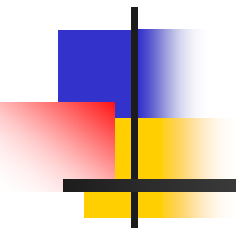
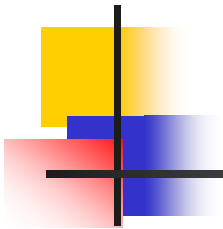
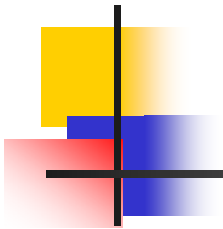


Arrays 1/4



Outline

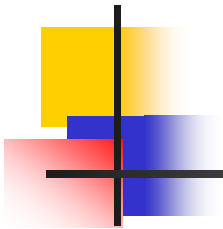
- Introduction
- Creating and Accessing Arrays
- Declaring and Creating an Array
- Referring to Arrays and Array Elements
- Three Ways to Use Square Brackets `[]` with an Array Name
- The **`length`** Instance Variable
- Initializing Arrays



- Introduction to Arrays

- An *array* is a data structure used to process a collection of data that is all of the same type
  - An array behaves like a numbered list of variables with a uniform naming mechanism
  - It has a part that does not change: the name of the array
  - It has a part that can change: an integer in square brackets
  - For example, given five scores:

    score[0], score[1], score[2], score[3], score[4]



- Creating and Accessing Arrays ...

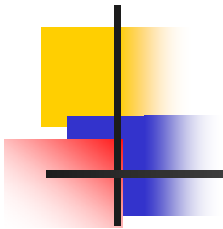
- An array that behaves like this collection of variables, all of type **`double`**, can be created using one statement as follows:

```
double[] score = new double[5];
```

- Or using two statements:

```
double[] score;
score = new double[5];
```

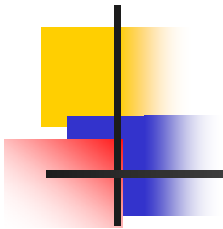
  - The first statement declares the variable **`score`** to be of the array type **`double[]`**
  - The second statement creates an array with five numbered variables of type **`double`** and makes the variable **`score`** a name for the array



... - Creating and Accessing Arrays ...

- The individual variables that together make up the array are called *indexed variables*
  - They can also be called *subscripted variables* or *elements* of the array
  - The number in square brackets is called an *index* or *subscript*
  - In Java, *indices must be numbered starting with* **`0`**, *and nothing else*

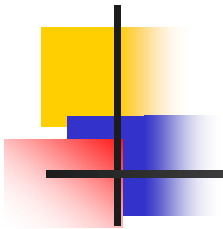
```
score[0], score[1], score[2], score[3], score[4]
```



... - Creating and Accessing Arrays ...

- The number of indexed variables in an array is called the *length* or *size* of the array
- When an array is created, the length of the array is given in square brackets after the array type
- The indexed variables are then numbered starting with **0**, and ending with the integer that is *one less than the length of the array*

score[0], score[1], score[2], score[3], score[4]



... - Creating and Accessing Arrays

```
double[] score = new double[5];
```

- A variable may be used in place of the integer (i.e., in place of the integer ***5*** above)
  - The value of this variable can then be read from the keyboard
  - This enables the size of the array to be determined when the program is run

```
double[] score = new double[count];
```

- An array can have indexed variables of any type, including any class type
- All of the indexed variables in a single array must be of the same type, called the *base type* of the array

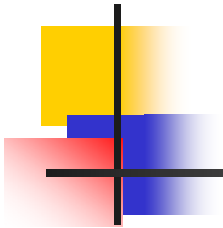
- Declaring and Creating an Array

- An array is declared and created in almost the same way that objects are declared and created:

```
BaseType[] ArrayName = new BaseType[size];
```

  - The ***size*** may be given as an expression that evaluates to a nonnegative integer, for example, an **int** variable

```
char[] line = new char[80];
double[] reading = new double[count];
Person[] specimen = new Person[100];
```



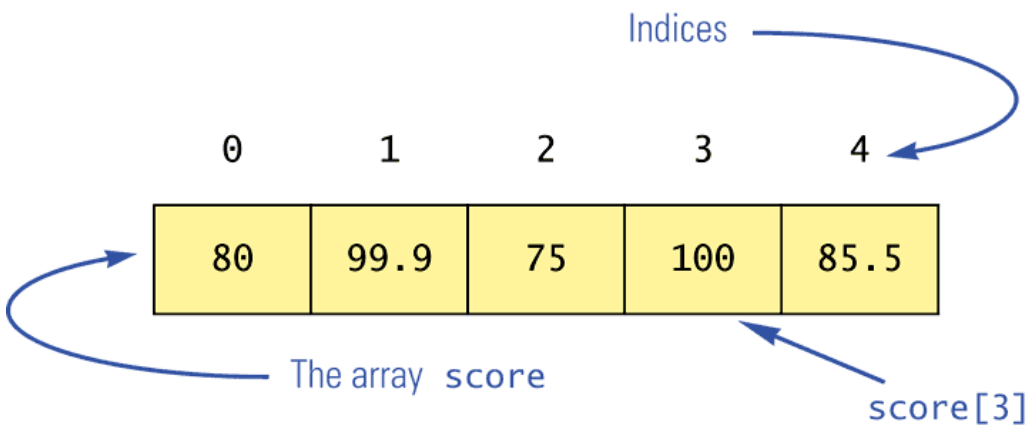
- Referring to Arrays and Array Elements

- Each array element can be used just like any other single variable by referring to it using an indexed expression: **`score[0]`**
- The array itself (i.e., the entire collection of indexed variables) can be referred to using the array name (without any square brackets): **`score`**
- An array index can be computed when a program is run
  - It may be represented by a variable: **`score[index]`**
  - It may be represented by an expression that evaluates to a suitable integer: **`score[next + 1]`**

-- Using the **score** Array in a Program

- The **for** loop is ideally suited for performing array manipulations:

```
for (index = 0; index < 5; index++)
    System.out.println(score[index] +
            " differs from max by " +
            (max-score[index]) );
```



- Three Ways to Use Square Brackets [ ] with an Array Name

- Square brackets can be used to create a type name:

```
double[] score;
```

- Square brackets can be used with an integer value as part of the special syntax Java uses to create a new array:

```
score = new double[5];
```

- Square brackets can be used to name an indexed variable of an array:

```
max = score[0];
```

- The `length` Instance Variable

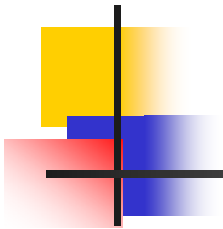
- An array is considered to be an object
- Since other objects can have instance variables, so can arrays
- Every array has exactly one instance variable named ***`length`***
  - When an array is created, the instance variable **`length`** is automatically set equal to its size
  - The value of **`length`** cannot be changed (other than by creating an entirely new array with **`new`**)

```
double[] score = new double[5];
```

  - Given **`score`** above, **`score.length`** has a value of 5

Pitfall: Array Index Out of Bounds

- Array indices always start with `0`, and always end with the integer that is one less than the size of the array
  - The most common programming error made when using arrays is attempting to use a nonexistent array index
- When an index expression evaluates to some value other than those allowed by the array declaration, the index is said to be *out of bounds*
  - An out of bounds index will cause a program to terminate with a run-time error message
  - Array indices get out of bounds most commonly at the *first* or *last* iteration of a loop that processes the array: Be sure to test for this!



- Initializing Arrays ...

- An array can be initialized when it is declared
  - Values for the indexed variables are enclosed in braces, and separated by commas
  - The array size is automatically set to the number of values in the braces

```
int[] age = {2, 12, 1};
```

  - Given **`age`** above, **`age.length`** has a value of 3

... - Initializing Arrays

- Another way of initializing an array is by using a **`for`** loop

```
double[] reading = new double[100];
int index;
for (index = 0;
     index < reading.length; index++)
  reading[index] = 42.0;
```

- If the elements of an array are not initialized explicitly, they will automatically be initialized to the default value for their base type

Pitfall: An Array of Characters Is Not a String

- An array of characters is conceptually a list of characters, and so is conceptually like a string
- However, an array of characters is not an object of the class **`String`**

```
char[] a = {'A', 'B', 'C'};
String s = a; //Illegal!
```

- An array of characters can be converted to an object of type **`String`**, however

Pitfall: An Array of Characters Is Not a String

- The class **`String`** has a constructor that has a single parameter of type **`char[]`**

```
String s = new String(a);
```

  - The object **`s`** will have the same sequence of characters as the entire array **`a`** (**`"ABC"`**), but is an *independent* copy

- Another **`String`** constructor uses a subrange of a character array instead

```
String s2 = new String(a,0,2);
```

  - Given **`a`** as before, the new string object is **`"AB"`**

Pitfall: An Array of Characters Is Not a String

- An array of characters does have some things in common with **`String`** objects
  - For example, an array of characters can be output using **`println`**

    ```
    System.out.println(a);
    ```

  - Given **`a`** as before, this would produce the output

    ```
    ABC
    ```

THE END