

## Visual Analytics and Data-driven Mining Techniques for Cryptocurrency

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# TimeLine

Currently, 6,700 different cryptocurrencies

□Total value reached \$2.2 trillions

Continuing to proliferate

#### Cryptocurrency



## Era of Crypto Economy

-fair, accessible, efficient, and transparent

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#### Regulation of Cryptocurrency – Global Policy

- Governments exploring the value of cryptocurrency
- Crucial to control over cryptocurrency
- Lack regulatory tools
- Approval of cryptocurrency depending on effectiveness of regulation

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#### Regulation of Cryptocurrency – U.S.

- U.S. government (SEC) considering to approve Bitcoin ETF as a regular stock
- Worried bitcoin as a way for terrorists to raise fund
- Delayed the decision on Bitcoin ETF
- RegTech helps accelerate the legalization of bitcoin



#### Regulation of Cryptocurrency – China

- In April 2021
  - Chinese government studying the regulatory environment
  - Cryptocurrency An investment option
  - Must avoiding illegal activities
- In September 2021
  - China declares all crypto-currency transactions illegal





#### Regulation of Cryptocurrency – Practice



 Chinese "Card Freezing actions" to fight cryptocurrency related crime



#### Significance of Regulation of Cryptocurrency

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and a

-make crucial the RegTech and FinTech of cryptocurrency

egulation, Analysis, and Visualization of Cryptocurrency

#### RegTech and FinTech Determine the Future of Cryptocurrency

Our research aims to promote RegTech and FinTech of cryptocurrency

# REGULATION

Regulation, Analysis, and Visualization of Cryptocurrency

#### Research on Fintech and RegTech of Cryptocurrency

- A frontier research field

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#### Intellectual challenges

- Huge amount of transactions
- Unknown transaction patterns
- Effective visual analytics
- Advanced mining techniques





Back-end

Visual Analytics and Data-driven Mining Techniques for Cryptocurrency

## Visual Analytics

- Help people understand the data
- Education purpose
- Analysis purpose

#### Visual Analytics – Education Purpose

- Tx Street <u>https://txstreet.com/v/ltc-btc</u>
- Bit Bonker <a href="https://privacypros.io/tools/bitbonkers/">https://privacypros.io/tools/bitbonkers/</a>
- Bit Listener <a href="https://www.bitlisten.com/">https://www.bitlisten.com/</a>
- Others <a href="https://news.bitcoin.com/18-visualizations-bitcoin-network/">https://news.bitcoin.com/18-visualizations-bitcoin-network/</a>

#### Visual Analytics – Analysis Purpose

- Basic Analysis
- Joint Analysis
- Transaction Analysis
- Fund Flow Analysis

#### Visual Analytics - Basic Analysis

• Price, Market Value, ...



Positive

Negative

#### Visual Analytics – Joint Analysis



2022/1/18

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#### Visual Analytics – Joint Analysis







- Circle: addresses, radius: balance
- Hide connection edges
- Easy to visualize trading distances
  - Place closer addresses trading with each other
  - Location distance correlated to trading distance
  - Color circles to indicate trading distances to address w



- Address glyph: Summarize address trading activities
  - Balance: Radius of the inner circle
  - Sent bitcoins: Central angle of the green annular sector
  - Received bitcoins: Central angle of the red annular sect
  - # input addresses: Thickness of the red annular sector
  - # output addresses: Thickness of the green annular sec



10000

10000

Received

Sent



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## Visual Analytics – Fund Flow Analysis



- Important for Anti Money Laundering (AML)
- Limitation of Connection Diagram
- A flow map
- Boxes: addresses, height: bitcoin amount,
- Curves: transactions
- Visualize circulation An important characteristic for

2022/1/18

## Visual Analytics

- Education purpose
  - Tx Street <u>https://txstreet.com/v/ltc-btc</u>
  - Bit Bonker <a href="https://privacypros.io/tools/bitbonkers/">https://privacypros.io/tools/bitbonkers/</a>
- Analysis purpose
  - Basic Analysis
  - Joint Analysis
  - Transaction Analysis
  - Fund Flow Analysis

#### • Help people understand data

## Mining Techniques

- Processing data to disclose the internal nature
- Transaction pattern mining
  - Ownership Analysis
  - Address type identification
  - Others

- Users often use a large number of different addresses
- to analyze different patterns of transactions
- to cluster addresses that share the same ownership

- Define transactions patterns that related to address co-ownership
- Project Transaction data into a multidimensional feature space
- Analyze data with machine learning technologies to group addresses

- Define transactions patterns that are related to address co-ownership
  - Peel Transaction : Always two outputs
  - Sweep Transaction: multiple inputs, one output
  - Distribution Transaction : Many output addresses
  - Relay Transaction: one input and one output
  - Self-spending transaction: An input address also appears as an output
  - Peeling chain transaction: A series of peel transactions.
- Some transaction patterns, such as relay, distributing, and gathering, are also used in the real-world banking systems for money laundering activities

- Project Transaction data into a multidimensional feature space
- Used features could be
  - Number of related inputs
  - Number of related outputs
  - Total sending amount
  - Total receiving amount
  - Address Balance

- Fed the data into a clustering algorithm to group similar addresses
  - Affinity Propagation
  - Agglomerative Clustering
  - BIRCH
  - DBSCAN
  - K-Means
  - Mini-Batch K-Means
  - Mean Shift
  - OPTICS
  - Spectral Clustering
  - Mixture of Gaussians
- Deep Learning Framework: Graph Convolutional Network

#### Transaction Pattern Mining

- Follows a similar procedure
  - Define interested transaction patterns
  - Project data into feature space

- -- Finance
- -- Computer Science
- Training the data with carefully designed mining algorithms -- Computer Science
- Cross-disciplinary research

#### References

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#### Conclusion

- Why research on cryptocurrency is important
- How visual analytics can help
- What is the basic procedures to use mining techniques for transaction pattern analysis

# Thank you!

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