

# 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



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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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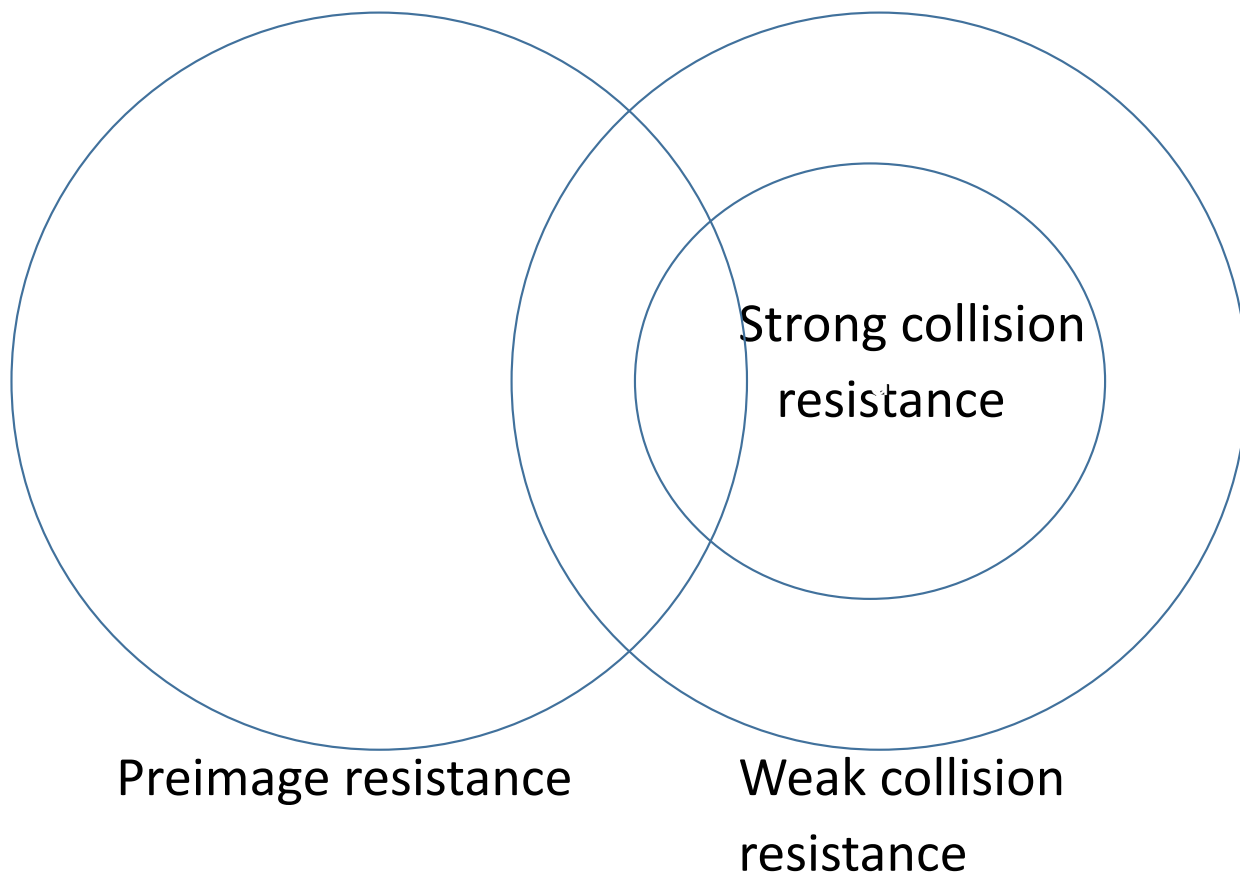
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3. Strong collision resistance

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





## **Brute Force Attack on Hash Functions**

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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)

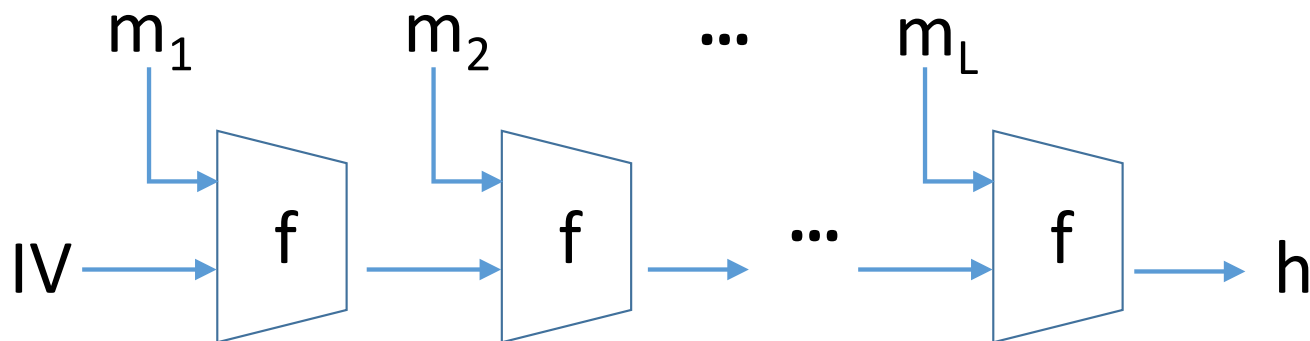


## Hash Iterative Structure

Iterative w/ compression functions (f)

To support variable-length input ( $m_i$ 's)

If f collision resistant, then so is the hash



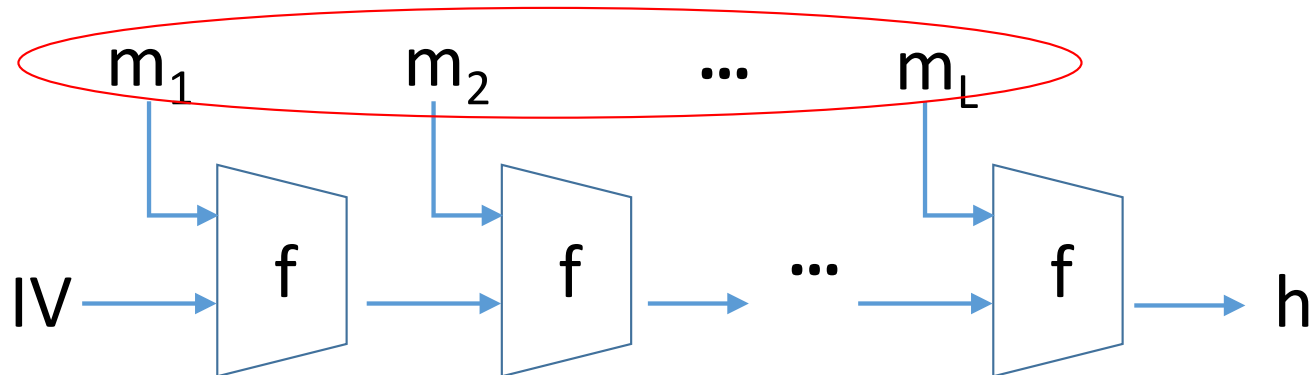


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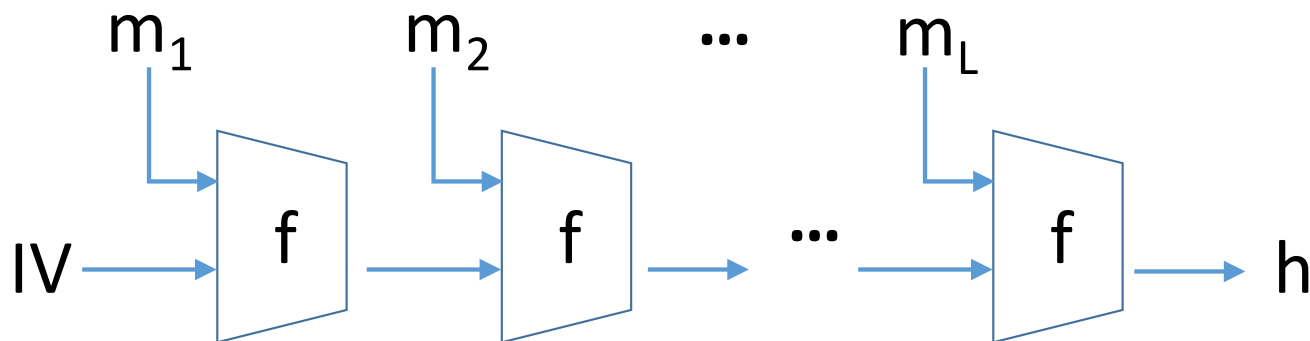


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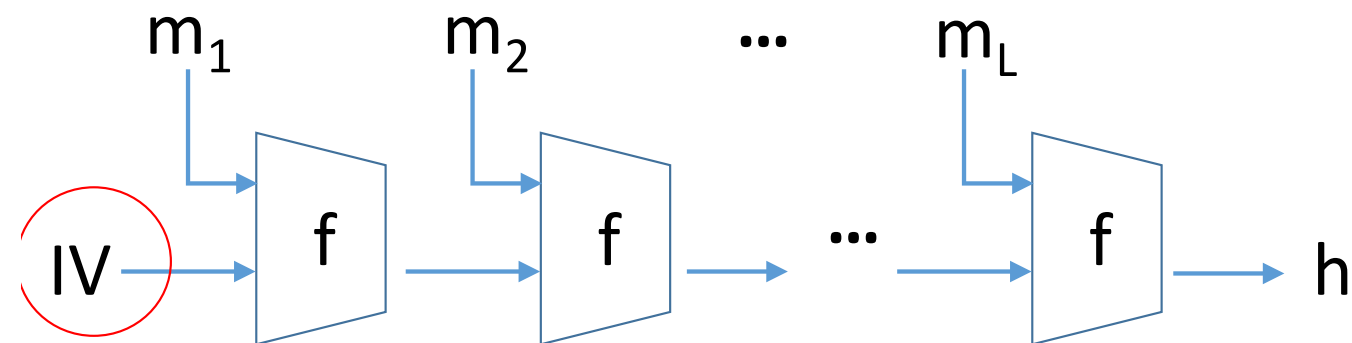


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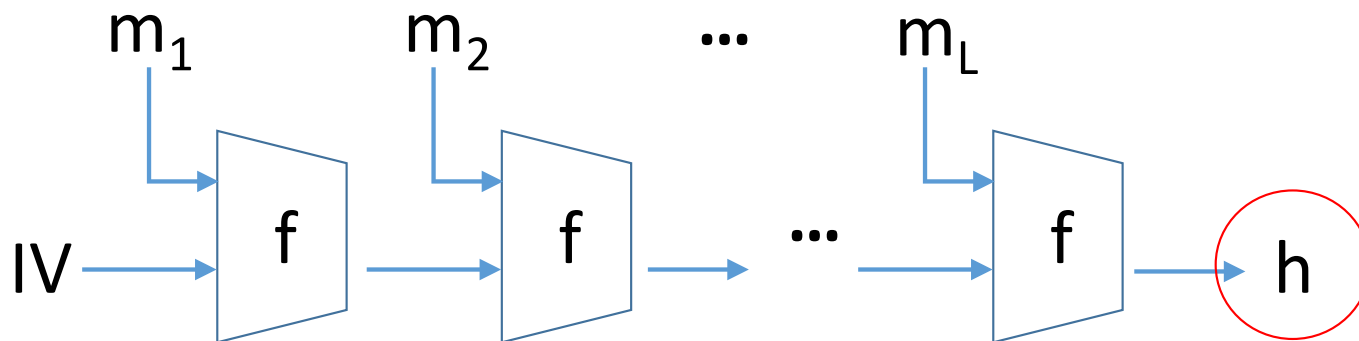


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## Hash Using Block Ciphers

$f$  can be a block cipher

Similar to CBC but with no key

