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The Subset-Sum Problem

cryptanalysis employing a probabilistic approach

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Matthias Minihold
ECRYPT-NET Early Stage Researcher
Cryptology and IT-Security, Ruhr-Universität Bochum

Horst Görtz Institut
für IT-Sicherheit

Outline

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Definition 1 (Subset-Sum)

$$\text{Given } n, S, a_1, a_2, \ldots a_n \in \mathbb{N}, \text{ find } I \subseteq [n] : \sum_{i \in I} a_i = S. \qquad (1)$$

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1. The Subset-Sum problem
   - Motivation
   - **Historical Remarks**
   - Easy and Hard Instances
   - Evolution of Algorithms
   - Technique 1 - Meet in the Middle
   - Technique 2 - Enlarge Number Set
   - Applications

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  - worst-case instances are computationally intractable

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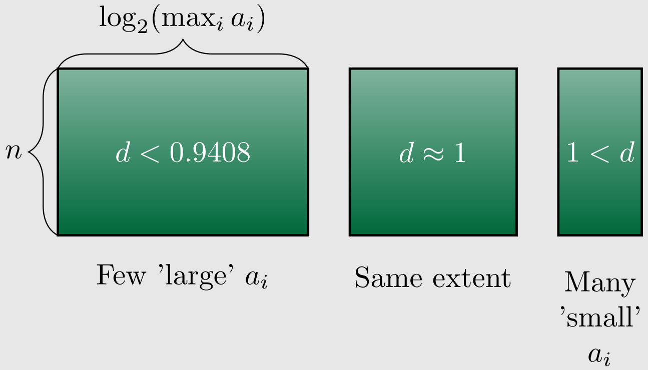

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  3. Finding x given (a, S) is (assumed to be) computationally hard.

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Algorithm (year)	Time	Space

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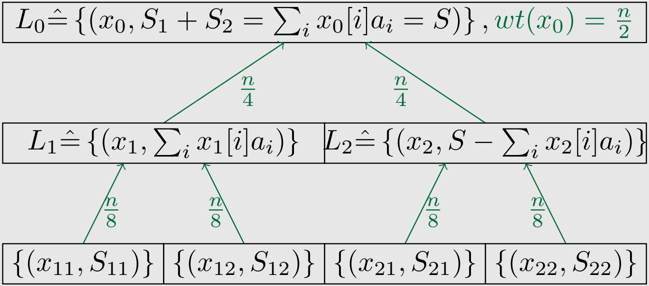

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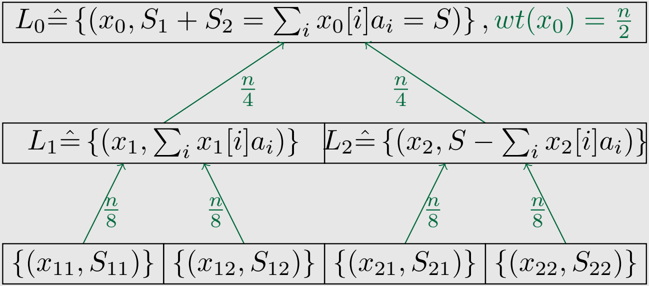

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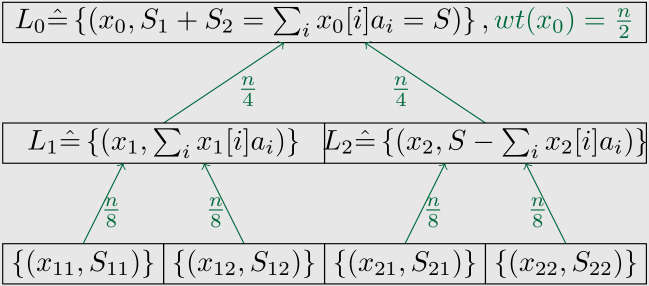

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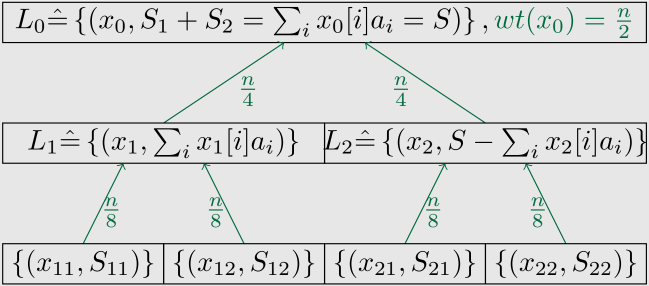

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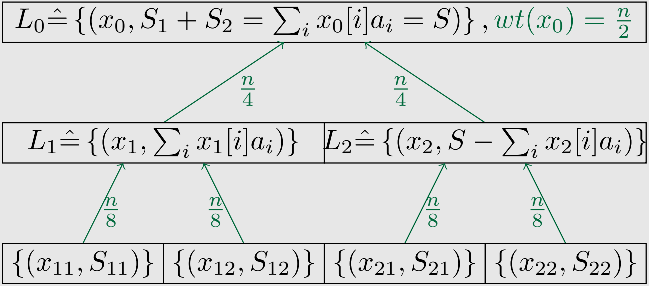

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- Merge L_1, L_2 to solutions $(x_0, S) \in L_0$ of the Subset-Sum problem.

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Technique 2 - Enlarge Number Set

$$L_0 \hat{=} \{(x_0, \sum_i x_0[i]a_i = S_1 + S_2 = S)\}, wt(x_0) = \frac{n}{2}$$

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- Enlarge intermediate 'number-set': $x_{11}[i] + x_{12}[i] =: x_1[i] \notin \{0, 1\}$.
- Speed-ups if $x_1[i], x_2[i] \sim \mathcal{D}(\{-1, 0, 1\})$ w.r.t. distribution $\mathcal{D}$.

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Goal: Cloud learns no information about text T and pattern P.

S. Faust, C. Hazay, and D. Venturi.
Outsourced pattern matching.
Cryptology ePrint Archive, Report 2014/662, 2014.
http://eprint.iacr.org/2014/662.

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QUESTIONS?

Thank you for your attention!

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