Presentation:

Issues in Testing Object Oriented Systems
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Outline

- Introduction
  - Motivation
  - Testing Types
- Overview on Object-Oriented Paradigm

- Issues on Testing
  - Testing Levels in OO Systems
  - Testing Concerns in OO Systems
Motivation

- Testing Achievements
  - Guarantee
  - Identification
Types of Testing

- Functional Testing
  - Black-box Testing
  - Inputs vs. Outputs
- Structural Testing
  - White-box Testing
  - Level of Code Coverage
- Which one?
Object-Oriented Paradigm

- Data Abstraction
- Encapsulation
- Inheritance
- Polymorphism
Data Abstraction
Encapsulation

- Interface
- Implementation
Inheritance

- Composite Inheritance
- Multiple Inheritance
Polymorphism

- Static Binding
- Dynamic Binding
Overriding

- Complete an incomplete behavior
- Specialize previous (upper) behavior

object is triangle
Area is 48

object is rectangle
Area is 100

object is rectangle
Area is 40

object is triangle
Area is 24.5

object is generic
Error: area() must be overridden.
Area is 0
Testing Levels

- Method Testing
- Class Testing
- Integration Testing
- System Testing
Method Testing

- Method Functional Specification
- Methods' Dependency
- Stubs
Class Testing

- Object Instantiation Testing
- Methods as a whole
- Intra-class Testing: Method Interaction
- Other classes
- Stubs
Integration Testing

- Class Communication Concerns: Faults
- Inter-class Testing: Class Interaction
- Strategies:
  - Big Bang
  - Bottom Up
  - Top Down
System Testing

- Program as a whole
- Specifications of the program
- Functional Testing Criteria
Concerns: Encapsulation

- Access Control Challenges
- Risks in Changing Object States
Concerns: Inheritance

- Actual Features in Class Hierarchy
- Testing Hierarchy: Re-testability, Re-usability,
- Testing Axioms: Anti-extensionality, Anti-decomposition, Anti-composition
- Class Flattening
Concerns: Polymorphism

Safety Testing Goals:
- Complete Branch Coverage
- Dynamically-Bound Methods
- External Polymorphic Objects
Research Areas

- **Automation**: Test Case Extraction, Test Case Generation, Test Suite Framework, Test Oracles
- **Algorithms**: Method Call Sequence Generation: Evolutionary Algorithms
- **Methodology-oriented Testing**
Software testing research roadmap

Why
- Education of software testers
- Testing patterns

How
- Understanding the costs of testing
- Test input generation
- Model-based testing
- Anti-model-based testing
- Explicit test hypotheses
- Test effectiveness

How much
- Domain-specific test approaches

What
- Controlling evolution
- Leveraging user population and resources
- On-line testing

Where
- Coherent testing of functional and extra-functional properties

When
- Testing within the emerging development paradigm

Achievements
- Empirical body of evidence

Challenges
- Universal test theory

Dreams
- Efficacy-maximized test engineering
- 100% automatic testing
- Test-based modeling

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References

- Automatic testing of object–oriented software, Bertrand Meyer, Ilinca Ciupa, Andreas Leitner, Lisa (Ling) Liu
- Software Testing Research: Achievements, Achievements, Dreams, Antonia Bertolino