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

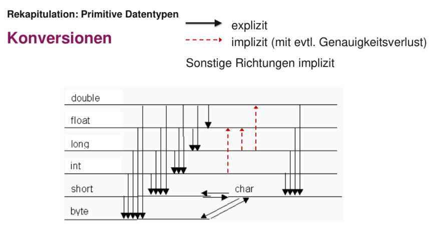
Default Values

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

Types

```
// char utf16 (16bit) = short
// float 32bit, double 64bit
// 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
double
float
long
int
short
char
byte

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);
intarr.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 p1.sub;
  public class E { }
```

```
package p2;
import p1.sub.E;
public class C {
  E e = new 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
```

IO

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

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: mby 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, int doors) {
      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 compiletime
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

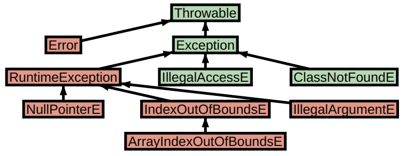
Error	Exception
Critical, don't handle	Runtime, handleable
OutOfMemoryError, StackOverflowError, AssertionError	IOException

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 catched!
}

1 / 0; // ArithmeticException div by zero
```

Unchecked Checked



Try with

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

Serializing

```java
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

```java
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<>();
```

Comparable

```java
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

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

Lambdas

```java
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
```

Streams

```java
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());

list.stream().mapToInt(Integer::intValue);
list.stream().mapToInt(Integer::parseInt);
```

Terminal operations:

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