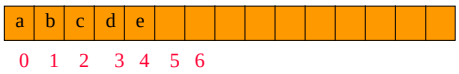
Data Representation Methods


array --- Chapter 5
linked --- Chapter 6
simulated pointer --- Chapter 7

Linear List Array Representation

use a one-dimensional array element[]



L = (a, b, c, d, e)

Store element i of list in element[i].

Right To Left Mapping

Mapping That Skips Every Other Position

Wrap Around Mapping

Representation Used In Text

0 1 2 3 4 5 6 size = 5

put element i of list in element[i]

use a variable size to record current number of elements

Add/Remove An Element

size = 5

add(1,g)

size = 6

Data Type Of Array element[]

Data type of list elements is unknown.

Define element[] to be of data type Object.

Cannot put elements of primitive data types (int, float, double, char, etc.) into our linear lists.

Length of Array element[]

Don't know how many elements will be in list.

Must pick an initial length and dynamically increase as needed.

Increasing Array Length

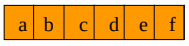
Length of array element[] is 6.

First create a new and larger array

newArray = new Object[15];

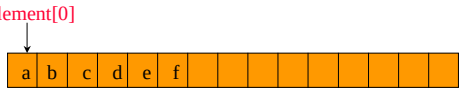
Increasing Array Length

Now copy elements from old array to new one.



Increasing Array Length

Finally, rename new array.
element = newArray;



element.length = 15

Altogether Now

```
// create a new array of proper length and data type
Object [] newArray = new Object [newLength];

// copy all elements from old array into new one
System.arraycopy(element, 0, newArray, 0,
      element.length);

// rename array
element = newArray;
```

```
public static Object [] changeLength(Object [] a,
                                     int newLength)
{
   Object [] newArray = new Object [newLength];
   System.arrayCopy(…);
   return newArray;
}
Integer [] a = new Integer [10];
….
a = (Integer []) changeLength(a, 100); // erroneous
```

How Big Should The New Array Be?

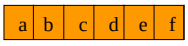
At least 1 more than current array length.

Cost of increasing array length is
Theta(new length)

Cost of n add operations done on an initially empty linear list increases by
Theta(n^2)

Space Complexity

element[6]



newArray = new char[7];

space needed = 2 * newLength – 1
= 2 * maxListSize – 1

Array Doubling

Double the array length.

newArray = new char[12];

Time for n adds goes up by Theta(n).

Space needed = 1.5*newLength.

Space needed <= 3*maxListSize – 3

How Big Should The New Array Be?

Resizing by any constant factor
new length = c * old length
increases the cost of n adds by Theta(n).

Resizing by an additive constant increases the cost of n add operations by Theta(n^2).

How Big Should The New Array Be?

Resizing by any constant factor
new length = c * old length
requires at most (1+c) * (maxListSize -1) space.

Resizing by an additive constant c requires at most (maxListSize – 1) + (maxListSize – 1 + c)
= 2 * (maxListSize – 1) + c space.

What Does Java Do?

java.util.Vector … array doubling

java.util.ArrayList … c = 1.5

dataStructures.ArrayLinearList of text … c = 2