Java 12-Week Boot Camp

Week 1 Basics: Arrays

PCWorkshops

Java Arrays

Including practical, illustrative coding examples

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Java 12-Week Boot Camp

Arrays

Course Notes and Exercises

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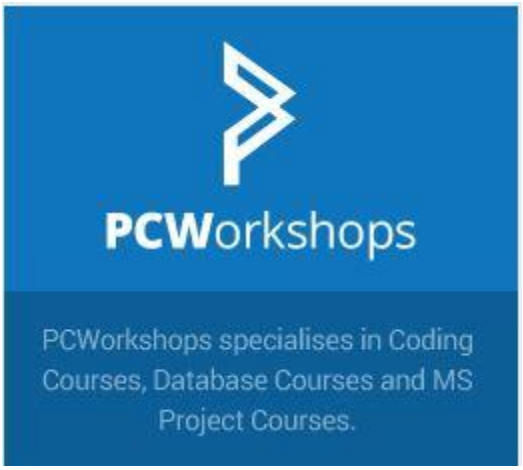

Java Arrays

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Array basics

Declaring arrays:

How to declare or declare and initialise One Dimensional Arrays:

datatype[] arrayname;

arrayname = new datatype [number];

datatype[] arrayname = new datatype [number];

datatype[] arrayname= {value1, value2…};

Examples of declaring an array

```
        String[] movies;
        movies = new String[7];
OR
        String[] movies = new String[7];
OR
        String[] movies =
        {"","Batman","Rambo","Scarface","Cinderell","Schrek",""};
```

Looping arrays with a for-loop

Looping through a one-dimensional array movies:

```
for ( int index=0; index  <  movies.length  ;  index++  ){
       System.out.println("The movie is " + movies [index] );
}
System.out.println();
```

Looping through the array day:

```
String[] days = {"Mon","Tue","Wed","Thu", “Fri”, “Sat”, “Sun”};
for (int index= 0 ; index  < days.length ; index++  ){
       System.out.print("The day is " + days [index] + “\t”);
}
System.out.println();
```

Print all the arrays

```
System.out.println(“Movie program”);
for (int index= 0; index < prices.length  ; index++  ){
   System.out.print(days[index] + “\t” + prices [index] + “\t” +
movies[index]);
}
System.out.println();
```

Exercise: Create and print an empty array

Home work

```
String [] movies = {"Bambi", "Endgame","Shrek","Rambo","Rocky"};
String [] svalues = new String[5];
```

1. Print all the values in svalues (they are all nulls, so you will see nulls)

Exercise– single array: Retrieving values per index

```
String[] movies = {"None","Batman","Ramco","Scarface", “Cinderella”, “Schrek”,
“None”};
String[] days = {"Mon","Tue","Wed","Thu", “Fri”, “Sat”, “Sun”};
double [] prices = {0.0 ,12.0,15.0, 12.0, 15.0, 18.0, 0.0};
double singleTicketPrice = 0.0;
String movieName = “”;
```

1. Get from the screen:
    a. the day of the week
    b. number of adults ,
    c. children (they pay 50%) and
    d. pensioners (they pay 30% of the adult price).
2. They have 200Pounds .

3. Loop the array to find the day they prefer and to find the row index.
4. Determine the single ticket price and the movieName
5. Calculate the total ticket price

6. Display:
    a. the day,
    b. the movieName,
    c. the single ticket price and
    d. If the full Price exceed £200,
        i. then print an appropriate message,
        ii. otherwise price the Price

Solution:

```
import java.util.Scanner;
public class ex1 {
	private static class innerClass {
	// variables
	String[] movies
	= {"None","Batman","Ramco","Scarface", "Cinderella", "Schrek", "None"};
		String[] days = {"Mon","Tue","Wed","Thu", "Fri", "Sat", "Sun"};
		double [] prices = {0.0 ,12.0,15.0, 12.0, 15.0, 18.0, 0.0};
		//scanners
		Scanner s = new Scanner(System.in);
		//methods
		String askForValue (String msg ){
			System.out.println(msg);
			String a = s.nextLine();
			return a;
		}
		int findMovie (String dOfW){
			int j = -1;
			for (int i = 0; i<days.length; i++){
				if (days[i].equalsIgnoreCase(dOfW)){
					j=i;
				}
			}
			return j;
		}
		double calcMovie (int arrayIndex, int a, int c, int p){
			double price = prices[arrayIndex];
			price = price * a + ( price*c/2) + (price * p * 0.3 );
			return price;
		}
		void printPrice (int arrayIndex, double price){
			System.out.println("Movie Name: "+ movies[arrayIndex]);
			System.out.println("Day: "+ days[arrayIndex]);
			System.out.println("Singe Ticket Price: "+
prices[arrayIndex]);
			if (price > 200){
				System.out.println("Price: "+ price + "It's over
£200");
			} else{
				System.out.println("Full Price: "+
prices[arrayIndex]);
			}
		}
	}
	public static void main(String[] args) {
		innerClass i = new innerClass();
		String dayOfW = i.askForValue("Day of the week?");
		int adults = Integer.parseInt(i.askForValue("Adults?"));
		int children = Integer.parseInt(i.askForValue("Children?"));
		int pensioners = Integer.parseInt(i.askForValue("Pensioners?"));

		int arrayIndex = i.findMovie(dayOfW);
		double fullPrice = i.calcMovie(arrayIndex, adults, children,
pensioners);
		i.printPrice(arrayIndex, fullPrice);
	}
}
```

Array Exercise

/* Description:
You have an array of salary values
It is year-end and you want to increase all the salaries with 7%
For example, a salary is 20000, then after the increase the salary is 20000 x 1.07 = 21400
Write a program that will increment all the salaries in the array with 7% and update the array with
the new values. Then display all the new values.
*/

```
import java.util.Scanner;
class page9{ //class
public static void main (String[ ] args) { //main

	int i =0;
	double[] salaries= {20000,10000,24000};

	//amend all the salaries
	for(i=0;i< salaries.length; i++ )  {
			salaries[i]= salaries [i]* 1.07;
	}

	//print all the salaries
	for(i=0;i< salaries.length; i++ )  {
		System.out.print(salaries [i]+"\t");
	}


} //main
} //class
```

Array Exercise

// Build array ccc from the values in array aaa, where the values in array aaa is NOT = 5.
// Display how many values NOT equals to 5 were found and transferred to array ccc
// Display all values in array ccc

```
//int aaa[] = {5,3,5,4,-5,5,6,2};
//int ccc[] = {0,0,0,0,0,0,0,0};
```

```
import java.util.Scanner;
class page10{  //class
public static void main (String[ ] args) {  //main

	int i =0;
	int x=0;
	int y=0;
	int aaa[] = {5,3,5,4,-5,5,6,2};
	int ccc[] = {0,0,0,0,0,0,0,0};


	for(i=0;i<aaa.length;i++ )
	{
		if (aaa[i]!=5) {
			x++;
			ccc[i]=aaa[i];
		}
	}//for


	for(i=0;i<ccc.length;i++ )
	{
		System.out.print(ccc[i]+"\t");
	}//for
		System.out.println();
		System.out.println("The number of replacements is  " + x);


}  //main
}  //class
```

Array Exercise

/*
You have 2 arrays: array arrayOne and array arrayTwo, assuming their length is the same:
Create an array called **arrayThree**that contains the component wise sum of two arrays
e.g., if the input arrays are {0, 1, 2} and {2, 2, 3}
then the output is {0 + 2, 1 + 2, 2 + 3},
i.e., {2, 3, 5}.
If the input arrays have different numbers of elements, no values are transferred and all the values in the new array are 0 .
int arrayOne[] = {0,1,2};
int arrayTwo[]= {2,2,3};
int arrayThree[] = {0,0,0};

*/

```
import java.util.Scanner;
class page11{  //class
public static void main (String[ ] args) {  //main

	int i =0;
	int x=0;
	int y=0;
	int arrayOne[] = {0,1,2};
	int arrayTwo[]= {2,2,3};
	int arrayThree[] = {0,0,0};

	x = arrayOne.length;
	y = arrayTwo.length;

	if (x==y){
		for (i=0; i<arrayOne.length; i++ ) {
			arrayThree[i]=arrayOne[i]+arrayTwo[i];
		}//for
	}//if

	 for (i=0; i<arrayThree.length; i++ ) {
		System.out.println(arrayThree[i]+"\t");
	}//for


}  //main
}  //class
```

Array Exercise

/*
You have an double array named **oldArray** and initialised to oldArray{1.8, 3.6, 5.0, 2.0}.
Create an array named **newArray**:
For every entry in array **oldArray**, divide the entry by the next one, i.e. 1.8/3.6 etc.
Place the result of this division into the array **newArray**.
However, the last entry does not change and is simply transferred as is to the **newArray** array.
Hint: The resulting array: new = {0.5, 0.72, 2.5, 2.0}
Print the array **newArray**
*/

Solution

```
import java.util.Scanner;
class page12{  //class
public static void main (String[ ] args) {  //main

	int index =0;
	double oldArray[] = {1.8,3.6,5.0,2.0};
	double newArray[] = {0.0,0.0,0.0,0.0};


	//build the array
	for(index=0;index<(oldArray.length-1);index++ )
	{
		newArray[index]= oldArray[index]/oldArray[index+1];
	}

	//transfer the last element
	newArray[oldArray.length-1]= oldArray[oldArray.length-1];

	//display the array
	for(index=0;index<newArray.length;index++ )
	{
		System.out.print(newArray[index]+"\t");
	}


}  //main
}  //class
```

Exercise: Hangman

Home work: Hangman

Create the Hangman Game

Solution

```
            Scanner myStringScanner = new Scanner(System.in);
            String letter   = "";
            String [] word  = {"c","i","n","d","e","r","e","l","l","a"};
            String [] dashes= {"_","_","_","_","_","_","_","_","_","_","_"};

            int y = 0;
            while ( y < 15 && !(Arrays.equals(word,dashes)) ){   // ||
                  System.out.println(" \n Give me a letter");
                  letter = myStringScanner.nextLine();
                  for (int x=0; x < word.length; x++){  //find the letter in
answer
                        if (word[x].equals(letter)) {    //is the letter
found
                              dashes[x]=letter;
      //put the letter into the dashes array
                        }
                  }
                  System.out.println(Arrays.toString(dashes));
// print dashes array ( give user a clue )
                  y++;
            }


            if (Arrays.equals(word, dashes)){
                  System.out.println("\n Correct");
            }else{
                  System.out.println("\n You got it wrong. The word was: ");
                  // print the answer array
            System.out.println(Arrays.toString(word));
            System.out.println(Arrays.toString(dashes));

            }

            myStringScanner.close();
      }
```

2-Dimensional arrays

Declare 2-dimensional Arrays

```
double []][] numbers = {
        {0.0 , 12.00 ,15.00 },
        {0.0 , 6.00 , 12,00  },
        {0.0 , 4.00 ,5.00 },
        };
```

```
double[ ][ ] prices = new double[3][3];
```

Example:

```
Double [ ][ ] number = new double[3][7];
```

OR:

Example:

```
int rows =0;
double [][] numbers = {
        {0.0 ,    12.00 ,  15.00 ,  12.00 ,  15.00 , 18.00 ,    0.0},
        {0.0 ,     6.00 ,   7.50 ,    6.00 ,    7.50 ,     9.00 ,   0.0},
        {0.0 ,    4.00 ,    5.00 ,    4.00 ,     5.0 0,   6.00 ,    0.0},
        } ;
```

Length of 2d Arrays

Arrayname.length	// number of rows
Arrayname[index _of_row].length	// number of columns

Example:

```
String [][] movies = {
      {"Mon","Tue","Wed","Thu","Fri","Sat","Sun"},
      {"None","Schrek","Batman","Rocky","Bambi","Cinderella",""},
      {"0.00","12.00","15.00","12.00","15.00","18.00","0.00"}, //price
      {"50","50","50","50","50","50","50"} //number of available seats
      };


int rows =0;
rows = movies.length;
System.out.println( rows ) ;                    //number of rows

System.out.println( movies[0].length ) ;  //number of cols on row 0
System.out.println( movies[1].length ) ;  //number of cols on row
System.out.println( movies[2].length ) ;  //number of cols on row 2
System.out.println(movies[3].length) ;    //number of cols on row 3
```

Referring to individual values in a 2d Array

```
System.out.println( movies [0][0]  ) ;      // Mon
System.out.println( movies [0][1]  ) ;      // Tue
System.out.println( movies [1][3]  ) ;      // Rocky
System.out.println( movies [2][3]  ) ;      // 12.00
```

Example 2-d array with String values

```
String [ ][ ] movies = {
            {"Mon","Tue","Wed","Thu","Fri","Sat","Sun"},
            {"None","Schrek","Batman","Rocky","Bambi","Cinderella",""},
            {"0.00","12.00","15.00","12.00","15.00","18.00","0.00"},
//price
            {"50","50","50","50","50","50","50"} //number of available
seats
            };
```

Looping through a two-dimensional array:

```
int rows = movies.length;
int cols = movies[0].length;
for (int r = 0 ; r <movies.length ;  r++)   {     //loop the row index
      for (int c=0; c<movies[r].length; c ++ ){   //loop the columns of a
row
            System.out.print ( movies[r][c]  +  "\t " ) ;
                                                  // print the elements on
                                                 a row
      }
      System.out.println();                       // move to the next row
}
```

Exercise print 2d Array

Print the 2-d Array :

Mon	Tue	Wed	Thu	Fri	Sat
None	Schrek	Batman	Rocky	Bambi	Cinderella
0.00	12.00	15.00	12.00	15.00	18.00

Exercise print 2d Array

Print the 2-d Array :

Mon	None	0.00
Tue	Schrek	12.00
Wed	Batman	15.00
Thu	Rocky	12.00
Fri	Bambi	12.00
Sat	Cinderella	15.00
Sun	None	18.00

Exercise – MovieTicketsGame V4 – 2d-array

```
String [ ][ ] movies = {
      {"Mon","Tue","Wed","Thu","Fri","Sat","Sun"},
      {"None","Schrek","Batman","Rocky","Bambi","Cinderella",""},
      {"0.00","12.00","15.00","12.00","15.00","18.00","0.00"}, //price
      {"50","50","50","50","50","50","50"} //number of available seats
      };
```

Use the 2-d array above.

1. Ask the end-user to input:
    a. The day of the week ,
    b. The number of adults ,
    c. The number of children (they pay 50%) and
    d. The number of pensioners (they pay 30% of the adult price).
2. Loop the array , for each occurance:
    a. Test if the day matches the day preferred by the user
    b. Keep the column-index of this day in a variable of type int
3. Display the movie name and price for that column-index
4. Convert the price to a double value
5. Calculate the total ticket price
6. Display the full price to be paid

Exercise – MovieTicketsGame and available seatsV4 – 2d-array

Exercise: Available seats

Loop while there are still seats available
Ask which movie they want to see
Ask how many want to go
Loop to find the column index for that day
If there are enough seats:
Display the corresponding day and price
Convert the price to double, display the price to pay
Subtract the number of people from the number of available seats ,
update the array to display number of seats.
Else display – no seats available

Home work

Look ahead to see how to compare 2 arrays
You have a String Array with the value : {“c”,”i”,”n”,”d”,”e”,”r”, “e”,”l”,”l”,”a” }
And a second array : {“-”,”-”,”-”,”-”,”-”,”-”,”-”, “-”,”-”,”-”,”-” }
Play the hangman game, filling every correct record into the second array, until the end user guessed 12 times or the 2 arrays are the same.

Irregular Column Arrays

Irregular Column length:

```
String[][] arrayString = {
        {"hello ","dolly"},
        {"Oh, ","hello ","dolly"},
        {"oh ","how ","nice ","that ","you "},
        {"are ","here "}
        };
```

Get the number of ***ROWS*** in the array:

arrayString.length

To determine the number of ***COLUMNS*** in a specific row:

arrayString[index].length

arrayString[0].length

arrayString[1].length

arrayString[2].length

arrayString[3].length

Looping through a this array:

```
for (int row=0;row<arrayString.length;row++){
        for (int column=0; column <arrayString[row].length; column ++){
                System.out.prints(arrayString[row][column] + " \t");
        } // end the inner for-loop
        System.out.println();
}// end the outer  for-loop
```

//Multi Dimensional Array with irregular column lengths

```
import java.util.Scanner;
public class page23{  //class
public static void main (String[ ] args) {  //main

int i =0;

String[][] arrayString =
{
{"hello ","dolly"},
{"Oh, ","hello ","dolly"},
{"oh ","how ","nice ","that ","you "},
{"are ","here "}
};

// prints the length of the array – how many ROWS are in the
arraySystem.out.println(arrayString.length +  " arrayString.length ");

// prints the length of each row, i.e. the number of columns per row
System.out.println("row [0] has " + arrayString[0].length + " " + "columns ");
System.out.println("row [1] has " + arrayString[1].length + " " + "columns");
System.out.println("row [2] has " + arrayString[2].length + " " + columns");
System.out.println("row [3] has " + arrayString[3].length + " " + "columns");



}  //main
}  //class
```

Array Class

Arrays Class

Import java.util.Arrays;

To Sort an array:

```
Arrays.sort(str4);
```

```
// import java.util.Arrays;

    String [] str4 = {"x", "c", "v", "b", "n", "s", "d", "f", "g", "h"};
    Arrays.sort(str4);
    for (String i : str4) {
            System.out.println(i);
    }
```

Compare Arrays

```
Arrays.equals(array1,array2);
```

```
import java.util.Arrays;
class page26a
{
   public static void main (String[] args)
   {
            int arr1[] = {1, 2, 3};
            int arr2[] = {1, 2, 3};

            if (Arrays.equals(arr1, arr2))
                  System.out.println("Same");
            else
                   System.out.println("Not same");

   }

}
```

System.arraycopy

(sourcearray, start in source, destination array, start, length)

System.arraycopy(x, 1, y, 2, 2);

X : the source array
1 : the start position in the source array
Y : the destination array
2 : start position in the destination array
3 : length to be copied

System.arraycopy(arr, 0, copied, 1, 5); //5 is the length to copy

```
String [] x = {"Wed","Thu", "Fri"};
String [] y = {"Mon","Tue", "none","none","none","Sat", "Sun"};


System.arraycopy(x, 0, y, 2, 3);


for(String var : y) {  // use with arrays
            System.out.println(var +" ");
} //for
System.out.println();

Exercise
        //x is the source,
        //0 Index of "Wed" in x
        //y is the destination  array,
        //2 is the starting position in the destination array,
              (the first none value
       //3 is the number of array elements to copy ("Wed","Thu", "Fri")

      OUTPUT: {"Mon","Tue","Wed","Thu", "Fri","Sat", "Sun"};
```

System.arraycopy

```
int[] copied =newint[10];
```

Output:

```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
```

```
int[] arr ={1,2,3,4,5};
System.arraycopy(arr, 0, copied, 1, 5);//5 is the length to copy
System.out.println(Arrays.toString(copied));
```

Output:

```
[0, 1, 2, 3, 4, 5, 0, 0, 0, 0]
```

Arrays.copyOf(arr, lengthNewArr)

```
Arrays.copyOf(arr, 10);
```

```
int[] arr ={1,2,3,4,5};
int[] copied =Arrays.copyOf(arr, 10);//10 the the length of the new array
System.out.println(Arrays.toString(copied));
```

Output:
[1, 2, 3, 4, 5, 0, 0, 0, 0, 0]

```
copied =Arrays.copyOf(arr, 3);
System.out.println(Arrays.toString(copied));
```

Outpout
[1, 2, 3]

Exercise 1: Arrays

For the array :

int[ ][ ] arrayNumbers = new int[4][4];

fill the array with numbers:

odd numbers 1 to 7 in row 1

odd numbers 11 to 17 in row 2

odd numbers 21 to 27 in row 3

odd numbers 31 to 37 in row 4

Then Print the array

Eg

1	3	5	7
11	13	15	17
21	23	25	27
31	33	35	37

Solution

```
import java.util.*;
import java.text.NumberFormat;
import java.lang.Math;

class  Array7 {
     public static void main(String [] args) {

       int z = -1;

       System.out.println("The first 20 Oddnumbers in 5 columns and 4 rows ");

       for (int j=0;j<4;j++){
              for ( int i=0;i<5;i++)
              {
              z=z+2;
              System.out.print(Oddnumbers[j][i]+"\t");
              }
       System.out.println();
       }
}//class
```

Exercise:Win a movie ticket, 2-d array

Home work: Win a movie ticket

Create the win a movie ticket game:

- You have:

```
String [][] movies = {
                {"Bambi","Rocky","Schrek","Rambo","Scarface"},
                {"Mon"  ,"Tue"    ,"Wed"   ,"Thu"  ,"Fri"},
                {"12.5" , "7.5"   ,"10.0"  , "12.5", "15.0" }    } ;
```

- Generate a random number between 0 and movies[0].length
- Store this generated random number
- Ask the end user to guess this random number, they have 3 tries.
- If they get it right they win a movie ticket.
- Use the random number as the column index to get the name of the movie, day and price , as their prize

Solution

```
Scanner scan = new Scanner (System.in);
        String [][] movies = {
                {"Bambi","Rocky","Schrek","Rambo","Scarface"},
                {"Mon"  ,"Tue"    ,"Wed"   ,"Thu"  ,"Fri"},
                {"12.5" , "7.5"   ,"10.0"  , "12.5", "15.0" }    } ;

        Random r = new Random();
        int  randomNum = ( r.nextInt(movies[0].length)  ) ;
        System.out.println(randomNum);

        int num   = -1;
        int count = 0;
        while ( (num!=randomNum) && (count < 3) ) {
                System.out.println("Guess a number: ");
                num = scan.nextInt();
                count = count + 1;
        }

        if (num != randomNum){
                System.out.println("You lose");
        } else  {
                System.out.println("You won a movie ticket:");
                System.out.println("Movie "  + movies[0][num]);
                System.out.println("On day " + movies[1][num]);
                System.out.println("To the value of " + movies[2][num]);
        }
```

Exercise: Print 2-d array

You have:

```
String [][] movies
= { {"Cinderella","Rocky","The Wolf of Wall Street","Rambo","Scarface"},
                              {"Mon"  ,"Tue"    ,"Wed"   ,"Thu"  ,"Fri"},
                              {"12.5" , "7.5"   ,"10.0"  , "12.5", "15.0" }   } ;
```

Print the following:

Cinderella	Mon	£12.50
Rocky	Tue	£ 7.50
The Wolf of Wall Street	Wed	£10.00
Rambo	Thu	£12.50
Scarface	Fri	£15.00

Index

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