COMP 110-003
Introduction to Programming
Midterm Review

March 5, 2013

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TR 11:00 – 12:15, SN 011
Spring 2013

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Announcements

- The grades for Lab 3 and Program 2 are released
  - Overall, most of you are doing quite well
  - Similar code has been detected. I will report officially next time
    - Some programs use the same techniques – please limit your discussions

Suggestions that I receive

- Your suggestions in Lab 4
  - Mostly mentioned: the instructor should show the procedure of writing a program, like the “case study” for loops
    - I will try to invent more “case studies” on class
    - Many new concepts can not be introduced using a full program. We have to continue the current way – using small pieces of code to introduce new concepts, and learning to combine them by assignments

Suggestions that I receive

- Your suggestions in Lab 4
  - More collaborations
    - That's not going to happen!
    - I hope that you can use the lab time and office hour more effectively
    - Also you can send me emails. I usually respond quickly.
  - Another TA
    - That's not going to happen, either…
    - Someone mentioned that the tutoring group was helpful

Suggestions that I receive

- Your suggestions in Lab 4
  - Focus on one topic, explain slowly and clearly
    - Next time when I ask “any questions”, please understand it as “do you want me to repeat”
    - Please don’t keep silent. I do reserve time for your questions but it was seldom used in recent lectures
  - Bring back daily jokes

Midterm Review

- Computer basics
- Primitive types and strings
- Branch statements and loop statements
- Classes and objects

Midterm Review

- **Computer basics**
- Primitive types and strings
- Branch statements and loop statements
- Classes and objects

Instructions

- An instruction is a sequences of 0's and 1's that represents a single operation on the computer
  - Example: 00000101 00000001 00000010
  - Means: ADD 1 2

    Instruction *Data*
  - The output will be 3
- These 0's and 1's are called **bits**
  - Why only 0 and 1?
    - Because it is easy to make an electrical device that has only two stable states

Hardware vs Software (Abstractly)

- Software
  - An organized collection of instructions
- Hardware
  - Circuits that execute, store and interact with instructions
    - Execution: CPU
    - Storage: Memory
    - Interaction: Peripherals, like keyboards, monitors, networks

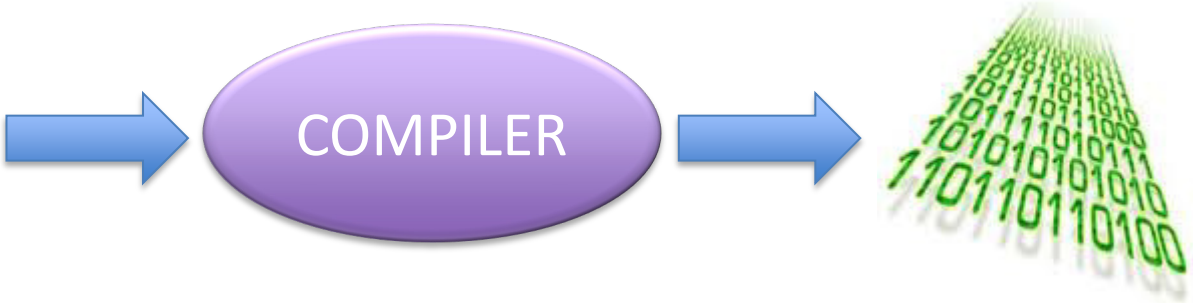
CPU (Central Processing Unit)

- It is the “brain” of the computer
  - CPU executes the instructions
  - CPU’s working routine
    - read instructions and data from memory
    - do calculation
    - write calculation results back to memory
- Intel Core i7 **3.4 GHz**
  - Executes *at most* 3,400,000,000 instructions per second
  - **Recall: KB, MB, GB, TB**

From Languages to Instructions

- The translator is called **compiler**
  - It is also a program
  - From human-readable to machine-readable

```
class Hello {
    public static void main(String[] arguments) {
        // Program execution begins here
        System.out.println("Hello world.");
    }
}
```



Midterm Review

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- **Primitive types and strings**
- Branch statements and loop statements
- Classes and objects

Primitive Types

- Integer (byte, short, int, long)
  - 0, -3, 5, 43
- Floating-point number (float, double)
  - 0.5, 12.4863, -4.3
- Characters (char)
  - A, r, %, T
- Boolean (boolean)
  - true, false

Variable Declaration

- **Syntax:**
  - *type variable_1, variable_2, …;*
- **Examples:**
  - *int count, score, myInt;*
  - *char letter;*
  - *double totalCost, ratio;*

How to name an identifier

- Naming rules:
  - Letters, digits(0-9)
  - First character *cannot* be a digit
  - No spaces
- Java is case sensitive
- Legal names
  - pinkFloyd, b3atles, eyeColor
- Illegal names
  - michael.bolton, kenny-G, 1CP

Assign and Change Variables

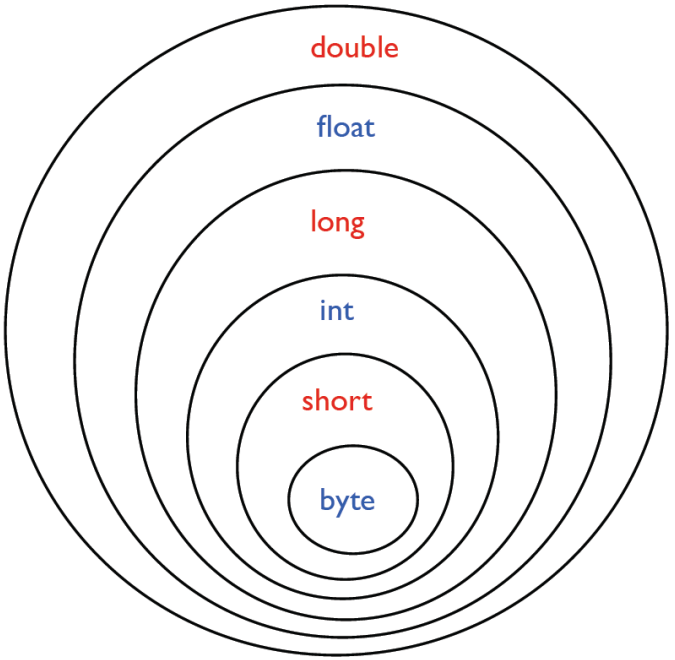
- *int changingVar = 0;*
  - Declare and assign value
  - *type variable = value;*
- *changingVar = 5;*
  - Assign/change value, variable must be declared before
  - *variable = value;*
- *changingVar = changingVar + 4;*
  - Can refer to itself
  - It means newValue = oldValue + 4. Now changingVar = ?

Special Assignment Operators

- Some operators are new to you
  - *total += 5; // is the same as*
  - *total = total + 5;*
  - *count++; // is the same as*
  - *count = count + 1;*
- They are created because
  - It's shorter
  - Less possibility of making mistakes

Assignment Compatibilities

- You can only put small things into bigger things
  - byte->short->int->long->float->double
- Some examples
  - ~~*myShort = myInt;*~~ Wrong
  - ~~*myByte = myLong;*~~ Wrong
  - *myFloat = mybyte;* Right
  - *myLong = myInt;* Right
- **Recall: double d = int1 / int2;**



Type Casting

- You can ask the computer to change the type of values which are against the compatibility.
  - ~~*myFloat = myDouble;*~~
  - ~~*myByte = myInt;*~~
  - ~~*myShort = myFloat;*~~
  - *myFloat = (float)myDouble;*
  - *myByte = (byte)myInt;*
  - *myShort = (short)myFloat;*
- You may lose information
- **Recall: int i = (int)(double1 / double2);**

Modular Arithmetic - %

- Remainder
  - 7 % 3 = 1 (7 / 3 = 2, remainder 1)
  - 8 % 3 = 2 (8 / 3 = 2, remainder 2)
  - 9 % 3 = 0 (9 / 3 = 3, remainder 0)
- "clock arithmetic"
  - Minutes on a clock are mod 60
- **Recall: what does (a%2 == 0) mean?**

indexOf() and substring()

2	.	5		+		3
0	1	2	3	4	5	6

- `String s = "2.5 + 3";`
- `int p1 = s.indexOf(" ");`
- `int p2 = s.lastIndexOf(" ");`
- `System.out.println(p1 + "," + p2);`
- The output will be **3,5**

indexOf() and substring()

2	.	5		+		3
0	1	2	3	4	5	6

- `String operand1 = s.substring(0, p1);`

indexOf() and substring()

2	.	5		+		3
0	1	2	3	4	5	6

- `String operand1 = s.substring(0, p1);`
- `String operator = s.substring(p1, p2);`

indexOf() and substring()

2	.	5		+		3
0	1	2	3	4	5	6

- `String operand1 = s.substring(0, p1);`
- `String operator = s.substring(p1, p2);`
- `String operand2 = s.substring(p2);`

Midterm Review

- Computer basics
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- **Branch statements and loop statements**
- Classes and objects

Boolean Expressions

- A combination of values and variables by comparison operators. Its value can only be ***true*** or ***false***
- Example expressions
  - *5 == 3; // false*
  - *variable <= 6; // depending on the value of variable*
    - What if variable is 5? What if variable is 6?
  - *myInt != temp; // depending on both values*
    - What if myInt is 0 and temp is 2? Am I lying?
- Syntax rule for if statement:
  - ***if (boolean expression)***
    { statements; }

Logical Operators

FIGURE 3.7 The Effect of the Boolean Operators && (*and*), || (*or*), and ! (*not*) on Boolean Values

Value of *A*	Value of *B*	Value of *A* && *B*	Value of *A* || *B*	Value of ! (*A*)
true	true	true	true	false
true	false	false	true	false
false	true	false	true	true
false	false	false	false	true

More Complex Boolean Expressions

- Combination of && and ||
  - *(((3 < 7)||(2==5)) && ((4!=2) && (1 <= 1)))*
  - *(((true)||(false)) && ((true) && (true))*
  - *(true) && (true)*
  - *true*
- ***if*** *(((I'm at Subway) && (You're at Subway)) ||*
  ((I'm at Starbucks) && (You're at Starbucks))

  {

  I will meet you;

  }

If and Else

- You can use only one if statement
  - ***if (boolean expression)***
    { statements; }
    other statements;
    - *Other statements* will always be executed
- You can also use an if-else statement
  - ***if (boolean expression)***
    { statements 1; }
    else { statement 2; }
    - If the *expression* is true, run *statement 1*, otherwise run *statement 2*

Multibranch and Switch Statement

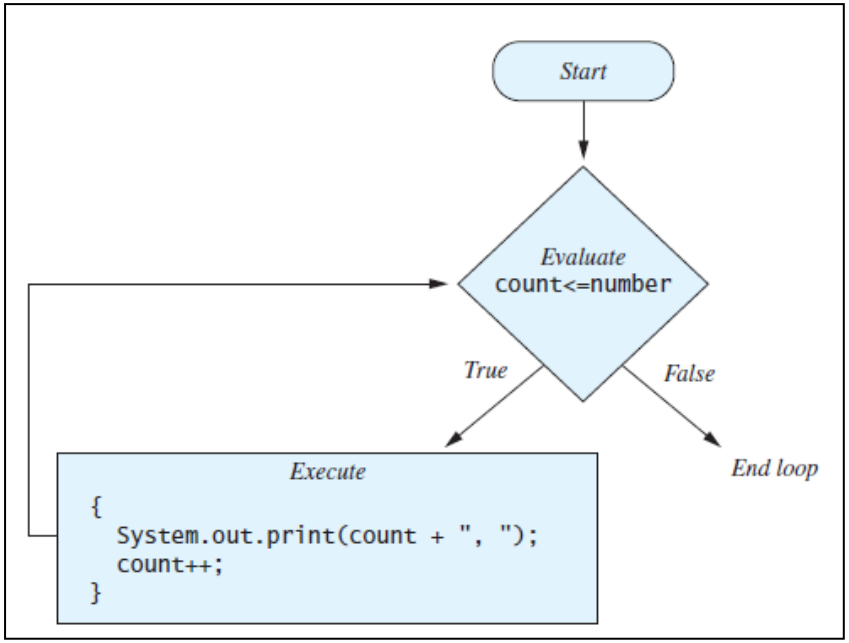
```
if (year == 1)
     System.out.println("freshman");
else if (year == 2)
     System.out.println("sophomore");
else if (year == 3)
     System.out.println("junior");
else if (year == 4)
     System.out.println("senior");
else if (year == 5)
     System.out.println("super
senior");
else
     System.out.println("huh?");
```

```
switch (year) {
  case 1:
    System.out.println("freshman");
    break;
  case 2:
    System.out.println("sophomore");
    break;
  case 3:
    System.out.println("junior");
    break;
  case 4:
    System.out.println("senior");
    break;
  case 5:
    System.out.println("super senior");
    break;
  default:
    System.out.println("unknown");
  break;
}
```

While Statement

- Flow of while statement
  - Start from expression evaluation
  - As long as it's true, repeat instructions in brackets

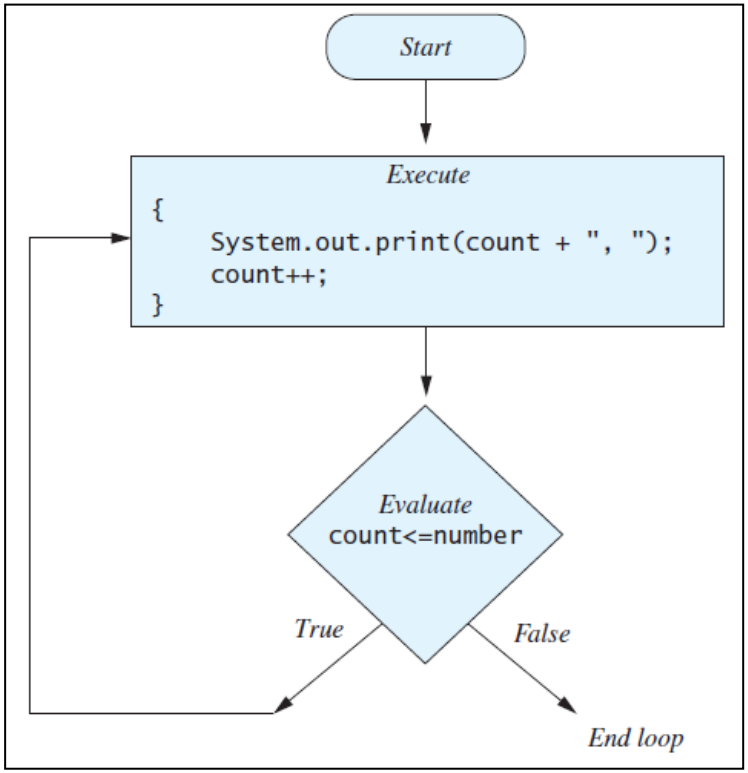
```
while (count <= number) {
   System.out.println(count);
   count++;
}
```



Do-While Statement

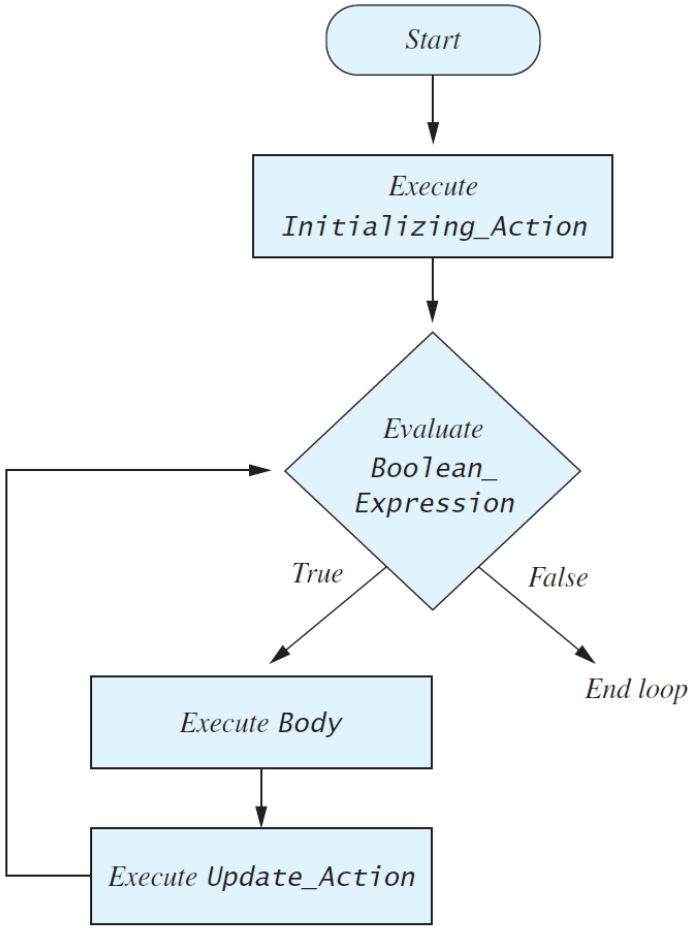
- Flow of do-while statement
  - Start from body statements
  - Repeat instructions in brackets as long as the expression is true

```
do {
   System.out.print(count);
   count++;
} while (count <= number);
```



For Statement

- Flow chart
  - **for** (*Initializing_Action; Boolean_Expression; Update_Action){*
    Body;
    }




```
for (count = 1; count <= number;
 count++) {
  // all the actions
}
```

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- **Classes and objects**

Classes vs. Objects

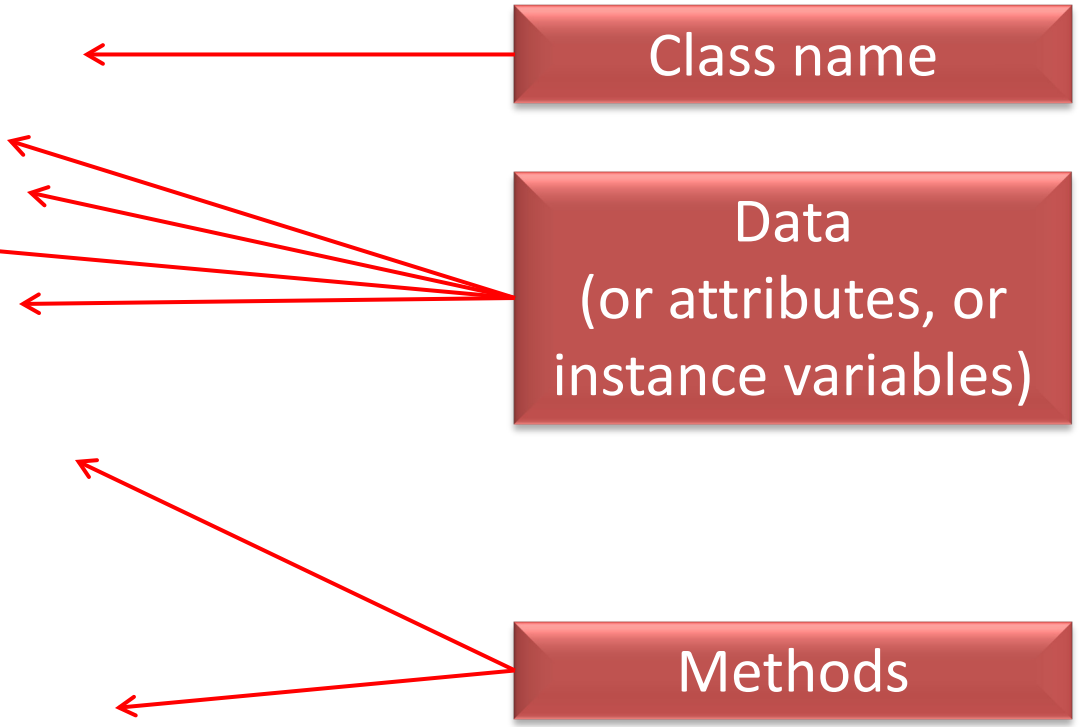
- **Classes:**
  - What we can create
  - Specify the data to save
- **Objects**:
  - What have been created
  - Save actual data

Defining a class

```
public class Student
{
    public String name;
    public int classYear;
    public double GPA;
    public String major;
    // ...

    public String getMajor()
    {
        return major;
    }

    public void increaseYear()
    {
        classYear++;
    }
}
```



Methods

```
public String getMajor()
{
    return major;
}

public void increaseYear()
{
    classYear++;
}
```

returns a String

return type

returns nothing

Methods with Parameters

```
public class Student
{
    public String name;
    public int classYear;
    // …
    public void setName(String studentName)
    {
        name = studentName;
    }
    public void setClassYear(int year)
    {
        classYear = year;
    }
}
```

Local Variable Rule

- Usually, a variable is only accessible in its surrounding brackets

```
public class Variable {
    String a = "a";

    public void f() {
        String b = "b";
        if (a.equals("b")) {
            String c = "c";
        }
    }
}
```

public/private Modifier

- public: there is no restriction on how you can use the method or instance variable
- private: can not directly use the method or instance variable's name outside the class

public/private Modifier

```
public class Student
{
    public int classYear;
    private String major;
}
public class StudentTest{
   public static void main(String[] args){
        Student jack = new Student();
        jack.classYear = 1;
        jack.major = "Computer Science"; // ERROR!!!
   }
}
```

OK, *classYear* is *public*

Error!!! *major* is *private*

Sample Questions

- The Fibonacci sequence is defined such that a number in the sequence is the sum of the previous two number in the sequence such that the first two numbers are 0, 1.
- The Fibonacci sequence: 0, 1, 1, 2, 3, 5, 8, 13, 21, …
- Write a function, fib that takes an integer as input and displays the Fibonacci sequence to the first value greater than the input.
- Example: fib(6) would display 0, 1, 1, 2, 3, 5, 8

Sample Questions

- What is the value of temp at the end of the loop for the following input? (23)
  - **9 4 2 3 8 11 7**

```
System.out.print("Please input an int: ");
int input = kb.nextInt();
int temp = 0;
for(int i=0; i < 6; i++){
    if(input % 2 == 1)
        temp += input;
    System.out.print("Please input an int: ");
    input = kb.nextInt();
}
```

Sample Questions

- Write a method that returns the *absolute value* of the integer passed in to the method. The *absolute value* of a number is its numerical value without regard to its sign. For example, the absolute value of -3 is 3. The absolute value of 3 is also 3. Fill in the return type for the method below, and then fill in the body.

```
public _____ absoluteValue(int num)   {
}
```


Sample Questions

```
public int absoluteValue(int num)
{
    if (num < 0)
        return –num;
    else
        return num;
}

Another possibility:
public int absoluteValue(int num)
{
    if (num < 0)
        num = -num;
    return num;
}
```