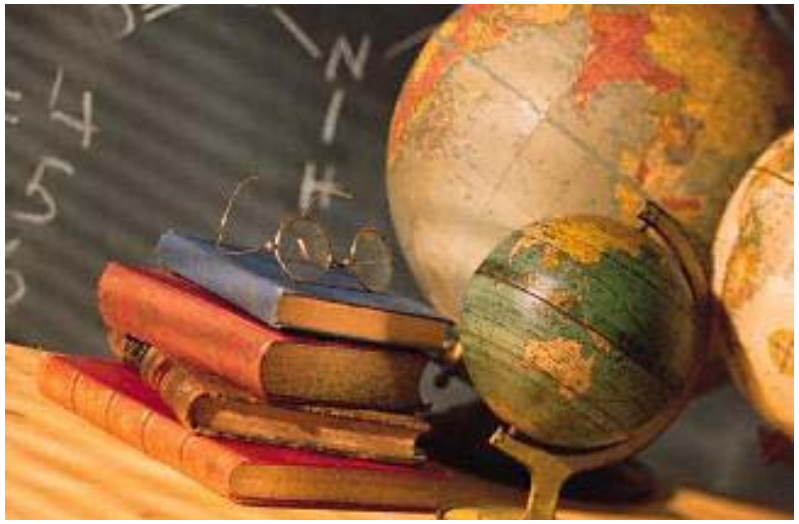
CoMet: A Tool Using CUMM to Measure Unused Component Members



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Agenda

- Background on components
- Problem of component's unused members
- Need of a Measurement Method
- Component's Unused Member Measurement (CUMM) method
- Applying CUMM: Example
- Comet In action
- Conclusion and future directions

Background on Components

- Component
  - Simple object oriented class
  - Conforming to a component model (EJB, COM, CORBA)
  - Subsystem
  - Complete application
- Component members
  - Attributes
    - Simple
    - Nested components
  - Operations

Problem of Component's Unused Members

- Unused attributes
- Unused operations (functionalities) [2]
- Consequences
  - No functional value
  - Leads to waste of memory resources
  - Might increase network traffic
  - Might compromise the application integrity and security

Need a Quantitative Measurement Method

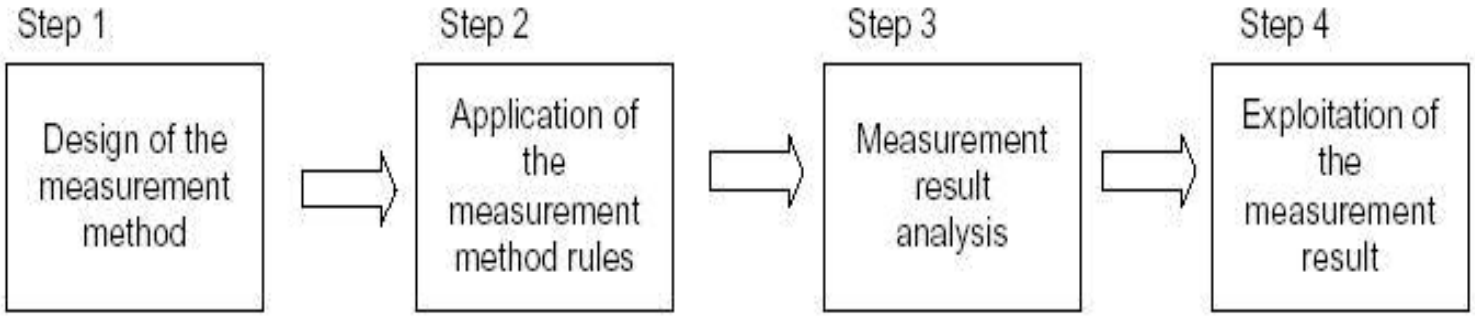
- How much unused **members** a component has?
- How much **memory** they consume?

Component's Unused Member Measurement (CUMM) method

- Measures statically
  - Unused members
    - Attributes
    - Operations
    - Attributes and operations memory consumption
- Statistical formulas
  - Percentages of unused members
  - Generality degree of a component's members

Challenge to Develop CUMM on a Sound Basis

- Traditionally measurement method are defined in terms of formulas
- Resorted to Measurement Method process defined [1]



CUMM Assignment Rules

- Number of unused attributes $u_a = |A|$, A is the set of a component's unused attributes
- Unit is ac (attribute per component)
- Number of unused operations $u_a = |F|$, F is the set of a component's unused operations
- Unit is fc (function per component)

CUMM Development process

- Total memory consumed by unused attributes where m_{ai} is the memory consumed by the i-th unused attribute

$$t_{ma} = \sum_{i=1}^{|A|} m_{ai}$$

- Total memory consumed by unused operations where m_{fi} is the memory consumed by the i-th unused operation

$$t_{mf} = \sum_{i=1}^{|F|} m_{fi}$$

CoMet (Component Measurement)

- CoMet automates the application of CUMM
- CoMet is a prototype developed in Java
- CoMet measures binary Java components
- Provided with a simple GUI
- Reuses apache BCEL (Byte Code Engineering Library)

CoMet in Action: Example I

```
public class ShowWelcomeMessage {
   static String message;

   public static void main(String[] args) {
       message = new String(“Hellow Dubai!");
       System.out.println(message);
   }
}
```

Measurement Results Example I

Element	Used	Instruction lines of code
Components		
`ShowWelcomeMessage`		
Attribute members		
`Message`	yes	1
Method members		
ShowWelcomeMessage.main	Yes	32
testpackage.ShowWelcomeMessage.<init> ()V	Yes	5

Example II

```
public class Foo {
   Bar _bar;

   public void doFoo() {
      _bar = new Bar();
      _bar.doBar();
   }

   public static void main(String[] args) {
      Foo myFoo = new Foo();

      myFoo.doFoo();
   }
} // end Foo
```

```
public class Bar {
   public int doBar () {
      int i = 1;
      int j = 2;
      int res = add(i, j);
      return res;
   }
   public int add (int v1, int v2) {
      int result = v1 + v2;
      return result;
   }
   public int mult (int v1, int v2) {
      int result = v1 * v2;
      return result;
   }
} // end Bar
```

Measurement Results Example II

Element	Used	Instruction lines of code
Components		
`testpackage.Bar`		
Method members		
`testpackage.Bar.mult (II)I`	No	6
`testpackage.Bar.<init> ()V`	Yes	5
`testpackage.Bar.doBar ()I`	Yes	13
`testpackage.Bar.add (II)I`	Yes	6

Measurement Results Example II

Element	Used	Instruction lines of code
Components		
`testpackage.Foo`		
Attribute members		
`testpackage.Foo._bar`	Yes	1
Method members		
`testpackage.Foo.main ([Ljava/lang/String;)V`	Yes	13
`testpackage.Foo.doFoo ()V`	Yes	20
`testpackage.Foo.<init> ()V`	Yes	5

Conclusion and Future Directions

- CoMet provides an automation tool to apply the CUMM method to Java Components
- CoMet provides an indicator of unused members
- CoMet next version
  - Measure the memory of unused members
  - Provide precise measurement result
  - Filter out library components from being measured
  - Enhanced GUI

Thank You !

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References

[1] J.-P. Jacquet and A. Abran, "From Software Metrics to Software Measurement Methods: A Process Model," presented at Third International Symposium and Forum on Software Engineering Standards (ISESS'97), Walnut Creek, CA, 1997.

[2] M. S. Al-Hatali and H. G. Walton, "Smart Features for Compositional Wrappers," presented at ICSR7 2002 Workshop on Component-based Software Development Processes, Austin, Texas, 2002.