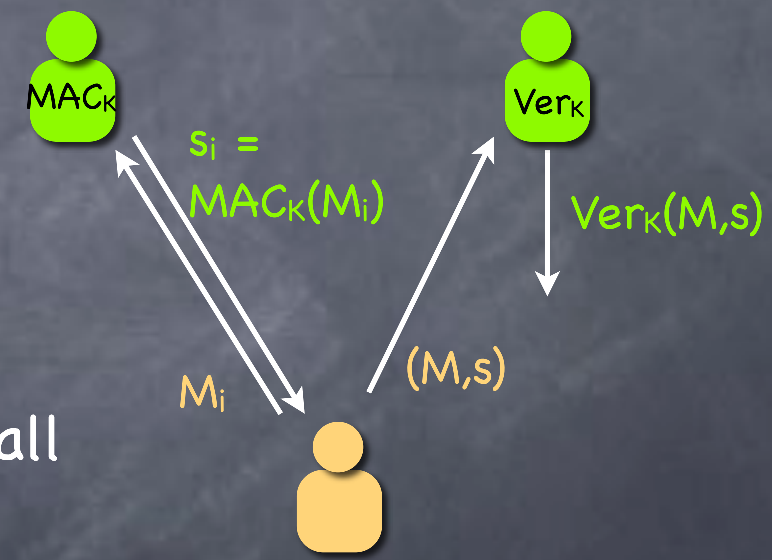
MAC.
SKE in Practice.

Lecture 5

RECALL

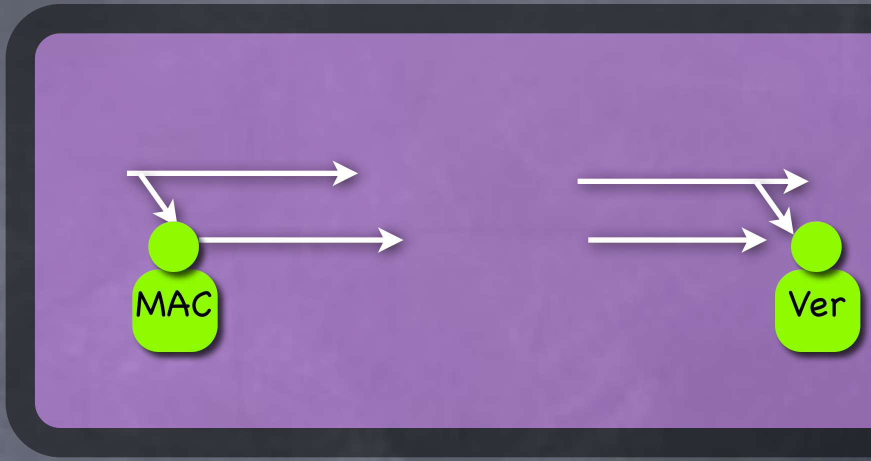
Message Authentication Codes

- A single short key shared by Alice and Bob
  - Can sign any (polynomial) number of messages
- A triple (KeyGen, MAC, Verify)
- Correctness: For all K from KeyGen, and all messages M, $\text{Verify}_K(M,\text{MAC}_K(M))=1$
- Security: probability that an adversary can produce (M,s) s.t. $\text{Verify}_K(M,s)=1$ is negligible unless Alice had computed and output $s=\text{MAC}_K(M)$



Advantage
$= \Pr[\ \text{Ver}_K(M,s)=1 \text{ and } (M,s) \notin \{(M_i,s_i)\}\ ]$

One-time MAC



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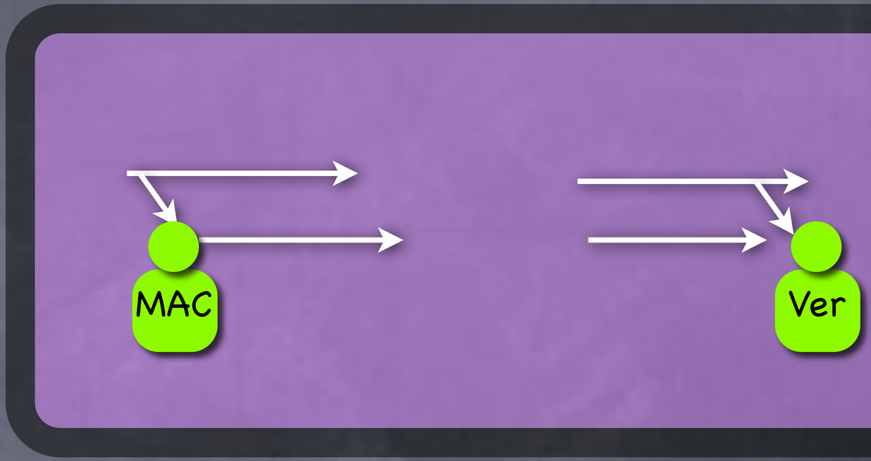

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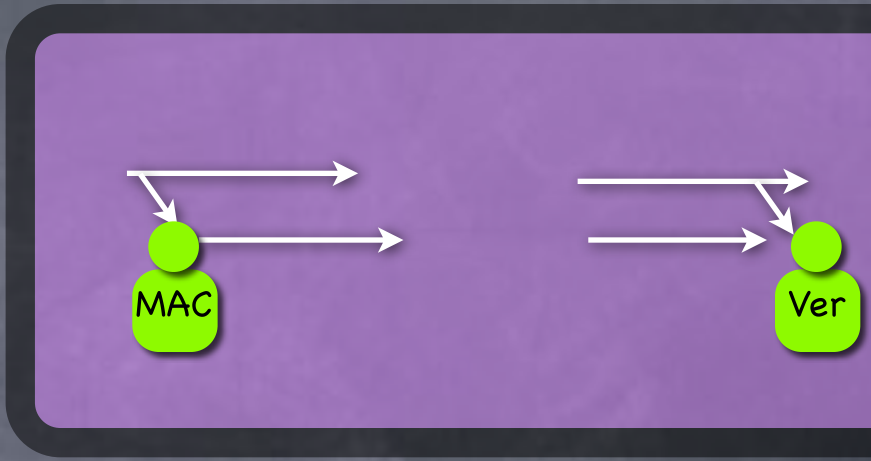

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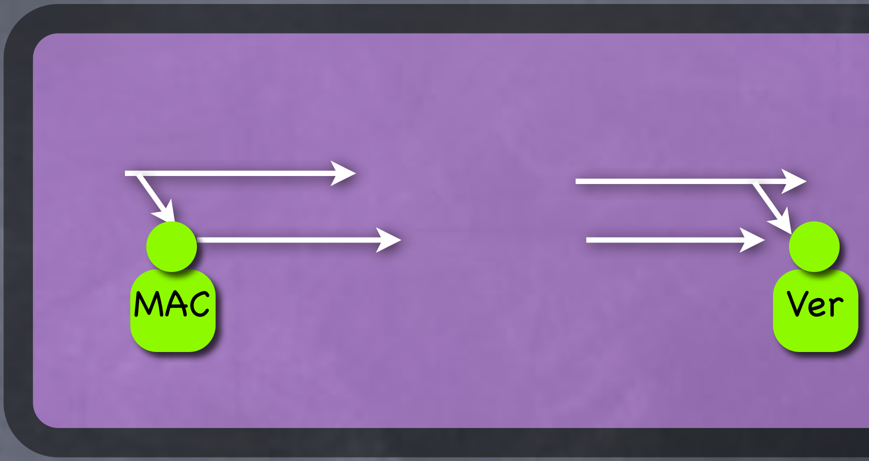

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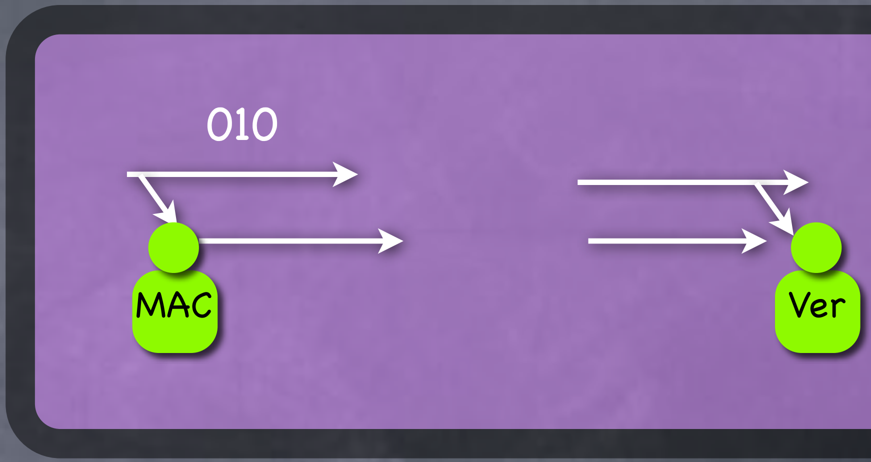

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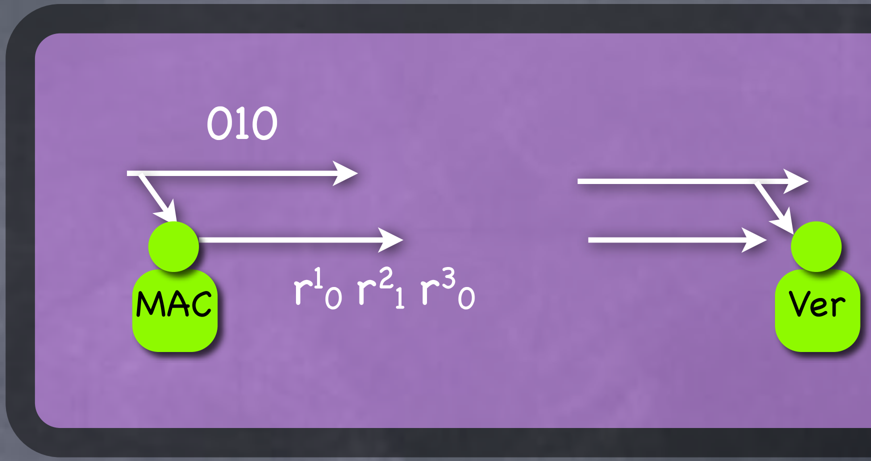

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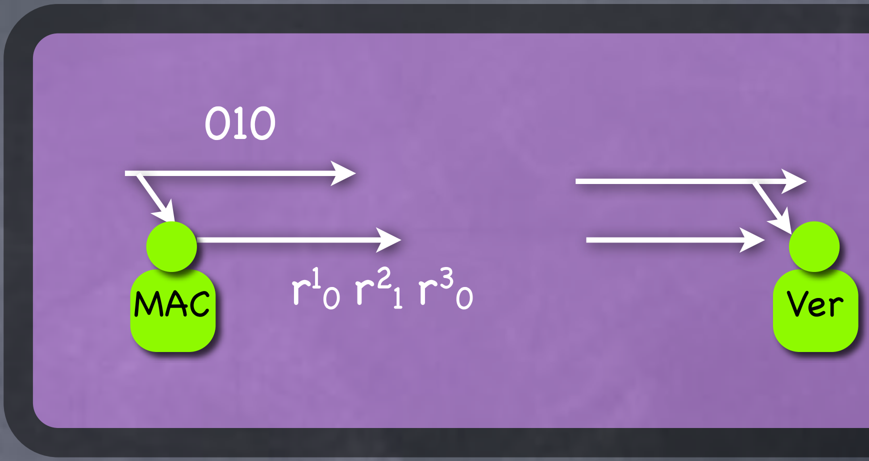

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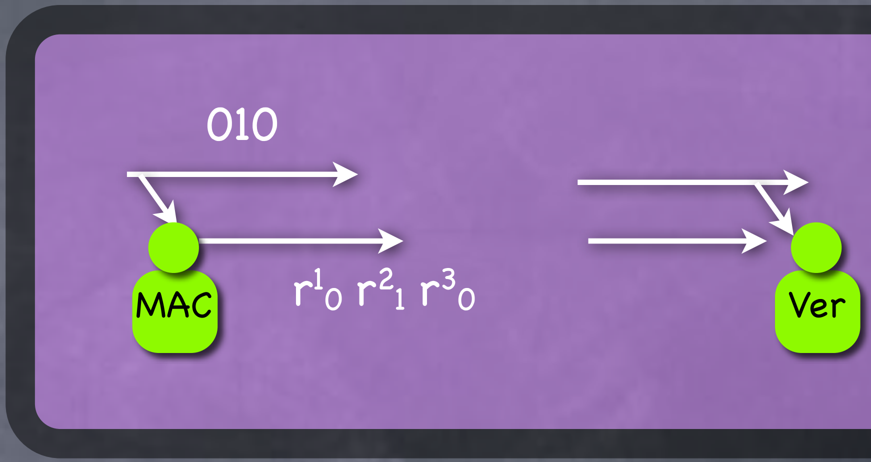

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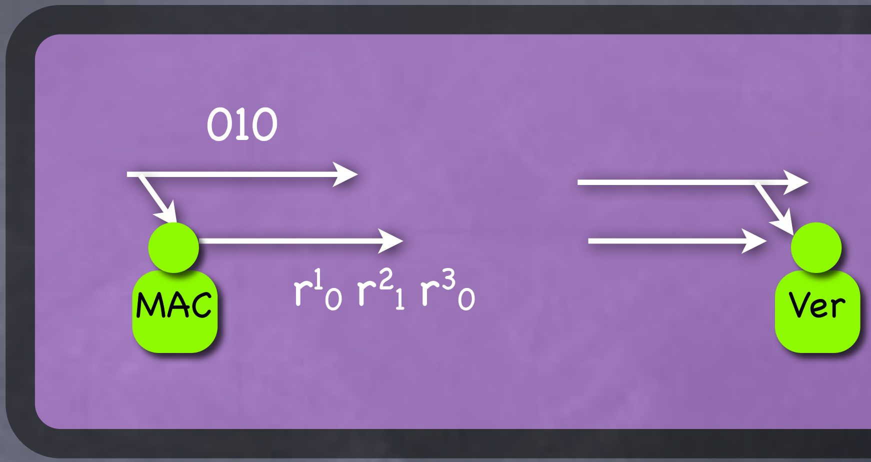

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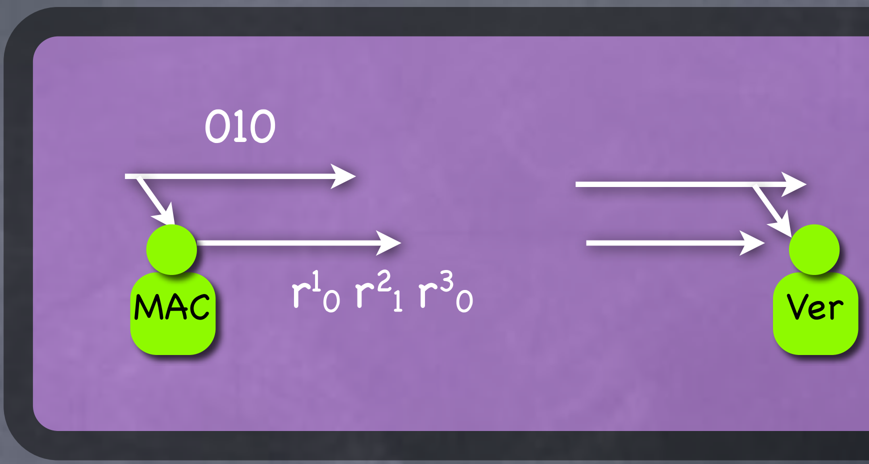

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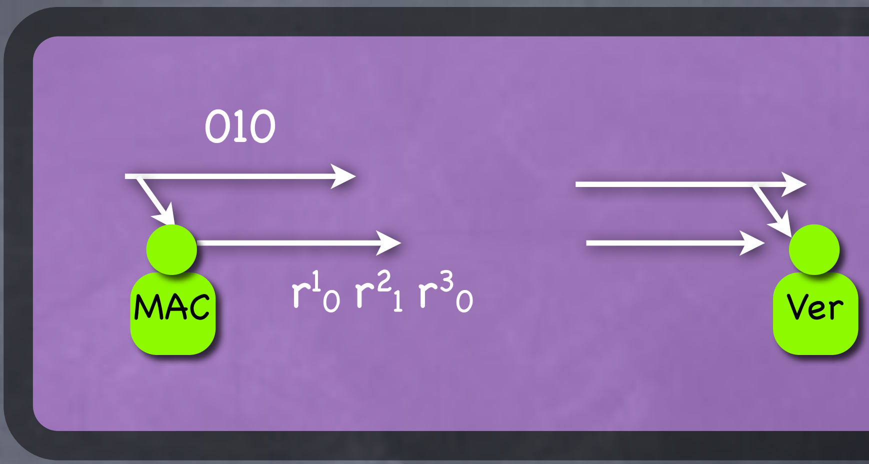

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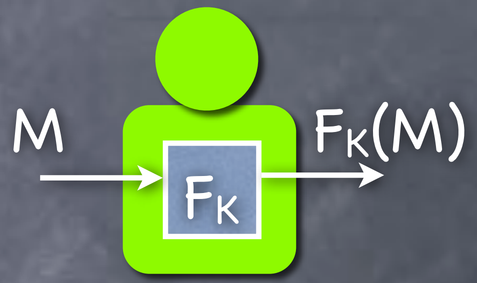

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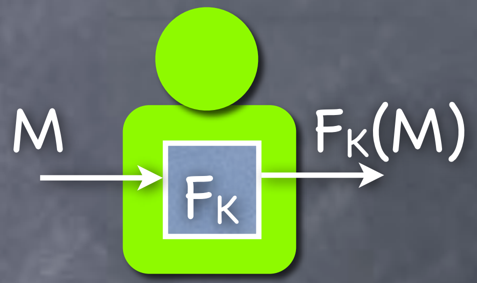

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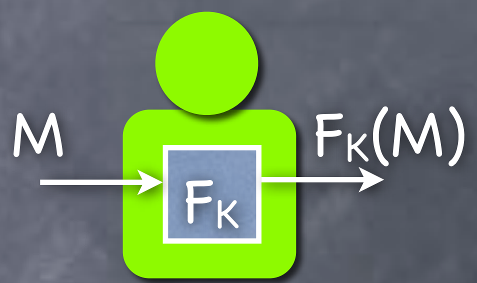

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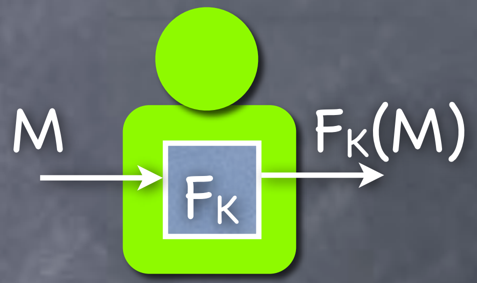

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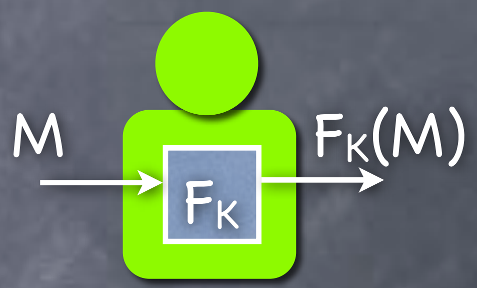

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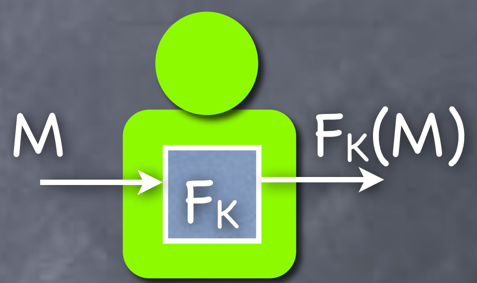

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Recall: advantage in breaking a PRF F is the diff in prob a test has of outputting 1, when given F vs. truly random R

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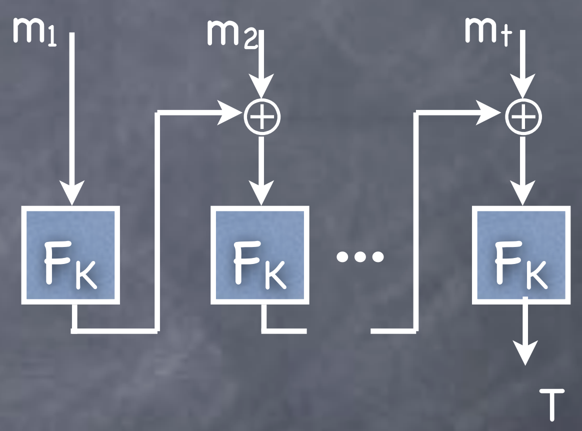

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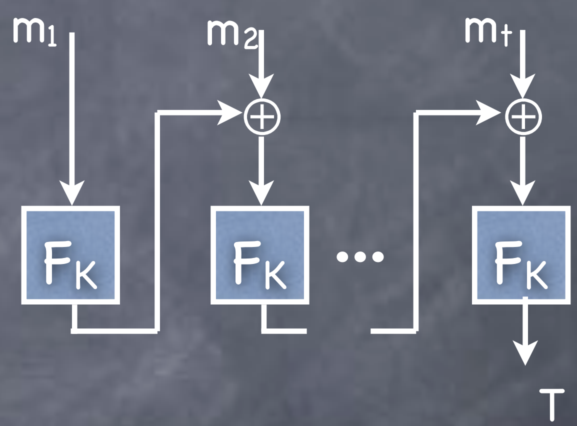

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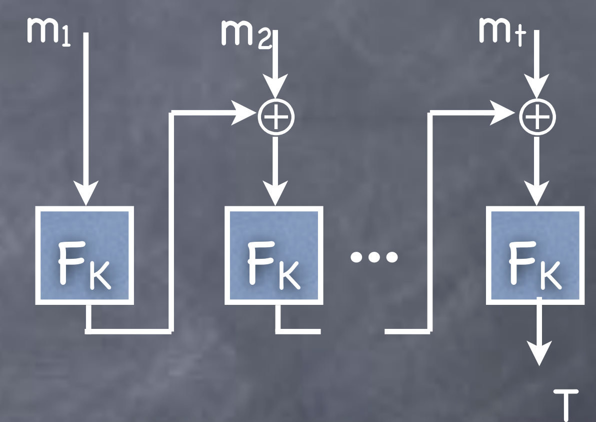

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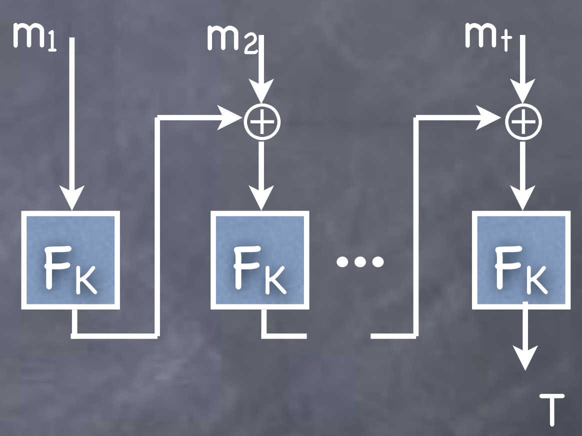

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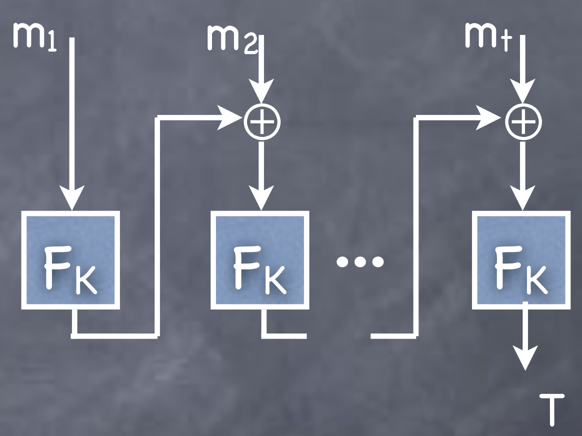

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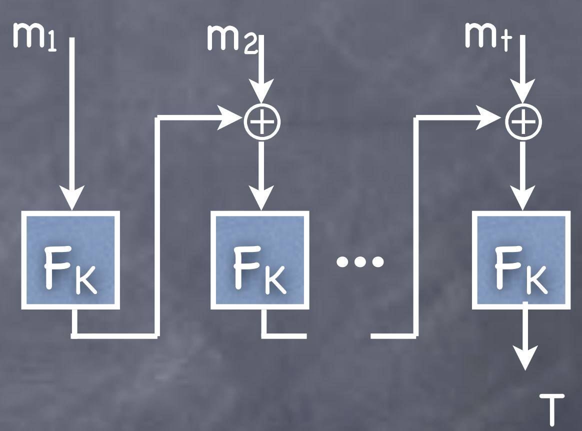

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  - Else attacks possible (by extending a previously signed message)

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- Later: Hash-based HMAC used in TLS and IPSec IETF Standard. 1997

SKE in Practice

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- NIST Standard: For multi-message encryption, use a block-cipher in CTR mode

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    - As a PRP (or at least, against key recovery)

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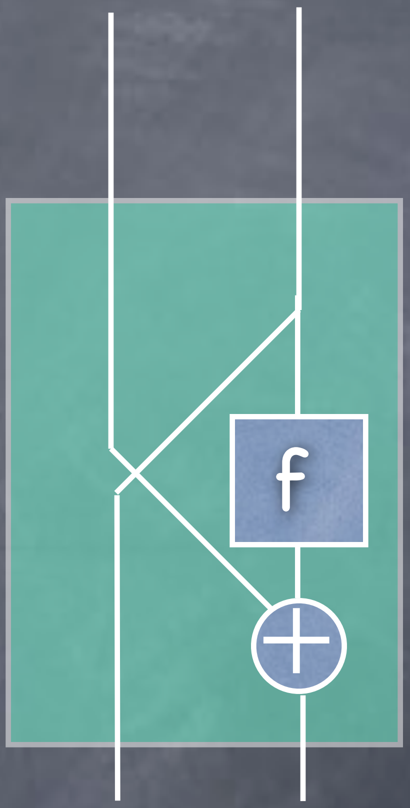

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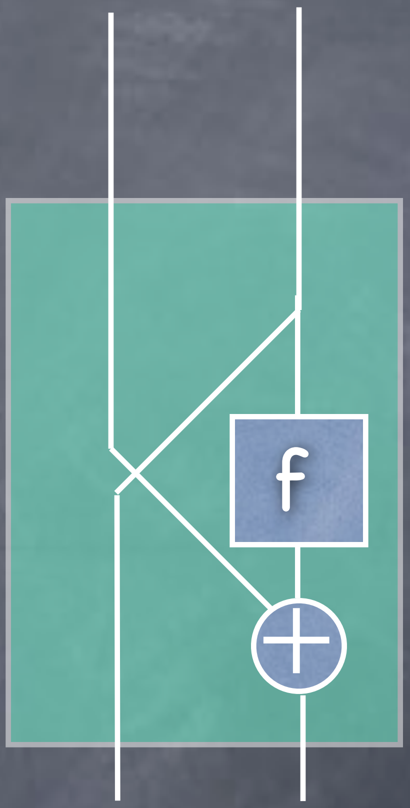
    - F_f is a permutation (Why?)



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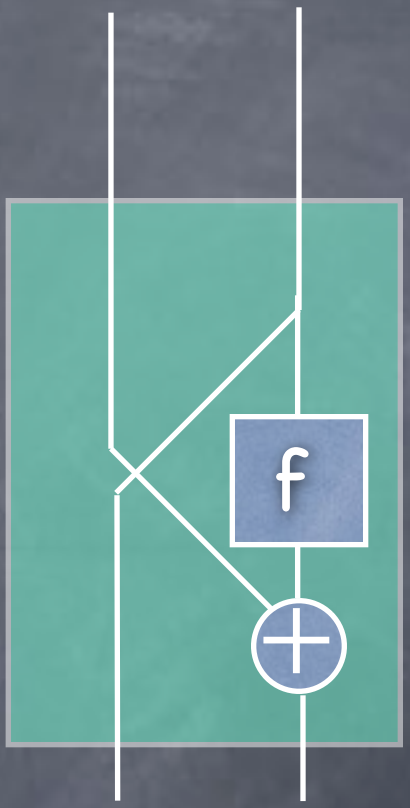
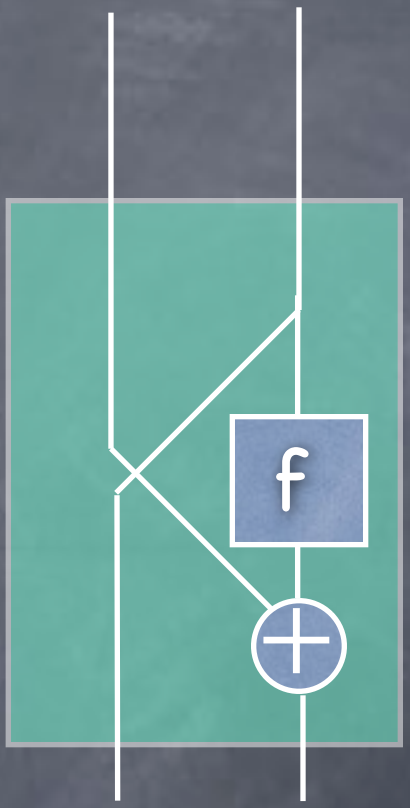


Feistel Network



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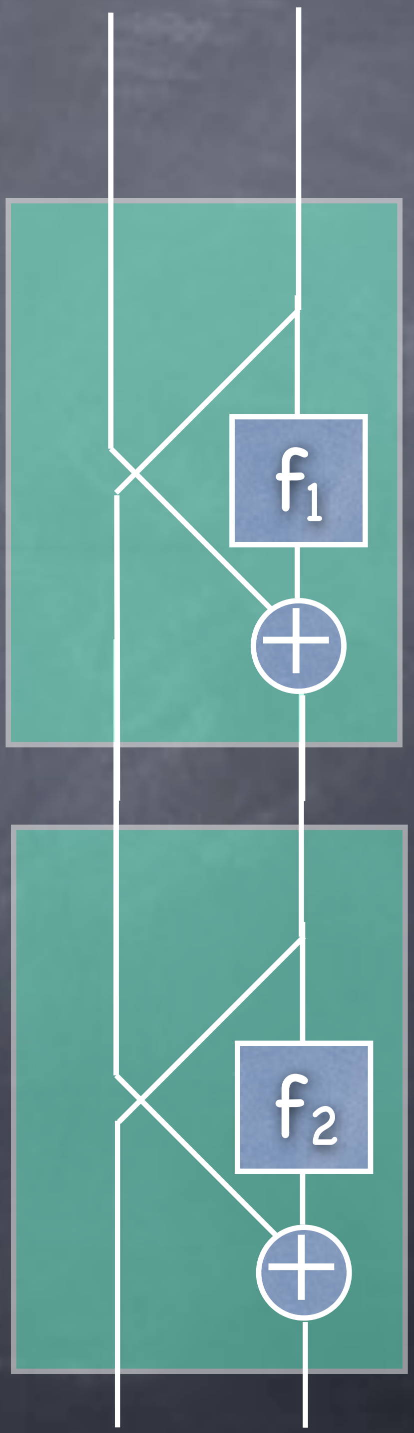

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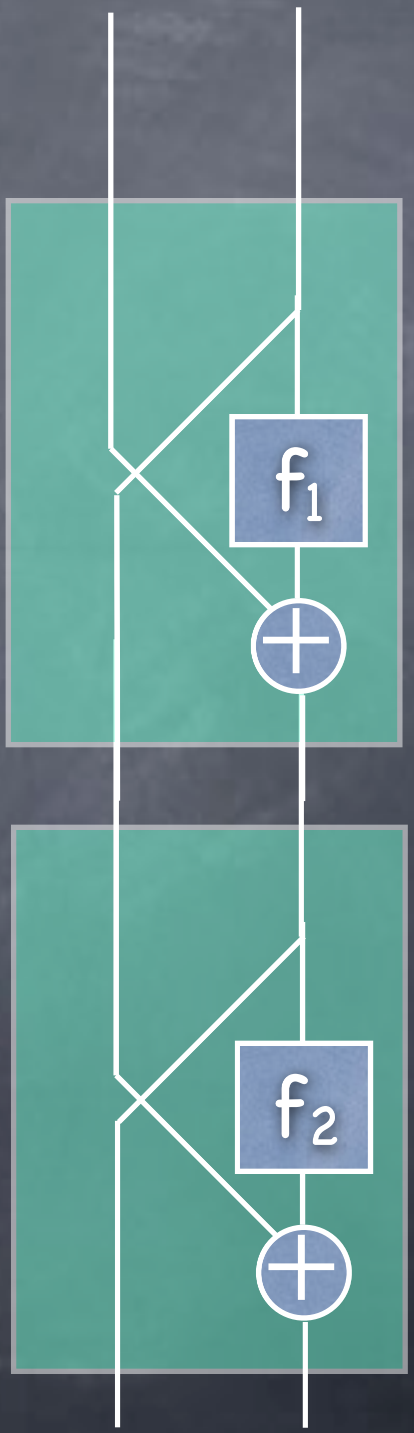

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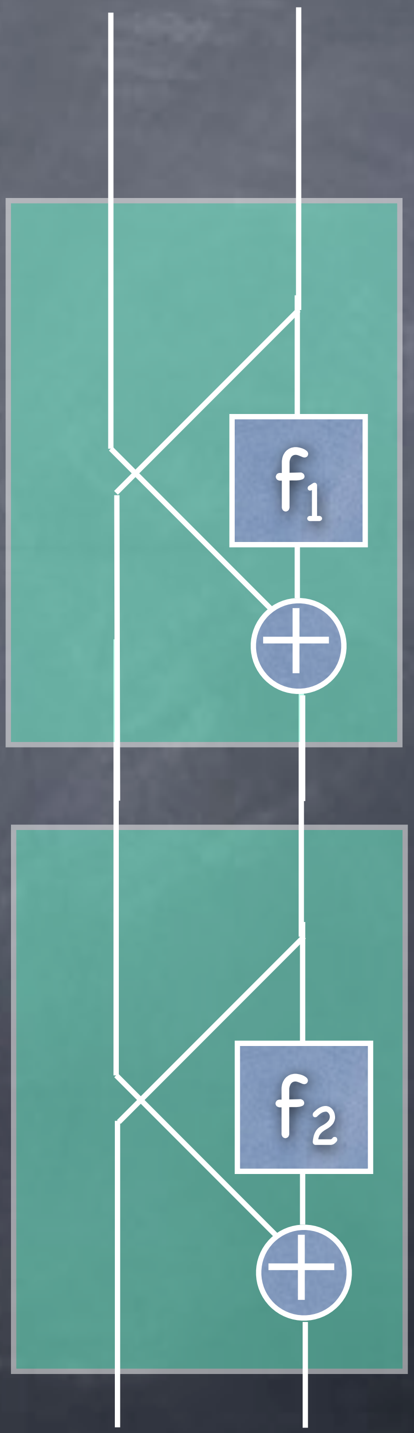

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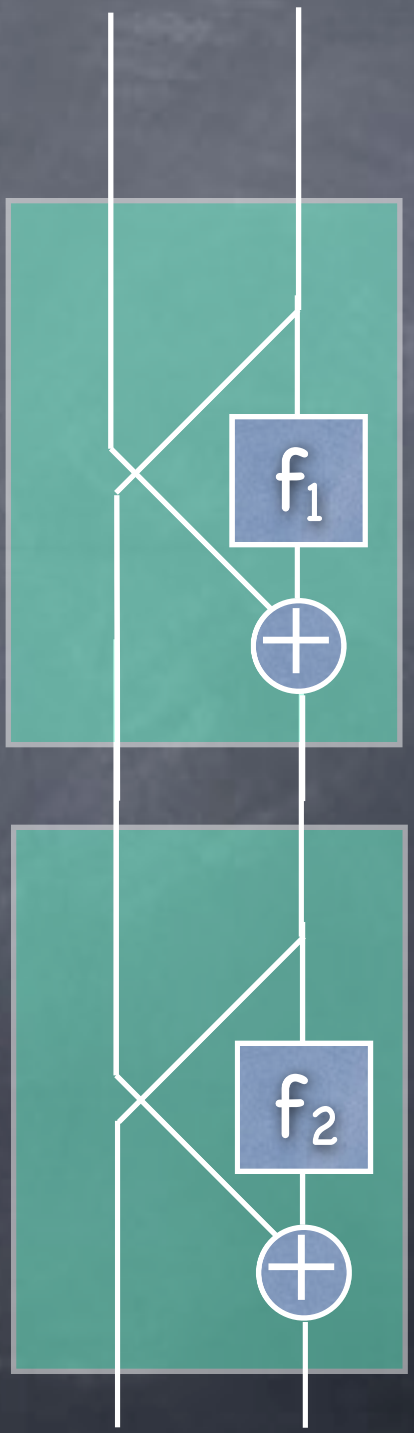
  - Fewer layers do not suffice! [Exercise]



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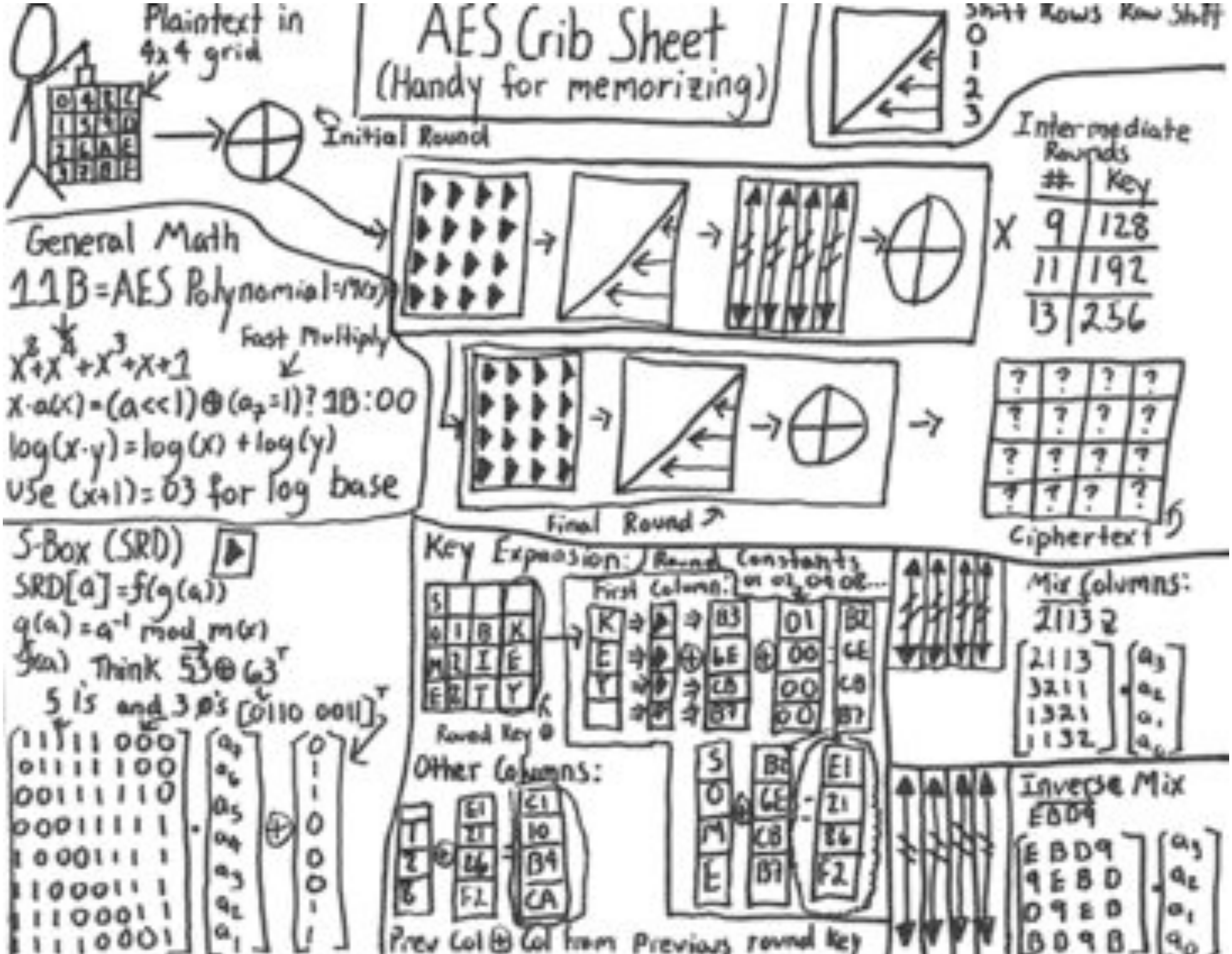

By Jeff Moser (http://www.moserware.com/2009/09/stick-figure-guide-to-advanced.html)

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  - Meet-in-the-middle, linear cryptanalysis, differential cryptanalysis, impossible differential cryptanalysis, boomerang attack, integral cryptanalysis, cube attack, ...

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  - AE with Associated Data: Allows unencrypted (but authenticated) parts of the plaintext, for headers etc.

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