CS 103000
Prof. Madeline Blount

Week 7:
VECTORS (cont.)

Attendance:
https://cs103-proton2.glitch.me/

Dall-E 2: cats learning C++ in the forest on '90's technology

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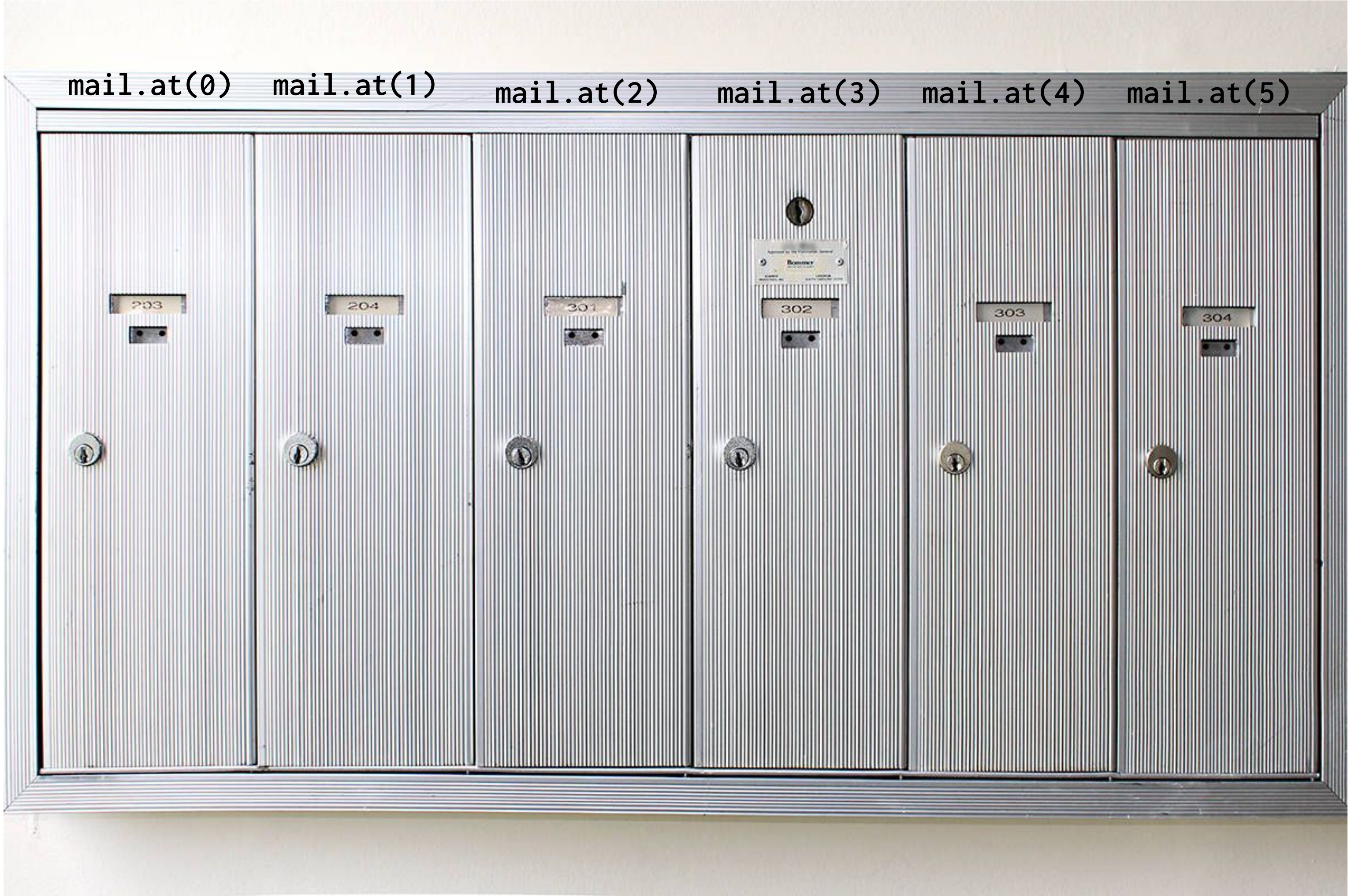

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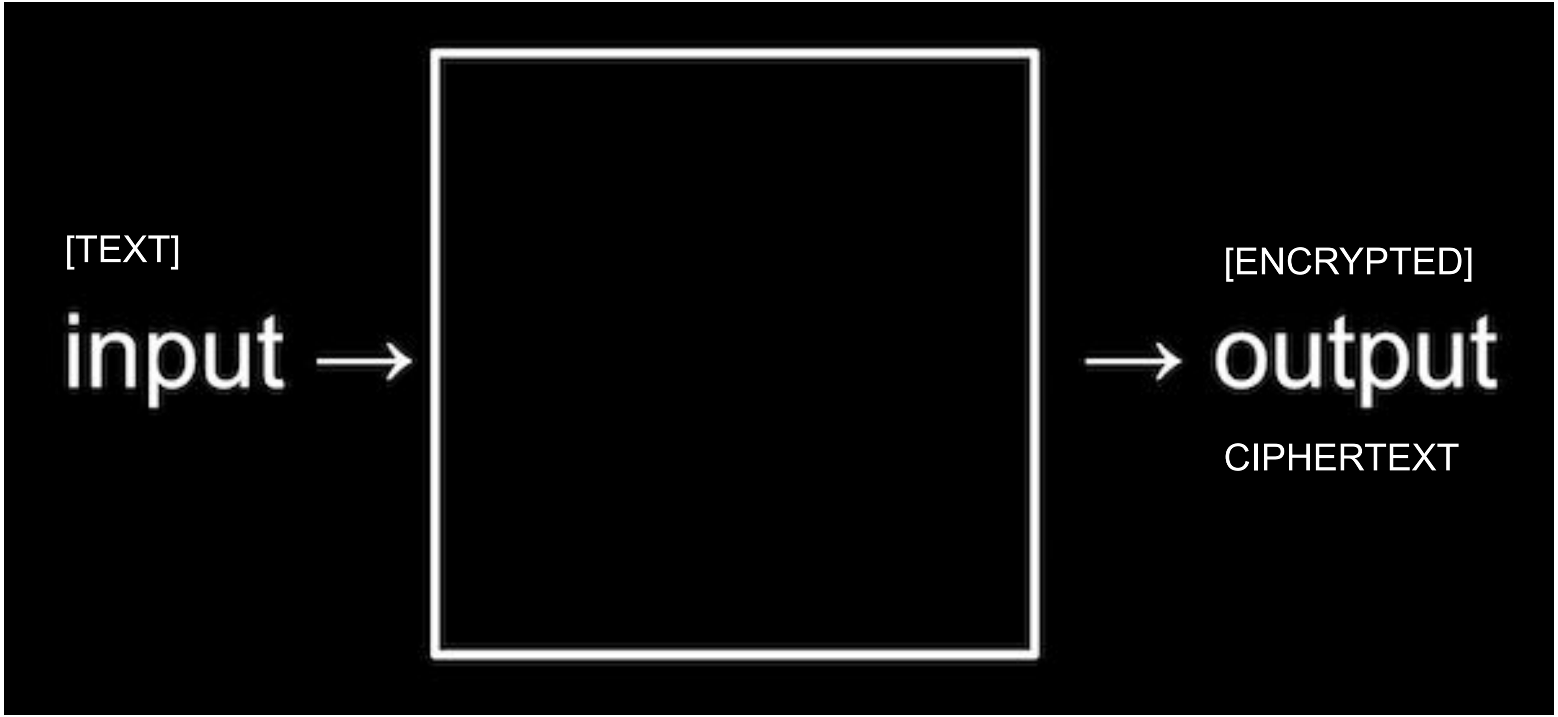
```
cryptography = hidden writing (Greek)
```



[TEXT]

input →

→ output

[ENCRYPTED]

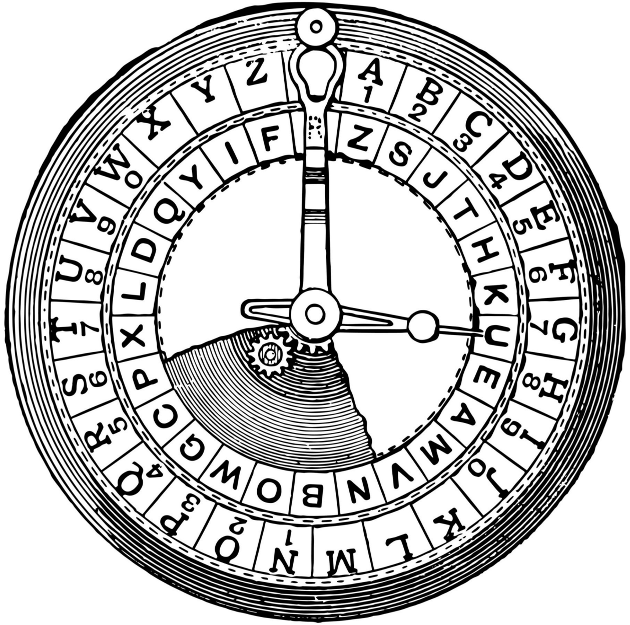
CIPHERTEXT

From Harvard CS50

cipher, cypher

- Origins: meant “zero” or circle
- Then meant number, doing arithmetic
- Then meant ***encoding*** text, hidden

cipher, cypher



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
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
Z S J T H K U E A M V N B O W G C P X L D Q Y I F

Caesar cipher

Caesar shift

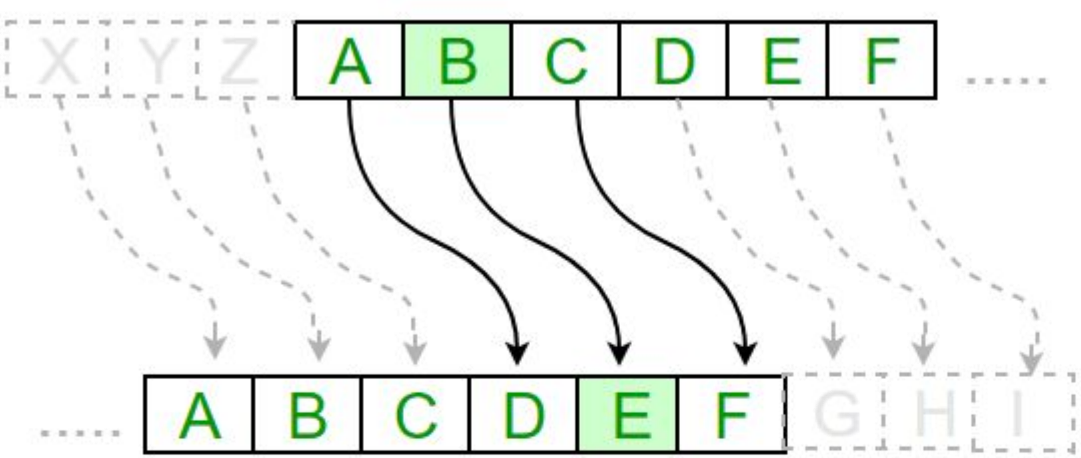
Substitution cipher

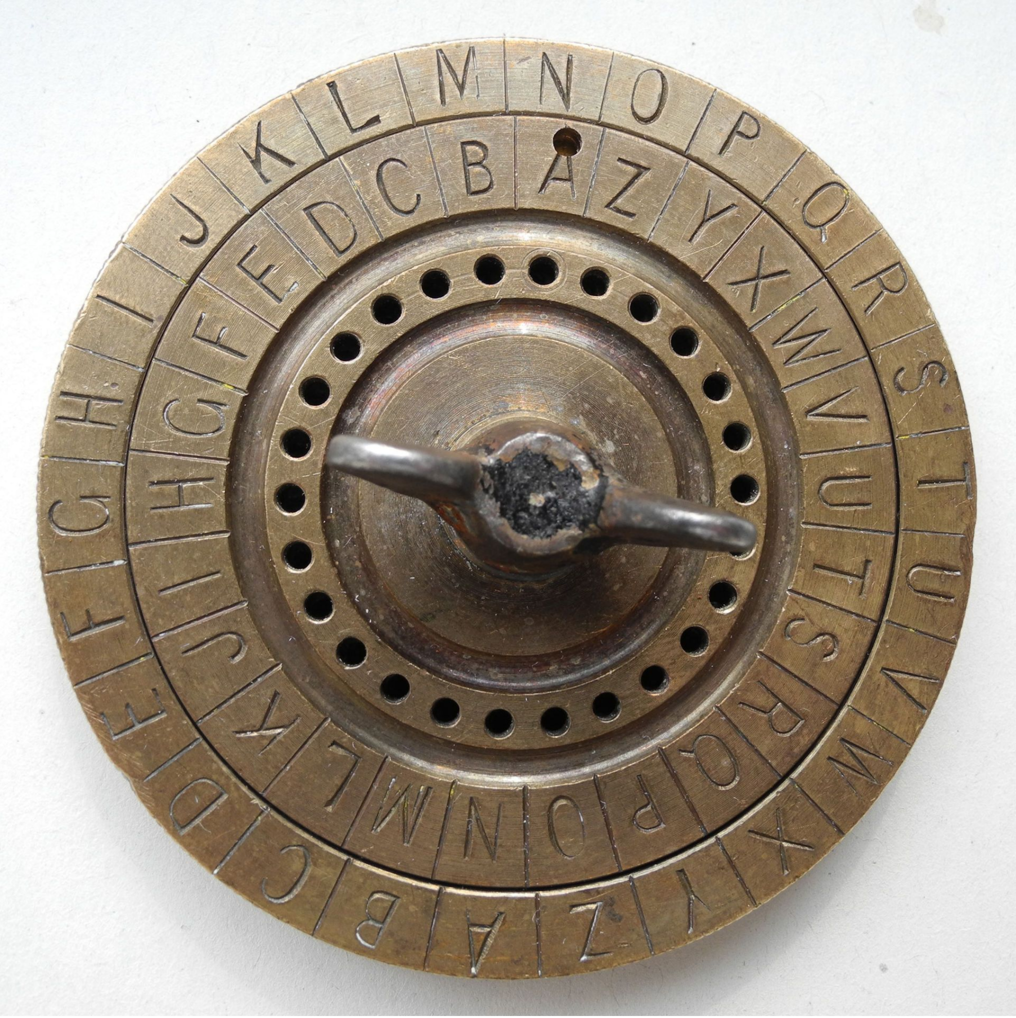
military messages, 1st cent. CE

Original Message: “ATTACK AT DAWN”

SHIFT, or KEY: 3

Encrypted Message: “DWWDFN DW GDZQ”




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

Wikimedia

Caesar shift in c++ :

- String as input
- 🔑 shift as input
- Decrypted ciphertext as output

ENCRYPT

🔑 = 1

90 - 65 = 25

25 + 🔑 = 26

26 % 26 = 0

0 + 65 = 65 = A

65	A
66	B
67	C
68	D
69	E
70	F
71	G
72	H
73	I
74	J
75	K
76	L
77	M
78	N
79	O
80	P
81	Q
82	R
83	S
84	T
85	U
86	V
87	W
88	X
89	Y
90	Z
91	[

26 letters in alphabet

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$$E_n(x) = (x + n) \mod 26.$$

DECRYPT

🔑 = 1

65 - 65 = 0

0 - 🔑 = -1

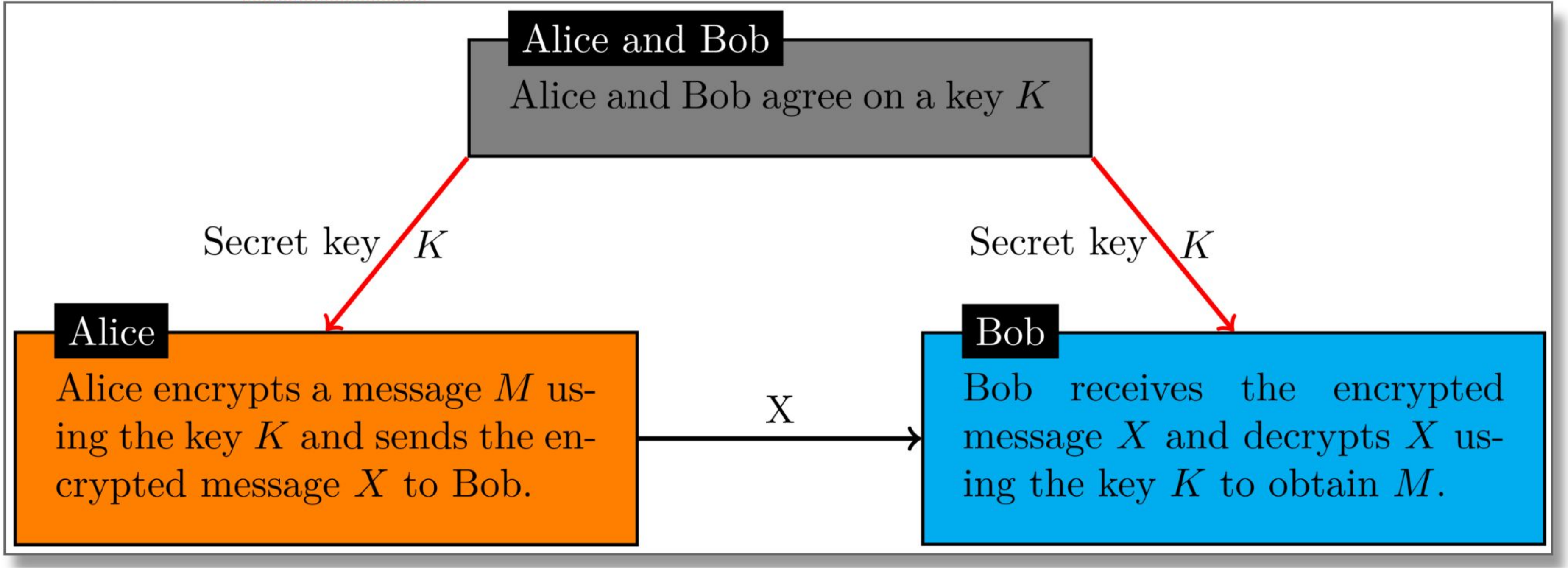
-1 + 26 = 25

25 % 26 = 25

25 + 65 = 90 = Z

65	A
66	B
67	C
68	D
69	E
70	F
71	G
72	H
73	I
74	J
75	K
76	L
77	M
78	N
79	O
80	P
81	Q
82	R
83	S
84	T
85	U
86	V
87	W
88	X
89	Y
90	Z
91	[

26 letters in alphabet



Alice and Bob

Alice and Bob agree on a key K

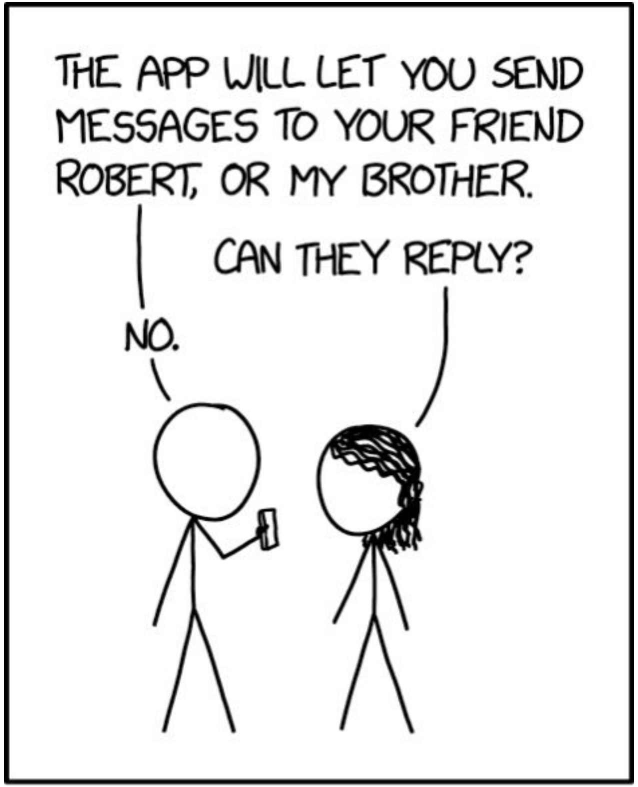
Alice

Alice encrypts a message M using the key K and sends the encrypted message X to Bob.

Bob

Bob receives the encrypted message X and decrypts X using the key K to obtain M.

OH *ALICE*... YOU'RE THE ONE FOR ME
BUT *BOB*... IN A *QUANTUM* WORLD HOW CAN WE BE SURE?
ψ^+ or ψ^- ?


THE APP WILL LET YOU SEND MESSAGES TO YOUR FRIEND ROBERT, OR MY BROTHER.
CAN THEY REPLY?
NO.

MY NEW SECURE TEXTING APP ONLY ALLOWS PEOPLE NAMED ALICE TO SEND MESSAGES TO PEOPLE NAMED BOB.

vectors vs. arrays?

Corporate needs you to find the differences between this picture and this picture.
They're the same picture.

```
vector<int> myNumbers(20);

int myNumbers[20];
```

vectors vs. arrays

- **BIG DIFFERENCE:**
  YOU CANNOT SIMPLY RESIZE ARRAYS!

- This makes arrays faster, if you are *really* in need of speedy performance (large, large datasets)

- Arrays don’t need a header #include

- For our purposes, simpler to use dynamic vectors

myContainer.at(i) vs. myContainer[i]

- .at() function checks the size of your container
- [] does not check the range!
- Both work for vectors
- Only [] works for built-in arrays … BUT …

C-strings vs. **strings** (C++)

```
char myWord[6] = “hello”;
string myWord = “hello”;
```

- C-string = older, from C, built-in
- Literally array of characters, with ‘\0’ to **END** (size = +1)
- Different library of functions than C++ strings
- Easy to make mistakes with!

Why learn arrays + C-strings?

- We still see them in code (“legacy”)
- Good to understand the most basic data types (like … binary) to know where our more advanced features come from!
- Vectors came from limitations with arrays, the standard template string from limitations with C-strings, etc.!