Loops, Methods, Classes

Using Loops, Defining and Using Methods, Using API Classes, Exceptions, Defining Classes

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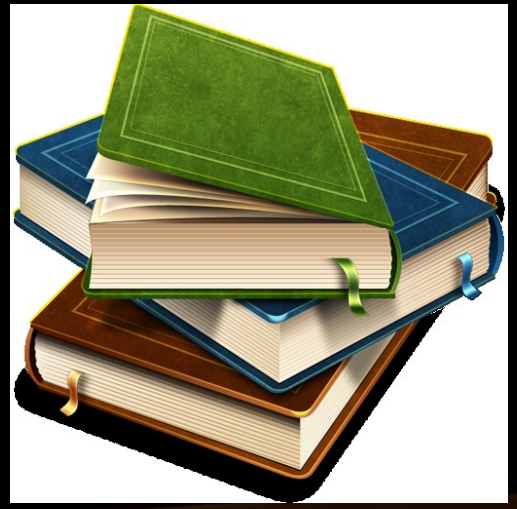
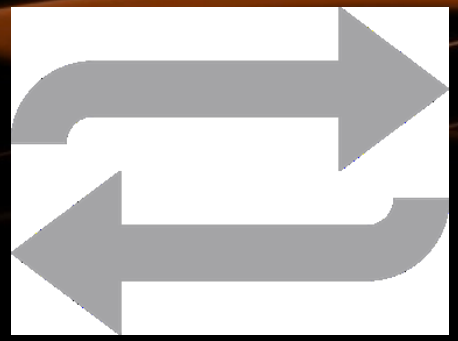
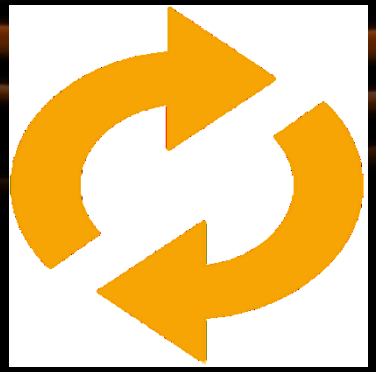


Warning: Not for Absolute Beginners

- The "**Java Basics**" course is NOT for absolute beginners
  - Take the "C# Basics" course at SoftUni first: https://softuni.bg/courses/csharp-basics
  - The course is for beginners, but with previous coding skills
- Requirements
  - Coding skills – entry level
  - Computer English – entry level
  - Logical thinking





Loops

Loop: Definition

- A loop is a control statement that repeats the execution of a block of statements

```
while (condition) {
    statements;
}
```

  - May execute a code block fixed number of times
  - May execute a code block while given condition holds
  - May execute a code block for each member of a collection
- Loops that never end are called an infinite loops

While Loop

- The simplest and most frequently used loop

```
while (condition) {
    statements;
}
```

- The repeat condition
  - Returns a boolean result of **`true`** or **`false`**
  - Also called loop condition

While Loop – Example: Numbers 0…9

```
int counter = 0;
while (counter < 10) {
    System.out.printf("Number : %d\n", counter);
    counter++;
}
```

Problems | Javadoc | Declaration | Console

```
<terminated> _01_WhileLoop [Java Application] C:\Program Files\Java\jre1.8.0_20\bin\javaw.exe
Number : 0
Number : 1
Number : 2
Number : 3
Number : 4
Number : 5
Number : 6
Number : 7
Number : 8
Number : 9
```

Do-While Loop

- Another classical loop structure is:

```
do {
    statements;
}
while (condition);
```

- The block of statements is repeated
  - While the boolean loop condition holds
- The loop is executed at least once

Product of Numbers [N..M] – Example

- Calculating the product of all numbers in the interval [**n**..**m**]:

```
Scanner input = new Scanner(System.in);
int n = input.nextInt();
int m = input.nextInt();
int number = n;
BigInteger product = BigInteger.ONE;
do {
    BigInteger numberBig = new BigInteger("" + number);
    product = product.multiply(numberBig);
    number++;;
}
while (number <= m);
System.out.printf("product[%d..%d] = %d\n", n, m, product);
```

For Loops

- The classical **for**-loop syntax is:

```
for (initialization; test; update) {
    statements;
}
```

- Consists of
  - Initialization statement
  - Boolean test expression
  - Update statement
  - Loop body block

For Loop – Examples

- A simple **for**-loop to print the numbers 0…9:

```
for (int number = 0; number < 10; number++) {
    System.out.print(number + " ");
}
```

- A simple **for**-loop to calculate n!:

```
long factorial = 1;
for (int i = 1; i <= n; i++) {
    factorial *= i;
}
```

Using the `continue` Operator

- **`continue`** bypasses the iteration of the inner-most loop
- Example: sum all odd numbers in [**1**…**n**], not divisors of 7:

```
int n = 100;
int sum = 0;
for (int i = 1; i <= n; i += 2) {
    if (i % 7 == 0) {
        continue;
    }
    sum += i;
}
System.out.println("sum = " + sum);
```

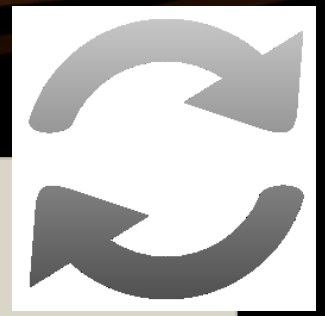
Using the break Operator

- The **break** operator exits the inner-most loop

```
public static void main(String[] args) {
    int n = new Scanner(System.in).nextInt();
    // Calculate n! = 1 * 2 * ... * n
    int result = 1;
    while (true) {
        if (n == 1)
            break;
        result *= n;
        n--;
    }
    System.out.println("n! = " + result);
}
```

For-Each Loop

- The typical **for-each** loop syntax is:



```
for (Type element : collection) {
    statements;
}
```

- Iterates over all the elements of a collection
  - The **element** is the loop variable that takes sequentially all collection values
  - The **collection** can be list, array or other group of elements of the same type

For-Each Loop – Example

- Example of **for-each** loop:

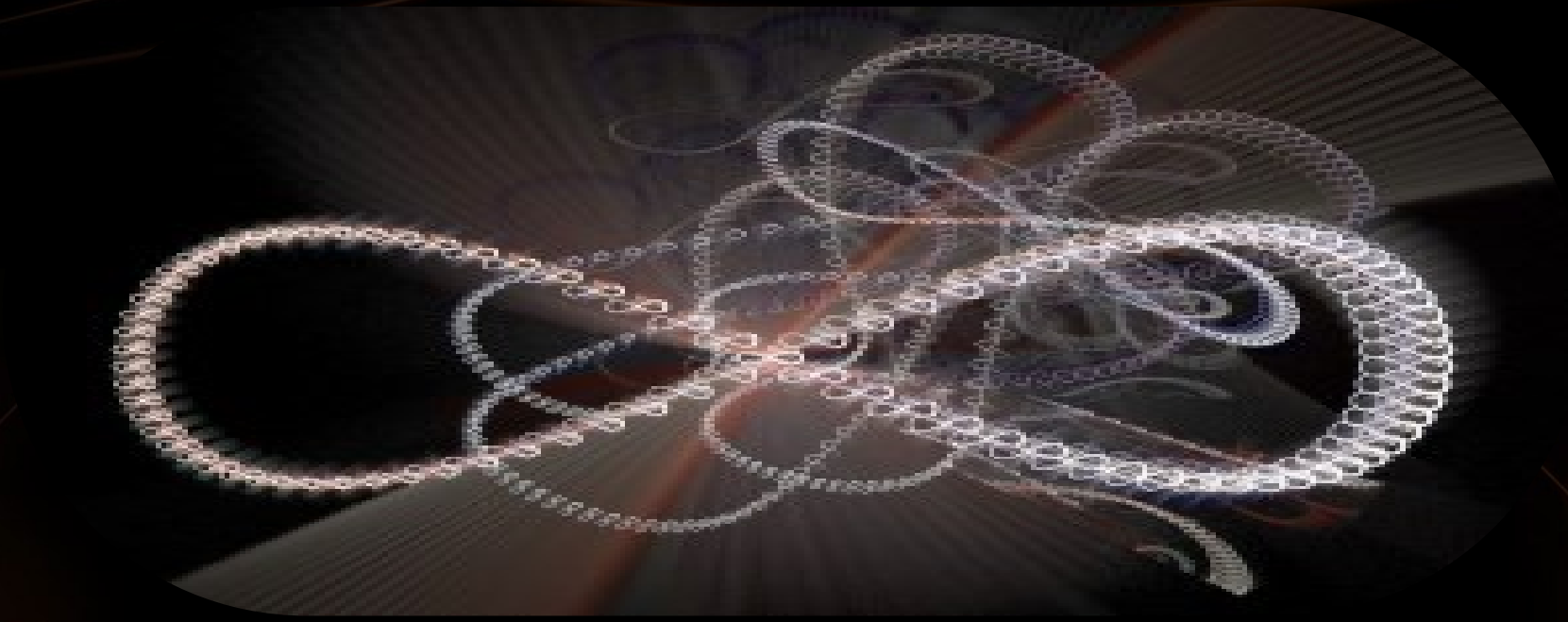
```
String[] days = { "Monday", "Tuesday", "Wednesday",
    "Thursday", "Friday", "Saturday", "Sunday" };
for (String day : days) {
    System.out.println(day);
}
```

- The loop iterates over the array of day names
  - The variable **day** takes all its values
- Applicable for all collections: arrays, lists, strings, etc.

Nested Loops

- Loops can be nested (one inside another)
- Example: print all combinations from TOTO 6/49 lottery

```
for (int i1 = 1; i1 <= 44; i1++)
  for (int i2 = i1 + 1; i2 <= 45; i2++)
    for (int i3 = i2 + 1; i3 <= 46; i3++)
      for (int i4 = i3 + 1; i4 <= 47; i4++)
        for (int i5 = i4 + 1; i5 <= 48; i5++)
          for (int i6 = i5 + 1; i6 <= 49; i6++)
            System.out.printf("%d %d %d %d %d %d\n",
                i1, i2, i3, i4, i5, i6);
```



Loops

Live Demo

```
  private static void printAsterix(int count) {
    for (int i = 0; i < count; i++) {
      System.out.print("*");
    }
    System.out.println();
  }

  public static void main(String[] args) {
    int n = 5;
    for (int i = 1; i <= n; i++) {
      printAsterix(i);
    }
  }
```

Methods

Defining and Invoking Methods

Methods: Defining and Invoking

- Methods are named pieces of code
  - Defined in the class body
  - Can be invoked multiple times
  - Can take parameters
  - Can return a value

```
private static void printAsterix(int count) {
  for (int i = 0; i < count; i++) {
    System.out.print("*");
  }
  System.out.println();
}

public static void main(String[] args) {
  int n = 5;
  for (int i = 1; i <= n; i++) {
    printAsterix(i);
  }
}
```

Methods with Parameters and Return Value

```
static double calcTriangleArea(double width, double height) {
  return width * height / 2;
}

public static void main(String[] args) {
  Scanner input = new Scanner(System.in);
  System.out.print("Enter triangle width: ");
  double width = input.nextDouble();
  System.out.print("Enter triangle height: ");
  double height = input.nextDouble();
  System.out.println("Area = " + calcTriangleArea(width, height));
}
```

Method names in Java should be in **camelCase**

Recursion

- Recursion == method can calls itself

```
public static void main(String[] args) {
  int n = 5;
  long factorial = calcFactorial(n);
  System.out.printf("%d! = %d", n, factorial);
}

private static long calcFactorial(int n) {
  if (n <= 1) {
    return 1;
  }
  return n * calcFactorial(n-1);
}
```

Method Return Types

- Type `void`
  - Does not return a value directly by itself

```
static void addOne(int n) {
    n += 1;
    System.out.println(n);
}
```

- Other types
  - Return values, based on the return type of the method

```
static int plusOne(int n) {
    return n + 1;
}
```

Method Access Modifiers

- `private`
  - Accessible only inside the current class. No subclass can call this
- `package` (default)
  - Accessible only inside the package. Subclasses can call this
- `protected`
  - Accessible by subclasses even outside the current package
- `public`
  - All code can access this, e.g. external classes

Methods

Live Demo

Problems | Javadoc | Declaration | Console

```
<terminated> _08_Methods [Java Application] C:\Program Fil
*
**
***
****
*****
```

```java
private static void printAsterix(int count) {
  for (int i = 0; i < count; i++) {
    System.out.print("*");
  }
  System.out.println();
}

public static void main(String[] args) {
  int n = 5;
  for (int i = 1; i <= n; i++) {
    printAsterix(i);
  }
}
```

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Using the Java API Classes

Build-in Classes in the Java API

- Java SE provides thousands of ready-to-use classes
  - Located in packages like **`java.lang`**, **`java.math`**, **`java.net`**, **`java.io`**, **`java.util`**, **`java.util.zip`**, etc.
- Using static Java classes:

```
LocalDate today = LocalDate.now();
double cosine = Math.cos(Math.PI);
```

- Using non-static Java classes

```
Random rnd = new Random();
int randomNumber = 1 + rnd.nextInt(100);
```

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Using the Java API Classes

Live Demo

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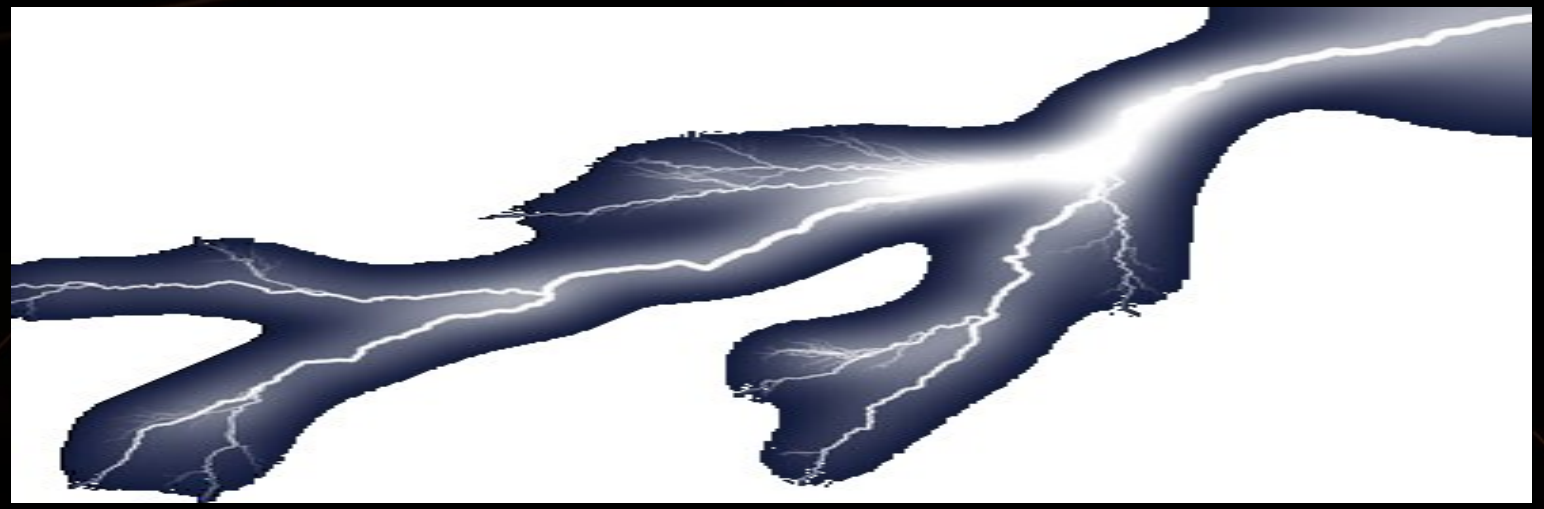


Exception Handling Basics

Catch and Throw Exceptions

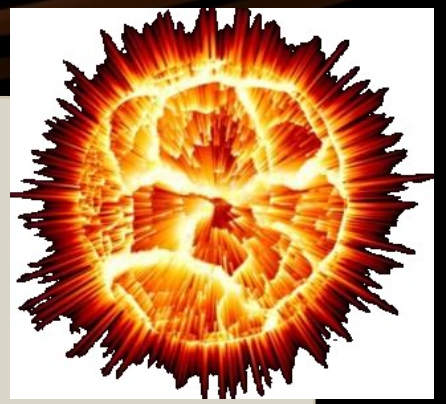
Handling Exceptions

- In Java exceptions are handled by the **try-catch-finally** construction

```
try {
  // Do some work that can raise an exception
} catch (SomeException ex) {
  // Handle the caught exception
} finally {
  // This code will always execute
}
```

- **catch** blocks can be used multiple times to process different exception types

Handling Exceptions – Example



```
public static void main(String[] args) {
  String str = new Scanner(System.in).nextLine();
  try {
    int i = Integer.parseInt(str);
    System.out.printf(
      "You entered a valid integer number %d.\n", i);
  }
  catch (NumberFormatException nfex) {
    System.out.println("Invalid integer number: " + nfex);
  }
}
```

The "throws ..." Declaration

- A method in Java could declare "**throws SomeException**"
  - This says "I don't care about **SomeException**", please re-throw it

```
public static void copyStream(InputStream inputStream,
    OutputStream outputStream) throws IOException {
  byte[] buf = new byte[4096]; // 4 KB buffer size
  while (true) {
    int bytesRead = inputStream.read(buf);
    if (bytesRead == -1)
      break;
    outputStream.write(buf, 0, bytesRead);
  }
}
```

Resource Management in Java

- When we use a resource that is expected to be closed, we use the try-with-resources statement

```
try(
  BufferedReader fileReader = new BufferedReader(
    new FileReader("somefile.txt"));
) {
  while (true) {
    String line = fileReader.readLine();
    if (line == null) break;
    System.out.println(line);
} catch (IOException ioex) {
  System.err.println("Cannot read the file ".);
}
```

```java
class Point {
    private double x, y;

    public Point(double x, double y) {

    public double getX() {

    public void setX(int x) {

    public double getY() {

    public void setY(double y) {

    public double calcDistance(Point otherPoint) {

    public static Point findMidPoint(Point p1, Point p2) {
}
```

Defining Simple Classes

Using Classes to Hold a Set of Fields

Defining Classes in Java

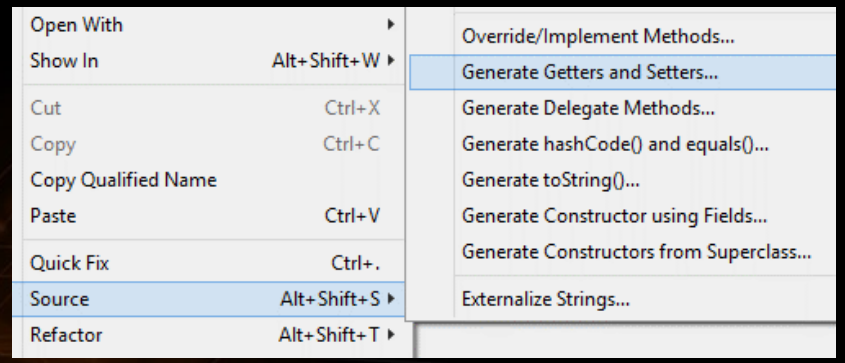
- Classes in Java combine a set of named fields / properties
- Defining a class **Point** holding **X** and **Y** coordinates:

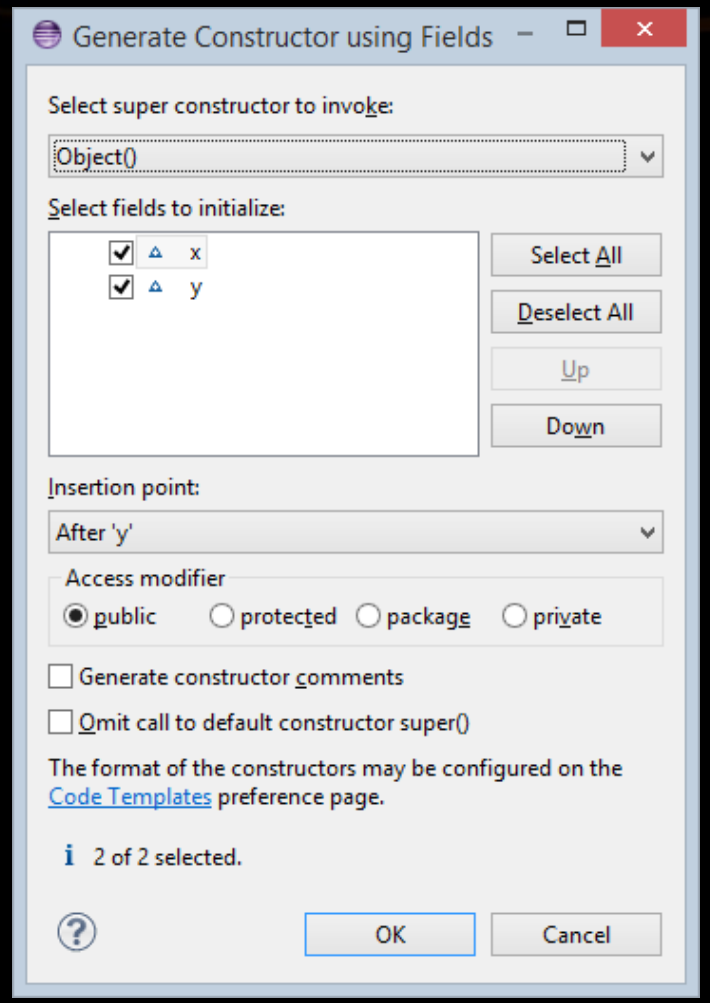
```
class Point {
  private int x, y;

  public Point(int x, int y) {
    this.x = x;
    this.y = y;
  }

  public int getX() {
    return x;
  }
```

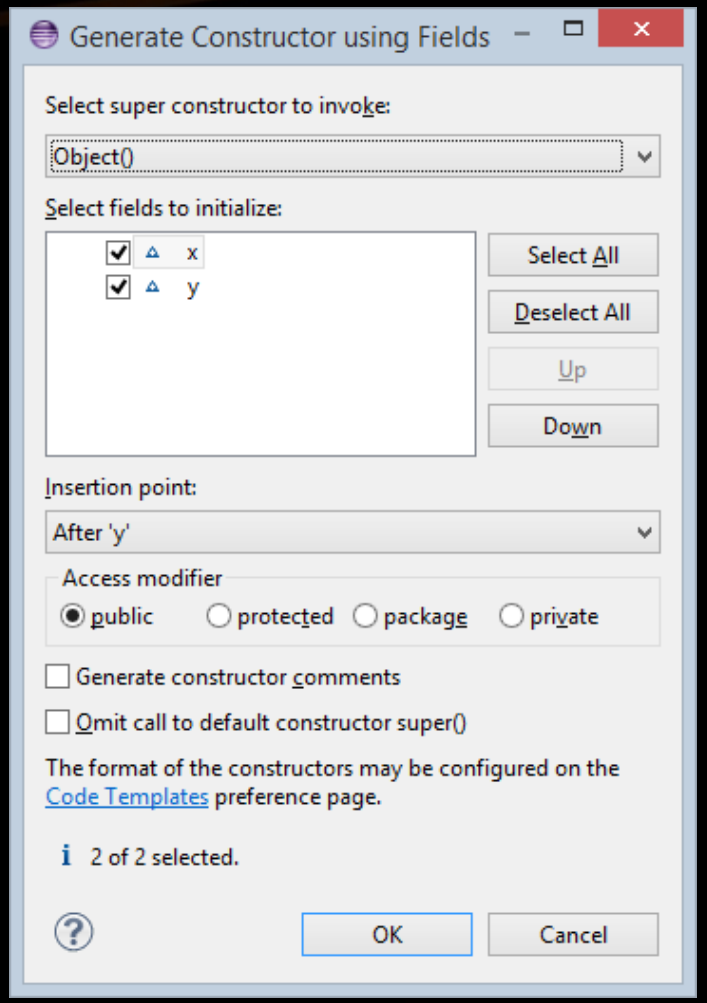
```
  public void setX(int x) {
    this.x = x;
  }

  public int getY() { … }

  public void setY(int y) { … }
}
```

Defining Classes in Eclipse

- Eclipse provides tools for automatic generation of constructors and getters / setters for the class fields







```java
class Point {
    private double x, y;

    public Point(double x, double y) {

    public double getX() {

    public void setX(int x) {

    public double getY() {

    public void setY(double y) {

    public double calcDistance(Point otherPoint) {

    public static Point findMidPoint(Point p1, Point p2) {
}
```

Defining Simple Classes

Live Demo

Summary

- Java supports the classical loop constructs
  - `while`, `do-while`, `for`, `for-each`
  - Similarly to C#, JavaScript, PHP, C, C++, …
- Java support methods
  - Methods are named code blocks
    - Can take parameters and return a result
- Java supports classical exception handling
  - Through the `try-catch-finally` construct
- Developers can define their own classes
  - With fields, methods, constructors, getters, setters, etc.

Loops, Methods, Classes

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Questions?

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