

Introduction to Cryptography

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1 Administrivia

Announcements

Assignment

Same reading.

Choose presentation topics. Grading criteria.

From Last Time

Perl/CGI lab.

Outline

1. Basic terminology.
2. Substitution.
3. Transposition.
4. What makes a good cipher?

Coming Up

More Cryptography.

2 Basic Terminology

1. Plain text, cipher text.
2. Key.
3. Interceptor aims: block, intercept, modify, fabricate.
4. Symmetric cipher: $P = D(K, E(K, P))$.

One key. Key distribution and management issues. Private key cryptography.

5. Asymmetric cipher: $P = D(K_d, E(K_e, P))$.

Two keys: private and public. Public key cryptography.

6. Product Ciphers — application of two or more ciphers: $C = E_2(K_2, E_1(K_1, P))$.

The result is not necessarily “better.”

7. Diffusion: A plain text character has a functional impact on multiple cipher text characters.

This forces the cryptanalyst to have access to large amounts of cipher text.

8. Confusion: A cryptanalyst should not be able to predict the changes that occur when one character of the plain text is changed. (Consider a Caesar cipher.)

This property makes it harder to understand the relationship between the plain text and the cipher text.

9. Stream cipher: One plain text character is used to produce one cipher text character.

Fast; no latency.

Poor diffusion; possibly little confusion.

10. Block cipher: A block of plain text is used to produce a block of cipher text.

Slower; latency.

Excellent diffusion and confusion.

3 Substitution

1. Exchange one character for another, using a table. Many variations.
2. Simple examples: Caesar rotation, ROT13.
3. Permutation and keys. $26!$ possible permutations.

Simple permutation scheme using “tolerant” as key: toleranbcd fgh...
(Use key and follow up with remaining letters.)

4. One time pad. Components:

(a) A set of n permutations.

(b) An infinite string of random numbers, modulo n .

For each plaintext character, use the next random number to select the permutation to apply.

Keeping the pads in synch.

5. Other methods: Vernam cipher, book cipher.

4 Transposition

1. Columnar technique.
2. Re-arrange the plaintext characters.
3. Primitive example: Pig Latin.

4. General idea:

- (a) Construct a matrix with n columns.
- (b) Length of plain text should be cn . If not, pad out.
- (c) Write plain text across rows of matrix.
- (d) Read cipher text across columns of matrix.

5 What Makes a Good Cipher?

1. According to Shannon:

- (a) Amount of secrecy should be proportional to amount of labor.
- (b) Keys, algorithms should be free from complexity.
- (c) Implementation process should be KISS.
- (d) Error in encrypting should not propagate.
- (e) Length of cipher text should match length of plain text.

2. “Trustworthy” encryption:

- (a) Based on sound mathematics.
- (b) Analyzed by experts and found to be sound.
- (c) Has withstood the “test of time.”