Lecture Set #3: Conditional and Iterative Structures

Control Structures
• uninitialized variables
• if branching
• if/else branching
• logical operators
• nesting of control structures
• proper indenting and spacing conventions
• java identifier naming conventions
• named constants
• while loop
• do-while loop
• for loop

Java, Eclipse and Uninitialized Variables

• Eclipse will complain if you try to use an uninitialized local variable:
  ```java
  int i;
  System.out.println("i is " + i);
  What is value of i?
  ```

• This feature interacts strangely with if/else statements sometimes

• Good programming practice: always initialize new variables
Control Flow and Conditionals

- **Control flow**: the order in which statements are executed
  - General rule: top to bottom
  - Several Control Structures that change that
- **Conditional statements**: permit control flow to be dependent on (true/false) conditions
  - if
  - if-else

if and if-else

The if and if-else statements should have the following form:

- if (condition) {
  statements;
}
  - tests the condition
  - if true statement is done; otherwise it is skipped
- if (condition) {
  statements1;
} else {
  statements2;
}
  - tests the condition
  - if true, statements1 is done; otherwise statements2 is done
Java and White Space

You can add: carriage returns, spaces, tabs

wherever you want in Java

Properly used, this makes your program easier to read and understand


Logical Operators

Used for forming more complex conditions.

- **“and”**  
  
  ```java
  if ( temp >= 97 && temp <= 99 ) {
      System.out.println( "Patient is healthy" );
  }
  ```

- **“or”**  
  
  ```java
  if ( months >= 3 || miles >= 3000 ) {
      System.out.println( "Change your oil" );
  }
  ```

- **“not”**:  
  
  ```java
  if ( ! phone.equals( "301-555-1212" ) ) {
      System.out.println( "Sorry, wrong number" );
  }
  ```
Blocks

- What happens?
  ```
  if (i > 10)
      i = 10;
      saturate = true;
  ```

- Desired: both `i`, `saturate` are set only when `i > 10`
- Actual: only the `i=10` statement is dependant
  - Only one statement can be associated with `if`
  - The `saturate` assignment statement is not part of the `if`
- Blocks solve this problem

Blocks

- What happens?
  ```
  if (i > 10)
      i = 10;
      saturate = true;
  else
      k = 100;
  ```

- Desired: both `i`, `saturate` are set only when `i > 10`
- Actual: syntax error
  - Only one statement can be associated with `if`
  - The `saturate` assignment statement is not part of the `if`
  - The else can’t find the if it belongs to
- Blocks solve this problem also
What Blocks Are

- Blocks are sequences of statements “glued together” into one
- Form:
  
  ```
  {
    <statement 1>;
    <statement 2>;
    ...
  }
  ```
- Example:
  ```
  if (i > 10) {
    i = 10;
    saturate = true;
  } else {
    i = i+1;
  }
  ```
- if, if-else, {...} are statement constructors
  - They take statement(s) and convert them into a new statement
  - Implications: if statements, etc. can also appear inside (“be nested within”) one another

Issues with if-else

- Nested If/Elses can be Ugly and Confusing!
  - indent and block carefully
- The “Dangling Else” Problem
  - Java rule: else is associated with “innermost” possible if
- Cascading Elses

- WE WILL USE { ... } FOR ALL IF, IF-ELSE, IF-ELSE-IF, STATEMENTS
In Projects

- You must use meaningful variable names
  - it must tell the purpose of that variable – what it is meant to hold
  - it can not have so much abbreviation that only you can read it
- You must use Java convention indenting and brace placement
  - the indenting show the purpose in nesting
  - with braces in the “Java determined” places with respect to the lines of code
- Java convention of capitalization of identifiers
  - variables and methods start with lower case
  - classes and interfaces start with upper case
  - variables, methods, classes and interface use camelCase
  - constants are all uppercase with underscores between words
- You must have “Fully Blocked” if statements and looping structures
- You must have all lines less than or equal to 80 columns of text
- You must use “named constants” for any literal values that will not change during program execution.

Named Constants

- If same value should be used in several places, how to ensure consistency?
  - i.e. Check on temperature may be performed more than once
  - i.e. Same prompt might be printed in several places
  - final int MAX_OK_TEMP = 99;
  - Just like a regular variable declaration/tutorial, except…
    - Special term final
    - Necessity of initial value
    - Any valid variable name will work, but convention is to use all capitals
- Difference from non-final variables: assignment attempt leads to error!
- literals (= named values)
  - e.g.
    - System.out.print ("Enter integer: ");
    - System.out.print (PROMPT);
Naming Rules and Conventions

- What is legal for variable names?
  - Letters, digits, $, _
  - Can’t start variable name with digit
  - Avoid reserved words
  - Avoid names starting or ending with $ or _

- Use camelCase:
  - Variables & Methods use lower-case for first letter
  - Classes/Interfaces use upper-case for first letter

- Naming Conventions: Standards developed over time.
  - Variables and methods: Start with lowercase, and use uppercase for each new word:
    ```java
dataList2 myFavoriteMartian showMyTheMoney
    ```
  - Class names: Start with uppercase and uppercase for each new word:
    ```java
String JOptionPane MyFavoriteClass
    ```
  - Named constants (variables whose value never changes): All uppercase with underscores between words:
    ```java
MAX_LENGTH DAYS_PER_WEEK BOILING_POINT
    ```

- Make variable names not too long, not too short
  - Bad: crtitm
  - Bad: theCurrentItemBeingProcessed
  - Good: currentItem

Meaningful Variable Names

- Choose names for your variables to reflect their purpose

- Bad
  ```java
  String string = "";
  System.out.println ("Enter name: ");
  string = sc.next();
  if (string.equals ("John Doe")) …
  ```

- Good
  ```java
  String name = "";
  System.out.println ("Enter name: ");
  name = sc.next();
  if (name.equals ("John Doe")) …
  ```
Loops in Java

- So far our programs execute every program statement at most once
- Often, we want to perform operations more than once:
  - “Sum all numbers from 1 to 10”
  - “Repeatedly prompt user for input”
- Loops allow statements to be executed multiple times. Loop types in Java:
  - while
  - do-while
  - for
- Call “iteration”

while and do-while Loops

- **while** and **do-while** loops contain:
  - A statement, called the **body**
  - A boolean **condition**
  - Idea: the body is executed one more time as long as the condition is true

- **while-loop**: The condition is tested before each body execution
  
  ```java
  while (〈condition〉) {
    〈body〉
  }
  ```

- **do-while-loop**: The condition is tested after each body execution
  
  ```java
  do{
    〈body〉
  } while (〈condition〉);
  ```

- **Main difference**: do-while loop bodies always executed at least once because it is “bottom tested” rather than “top tested”
Types of loops

- indefinite iteration
  - usually tests something that is coming from outside the loop structure (e.g. input)
  - needs to eventually change from true to false
- counted iteration
  - something that is controlled inside the loop
  - to start at some value and count up or down until some set ending point

for loop

- for-loop: The counter is set, the condition is tested before each body execution, the update is performed at the end of each iteration
  
  ```
  for (〈initialization〉; 〈condition〉; 〈update〉) {
    〈body〉
  }
  ```

- Usually used for counted loops, but any of the parts can be left empty.
Infinite Loops

- Loops can run forever if condition never becomes false
- Be careful when programming loops!
  - Add statements for termination into loop body first
  - Make sure these statements are at end of body
  - e.g.

        while (i <= 10) {
            System.out.println(i);
            i = i + 1;
        }

Variables, Blocks and Scoping

- Variables can be declared anywhere in a Java program
- When are the declarations active?
  - After they are executed
  - Only inside the block in which they are declared
- Scope rules formalize which variable declaration are active when
  - Global variables: scope is entire program
  - Local variables: scope is a block
Nested Loops

- while, do-while are statement constructors (like if and if-else: they use blocks)
- Loops can thus be used inside other loops!

Nesting Example

```java
public class NestedLoops {

    public static void main(String[] args) {

        int rowNumber = 1;
        while (rowNumber < 10) {
            int colNumber = 1;
            while (colNumber < 10) {
                System.out.print((rowNumber + colNumber) % 2);
                colNumber = colNumber + 1;
            }
            System.out.println();
            rowNumber = rowNumber + 1;
        }
    }
}
```