CS 161: Object Oriented Problem Solving

About this course

- Like 160, 161 is a combination of programming and discrete math.
  - Why is math important to us? What does that have to do with computer science?
- From procedural to object oriented programming

About this course

- Course webpage: http://www.cs.colostate.edu/~cs161/
- Slides/recitations/assignments are posted on the course webpage's schedule page.
- Canvas will be used for: forums, grades

Texts

- Java: an introduction to problem solving and programming, 7th edition.

- Discrete Mathematics and Its Applications, 7th edition. Kenneth Rosen.

The library reserve desk has many copies you an check out!

Components of the course

- iClicker quizzes
  - *"are you with us?"*
- Tests:
  - *"what have you learned?" Important checkpoints!!*
- Programming assignments:
  - *"can you implement it?" Important!! We will use the same automatic submission/grading system used last semester in 160.*
- Written assignments:
  - *"do you understand the theory?"*

About this course

- Lectures
  - You pay for them, might as well use them
  - Slides are posted ahead of time so you can print them and take notes during class
- Recitation
  - Help you with programming and homework assignments, reinforce material from lecture.
  - You get credit for attending and participating in recit

Grading

Assignments (around 8)
Clicker quizzes
Recitation (attendance + completion)
Midterms (2))
Final

For the percentages see course website.

CS building

- Make sure you can get into the Unix lab (CSB 120)!

  If you have keycard access problems:
  - CS students: talk to a CS accounting person (Kim or student employee)
  - Non CS students: Key Desk at Facilities Management

Professional class behavior

- We all have to have respect for each other, independent of race, gender, ability
- Laptop usage: use the back row of the class
- THERE ARE NO STUPID QUESTIONS
  - Your classmates will be grateful you asked.
  - Questions outside of class: use Piazza rather than emailing your instructor/TA

Cheating

- What is cheating? What is not?
- What is gained / lost when cheating?
- What are the consequences?
- When / how does it happen?
  - **How can cheating be avoided?**

First topic: Recap of CS160.

- Lecture: Overview of Java program structure
- Recitation: Write simple programs
- Programming assignment 1: Review

A barebones Java class

```
public class Point {
  private int x;        // instance variable
  private int y;

  public static void main(String[ ] args){
     Point p = new Point();
     p.x = 1;
     p.y = 2;
     int x = 10;        // local variable
  }
}
```

Reading from a file

```
import java.io.*;
import java.util.*;
class FileReader1{
  public static void main(String[ ] args) throws IOException{
      String filename = "values.dat";
      Scanner in = new Scanner(new File(filename));
      int index =  0;
      int[ ] list = new int [9999];
      while(in.hasNextLine() ){
         String line = in.nextLine();
         list[index] = Integer.parseInt(line);
         index++;
      }
      in.close( );
      // do something with the array
  }
}
```

Issues with the code?

Methods

```
public class C2F {
    public static void main(String[ ] args){
        C2F converter = new C2F();
        System.out.print("100C eq."); argument
        System.out.print(converter.c2f(100) + " F");
  }
                                parameter
  public double c2f(double celsius) {
      return celsius * 9 / 5 + 32;
  }
}
```

Methods are discussed in section 5.1 in Savitch

Primitive variables

- When a primitive variable is assigned to another, the value is copied.
- Therefore: modifying the value of one does not affect the copy.
- Example:

```
int x = 5;
int y = x;      // x = 5, y = 5
y = 17;         // x = 5, y = 17
x = 8;          // x = 8, y = 17
```

Primitive variables as method arguments

What will be the output of a call to the method caller()?

```
public void caller() {
    int x = 23;
    strange(x);
    System.out.println("2. Value of x in caller = " + x);
}
public void strange(int x) {
    x = x + 1;
    System.out.println("1. Value of x in strange  = " + x);
}
```

Primitive variables as method arguments

When primitive variables (`int`, `double`) are passed as arguments, their values are copied. Modifying the parameter inside the method will not affect the variable passed in.

```
public void caller() {
    int x = 23;
    strange(x);
    System.out.println("2. Value of x in caller = " + x);
}
public void strange(int x) {
    x = x + 1;
    System.out.println("1. Value of x in strange  = " + x);
}
```

Output:
```
1. Value of x in strange = 24
2. Value of x in caller = 23
```

Objects and the **new** operator

- Compare

  `int[ ] list = new int [9999];`

  with

  `int index =  0;`
- Why does one use the new operator while the other doesn't?

Objects and references

- Object variables store the address of the object value in the computer's memory.
- Example:

```
int [] values  = new int[5];
```


```
int x = 1;
```

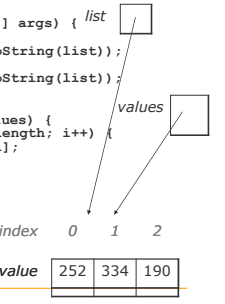
Example

```
public static void main(String[] args) {
    int[] list = {126, 167, 95};
    System.out.println(Arrays.toString(list));
    doubleAll(list);
    System.out.println(Arrays.toString(list));
}

public void doubleAll(int[] values) {
    for (int i = 0; i < values.length; i++) {
        values[i] = 2 * values[i];
    }
}
```

- **Output:**

```
[126, 167, 95]
[252, 334, 190]
```



Reading values from a file (again)

```
import java.io.IOException;
import java.util.Scanner;
import java.io.File;
class FileReader1{
   public static void main(String[ ] args) throws IOException{
        String filename = "values.dat";
        Scanner in = new Scanner(new File(filename));
        int[ ] list = new int [9999];
        int index =  0;
        while(in.hasNextLine() ){
           String line = in.nextLine();
           list[index] = Integer.parseInt(line);
           index++;
        }
        in.close( );
        // do something with the array
   }
`
```

Let's improve this version using methods!

```
import java.io.IOException;
import java.util.Scanner;
import java.util.Arrays;
class FileReader2{
   public static void main(String[ ] args) throws IOException {
      String filename = "values.dat";
      FileReader2 fileReader = new FileReader2();
      int [ ] values = fileReader.readFile(filename);
      System.out.println(Arrays.toString(values));
   }
   public int [ ] readFile(String filename) throws IOException {
      Scanner in = new Scanner(new File(filename));
      int index =  0;
      int[ ] list = new int [9999];
      while(in.hasNextLine() ){
           //read the next line and store the value in the array
      }
      in.close( );
      return list;
   }
}
```

```
import java.io.*;
import java.util.*;
class FileReader3 {
   public static void main(String[ ] args) throws IOException{
      String filename = "values.dat";
      FileReader3 fileReader = new FileReader3();
      int[ ] list = new int [9999];
      fileReader.readFile(filename, list);
      System.out.println(Arrays.toString(list));
   }
   public void readFile(String filename, int [ ] values) throws
        IOException {
      Scanner in = new Scanner(new File(filename));
      int index =  0;
      while(in.hasNextLine( ))     {
           //read the next line and store the value in the array
      }
      in.close( );
   }
}
```

Variable scope

- **scope**: The part of a program where a variable exists.
  - A variable's scope is from its declaration to the end of the { } braces in which it was declared.
  - If a variable is declared in a `for` loop, it exists only in that loop.
  - If a variable is declared in a method, it exists only in that method.

```
public void example() {
    int x = 3;
    for (int i = 1; i <= 10; i++) {
        System.out.println("i=" + i + "x=" + x);
    }
    // i no longer exists here
} // x ceases to exist here
```

Variable scope

- It is illegal to try to use a variable outside of its scope.

```
public void example() {
    int x = 3;
    for (int i = 1; i <= 10; i++) {
        System.out.println(x);
    }
    System.out.println(i);  // illegal
}
```

Variable scope

- It is legal to declare variables with the same name, as long as their scopes do not overlap:

```
public static void main(String[] args) {
    int x = 2;
    for (int i = 1; i <= 5; i++) {
        int y = 5;
        System.out.println(y);
    }
    for (int i = 3; i <= 5; i++) {
        int y = 2;
        int x = 4;  // illegal
        System.out.println(y);
    }
}
Public void anotherMethod() {
    int i = 6;
    int y = 3;
    System.out.println(i + ", " + y);
}
```