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Fast verified post-quantum software, part 1: RAM subroutines
D. J. Bernstein

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If all of this is done, great!
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Optimization experts: spec → opt → opt2 → opt3 →
opt4 → opt5 → ... → avx2.
Some manual steps, some tools.
CPUs share some steps.
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Verifying fast software

Optimization experts:
spec → opt → opt2 → opt3 → opt4 → opt5 → ⋯ → avx2.
Some manual steps, some tools.
CPUs share some steps.

“Translation validation”:
verify equivalence of
tool output to tool input.
Doesn’t require verifying
that the tool always works.

“Transformation verification”:
verify equivalence of
manual output to manual input.

Allowing new verification chains

For verification, suffices to build
spec ↔ verif ↔ verif2 ↔ verif3 ↔ ⋯ ↔ avx2.
Don’t try to force this chain to
match the development path
spec → opt → opt2 → opt3 → opt4 → opt5 → ⋯ → avx2.
Verifying fast software

Optimization experts:

\[
\text{spec} \rightarrow \text{opt} \rightarrow \text{opt2} \rightarrow \text{opt3} \rightarrow \\
\text{opt4} \rightarrow \text{opt5} \rightarrow \cdots \rightarrow \text{avx2}.
\]

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Optimization experts:

spec → opt → opt2 → opt3 → opt4 → opt5 → ··· → avx2.

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Allowing new verification chains

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Don’t try to force this chain to match the development path spec → opt → opt2 → opt3 → opt4 → opt5 → ··· → avx2.

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.