Visualizing Proof-of-Work Algorithms using MicroProcessors

A Little About Me...

- Software Engineer @ Microsoft in Pittsburgh
- Run https://chaintuts.com creating Bitcoin & blockchain related tutorials
  - On YouTube, Twitter (@chaintuts), Github (chaintuts)
  - Articles, Videos, and Code
  - Check it out and share!
- Interested in how the tech works and its societal & financial impacts

Why Proof-of-Work?

- Traditional financial systems required *trust* in a central authority
- Ex: Bob pays Alice via PayPal – PayPal verifies Bob has funds, deposits in Alice's account

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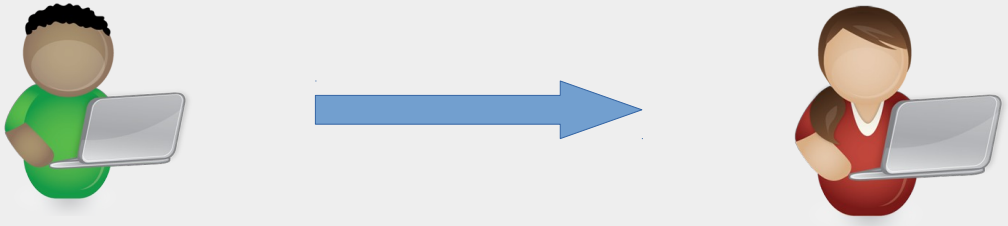

Blockchain & POW

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  - Like a spreadsheet that shows all transfers – we can infer address balances from this
- Every 10 minutes, pending txs batch processed into a new “block”
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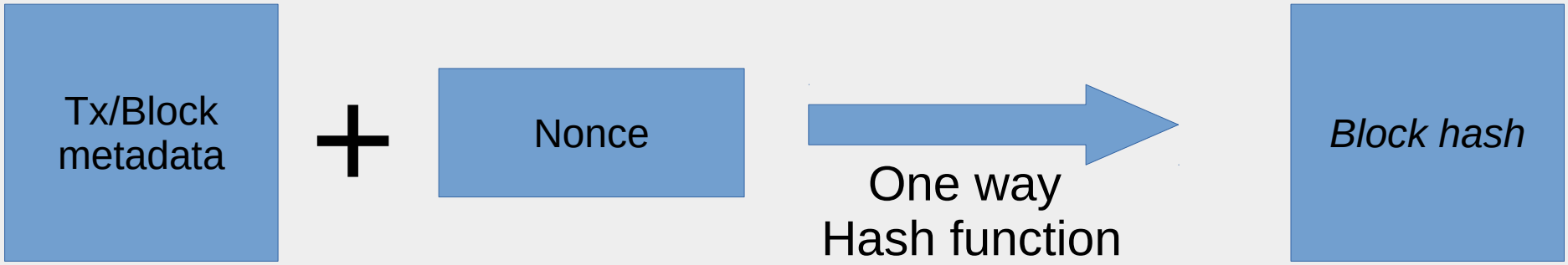
- This gets run through a one way function called a *hash*
- *Block hash* has to meet security challenge requirements



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- Only way to find *nonce* that meets guidelines is to guess a bunch of times – no formula or predictable outcome
- Once the answer is found, anyone can verify in one step!
- Bitcoin nodes share and *verify* the shared blockchain ledger so that the rules are followed

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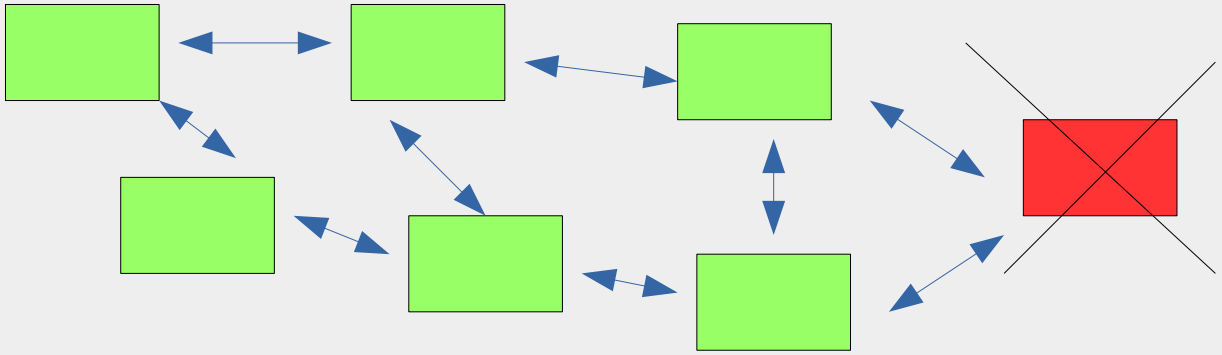
- **Attackers would have to out-solve the rest of the Bitcoin network – nearly impossible at scale!**



BTC: ~75 quintillion attempts / sec
BCH: ~2 quintillion attempts / sec
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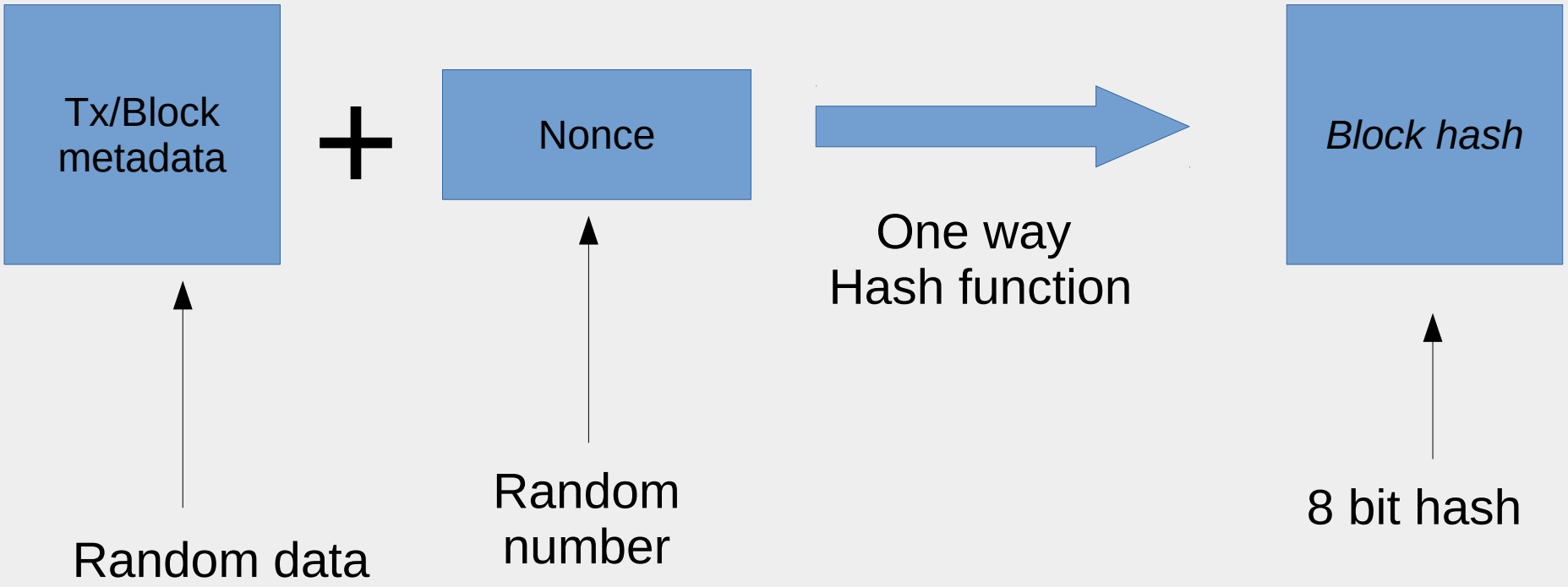
What is the POW - “Security Challenge”?

- Hashes (result of the one way function) are just numbers represented in binary
- The challenge is to find a *nonce* such that the resulting hash is **less than** the *difficulty target*
- The lower the *difficulty*, the longer it takes to find an answer!!
  - Bitcoin adjusts target so a solution is found and a new block is processed about every 10 minutes

Our POW Simulation



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- The difficulty target menu – press B to set difficulty from 1 – 7
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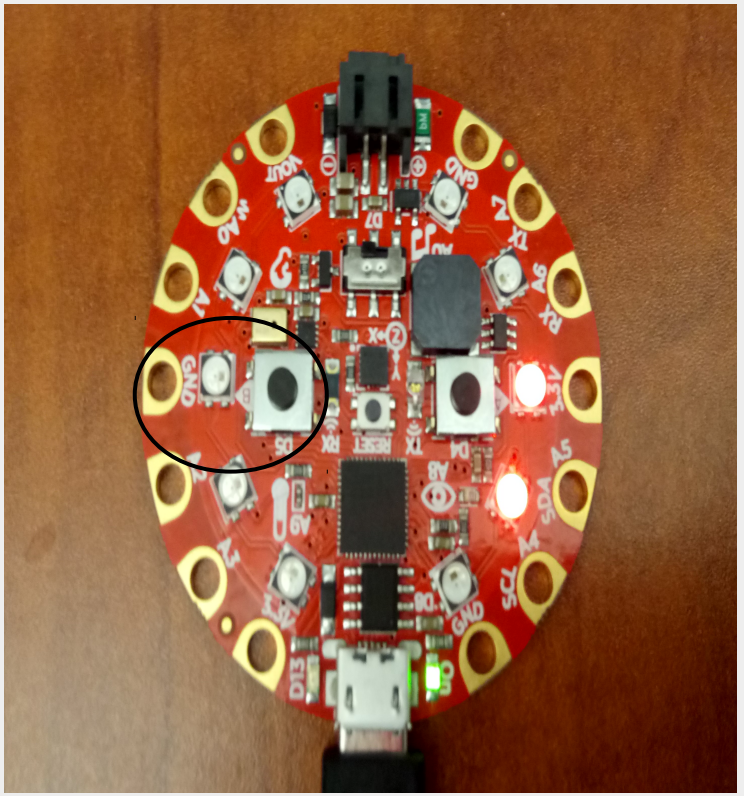

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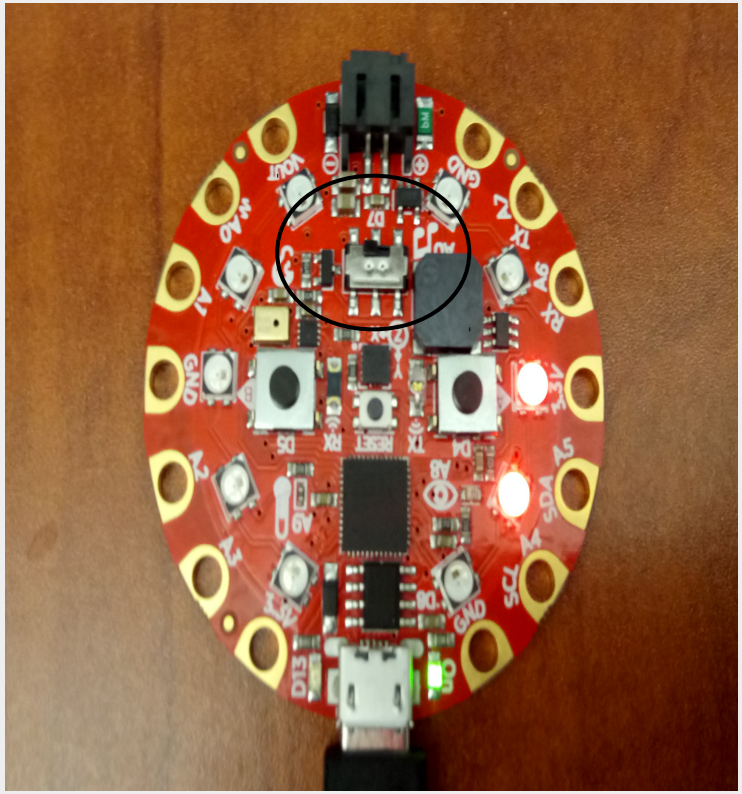

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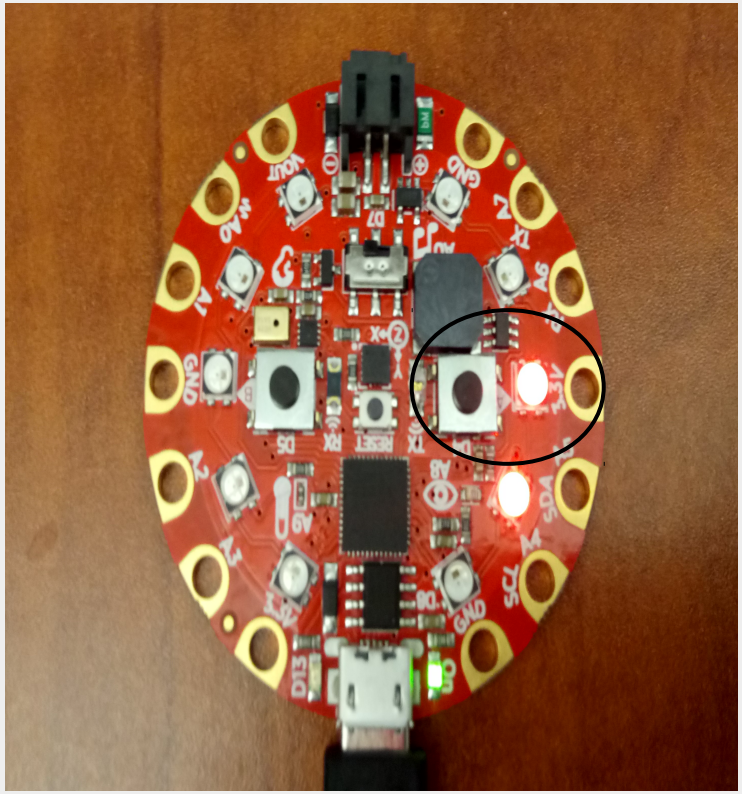

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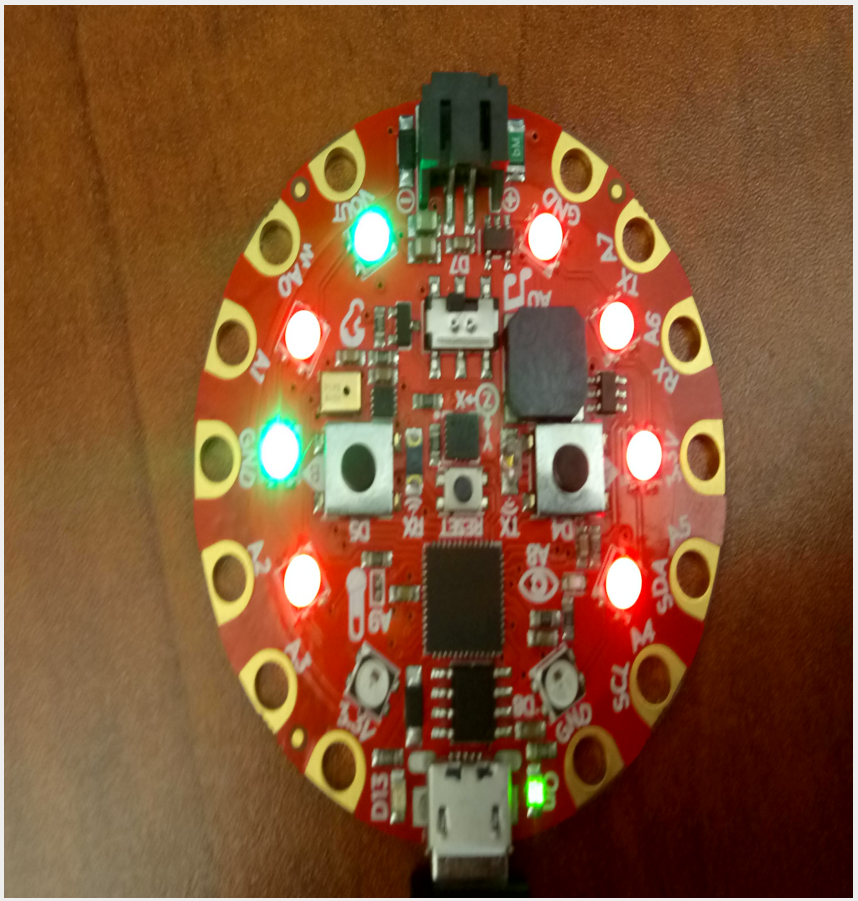

Final “block hash”:

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- 8 bit numbers:

0 0 1 0 0 0 0 0

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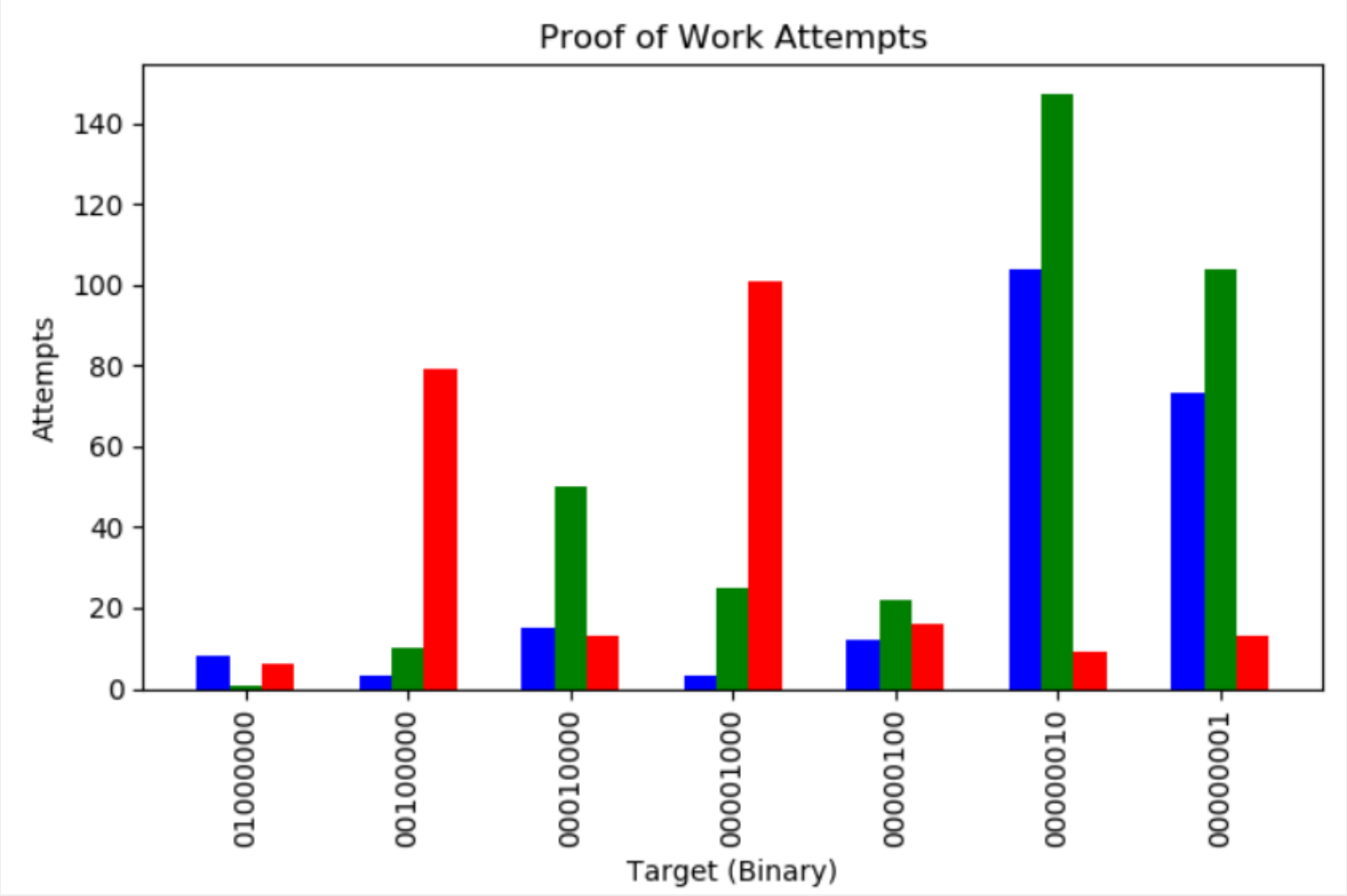

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Simulation vs. Real Bitcoin

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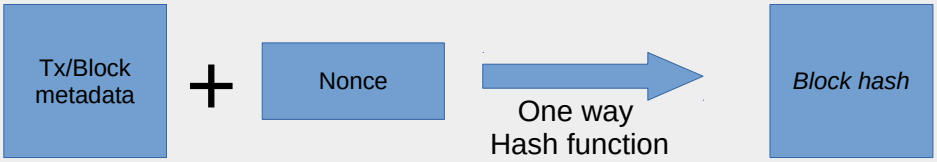

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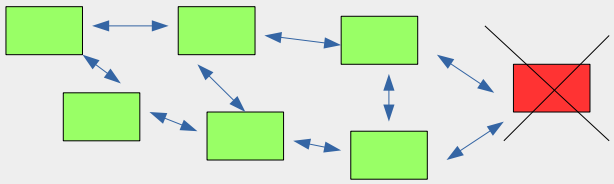

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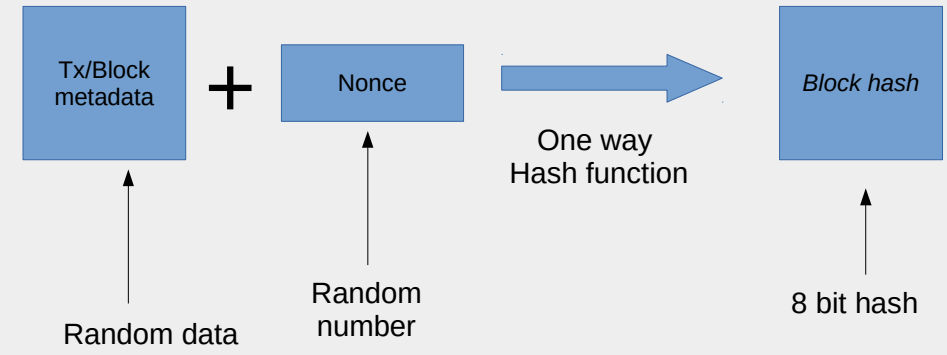

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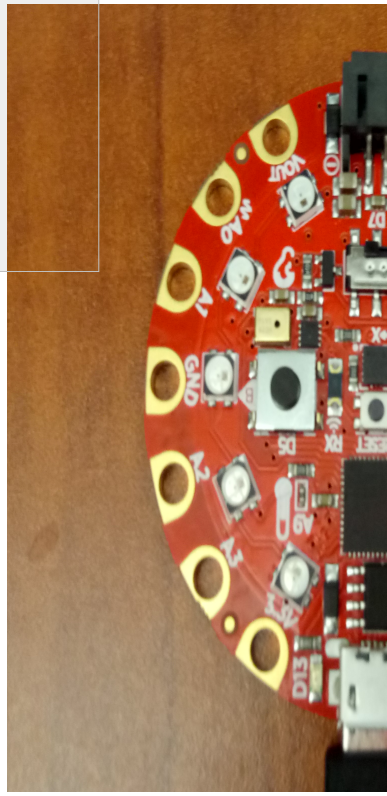

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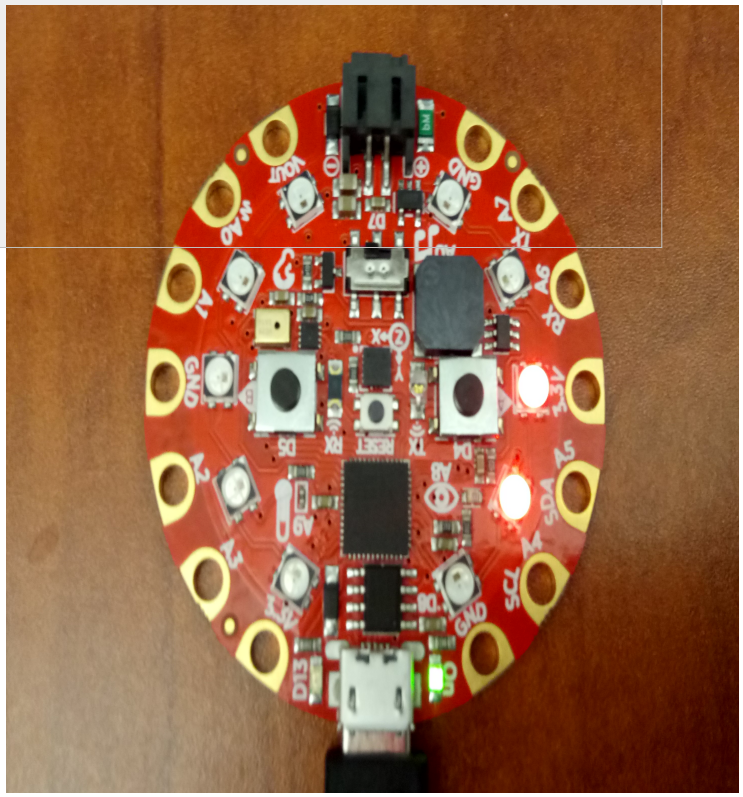

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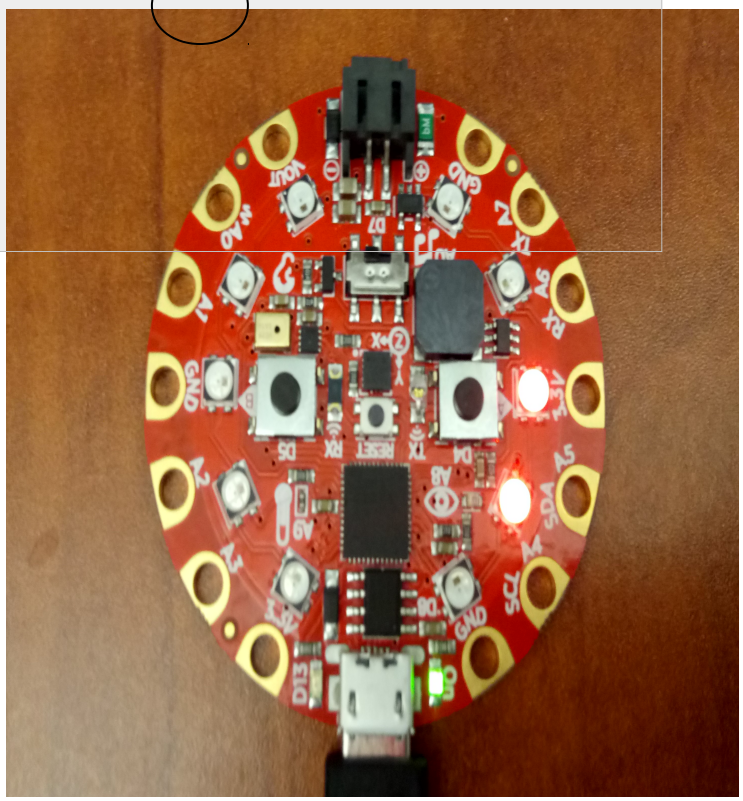

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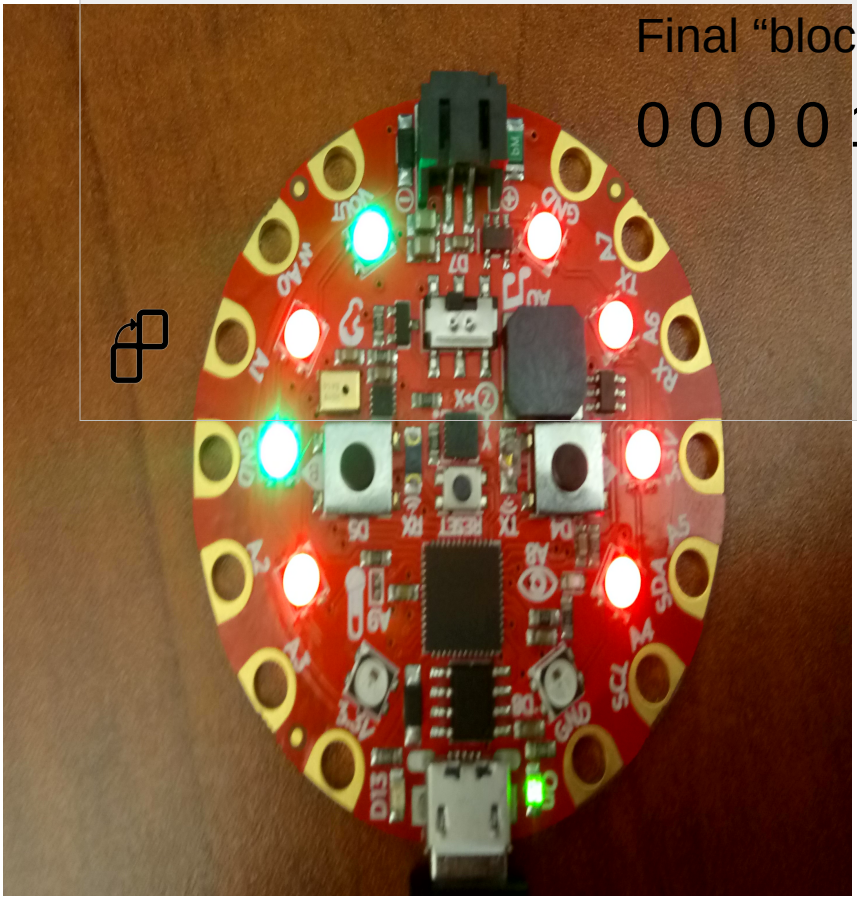

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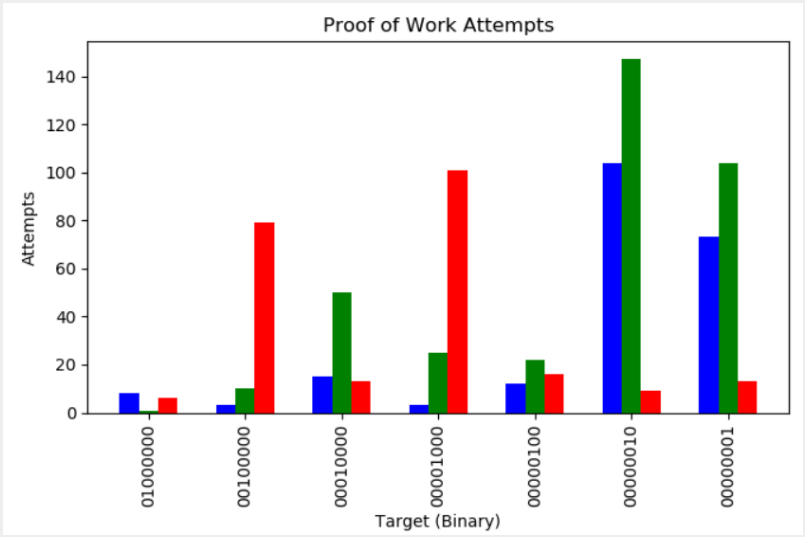

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