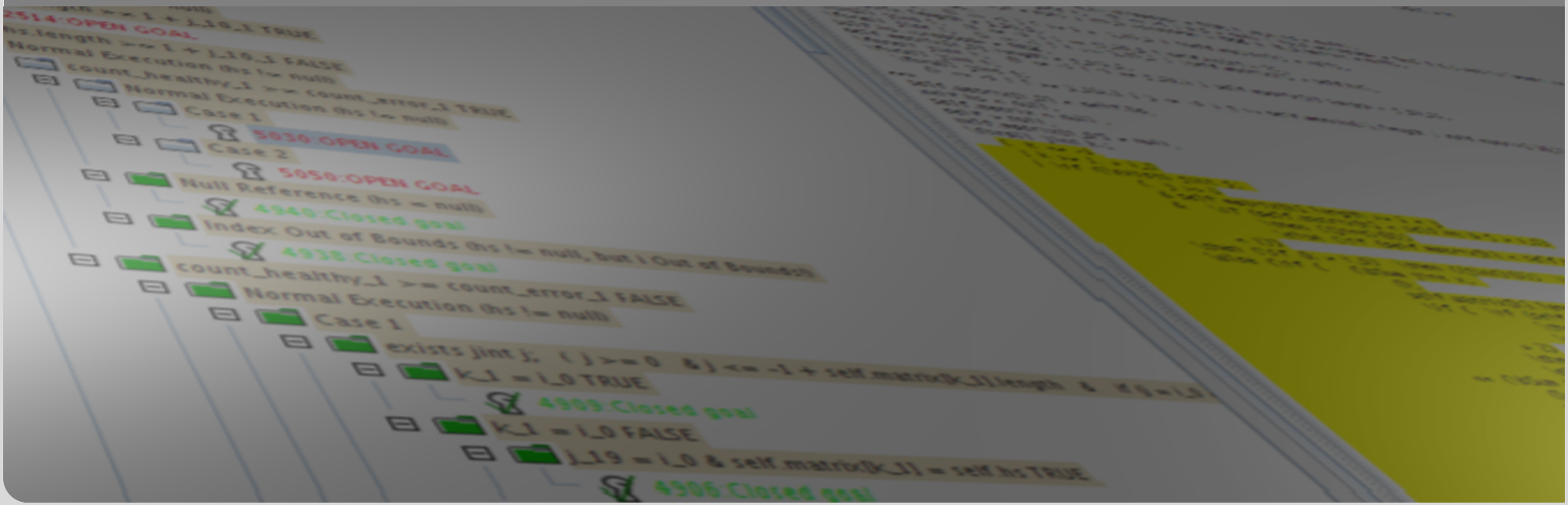
Karlsruhe Institute of Technology

Program Verification: Next Steps For Usability

Usable Verification 2010

Peter H. Schmitt and Mattias Ulbrich | November 16, 2010

LOGIC AND FORMAL METHODS



Overview

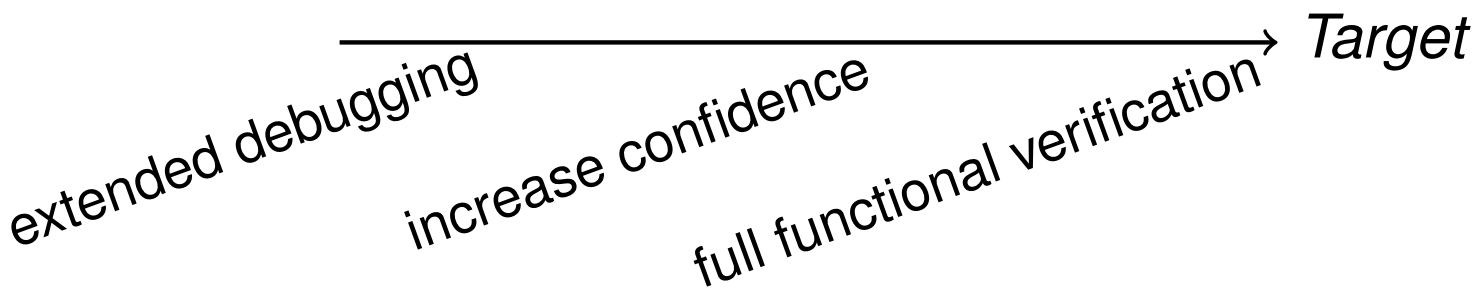
Who we are

- Deductive Java source code verification
- Dynamic logic, symbolic execution
- JML
- Combine interaction and automation

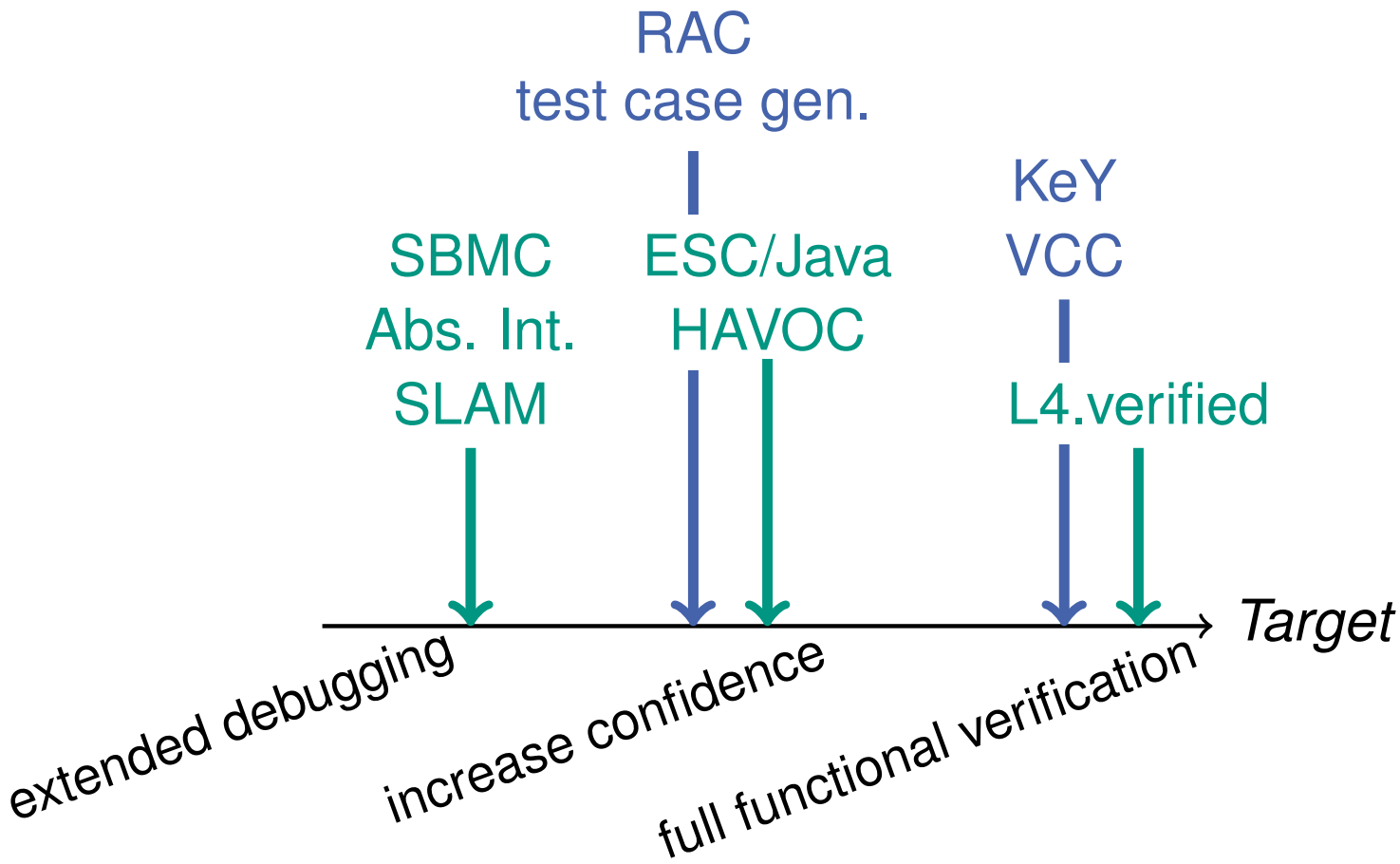
What we did

1. Our view of the field
2. next steps for more usable verification systems

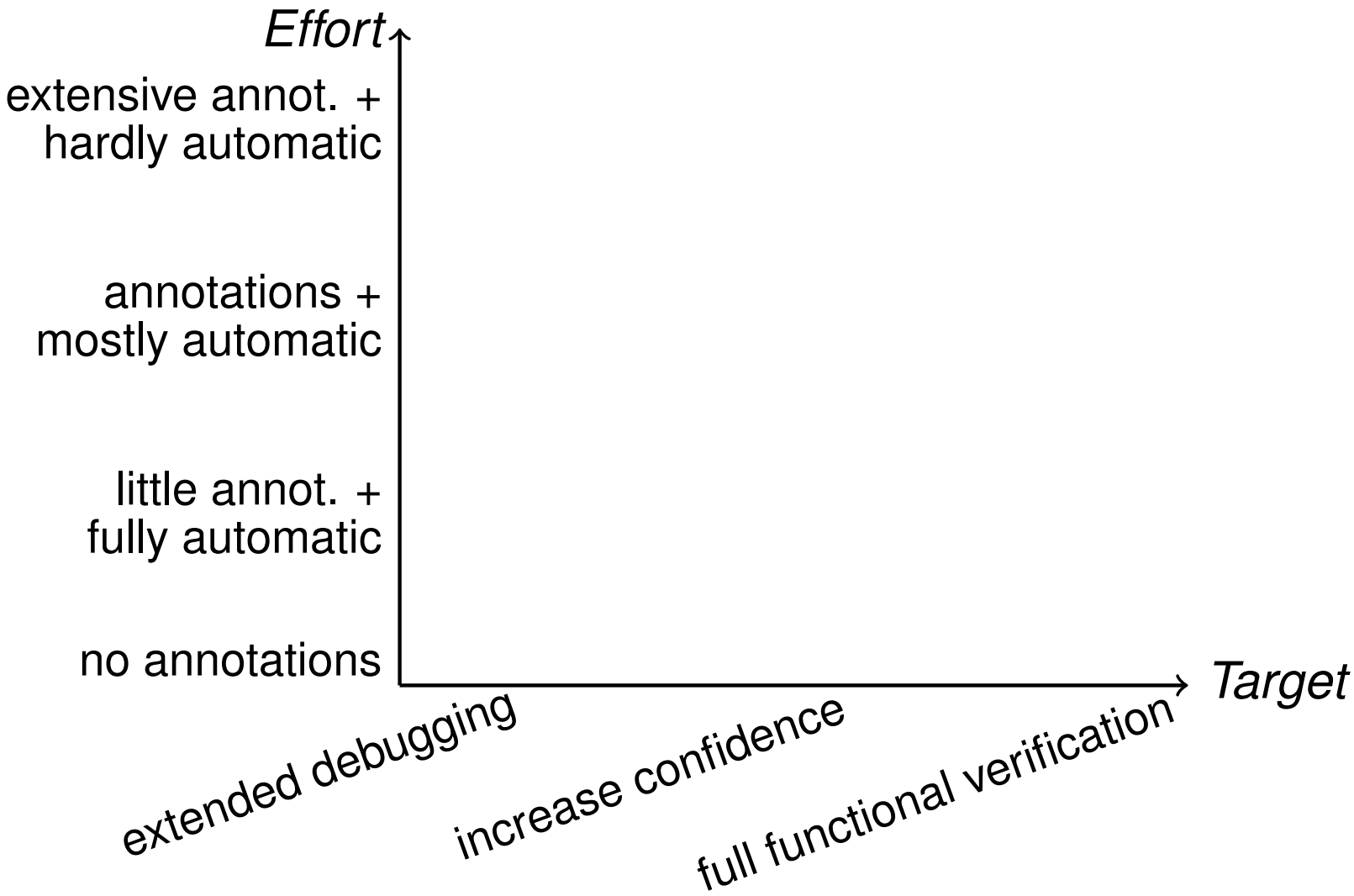
Program verification



Program verification



Program verification



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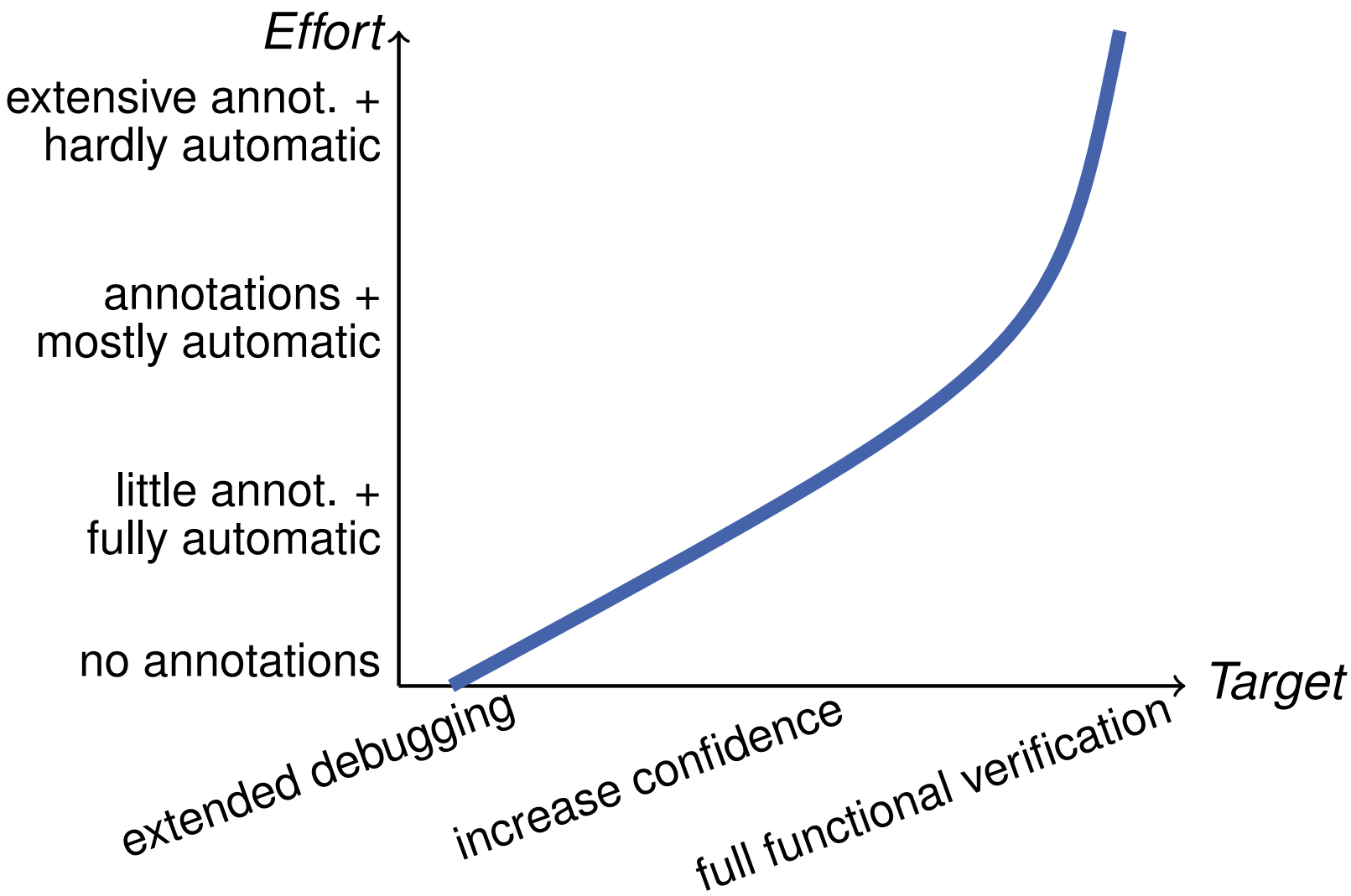
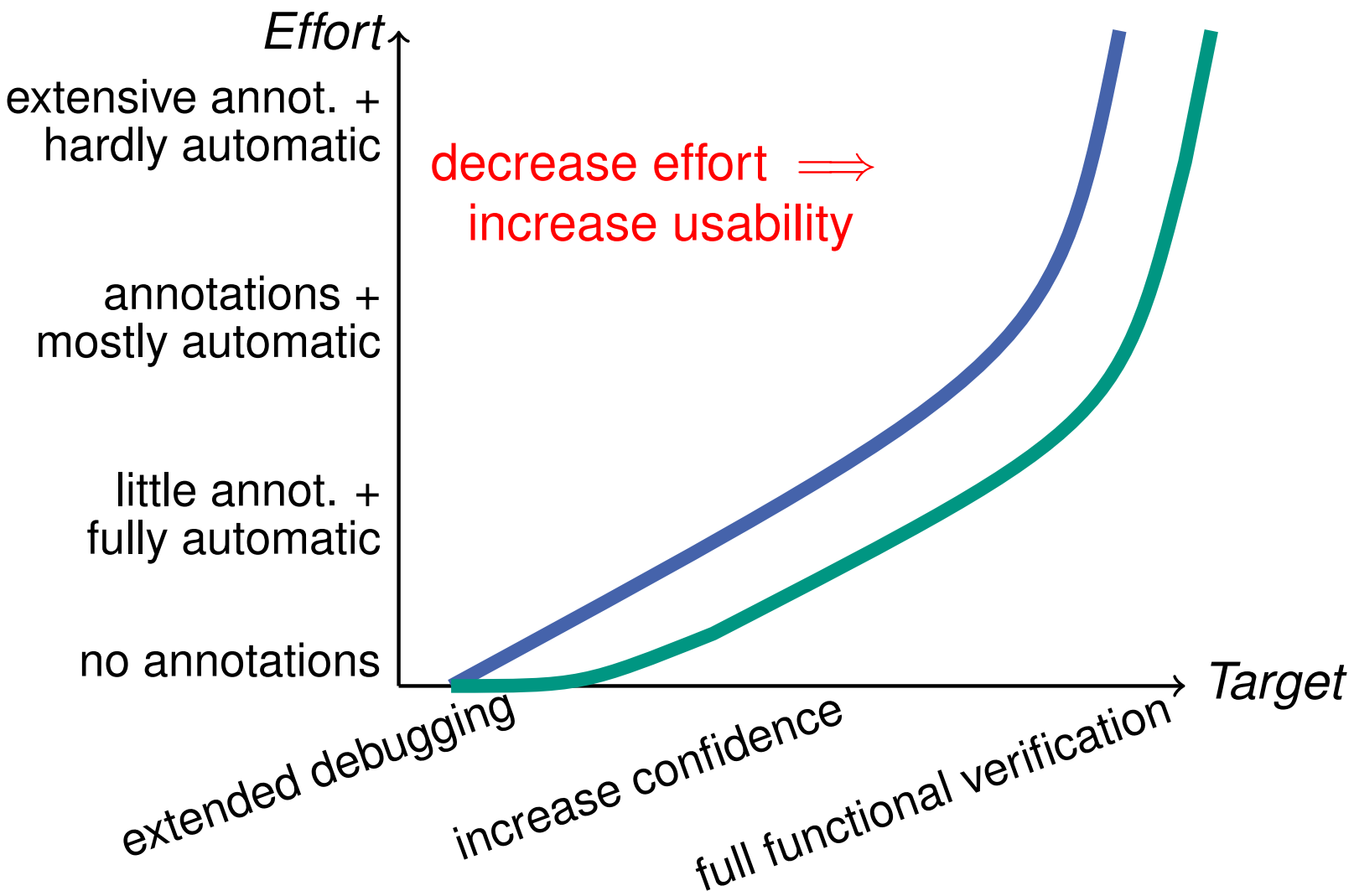


Program verification



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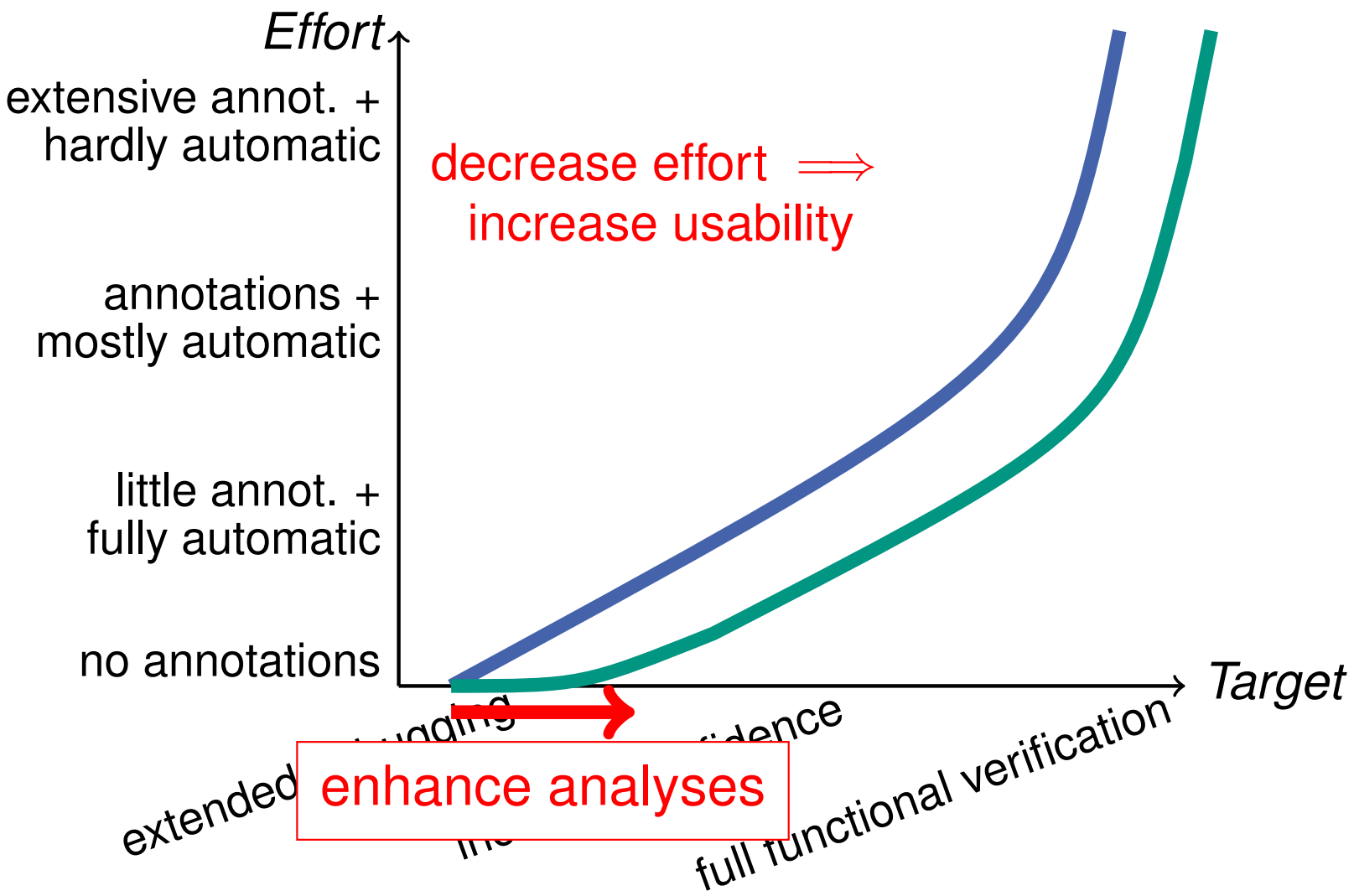

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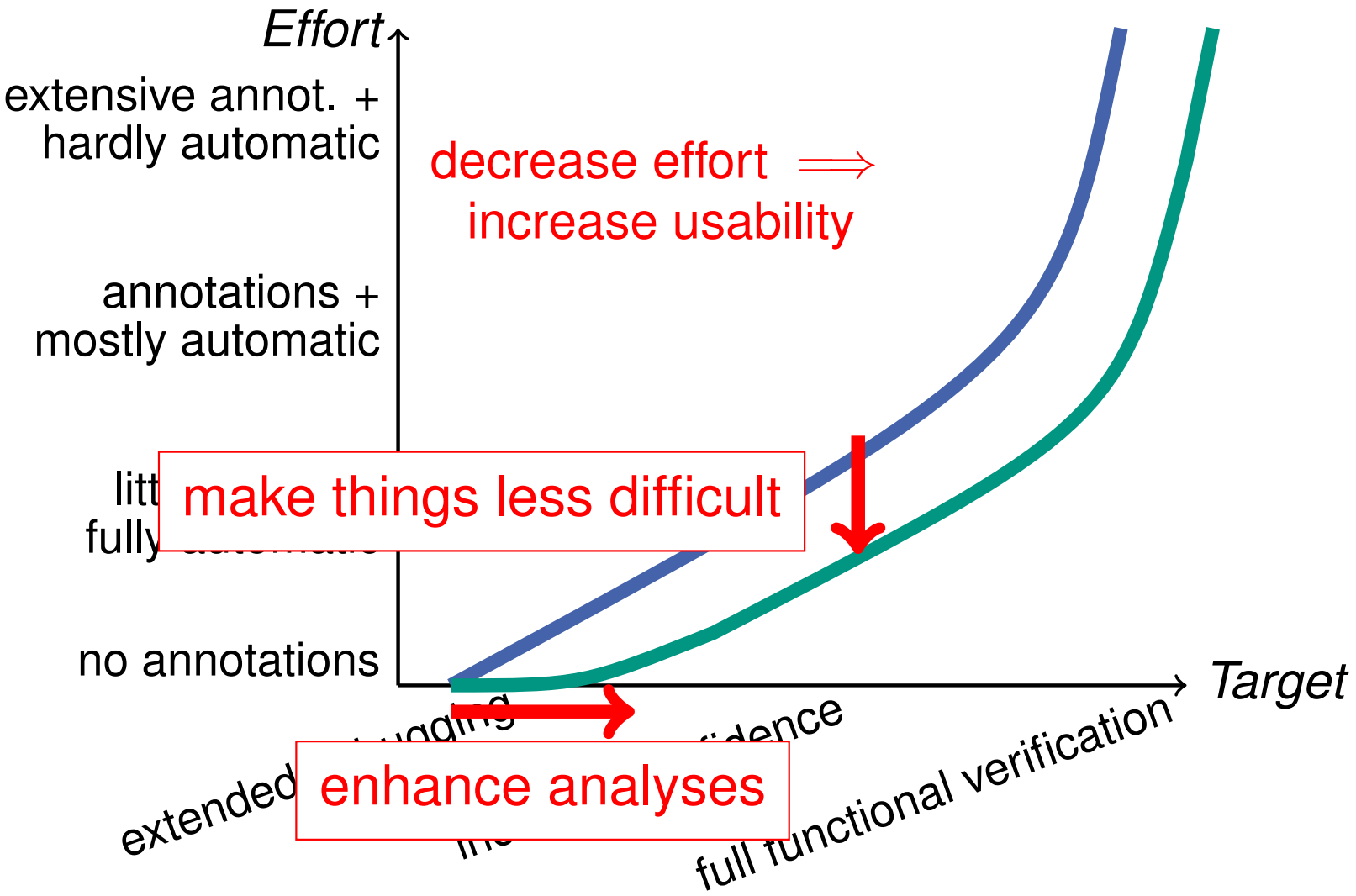

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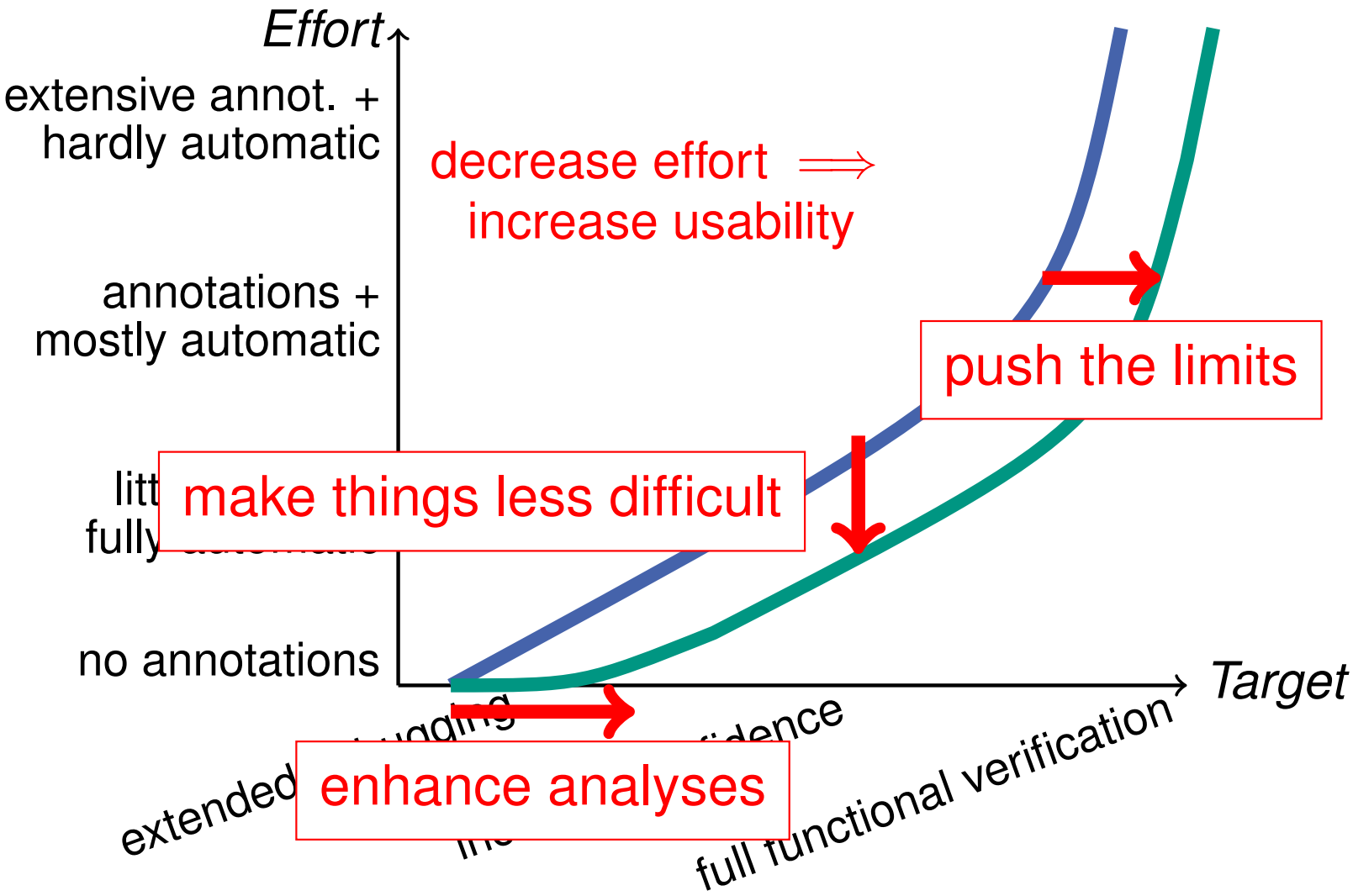


Next Steps (1)

Mature Specification Languages

1. Compare with programming languages: C $\overset{20yrs}{\rightsquigarrow}$ Java: types, semantics, portability, ...
2. Integrative spec language for light and heavy weight specification, common platform
   (RAC, deduction, testing, documentation, ...)
3. good data abstraction concept (framing problem)
4. abstract data types
5. candidates: JML, ACSL, CodeContracts, ...
   (however: Many tools, many syntaxes, many semantics)

Next Steps (2)

Specified and Verified Libraries

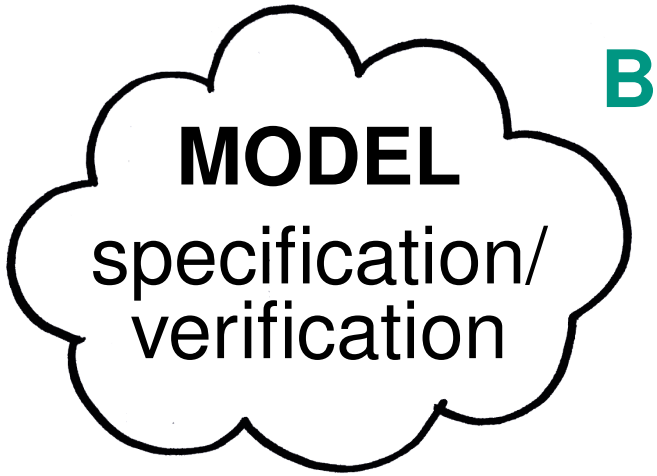
1. needed for wide-spread use of verification
2. a large task
3. open research questions
4. full functional and/or special purpose?
5. which libraries?
6. should be a community effort
   (see JML specathlon)

Next Steps (3)

Domain Specific Specifications

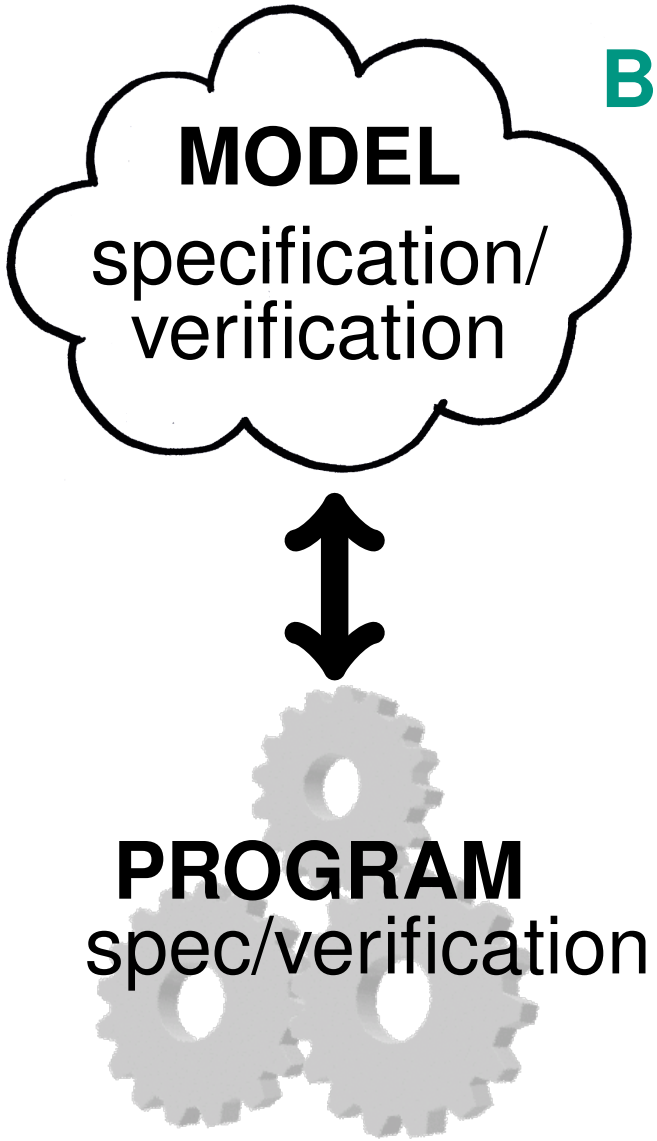
1. $\rightarrow$ *model driven software development*
2. conciser, shorter, easier to understand
3. broader audience
4. code and specification generation
5. examples: security flow properties, algorithmic properties

Next Steps (4)



Bridge the Gap between Model and Program Verification

Next Steps (4)



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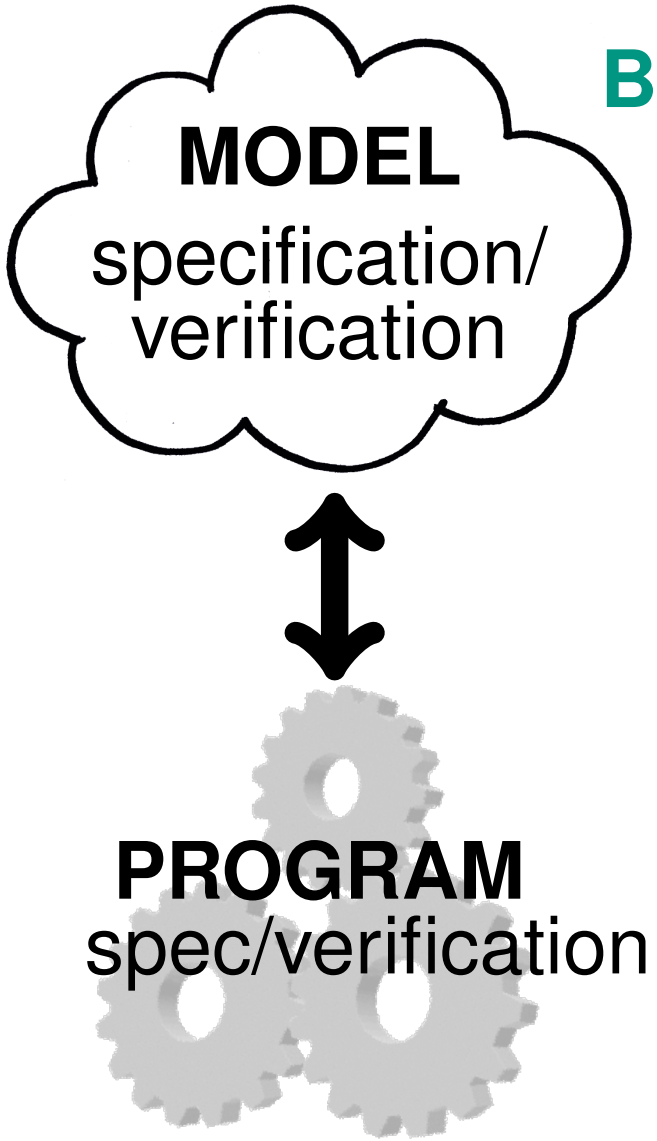
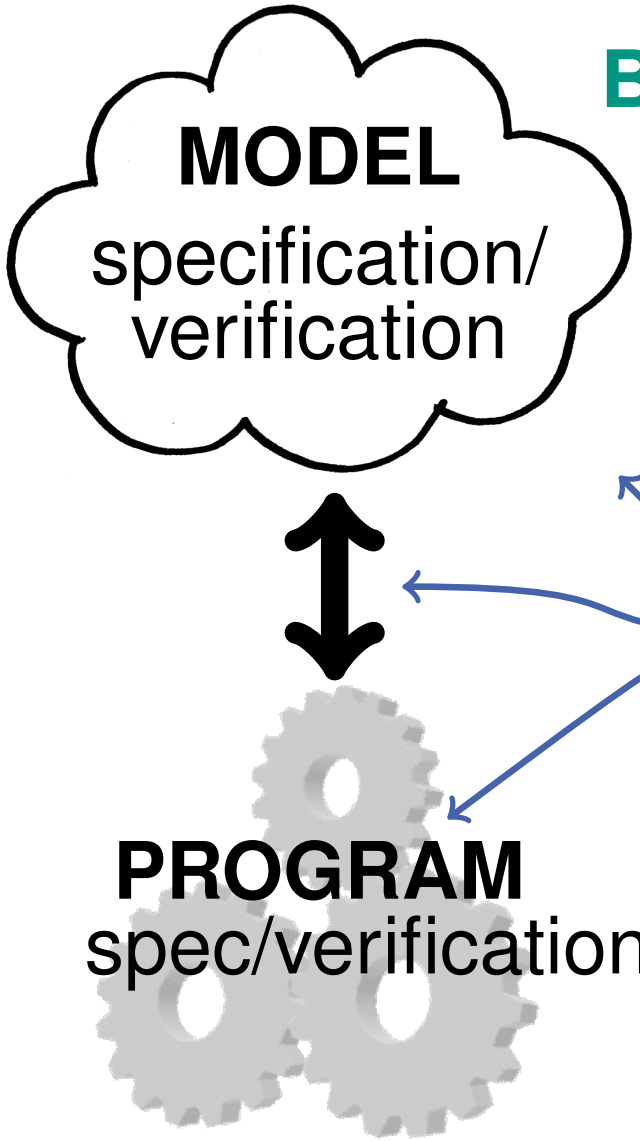


Bridge the Gap between Model and Program Verification

1. established modelling methodologies like B, Z, ASM, ...

   Have a concept of refinement
3. integrate into software design process
4. code generation / specification generation

Next Steps (4)



Bridge the Gap between Model and Program Verification

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Next steps (5)

Integrate Automation and Interaction

There will always be interaction
if the problem is sufficiently difficult

like loop invariants, quantifier instantiations, lemmata.

1. reduce interactions
   (inference, powerful decision procedures)
2. help verifying person find these auxiliary information
3. provide good feedback to **where** and **what** failed,
   and **how** to proceed.

Next steps (5)

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How to **proceed**

- "Help me by providing an upper bound for int-variable x."
- "Help me by providing evidence that $x > 5$ is part of the loop invariant in line..."
- "Adjust your post condition because $x > 5$ does not hold for input $y = 10$."

5 Next Steps for Usability

1. Mature Specification Languages
2. Specified and Verified Libraries
3. Domain Specific Specifications
4. Bridge the Gap between Model and Program Verification
5. Integrate Automation and Interaction

Thank you