E-Security

1. Cryptography Fundamentals.
2. Symmetric Key Encryption.
3. Hashing and MAC.
4. Asymmetric (Public) Key Encryption.
5. Key Exchange.
6. Trust and Digital Certificates.
7. Tunnelling.
8. Cryptocurrencies and Blockchain.
9. Future Cryptography.
10. Host Security.

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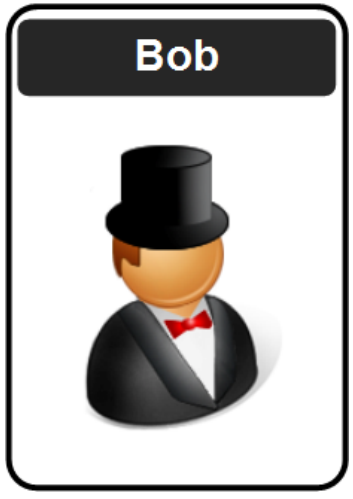
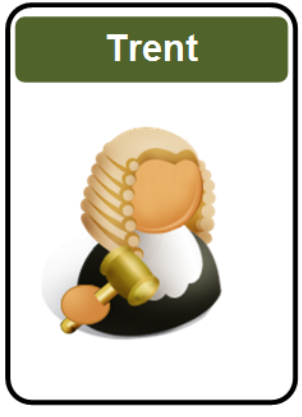
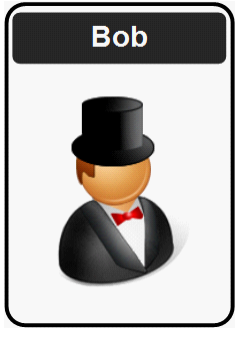
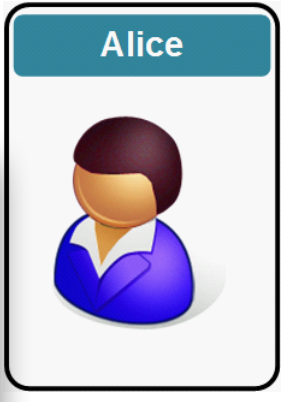
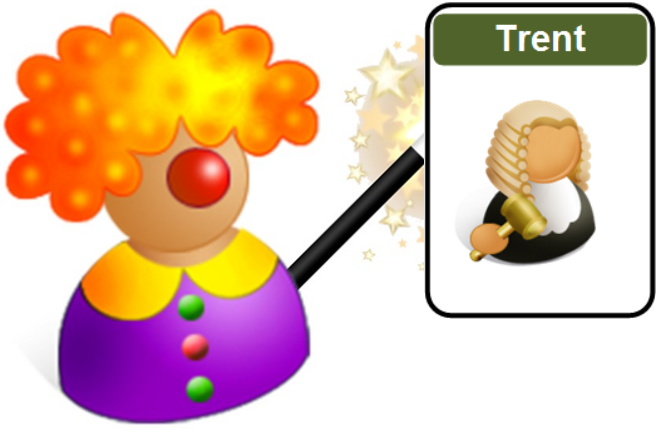




Disclaimer







- Encryption works great, until it doesn't.
- Encryption works great, as long as no one makes a mistake.
- Encryption works great, unless something goes wrong.
- Encryption works great, as long as everything works right.

Module Delivery

Web site

youtube.com

slack esecurityworkspace.com

Overleaf

@billatnapier

asecuritysite.com

github.com/billbuchanan/esecurity

Module Delivery

Web site

youtube.com

Lectures/Lab Demos

Overleaf

Coursework submission

ubuntu

Open SSL

Labs

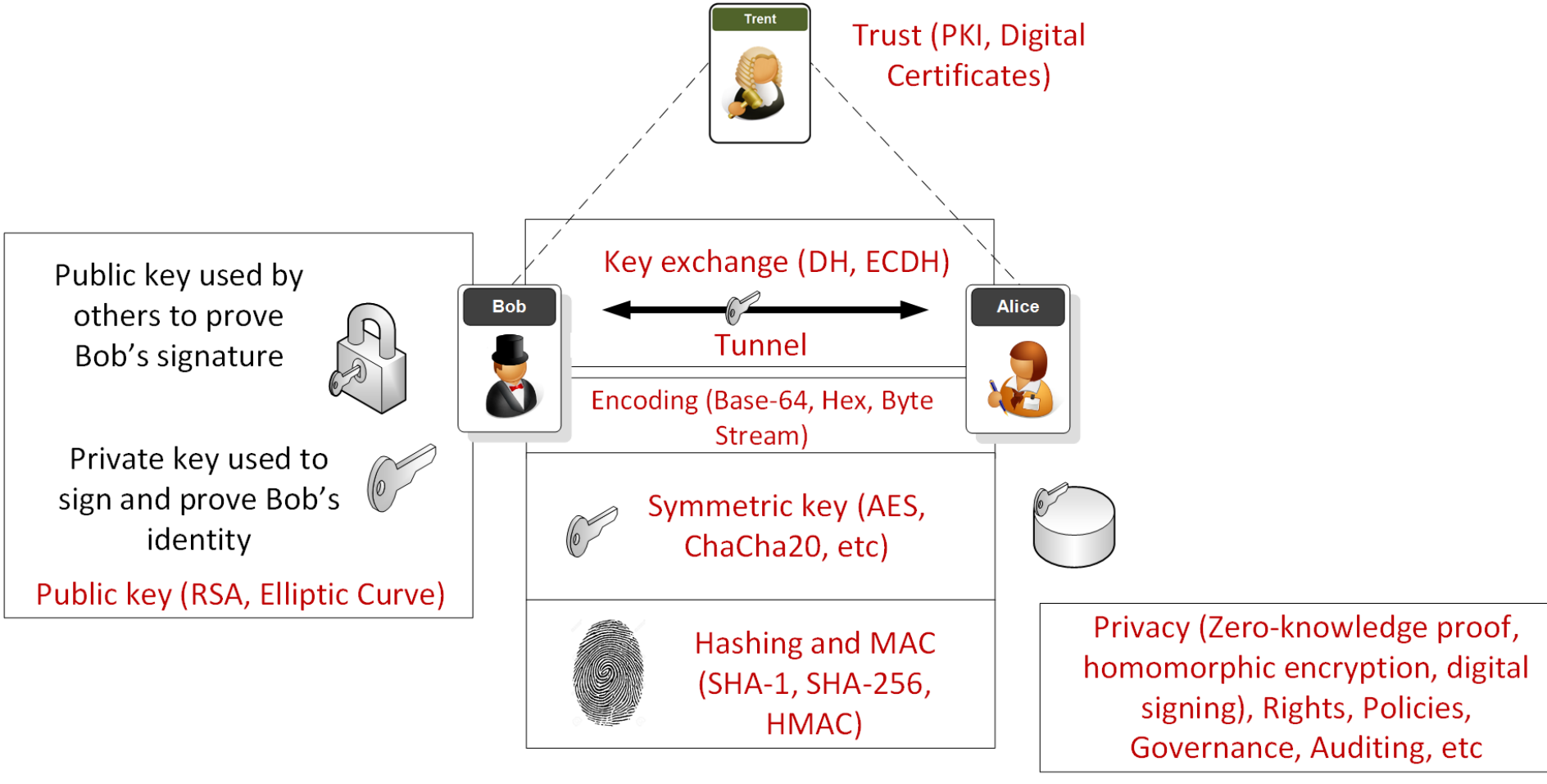
github.com/billbuchanan/esecurity

Draft Timetable

Web site

No	Date	Subject	Lab
1	18 Jan 2019	Ciphers and Fundamentals Unit	Lab [Link]
2	25 Jan 2019	Symmetric Key Unit	Lab [Link]
3	1 Feb 2019	Hashing and MAC Unit	Lab [Link]
4	8 Feb 2019	Asymmetric (Public) Key Unit	Lab [Link]
5	15 Feb 2019	Key Exchange Unit	Lab [Link]
6	22 Feb 2019	Guest lecture	Mini-project/Coursework
7	1 Mar 2019	Trust and Digital Certificates Unit	Lab [Link]
8	8 Mar 2019	Tunnelling Unit	Lab [Link]
9	15 Mar 2019	Test 1 (Units 1-7)	
10	22 Mar 2019	Blockchain Unit	Lab [Link]
11	29 Mar 2019	Future Cryptography Unit	Lab [Link]
12	5 April 2019	Host Security 1	
13	12 April 2019	Host Security 2	
Easter Break			
14	29 April 2019	Test 2 (Units 8-12)	
15	6 May 2019	Coursework Hand-in	

Overview


Trent
Trust (PKI, Digital Certificates)
Public key used by others to prove Bob's signature
Private key used to sign and prove Bob's identity
Public key (RSA, Elliptic Curve)
Bob
Key exchange (DH, ECDH)
Tunnel
Alice
Encoding (Base-64, Hex, Byte Stream)
Symmetric key (AES, ChaCha20, etc)
Hashing and MAC (SHA-1, SHA-256, HMAC)
Privacy (Zero-knowledge proof, homomorphic encryption, digital signing), Rights, Policies, Governance, Auditing, etc

1. Fundamentals

Traditional Ciphers.
Key-based Encryption.
Encoding Methods.
Frequency Analysis.
GCD.
Random Numbers.
Prime Numbers.
Big Integers.
Encryption Operators (MOD, XOR and Shift).

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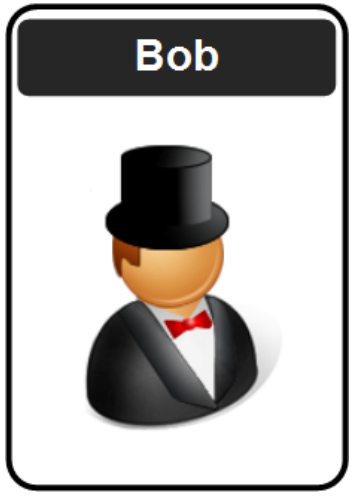
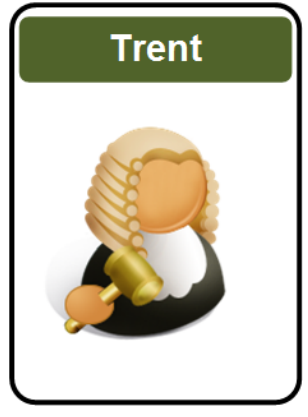
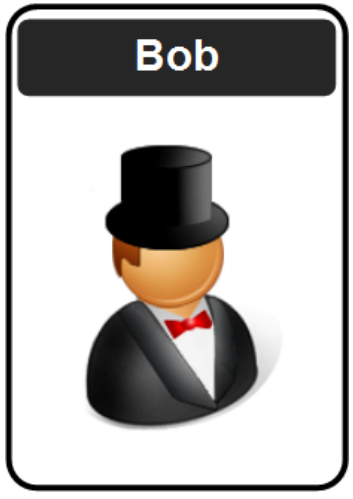
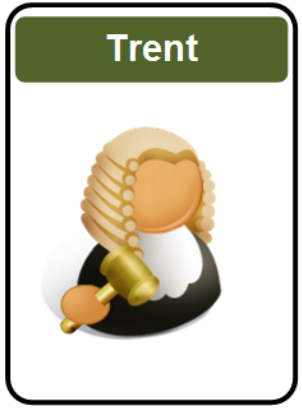




2. Symmetric Key





Basics
Block or Stream?
Secret Key Methods
Salting
AES
3DES
ChaCha20/Poly1305
Key Entropy

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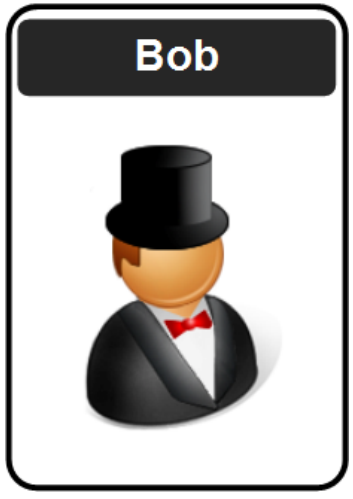
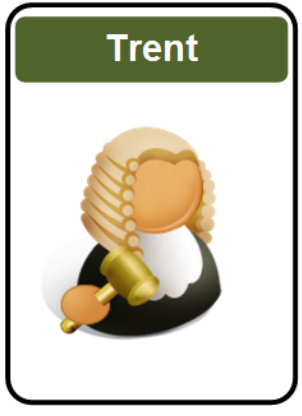
3. Hashing and MAC



Hashing Methods.
Cracking.
Typical Methods: MD5, SHA-1, SHA-3, LM, Bcrypt, PBKDF2
Hashed Passwords.
Timed One Time Passwords.
Message Authentication Codes (MACs).



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4. Asymmetric Key

Principles.
RSA.
Elliptic Curve.
Using Private Key to Authenticate.
PGP: Signed Email.

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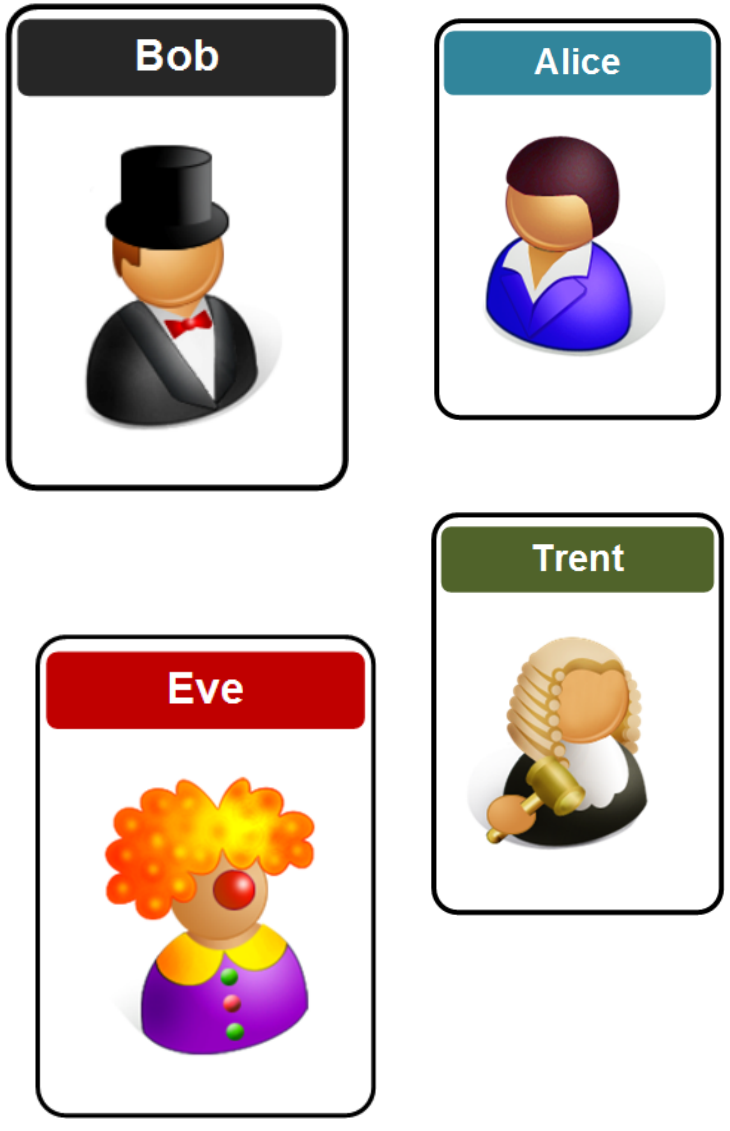
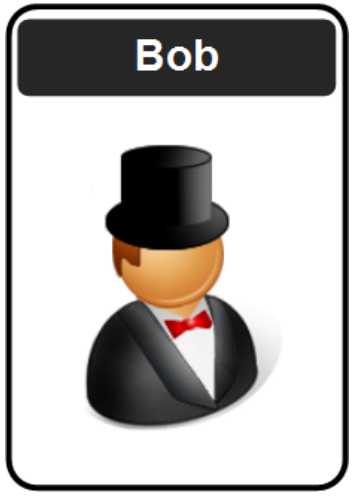


5. Key Exchange

Principles.
Diffie-Hellman (DH).
Passing the secret key with key exchange.
Elliptic Curve Diffie-Hellman (ECDH)



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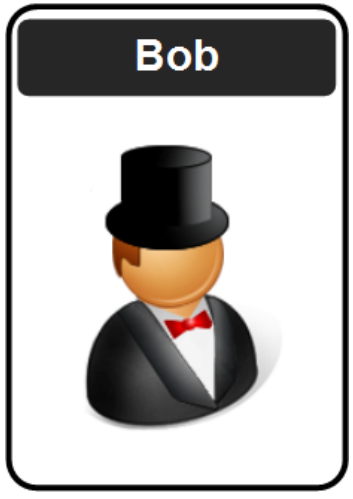
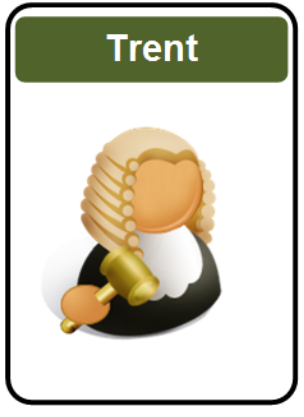
6. Trust and Digital Certificates





Principles.
Trust Infrastructures.
PKI Infrastructure.
Creating Signed Certificates.
Signatures (ECDSA, Hashed-based).

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7. Tunnelling

SSL/TLS.
Key generation/key exchange.
SSH.
IPSec.

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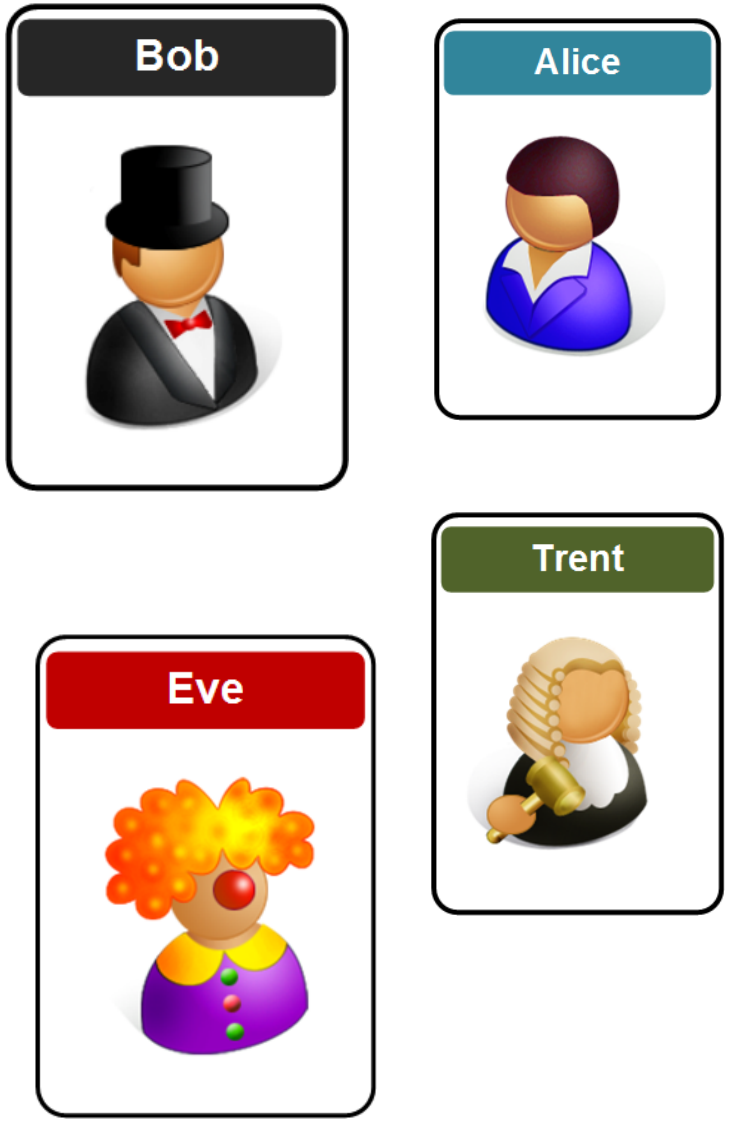
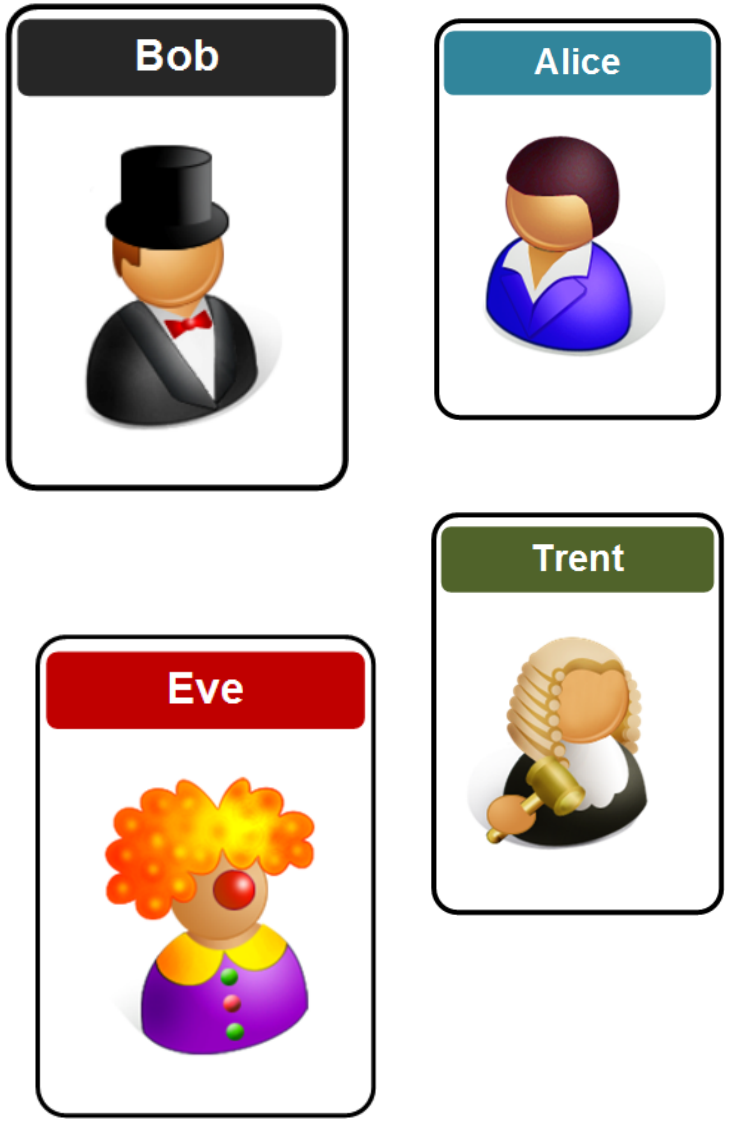


8. Blockchain & Cryptocurrencies

Principles.
Bitcoin.
Ethereum.
Smart Contracts.



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9. Future Crypto

Zero knowledge proof.
Homomorphic encryption.
Light-weight crypto.
Quantum-robust cryptography.

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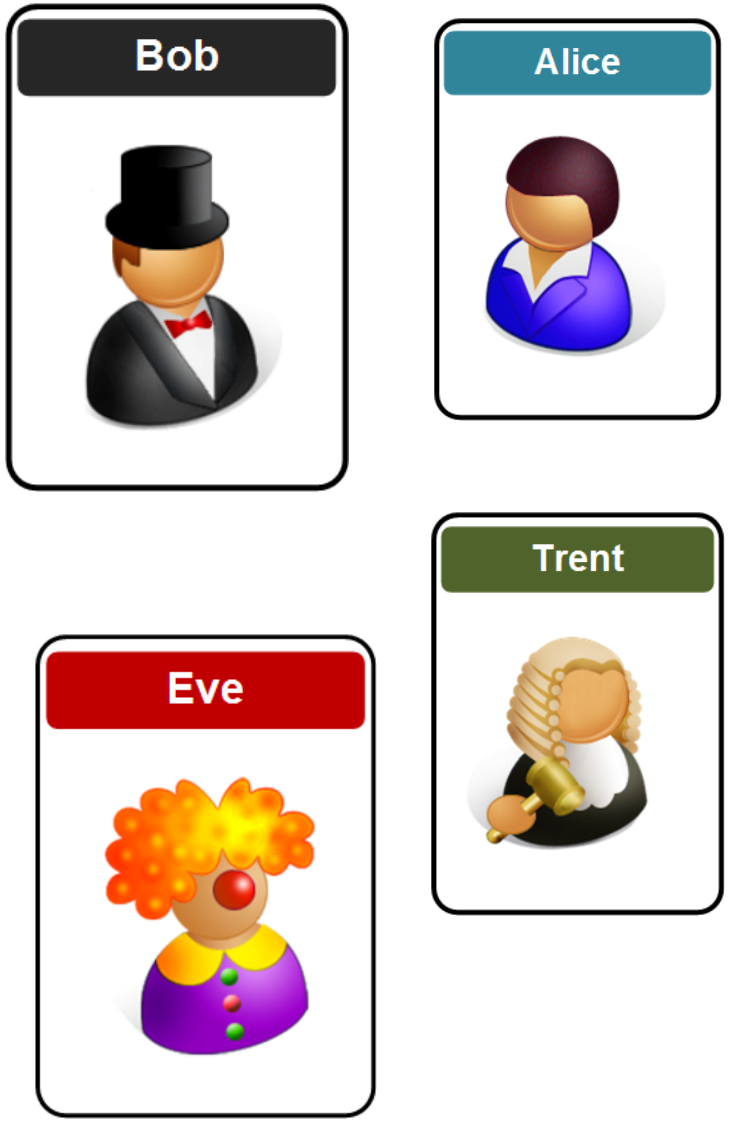

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