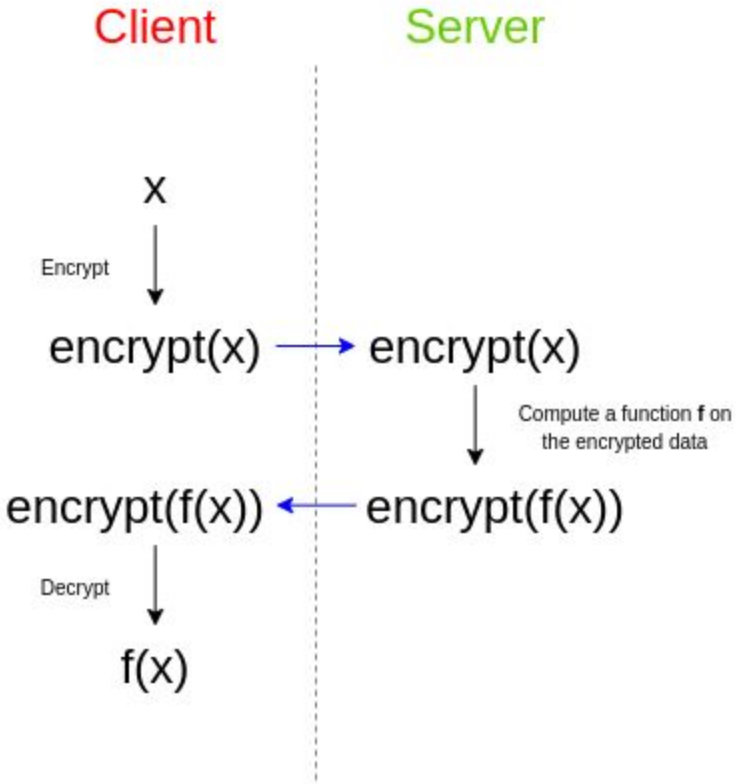
Homomorphic Encryption

Aakanksha Duggal
Senior Data Scientist
ET Data Science Team

Red Hat

What is Homomorphic Encryption?



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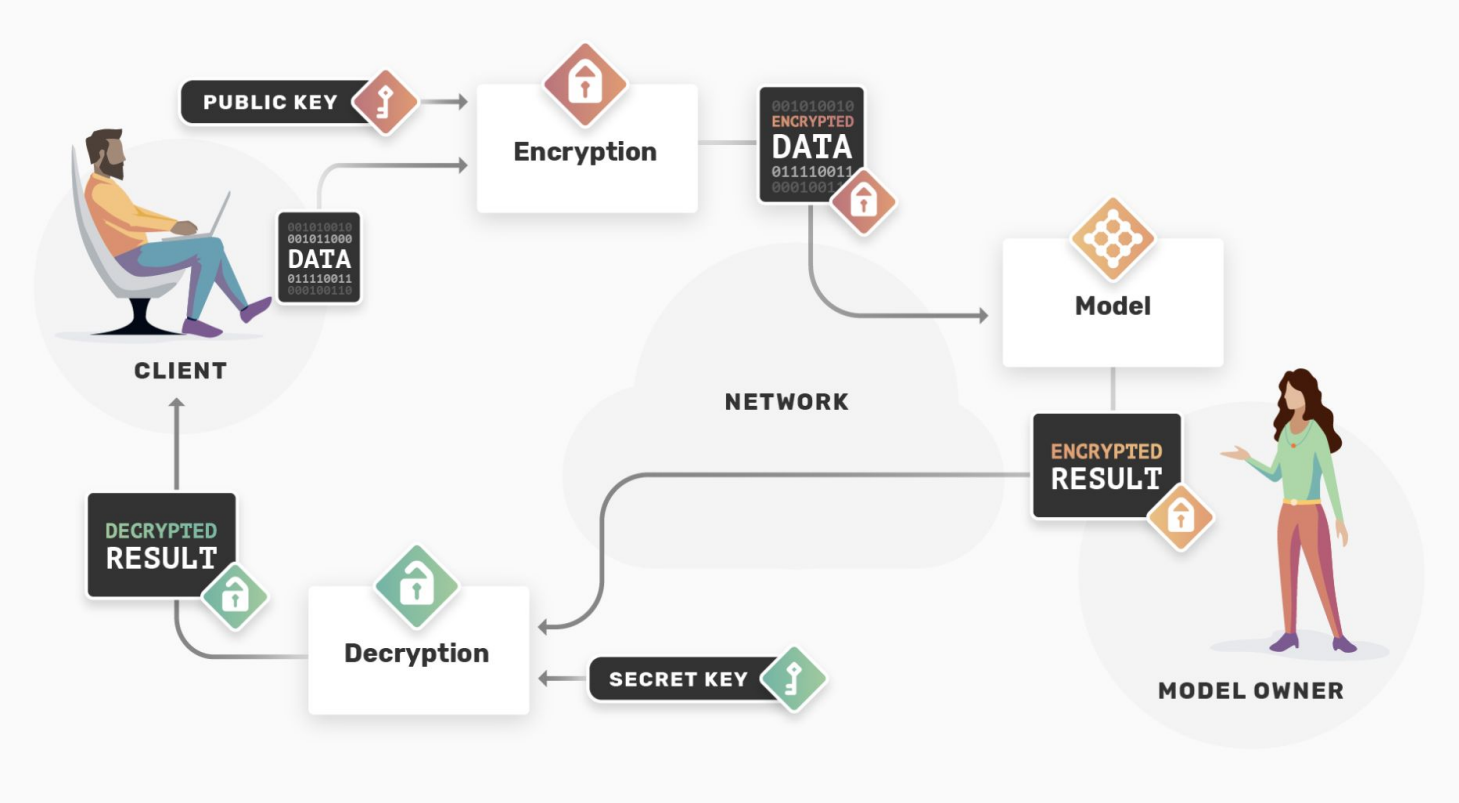
What is Homomorphic Encryption?



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Applications of Homomorphic Encryption

Telco
Telecommunications

Software Companies

Transportation
Car

Government (general)
Government

Aerospace/defense
Fighter jet

Healthcare
Heart monitor

Financial services
Money

Hybrid cloud infrastructure

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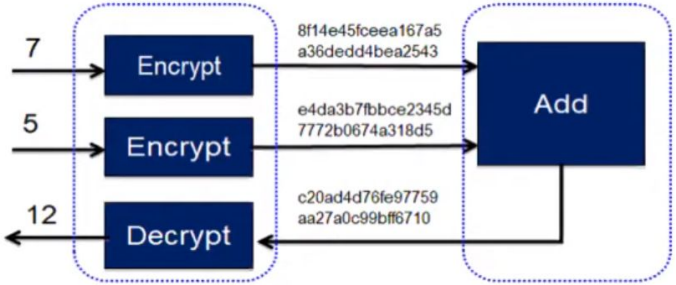
Homomorphic Encryption



Advantages

- Perform inference on encrypted data
- No interaction between the data and the model owners
- Data Storage outsourcing

Disadvantages

- Computationally expensive
- Limited calculations and operations

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Homomorphic Encryption

Partially HE (PHE)

Supports only one operation
“+ Or x”

Paillier Partially HE

Somewhat HE (SHE)

Supports only two operations
But limits to a certain operations.

BFV Scheme

Fully HE (FHE)

Can support any number of complex operations.

CKKS and BGV Scheme

Comparison Study

	+	-	x					
Pallier (PHE)	✔		✔					
BFV (SHE)	✔	✔	✔					
CKKS (FHE)	✔	✔	✔					

Comparison Study

	+	-	x	Python-paillier				
Pallier (PHE)	✔		✔	✔				
BFV (SHE)	✔	✔	✔	❌				
CKKS (FHE)	✔	✔	✔	❌				

Comparison Study

	+	-	x	Python-paillier	PySEAL/ SEAL-python			
Pallier (PHE)	✔		✔	✔	❌			
BFV (SHE)	✔	✔	✔	❌	✔			
CKKS (FHE)	✔	✔	✔	❌	✔			

Comparison Study

	+	-	x	Python-paillier	PySEAL	pyFHE		
Pallier (PHE)	✔		✔	✔	❌	❌		
BFV (SHE)	✔	✔	✔	❌	✔	✔		
CKKS (FHE)	✔	✔	✔	❌	✔	✔		

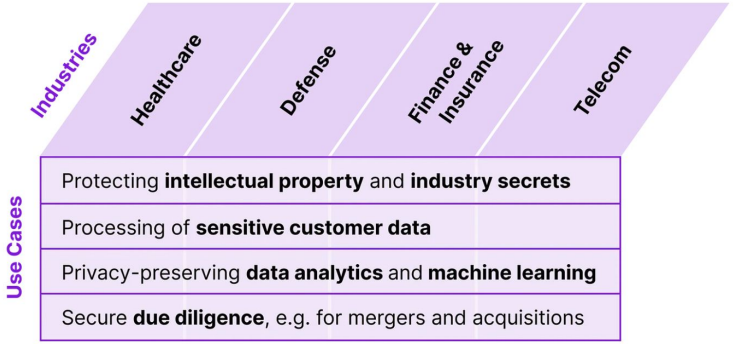
Comparison Study

	+	-	x	Python-paillier	PySEAL	pyFHE	PyFHEL	
Pallier (PHE)	✔		✔	✔	❌	❌	❌	
BFV (SHE)	✔	✔	✔	❌	✔	✔	✔	
CKKS (FHE)	✔	✔	✔	❌	✔	✔	✔	

Comparison Study

	+	-	x	Python-paillier	PySEAL	pyFHE	PyFHEL	TenSEAL
Pallier (PHE)	✔		✔	✔	❌	❌	❌	❌
BFV (SHE)	✔	✔	✔	❌	✔	✔	✔	✔
CKKS (FHE)	✔	✔	✔	❌	✔	✔	✔	✔

Homomorphic Encryption vs Confidential computing



Use cases and industries for which HE and CC are relevant

HE

- **No specialized hardware**
- Lack of hardware for compute intensive tasks
- Lack of attestation mechanism

CC

- **Works with hardware**
- Limited to a certain places to execute
- attestation mechanism ensures data and code integrity

Source : https://blog.edgeless.systems/the-differences-between-homomorphic-encryption-and-confidential-computing-and-when-to-use-what-bea3fb0ddfd

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Thank you, questions?

- Github - https://github.com/redhat-et/homomorphic-learning/


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