Understanding Object Oriented Software

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MITRE Sponsored Research

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Problem

- Developing and sustaining large, reliable software systems is a challenge
- Understanding software assets is necessary for decreasing the cost and improving the quality of software by supporting
  - Iterative development, training
  - Reuse of legacy components
  - Assessment of software quality, performance, security, and other features

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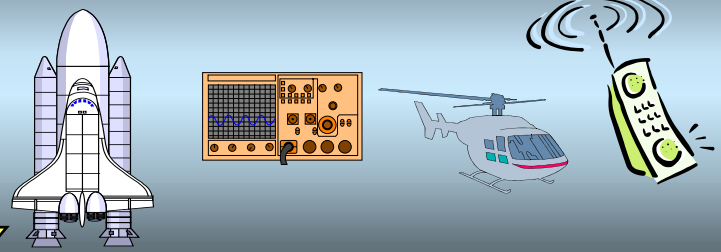
Background

Software Developers

Using
S/W architecture
Design Patterns
Programming Idioms

Large, Complex Systems



Source Code (today's systems using object-oriented software - C++, Java)

What have we got here?

How and where can we safely and effectively use it?

Analysts, Funding agencies

?????

If we know the structures used, can we answer these questions?

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Objective

- Develop the capability to understand object oriented software by
  - Recognizing patterns of communicating classes (design patterns and architecture patterns), and
  - Reasoning about these interacting classes to understand the rationale behind design decisions

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Activities

- Develop class interaction extractors for C, C++ programs
- Build small-footprint analysis tools -- Osprey
  - Specification language for design pattern recognizers. 68 recognizers for 41 patterns
  - Finders that match source code data to recognizer descriptions
  - Generator for pattern-centric documents -- inferred design, code qualities, links to source code
- Validate results using Go4, SUIF, ACE, Mozilla -- documented use of patterns

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Highlight

TCL Wrapper

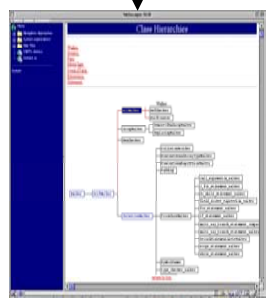
Imagix

High-level Analysis
- Compliance
- Pattern interactions
- Trade-offs
- Design Rationale

Design and Architecture Pattern Recovery

Recognizer Library

Visualization and Presentation



Class hierarchy
Variable set/use
Call trees

```
<class> Observer
<method> update </method>
<member> observerState
<type> Subject-ref </type
</member>
</class>
```

XML Database

Low-level Analysis
- Class interactions
- Type inference
- Control Flow
- Data Flow

Osprey Architecture

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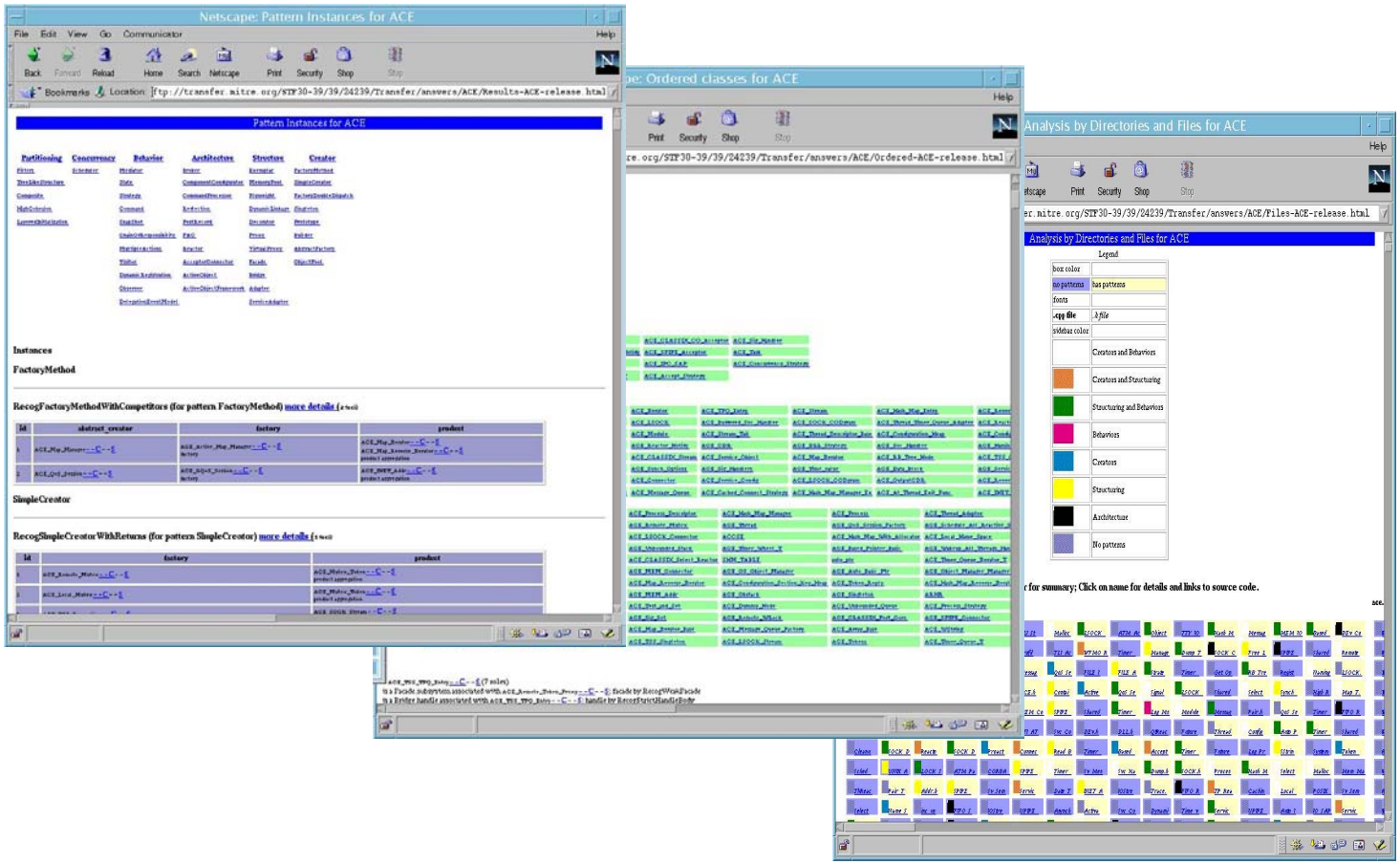
Demonstration

Osprey-Generated Documentation Packages



Impacts

- Support for Integrated Broadcast Service (IBS) program - quality assessments
- Analysis of MITRE-developed MSIM simulation program - documentation
- Developing software vulnerability recognition for C++ code
  - Internal and external requests for this capability

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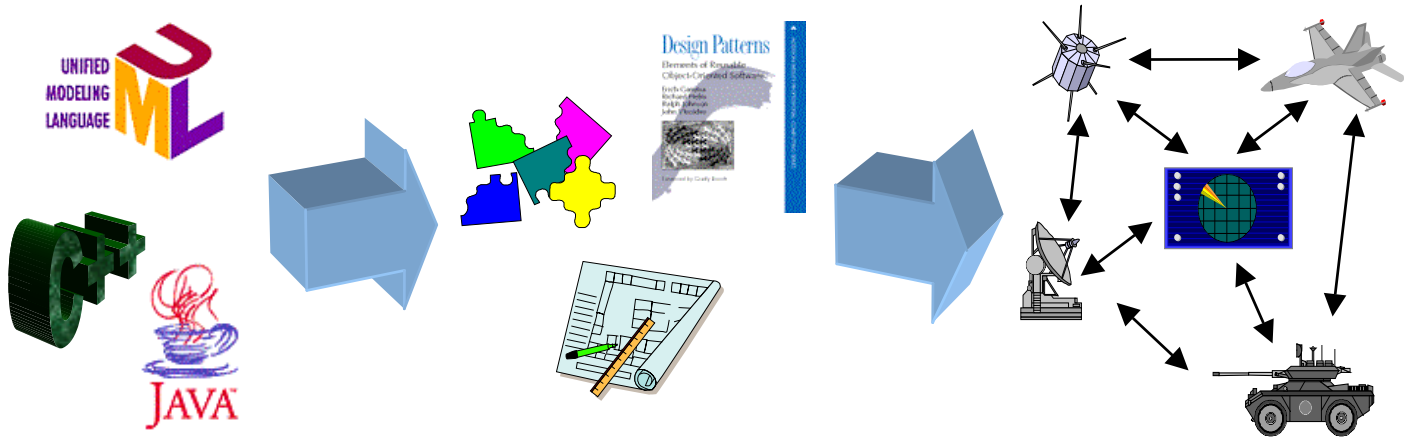
Future Plans



Using
Source code
Models
Documentation

Recognize
Patterns
Components
Architectures

Map design elements to functionality
Analyze design trade-offs
Ensure architectural conformance
Assess qualities (e.g., performance, security)

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