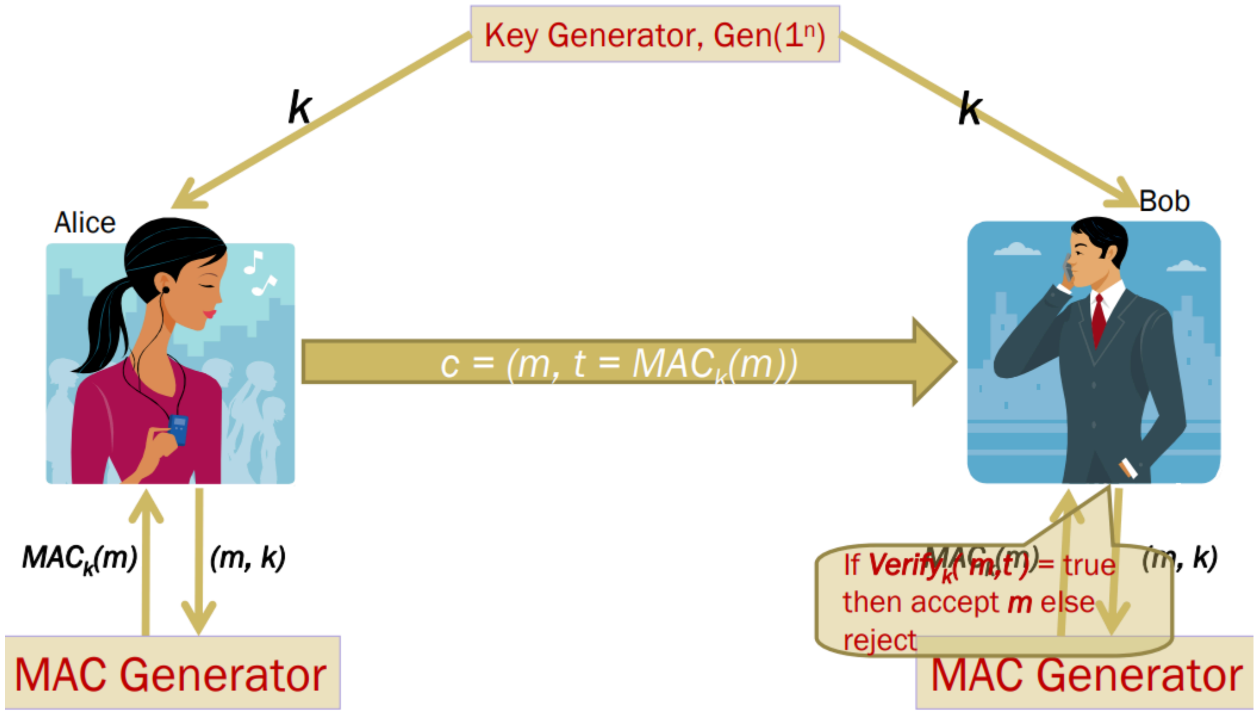
Message Authentication Code (MAC)

Theory:



- 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 = Verify (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

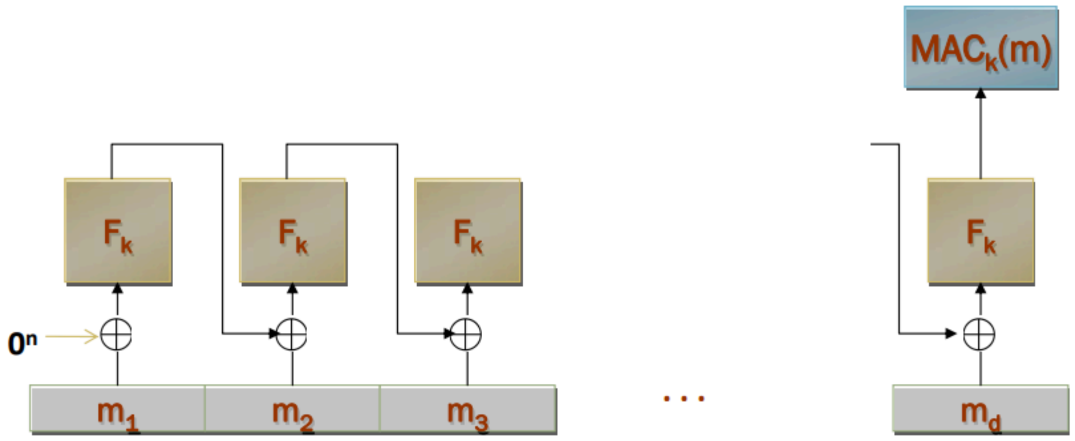
Generating MAC:

- 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	valid
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:

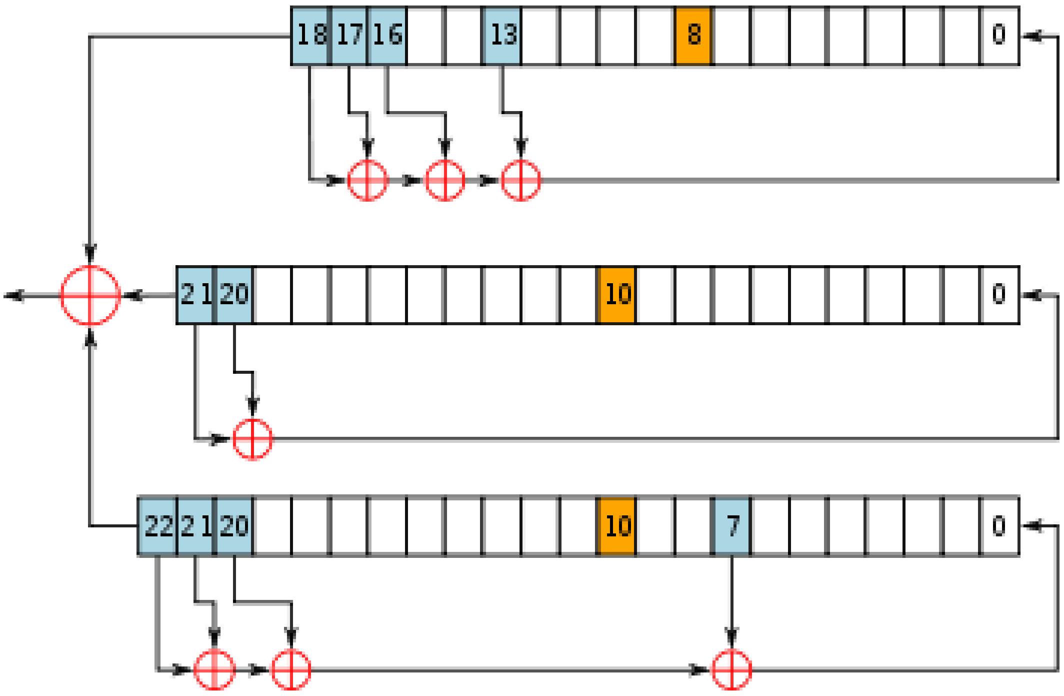
Colab Notebook Link for this lab: Lab 4 - CBC-MAC_A5_1 [Fall-2025] n

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:

Encrypt the following plaintext:

X=1110001100101001011

Y=0011000000010000001101

Z=10011101101111001001110

Prepare a function **A51(X, Y, Z, n)**

Plaintext	**Key stream** len(Plaintext) Use A51 algorithm (Binary)	**Ciphertext =** **Plaintext ⊕ key** (Binary)	**Plaintext =** **Ciphertext ⊕ Key** (String)
It is alive			
Snap out of it			
I am as mad as hell and I am not going to take this anymore			
Bond James Bond			
Love means never having to say you're sorry			