



INTEGRATION AND OBJECT ORIENTED TESTING – PART 2

DR. ISAAC GRIFFITH

IDAHO STATE UNIVERSITY



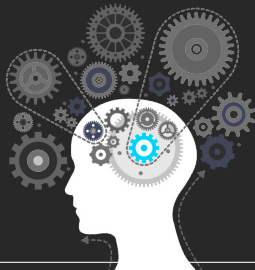
"Lots of methodologies have come and gone, paradigms have changed but the requirements are always the same; Make it good and make it fast." – Anonymous

Outcomes



After today's lecture you will be able to:

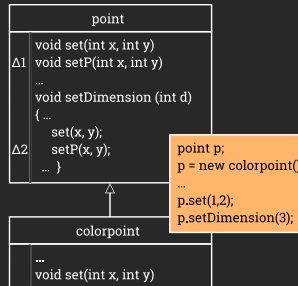
- Understand the basic idea of integration testing and what it is for
- Understand the concepts of mutation testing applied to integration testing
- Understand and use the 4 basic types of mutation operators
- Understand and use the 5 basic integration mutation operators
- Start to understand the ideas of integration mutation applied to java and other OO languages



6. IOR – Overridden Method Rename

Renames the parent's versions of methods that are overridden in a subclass so that the overriding does not affect the parent's method

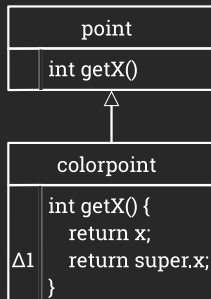
Example



7. ISI – Super Keyword Insertion

Inserts the super keyword before overriding variables or methods (if the name is also defined in an ancestor class)

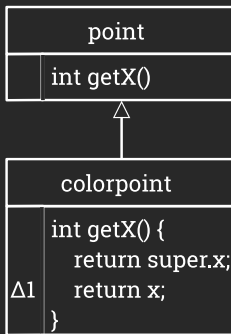
Example



8. ISD – Super Keyword Deletion

Delete each occurrence of the super keyword

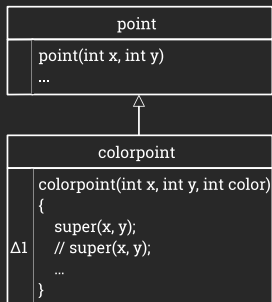
Example



IPC – Explicit Parent Constructor Deletion

Each call to a super constructor is deleted

Example



(1) Encapsulation

AMC

(2) Inheritance

IHI, IHD, IOD, IOP, IOR, ISI, ISD, IPC

(3) Polymorphism

PNC, PMD, PPD, PCI, PCD, PCC, PRV, OMR, OMD, OAC

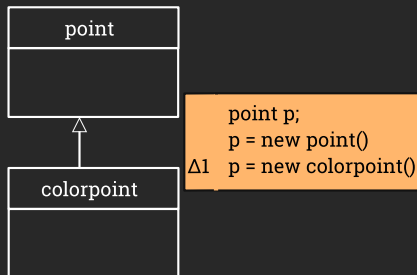
(4) Java-Specific

JTI, JTD, JSI, JSD, JID, JDC

10. PNC – new Method Call with Child Class Type

The actual type of a new object is changed in the new() statement

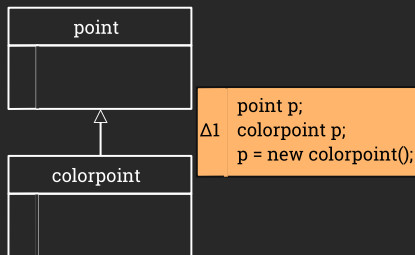
Example



11. PMD – Member Variable Declaration with Parent Class Type

The declared type of each new object is changed in the declaration

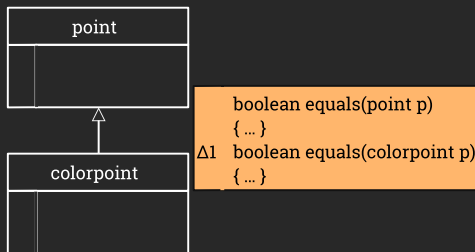
Example



12. PPD – Parameter Variable Declaration with Child Class Type

The declared type of each parameter object is changed in the declaration

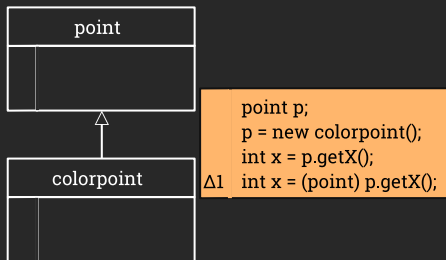
Example



PCI – Type Cast Operator Insertion

The actual type of an object reference is changed to the parent or to the child of the original declared type

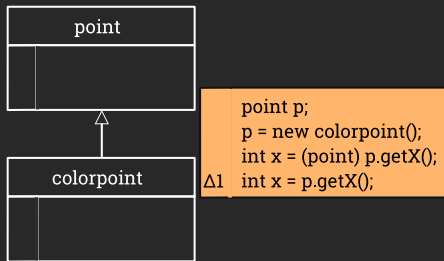
Example



PCD – Type Cast Operator Deletion

Type casting operators are deleted

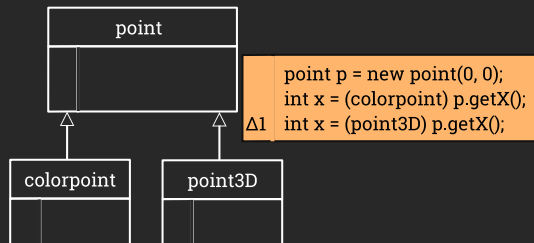
Example



PPC – Cast Type Changed

Changes the type to which an object reference is being cast

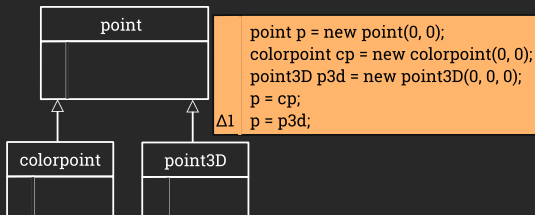
Example



PRV – Reference Assignment with Other Compatible Type

The right side objects of assignment statements are changed to refer to objects of a compatible type

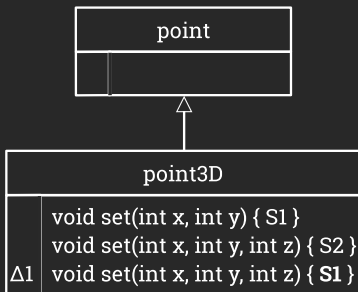
Example



OMR – Overloading Method Contents Replacement

For each pair of methods that have the same name, the bodies are interchanged

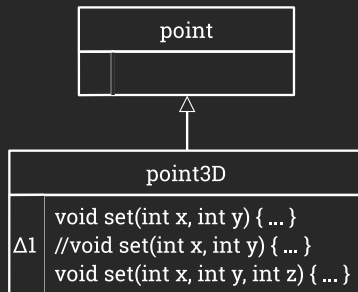
Example



OMD – Overloading Method Deletion

Each overloaded method declaration is deleted, one at a time

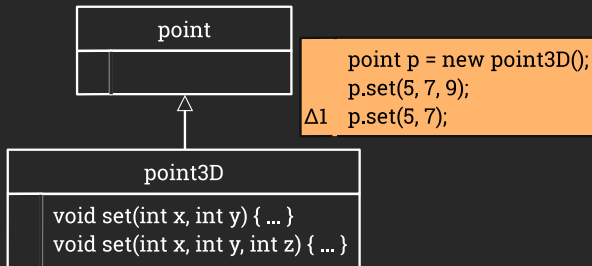
Example



OAC – Arguments of Overloading Method Call Changed

The order of the arguments in method invocations is changed to the same as that of another overloading method, if one exists

Example



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AMC

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(4) Java-Specific

JTI, JTD, JSI, JSD, JID, JDC

JTI – this Keyword Insertion

The keyword `this` is inserted whenever possible

Example

| point | |
|-------|------------------------|
| | ... |
| | void set(int x, int y) |
| | { |
| | x = x; |
| Δ1 | this.x = x; |
| | y = y; |
| Δ2 | this.y = y; |
| | } |
| | ... |

JTD – this Keyword Deletion

The keyword `this` is deleted whenever possible

Example

| point | |
|-------|------------------------|
| | ... |
| | void set(int x, int y) |
| | { |
| | this.x = x; |
| Δ1 | x = x; |
| | this.y = y; |
| Δ2 | y = y; |
| | } |
| | ... |

JSI – Static Modifier Insertion

The static modifier is added to instance variables

Example

| point | |
|-------|--------------------------|
| | public int x = 0; |
| Δ1 | public static int x = 0; |
| | public int y = 0; |
| Δ2 | public static int y = 0; |

JSD – Static Modifier Deletion

Each instance of the static modifier is removed

Example

| point | |
|-------|--------------------------|
| Δ1 | public static int x = 0; |
| | public int x = 0; |
| Δ2 | public static int y = 0; |
| | public int y = 0; |

JID – Member Variable Initialization Deletion

Remove initialization of each member variable

Example

| point | |
|------------|--|
| $\Delta 1$ | <pre>int x = 5; int x; ...</pre> |

JDC – Java-supported Default Constructor Deletion

Delete each declaration of default constructor (with no parameters)

Example

| point | |
|------------|---|
| $\Delta 1$ | <pre>point() {...} // point() {...} ...</pre> |

(1) Encapsulation

AMC

(2) Inheritance

IHI, IHD, IOD, IOP, IOR, ISI, ISD, IPC

(3) Polymorphism

PNC, PMD, PPD, PCI, PCD, PCC, PRV, OMR, OMD, OAC

(4) Java-Specific

JTI, JTD, JSI, JSD, JID, JDC



- Integration testing often looks at **couplings**
- We have not used **grammar testing** at the integration level
- Mutation testing modifies **callers** and **callees**
- **OO Mutation** focuses on inheritance, polymorphism, dynamic binding, information hiding and overloading
 - The access levels make it easy to make mistakes in OO software
- **muJava** is an educational & research tools for mutation of Java programs
 - <http://cs.gmu.edu/~offutt/mujava/>

For Next Time



Idaho State
University

Computer
Science

- Review the Reading
- Review this Lecture
- Come to Class





Are there any questions?