

CS/ENGRD 2110

SPRING 2016

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

CS2110 Announcements

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A1 now on course website and Piazza.

Piazza

- Check course Piazza regularly for announcements.
- To learn about issues with A1, check the pinned A1 FAQs (Frequently Asked Questions) note often!

Take course S/U?

OK with us. Check with your advisor/major. To get an S, you need to do at least C– work. Do D+ work or less, you get a U.

VideoNote.com.

Last semester's videos are under 2016! Don't look for fall 2015.

Assignment A1

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Write a class to maintain information about PhDs –their advisor(s) and 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 500 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:

4 Feb. Spend 20 minutes reading the assignment.

6 Feb. Write and test the Group A methods. This includes writing the Junit test procedure for the group.

7 Feb. Write and test the Group B methods AND the Group C methods.

8 Feb. Write and test the GroupD methods.11

10 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 fields 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"

t1 Time@150

t2 Time@fa8

Time@150

hr 8

min 0

Time

getHour()
getMin()
toString()

Time@fa8

hr 9

min 5

Time

getHour()
getMin()
toString()

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

```
}
```

Time@fa8

hr

9

min

5

Time

Class invariant

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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
```

Class invariant:

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

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 **/****

Time@fa8

hr

9

Time

min

5

getHour()

getMin()

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 representation 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

Catenate with empty String to change any value to a String

“helper” function is private, so it can’t be seen outside class

Concatenate or catenate?

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I never **concatenate** strings;

I just **catenate** those little things.

Of syllables few,

I'm a man through and through.

Shorter words? My heart joyfully sings!

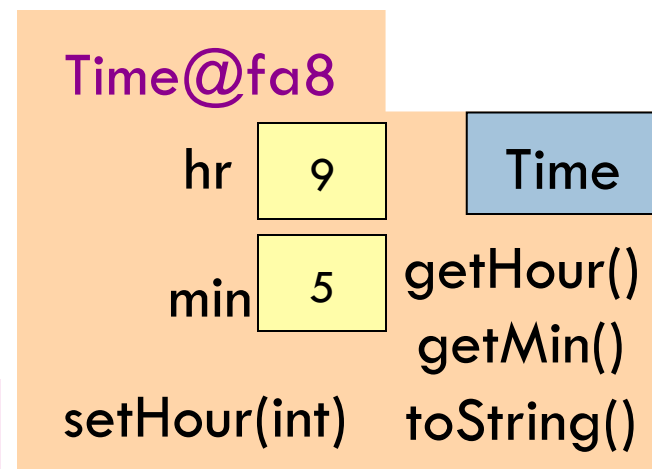
Setter methods (procedures)

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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”

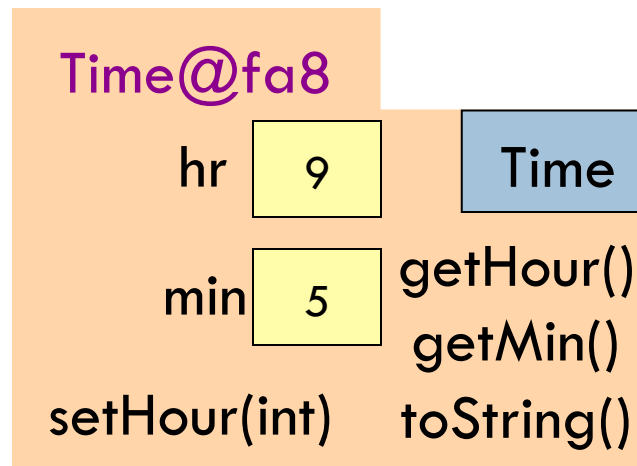
setHour(int) is now in the object



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 imple-
mentation that
doesn't have field h
but “behavior” is the
same

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:

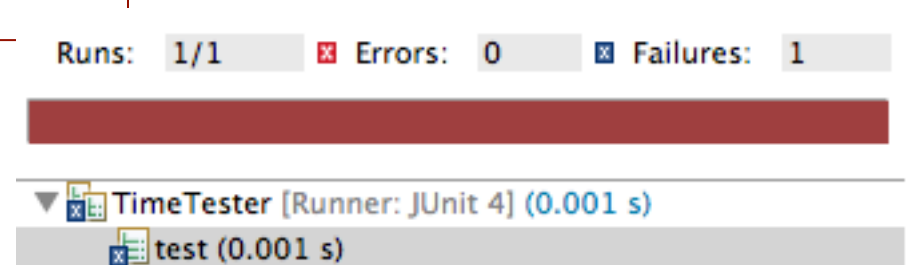
```
import static org.junit.Assert.*;
import org.junit.Test;

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 testConstructor() {  
        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

setHour(int)

Time
getHour()
getMin()
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;  
}
```

No return type
or void

Name of constructor
is the class name

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

Memorize!

Need precondition

Time@fa8

hr	9	min	5	Time
----	---	-----	---	------

getHour() getMin()
toString() setHour(int)
Time(int, int)

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> () { }
```

Time@fa8

hr	9	min	5	Time
----	---	-----	---	------

```
getHour() getMin()  
toString() setHour(int)  
Time(int, int)
```

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) {  
    hr= m/60; min= m%60;  
    ??? What do we put here ???  
}  
...    new Time(9, 5)  
        new Time(1 25)
```

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

Time@fa8

hr	9	min	5	Time
----	---	-----	---	------

```
getHour() getMin()  
toString() setHour(int)  
Time(int, int) Time (int)
```

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;  
  }  
}
```

Time@fa8

hr 9

min 5

setHour(int)

Time

getHour()
getMin()
toString()

Time@fa8

min 545

Time

getHour() getMin()
toString() setHour(int)

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