

**MATH 195: CRYPTOGRAPHY
HOMEWORK #2**

Problem 2.7. *A disadvantage of the general monoalphabetic cipher is that both sender and receiver must commit the permuted cipher sequence to memory. A common technique for avoiding this is to use a keyword from which the cipher sequence can be generated. For example, using the keyword CIPHER, write out the keyword followed by unused letters in normal order and match this against the plaintext letters:*

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

If it is felt that this process does not produce sufficient mixing, write the remaining letters on successive lines and then generate the sequence by reading down the columns:

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

This yields the sequence:

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

Such a system is used in the example in Section 2.3:

UZQSOVUOHXMOPVGPOZPEVSGZWSZOPFPESXUDBMETSXAIZ
itwasdisclosedyesterdaythatseveralinformalbut

VUEPHZHMZSHZOWSFPAPPDTSVPPQZWYMXUZUHSX
directcontactshavebeenmadewithpolitical

EPYEPDPDZSZUFPOMBZWPFPUPZHMDJUDTMOHMQ
representativesofthevietconginnoscow

Determine the keyword.

Problem 2.8. *How many possible keys does a Playfair cipher have? Express your answer as an approximate power of 2.*

Problem 2.9. *We have shown that the Hill cipher succumbs to a known plaintext attack if sufficient plaintext-ciphertext pairs are provided. It is even easier to solve the Hill cipher if a chosen plaintext attack can be mounted. Describe such an attack.*

Date: February 5, 2002.
2.7–2.10.

Problem 2.10. *Let S be a (finite) set and $f : S \rightarrow S$ a bijective map. Show that there are maps $g, h : S \rightarrow S$ such that $f = g \circ h$ and $g^2 = h^2 = \text{id}_S$.*