

TODO
- Function<T, V> Predicate<T> Stream<T> Collection<T>

Final (Attributes/Parameters)

Variable	Method	Class
Constant	No overriding	No inheritance

Initialisation

- 1) Default-Values ↓
- 2) Attribute Assignments
- 3) Initialisation block
- 4) Constructor

Default Values

Type	Default	Type	Default
boolean	false	char	'\u0000'
byte	0	short	0
int	0	long	0L
float	0.0f	double	0.0d

Types

Type	Size (bit)	From	To
byte	8	-128	127
short	16	-32'768	32'767
char	16	all UTF-16 chars	
int	32	-2 ³¹	2 ³¹ - 1
long	64	-2 ⁶³	2 ⁶³ - 1
float	32	±1.4 · 10 ⁻⁴⁵	±3.4 · 10 ³⁸
double	64	±4.9 · 10 ⁻³²⁴	±1.7 · 10 ³⁰⁸

```
// short * int      => int
// float + int     => float
// int / double    => double
// int + long * float => float
// 1 / 0.0          => Infinity
// 0.0 / 0.f        => NaN
```

```
long l = 1L;   long ll = 0b1l;
float f = 0.0f; double d = 0.0d;
```

```
12 == '.'; // implicit int/char conversion
0.1 + 0.1 != 0.2; // true
5/2 == 2; // true, int div truncates to 0
```

```
NaN == NaN; // false
Integer.MAX_VALUE + 1 == Integer.MIN_VALUE;
```

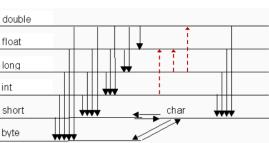
```
String multiline = """
Hello, "world"
""";
"a:b:c".split(":",2).length == 2; // true
```

```
var ints = new ArrayList<Integer>();
int[] jnts = new int[69];
```

```
if (obj instanceof ArrayList<Integer>)
  ((ArrayList<Integer>)obj).add(2);
```

```
public List<String> method(
  BiFunction<Integer, String, List<String>> fn){
  return fn.apply(5, "FooBar");
}
```

Implicit casting

Rekapitulation: Primitive Datentypen

Konversionen
 → explizit
 →→→ implizit (mit evtl. Genauigkeitsverlust)
 Sonstige Richtungen implizit

No information loss int→float, to larger type int→long
 Sub->Super is implicit, Super->Sub ClassCastException
Misc

```
int[] intarr = new int[] {1, 2, 3, 4, 5};
int[] sub = Arrays.copyOfRange(intarr, 1, 3); // 2, 3

var intlist = new ArrayList<Integer>();
intlist.add(1);
intlist.length(); intlist.size();

// Multiply first to not lose precision
int percent = (int)((filled * 100) / capacity);

obj.clone();
```

Double.POSITIVE_INFINITY; // exists

Math.min(i,y); Math.max(i,y);

Variable args

```
static int sum(int... numbers) {
  int sum = 0;
  for (int i = 0; i < numbers.length; i++)
    sum += numbers[i];
  return sum;
}
```

Equality

```
s.equals(sOther); // Strings / Objects
Arrays.equals(a1, a2); // arrays
Arrays.deepEquals(a1, a2); // nested arrays
```

```
class Student extends Person {
  @Override
  public boolean equals(Object obj) {
    if (obj == null) return false;
    if (getClass() != obj.getClass()) return false;
    if (!super.equals(obj)) return false;
    Student other = (Student) obj;
    return getNumber() == other.getNumber();
  }
}
```

Hashing

Should be added to equals fn's for strict equality

String pooling

```
String first = "hello", second = "hello";
System.out.println(first == second); // true
```

```
String third = new String("hello");
String fourth = new String("hello");
System.out.println(third == fourth); // false
System.out.println(third.equals(fourth)); // true
```

```
String a = "A", b = "B", ab = "AB";
System.out.println(a + b == ab); // false
```

```
final String d = "D", e = "E", de = "DE";
System.out.println(d + e == de); // true
```

Visibility

public	all classes
protected	package + sub-classes
private	only self
(none)	all classes in same package

Packages

p1.sub won't be automatically imported in p1.
 Package name collisions: first gets imported.

```
package p1;
public class A { }

package p2;
import p1.sub.E;
public class C {
  E e = new E();
}

package p1.sub;
public class E { }
```

```
package p1; public class A { }
package p2; public class A { }
```

```
import p1.A; import p2.*; // OK
import p1.*; import p2.*; // reference to A is ambiguous
import static java.lang.Math.*; // sin, PI
```

Enums

```
public enum Weekday {
  MONDAY(true), TUESDAY(true), WEDNESDAY(true),
  THURSDAY(true), FRIDAY(true),
  SATURDAY(false), SUNDAY(false);

  private boolean workDay;

  Weekday(boolean workDay) { // private constructor
    this.workDay = workDay;
  }

  public boolean isWorkDay() {
    return workDay;
  }

  switch (wd) {
    case MONDAY:
    case TUESDAY:
      System.out.println("First two");
      break;
    default:
      System.out.println("Rest");
  }
}
```

Switch

```
switch (x) {
  case 'a':
    System.out.println("1");
    break;
  default:
    System.out.println("2");
}

int y = switch (x) {
  case 'a' -> 1;
  default -> 2;
}
```

Overloading

Methods with same names but different parameters

Gets statically chosen by compiler

TODO with class instances

```
void print(int i, double j) {} // 1
void print(double i, int j) {} // 2
void print(double i, double j) {} // 3

print(1.0, 2.0); // 3
print(1,2); // error: reference to print is ambiguous
print(1.0, 2); // 2
print(2.0, (double) 2); // 3
```

Overriding

Methods with same names and signatures

Dynamically chosen (Dynamic dispatch / Virtual call)

Error: Cannot override the final method...

Error: Cannot be subclass of final class...

```
class Fruit {
  void eat(Fruit f) { System.out.println("1"); }
}

class Apple extends Fruit {
  void eat(Fruit f) { System.out.println("2"); }
  void eat(Apple a) { System.out.println("3"); }
}
```

```
Apple a = new Apple();
Fruit fa = new Apple();
Fruit f = new Fruit();
```

```
a.eat(fa); // 2
a.eat(a); // 3
fa.eat(a); // 2
fa.eat(fa); // 2
f.eat(fa); // 1
f.eat(a); // 1
((Fruit) a).eat(fa); // 3
```

```
((Apple) fa).eat(a); // 2
((Apple) f).eat(a); // ClassCastException
```

Hiding

```
super.description == ((Vehicle)this).description
super.super // doesn't exist, use v
((SuperSuperClass)this).variable
```

Abstract classes

```
public abstract class Vehicle {
  private int speed;
  public abstract void drive();
  public void accelerate(int acc) {
    this.speed += acc;
  }
}

public class Car extends Vehicle {
  @Override
  public void drive() {
  }

  @Override
  public void accelerate (int acc) {
  }
}
```

Interfaces default methods

```
interface Vehicle {
  default void printModel() {
    System.out.println("Undefined vehicle model");
  }
}
```

Interfaces

Cannot have Attributes

```
interface RoadV {
  int MAX_SPEED = 120;
  void drive();
}

interface WaterV {
  int MAX_SPEED = 80;
  void drive();
}

class AmphibianMobile implements RoadV, WaterV {
  @Override // because ambiguous
  public void drive() {
    println(RoadV.MAX_SPEED); // MAX_SPEED ambiguous
  }
}
```

interface RoadV { String getModel(); }
interface WaterV { int getModel(); }

// Error, because of different return types
class AmphibianMobile implements RoadV, WaterV { }

Anonymous Classes

```
var v = new RoadV() {
  @Override
  public void drive() {
    System.out.println("Anon");
  }
}
```

TODO: mb more interfaces stuff**Inheritance**

```
public class Vehicle {
  private int speed;
  public Vehicle(int speed) {
    this.speed = speed;
  }
}
```

```
public class Car extends Vehicle {
  private int doors;
  public Car(int speed) {
    super(speed);
    this.doors = doors;
  }
}
```

```
Car c = new Car(); // Points to Car
Vehicle v = new Car(); // Points to Car
Object o = new Car(); // Points to Car
// static      dynamic
Car c = (Car) new Vehicle(); // ClassCastException
```

More Inheritance

```
public class Qwer {
  public void print() {
    System.out.println("1");
  }
}

public class Asdf extends Qwer {
  @Override
  public void print() {
    System.out.println("2");
  }
  public void dostuff () {
  }
}
```

var x = new Asdf();
x.print(); // 2
((Qwer) x).print(); // 2
((Qwer) x).dostuff(); // cannot find symbol

Static Type: According to var declaration at compilation time

Dynamic Type: Type of the instance at runtime

Iterators

```
Iterator<String> it = stringList.iterator();
while (it.hasNext()) {
  String s = it.next();
  System.out.println(s);
}
```

Mutating Collection while iterating over it: ConcurrentModificationException

Exceptions

Error	Exception
Critical, don't handle	Runtime, handleable
OutOfMemoryError, StackOverflowError, AssertionException	IOException
Checked	Unchecked
Must be handled (or throws declaration)	Not necessary
Checked by compiler	Compiler doesn't check
Exception, not RuntimeException	RuntimeException, Error

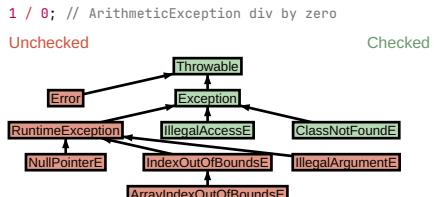
Child Exception gets caught in catch clause with parent class

```
void test() throws ExceptionA, ExceptionB {
  String c = clip("asdf");
  throw new ExceptionB("wack");
}
```

// finally ALWAYS executes, even on unhandled Exc.
try { test() } catch (ExceptionA | ExceptionB e) {
} finally { }

```
try { ... } catch(NullPointerException e) {
  throw e; // --leaves blocks--
} catch (Exception e) {
  // above e won't get caught!
}
```

1 / 0; // ArithmeticException div by zero

Unchecked**IO**

```
try (var fr = new FileReader(path)) {
  int input = fr.read();
  while (input >= 0) {
    if (input == ';') { /* do something */ }
    input = fr.read();
  }
}
```

Georgiy Shevoroshkin

```

var input = new FileInputStream("text.txt");
int i = input.read();
while(i != -1) {
    System.out.print((char)i);
    i = input.read();
}
input.close();
} catch (Exception e) { e.printStackTrace(); }

Try with
try (var output = new FileOutputStream("f.txt")) {
    output.write("Hello".getBytes());
} catch (IOException e) {
    System.out.println("Error writing file.");
}

Serializing
class X implements Serializable {}  

// Serializing
try (var stream = new ObjectOutputStream(
    new FileOutputStream("s.bin"))) {
    stream.writeObject(new X());
}
// Deserializing
try (var stream = new ObjectInputStream(
    new FileInputStream("s.bin")) {
    X x = (X) stream.readObject();
}

Collection
boolean add(E e);           boolean remove(Object o);
boolean equals(Object o);   int hashCode();
int size();                 boolean isEmpty();
boolean contains(Object o);

Set<String> noDup = new HashSet<>();

Function
public interface Function<T, R> {
    R apply(T t);
    static <T> Function<T, T> identity() {
        <V> Function<T, V> andThen(
            Function<? super R, ? extends V> after);
        <V> Function<V, R> compose(
            Function<? super V, ? extends T> before);
    }
}

Comparable
public interface Comparable<T> {
    int compareTo(T obj);
}

var l = new ArrayList<Integer>(asList(3,2,4,5,1));
l.sort((a, b) → a > b ? 1 : -1); // ==
l.sort((a, b) → a - b);          // 1,2,3,4,5

class Person implements Comparable<Person> {
    private final String firstName, lastName;
    @Override
    public int compareTo(Person other) {
        int result = lastName.compareTo(other.lastName);
        if (result == 0)
            result = firstName.compareTo(other.firstName);
        return result;
    }

    static int compareByAge(Person a, Person b) {
        return Integer.compare(a.getAge(), b.getAge());
    }
}
List<Person> people = ...;
Collections.sort(people);
people.sort(Person::compareByAge);

class AgeComparator implements Comparator<Person> {
    @Override
    public int compare(Person a, Person b) {
        return Integer.compare(a.getAge(), b.getAge());
    }
}
Collections.sort(people, new AgeComparator());

```

people.sort(new AgeComparator());

```

people.sort(Comparator
    .comparing(Person::getAge)
    .thenComparing(Person::getFirstName)
    .reversed())

```

Predicate

```

public interface Predicate<T> {
    boolean test(T t);
}

static void removeAll(Collection<Person> collection,
    Predicate criterion) {
    var it = collection.iterator();
    while (it.hasNext())
        if (criterion.test(it.next()))
            it.remove();
}

```

Lambdas

```

String pattern = readFromConsole();
//      vvv not final → Error
while (pattern.length() == 0)
    pattern = readFromConsole();
Utils.removeAll(people, p →
    p.getLastName().contains(pattern));
// local variable ... referenced from a lambda
expression must be final or effectively final

```

// Predicate :: a → boolean

```

Predicate<Integer> isLarge = (v) → v > 69420;

```

// Function :: a → b

```

Function<Integer, String> str = (v) → "" + v;

```

// Supplier :: a

```

Supplier<String> hello = () → "Hello, World!";

```

// Consumer :: a → void

```

Consumer<Integer> consumer = (v) → log(v);

```

// UnaryOperator :: a → a

```

UnaryOperator<Integer> more = (v) → v * v;

```

// BinaryOperator :: a → a → a

```

BinaryOperator<Integer> less = (a, b) → a - b;

```

Streams

```

import java.util.stream.*;

```

people

```

    .stream()
    .distinct()
    .filter(p → p.getAge() ≥ 18)
    .skip(5)
    .limit(10)
    .map(p → p.getLastName())
    .sorted()
    .forEach(System.out::println);

```

people

```

    .stream()
    .reduce(0, (acc,cur) → acc + cur.getAge());

```

Terminal operations:

min()	max()
average()	sum()
findAny()	findFirst()
forEach(Consumer)	count()
forEachOrdered(Consumer)	