CS 1010

Image Encryption and Decryption

Another application of Raspberry Pi and PiCamera

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from picamera import PiCamera

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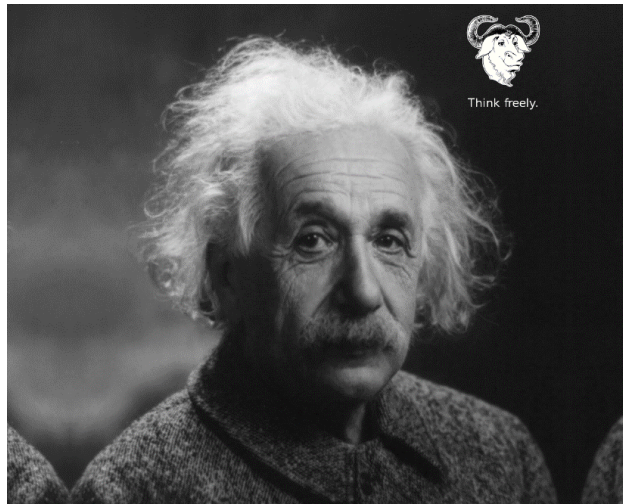
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Photo: Kartik Bulusu

Very basics of data encryption-decryption and applications

Encryption is the transformation of data into some unreadable form.

Decryption is the reverse of encryption; it is the transformation of encrypted data back into some intelligible form.

$$\begin{bmatrix} 49 & 49 & \cdots & 34 & 35 & 35 \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots \\ 40 & 34 & \cdots & 51 & 49 & 46 \end{bmatrix}$$

Image encryption - process of encoding image with the help of an encryption algorithm in such a way that <u>unauthorized</u> users can't access it.

Authorization entails a "key".

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Assign each letter in the alphabet a number
- Start from 0
- I have row matrix: A_{1x26}

Message (X) = T E A C H
- Convert the letter into the number that matches its order in the alphabet starting from 0
- I now have a row matrix: $X_{1x5} = [19\ 4\ 0\ 2\ 7]$

To encrypt assign a shift key (K) = 4
- Must be an integer from 0 to 25
- Map each letter to a different letter using the shift key
- **Y = (X+KJ)** where *J is a vector-of-ones i.e., [1 1 1 1 ….]*
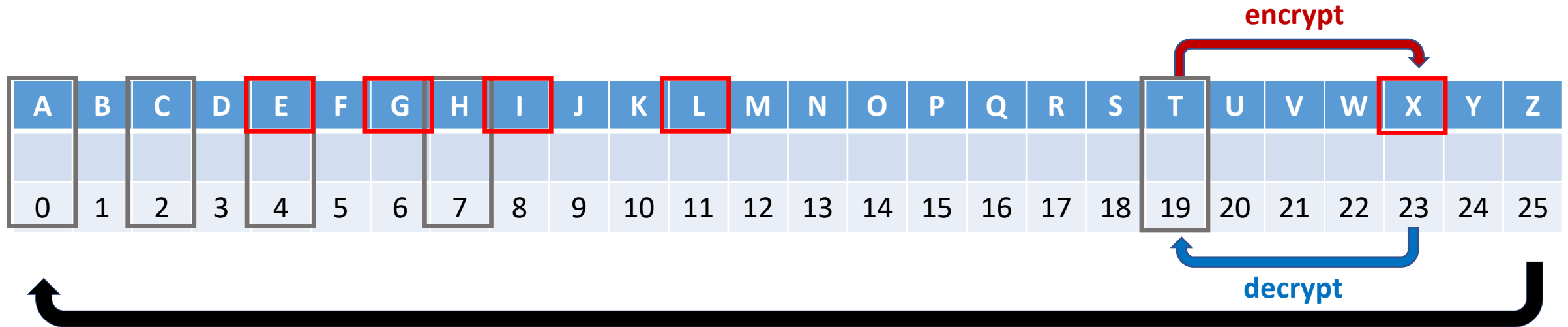- I have a new row matrix: $Y_{1x5} = [23\ 8\ 4\ 6\ 11]$

Encrypted message (Y) = X I E G L

To decrypt apply the same shift key (K) = 4
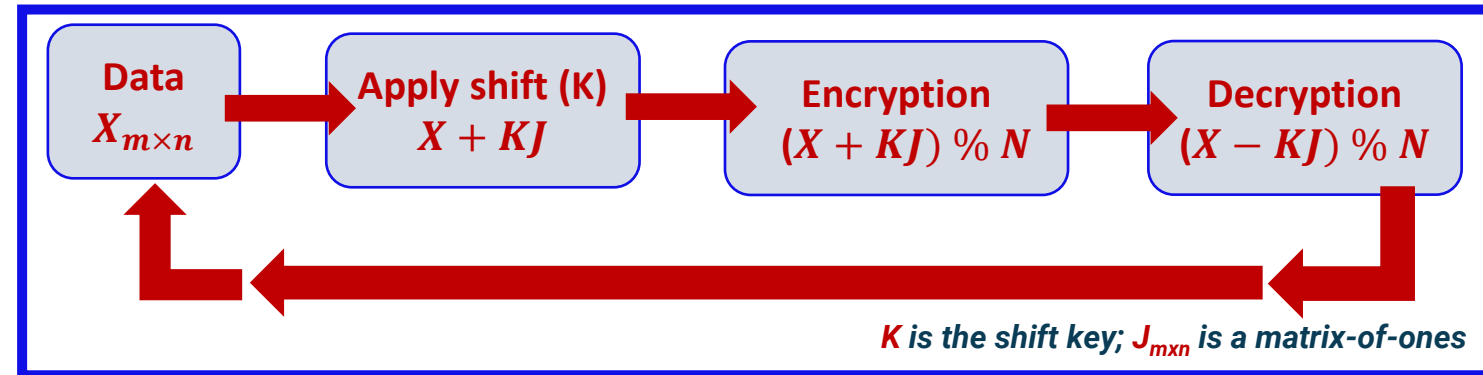- Map each encrypted letter to a different letter using the shift key
- **X = (Y-KJ)** where *J is a vector-of-ones i.e., [1 1 1 1 ….]*
- I have a new row matrix: $X_{1x5} = [19\ 4\ 0\ 2\ 7]$

Decrypted Message (X) = T E A C H

encrypt

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
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

decrypt

Building up the vocabulary: Modulo

In computing, the modulo operation finds the remainder after division of one number by another.

```
Data          Apply shift (K)       Encryption           Decryption
X_{m×n}  →    X + KJ          →    (X + KJ) % N    →    (X − KJ) % N
```

Data $X_{m \times n}$ → **Apply shift (K)** $X + KJ$ → **Encryption** $(X + KJ) \% N$ → **Decryption** $(X - KJ) \% N$

K is the shift key; J_{mxn} is a matrix-of-ones

Encryption

	T	E	A	C	H
X	19	4	0	2	7
K	20	20	20	20	20
X + K	39	24	20	22	27
(X + K)%N	13	24	20	22	1
	N	Y	U	W	B

Decryption

	N	Y	U	W	B
Y	13	24	20	22	1
K	20	20	20	20	20
Y - K	-7	4	0	2	-19
(Y - K)%N	19	4	0	2	7
	T	E	A	C	H

The in-class programming exercise will demonstrate these operations on images using Python

Apply Python to Encrypt and Decrypt an image
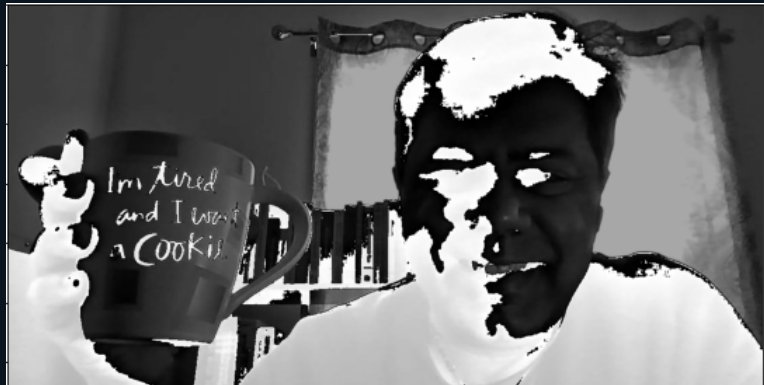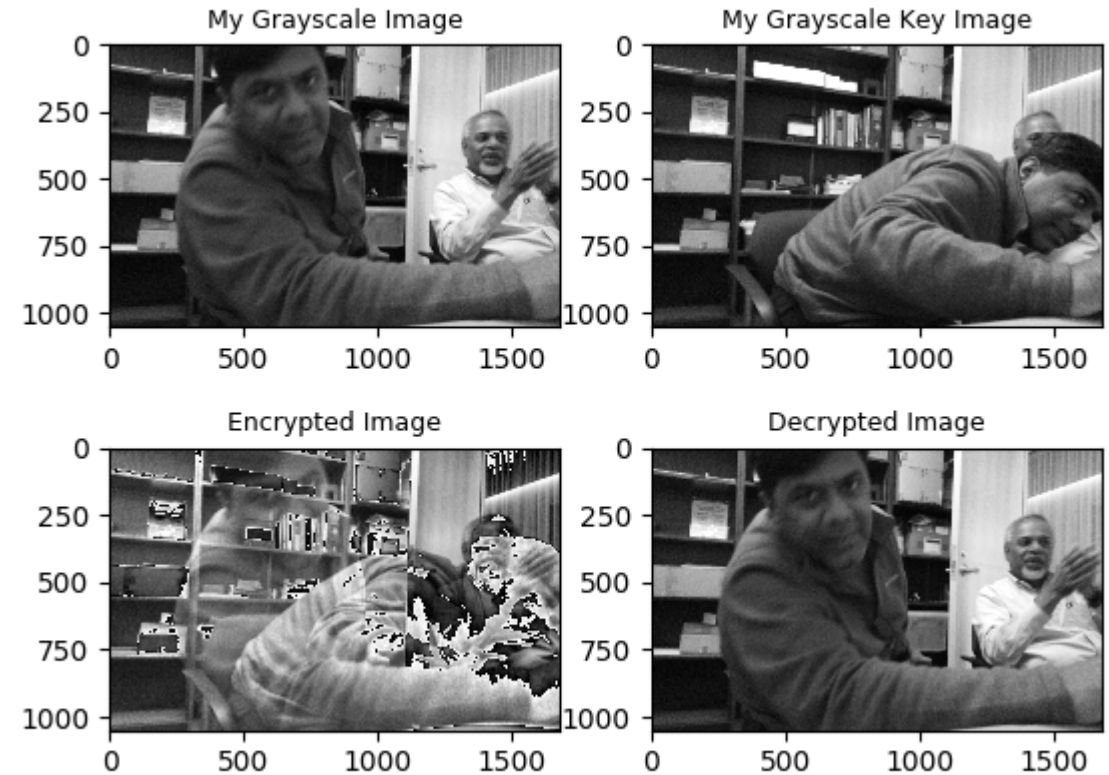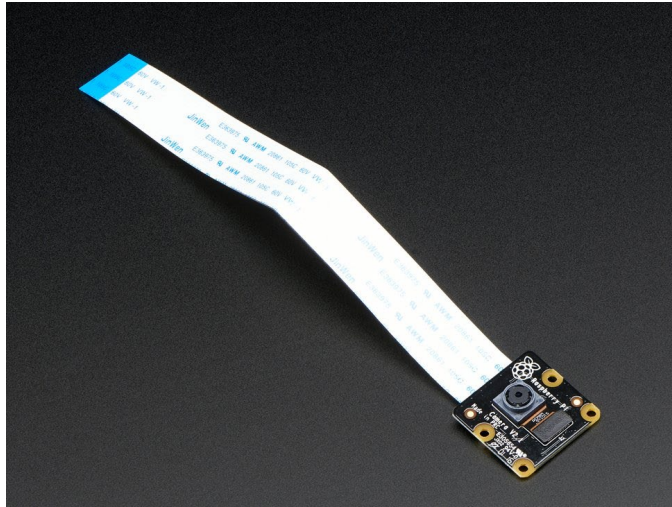

Import Libraries

Import images

Perform encryption and decryption

Image Encryption and Decryption using the Raspberry Pi +Pi NoIR Camera

- 8 megapixel native resolution high quality Sony IMX219 image sensor
- 3280 x 2464 pixel static images

https://www.adafruit.com/product/3100#description

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