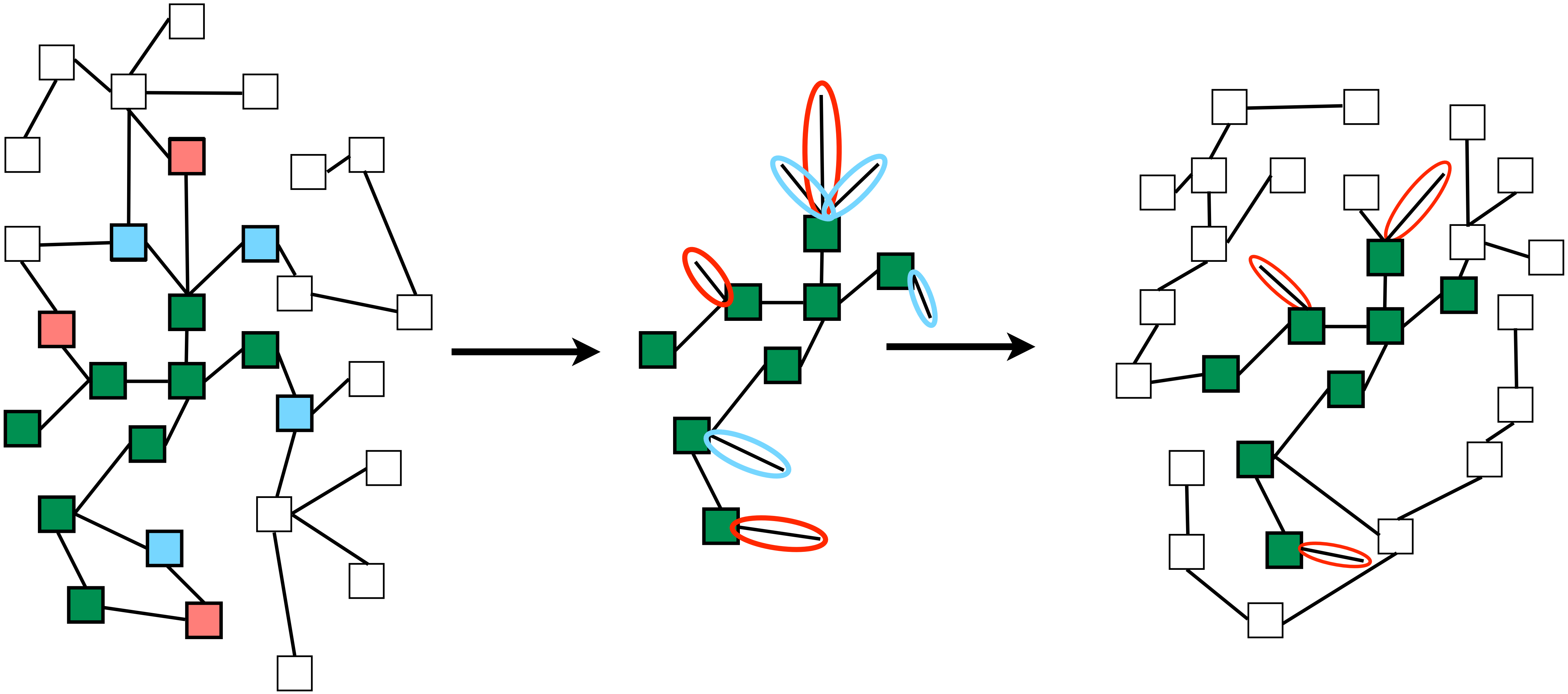
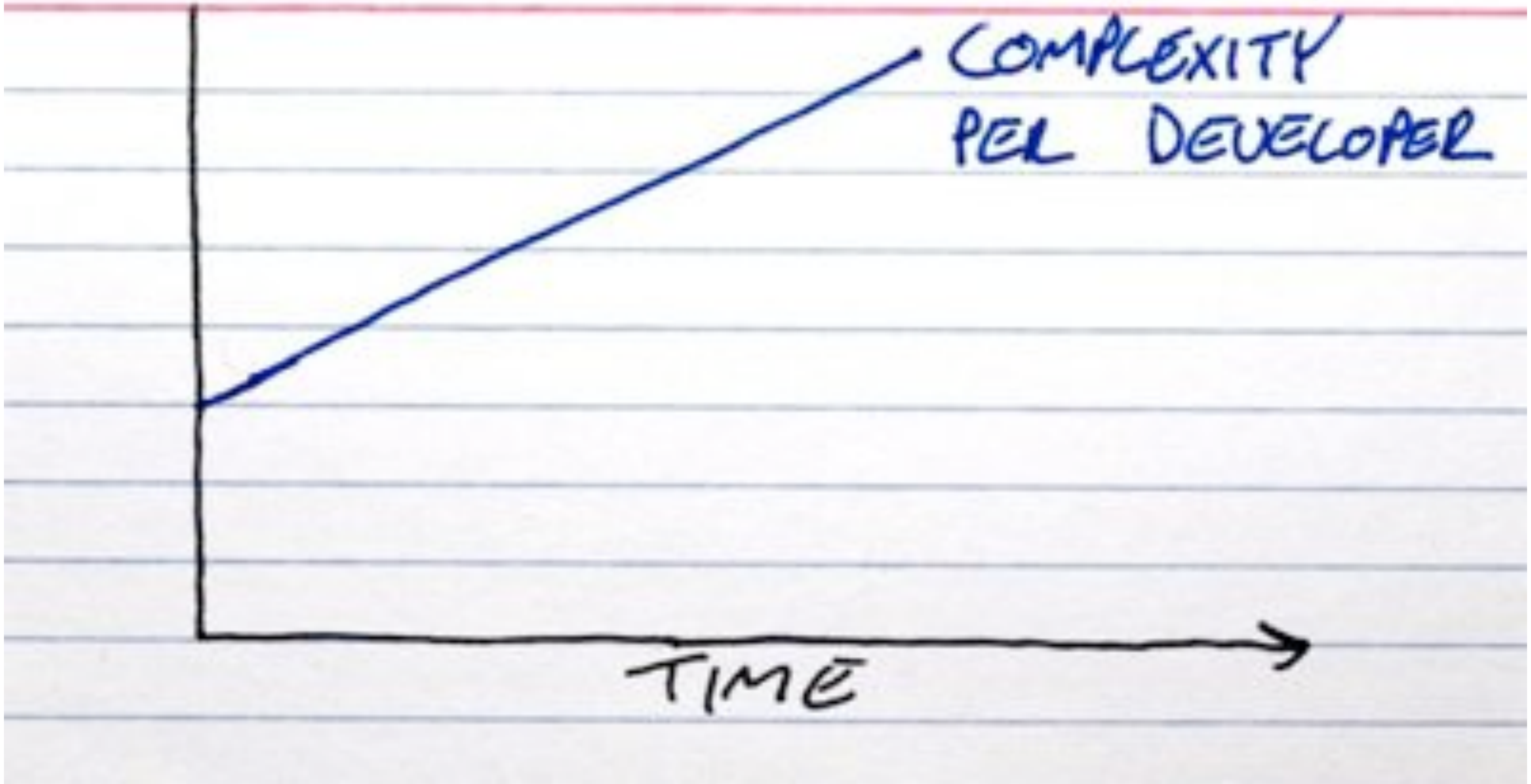


CSE403: Software Engineering

Reid Holmes
Winter 2009

COMPLEXITY



NSB REDUX

- Confusions over accidental complexity
- Emergence of OOP
- "The best way to address the complexity of software is to not build it at all"
    - Several NSB responses highlight software reuse
        - As a means to reduce complexity
        - As a means to improve productivity
        - As a means to increase reliability

SOFTWARE REUSE

- Domain-specific component markets
  - Populated by carefully created reusable components
- New features are added by dropping in components
  - Accounts for 53% of reuse at NASA [Selby 2005]
- Three main impediments:
  - High up-front cost [Gaffney 1992, ICSE]
  - Library scaling problem [Biggerstaff 1994, ICSR]
  - Architectural mismatch [Garlan *et. al.* 1995, IEEE Software]

ECONOMICS

- Budgets are drawn up annually
  - Heavy emphasis on the current quarter
- Reusable software is:
  - ~Twice as expensive [Gaffney 1992, ICSE]
  - ~Three times as expensive [Brooks 1975]
- Requires careful forethought to determine what software *will* be reused and whether any savings outweigh extra costs
- What is the benefit to the customer?

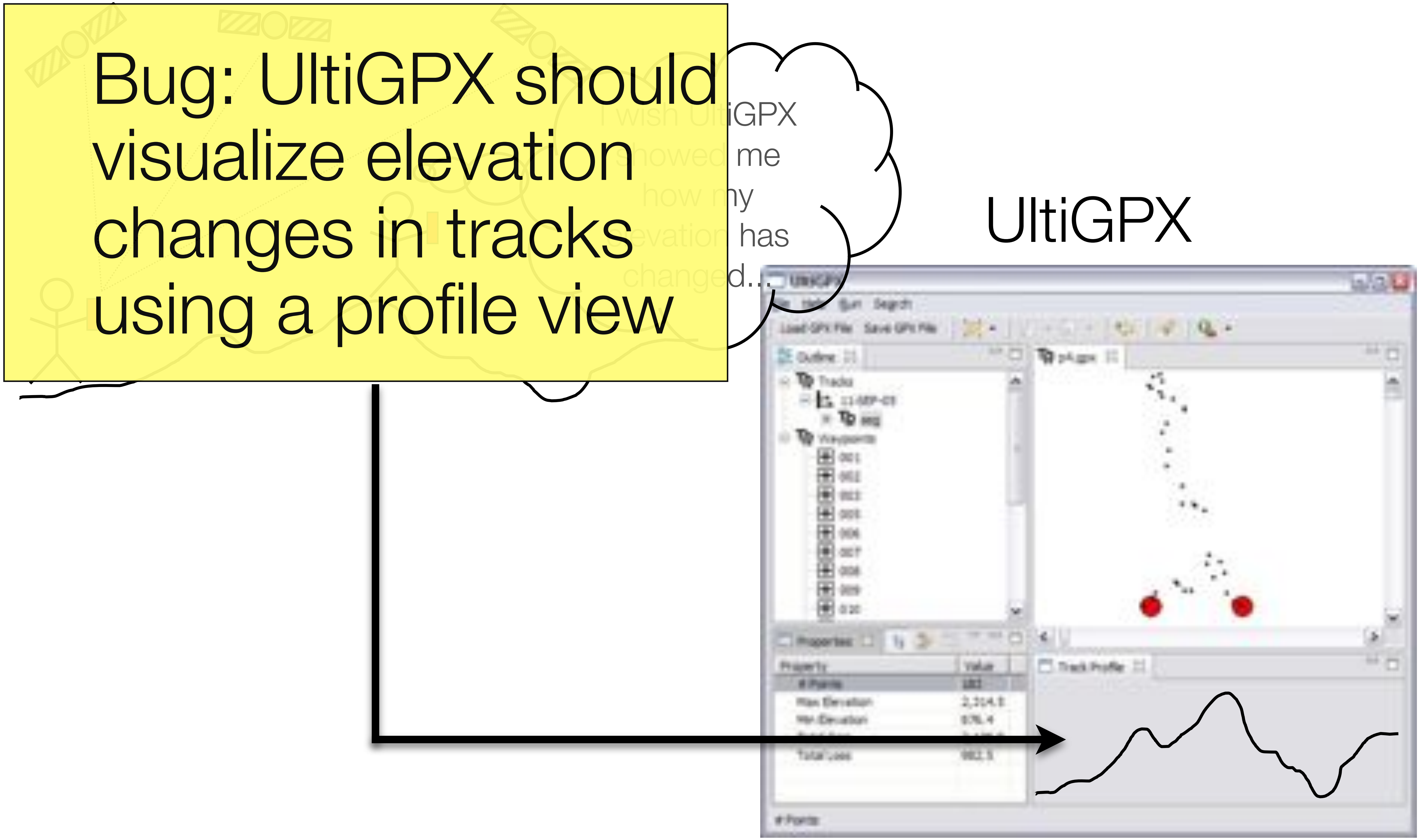
LIBRARY SCALING

- Two extremes:
  - Large, feature-laden, components
  - Small, simple, components
- Adapting large components to a system can be difficult
- The effort of adapting a small component might outweigh any benefits of reuse in the first place

ARCHITECTURAL MISMATCH

- Even reusable code makes some assumptions about *how* it should be reused; these assumptions are often implict
    - Explicit assumptions are often easy to identify:
        - Programming language
        - Libraries & frameworks
    - Implicit assumptions are harder to spot:
        - Topology assumptions
        - Protocols of use
- Implicit assumptions are often not documented because the original developer may not have considered them constraints

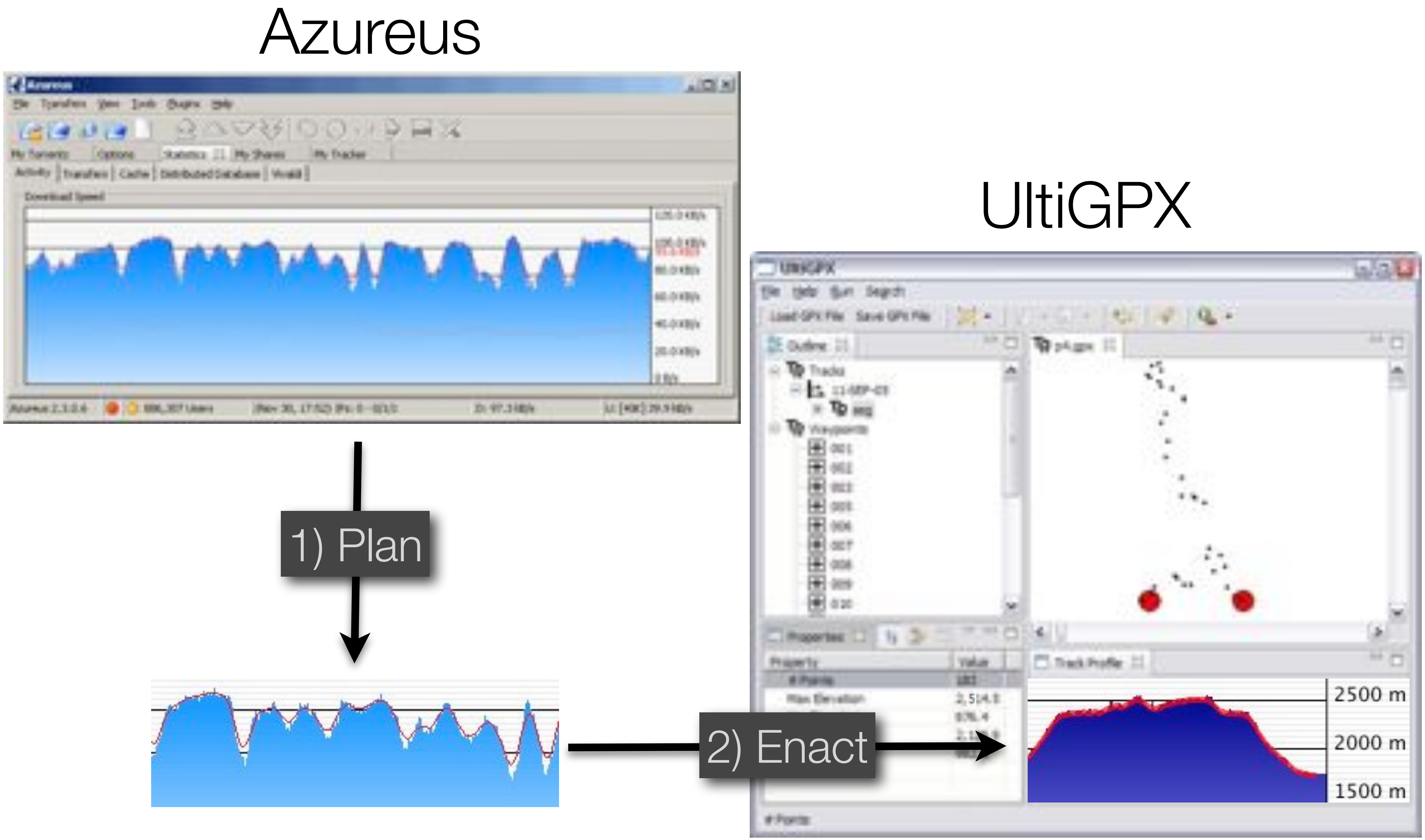
AN ALTERNATIVE REUSE APPROACH



Bug: UltiGPX should visualize elevation changes in tracks using a profile view

Property	Value
# Points	182
Max Elevation	2,314.5
Min Elevation	876.4
Total Gain	[illegible]
Total Loss	982.5

MOTIVATION



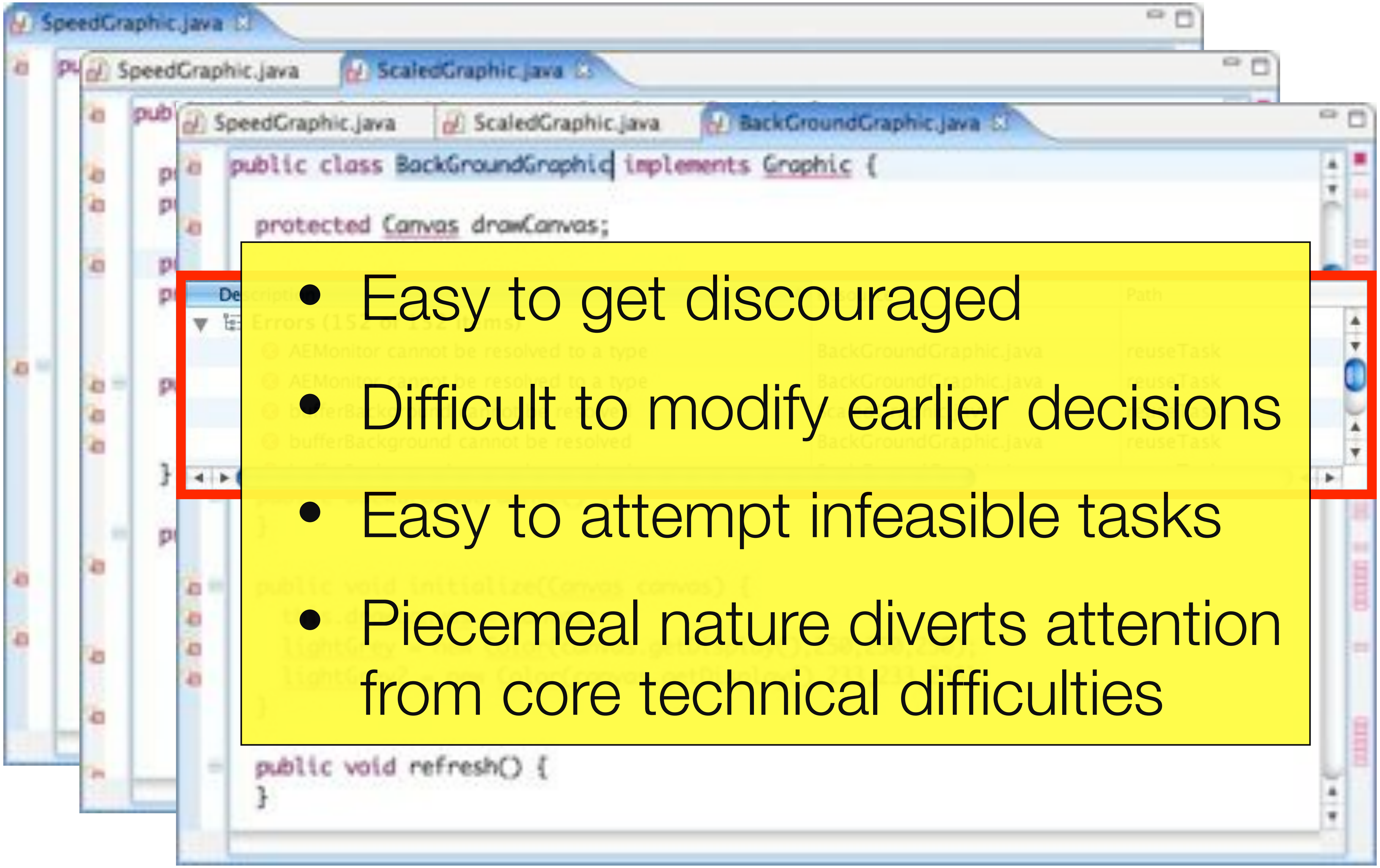
Azureus

UltiGPX

1) Plan

2) Enact

MANUAL REUSE APPROACH



```
public class BackGroundGraphic implements Graphic {

    protected Canvas drawCanvas;

    public void refresh() {
    }
```

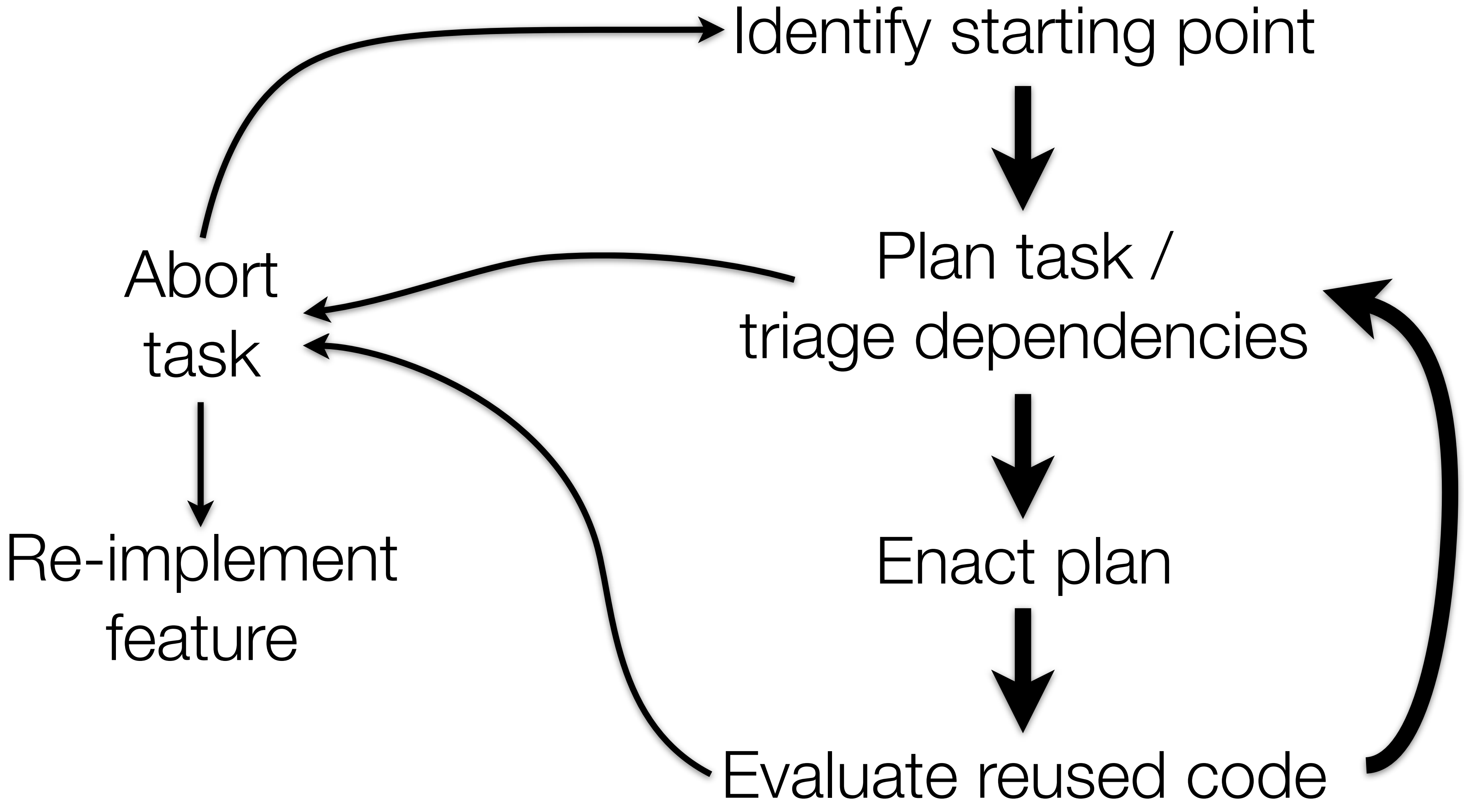
```
Errors (152 of 152 items)
    AEMonitor cannot be resolved to a type        BackGroundGraphic.java    reuseTask
    AEMonitor cannot be resolved to a type        BackGroundGraphic.java    reuseTask
    bufferBackground cannot be resolved           BackGroundGraphic.java    reuseTask
```

- Easy to get discouraged
- Difficult to modify earlier decisions
- Easy to attempt infeasible tasks
- Piecemeal nature diverts attention from core technical difficulties

PRAGMATIC REUSE

- White-box reuse
  - Code Scavenging [Krueger 1992, ACM Computing Surveys]
    - Ad hoc nature increases risk of bad decisions
    - Adaptation expensive and overwhelming
  - Industrially effective
    - Effective reuse approach [Frakes 1995, CACM]
    - Common risk-aversion practice [Cordy 2003, IWPSE]
    - Replicate & specialize [Kapser & Godfrey, 2006, WCRE]

PRAGMATIC REUSE PROCESS



Identify starting point

Plan task / triage dependencies

Enact plan

Evaluate reused code

Abort task

Re-implement feature

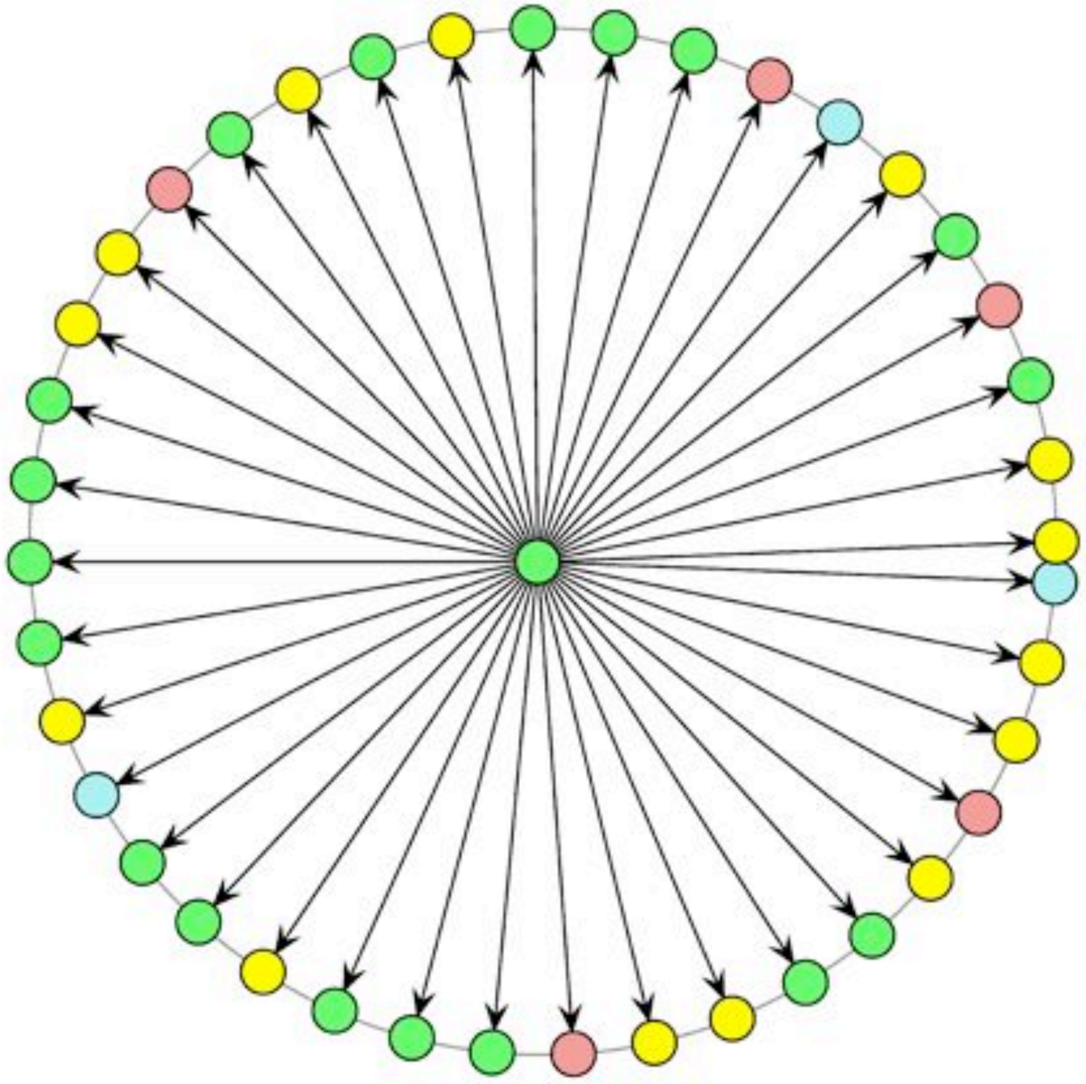
PLANNING A TASK

- 4 main kinds of decisions:
  - Common 🟡
  - Accept 🟢
  - Reject 🔴
  - Remap 🔵

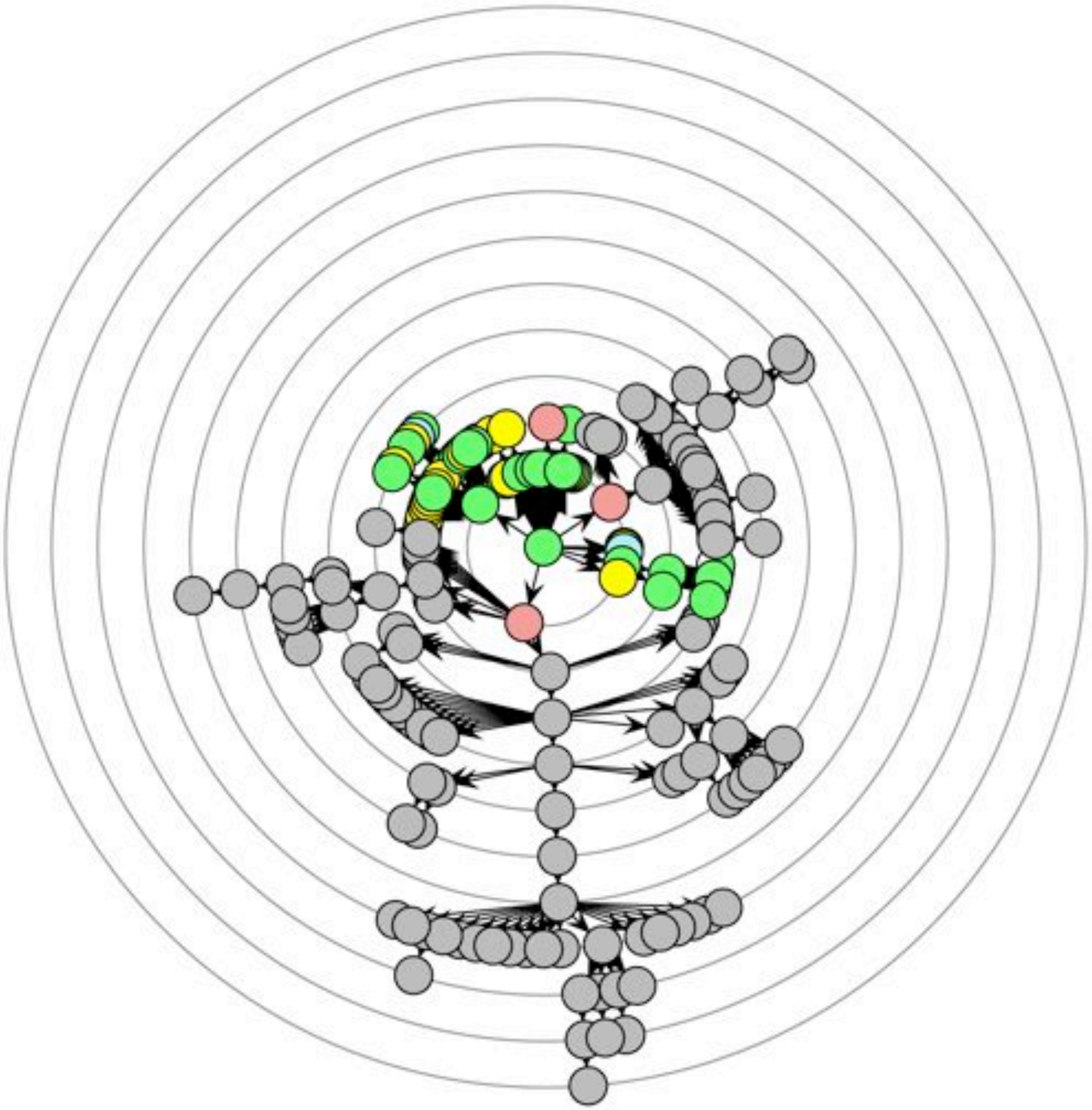
Legend

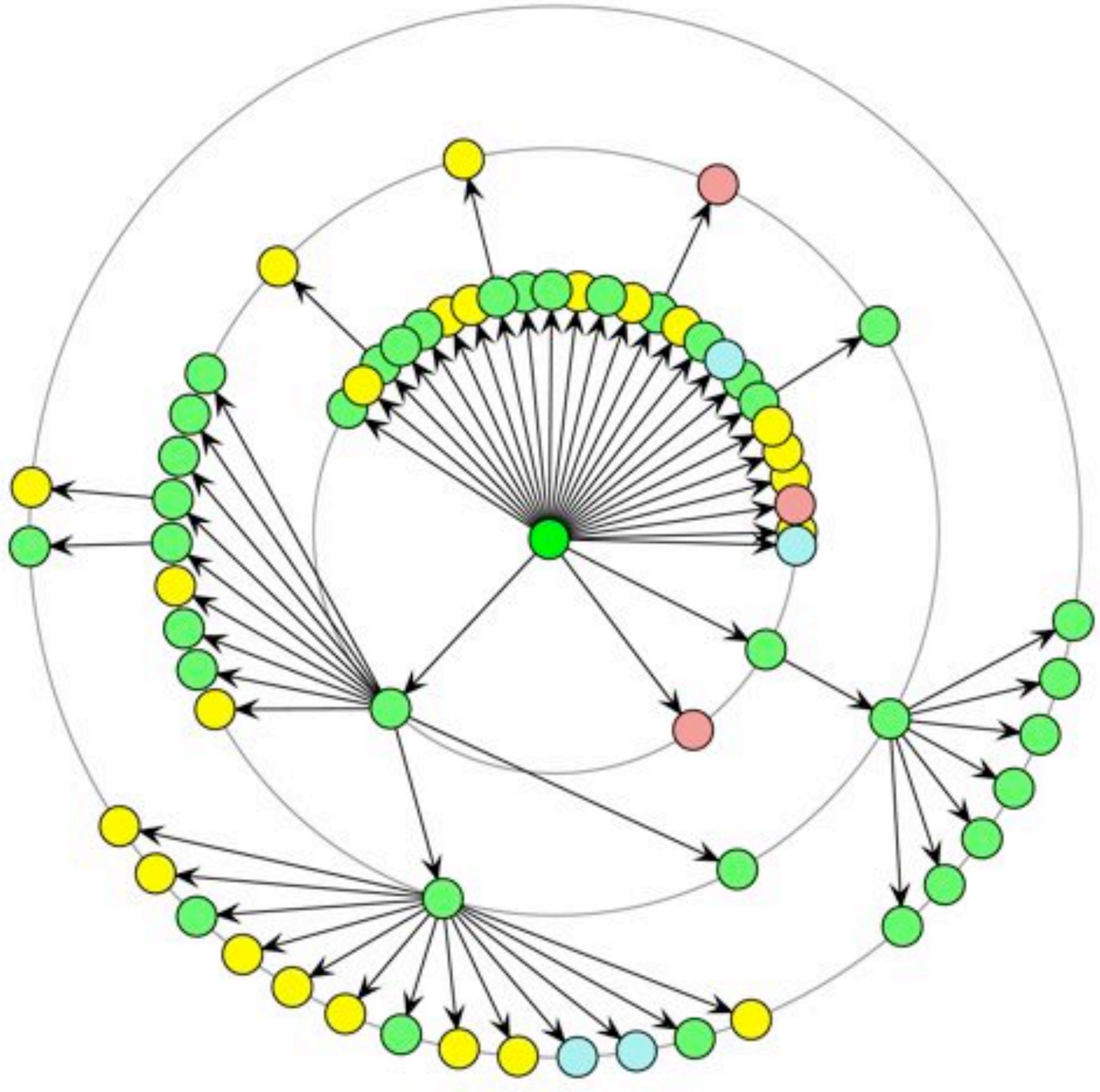
O Method or Field

→ Call or Reference



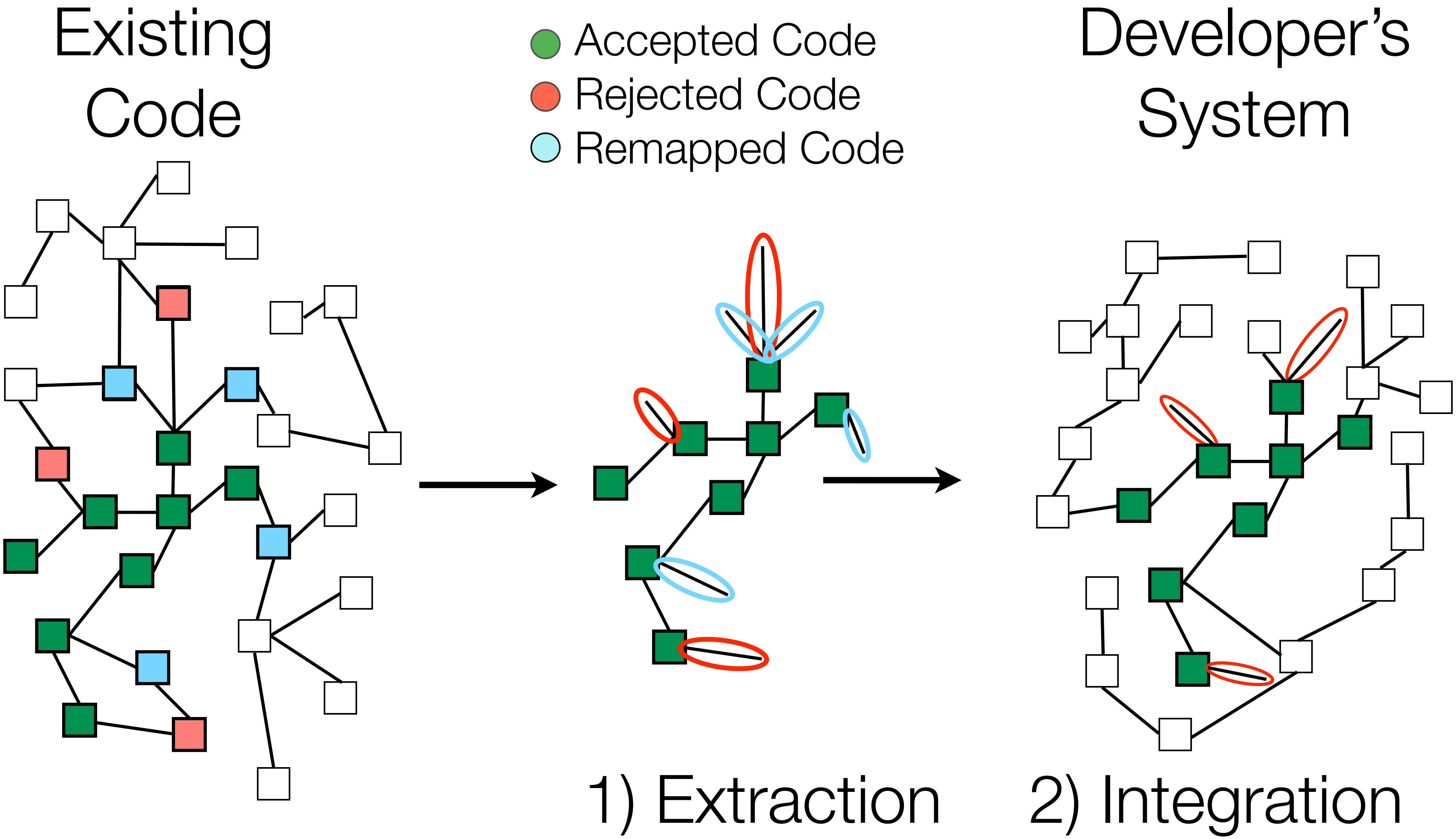
TRANSITIVE IMPLICATIONS





🟢 Accepted Code 🔴 Rejected Code 🔵 Remapped Code 🟡 Common Code

ENACTMENT PROCESS



Existing Code

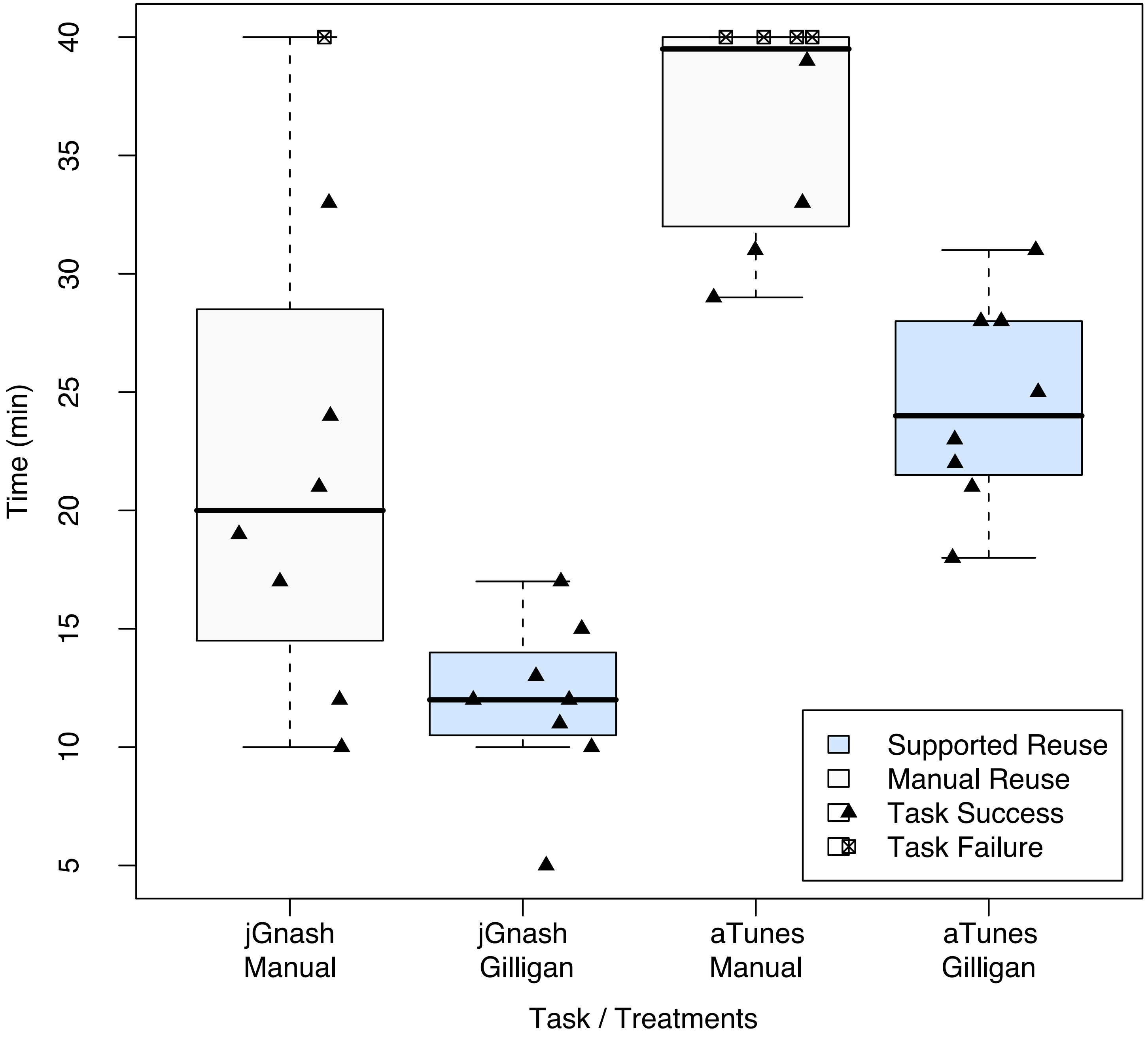
🟢 Accepted Code
🔴 Rejected Code
🔵 Remapped Code

Developer's System

1) Extraction

2) Integration

H-1: TASK TIME



Developers using Gilligan significantly faster

Repeated Measures ANOVA (F(1,14)=5.1,p=0.04)

EFFORT-BASED CASE STUDY

Automatically resolving low-level compilation errors enables the developer to focus on higher-level mismatch

Case	Manual	Gilligan	Decision Reduction
T1	60	2	97%
T2	25	4	84%

PR SHORTCOMINGS

- Pragmatic reuse tasks are fraught with problems
  - Reused code is less-understood
  - Tracking and merging changes difficult
  - Often associated with bad practice
- Rely on software engineers to make the right decisions about downsides and benefits of these tasks
- Questions?