5th International Workshop on Quantitative Approaches to Software Quality

Automatically Identifying Dead Fields in Test Code by Resolving Method Call and Field Dependency

Presented by

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Outline

- Broad Domain – Test Smell, Dead Field
- Problem Specification
- Literature Review
- Research Question
- Proposed Technique
- Result Analysis
- Conclusion

Test Smell

```
DBContext dbContext = new
DBContext();

void login(String userName, String
password){
        bool found =
dbContext.exists(userName,
password);
        if(found == true)
                session.set("logged_in");
}
```

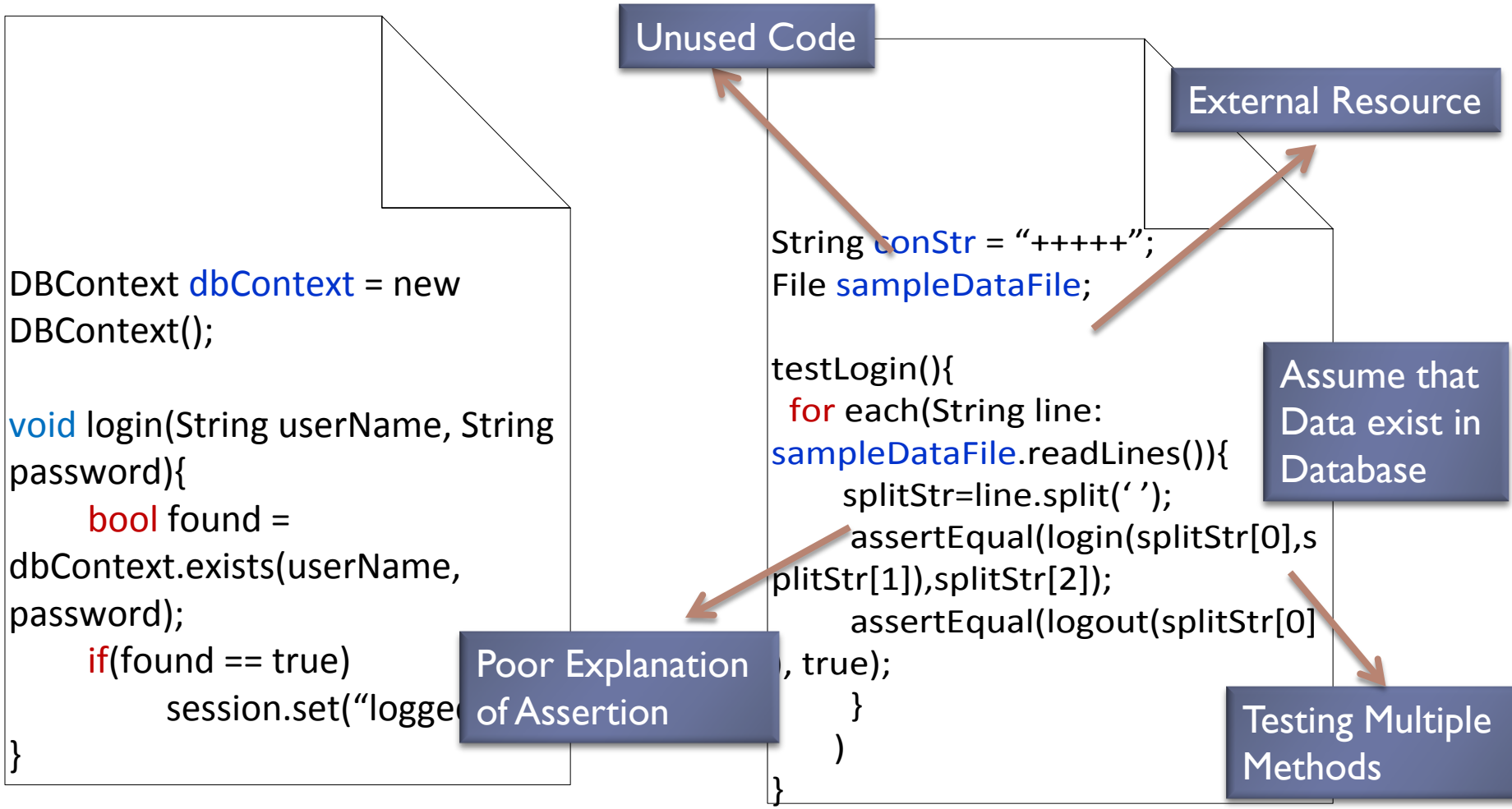
Production Code

```
String conStr = "+++++";
File sampleDataFile;

testLogin(){
        for each(String line:
sampleDataFile.readLines()){
        splitStr=line.split(' ');
        assertEqual(login(splitStr[0],s
plitStr[1],splitStr[2]));
        }
}
```

Test Code

Test Smell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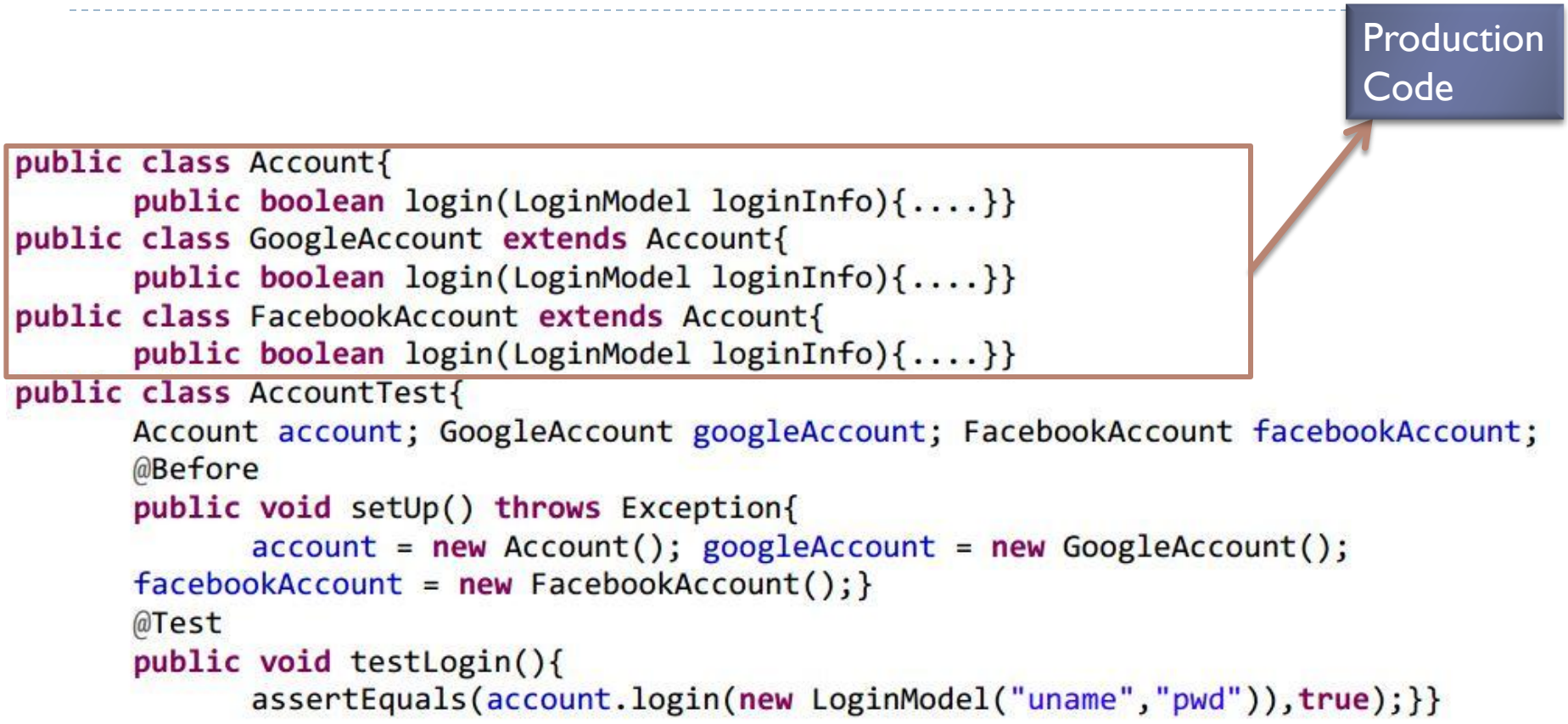
splitStr=line.split(' ');
assertEqual(login(splitStr[0],splitStr[1]),splitStr[2]);
assertEqual(logout(splitStr[0]
, true);
}
)
}
Unused Code
External Resource
Assume that Data exist in Database
Poor Explanation of Assertion
Testing Multiple Methods

Dead Field


Production Code
public class Account{
public boolean login(LoginModel loginInfo){....}}
public class GoogleAccount extends Account{
public boolean login(LoginModel loginInfo){....}}
public class FacebookAccount extends Account{
public boolean login(LoginModel loginInfo){....}}
public class AccountTest{
Account account; GoogleAccount googleAccount; FacebookAccount facebookAccount;
@Before
public void setUp() throws Exception{
account = new Account(); googleAccount = new GoogleAccount();
facebookAccount = new FacebookAccount();}
@Test
public void testLogin(){
assertEquals(account.login(new LoginModel("uname","pwd")),true);}}

Dead Field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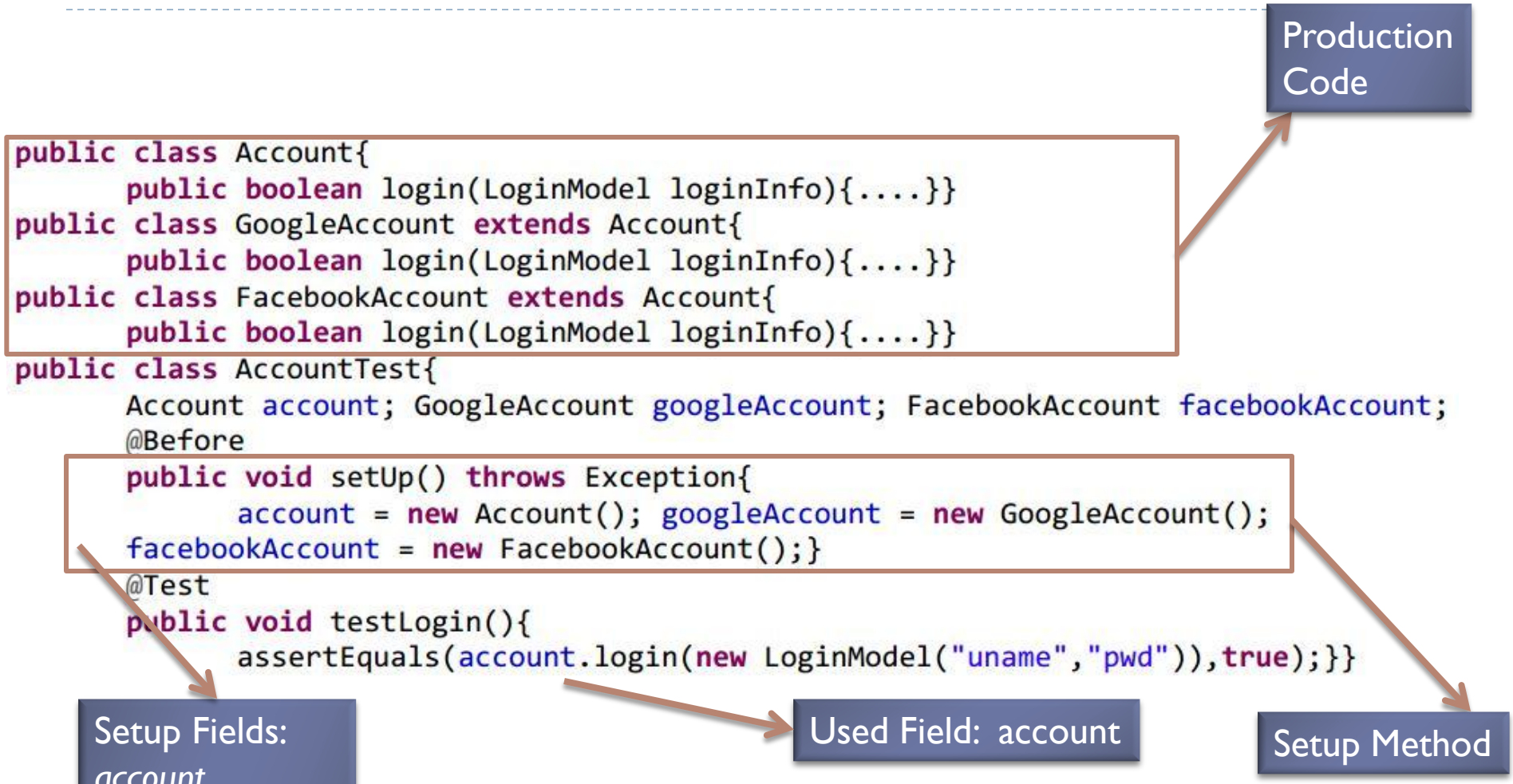
Setup Fields:
account
facebookAccount
googleAccount
Setup Method

Dead Field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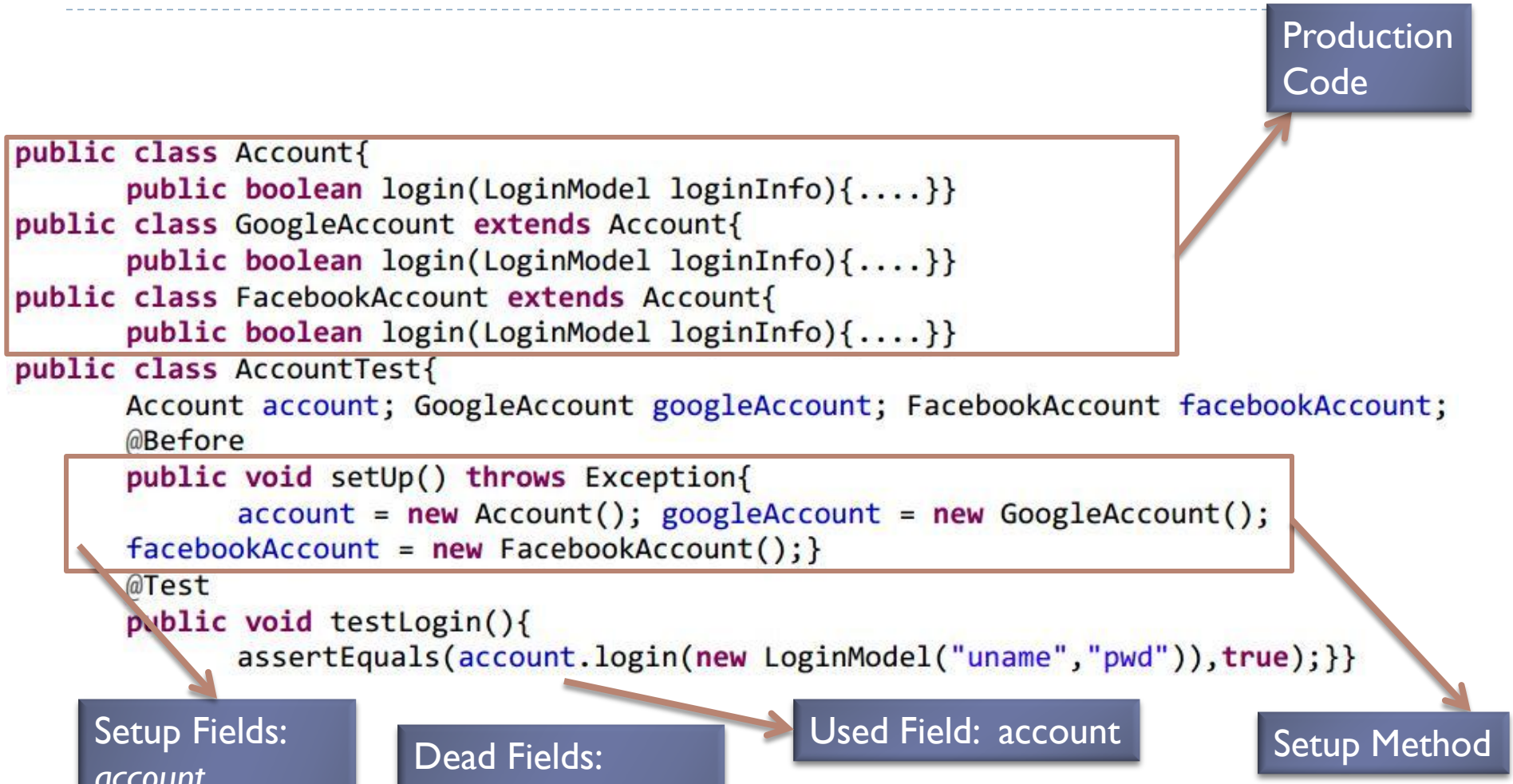
Setup Fields:
account
facebookAccount
googleAccount
Used Field: account
Setup Method

Dead Field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assertEquals(account.login(new LoginModel("uname","pwd")),true);}}
Setup Fields:
account
facebookAccount
googleAccount
Dead Fields:
facebookAccount
googleAccount
Used Field: account
Setup Method

Impact of Dead Field

- Increase line of code
- Decrease maintainability
- Make the code difficult to comprehend
- Increase the amount of production code in Test Driven Development (TDD) approach

Refactoring: improving the design of existing code[1]

- Martin Fowler first introduced code smell
- Discussed impact of code smells in software maintainability
- Provided refactoring mechanism to remove code smells

Refactoring Test Code[2]

- van Deursen first introduced term test smell
- Identified eleven test smells based on the concept of code smell
- Proposed different techniques to remove test smells from test code
- However, no technique was provided to detect dead field because this smell was not discovered at that time

An Empirical Analysis of the Distribution of Unit Test Smells[3]

- Two studies were carried out by Bavota et al. on 18 software systems with twenty masters students
- Explained the distribution of test smells in test code
- Described the impact of test smells in test code comprehension in the controlled experiment
- However, they did not provide any information regarding dead field

Testq: Exploring structural and maintenance characteristics of unit test suites[4]

- Tool presented by Bart Van Rompaey for exploring structural maintenance characteristics of test code
- Eleven different test smells like assertionless, eager test and so on could be identified by the tool
- Uses test smell characteristics for test smell detection
- Visualization feature helps to explore test suites visually
- The tool could not identify dead field as no metric was defined for the detection

Rule-based assessment of test quality[5]

- This rule based tool proposed by Stefan Reichart for assessing test code quality
- The tool parses the source code, analyzes the source tree, detects pattern and identifies smell
- Pattern detection involved test smell characteristics
- The tool could not detect dead fields as no rule was provided for it

Automated Detection of Test Fixture Strategies and Smells[6]

- Introduced five new test smells
  - Test Maverick
  - Dead Fields
  - Lack of Cohesion of Test Methods
  - Obscure In-Line Setup
  - Vague Header setup
- Implemented a tool named TestHound to detect these smells
- Could identify test smells well but could not identify dead field correctly due to not considering field dependency and usage of setup fields properly

Research Question

- How to develop a process to identify dead fields automatically by analyzing method call and field dependency in test methods?

Dead Field Detector (DFD)

- The technique comprises four steps –
  - Call Graph Generation
  - Data Dependency Graph Generation
  - Setup Field Detection
  - Dead Field Detection

Dead Field Detector (DFD)

```
import java.lib2
import java.lib3
int p=200;
int x=p-3;
int y=20;
int z;
int setup(int a, int b){
   a=lib2.pow(a,4);
   x=x+a+b;
   return m2(x);
}
int m2(int a){
   return m3()-2*a;
}
int m3(){
   return y*y-2*y;
}
int m4(){
   return p+x-y;
}
```

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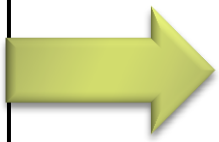

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Parsing Methods

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}
```

Call Graph Generation

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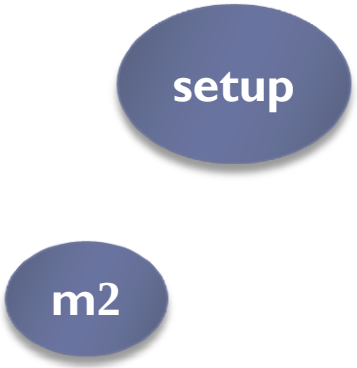
Call Graph Generation



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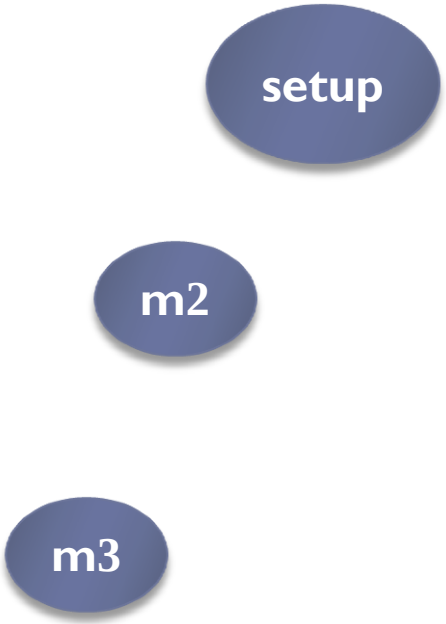

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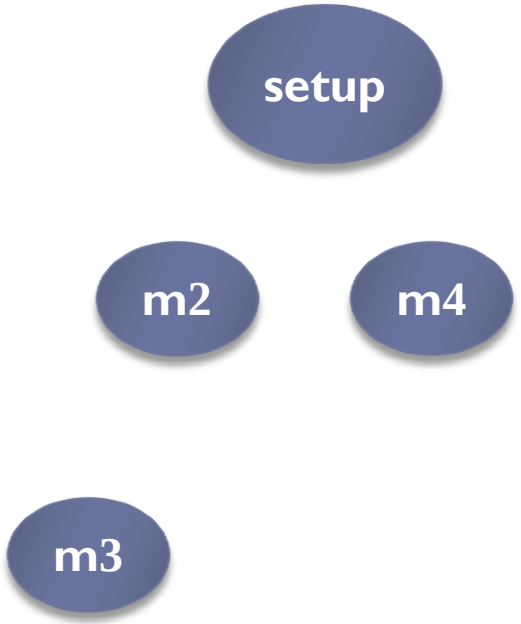

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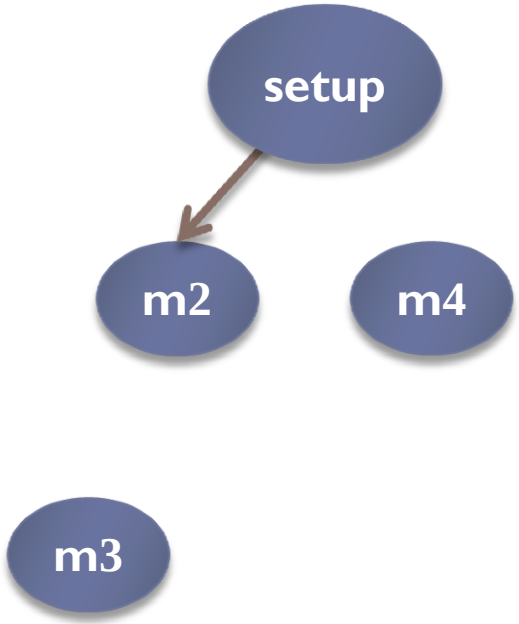

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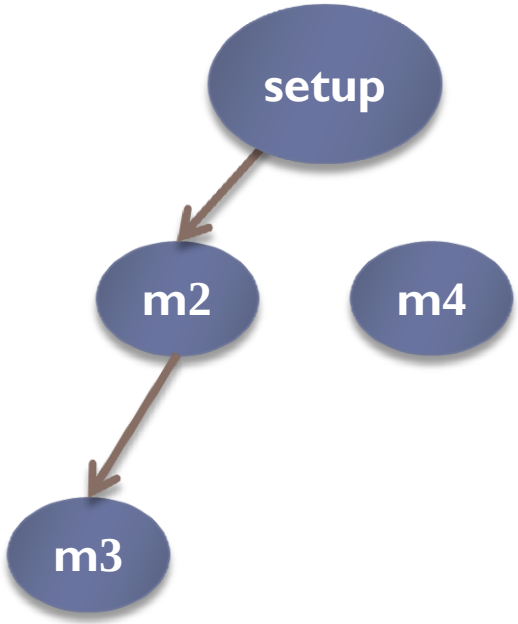

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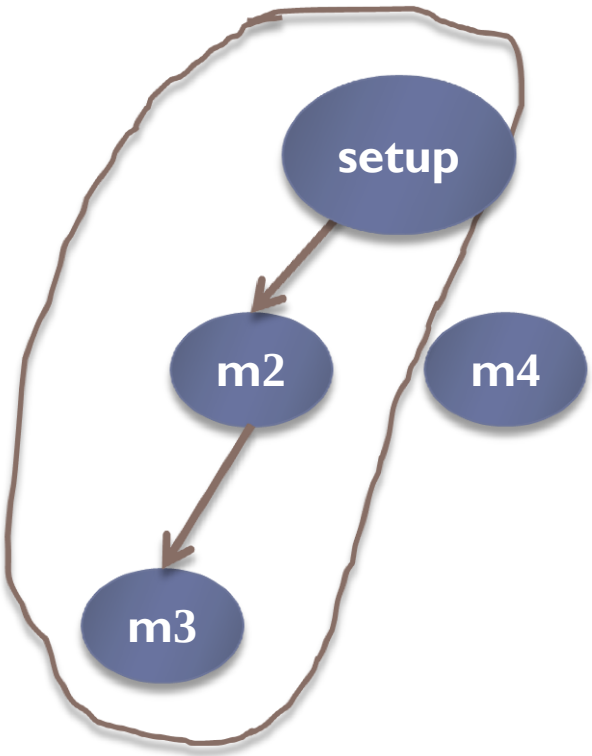
Method Call Resolution



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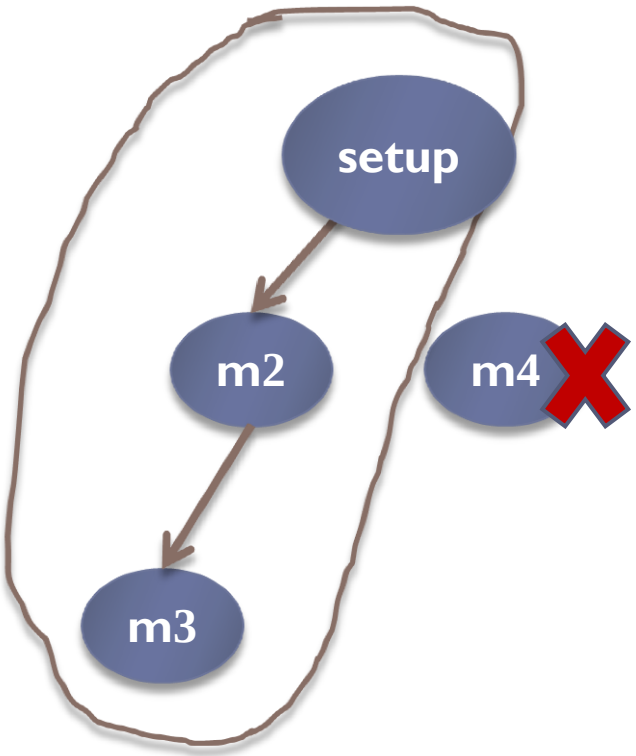

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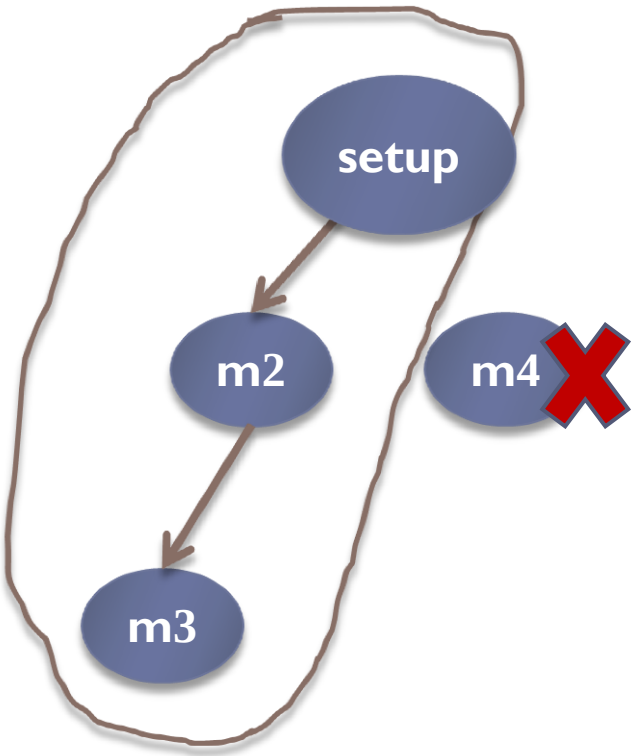

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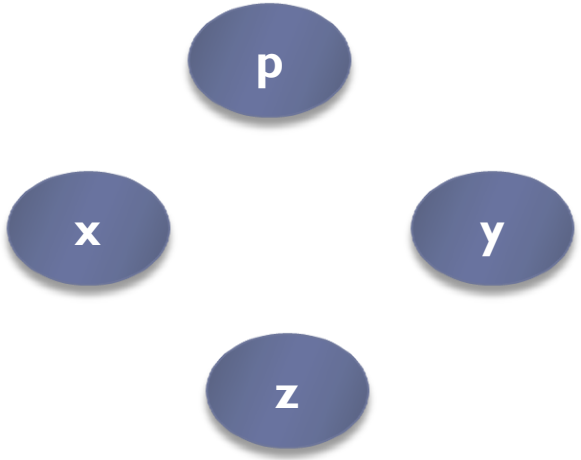
Data Dependency Graph Generation



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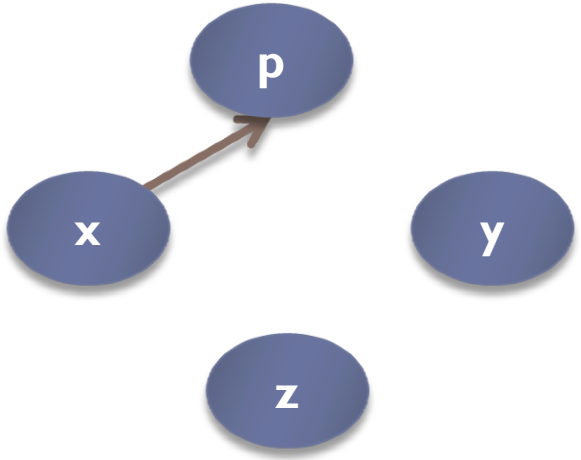

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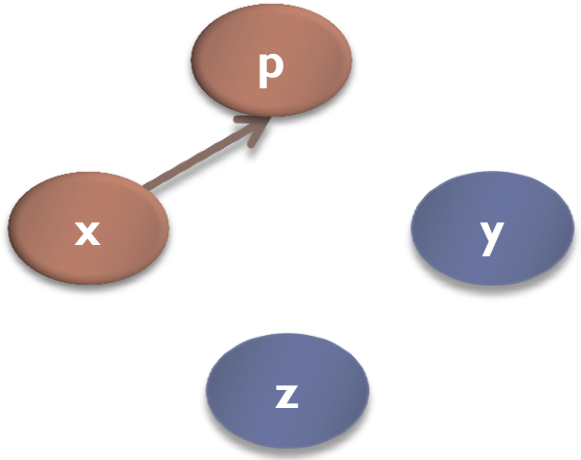

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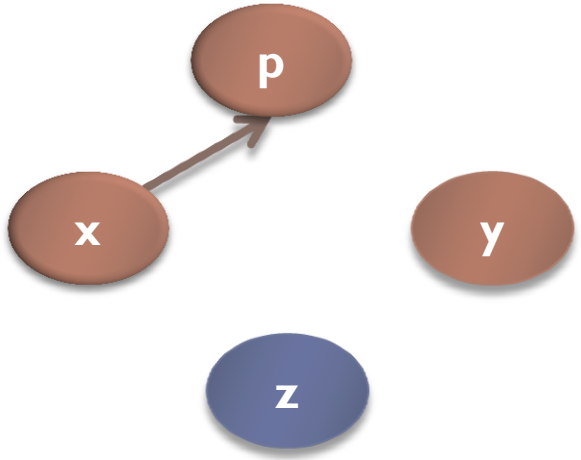

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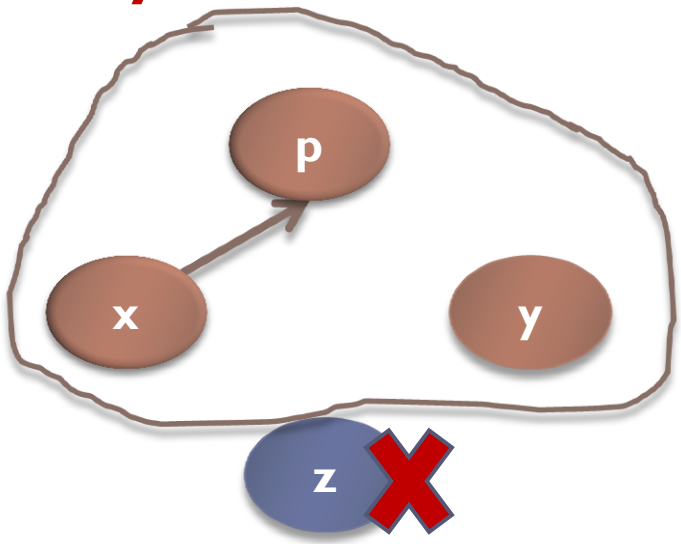

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}
```
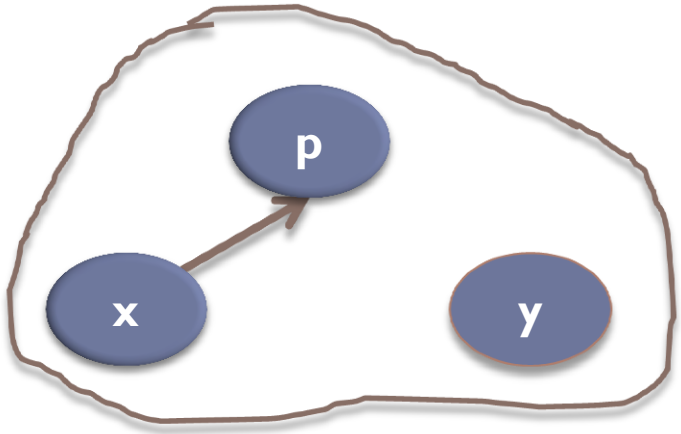

```
int testDummy(){
   -------
   -------
   -------
   dummy1();
}

void dummy1(){
  -------
  -------
 pow(2,x);
}
```

Data Dependency Graph



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   -------
   -------
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  -------
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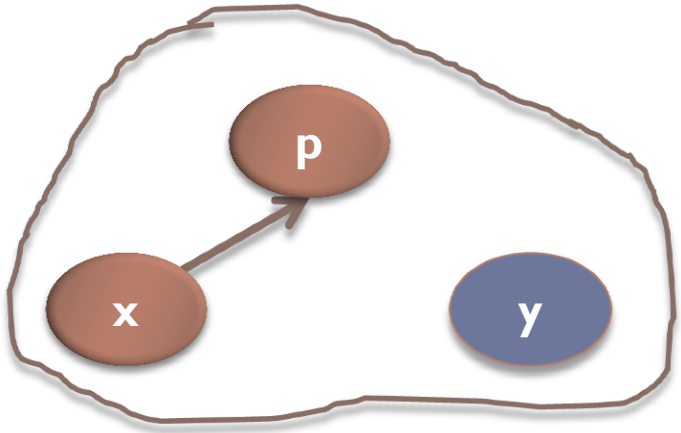

Used setup field={ x, p}

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   -------
   -------
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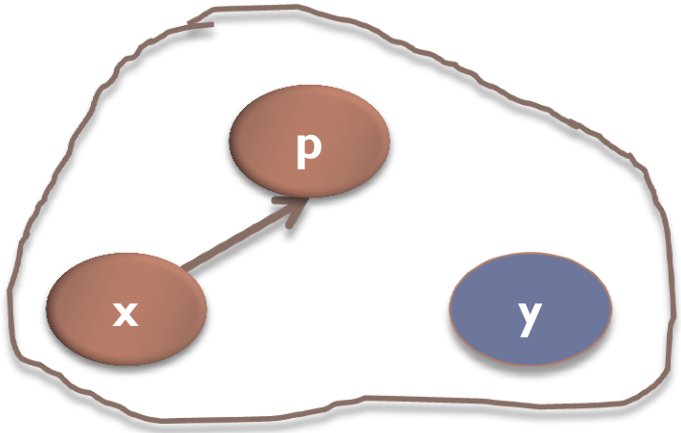


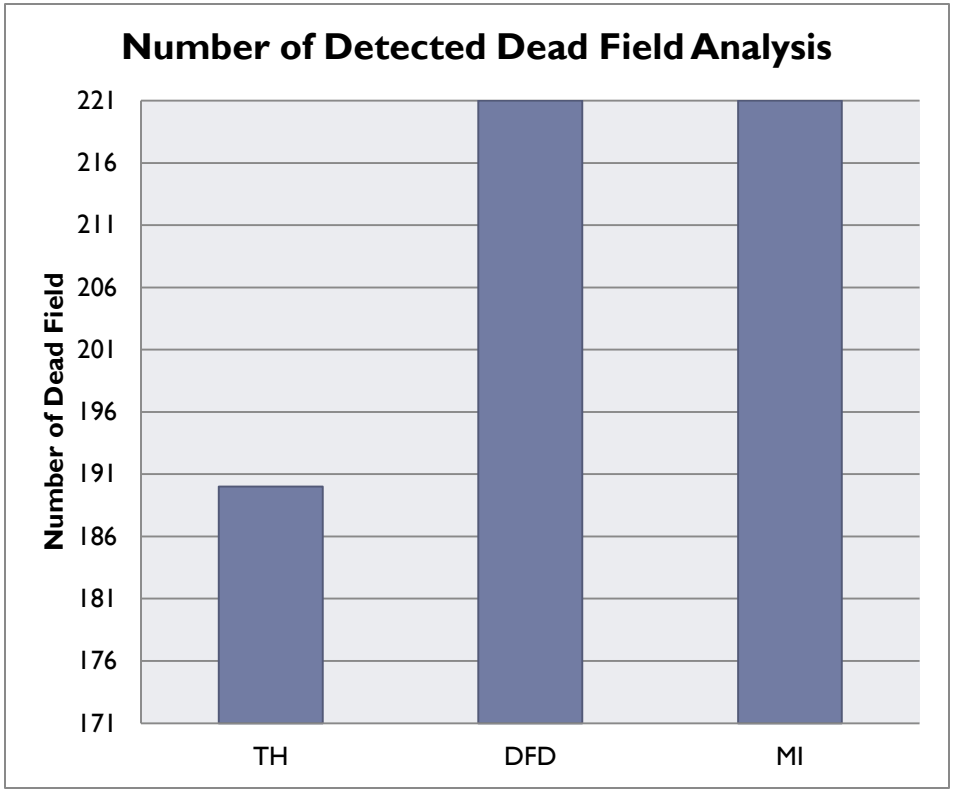
Used setup field={ x, p}

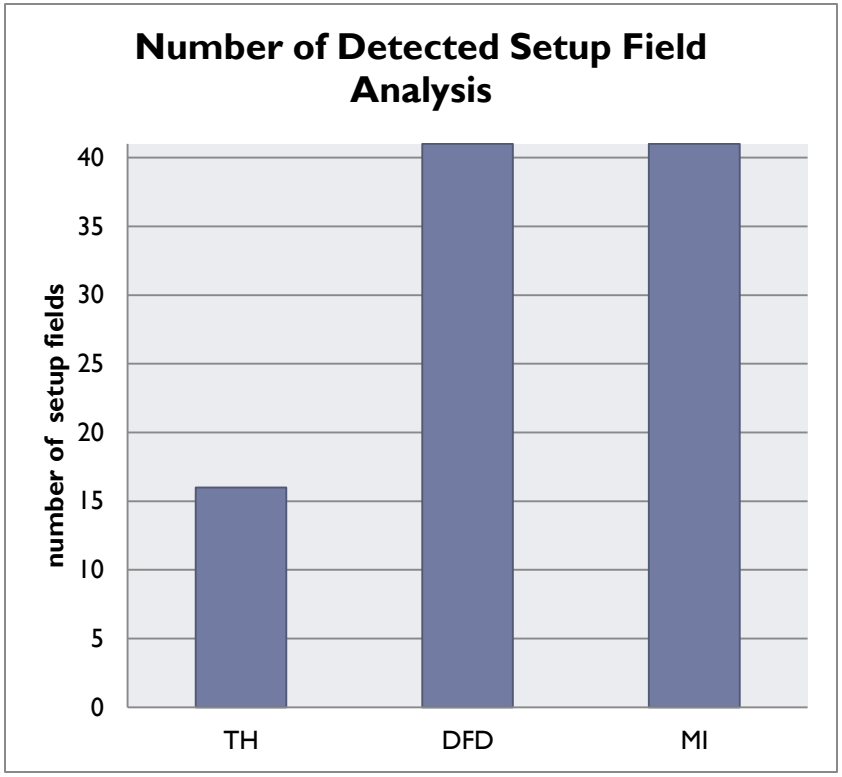
Dead Field = {x, p, y } - { x, p}
= {y}

Experimental Setup

- Implementation Details
  - Java
  - Java Parser
  - Maven
- Experimental Project
  - eGit
  - 130K lines of code, 85 test classes and 10 modules

Result Analysis





TH = TestHound
DFD = Dead Field Detector
MI = Manual Inspection

Conclusion

- DFD seems to identify more setup fields and dead fields correctly than existing approaches
- Automatic identification reduces the time and effort in software maintenance
- In future, experiments will be performed on industrial projects

Thank You

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