COMP 249: Object Oriented Programming II

Tutorial 4:

Inheritance and Polymorphism

Output Question 1

```
What is the output of the following program?
class Base {
        public void print() {
                 System.out.println("Base");
class Derived extends Base {
        public void print() {
                 System.out.println("Derived");
class Main{
        public static void doPrint( Base o ) {
                 o.print();
        public static void main(String[] args) {
                 Base x = new Base();
                 Base y = new Derived();
                 Derived z = new Derived();
                 doPrint(x);
                 doPrint(y);
                 doPrint(z);
```

Output Question 2

}

What are the errors in the following program and how they can be fixed ?

```
public class A {
    private int a = 100;
    public void setA( int value) {
        a = value;
     public int getA() {
        return a;
                     public class OOPExercises {
                         public static void main(String[] args)
                                 A objA = new A();
                                 System.out.println("in main(): ");
                                 System.out.println("objA.a = "+objA.a);
                                 objA.a = 222;
```

Programming Question

- Implement the UML diagram on the right.
- Both Classes in package "Automobile", Driver.java should be in a separate (default) package.
- Privacy Legend:
 - + means public
 - ~ means package
 - # means protected

- means private



Programming Question

- startCar(...) of Ford class should overload that of the Car class, which allows the user to optionally enter a password that would unlock special features not implemented in this program.
 - Print an appropriate message if the password is correct.
 - Method should call the startCar() of the superclass regardless of password validity.
- Overriding toString() from the Ford class should use that of its superclass.
- Proper implementation of the equals method consists of handling null references and object-attribute comparison.

What is a software Bug ?

A defect in a computer program causing it to malfunction

Reasons:

Insufficient logic or erroneous logic

Design flaws

Hardware failures

Etc.

What is a software Bug ? Cont'd.

First computer bug was in fact an actual Bug 🙂

1945 at Harvard, a Moth trapped between two electrical relays of the Mark II Aiken Relay Calculator caused the whole machine to shut down.



Some famous Bugs

- The European Space Agency's Ariane 5 Flight 501 was destroyed 40 seconds after takeoff (June 4, 1996) due to a bug in the on-board guidance software.
- NASA's Spirit rover became unresponsive on January 21, 2004, a few weeks after landing on Mars due to accumulation of too many files in the rover's flash memory.
- The 2003 North America blackout was triggered by a local outage that went undetected due to a race condition in General Electric Energy's XA/21 monitoring software.
- Smart ship USS Yorktown was left dead in the water in 1997 for nearly 3 hours after a divide by zero error.

What is software Debugging?

The process of investigating and fixing defects / bugs within a computer program.

- Methods of debugging
 - printf debugging
 - Log scraping
 - Post-mortem debugging
 - Debugging of the program after it has already crashed.
 - Create core dumps/crash dumps
 - Analyse using various tools : WinDbg , gdb
 - built-in debugging features in IDE Platforms, Visual Studio.NET, Eclipse, NetBeans etc.

Debug using Eclipse

- Debugging support on Eclipse
 - Provide and execution mode 'Debug'
 - Lots of features to investigate the program behaviour while it's executing.



Eclipse Debug view

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Eclipse Debug Features: Breakpoints

Breakpoints

Set a particular breakpoint inside the code.

When executed in Debug mode, the execution get suspended at the breakpoint.

Gives the facility to investigate current execution status of the program.

Setting a breakpoint in Eclipse

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Eclipse Debug Features: Breakpoints cont'd.

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<pre>if (depositAmount >= 0) { // depositAmount must be positive balance+= depositAmount; } } /** withdraw money from the account */ public void withdraw(double withdrawAmount) { /* If the withdrawAmount is negative or there is not enough balance for withdraw</pre>	2	*	
do nothing */		_	
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<pre>/** return balance */ public double getbalance() {</pre>		-	
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Eclipse Debug Features: Different Views

Execution View

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<pre>if (depositAmount >= 0) { // depositAmount must be positive balance+= depositAmount; } </pre>	*	
<pre>/** withdraw money from the account */ public void withdraw(double withdrawAmount) { /* If the withdrawAmount is negative or there is not enough balance for withdraw do nothing */ if (withdrawAmount >= 0.22 withdrawAmount <= balance) { </pre>		
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Eclipse Debug Features: Different Views cont'd.

Stack View



Eclipse Debug Features: Different Views cont'd.

The Variables View

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Eclipse Debug Features: Different Views cont'd.

The Breakpoints View

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Eclipse Debug Features: Line breakpoint properties



Eclipse Debug Features: Line breakpoint properties cont'd.

Set 'hit count' break points

The program suspends at the particular break point when it reaches the 'hit count' limit.

Set 'conditional' break points

The program suspends at the particular break point when the given condition is true.

Eclipse Debug Features: Line breakpoint properties cont'd.



Eclipse Debug Features: Conditional line breakpoints cont'd.

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Thread [main] (Suspended (breakpoint at line 108 in BankAccount))		withdraw	Amount	101.0
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Student,java Driver,java Bank,java S /** withdraw money from the account */ public void withdraw(double withdrawAmount) { /* If the withdrawAmount is negative or there is not enough balance for withdraw do nothing */ if (withdrawAmount >= 0 && withdrawAmount <= balance balance-= withdrawAmount; } } /** return balance */ public double getbalance() { return balance; }	Properties	s for BankAccount [li	ne:108] - withdraw(double) Line Breakpoint Type: BankAccount Line Number: 108 Member: withdraw(double) Ø Enabled Hit count: ③ Suspend when 'true <choose a="" conditio="" entered="" previously="" withdrawamount=""> 100</choose>	end thread O Suspend VM
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Eclipse Debug Features: watchpoints

A watchpoint is a break point which targeted on a particular field.

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Eclipse Debug Features: Method breakpoints

A method breakpoint is a break point which targeted on a particular method.

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<pre>do nothing */ if (withdrawAmou balance-= wi } /** return balance public double getbal return balance; } /** return name */ public String getNam return name; } Console % @ Tasks <terminated> Bank [Java Application]</terminated></pre>	Method Breakpoint Type: BankAccount Method: Withdraw(double) If the count: If

Eclipse Debug Features: Expression View & Watch Expressions

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Eclipse Debug Features: Expression View & Watch Expressions cont'd.

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<pre>interestRate = newInterestRate; } /** withdraw money from the account with a maximum limi public void withdraw(double withdrawAmount){ if (withdrawAmount < SavingsAccount.MAX_NITHDRAWAMO super.withdraw(withdrawAmount); } else{ System.out.println("The withdraw amount exceeds } }</pre>	it*/ DUNT && isAllowedT s the limit of max	<pre>ToWithdraw()){ timum withdraw amount allowed!");</pre>		
<pre>public String toString() { return super.toString() + "\nInterest Rate : " + in public boolean isAllowedToWithdraw() { return allowedToWithdraw; </pre>	nterestRate + "\n"	;		•

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Debug using NetBeans

Basic features are more or less the same as in Eclipse.



Debug using NetBeans cont'd.

- NetBeans also supports:
 - Line breakpoints.
 - ► Watchpoints
 - Method breakpoints
- Provide different views:
 Code execution
 Variables
 Breakpoints

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Moral of the story...

Try to avoid writing buggy code!

Design your program before putting it in to code.

Modularize your code.

Test continuously what has implemented so far.

Yet ... In reality, bug free code is a hard guarantee!

References

http://en.wikipedia.org/wiki/Debugging

http://www.vogella.com/articles/ EclipseDebugging/ article.html#debugging_overview

http://en.wikipedia.org/wiki/ List_of_software_bugs