101: Java

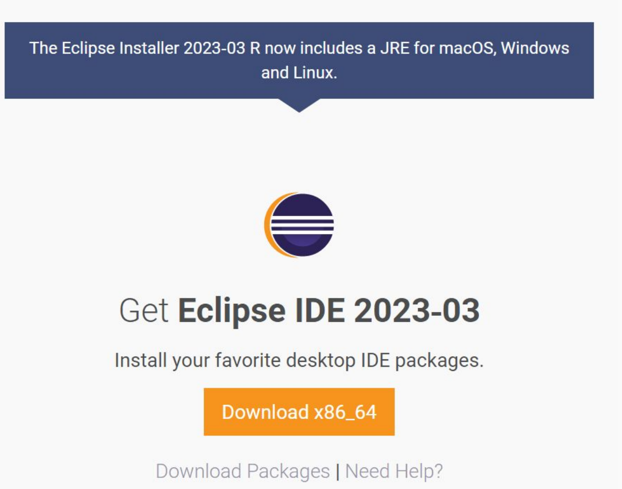
May, 2023

Objective

- インストール: Eclipse
- Hello world!
- 文法
- Data types
- Operators (演算子)
- Loops (繰り返し処理)
- Condition (条件分岐)
- Array (配列)
- Exception (例外)
- Files and I/O
- Scanner

Eclipse IDE

- Eclipse IDE
  - https://www.eclipse.org/downloads/



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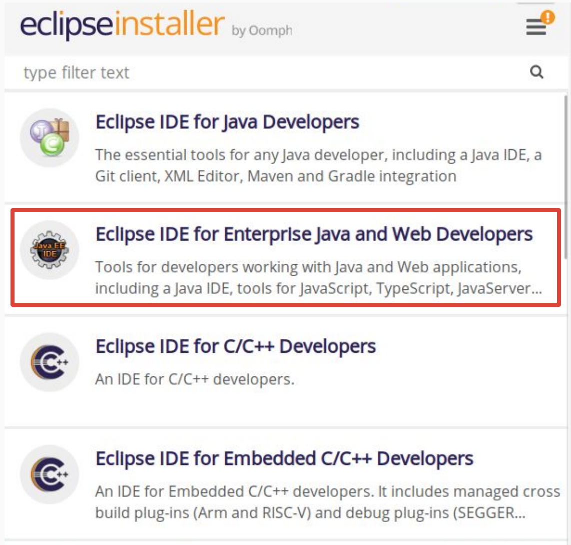

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Eclipse IDE for Java Developers

The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Maven and Gradle integration

Eclipse IDE for Enterprise Java and Web Developers

Tools for developers working with Java and Web applications, including a Java IDE, tools for JavaScript, TypeScript, JavaServer...

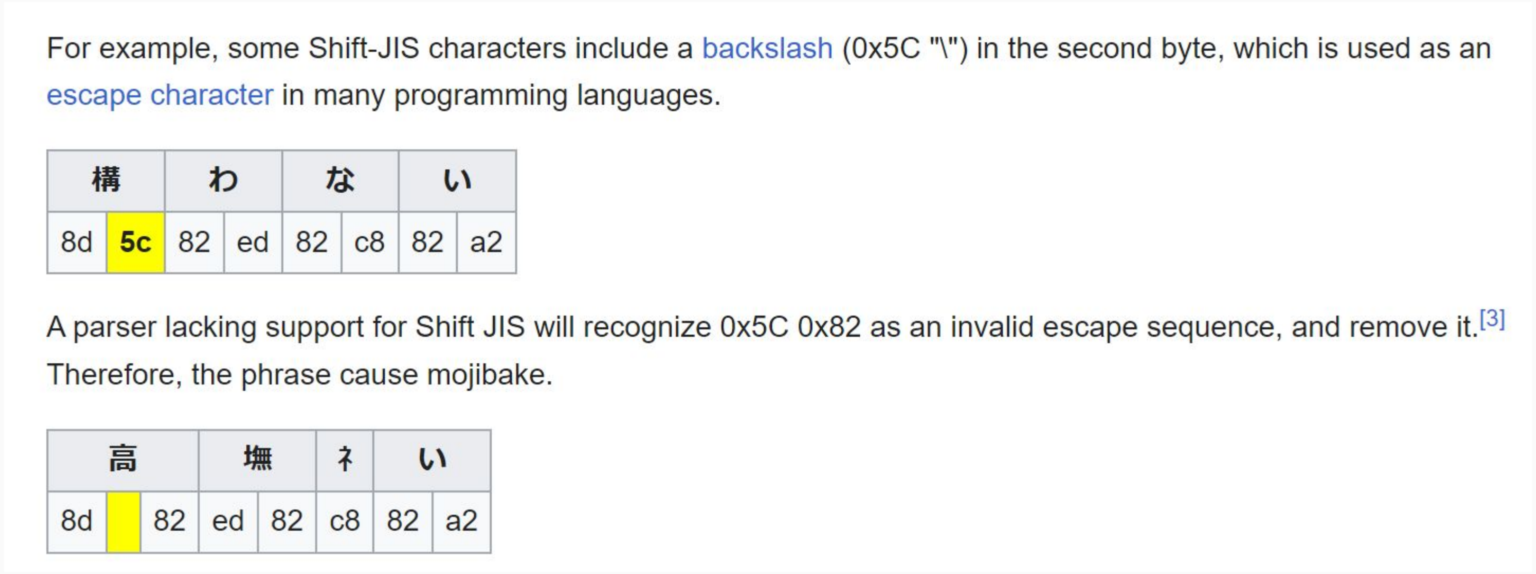
Eclipse IDE for C/C++ Developers

An IDE for C/C++ developers.

Eclipse IDE for Embedded C/C++ Developers

An IDE for Embedded C/C++ developers. It includes managed cross build plug-ins (Arm and RISC-V) and debug plug-ins (SEGGER...

MJBK防止策: UTF-8



For example, some Shift-JIS characters include a backslash (0x5C "\") in the second byte, which is used as an escape character in many programming languages.

構		わ		な		い	
8d	**5c**	82	ed	82	c8	82	a2

A parser lacking support for Shift JIS will recognize 0x5C 0x82 as an invalid escape sequence, and remove it.[3] Therefore, the phrase cause mojibake.

高			墲		ﾈ	い	
8d		82	ed	82	c8	82	a2

https://en.wikipedia.org/wiki/Japanese_language_and_computers

Hello world

```
public class MyFirstJavaProgram {                   //class

    /* First java program.
     * This will print 'Hello world' as the output
     */

    public static void main(String[] args) {         //main() method not Main
        System.out.println("Hello world");       /*prints "Hello world"*/
    }
}
```

```
javac MyFirstJavaProgram.java
java MyFirstJavaProgram
```

```c
#include <stdio.h>
int main() {
   printf("Hello, world!\n");
   return 0;
}
```

```cpp
#include <iostream>
int main() {
    std::cout << "Hello world!\n";
    return 0;
}
```

```python
print("Hello world")
```

Object-oriented programming (OOP)

- Objects

- Class
  - blueprint/template (e.g. DNA, RNA)

States(屬性/狀態)

♂/♀、年齡、白柴/胡麻柴/黑柴, etc.

Behaviors(操作/動作)

例: class Dog

```
public class Dog {
  String breed;
  int age;
  String color;

  void bark() {
    System.out.println("Wan wan");
  }

  void eat() {
  }

  void sleep() {
  }
}
```

Keywords: abstract, boolean, break, byte, case, catch, char, class, do, for, if, ...

Constructors

MyClass.java

```
public class MyClass {
  int num;
  MyClass() {
    num = 100;
  }
}
```

constructor

ConsDemo.java

```
public class ConsDemo {
  public static void main(String[] args) {
    MyClass t1 = new MyClass();
    MyClass t2 = new MyClass();
    System.out.println(t1.num + " " + t2.num);
  }
}
```

new objects

Constructors

MyClass2.java

```
class MyClass2 {
  int x;

  MyClass2(int i) {
    x = i;
  }
}
```

instance variable

constructor

parameter

ConsDemo2.java

```
public class ConsDemo2 {
  public static void main(String[] args) {
    MyClass2 t1 = new MyClass2(10);
    MyClass2 t2 = new MyClass2(20);
    System.out.println(t1.x + " " + t2.x);
  }
}
```

- a special method, matches the class name
- does not have a return type (void, int, etc.)
- is called when the object is created
- All Java classes have constructors

```
public class Puppy {
  int puppyAge;                      //instance variable, outside any method

  Puppy(String name) {
    // This constructor* has one parameter, name.
    System.out.println("The name is: " + name);
  }

  public void setAge(int age) {          //This method takes one parameter, age.
    puppyAge = age;
  }

  public int getAge() {
    System.out.println("Puppy's age is: " + puppyAge);
    return puppyAge;
  }

  public static void main(String[] args) {
    // create an object myPuppy
    Puppy myPuppy = new Puppy("Cody");

    myPuppy.setAge(2);

    myPuppy.getAge();

      /* read age again */
    System.out.println("Variable Value: " + myPuppy.puppyAge);
  }
}
```

Primitive data types

- byte (8 bit signed integer)
  - byte a = 100;
  - min: -128 (-2^7), max: 127 (2^7-1)
- short (16 bit signed integer)
  - short b = 11000;
  - min: -32,768 (-2^15), max: 32,767 (2^15-1)
- int (32 bit signed integer)
  - int c = -2000000;
  - min: -2^31, max: 2^31-1
- long (64 bit signed integer)
  - min: -2^63, max: 2^63-1

default: 0

- float (32 bit single precision floating point)
  - float f = 22.22;
- double (64 bit double precision floating point)
  - double d = 33.4444;
- boolean
  - boolean isAlive = true;
  - boolean isDead = false;

default: false

- char (single 16 bit Unicode character)
  - char letterA = 'A';

Data type conversion (型変換)

```
public void method1(){
  byte a = 18;
  int b = 157;
  long c = 5000000L;
  float f = 3.14f;
  double d = 88.888888888;
  char j = 'j';
  ...

}
```

Unicode表
j: 0x006A (16進数), 106 (10進数)

```
int ab = a + b;        //OK
byte ba = a + b; //NG, compile error
float bf = b + f;       //OK
float cf = c + f;       //OK
double bcfd = b+c+f+d;       //OK
int da = d + a;        //NG

int f2 = (int)f;       // 3

int j1 = j + 1;       // 107
```

Reference data types

```
Puppy myPuppy = new Puppy("Cody");
```

reference variable

default: null

Variable types

```
public class Test {
  public void puppyAge() {
    int age = 0;
    age = age + 7;
    System.out.println("Puppy age is: " + age);
  }

  public static void main(String[] args) {
    Test test = new Test();
    test.puppyAge();
  }
}
```

```
public class Test {
  public void puppyAge() {
    int age;          //エラー、初期化されてない
    age = age + 7;
    System.out.println("Puppy age is: " + age);
  }

  public static void main(String[] args) {
    Test test = new Test();
    test.puppyAge();
  }
}
```

Local variables: declared in methods, constructors

“変数宣言”

no modifiers, no default value

```
public class Employee {

  // this instance variable is visible for any child class.
  public String name;

  // salary variable is visible in Employee class only.
  private double salary;

  // The name variable is assigned in the constructor.
  public Employee (String empName) {
    name = empName;
  }

  // The salary variable is assigned a value.
  public void setSalary(double empSal) {
    salary = empSal;
  }

  // This method prints the employee details.
  public void printEmp() {
    System.out.println("name: " + name);
    System.out.println("salary:" + salary);
  }

  public static void main(String[] args) {
    Employee empOne = new Employee("Rajesh");
    empOne.setSalary(100000);
    empOne.printEmp();
  }
}
```

instance variable

declared outside any method or constructor, inside a class
“public””private”: modifiers
in a static method, should be called using fully qualified name.
empOne.name

no nested method

```java
public class Employee {

  // salary variable is a private static variable
  private static double salary;

  // DEPARTMENT is a constant
  public static final String DEPARTMENT = "システム開発部";

  public static void main(String[] args) {
    salary = 300000;
    System.out.println(DEPARTMENT + " average salary: " + salary);
  }
}
```

class/static variables

from outside class:
Employee.DEPARTMENT

Modifiers

- Access modifiers
  - (空欄)
  - public
  - private
  - protected
- Non access modifiers
  - static (method, class)
  - final
  - abstract
  - synchronized*, volatile*

```java
public class Dog {
  private String birthday;

  public String getBirthday() {
    return this.birthday;
  }

  public void setBirthday(String birthday) {
    this.birthday = birthday;
  }
}
```

Operators

- +
- -
- *
- /
- %
- ++
- --
- ==
- !=
- >
- <
- >=
- <=
- &&
- ||
- !
- =

Loops

```
public class TestLoop1 {

  public static void main(String[] args) {
    int x = 10;

    while(x < 20) {            // also try x <= 20
      System.out.print("value of x: " + x);
      x++;
      System.out.print("\n");         //手動で改行 escape sequence
    }
  }
}
```

Loops

```
public class TestLoop2 {

  public static void main(String[] args) {

    for(int x = 10; x < 20; x = x + 1) {
      System.out.println("value of x: " + x );
    }
  }
}
```

Loops

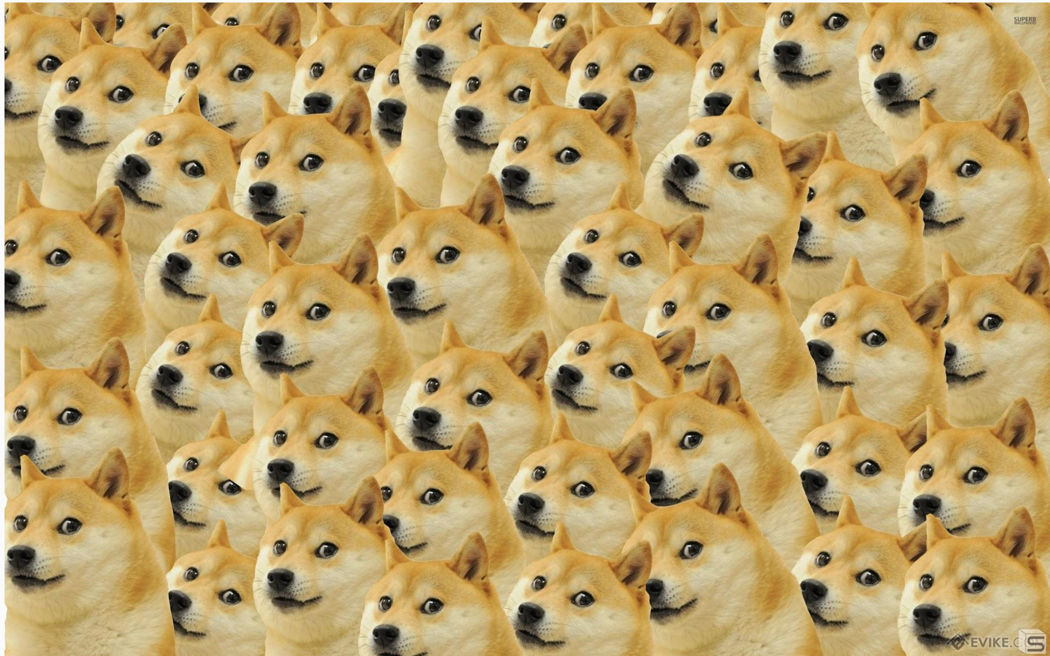
```
public class TestLoop3 {

    public static void main(String[] args) {
        int x = 10;

        do {
            x++;
            System.out.println("value of x: " + x );
        } while(x < 20);
    }
}
```

```
public class TestLoop4 {

    public static void main(String[] args) {
        int i = 8;
        while (true) {
            System.out.println(i);
            i++;
            if (i == 20) {
                System.out.
println("i is 20");
                break;
            }
        }
    }
}
```



```
public class TestLoop5 {

    public static void main(String[] args) {
        int x = 8;
        for (int i=1; i<10; i++) {
            x++;
            if (x % 3 == 0) {
                continue;
            }
            System.out.println(x + " x%3!=0");
        }
        System.out.println("Value of x: " + x);
    }
}
```

```java
public class TestLoop6 {

    public static void main(String[] args) {
        int x = 8;
        for (int i=1; i<10; i++) {
            num++;
            if (x % 2 == 0) {
                System.out.println("even number: " + x);
            } else {
                System.out.println("odd number: " + x);
            }
        }
    }
}
```

```java
public class TestLoop7 {

    public static void main(String[] args) {
        int time = 0;
        for (int i=1; i<=24; i++) {
            if (time < 12) {
                System.out.println("Morning: " + time);
            } else if (time <= 18) {
                System.out.println("Afternoon: " + time);
            } else {
                System.out.println("Evening: " + time);
            }
            time++;
        }
    }
}
```

```java
public class TestLoop8 {

    public static void main(String[] args) {
        int x = 1, y = 2;

        for (int i=1; i<11; i++) {
            if (x < 15) {
                x++;
                if (x != y) {
                    y = y + 2;
                }
            }
            System.out.println("x: " + x + "\ny: " + y + "\n");
        }
    }
}
```

Exercise: nested for loop

```
********
********
********
********
********

5*8
```

```
for (...) {
  for (...) {
    System.out.print("*");
  }
  ...
}
```

```
public class TestSwitch {
    public static void main(String[] args) {
        char grade = 'C';           // 任意の値を

        switch(grade) {
        case 'A':
            System.out.println("Excellent!");
            break;
        case 'B':
        case 'C':
            System.out.println("Well done");
            break;
        case 'D':
            System.out.println("You passed");
        case 'F':
            System.out.println("Better try again");
            break;
        default:
            System.out.println("Invalid grade");
        }
        System.out.println("Your grade is " + grade);
    }
}
```

String (文字列)

```
String str = Integer.toString(b);
String str2 = String.valueOf(c);

System.out.println(Integer.parseInt("-20"));       // -20

int hoge = Integer.valueOf("12345");           // valueOf() returns Integer
int fuga = Integer.parseInt("12345");          // parseInt() returns int
```

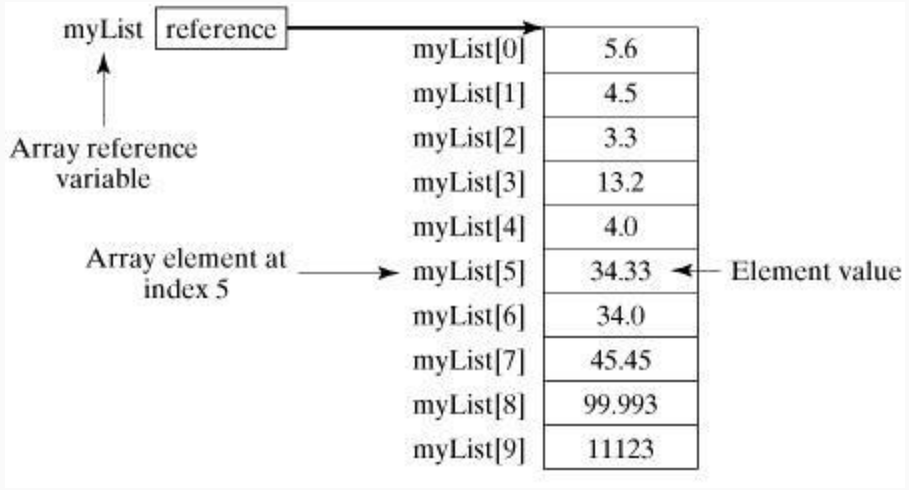
Arrays (配列)

```
String[] args

double[] myList
= {5.6, 4.5, 3.3, 13.2,
4.0, 34.33, 34.0, 45.45,
99.993, 11123};

int[] myList2 = new int[5];
```

固定



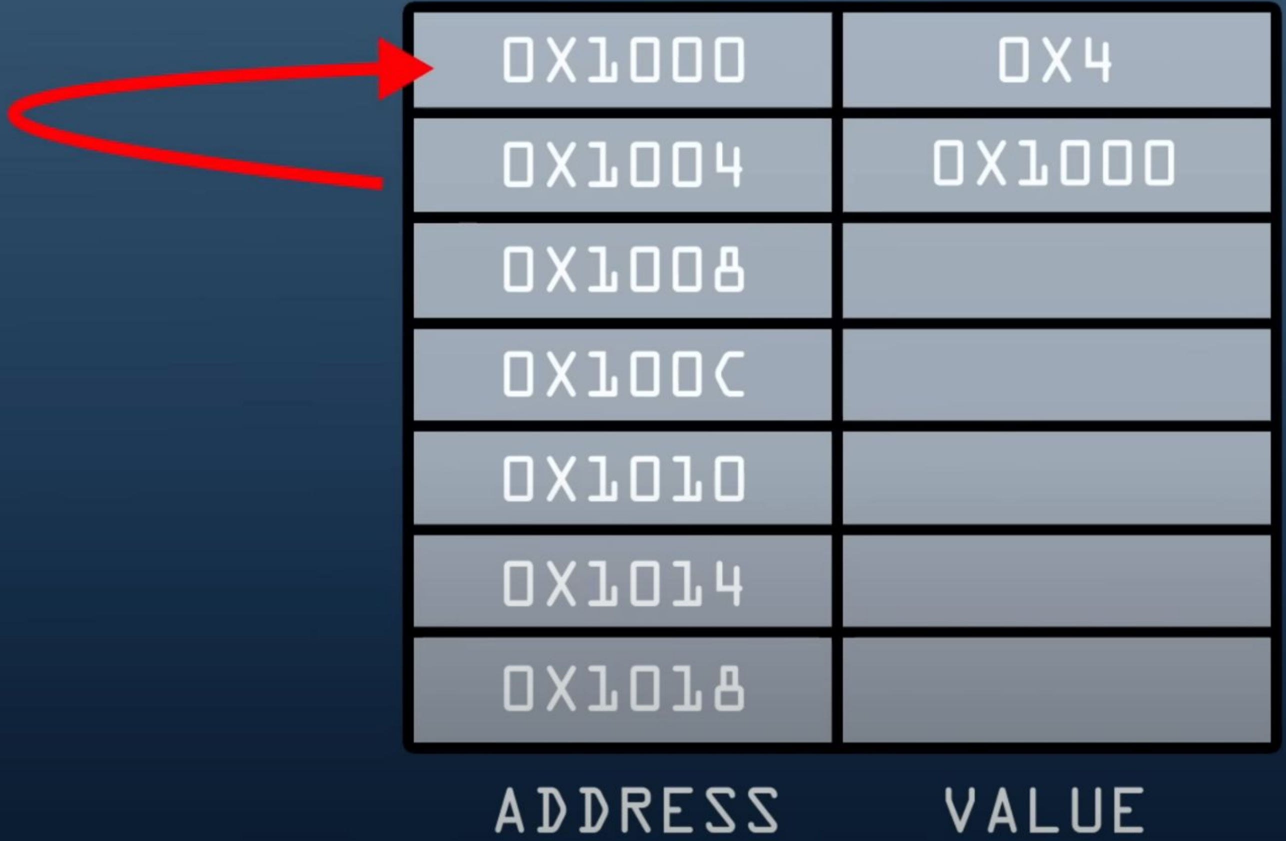
Print the array: TestArray1.java

```
public class TestArray1 {
    public static void main(String[] args) {
      double[] myList = {5.6, 4.5, 3.3, 13.2, 4.0, 34.33, 34.0, 45.45,
99.993, 11123};
        System.out.println(myList);
    }
}

$ javac TestArray1.java
$ java TestArray1
[D@7ad041f3
```

reference variable

MEMORY



ADDRESS	VALUE
0X1000	0X4
0X1004	0X1000
0X1008	
0X100C	
0X1010	
0X1014	
0X1018	

```
int x = 4;
int *pX = &x;
```

Exercise 1. print all array elements 2. sum all elements 3. find max

```
public class TestArray2 {

  public static void main(String[] args) {
      double[] myList = {5.6, 4.5, 3.3, 13.2, 4.0, 34.33, 34.0, 45.45,
99.993, 11123};

      // Print all the array elements
      for (int i = 0; i < myList.length; i++) {
         System.out.println(myList[i] + " ");
      }
      for () {}
      for () {}
  }
}
```

Foreach loop: enhanced for loop

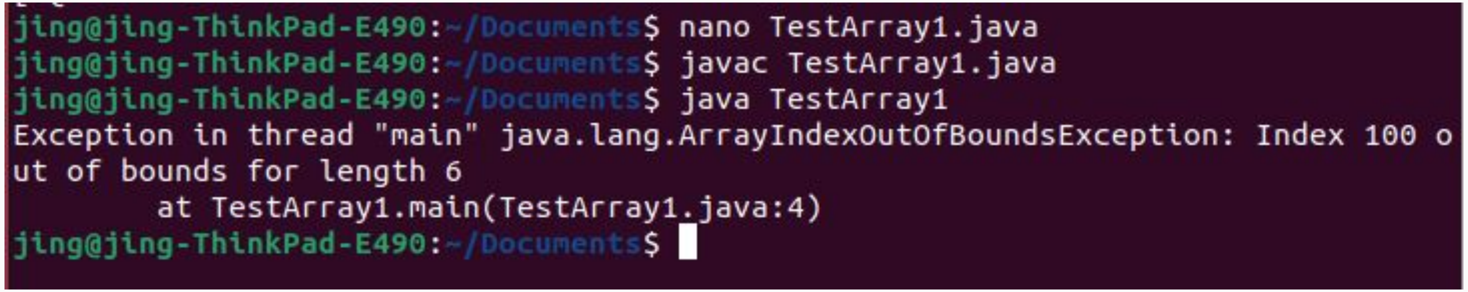
```
for (double element: myList){
  System.out.println(element + " ");
}
```

Sort the array: int, char, and String

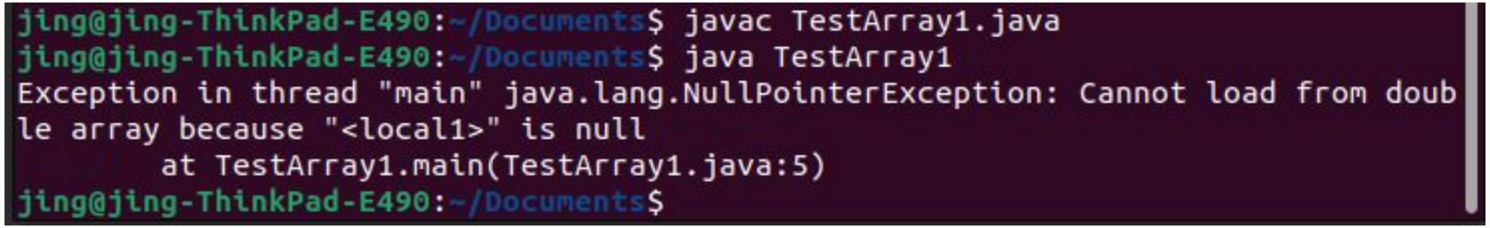
```
Arrays.sort(arr);      Arrays.sort(arr, 1, 5);
Arrays.sort(arr, Collections.reverseOrder());
```

Exercise: sort an int array without using .sort()

Exceptions



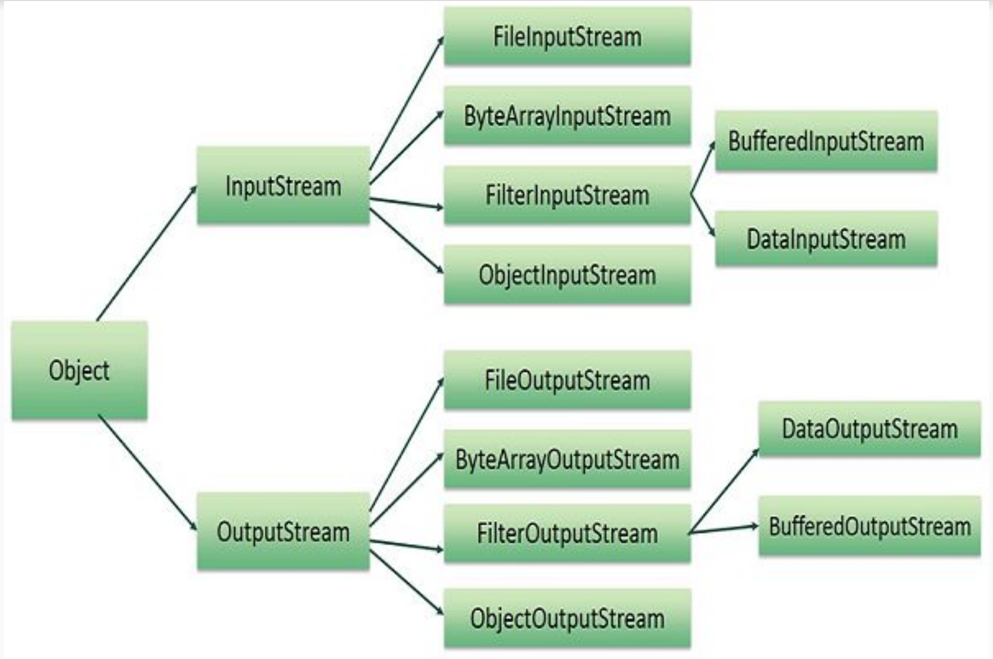
```
jing@jing-ThinkPad-E490:~/Documents$ nano TestArray1.java
jing@jing-ThinkPad-E490:~/Documents$ javac TestArray1.java
jing@jing-ThinkPad-E490:~/Documents$ java TestArray1
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: Index 100 o
ut of bounds for length 6
        at TestArray1.main(TestArray1.java:4)
jing@jing-ThinkPad-E490:~/Documents$
```

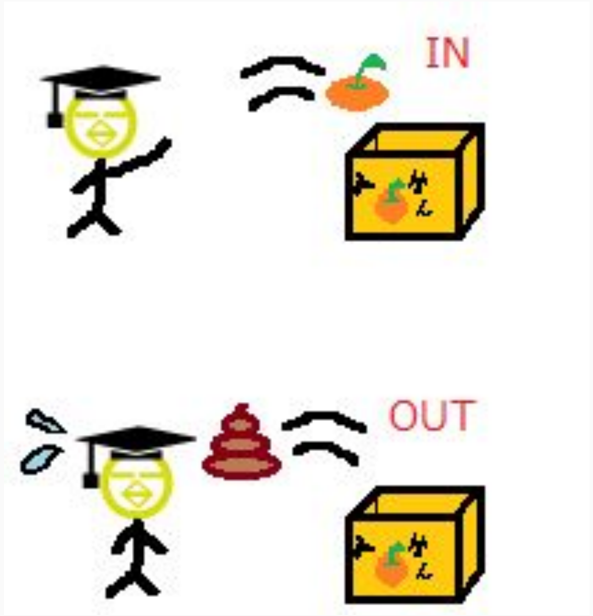


```
jing@jing-ThinkPad-E490:~/Documents$ javac TestArray1.java
jing@jing-ThinkPad-E490:~/Documents$ java TestArray1
Exception in thread "main" java.lang.NullPointerException: Cannot load from doub
le array because "<local1>" is null
        at TestArray1.main(TestArray1.java:5)
jing@jing-ThinkPad-E490:~/Documents$
```

More on that later

Files and I/O


Object
InputStream
FileInputStream
ByteArrayInputStream
FilterInputStream
ObjectInputStream
BufferedInputStream
DataInputStream
OutputStream
FileOutputStream
ByteArrayOutputStream
FilterOutputStream
ObjectOutputStream
DataOutputStream
BufferedOutputStream


IN
OUT

CopyFile1.java

```
import java.io.*;
public class CopyFile1 {

   public static void main(String[] args) throws IOException {
      FileInputStream in = null;
      FileOutputStream out = null;        //初期化

      try {
         in = new FileInputStream("input.txt");
         out = new FileOutputStream("output.txt");

         int c;
         while ((c = in.read()) != -1) {
            out.write(c);
         }
      }finally {
         if (in != null) {
            in.close();
         }
         if (out != null) {
            out.close();
         }
      }
   }
}
```

input.txt

```
Tesuto
```

byte stream
1 byte (8 bit)

end of file

①
```
InputStream in = new
FileInputStream("C:/java/input.txt
");
```

②
```
File f = new File("~/input.txt");
InputStream in = new
FileInputStream(f);
```

CopyFile2.java

```
import java.io.*;
public class CopyFile2 {

   public static void main(String[] args) throws IOException {
      FileReader in = null;
      FileWriter out = null;

      try {
         in = new FileReader("input.txt");
         out = new FileWriter("output.txt");

         int c;
         while ((c = in.read()) != -1) {
            out.write(c);
         }
      }finally {
         if (in != null) {
            in.close();
         }
         if (out != null) {
            out.close();
         }
      }
   }
}
```

input.txt

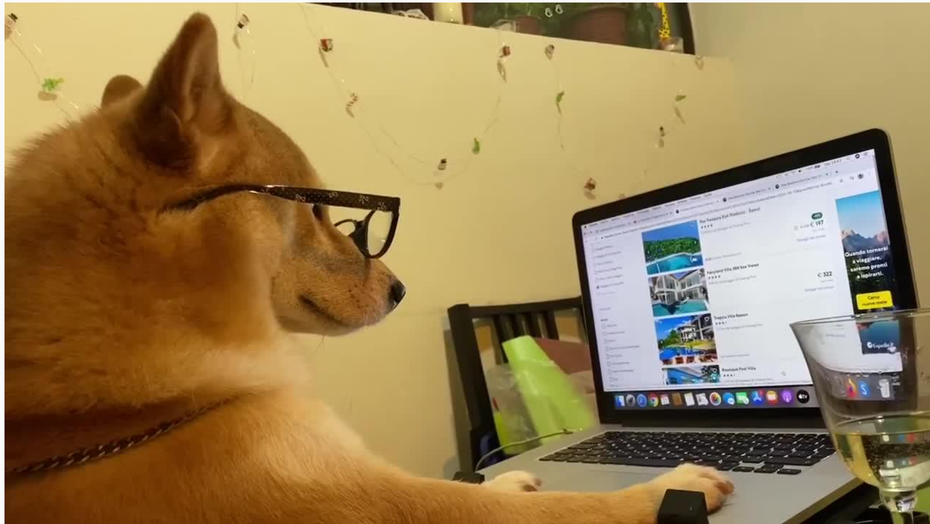
```
Tesuto
```

character stream
2 bytes (16 bit)

```
import java.io.*;
public class ReadConsole {

   public static void main(String[] args) throws IOException {
      InputStreamReader cin = null;

      try {
         cin = new InputStreamReader(System.in);
         System.out.println("Enter characters, 'q' to quit.");
         char c;
         do {
            c = (char) cin.read();
            System.out.print(c);
         } while(c != 'q');
      }finally {
         if (cin != null) {
            cin.close();
         }
      }
   }
}
```



Scanner

```
import java.util.Scanner;
public class ScannerDemo1 {
    public static void main(String[] args){

        Scanner sc = new Scanner(System.in);

        String name = sc.nextLine();        // String input
        int age = sc.nextInt();

        System.out.println("Name: "+name);
        System.out.println("Age: "+age);
    }
}
```

Exercise: calculate the mean

Scannerクラスを使って、入力された整数値の平均値を求めなさい。

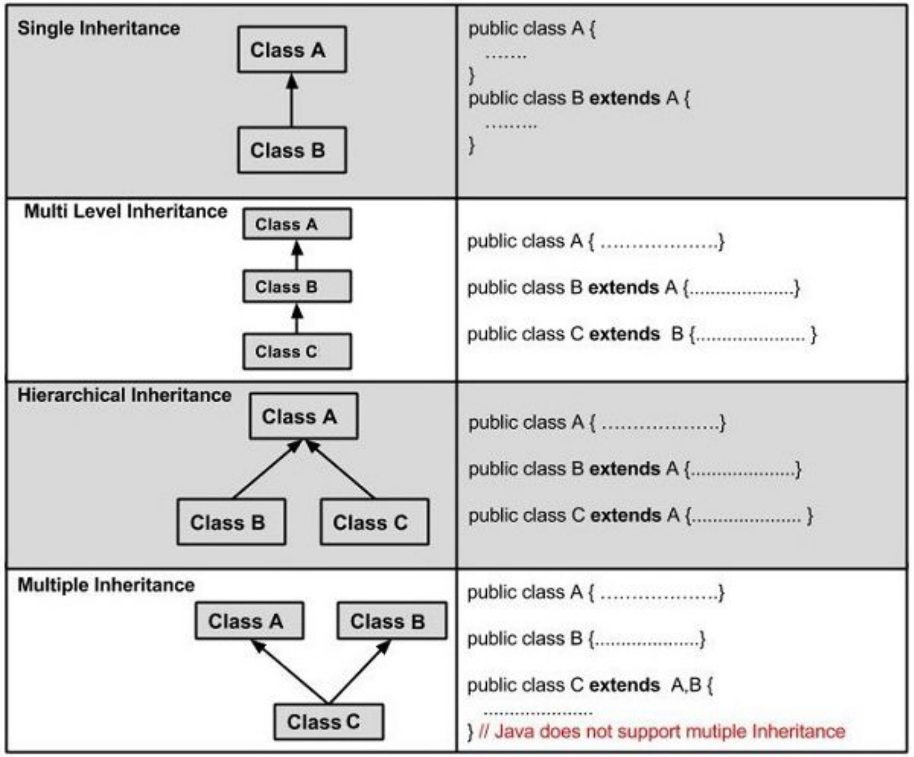
Hint: `boolean Scanner.hasNextInt()`

```
 boolean Scanner.hasNextLine()

void Scanner.close()
```

Inheritance: `extends`

- the subclass (child class) inherits methods and fields from the superclass (parent class)



```
public class A {
    .......
}
public class B extends A {
    .........
}
```

```
public class A { ....................}
public class B extends A {....................}
public class C extends  B {.................... }
```

```
public class A { ....................}
public class B extends A {....................}
public class C extends A {.................... }
```

```
public class A { ....................}
public class B {....................}
public class C extends  A,B {
    ......................
} // Java does not support mutiple Inheritance
```

```java
class Calculation {

    public int addition(int x, int y) {
        return x + y;
    }

    public int subtraction(int x, int y) {
        return x - y;
    }
}

public class My_Calculation extends Calculation {
    public int multiplication(int x, int y) {
        return x * y;
    }

    public static void main(String[] args) {
        int a = 20, b = 10;
        My_Calculation demo = new My_Calculation();
        System.out.println(demo.addition(a, b));
        System.out.println(demo.subtraction(a, b));
        System.out.println(demo.multiplication(a, b));
    }
}
```

```
class Super_class {
   int num = 20;

   public void display() { System.out.println("This is the superclass"); }
}

public class Sub_class extends Super_class {
   int num = 10;

   public void display() {System.out.println("This is the subclass"); }

   public void my_method() {
      Sub_class sub = new Sub_class();
      sub.display();
      super.display();

      System.out.println("sub class:"+ sub.num);
      System.out.println("super class:"+ super.num);
   }

   public static void main(String[] args) {
      Sub_class sub = new Sub_class();
      sub.my_method();
   }
}
```

```java
class Animal {
}

class Mammal extends Animal {
}

class Reptile extends Animal {
}

public class Dog extends Mammal {

    public static void main(String[] args) {
        Animal a = new Animal();
        Mammal m = new Mammal();
        Dog d = new Dog();

        System.out.println(m instanceof Animal);
        System.out.println(d instanceof Mammal);
        System.out.println(d instanceof Animal);
    }
}
```

“Dog IS-A mammal”

Abstract

abstract methods must be overridden

```java
abstract class Store {
  abstract void payment();
}

class ConvenienceStore extends Store {
  void payment() {
    System.out.println("Credit card");
  }
}

class SuperMarket extends Store {
  void payment() {
    System.out.println("Suica and Paypay");
  }
}

class FastFoodStore extends Store {
  void payment() {
    System.out.println("食券");
  }
}
```

```java
public class Shopping {
  public static void main(String[] args) {
    ConvenienceStore store1 = new
ConvenienceStore();
    SuperMarket store2 = new SuperMarket();
    FastFoodStore store3 = new
FastFoodStore();

    store1.payment();
    store2.payment();
    store3.payment();
  }
}
```

```java
abstract class Bike{
  Bike(){System.out.println("bike is created");}       // constructor
  abstract void run();
  void changeGear(){System.out.println("gear changed");}
}

class Honda extends Bike{
  void run(){System.out.println("Honda running safely..");}
}

class TestAbstraction2{
  public static void main(String[] args){
    Bike obj = new Honda();
    obj.run();
    obj.changeGear();
  }
}
```

```java
/* File name : Employee.java */
public class Employee {
  private String name;
  private String idNum;          // 社員番号
  private int age;

  public String getName() {
    return name;
  }

  public String getidNum() {
    return idNum;
  }

  public int getAge() {
    return age;
  }

  public void setAge(int newAge) {
    age = newAge;
  }

  public void setName(String newName) {
    name = newName;
  }

  public void setIdNum(String newId) {
    idNum = newId;
  }
}
```

```java
/* File name : RunEncap.java */
public class RunEncap {

   public static void main(String[] args) {
      Employee encap = new Employee();
      encap.setName("James");
      encap.setAge(20);
      encap.setIdNum("ME12343");

      System.out.print("Name: " + encap.getName() + "
Age: " + encap.getAge());
   }
}
```

Interface (is not a class)

100% abstract

```
interface ALaw {
    public void noLiquid();
    public void noBattery();
}

interface BLaw {
    public void noPets();
}
```

```
public class AirlineA implements ALaw,BLaw{
  public void noLiquid() {...// Ban liquids}
  public void noBattery() {...}
  public void noPets() {...// Ban pets}

  public static void main(String[] args){
    // …
}
```

```java
interface Bank{
  float rateOfInterest();
}

class UFJ implements Bank{
  public float rateOfInterest(){return 9.15f;}
}

class Mizuho implements Bank{
  public float rateOfInterest(){return 9.7f;}
}

class TestInterface2{
  public static void main(String[] args){
    Bank bank1 = new UFJ();
    Bank bank2 = new Mizuho();
    System.out.println("UFJ ROI: " + bank1.rateOfInterest());
    System.out.println("Mizuho ROI: " + bank2.rateOfInterest());
  }
}
```