Lecture Set #3:
Conditional and Iterative Structures

Control Structures
- 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

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" );
  }
  ``

- Short Circuiting
  - Once the answer is known – stop evaluation of the expression

Blocks

- What happens?
  ```java
  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?
  ```java
  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:
  ```java
  {<statement 1>;
  <statement 2>;
  ...
  }
  ```
- Example:
  ```java
  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 cannot have so much abbreviation that only you can read it.
- You must use Java convention indenting and brace placement
  - The indenting shows 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/initialization, 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. if (temp >= 212 || temp <= 32) …
    - if (temp >= BOILING || temp <= FREEZING)
    - 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.
  - Class names: Start with uppercase and uppercase for each new word.
  - Named constants: Variables whose value never changes: All uppercase with underscores between words:
    - MAX_LENGTH
    - DAYS_PER_WEEK
    - BOILING_POINT
- Make variable names not too long, not too short.
  - Bad: order
  - Bad: failed
  - Good: orderFinished

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
  ```java
  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
  - Often these statements are at end of body
  - e.g.
  ```java
  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;
        }
    }
}
```