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CS/ENGRD 2110 SPRING 2015

Lecture 3: Fields, getters and setters, constructors, testing
http://courses.cs.cornell.edu/cs2110

CS2110 Announcements

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A0 No late penalty (this time) for A0 handed in through Sunday.

A1 Is available on CMS and the course website this morning. Don't wait until the last minute! Start today and do a little bit every day. With 600 students, the consultants in 360 will be really busy just before the deadline. Help: hard to come by.

Piazza

- Check course Piazza regularly for announcements.
- Also to learn about issues with A1, We will pin a note with FAQs (Frequently Asked Questions) for A1. Check it often!

Assignment A1

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Write a class to maintain information about PhDs –their advisor(s) an date of PhD.

Objectives in brief:

- Get used to Eclipse and writing a simple Java class
- Learn conventions for Javadoc specs, formatting code (e.g. indentation), class invariants, method preconditions
- Learn about and use JUnit testing

Important: READ CAREFULLY, including Step 7, which reviews what the assignment is graded on.

Groups. You can do the assignment with 1 other person. FORM YOUR GROUP EARLY! Use Piazza Note @5 to search for partner!

Recommended time-table for doing A1

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Start A1 the day before it is due? You may be frustrated, upset, rushed because you can't get the help you need. With 600 students, too many will be trying to get help at the last minute. Not a good educational experience. Instead, use following schedule, which gives you a day or two after each part to get help if you need it:

29 Jan. Spend 20 minutes reading the assignment.

31 Jan (Sat). Write and test the GroupA methods. This includes writing the Junit test procedure for the group.

03 Feb. Write and test the GroupB methods AND the GroupC methods.

05 Feb. Write and test the GroupD methods.

06 Feb. Do point 7 of the handout: Review the learning objectives and check each of the items given in point 7. Submit on the CMS.

CHECK the pinned A1 note on the Piazza every day.

Homework

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1. Course website will contain classes Time and TimeTester. The body of the one-parameter constructor is not written. Write it. The one-parameter constructor is not tested in TimeTester. Write a procedure to test it.

2. Visit course website, click on Resources and then on Code Style Guidelines. Study

    1. Naming conventions

    3.3 Class invariant

    4. Code organization

        4.1 Placement of field declarations

    5. Public/private access modifiers

3. Look at slides for next lecture; bring them to next lecture

Overview

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- An object can contain variables as well as methods. Variable in an object is called a field.
- Declare fields in the class definition. Generally, make fields private so they can't be seen from outside the class.
- May add getter methods (functions) and setter methods (procedures) to allow access to some or all fields.
- Use a new kind of method, the constructor, to initialize fields of a new object during evaluation of a new-expression.
- Create a JUnit Testing Class to save a suite of test cases.

References to text and JavaSummary.pptx

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Declaration of fields: B.5-B.6 slide 12

Getter/setter methods: B.6 slide 13, 14

Constructors: B.17-B.18 slide 15

Class String: A.67-A.73

JUnit Testing Class: none slide 74-80

Overloading method names: B-21 slide 22

class Time

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Object contains the time of day in hours and minutes.

Methods in object refer to field in object.

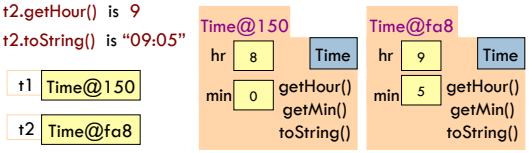
Could have an array of such objects to list the times at which classes start at Cornell.

With variables t1 and t2 below,

t1.getHour() is 8

t2.getHour() is 9

t2.toString() is "09:05"



Class Time

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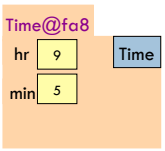
```
/** An instance maintains a time of day */
public class Time {
   private int hr;   //hour of the day, in 0..23
   private int min; // minute of the hour, in 0..59

}
```

Access modifier **private**:
can't see field from outside class
Software engineering principle:
make fields private, unless there is a real reason to make public



Class invariant

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Class invariant: collection of defs of variables and constraints on them (green stuff)

```
/** An instance maintains a time of day */
public class Time {
   private int hr;   // hour of the day, in 0..23
   private int min;  // minute of the hour, in 0..59

}
```

Software engineering principle: Always write a clear, precise class invariant, which describes all fields.

Call of every method starts with class invariant true and should end with class invariant true.

Frequent reference to class invariant while programming can prevent mistakes.

Getter methods (functions)

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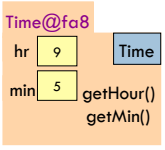
```
/** An instance maintains a time of day */
public class Time {
   private int hr;   // hour of the day, in 0..23
   private int min; // minute of the hour, in 0..59
   /** Return hour of the day */
   public int getHour() {
     return hr;
   }
   /** Return minute of the hour */
   public int getMin() {
     return min;
   }
}
```

Spec goes before method.
It's a Javadoc comment
—starts with /**



A little about type (class) String

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```
public class Time {
   private int hr;   //hour of the day, in 0..23
   private int min; // minute of the hour, in 0..59
   /** Return a represention of this time, e.g. 09:05*/
   public String toString() {
     return prepend(hr) + ":" + prepend(min);
   }
   /** Return i with preceding 0, if
       necessary, to make two chars. */
   private String prepend(int i) {
     if (i > 9 || i < 0) return "" + i;
     return "0" + i;
   }
   …
```

Java: double quotes for String literals

Java: + is String catenation

Concatenate with empty String to change any value to a String

"helper" function is private, so it can't be seen outside class

Setter methods (procedures)

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```
/** An instance maintains a time of day */
public class Time {
   private int hr;    //hour of the day, in 0..23
   private int min; // minute of the hour, in 0..59
   …
   /** Change this object's hour to h */
   public void setHour(int h) {
        hr= h;
   }
}
```

No way to store value in a field! We can add a "setter method"

setHour(int) is now in the object

Time@fa8
hr 9
min 5
Time
getHour()
getMin()
setHour(int)
toString()

Setter methods (procedures)

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```
/** An instance maintains a time of day */
public class Time {
   private int hr;    //hour of day, in 0..23
   private int min; // minute of hour, in 0..59
   …
   /** Change this object's hour to h */
   public void setHour(int h) {
        hr= h;
   }
}
```

Do not say "set field hr to h"

User does not know there is a field. All user knows is that Time maintains hours and minutes. Later, we show an implementation that doesn't have field h but "behavior" is the same

Time@fa8
hr 9
min 5
Time
getHour()
getMin()
setHour(int)
toString()

Test using a JUnit testing class

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In Eclipse, use menu item File → New → JUnit Test Case to create a class that looks like this:

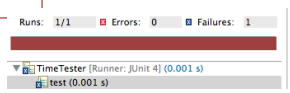
```
import static org.junit.Assert.*;
import org.junit.Test;

public class TimeTester {
   @Test
   public void test() {
      fail("Not yet implemented");
   }
}
```

Select TimeTester in Package Explorer.

Use menu item Run → Run.

Procedure test is called, and the call fail(…) causes execution to fail:



Test using a JUnit testing class

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```
…
public class TimeTester {
   @Test
   public void test() {
      Time t1= new Time();
      assertEquals(0, t1.getHour());
      assertEquals(0, t1.getMin();
      assertEquals("00:00", t1.toString());
   }
}
```

Write and save a suite of "test cases" in TimeTester, to test that all methods in Time are correct

Store new Time object in t1.

Give green light if expected value equals computed value, red light if not:
assertEquals(expected value, computed value);

Test setter method in JUnit testing class

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```
public class TimeTester {
   …

   @Test
   public void testSetters() {
      Time t1= new Time();
      t1.setHour(21);
      assertEquals(21, t1.getHour());
   }
}
```

TimeTester can have several test methods, each preceded by @Test.

All are called when menu item Run→ Run is selected

Time@fa8
hr 9
min 5
Time
getHour()
getMin()
setHour(int)
toString()

Constructors —new kind of method

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```
public class C {
   private int a;
   private int b;
   private int c;
   private int d;
   private int e;
}
```

```
C var= new C();
var.setA(2);
var.setB(20);
var.setC(35);
var.setD(-15);
var.setE(150);
```

C has lots of fields. Initializing an object can be a pain —assuming there are suitable setter methods

Easier way to initialize the fields, in the new-expression itself. Use:

```
C var= new C(2, 20, 35, -15, 150);
```

But first, must write a new method called a constructor

Constructors —new kind of method

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```
/** An object maintains a time of day */
public class Time {
   private int hr;    //hour of day, 0..23
   private int min; // minute of hour, 0..59
   /** Constructor: an instance with
       h hours and m minutes.
       Precondition: h in 0..23, m in 0..59  */
   public Time(int h, int m) {
     hr= h;
     min= m;
   }
```

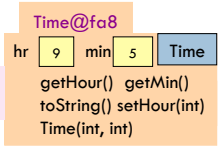
Purpose of constructor: Initialize field of a new object so that its class invariant is true

Memorize!

Need precondition

No return type or void

Name of constructor is the class name



Revisit the new-expression

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Syntax of new-expression: **new** <constructor-call>

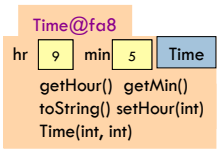
Example: **new** Time(9, 5)

Time@fa8

Evaluation of new-expression:

1. Create a new object of class, with default values in fields
2. Execute the constructor-call
3. Give as value of the expression the name of the new object

If you do not declare a constructor, Java puts in this one:
public <class-name> () { }



How to test a constructor

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Create an object using the constructor. Then check that all fields are properly initialized —even those that are not given values in the constructor call

```
public class TimeTester {
   @Test
   public void testConstructor1() {
      Time t1= new Time(9, 5);
      assertEquals(9, t1.getHour());
      assertEquals(5, t1.getMin();
   }
   …
}
```

Note: This also checks the getter methods! No need to check them separately.

But, main purpose: check constructor

A second constructor

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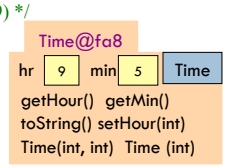
```
/** An object maintains a time of day */
public class Time {
   private int hr;    //hour of day, 0..23
   private int min; // minute of hour, 0..59
   /** Constructor: an instance with
       m minutes.
       Precondition: m in 0..(23*60 +59) */
   public Time(int m) {
     ??? What do we put here ???
   }
   …
```

Time is overloaded: 2 constructors! Have different parameter types. Constructor call determines which one is called

new Time(9, 5)
new Time(125)



Generate javadoc

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- With project selected in Package explorer, use menu item Project -> Generate javadoc
- In Package Explorer, click on the project -> doc -> index.html
- You get a pane with an API like specification of class Time, in which javadoc comments (start with /**) have been extracted!
- That is how the API specs were created.

Method specs should not mention fields

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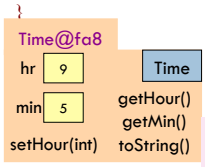
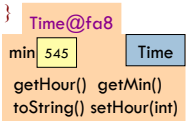
```
public class Time {
  private int hr;    //in 0..23
  private int min; //in 0..59
  /** return hour of day*/
  public int getHour() {
    return h;
  }
```

Decide to change implemen -tation




```
public class Time {
  // min, in 0..23*60+59
  private int min;
  /** return hour of day*/
  public int getHour() {
     return min / 60;
  }
```



Specs of methods stay the same. Implementations, including fields, change!