Experiment No. 5

Title: Vlab on Message Authentication Codes

Batch: A3 **Roll No.: 16010421073** **Experiment No.: 5**

Title: Illustrate and implement message authentication code.

Resources needed: Windows/Linux OS

Theory:

In cryptography, a cipher block chaining message authentication code (CBC-MAC) is a technique for constructing a message authentication code (MAC) from a block cipher. The message is encrypted with some block cipher algorithm in cipher block chaining (CBC) mode to create a chain of blocks such that each block depends on the proper encryption of the previous block. This interdependence ensures that a change to any of the plaintext bits will cause the final encrypted block to change in a way that cannot be predicted or counteracted without knowing the key to the block cipher.

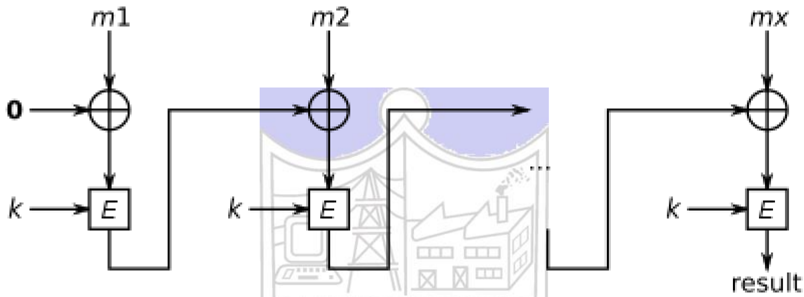


Figure 1 - CBC-MAC construction

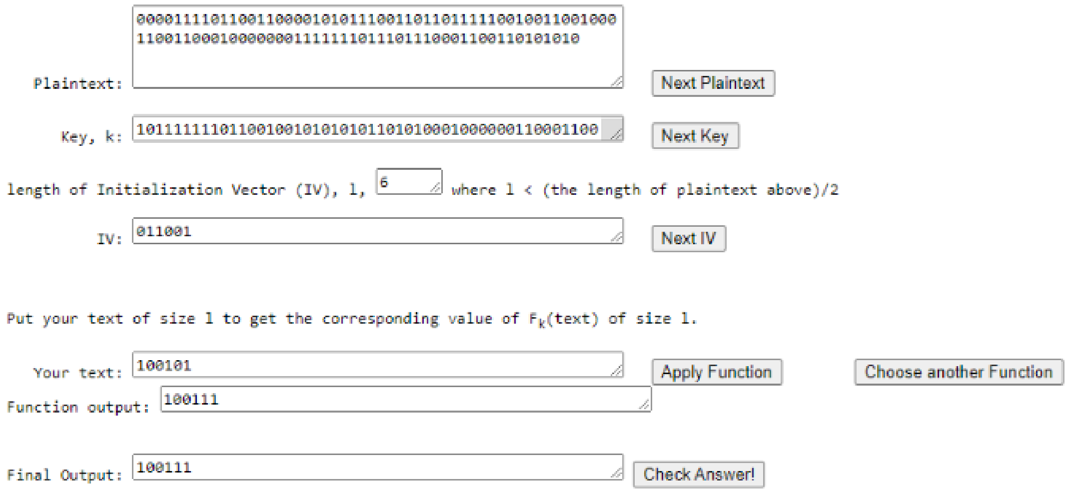
To calculate the CBC-MAC of message m, one encrypts m in CBC mode with zero initialization vector(IV) and keeps the last block. The figure 1 sketches the computation of the CBC-MAC of message comprising blocks m1, m2,…mx using a secret key k and a block cipher E.

Activity :

1) Perform the Vlab on MAC - https://cse29-iiith.vlabs.ac.in/exp/message-authentication-codes/index.html
2) Implement the similar vlab simulation with a simple block cipher in CBC mode with following details-
   - Plain text message M = user's choice (string type)
   - Block Size = user's choice (must be < (length of M_2)/2)
   - Key k = user's choice (length of key is same as block size)
   - IV = user's choice (length of IV is same as block size)
   - E = XOR function

Results:

Vlab Output:



HTML Code:

```
body {
   font-family: Arial, sans-serif;
   text-align: center;
}

h1 {
   color: #333;
}

.input-section {
   margin-top: 20px;
   border: 1px solid #ddd;
   padding: 20px;
   max-width: 400px;
   margin: 0 auto;
   background-color: #f9f9f9;
}
```

```
input[type="text"], input[type="number"] {
    width: 100%;
    padding: 10px;
    margin: 5px 0;
    border: 1px solid #ccc;
    border-radius: 4px;
}

button {
    background-color: #007bff;
    color: #fff;
    padding: 10px 20px;
    border: none;
    border-radius: 4px;
    cursor: pointer;
}

button:hover {
    background-color: #0056b3;
}

.output-section {
    margin-top: 20px;
}

#encrypted-message {
```

```
    font-weight: bold;
}
```

CSS CODE

```css
body {
    font-family: Arial, sans-serif;
    text-align: center;
}

h1 {
    color: #333;
}

.input-section {
    margin-top: 20px;
    border: 1px solid #ddd;
    padding: 20px;
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    font-weight: bold;
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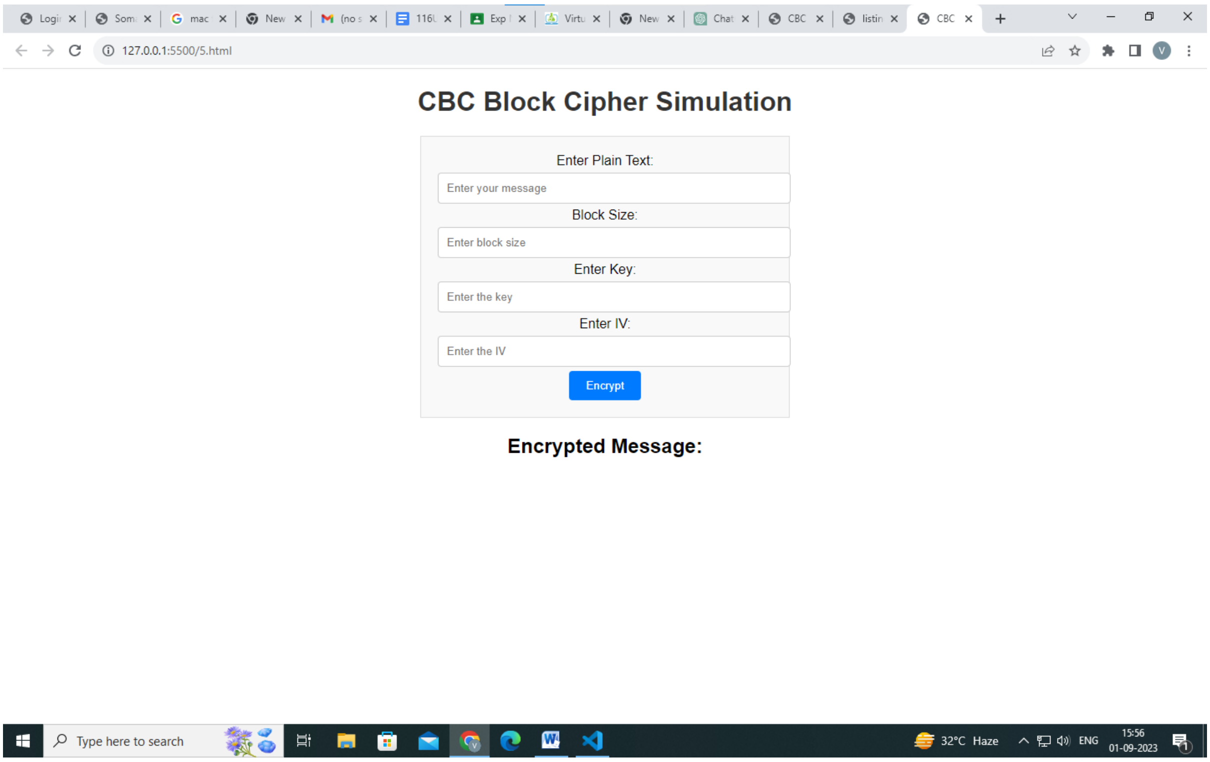
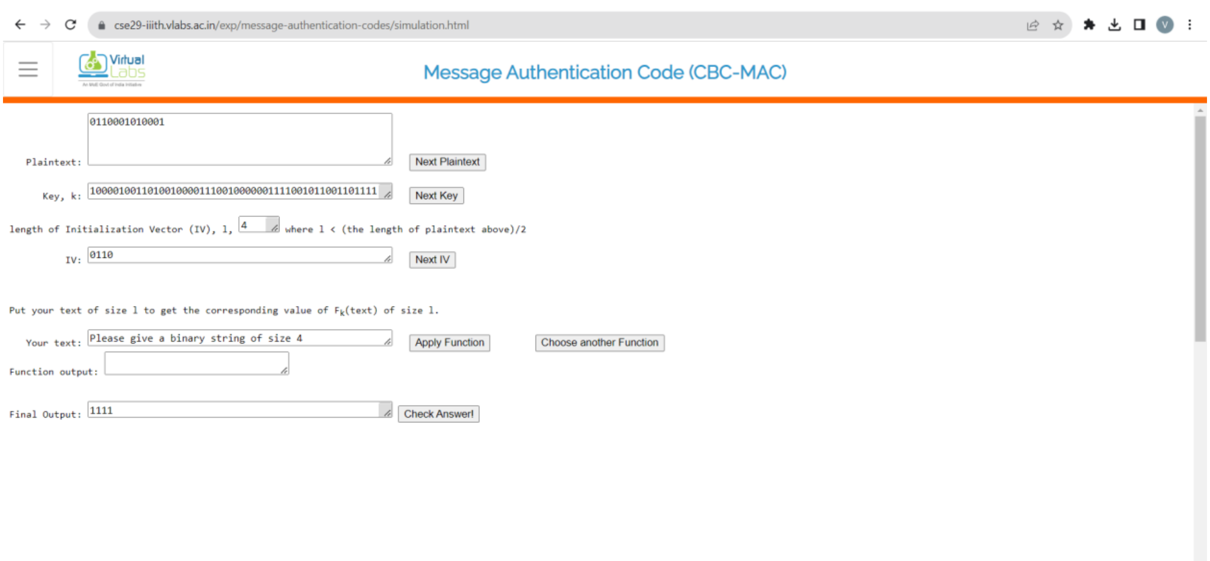
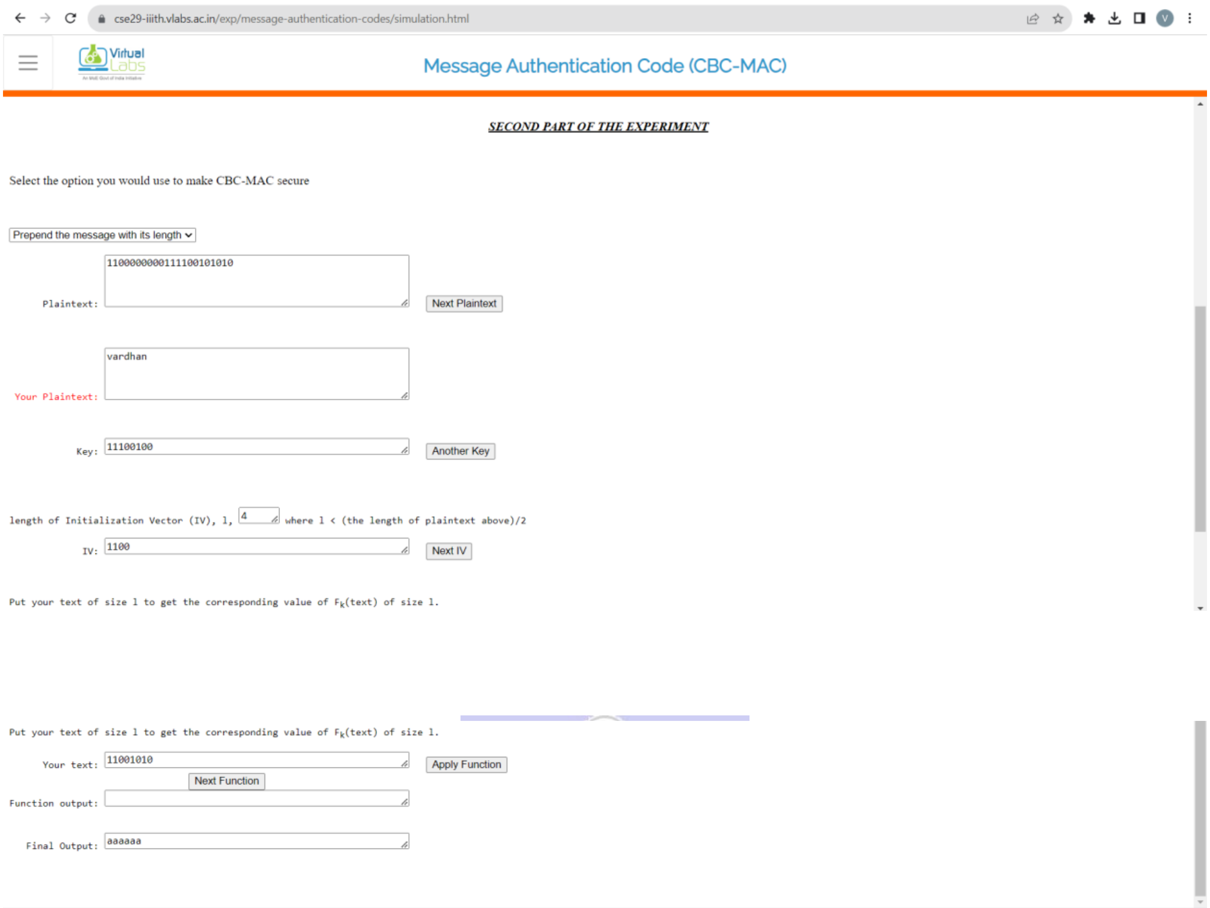
Output:







Questions:

1) **Compare MAC and cryptographic Hash functions.**

Ans:

MAC (Message Authentication Code) and cryptographic hash functions are both used in cryptography, but they serve different purposes and have distinct characteristics. Here's a comparison of the two:

1. Purpose:

- **MAC (Message Authentication Code):** MAC is primarily used for ensuring the integrity and authenticity of a message. It is used to verify that a message has not been tampered with and that it was indeed generated by a specific sender.
- **Cryptographic Hash Function:** Cryptographic hash functions are used to transform data into a fixed-size output (hash) in a way that is difficult to reverse. They are commonly used for data integrity checks, digital signatures, and password storage.

2. Key Usage:

- **MAC:** MAC requires a secret key to generate and verify the authentication code. Both the sender and the receiver must possess the same secret key.

- Cryptographic Hash Function: Hash functions do not require a key; they produce a hash based solely on the input data. Hash functions are one-way functions, meaning you can't reverse them to obtain the original data.

3. Verification:

- MAC: Verification of a MAC involves re-computing the MAC on the received data using the same key and comparing it to the received MAC. If they match, the message is considered authentic.

- Cryptographic Hash Function: Hashes can't be directly verified in the same way as MACs. They are typically used for comparing the hash of received data to a known, trusted hash value to check for tampering.

4. Collision Resistance:

- MAC: MACs are designed to be collision-resistant, which means it should be computationally infeasible for an attacker to find two different messages that produce the same MAC with the same key.

- Cryptographic Hash Function: Cryptographic hash functions are also designed to be collision-resistant, meaning it should be computationally difficult to find two different inputs that produce the same hash value.

5. Output Length:

- MAC: The length of a MAC depends on the specific algorithm and key size. It can be variable.

- Cryptographic Hash Function: The output length of a cryptographic hash function is fixed. For example, SHA-256 always produces a 256-bit hash.

6. Examples:

- MAC: HMAC (Hash-based Message Authentication Code) is a widely used MAC algorithm.

- Cryptographic Hash Function: Examples include SHA-256, SHA-3, and MD5 (though MD5 is not recommended for security-sensitive applications due to vulnerabilities).

Outcomes:

CO 2 Illustrate different cryptographic algorithms for security.

Conclusion:

Thus, we have successfully completed the implementation of MAC and also made a simple GUI to describe it.

Grade: AA / AB / BB / BC / CC / CD /DD

Signature of faculty in-charge with date

References:

Books/ Journals/ Websites:

- William Stallings, “Cryptography and Network Security” by Pearson Education 4th Edition 2014.