Topic 2.1 - Introduction to Cryptography

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1. Cryptography and Cryptanalysis
2. Basic Encryption Model
3. Substitution Algorithms
4. Transposition Algorithms
5. One Time Pads (OTPs)

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Cryptography

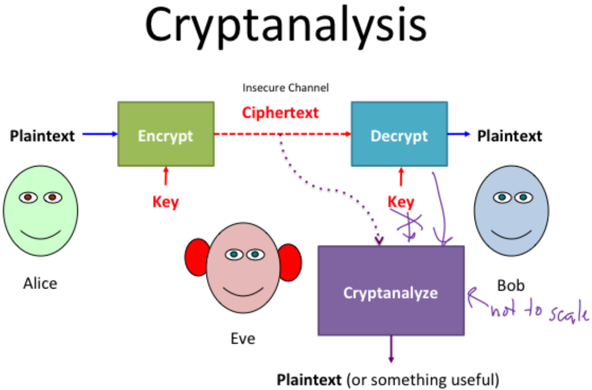
- Cryptography is the science of using mathematics to encrypt and decrypt data
- Cryptography enables you to store sensitive information or transmit it across insecure networks so that it cannot be read by anyone except the intended recipient
- Thanks to cryptography we can send messages over the internet without anyone knowing the content of the messages
- The security in cryptography must reside in the **KEYS** not in the algorithm
- The algorithm can be public, the keys private
- "Do not rely on security through obscurity"

Cryptography vocabulary

- Plaintext: Data that can be read and understood without any special measures.
- Encryption: The method of disguising plaintext in such a way as to hide its substance.
- Cipher text: Result of the encryption of the Plaintext.
- Decryption: The process of reverting cipher text to its original plaintext.
- Key: some secret piece of information

Cryptanalysis

- Cryptanalysis is the "art" of breaking ciphers



Types cryptographic algorithms

- Symmetric key cryptography: It is an encryption system where the sender and receiver of message use a single common key to encrypt and decrypt messages
- Asymmetric key cryptography: It is an encryption method where the sender and receiver of a message use 2 pair of keys, one public and one private to encrypt and decrypt messages

Encryption methodologies

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Basic encryption Model

- Confidentiality encodes the message's content
- Authentication verifies the origin of a message
- Integrity proves the contents of a message have not been changed since it was sent
- Nonrepudiation prevents senders from denying they sent the encrypted message

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Substitution I

- Substitutions are quite simple, they substitute one thing for another to encrypt plaintext into ciphertext.
- The key is the arrangement of the characters (if we're dealing with an alphabet substitution) that tells us what is exchanged for what.

Substitution II

- Consider the alphabet and a rotation cipher of 2 positions
  abcdefghijklmnopqrstuvwxyz -> cdefghijklmnopqrstuvwxyzab
- To encrypt, replace all letters in your plain text with the corresponding letter below it, as given in the box above
  eric wrote this -> gtke ytqvg vjku
- To decrypt, simply replace these letters with the corresponding ones above

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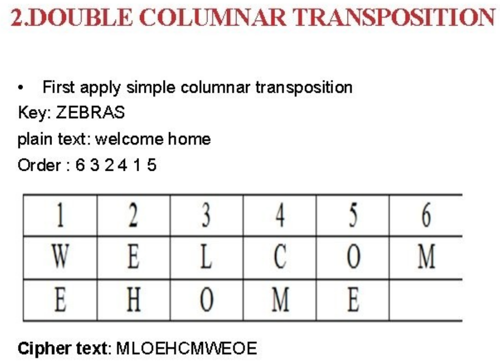
Transposition

- Transposition cipher is the name given to any encryption that involves rearranging the plain text letters in a new order



2.DOUBLE COLUMNAR TRANSPOSITION

- First apply simple columnar transposition

Key: ZEBRAS

plain text: welcome home

Order : 6 3 2 4 1 5

1	2	3	4	5	6
W	E	L	C	O	M
E	H	O	M	E	

Cipher text: MLOEHCMWEOE

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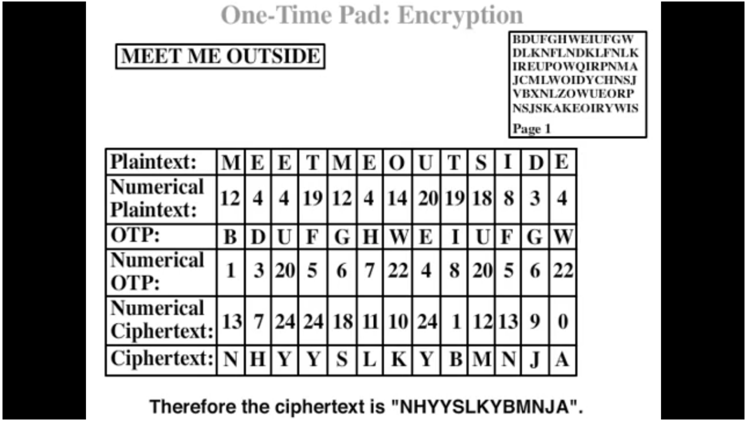
OTPs

- One-time-pad is a system that generates a unique, randomly organized key
- The one-time-use key is used to encrypt a message which is later decrypted by the recipient with the use of a one-time key
- Information encrypted with keys is unbreakable
- Each encryption is unique and shows no relation to another encryption
- The key used is known as the secret key, as they contain crucial information

Properties to be unbreakable

- The key is as long as the given message.
- The key is truly random and specially auto-generated.
- Each key should be used once and destroyed by both sender and receiver.
- There should be two copies of key: one with the sender and other with the receiver.

Example OTP



One-Time Pad: Encryption

MEET ME OUTSIDE

BDUFGHWEIUFGW
DLKNFLNDKLFNLK
IREUPOWQIRPNMA
JCMLWOIDYCHNSJ
VBXNLZOWUEORP
NSJSKAKEOIRYWIS

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Plaintext:	M	E	E	T	M	E	O	U	T	S	I	D	E
Numerical Plaintext:	12	4	4	19	12	4	14	20	19	18	8	3	4
OTP:	B	D	U	F	G	H	W	E	I	U	F	G	W
Numerical OTP:	1	3	20	5	6	7	22	4	8	20	5	6	22
Numerical Ciphertext:	13	7	24	24	18	11	10	24	1	12	13	9	0
Ciphertext:	N	H	Y	Y	S	L	K	Y	B	M	N	J	A

Therefore the ciphertext is "NHYYSLKYBMNJA".

The END!