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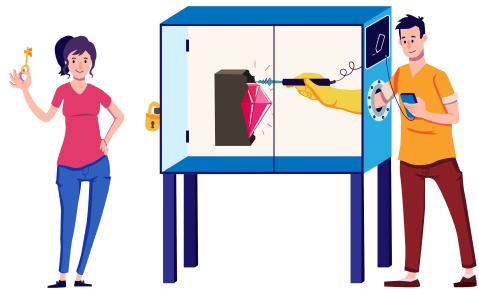
Open Source Framework for Hybrid Homomorphic Encryption

Lukas Helminger, Daniel Kales, Christian Rechberger, **Roman Walch**

FSE 2020 Rump Session

Hybrid Homomorphic Encryption

- Evaluate symmetric ciphers under homomorphic encryption
- Why?
  - Ciphertext expansion prevention
  - See also Dasta talk from Monday
- Relevant metrics:
  - Multiplicative depth (AND-depth)
  - ANDs per encrypted bit

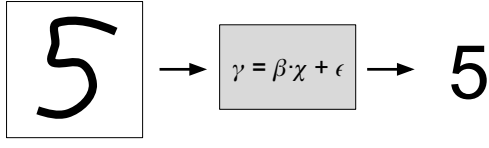


HHE Schemes

- So far:
  - Many candidate schemes
  - Many different HE libraries
  - But: No meaningful comparison done/possible
- Which scheme is best suited for
  - ... which metric?
  - ... which HE library?
  - ... which use case afterwards?

Benchmarking Framework

- No meaningful comparison done/possible → until now!
- We build a open-source Framework:
  - Compares candidate schemes in different libraries
  - Benchmarks use cases afterwards
  - Easy integration of new designs
- Small use cases from Privacy-Preserving Machine Learning
  - E.g. linear regression to identify handwritten digits



Benchmarking Framework – Status

- So far:
  - Implementations of candidate ciphers in three different libraries
  - Small benchmarks

	SEAL	HElib	TFHE
Rasta	✓	✓	✓
Agrasta	✓	✓	✓
Dasta	✗	✗	✗
FiLIP	✓	✓	✓
Kreyvium	✓	✓	✓
LowMC	✓	✓	✓

Benchmarking Framework – Status (cont.)

- Up next:
  - Implement missing ciphers
  - Extensive Benchmarks
  - Compare to orthogonal approach
    - E.g. LWEs $\rightarrow$ RLWE [CDKS20]
  - Publish Code
    - Will be available at `https://github.com/IAIK/hybrid-HE-framework`

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