INFO 310

Fall 2016

Week 2 – Lecture 2

HOUSEKEEPING

- Attendance
- Discussion!

TODAY'S MAIN ATTRACTION…

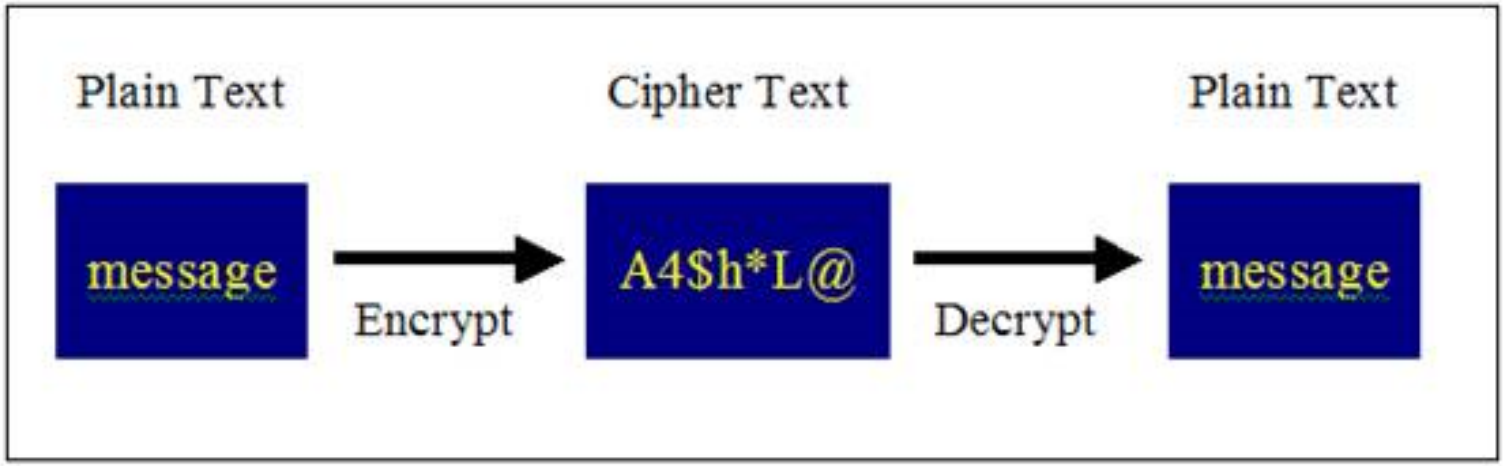
…Or more accurately: Cryptography

- Cryptography (from Greek kryptós, "hidden, secret"; and graphein, "writing“) is the practice (and study) of techniques for secure communication in the presence of adversarial third parties.
- Various aspects in information security such as data confidentiality, data integrity, authentication, and non-repudiation are central to modern cryptography.
- Modern cryptography exists at the intersection of the disciplines of mathematics, computer science, and electrical engineering.

Why Cryptography?

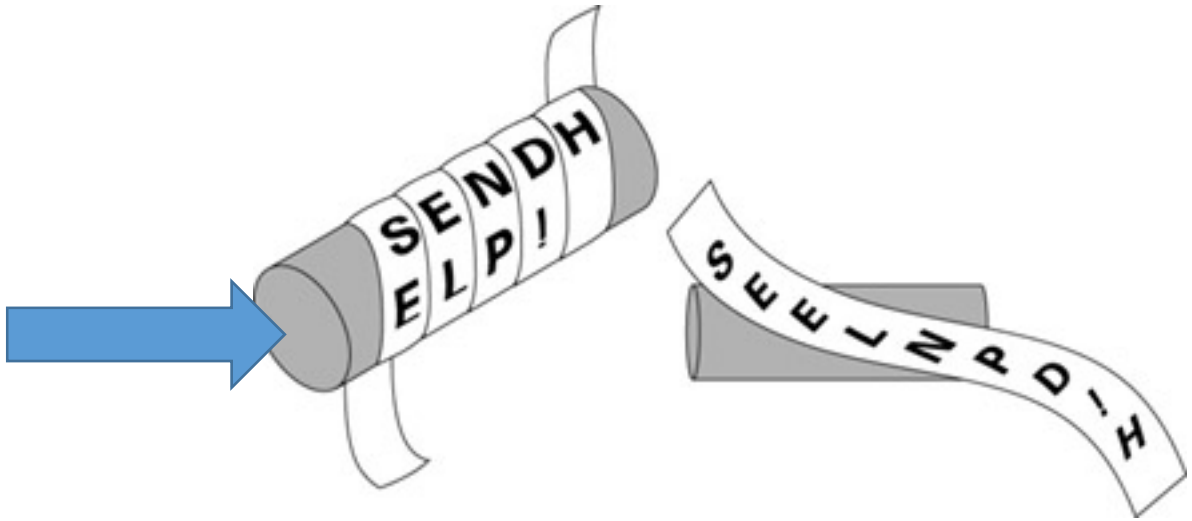
Basic Vocabulary

- Plaintext / Cleartext
- Ciphertext
- Key
- Encryption, Decryption

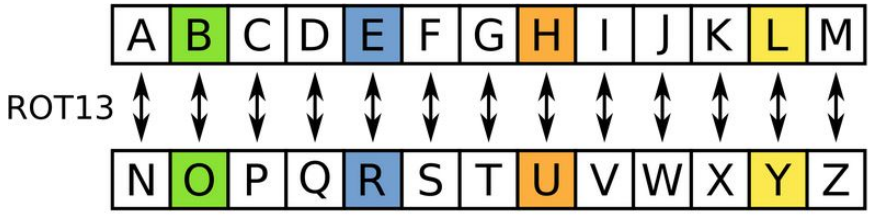


But first, a bit of history…

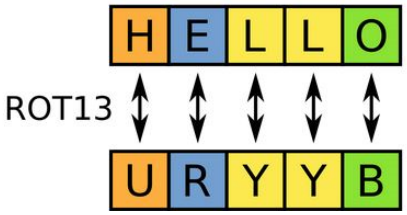
- Examples as far back as 1900 BC Egypt, 1500 BC Mesopotamia
- Scytale – Ancient Greece and Sparta – 650 BC

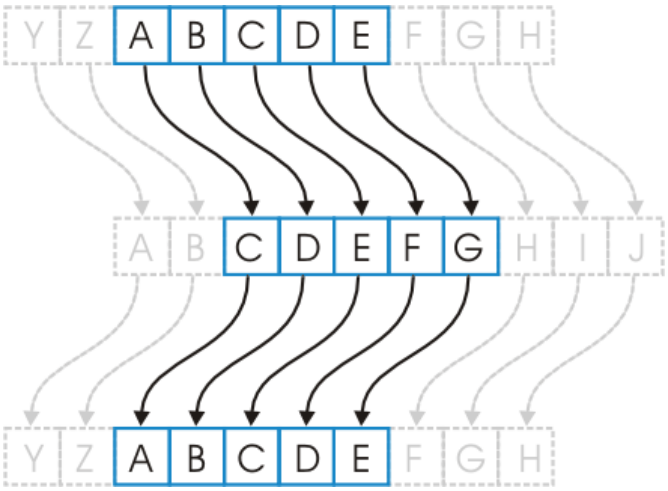


- Evidence of monoalphabetic substitution ciphers in use around 500 BC
  - ROT13



- Shift Ciphers
  - Caesar Cipher





- Polyalphabetic substitution ciphers – 15th century

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
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S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
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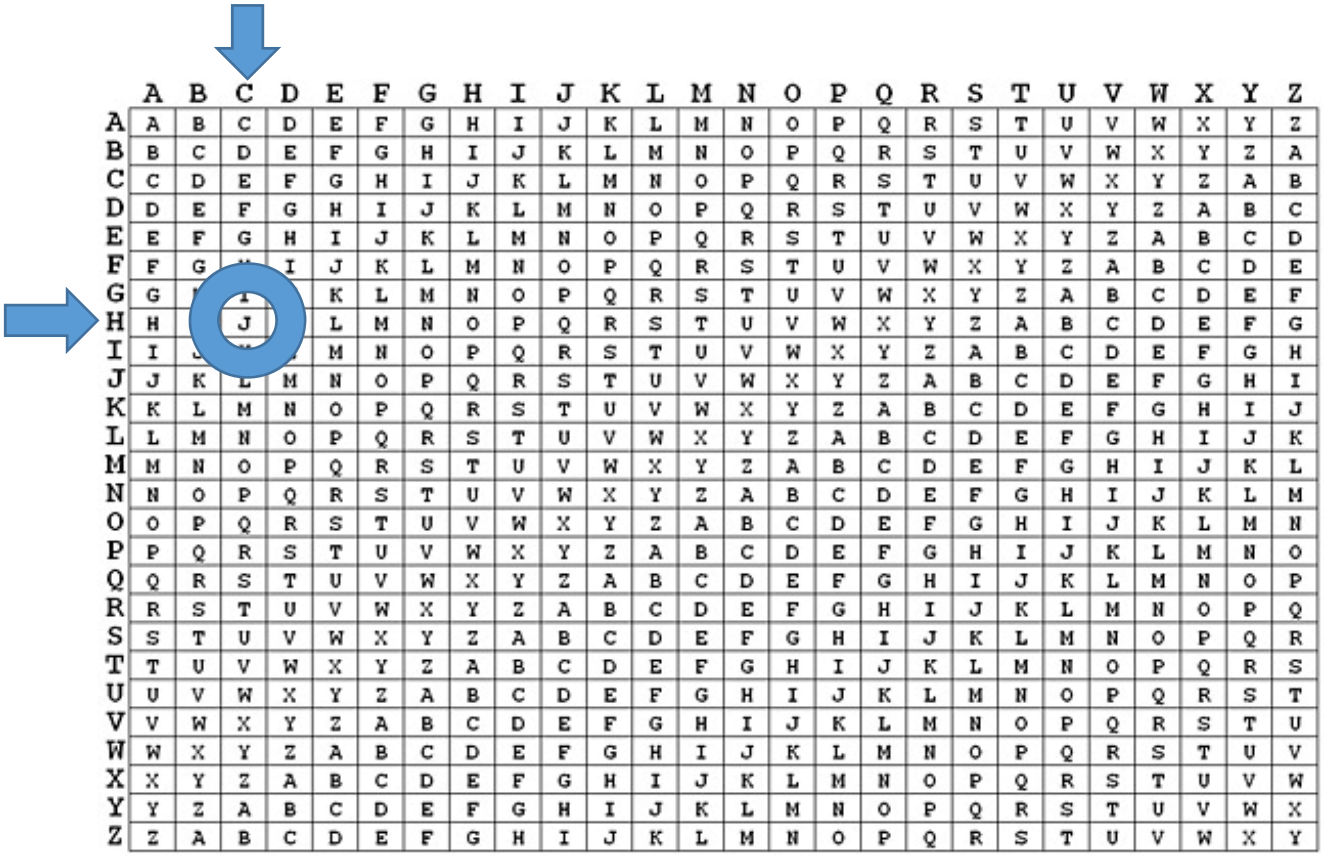
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

- Vigenere Cipher – Autokey cipher

Key: CRYPT OCRYP

Plaintext: HELLO WORLD

Ciphertext: JVJAH KQIJS



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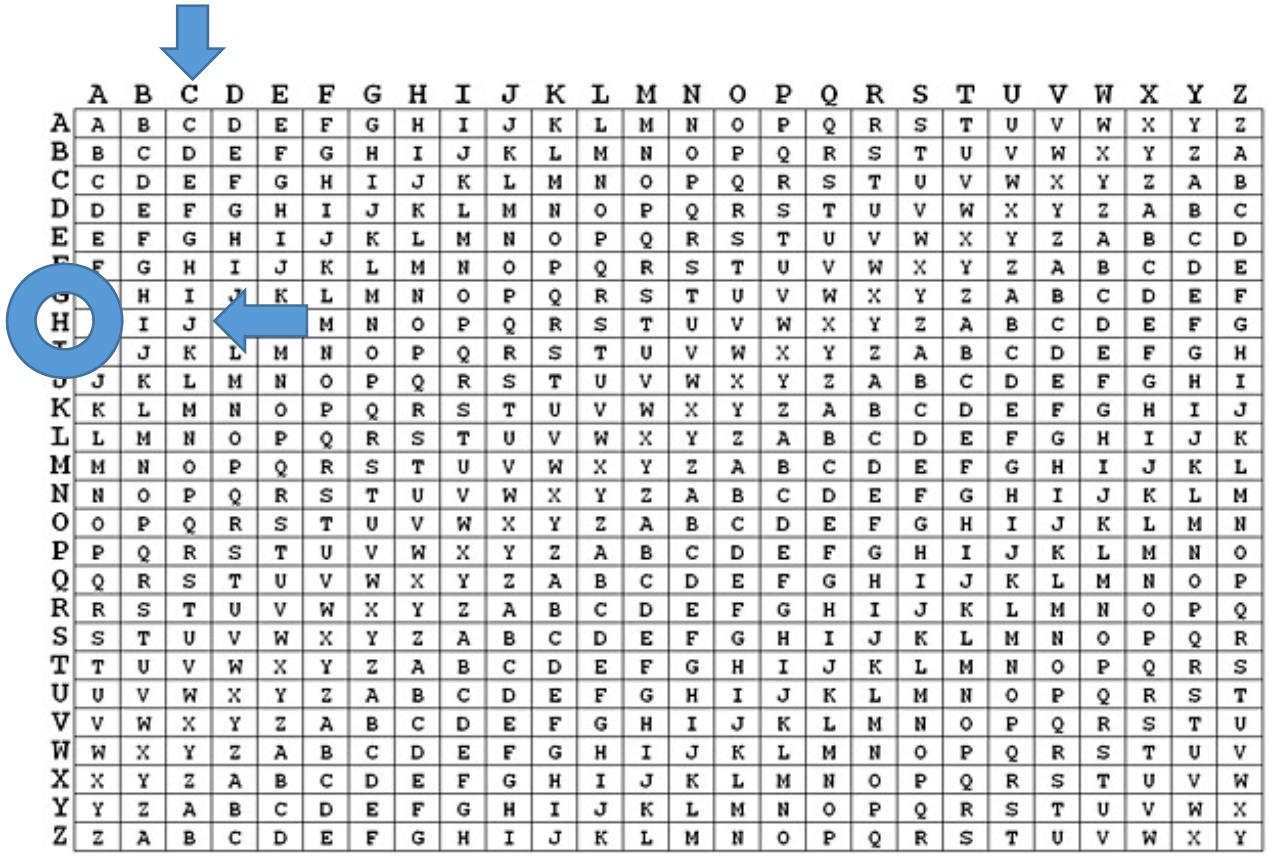

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C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
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Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Key:	CRYPT OCRYP
Ciphertext:	JVJAH KQIJS
Plaintext:	HELLO WORLD

Codes, and the Spies wo loved them

- Book ciphers
- One Time Pads (OTP)
- ENIGMA!

Types of Encryption

1. Symmetric
   - Same key used for encryption and decryption
   - Fast , Robust ciphers available
   - Sharing & protecting the key is difficult
   - Common uses: File systems, storage, fixed channel
2. Asymmetric
   - Different keys used for encryption and decryption
   - Allows for “signing”
   - Trust issues
   - Common Uses: SSL/TLS*, SSH, PGP, S/MIME
3. “Proprietary”
   - Run fast and far, or point and laugh

Let’s not forget Hashing

A mathematical function that maps data of arbitrary size to a fixed size.

- Must be irreversible to be useful
- Must be repeatable and unique
- Useful to verify message integrity, fast lookups, security

Popular hash functions

- MD5 (deprecated but still widely in use)
- SHA-1 (deprecated but still widely in use)
- SHA-256
- RIPEMD

➢A word about Rainbowtables

Hashing

HELLO WORLD

DEPRECATED!

- MD5 (128bit) 361FADF1C712E8[illegible]D198C4CAB5712A79
- SHA-1 (160bit) 4B68507F1746B0E5F3EFE99B8EF42AFEF79DA017
- SHA256
  787EC76DCAFD20C1908EB0936A12F91EDD105AB5CD7ECC2B1AE203
  2648345DFF
- SHA512
  13D6C73AC8CCEEFF9FF6B0BA2CE19C5FC47AC21F9FD403C151FE88E
  0FD39F4223C29BC9BDED59E1E3F272FD969FD6E2E6E35BE35072E74
  2C4B36FEC48FEB87DF

  - For Windows: http://sourceforge.net/projects/quickhash/

Public Key Cryptography Players

- RSA Cryptosystem
  - Ron Rivest, Adi Shamir, Leonard Adleman, 1977
- D-H Keyexchange
  - Whitfield Diffie, Martin Hellman, 1976
- PGP – Pretty Good Privacy
  - Phil Zimmerman, 1991
- GPG – GNU Privacy Guard
  - Werner Koch, 1999
- OpenPGP, RFC 4880, 2007

Public Key Cryptography
The Basics

- The concept of key pairs
- Public key vs. Private key
- Key Attributes
  - Size /Strength
  - Expiration
  - Identity
  - Fingerprint
- Key chains

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NEXT TIME…

(more crypto)