



Cryptic Challenge

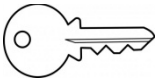
St. Paul's Catholic School, Milton Keynes
27th November 2014

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Department of Mathematics and Statistics
The Open University, Milton Keynes

What is cryptography?



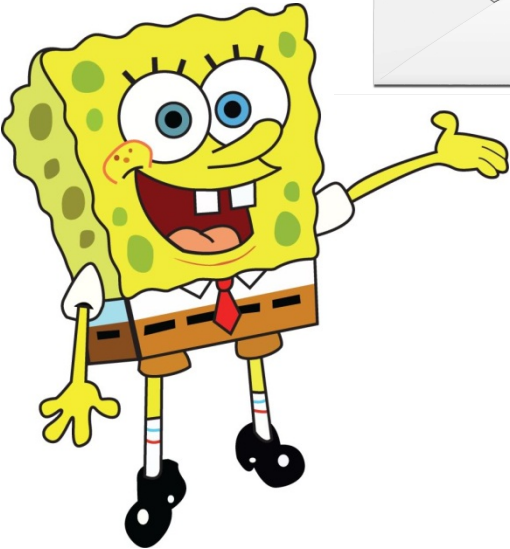
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encrypt



decrypt



Bob



Alice

Bletchley Park

Milton Keynes



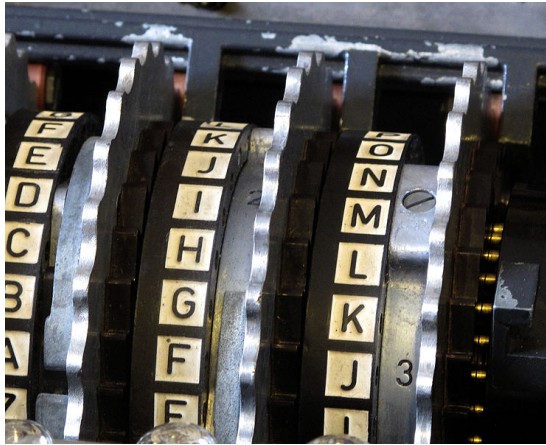
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Enigma



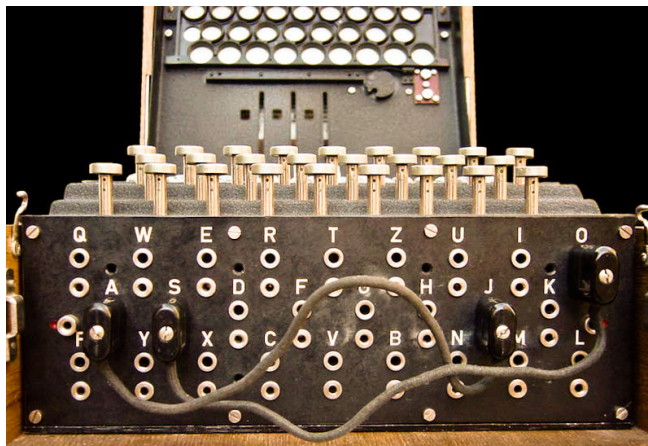
158,962,555,217,826,360,000 configurations!



Choose 3 rotors out of a set of 5, 60 possibilities.

Each rotor has 26 positions, one for each letter.

Connect 10 pairs of letters in the plugboard.



Alan Turing

Wilmslow (Cheshire), 1912 – 1954



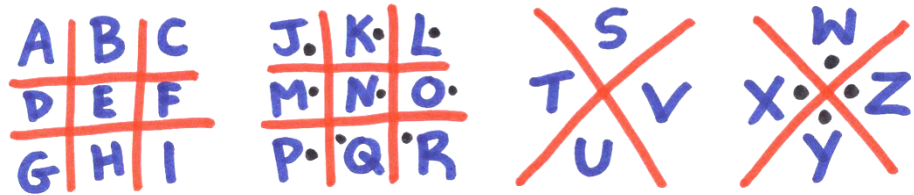
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Starter activity



Crack the cypher to find out what we'll do today



A=J B=L C=L M=J U=^ etc.

□□L□□□ □□VVJ□□V
^V□□□ □□□□□□>
L□□□□V

Starter activity

Crack the cypher to find out what we'll do today



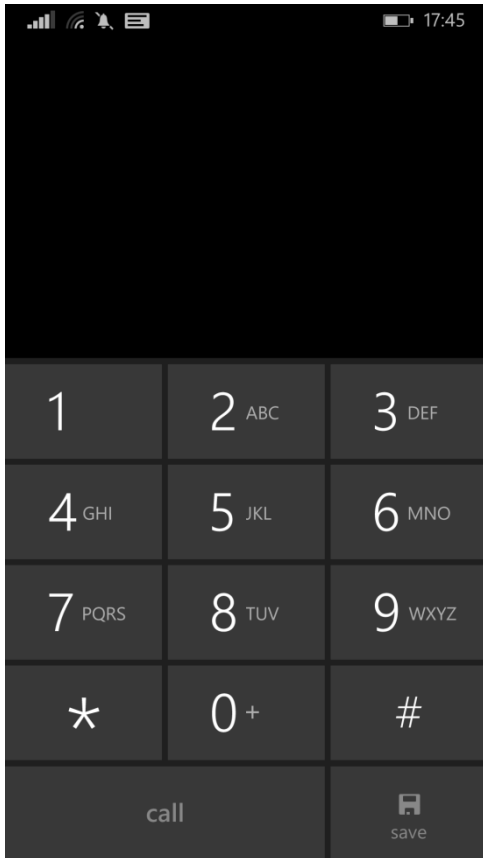
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By the end of this session you will be able to:

Decode messages using
different cyphers.

Challenge 1

The texting challenge



Examples

927 = WAS/WAR

2628 = BOAT/COAT

4483 = GIVE/HIVE

Challenge 1

The texting challenge



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Challenge 1: Decode the message

"9428 36 968 2255
2 74337 9484 66
5347?"

"2 25683!"

Challenge 1

The texting challenge



Challenge 1: The message says...

"What do you call
a sheep with no
legs?"

"A cloud!"

Challenge 2



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The transposition challenge

We want to encrypt the message

“We are at St Paul’s Catholic School”

First remove all punctuation and spaces

weareatstpaulscatholicschool

There are 28 letters. How can we factorise 28?

$$28 = 2 \times 14 = 4 \times 7$$

We’ll choose 4×7

Challenge 2



The transposition challenge

We write our message in a 4×7 grid going along the rows

w	e	a	r
e	a	t	s
t	p	a	u
l	s	c	a
t	h	o	l
i	c	s	c
h	o	o	l

We read off the coded message going down the columns

`"wetltiheapshcoatacosorsualcl"`

Challenge 2



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The transposition challenge

Suppose we want to decode the message

`"ckatsoenaadekifepdlesbesr"`

We need to put the text back into the grid. But how big should the grid be?

The message is 25 letters long. There is only one factorisation of 25, 5×5 .

Now we can crack the cypher!

Challenge 2

The transposition challenge



This time we write the message going down the columns

c	o	d	e	s
k	e	e	p	b
a	n	k	d	e
t	a	i	l	s
s	a	f	e	r

Then we read off the message going along the rows

`"Codes keep bank details safe"`

Challenge 2

The transposition challenge



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Challenge 2: Decode the message

`"trmsimhlatsledld1
owslo5nosegcg"`

Hint: You might have to try different grids!

Challenge 2

The transposition challenge



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Challenge 2: The message says...

"The world's
smallest dog is
15cm long"

Challenge 3

The binary challenge



Computers code messages in the binary language.

A = 1 = 00001

H = 8 = 01000

B = 2 = 00010

I = 9 = 01001

C = 3 = 00011

J = 10 = 01010

D = 4 = 00100

K = 11 = 01011

E = 5 = 00101

L = 12 = ?

F = 6 = 00110

M = 13 = ?

G = 7 = 00111

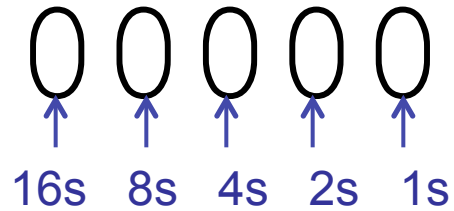
N = 14 = ?

Challenge 3

The binary challenge



How do we get from a binary number to a letter?



1 0 1 0 1

↑ ↑ ↑ ↑ ↑

16 + 0 + 4 + 0 + 1

= 21 = U

Challenge 3

The binary challenge



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What are the following letters?

01110

00010

10111

11001

Challenge 3

The binary challenge



Challenge 3: Decode the message

```
"00011 01111 01101 10000 10101 10100
00101 10010 10011 10110 01001 00101
10111 00101 10110 00101 10010 11001
10100 01000 01001 01110 00111 00001
10011 01111 01110 00101 10011 00001
01110 00100 11010 00101 10010 01111
00101 10011 11011"
```

Challenge 3

The binary challenge



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Challenge 3: The message says...

`"Computers view everything as ones
and zeroes!"`

Challenge 4

???



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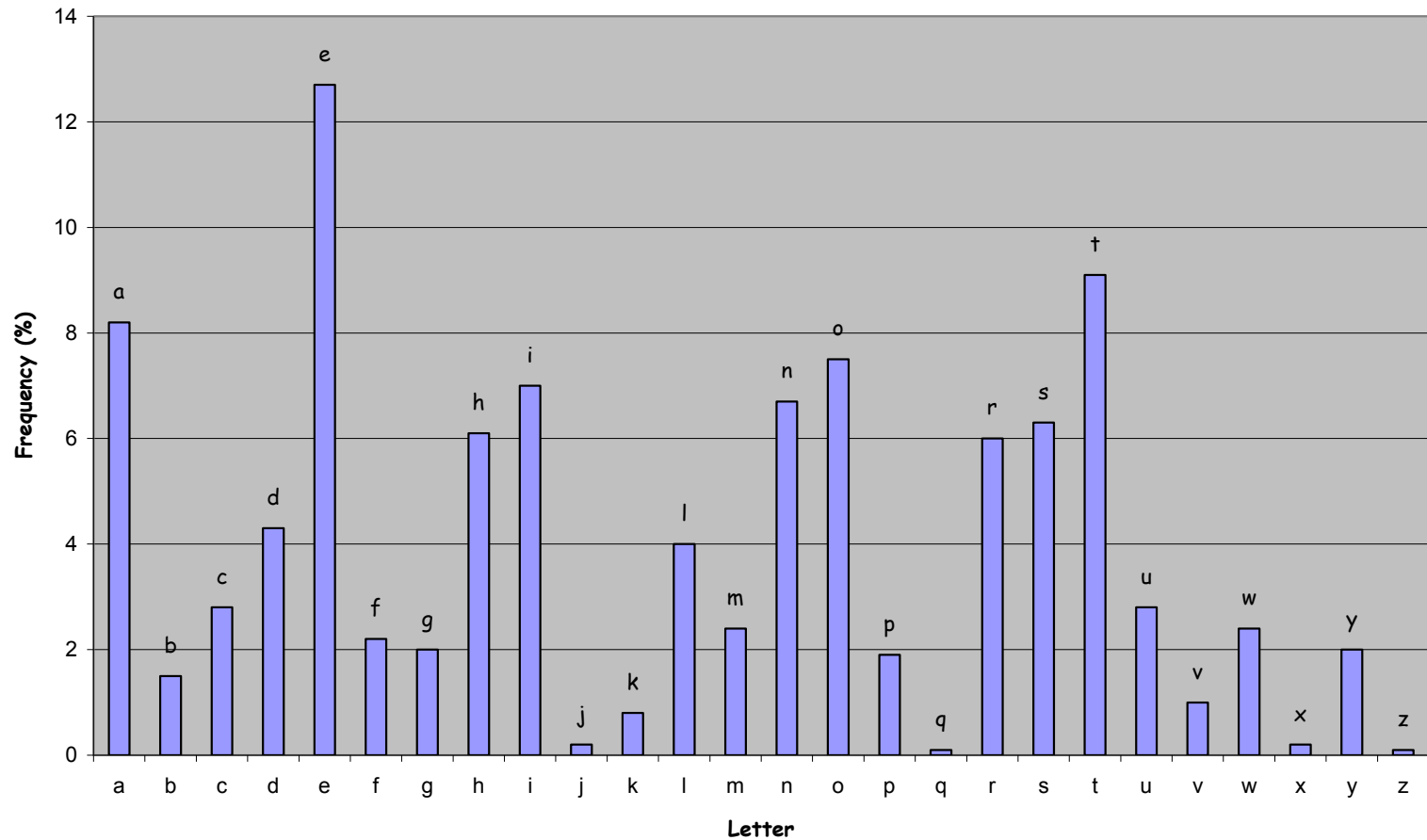
How might you crack a substitution cypher if you don't know which substitutions have been made?

Challenge 4

???



Frequency Analysis of Letters Used in the English Language



Challenge 4

The frequency analysis challenge



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Challenge 4: Decode the message

“IHU EUTI NYSU NLRNKULT MYJI
PGQU WF RJS RAMRVT MRJI IY
BGJS IHU RJTMUL. YBIUJ IHULU
GT R LUMRLS BYL IHYLU MHY
TWNNUUS.”

Challenge 4

The frequency analysis challenge



Challenge 4: The message says...

`"The best code crackers won't
give up and always want to
find the answer. Often there
is a reward for those who
succeed."`

The ALAN TURING Cryptography Competition



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by University of Manchester

http://www.maths.manchester.ac.uk/cryptography_competition/



The ALAN TURING Cryptography Competition.

(edition 2015: #4).

Welcome guest.



Alan Turing
(what's Alan got up
his sleeve this time??)

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The Tale of the Carbon Conundrum

[Chapter 1](#)

[Chapter 2](#)

[Chapter 3](#)

[Chapter 4](#)

[Chapter 5](#)

[Chapter 6](#)

[Epilogue](#)

[Solutions](#)

Do you like breaking codes and solving ciphers?

Can you, and your friends, discover the secret of the Carbon Conundrum?

Would you like the chance to use your mathematical skills to win some great prizes?

Then the Alan Turing Cryptography Competition is for you!

Now in its fourth year, the Alan Turing Cryptography Competition is aimed at secondary school children up to Year 11 (England and Wales), S4 (Scotland), Year 12 (Northern Ireland). You don't need to be a computer whizz or a mathematical genius - you just need to keep your wits about you and be good at solving problems!

Registration for the fourth edition of the Competition will open **December 1st**. In the meantime, why not explore the previous editions of the Competition to get inspired? You can find them here: [2012](#), [2013](#) and [2014](#).

If you wish, you can leave your email address behind and we will send you a reminder when registration opens.

Email address:

The Imitation Game

...in cinemas now!



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Thanks to:



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UNIVERSITY OF LEEDS

STEMNET
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