Structural Programming and Data Structures

Winter 2000

CMPUT 102: Arrays

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Course Content

- Introduction
- Objects
- Methods
- Tracing Programs
- Object State
- Sharing resources
- Selection
- Repetition
- Vectors
- Testing/Debugging
- **Arrays**
- Searching
- Files I/O
- Sorting
- Inheritance
- Recursion

Objectives of Lecture 20

Arrays

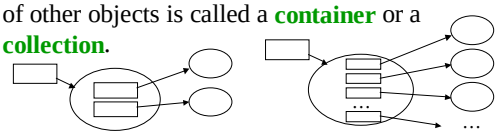
- Introduce another Java container class called Array.
- Compare Arrays with Vectors
- See some examples with Arrays.

Outline of Lecture 20

- Arrays
- Arrays versus Vectors
- Two simple array examples

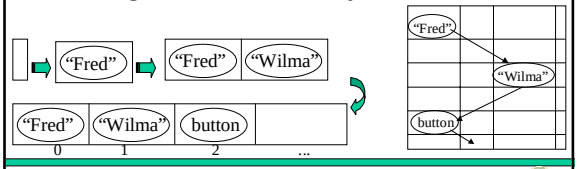
Containers - Review

- An object's state consists of instance variables that are bound to other objects or values.
- Sometimes it is useful for an object's state to include an arbitrary number of other objects.
- An object that remembers an arbitrary number of other objects is called a **container** or a **collection**.



Vector: an Indexed Collection

- Vectors are containers whose elements are indexed by integers are called indexed containers.
- A Vector, can hold any kind of Objects, but not values.
- The integer indexes are the object references.



Vector: Condition of use

- A Vector is indexed by non-negative ints so it can be accessed by position;
- The first position is 0, not 1;
- A Vector knows its current size;
- A vector is initially empty and of size 0;
- The size of a vector is not known in advance.
- A Vector can be iterated by index;
- When you access an Object in a Vector, you must **cast** its type to use it.

```
myCD=(CompactDisc) myCollection.ElementAt(index);
```


Java Arrays - Declarations

- In Java there is a container called an array that can hold an arbitrary number of Objects or values.
- Since arrays can contain values, they can sometimes be used when Vectors cannot.
- An array is declared using brackets:

```
int    markArray[];
Person personArray[];
String stringArray[];
```

or

```
int[]    markArray;
Person[] personArray;
String[] stringArray;
```


Java Arrays - Constructors

- When an array is created, its size must be specified and the size cannot change.
- Since the size of an array is fixed when it is created, Vectors can sometimes be used when arrays cannot.
- An array is created using an array constructor:

```
markArray = new int[30];
personArray = new Person[30];
stringArray = new String[10];
```

54	78	90	60	
Fred	Wilma			

Java Arrays - Accessing

- Array elements can be accessed using brackets: markArray[3].
- The length of an array can be obtained using the public length attribute (not a message): markArray.length.
- Since arrays are indexed, starting at zero, the indexes go from: 0 to length - 1.

```
// add 5 to  all elements of an array
for (index = 0; index < markArray.length; index++)
   markArray[index] = markArray[index] + 5;
```


Java Arrays - Literal Initializers

- Literal values can be put into an array using braces.

```
int    markArray[] = { 10, 20, 30, 40, 50};
String stringArray[] = {"Fred", "Barney"};
```


Outline of Lecture 20

- Arrays
- Arrays versus Vectors
- Two simple array examples

Multidimensional Arrays

- We ca have vectors inside a vector;
- Arrays can be multidimensional;

int numList[2][3];

int numbers[][] = {{1,2,3},{4,5,6}};

int oneNumber = numbers[1][2];

1	2	3
4	5	6

Warning: Do not try to access an element that dos not exist (i.e. and index beyond the size of the array or array dimension)

6 onNumber

Vectors and Arrays

- An array is a list (multidimensional lists) of object/values of the same type, while a vector is a list of objects of any type
- An array is a structure, not an object, and thus can be accessed relatively faster while an vector is an object accessible only by sending messages
- arrays are fixed sized and cannot grow while vectors are dynamic collections of objects

Accessing Vectors vs. Accessing Arrays

- Arrays: reference the arrays at a given index;

myVariable = myArray[index];

- Vectors: send a message elementAt to vector.

myObject = (objectClass)myVector.elementAt(index);

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Array Example

```
// Find the largest element in an array of ints

int  markArray[] = {50, 37, 71, 99, 63};
int  index;
int  max;
index = 0;
max = markArray[index];
for (index = 1; index < markArray.length; index++)
        if (markArray[index] > max)
                max = markArray[index];
System.out.println(max);
```

markArray

50	0
37	1
71	2
99	3
63	4

index=5

max

99

Array Example2

```
// Find the index of the largest element in an
array of ints
int  markArray[] = {50, 37, 71, 99, 63};
int  index;
int  indexOfMax;
index = 0;
indexOfMax = 0;
for (index = 1; index < markArray.length; index++)
  if (markArray[index] > markArray[indexOfMax])
    indexOfMax = index;
System.out.println(indexOfMax);
```

markArray

50	0
37	1
71	2
99	3
63	4

index = 5

indexOfMax

3

Java Multidimensional Array Example

```
// multidimentional array
int  matrix[][] = { {0, 1, 2, 3}, {1, 0, 3, 2}, {2, 3, 0, 1}, {3, 2, 1, 0} };
int row, column;
  for ( row = 0; row < 4; row++ ) {
    for ( column = 0; column < 4; column++)
      System.out.print("    " + matrix[row][column]);
    System.out.println();
  }
  }
}
```

0	1	2	3
1	0	3	2
2	3	0	1
3	2	1	0