Applications of Hash Functions

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Outline

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Message Integrity

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One way to preserve the integrity of the document is through use of **fingerprints**.

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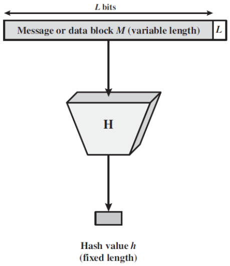

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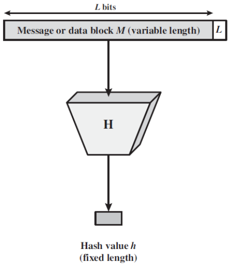

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- 3) **Collision resistance:** A hash function H is collision resistant if it is hard to find two inputs that hash to the same output; that is, two inputs x and y such that $H(x) = H(y)$, and $x \neq y$.

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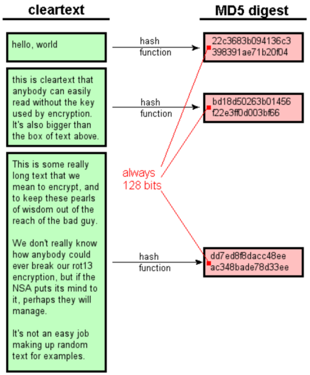
cleartext
MD5 digest
hello, world
hash function
22c3683b094136c3 398391ae71b20f04
this is cleartext that anybody can easily read without the key used by encryption. It's also bigger than the box of text above.
hash function
bd18d50263b01456 f22e3ff0d003bf66
This is some really long text that we mean to encrypt, and to keep these pearls of wisdom out of the reach of the bad guy. We don't really know how anybody could ever break our rot13 encryption, but if the NSA puts its mind to it, perhaps they will manage. It's not an easy job making up random text for examples.
hash function
dd7ed8f8dacc48ee ac348bade78d33ee
always 128 bits

Figure: Hashing - a one-way operation

Random Oracle

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Example

Here is an example which shows the Message and Message Digest listed in Hexadecimal.

Message	Message Digest
4523AB1352CDEF45126	13AB
723BAE38F2AB3457AC	02CA
AB45CD1048765412AAAB6662BE	A38B

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- We call this scheme as **iterated cryptographic hash function.**

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Merkle-Damgard Scheme is an iterated hash function that is **collision resistant** if the compression function is collision resistant. The scheme uses the following steps.

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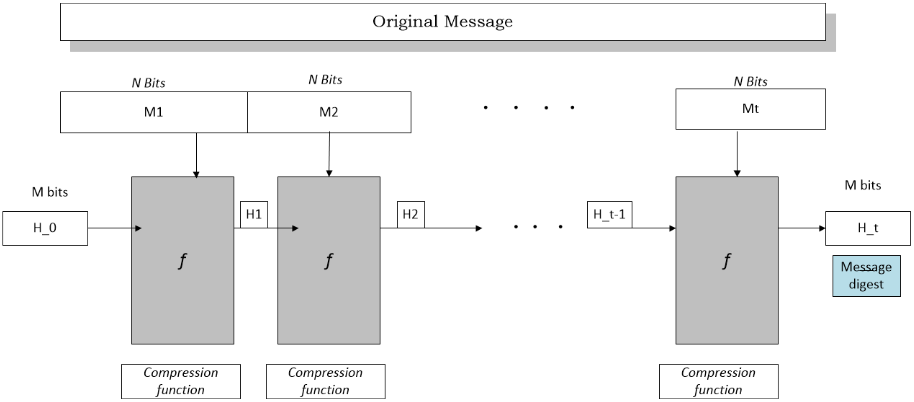

Figure: Merkle-Damgard scheme

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- When Alice sends a message to Bob, Bob needs to know if the message is coming from Alice.
- Now to provide such a proof, Alice uses a hash function to create a **Message Authentication code (MAC)** from the concatenation of the key and the message, $h(K||M)$.

Message Authentication - Implementation Steps

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- If two MAC's match, then the message is authentic.

Message Authentication - Implementation

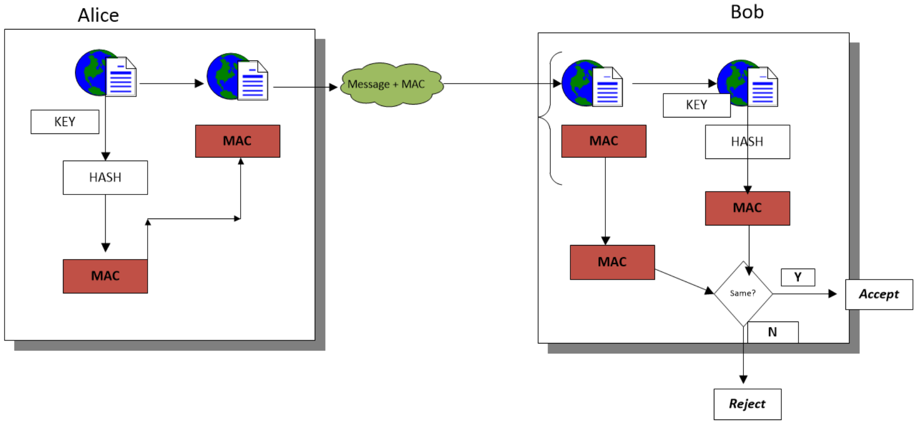

Figure: Message authentication code (MAC)

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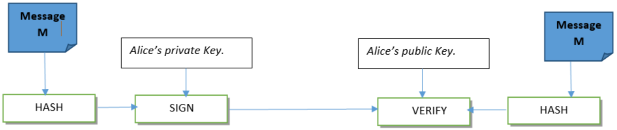

Figure: Signing the message digest

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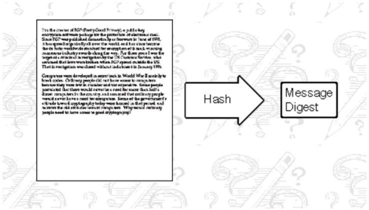
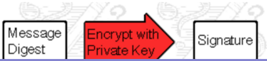


Figure: Converting message to message digest



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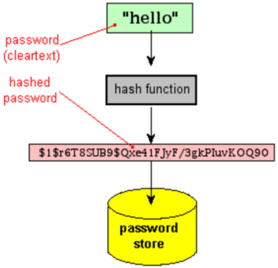
- In simple terms, when a user enters a password, the hash of that password is compared to the stored hash value for verification. This approach to **password protection** is used by most operating systems.



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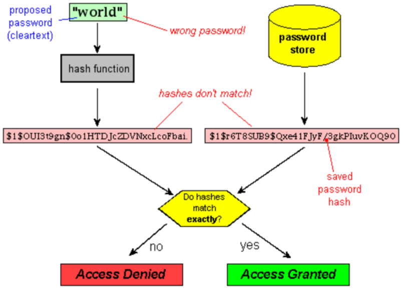

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Thank you for your attention.