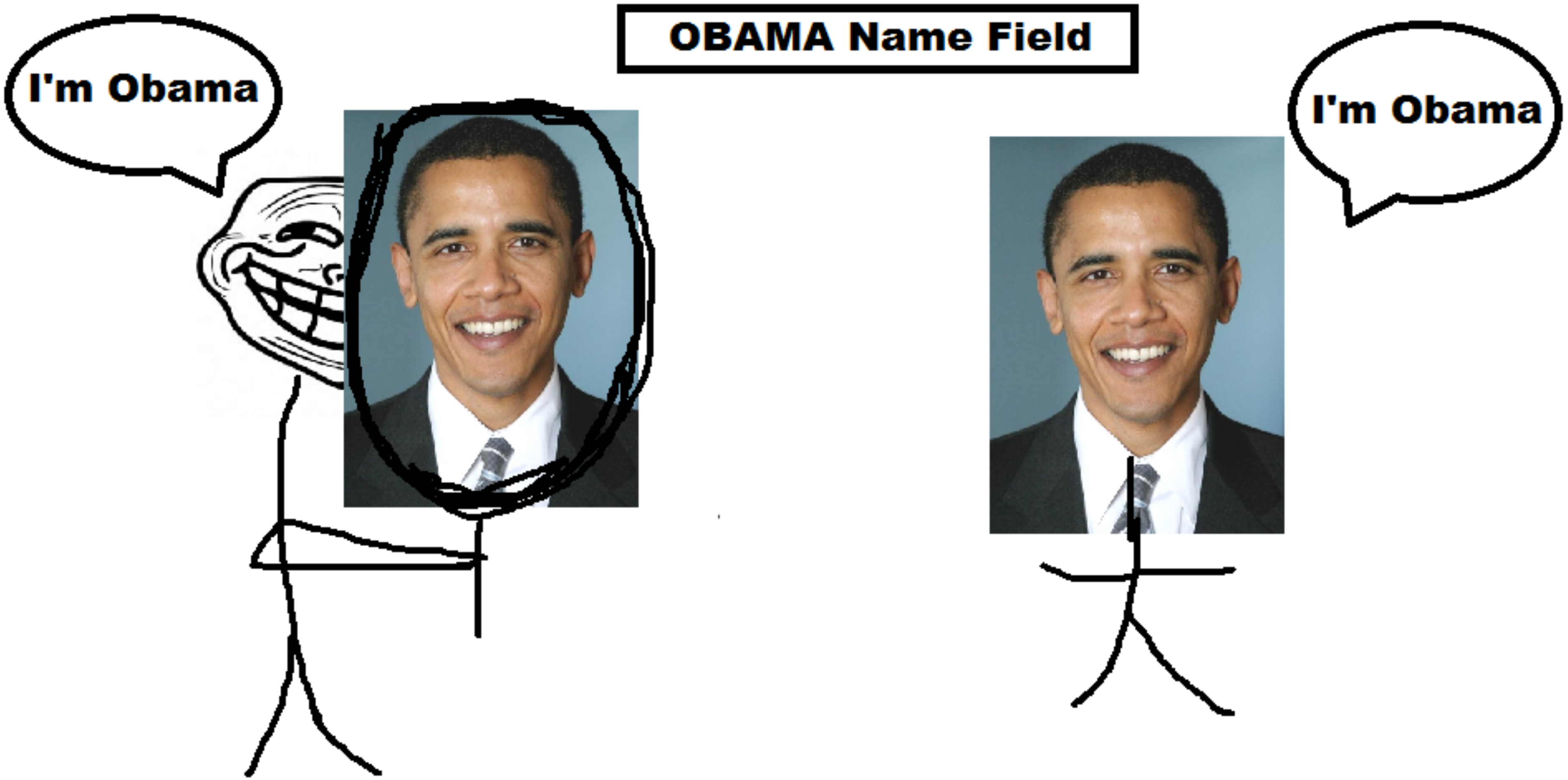
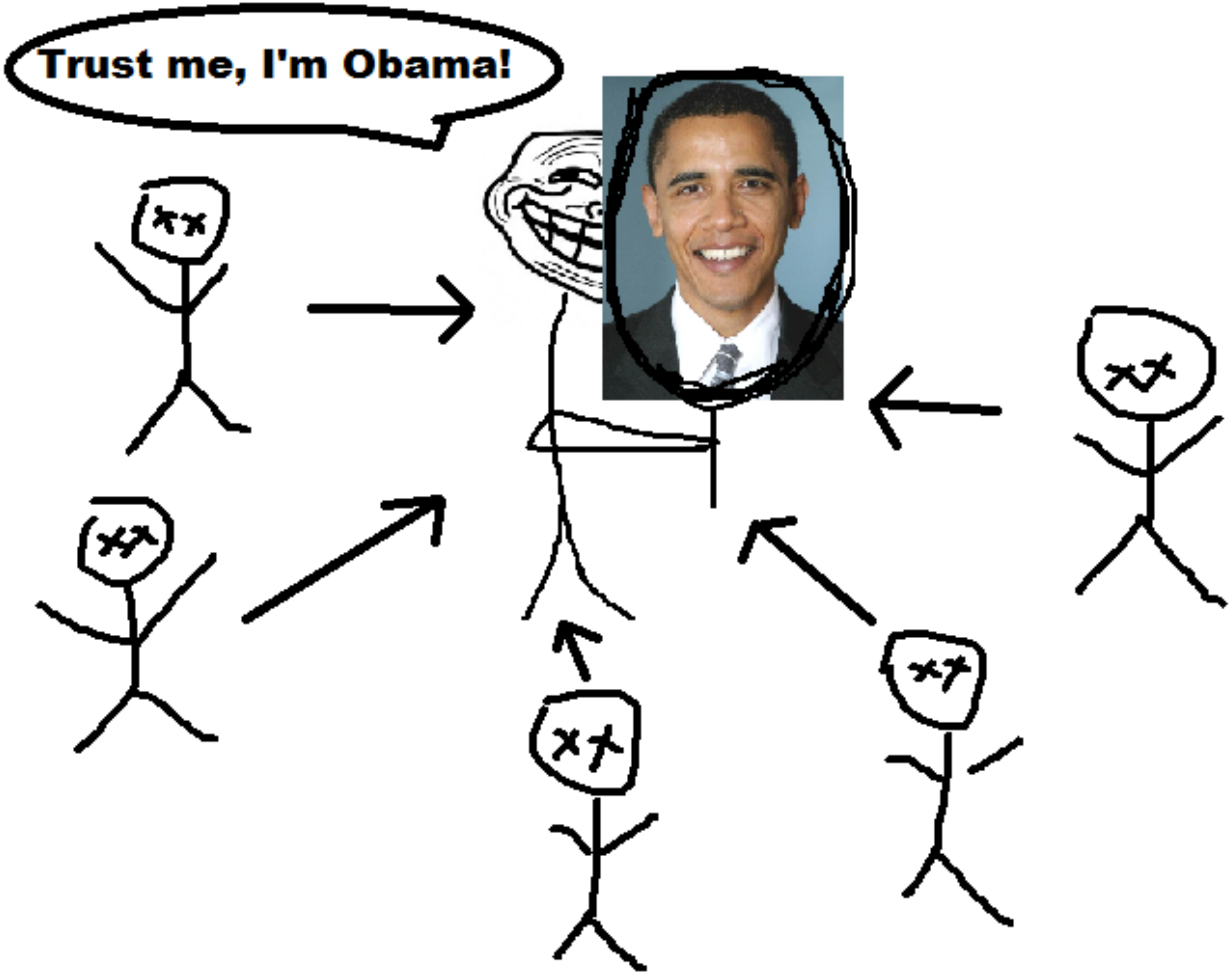
Part 2

PGP Problem 1: Impersonation



Problem 2: *Anyone* can sign *Any* key



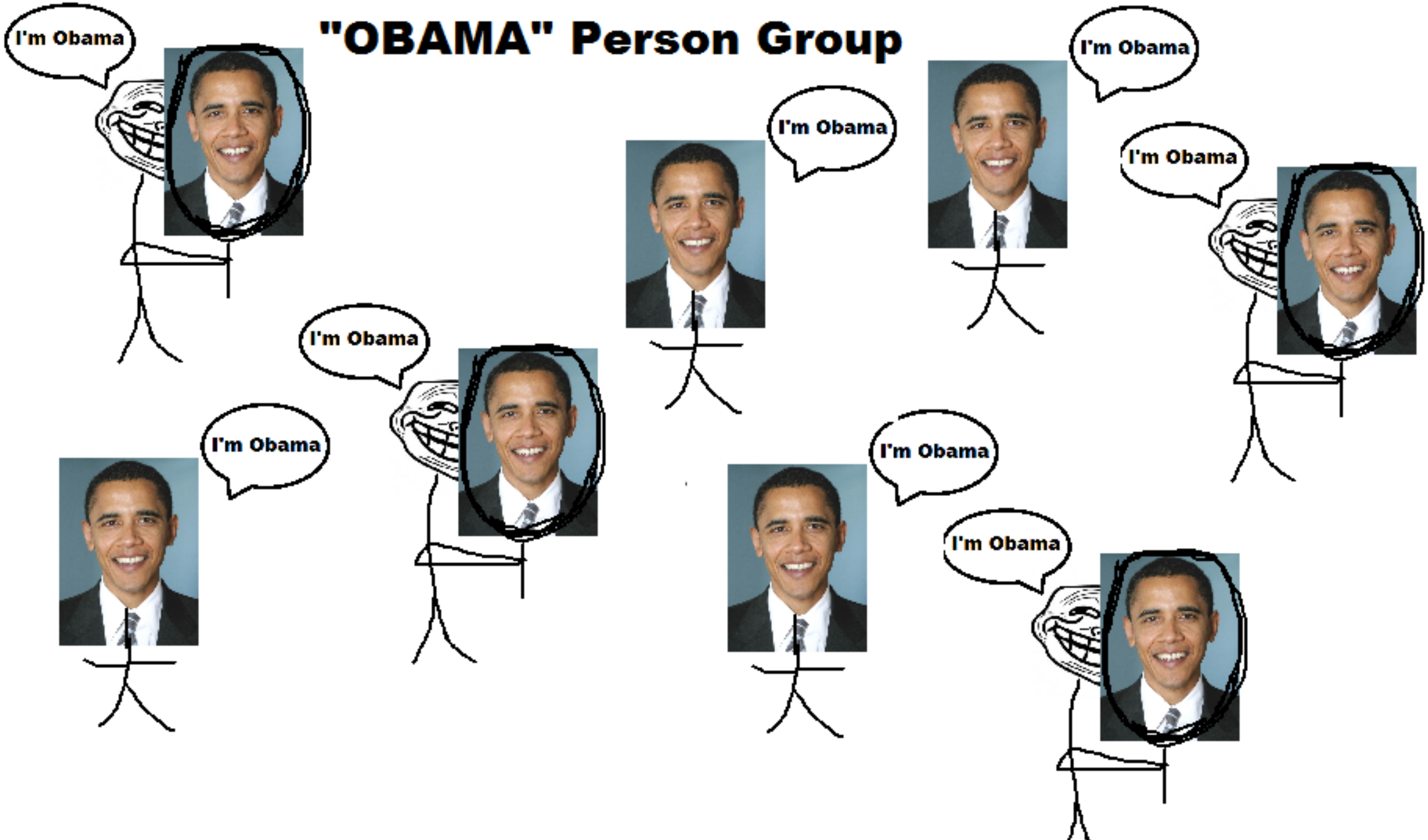
Who can we trust?

Our Approach Specifications

Graphical Representation

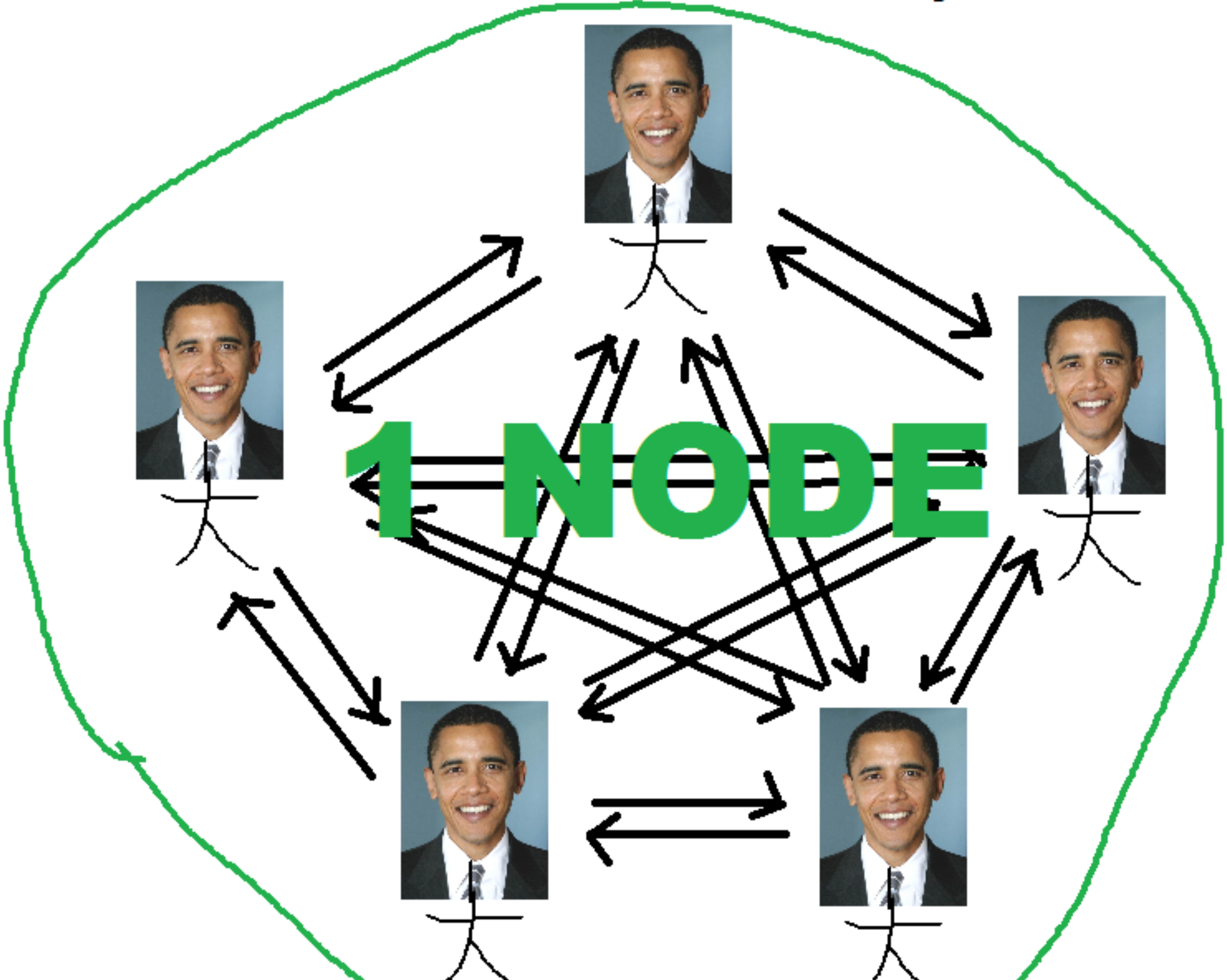
- Key = Node
- A -- signed --> B

Person Group:
All keys claiming to be XX



wolg each real person has 1 key

If the real Obama made 5 keys ...



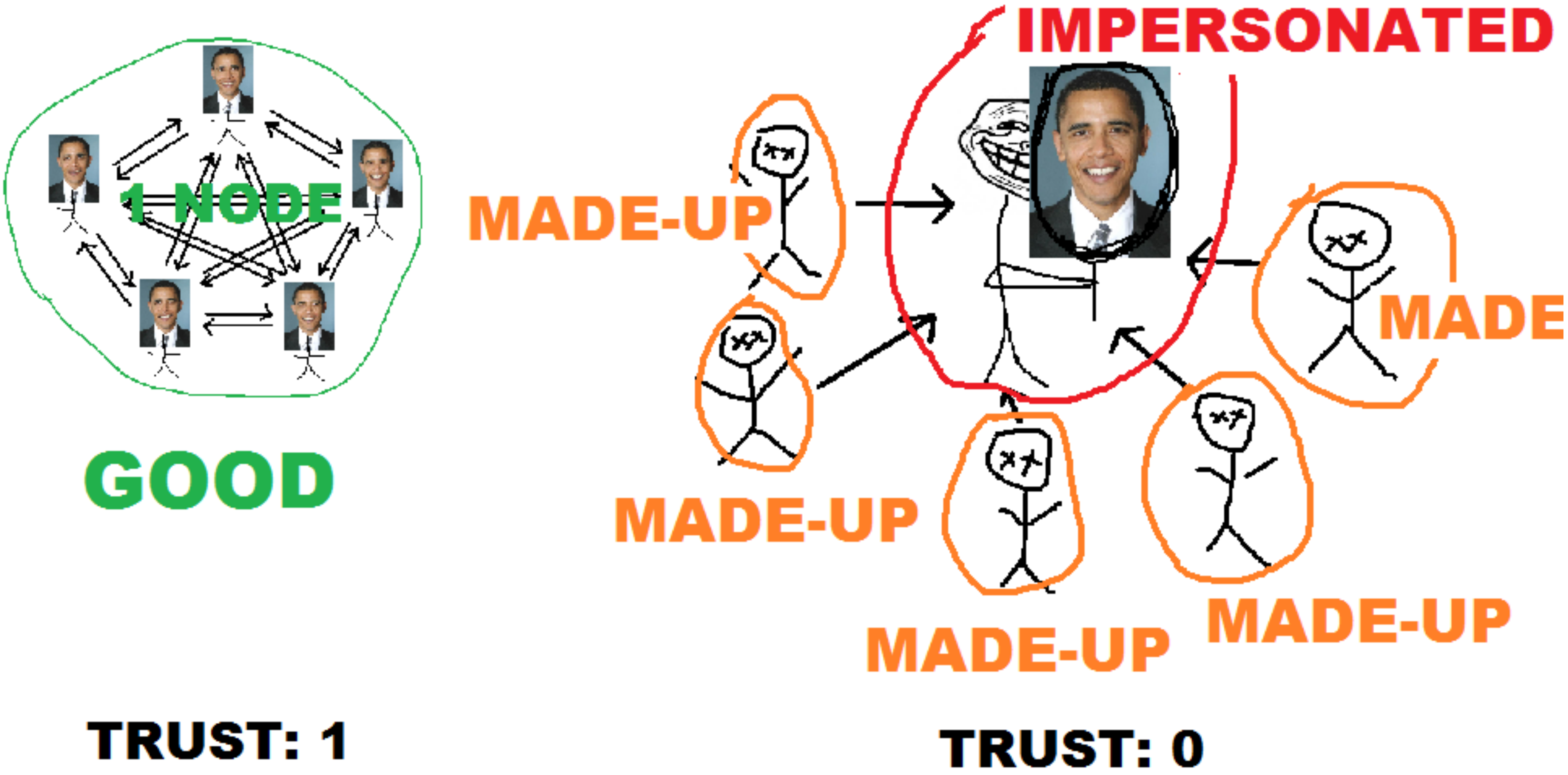
TRUST is Boolean

1 = Trustworthy

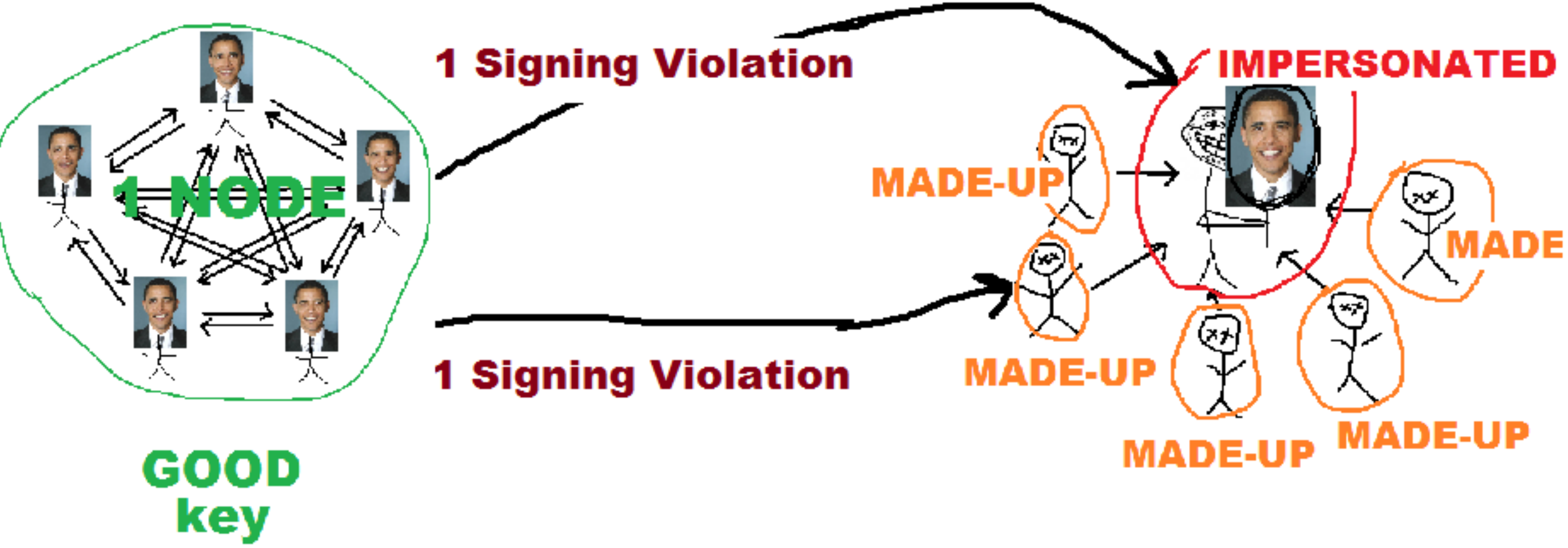
0 = Not Trustworthy

keys:

Good, Impersonated, Made-up



Signing Violation
= Trust 1 signs Trust 0



Trust 1

Trust 0

Goal:

**How to assign trust to each node
to result in
the least violation score?**

Algorithm Inputs

- Directed Graph
- Source person (trust is always 1)
- Person group constraints
- --> calculate trust w.r.t. Source person

Naive Algorithm

Try all possibilities **consistent** with person groups

Consistent
= each person group can have *at most* 1 real person (i.e. 1 key with trust 1)

Exponential time :(

Our Approach: Evolutianary Algorithm

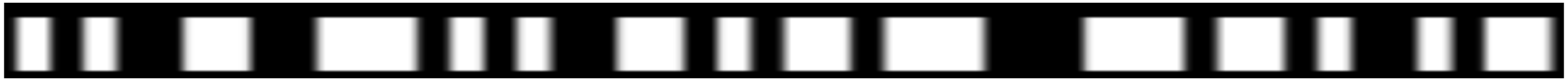
- Gen 0: Randomly assign trust to each key (except src is always 1)

Sort the scores of all 100 assignment sets

- Pick the **best 5** to be parents
- Each parent **produces** 20 children
  - w/ mutations. 1% chance switch trust
- **Score** each of the 100 assignment sets

Results

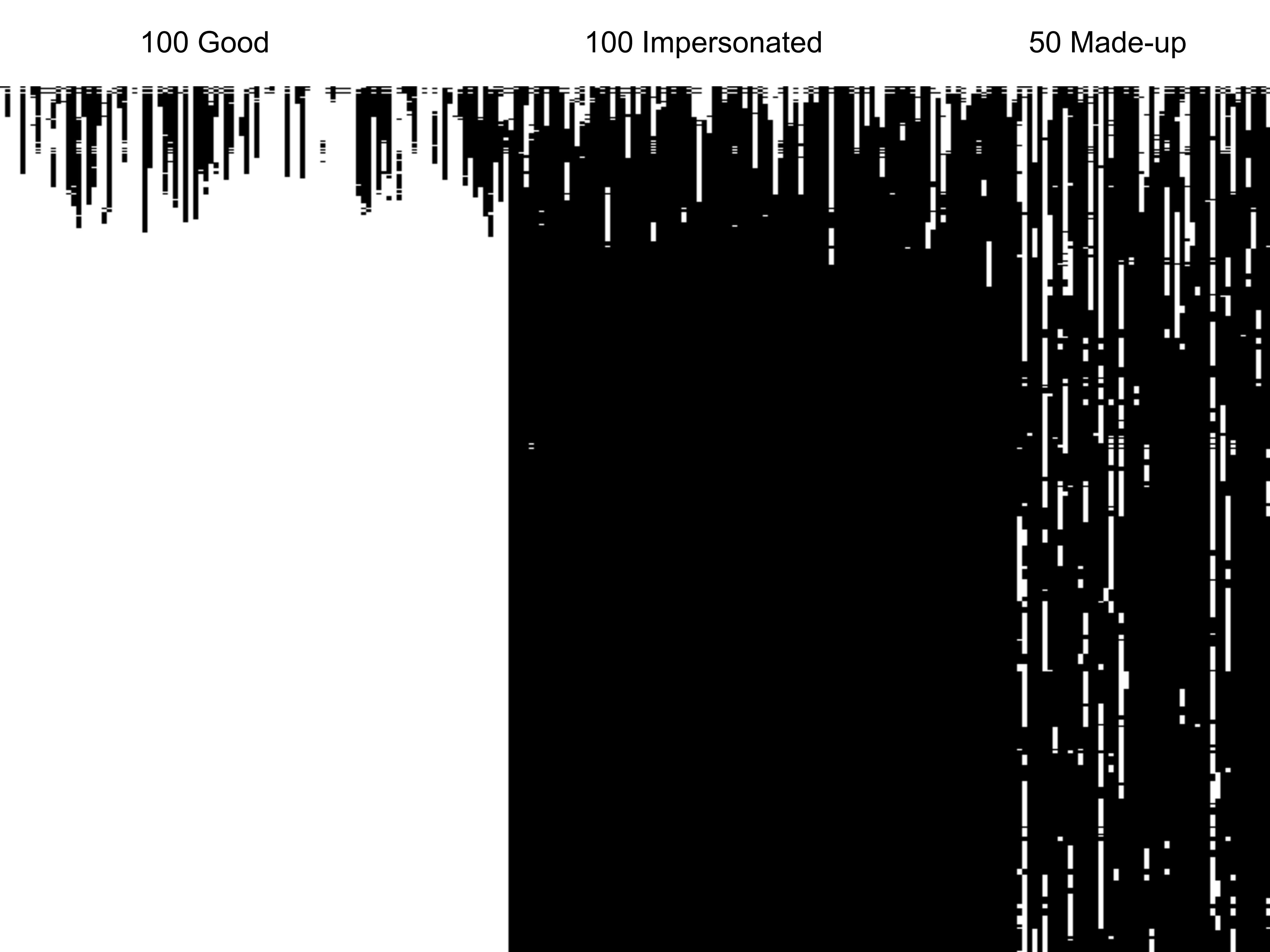
Genetic Alg Time Image



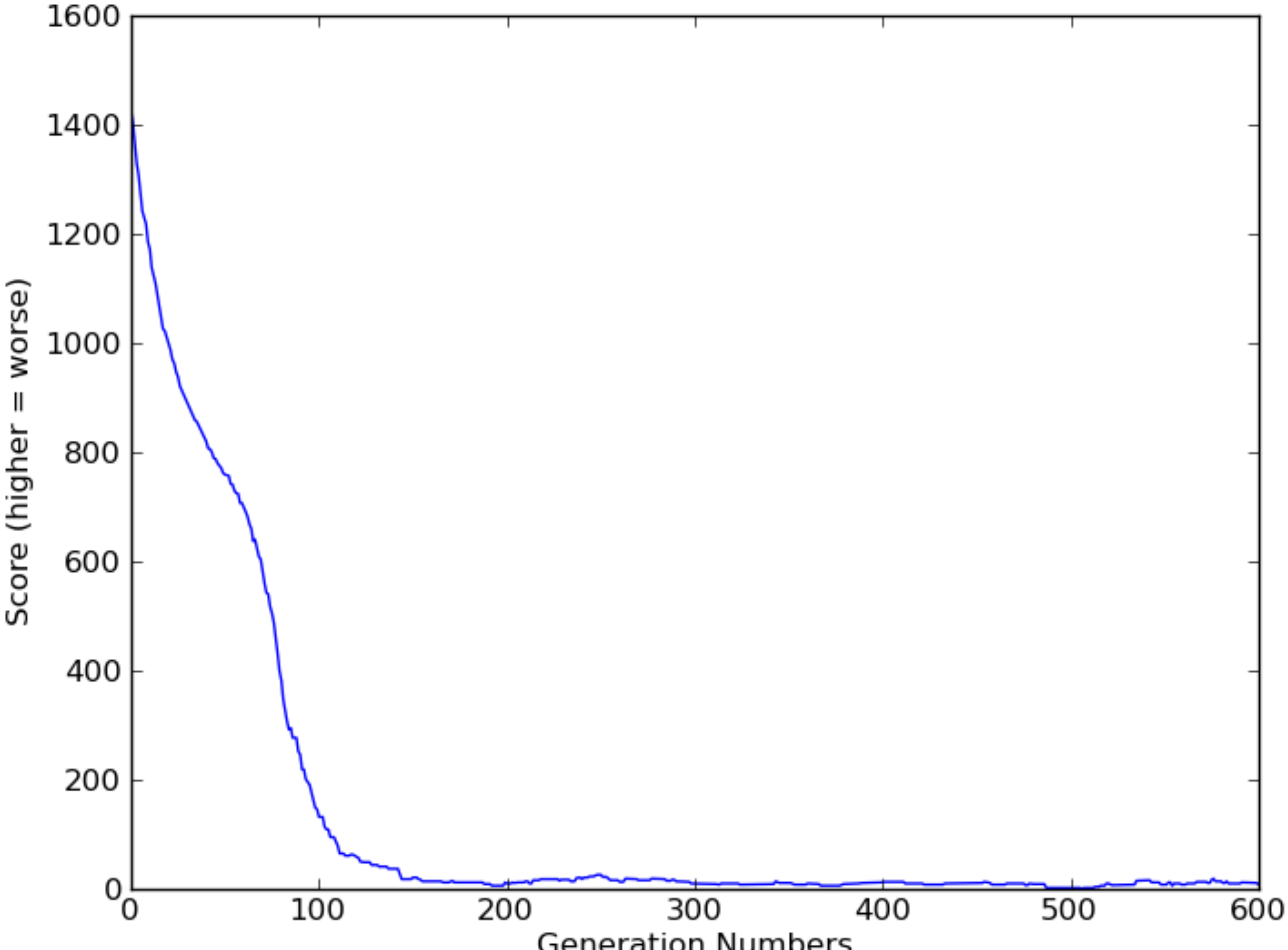
- 1 Row = 1 Generation
- 1 Column = 1 Key

- Trust 1 Key: White
- Trust 0 Key: Black

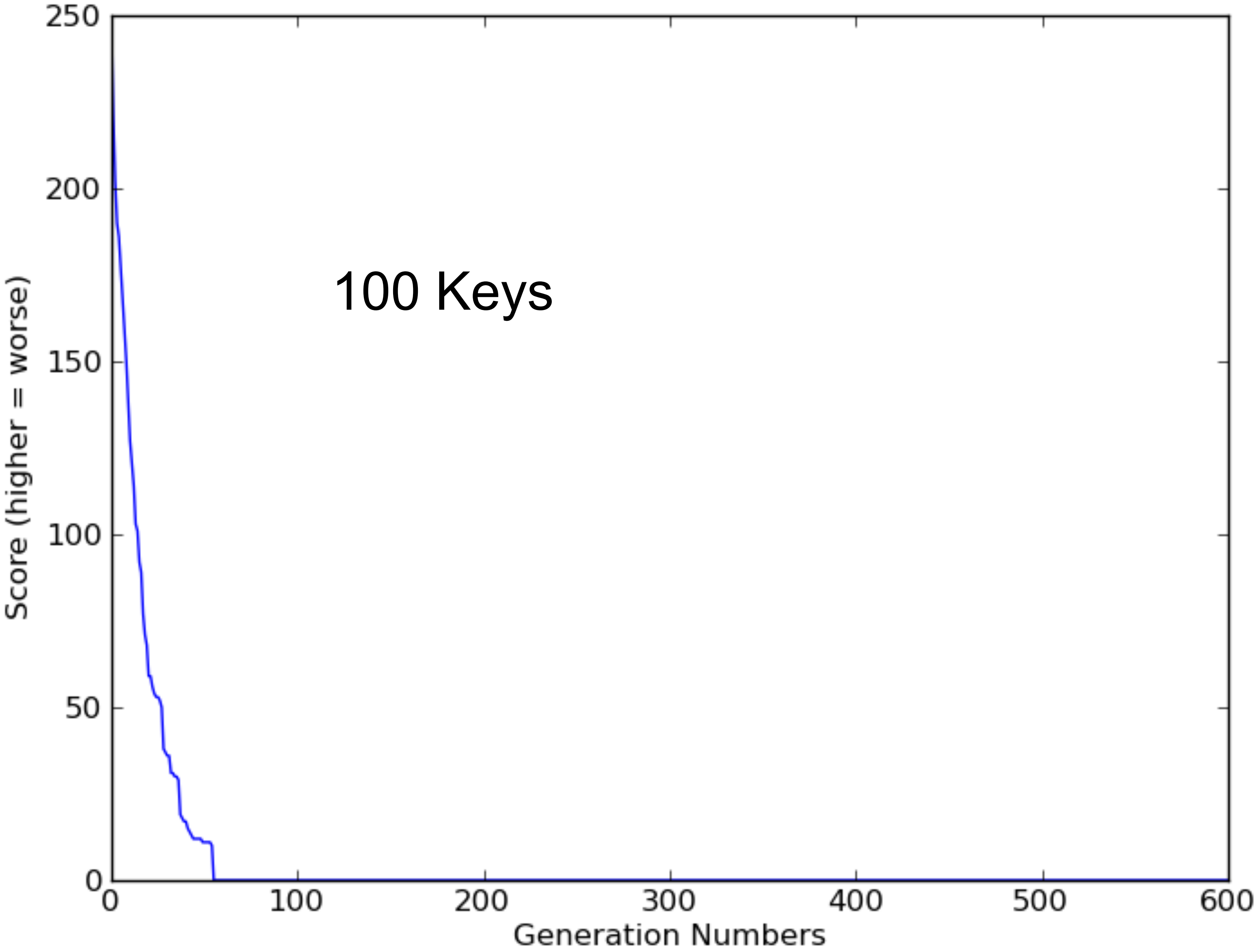
- **Time** goes down
- Generations ++


100 Good
100 Impersonated
50 Made-up

Violation Scoring



Yes, it runs in Polynomial Time



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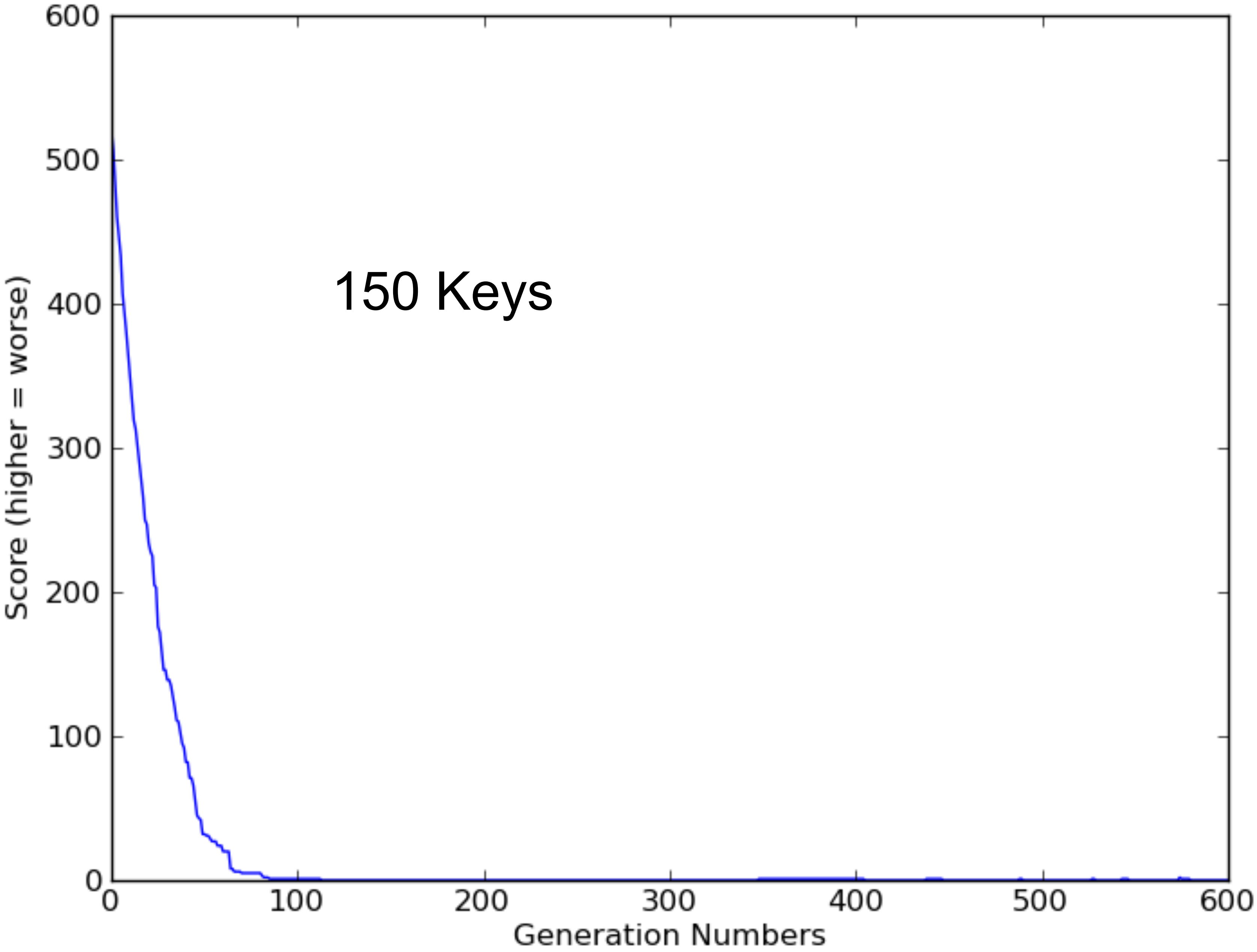
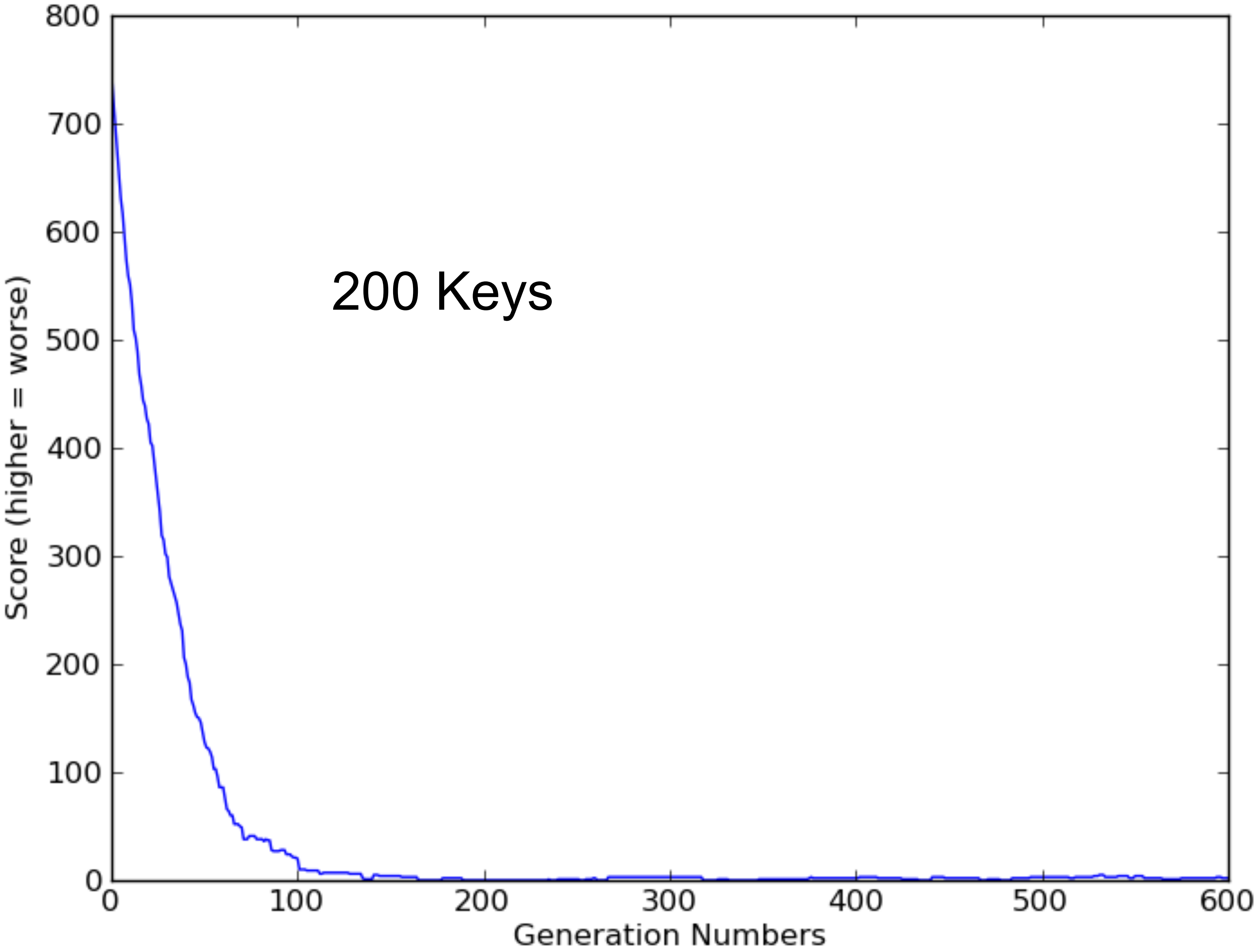


Yes, it runs in Polynomial Time



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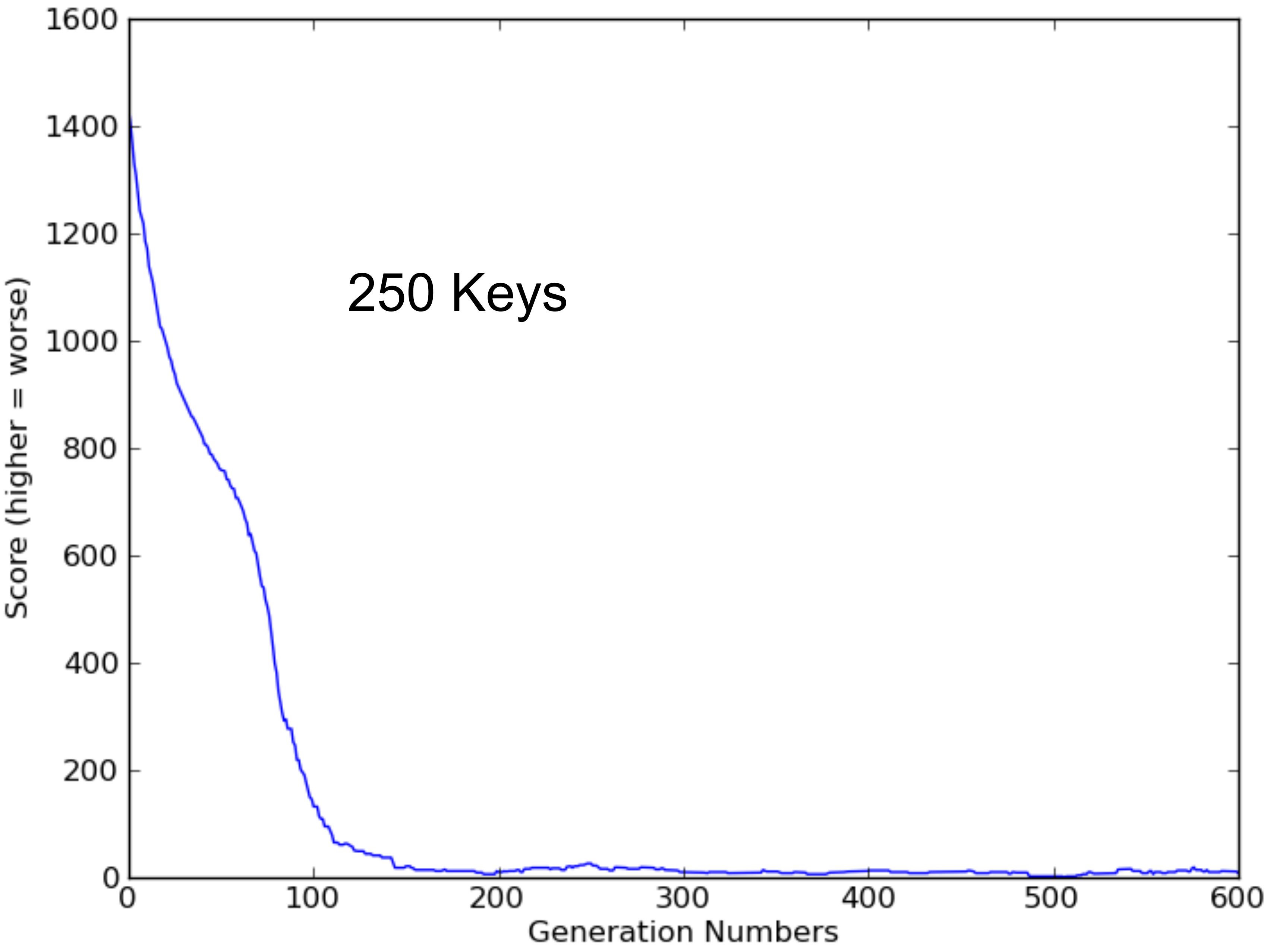
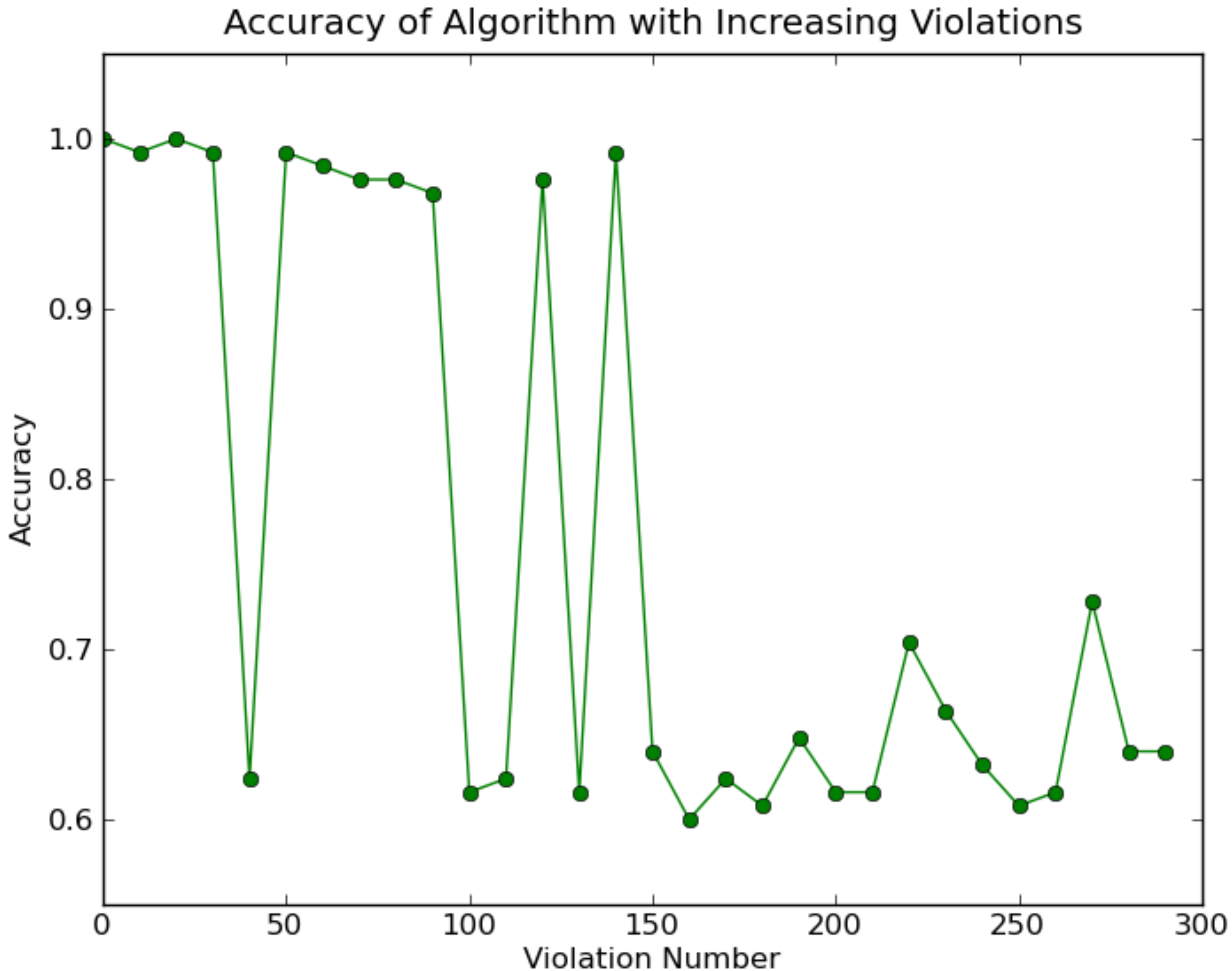
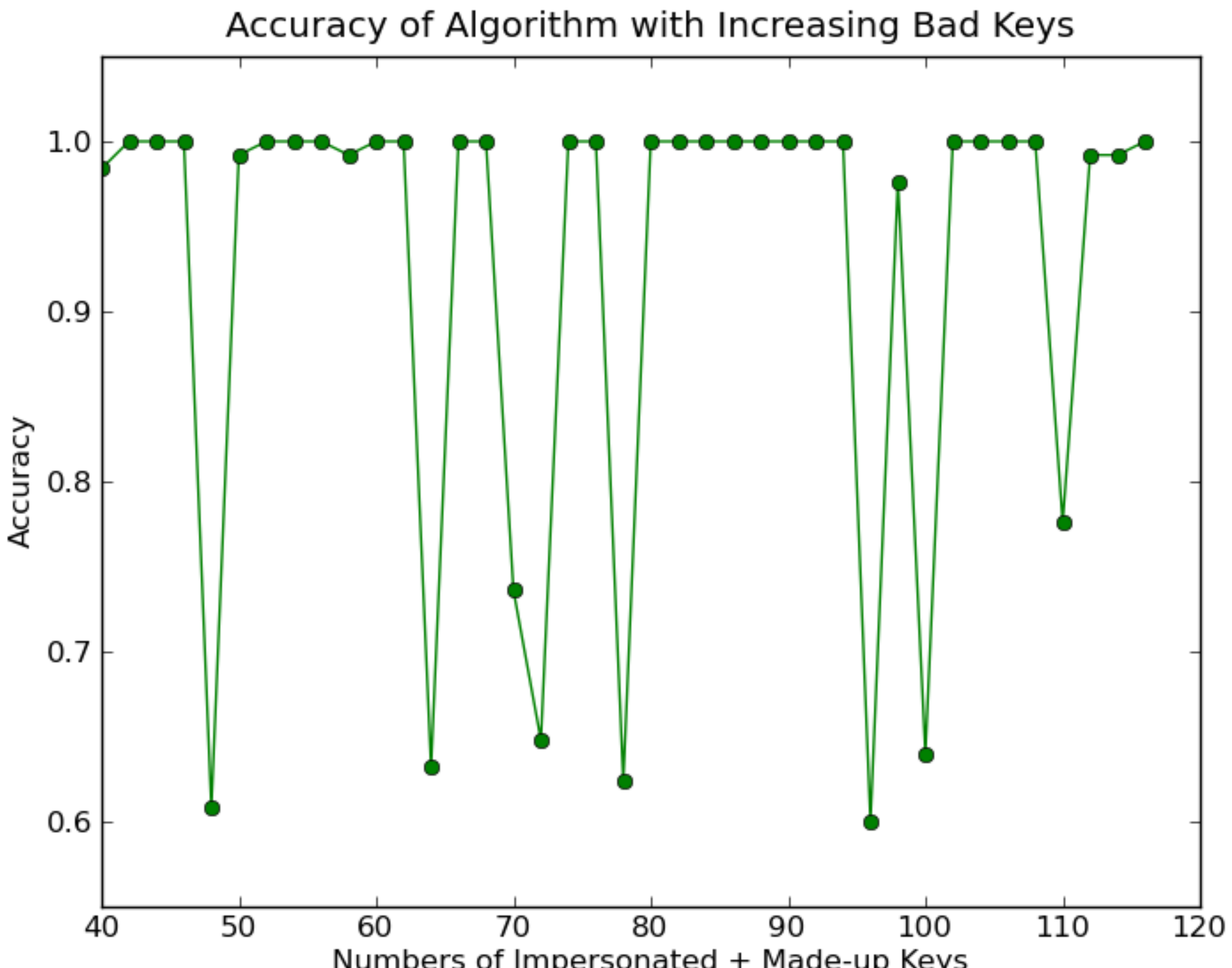


In Imperfect World (with Violations)

show alg is **resistant to**
- **signing violations**
- high volume of **bad keys**


Accuracy of Algorithm with Increasing Violations
Accuracy
1.0
0.9
0.8
0.7
0.6
Violation Number
0
50
100
150
200
250
300


Accuracy of Algorithm with Increasing Bad Keys
Accuracy
1.0
0.9
0.8
0.7
0.6
40
50
60
70
80
90
100
110
120
Numbers of Impersonated + Made-up Keys

Conclusion

- we made Android signing work

- Given a graph and a node, **used evolutionary algorithm** to assign trust value to each other node

- **Fast**: Runs in sub-exponential time

- **Resistant to signing violations**: (can tolerate about 20% of all certificates signed by good guys
are violations)

- **Resistant to flood of bad guys**: at least 80% of all keys can be either impersonated or madeup without significantly decreasing the accuracy of the algorithm.