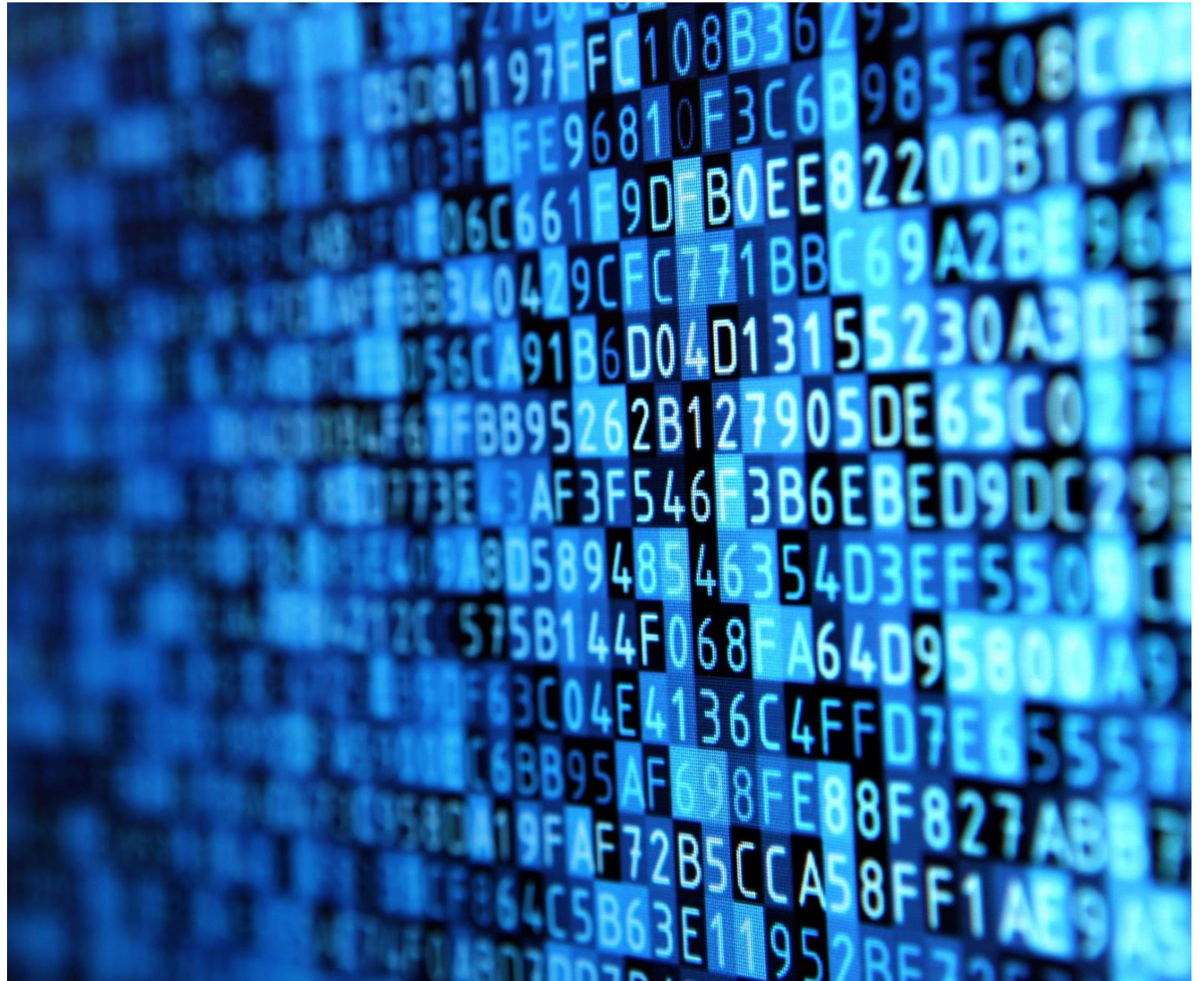


# Cryptography

Past, Present,  
and Future



# Historical Cryptography

7th Century BC – Scytale

1st Century BC – Caesar  
Cipher

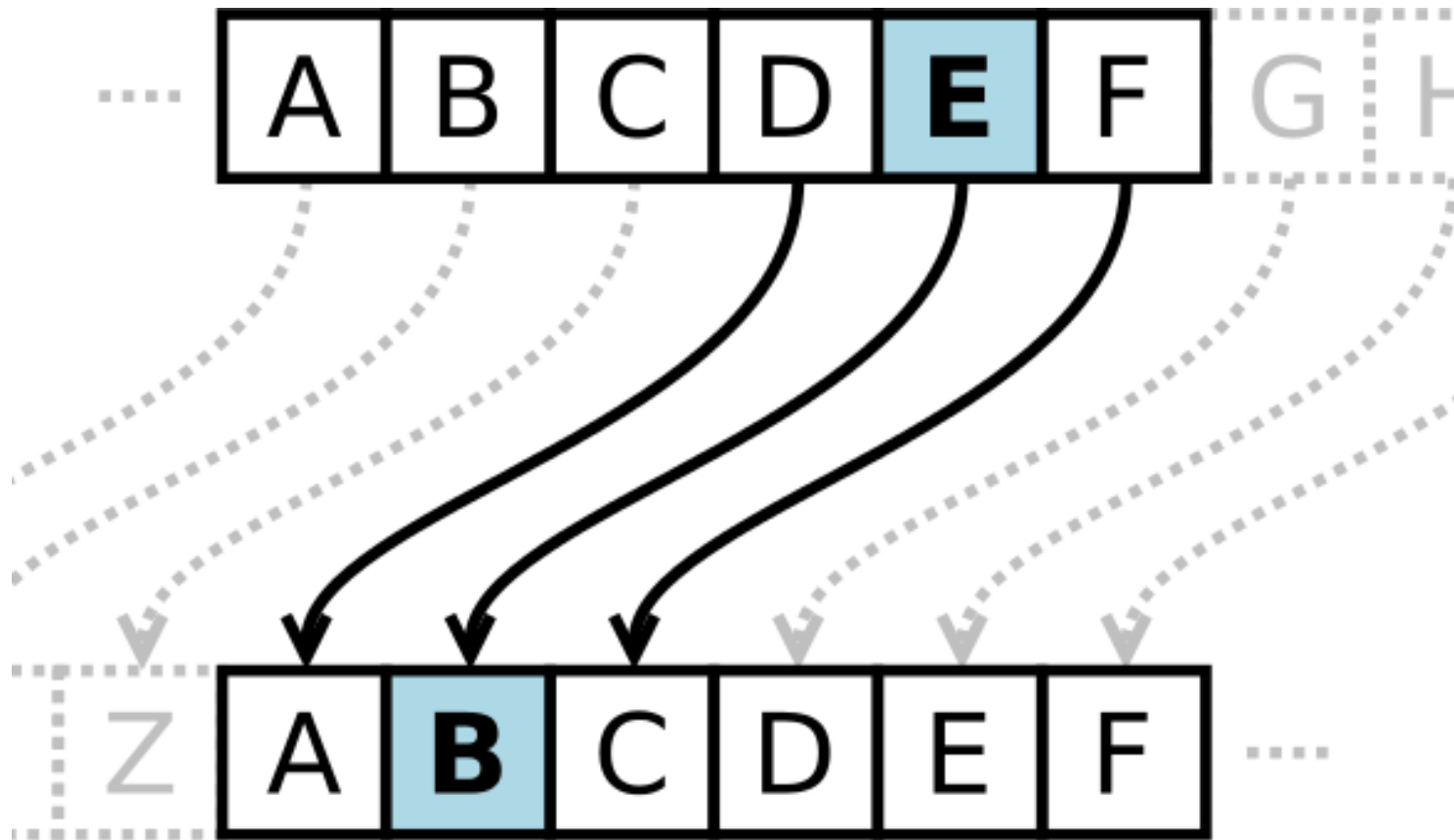
1500's - Vigenère Cipher

# Scytale



- As old as 7th century BC.
- Used by ancient Roman military.
- Transposition cipher.
- May have been used as authentication, not encryption.

# Caesar Cipher



- As old as 1st century BC.
- Used by ancient Roman military.
- Shift-style, monoalphabetic substitution cipher.



# Vigenère Cipher

- Developed in the 1500's.
- Multi-alphabetic substitution cipher.
- Cracked in the mid-1800's but saw continued use throughout the American Civil War.

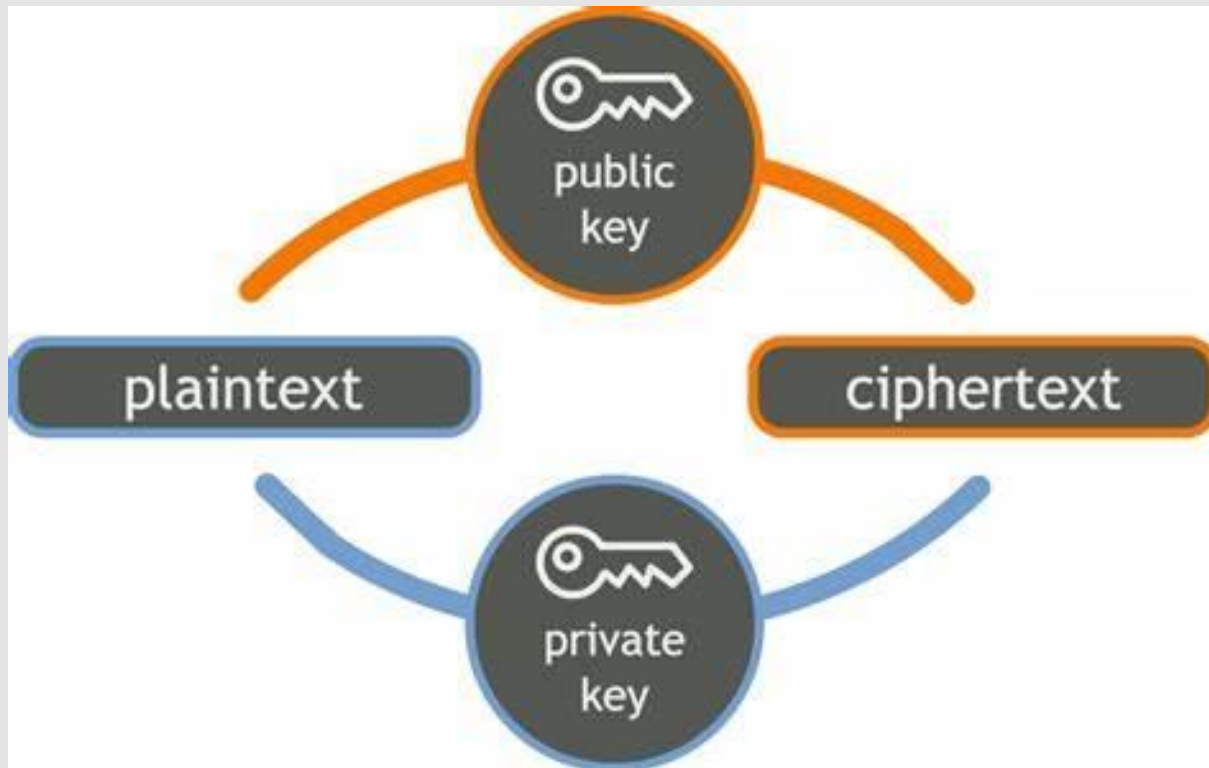
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B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
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J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
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M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
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T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
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V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
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Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

# Modern Cryptography

Rivest-Shamir-  
Adleman (RSA)

Advanced Encryption  
Standard (AES)

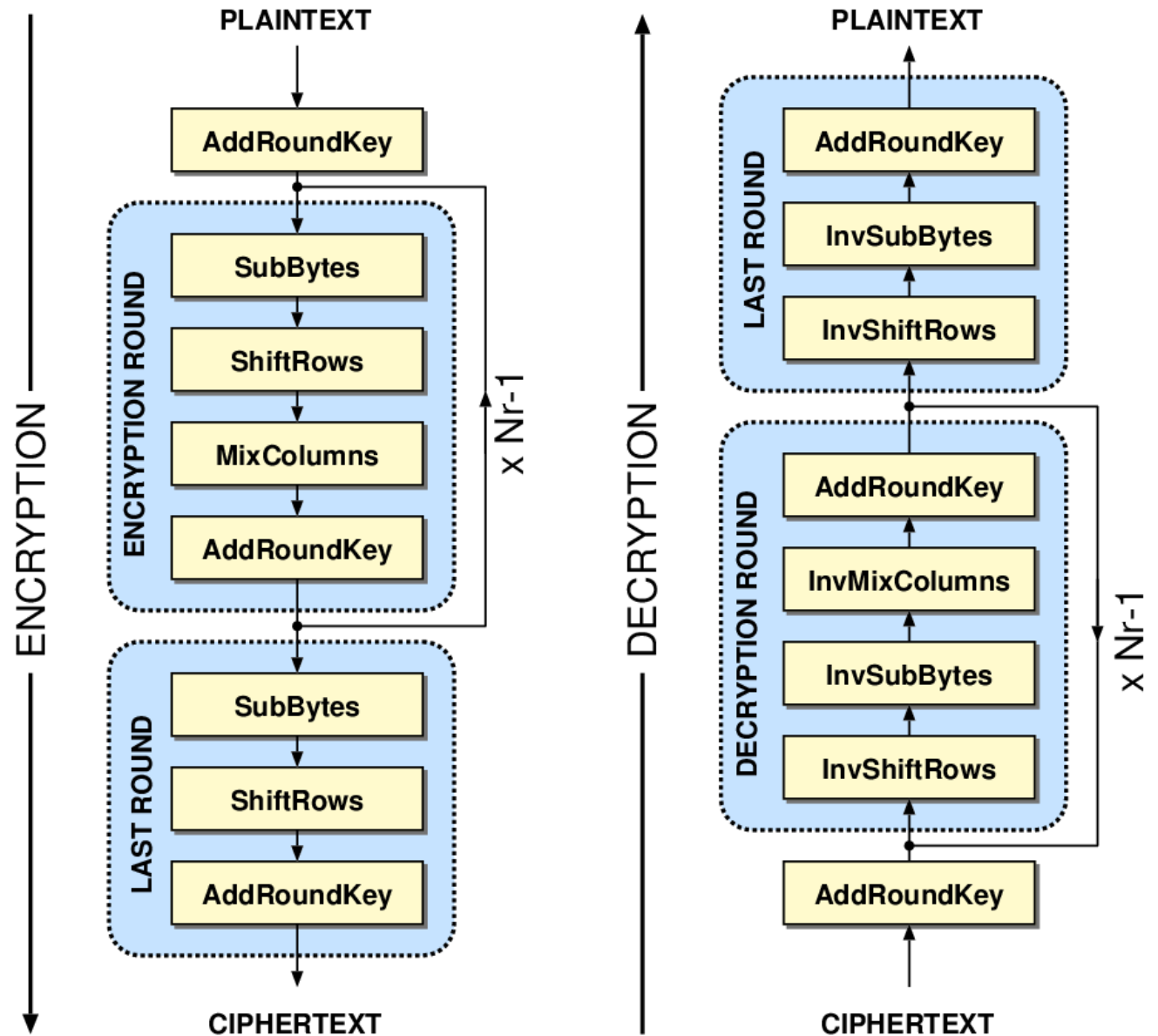
# RSA



- Developed in the 1970's by MIT students.
- Uses a two key, asymmetric system.
- Each user has a matching pair of keys:
  - Private key is kept secure locally.
  - Public key is shared with other users.
- Relies on the difficulty of factoring large prime numbers.

# AES / Rijndael

- Developed in the 1990's by Dutch cryptographers.
- Symmetric block cipher encryption.
- 128-, 192-, and 256-bit keys.
- Data goes through multiple rounds of sequential encryption, depending on key length.





# Future Cryptography

Quantum  
Computing

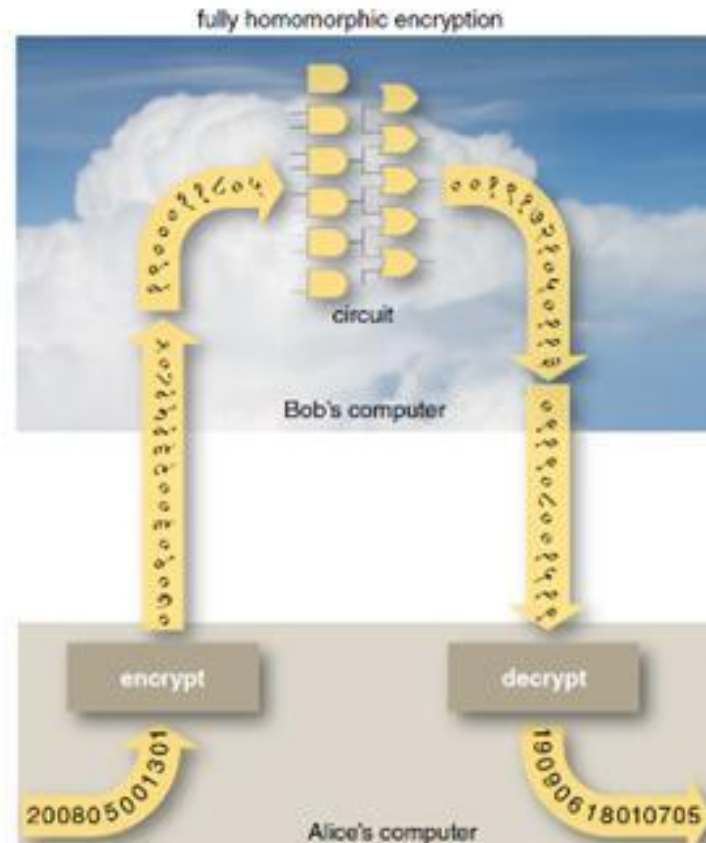
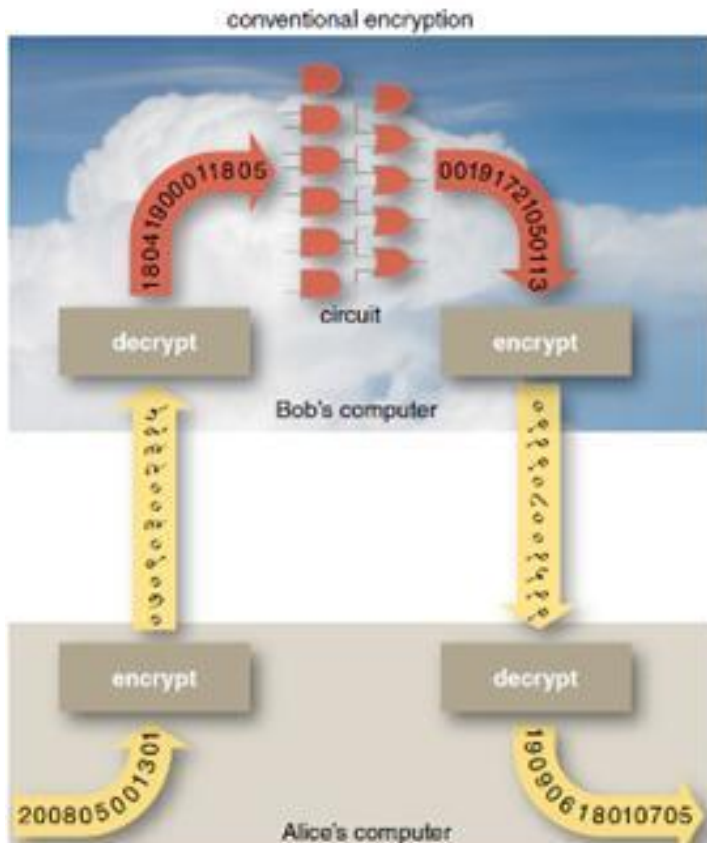
Homomorphic  
Encryption

# Quantum Computing



- Machines operate on qubits instead of bits.
- Based on quantum mechanics allowing qubits to exist as both on and off at the same time.
- Algorithms already exist to quickly factor large prime numbers.

# Homomorphic Encryption



- New encryption standard for cloud computing.
- Allows encrypted data to be mathematically and logically manipulated without being decrypted first.
- Removes a major security risk in using cloud architecture.