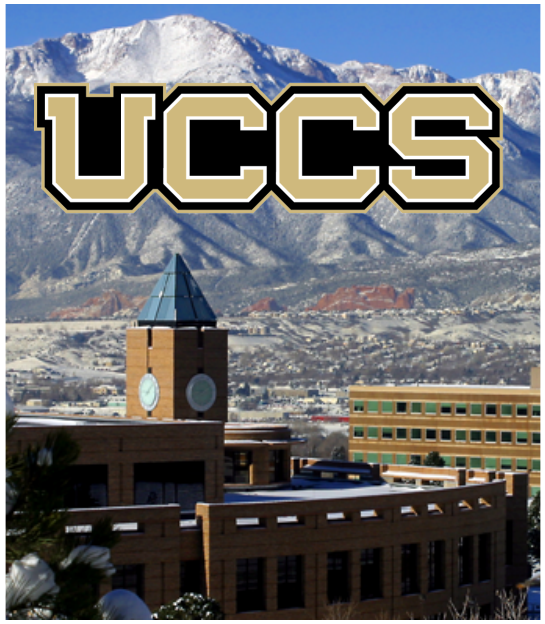

Cryptographic Hash and Integrity Protection

Cryptographic Hash Function

Sang-Yoon Chang, Ph.D.

Module: Cryptographic Hash Function

Hash Function Definitions

Insecure Hash Function Examples

Cryptographic Hash Requirements

Iterative Structure

Hash Functions

Functions transforming large input (variable size) to small fixed output

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Bit-by-bit XOR (parity) of multiple blocks

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Easy to generate collision

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Deterministic and efficient computation given the input

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Input is also called *message* and output can be called *digest*, *fingerprint*, *hash*

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

Cryptographic Hash (h) Requirements

(0. The output of h is pseudo-random)

1. Preimage resistance (one-wayness)

    For any output h', it is computationally infeasible to find y such that h(y)=h'

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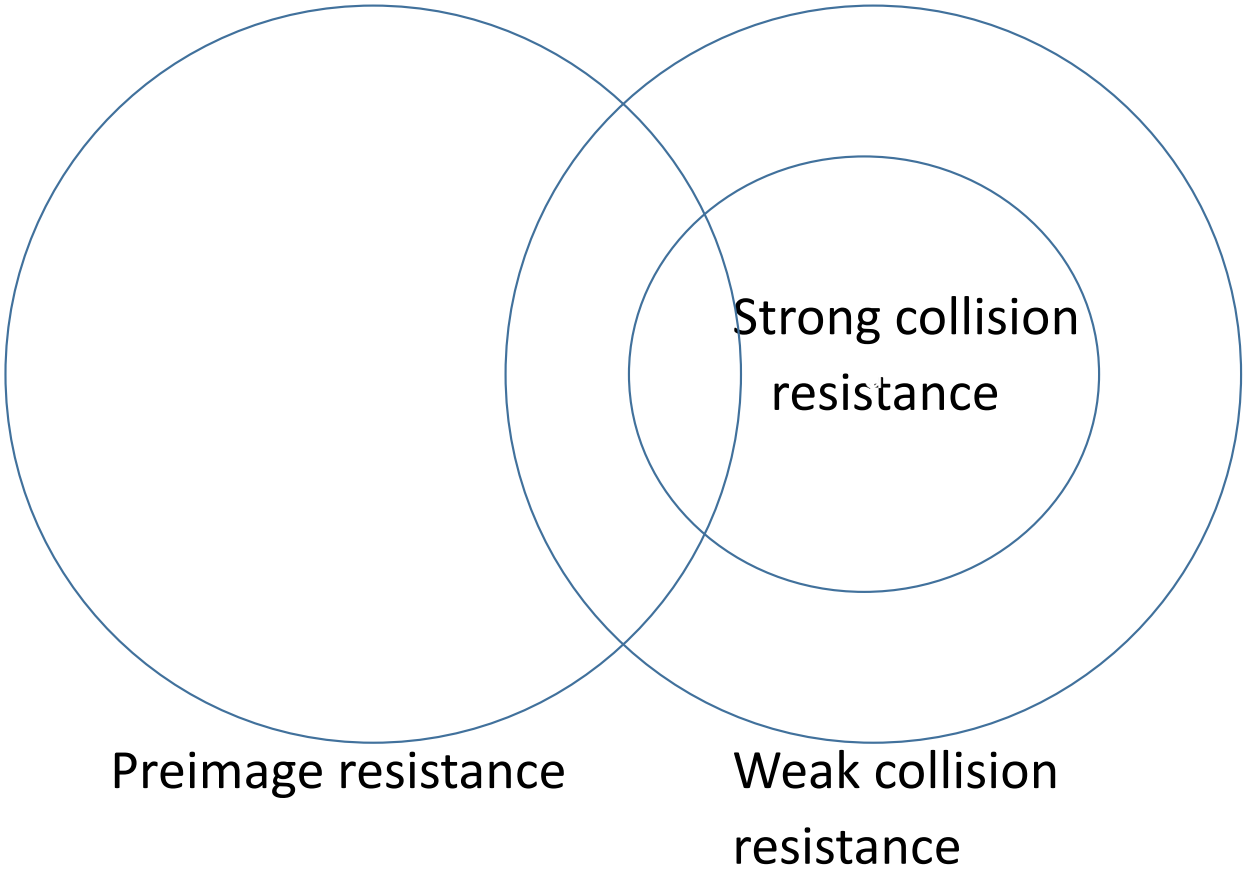
   It is computationally infeasible to find any pair (x,y) such that h(x)=h(y)


Strong collision resistance
Preimage resistance
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Security depends on the length of h (n)

Attack on preimage resistance or weak collision resistance takes 2^{n-1}

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Attack on strong collision resistance takes $2^{n/2}$ due to Birthday Paradox

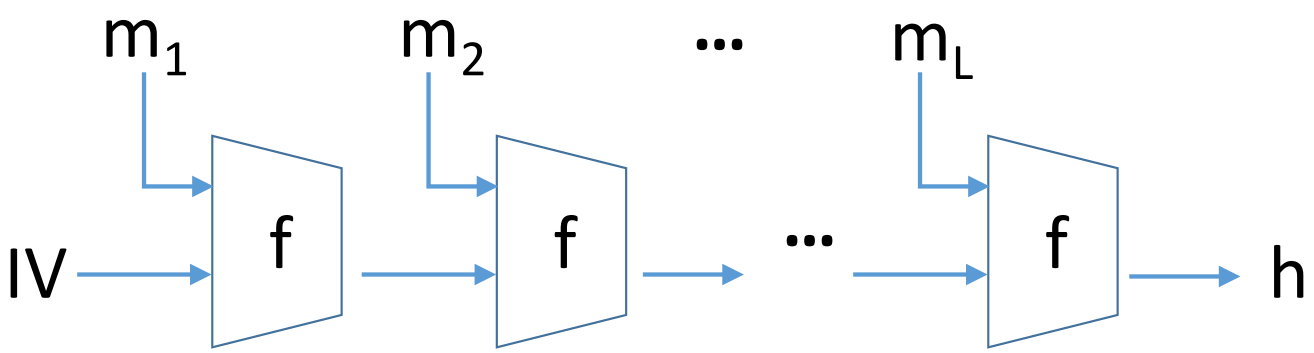
(Strong collision resistance is harder to achieve in the defender perspective)

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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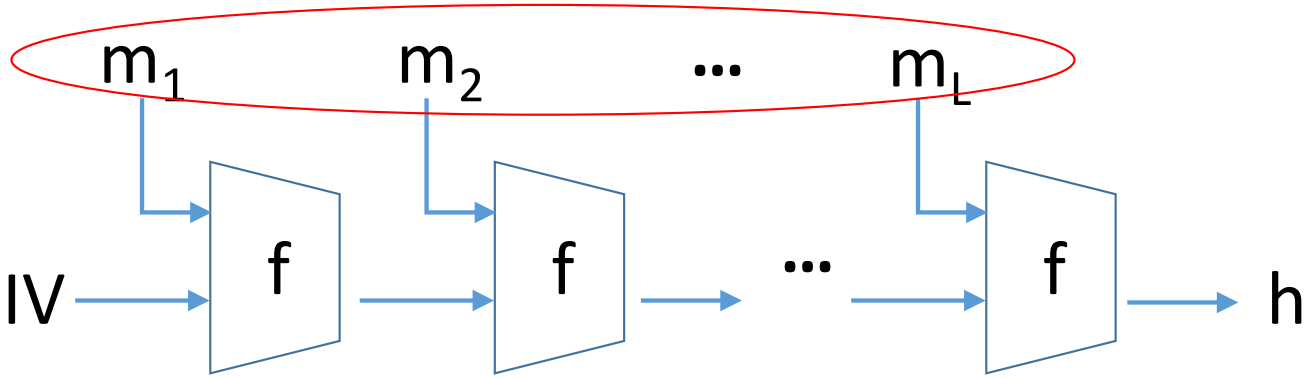

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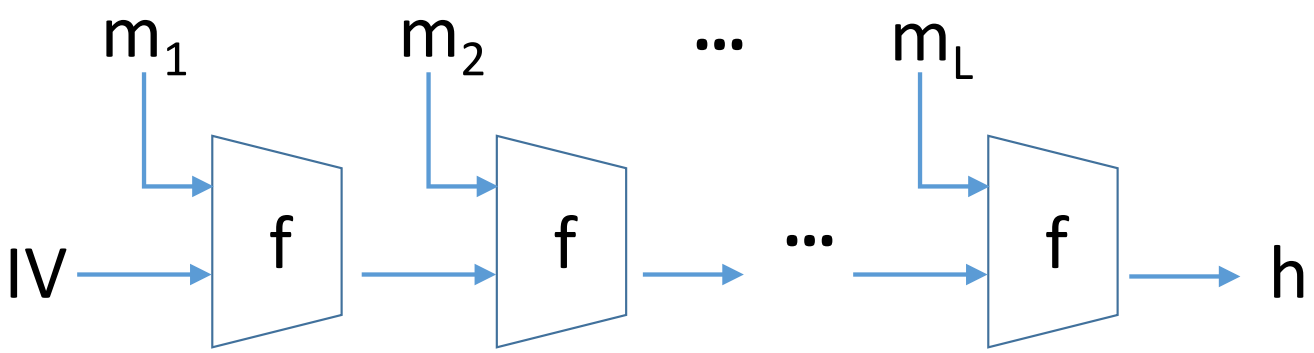

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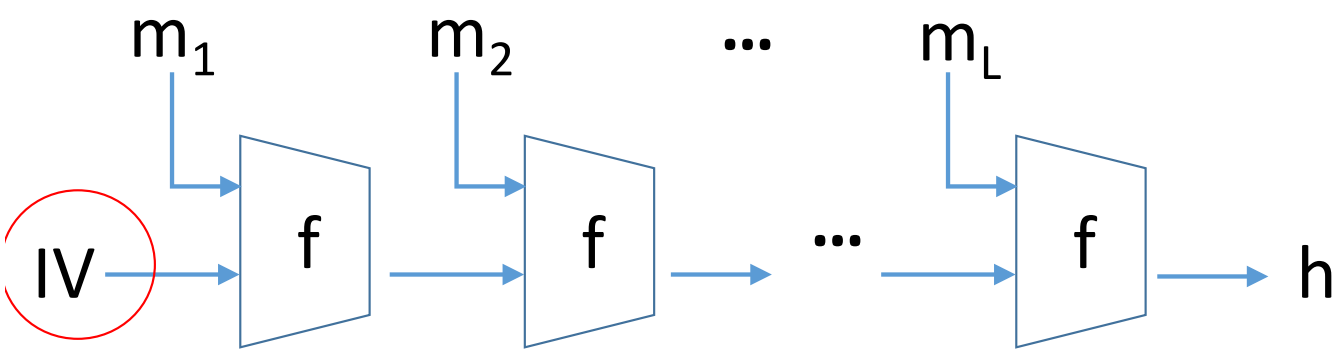

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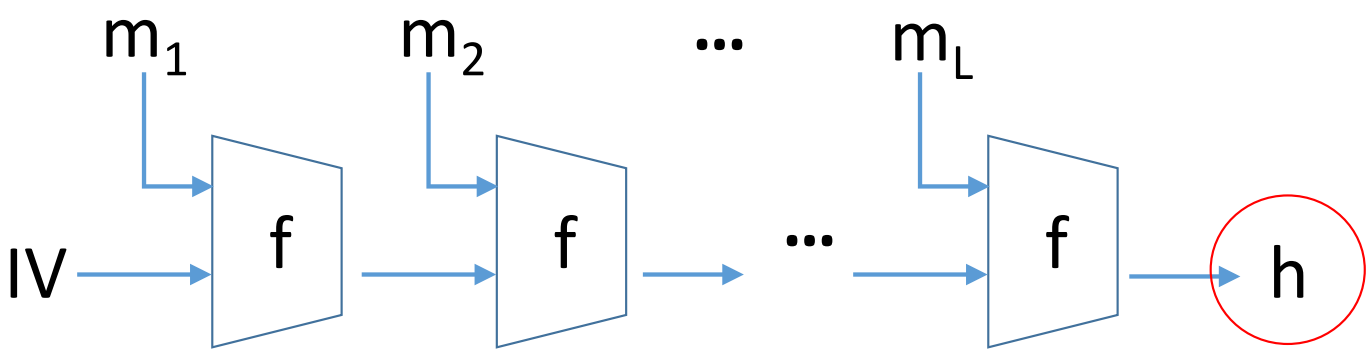

Hash Using Block Ciphers

f can be a block cipher

Similar to CBC but with no key