Cryptocurrency Yearly Market Analysis Database

Project Overview:

This project analyzes the real-time impact of the cryptocurrency market on global and national levels. This project is based on yearly data. It explores how crypto mining, ETFs, new investors and traders, and decentralized finance influence employment, the environment, and the economy. The study highlights both positive outcomes, such as job creation, financial inclusion, and innovation, and negative effects, such as energy consumption, financial risk, and regulatory challenges. Real-world examples include the USA, Canada, and El Salvador's adoption of Bitcoin, the rise of crypto-based freelancing, and increased global investment through crypto ETFs. It has also become a new financial weapon for some countries, as they use crypto for their strategic reserves. This project serves as a foundational tool for the crypto industry, bridging technical, financial, and regulatory domains to foster innovation, compliance, and market efficiency in real-time scenarios.

Tools & Data Sources Used in This Project:

- **Database Engine**: MySQL, MSSQL
- **Design Tools**: DB Diagram (for ER diagram), DataGrip (for schema diagram)
- **IDE:** DataGrip, SSMS (SQL Server Management Studio)
- **Data Sources**:
    - CoinMarketCap, Statista, Global Crypto Adoption Index, Chainalysis (historical crypto prices, market cap, dominance).
    - Cambridge Bitcoin Electricity Consumption Index (energy metrics).
    - FATF, IMF, World Bank reports, government publications (GDP, unemployment rates, education percentages,Global Crypto Regulations).
    - CryptoCompare (transaction fees, hash rate data).
    - Whattomine (historical hashrate, halving data)
    - Bitcoin Whitepaper, Ethereum documentation, project-specific whitepapers (Block Reward)
    - SEC Filings, Bloomberg, DTCC (ETF and Financial Firms)

Database Tables Overview:

1. BLOCKCHAIN_ACCESS_TYPE

- **Description**: Stores types of blockchain access (e.g., public, private) and their descriptions.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique identifier for the access type.
  - DESCRIPTION (TEXT, NOT NULL): Explanation of the access type.
- **Normalization**: In 3NF. No partial or transitive dependencies; TYPE uniquely determines DESCRIPTION.
- **Cardinality**:
  - **1:N with CRYPTO (BLOCKCHAIN_ACCESS_TYPE)**: One access type can be associated with multiple cryptocurrencies, ensuring standardized categorization.
- **Real-Time Usage**: Used to classify cryptocurrencies by access type for regulatory compliance and investor analysis in the crypto market.

2. BLOCKCHAIN_TOKEN_TYPE

- **Description**: Defines types of blockchain tokens (e.g., utility, security) with their descriptions.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique token type identifier.
  - DESCRIPTION (TEXT, NOT NULL): Details about the token type.
- **Normalization**: In 3NF. No dependencies.
- **Cardinality**:
  - **1:N with CRYPTO (BLOCKCHAIN_TOKEN_TYPE)**: One token type applies to multiple cryptocurrencies, ensuring consistent token classification.
- **Real-Time Usage**: Helps in token classification for tax purposes, risk assessment, and market trend analysis.

3. CONSENSUS_ALGORITHM_TYPE

- **Description**: Stores types of consensus algorithms (e.g., Proof of Work, Proof of Stake) with descriptions.
- **Attributes**:
    - TYPE (VARCHAR(200), PK, NOT NULL): Unique algorithm type identifier.
    - DESCRIPTION (TEXT, NOT NULL): Explanation of the algorithm.
- **Normalization**: In 3NF. No redundancy or dependencies.
- **Reason for Process Failure**: None. Simple and normalized.
- **Cardinality**:
    - **1:N with CRYPTO (CONSENSUS_ALGORITHM_TYPE)**: One algorithm type applies to multiple cryptocurrencies.
    - **1:N with HASH_ALGO_NAME (CONSENSUS_ALGORITHM_TYPE)**: One algorithm type can be linked to multiple hash algorithms.
- **Real-Time Usage**: Used to evaluate the security, scalability, and energy efficiency of cryptocurrencies based on their consensus mechanisms.

4. BLOCKCHAIN_NETWORK_TYPE

- **Description**: Categorizes blockchain network types (e.g., mainnet, testnet) with examples and features.
- **Attributes**:
    - TYPE (VARCHAR(200), PK, NOT NULL): Unique network type identifier.
    - DESCRIPTION (TEXT, NOT NULL): Network type explanation.
    - EXAMPLES (TEXT, NOT NULL): Example networks.
    - KEY_FEATURES (TEXT, NOT NULL): Distinct features of the network type.
- **Normalization**: In 3NF. All attributes depend on TYPE.
- **Cardinality**:
    - **1:N with CRYPTO (BLOCKCHAIN_NETWORK_TYPE)**: One network type applies to multiple cryptocurrencies.
- **Real-Time Usage**: Assists in comparing network scalability and decentralization for investment and development decisions.

5. HASH_ALGO_NAME

- **Description**: Details hash algorithms used in consensus mechanisms, including hardware and efficiency metrics.
- **Attributes**:
    - NAME (VARCHAR(200), PK, NOT NULL): Hash algorithm name (e.g., SHA-256).
    - CONSENSUS_ALGORITHM_TYPE (VARCHAR(200), PK, NOT NULL): Associated consensus algorithm.
    - DESCRIPTION (VARCHAR(MAX), NOT NULL): Algorithm details.
    - HARDWARE_TYPE (VARCHAR(200), NOT NULL): Hardware used (e.g., ASIC, GPU).
    - PROS (VARCHAR(MAX), NOT NULL): Advantages of the algorithm.
    - CONS (VARCHAR(MAX), NOT NULL): Disadvantages of the algorithm.
    - ENERGY_EFFICIENCY (VARCHAR(10), NOT NULL, CHECK): Efficiency level (HIGH, LOW, MODERATE).
- **Normalization**: In 3NF. Composite PK (NAME, CONSENSUS_ALGORITHM_TYPE) ensures no redundancy.
- **Cardinality**:
    - **N:1 with CONSENSUS_ALGORITHM_TYPE**: Multiple hash algorithms can be associated with one consensus type.
    - **1:N with CRYPTO (HASH_ALGO_NAME, HASH_ALGO_CONSENSUS_TYPE)**: One hash algorithm can be used by multiple cryptocurrencies.
- **Real-Time Usage**: Evaluates mining efficiency, hardware requirements, and environmental impact for crypto mining operations.

6. CRYPTO

- **Description**: Core table storing cryptocurrency details, including price, supply, and technical attributes.
- **Attributes**:
    - NAME (VARCHAR(200), NOT NULL): Cryptocurrency name.
    - SYMBOL (VARCHAR(10), PK, NOT NULL): Unique ticker (e.g., BTC).

    - MAX_PRICE, MIN_PRICE (DECIMAL(38,15), NOT NULL): Historical price extremes.
    - MAX_PRICE_DATE, MIN_PRICE_DATE (DATE): Dates of price extremes.
    - TOTAL_SUPPLY, CIRCULATING_SUPPLY (DECIMAL(38,15), NOT NULL): Supply metrics.
    - BLOCKCHAIN_ACCESS_TYPE, CONSENSUS_ALGORITHM_TYPE, BLOCKCHAIN_NETWORK_TYPE, BLOCKCHAIN_TOKEN_TYPE (VARCHAR(200), NOT NULL): References to respective types.
    - HASH_ALGO_NAME, HASH_ALGO_CONSENSUS_TYPE (VARCHAR(200)): Composite FK to hash algorithm.
    - FOUNDER (VARCHAR(200), NOT NULL): Founder name.
    - INITIAL_RELEASE_YEAR (INT, NOT NULL): Launch year.
    - OFFICIAL_WEBSITE (VARCHAR(100), NOT NULL): Official website.
    - DESCRIPTION_FOR_MAJOR_CHANGES (VARCHAR(MAX), NOT NULL): Details of major updates (e.g., forks).
- **Normalization**: In 3NF. All attributes depend on SYMBOL. FKs ensure referential integrity.
- **Cardinality**:
    - **1:N with multiple tables (e.g., CRYPTO_CURRENCY_PERFORMANCE_METRICS, MARKET_DOMINANCE)**: One cryptocurrency has multiple performance or dominance records.
    - **N:1 with lookup tables (e.g., BLOCKCHAIN_ACCESS_TYPE)**: Multiple cryptocurrencies share one access type.
    - **`M:N COUNTRY` ↔ `CRYPTO` via `ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO`**
- **Real-Time Usage**: Central table for price tracking, technical analysis, and regulatory reporting in the crypto market.

7. CRYPTO_CURRENCY_PERFORMANCE_METRICS

- **Description**: Stores performance metrics for cryptocurrencies, such as transaction speed and energy costs.
- **Attributes**:
  - SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - TRANSACTION_PER_SECOND, AVERAGE_TRX_FEE, ELECTRICITY_COST_PER_BLOCK (DECIMAL(38,15)): Performance and cost metrics.
  - HEAT_IMMERSION_PER_TX (DECIMAL(38,2)): Energy per transaction in Joules.
  - HASH_RATE_PER_UNIT (VARCHAR(50)): Hash rate metric.
  - TOTAL_USERS (DECIMAL(38,0)): Total user count.
- **Normalization**: In 3NF. All attributes depend on SYMBOL.
- **Cardinality**:
  - **1:1 with CRYPTO**: One performance record per cryptocurrency.
- **Real-Time Usage**: Analyzes transaction efficiency, cost, and environmental impact for investment and scalability decisions.

8. TOTAL_USER_DISTRIBUTION

- **Description**: Tracks global cryptocurrency user distribution by region and market cap annually.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - ASIA_USER, NORTH_AMERICA_USER, AMERICA_USER, AFRICA_USER, EUROPE_USER, OCEANIA_USER (DECIMAL(38,15)): Regional user counts.
  - TOTAL_USER_IN_WORD (DECIMAL(38,15)): Global user count.
  - TOTAL_MARKET_CAP (DECIMAL(38,15)): Total market capitalization.
- **Normalization**: In 2NF. Partial dependency on YEAR for regional users. AMERICA_USER (sum of North and South America) introduces redundancy.

- **Cardinality**:
    - **1:N with MARKET_DOMINANCE, TOP_BROKERAGE**: One year has multiple dominance or brokerage records.
- **Real-Time Usage**: Monitors global adoption trends and market growth for strategic planning and market expansion.

9. MARKET_DOMINANCE

- **Description**: Tracks annual market dominance of cryptocurrencies.
- **Attributes**:
    - YEAR (INT, PK): Year of data.
    - SYMBOL (VARCHAR(10), PK): Cryptocurrency ticker.
    - MAX_PRICE, MIN_PRICE (DECIMAL(38,15/30)): Price extremes.
    - MAX_PRICE_DATE, MIN_PRICE_DATE (DATE): Dates of price extremes.
    - TOTAL_MARKET_CAP_OF_THIS_CURRENCY (DECIMAL(38,10)): Market cap of the currency.
    - DOMINANCE (FLOAT, CHECK <= 100): Market share percentage.
    - TOTAL_TRANSACTION, TOTAL_USER, TOTAL_WALLET_COUNT (DECIMAL(38,10)): Transaction, user, and wallet metrics in millions.
- **Normalization**: In 3NF. Composite PK (SYMBOL, YEAR) ensures no redundancy.
- **Cardinality**:
    - **N:1 with CRYPTO**: Multiple dominance records per cryptocurrency.
    - **N:1 with TOTAL_USER_DISTRIBUTION**: Multiple dominance records per year.
- **Real-Time Usage**: Analyzes market share and volatility for portfolio management and competitive analysis.

10. COUNTRY

- **Description**: Stores country data, including crypto regulatory status and socioeconomic metrics.
- **Attributes**:
    - COUNTRY_CODE (VARCHAR(50), PK): ISO country code.

    - COUNTRY_NAME (VARCHAR(200)): Country name.
    - CRYPTO_STATUS (VARCHAR(20), CHECK): Status (ACCEPTED, RESTRICTED, BANNED).
    - EDUCATION_PERCENTAGE, UNEMPLOYMENT_RATE (FLOAT): Socioeconomic indicators.
    - GDP (DECIMAL(38,10)): GDP in billions.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Cardinality**:
    - **1:N with ACCEPTED_COUNTRY, BANNED_COUNTRY, USER_AMOUNT_IN_BANNED_COUNTRY**: One country has multiple related records.
- **Real-Time Usage**: Assesses regulatory environments and socioeconomic factors for market entry strategies.

11. ACCEPTED_COUNTRY

- **Description**: Details countries where crypto is accepted, including restrictions and infrastructure.
- **Attributes**:
    - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
    - RESTRICTIONS (VARCHAR(200)): Regulatory restrictions.
    - CRYPTO_ATMS (INT, NOT NULL): Number of crypto ATMs.
    - ACCEPTED_YEAR (INT): Year crypto was accepted.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Cardinality**:
    - **1:1 with COUNTRY**: One acceptance record per country.
- **Real-Time Usage**: Tracks crypto adoption and infrastructure for market expansion and investment planning.

12. BANNED_COUNTRY

- **Description**: Details countries where crypto is banned, including restrictions.
- **Attributes**:
  - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
  - RESTRICTIONS (VARCHAR(200)): Ban details.
  - CRYPTO_ATMS (INT, NOT NULL): Number of ATMs (likely 0).
  - BANNED_YEAR (INT): Year of ban.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Cardinality**:
  - **1:1 with COUNTRY**: One ban record per country.
- **Real-Time Usage**: Identifies regulatory risks for crypto businesses and compliance strategies.

13. USER_AMOUNT_IN_BANNED_COUNTRY

- **Description**: Tracks user counts in banned countries annually.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
  - USER_AMOUNT (DECIMAL(38,20)): User count in millions.
- **Normalization**: In 3NF. Composite PK (YEAR, COUNTRY_CODE) ensures no redundancy.
- **Cardinality**:
  - **N:1 with COUNTRY**: Multiple user records per country over different years.
- **Real-Time Usage**: Monitors illicit crypto usage in restricted regions for regulatory enforcement.

14. ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO

- **Description**: Tracks the most-used cryptocurrencies in accepted countries annually.

- **Attributes**:
    - YEAR (INT, PK): Year of data.
    - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
    - CRYPTO_SYMBOL (VARCHAR(10), PK): References CRYPTO.
    - USER_PERCENTAGE (DECIMAL(10,5), CHECK <= 100): Percentage of users.
- **Normalization**: In 3NF. Composite PK ensures uniqueness.
- **Cardinality**:
    - **N:1 with COUNTRY, CRYPTO**: Multiple records per country and cryptocurrency.
- **Real-Time Usage**: Identifies popular cryptocurrencies by region for targeted marketing and adoption strategies.

15. BLOCK_REWARD_EMISSION_TYPE

- **Description**: Defines types of block reward emission (e.g., halving, tail emission).
- **Attributes**:
    - TYPE (VARCHAR(50), PK): Emission type.
- **Normalization**: In 3NF. Single attribute table.
- **Cardinality**:
    - **1:N with REWARD_DETAILS**: One emission type applies to multiple cryptocurrencies.
- **Real-Time Usage**: Classifies emission models for supply and price impact analysis.

16. REWARD_DETAILS

- **Description**: Stores block reward details for cryptocurrencies.
- **Attributes**:
    - SYMBOL (VARCHAR(10), PK): References CRYPTO.
    - EMISSION_TYPE (VARCHAR(50)): References BLOCK_REWARD_EMISSION_TYPE.
    - EMISSION_TIME (DECIMAL(38,0)): Emission duration.

    - STARTING_TIME_BLOCK_REWARD, CURRENT_BLOCK_REWARD (DECIMAL(38,5)): Reward amounts.
    - BLOCK_REWARD_TIME (DECIMAL(38,30)): Time per reward.
- **Normalization**: In 3NF. All attributes depend on SYMBOL.
- **Cardinality**:
    - **1:1 with CRYPTO**: One reward detail per cryptocurrency.
    - **N:1 with BLOCK_REWARD_EMISSION_TYPE**: Multiple cryptocurrencies per emission type.
- **Real-Time Usage**: Analyzes mining incentives and supply dynamics for price forecasting.

17. BLOCK_REWARD_EMISSION

- **Description**: Tracks block reward changes (e.g., halving events) annually.
- **Attributes**:
    - SYMBOL (VARCHAR(10), PK): References CRYPTO.
    - YEAR (INT, PK): Year of event.
    - DATE (DATE): Event date.
    - BLOCK_REWARD (DECIMAL(38,10)): Reward amount.
    - HALVING_YEAR_MARKET_PRICE, HALVING_YEAR_MARKET_CAP (DECIMAL(38,20)): Market metrics during halving.
    - NETWORK_HASH_RATE (DECIMAL(38,0)): Hash rate.
- **Normalization**: In 3NF. Composite PK (SYMBOL, YEAR) ensures no redundancy.
- **Cardinality**:
    - **N:1 with CRYPTO**: Multiple emission records per cryptocurrency.
- **Real-Time Usage**: Predicts price impacts of halving events for investment strategies.

18. HFT_AMF_FIRMS

- **Description**: Stores details of high-frequency trading and asset management firms.
- **Attributes**:
  - COMPANY_NAME (VARCHAR(200), PK): Firm name.
  - HEAD_QUARTER (VARCHAR(200)): Location.
  - ESTABLISHED_YEAR (INT): Founding year.
  - WORK_TYPE (VARCHAR(500)): Type of work.
  - FAMOUS_FOR (VARCHAR(500)): Notable achievements.
- **Normalization**: In 3NF. All attributes depend on COMPANY_NAME.
- **Cardinality**:
  - **1:N with CRYPTO_ETF**: One firm manages multiple ETFs.
- **Real-Time Usage**: Tracks firms influencing crypto markets for investor due diligence.

19. ETF_INVESTMENT_TYPE

- **Description**: Defines types of crypto ETF investments (e.g., spot, futures).
- **Attributes**:
  - TYPE (VARCHAR(200), PK): Investment type.
  - DESCRIPTION (TEXT): Type explanation.
- **Normalization**: In 3NF. No dependencies.
- **Cardinality**:
  - **1:N with CRYPTO_ETF**: One investment type applies to multiple ETFs.
- **Real-Time Usage**: Classifies ETFs for investor risk assessment and regulatory compliance.

20. CRYPTO_ETF

- **Description**: Stores details of cryptocurrency ETFs.
- **Attributes**:
  - ETF_NAME (VARCHAR(300)): ETF name.
  - ETF_CODE (VARCHAR(200), PK): Unique code.

    - COMPANY_NAME (VARCHAR(200)): References HFT_AMF_FIRMS.
    - LAUNCH_DATE (DATE): Launch date.
    - YEAR (INT): Launch year.
    - TOTAL_AUM_UNDER_ETF (DECIMAL(38,20)): Assets under management.
    - CRYPTO_SYMBOL (VARCHAR(10), PK): References CRYPTO.
    - ETF_INVESTMENT_TYPE (VARCHAR(200)): References ETF_INVESTMENT_TYPE.
    - EXPENSE_RATIO (DECIMAL(10,5), CHECK < 100): Fee percentage.
- **Normalization**: In 3NF. Composite PK (ETF_CODE, CRYPTO_SYMBOL) ensures no redundancy.
- **Cardinality**:
    - **N:1 with CRYPTO, HFT_AMF_FIRMS, ETF_INVESTMENT_TYPE**: Multiple ETFs per cryptocurrency, firm, or investment type.
- **Real-Time Usage**: Tracks ETF performance and fees for investment decisions and market analysis.

21. BROKERAGE

- **Description**: Stores details of crypto brokerages.
- **Attributes**:
    - NAME (VARCHAR(200), PK): Brokerage name.
    - HEADQUARTER (VARCHAR(200)): Location.
    - ESTABLISHED_YEAR (INT): Founding year.
    - OWN_CRYPTO_CURRENCY (VARCHAR(10)): Associated cryptocurrency.
    - FOUNDER_NAME (VARCHAR(200)): Founder.
- **Normalization**: In 3NF. All attributes depend on NAME.
- **Cardinality**:
    - **1:N with TOP_BROKERAGE, CONTROVERSY**: One brokerage has multiple performance or controversy records.
- **Real-Time Usage**: Evaluates brokerage reliability and market influence for investor trust.

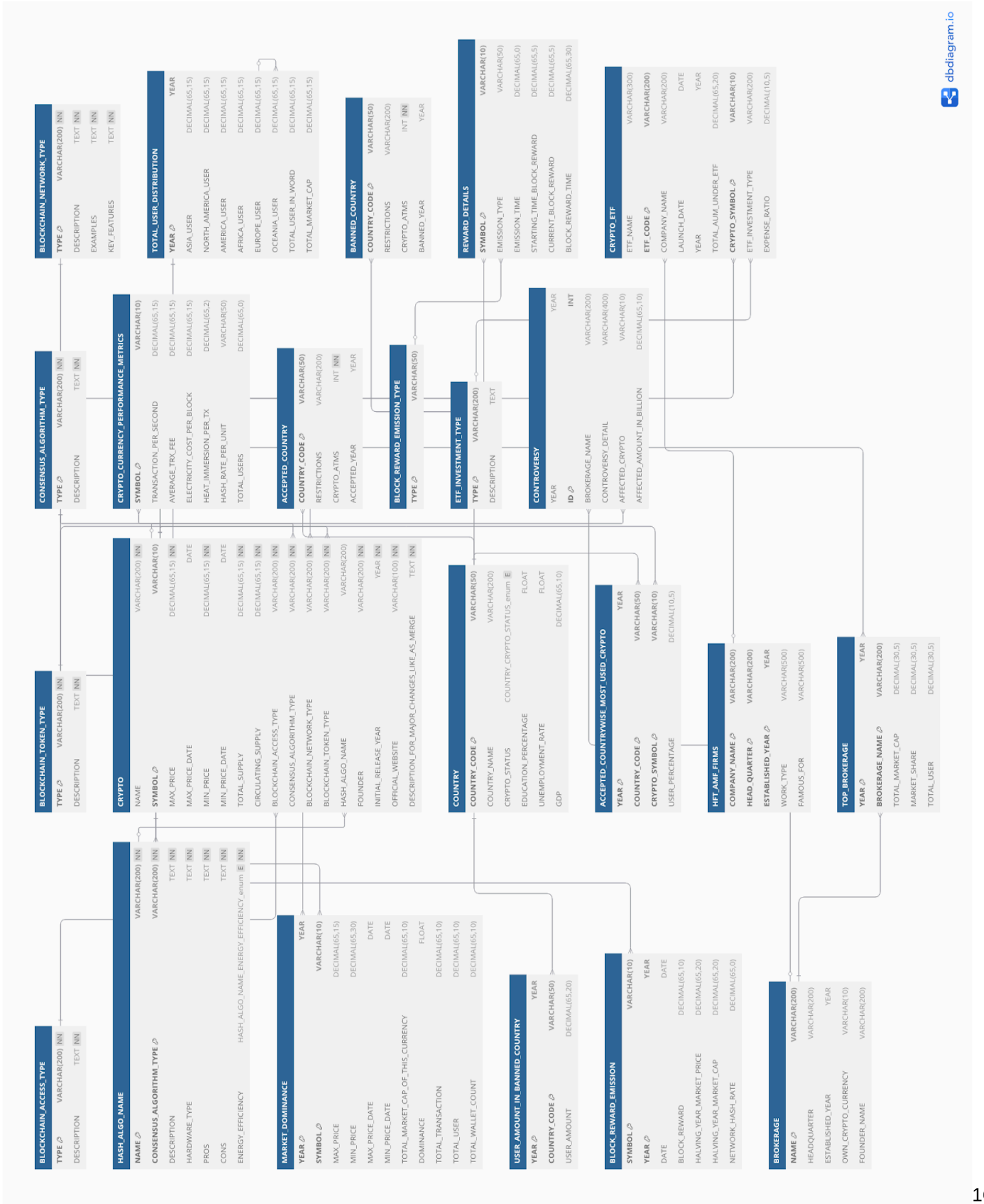
22. TOP_BROKERAGE

- **Description**: Tracks top brokerages annually by market cap and user base.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - BROKERAGE_NAME (VARCHAR(200), PK): References BROKERAGE.
  - TOTAL_MARKET_CAP, MARKET_SHARE, TOTAL_USER (DECIMAL(30,5)): Performance metrics.
- **Normalization**: In 3NF. Composite PK (BROKERAGE_NAME, YEAR) ensures no redundancy.
- **Cardinality**:
  - **N:1 with BROKERAGE, TOTAL_USER_DISTRIBUTION**: Multiple records per brokerage or year.
- **Real-Time Usage**: Identifies leading brokerages for investor trust and market analysis.

23. CONTROVERSY

- **Description**: Records controversies involving brokerages and affected cryptocurrencies.
- **Attributes**:
  - YEAR (INT): Year of controversy.
  - BROKERAGE_NAME (VARCHAR(200)): References BROKERAGE.
  - CONTROVERSY_DETAIL (VARCHAR(400)): Details of the issue.
  - AFFECTED_CRYPTO (VARCHAR(10)): References CRYPTO.
  - AFFECTED_AMOUNT_IN_BILLION (DECIMAL(38,10)): Financial impact.
- **Normalization**: In 2NF.
- **Cardinality**:
  - **N:1 with BROKERAGE, CRYPTO**: Multiple controversies per brokerage or cryptocurrency.
- **Real-Time Usage**: Tracks risks and reputational issues for risk management and investor due diligence.

Entity Relationship Diagram



Schema Diagram

Complex Engineering Problem Project Mapping Report (Washington Accord)

This report maps the database project to the Washington Accord's **Knowledge Profile (K1-K8)**, **Complex Engineering Problem Solving Skills (P1-P7)**, and **Complex Engineering Activities (A1-A5)**, using the provided slides as reference. Each attribute is tied to specific tables and explained in the context of the project.

Knowledge Profile (K1-K8)

- **K1: A systematic, theory-based understanding of the natural sciences applicable to the discipline**
    - **How Applied**: These attributes require understanding of **physics (energy consumption, heat transfer), thermodynamics, and mathematics (cost calculations)** to model the environmental impact of blockchain operations, aligning with natural sciences principles.
    - **Sample Parameter**: ELECTRICITY_COST_PER_BLOCK and HEAT_IMMERSION_PER_TX in the CRYPTO_CURRENCY_PERFORMANCE_METRICS table.

- **K2: Conceptually based mathematics, numerical analysis, statistics, and the formal aspects of computer and information science**
    - **How Applied**: **Calculating market dominance involves statistical analysis**, while **hash rate computations require numerical modeling**, both rooted in **computer science and mathematics**.
    - **Sample Parameter**: DOMINANCE (FLOAT, CHECK <= 100) in the MARKET_DOMINANCE table and NETWORK_HASH_RATE in the BLOCK_REWARD_EMISSION table.

- **K3: A systematic, theory-based formulation of engineering fundamentals**
    - **How Applied**: Modeling **consensus mechanisms (e.g., PoW, PoS)**, **hash algorithms (e.g., SHA-256, RandomX)** requires engineering fundamentals of distributed systems and **cryptography**, ensuring accurate representation of blockchain operations.
    - **Sample Parameter**: CONSENSUS_ALGORITHM_TYPE in the CRYPTO and HASH_ALGO_NAME tables.

- **K4: Engineering specialist knowledge that provides theoretical frameworks**
    - **How Applied**: Understanding **block reward emission models (e.g., halving, tailing)** requires specialized knowledge of **blockchain economics** and **tokenomics**, providing a theoretical framework for supply dynamics.
    - **Sample Parameter**: EMISSION_TYPE in the REWARD_DETAILS table and BLOCK_REWARD_EMISSION_TYPE table.

- **K5: Knowledge that supports engineering design**
    - **How Applied**: **Designing a normalized schema** with FKs supports efficient data retrieval and integrity, crucial for engineering a scalable database system. Tools like **DB Diagram** and **DataGrip** were used to design the **ER diagram, schema diagram, and ensure normalization.**
    - **Sample Parameter**: FK relationships in the CRYPTO table (e.g., BLOCKCHAIN_ACCESS_TYPE, BLOCKCHAIN_TOKEN_TYPE).

- **K6: Knowledge of engineering practice (technology)**
    - **How Applied**: Specifying **hardware (e.g., ASIC, GPU) for mining reflects practical knowledge** of blockchain technology and its **computational requirements**. For make this project we use DBMS knowledge. **Data from CoinMarketCap, Cambridge Bitcoin Electricity Consumption Index, CryptoCompare, and Whattomine was integrated using SQL Server Management Studio.**
    - **Sample Parameter**: This project, HARDWARE_TYPE in the HASH_ALGO_NAME table.

- **K7: Comprehension of the role of engineering in society**
    - **How Applied**: These attributes address **regulatory, ethical, and social impacts of cryptocurrencies**, such as public safety and economic implications, aligning with engineering's societal role.
    - **Sample Parameter**: CRYPTO_STATUS in the COUNTRY table and CONTROVERSY_DETAIL in the CONTROVERSY table.

- **K8: Engagement with selected knowledge in the research literature**
    - **How Applied**: Assessing **energy efficiency requires engaging with research on sustainable blockchain technologies**, ensuring the project aligns with current environmental studies.
    - **Sample Parameter**: ENERGY_EFFICIENCY in the HASH_ALGO_NAME table.

Complex Engineering Problem-Solving Skills (P1-P7)

- **P1: Cannot be resolved without in-depth engineering knowledge**
    - **How Applied**: **Calculating energy costs and heat per transaction requires deep knowledge of electrical engineering** and **thermodynamics**, as these are not trivial metrics and involve complex modeling.
    - **Sample Parameter**: ELECTRICITY_COST_PER_BLOCK and HEAT_IMMERSION_PER_TX in the CRYPTO_CURRENCY_PERFORMANCE_METRICS table.

- **P2: Involve wide-ranging or conflicting technical, engineering, and other issues**
    - **How Applied**: **Balancing regulatory compliance (legal issues) with technical implementation (blockchain accessibility) involves conflicting requirement**s, such as privacy versus transparency.
    - **Sample Parameter**: CRYPTO_STATUS in the COUNTRY table and RESTRICTIONS in the ACCEPTED_COUNTRY and BANNED_COUNTRY tables.

- **P3: Has no obvious solution and requires abstract thinking**
    - **How Applied**: Calculating **market dominance requires abstract modeling of market share**, with no obvious formula, as it involves dynamic market data and competitive analysis.
    - **Sample Parameter**: DOMINANCE in the MARKET_DOMINANCE table.

- **P4: Involve infrequently encountered issues**
    - **How Applied**: **Controversies** in crypto markets (e.g., hacks, fraud) are infrequent but impactful, requiring unique **risk assessment** and **mitigation strategies**.
    - **Sample Parameter**: CONTROVERSY_DETAIL in the CONTROVERSY table.

- **P5: Are outside problems encompassed by standards and codes**
    - **How Applied**: **Halving events** and their market impacts are not governed by **standard financial codes**, requiring **custom analysis** beyond traditional frameworks.
    - **Sample Parameter**: BLOCK_REWARD_EMISSION table's HALVING_YEAR_MARKET_PRICE and HALVING_YEAR_MARKET_CAP.

- **P6: Involve diverse groups of stakeholders with widely varying needs**
    - **How Applied**: The table addresses the needs of **diverse stakeholders** (investors, regulators, developers) with varying interests in regional adoption trends and market growth.
    - **Sample Parameter**: TOTAL_USER_DISTRIBUTION table's regional user attributes (e.g., ASIA_USER, EUROPE_USER).

- **P7: Are high-level problems including many component parts or sub-problems**
    - **How Applied**: The **CRYPTO table integrates multiple sub-problems (access type, consensus mechanism, token type), forming a high-level system for crypto analysis.**

- **Sample Parameter**: Multiple FKs in the CRYPTO table (e.g., BLOCKCHAIN_ACCESS_TYPE, CONSENSUS_ALGORITHM_TYPE).

Complex Engineering Activities (A1-A5)

- **A1: Involve the use of diverse resources**
  - **How Applied**: Managing ETF data involves diverse resources, including **financial data (AUM), human resources (firms), and technology (database systems)**, to support investment analysis.
  - **Sample Parameter**: CRYPTO_ETF table's TOTAL_AUM_UNDER_ETF and COMPANY_NAME.

- **A2: Require resolution of significant problems arising from interactions**
  - **How Applied**: Balancing **energy efficiency (environmental concern)** with **consensus mechanisms (technical requirement)** resolves conflicts between sustainability and performance.
  - **Sample Parameter**: HASH_ALGO_NAME table's ENERGY_EFFICIENCY and CRYPTO table's CONSENSUS_ALGORITHM_TYPE.

- **A3: Involve creative use of engineering principles**
  - **How Applied**: **Modeling emission types (e.g., halving, tailing)** creatively applies engineering principles to predict supply dynamics and market impacts, a novel challenge in blockchain.

- **Sample Parameter**: BLOCK_REWARD_EMISSION_TYPE and REWARD_DETAILS tables' emission models.

- **A4: Have significant consequences in a range of contexts**
  - **How Applied**: **Controversies can impact financial markets**, while regulatory status affects global adoption, both with **significant economic and social consequences.**
  - **Sample Parameter:** CONTROVERSY table's AFFECTED_AMOUNT_IN_BILLION and COUNTRY table's CRYPTO_STATUS.

- **A5: Can extend beyond previous experiences by applying principles-based approaches.**
  - **How Applied**: Analyzing crypto usage by country extends beyond **traditional financial analysis**, using principles-based data modeling to explore new adoption patterns.
  - **Sample Parameter**: ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO table's USER_PERCENTAGE.

QUERIES

Question 1 :

Write a query to display the cryptocurrencies whose transaction fees are greater than or equal to 1 USD, and show them in ascending order of their transaction fees.

Query:

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

Output:

Results | Messages

	SYMBOL	TRANSACTION_PER_SECOND	AVERAGE_TRX_FEE	ELECTRICITY_COST_PER_BLOCK	HEAT_IMMERSION_PER_TX	HASH_RATE_PER_UNIT	TOTAL_USERS
1	DAI	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	500000
2	ETH	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	500000
3	GRT	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	400000
4	LDO	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	300000
5	LINK	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	600000
6	MANA	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	300000
7	MKR	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	300000
8	ONDO	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	200000
9	SAND	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	400000
10	SHIB	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	1000000
11	USDC	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	8000000
12	USDT	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	10000000
13	AAVE	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	400000
14	AXS	15.000000000000000	1.452000000000000	0.005000000000000	0.02	N/A	500000
15	BTC	7.000000000000000	3.025000000000000	1449.000000000000000	5216.40	2.31E+09	1000000

Question 2 :

Write a query to display the all-time maximum price, all-time minimum price, the date of the maximum price, the date of the minimum price, and the maximum return of any cryptocurrency. The query should calculate the return as the percentage difference between the maximum and minimum prices.

Query:

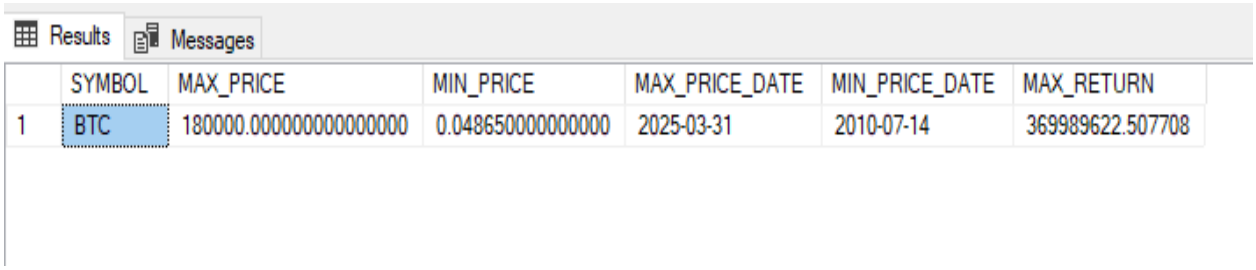
```
WITH TMP AS

( 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 = 'BTC';
```

Output:



Results | Messages

	SYMBOL	MAX_PRICE	MIN_PRICE	MAX_PRICE_DATE	MIN_PRICE_DATE	MAX_RETURN
1	BTC	180000.000000000000000	0.048650000000000	2025-03-31	2010-07-14	369989622.507708

Question 3 :

Write a query to display the brokerages that have their headquarters in countries where cryptocurrency is accepted and legal.

Query:

```
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';
```

Output:

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

Question 4 :

Write a query to display year-over-year cryptocurrency user growth and market capitalization growth. The query should show each year, the total number of users (with 'million' appended), the percentage growth in users compared to the previous year, the total market cap (with 'billion' appended), and the percentage market cap growth relative to the previous year's total users.

Query:

```
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;
```

Output:

Results | Messages

	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%	17.000000000000000 bill...	333.333333%
8	2017	30.500000000000000 mill...	281.250000%	600.000000000000000 b...	7287.500000%
9	2018	50.000000000000000 mill...	63.934426%	120.000000000000000 b...	-1573.77049...
10	2019	80.000000000000000 mill...	60.000000%	250.000000000000000 b...	260.000000%
11	2020	150.000000000000000 m...	87.500000%	1000.000000000000000 ...	937.500000%
12	2021	300.000000000000000 m...	100.000000%	2900.000000000000000 ...	1266.666666%
13	2022	420.000000000000000 m...	40.000000%	1000.000000000000000 ...	-633.333333%
14	2023	580.000000000000000 m...	38.095238%	1750.000000000000000 ...	178.571428%
15	2024	833.700000000000000 m...	43.741379%	3800.000000000000000 ...	353.448275%
16	2025	926.750000000000000 m...	11.161089%	2970.000000000000000 ...	-99.556195%

Question 5 :

Write a query to display the cryptocurrency symbols that are present in both the CRYPTO and MARKET_DOMINANCE tables for the year 2025.

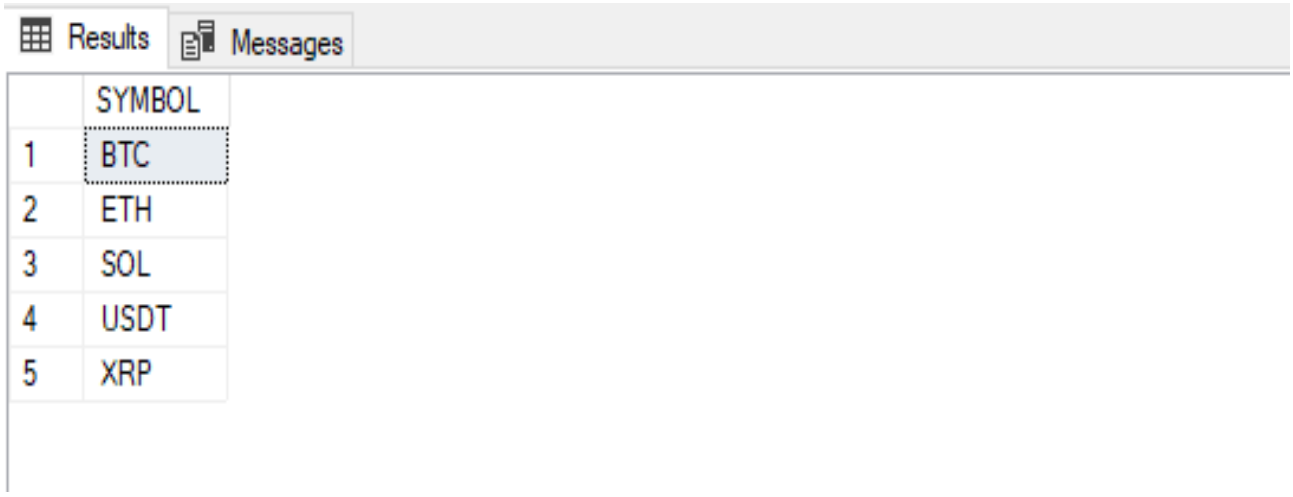
Query:

```
SELECT SYMBOL FROM CRYPTO INTERSECT

SELECT SYMBOL FROM MARKET_DOMINANCE

WHERE YEAR = 2025;
```

Output:


Results Messages

	SYMBOL
1	BTC
2	ETH
3	SOL
4	USDT
5	XRP

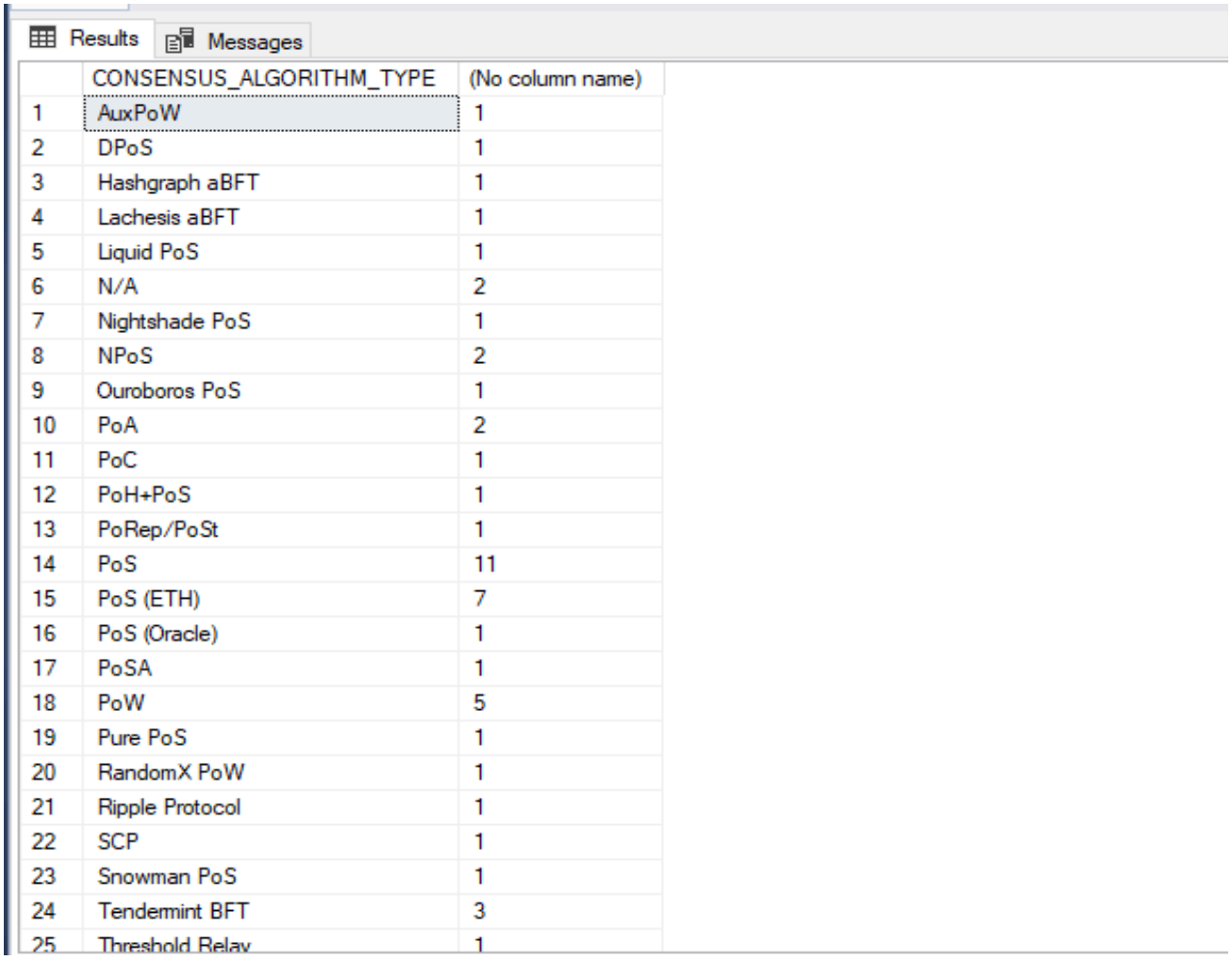
Question 6 :

Write a query to display the total number of cryptocurrencies for each consensus algorithm type.

Query:

```
SELECT CONSENSUS_ALGORITHM_TYPE,count(CONSENSUS_ALGORITHM_TYPE)
from CRYPTO group by CONSENSUS_ALGORITHM_TYPE;
```

Output:



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
17	PoSA	1
18	PoW	5
19	Pure PoS	1
20	RandomX PoW	1
21	Ripple Protocol	1
22	SCP	1
23	Snowman PoS	1
24	Tendermint BFT	3
25	Threshold Relay	1

Question 7 :

Write a query to display the total number of cryptocurrencies for each specific consensus algorithm, such as PoS, PoW, and AuxPoW. Use having for this.

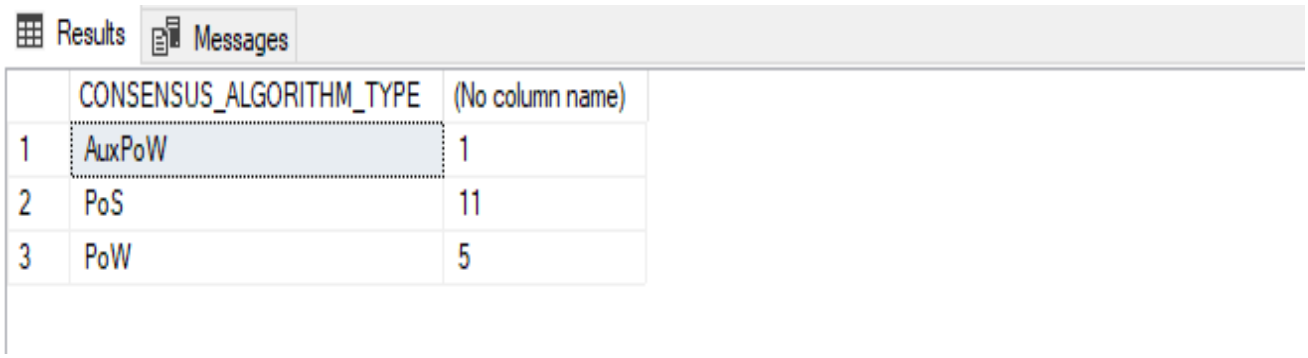
Query:

```
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';
```

Output:


Results Messages

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

Question 8 :

Write a query to display a combined list of cryptocurrency symbols from countries where cryptocurrencies are accepted (ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO) and from banned countries (USER_AMOUNT_IN_BANNED_COUNTRY) for the year 2024. Also, include affected cryptocurrencies from the CONTROVERSY table for the same year, excluding any null values.

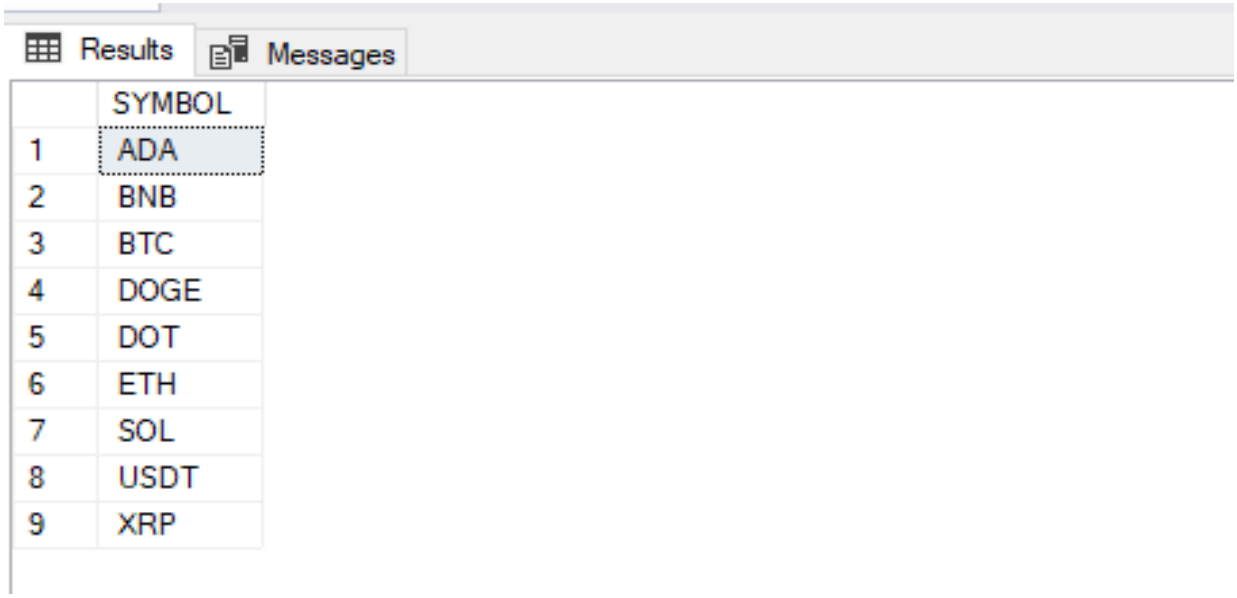
Query:

```
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;
```

Output:


Results Messages

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

Question 9 :

Write an SQL query to increase the AVERAGE_TRX_FEE by 10% for all cryptocurrencies in the CRYPTO_CURRENCY_PERFORMANCE_METRICS table where the current AVERAGE_TRX_FEE is greater than 1. After updating, display the entire table.

Query:

```
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;
```

Output:

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	1.756920000000000	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	1.756920000000000	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	3.660250000000000	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	1.756920000000000	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	200000
18	ETH	15.000000000000000	1.756920000000000	0.005000000000000	0.02	N/A	500000
19	FET	1000.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	400000
20	FIL	3000.000000000000000	0.010000000000000	0.001000000000000	0.00	N/A	400000
21	FTM	300.000000000000000	0.001000000000000	0.001000000000000	0.00	N/A	500000
22	GRT	15.000000000000000	1.756920000000000	0.005000000000000	0.02	N/A	400000
23	HBAR	10000.000000000000000	0.000100000000000	0.000100000000000	0.00	N/A	400000
24	HNT	2000.000000000000000	0.001000000000000	0.001000000000000	0.00	N/A	300000
25	ICP	11000.000000000000000	0.000100000000000	0.001000000000000	0.00	N/A	500000

Question 10 :

Write a query to display the cryptocurrency symbols, names, and their maximum prices, along with a price tier classification. The price tier should categorize the maximum price as 'High Price' (greater than 10,000), 'Medium Price' (between 100 and 10,000), and 'Low Price' (less than 100). Sort the results in descending order of maximum price.

Query:

```
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;
```

Output:

Results | Messages

	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 Co...	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 C...	167.090000000000000	Medium Price
15	AXS	Axie Infinity	164.900000000000000	Medium Price
16	AVAX	Avalanche	144.960000000000000	Medium Price
17	DOT	Polkadot	54.980000000000000	Low Price
18	HNT	Helium	54.880000000000000	Low Price
19	LINK	Chainlink	52.700000000000000	Low Price
20	INJ	Injective	44.950000000000000	Low Price
21	ATOM	Cosmos	44.450000000000000	Low Price
22	NEAR	NEAR Prot...	20.440000000000000	Low Price
23	APT	Aptos	20.250000000000000	Low Price
24	XTZ	Tezos	9.120000000000000	Low Price
25	SAND	The Sandbox	8.400000000000000	Low Price

Disclaimer:

This project report is prepared solely for academic and educational purposes. The information, data, and analysis included are based on publicly available sources such as CoinMarketCap, IMF, World Bank, and others. While efforts have been made to ensure the accuracy and reliability of the content, the report does not constitute financial, investment, or legal advice. **The authors are not liable for any loss or damages resulting from the use of the information presented herein.**

Conclusion:

This project concludes with the successful design and implementation of a highly normalized, scalable, and semantically rich SQL database for analyzing the cryptocurrency market. Through careful schema planning in 3NF, the system ensures data integrity, eliminates redundancy, and supports efficient query processing.

In essence, if anyone uses real-time, most updated data from resources, this SQL project is not merely a technical exercise, but a real-world simulation of how database systems can support strategic decision-making and financial investment in the rapidly evolving landscape of digital finance.