03

Java resume

Example For Loops

- Compute the sum of an array of doubles:

```
public static double sum(double[ ] data) {
  double total = 0;
  for (int j=0; j < data.length; j++)      // note the use of length
    total += data[j];
  return total;
}
```

- Compute the maximum in an array of doubles:

```
public static double max(double[ ] data) {
  double currentMax = data[0];        // assume first is biggest (for now)
  for (int j=1; j < data.length; j++)      // consider all other entries
    if (data[j] > currentMax)              // if data[j] is biggest thus far...
      currentMax = data[j];                // record it as the current max
  return currentMax;
}
```

For-Each Loops

- Since looping through elements of a collection is such a common construct, Java provides a shorthand notation for such loops, called the **for-each** loop.
- The syntax for such a loop is as follows:

```
for (elementType name : container)
    loopBody
```

Per le collezioni (Per le iterable classes)

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For-Each Loop Example

- Computing a sum of an array of doubles:

```
public static double sum(double[ ] data) {
  double total = 0;
  for (double val : data)                    // Java's for-each loop style
    total += val;
  return total;
}
```

- When using a for-each loop, there is no explicit use of array indices.
- The loop variable represents one particular element of the array.
- In java we can use it on objects of the Iterable type, that is with an iterator (java.util.Iterator). The Java Collections (Linkedlist, ArrayList, etc.) are all objects of the Iterable type.

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Simple Output

- Java provides a built-in static object, called System.out, that performs output to the "standard output" device, with the following methods:

print(String *s*):	Print the string *s*.
print(Object *o*):	Print the object *o* using its toString method.
print(*baseType b*):	Print the base type value *b*.
println(String *s*):	Print the string *s*, followed by the newline character.
println(Object *o*):	Similar to print(*o*), followed by the newline character.
println(*baseType b*):	Similar to print(*b*), followed by the newline character.

Simple Input

- There is also a special object, **System.in**, for performing input from the Java console window.
- A simple way of reading input with this object is to use it to create a **Scanner** object, using the expression

  new Scanner(System.in)

- Example:

```
import java.util.Scanner;                    // loads Scanner definition for our use

public class InputExample {
  public static void main(String[ ] args) {
    Scanner input = new Scanner(System.in);
    System.out.print("Enter your age in years: ");
    double age = input.nextDouble( );
    System.out.print("Enter your maximum heart rate: ");
    double rate = input.nextDouble( );
    double fb = (rate – age) * 0.65;
    System.out.println("Your ideal fat-burning heart rate is " + fb);
  }
}
```

java.util.Scanner Methods

- The Scanner class reads the input stream and divides it into tokens, which are strings of characters separated by delimiters.

hasNext():	Return **true** if there is another token in the input stream.
next():	Return the next token string in the input stream; generate an error if there are no more tokens left.
hasNext*Type*():	Return **true** if there is another token in the input stream and it can be interpreted as the corresponding base type, *Type*, where *Type* can be Boolean, Byte, Double, Float, Int, Long, or Short.
next*Type*():	Return the next token in the input stream, returned as the base type corresponding to *Type*; generate an error if there are no more tokens left or if the next token cannot be interpreted as a base type corresponding to *Type*.

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Abstract Data Types

- **Abstraction** is to distill a system to its most fundamental parts.
- Applying the abstraction paradigm to the design of data structures gives rise to **abstract data types** (ADTs).
- An ADT is a model of a data structure that specifies the **type** of data stored, the **operations** supported on them, and the types of parameters of the operations.
- An ADT specifies what each operation does, but not how it does it.
- The collective set of behaviors supported by an ADT is its **public interface**.

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Dff. di classe: Campi + metodi che event. definisce

Class Definitions

- A class serves as the primary means for abstraction in object-oriented programming.
- In Java, every variable is either a base type or is a reference to an instance of some class.
- A class provides a set of behaviors in the form of member functions (also known as **methods**), with implementations that belong to all its instances.
- A class also serves as a blueprint for its instances, effectively determining the way that state information for each instance is represented in the form of **attributes** (also known as **fields**, **instance variables**, or **data members**).

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Unified Modeling Language (UML)

A **class diagram** has three portions.

1. The name of the class
2. The recommended instance variables
3. The recommended methods of the class.

class:	CreditCard	
fields:	− customer : String − bank : String − account : String	− limit : int # balance : double
methods:	+ getCustomer( ) : String + getBank( ) : String + charge(price : double) : boolean + makePayment(amount : double)	+ getAccount( ) : String + getLimit( ) : int + getBalance( ) : double

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Constructors

- Each **object** created in a program is an **instance** of a **class**.
- A user can create an instance of a class by using the **new** operator with a method that has the same name as the class.
- Such a method, known as a **constructor**, has as its responsibility is to establish the state of a newly object with appropriate initial values for its instance variables.

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Interfaces and Abstract Classes

- The main structural element in Java that enforces an application programming interface (API) is an **interface**.
- An interface is a collection of method declarations with no data and no bodies.
- Interfaces do not have constructors and they cannot be directly instantiated.
  - When a class **implements** an interface, it must implement all of the methods declared in the interface.
- An abstract class also cannot be instantiated, but it can define one or more common methods that all implementations of the abstraction will have.

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Inheritance

- A mechanism for a modular and hierarchical organization is **inheritance**.
- This allows a new class to be defined based upon an existing class as the starting point.
- The existing class is typically described as the **base class**, parent class, or superclass, while the newly defined class is known as the **subclass** or child class.
- There are two ways in which a subclass can differentiate itself from its superclass:
  - A subclass may specialize an existing behavior by providing a new implementation that overrides an existing method.
  - A subclass may also extend its superclass by providing brand new methods.

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Inheritance and Constructors

- Constructors are never inherited in Java; hence, every class must define a constructor for itself.
  - All of its fields must be properly initialized, including any inherited fields.
- The first operation within the body of a constructor must be to invoke a constructor of the superclass, which initializes the fields defined in the superclass.
- A constructor of the superclass is invoked explicitly by using the keyword **super** with appropriate parameters.
- If a constructor for a subclass does not make an explicit call to **super** or **this** as its first command, then an implicit call to **super**( ), the zero-parameter version of the superclass constructor, will be made.

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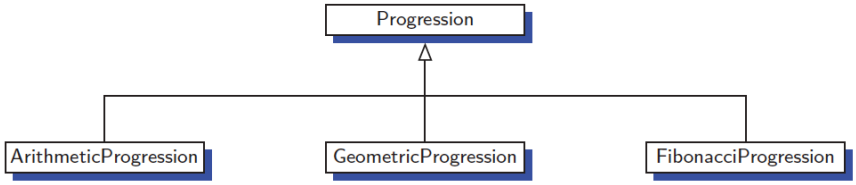
An Extended Example

- A **numeric progression** is a sequence of numbers, where each number depends on one or more of the previous numbers.
  - An **arithmetic progression** determines the next number by adding a fixed constant to the previous value.
  - A **geometric progression** determines the next number by multiplying the previous value by a fixed constant.
  - A **Fibonacci progression** uses the formula $N_{i+1}=N_i+N_{i-1}$



The Progression Base Class

```
1  /** Generates a simple progression. By default: 0, 1, 2, ... */
2  public class Progression {
3
4    // instance variable
5    protected long current;
6
7    /** Constructs a progression starting at zero. */
8    public Progression( ) { this(0); }
9
10   /** Constructs a progression with given start value. */
11   public Progression(long start) { current = start; }
12
13   /** Returns the next value of the progression. */
14   public long nextValue( ) {
15     long answer = current;
16     advance( );      // this protected call is responsible for advancing the current value
17     return answer;
18   }
```

Chiama costruttore

Vedila come classe base

The Progression Base Class, 2

```
19
20    /** Advances the current value to the next value of the progression. */
21    protected void advance( ) {
22      current++;
23    }
24
25    /** Prints the next n values of the progression, separated by spaces. */
26    public void printProgression(int n) {
27      System.out.print(nextValue( ));          // print first value without leading space
28      for (int j=1; j < n; j++)
29        System.out.print(" " + nextValue( )); // print leading space before others
30      System.out.println( );                   // end the line
31    }
32  }
```

Metodo Abstract!

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ArithmeticProgression Subclass

```
1   public class ArithmeticProgression extends Progression {
2
3     protected long increment;
4
5     /** Constructs progression 0, 1, 2, ... */
6     public ArithmeticProgression( ) { this(1, 0); }      // start at 0 with increment of 1
7
8     /** Constructs progression 0, stepsize, 2*stepsize, ... */
9     public ArithmeticProgression(long stepsize) { this(stepsize, 0); }      // start at 0
10
11    /** Constructs arithmetic progression with arbitrary start and increment. */
12    public ArithmeticProgression(long stepsize, long start) {
13      super(start);
14      increment = stepsize;
15    }
16
17    /** Adds the arithmetic increment to the current value. */
18    protected void advance( ) {
19      current += increment;
20    }
21  }
```

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GeometricProgression Subclass

```
1  public class GeometricProgression extends Progression {
2
3    protected long base;
4
5    /** Constructs progression 1, 2, 4, 8, 16, ... */
6    public GeometricProgression( ) { this(2, 1); }            // start at 1 with base of 2
7
8    /** Constructs progression 1, b, b^2, b^3, b^4, ... for base b. */
9    public GeometricProgression(long b) { this(b, 1); }                  // start at 1
10
11   /** Constructs geometric progression with arbitrary base and start. */
12   public GeometricProgression(long b, long start) {
13     super(start);
14     base = b;
15   }
16
17   /** Multiplies the current value by the geometric base. */
18   protected void advance( ) {
19     current *= base;                          // multiply current by the geometric base
20   }
21 }
```

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FibonacciProgression Subclass

```
1  public class FibonacciProgression extends Progression {
2
3    protected long prev;
4
5    /** Constructs traditional Fibonacci, starting 0, 1, 1, 2, 3, ... */
6    public FibonacciProgression( ) { this(0, 1); }
7
8    /** Constructs generalized Fibonacci, with give first and second values. */
9    public FibonacciProgression(long first, long second) {
10     super(first);  Sets current
11     prev = second - first;        // fictitious value preceding the first
12   }
13
14   /** Replaces (prev,current) with (current, current+prev). */
15   protected void advance( ) {
16     long temp = prev;
17     prev = current;
18     current += temp;
19   }
20 }
```

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Tutte le cose in comune non astratte. Cose diverse astratte!

Nested Classes

- Java allows a class definition to be nested inside the definition of another class.
- The main use for nesting classes is when defining a class that is strongly affiliated with another class.
  - This can help increase encapsulation and reduce undesired name conflicts.
- Nested classes are a valuable technique when implementing data structures, as an instance of a nested use can be used to represent a small portion of a larger data structure, or an auxiliary class that helps navigate a primary data structure.

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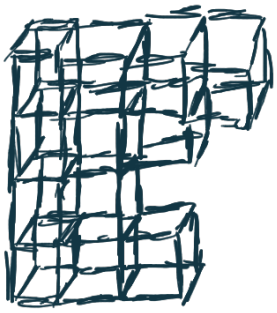

Classe statica può essere utile

Nested Classes: example

```
Public class CPU {
double price;
    class Processor{
        double cores;
        String manufacturer;
        double getCache(){ return 4.3; }
        double getPrice(){ return CPU.this.price; }
    }
    protected class RAM{
        double memory;
        String manufacturer;
        double getClockSpeed(){ return 5.5; }
    }
public static void main(String[] args) {
CPU cpu = new CPU();
CPU.Processor processor = cpu.new Processor();
CPU.RAM ram = cpu.new RAM();
System.out.println("Processor Cache = " + processor.getCache());
System.out.println("Ram Clock speed = " + ram.getClockSpeed());
} }
```

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Exceptions

- Exceptions are unexpected events that occur during the execution of a program.
- An exception might result due to an unavailable resource, unexpected input from a user, or simply a logical error on the part of the programmer.
- In Java, exceptions are objects that can be **thrown** by code that encounters an unexpected situation.
- An exception may also be **caught** by a surrounding block of code that "handles" the problem.
- If uncaught, an exception causes the virtual machine to stop executing the program and to report an appropriate message to the console.

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Catching Exceptions

- The general methodology for handling exceptions is a **try-catch** construct in which a guarded fragment of code that might throw an exception is executed.

```
try {
    guardedBody
} catch (exceptionType1 variable1) {
    remedyBody1
} catch (exceptionType2 variable2) {
    remedyBody2
} ...
    ...
```

- If it **throws** an exception, then that exception is caught by having the flow of control jump to a predefined **catch** block that contains the code to apply an appropriate resolution.
- If no exception occurs in the guarded code, all **catch** blocks are ignored.

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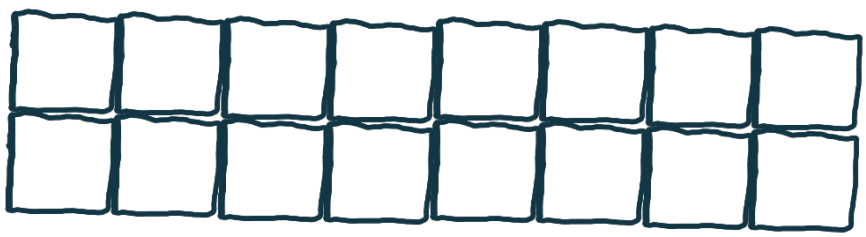

Eurospin = massima convenienza 2

Throwing Exceptions

- Exceptions originate when a piece of Java code finds some sort of problem during execution and throws an exception object.
- This is done by using the **throw** keyword followed by an instance of the exception type to be thrown.
- It is often convenient to instantiate an exception object at the time the exception has to be thrown. Thus, a throw statement is typically written as follows:

```
throw new exceptionType(parameters);
```

where exceptionType is the type of the exception and the parameters are sent to that type's constructor.

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The throws Clause

- When a method is declared, it is possible to explicitly declare, as part of its signature, the possibility that a particular exception type may be thrown during a call to that method.
- The syntax for declaring possible exceptions in a method signature relies on the keyword **throws** (not to be confused with an actual **throw** statement).
- For example, the parseInt method of the Integer class has the following formal signature:

```
public static int parseInt(String s) throws NumberFormatException;
```

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Esempio uso eccezioni

```
import java.util.Scanner;
import java.lang.RuntimeException;

public class TestEccezione {
private class NonpositiveExc extends RuntimeException{
NonpositiveExc() { super();}
}
public int leggi () throws NonpositiveExc {
    Scanner input= new Scanner (System.in);
    int valore=input.nextInt();
    if (valore<=0) throw new NonpositiveExc();
    return valore;}

public static void main(String[] args) {
    int x=0;
    TestEccezione mia=new TestEccezione();
    System.out.println("Dammi un intero positivo");
    try {
    x=mia.leggi();
    System.out.println("Ho letto "+x);
    } catch (NonpositiveExc ex) {System.out.println("Non hai scritto un numero positivo");}

}
}
```

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Generics

- Java includes support for writing generic classes and methods that can operate on a variety of data types while often avoiding the need for explicit casts.
- The generics framework allows us to define a class in terms of a set of formal type parameters, which can then be used as the declared type for variables, parameters, and return values within the class definition.
- Those formal type parameters are later specified when using the generic class as a type elsewhere in a program.

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Syntax for Generics

- Types can be declared using generic names:

```
1  public class Pair<A,B> {
2    A first;
3    B second;
4    public Pair(A a, B b) {                    // constructor
5      first = a;
6      second = b;
7    }
8    public A getFirst( ) { return first; }
9    public B getSecond( ) { return second;}
10 }
```

- They are then instantiated using actual types:

```
Pair<String,Double> bid;
```

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Generics class

```
public class Pair<A,B> {
A first;
B second;
public Pair (A a, B b){
    first=a;
    second=b;
}

    public A getFirst(){ return first; }
    public B getSecond(){ return second; }
    public String toString() {
    return "[" + first + ", " + second + "]";
  }


public static void main(String[] args) {
Pair<String,Integer> nuovo;
nuovo= new Pair<String,Integer>("MIO",125);
System.out.println("stampo "+nuovo);

Pair<String,Double> bid;
    bid = new Pair<>("ORCL", 32.07);
    System.out.println(" stampo "+bid);
    System.out.println(" stampo first "+bid.getFirst());
}
 }
```

Senza viene usato il tipo Object Warning!

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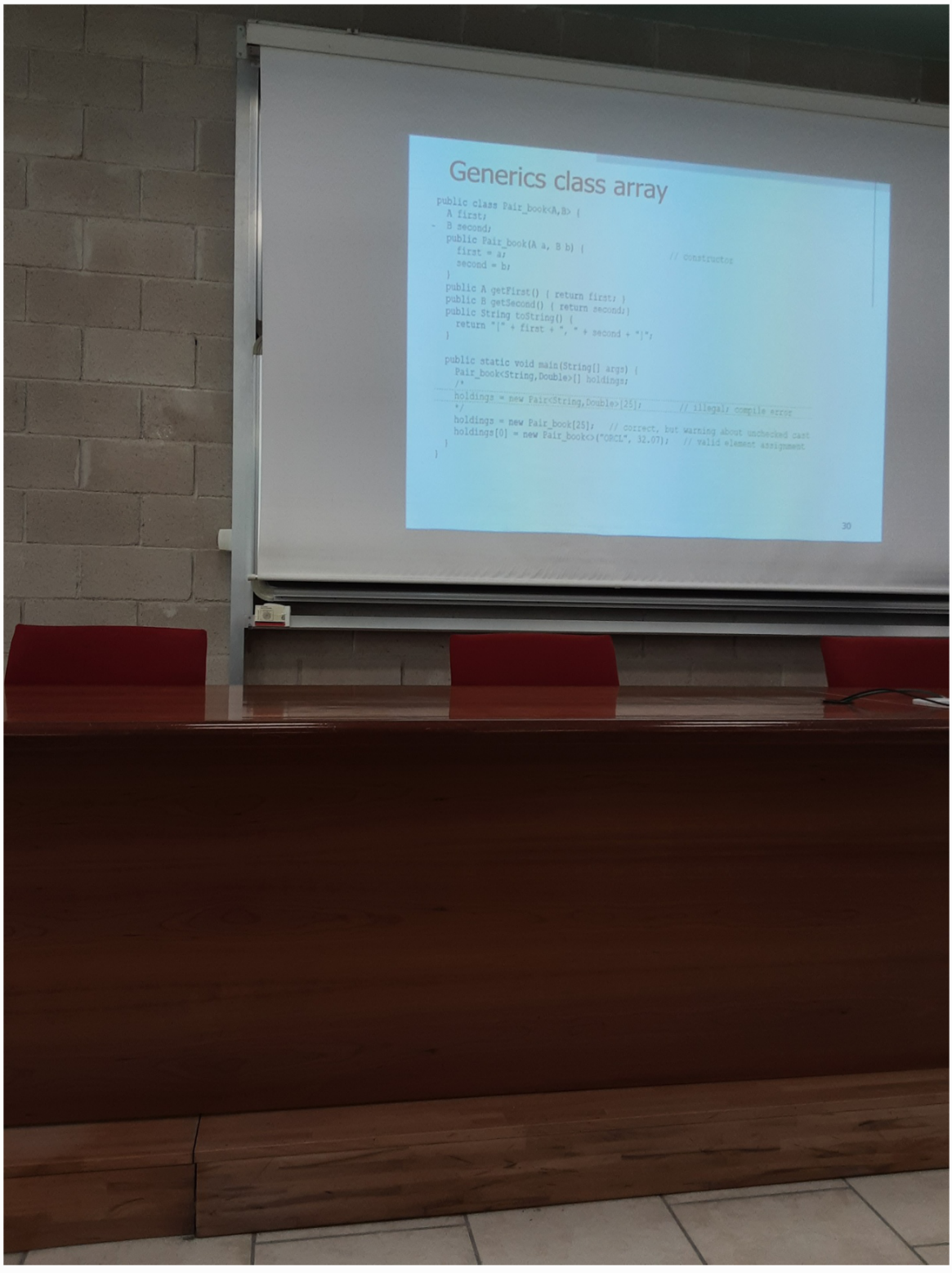
Generics class array
public class Pair_book<A,B> {
A first;
B second;
public Pair_book(A a, B b) {
first = a;
second = b;
}
public A getFirst() { return first; }
public B getSecond() { return second;}
public String toString() {
return "[" + first + ", " + second + "]";
}
public static void main(String[] args) {
Pair_book<String,Double>[] holdings;
/*
holdings = new Pair<String,Double>[25];
*/
holdings = new Pair_book[25];
holdings[0] = new Pair_book<>("ORCL", 32.07);
}
}
// constructor
// illegal; compile error
// correct, but warning about unchecked cast
// valid element assignment
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Generics methods

```
public class DemoGeneric {


  public static <T> void Reverse(T[] vett) {
    int low=0, high=vett.length-1;
    T temp;
    while (low<high) {
   temp=vett[low];
      vett[low++]=vett[high];
      vett[high--]=temp;

    }
      }

  public static void main(String[] args) {

      Integer test[] = {3, 5, 2, 4, 1, 9, 10, 12, 11, 8, 7, 6};
     System.out.print("Before: ");
     for (int el : test)
       System.out.print(el+", ");
      System.out.println();
      Reverse(test);
    System.out.print("After: ");
     for (int el : test)
        System.out.print(el+", ");
      System.out.println();
     }
  }
```

Non può essere un tipo fondamentale

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Public class ShoppingCart<T extends Sellable>{}

↓

Tipo generico vincolato

All'interno della classe posso istanziare oggetti sia di subclasses statiche che non.

Nel Main (Metodo statico)

- Posso istanziare oggetto della classe statica interna: Non associato a oggetto di classe esterna.
- Non posso istanziare oggetto di classe sub non statica senza fare riferimento a superclasse.

new CPU.Processor();

MAIN è metodo statico, non posso accedere a classi non statiche.