Fast verified post-quantum software, part 1: RAM subroutines

D. J. Bernstein

Performance pressure $\Rightarrow$
tons of new crypto software $\Rightarrow$
many mistakes passing tests $\Rightarrow$
frequent security disasters.

e.g. 2019.06 "Warning: Google Researcher Drops Windows 10 Zero-Day Security Bomb": modular inverse.

e.g. 2019.09 "Produced signatures were valid but leaked information on the private key": Falcon.

e.g. 2019.10 "Minerva attack can recover private keys from smart cards, cryptographic libraries".

e.g. 2020.08 "A key-recovery timing attack on ... FrodoKEM".

e.g. 2020.12 "It looks like the FrodoKEM team also fixed the timing oracle [GJN20] badly and caused a more serious security problem while trying to do that."

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`opt4` → `opt5` → $\cdots$ → `avx2`.
Some manual steps, some tools.
CPUs share some steps.

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verify equivalence of
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Doesn't require verifying
that the tool *always* works.

"Transformation verification":
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this is done, great!

Again, look at Keccak.

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automated speedups.

Verifying fast software

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opt4 → opt5 → · · · → avx

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Separation promotes independent
speedups in (1) the development
process and (2) the verification
process: e.g., vectorization is
often challenging for development
but trivial for verification.