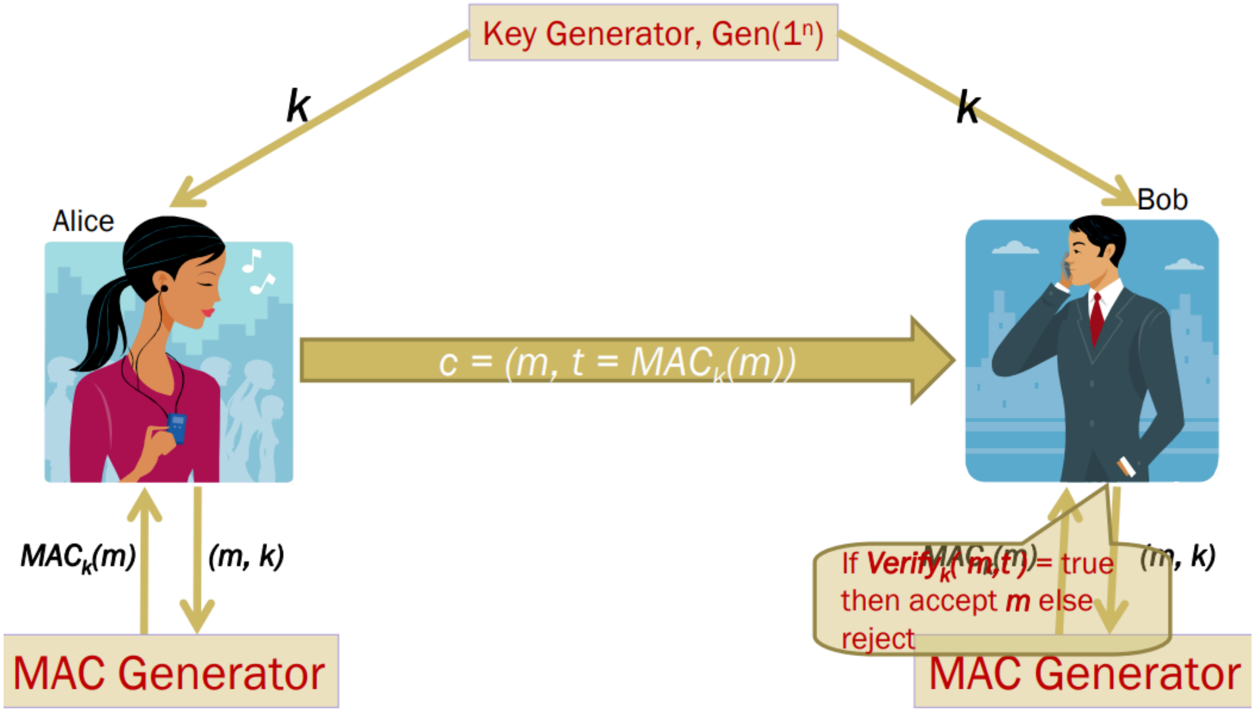
Message Authentication Code (MAC)

Theory:


Key Generator, Gen(1^n)
k
k
Alice
Bob
c = (m, t = MAC$_k$(m))
MAC$_k$(m)
(m, k)
MAC Generator
If ***Verify$_k$(m,t)*** = true then accept ***m*** else reject
MAC$_k$(m)
(m, k)
MAC Generator

- A Key Generation Algorithm that returns a secret key k
- A MAC generating algorithm that returns a tag for a given message m. Tag t = MACk (m)
- A Verification algorithm that returns a bit
- b = Verifyk (m1, t1), given a message m1 and a tag t1
- If the message is not modified then with high probability, the value of b is true otherwise false

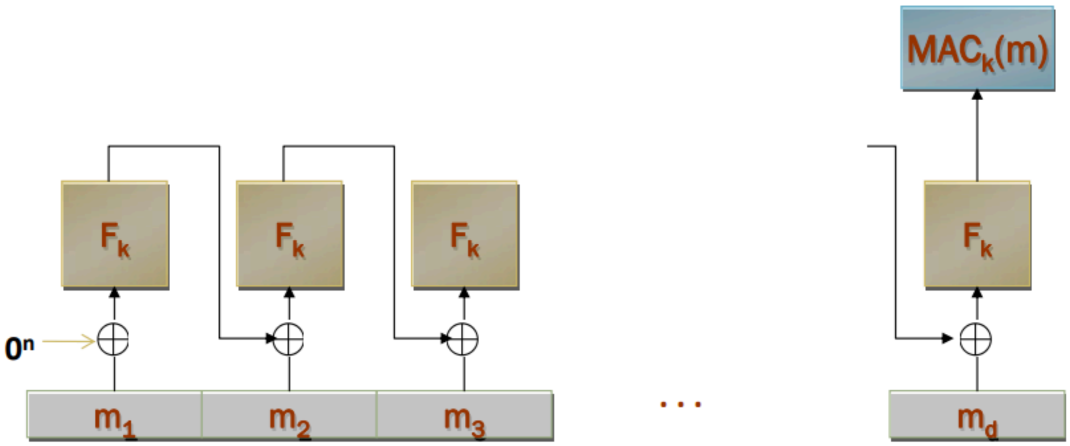
Generating MAC:

- Partition the message m to n sized blocks m1m2...mq
- Calculate MACk(m) = MACk(m1 ⊕ m2 ... ⊕ mq)

Is this method secure?

NO! We are authenticating the xor of the message blocks but not the message itself. So we can always choose a message whose xor value is the same as some other message.

CBC-MAC:



Task:
You are given 3 pieces of information: a message, key, and CBC-MAC signature. Your task is to verify whether the received message is valid or not.

Message	Key	MAC Signature	Validity
I met an interesting turtle while the song on the radio blasted away	b'\x01\xd8i\xa1^0\x9a<\x0f\xf0\r\xc1\xdd\xd5\x89\xa6'	ba4ecb8db45c6ae0	
I like to leave work after my eight-hour tea-break	b'\xa6+\x16\x9d-1\xda\x8aV\xed\xf5\xf0cv\x04\x88'	f47e78c537fa1435	
Her daily goal was to improve on yesterday	b'[\xc5\xbd\xe4z\xd1=E\x17-ku\x02=|='	ddaf3152edbe868a	
He found the chocolate covered roaches quite tasty	b'5"k\xff\x81a\x9b 7\x8c>\xb7\xb9\xdcu\xaa'	9d30d856f84489a8	
After fighting off the alligator, Brian still had to face the anaconda	b'\xa1\xfcw"?3\x91\x1c\t\x9c\x91\xe2He\x935'	b9d173e05bbf7738	
He decided to count all the sand on the beach as a hobby	b'\xa7\x83@\xde\xbf\xb494\xee\x84\x1e-\xc8A\xf9:'	6355e471bd9930a1	
The sign said there was road work ahead so he decided to speed up	b'2\xcbv\xdcU6\x99\xb6.\xa7\xea\xeb\xaf\x10\xc7\x90'	9fbafc75e0a5056a	

Send 500$ to this account - 6589415651548	b'\xc3\xea\x99e\xaal\xab\xd4\x9b\xf9\xb4Z\x19\xed\xcf\xcb'	35273149636aca35	
Garlic ice-cream was her favorite	b'\x05\xf9\x83\x9d\xb7\xb6\xc3\xb8\x9e\xc5\xd9\xd8\x07]\xc6\xb3'	dc2de1e07b71d391	
I'd rather be a bird than a fish	b'\x84YY\xf0\x02GU\xa4LD\xd5\x85!A\xc2c'	5e191d02aa5fc0b1	

Procedure:

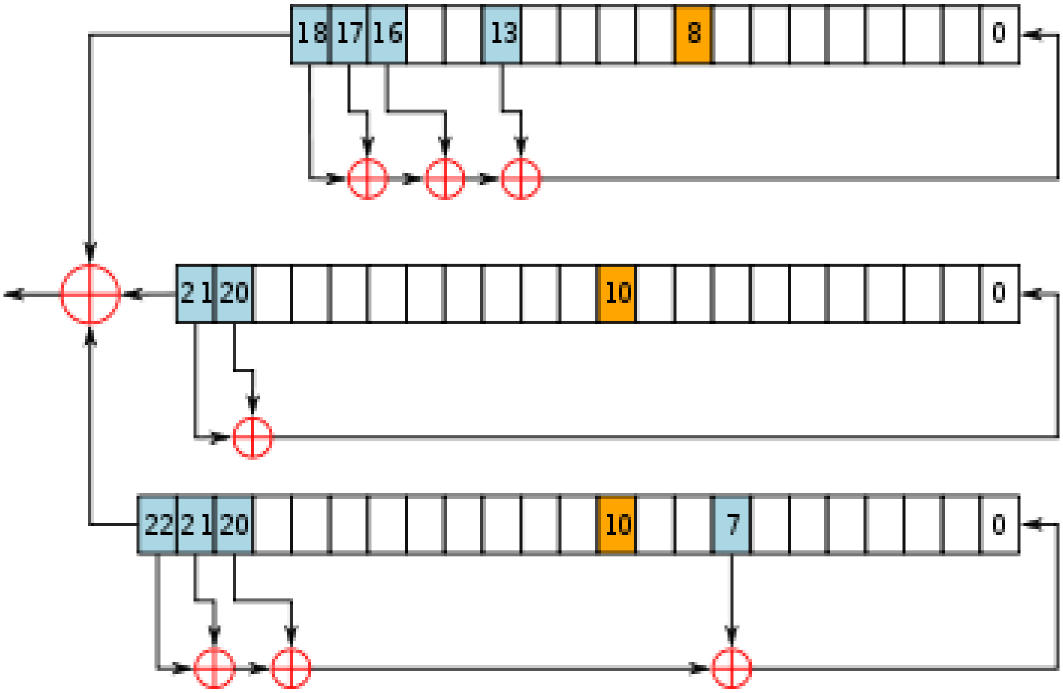
Colab Notebook Link for this lab:
https://colab.research.google.com/drive/1y0Za5ASOThcuahg7mxysdnd7QOEszlxj?

1. Create a cmac object as shown using **key**
2. Update() the created object with your received message
3. Generate the MAC signature using finalize() function
4. Finally, print the decoded version of the signature and match it with your given signature.

A5/1

Theory:

A5/1 consists of 3 shift registers.
X: 19 bits
Y: 22 bits
Z: 23 bits



Procedure:

Colab Notebook Link for this lab:
https://colab.research.google.com/drive/1y0Za5ASOThcuahg7mxysdnd7QOEszlxj?

1. **Complete** the encrypt() and decrypt() functions
2. Test your work by encrypting any plaintext and decrypting the found ciphertext

Encrypt the following plaintext:

Plaintext	64-Bit Key	Ciphertext
It is alive	00110000011111110111100010110110100110100000001000011101101101011	
Snap out of it	11100110101010101001110110	

	1010000001001100111011011000001011001010	
I am as mad as hell and I am not going to take this anymore	0011101011001100010001111101110001110011001011011010100111001011	
Bond James Bond	1101000000111100110011110000001100111001001100000010110011100111	
Love means never having to say you're sorry	0111110000101011000010101111100111000000111000000001001101110110	

Decrypt the following Ciphertext:

Ciphertext	64-Bit Key	Plaintext
101100001100101111010100100100100010111010100001	1000000001111001000000111010110000111100100101001011001111000111	
0110000101000001000000101110101100010100011001100111111100100011	1100010111111111101000001000110011010100100100111011001000001100	
10100111010010010110101101110111	0010110010011001111001011100010100111010111011111000010100010010	
1000111101111000000100001110010000000110011111000101011111001010000100110101011101001010001011001111110101100100	0001101101111111100111011101010100000100111111100011010010111010	
1010111111111001100101000100000111110010011000000011010011010000111001010 0010010	1110000000011000101110110000101011101101011100001110110110000100	