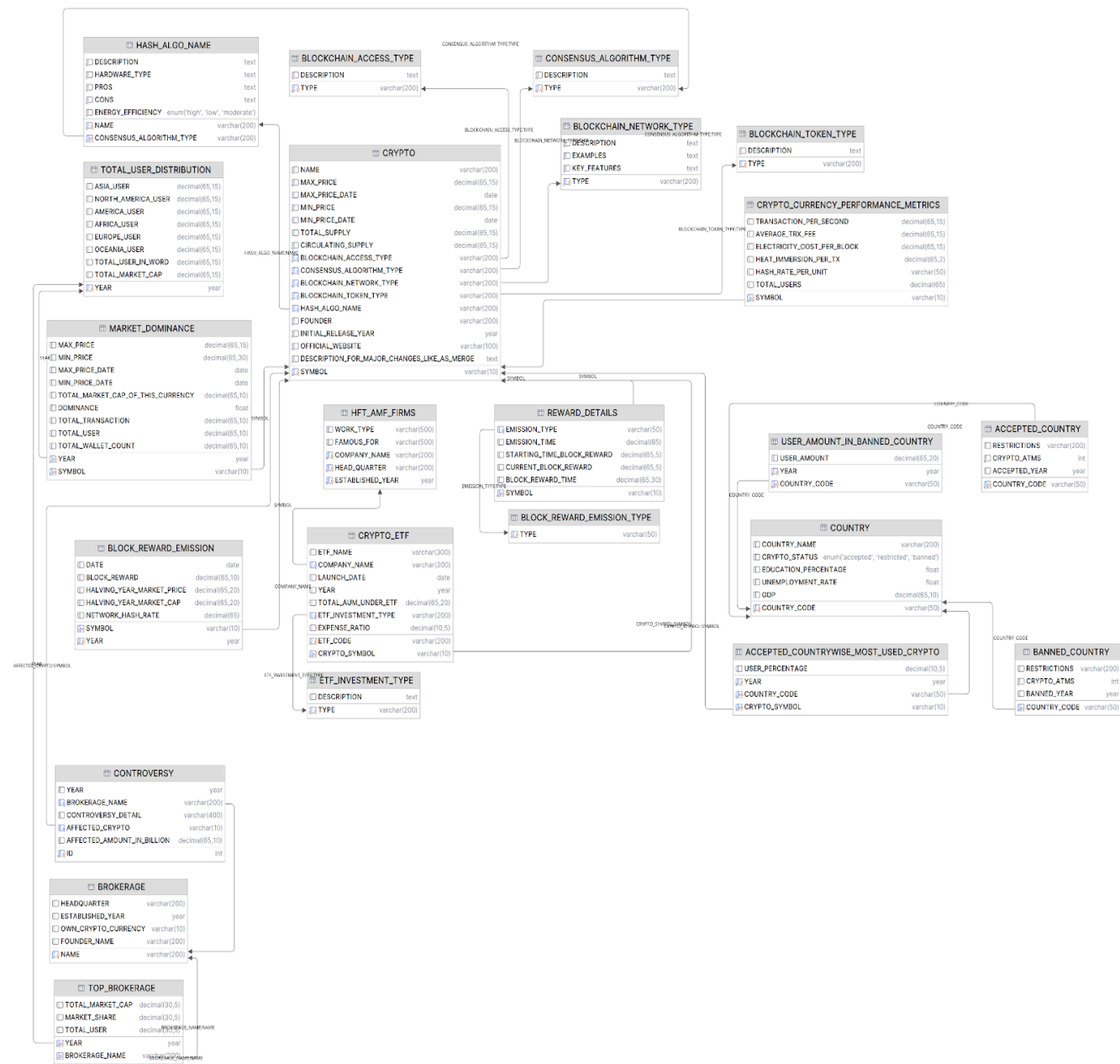22. **TOP_BROKERAGE**
23. **CONTROVERSY**

Key Relationships

- CRYPTO references multiple dimension tables (BLOCKCHAIN_ACCESS_TYPE, TOKEN_TYPE, etc.).
- MARKET_DOMINANCE links to CRYPTO (SYMBOL) and TOTAL_USER_DISTRIBUTION (YEAR).
- BROKERAGE controversies are logged in CONTROVERSY, affecting specific cryptos.
- COUNTRY data split into ACCEPTED/BANNED with usage statistics.

ER DIAGRAM:-

SCHEMA DIAGRAM:-

HASH_ALGO_NAME

Field	Type
DESCRIPTION	text
HARDWARE_TYPE	text
PROS	text
CONS	text
ENERGY_EFFICIENCY	enum('high', 'low', 'moderate')
NAME	varchar(200)
CONSENSUS_ALGORITHM_TYPE	varchar(200)

BLOCKCHAIN_ACCESS_TYPE

Field	Type
DESCRIPTION	text
TYPE	varchar(200)

CONSENSUS_ALGORITHM_TYPE

Field	Type
DESCRIPTION	text
TYPE	varchar(200)

BLOCKCHAIN_NETWORK_TYPE

Field	Type
DESCRIPTION	text
EXAMPLES	text
KEY_FEATURES	text
TYPE	varchar(200)

BLOCKCHAIN_TOKEN_TYPE

Field	Type
DESCRIPTION	text
TYPE	varchar(200)

TOTAL_USER_DISTRIBUTION

Field	Type
ASIA_USER	decimal(65,15)
NORTH_AMERICA_USER	decimal(65,15)
AMERICA_USER	decimal(65,15)
AFRICA_USER	decimal(65,15)
EUROPE_USER	decimal(65,15)
OCEANIA_USER	decimal(65,15)
TOTAL_USER_IN_WORD	decimal(65,15)
TOTAL_MARKET_CAP	decimal(65,15)
YEAR	year

CRYPTO

Field	Type
NAME	varchar(200)
MAX_PRICE	decimal(65,15)
MAX_PRICE_DATE	date
MIN_PRICE	decimal(65,15)
MIN_PRICE_DATE	date
TOTAL_SUPPLY	decimal(65,15)
CIRCULATING_SUPPLY	decimal(65,15)
BLOCKCHAIN_ACCESS_TYPE	varchar(200)
CONSENSUS_ALGORITHM_TYPE	varchar(200)
BLOCKCHAIN_NETWORK_TYPE	varchar(200)
BLOCKCHAIN_TOKEN_TYPE	varchar(200)
HASH_ALGO_NAME	varchar(200)
FOUNDER	varchar(200)
INITIAL_RELEASE_YEAR	year
OFFICIAL_WEBSITE	varchar(100)
DESCRIPTION_FOR_MAJOR_CHANGES_LIKE_AS_MERGE	text
SYMBOL	varchar(10)

CRYPTO_CURRENCY_PERFORMANCE_METRICS

Field	Type
TRANSACTION_PER_SECOND	decimal(65,15)
AVERAGE_TRX_FEE	decimal(65,15)
ELECTRICITY_COST_PER_BLOCK	decimal(65,15)
HEAT_IMMERSION_PER_TX	decimal(65,2)
HASH_RATE_PER_UNIT	varchar(50)
TOTAL_USERS	decimal(65)
SYMBOL	varchar(10)

MARKET_DOMINANCE

Field	Type
MAX_PRICE	decimal(65,15)
MIN_PRICE	decimal(65,30)
MAX_PRICE_DATE	date
MIN_PRICE_DATE	date
TOTAL_MARKET_CAP_OF_THIS_CURRENCY	decimal(65,10)
DOMINANCE	float
TOTAL_TRANSACTION	decimal(65,10)
TOTAL_USER	decimal(65,10)
TOTAL_WALLET_COUNT	decimal(65,10)
YEAR	year
SYMBOL	varchar(10)

HFT_AMF_FIRMS

Field	Type
WORK_TYPE	varchar(500)
FAMOUS_FOR	varchar(500)
COMPANY_NAME	varchar(200)
HEAD_QUARTER	varchar(200)
ESTABLISHED_YEAR	year

REWARD_DETAILS

Field	Type
EMISSION_TYPE	varchar(50)
EMISSION_TIME	decimal(65)
STARTING_TIME_BLOCK_REWARD	decimal(65,5)
CURRENT_BLOCK_REWARD	decimal(65,5)
BLOCK_REWARD_TIME	decimal(65,30)
SYMBOL	varchar(10)

BLOCK_REWARD_EMISSION_TYPE

Field	Type
TYPE	varchar(50)

USER_AMOUNT_IN_BANNED_COUNTRY

Field	Type
USER_AMOUNT	decimal(65,20)
YEAR	year
COUNTRY_CODE	varchar(50)

ACCEPTED_COUNTRY

Field	Type
RESTRICTIONS	varchar(200)
CRYPTO_ATMS	int
ACCEPTED_YEAR	year
COUNTRY_CODE	varchar(50)

COUNTRY

Field	Type
COUNTRY_NAME	varchar(200)
CRYPTO_STATUS	enum('accepted', 'restricted', 'banned')
EDUCATION_PERCENTAGE	float
UNEMPLOYMENT_RATE	float
GDP	decimal(65,10)
COUNTRY_CODE	varchar(50)

BLOCK_REWARD_EMISSION

Field	Type
DATE	date
BLOCK_REWARD	decimal(65,10)
HALVING_YEAR_MARKET_PRICE	decimal(65,20)
HALVING_YEAR_MARKET_CAP	decimal(65,20)
NETWORK_HASH_RATE	decimal(65)
SYMBOL	varchar(10)
YEAR	year

CRYPTO_ETF

Field	Type
ETF_NAME	varchar(300)
COMPANY_NAME	varchar(200)
LAUNCH_DATE	date
YEAR	year
TOTAL_AUM_UNDER_ETF	decimal(65,20)
ETF_INVESTMENT_TYPE	varchar(200)
EXPENSE_RATIO	decimal(10,5)
ETF_CODE	varchar(200)
CRYPTO_SYMBOL	varchar(10)

ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO

Field	Type
USER_PERCENTAGE	decimal(10,5)
YEAR	year
COUNTRY_CODE	varchar(50)
CRYPTO_SYMBOL	varchar(10)

BANNED_COUNTRY

Field	Type
RESTRICTIONS	varchar(200)
CRYPTO_ATMS	int
BANNED_YEAR	year
COUNTRY_CODE	varchar(50)

ETF_INVESTMENT_TYPE

Field	Type
DESCRIPTION	text
TYPE	varchar(200)

CONTROVERSY

Field	Type
YEAR	year
BROKERAGE_NAME	varchar(200)
CONTROVERSY_DETAIL	varchar(400)
AFFECTED_CRYPTO	varchar(10)
AFFECTED_AMOUNT_IN_BILLION	decimal(65,10)
ID	int

BROKERAGE

Field	Type
HEADQUARTER	varchar(200)
ESTABLISHED_YEAR	year
OWN_CRYPTO_CURRENCY	varchar(10)
FOUNDER_NAME	varchar(200)
NAME	varchar(200)

TOP_BROKERAGE

Field	Type
TOTAL_MARKET_CAP	decimal(30,5)
MARKET_SHARE	decimal(30,5)
TOTAL_USER	decimal(30,5)
YEAR	year
BROKERAGE_NAME	varchar(200)

QUERIES:-

1.

```
--ORDER BY

SELECT * FROM CRYPTO_CURRENCY_PERFORMANCE_METRICS WHERE CRYPTO_CURRENCY_PERFORMANCE_METRICS.AVERAGE_TRX_FEE>=1 ORDER BY AVERAGE_TRX_FEE ASC;

SELECT * FROM TOTAL_USER_DISTRIBUTION;

--WITH TMP AS (SELECT SYMBOL,MAX_PRICE,MIN_PRICE,MAX_PRICE_DATE,MIN_PRICE_DATE,(MAX_PRICE-MIN_PRICE)*100/MIN_PRICE AS MAX_RETURN FROM CRYPTO OR
--SELECT *,TMP.MAX_RETURN FROM TMP WHERE SYMBOL='XMR' ;

--SELECT SYMBOL,DOMINANCE FROM MARKET_DOMINANCE WHERE YEAR=2025 ORDER BY DOMINANCE DESC ;
```

Results | Messages

SYMBOL	TRANSACTION_PER_SECOND	AVERAGE_TRX_FEE	ELECTRICITY_COST_PER_BLOCK	HEAT_IMMERSION_PER_TX	HASH_RATE_PER_UNIT	TOTAL_USERS
DAI	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	500000
ETH	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	500000
GRT	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	400000
LDO	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	300000
LINK	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	600000
MANA	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	300000
MKR	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	300000
ONDO	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	200000
SAND	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	400000
SHIB	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	1000000
USDC	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	8000000
USDT	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	10000000
AAVE	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	400000
AXS	15.000000000000000	1.320000000000000	0.005000000000000	0.02	N/A	500000
BTC	7.000000000000000	2.750000000000000	1449.000000000000000	5216.40	2.31E+09	1000000

2.

```
--WITH TEMP
WITH TMP AS (
    SELECT
        SYMBOL,
        MAX_PRICE,
        MIN_PRICE,
        MAX_PRICE_DATE,
        MIN_PRICE_DATE,
        (MAX_PRICE - MIN_PRICE) * 100 / NULLIF(MIN_PRICE, 0) AS MAX_RETURN  -- Added NULLIF to avoid division by zero
    FROM CRYPTO
    -- Removed ORDER BY from CTE (not allowed in MSSQL CTE definitions)
)
SELECT *
FROM TMP
WHERE SYMBOL = 'XMR';--MONERO
--LIKE
```

Results | Messages

	SYMBOL	MAX_PRICE	MIN_PRICE	MAX_PRICE_DATE	MIN_PRICE_DATE	MAX_RETURN
1	XMR	542.330000000000000	0.216177000000000	2018-01-09	2015-01-14	250773.127113

3.

```sql
--LIKE
SELECT
    BROKERAGE.NAME,
    BROKERAGE.HEADQUARTER,
    COUNTRY.CRYPTO_STATUS
FROM
    BROKERAGE
JOIN
    COUNTRY
ON
    BROKERAGE.HEADQUARTER LIKE '%' + COUNTRY.COUNTRY_NAME
    -- BROKERAGE.HEADQUARTER LIKE '%' + COUNTRY.COUNTRY_NAME + '%'
WHERE
    COUNTRY.CRYPTO_STATUS = 'ACCEPTED';
    select * from COUNTRY
    Select * from BROKERAGE
```

100 %

⊞ Results 📄 Messages

	NAME	HEADQUARTER	CRYPTO_STATUS
1	FTX	Nassau, Bahamas	ACCEPTED
2	Binance	George Town, Cayman Islands	ACCEPTED
3	Gate.io	George Town, Cayman Islands	ACCEPTED
4	Capital.com	Limassol, Cyprus	ACCEPTED
5	Bitfinex	Hong Kong	ACCEPTED
6	AvaTrade	Dublin, Ireland	ACCEPTED
7	eToro	Tel Aviv, Israel	ACCEPTED
8	Mt. Gox	Shibuya, Tokyo, Japan	ACCEPTED
9	Bitstamp	Luxembourg City, Luxembourg	ACCEPTED
10	Crypto.com	Singapore	ACCEPTED
11	NiceHash	Ljubljana, Slovenia	ACCEPTED
12	Bitget	Victoria, Seychelles	ACCEPTED
13	KuCoin	Victoria, Seychelles	ACCEPTED
14	OKX	Victoria, Seychelles	ACCEPTED

4.

```sql
--SUBQUERIES
SELECT
T2.year,
CAST(T2.TOTAL_USER_IN_WORD AS VARCHAR) + ' million' AS total_user,
CAST(((T2.TOTAL_USER_IN_WORD - T1.TOTAL_USER_IN_WORD) * 100.0 / T1.TOTAL_USER_IN_WORD) AS VARCHAR) + '%' AS user_growth,
CAST(T2.total_market_cap AS VARCHAR) + ' billion' AS market_cap,
CAST(((T2.total_market_cap - T1.total_market_cap) * 100.0 / T1.TOTAL_USER_IN_WORD) AS VARCHAR) + '%' AS market_growth
FROM
Total_User_Distribution T1
JOIN
Total_User_Distribution T2 ON T2.year = T1.year + 1

--INTERSECTION
SELECT SYMBOL
FROM CRYPTO
```

	year	total_user	user_growth	market_cap	market_growth
1	2010	0.020000000000000 million	400.000000%	0.000300000000000 billion	7.250000%
2	2011	0.070000000000000 million	250.000000%	0.040000000000000 billion	198.500000%
3	2012	0.150000000000000 million	114.285714%	0.130000000000000 billion	128.571428%
4	2013	0.500000000000000 million	233.333333%	1.500000000000000 billion	913.333333%
5	2014	1.500000000000000 million	200.000000%	5.000000000000000 billion	700.000000%
6	2015	3.000000000000000 million	100.000000%	7.000000000000000 billion	133.333333%
7	2016	8.000000000000000 million	166.666666%	17.00000000000000 billion	333.333333%
8	2017	30.50000000000000 million	281.250000%	600.0000000000000 billion	7287.500000%
9	2018	50.00000000000000 million	63.934426%	120.0000000000000 billion	-1573.770491%
10	2019	80.00000000000000 million	60.000000%	250.0000000000000 billion	260.000000%
11	2020	150.0000000000000 million	87.500000%	1000.000000000000 billion	937.500000%
12	2021	300.0000000000000 million	100.000000%	2900.000000000000 billion	1266.666666%
13	2022	420.0000000000000 million	40.000000%	1000.000000000000 billion	-633.333333%
14	2023	580.0000000000000 million	38.095238%	1750.000000000000 billion	178.571428%
15	2024	833.7000000000000 million	43.741379%	3800.000000000000 billion	353.448275%
16	2025	926.7500000000000 million	11.161089%	2970.000000000000 billion	-99.556195%

5.

```sql
--INTERSECTION
SELECT SYMBOL
FROM CRYPTO
INTERSECT
SELECT SYMBOL
FROM MARKET_DOMINANCE
WHERE YEAR = 2025;
--GROUP BY
select CONSENSUS_ALGORI
--HAVING
select CONSENSUS_ALGORITHM_
```

	SYMBOL
1	BTC
2	ETH
3	SOL
4	USDT
5	XRP

6.

```sql
--GROUP BY
    select CONSENSUS_ALGORITHM_TYPE,count(CONSENSUS_ALGORITHM_TYPE) from CRYPTO group by CONSENSUS_ALGORITHM_TYPE;
--HAVING
select CONSENSUS_ALGORITHM_TYPE,count(CONSENSUS_ALGORITHM_TYPE) from CRYPTO group by CONSENSUS_ALGORITHM_TYPE
                                                    having CONSENSUS_ALGORITHM_TYPE='PoW'
or CONSENSUS_ALGORITHM_TYPE='PoS' or CONSENSUS_ALGORITHM_TYPE='AuxPoW';

--UNION
--(Combine the list of cryptocurrency symbols from countries where cryptocurrencies are accepted(ACCEPTED_COUNTRYWISE_MOST_
SELECT CRYPTO_SYMBOL AS SYMBOL
```

121 %

⊞ Results   ▤ Messages

	CONSENSUS_ALGORITHM_TYPE	(No column name)
1	AuxPoW	1
2	DPoS	1
3	Hashgraph aBFT	1
4	Lachesis aBFT	1
5	Liquid PoS	1
6	N/A	2
7	Nightshade PoS	1
8	NPoS	2
9	Ouroboros PoS	1
10	PoA	2
11	PoC	1
12	PoH+PoS	1
13	PoRep/PoSt	1
14	PoS	11
15	PoS (ETH)	7
16	PoS (Oracle)	1

7.

```sql
--HAVING
select CONSENSUS_ALGORITHM_TYPE,count(CONSENSUS_ALGORITHM_TYPE) from CRYPTO group by CONSENSUS_ALGORITHM_TYPE
                                                    having CONSENSUS_ALGORITHM_TYPE='PoW'
or CONSENSUS_ALGORITHM_TYPE='PoS' or CONSENSUS_ALGORITHM_TYPE='AuxPoW';

--UNION
--(Combine the list of cryptocurrency symbols from countries where cryptocurrencies are accepted(ACCEPTED_COUNTRYWISE
SELECT CRYPTO_SYMBOL AS SYMBOL
FROM ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO
WHERE YEAR = 2024
UNION
```

21 %

⊞ Results   ▤ Messages

	CONSENSUS_ALGORITHM_TYPE	(No column name)
1	AuxPoW	1
2	PoS	11
3	PoW	5

8.

```sql
--UNION
--(Combine the list of cryptocurrency symbols from countries where cryptocurrencies are accepted(ACCEPTED_COUNTRYWISE_MOST_USE

SELECT CRYPTO_SYMBOL AS SYMBOL
FROM ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO
WHERE YEAR = 2024
UNION
SELECT AFFECTED_CRYPTO AS SYMBOL
FROM CONTROVERSY
WHERE YEAR = 2024 AND AFFECTED_CRYPTO IS NOT NULL;


--UPDATE
```

121 % ◄

Results | Messages

	SYMBOL
1	ADA
2	BNB
3	BTC
4	DOGE
5	DOT
6	ETH
7	SOL
8	USDT
9	XRP

9.

```sql
--UPDATE
UPDATE CRYPTO_CURRENCY_PERFORMANCE_METRICS
SET AVERAGE_TRX_FEE = AVERAGE_TRX_FEE * 1.10
WHERE AVERAGE_TRX_FEE > 1;

SELECT * FROM CRYPTO_CURRENCY_PERFORMANCE_METRICS

CASE
```

146 % ◄

Results | Messages

	SYMBOL	TRANSACTION_PER_SECOND	AVERAGE_TRX_FEE	ELECTRICITY_COST_PER_BLOCK	HEAT_IMMERSION_PER_TX	HASH_RATE_PER_UNIT	TOTAL_USERS
1	AAVE	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	400000
2	ADA	250.000000000000000	0.050000000000000	0.000500000000000	0.00	N/A	1000000
3	ALGO	6000.000000000000000	0.001000000000000	0.000500000000000	0.00	N/A	500000
4	APT	10000.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	200000
5	ARB	40.000000000000000	0.050000000000000	0.005000000000000	0.02	N/A	600000
6	ATOM	10000.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	500000
7	AVAX	4500.000000000000000	0.020000000000000	0.001000000000000	0.00	N/A	800000
8	AXS	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	500000
9	BCH	7.000000000000000	0.050000000000000	200.000000000000000	720.00	1.43E+07	300000
10	BNB	100.000000000000000	0.100000000000000	0.010000000000000	0.04	N/A	5000000
11	BTC	7.000000000000000	3.025000000000000	1449.000000000000000	5216.40	2.31E+09	1000000
12	CHZ	100.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	300000
13	CRO	300.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	500000
14	DAI	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	500000
15	DOGE	7.000000000000000	0.500000000000000	100.000000000000000	360.00	1.67E+06	500000
16	DOT	1000.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	700000
17	ETC	7.000000000000000	0.100000000000000	150.000000000000000	540.00	6.43E+06	300000

10.

```sql
--CASE

SELECT
    SYMBOL,
    NAME,
    MAX_PRICE,
    CASE
        WHEN MAX_PRICE > 10000 THEN 'High Price'
        WHEN MAX_PRICE BETWEEN 100 AND 10000 THEN 'Medium Price'
        ELSE 'Low Price'
    END AS PRICE_TIER
FROM CRYPTO
ORDER BY MAX_PRICE DESC;
```

	SYMBOL	NAME	MAX_PRICE	PRICE_TIER
1	BTC	Bitcoin	180000.000000000000000	High Price
2	ETH	Ethereum	6000.000000000000000	Medium Price
3	ZEC	Zcash	5941.800000000000000	Medium Price
4	MKR	Maker	4095.000000000000000	Medium Price
5	BCH	Bitcoin Cash	3785.820000000000000	Medium Price
6	BNB	Binance Coin	717.480000000000000	Medium Price
7	ICP	Internet Computer	700.650000000000000	Medium Price
8	AAVE	Aave	661.690000000000000	Medium Price
9	KSM	Kusama	621.710000000000000	Medium Price
10	XMR	Monero	542.330000000000000	Medium Price
11	LTC	Litecoin	410.260000000000000	Medium Price
12	SOL	Solana	259.960000000000000	Medium Price
13	FIL	Filecoin	236.840000000000000	Medium Price
14	ETC	Ethereum Classic	167.090000000000000	Medium Price
15	AXS	Axie Infinity	164.900000000000000	Medium Price
16	AVAX	Avalanche	144.960000000000000	Medium Price

CEP Mapping with K1–K8, A1–A5, and P1–P7

The CRYPTO_MARKET_ANALYSIS_PROJECT_DATABASE is a complex system for analyzing cryptocurrency markets, involving blockchain technology, financial metrics, and global regulatory data. The CEP mapping aligns the database's design and queries with the **Knowledge Profile (K1–K8)**, **Complex Engineering Activities (A1–A5)** from the PDF, and **Physical Schema Levels (P1–P7)** as previously discussed (e.g., storage, indexing, optimization). Below is the comprehensive mapping.

Knowledge Profile Mapping (K1–K8)

Attribute	Description (from PDF)	Mapping to Database Project
K1	Systematic, theory-based understanding of natural sciences	The database incorporates cryptographic principles (e.g., SHA-256, Scrypt in HASH_ALGO_NAME) and distributed systems theory (CONSENSUS_ALGORITHM_TYPE). These rely on computer science and mathematics, grounding the project in natural sciences.
K2	Conceptually based mathematics, numerical analysis, statistics	Queries like (MAX_PRICE - MIN_PRICE) * 100 / NULLIF(MIN_PRICE, 0) in CRYPTO for return calculations and aggregations (GROUP BY, COUNT in TOP_BROKERAGE) use numerical analysis. Statistical data (e.g., DOMINANCE in MARKET_DOMINANCE) supports market analysis.
K3	Systematic, theory-based formulation of engineering fundamentals	The schema organizes blockchain fundamentals: BLOCKCHAIN_ACCESS_TYPE (Public, Private), BLOCKCHAIN_NETWORK_TYPE (Layer-1, Layer-2), and BLOCKCHAIN_TOKEN_TYPE (Stablecoin, NFT). These systematize decentralized system principles.
K4	Engineering specialist knowledge at the forefront of the discipline	The database captures advanced blockchain concepts like PoH+PoS (Solana), Ouroboros PoS (Cardano), and Layer-0 networks (BLOCKCHAIN_NETWORK_TYPE). Data on Ethereum's Merge (CRYPTO.DESCRIPTION_FOR_MAJOR_CHANGES_LIKE_AS_MERGE) reflects cutting-edge knowledge.

K5	Knowledge that supports engineering design	Tables like CRYPTO_CURRENCY_PERFORMANCE_METRICS (e.g., TRANSACTION_PER_SECOND) and CRYPTO_ETF (e.g., TOTAL_AUM_UNDER_ETF) enable the design of market analysis tools, risk models, and regulatory frameworks.
K6	Knowledge of engineering practice (technology)	Practical blockchain technologies are captured in HASH_ALGO_NAME.HARDWARE_TYPE (ASIC, GPU), ENERGY_EFFICIENCY, and CRYPTO_CURRENCY_PERFORMANCE_METRICS.AVERAGE_TRX_FEE. Brokerage operations (BROKERAGE) and ETFs (CRYPTO_ETF) reflect real-world practices.
K7	Comprehension of engineering's role in society, ethics, professional responsibility	The database addresses societal impacts via COUNTRY.CRYPTO_STATUS (ACCEPTED, BANNED), CONTROVERSY (e.g., FTX fraud), and USER_AMOUNT_IN_BANNED_COUNTRY. Environmental concerns (e.g., ELECTRICITY_COST_PER_BLOCK) and economic metrics (e.g., GDP) highlight ethical responsibilities.
K8	Engagement with research literature	The database incorporates research-driven data, such as CONSENSUS_ALGORITHM_TYPE.DESCRIPTION (e.g., Tendermint BFT), HASH_ALGO_NAME.PROS/CONS, and ETF_INVESTMENT_TYPE.DESCRIPTION (Spot, Futures). Queries like MARKET_DOMINANCE align with blockchain/finance research.

Complex Engineering Activities Mapping (A1–A5)

Attribute	Description (from PDF)	Mapping to Database Project

A1	Involve diverse resources (people, money, equipment, materials, information, technologies)	The database integrates **information** (prices, market cap in CRYPTO, MARKET_DOMINANCE), **technologies** (blockchain protocols in CONSENSUS_ALGORITHM_TYPE, ETFs in CRYPTO_ETF), and **financial data** (TOTAL_AUM_UNDER_ETF). It supports stakeholders like brokers (BROKERAGE) and regulators (COUNTRY).
A2	Require resolution of significant problems from wide-ranging/conflicting issues	The database resolves conflicts between technical performance (TRANSACTION_PER_SECOND vs. ENERGY_EFFICIENCY), regulatory compliance (ACCEPTED_COUNTRY vs. BANNED_COUNTRY), and ethics (CONTROVERSY for hacks). Joins like BROKERAGE with COUNTRY address regulatory challenges.
A3	Involve creative use of engineering principles and research-based knowledge	Creative queries like CASE statements for price tiering (High Price, Medium Price) and return calculations ((MAX_PRICE - MIN_PRICE) * 100 / MIN_PRICE) combine blockchain (BLOCKCHAIN_NETWORK_TYPE) and financial analysis (CRYPTO_ETF). The schema's normalization reflects innovative design.
A4	Have significant consequences in a range of contexts, with difficulty of prediction/mitigation	Insights from TOTAL_MARKET_CAP, DOMINANCE, and USER_AMOUNT_IN_BANNED_COUNTRY impact economic, environmental (ELECTRICITY_COST_PER_BLOCK), and regulatory contexts. Controversies (e.g., $16B FTX repayment in CONTROVERSY) show prediction/mitigation challenges.
A5	Extend beyond previous experiences by applying principles-based approaches	The database applies principles to emerging areas like Layer-2 (BLOCKCHAIN_NETWORK_TYPE), meme tokens (BLOCKCHAIN_TOKEN_TYPE), and spot ETFs (ETF_INVESTMENT_TYPE). Global adoption analysis (TOTAL_USER_DISTRIBUTION) extends beyond traditional finance.

Physical Schema Levels Mapping (P1–P7)

Based on our previous conversation, **P1–P7** likely represent progressive levels of physical schema implementation, from basic storage to advanced optimization. Since the PDF does not define these, I'll use the following assumed definitions, aligned with database engineering:

- **P1**: Basic storage structures (tables, columns, data types).
- **P2**: Primary and foreign key constraints for data integrity.
- **P3**: Indexes for query performance.
- **P4**: Partitioning and clustering for scalability.
- **P5**: Query optimization (e.g., execution plans, caching).
- **P6**: Distributed storage and replication for high availability.
- **P7**: Advanced analytics and machine learning integration.

Level	Description	Mapping to Database Project
P1	Basic storage structures	The database defines tables like CRYPTO, HASH_ALGO_NAME, and COUNTRY with appropriate data types (e.g., DECIMAL(38,15) for prices, VARCHAR(200) for names). The schema supports storage of diverse data (e.g., TOTAL_SUPPLY, CRYPTO_STATUS).
P2	Primary and foreign key constraints	Primary keys (e.g., CRYPTO_TABLE_PK on SYMBOL, HASH_ALGO_NAME_PK on NAME, CONSENSUS_ALGORITHM_TYPE) and foreign keys (e.g., CRYPTO_TABLE_FK_BLOCKCHAIN_TYPE referencing BLOCKCHAIN_ACCESS_TYPE) ensure referential integrity. The ON DELETE NO ACTION clauses maintain data consistency.
P3	Indexes for query performance	While the provided SQL does not explicitly define indexes, frequent queries (e.g., SELECT * FROM CRYPTO WHERE SYMBOL='BTC', joins on BROKERAGE and COUNTRY) imply the need for indexes on columns like SYMBOL, YEAR, and COUNTRY_CODE. This aligns with performance optimization for market analysis.
P4	Partitioning and clustering	The database does not explicitly use partitioning, but tables like MARKET_DOMINANCE and TOTAL_USER_DISTRIBUTION (with YEAR as a key) could benefit from range partitioning by year to handle large datasets. Clustering by SYMBOL or COUNTRY_CODE could improve join performance.

P5	Query optimization	Queries like WITH TMP AS (...) and INTERSECTION/UNION show optimization efforts (e.g., CTEs for readability, set operations for efficiency). The use of NULLIF in return calculations prevents errors, and ORDER BY/GROUP BY clauses optimize result sets. Execution plans are implied but not specified.
P6	Distributed storage and replication	The database is designed as a single-instance schema, but its global scope (e.g., TOTAL_USER_DISTRIBUTION, ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO) suggests potential for distributed deployment. Replication could support high availability for real-time market data, though not implemented in the SQL.
P7	Advanced analytics and ML integration	The database supports analytics via aggregations (COUNT in CONSENSUS_ALGORITHM_TYPE, SUM in TOTAL_MARKET_CAP) and could integrate with ML for predictive modeling (e.g., price trends using MAX_PRICE, MIN_PRICE). However, ML integration is not explicit in the SQL.

Dependency on CEP Levels

Based on our prior discussion, the database project depends on:

- **K1–K8 (Fully)**: All knowledge attributes are critical. Theoretical foundations (K1–K4) underpin blockchain and crypto data, while practical design (K5–K6), societal impacts (K7), and research engagement (K8) drive the schema and queries.
- **A1–A5 (Fully)**: The project addresses diverse resources (A1), conflicting issues (A2), innovation (A3), societal consequences (A4), and novel approaches (A5), making it a complex engineering activity.
- **P1–P7 (Partially)**:
    - **P1–P3 (Fully)**: The schema defines storage, constraints, and implies indexing needs.
    - **P4–P5 (Partially)**: Partitioning and query optimization are implied but not fully implemented.
    - **P6–P7 (Minimally)**: Distributed systems and ML are potential extensions but not present in the SQL.

Specific Examples

- **K2/P5**: The query WITH TMP AS (SELECT SYMBOL, MAX_PRICE, MIN_PRICE, MAX_PRICE_DATE, MIN_PRICE_DATE, (MAX_PRICE - MIN_PRICE) * 100 / NULLIF(MIN_PRICE, 0) AS MAX_RETURN FROM CRYPTO) SELECT * FROM TMP WHERE SYMBOL = 'XMR' uses numerical analysis (K2) and optimizes with a CTE (P5).
- **A4/K7**: The CONTROVERSY table (e.g., FTX's $8B fraud) and COUNTRY.CRYPTO_STATUS (e.g., China's ban) highlight societal consequences (A4) and ethical responsibilities (K7).
- **P2/A2**: Foreign keys like CRYPTO_TABLE_FK_HASH_ALGO_NAME resolve referential integrity (P2) while addressing technical-regulatory conflicts (A2) in ACCEPTED_COUNTRY vs. BANNED_COUNTRY.