ASAP: High Security at Low Overhead

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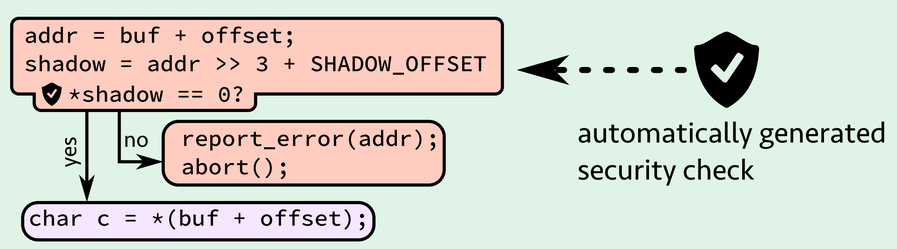
Problem: Security is too expensive

Systems software is written in unsafe languages (for performance reasons)

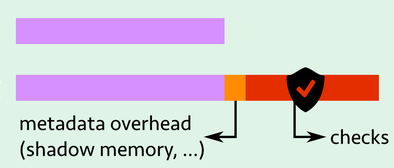
```
char c = *(buf + offset);
```

Security is retrofitted through instrumentation

$ gcc -fsanitize=address prog.c -o safeprog



Performance suffers



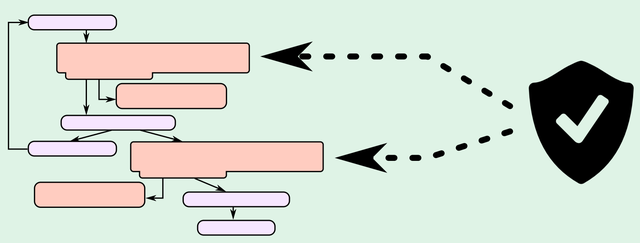
typically: 74% overhead, of which
87% due to checks
13% due to other sources

Solution: Given an overhead budget, maximize security

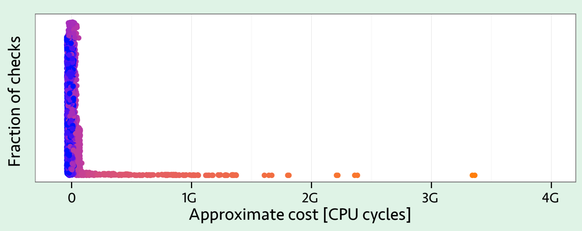
User specifies tolerable overhead

"I want bzip2 with **< 10%** overhead."

Our tool ASAP automatically recognizes security checks in program bitcode



ASAP performs a cost analysis for every check



Checks in bzip2 and their cost

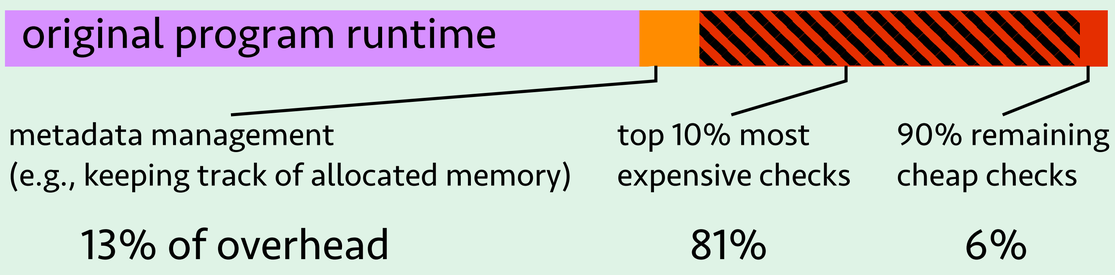
ASAP selects checks that maximize security for the desired overhead level.

overhead: **9.2%**
security: **> 90%**

Result of optimizing bzip2 with ASAP

Key insights

Overhead is dominated by a handful of expensive checks

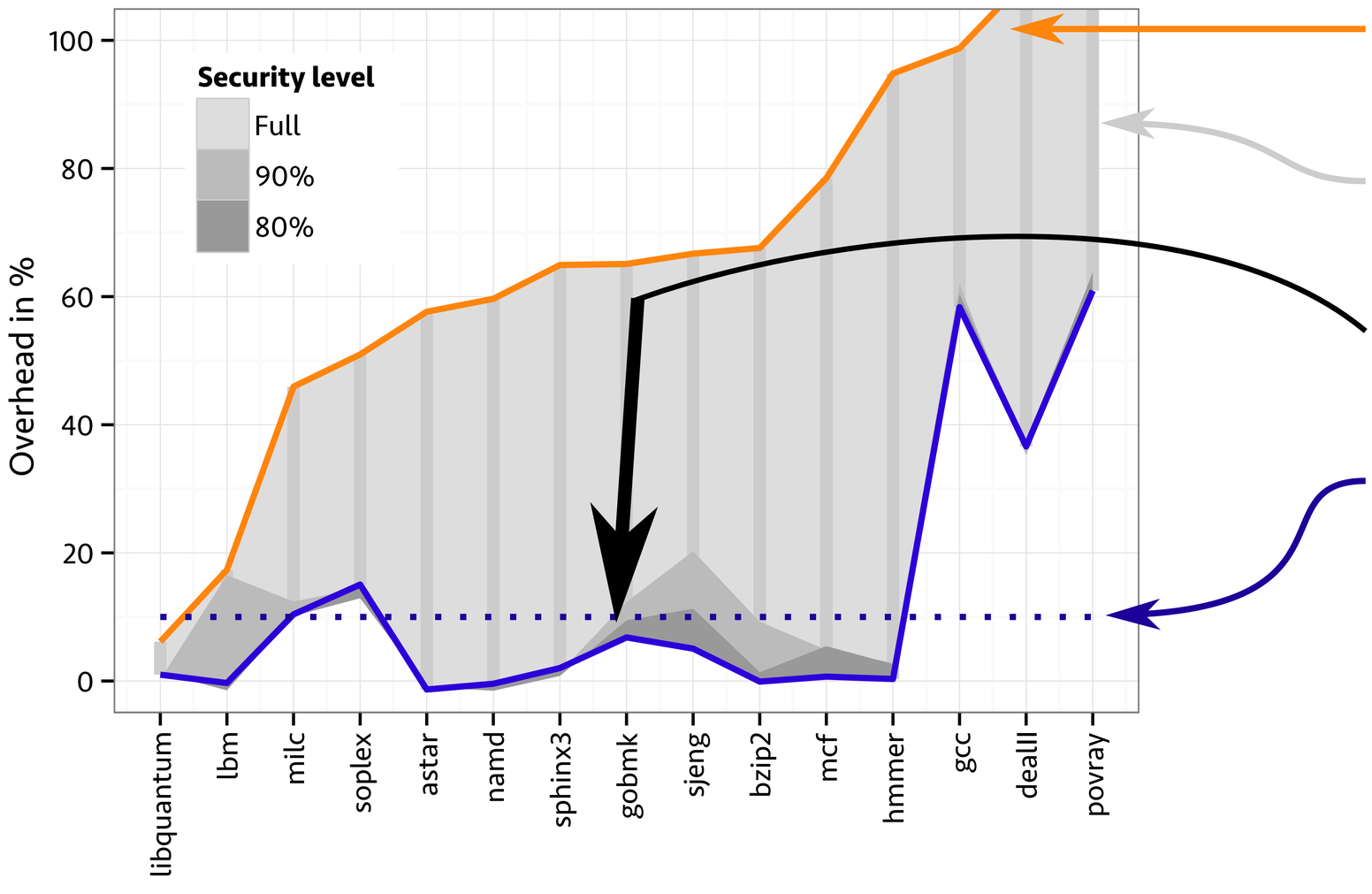


Security is provided primarily by many cheap checks

Our experiments show that:

- 97% of all memory-related CVE vulnerabilities are in cold code, where checks are cheap
- Checks in buggy code are colder than checks in stable code

Experimental results



Existing tools like AddressSanitizer have a high overhead (avg: 74%)

With ASAP:
Choose perfect overhead/security trade-off

ASAP strongly reduces overhead while preserving most of the security

Achieves target overhead of <10% for 10 out of 15 SPEC benchmarks

ASAP prevents the Heartbleed vulnerability with only 5% reduction in OpenSSL throughput

Security checks logo by http://icons8.com/