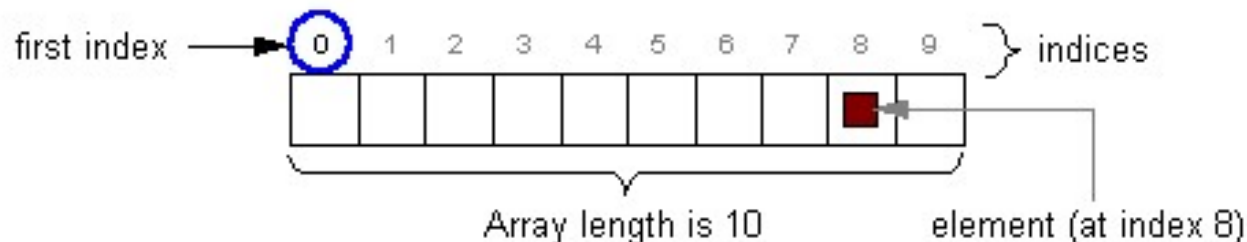


Arrays

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What is a array ?

- Is a structure that holds multiple values of the same type.
- The length of an array is established when the array is created (at runtime).
- After creation, an array is a fixed-length structure.



Declaring Arrays

- Group data objects of the same type.
- You access each individual value through an integer *index*.
- Declare arrays of primitive or class types.

```
char s [] ;  
Point p [] ;  
char [] s;  
Point [] p;
```

- Create space for a reference.
- An array is an object ; it is created with **new**.

Creating Arrays

- Use the **new** keyword to create an array object.

```
s = new char[20];  
p = new Point[100];
```

```
p[0]= new Point();  
p[1]= new Point();
```

Initializing Arrays

- Initialize an array element.
- Create an array with initial values:

```
1 String names[];  
2 names = new String[3];  
3 names[0] = "Sujan";  
4 names[1] = "Michael";  
5 names[2] = "John";
```

```
1 MyDate [] dates;  
2 dates = new MyDate[3];  
3 dates[0] = new MyDate(1978, 9, 15);  
4 dates[1] = new MyDate(1986, 3, 5);  
5 dates[2] = new MyDate(2003, 6, 28);
```

```
1 String names[] = {  
2     "Sujan",  
3     "Michael",  
4     "John"  
5 }
```

```
1 MyDate [] dates = {  
2     new MyDate(1978, 9, 15),  
3     new MyDate(1986, 3, 5),  
4     new MyDate(2003, 6, 28)  
5 }
```

Multi-Dimensional Arrays

■ Arrays of arrays:

```
int [][] twoDim = new int [4][];  
twoDim[0] = new int[5];  
twoDim[1] = new int[5];
```

```
int [][] twoDim = new int [][4]; //illegal
```

```
double[][] balances;  
balances = new double[12][10];  
  
int[][] matrix = {  
    {1, 5, 2, 8},  
    {2, 7, 1, 9},  
    {7, 2, 6, 2},  
    {9, 1, 4, 8}  
};
```

ArrayEx.java

Multi-dimensional Arrays

1	5	2	8
2	7	1	9
7	2	6	2
9	1	4	8

Ragged Arrays

1			
1	2		
1	2	3	
1	2	3	4

Multi-Dimensional Arrays (Cont.)

- Non-rectangular arrays of arrays:

```
twoDim[0] = new int[2];  
twoDim[1] = new int[4];  
twoDim[2] = new int[6];  
twoDim[3] = new int[8];
```

- Array of four arrays of five integers each:

```
int [][] twoDim = new int[4][5];
```

Arrays Bounds

- All array subscripts begin at 0:

```
int list[] = new int[10];  
for (int i = 0; i < list.length; i++) {  
    System.out.println(list[i]);  
}
```


Array Resizing

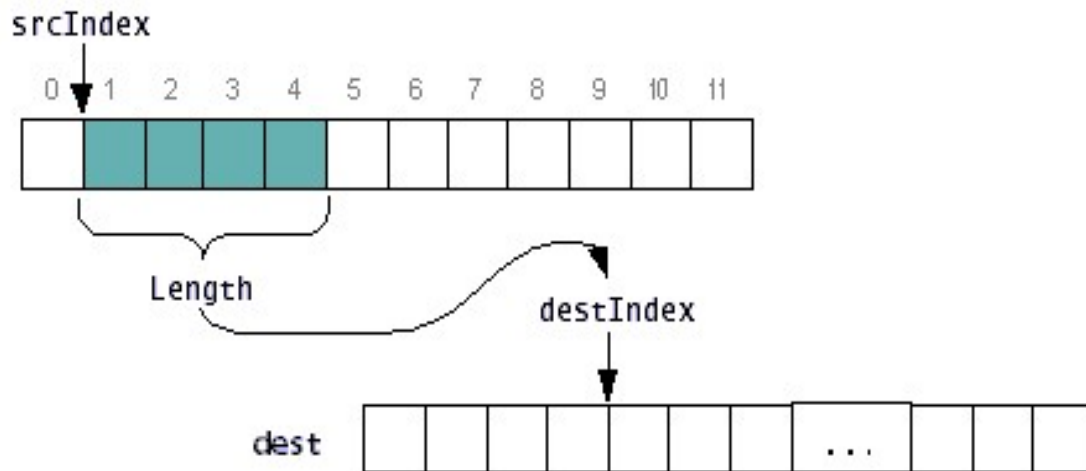
- Cannot resize an array.
- Can use the same reference variable to refer to an entirely new array:

```
int elements[] = new int[6];  
elements = new int[10];
```

Copying Arrays

- The `System.arraycopy()` method.
- This method requires five arguments.

```
public static void arraycopy (Object source,  
                              int srcIndex,  
                              Object dest,  
                              int destIndex,  
                              int length)
```



Copying Arrays (Cont.)

- 배열 변수를 복사하는 경우, 참조변수만 복사되어 실제로는 두 변수가 동일한 배열을 참조합니다.

```
int[] a = new int[5];  
int[] b = a;  
b[0] = 5; // a[0]의 값도 변경된다.
```

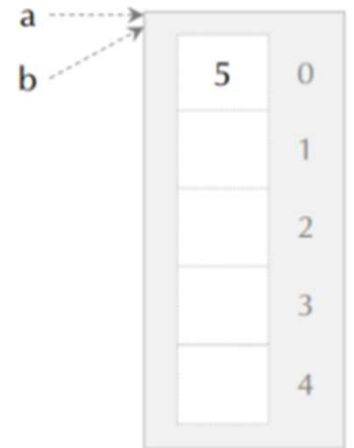
- Arrays.copyOf() 메소드는 배열의 내용까지 복사합니다.

```
int[] copy = Arrays.copyOf(a, a.length);
```

- 배열 복사와 동시에 배열의 크기를 늘릴 수 있습니다.

```
int[] copy = Arrays.copyOf(a, 2 * a.length);
```

ArrayEx.java



Command Line Parameters

- Every Java program has a main method with a **String [] args** parameter.
- Indicates that the main method receives an array of strings, namely, the arguments specified on the command line.

Sorting an Array

- If you want to sort an array of numbers, you can use one of the **sort** methods in the **Arrays** class.
- This method uses a tuned version of the *QuickSort* algorithm that is claimed to be very efficient on most data sets.

Exercise : Using Arrays

■ Level 1 Lab : Create a Basic Array

1. Create a class called **BasicArray**. In the **main()** method, declare two variables called **thisArray** and **thatArray**. They should be of type array of **int**.
2. Create an array of 10 **int** values that range from 1 to 10. Assign the reference of this third array to the variable **thisArray**.
3. Use a **for()** loop to print out all values of **thisArray**.
4. For each element of **thisArray**, set the value to be the factorial of the index value. Print out the values of the array.
5. Assign the reference of **thisArray** to the variable **thatArray**. Print out all the elements of **thatArray**.

Exercise : Using Arrays

- Level 1 Lab : Create a Basic Array (cont.)
- 6. Modify some of the elements or `thisArray`. Print out the value of `thatArray`.
- 7. Create an array of 20 `int` values. Assign the reference of the new array to the variable `thatArray`. Print out the values of `thatArray`.
- 8. Copy the values of `thisArray` into `thatArray`.
- 9. Print out the values of `thatArray`.
- 10. Change some values of `thatArray`. Print out both `thisArray` and `thatArray`.

Exercise : Using Arrays

■ Level 2 Lab : Create Arrays of Arrays

1. Create a class called `Array2D`. In the `main()` method declare a variable called `twoD`, of type `array` of `array` of `int`. Make the first dimension equal to 4 (`[4][]`).
2. Create an array of element type `int`. The array should have four elements and be assigned to element `[0]` of the variable, `twoD`.
3. Write two nested `for()` loops that print out all the values of `twoD`. Arrange the output in a matrix format (`System.out.print()`).
4. Runtime error `returns(NullPointerException)`.

Exercise : Using Arrays

- Level 2 Lab : Create Arrays of Arrays (cont.)
- 5. Create further arrays of `ints` containing five, six, and seven elements, respectively. Assign the reference to these to the elements [1],[2], and [3] of `twoD`, respectively. Ensure that the code for this is inserted before the nested `for()` loop described in step 3.
- 6. Assign a distinct nonzero value to each element of the `twoD` array(Hint- Use `Math.random()`).
- 7. Declare a variable called `oneD` of type array of `int`. Then, create an array of `int` that holds four elements, and assign the reference to this array to the first element of array `twoD` and array `oneD`. After making the assignmen, print out both the `oneD` and `twoD` arrays.