An Analysis Framework and Additive Software Analysis

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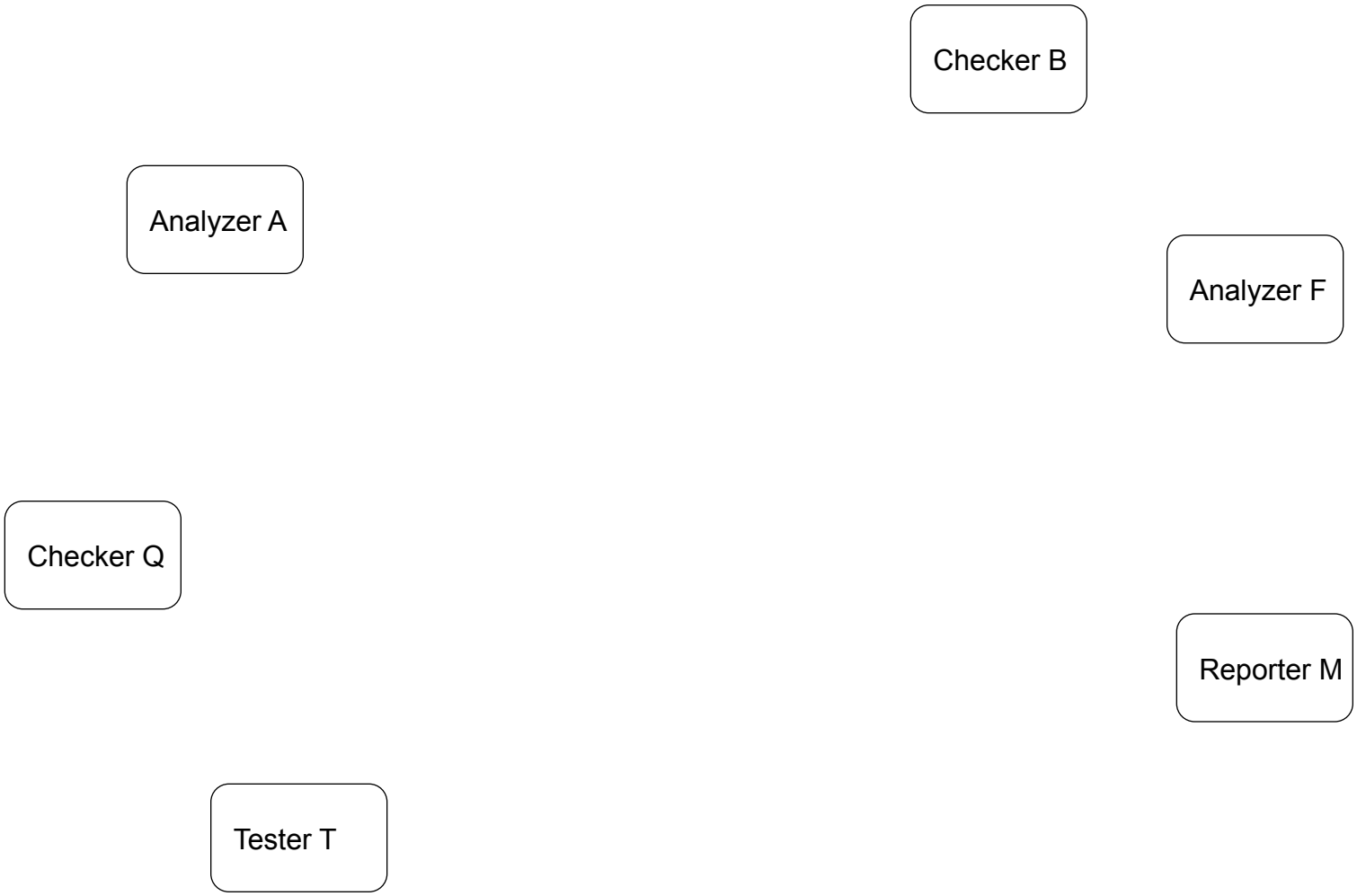
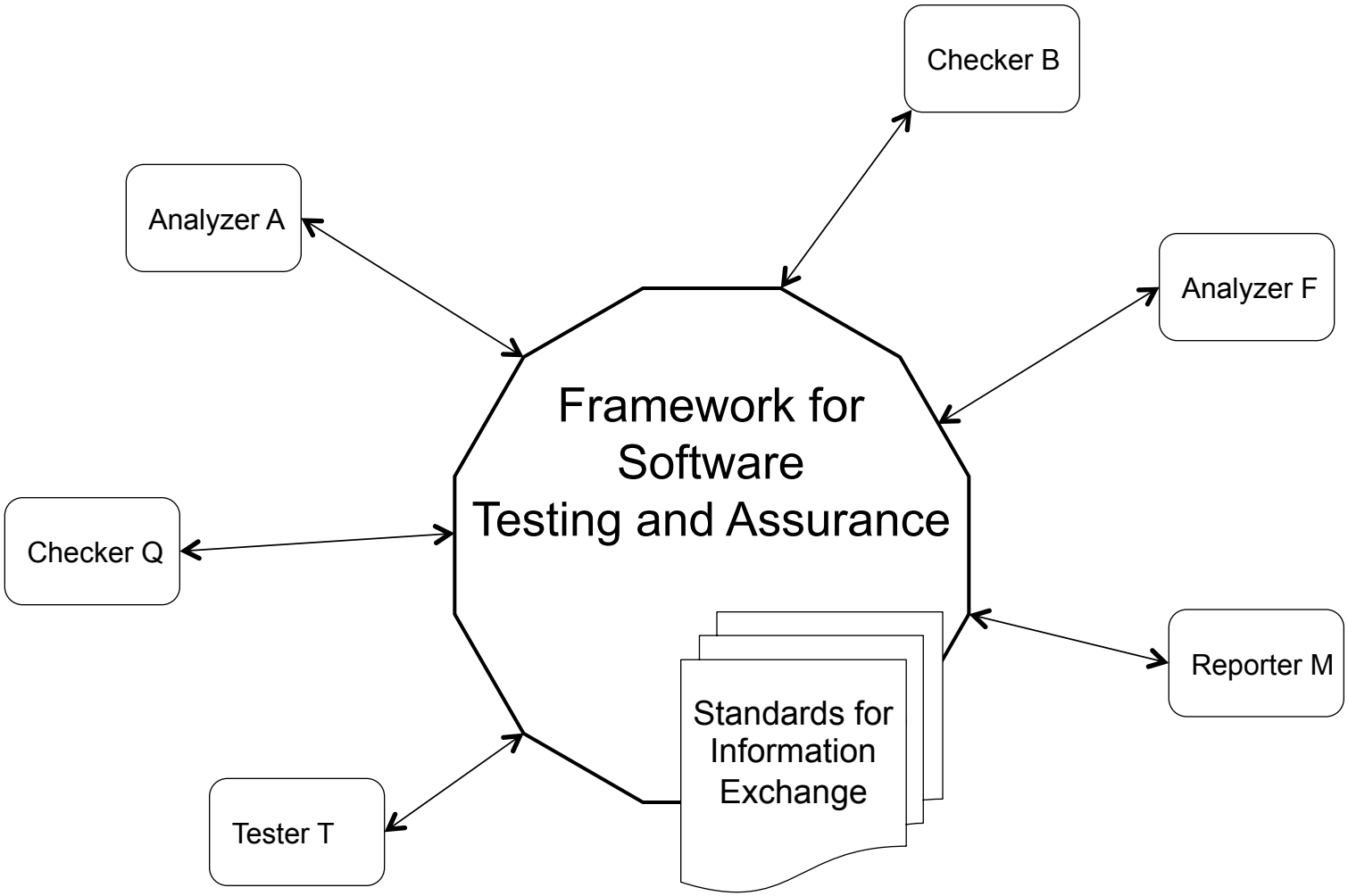
Outline

- **A Framework for Software Assurance**
- **Additive Software Analysis**


Checker B
Analyzer A
Analyzer F
Checker Q
Reporter M
Tester T


Checker B
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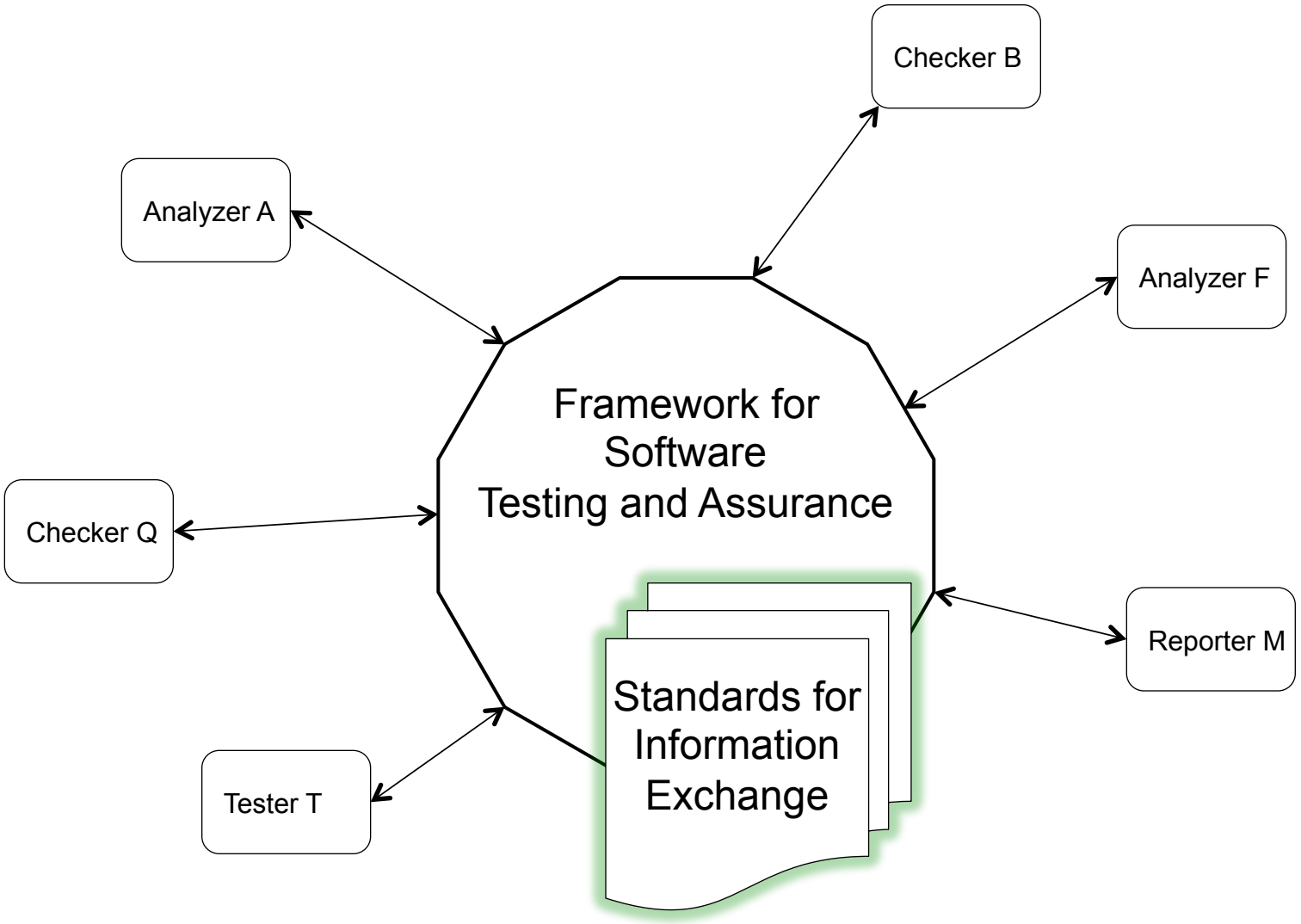
Functions of a Framework

- **Aggregate tool outputs.**
- **Allow software assurance checkers to interoperate.**
- **Pass program information between tools.**

Benefits of a Framework

- **Modular and distributed development.**
  - **Existing modules may be replaced by superior ones.**
  - **Facilitate synergy between groups of researchers.**
- **Enable development of “hybrid” tools.**
  - **A tool uses a static analyzer module to find problematic code locations, then uses a constraint satisfier module and a symbolic execution engine to create inputs that trigger failures.**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Possibly Useful Information

- **Location in code**
  - **File name, class file, method/function name, line number, etc.**
- **Variables visible at a location**
- **Possible variable values at a location**
  - **Intervals? enumerations? relations (e.g. x < y)**
- **Data flows**
- **Paths**
- **Stack traces**

Additional Information

- **Origin of binary chunk in source code**
- **Warnings of possible problems**
- **Assertion, pre- & postcondition, invariant**
- **Function signatures**

Much of This Already Exists

- **LLVM**
- **Clang**
- **gcc**
- **Rose compiler infrastructure**
- **findbugs**
- **Yasca**
- **TOIF, SAFES**
- **Code Dx**

XKCD cartoon used with permission. Permanent link is http://xkcd.com/927/

ADDITIVE SOFTWARE ANALYSIS

Case 1: More Information

Each analyzer or checker added gives the programmer more information.

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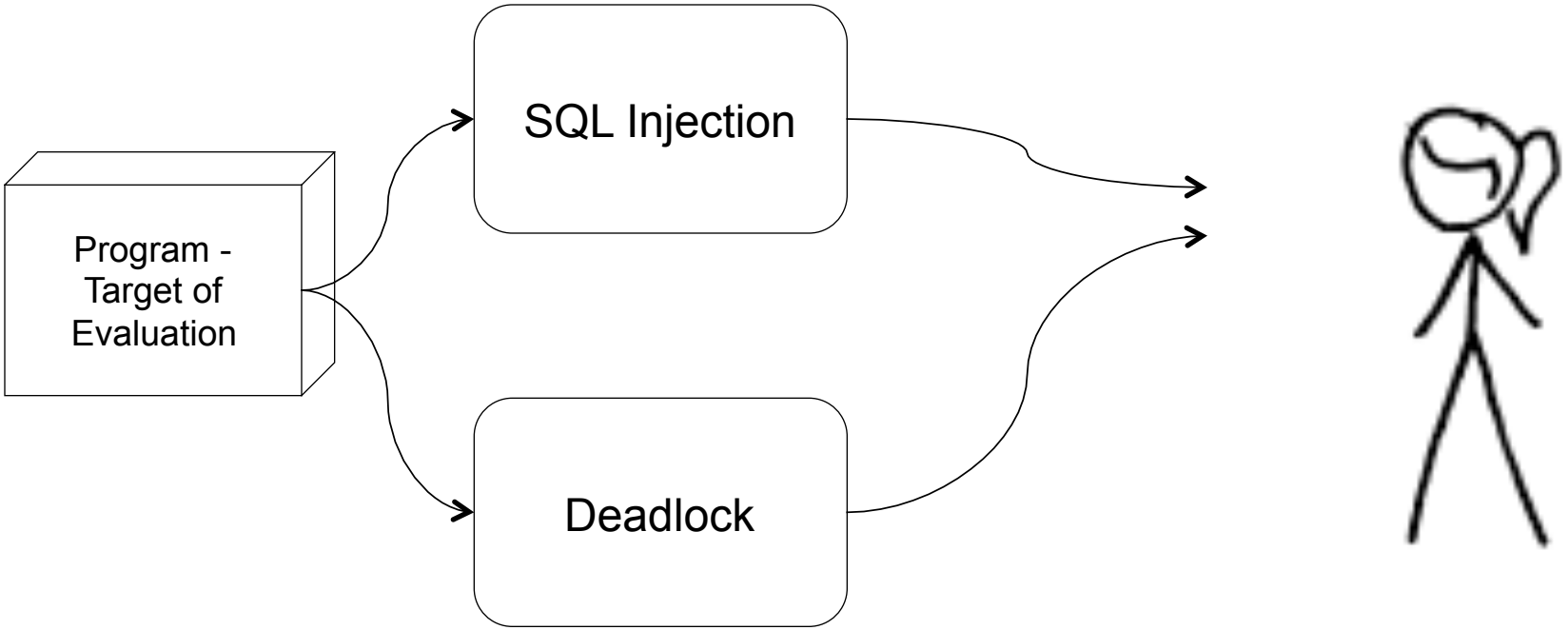

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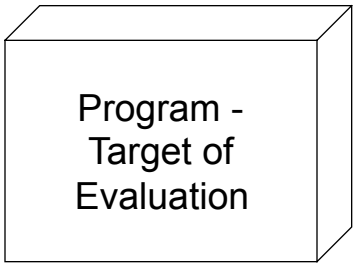
Case 2: Confirmation



Results are correlated or compared to provide better information than either one alone.

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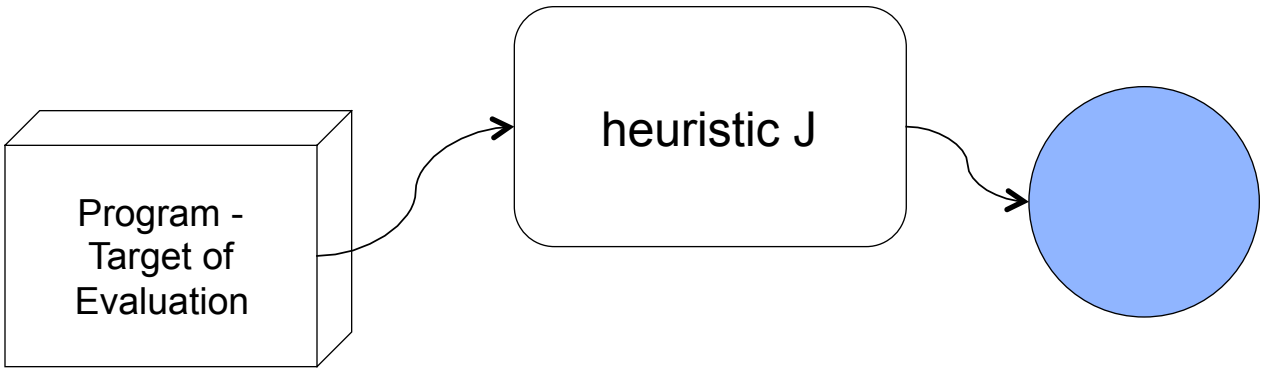

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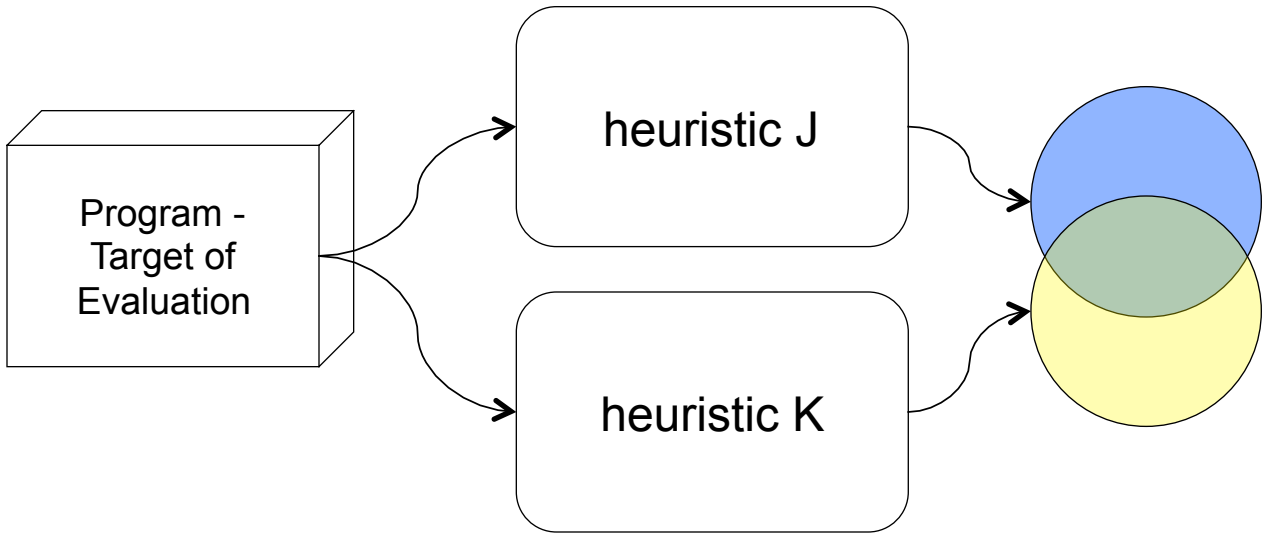
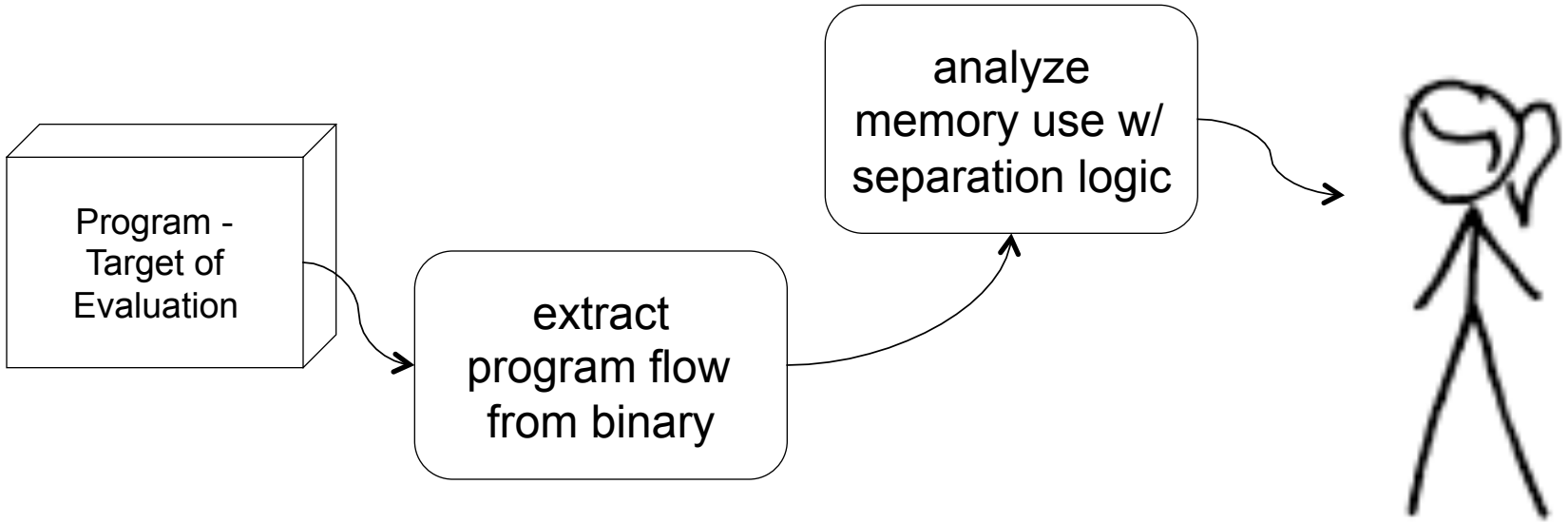


Results are correlated or compared to provide better information than either one alone.

Case 3: Synergy



Another example: tie static analysis with execution monitoring and constraint solving to get a hybrid analyzer.

Additive Software Analysis Benefits

- **Checkers and analyzers work together.**
- **Foster an "ecosystem" for tools.**
- **Growing set of problematic and virtuous programming patterns and idioms may be checked by tools.**

Possibly Useful Information

- **A descriptive taxonomy of checkers.**
  - **Inputs needed.**
  - **Languages/constructs handled.**
  - **Checking/analysis performed.**
  - **Outputs provided.**
- **A catalog of publically-vetted checkers and analyzers.**
- **A publicly accessible repository of checkers.**

Framework and Additive Software Analysis Together Are Powerful