# Bitcoin who-trusts-whom analysis

Jan Maděra

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# Dataset

- Source: https://snap.stanford.edu/data/soc-sign-bitcoin-otc.html
- Nodes (accounts): 5881
- Undirected Edges (ratings): 35592
- Range of edge weight: -10 to +10
- Percentage of positive edges: 89%

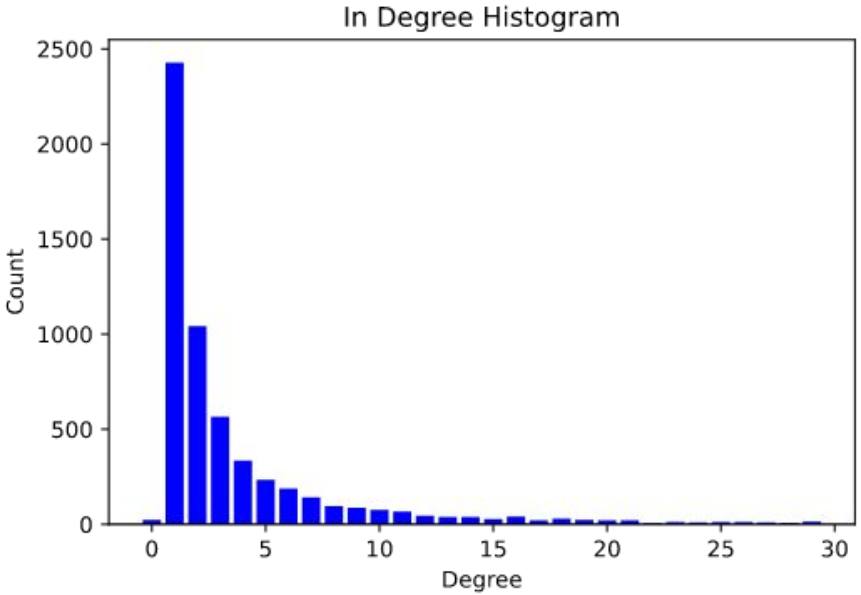
# Dataset

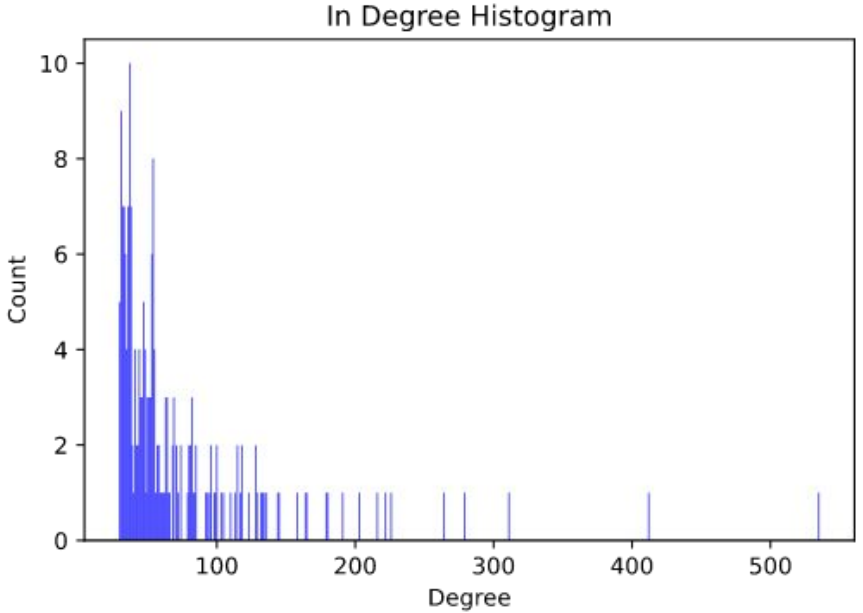
- Bitcoin transactions are anonymous
- Need to detect fraudulent and risky users
- Record of users' reputation
  - Prevents transaction with risky users
- Nodes: Users
- Weighted directed edges: Rating from other users
  - -10: Total distrust
  - +10: Total trust

# Technologies

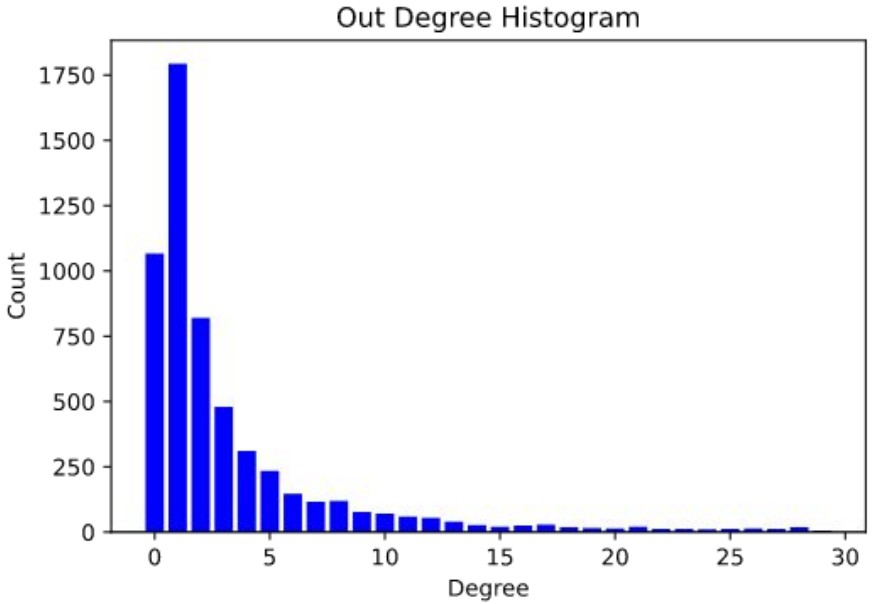
- Python
- NetworkX

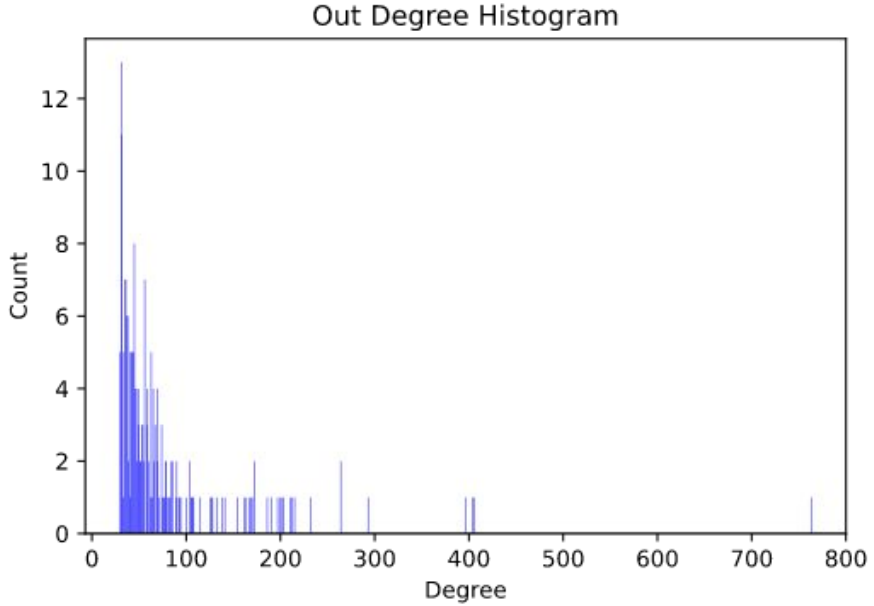
# Indegree histogram (evaluation from others)



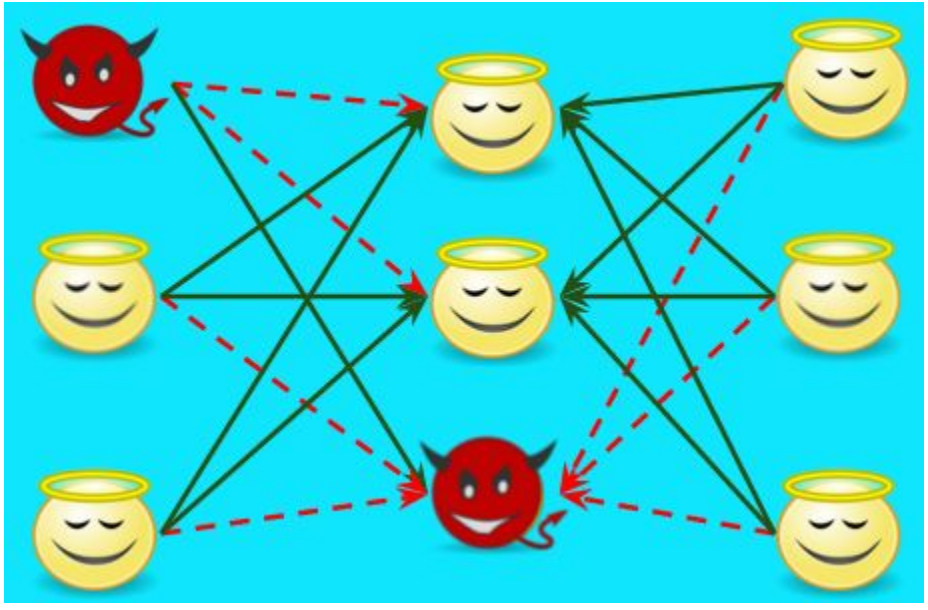
# Outdegree histogram (evaluation of others)



# Fairness, goodness

- https://cs.stanford.edu/~srijan/wsn/
- Fairness in interval [0,1]
- Goodness in interval [-1,1]



# Fairness, goodness

$$g(v) = \frac{1}{|in(v)|} \sum_{u \in in(v)} f(u) \times W(u,v)$$

$$f(u) = 1 - \frac{1}{|out(u)|} \sum_{v \in out(u)} \frac{|W(u,v) - g(v)|}{R}$$

- f(v) - fairness of node v
- g(v) - goodness of node v
- W(u,v) - weight of directed edge from node **u** to node **v**
- in(v) - set of nodes from which an edge leads to the vertex **v**
- |in(v)| - indegree of node **v**
- |out(v)| - outdegree of node **v**
- R - size of range of goodness values (2 in our case [-1,1])

# Fairness

median = 0.9634

mean = 0.9362

zero outdegree -> Fairness = 1

| Node | Out degree c. | Fairness |
|---|---|---|
| 35 | 0.130 | 0.983 |
| 2642 | 0.069 | 0.949 |
| 1810 | 0.069 | 0.871 |
| 2125 | 0.068 | 0.932 |
| 2028 | 0.050 | 0.919 |

# Goodness

median = 0.0701

mean = 0.0975

zero indegree -> Goodness = 0

| Node | In degree c. | Goodness |
|---|---|---|
| 35 | 0.091 | 0.173 |
| 2642 | 0.070 | 0.230 |
| 1810 | 0.053 | 0.103 |
| 2028 | 0.047 | 0.076 |
| 905 | 0.045 | 0.079 |

# Centrality values

- values: node number (goodness, fairness)

| Order | Betweenness c. | Eigenvector c. | Closeness c. |
|---|---|---|---|
| 1. | 35 (0.17, 0.98) | 2642 (0.23, 0.95) | 905 (0.08, 0.91) |
| 2. | 2642 (0.23, 0.95) | 905 (0.08, 0.91) | 35 (0.17, 0.98) |
| 3. | 1810 (0.10, 0.87) | 1810 (0.10, 0.87) | 1 (0.32, 0.92) |
| 4. | 905 (0.08, 0.91) | 35 (0.17, 0.98) | 2642 (0.23, 0.95) |
| 5. | 1 (0.32, 0.92) | 2028 (0.08, 0.92) | 13 (0.17, 0.95) |

# Fairness

median = 0.9634

mean = 0.9362

| Node | Fairness | Out degree | ratings (to others) |
|---|---|---|---|
| 5129 | 0.320 | 1 | +10 |
| 5237 | 0.320 | 1 | +10 |
| 2720 | 0.342 | 3 | 3x +10 |
| 5201 | 0.393 | 6 | 5x -10<br>1x +10 |

# Goodness

median = 0.0701

mean = 0.0975

| Node | Goodness | In degree | ratings (from others) |
|---|---|---|---|
| 3665 | -1 | 1 | -10 |
| 4182 | -1 | 1 | -10 |
| 1211 | -0.999 | 1 | -10 |
| 5791 | -0.973 | 2 | 2x -10 |

Thank you for your attention