



Bad Smells in Code

Shin-Jie Lee (李信杰)

Assistant Professor

Computer and Network Center

Department of CSIE

National Cheng Kung University



Unresolved warnings

- ❑ The program is still runnable, but may cause unexpected errors

```
1 public void printSomething() {  
2     int size = 3  
3     String target = null;  
4  
5     for(int i = 0; i < size; i++) {  
6         System.out.println("i = " + i);  
7     }  
8  
9  
10    System.out.println(target.toString(  
    ));  
10 }
```

15 Null pointer access: The variable target can only be null at this location

```
i = 0  
i = 1  
i = 2  
Exception in thread "main" java.lang.NullPointerException  
    at Examples.main(Examples.java:15)
```



Every dynamic allocated memory is de-allocated or there is garbage collection

- ❑ The memory may be fully occupied when an amount of instantiated objects are not deleted as they will no longer be used.

```
1  int main() {  
2      int size = 10;  
3      int result = 0;  
4      int array = new int[size];  
5  
6      // Assign value to the array  
7      for(int i = 0; i < size; i++) {  
8          array[i] = i;  
9      }  
10  
11     for(int i = 0; i < size; i++) {  
12         result += array[i];  
13     }  
14 }
```

Memory Leak



Long method(1/2)

- ☐ The object programs that live best and longest are those with short methods.
- ☐ The longer a procedure is, the more difficult it is to understand.
- ☐ It's not easy to name the long method



Long method(2/2)

- ❑ Decompose the long method into short methods through *Extract Method*

```
1 public void createPartControl(Composite parent) {  
2     _failnodes = new HashSet<Object>();  
3     _comps = new ConcurrentLinkedQueue<IComponent>();  
4     _viewer = new TreeViewer(parent, SWT.MULTI |  
        SWT.H_SCROLL);  
5     _viewer.setInput(getViewSite());  
6     ...  
59     _selectionHandler = new SelectionChangHandler();  
60     _selectionHandler.setViewer(_viewer);  
61 }
```



Feature envy

- ❑ A classic smell is a method that seems more interested in a class other than the one it actually is in.

```
1 public void doSomething() {  
2     ClassA a = new ClassA();  
3     int x = a.getX();  
4     int y = a.getY();  
5     int z = a.calculateSomething(x +  
6     y, y);  
7     a.setZ(z);  
8 }
```

```
1 public ClassA() {  
2     public void doSomething() {  
3         z = calculateSomething(x + y, y);  
4     }  
5 }
```

- ❑ Use *Move Method* to move the method to another class



Unsuitable naming

- ❑ Giving a suitable name for a class, a method, or a variable will make programmers easy to understand

```
1 public class T() {  
2     boolean b = false;  
3  
4     public int xyz(int x, int y, int z) {  
5         int r = 0;  
6         r = (x + y) * z / 2;  
7         return r;  
8     }  
9 }
```

```
1 public class Trapezoid() {  
2     boolean isIsosceles = false;  
3  
4     public int calculateArea(int top, int bottom, int  
5     height) {  
6         int area = 0;  
7         area = (top + bottom) * height / 2;  
8         return area;  
9     }  
10 }
```



All assigned variables have proper type consistency or casting (1/2)

- ❑ Casting is another bane of the Java programmer's life.
- ❑ As much as possible try to avoid making the user of a class do downcasting.

```
1 void testType() {  
2     unsigned short x = 65535;  
3     short y = x;  
4  
5     for(int i = 0; i < y; i++) {  
6         Do something  
7     }  
8 }
```




All assigned variables have proper type consistency or casting (2/2)

□ Upcasting

```
1 class Animal() {}  
2  
3 class Mammal extends Animal() {}  
4  
5 class Cat extends Mammal() {}  
6  
7 class Dog extends Mammal() {}
```

```
1 Mammal m = new  
  Mammal()  
2 Cat c = (Cat)m;
```





Loop termination conditions are obvious and invariably achievable

```
1 for(int i = 1; (i % 2) ? ((i + 100) < 200) : ((i * 30) < 50);  
  i++) {  
2   Do something  
3 }  
4  
5 for(int i = 0; i < 100; i++) {  
6   Do something  
7   i = i * 5;  
8 }  
9  
10 int i = 0;  
11 while(i < 10) {  
12   Do something  
13 }
```

```
1 for(int i = 1; i < 10; i++) {  
2   Do something  
3 }  
4  
5 for(int i = 0; i < 100; i++) {  
6   Do something  
7 }  
8  
9  
10 int i = 0;  
11 while(i < 10) {  
12   Do something  
13   i++;  
14 }
```



Parentheses are used to avoid ambiguity

- ❑ Use parentheses to increase the readability and prevent logical errors

```
1 public int trapezoidArea(int top, int bottom, int height) {  
2     int area = top + bottom * height / 2;  
3     return area;  
4 }  
5  
6 if (isOk && getX() * getY() == 2000 && !isFinished) {  
7     Do something  
8 }
```

```
1 public int trapezoidArea(int top, int bottom, int height) {  
2     int area = (top + bottom) * height / 2;  
3     return area;  
4 }  
5  
6 if ((isOk) && (getX() * getY() == 2000) && (!isFinished)) {  
7     Do something  
8 }
```



Lack of comments(1/2)

- ☐ A good time to use a comment is when you don't know what to do.
- ☐ In addition to describing what is going on, comments can indicate areas in which you aren't sure.
- ☐ A comment is a good place to say *why* you did something. This kind of information helps future modifiers, especially forgetful ones.



Lack of comments(2/2)

```
1 public RSSIMapCollection() {  
2     _maps = new Hashtable<String, RSSIMap>();  
3     _listeners = new Vector<RSSIMapCollectionEventListener>();  
4     _stabilizes = new SelectionProperty(STABILIZES_LABEL);  
5     _stabilizes.addElement(Stabilize.NONE);  
6     _stabilizes.addElement(Stabilize.THRESHOLD);  
7     _stabilizes.addElement(Stabilize.AVERAGE);  
8     _stabilizes.addElement(Stabilize.WIEGHTED);  
9     _stabilizes.setSelectedItem(Stabilize.THRESHOLD);  
10 }
```

```
1 public RSSIMapCollection() {  
2     _maps = new Hashtable<String, RSSIMap>();  
3     _listeners = new Vector<RSSIMapCollectionEventListener>();  
4  
5     // Initialize a selection property for multiple stabilizations  
6     _stabilizes = new SelectionProperty(STABILIZES_LABEL);  
7     _stabilizes.addElement(Stabilize.NONE);  
8     _stabilizes.addElement(Stabilize.THRESHOLD);  
9     _stabilizes.addElement(Stabilize.AVERAGE);  
10    _stabilizes.addElement(Stabilize.WIEGHTED);  
11    _stabilizes.setSelectedItem(Stabilize.THRESHOLD);  
12 }
```



Fat View (1/2)

```
1 // codes that create menus, buttons, and connects signals to slots
  (omitted)
32 MainWindow::loadMindMap() {
33     /** open dialogue box that let user input the text
34         * file using ifstream. Also, read the text
35         * variables that we need to process
36     */
37     ...
45     while (fin.eof()) { // fin is a ifstream object.
46         fin >> line;
47         if (line == "//ROOTNODE") {
48             fin >> nodeId >> nodeDescription;
49             newRoot = new AbstractNode(nodeId, nodeDescription);
50             fin >> coordinateX >> coordinateY >> width >> height;
51             newRoot->setX(coordinateX);
52             ... // more bussiness logic
100 }
```

```
// ROOTNODE
0 MindMind_Topic
50 50 40 60
// NODE
1 10 Node_Description
150 0 40 60
...
```

含

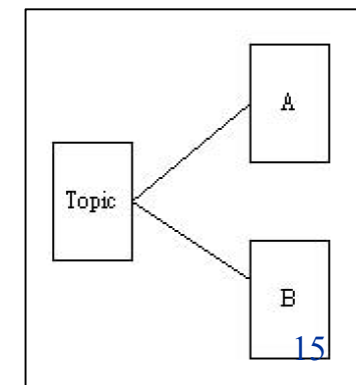


Fat View (2/2)

```
1 // codes that create menus, buttons, and connects signals to slots (omitted)
32 MainWindow::loadMindMap() {
33     /** open dialogue box that lets user specify a file path, and read the text
34      * file using ifstream. Also, assume we have properly declared the
35      * variables that we need to restore a mind map.
36      */
37     ...
38     m_mindMap->loadMindMap(filePath);
39 }
40 ... // more methods
41
```

```
10 void MindMap::loadMindMap(string filePath) {
11     while (fin.eof()) {
12         fin >> line;
13         if (line == "//ROOTNODE") {
14             fin >> nodeId >> nodeDescription;
15             newRoot = new AbstractNode(nodeId, nodeDescription);
16             fin >> coordinateX >> coordinateY >> width >> height;
17             newRoot->setX(coordinateX);
18             ... // set coordinateY, width, and height for root node.
19         } else if (line == "//NODE") {
20             fin >> parentId >> nodeId >> nodeDescription;
21             ... // more bussiness logic
22         }
23     }
24     ... // more methods
25 }
```

MindMap object is now responsible for loading existing mind map.





Files are checked for existence before attempting to access them

- ❑ 開啟檔案之後沒有測試檔案是否正確載入就進行操作。
(using C++ as example language)
 - 開啟檔案之後應該測試檔案是否已正確開啟。

```
1 ... // include necessary header files.
5 using namespace std;
6 int main () {
7     ifstream inputFileStream;
8     inputFileStream.open("MyText.txt");
9     char output[100];
10    while (!inputFileStream.eof()) {
11        inputFileStream >> output;
12        ... // process read-in data
16    }
17    inputFileStream.close();
18 }
```

read in lines
without checking
file existence.

```
1 ... // include necessary header files.
5 using namespace std;
6 int main () {
7     ifstream inputFileStream;
8     inputFileStream.open("MyText.txt");
9     char output[100];
10    if (inputFileStream.is_open()) {
11        while (!inputFileStream.eof()) {
12            inputFileStream >> output;
13            ... // process read-in data
16        }
17    } else {
18        ... // error-handling code
20    }
22 }
```

Check if file
has been
opened
successfully.



Each class have appropriate constructors and destructors

```
1 Class Student {
2 public:
3     ~Student () {
4         delete _fullName; // release source
5     }
6     Student (int id, char *fullName) {
7         _id = id;
8         int length;
9         _fullName = new char [length + 1]; // allocate memory space
10        strcpy(_fullName, fullName);
11    }
12    ...
20 private:
21     int _id;
22     char* _fullName;
23 }
```

Now we have
Constructor and
Destructor



Duplicated Code (1/2)

- ❑ If you see the same code structure in more than one place, you can be sure that your program will be better if you find a way to unify them.

```
1 public class ClassAReport {
2     ...
3     public int calculateAverage(List<Integer>
scores) {
4         int sum, average = 0;
5         for (int i = 0; i < scores.size(); i++) {
6             sum += scores.get(i);
11        }
20        average = sum / scores.size();
21        retrun average;
22    }
23    ...
}
```

```
1 public class ClassBReport {
2     ...
3     public int calculateAverage(List<Integer>
scores) {
4         int sum, average = 0;
5         for (int i = 0; i < scores.size(); i++) {
6             sum += scores.get(i);
11        }
20        average = sum / scores.size();
21        return average;
22    }
23    ...
}
```

This piece of code occurs
more than once!¹⁸



Duplicated Code (2/2)

- ❑ The simplest duplicated code problem is when you have the same expression in two methods of the same class.
 - Then all you have to do is *Extract Method* and invoke the code from both places.

```
1 public class AverageCalculator {
2     public int calculateAverage(List<Integer>
  scores) {
3         int sum, average = 0;
4         for (int i = 0; i < scores.size(); i++) {
5             sum += scores.get(i);
6         }
7         average = sum / scores.size();
8         return average;
9     }
10    ...
}
```

This class is responsible
for calculating average.

```
1 public class ReportCardManager {
2     public static void main (String args[]) {
3         AverageCalculator ac = new AverageCalculator();
4         ClassAReport classAReport = new ClassAReport();
5         ClassBReport classBReport = new ClassBReport();
6         int classAAverage = classAReport.calculateAverage(ac);
7         int classBAverage = classBReport.calculateAverage(ac);
8         ....
9     }
10 }
```

```
1 public class classAReportCard {
2     private List<Integer> classAScores;
3     ... // initialize scores
4     public int calculateAverage (AverageCalculator ac) {
5         return ac.calculateAverage(classAScores);
6     }
  // Another Class
1 public class classBReportCard {
2     private List<Integer> classBScores;
3     ... // initialize scores
4     public int calculateAverage (AverageCalculator ac) {
5         return ac.calculateAverage(classBScores);
6     }
```



All methods have appropriate access modifiers and return types (1/2)

- ❑ The access to classes, constructors, methods and fields are regulated using access modifiers i.e. a class can control what information or data can be accessible by other classes.

```
1 Class Account {  
2 public:  
3     string _password;  
4     string getPassword();  
5     ...  
};
```

```
1 Class Account {  
2 public:  
3     string getPassword();  
4     ...  
5 private:  
6     string _password;  
7     ...  
};
```



All methods have appropriate access modifiers and return types (2/2)

- Add an appropriate return type to help check if the method executes successfully.

```
1 bool openAndProcessFile(string filePath) {  
2     ifstream ifs;  
3     ifs.open(filePath.c_str());  
4     if (!ifs.is_open())  
5         return false;  
6     ...  
10    return true;  
11 }
```

Return false if file
is not opened
successfully.



Are there any redundant or unused variables?

- ❑ Remove unused variables from source code

```
1 public int calculateClassAverage (List<Integer> scores) {
2     int rank = 0; // never used
3     int sum, average = 0;
4     for (int i = 0; i < scores.size(); i++) {
5         sum += scores.get(i);
6     }
7     return average;
8 }
```

```
1 public int calculateClassAverage (List<Integer> scores) {
2     int sum, average = 0,
3     for (int i = 0; i < scores.size(); i++) {
4         sum += scores.get(i);
5     }
6     return average;
7 }
```

Delete unused variable



Indexes or subscripts are properly initialized, just prior to the loop

- Variables used in the termination conditions should be initialized properly

```
1 int i;  
2 while (i < 0) {  
3     doSomething();  
4     i++;  
5 }
```

```
1 int i = -10; | initialized  
2 while (i < 0) {  
3     doSomething();  
4     i++;  
5 }
```

```
1 int i;  
2 for (i ; i < someInt; i++) {  
3     doSomething();  
4 }
```

```
1 int i = 0; | initialized  
2 for (i ; i < someInt; i++) {  
3     doSomething();  
4 }
```



Is overflow or underflow possible during a computation?

- ❑ An overflow or underflow during a computation may cause system crash

```
1 int main () {  
2     short int addend = 30000;  
3     short int augend = 30000;  
4     short sum = addend + augend;  
5     doSomething(sum);  
6 }
```

```
1 int main () {  
2     short int addend, augend;  
3     cin >> addend;  
4     cin >> augend;  
5  
6     if (addend + augend > numeric_limits<short>::max() ||  
7         (addend + augend < numeric_limits<short>::min())) {  
8         throw "short integer overflow / underflow"  
9     }  
10     short int sum = addend + augend;  
11  
12 }
```




Are divisors tested for zero?

❑ Divisors should not be zero at runtime

```
1  int divisor;  
2  int dividend;  
3  cin >> divisor;  
4  cin >> dividend;  
5  int quotient = dividend /  
   divisor;  
6  ...  
}
```

```
1  int divisor;  
2  int dividend;  
3  cin >> divisor;  
4  cin >> dividend;  
5  
6  if (divisor == 0) {  
7      throw "divisor is 0";  
8  }  
9  int quotient = dividend /  
   divisor;  
10 ...  
}
```



Inconsistent coding standard

- ❑ To use meaningful names
- ❑ To use an underline as the prefix of an attribute of a class

- 1 成員變數名稱前應加底線。
- 2 To use meaningful names

```
1 class Car {  
2 public:  
3     int getAbc();  
4     string getXyz();  
5     ...  
6 private:  
7     int id;  
8     string manufactureDate;  
9     ...  
10 };
```

meaningless naming

Inconsistent coding standard

```
1 class Car {  
2 public:  
3     int getVehicleId ();  
4     string getManufactureDate();  
5     ...  
6 private:  
7     int _id;  
8     string _manufactureDate;  
9     ...  
10 };
```



Data clumps₁

- ❑ Often you'll see the same three or four data items together in lots of places: fields in a couple of classes, parameters in many method signatures.

```
1 public class Customer {  
2     private String name;  
3     private String title;  
4     private String house;  
5     private String street;  
6     private String city;  
7     private String postcode;  
8     private String country;  
9     ...  
10 }
```

```
1 public class Staff {  
2     private String lastname;  
3     private String firstname;  
4     private String house;  
5     private String street;  
6     private String city;  
7     private String postcode;  
8     private String country;  
9     ...  
10 }
```



Data clumps₂

- ❑ Often you'll see the same three or four data items together in lots of places: fields in a couple of classes, parameters in many method signatures.

```
1 public class Address {  
2     private String house;  
3     private String street;  
4     private String city;  
5     private String country;  
6     ...  
7 }
```

```
1 public class Customer {  
2     private String name;  
3     private String title;  
4     private Address customerAddr;  
5  
6  
7  
8     ...  
9 }
```

```
1 public class Staff {  
2     private String lastname;  
3     private String firstname;  
4     private Address staffAddr;  
5  
6  
7  
8     ...  
9 }
```



Switch statement

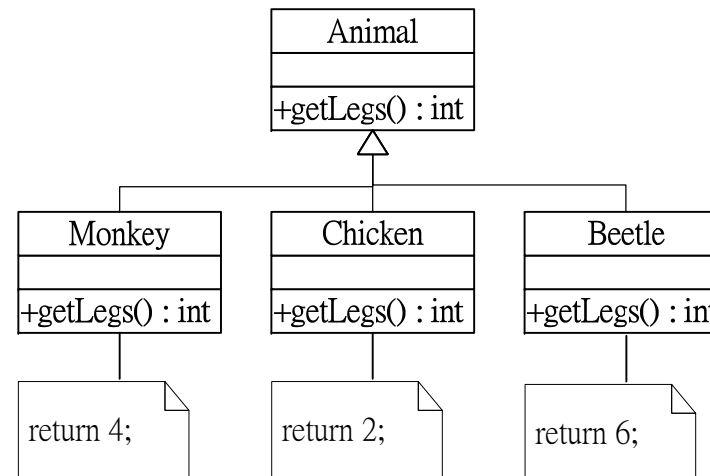
❑ To use polymorphism instead of switch statement ◦

- Not good:

```
1 public int getLegsNum() {  
2     switch(animal) {  
3         case 'chicken':  
4             return 2;  
5         case 'monkey':  
6             return 4;  
7         case 'beetle':  
8             return 6;  
9         default:  
10            return 0;  
11     }  
12 }
```

- Better solution:

```
1 public int getLegsNum(Animal a) {  
2     return a.getLegs();  
3 }
```





Large class

- ❑ As with a class with too many instance variables, a class with too much code is prime breeding ground for duplicated code, chaos, and death.

```
1 public class A() {  
2     public void method_A() {  
3         ...  
4         m1();  
5         m2();  
6         m3();  
7     }  
8     public void m1() {...}  
9     public void m2() {...}  
10    public void m3() {...}  
11 }  
12 public class A() {
```

```
1 public class A() {  
2     public void method_A() {  
3         ...  
4         b.m1();  
5         c.m2();  
6         d.m3();  
7     }  
8  
11  
12  
13 }
```

```
1 public class B () {  
2     public void m1() {  
3         ...  
4     }  
5 }  
6 public class C() {  
7     public void m2() {  
8         ...  
9     }  
10 }  
11 public class D() {  
12     public void m3() {  
13         ...  
14     }  
15 }
```



Long parameter list

- ❑ Long parameter lists are hard to understand, and they become inconsistent and difficult to use

- Not good:

```
1 public class Member {  
2     public createMember(  
3         Name name,  
4         String country,  
5         String postcode,  
6         String city,  
7         String street,  
8         String house) {  
9         ...  
10    }  
11 }
```

- Better solution:

```
1 public class Member {  
2     public createMember(  
3         Name name,  
4         Address address) {  
5         ...  
6     }  
7 }
```

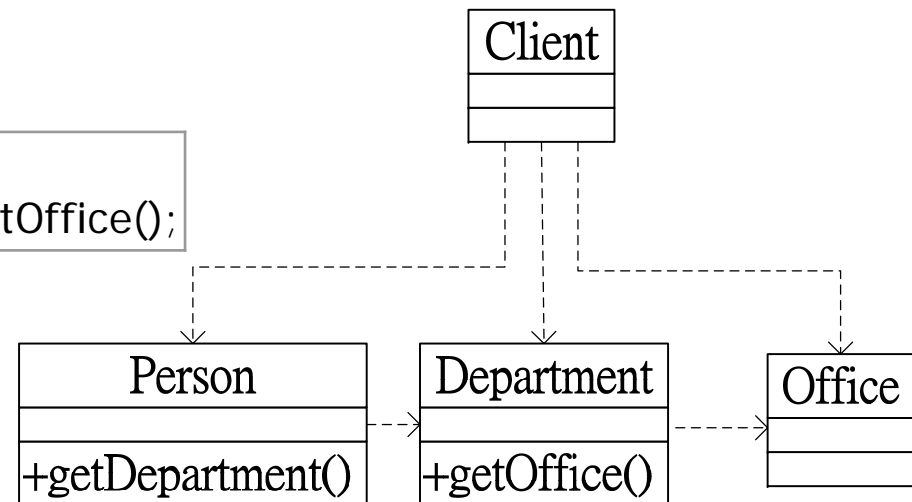


Message Chains

- ❑ You see message chains when a client asks one object for another object, which the client then asks for yet another object, which the client then asks for yet another another object, and so on.

- Not good:

```
1 Person jack = new Person();  
2 Office office = jack.getDepartment().getOffice();
```



- Better solution:

```
1 Person jack = new Person();  
2 Office office = jack.getOffice();
```




Literal constants

❑ To use keyword (*static*) *const* or *define* to define constants

- Not good:

```
1 public double potentialEnergy(double mass, double height) {  
2     return mass * 9.81 * height;  
3 }
```

- Better solution:

```
1 public double potentialEnergy(double mass, double height) {  
2     final static double GRAVITATION = 9.81;  
3     return mass * GRAVITATION * height;  
4 }
```



Every variable is properly initialized

- Not good:

```
1 Person person;  
2 Manager = person.getManager();  
3 int workHours, hourlyWage;  
4 Int salary = workHours * hourlyWage;
```

- Better solution:

```
1 Person person = new Person();  
2 Manager = person.getManager();  
3 int workHours = 40, hourlyWage = 120;  
4 Int salary = workHours * hourlyWage;
```



There are uncalled or unneeded procedures or any unreachable code

- ☐ Uncalled, unneeded, or unreachable code may occupy unnecessary memory
- ☐ Time and effort may be spent maintaining and documenting a piece of code which is in fact unreachable.



There are uncalled or unneeded procedures or any unreachable code

```
1  if(i < 60) {  
2      //unreachable  
3      if(i == 60) {  
4          System.out.println("PASS");  
5      }  
6      else{  
7          System.out.println("NOT PASS");  
8      }  
9  }  
10 else{  
11     System.out.println("PASS");  
12 }
```

```
1  public class Client {  
2      public createMember(Name name)  
3      {  
4          Name name = new Name();  
5          Member.createMember(name);  
6      }  
7  }
```

```
1  public class Member {  
2      public Member createMember(  
3          Name name  
4      ) {...}  
5      //uncalled or unneeded procedure  
6      public Member createMember(  
7          String lastName,  
8          String firstName,  
9      ) {...}  
10 }
```



Does every switch statement have a default?

❑ Every switch-case should define a default action

• Not good:

```
1 switch(weekday) {  
2     case 'Monday':  
3         System.out.println("國文課");break;  
4     case 'Tuesday':  
5         System.out.println("英文課");break;  
6     case 'Thursday':  
7         System.out.println("數學課");break;  
8 }
```

• Better solution:

```
1 switch(weekday) {  
2     case 'Monday':  
3         System.out.println("國文課");break;  
4     case 'Tuesday':  
5         System.out.println("英文課");break;  
6     case 'Thursday':  
7         System.out.println("數學課");break;  
8     default:  
9         System.out.println("休息");break;  
12 }
```



The code avoids comparing floating-point numbers for equality

- ❑ Suggest to prevent comparing two floating-point numbers
- ❑ Not good:

```
1 double x = 1e-10, y1 = 20e-10, y2 = 19e-10;  
2 double y = y1 - y2;  
3 if(x == y) {  
4     System.out.println("X == Y");//並不會成立  
5 }
```

- Better solution:

```
1 double x = 1e-10, y1 = 20e-10, y2 = 19e-10;  
2 double y = y1 - y2;  
3 if(Math.abs(x - y) < 1e-5) {  
4     System.out.println("X == Y");//成立  
5 }
```



All comments are consistent with the code

❑ Not good:

```
1 // 計算一年獲利, 傳入參數(int amount)
2 public void countProfit(int amount, double rate) {
3     _profit = amount * ( 1 + rate );
4 }
```

- Better solution:

```
1 // 計算一年獲利, 傳入參數(int amount, double rate)
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