

SE 333/433 Software Testing & Quality Assurance

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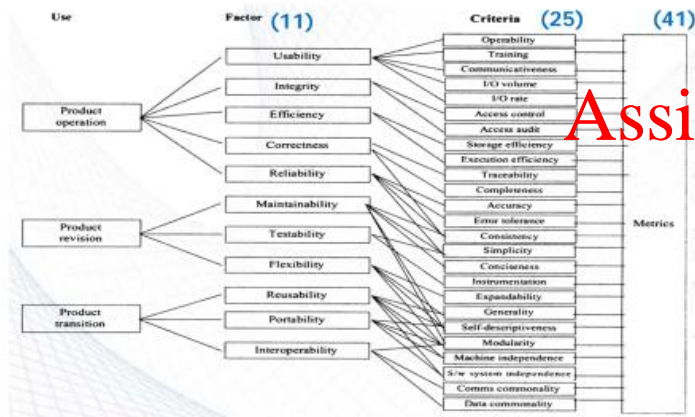
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Code-smells and bad-design practices

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Last Week

McCall's Model



Chidamber and Kemerer OO Metrics (CK - 1994)

- Weighted methods per class (MWC)
- Depth of inheritance tree (DIT)
- Number of children (NOC)
- Coupling between object classes (CBO)
- Response for class (RFC)
- Lack of cohesion metric (LCOM)

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28

McCall's quality factors



Functional vs Non-Functional Requirements

Functional Requirements



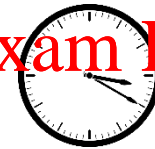
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Functionality
of the program

Non-Functional Requirements



Execution Time



Size



Battery



Memory

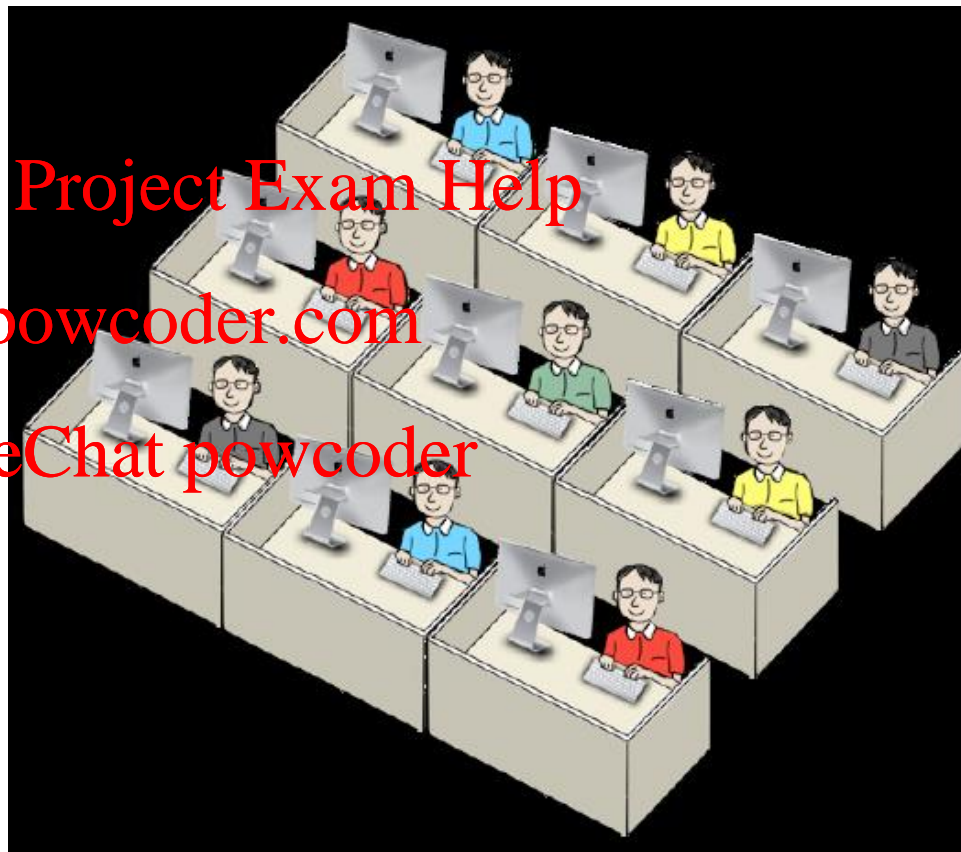


- Text chat
 - Friends list
-

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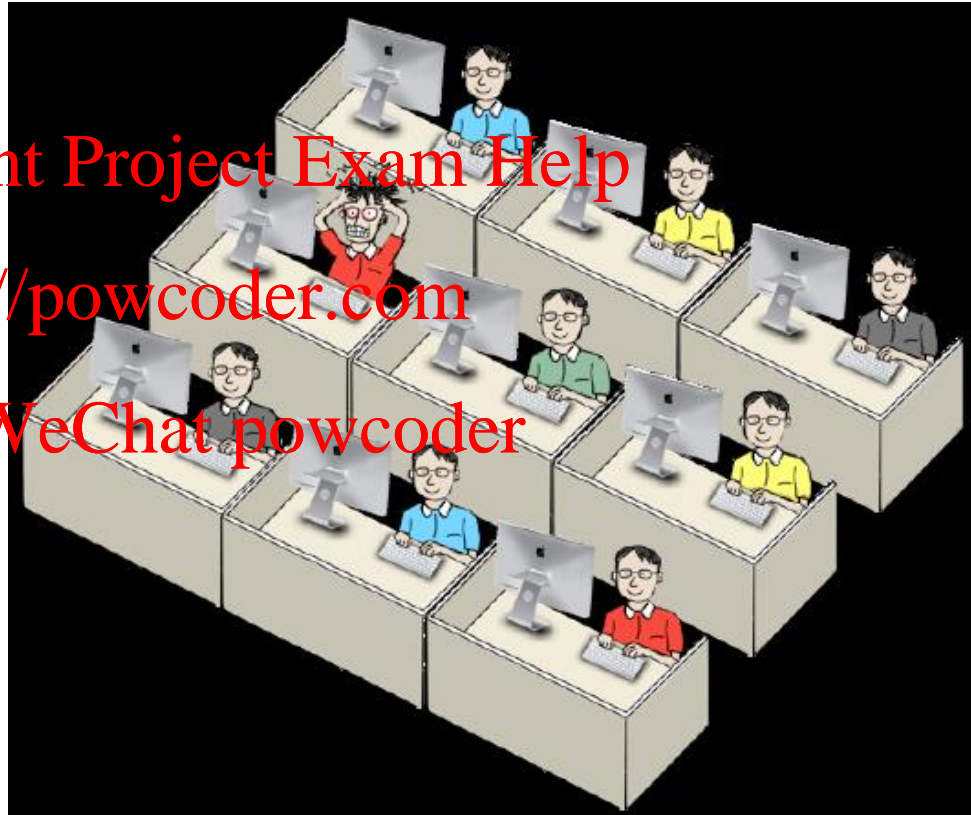
- Text chat
- Friends list

- Voice Communication

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- Text chat
- Friends list

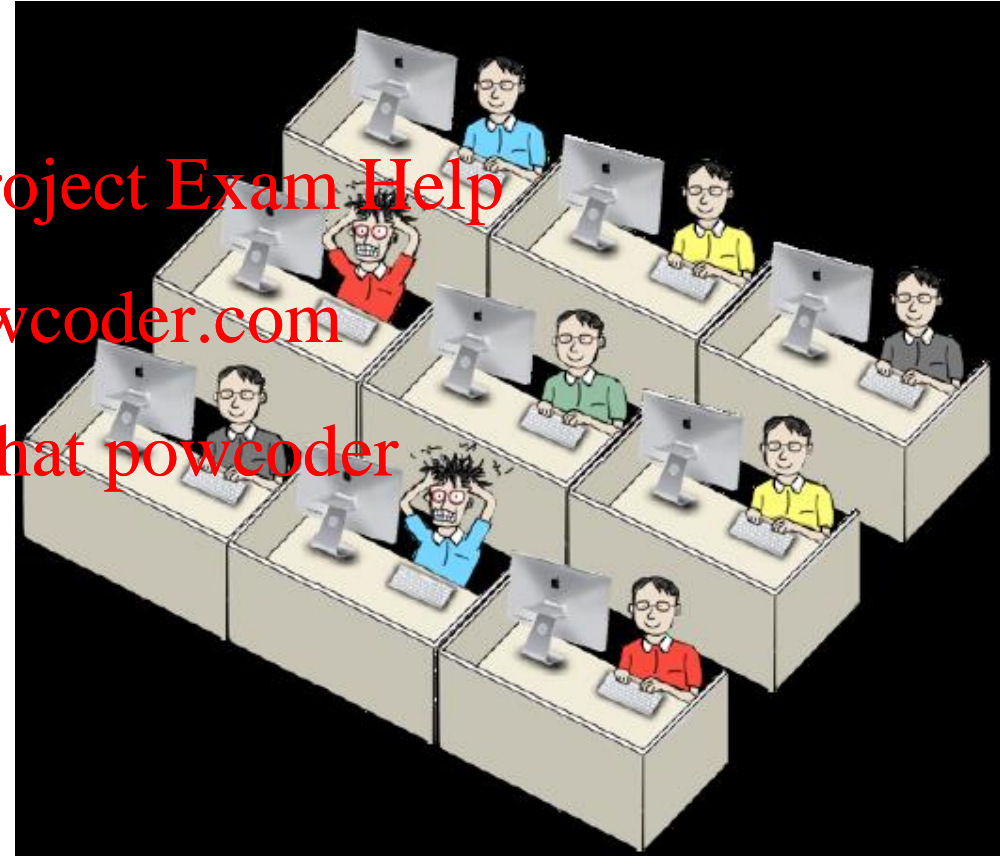
- Voice Communication



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- Text chat
- Friends list



- Voice Communication



-Execution time



-Battery consumption

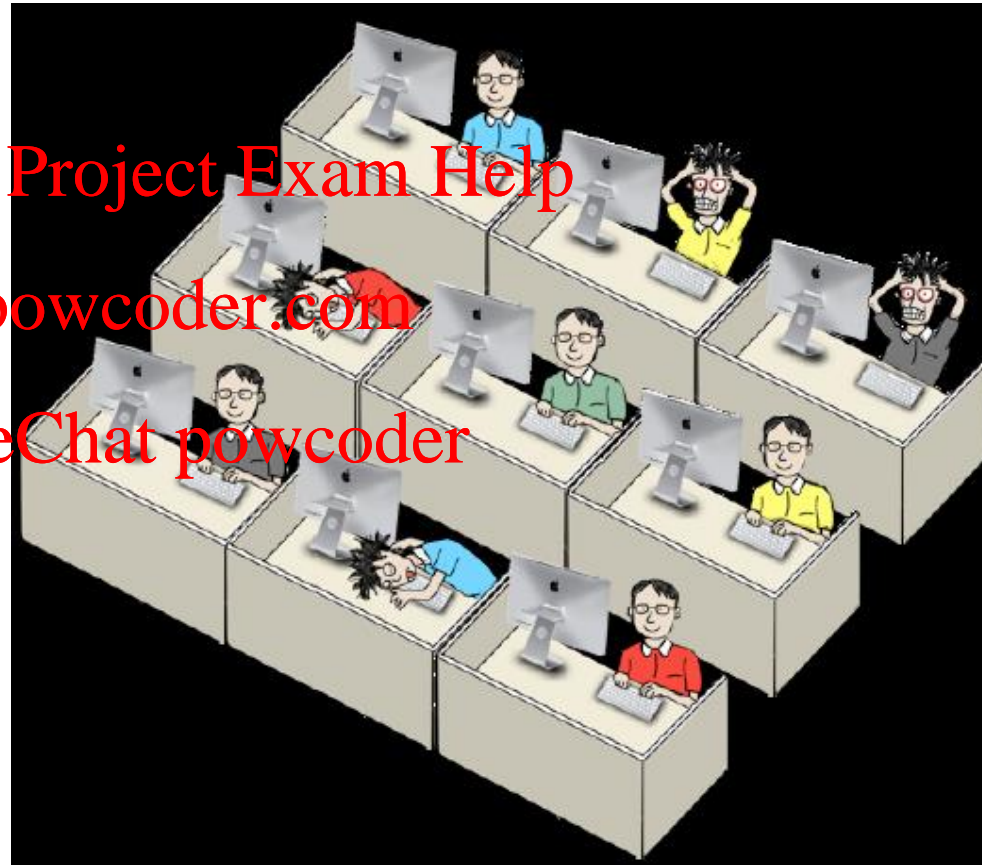


-Size

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- Text chat
- Friends list



- Voice Communication



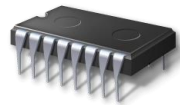
-Execution time



-Battery consumption



-Size



-Memory leak

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Functional Requirements



humans have to define these

Non-Functional Requirements



a machine can optimize these

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Functional Requirements



humans have to define these

Non-Functional Requirements



a machine can optimize these

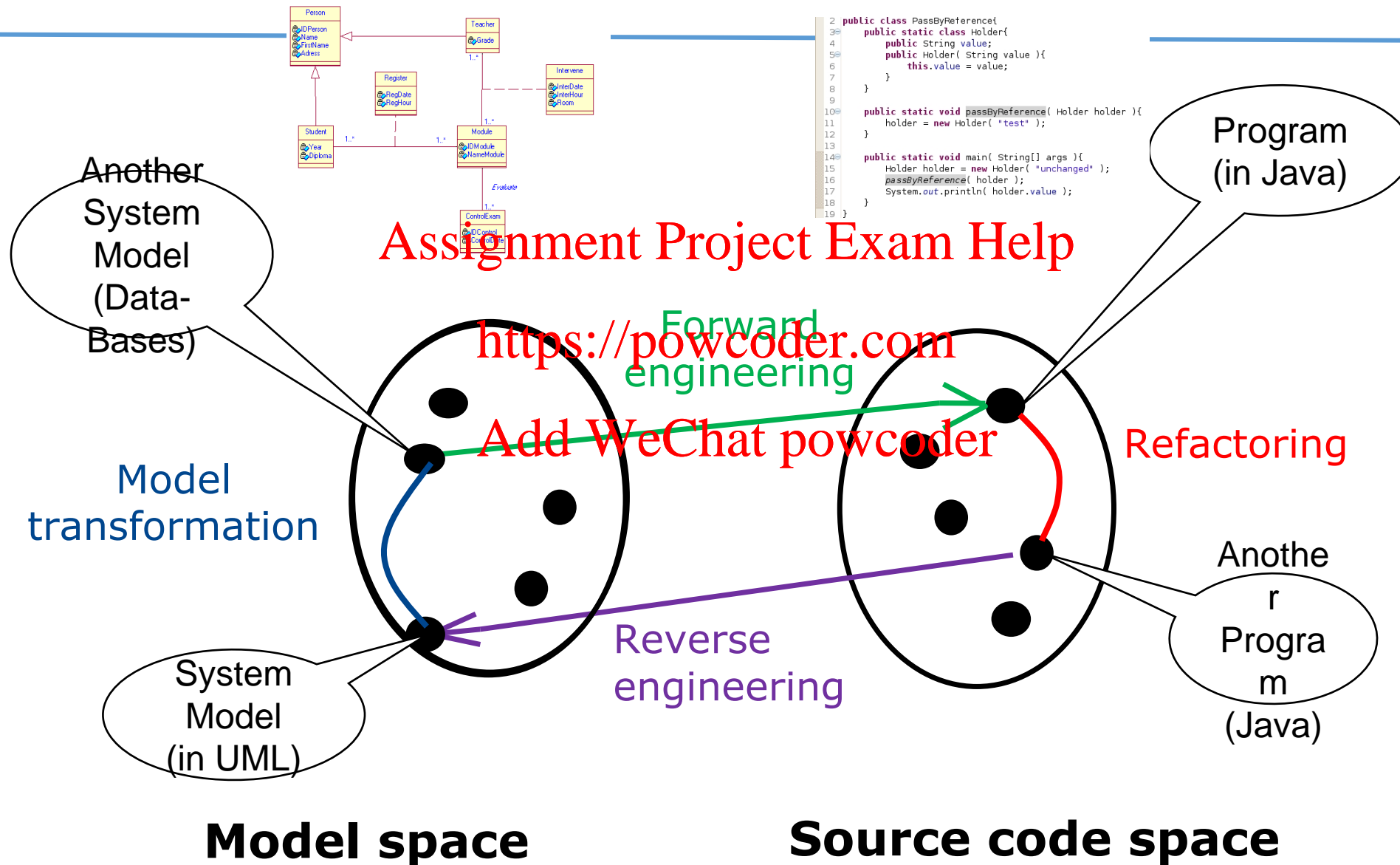
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- Software Refactoring:
 - Antipatterns Detection <https://powcoder.com>
 - Antipatterns Correction (Refactoring Recommendation)
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- Refactoring <https://powcoder.com>
– The process of improving a code after it has been written **by changing its internal structure without changing the external behavior** (Fowler et al., '99)
– Examples: *Move method, extract class, move attribute, ...*
- Two main refactoring steps
 1. detection of code fragments to improve (e.g., Anti pattern)
 2. identification of refactoring solutions

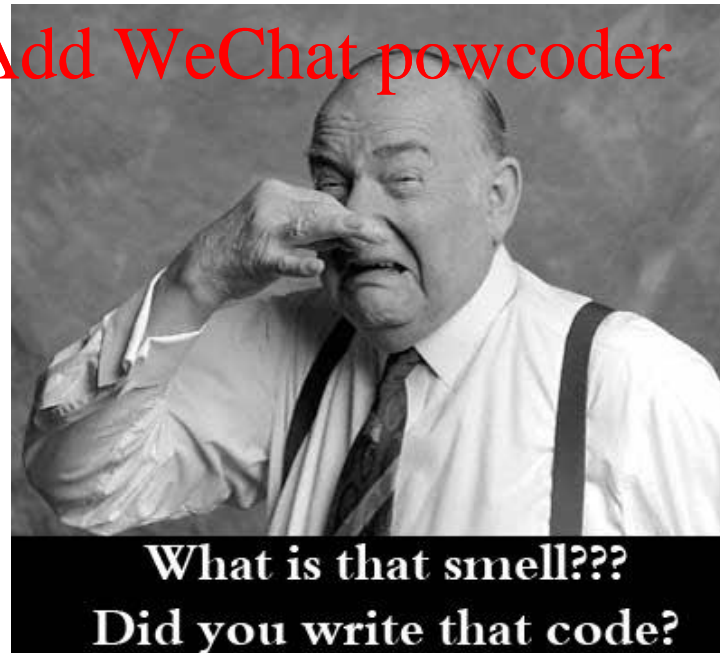
Learning objectives

- Anti-patterns: Overview
- Examples of anti-patterns
- How to detect anti-patterns using quality metrics?

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Design defects/antipatterns

- Design defects/antipatterns are poor coding and design choices introduced during different phases of software development
 - Anomalies, code smells, bad smells...
 - Make the design harder to understand, to change
 - Design situations that adversely affect the development of a software (**not bugs**)

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Management Antipatterns



Examples of antipatterns

- Duplicated code
 - Long method
 - God class
 - Long parameter list
 - Message chain
 - Data class
 - Functional decomposition
 - ...
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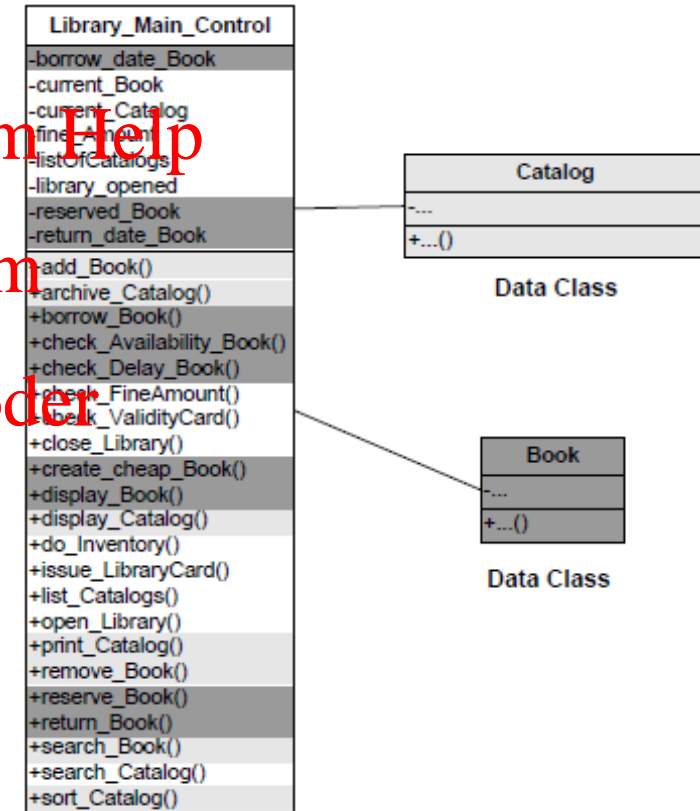
The Blob (God Class)

- Definition

- Procedural-style design leads to one object with numerous responsibilities and most other objects only holding data or executing simple processes.

- Symptoms

- A Blob is a *controller* class, *abnormally large*, with *almost* no parents and no children. It *mainly uses* data classes, i.e. *very small* classes with *almost* no parents and no children ([Brown et al. '98](#)).



- Causes

- *Lack of an object-oriented architecture.*
 - *Inadequate understanding of OO principles*
- *Lack of (any) architecture*
 - *Design, interaction between object etc.*
- *Too limited intervention*

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Duplicate Code or Cut and Paste Programming

- Code reused by copying source statements leads to significant maintenance problems.
 - Duplicate methods in subclasses
 - Duplicate expressions in same class
 - Duplicate expressions in different classes

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```
def to_time(value)
  if value.respond_to?(:to_time)
    value.to_time
  else
    Coercion::String.to_time(to_string(value))
  end
end

def to_datetime(value)
  if value.respond_to?(:to_datetime)
    value.to_datetime
  else
    Coercion::String.to_datetime(to_string(value))
  end
end
```

```
public function add()
{
    if($this->input->post("departmentName"))
    {
        $departmentName = $this->input->post("departmentName");
        $departmentBudget = $this->input->post("departmentBudget");

        $this->departments_m->addDepartment($departmentName, $departmentBudget);
        redirect("/departments");
    }

    $data = array('title' => 'Add Department - DB Hotel Management System', 'page' => 'departments');
    $this->load->view('header', $data);
    $departments = $this->departments_m->get_departments();
    $viewdata = array('departments' => $departments);
    $this->load->view('departments/add', $viewdata);
    $this->load->view('footer');
}
```

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```
public function edit($department_id)
{
    if($this->input->post("departmentName"))
    {
        $departmentName = $this->input->post("departmentName");
        $departmentBudget = $this->input->post("departmentBudget");

        $this->departments_m->editEmployee($department_id, $departmentName, $departmentBudget);
        redirect("/departments");
    }

    $data = array('title' => 'Edit Department - DB Hotel Management System', 'page' => 'departments');
    $this->load->view('header', $data);
    $department = $this->departments_m->getDepartment($department_id);
    $viewdata = array('department' => $department[0]);
    $this->load->view('departments/edit', $viewdata);
    $this->load->view('footer');
}
```

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Large method

- A method that does more than one thing
 - Many things, sometimes unconnected things
- Problems
 - Could indicate low levels of abstraction, low level of class design, reduced re-usability
 - Harder to test, poor readability

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Long Parameter List

- Introduce parameter object
- Only worthwhile if there are several methods with same parameter list, and they call each other

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```
user= userManager.create(USER_NAME,group, USER_NAME,  
“test”, Language, false, false, new Date(), “blah”, “new Date() )
```


Message Chain

- Long list of method calls:
 - `customer.getAddress().getState()`
 - `window.getBoundingBox().getOrigin().getX()`

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Message Chain

```
Class Employee{  
    public function getConfiguration() {  
        $this->employeeConfig->getConfiguration();  
    }  
}  
  
Class EmployeeConfig{  
    public function getConfiguration() {  
        $this->config->getConfiguration();  
    }  
}  
  
Class Config{  
    public function getConfiguration() {  
        $this->loadConfiguration();  
    }  
}
```

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Data Class/Lazy Class

- Class has no methods except for getter and setters

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```
public class Example implements InterfaceExample {  
    @Override  
    public void doSomething() {  
        // Input text is put here.  
    }  
}
```

Switch statements

- **Switch** statements are very rare in properly designed object-oriented code
 - Therefore, a **switch** statement is a simple and easily detected “bad smell”
 - Of course, not all uses of **switch** are bad
 - A switch statement should *not* be used to distinguish between various kinds of object

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Example 1, continued

- class Animal {
 final int MAMMAL = 0, BIRD = 1, REPTILE = 2;
 int myKind; Assignment Project Exam Help
 ...
 String getSkin() { <https://powcoder.com>
 switch (myKind) {
 case MAMMAL: return "hair"; Add WeChat powcoder
 case BIRD: return "feathers";
 case REPTILE: return "scales";
 default: return "skin";
 }
 }
}

Example 1, improved

```
class Animal {  
    String getSkin() { return "skin"; }  
}  
class Mammal extends Animal {  
    String getSkin() { return "hair"; }  
}  
class Bird extends Animal {  
    String getSkin() { return "feathers"; }  
}  
class Reptile extends Animal {  
    String getSkin() { return "scales"; }  
}
```

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Dead Code/ Old Baggage

- Description

- System contains many classes whose purpose is not known
 - Lava Flow, ~~Dead Code~~
- Much of the code is left over from previous ideas and no longer has a purpose
 - was once fluid and useful, now is solid lava that you are afraid to remove

- Consequences

- difficult to maintain, just gets worse

Comments?

- The purpose of comments should be only “why you are doing something (to help future modifiers, rather than “what code is doing”
- Whenever possible make your code express the intent of the comment and remove the comment.
- Comments are to provide intent that is not expressible in code
- Any comment that duplicates what the code says should be deleted

```
public void add(Object element) {  
    if (!readOnly) {  
        int newSize = size + 1;  
        if (newSize > elements.length) {  
            // grow the array  
            Object[] newElements =  
                new Object[elements.length + 10];  
            for (int i = 0; i < size; i++)  
                newElements[i] = elements[i];  
            elements = newElements;  
        }  
        elements[size++] = element;  
    }  
}
```

```
public void add(Object element) {  
    if (!readOnly) {  
        int newSize = size + 1;  
        if (newSize > elements.length) {  
            grow();  
        }  
        elements[size++] = element;  
    }  
}
```

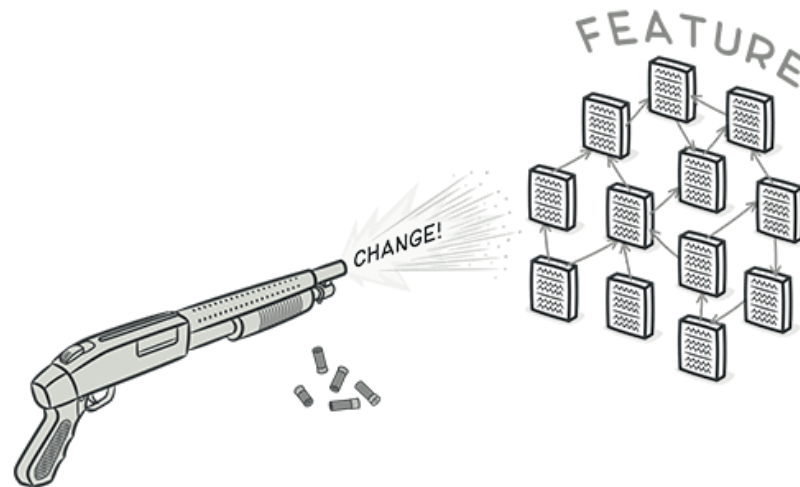
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Shotgun Surgery

- This happens when, you want to make some kind of change, you are forced to make a lot of changes to a lot of different classes
- And when changes are all over the place, they are hard to find, and it's easy to miss an important change



Functional Decomposition

- Description

- Classes with names "functions"
- All class attributes are private and are used only inside the class
- Classes with a single action similar to a procedural function.

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- Consequences

- No O/O benefits such as inheritance and polymorphism
 - Expensive to maintain
 - Complexity of testing software
 - Complexity of reuse of the code

Spaghetti code

- Description

- System hard to debug, modify
- Bunch of code similar in structure to a bowl of spaghetti.
 - Bad coding practices

- Consequences

- Low readability
- Impossible to understand how it exactly works

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Feature envy

- When a method seems more interesting in a class, other than the one in actually it is
- Example : a method that invokes half a dozen getting methods on another object to calculate some value.

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```
class User
{
    private $contactInfo;

    public function __construct()
    {
        $this->contactInfo = new ContactInfo();
    }

    public function getFullAddress()
    {
        $address = $this->contactInfo->getStreetName();
        $address .= " " . $this->contactInfo->getStreetNumber() . ', ';
        $address .= $this->contactInfo->getZipCode() . ', ';
        $address .= $this->contactInfo->getCity() . ', ';
        $address .= $this->contactInfo->getCountry();

        return $address;
    }
}
```

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Class Activity

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See additional file added on d2l

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