

Cryptographic Hash and Integrity Protection

Cryptographic Hash Function

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Module: Cryptographic Hash Function

Hash Function Definitions

Insecure Hash Function Examples

Cryptographic Hash Requirements

Iterative Structure

Hash Functions

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(variable size) to small fixed output

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can be called *digest*, *fingerprint*, *hash*

Insecure Hash Functions: Checksums

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Easy to generate collision

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Cryptographic Hash (h) Requirements

The output of h is pseudo-random and exhibits avalanche effect

One-wayness Difficult to find a input that maps to a given hash output

Collision resistance Difficult to find two inputs mapping to same hash output

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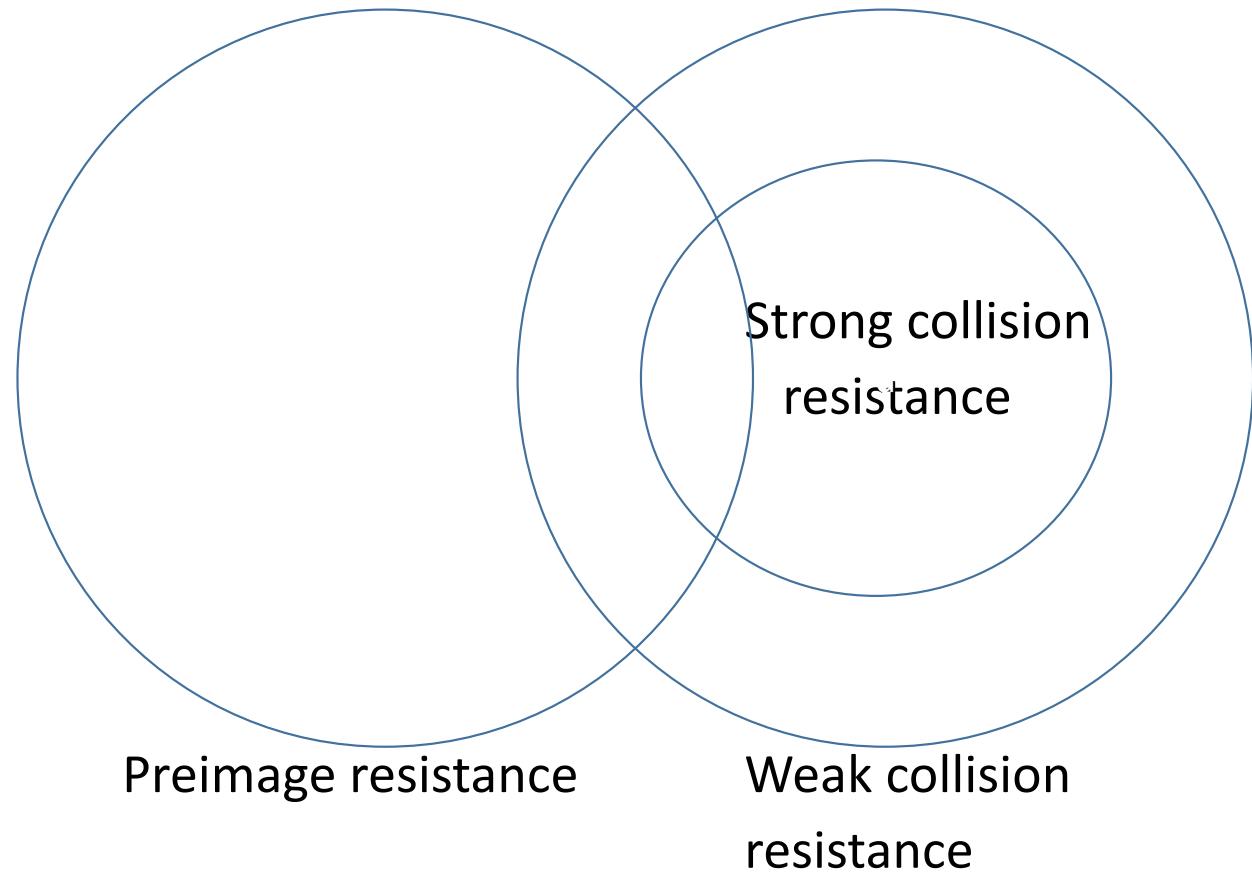
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2. Weak collision resistance

For any x , it is computationally infeasible to find $y \neq x$ with $h(y)=h(x)$

3. Strong collision resistance

It is computationally infeasible to find any pair (x,y) such that $h(x)=h(y)$



Brute Force Attack on Hash Functions

Security depends on the length of $h(n)$

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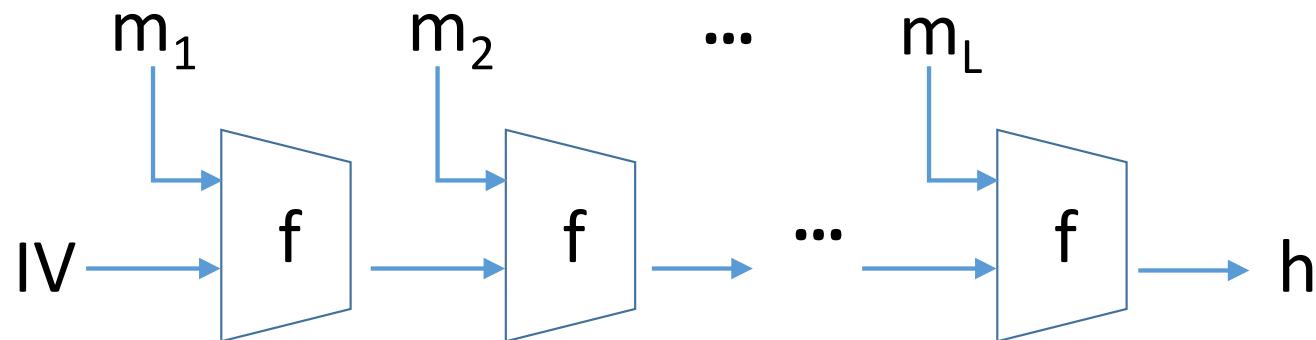
Attack on strong collision resistance takes $2^{n/2}$ due to Birthday Paradox
(Strong collision resistance is harder to achieve in the defender perspective)

Hash Iterative Structure

Iterative w/ compression functions (f)

To support variable-length input (m_i 's)

If f collision resistant, then so is the hash

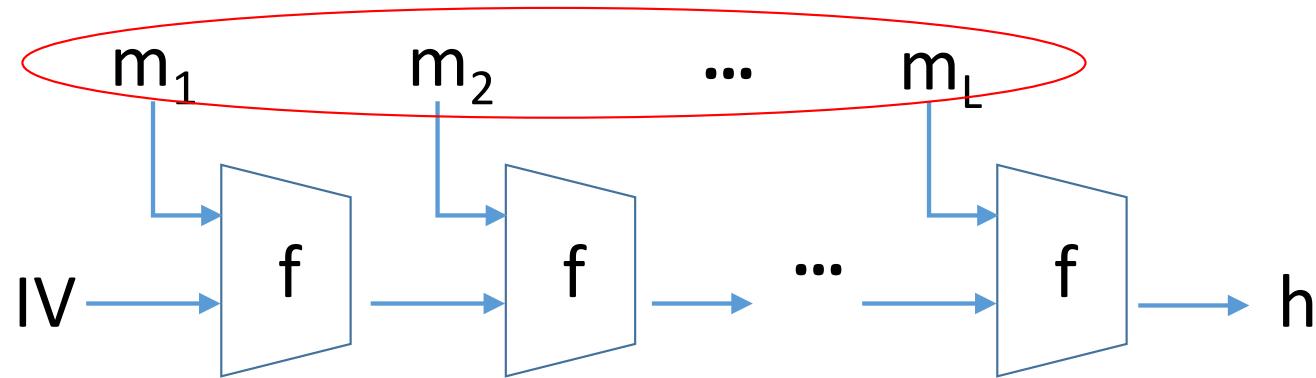


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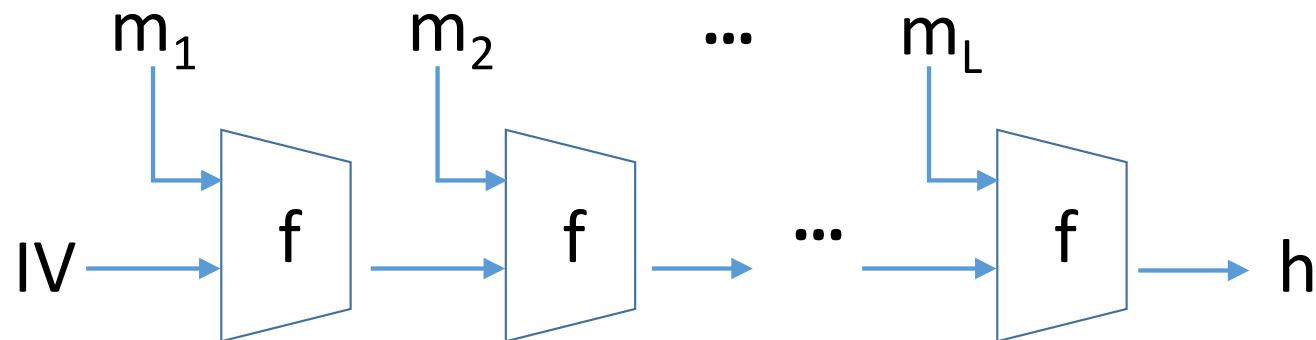


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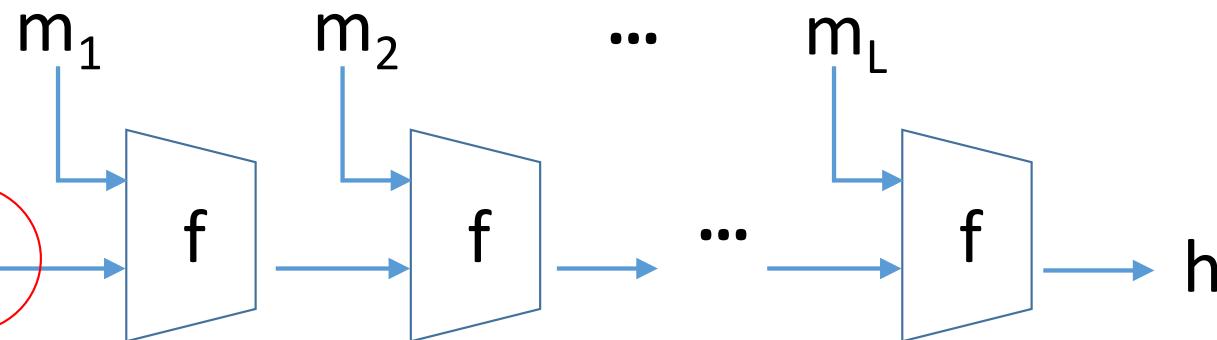


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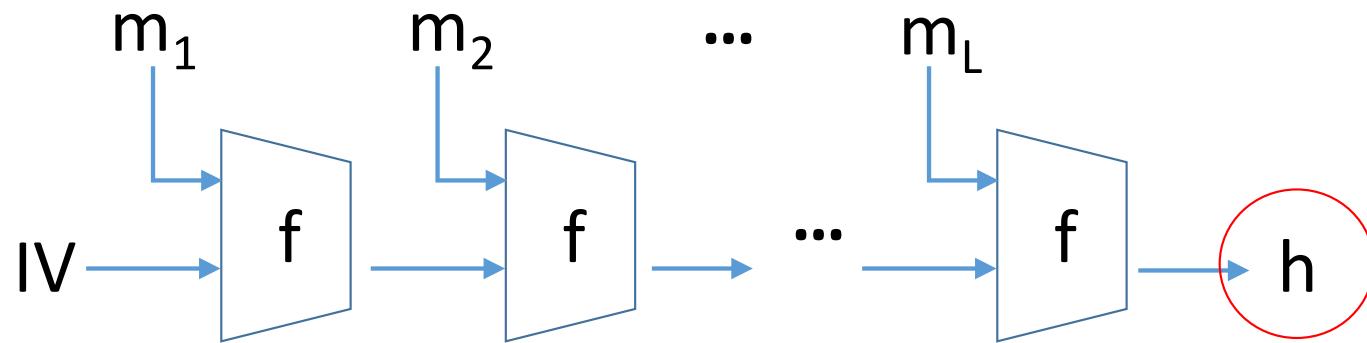


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Hash Using Block Ciphers

f can be a block cipher

Similar to CBC but with no key

