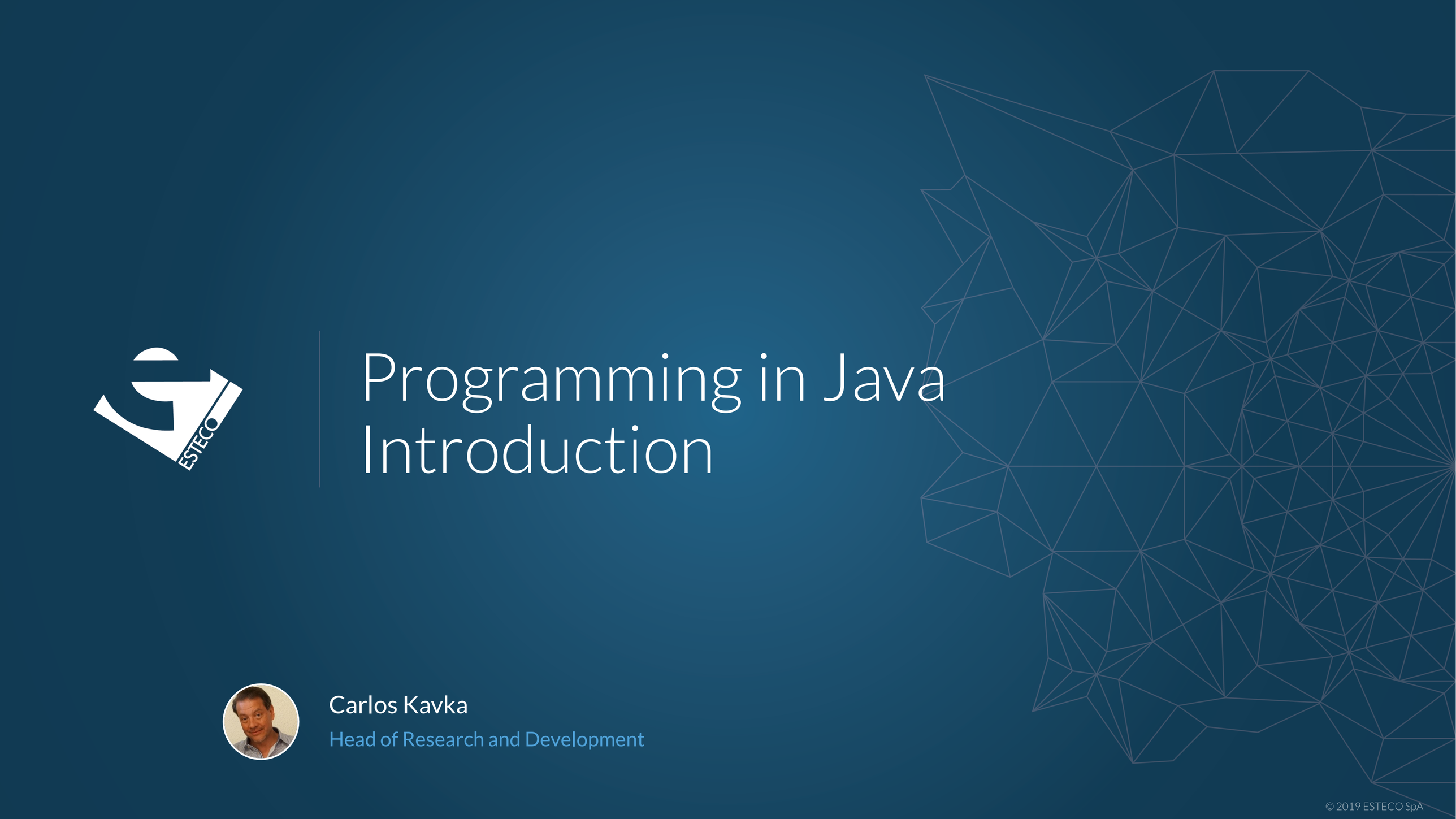


Programming in Java
Introduction

Carlos Kavka

Head of Research and Development

Course structure

Introduction to the language

Covering most aspects of the language till last release

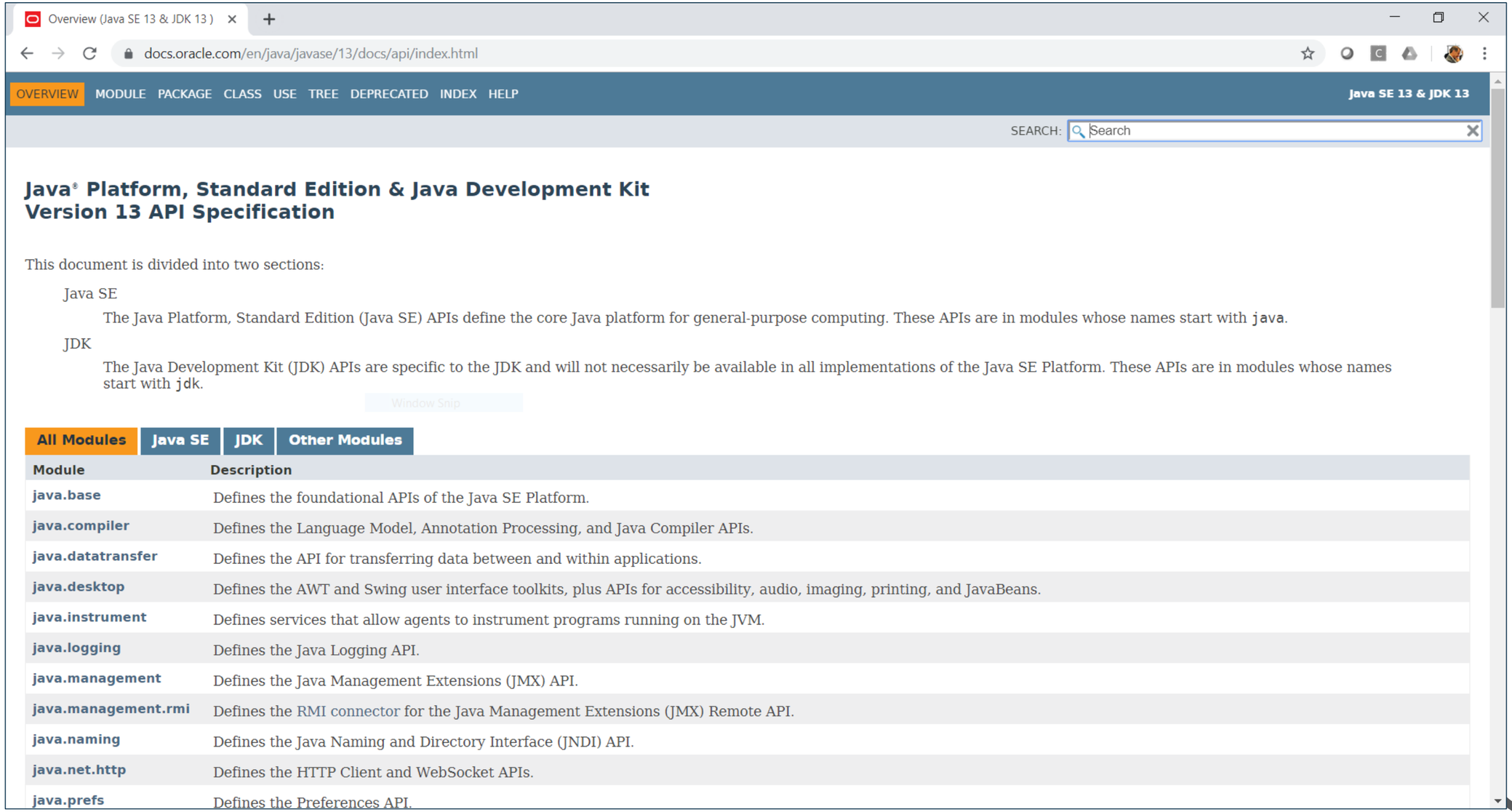
Many examples

Most concepts will be explained through examples

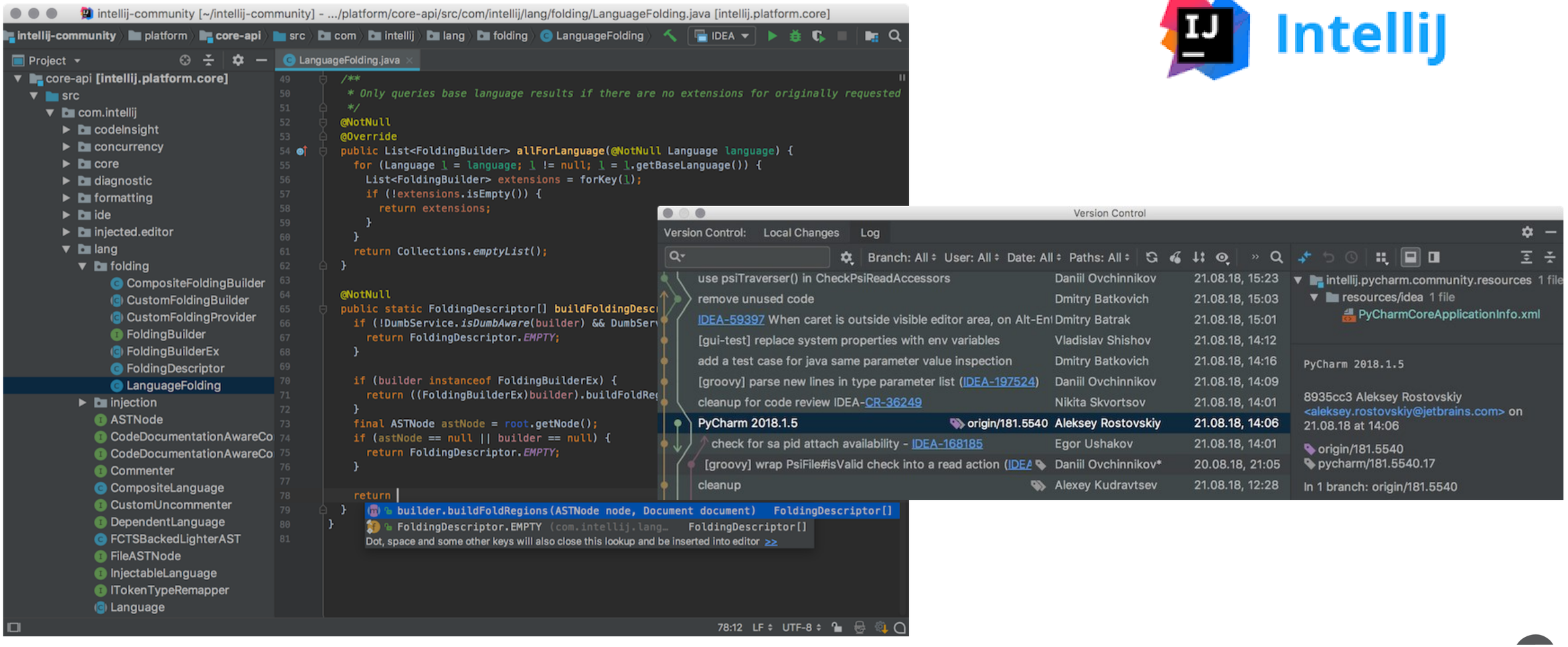
Emphasis on functional programming

One of the most exciting features of the language

Recommended online reference

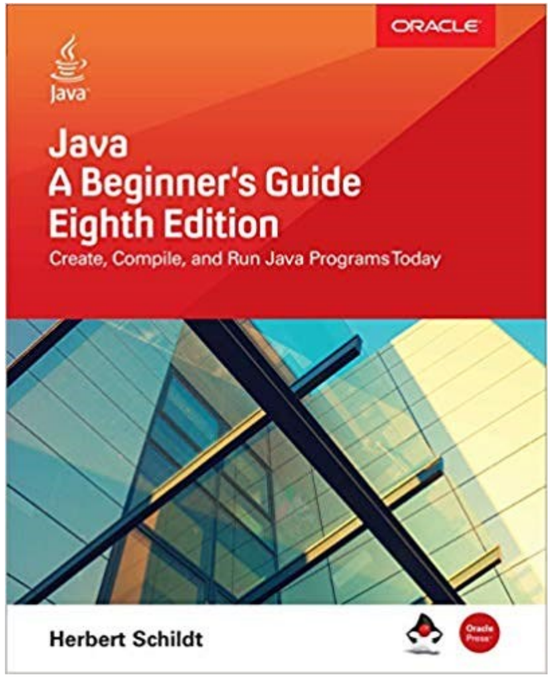


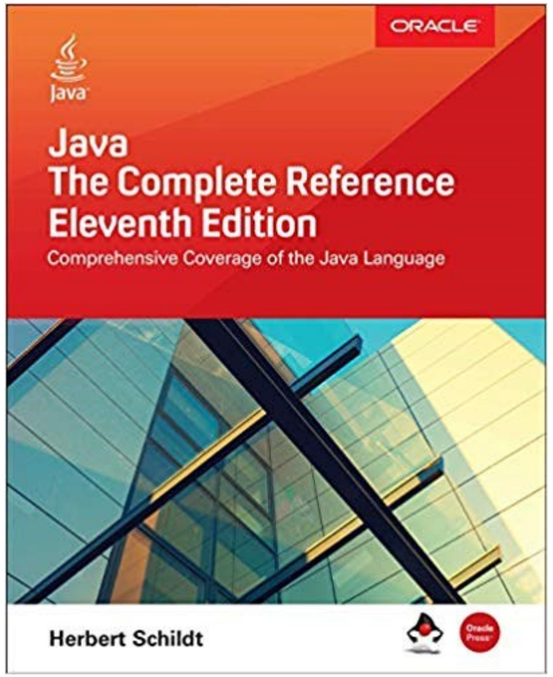
Recommended development tool

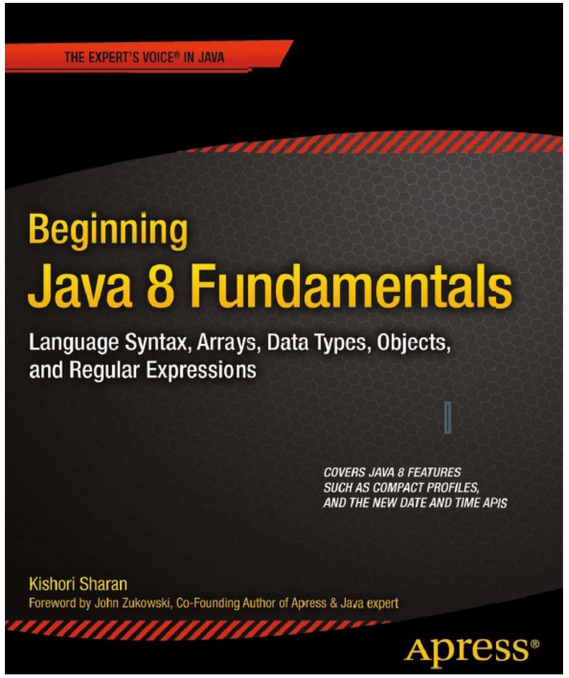


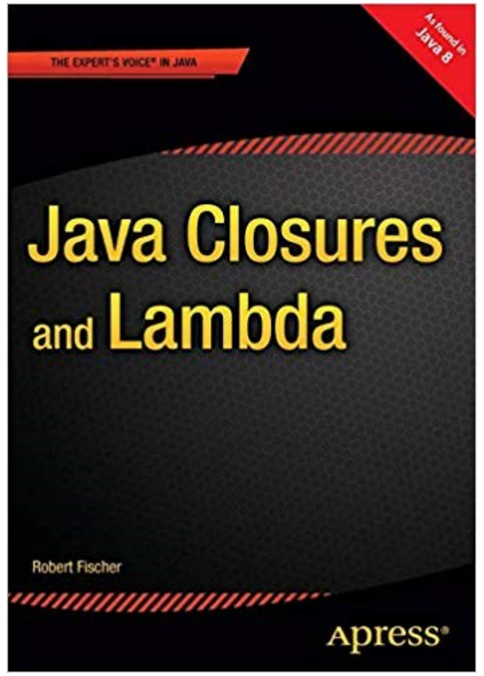
Intellij

Recommended books









Many good books available!

Programming in Java
Part I - basic concepts

Carlos Kavka

Head of Research and Development

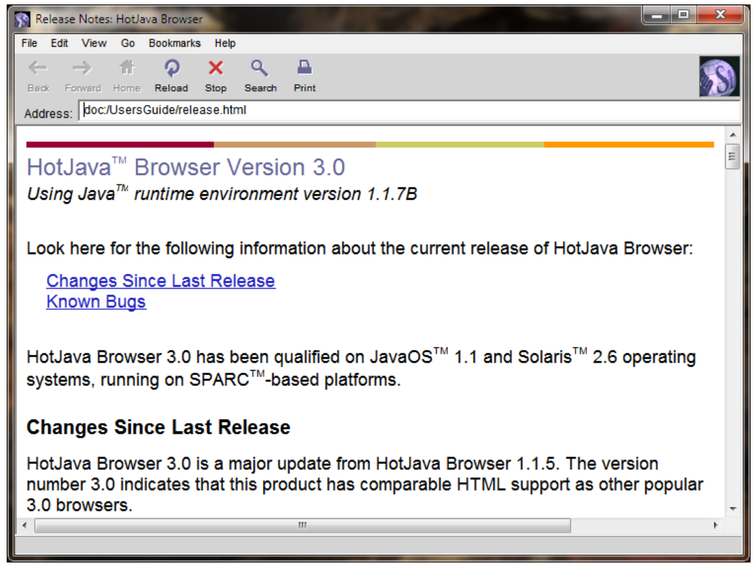
Agenda

- A bit of history
- Basic types
- Basic expressions
- Control structures
- Arrays

A bit of history

*7

HotJava browser

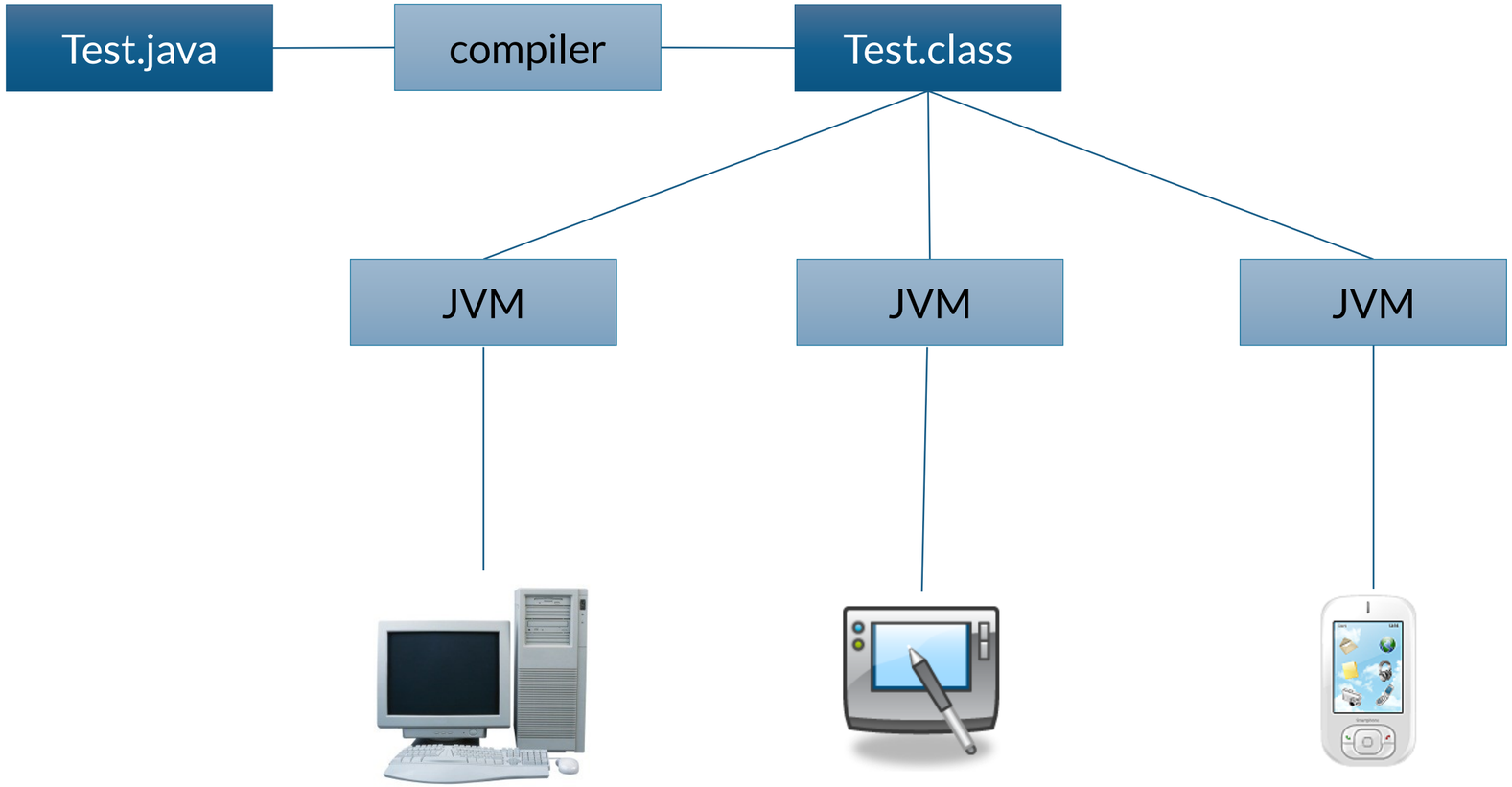


1991	1996	2004	2011	2014	2017	2018	2019	2020
Oak	Java 1.0	Java 5	Java 7	Java 8	Java 9	Java 10/11	Java 12/13	Java 14/15

Carlos teaching his first course on Java

In the island of Java!

The Java platform



The compiled code is independent of the architecture of the computer

A first example

HelloWorld application 

```
/**
 * * Hello World Application
 */
public class HelloWorld {
   public static void main(String[] args) {
      System.out.println("Hello World!");    // display output
   }
}
```

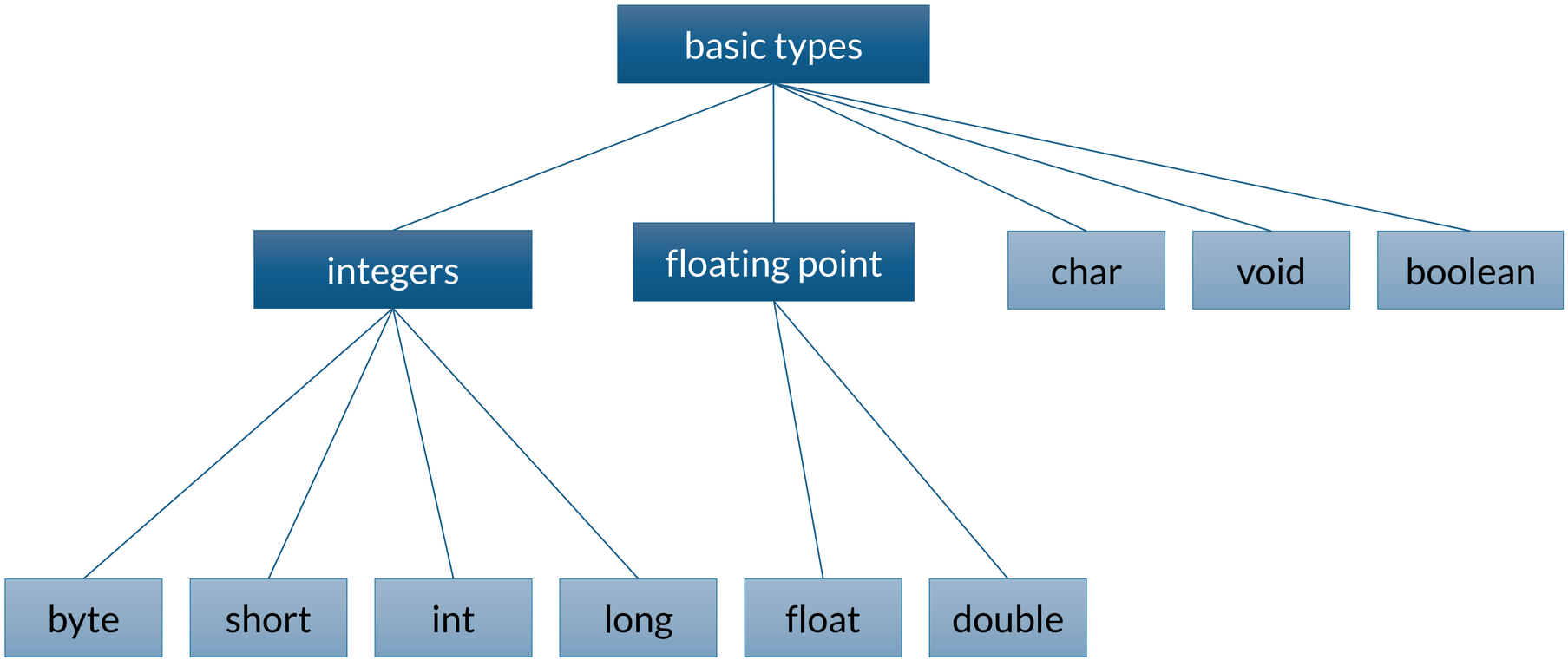
```
$ javac HelloWorld.java

$ ls
HelloWorld.class
HelloWorld.java

$ java HelloWorld
Hello World
```

Only single source applications can be executed directly:

```
$ java HelloWorld.java
Hello World
```

Basic types

Java provides the following primitive types



Variables and constants definition

```
int x;
double d = 0.33;
float f = 0.22F;
char c = 'a';
boolean ready = true;

x = 15;
```

Variables are declared specifying its type and name, and initialized in the point of declaration, or later with the assignment expression

Constants are declared with the word final in front. The specification of the initial value is compulsory

```
final double pi = 3.1415;
final int maxSize = 100_000;
final char lastLetter = 'z';
```

```
var f = 10.0; // a double variable
var i = 50;    // an int variable
```

Only local variables can be declared without an explicitly declared type by using the so-called type inference

Strings

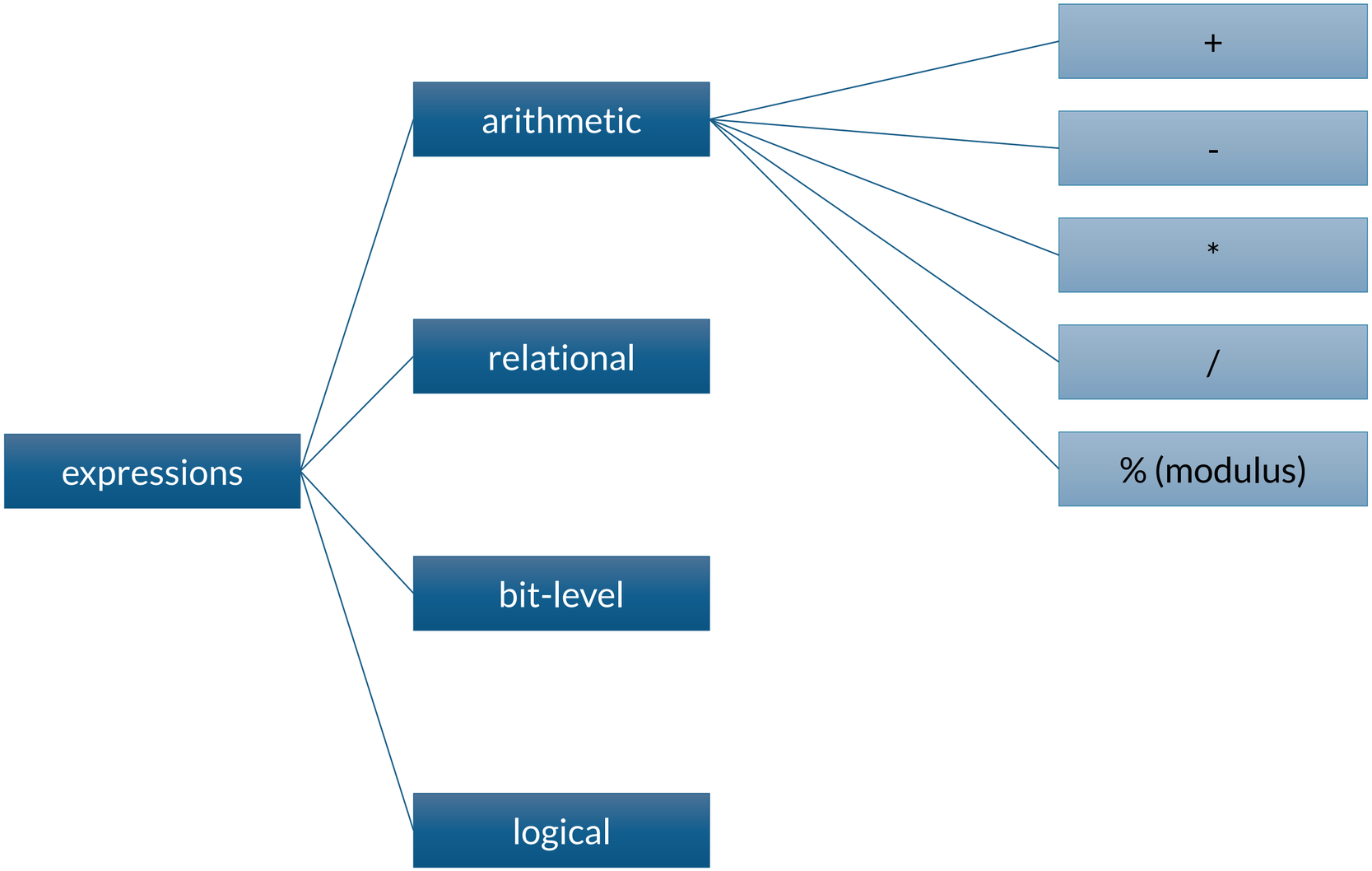
Strings are not a basic type, but defined as a class, more details later!

```
String a = "abc";
```

If the expression begins with a string and uses the + operator,
then the next argument is converted to a string

```
int cost = 22;
String b = "the cost is " + cost + " euro";
```

Arithmetic expressions



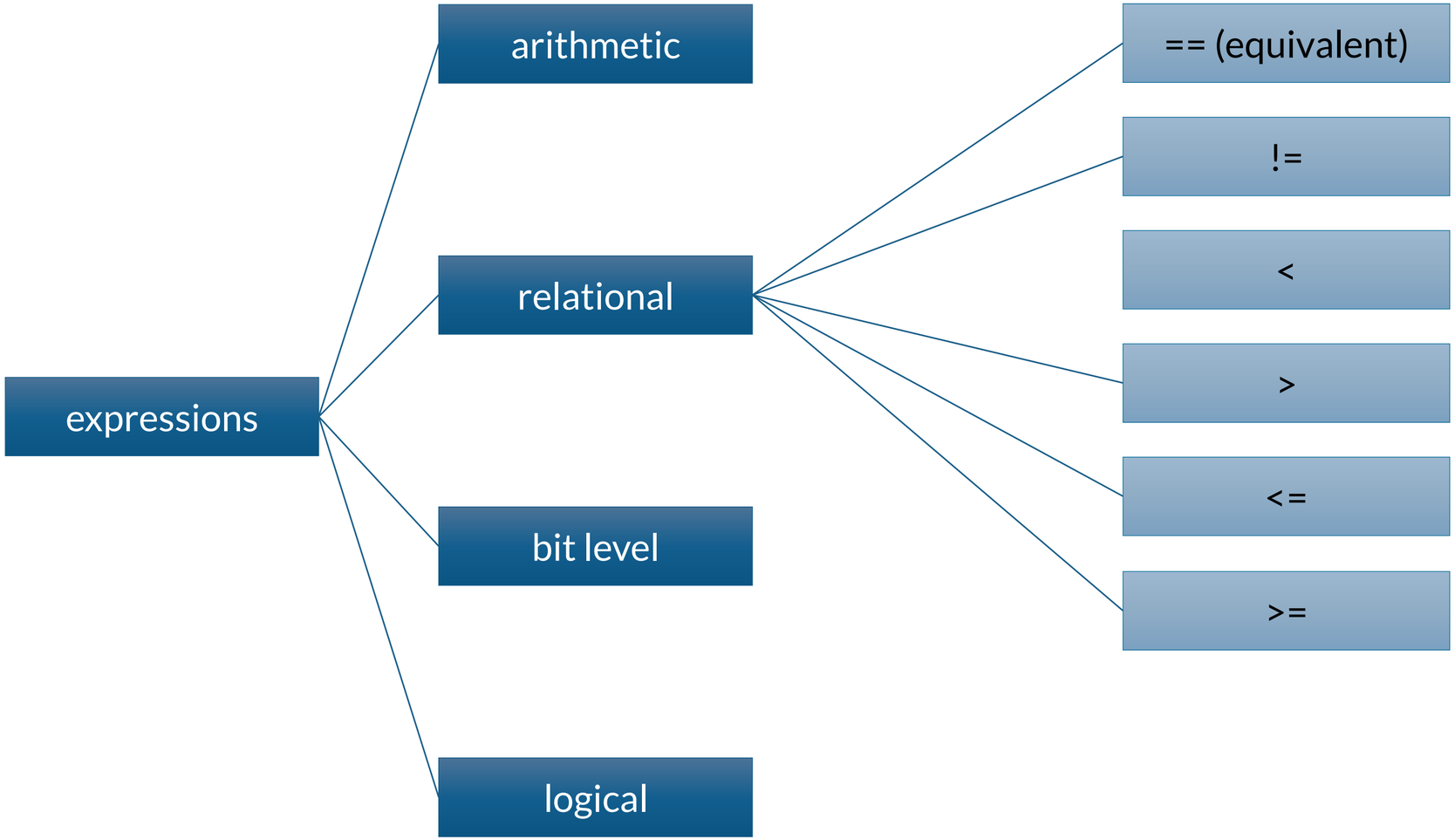
Example with arithmetic operators

Arithmetic class 

```
public class Arithmetic{
 public static void main(String[] args) {
  int x = 12;
  x += 5;                                  // x = x + 5
  System.out.println(x);

  int a = 12,b = 12;
  System.out.print(a++);              // printed and then incremented
  System.out.print(a);

  System.out.print(++b);              // incremented and then printed
  System.out.println(b);
 }
}
```

```
$ java Arithmetic
17
12 13 13 13
```

Relational expressions



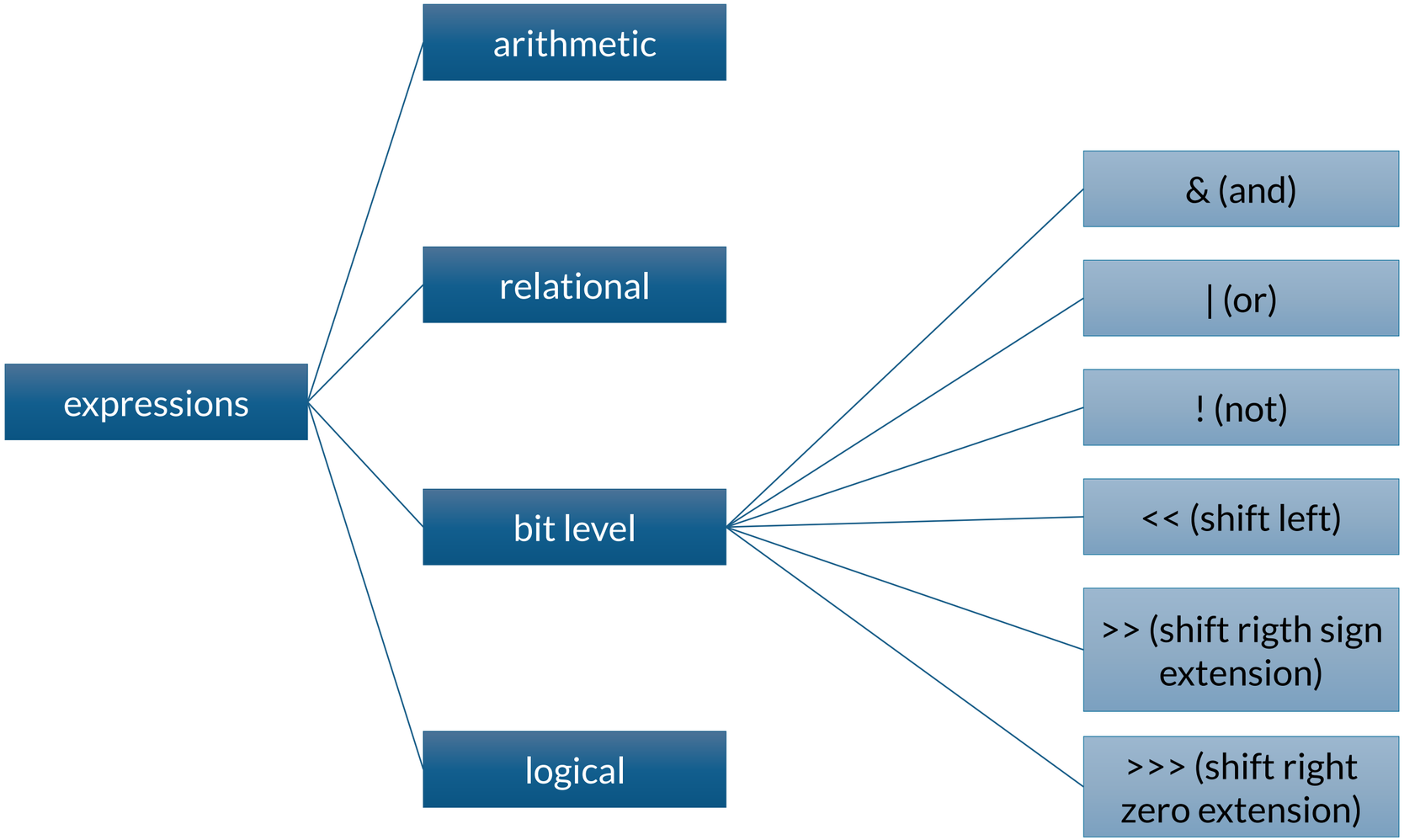
Example with relational operators

Boolean class 

```
public class Boolean {
 public static void main(String[] args) {
  int x = 12,y = 33;

  System.out.println(x < y);
  System.out.println(x != y - 21);

  boolean test = x >= 10;
  System.out.println(test);
 }
}
```

```
$ java Boolean
true
false
true
```

Bit level expressions

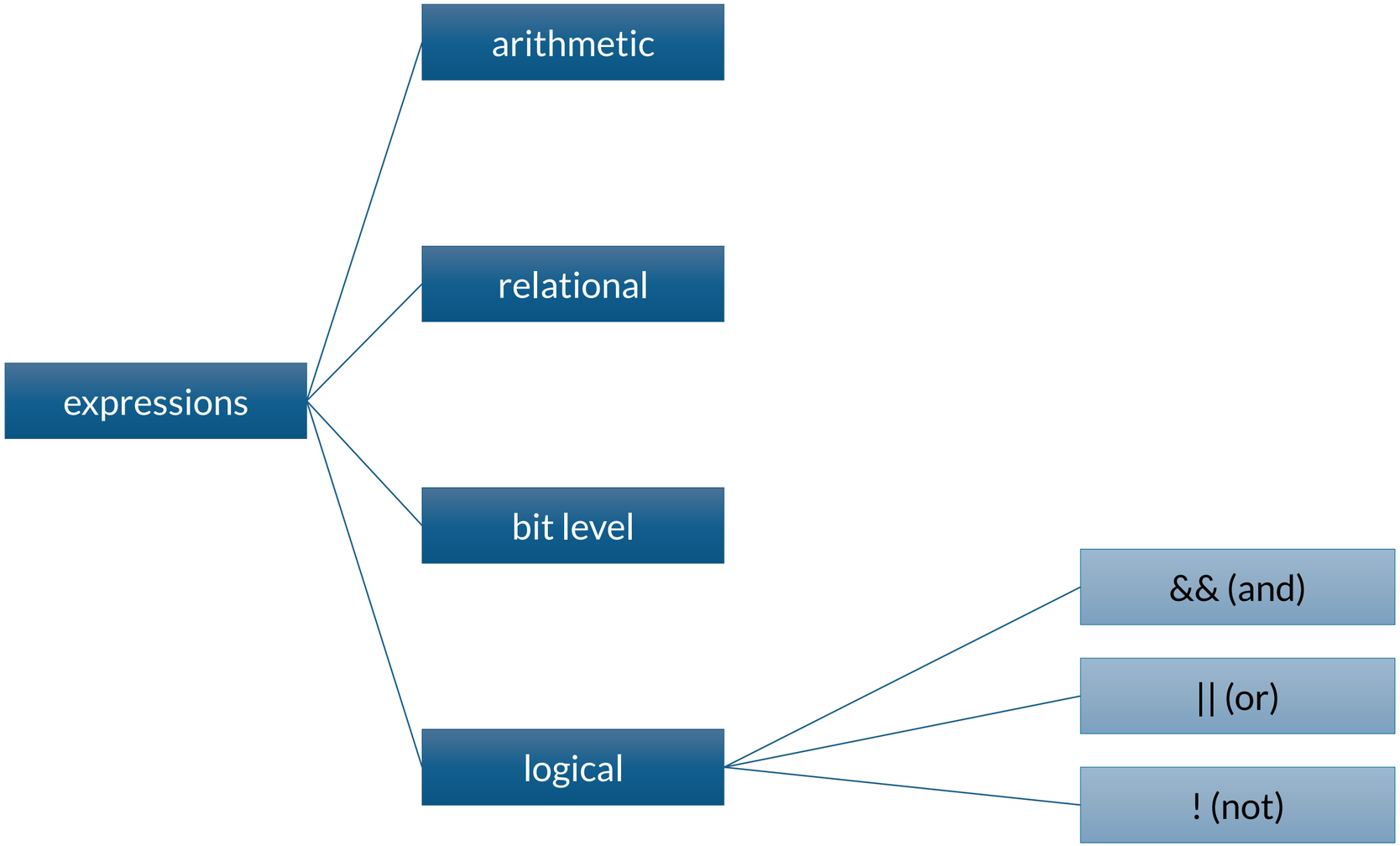


Example with bit-level operators

Boolean class

```
public class Bits {
  public static void main(String[] args) {
    int x = 0b00000000000000000000000000010110;
    int y = 0b00000000000000000000000000110011;

    System.out.println(x & y);          // 00000000000000000000000000010010
    System.out.println(x | y);          // 00000000000000000000000000110111
    System.out.println(~x);             // 11111111111111111111111111101001

     x = 0b00000000000000000000000000001001;  // 9
    System.out.println(x >> 3);         //00000000000000000000000000000001
    System.out.println(x >>>3);         //00000000000000000000000000000001

    x = -9;                              //11111111111111111111111111110111
    System.out.println(x >> 3);         //11111111111111111111111111111110
    System.out.println(x >>>3);         //00011111111111111111111111111110
  }
}
```

Logical expressions



Example with logical operators

Logical class 

```
public class Logical {
  public static void main(String[] args) {
    int x = 12,y = 33;
    double d = 2.45,e = 4.54;

    System.out.println(x < y && d < e);
    System.out.println(!(x < y));

    boolean test = 'a' > 'z';
    System.out.println(test || d - 2.1 > 0);
  }
}
```

```
$ java Logical
true
false
true
```

Please note that there are also logical non-short circuit operators. Investigate about them

Casting

Java performs a automatic type conversion when there is no risk for data to be lost.

In order to specify conversions where data can be lost it is necessary to use the cast operator.

TestCast class 

```
public class TestCast {
 public static void main(String[] args) {

  int a = 'x';      // 'x' is a character
  long b = 34;      // 34 is an int
  float c = 1002;   // 1002 is an int
  double d = 3.45F; // 3.45F is a float

  long e = 34;
  int f = (int)e;       // e is a long
  double g = 3.45;
  float h = (float)g;   // g is a double
 }
}
```

Control structures: if

If class 

```
public class If {
 public static void main(String[] args) {
  char c = 'x';

  if ((c >= 'a' && c <= 'z') || (c >= 'A' && c <= 'Z'))
   System.out.println("letter: " + c);
  else
   if (c >= '0' && c <= '9')
    System.out.println("digit: " + c);
   else {
    System.out.println("the character is: " + c);
    System.out.println("it is not a letter nor a digit");
   }
 }
}
```

```
$ java If
letter: x
```

Control structures: while

While class 

```
public class While {
  public static void main(String[] args) {
    final float initialValue = 2.34F;
    final float step = 0.11F;
    final float limit = 4.69F;
    float var = initialValue;

    int counter = 0;
    while (var < limit) {
      var += step;
      counter++;
    }
    System.out.println("Incremented " + counter + " times");
  }
}
```

```
$ java While
Incremented 22 times
```

Control structures: for

For class 

```
public class For {
  public static void main(String[] args) {
    final float initialValue = 2.34F;
    final float step = 0.11F;
    final float limit = 4.69F;
    int counter = 0;

    for (float var = initialValue;var < limit;var += step)
      counter++;
    System.out.println("Incremented " + counter + " times");
  }
}
```

```
$ java For
Incremented 22 times
```

Control structures: break and continue

BreakContinue class 

```
public class BreakContinue {
  public static void main(String[] args) {

    for (int counter = 0;counter < 10;counter++) {

      if (counter % 2 == 1) continue; // start a new iteration if the counter is odd
      if (counter == 8) break; // abandon the loop if the counter is equal to 8

      System.out.println(counter);
    }
    System.out.println("done.");
  }
}
```

```
$ java BreakContinue
0 2 4 6 done.
```

Control structures:switch

Switch class

```
public class Switch {
 public static void main(String[] args) {

  boolean leapYear = true;
  int days = 0;

  for(int month = 1;month <= 12;month++) {
   switch(month) {
    case 1:// months with 31 days
    case 3:
    case 5:
    case 7:
    case 8:
    case 10:
    case 12: days += 31;
     break;
```

```
    case 2: // February is a special case
      if (leapYear)
       days += 29;
      else
       days += 28;
      break;
    default: // a month with 30 days
      days += 30;
      break;
    }
   }
   System.out.println(days);
 }
}
```

```
$ java Switch
366
```

The switch-expression must evaluate to byte, short, char, int, enum, or String

Arrays

Arrays can be used to store a number of elements of the same type

```
int[] a;
float[] b;
String[] c;
```

```
int[] a = {13,56,2034,4,55};
float[] b = {1.23F,2.1F};
String[] c = {"Java","is","great"};
```

Important: The declaration does not specify a size. However, it can be inferred when initialized

Other possibility to allocate space for arrays consists in the use of the operator new

```
int i = 3,j = 5;
double[] d;

d = new double[i+j];
```

Arrays

Components can be accessed with an integer index with values from 0 to length minus 1.

```
a[2] = 1000;
```

```
int len = a.length;
```

Every array has a member called length that can be used to get the length of the array

Components of the arrays are initialized with default values

```
int []a = new int[3];
for(int i = 0;i < a.length;i++)
  System.out.println(a[i]);
}
```

```
0
0
0
```

Arrays

Arrays class 

```
public class Arrays {
  public static void main(String[] args) {
    int[] a = {2,4,3,1};

    // compute the summation of the elements of a
    int sum = 0;
    for(int i = 0;i < a.length;i++) sum += a[i];

    // create an array of the size computed before
    float[] d = new float[sum];
    for(int i = 0;i < d.length;i++) d[i] = 1.0F / (i+1);

     // print values in odd positions
    for(int i = 1;i < d.length;i += 2)
      System.out.println("d[" + i + "]=" + d[i]);
  }
}
```

```
$ java Arrays
d[1]=0.5
d[3]=0.25
d[5]=0.16666667
d[7]=0.125
d[9]=0.1
```

The for-each iteration

ForEach class

```
public class ForEach {
  public static void main(String[] args) {
    int[] a = {2,4,3,1};

    // compute the summation of the elements of a
    int sum = 0;
    for(int x : a) sum += x;

    // create an array of the size computed before
    float[] d = new float[sum];
    for(int i = 0;i < d.length;i++) d[i] = 1.0F / (i+1);

     // print all values (note the use of type inference!!)
    for(var f : d)
      System.out.println(f);
  }
}
```

Methods with variable number of arguments

A variable length argument list is specified with three periods:

```
int add(int ... values) {
  int summation = 0;
  for(int i = 0;i < values.length;i++) {
     summation += values[i];
  }
  return summation;
}
```

```
int sum = add(1, 2, 3, 4, 5);
```

The argument is implicitly declared as an array, however, the function can be called with a variable number of arguments

Thank you!

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