

Array

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Topik

- Mendeklarasikan Array
- Creating Array
- Initializing Array
- Array Multidimensional
- Array Bounds
- Array Resizing
- Copying Arrays

Pengenalan Array

- Misalkan kita memiliki tiga data yang berbeda dan kita simpan dalam variabel yang berbeda.

```
int number1;
```

```
int number2;
```

```
int number3;
```

```
number1 = 1;
```

```
number2 = 2;
```

```
number3 = 3;
```

- Bagaimana jika terdapat banyak data yang berbeda yang memiliki tujuan yang sama, dan bagaimana cara menyimpannya ?

Pengenalan Array

- Di Java dan bahasa pemrograman lainnya, ada satu kemampuan dimana kita dapat menggunakan satu variabel untuk menyimpan sekumpulan data dan memanipulasinya lebih efisien disebut dengan Array

	0	1	2
number:	1	2	3

Array

- Array adalah object yang digunakan untuk menyimpan banyak data dengan tipe yang sama.
- Tipe dari array bisa : tipe data **primitif** atau **class**

Array

- Terdapat 3 langkah untuk membuat array:
 1. Mendeklarasikan variabel array
 2. Memcreate array beserta ukurannya.
 3. Memberikan sebuah nilai pada setiap element array.

Membuat Array

1. Pendeklarasian Array

- `int[] ints`
- `double[] dubs`
- `Dimension[] dims ;`
- `float[][] twoDee`

- Yang tidak legal
 - `int [5] scores;`

Membuat Array

2. Create Array

- Karena array adalah sebuah object, maka create array dengan operator **new**.
- Besar array ditentukan pada saat runtime
 - `int[] ints ;`
 - `ints = new int[25] ;`
- Pada saat array di buat, isi array diinisialisasi dengan **default** value.

```
int[] ints = new int[25] ;
```

Membuat Array

3. Memberikan nilai pada elemen array

- Untuk mengakses data/elemen di array kita menggunakan indeks. Data ke-1 disimpan di array indeks ke-0

Isi dari array : nilai primitif

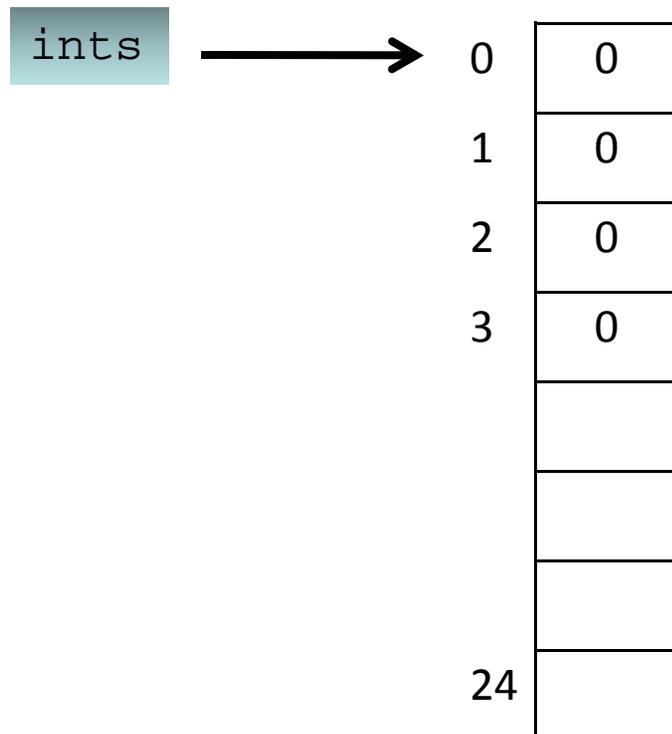
- `int scores = new int[3];`
- `scores[0] = 75;`
- `scores[1] = 80;`
- `scores[2] = 100;`

Isi dari array : object

- `Student students[] = new Students[3]`
- `students[0] = new Student();`
- `students[1] = new Student();`
- `students[2] = new Student();`

Membuat Array

- `int[] ints = new int[25] ;`



- data dimasukkan ke array mulai dari indeks ke-0
- `int[] ints = new int[25] ;` → data disimpan mulai dari indeks 0 sampai 24
- Pada saat array di buat, isi array diinisialisasi dengan **default** value, nilai default untuk int adalah 0

Inisialisasi Array

- Gabungan dari 3 langkah

```
float[] diameters = {1.1f, 2.2f, 3.3f, 4.4f, 5.5f}  
Point[] markup = {new Point(1,5), new Point(3,3),  
    new Point(2,3)} ;
```

- Untuk mengetahui besar dari array gunakan **.length** setelah nama array.

```
long squares ;  
squares = new long[6000] ;  
for (int i=0 ; i<squares.length ; i++)  
{  
    squares[i] = i * i ;  
}
```

Contoh program

```
class Coba
{
    public static void main(String args[]){
        int a[] ;
        a = new int[5] ;

        boolean b[] ;
        b = new boolean[6];

        for(int i=0 ;i<a.length;i++)
            System.out.println(a[i]);

        for(int i=0 ;i<b.length;i++)
            System.out.println(b[i]);
    }
}
```

Hasil running

- 0
 - 0
 - 0
 - 0
 - 0
 - false
 - false
 - false
 - false
 - false
 - false
 - Finished executing
- Nilai default dari int adalah 0
 - Nilai default dari boolean adalah false

Contoh:

```
int[] weightList = new int [5];  
byte b = 4;  
char c = 'c';  
short s = 7;  
weightList[0] = b; // OK, byte is smaller than int  
weightList[1] = c; // OK, char is smaller than int  
weightList[2] = s; // OK, short is smaller than int
```

Creating Arrays

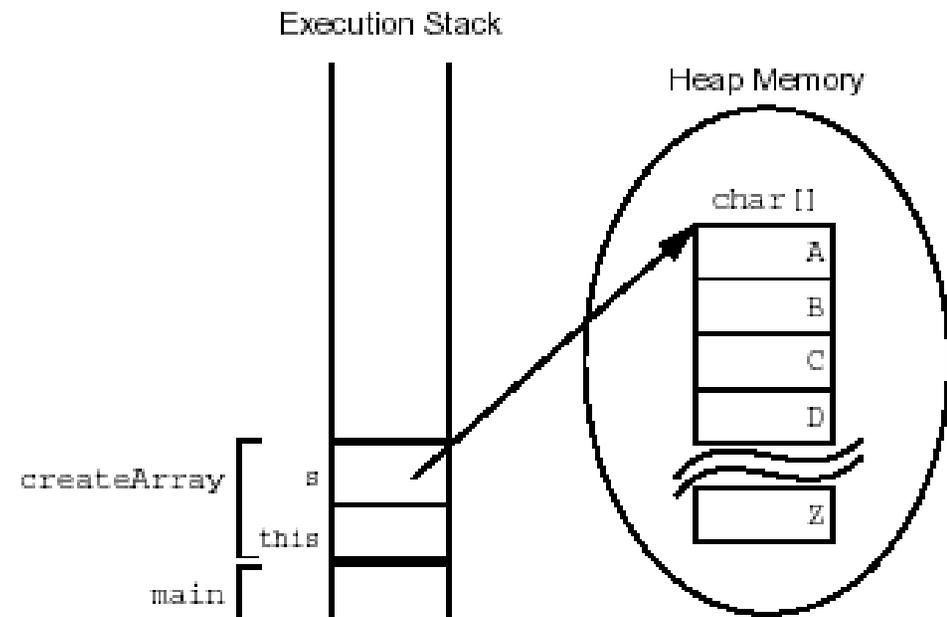
Use the new keyword to create an array object.

For example, a primitive (char) array:

```
public char[] createArray() {
    char[] s;

    s = new char[26];
    for ( int i=0; i<26; i++ ) {
        s[i] = (char) ('A' + i);
    }

    return s;
}
```



Contoh Program

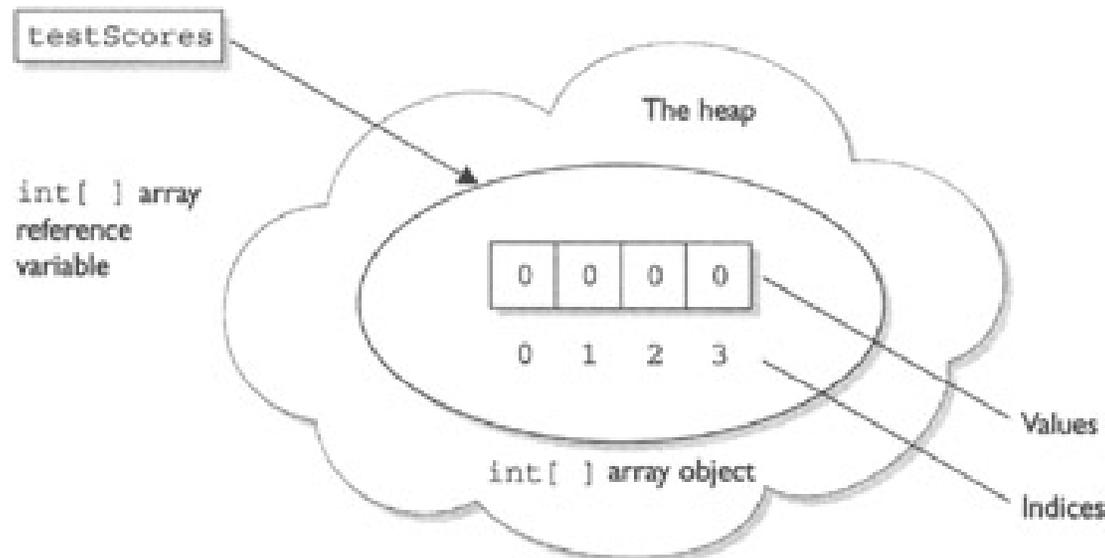
```
1 public class Array1{
2     public char[] createArray(){
3         char s[] = new char[26];
4         for(int i=0;i<26;i++)
5             s[i] = (char) ('A'+i);
6         return s ;
7     }
8
9     public static void main(String args[]){
10        char hasil[] = new char[26];
11        Array1 Arr = new Array1();
12        hasil = Arr.createArray();
13
14        for(int i=0;i<hasil.length;i++)
15            System.out.print(hasil[i]+" ") ;
16
17    }
18 }
```

Hasil Program

- A B C D E F G H I J K L M N O P
Q R S T U V W X Y Z

Membuat Array Dimensi 1

- `int [] testScores; // Declares the array of ints`
`testScores = new int[4]; // constructs an array`
`and assigns it // the testScores variable`



Arrays of Objects

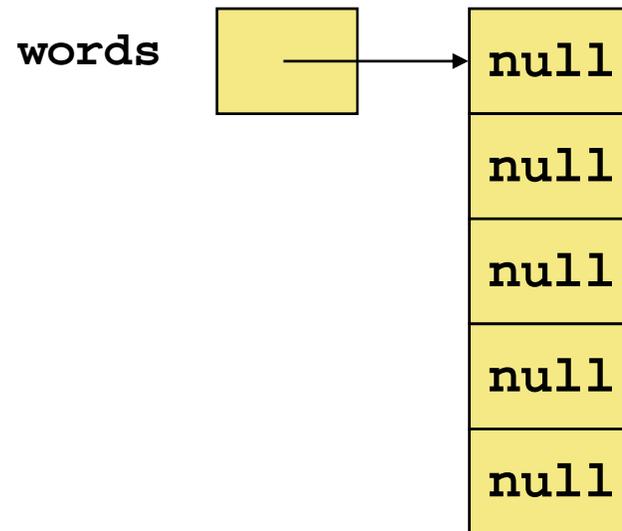
- Elemen dari array berupa object
- Contoh berikut ini menyiapkan ruang untuk menyimpan 5 objek String

```
String[] words = new String[5];
```

- Pada saat menginisialisasi array dengan tipe objek, nilai default dari elemen array adalah `null`

Arrays of Objects

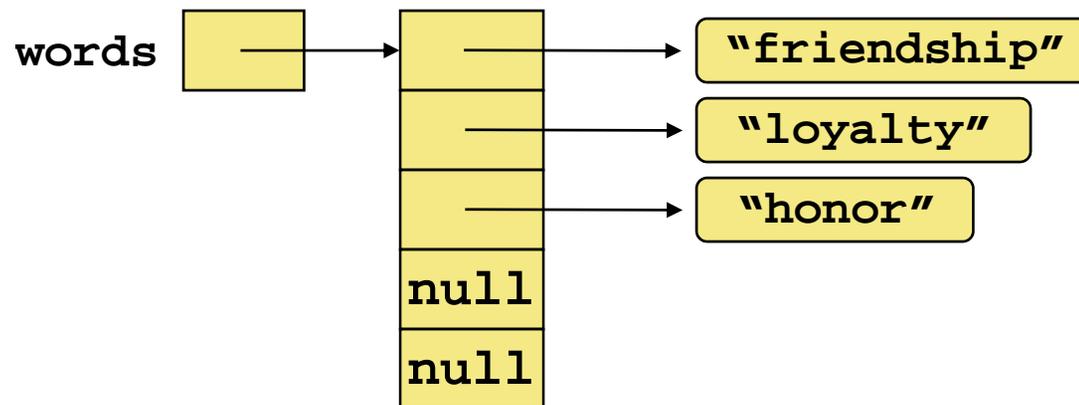
- Array words



Arrays of Objects

- Buat object String dan simpan di array

```
words[0] = new String("friendship");  
words[1] = "loyalty";  
words[2] = "honor";
```



Arrays of Objects

- Object `String` dapat dibuat menggunakan literal.
- Contoh dibawah ini, membuat object array dengan nama `verbs` panjang 4 dan diisi dengan 4 object `String`, yang dibuat menggunakan string literal.

```
String[] verbs = {"play", "work", "eat", "sleep"};
```

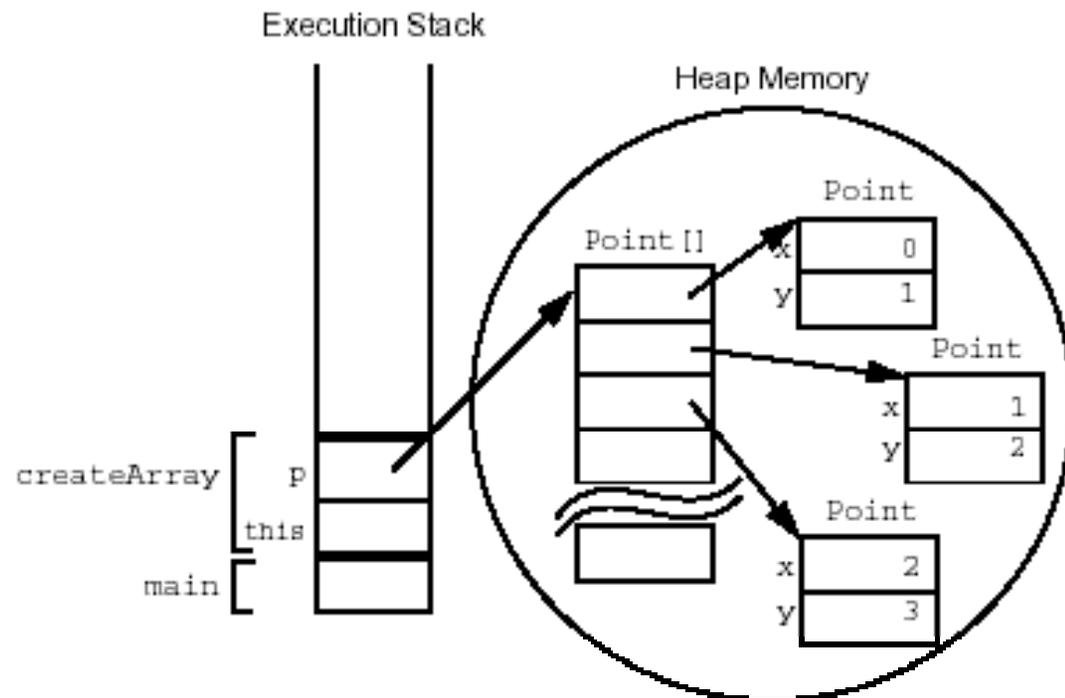
Creating Arrays

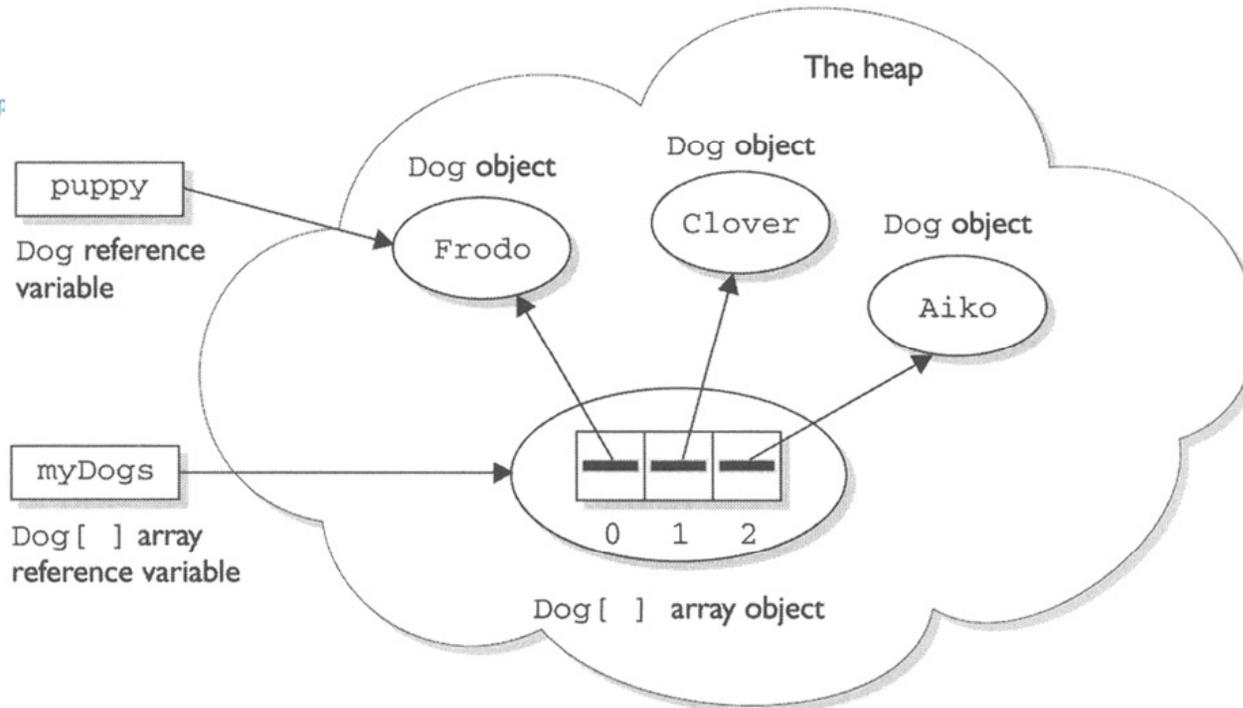
Another example, an object array:

```
public Point[] createArray() {
    Point[] p;

    p = new Point[10];
    for ( int i=0; i<10; i++ ) {
        p[i] = new Point(i, i+1);
    }

    return p;
}
```





Picture demonstrates the result of the following code:

```
Dog puppy = new Dog("Frodo");
Dog[] myDogs = {puppy, new Dog("Clover"), new Dog("Aiko")};
```

Four objects are created:

- | Dog object referenced by puppy and by myDogs(0)
- | Dog[] array referenced by myDogs
- 2 Dog objects referenced by myDogs[1] and myDogs[2]

Initializing Arrays

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

```
String names[];  
names = new String[3];  
names[0] = "Georgianna";  
names[1] = "Jen";  
names[2] = "Simon";
```

```
String names[] = {  
    "Georgianna",  
    "Jen",  
    "Simon"  
};
```

```
MyDate dates[];  
dates = new MyDate[3];  
dates[0] = new MyDate(22, 7, 1964);  
dates[1] = new MyDate(1, 1, 2000);  
dates[2] = new MyDate(22, 12, 1964);
```

```
MyDate dates[] = {  
    new MyDate(22, 7, 1964),  
    new MyDate(1, 1, 2000),  
    new MyDate(22, 12, 1964)  
};
```



Assignment pada array dimensi 1

```
package A;

public class MainA {
    public static void main(String args[]){
        int[] splats;
        int[] data = new int[4];
        char[] letters = new char[5];
        splats = data; // OK, data refers to an int array
        splats = letters; // NOT OK, letters refers to a char array
    }
}
```

Output - ProjectModifier (compile-single)

```
init:
deps-jar:
Compiling 1 source file to D:\Beban_Mengajar\OOPJava\Materi Tita\OOP\Day 8\ProjectModifier\build\classes
D:\Beban_Mengajar\OOPJava\Materi Tita\OOP\Day 8\ProjectModifier\src\A\MainA.java:14: incompatible types
found   : char[]
required: int[]
    splats = letters; // NOT OK, letters refers to a char array
1 error
BUILD FAILED (total time: 0 seconds)
```

Assignment pada array dimensi 1

- Karena Honda extends Car (Honda IS A Car), sehingga array Honda dapat diassignkan ke array Car.

```
Car[] cars;  
Honda[] cuteCars = new Honda [5];  
cars = cuteCars; // OK because Honda is a type of Car  
Beer[] beers = new Beer [99];  
cars = beers; // NOT OK, Beer is not a type of Car
```

Array 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]);  
}
```

Contoh Program

```
1 public class Array1{
2     public static void main(String args[]){
3         String animals[] = new String[4];
4         animals[0] = "snake";
5         animals[1] = "kangaroo";
6         animals[2] = "wombat";
7         animals[3] = "bird";
8
9         for (int i=0; i<animals.length; i++) {
10            System.out.println("animal " + i + " : " + animals[i]);
11        }
12    }
13 }
```

Output

- animal 0 : snake
- animal 1 : kangaroo
- animal 2 : wombat
- animal 3 : bird

Contoh Program

- Lakukan modifikasi dengan melakukan sorting pada data animal

```
1 import java.util.Arrays;
2 public class Array1{
3     public static void main(String args[]){
4         String animals[] = new String[4];
5         animals[0] = "snake";
6         animals[1] = "kangaroo";
7         animals[2] = "wombat";
8         animals[3] = "bird";
9         System.out.println("Sebelum di sorting");
10        for (int i=0; i<animals.length; i++) {
11            System.out.println("animal " + i + " : " + animals[i]);
12        }
13        System.out.println("\nSetelah di sorting");
14        Arrays.sort(animals);
15        for (int i=0; i<animals.length; i++) {
16            System.out.println("animal " + i + " : " + animals[i]);
17        }
18    }
```

- Sebelum di sorting
 - animal 0 : snake
 - animal 1 : kangaroo
 - animal 2 : wombat
 - animal 3 : bird
-
- Setelah di sorting
 - animal 0 : bird
 - animal 1 : kangaroo
 - animal 2 : snake
 - animal 3 : wombat

Class Arrays

- Class Array berisi berbagai macam method untuk memanipulasi array (seperti searching dan sorting)
- Semua method melempar/throw **NullPointerException** jika array yang diakses bernilai null.

Contoh

- Buat program untuk menerima masukan data nama mahasiswa yang disimpan dalam array dengan tipe String. Kemudian tampilkan data mahasiswa tersebut.

Program

```
1 import java.io.*;
2 public class Array2{
3     public static void main(String args[]){
4         String nama[] = new String[20], line;
5         BufferedReader reader = new BufferedReader(new InputStreamReader(System.in));
6         int i=0, p ;
7         try{
8             while(true){
9                 System.out.println("Masukkan Nama Mahasiswa ke- = " + i);
10                line = reader.readLine();
11                if (line.equals("***")) break ;
12                nama[i] = line;
13                i++;
14            }
15        }catch(IOException e){
16            System.out.println(e);
17        }
18
19        p = i ;
20        for(i=0;i<p;i++){
21            System.out.println(nama[i]);
22        }
23    }
24 }
```

Hasil Program

```
D:\Beban_Mengajar_2005\oopppjj\Telekonference>java Array2
Masukkan Nama Mahasiswa ke- = 0
Yuliana
Masukkan Nama Mahasiswa ke- = 1
Andina
Masukkan Nama Mahasiswa ke- = 2
Candra
Masukkan Nama Mahasiswa ke- = 3
Ika
Masukkan Nama Mahasiswa ke- = 4
Munir
Masukkan Nama Mahasiswa ke- = 5
***

Data Mahasiswa
Yuliana
Andina
Candra
Ika
Munir
```

Contoh Program

- Lanjutkan program sebelumnya dengan menampilkan data mahasiswa dengan di sorting ascending terlebih dahulu

```
21     p = i ;  
22     Arrays.sort(nama,0,p);  
23     System.out.println("\nData Mahasiswa");  
24     for (i=0;i<p;i++){  
25         System.out.println(nama[i]);  
26     }  
27 }  
28 }
```

Output Program

```
D:\Beban_Mengajar_2005\ooppjj\Telekonference>java Array2
Masukkan Nama Mahasiswa ke- = 0
Yuliana
Masukkan Nama Mahasiswa ke- = 1
Candra
Masukkan Nama Mahasiswa ke- = 2
Andika
Masukkan Nama Mahasiswa ke- = 3
Munir
Masukkan Nama Mahasiswa ke- = 4
Udin
Masukkan Nama Mahasiswa ke- = 5
***

Data Mahasiswa
Andika
Candra
Munir
Udin
Yuliana
```

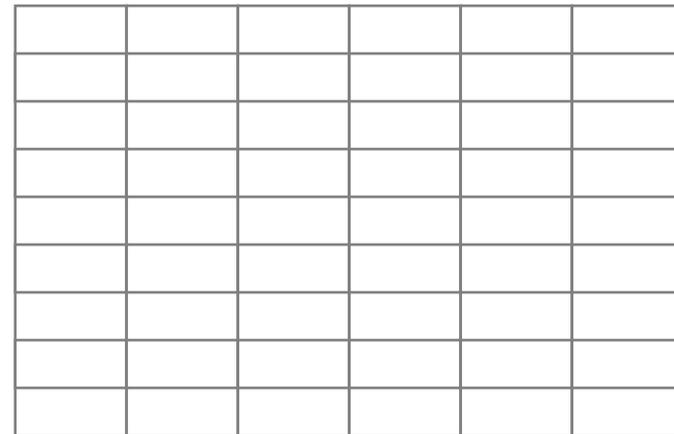
Jenis Array

- Array dimensi 1 menyimpan sekumpulan elemen
- Array dimensi 2, dapat dianggap seperti tabel elemen dengan baris dan kolom

Dimensi 1



Dimensi 2



Array Multidimensional

- Arrays of arrays:

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

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

Array Multidimensional

- Array dengan 4 baris dan 5 kolom

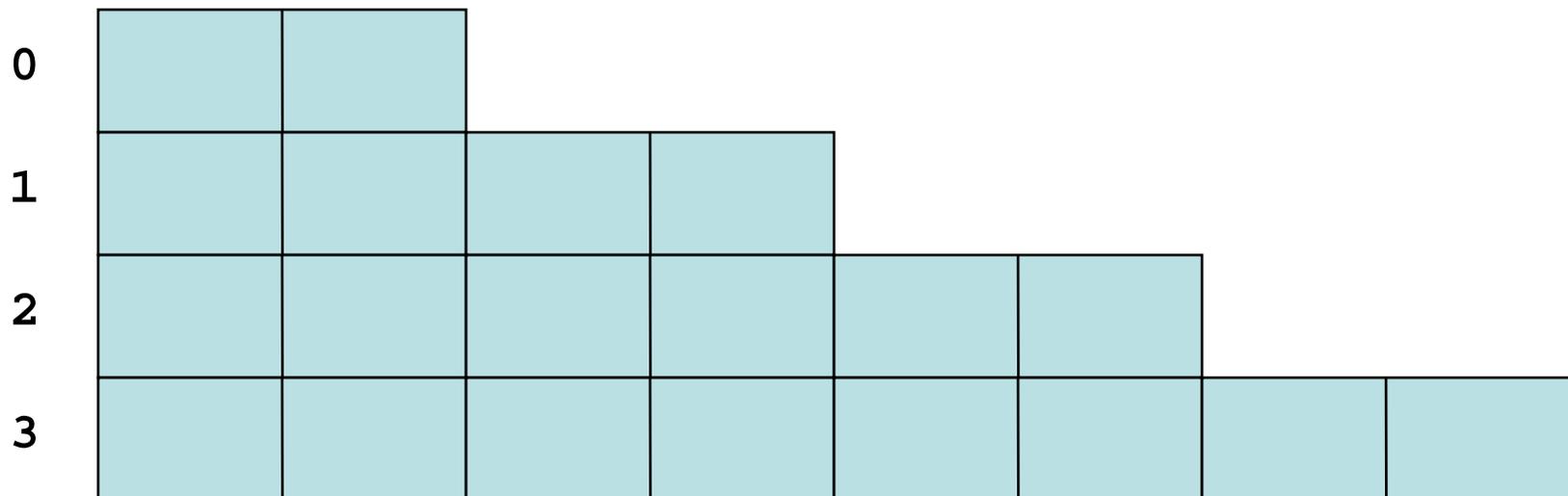
```
int twoDim[] [] = new int [4] [5] ;
```

	0	1	2	3	4
0					
1					
2					
3					

Array Multidimensional

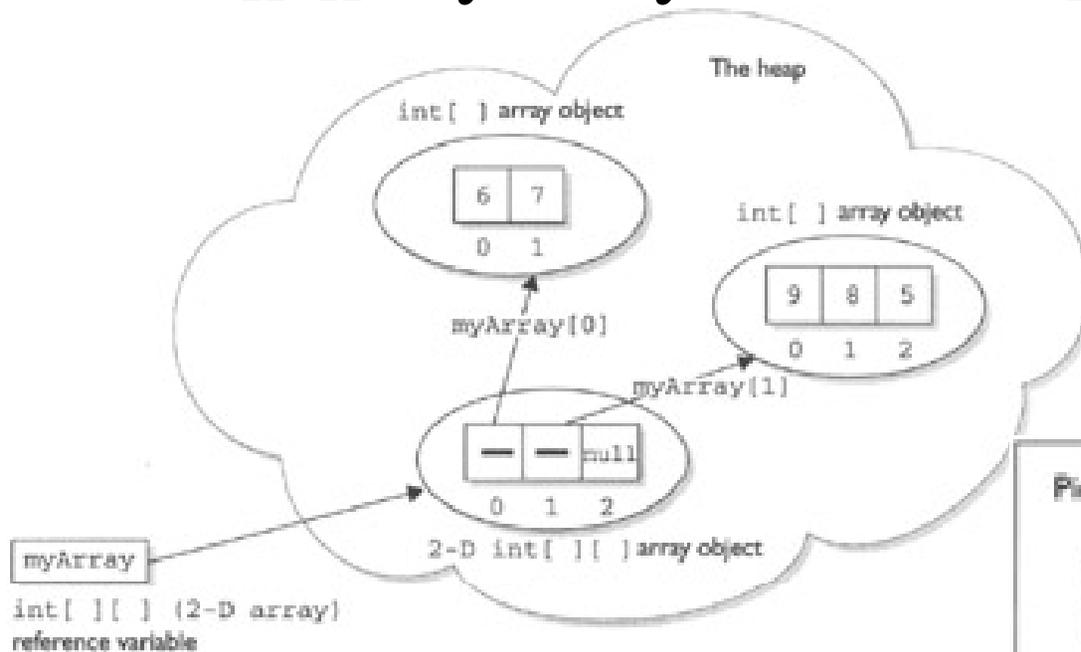
- Arrays of arrays yang bukan persegi panjang

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



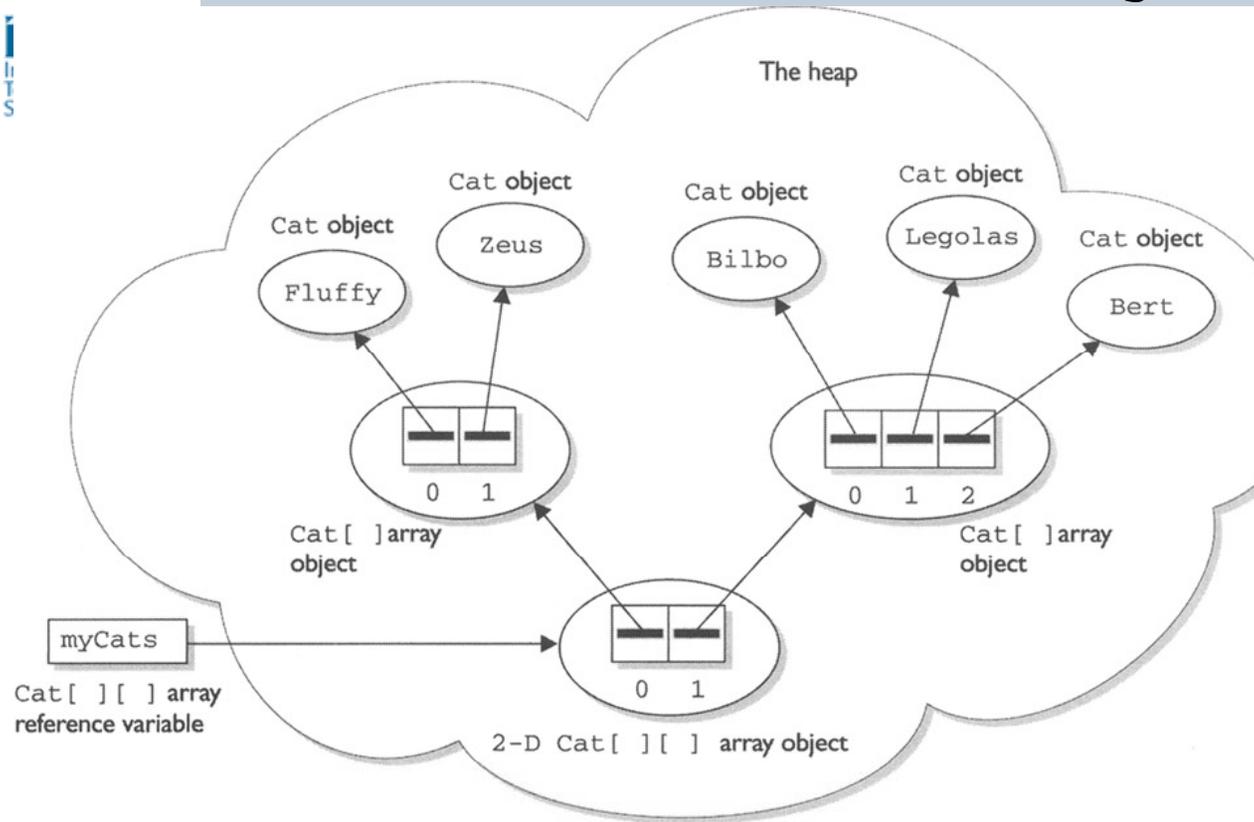
Create dua dimensional array

- `int[] [] myArray = new int [3] [];`



Picture demonstrates the result of the following code:

```
int[] [] myArray = new int[3][ ];
myArray[0] = new int[2];
myArray[0][0] = 6;
myArray[0][1] = 7;
myArray[1] = new int[3];
myArray[1][0] = 9;
myArray[1][1] = 8;
myArray[1][2] = 5;
```



Picture demonstrates the result of the following code:

```
Cat[ ][ ] myCats = {{new Cat("Fluffy"), new Cat("Zeus")},
{new Cat("Bilbo"), new Cat("Legolas"), new Cat("Bert")}}
```

Eight objects are created:

- 1 2-D `Cat[][]` array object
- 2 `Cat[]` array objects
- 5 `Cat` objects

Contoh program

```
int twoDim[][] = new int[2][];  
twoDim[0] = new int[3] ;  
twoDim[1] = new int[5] ;
```

```
System.out.println("Length pada Indeks ke-0 =" + twoDim[0].length);  
System.out.println("Length pada Indeks ke-1 =" + twoDim[1].length);
```

Hasil running

- Length pada Indeks ke-0 = 3
- Length pada Indeks ke-1 = 5

Contoh Program

```
int[][][] century = new int[2][3][4] ;  
System.out.println("Elemen pd Dimensi ke-1 = " + century.length) ;  
System.out.println("Elemen pd Dimensi ke-2 = " + century[0].length) ;  
System.out.println("Elemen pd Dimensi ke-3 = " + century[0][0].length) ;
```

Hasil running

- Elemen pd Dimensi ke-1 = 2
- Elemen pd Dimensi ke-2 = 3
- Elemen pd Dimensi ke-3 = 4

Contoh

- Terdapat sebuah array yang terdiri dari 4 baris, besar kolom tiap baris dibangkitkan secara random. Isi masing-masing dari array tersebut harus memenuhi aturan
 - Baris 0 : kelipatan 2
 - Baris 1 : kelipatan 3
 - Baris 2 : kelipatan 4
 - Baris 3 : kelipatan 5

0	2	4						
1	3	6	9	12				
2	4	8	12	16	20	24		
3	5	10	15	20	25	30	35	40

```
17 public class ArrayDim2{
18     public static void main(String args[]){
19         int twoDim[][] = new int[4][];
20         int i,j, r, awal;
21
22         System.out.println("KOLOM YANG DIBANGKITKAN");
23         for(i=0;i<twoDim.length;i++){
24             r = (int) (Math.random() * 10+1) ;
25             twoDim[i] = new int[r] ;
26             System.out.println("Baris ke-" + i + " = " + r);
27         }
28
29         System.out.println("\nMENGISI MATRIK");
30         awal = 2 ;
31         for(i=0;i<twoDim.length;i++){
32             for(j=0;j<twoDim[i].length;j++){
33                 twoDim[i][j] = awal * (j+1);
34                 System.out.print(twoDim[i][j]+" ");
35             }
36             awal++;
37             System.out.println();
38         }
39     }
40 }
```

- KOLOM YANG DIBANGKITKAN

Baris ke-0 = 1

Baris ke-1 = 8

Baris ke-2 = 7

Baris ke-3 = 4

- MENGISI MATRIK

2

3 6 9 12 15 18 21 24

4 8 12 16 20 24 28

5 10 15 20

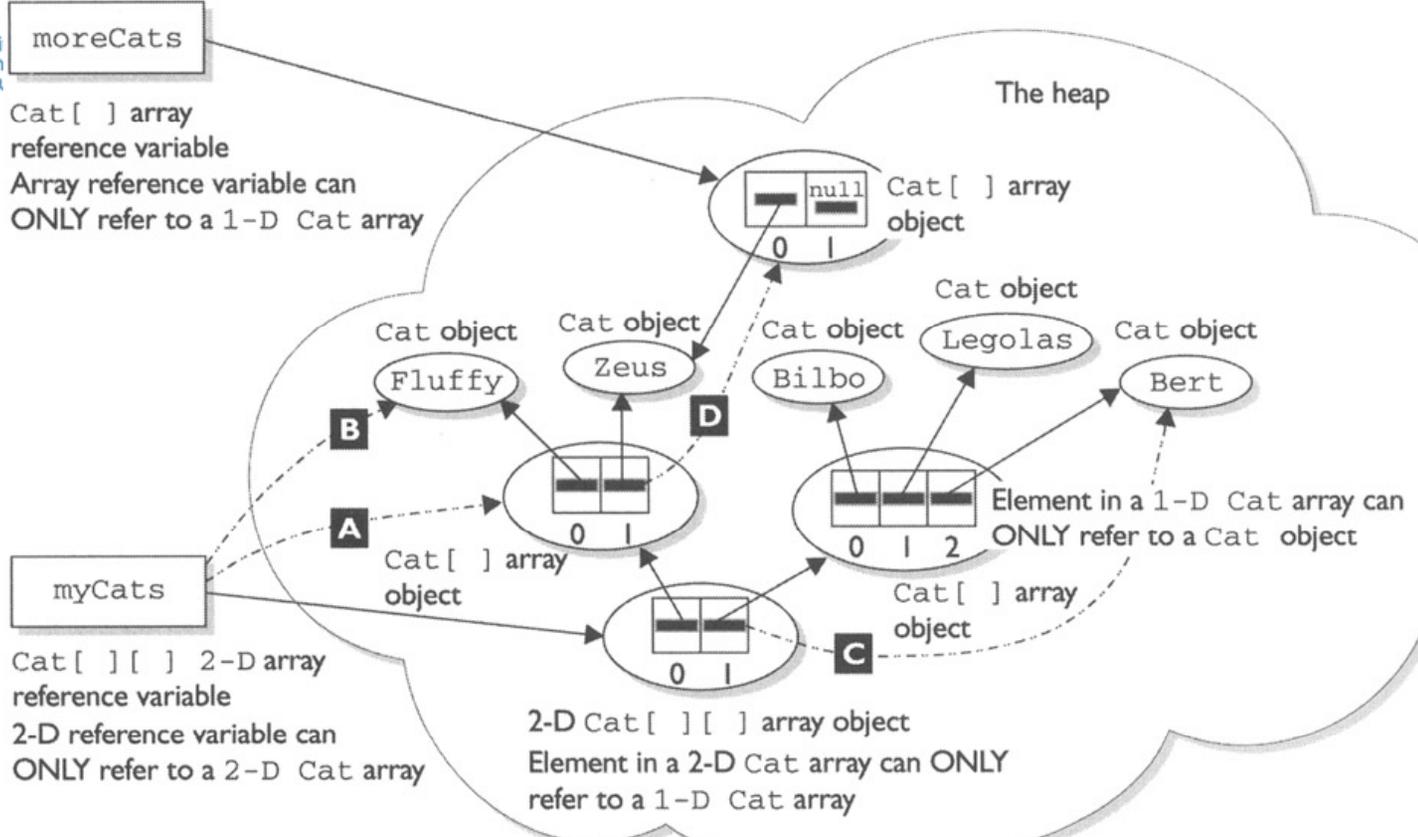


Array Reference Assignments for Multidimensional Arrays

```
int[] blots;
int[][] squeegees = new int [3][] ;
blots = squeegees;           // NOT OK, squeegees is a
                             // two-d array of int arrays

int[] blocks = new int[6] ;
blots = blocks;             // OK, blocks is an int array

int[][] books = new int[3][] ;
int[] numbers = new int[6];
int aNumber = 7;
books[0] = aNumber;        // NO, expecting an int array not an int
books[0] = numbers;       // OK, numbers is an int array
```



Illegal Array Reference Assignments

```

A myCats = myCats[0];
// Can't assign a 1-D array to a 2-D array reference

B myCats = myCats[0][0];
// Can't assign a nonarray object to a 2-D array reference

C myCats[1] = myCats[1][2];
// Can't assign a nonarray object to a 1-D array reference

D myCats[0][1] = moreCats;
// Can't assign an array object to a nonarray reference
//myCats[0][1] can only refer to a Cat object
  
```

KEY

- Legal
- - - - -→ Illegal

Array Resizing

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

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

Contoh Program

```
1 public class Array4{
2     public static void main(String args[]){
3         int myArray[] = new int[6];
4         int i ;
5         for(i=0 ; i<myArray.length;i++){
6             myArray[i] = i ;
7             System.out.print(myArray[i] + " ");
8         }
9
10        System.out.println("\nSetelah di Array Diperbesar");
11        myArray = new int[10] ;
12        for(i=0 ; i<myArray.length;i++){
13            myArray[i] = i ;
14            System.out.print(myArray[i] + " ");
15        }
16    }
17 }
```

Output

0 1 2 3 4 5

Setelah di Array Diperbesar

0 1 2 3 4 5 6 7 8 9

Copying Array

```
1 public class Array5 {  
2     public static void main(String args[]){  
3         int elements[] = {0,1,2,3,4,5,6};  
4         int hold[] = {10,9,8,7,6,5,4,3,2,1};  
5         System.arraycopy(elements,0,hold,0,elements.length);  
6         System.arraycopy(  
7             ) Object src int srcPos Object dest int destPos int length  
8     }
```

Hasil Running

- 1 2 3 4 5 6
- 1 2 3 4 5 6 4 3 2 1