BBM 102 – Introduction to Programming II

Spring 2017

Introduction to Java

Instructors: Ayça Tarhan, Fuat Akal, Gönenç Ercan, Vahid Garousi

TAs: Selma DİLEK, Selim YILMAZ, Selman BOZKİR
Today

- Introduction
  - About the class
  - Organisation of this course

- Introduction to Java
  - Java as a Platform
  - Your First Java Program
  - Basic Programming Elements
Today

- **Introduction**
  - About the class
  - Organisation of this course

- **Introduction to Java**
  - Java as a Platform
  - Your First Java Program
  - Basic Programming Elements
About the course

- This course will help students understand **object-oriented programming** principles and apply them in the construction of Java programs.
  - The course is structured around basic topics such as **classes**, **objects**, **encapsulation**, **inheritance**, **polymorphism**, **abstract classes and interfaces** and **exception handling**.

- **BBM 104 Introduction to Programming Practicum**: The students will gain hand-on experience via a set of programming assignments supplied as complementary.

- **Requirements**: You must know basic programming (i.e. BBM101).
BBM 102-104 Team

Instructors

Ayça Tarhan (Section 1)
Fuat Akal (Section 2)
Gönenç Ercan (Section 3)
Vahid Garousi (Section 4)

TAs

Selma DİLEK
Selim YILMAZ
Selman BOZKİR

Office hours: See Web page
Reference Book

- Java - An Introduction to Problem Solving and Programming, Walter Savitch, Pearson, 2012
- Java - How to Program, Paul Deitel and Harvey Deitel, Prentice Hall, 2012
Communication

The course web page will be updated regularly throughout the semester with lecture notes, programming assignments, announcements and important deadlines.

http://web.cs.hacettepe.edu.tr/~bbm102
Getting Help

- **Office hours**
  - See the web page for details

- **BBM 104 Introduction to Programming Practicum**
  - Course related recitations, practice with example codes, etc.

- **Communication**
  - Announcements and course related discussions through Piazza
Course Work and Grading

- 2 midterm exams (20 + 30 = 50%)
  - Closed book and notes
  - On April 5th and May 3rd, respectively.

- Final exam (45%)
  - Closed book
  - To be scheduled by the registrar

- Class Attendance (5%)
  - Attempting to create false attendance (e.g., signing in the attendance list on behalf of someone else) will be punished.
## Course Overview

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15-Feb</td>
<td>Introduction to Java</td>
</tr>
<tr>
<td>2</td>
<td>22-Feb</td>
<td>Introduction to Objects</td>
</tr>
<tr>
<td>3</td>
<td>1-Mar</td>
<td>Classes and Objects in Java</td>
</tr>
<tr>
<td>4</td>
<td>8-Mar</td>
<td>Encapsulation</td>
</tr>
<tr>
<td>5</td>
<td>15-Mar</td>
<td>Inheritance</td>
</tr>
<tr>
<td>6</td>
<td>22-Mar</td>
<td>Wrap-up</td>
</tr>
<tr>
<td>7</td>
<td>29-Mar</td>
<td>Polymorphism</td>
</tr>
<tr>
<td>8</td>
<td>5-Apr</td>
<td>Midterm Exam 1</td>
</tr>
<tr>
<td>9</td>
<td>12-Apr</td>
<td>Abstract Classes and Interfaces</td>
</tr>
<tr>
<td>10</td>
<td>19-Apr</td>
<td>Collections</td>
</tr>
<tr>
<td>11</td>
<td>26-Apr</td>
<td>Exceptions</td>
</tr>
<tr>
<td>12</td>
<td>3-May</td>
<td>Midterm Exam 2</td>
</tr>
<tr>
<td>13</td>
<td>10-May</td>
<td>Streams and Input/Output</td>
</tr>
<tr>
<td>14</td>
<td>17-May</td>
<td>Wrap-up</td>
</tr>
</tbody>
</table>
BBM 104 Introduction to Programming Practicum

- **Programming assignments (PAs)**
  - Four assignments throughout the semester.
  - Each assignment has a well-defined goal such as solving a specific problem.
  - You **must work alone** on all assignments stated unless otherwise.

- **Important Dates**
  - See the course web page for schedule.
Policies

- **Work groups**
  - You must work alone on all assignments stated unless otherwise

- **Submission**
  - Assignments due at 23:59 (no extensions!)
  - Electronic submissions (no exceptions!)

- **Lateness penalties**
  - Get penalised 10% per day
  - No late submission is accepted 3 days after due date
Cheating

What is cheating?

- Sharing code: by copying, retyping, looking at, or supplying a file
- Coaching: helping your friend to write a programming assignment, line by line
- Copying code from previous course or from elsewhere on WWW

What is NOT cheating?

- Explaining how to use systems or tools
- Helping others with high-level design issues
Cheating

- Penalty for cheating:
  - Removal from course with failing grade

- Detection of cheating:
  - We do check: Our tools for doing this are much better than most cheaters think!
Today

- Introduction
  - About the class
  - Organization of this course

- Introduction to Java
  - Java as a Platform
  - Your First Java Program
  - Basic Programming Elements
What is Java?

- An island of Indonesia lying between the Indian Ocean and the Java Sea.
What is Java?

- Informal. Brewed coffee.
What is Java?

- A technology which is both a programming language and a platform.

- Developed by Sun Microsystems.

- First public version was released in 1995.
Software Development with Java

- All source code is first written in plain text files ending with the “.java” extension.

- Those source files are then compiled into “.class” files by the javac compiler.

- A “.class” file does not contain code that is native to your processor; it instead contains bytecodes — the machine language of the Java Virtual Machine (Java VM).

- The java launcher tool then runs your application with an instance of the Java Virtual Machine, i.e. your code is run by JVM.

http://docs.oracle.com/javase/tutorial/getStarted/intro/definition.html
Platform Independence: Write Once Run Anywhere

Because the Java VM is available on many different operating systems, the same .class files are capable of running on Microsoft Windows, the Solaris™ Operating System (Solaris OS), Linux, or Mac OS.

http://docs.oracle.com/javase/tutorial/getStarted/intro/definition.html
The Java Platform

- A platform is the hardware or software environment in which a program runs.

- The Java platform has two components:
  - The Java Virtual Machine: It's the base for the Java platform and is ported onto various hardware-based platforms
  - The Java Application Programming Interface (API): It is a large collection of ready-made software components that provide many useful capabilities.

- As a platform-independent environment, the Java platform can be a bit slower than native code.
  - However, advances in compiler and virtual machine technologies are bringing performance close to that of native code without threatening portability.

http://docs.oracle.com/javase/tutorial/getStarted/intro/definition.html
Your First Java Program

HelloWorld.java

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello world!");
    }
}
```

$ javac HelloWorld.java ← Compile

$ java HelloWorld ← Run

Hello world!
Basic Programming Elements

- Variables, Types and Expressions
- Flow of Control
  - Branching
  - Loops
Variables

- **Variables** in a program are used to store data such as numbers and letters. They can be thought of as containers of a sort.

- You should choose variable names that are helpful. Every variable in a Java program must be declared before it is used for the first time.

- A variable declaration consists of a type name, followed by a list of variable names separated by commas. The declaration ends with a semicolon.

Syntax:
```
data_type variable_name [ = initial_value ];
```

```
int styleNumber, numberOfChecks, numberOfDeposits;
double amount, interestRate;
char answer;
```
# Primitive Data Types

<table>
<thead>
<tr>
<th>Type Name</th>
<th>Kind of Value</th>
<th>Memory Used</th>
<th>Range of Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>byte</td>
<td>Integer</td>
<td>1 byte</td>
<td>-128 to 127</td>
</tr>
<tr>
<td>short</td>
<td>Integer</td>
<td>2 bytes</td>
<td>-32,768 to 32,767</td>
</tr>
<tr>
<td>int</td>
<td>Integer</td>
<td>4 bytes</td>
<td>-2,147,483,648 to 2,147,483,647</td>
</tr>
<tr>
<td>long</td>
<td>Integer</td>
<td>8 bytes</td>
<td>-9,223,372,036,854,75,808 to 9,223,372,036,854,775,807</td>
</tr>
<tr>
<td>float</td>
<td>Floating-point</td>
<td>4 bytes</td>
<td>±3.40282347 × 10+38 to ±1.40239846 × 10−45</td>
</tr>
<tr>
<td>double</td>
<td>Floating-point</td>
<td>8 bytes</td>
<td>±1.79769313486231570 × 10+308 to ±4.94065645841246544 × 10−324</td>
</tr>
<tr>
<td>char</td>
<td>Single character (Unicode)</td>
<td>2 bytes</td>
<td>All Unicode values from 0 to 65,535</td>
</tr>
<tr>
<td>boolean</td>
<td></td>
<td>1 bit</td>
<td>True or false</td>
</tr>
</tbody>
</table>

*There are also Class Data Types which we will cover later.*
Identifiers

- The technical term for a name in a programming language, such as the name of a variable, is an **identifier**.
- An identifier can contain only letters, digits 0 through 9, and the underscore character “_”.
- The first character in an identifier cannot be a digit.
- There is no limit to the length of an identifier.
- Java is **case sensitive** (e.g., `personName` and `personname` are two different variables).

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Valid?</th>
</tr>
</thead>
<tbody>
<tr>
<td>outputStream</td>
<td>Yes</td>
</tr>
<tr>
<td>4you</td>
<td>No</td>
</tr>
<tr>
<td>my.work</td>
<td>No</td>
</tr>
<tr>
<td>FirstName</td>
<td>Yes</td>
</tr>
<tr>
<td>_tmp</td>
<td>Yes</td>
</tr>
<tr>
<td>Public</td>
<td>No</td>
</tr>
</tbody>
</table>

Public is a reserved word.
# Java Reserved Words

<table>
<thead>
<tr>
<th>abstract</th>
<th>assert</th>
<th>boolean</th>
<th>break</th>
<th>byte</th>
<th>case</th>
</tr>
</thead>
<tbody>
<tr>
<td>catch</td>
<td>char</td>
<td>class</td>
<td>const</td>
<td>continue</td>
<td>default</td>
</tr>
<tr>
<td>double</td>
<td>do</td>
<td>else</td>
<td>enum</td>
<td>extends</td>
<td>FALSE</td>
</tr>
<tr>
<td>final</td>
<td>finally</td>
<td>float</td>
<td>for</td>
<td>goto</td>
<td>if</td>
</tr>
<tr>
<td>implements</td>
<td>import</td>
<td>instanceof</td>
<td>int</td>
<td>interface</td>
<td>long</td>
</tr>
<tr>
<td>native</td>
<td>new</td>
<td>null</td>
<td>package</td>
<td>private</td>
<td>protected</td>
</tr>
<tr>
<td>public</td>
<td>return</td>
<td>short</td>
<td>static</td>
<td>strictfp</td>
<td>super</td>
</tr>
<tr>
<td>switch</td>
<td>synchronized</td>
<td>this</td>
<td>throw</td>
<td>throws</td>
<td>transient</td>
</tr>
<tr>
<td>TRUE</td>
<td>try</td>
<td>void</td>
<td>volatile</td>
<td>while</td>
<td></td>
</tr>
</tbody>
</table>
Naming Conventions

- Class types begin with an uppercase letter (e.g. String).

- Primitive types begin with a lowercase letter (e.g. float).

- Variables of both class and primitive types begin with a lowercase letters (e.g. firstName, classAverage).

- Multiword names are "punctuated" using uppercase letters.
Assignment Statements

- An assignment statement is used to assign a value to a variable.
- The "equal sign" is called the assignment operator
- Syntax:

  ```
  variable_name = expression;
  ```

  where expression can be another variable, a literal or constant, or something to be evaluated by using operators.

  ```
  amount = 100;
  interestRate = 0.12;
  answer = 'Y';
  fullName = firstName + " " + lastName;
  ```
Initializing Variables

- A variable that has been declared, but no yet given a value is said to be *uninitialized*.
- Uninitialized class variables have the value **null**.
- Uninitialized primitive variables may have a default value.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>byte</td>
<td>0</td>
</tr>
<tr>
<td>short</td>
<td>0</td>
</tr>
<tr>
<td>int</td>
<td>0</td>
</tr>
<tr>
<td>long</td>
<td>0L</td>
</tr>
<tr>
<td>float</td>
<td>0.0f</td>
</tr>
<tr>
<td>double</td>
<td>0.0d</td>
</tr>
<tr>
<td>char</td>
<td>\u0000'</td>
</tr>
<tr>
<td>String (or any object)</td>
<td>null</td>
</tr>
<tr>
<td>boolean</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

- It's good practice **not** to rely on a default value.
Constants

- Literal expressions such as 2, 3.7, or 'y' are called *constants*.

- Integer constants can be preceded by a + or - sign, but cannot contain commas.

- Floating-point constants can be written with digits after a decimal point or using *e notation*.
  - 7650000000.0 can be written as 7.65e8
  - 0.000483 can be written as 4.83e-4
Imprecision in Floating Point Numbers

- Floating-point numbers often are only approximations since they are stored with a finite number of bits.

- Hence $1.0/3.0$ is slightly less than $1/3$.

- $1.0/3.0 + 1.0/3.0 + 1.0/3.0$ is less than 1.
Named Constants

- Java provides a mechanism that allows you to define a variable, initialise it, and moreover fix the variable’s value so that it cannot be changed.

```java
public static final Type Variable = Constant;
```

- The convention for naming constants is to use all uppercase letters, with an underscore symbol “_” between words.

```java
public static final double PI = 3.14159;
public static final int DAYS_PER_WEEK = 7;
...
float area = PI * r * r ;
int daysInYear = 52 * DAYS_PER_WEEK ;
```
Assignment Compatibility

- Java is *strongly typed*.

- A value of one type can be assigned to a variable of any type further to the right (not to the left):
  
  \[
  \text{byte} \rightarrow \text{short} \rightarrow \text{int} \rightarrow \text{long} \rightarrow \text{float} \rightarrow \text{double}
  \]

- You can assign a value of type `char` to a variable of type `int`. 


Type Conversion (Casting)

- Implicit conversion

```java
double doubleVariable = 5;       // 5.0
int intVariable = 5;             // 5
doubleVariable = intVariable;    // 5.0
```

- Explicit conversion

```java
double doubleVariable = 5.0;
int intVariable = doubleVariable ;  // Illegal
int intVariable = (int) doubleVariable ;  // Legal, 5
```
Operators and Precedence

- **Precedence**
  - First: The unary operators: plus (+), minus (-), not (!), increment (++) and decrement (--)
  - Second: The binary arithmetic operators: multiplication (*), integer division (/) and modulus (%)
  - Third: The binary arithmetic operators: addition (+) and subtraction (-)

- When binary operators have equal precedence, the operator on the left acts before the operator(s) on the right.

- When unary operators have equal precedence, the operator on the right acts before the operation(s) on the left.

- Parenthesis can change the precedence.
## Operators and Precedence - Example

### Ordinary Math
### Java (Preferred Form)
### Java (Parenthesized Form)

<table>
<thead>
<tr>
<th>Expression</th>
<th>Preferred Form</th>
<th>Parenthesized Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{rate}^2 + \text{delta} )</td>
<td>\text{rate} \times \text{rate} + \text{delta}</td>
<td>(\text{rate} \times \text{rate}) + \text{delta}</td>
</tr>
<tr>
<td>( 2(\text{s战斗力} + \text{bonus}) )</td>
<td>2 \times (\text{s战斗力} + \text{bonus})</td>
<td>2 \times (\text{s战斗力} + \text{bonus})</td>
</tr>
<tr>
<td>( \frac{1}{\text{time} + 3\text{mass}} )</td>
<td>( \frac{1}{\text{time} + 3 \times \text{mass}} )</td>
<td>( \frac{1}{\text{time} + (3 \times \text{mass})} )</td>
</tr>
<tr>
<td>( \frac{a - 7}{t + 9v} )</td>
<td>( \frac{a - 7}{t + 9 \times v} )</td>
<td>( \frac{a - 7}{t + (9 \times v)} )</td>
</tr>
</tbody>
</table>
### Specialised Assignment Operators

You can precede the simple assignment operator (=) with an arithmetic operator (+, -, *, /, %) to produce a kind of special-purpose assignment operator.

- `amount += 5;`  
  equals to  
  `amount = amount + 5;`

- `amount *= 5;`  
  equals to  
  `amount = amount * 5;`
Increment / Decrement Operators

- Used to increase (or decrease) the value of a variable by 1

- The increment operator
  - `count++` → Use the value of `count` and then increase it.
  - `++count` → Increase the value of `count` and then use it.

- The decrement operator
  - `count--` → Use the value of `count` and then decrease it.
  - `--count` → Decrease the value of `count` and then use it.
Increment / Decrement Operators - Example

- The increment operator (prefix form)

```java
int n = 3;
int m = 4;
int result = n * (++m);  // result = 15
```

- The increment operator (postfix form)

```java
int n = 3;
int m = 4;
int result = n * (m++);  // result = 12
```
Arrays

- Array is a sequence of values.
- Array indices begin at zero.

Defining Arrays

```
Base_Type[] Array_Name = new Base_Type[Length];
```

```
int[] numbers = new int[100];  // or,
```

```
int[] numbers;
numbers = new int[100];
```

Initialising Arrays

```
double[] reading = {3.3, 15.8, 9.7};  // or,
```

```
double[] reading = new double[3];
reading[0] = 3.3;
reading[1] = 15.8;
reading[2] = 9.7;
```
Strings

- A value of type `String` is a
  - Sequence (Array) of characters treated as a single item
  - Character positions start with 0

---

Can be declared in three ways:

```java
String greeting;
greeting = "Hello World!";

String greeting = "Hello World!";

String greeting = new String("Hello World!");
```
Concatenating Strings

You can connect—or join or paste—two strings together to obtain a larger string. This operation is called concatenation and is performed by using the “+” operator.

```java
String greeting, sentence;
greeting = "Hello";

sentence = greeting + " my friend!";
System.out.println(sentence); // Hello my friend!

String solution = "The answer is " + 42;
System.out.println(solution); // The answer is 42

// Java converts the number constant 42 to the string constant "42" and then concatenates the two strings
```
String Methods

- **Homework**: Investigate the methods given below. You will be responsible in the exams.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>charAt (Index)</td>
<td>Length()</td>
</tr>
<tr>
<td>compareTo(A_String)</td>
<td>replace(OldChar, NewChar)</td>
</tr>
<tr>
<td>concat(A_String)</td>
<td>substring(Start)</td>
</tr>
<tr>
<td>equals(Other_String)</td>
<td>substring(Start, End)</td>
</tr>
<tr>
<td>equalsIgnoreCase(Other_String)</td>
<td>toLowerCase()</td>
</tr>
<tr>
<td>indexOf(A_String)</td>
<td>toUpperCase()</td>
</tr>
<tr>
<td>lastIndexOf(A_String)</td>
<td>trim()</td>
</tr>
</tbody>
</table>
Boolean Type

- Java has the logical type boolean

- Type boolean has two literal constants
  - true
  - false

```java
int number = -5;
boolean isPositive = (number > 0); // False
```
# Java Comparison Operators

<table>
<thead>
<tr>
<th>Math Notation</th>
<th>Name</th>
<th>Java Notation</th>
<th>Java Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>Equal to</td>
<td>==</td>
<td>balance == 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>answer == 'y'</td>
</tr>
<tr>
<td>≠</td>
<td>Not equal to</td>
<td>!=</td>
<td>income != tax</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>answer != 'y'</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
<td>&gt;</td>
<td>expenses &gt; income</td>
</tr>
<tr>
<td>≥</td>
<td>Greater than or equal to</td>
<td>&gt;=</td>
<td>points &gt;= 60</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
<td>&lt;</td>
<td>pressure &lt; max</td>
</tr>
<tr>
<td>≤</td>
<td>Less than or equal to</td>
<td>&lt;=</td>
<td>expenses &lt;= income</td>
</tr>
</tbody>
</table>

Figure from “Java - An Introduction to Problem Solving and Programming, Walter Savitch, Pearson, 2012”
### Java Logical Operators

<table>
<thead>
<tr>
<th>Name</th>
<th>Java Notation</th>
<th>Java Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical and</td>
<td><code>&amp;&amp;</code></td>
<td><code>(sum &gt; min) &amp;&amp; (sum &lt; max)</code></td>
</tr>
<tr>
<td>Logical or</td>
<td>`</td>
<td></td>
</tr>
<tr>
<td>Logical not</td>
<td><code>!</code></td>
<td><code>!(number &lt; 0)</code></td>
</tr>
</tbody>
</table>

Figure from “Java - An Introduction to Problem Solving and Programming, Walter Savitch, Pearson, 2012”
Flow of Control

- *Flow of control* is the order in which a program performs actions.

- A *branching statement* chooses between two or more possible actions.
  - If-else, switch statements

- A *loop statement* repeats an action until a stopping condition occurs.
  - For, while, do-while loops
Basic if Statement

- **Syntax**

  ```java
  if (Expression) 
  Action
  ```

- If the *Expression* is true then execute *Action*

- *Action* is either a single statement or a group of statements within braces

```java
if (value2 < value1) {     // Rearrange numbers so
    int tmp = value1;     // value2 variable should
    value1 = value2;      // hold the bigger value
    value2 = tmp;
}                           
```
if-else Statement

Syntax

```plaintext
if (Expression)
  Action1
else
  Action2
```

If `Expression` is true then execute `Action1` otherwise execute `Action2`

The actions are either a single statement or a list of statements within braces

```plaintext
int maximum;
if (value1 < value2) {
  // is value2 larger?
  maximum = value2;  // yes: value2 is larger
}
else {
  // (value1 >= value2)
  maximum = value1;  // no: value2 is not larger
}
```
If statements can be nested (also called as multi-way, multi-branch if statement)

```java
if (a == '0')
    System.out.println ("zero");
else if (a == '1')
    System.out.println ("one");
else if (a == '2')
    System.out.println ("two");
else if (a == '3')
    System.out.println ("three");
else if (a == '4')
    System.out.println ("four");
else
    System.out.println ("five+");
```
Switch Statement

- Switch statement can be used instead of multi-way if statement.

- Syntax

  ```java
  switch(controlling_expression) {
    case expression1:
      action1;
      break;
    case expression2:
      action2;
      break;
    ...
    default:
      actionN;
  }
  ```

- Every case ends with `break` statement.
Switch Statement

Switch statements are more readable than nested if statements

```java
switch (a) {
    case '0':
        System.out.println ("zero"); break;
    case '1':
        System.out.println ("one"); break;
    case '2':
        System.out.println ("two"); break;
    case '3':
        System.out.println ("three"); break;
    case '4':
        System.out.println ("four"); break;
    default:
        System.out.println ("five+"); break;
}
```
The Conditional (Ternary) Operator

- The `?` and `:` together are called the *conditional operator* or *ternary operator*.

```java
if (n1 > n2)
    max = n1;
else
    max = n2;
```

can be written as:

```java
max = (n1 > n2) ? n1 : n2;
```
for Loops

- The for loop is a pretest loop statement. It has the following form.

  ```java
  for (initialisation; boolean-expression; increment) {
    nested-statements
  }
  ```

- `initialisation` is evaluated first.
- `boolean-expression` is tested before each iteration of the loop.
- `increment` is evaluated at the end of each iteration.
- `nested-statements` is a sequence of statements. If there is only one statement then the braces may be omitted.
Varying Control Variable

- for ( int i = 1; i <= 100; i++)
  - from 1 to 100 in increments of 1

- for ( int i = 100; i >= 1; i--)
  - from 100 to 1 in increments of -1

- for ( int i = 7; i <= 77; i += 7)
  - from 7 to 77 in increments of 7

- for ( int i = 20; i >= 2; i -= 2)
  - from 20 to 2 in decrements of 2
For Loop Example

String[] classList = {"Jean", "Claude", "Van", "Damme");

for (int i=0; i<classList.length; i++) {
    System.out.println(classList[i]);
}

for (String name : classList) {
    System.out.println(name);
}
While Loop

- The while loop is a pretest loop statement. It has the following form.

  ```java
  while (boolean-expression) {
    nested-statements
  }
  ```

- `boolean-expression` is an expression that can be true or false.

- `nested-statements` is a sequence of statements. If there is only one statement then the braces can be omitted.

- The boolean expression is tested *before* each iteration of the loop. The loop terminates when it is false.
While Loop Example

```java
int[] numbers = { 1, 5, 3, 4, 2 };  // Note: the key is 3, not 33 as mentioned.
int i=0, key = 33;  
boolean found = false;

while (!found){
    if (numbers[i++] == key)
        found=true;
}

if (found)
    System.out.println("Key is found in the array");  
else
    System.out.println("Key is NOT found!");
```
While Loop Example

```java
int[] numbers = { 1, 5, 3, 4, 2 }; int i=0, key = 33;

boolean found = false;

while (!found && i<numbers.length){
    if (numbers[i++] == key)
        found=true;
}

if (found)
    System.out.println("Key is found in the array");
else
    System.out.println("Key is NOT found!");
```

Make sure that the loop ends somehow.

Figure from “Java - An Introduction to Problem Solving and Programming. Walter Savitch, Pearson, 2012”
Do-While Loop

- The do-while loop is a post-test loop statement. It has the following form.

  ```
  do {
    nested-statements
  } while (boolean-expression);
  ```

- `nested-statements` is a sequence of statements. If there is only one statement then the braces may be omitted.

- `boolean-expression` is an expression that can be true or false.

- The boolean expression is tested *after* each iteration of the loop. The loop terminates when it is false.
Do-While Example

Scanner scan = new Scanner(System.in);
int myNumber;

do {
    System.out.println("Enter a number between 0 and 100: ");

    myNumber = scan.nextInt();
}
while (!(myNumber >= 0 && myNumber <= 100));

System.out.println("You entered a valid number");
Break Statement

- The break statement is used in loop (for, while, and do-while) statements and switch statements to terminate execution of the statement. A break statement has the following form.

  break;

- After a break statement is executed, execution proceeds to the statement that follows the enclosing loop or switch statement.

- Use `break` statements sparingly (if ever).
Continue Statement

- A **continue** statement
  - Ends current loop iteration
  - Begins the next one

- Use of continue statement is not recommended
  - Introduce unneeded complications
Breaking a Loop

```java
int[] numbers = { 1, 5, 3, 4, 2 };
int i = 0, key = 3;

while (i < numbers.length) {
    if (numbers[i] == key)
        break;
    i++;
}

if (i < numbers.length)
    System.out.println("Key is found in the array");
else
    System.out.println("Key is NOT!");
```
Summary

- So far, it should be fairly easy to follow for those who has basic programming skills / who has taken BBM101.

- We will continue with objects next week.

- In the mean time, here is a good starting point to Java:
  
  http://docs.oracle.com/javase/tutorial/index.html

- Also check out these notes by Oğuz Aslantürk in Turkish:
  
Acknowledgments

The course material used to prepare this presentation is mostly taken/adopted from the list below:

- Java tutorials [http://docs.oracle.com/javase/tutorial/](http://docs.oracle.com/javase/tutorial/)
- Aaron Bloomfield, CS101, University of Virginia.