An Oblivious Password Cracking Server

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Corelabs
Core Security Technologies

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Agenda

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Intro

- Reversing cryptographically-strong hashes is really resource intensive.
- What if a resource constrained hacker wants to crack a password?
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  - For instance a rainbow table used to break *LM* takes 34GBytes.
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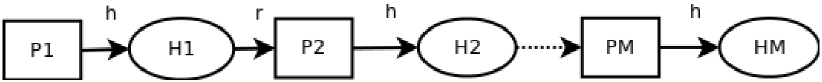
Hellman Tables



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- Each table stores *M* chains.
- *M* tables. Each one uses its own reduction function.

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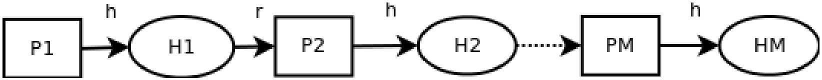

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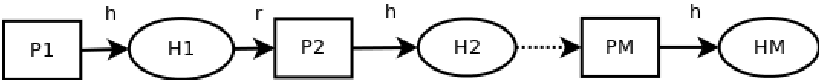
$$\begin{tikzcd}\boxed{P1} \arrow[r, "h"] & H1 \arrow[r, "r"] & \boxed{P2} \arrow[r, "h"] & H2 \arrow[r, dotted] & \boxed{PM} \arrow[r, "h"] & HM\end{tikzcd}$$

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Hellman Tables with Distinguished End-Points

Differences with Hellman Tables

- End-points have a property that distinguishes them
  - Such as number of leading 0s
- The expected length of chains is M.
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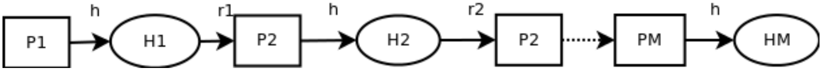

- Just one table with M^2 entries.
- Collisions are avoided by using a different reduction function for each step.
- This is the most popular kind of hash reversing tables.

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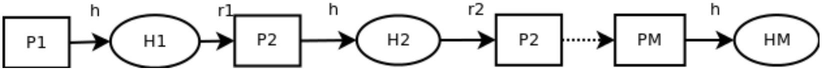

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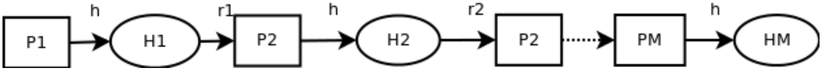

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Table sizes

- Number of chains = M^2
  - M chains for each of the M tables for Hellman Tables and Hellman Tables With Distinguished Endpoints.
- Chain length = M
  - Average chain length for Hellman Tables With Distinguished Endpoints.
- $M = -\sqrt[3]{\ln(1-\alpha)\cdot N}$ where:
  - N is the size of the preimage
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- Ask for a bit in a database stored by a server without revealing the requested bit to the server.
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"Something being imposible does not imply that it has never been done" (Fernando Russ)

Classic PIR

Eyal Kushilevitz and Rafail Ostrovsky
Replication is not needed: Single database, computationally-private information retrieval.
Proceedings of the 38th Annu. IEEE Symp. on Foudations of Computer Science, pages:364–373, 1997.

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Classic PIR - Complexities

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- Client processing complexity: $O(\sqrt{n})$.
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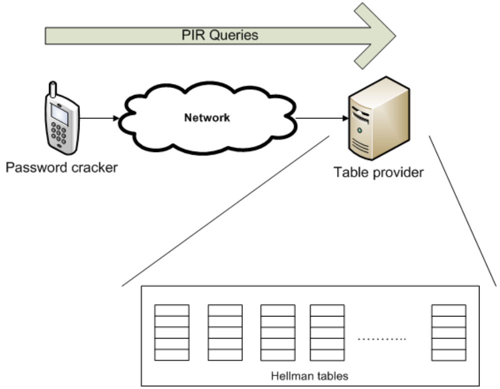
Our Work

Hellman Tables With Distinguished Endpoints as Hash-Reversing Tables queried using Classic PIR.



Calculating the tables

- (*begin*, *end*) pairs are stored in a closed hash table.
- The size of each table is βM, where $\beta > 1$.
- Each entry has an index, representing the initial plain-text, and the end-of-chain hash.
- The key of the entry is the end-of-chain hash.
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- The client calculates the *M* ends-of-chain for the hash being reversed. One for each table.
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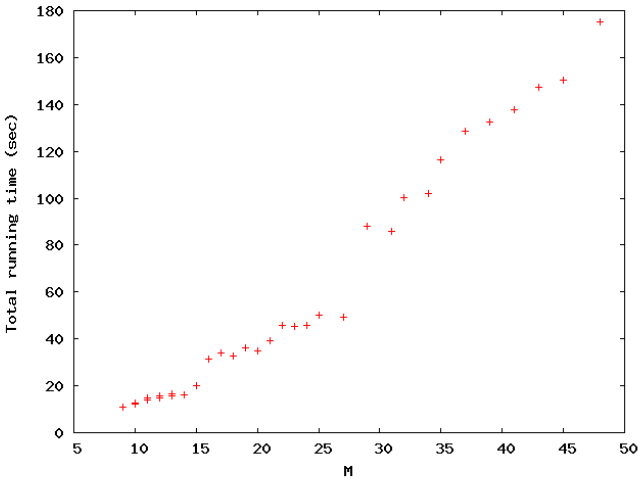
Experimental Results



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Any Question?

Thank you!