University of British Columbia CPSC 111, Intro to Computation 2009W2: Jan-Apr 2010

Tamara Munzner

More Class Design

Lecture 11, Fri Jan 29 2010

borrowing from slides by Paul Carter and Wolfgang Heidrich

http://www.cs.ubc.ca/~tmm/courses/111-10

Reminders

- Assignment 1 due Wed 5pm
- TA office hours in DLC
  - http://www.cs.ubc.ca/ugrad/current/resources/cslearning.shtml
- Check your ugrad email account regularly (or forward to active account)
  - grade info will be sent there

Exam

- Midterm reminder: Mon Feb 8, 18:30 - 20:00
  - FSC 1005
  - exam will be one hour, extra time is just in case needed
  - I'll discuss coverage next time

- DRC: Disability Resource Center
  - academic accommodation for disabilities
  - forms due one week before exam (Monday!)
  - http://students.ubc.ca/access/drc.cfm

Recap: Public vs Private

- **`public`** keyword indicates that something can be referenced from outside object
  - can be seen/used by client programmer
- **`private`** keyword indicates that something cannot be referenced from outside object
  - cannot be seen/used by client programmer

Recap: Designing Classes

- Blueprint for constructing objects
  - build one blueprint
  - manufacture many instances from it
- Consider two viewpoints
  - client programmer: want to use object in program
    - what public methods do you need
  - designer: creator of class
    - what private fields do you need to store data
    - what other private methods do you need

Public vs. Private Example

```
public class Die {
...
  public int roll()
  ...
  private void cheat(int nextRoll)
...
}
```

Public vs. Private Example

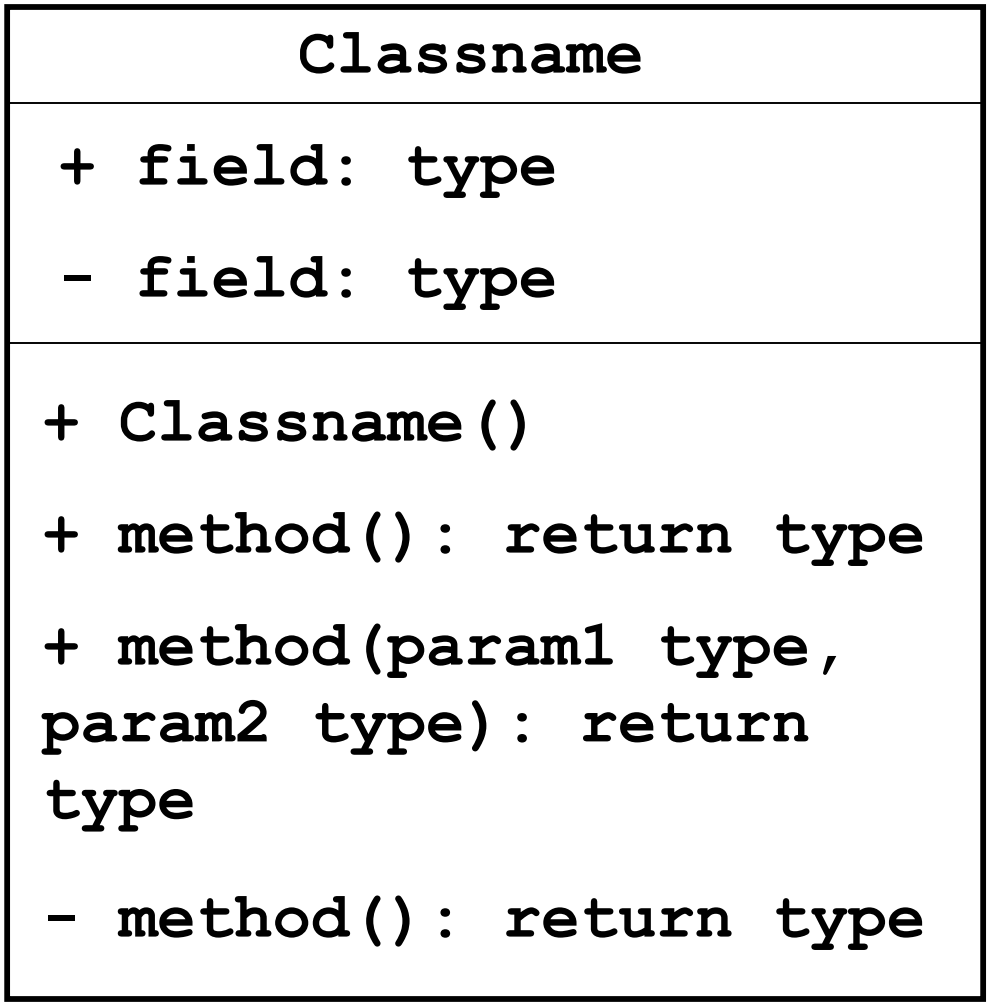
```
Die myDie = new Die();

int result = myDie.roll();  // OK
myDie.cheat(6);                  //not allowed!
```

Unified Modeling Language

- Unified Modeling Language (UML) provides us with mechanism for modeling design of software
  - critical to separate design from implementation (code)
  - benefits of good software design
    - easy to understand, easy to maintain, easy to implement
- What if skip design phase and start implementing (coding)?
  - code difficult to understand, thus difficult to debug
- We'll use UML class diagrams represent design of our classes
- Once the design is completed, could be implemented in many different programming languages
  - Java, C++, Python,...

UML Visual Syntax

- + for public, - for private
- fields above, methods below

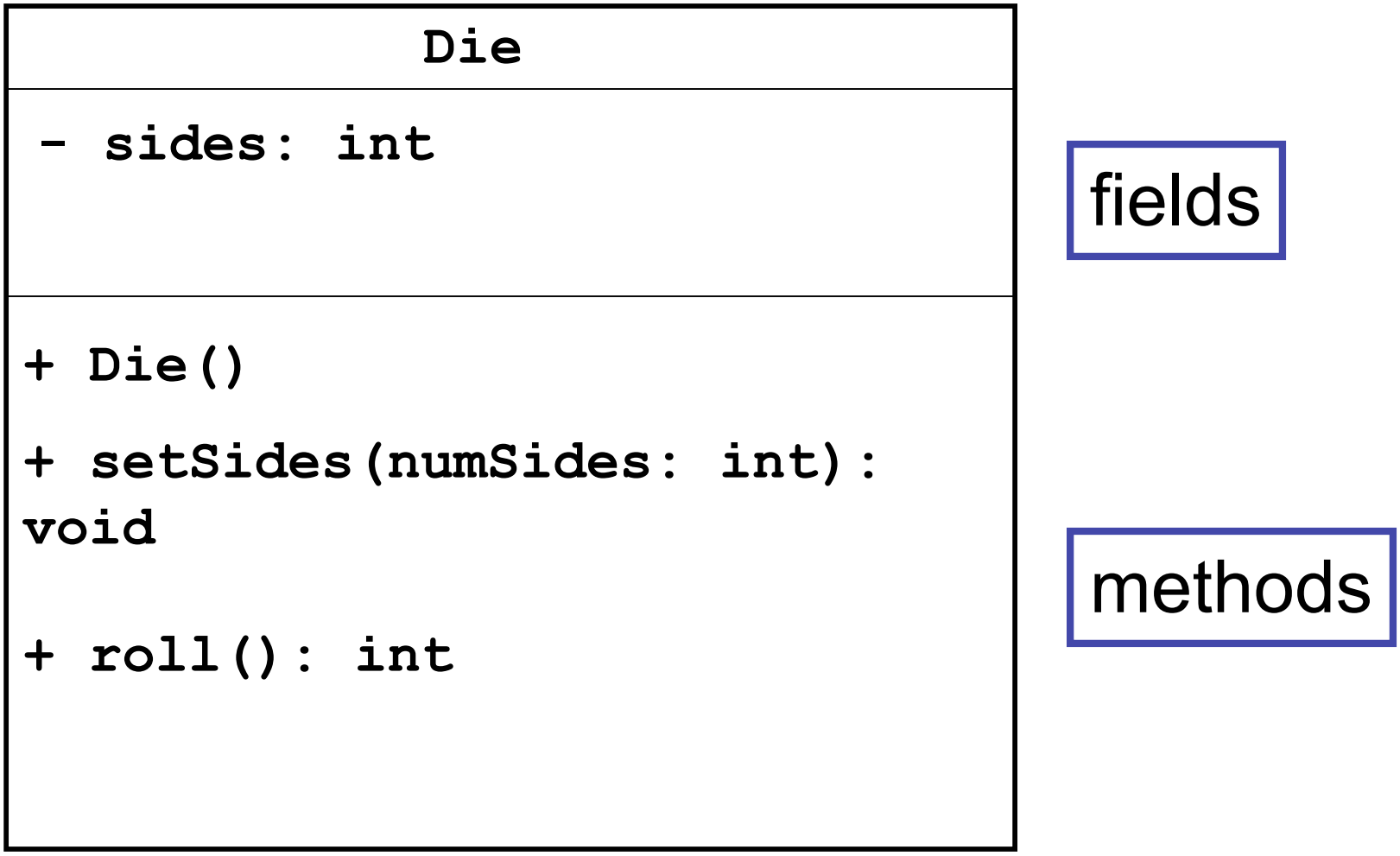


fields

methods

UML for `Die`

- UML diagram for **`Die`** class we designed



Separation and Modularity

- Design possibilities
  - **`Die`** and **`RollDice`** as separate classes
  - one single class that does it all
- Separation allows code re-use through modularity
  - another software design principle
- One module for modeling a die: **`Die`** class
- Other modules can use die or dice
  - we wrote one, the **`RollDice`** class
- Modularization also occurs at file level
  - modules stored in different files
  - also makes re-use easier

Control Flow Between Modules

- Last week was easy to understand control flow: order in which statements are executed
  - march down line by line through file
- Now consider control flow between modules

Client code

```
int rollResult;

myDie.setSides();

rollResult = myDie.roll();
```

Die class methods

```
public int roll()
{
    …
}

public void setSides()
{
    …
}
```

Designing `Point`: UML

- class to represent points in 2D space

Implementing `Point`

```
public class Point {



}
```

Formal vs. Actual Parameters

- formal parameter: in declaration of class
- actual parameter: passed in when method is called
  - variable names may or may not match
- if parameter is primitive type
  - call by value: value of actual parameter copied into formal parameter when method is called
  - changes made to formal parameter inside method body will not be reflected in actual parameter value outside of method
- if parameter is object: covered later

Scope

- Fields of class are have class scope: accessible to any class member
  - in **`Die`** and **`Point`** class implementation, fields accessed by all class methods
- Parameters of method and any variables declared within body of method have local scope: accessible only to that method
  - not to any other part of your code
- In general, scope of a variable is block of code within which it is declared
  - block of code is defined by braces { }

Commenting Code

- Conventions
  - explain what classes and methods do
  - plus anywhere that you've done something nonobvious
    - often better to say why than what
      - not useful

```
int wishes = 3; // set wishes to 3
```

      - useful

```
int wishes = 3; // follow fairy tale convention
```

`javadoc` Comments

- Specific format for method and class header comments
  - running javadoc program will automatically generate HTML documentation
- Rules
  - `/**` to start, first sentence used for method summary
  - `@param` tag for parameter name and explanation
  - `@return` tag for return value explanation
  - other tags: `@author`, `@version`
  - `*/` to end
- Running

```
% javadoc Die.java
% javadoc *.java
```

javadoc Method Comment Example

```
/**
 Sets the die shape, thus the range of values it can roll.
 @param numSides the number of sides of the die
*/
public void setSides(int numSides) {
  sides = numSides;
}

/**
 Gets the number of sides of the die.
 @return the number of sides of the die
*/
public int getSides() {
  return sides;
}
```

javadoc Class Comment Example

```
/** Die: simulate rolling a die
 * @author: CPSC 111, Section 206, Spring 05-06
 * @version: Jan 31, 2006
 *
 * This is the final Die code. We started on Jan 24,
 * tested and improved in on Jan 26, and did a final
 * cleanup pass on Jan 31.
 */
```

Cleanup Pass

- Would we hand in our code as it stands?
  - good use of whitespace?
  - well commented?
    - every class, method, parameter, return value
  - clear, descriptive variable naming conventions?
  - constants vs. variables or magic numbers?
  - fields initialized?
  - good structure?
  - follows specification?
- ideal: do as you go
  - commenting first is a great idea!
- acceptable: clean up before declaring victory

Key Topic Summary

Borrowed phrasing from Steve Wolfman

- Generalizing from something concrete
  - fancy name: abstraction
- Hiding the ugly guts from the outside
  - fancy name: encapsulation
- Not letting one part ruin the other part
  - fancy name: modularity
- Breaking down a problem
  - fancy name: functional decomposition

Reading Assignment Next Week

- Chap 4.3-4.5 re-read