plookup: speeding up SNARKs on non-friendly functions with lookup tables

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Aztec

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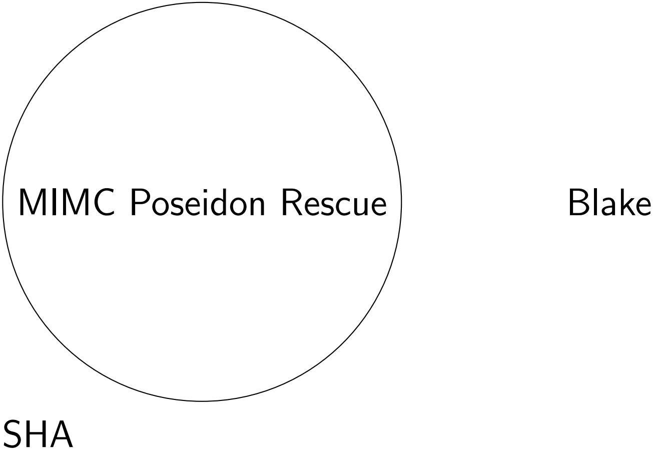
This is a *multiplicative* factor you pay on each small operation while computing SHA/BLAKE

Approach 1: Keep SNARKs in friendly neighborhoods



MIMC Poseidon Rescue

Blake

SHA

Our Approach: lookup tables (see also: Arya[Bootle, Cerulli, Groth, Jakobsen, Maller])

Precompute table $\mathbf{T}$ of all triplets $(\mathbf{a}, \mathbf{b}, \mathbf{c})$ s.t. $\mathbf{c} = \mathbf{a} \ \mathbf{xor} \ \mathbf{b}$.

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After enough lookups, has amortized cost of ~ 1 constraint per $\mathbf{xor}$.

The plookup protocol in a nutshell

Witness $\mathbf{f} = \{\mathbf{f_i}\}_{\mathbf{i}\in[\mathbf{n}]}$ Table $\mathbf{t} = \{\mathbf{t_i}\}_{\mathbf{i}\in[\mathbf{d}]}$
Want to prove $\mathbf{f} \subset \mathbf{t}$. (using randomness we have reduced tuples to single elements).

First thing that comes to mind Some divisibility check between

$$F = \prod_{i \in [n]} (X - f_i), T = \prod_{i \in [d]} (X - t_i)$$