BILL, RECORD LECTURE!!!!

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PIN Numbers

September 27, 2020

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1	1234	10.713%
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13	5555	0.395%
14	6666	0.391%
15	1122	0.366%
16	1313	0.304%
17	8888	0.303%
18	4321	0.293%
19	2001	0.290%
20	1010	0.285%

Was our number in spots 11-20? Raise hands.

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Least common PIN when article was written was 8068. So use? Could not find when article was written—author uses year as PIN?

Other Ciphers That Were Actually Used

September 27, 2020

The Playfair Cipher

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The Playfair Cipher: The Motivation

Let
$$\Sigma = \{a, \dots, z\}$$

Recall:

- 1. The cipher that picks a RANDOM bijection from Σ^2 to Σ^2 was never used since there was never a time when it was usable by AND hard to crack.
- 2. The 2 × 2 matrix cipher was a way to get a *random looking* function (maybe) that was EASY for Alice and Bob to compute. But alas, its very use of math made it crackable.
- 3. We need another way to EASILY specify a bijection Σ^2 to Σ^2 .

The Playfair Cipher: The Key

We use $\Sigma = \{a, \dots, z\} - \{j\}$. Need a square. If need to use j use an i.

Key is a word or phrase. Delete all repeats from it. We will use Bill Gasarch which becomes BILGASRCH. Use the key to start a 5×5 array of all of the letters

В	ı	L	G	Α
S	R	С	Н	D
Е	F	K	М	N
0	Р	Q	Т	U
V	W	Χ	Υ	Z

The Playfair Cipher: The First Case

В	I	L	G	Α
S	R	С	Н	D
Е	F	K	М	N
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V	W	Χ	Υ	Z

Given a pair, what do you map it to? Start by finding the pair in the grid.

1) If the pair are NOT in the same row or column then look at rectangle formed and take other corners. EXAMPLE: Map RA:

I	L	G	Α
R	С	Н	D

RA maps to *ID*.

The Playfair Cipher: The Second and Third Cases

В	I	L	G	Α
S	R	С	Н	D
Е	F	K	М	N
0	Р	Q	Т	U
V	W	Х	Υ	Z

2) If pair is in SAME col then map down 1 (wrap around)

3) If pair is in SAME row then map right (wrap around).

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What do do about the double letters oo?

What if message is **'Problems with a point' is a great book**. What do do about the double letters **oo**? Before coding put an *x* after the first letter of a double letter: **'Problems with a point' is a great boxok**

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What if the message has an odd number of letters?

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What if the message has an odd number of letters? Add an x to the end.

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 - **P:** I will demonstrate its ease of use by teaching it to 3 elementary school boys in less than an hour.
 - Officer: That may be, but I think diplomats would have a hard time with it.
 - **P:** That is a problem with the diplomats, not with the cipher.

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- 2. Was used in WW II in the Pacific by the Americans. Was used to rescue JFK when the PT 109 sank.

The Rail Fence Cipher

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Discuss

Write each row: MNAAIASTRIA

How would you describe this cipher in modern terminology?

Discuss

In current case of 3 rows and message of length 11 we did

Key is 3. Message is Marina is a TA.

Write it in three rows as such:

Write each row: MNAAIASTRIA

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Third list out letters in positions $\equiv 3 \pmod{4}$).

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Leave as an exercise what happens if k rows, n letter message.

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- 4. We do believe Kerckhoff's Principle.

The Autokey Cipher

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- 1. There is a key, a short word or phrase. We'll use Metz .
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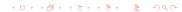
- 1. Encode (j,o,e,b) by shifting by (12, 4, 19, 25).
- 2. Encode

$$(i, d, e, n, i, s, r, u, n, n, i, n, g)$$

by the shift induced by

$$(j, o, e, b, i, d, e, n, i, s, r, u, n)$$

To Decode will need to do this four letters at a time.



AutoKey Pros and Cons

PROS: The techniques for cracking Vig do not work.

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CON: Complicated to use (more on that next slide).

Question: How would you crack it?

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Similar to Book Cipher in that the key and the message are **both** in English so can use freq somewhat.

If guess the key word then rest is EASY!

Autokey History

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- 2. People found it hard to use so they simplified it into what we now call the Vig cipher.

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That could be why Playfair was not cracked! Unless it was.



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- 4. Bob has same book so can decode.

Security Known to be crackable, but won't go into that here.

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