Lecture 1: Introduction

Instructor: Omkant Pandey

Spring 2018 (CSE390)

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  - Online banking
  - Ordering something on Amazon
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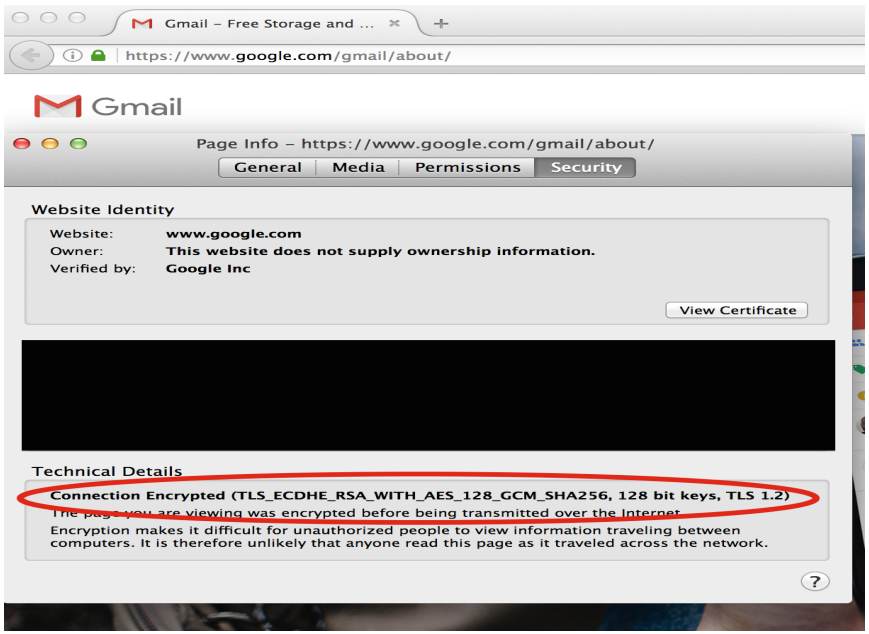

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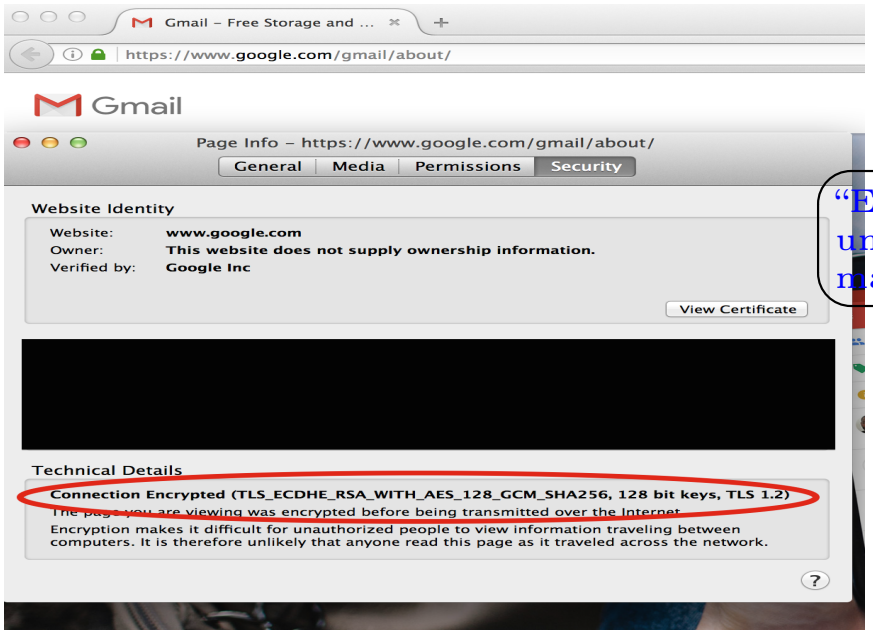
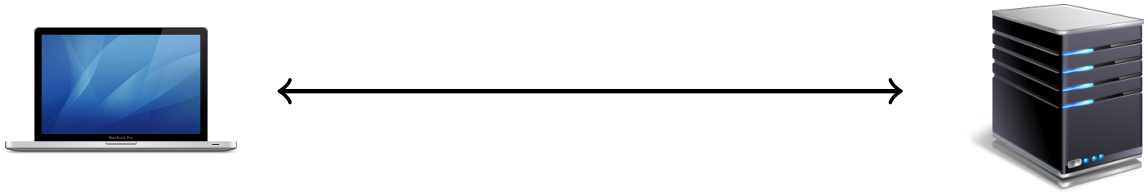


"Encryption makes it difficult for unauthorized people to view the information"

Secret Communication



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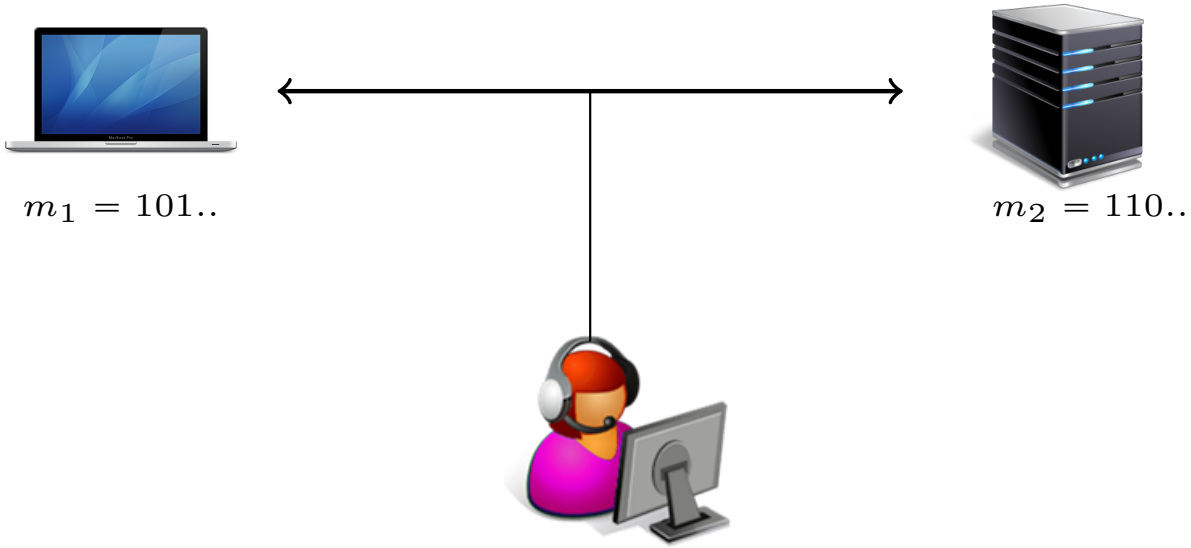

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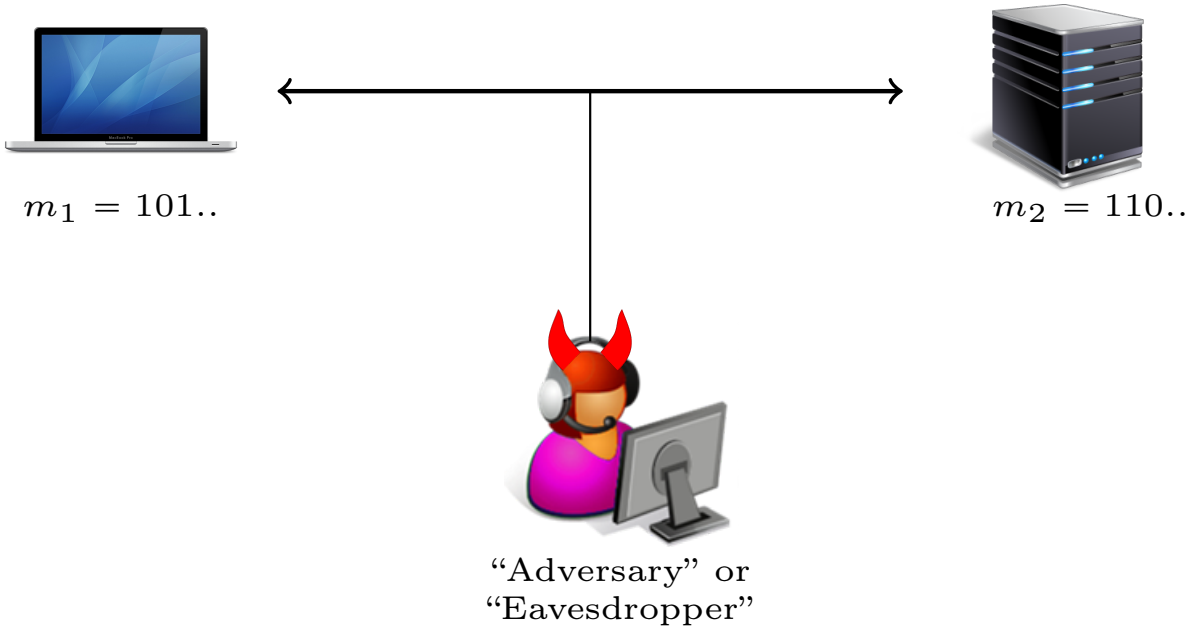

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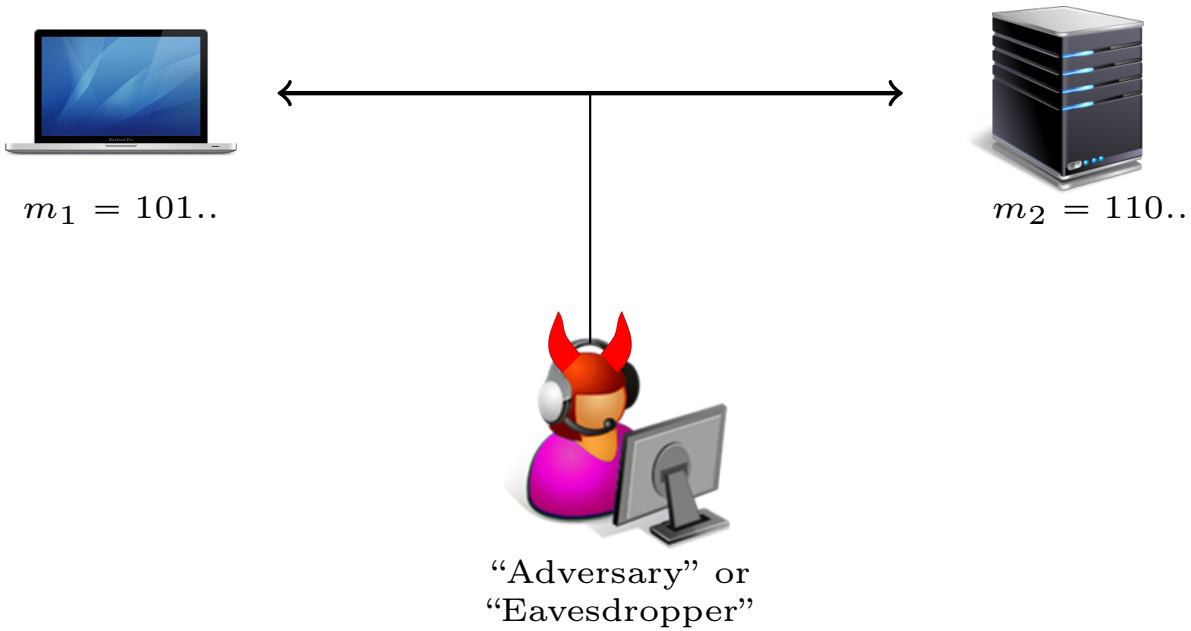

- Historically, such mechanisms are called ciphers.

Ciphers

k   k

Ciphers

k  k 

$m = 101..$

Ciphers

k 

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$E(k, m)$

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Ciphers

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$E(k, m) \rightarrow c$

 k

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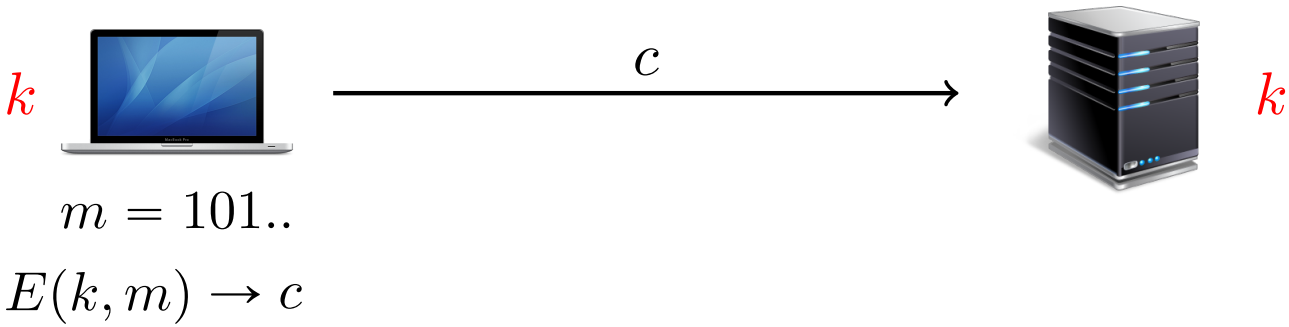

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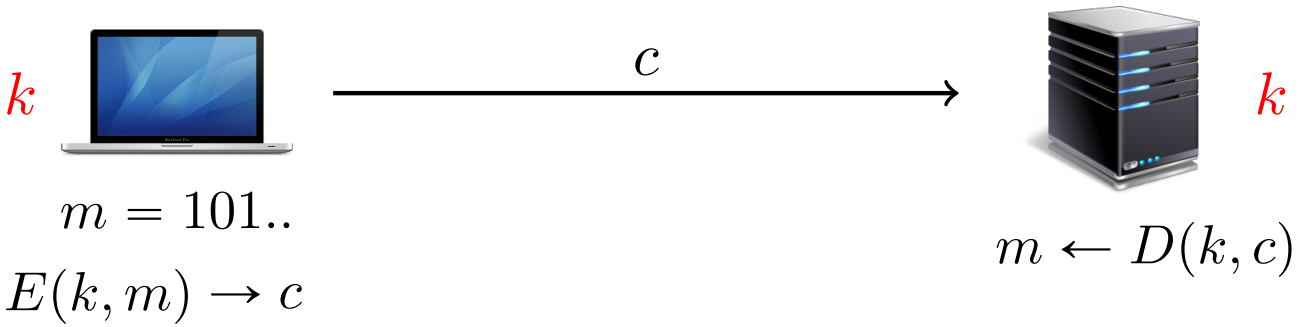

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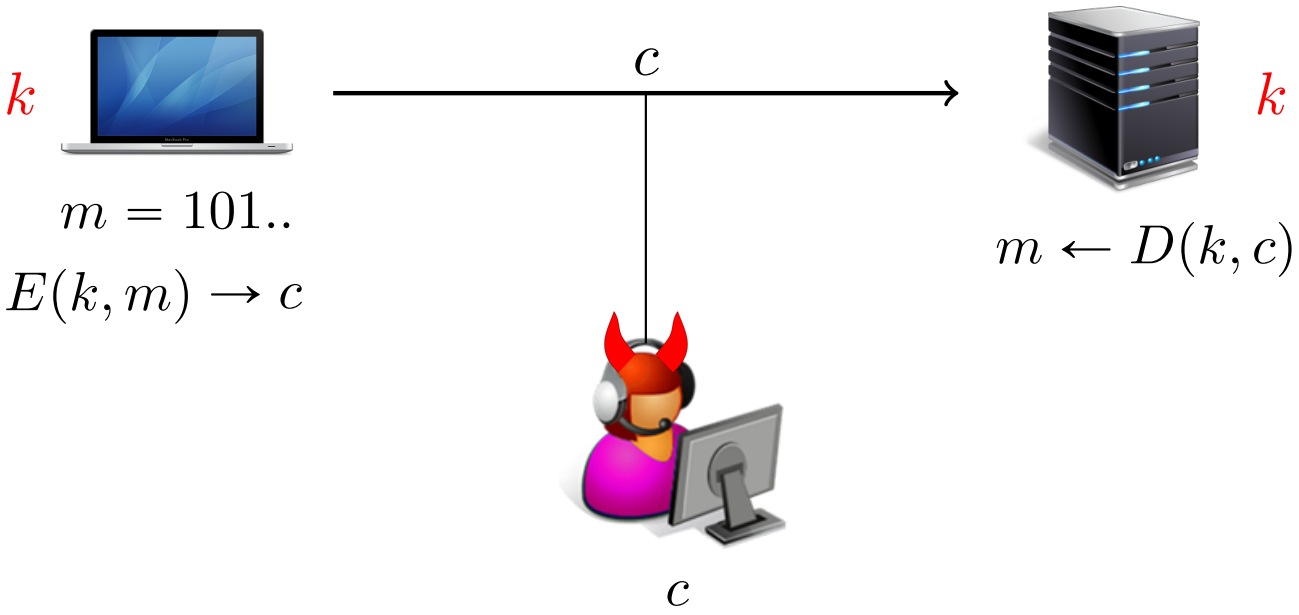

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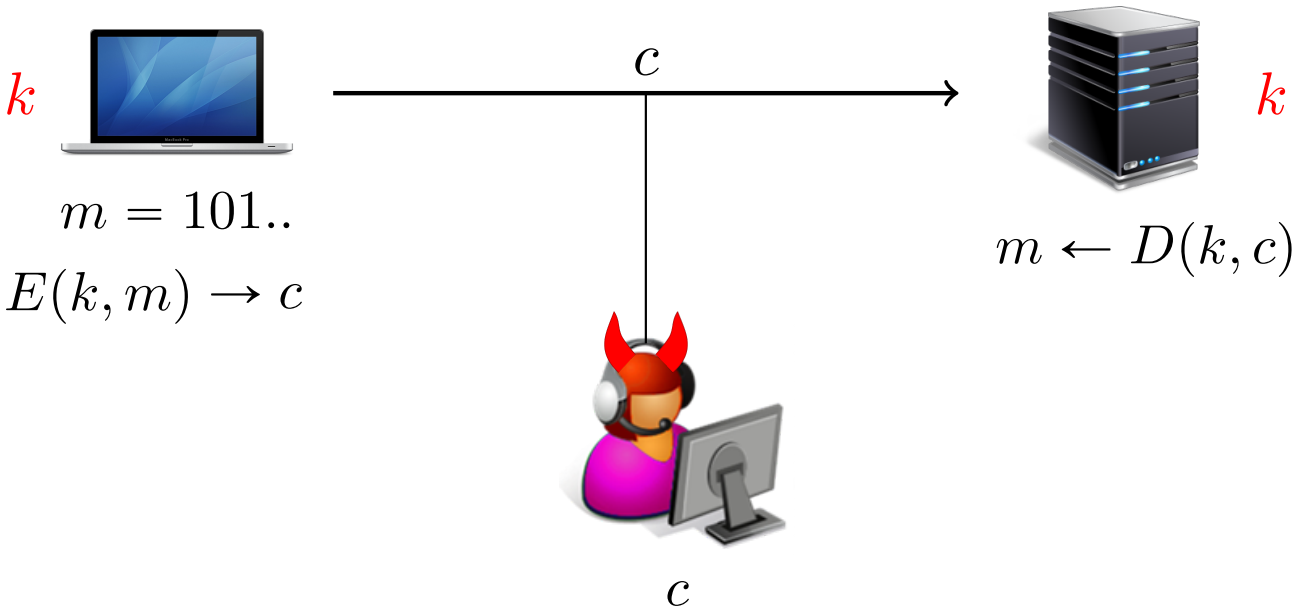

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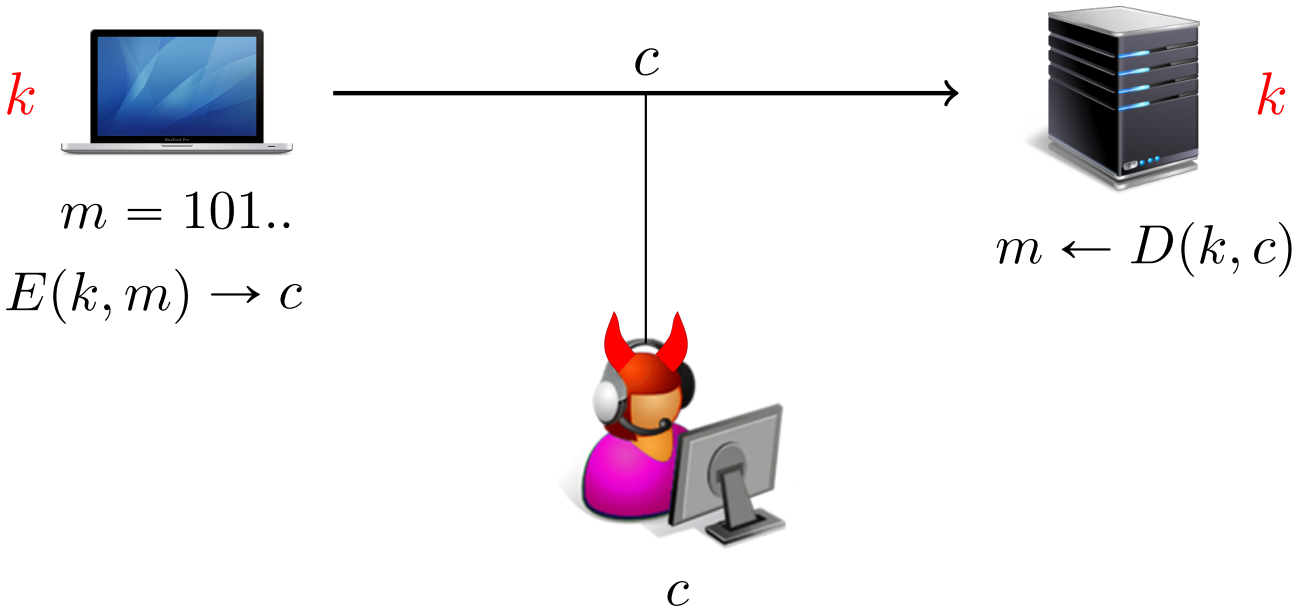

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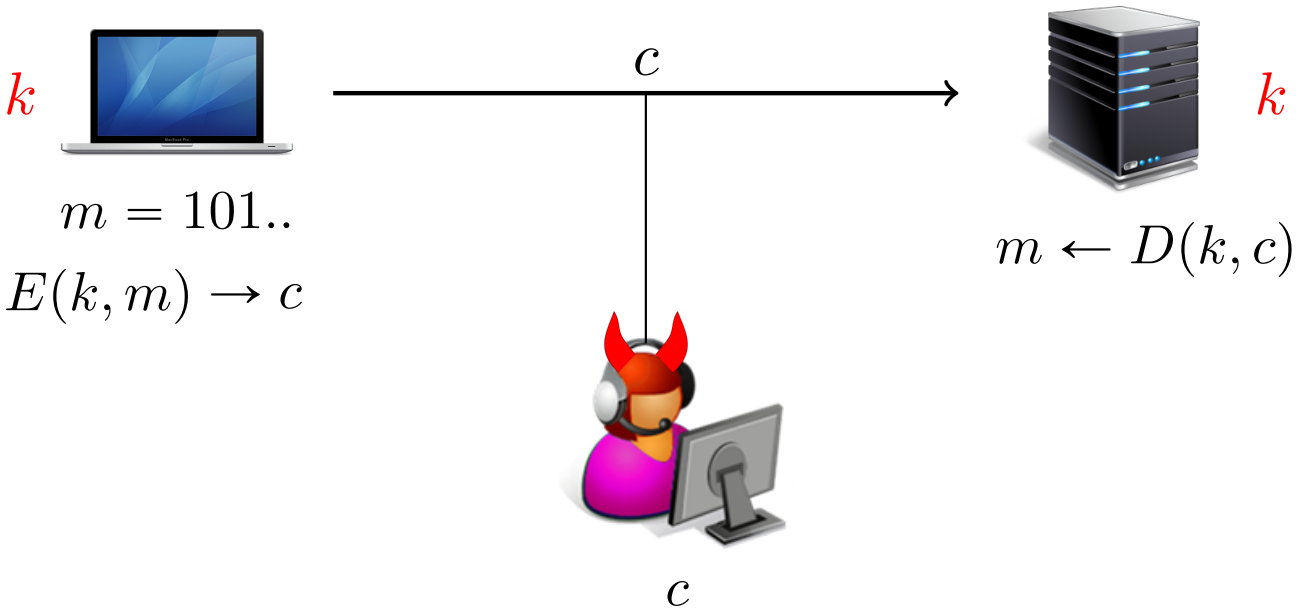

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- Symmetric Cipher: k is same for both E and D.

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...all completely broken

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- Ciphertext only attack! (worst kind)

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- Break by frequency analysis

Frequency Analysis

- Frequency of letters, bigrams, double letters in English:

Letters								
e	t	a	o	i	n	s	r	h
12.49%	9.28%	8.04%	7.64%	7.57%	7.23%	6.51%	6.28%	5.05%

Bigrams											
th	he	in	er	an	re	on	at	en	nd	ti	es
3.56%	3.08%	2.43%	2.05%	1.99%	1.85%	1.76%	1.49%	1.45%	1.35%	1.34%	1.34%

Double Letters										
ll	ss	ee	oo	tt	ff	pp	rr	mm	cc	nn
0.58%	0.41%	0.38%	0.21%	0.17%	0.15%	0.14%	0.12%	0.10%	0.08%	0.07%

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(Image courtesy Rick Wicklin: blog.sas.org)

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  - Great blogpost about this: http://norvig.com/mayzner.html

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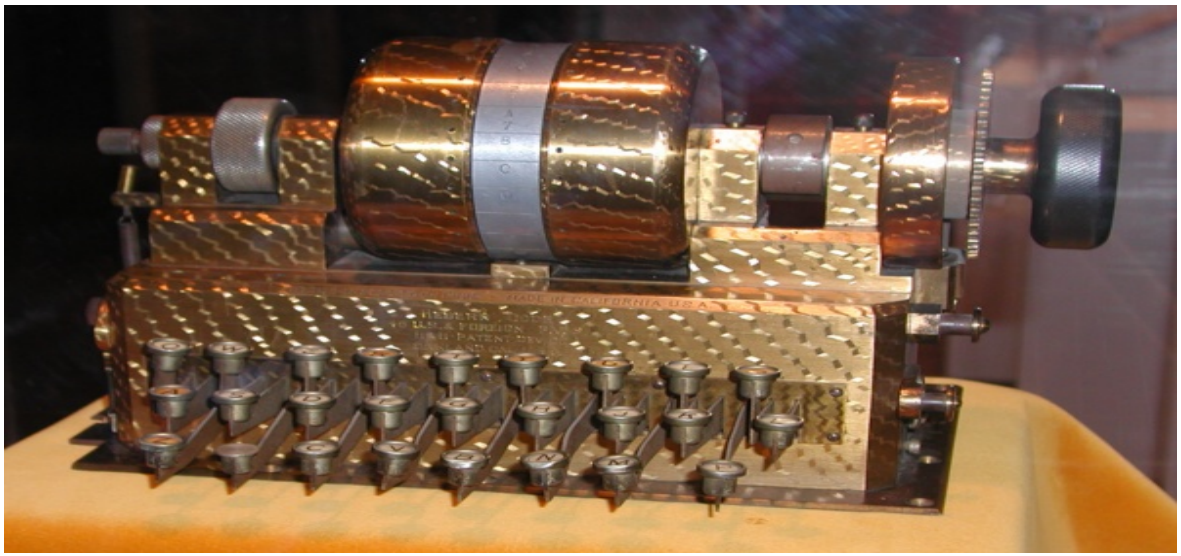
Rotor Machines

- After the typewriter, encryption based on rotor machines.



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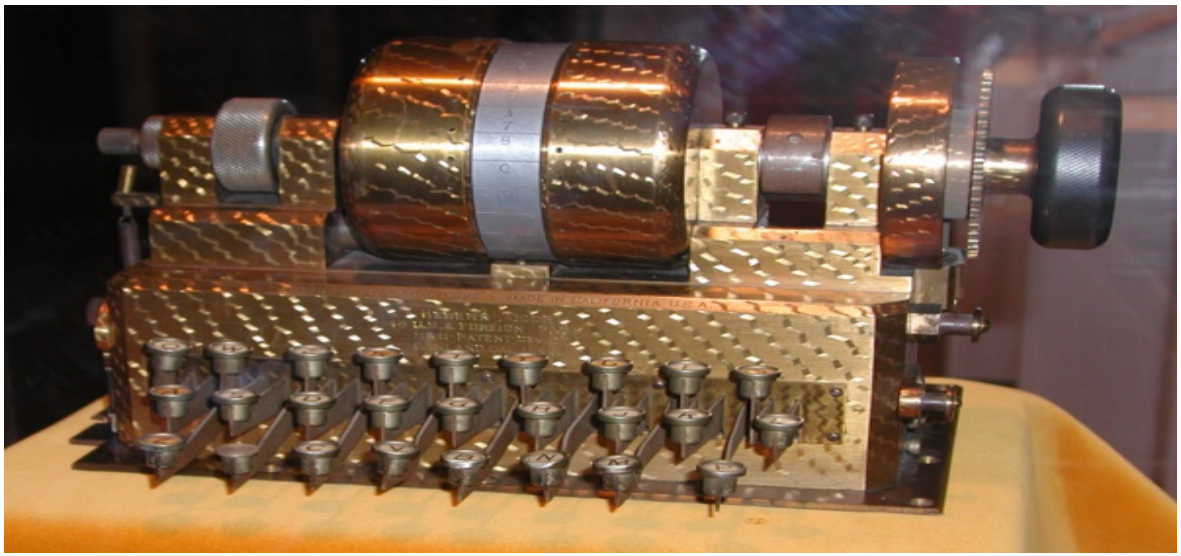

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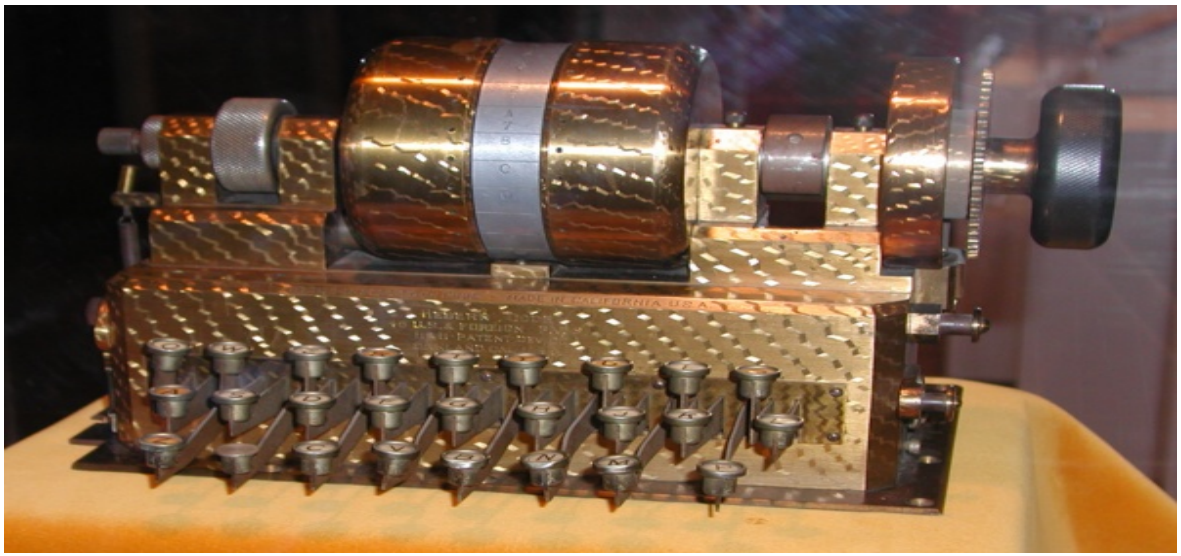

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- Rotor encodes the key
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- Rotor moves as you type, changing the key each time.
- Measure the cycle after which the key starts repeating

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Enigma with 3 rotors (Wikipedia)

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- More rotors = more keys $\approx 2^{36}$ in Enigma with 3-rotors.
- All susceptible to known cryptanalysis methods
- Friedman had several important cryptanalysis methods for Hebern.
- Further improved and highly optimized by others.
- Turing designed a machine to search for Enigma key from known ciphertexts/plaintext pairs.

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- Many other ciphers known today, e.g., Salsa, Twofish, ...

Next class

- What does it mean for a cipher to be secure?
- Shannon's treatment of perfect secrecy.