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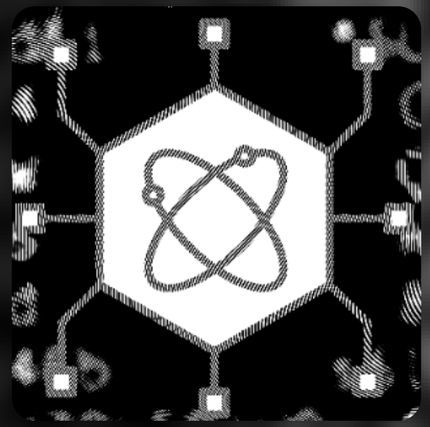

CYBER SECURITY & CRYPTOGRAPHY

INTRODUCTION TO CRYPTOGHRAPHY

An overview of the most common cryptographic methods and algorithms.

Ashad Mohamed
Security Researcher

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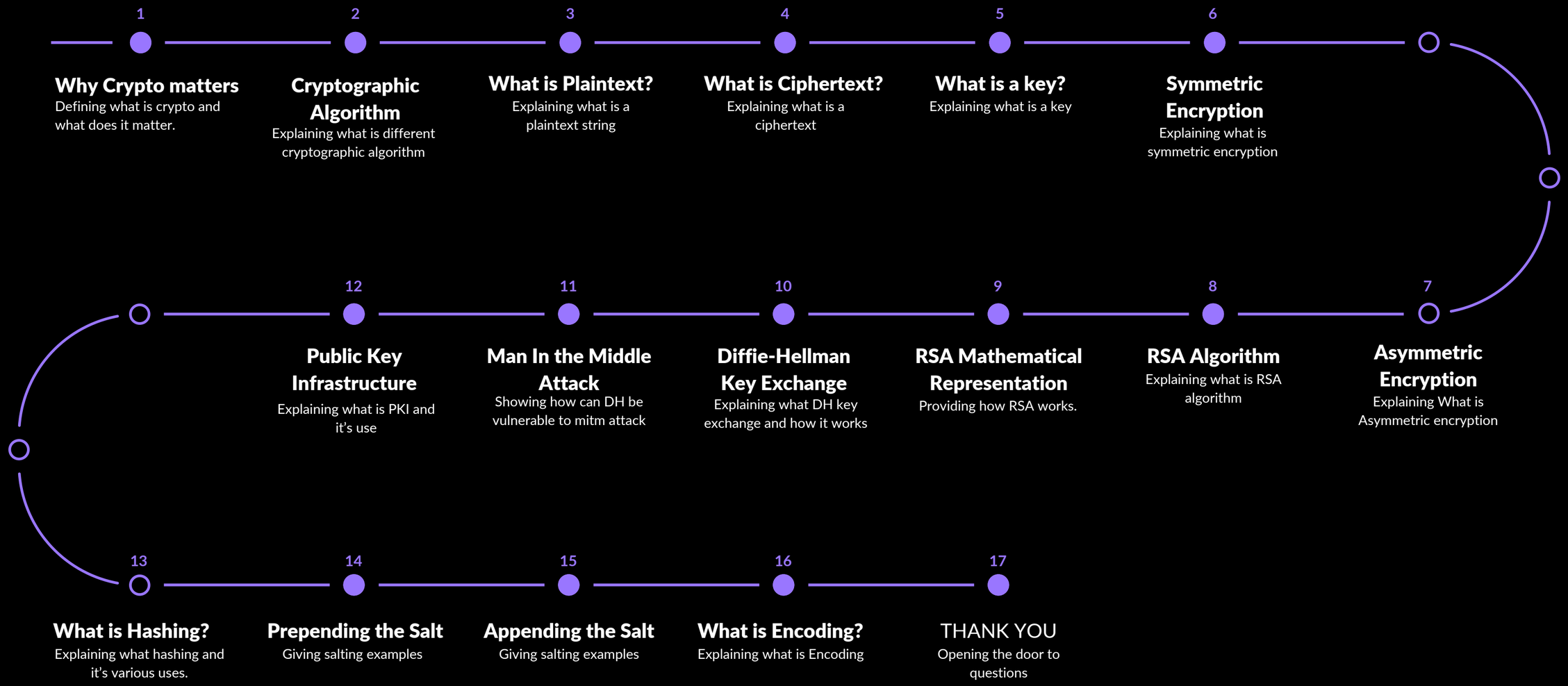

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Why Cryptoghraphy Matters

Cryptography is one of the most **important** tools **businesses** use to **secure** the **systems** that hold its most important **asset** whether it is at-rest or in-motion.

Cryptographic Algorithm

A **cryptographic** algorithm is the **mathematical** equation used to scramble the **plain text** and make it **unreadable**.

What is Plaintext?

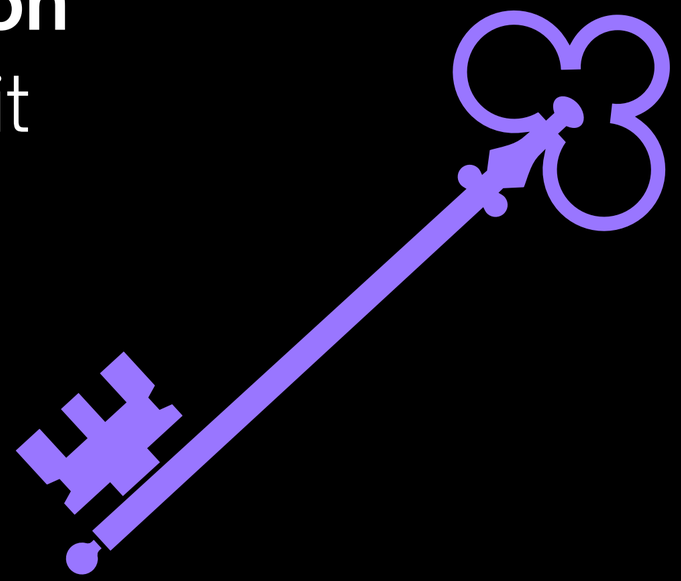
Readable and **understandable** data that is given to an **encryption algorithm** as an **input.**

What is Ciphertext?

Output of **encryption algorithm** in an **unintelligible** form that one **cannot** understand.

What is a key?

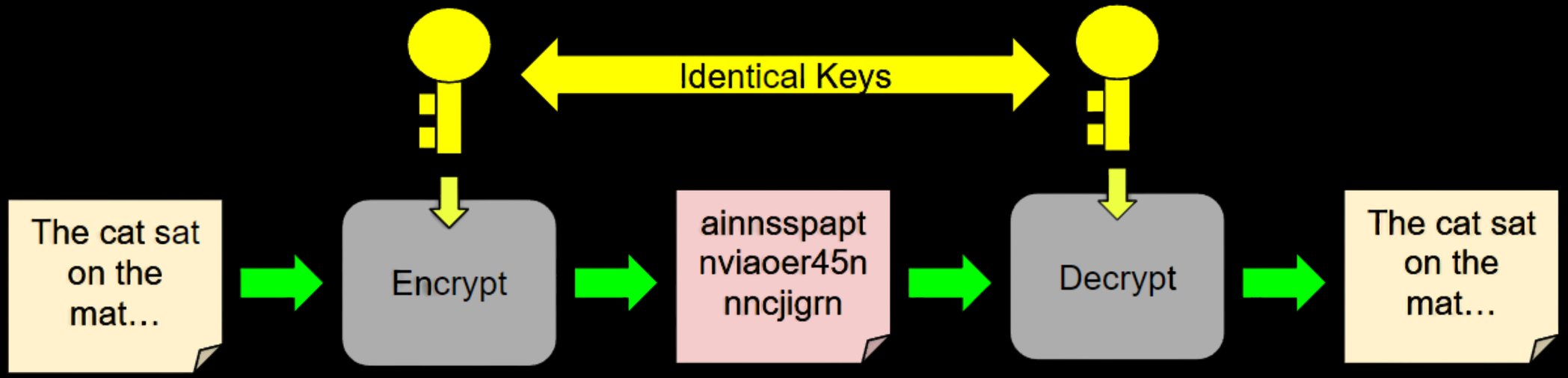
In **cryptography**, a **key** is a string of characters used within an **encryption algorithm** for **altering** data so that it **appears random**.



Symmetric Encryption

Symmetric Encryption is an **Algorithms** that use the same **cryptographic keys** for both the **encryption** of **plaintext** and the **decryption** of **ciphertext**.

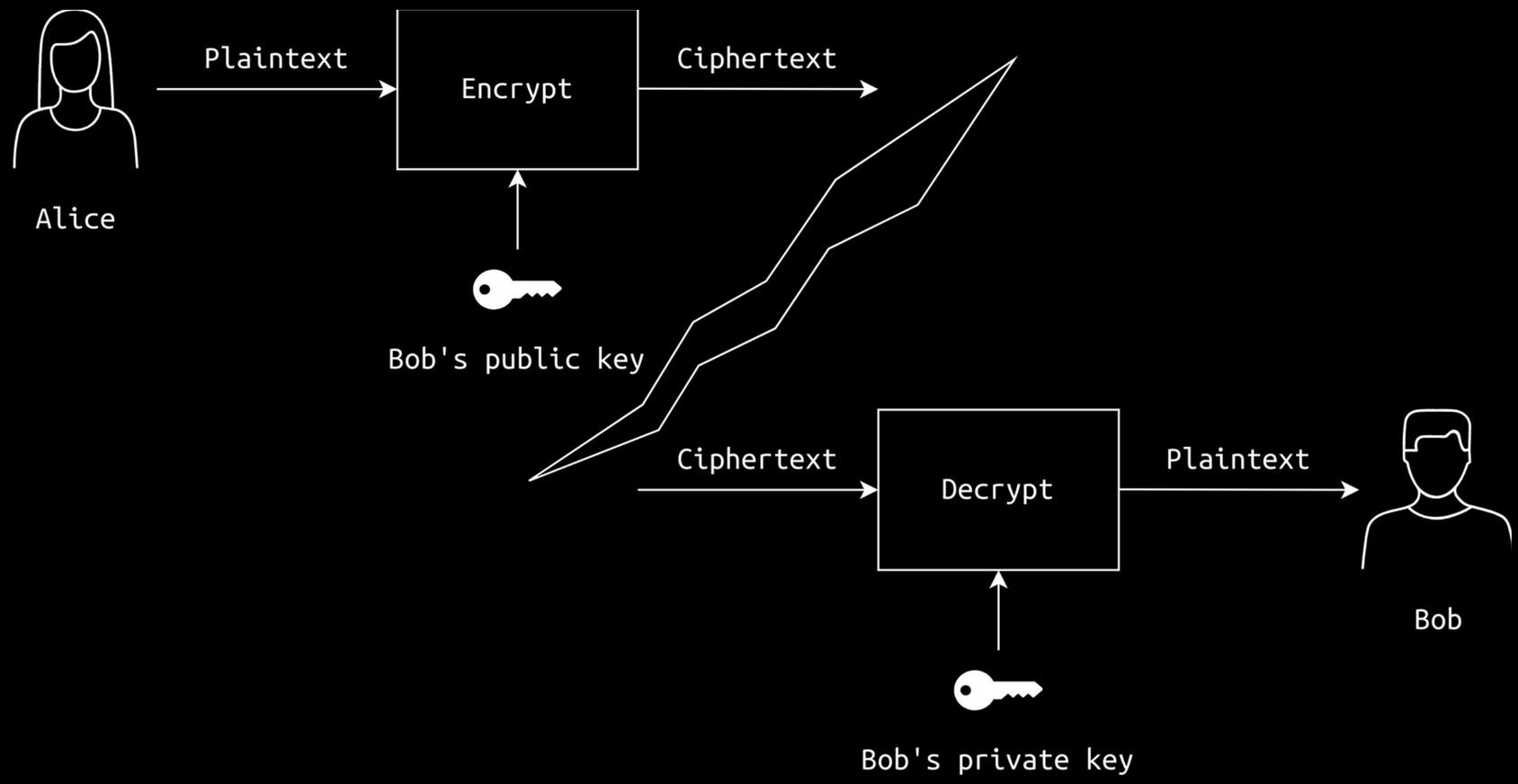
Symmetric Encryption



Asymmetric Encryption

Asymmetric Encryption or **Public-key cryptography**, uses **two different keys** - a **private key** and a **public key**. The private key is **kept secret**, while the public key is **shared freely**.

Asymmetric Encryption



RSA Algorithm

RSA is a **public-key** cryptosystem, one of the **oldest**, that is **widely** used for secure **data transmission**.

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RSA Mathematical Representation

1. Choose two random prime numbers, **p** and **q**. Calculate ***N = p × q***.

2. Choose two integers **e** and **d** such that **e × d = 1 mod ϕ(N)**, where: $\phi(N) = N - p - q - 1$

This step will let us generate the public key **(N,e)** and the private key **(N,d)**.

3. The sender can encrypt **a** value **x** by calculating: $y = x^e mod N$

4. The recipient can decrypt y by calculating: $x = y^d mod N$

Diffie-Hellman Key Exchange

Diffie-Hellman (DH) is a cryptographic **protocol** that **enables** two parties to agree on a **shared secret key** without prior **knowledge** of each other.

Diffie-Hellman Key Exchange

Alice

Chooses a

Sends A

0 Agree on q and g; e.g., 29 and 3

1 $A = g^a \bmod q = 3^{13} \bmod 29 = 19$

$B = g^b \bmod q = 3^{15} \bmod 29 = 26$ 2

Chooses b

Sends B

Bob

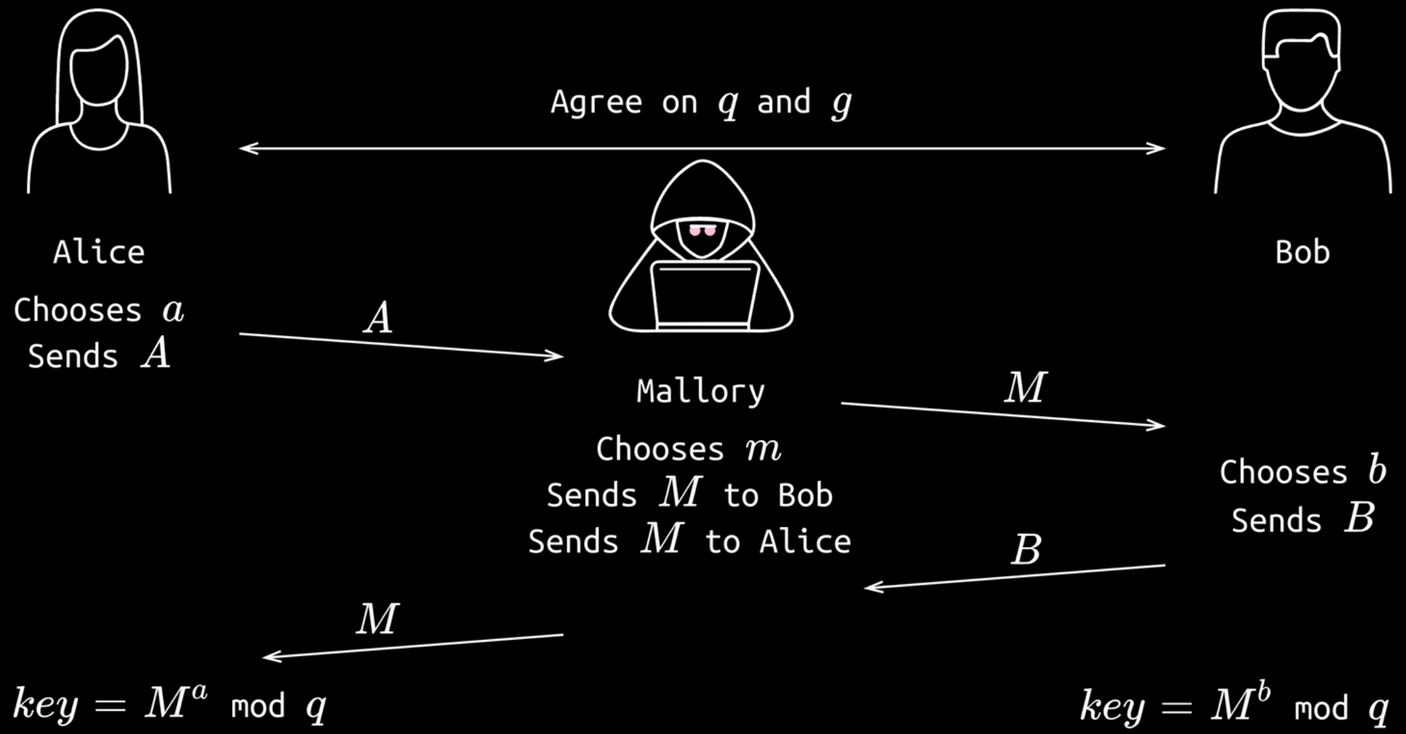
3 $key = B^a \bmod q$

$= 26^{13} \bmod 29 = 10$

4 $key = A^b \bmod q$

$= 19^{15} \bmod 29 = 10$

Man In the Middle Attack



The Diffie-Hellman (DH) key exchange is **vulnerable** to a **man-in-the-middle** attack.

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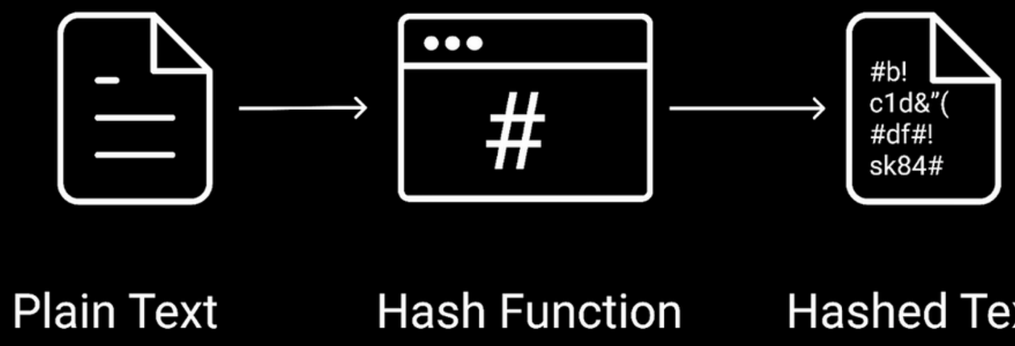
Public Key Infrastructure

Public Key Infrastructure (PKI) is a set of **rules** and **policies** that makes it possible for **different entities** to communicate **securely** over a **network**.

What is Hashing?

A **hash function** is a **mathematical algorithm** that takes an **input** (or ‘message’) and returns a **fixed-size string** of bytes, usually in the form of a **hexadecimal number.**



Message Digest Method 5

MD5 a cryptographic **hash algorithm** used to generate a **128-bit** digest from a **string of any length.**

Salting

Adding random **data** to the **input of a hash** function to **guarantee** a unique output, the **hash**, even when the **inputs are the same**.

Prepending the Salt

Password: hello@/0-2freesh
Salt: datae8300kd/as
Salted Input: datae8300kd/ashello@/0-2freesh

Hash (SHA-256):
f5ac26a91c388aaff9bd849a03ce888b91f1cf7474b07d68ea554d78d7426740

```
e2r1p8% echo -n  "datae8300kd/ashello@/0-2freesh" | openssl sha256
SHA2-256(stdin)= f5ac26a91c388aaff9bd849a03ce888b91f1cf7474b07d68ea554d78d7426740
```

Appending the Salt

Password: hello@/0-2freesh
Salt: datae8300kd/as
Salted Input: hello@/0-2freeshdatae8300kd/as

Hash (SHA-256):
614690e6eaf823b189bae26fc046e13598d67effeee253f4231305ae1832f1e3

```
e2r1p8% echo -n  "hello@/0-2freeshdatae8300kd/as" | openssl sha256
SHA2-256(stdin)= 614690e6eaf823b189bae26fc046e13598d67effeee253f4231305ae1832f1e3
```

What is Encoding?

Encoding is the process of transforming a set of Unicode characters into a **sequence of bytes**.

THANK YOU FOR YOUR ATTENTION

Any questions?