AP Computer Science A

Java Programming Essentials [Ver. 2.0]

Unit 3: Basic Data Structure

WEEK 14: ARRAYLIST (PART 2: ARRAYLIST PROCESSING)

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Objectives

- ArrayList Processing II: reverse of a list, sorting of a list, ListIterator
- Information List: Occurrence List, Available list, Non-recurring list, interval list, difference list (Generation of special lists)
- Abstract Data Types: (Basic Data Structures)
- Enum (Non-AP Topics)
- Washington High School Project
- Bible word count sorted by occurrence project

ArrayList Processing II

LECTURE 1

ArrayList Processing II

ArrayListProcessingII.java

1. Traversal of ArrayList (by index, object, object pointer)
2. Iterator and ListIterator
3. ArrayList of user-defined Class
4. Occurrence List (Char freq and bible.txt **WordCountArrayList.java**)
5. Reverse of List
6. Sorting of Array by ArrayList

[1] How to traverse through ArrayList?

(1) By index: (access by **index**)

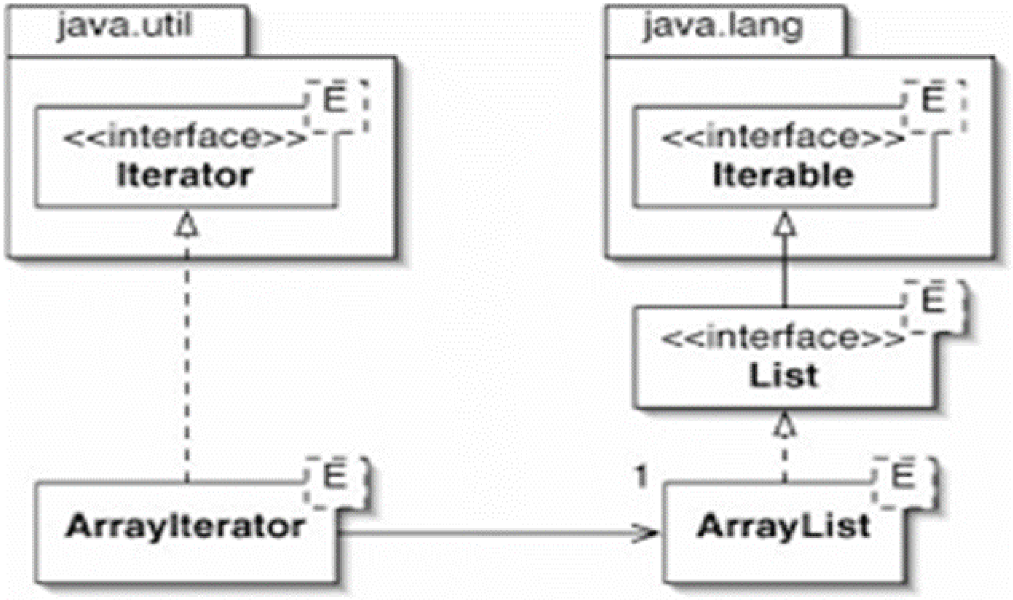
```
for (int index=0; i<arrayList.size(); i++)
    System.out.println(arrayList.get(i));
```

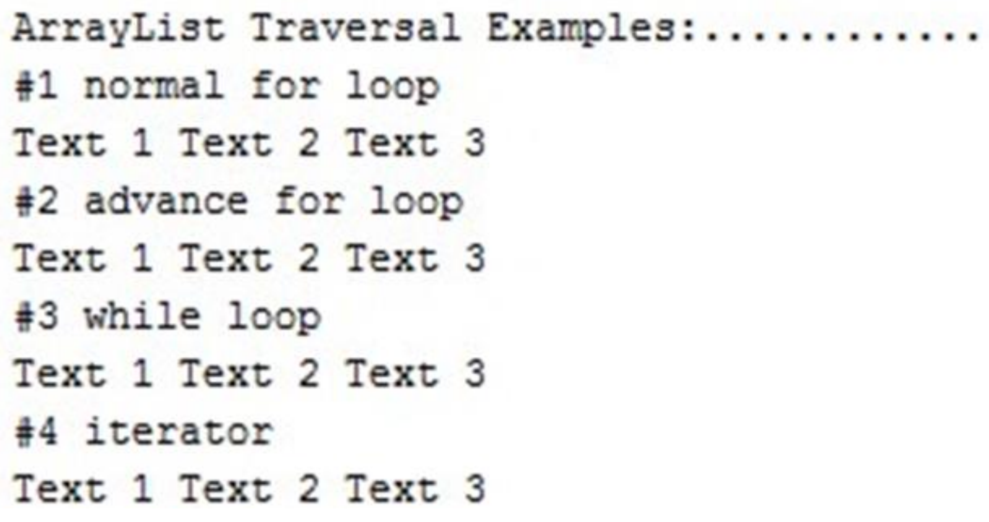
(2) for-each loop: (access by **object**)

```
for (String e: arrayList)
    System.out.println(e);
```

(3) Iterator: (access by **object pointer**)

```
Iterator<String> itr = arrayList.iterator();
while (itr.hasNext())
     System.out.println(itr.next());
```





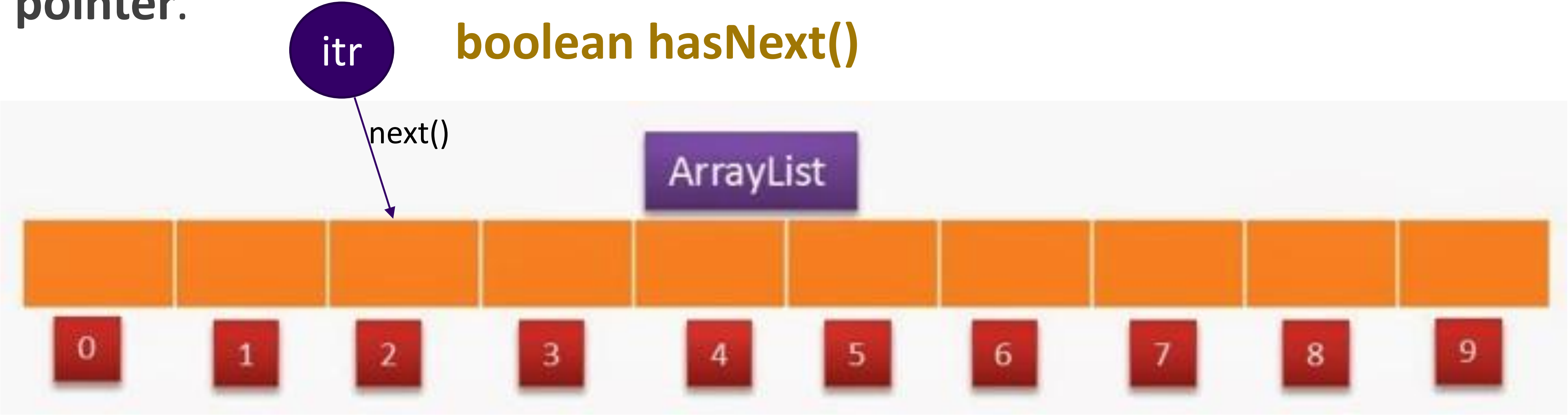
```
ArrayList Traversal Examples:...........
#1 normal for loop
Text 1 Text 2 Text 3
#2 advance for loop
Text 1 Text 2 Text 3
#3 while loop
Text 1 Text 2 Text 3
#4 iterator
Text 1 Text 2 Text 3
```

[2] Index versus Iterator

(Primitive type pointer versus Object Type Pointer)

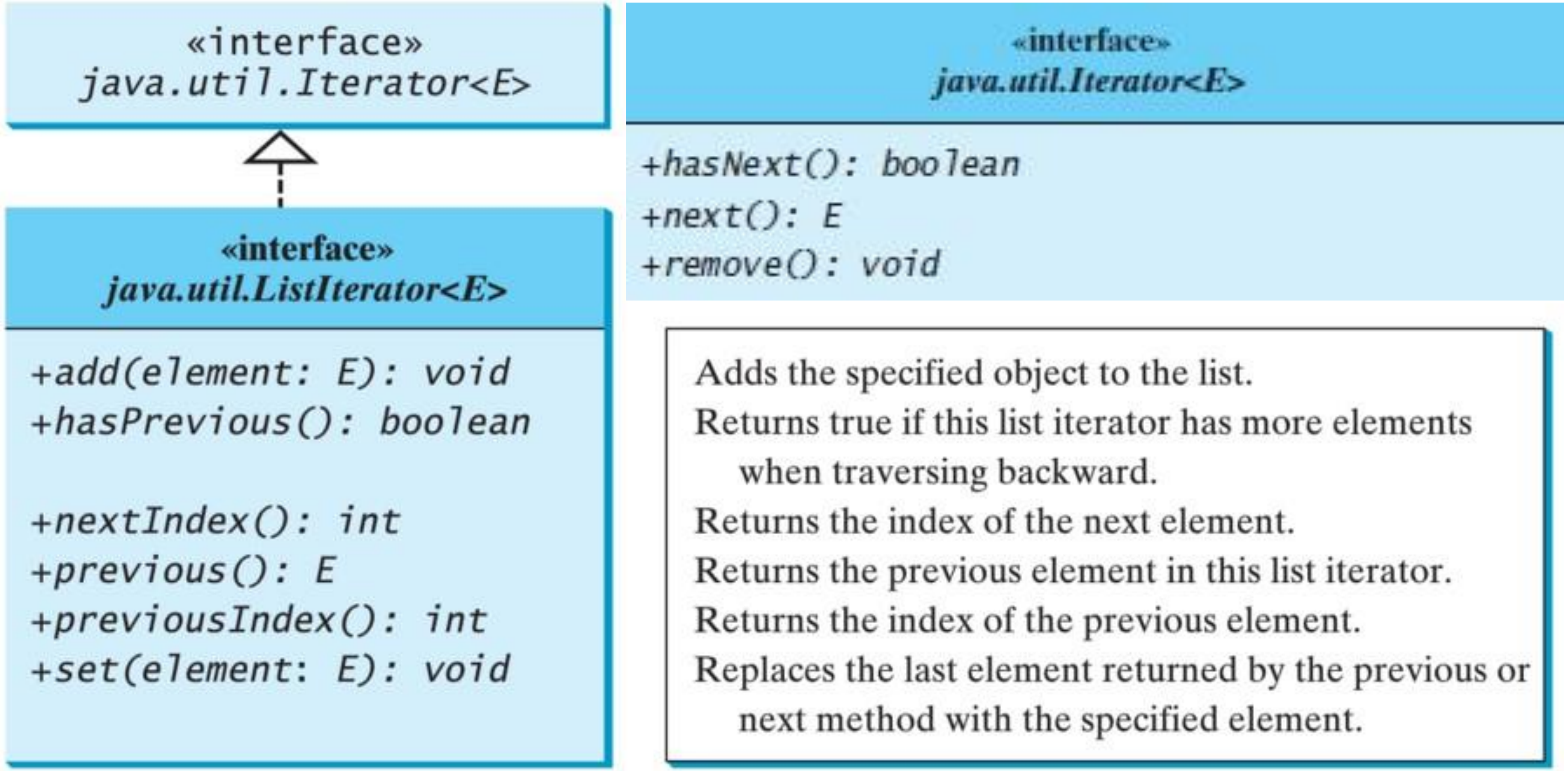
- You may have heard of me talking about input stream handler(Scanner), file handler(File), and XYZ handlers. Handler is a pointer to an object. It is an object itself. It is an **object-type pointer**.

boolean hasNext()



Iterator of ArrayList (Iterator and ListIterator)

Iterator<ElementType> itr = arraylist.iterator();
ListIterator<ElementType> itr = arraylist.iterator();



«interface»
java.util.Iterator<E>

«interface»
java.util.Iterator<E>

```
+hasNext(): boolean
+next(): E
+remove(): void
```

«interface»
java.util.ListIterator<E>

```
+add(element: E): void
+hasPrevious(): boolean

+nextIndex(): int
+previous(): E
+previousIndex(): int
+set(element: E): void
```

Adds the specified object to the list.
Returns true if this list iterator has more elements when traversing backward.
Returns the index of the next element.
Returns the previous element in this list iterator.
Returns the index of the previous element.
Replaces the last element returned by the previous or next method with the specified element.

ListIterator Versus Iterator

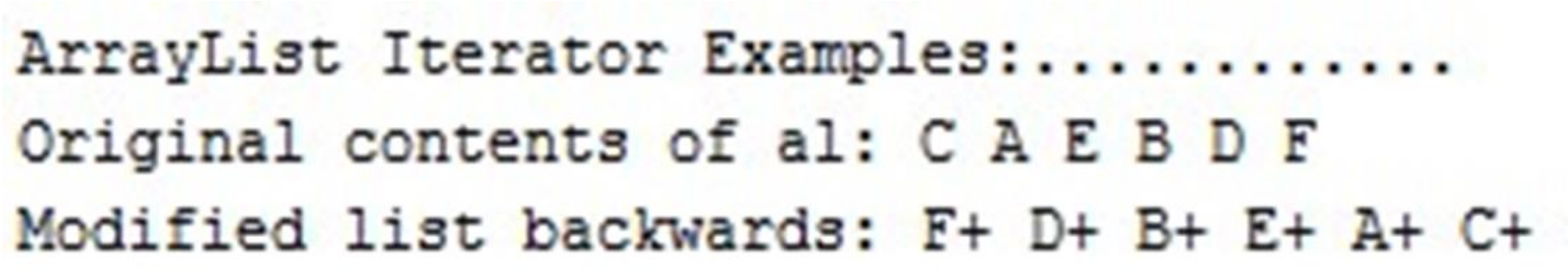
```
public static void iteratorExample() {
   System.out.println("ArrayList Iterator Examples:............");
   ArrayList<String> al = new ArrayList<String>();
   al.add("C"); al.add("A"); al.add("E");
   al.add("B"); al.add("D"); al.add("F");
   System.out.print("Original contents of al: ");

   Iterator<String> itr = al.iterator();
   while (itr.hasNext()) {
     String element = itr.next();
     System.out.print(element + " ");
   }
   System.out.println();
```

ListIterator Versus Iterator

```
  ListIterator<String> litr = al.listIterator();
  while (litr.hasNext()) {
    String element = litr.next();
    litr.set(element + "+");
  }

  // Now, display the list backwards.
  System.out.print("Modified list backwards: ");
  while (litr.hasPrevious()) {
    String element = litr.previous();
    System.out.print(element + " ");
  }
}
```

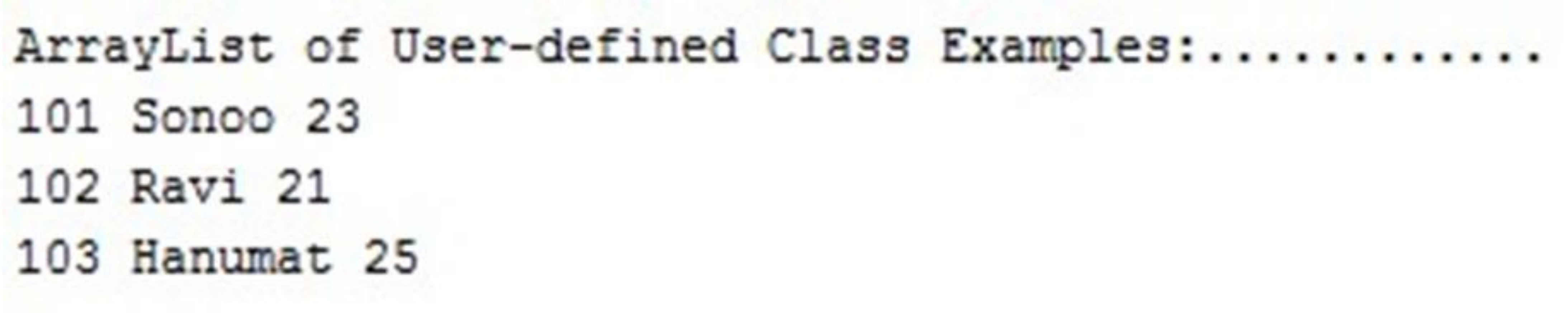


```
ArrayList Iterator Examples:............
Original contents of al: C A E B D F
Modified list backwards: F+ D+ B+ E+ A+ C+
```

[3] ArrayList of User-Defined Class

```
static class Student{
   int rollno;
   String name;
   int age;
   Student(int rollno,String name,int age){
    this.rollno=rollno;
    this.name=name;
    this.age=age;
   }
 }
```

```
public static void userDefinedClass(){
   System.out.println("ArrayList of User-defined Class Examples:...........");
   //Creating user-defined class objects
   Student s1=new Student(101,"Sonoo",23);
   Student s2=new Student(102,"Ravi",21);
   Student s3=new Student(103,"Hanumat",25);
   ArrayList<Student> al=new ArrayList<Student>();  //creating arraylist
   al.add(s1);      //adding Student class object
   al.add(s2);
   al.add(s3);
   Iterator itr=al.iterator();
   //traversing elements of ArrayList object
   while(itr.hasNext()){
     Student st=(Student)itr.next();
     System.out.println(st.rollno+" "+st.name+" "+st.age);
   }
  }
```



```
ArrayList of User-defined Class Examples:...........
101 Sonoo 23
102 Ravi 21
103 Hanumat 25
```

[4] Character Occurrence Counting

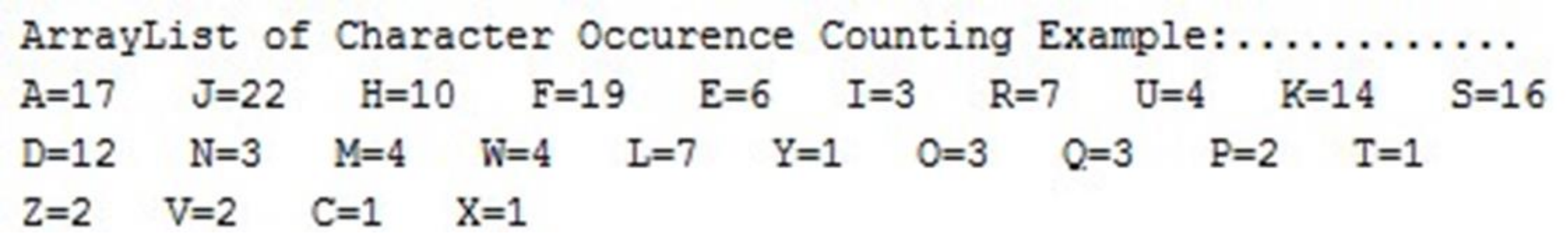
```
char[] cc = {A,J,A,H,F,A,E,I,R,U,I,J,F,K,S,A,J,F,K,D,S,A,K,F,H,J,D,S,H,F,D,S,N,M,
             A,N,R,W,E,M,H,F,J, H,F,J,K,L,D,S,A,H,F,J,H,D,S,A,J,K,H,F,J,K,D,S,
             A,H,J,R,E,Y,W,O,H,F,D,S,J,F,L,K,A,J,F,K, J,D,S,L,K,A,F,J,S,A,U,O,
             R,E,U,W,O,F,J,L,S,A,J,F,K,L,D,S,J,A,F,K,L,S,D,J,R,Q,P,U,R,I,Q,E,J,
             T,J,Z,M,M,V,Z,C,X,N,V,A,D,J,K,A,S,J,F,S,P,R,E,W,Q,F,K,A,K,F,D,L,S};

ArrayList<Character> cccc = new ArrayList<Character>();// dictionary list

ArrayList<Integer>   freq = new ArrayList<Integer>();  // occurrence count list
```

[4] Character Occurrence Counting

```
 for (char c: cc){
          boolean found = false;
           for (int i=0; i<cccc.size(); i++){
                // found c in the cccc (dictionary)
                if (cccc.contains(new Character(c))){
                    int j = cccc.indexOf(new Character(c));
                    int k =freq.get(j); k++; freq.set(j, k);  found = true;  break;
                }
            }
           //new, add c to dictionary, not 1 (int type)
           if (!found) {cccc.add(c); freq.add(new Integer(1));}
}
```



```
ArrayList of Character Occurence Counting Example:............
A=17    J=22    H=10    F=19    E=6    I=3    R=7    U=4    K=14    S=16
D=12    N=3    M=4    W=4    L=7    Y=1    O=3    Q=3    P=2    T=1
Z=2    V=2    C=1    X=1
```

Word Occurrence Count

WordCountArrayList.java

```
// ArrayList Version:  New Dictionary Represenation
    static class Word {
      String name = "";
      int count = 0;
    }
static ArrayList<Word> dict = new ArrayList<Word>();
```

Note:

(1)getter method (**get()**) does not only return an object in the arraylist but also work as an **object pointer**. Using it can access the data in the object.

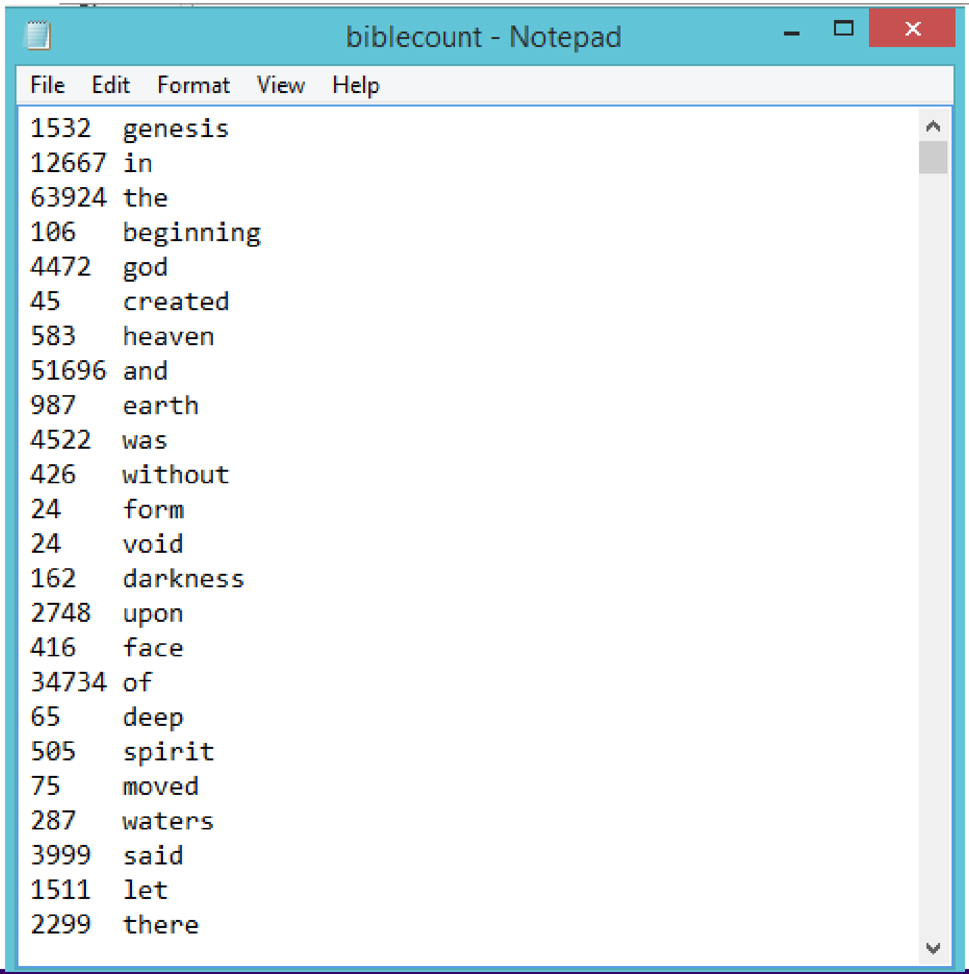
(2)dict.get(i) works like words[i]

Word Occurrence Count

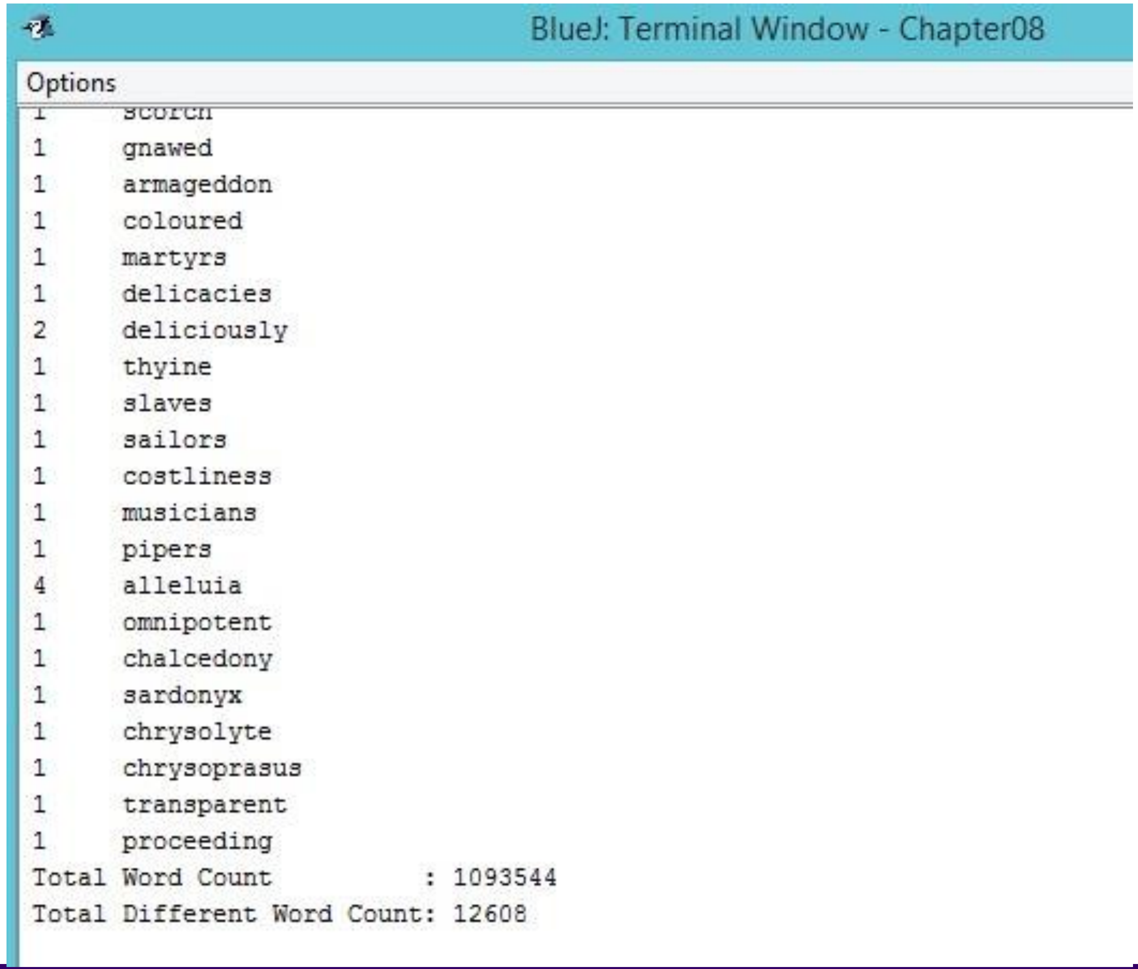
WordCountArrayList.java

```
for (int i =0; i<words.length; i++) {
         found = false;
         words[i] = words[i].trim();
         if (!words[i].equals("")){ // for non-empty strings
    for (int j=0; j<dict.size() && !found; j++)
       if (words[i].equals(dict.get(j).name)){
          dict.get(j).count++;   found = true;
              } // try to find new word in dictionary
    If (!found){   Word a = new Word();
              a.name = words[i];
              a.count++;
              dict.add(a);
            } // word not found in current dictionary.
         }
       }
```

WordCountArrayList.java Output



```
1532   genesis
12667  in
63924  the
106    beginning
4472   god
45     created
583    heaven
51696  and
987    earth
4522   was
426    without
24     form
24     void
162    darkness
2748   upon
416    face
34734  of
65     deep
505    spirit
75     moved
287    waters
3999   said
1511   let
2299   there
```



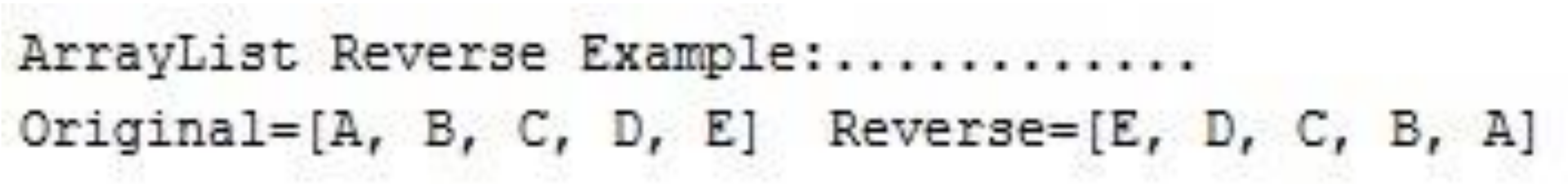
```
1      scorch
1      gnawed
1      armageddon
1      coloured
1      martyrs
1      delicacies
2      deliciously
1      thyine
1      slaves
1      sailors
1      costliness
1      musicians
1      pipers
4      alleluia
1      omnipotent
1      chalcedony
1      sardonyx
1      chrysolyte
1      chrysoprasus
1      transparent
1      proceeding
Total Word Count          : 1093544
Total Different Word Count: 12608
```

Demonstration Program

WORDCOUNTARRAYLIST.JAVA

[5] ArrayList Reverse Example:

```
ArrayList<Character> original = new ArrayList<Character>(Arrays.asList(new
Character[]{A, B, C, D, E}));
ArrayList<Character> reverse = new ArrayList<Character>();
// perform reverse
for (int i=original.size()-1; i>=0; i--) reverse.add(original.get(i));
// print out
System.out.println("Original="+original+"  Reverse="+reverse);
```



```
ArrayList Reverse Example:............
Original=[A, B, C, D, E]  Reverse=[E, D, C, B, A]
```

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

```
ArrayList<Character> newcccc = new ArrayList<Character>();
ArrayList<Integer>   newfreq = new ArrayList<Integer>();
int len = cccc.size();
for (int i=0; i<len; i++){
        int min = min(freq);
        Character ccc = cccc.get(freq.indexOf(min));
        Integer   iii = freq.get(freq.indexOf(min));
        newcccc.add(ccc);
        newfreq.add(iii);
        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```

freq	4	3	5	2	16	7
cccc	A	E	W	Y	Z	C

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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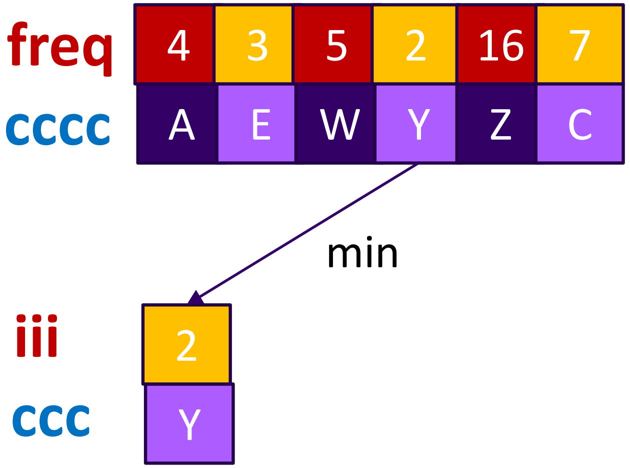

freq	4	3	5	2	16	7
cccc	A	E	W	Y	Z	C

iii	2
ccc	Y

[6] Sorting on Occurrence of Character

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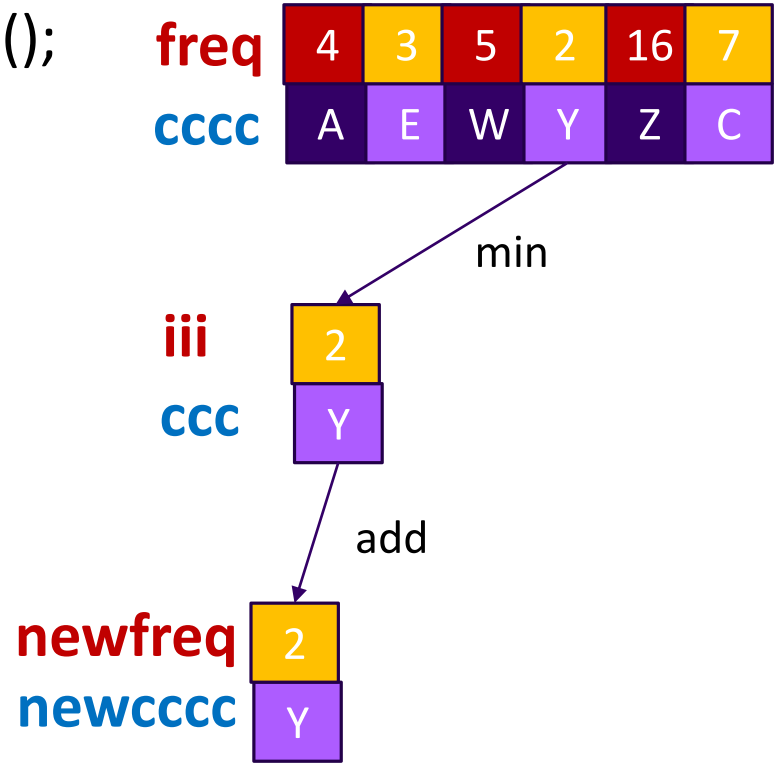
}
```



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        Integer   iii = freq.get(freq.indexOf(min));
        newcccc.add(ccc);
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        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```

freq	4	3	5	16	7
cccc	A	E	W	Z	C

iii	2
ccc	Y

newfreq	2
newcccc	Y

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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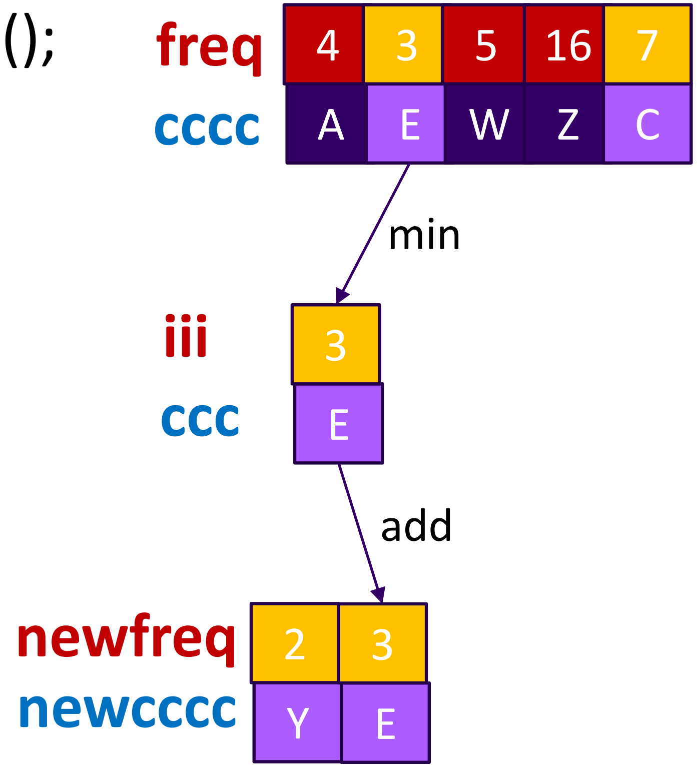

freq	4	3	5	16	7
cccc	A	E	W	Z	C

iii	3
ccc	E

newfreq	2	3
newcccc	Y	E

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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        newfreq.add(iii);
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freq	4	5	16	7
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newfreq	2	3
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(follow-up of Counting the Occurrence of Character)

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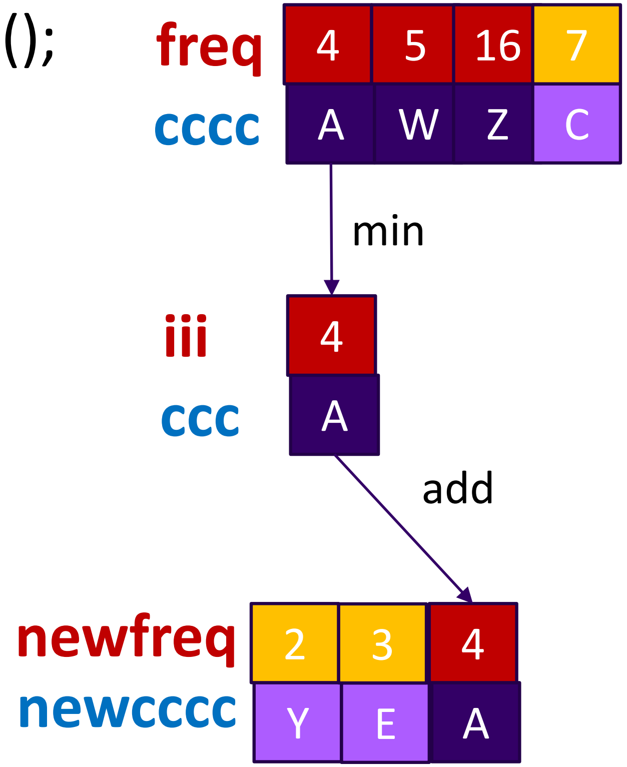
        newfreq.add(iii);
        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```



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        Character ccc = cccc.get(freq.indexOf(min));
        Integer   iii = freq.get(freq.indexOf(min));
        newcccc.add(ccc);
        newfreq.add(iii);
        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```

freq	5	16	7
cccc	W	Z	C

iii	4
ccc	A

newfreq	2	3	4
newcccc	Y	E	A

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

```
ArrayList<Character> newcccc = new ArrayList<Character>();
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        freq.remove(freq.indexOf(min));
}
```

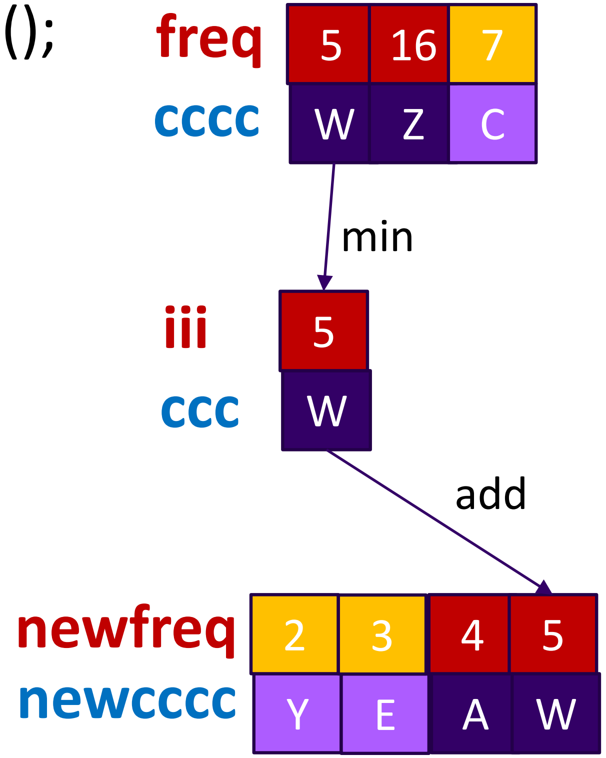

freq 5 16 7

cccc W Z C

min

iii 5

ccc W

add

newfreq 2 3 4 5

newcccc Y E A W

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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        Integer   iii = freq.get(freq.indexOf(min));
        newcccc.add(ccc);
        newfreq.add(iii);
        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```

freq	16	7
cccc	Z	C

iii	5
ccc	W

newfreq	2	3	4	5
newcccc	Y	E	A	W

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

```
ArrayList<Character> newcccc = new ArrayList<Character>();
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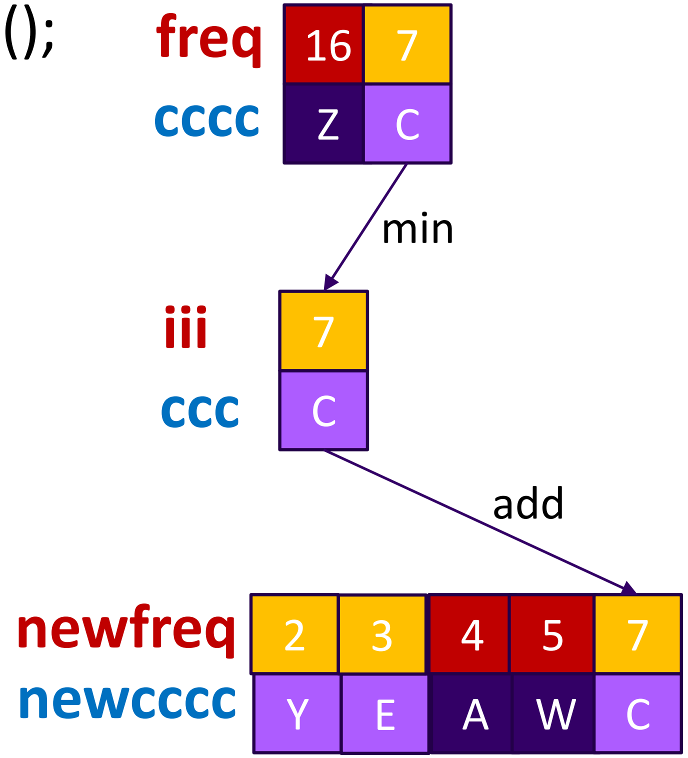
}
```



[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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        freq.remove(freq.indexOf(min));
}
```

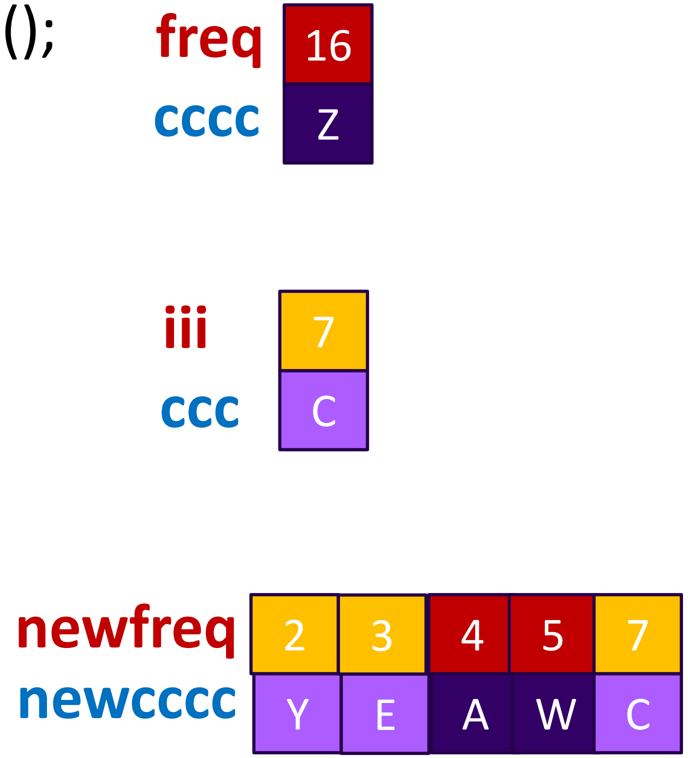

freq	16
cccc	Z

iii	7
ccc	C

newfreq	2	3	4	5	7
newcccc	Y	E	A	W	C

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

```
ArrayList<Character> newcccc = new ArrayList<Character>();
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        Integer   iii = freq.get(freq.indexOf(min));
        newcccc.add(ccc);
        newfreq.add(iii);
        cccc.remove(freq.indexOf(min));
        freq.remove(freq.indexOf(min));
}
```

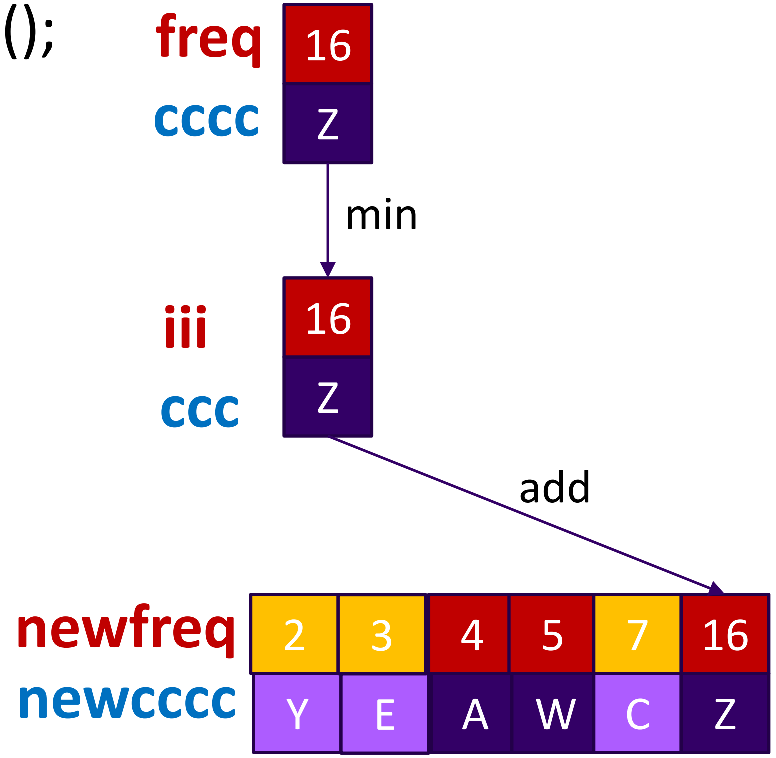

[6] Sorting on Occurrence of Character

(follow-up of Counting the Occurrence of Character)

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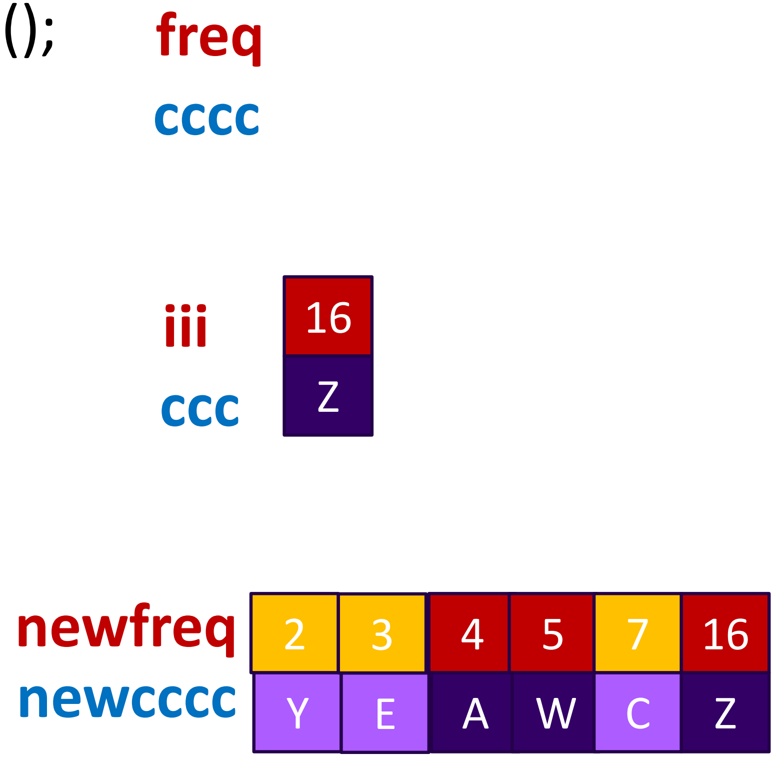


freq

cccc

iii	16
ccc	Z

newfreq	2	3	4	5	7	16
newcccc	Y	E	A	W	C	Z

[6] Sorting by ArrayList

Advantage:

- Easiest to understand.
- Easy to use.
- Less than 10 lines of code.

Disadvantage:

- O(n^2) Algorithm. Slow in performance.

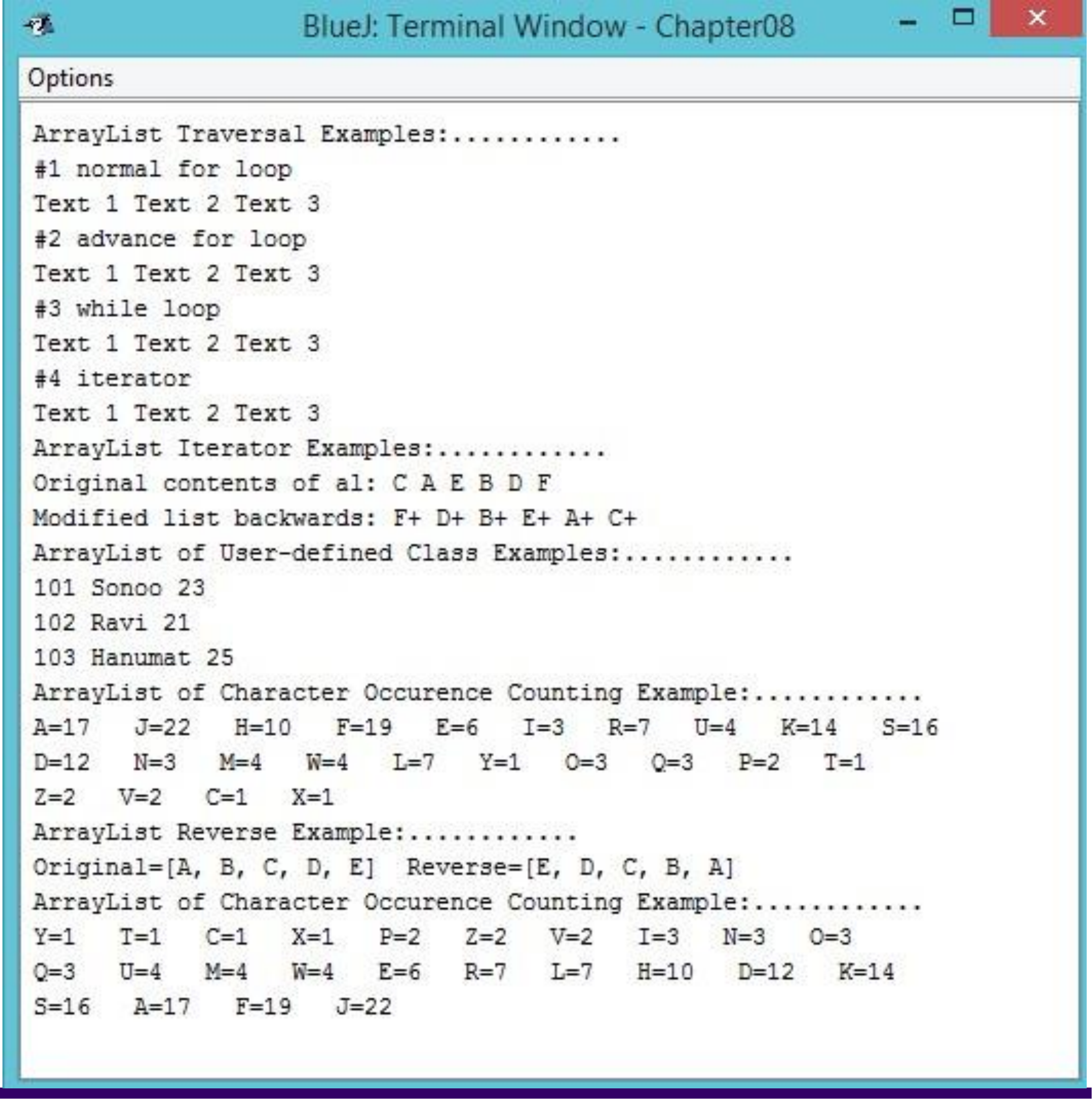
Download

ArrayProcessingII.java

WordCountArrayList.java

bible.txt

In ArrayProcessingII.zip



```
ArrayList Traversal Examples:............
#1 normal for loop
Text 1 Text 2 Text 3
#2 advance for loop
Text 1 Text 2 Text 3
#3 while loop
Text 1 Text 2 Text 3
#4 iterator
Text 1 Text 2 Text 3
ArrayList Iterator Examples:............
Original contents of al: C A E B D F
Modified list backwards: F+ D+ B+ E+ A+ C+
ArrayList of User-defined Class Examples:............
101 Sonoo 23
102 Ravi 21
103 Hanumat 25
ArrayList of Character Occurence Counting Example:............
A=17    J=22    H=10    F=19    E=6    I=3    R=7    U=4    K=14    S=16
D=12    N=3    M=4    W=4    L=7    Y=1    O=3    Q=3    P=2    T=1
Z=2    V=2    C=1    X=1
ArrayList Reverse Example:............
Original=[A, B, C, D, E]  Reverse=[E, D, C, B, A]
ArrayList of Character Occurence Counting Example:............
Y=1    T=1    C=1    X=1    P=2    Z=2    V=2    I=3    N=3    O=3
Q=3    U=4    M=4    W=4    E=6    R=7    L=7    H=10    D=12    K=14
S=16    A=17    F=19    J=22
```

Parallel Lists Using ArrayLists

LECTURE 2

Parallel Array/Parallel ArrayList

- When two or more array or arraylist are used to represent a same set of data. Each index represents data of a same entity across the different array or arraylist. We call them parallel array or parallel arraylist.

```
    double[] x = new double[20];
    double[] y = new double[20];
```

- (x, y) represents a point in the Cartesian coordinate.

Design Patterns with ArrayLists

1. Available List
2. SelectionList
3. Non-RecurringList
4. OccurrenceList
5. DifferenceList

Available List

AvailableList.java

Two ways to implement available list.

(1) Use a single list to list all the available element or available indice.

(2) Use a separate parallel boolean list to keep track of whether an element is available or not.

Demonstration Program

AVAILABLELIST.JAVA

Selection List

SelectionList.java

- Using arraylist for selection sort.
- Selection and remove is the core operations.

Demonstration Program

SELECTIONLIST.JAVA

Non Recurring List

NonRecurring.java

Using Arraylist as a set.

When an item is added to a set, it will be added only if the list does not contain the item.

Discussion:

(1) Ordered non-recurring list.

(2) Ordered non-recurring list.

Demonstration Program

NONRECURRING.JAVA

Occurrence List

Occurrence.java

Using Arraylist as a histogram to keep track of the frequency of each item in the list. This list sometime used along with the non-recurring list.

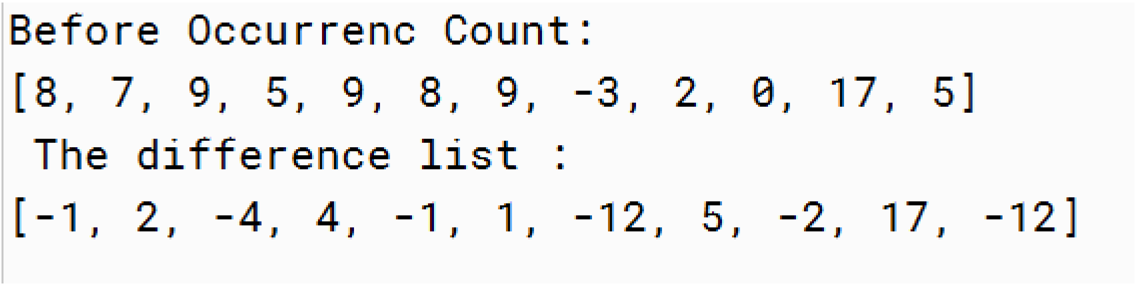
Demonstration Program

OCCURRENCE.JAVA

Difference List

DifferenceList.java

- The difference list can be used to predict the growth rate for the original list.
- It is quite useful.



```
Before Occurrenc Count:
[8, 7, 9, 5, 9, 8, 9, -3, 2, 0, 17, 5]
 The difference list :
[-1, 2, -4, 4, -1, 1, -12, 5, -2, 17, -12]
```

Demonstration Program

DIFFERENCELIST.JAVA

Comparison of String, Array, ArrayList

LECTURE 3

Study of Programming

(Object-Oriented Programming is One Programming Paradigm to Handle All)

Program Structure:

Study of Algorithm, Programming Paradigm, and Software Engineering.

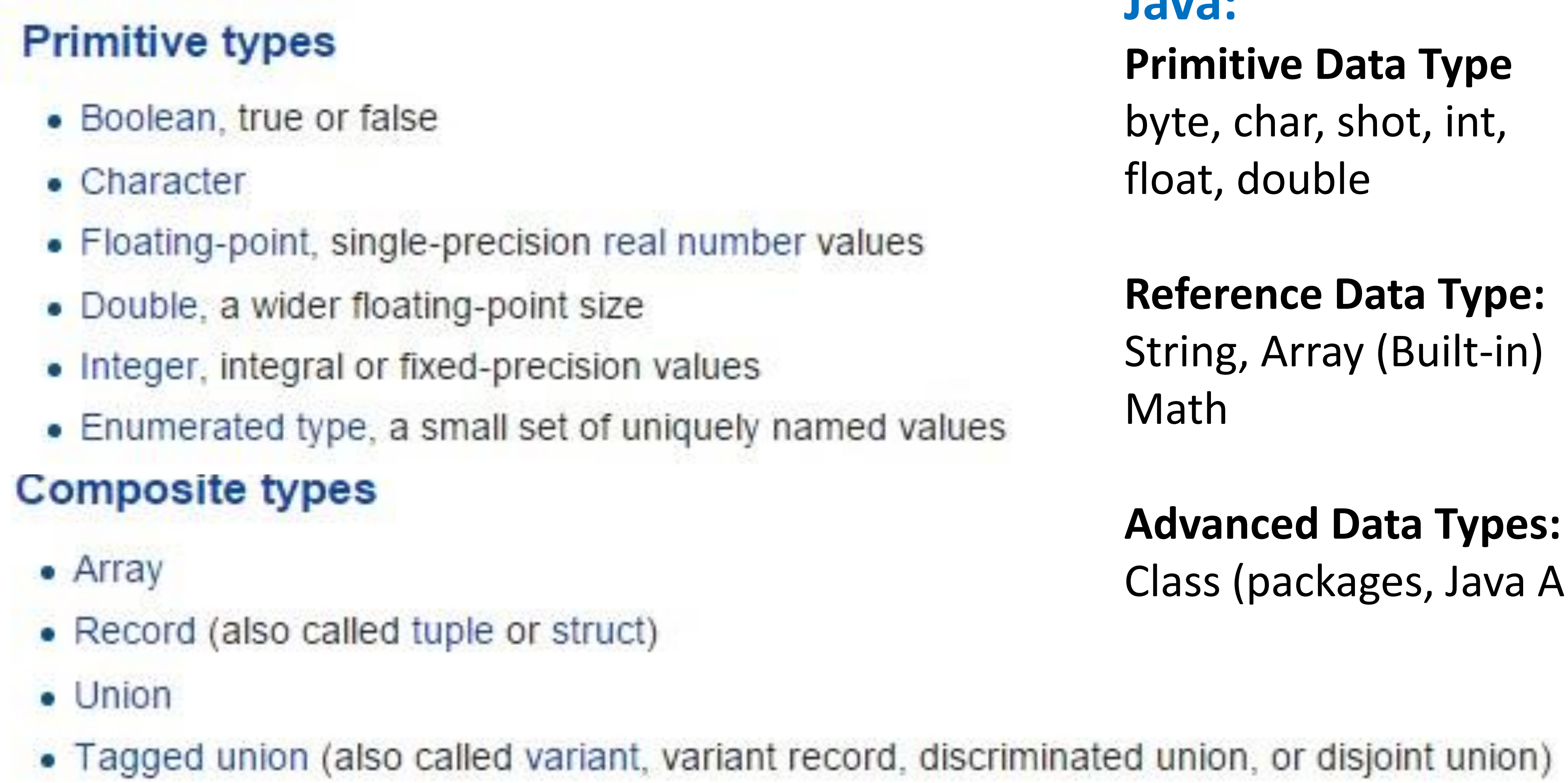
Data Structure:

Study of Data Structure, Object, and Classes, Data Bases, and Data Science.

Data structure (From Wikipedia)

- In computer science, a data structure is a particular way of organizing data in a computer so that it can be used efficiently.
- Data structures can implement one or more particular **abstract data types** (ADT), which are the means of specifying the contract of operations and their complexity. In comparison, a data structure is a concrete implementation of the contract provided by an **ADT**.

Data type and data Structure in Programming Language (Not Specific for Java)



Primitive types

- Boolean, true or false
- Character
- Floating-point, single-precision real number values
- Double, a wider floating-point size
- Integer, integral or fixed-precision values
- Enumerated type, a small set of uniquely named values

Composite types

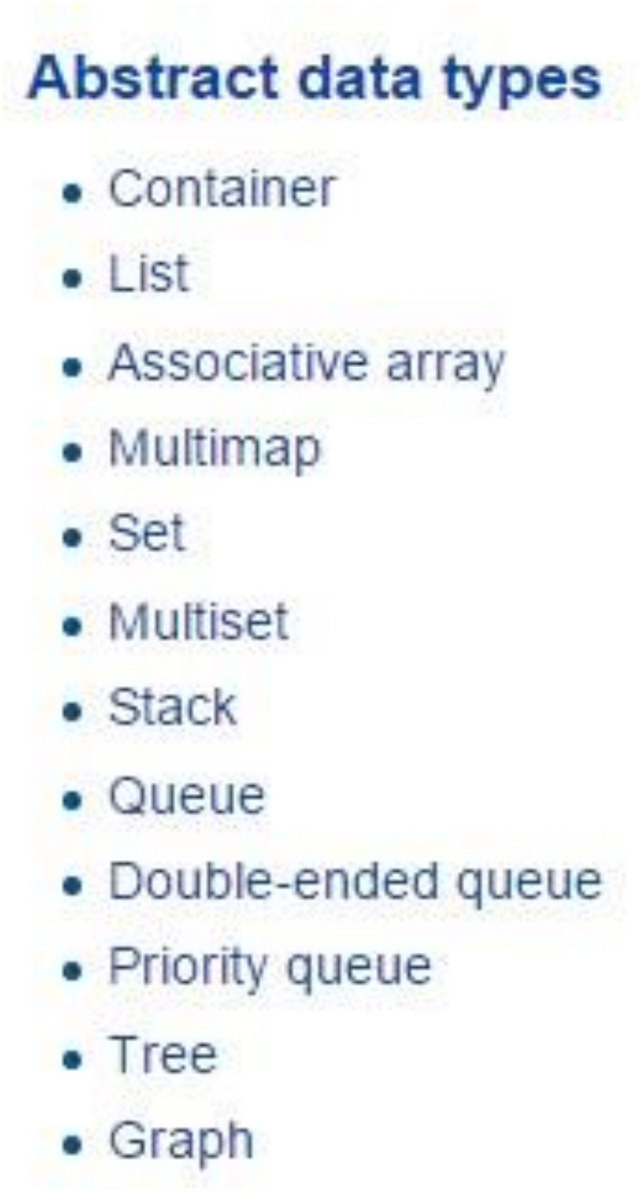
- Array
- Record (also called tuple or struct)
- Union
- Tagged union (also called variant, variant record, discriminated union, or disjoint union)

Java:

Primitive Data Type
byte, char, shot, int, float, double

Reference Data Type:
String, Array (Built-in)
Math

Advanced Data Types:
Class (packages, Java API)



Abstract data types

- Container
- List
- Associative array
- Multimap
- Set
- Multiset
- Stack
- Queue
- Double-ended queue
- Priority queue
- Tree
- Graph

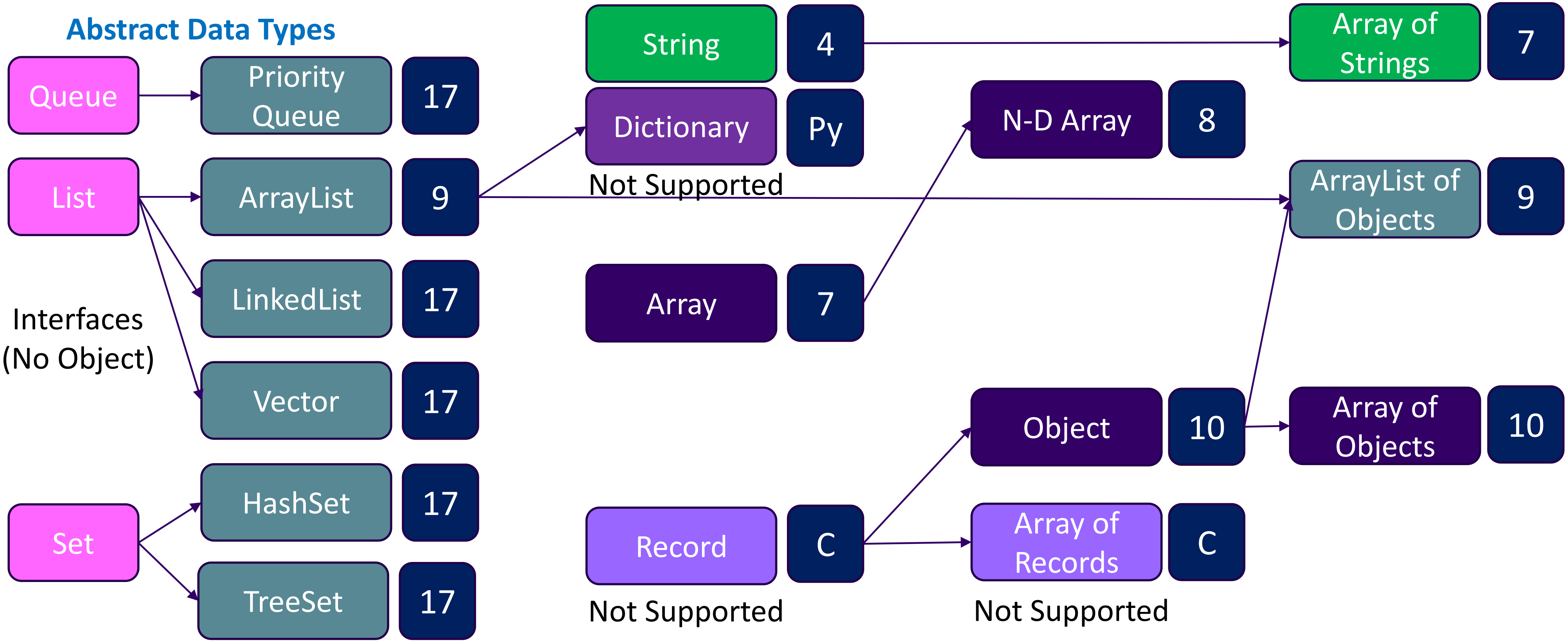
Java Supports for ADT:

Object-Oriented Programming Paradigm.

Classes and Objects (Ch. 9-13)

More Data Structures (Ch. 16)

Data Structure Supported by Java



Comparison between Array and String

(Using Array of Char as example)

	Array of Character	String
Declaration	char[] chary = {‘A’, ’B’, ’C’};	String str = “ABC”;
New Object	char[] chary = new char[3];	String str = new String(“ABC”);
Access to Elements	chary[2]	str.charAt(2)
Change Content?	Yes	Immutable
Length	chary.length	str.length()
Partial elements	none	**substring(1,3)**
Easy Indexing	**chary[(a+b)/3*4-1+5/2]**	str.charAt((a+b)/3*4-1+5/2) can only fetch data
Object Traversal	Yes	**No**
Easy for println()?	**No**	Yes
Concatenation?	**No**	Yes **System.out.println(str+str1+str2)**
Application	Tabularize data	Message Processing
Sorting of Elements	Yes	**No**
Adding new elements	**No**	**No, but allow concatenation to create new string**

Differences and Similarities between Arrays and ArrayList

Operation	*Array*	*ArrayList*
Creating an array/ArrayList	String[] a = new String[10]	ArrayList<String> list = new ArrayList<>();
Accessing an element	a[index]	list.get(index);
Updating an element	a[index] = "London";	list.set(index, "London");
Returning size	a.length	list.size();
Adding a new element		list.add("London");
Inserting a new element		list.add(index, "London");
Removing an element		list.remove(index);
Removing an element		list.remove(Object);
Removing all elements		list.clear();

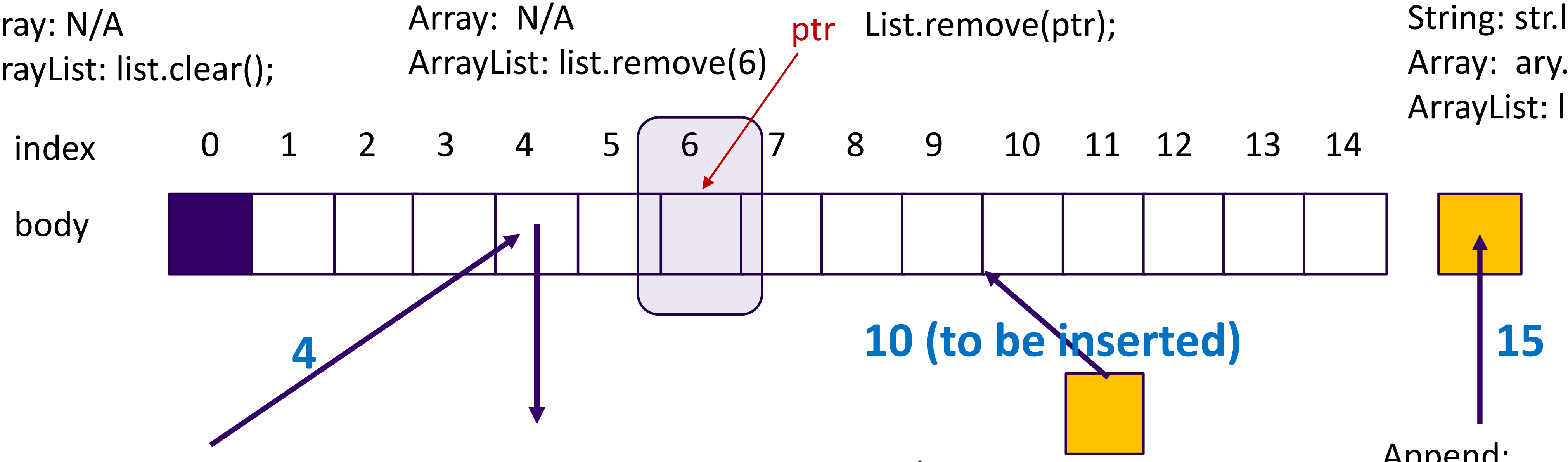
Operation for String, Array and ArrayList

Clear: (reset)
String: str = “”;
Array: N/A
ArrayList: list.clear();

Remove:
String: N/A
Array: N/A
ArrayList: list.remove(6)

ptr:
Pointer to the data type
List.remove(ptr);

Length:
String: str.length()
Array: ary.length
ArrayList: list.size()



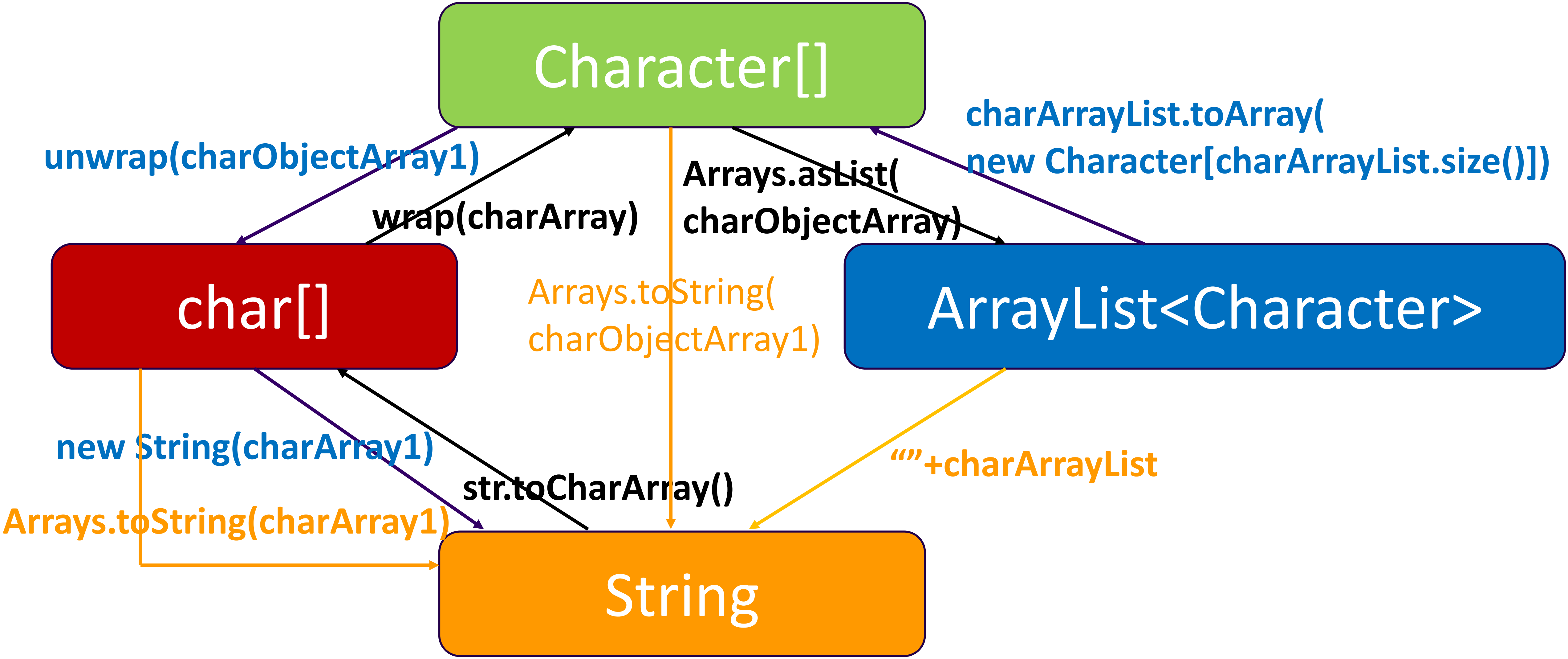
Element Access: set Method
String: immutable
Array: ary[4] = 4;
ArrayList: list.set(4, 4)

Element Access: get Method
String: str.charAt(4)
Array: ary[4]
ArrayList: list.get(4)

Insert:
String: N/A
Array: N/A
ArrayList: list.add(10, Obj)

Append:
String: N/A
Array: N/A
ArrayList: list.add(Obj)

Conversion Among String, char[], Character[] and ArrayList<Character>



Character[]

char[]

ArrayList<Character>

String

unwrap(charObjectArray1)

wrap(charArray)

Arrays.asList(charObjectArray)

charArrayList.toArray(new Character[charArrayList.size()])

Arrays.toString(charObjectArray1)

new String(charArray1)

Arrays.toString(charArray1)

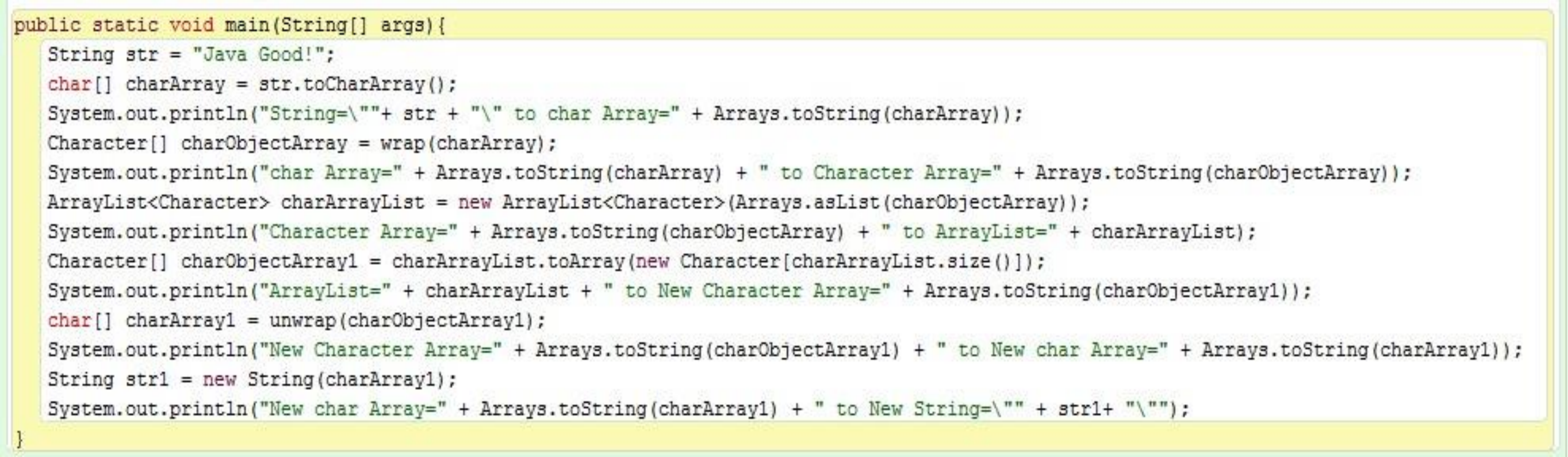
str.toCharArray()

“”+charArrayList

Demonstration Program

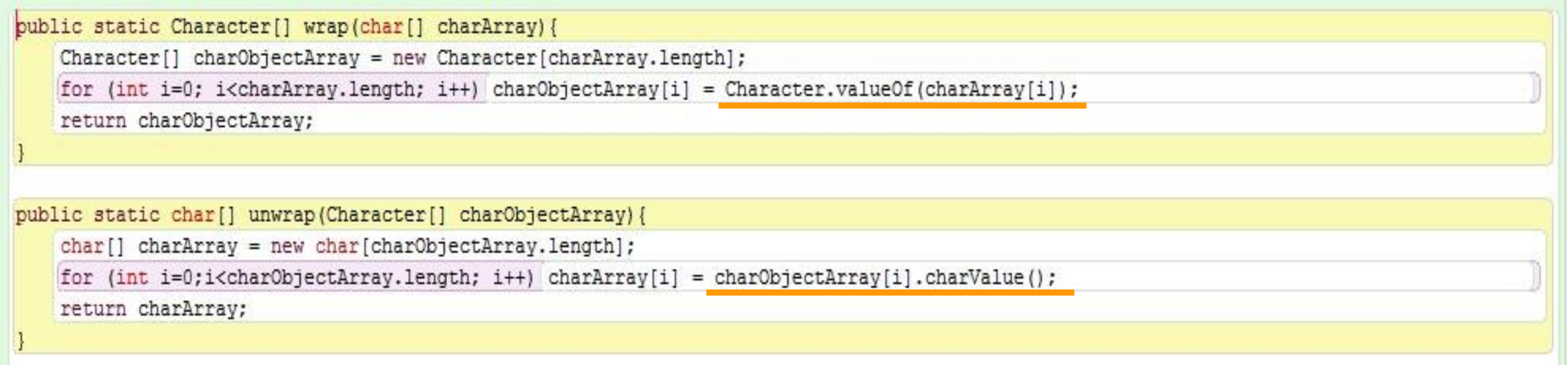
COMPARISON.JAVA

Conversion among String, char[], Character[] and ArrayList<Character>



```
public static void main(String[] args){
    String str = "Java Good!";
    char[] charArray = str.toCharArray();
    System.out.println("String=\""+ str + "\" to char Array=" + Arrays.toString(charArray));
    Character[] charObjectArray = wrap(charArray);
    System.out.println("char Array=" + Arrays.toString(charArray) + " to Character Array=" + Arrays.toString(charObjectArray));
    ArrayList<Character> charArrayList = new ArrayList<Character>(Arrays.asList(charObjectArray));
    System.out.println("Character Array=" + Arrays.toString(charObjectArray) + " to ArrayList=" + charArrayList);
    Character[] charObjectArray1 = charArrayList.toArray(new Character[charArrayList.size()]);
    System.out.println("ArrayList=" + charArrayList + " to New Character Array=" + Arrays.toString(charObjectArray1));
    char[] charArray1 = unwrap(charObjectArray1);
    System.out.println("New Character Array=" + Arrays.toString(charObjectArray1) + " to New char Array=" + Arrays.toString(charArray1));
    String str1 = new String(charArray1);
    System.out.println("New char Array=" + Arrays.toString(charArray1) + " to New String=\"" + str1+ "\"");
}
```

wrap() and unwarp() to convert between char[] and Character[]

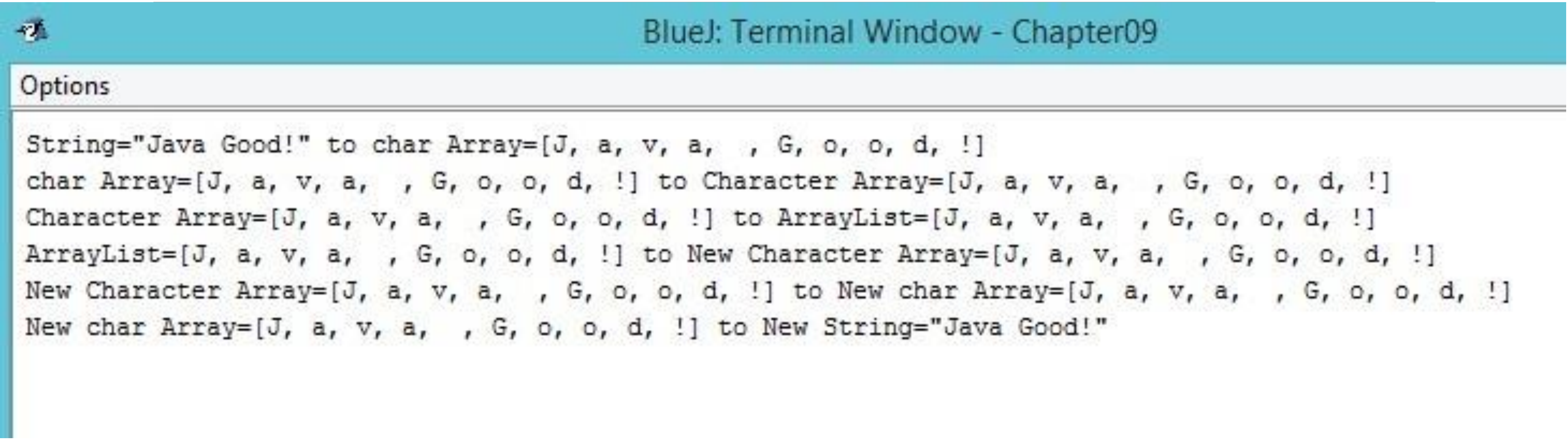


```
public static Character[] wrap(char[] charArray){
    Character[] charObjectArray = new Character[charArray.length];
    for (int i=0; i<charArray.length; i++) charObjectArray[i] = Character.valueOf(charArray[i]);
    return charObjectArray;
}

public static char[] unwrap(Character[] charObjectArray){
    char[] charArray = new char[charObjectArray.length];
    for (int i=0;i<charObjectArray.length; i++) charArray[i] = charObjectArray[i].charValue();
    return charArray;
}
```

Comparison.java

Execution Result for Comparison.java



```
String="Java Good!" to char Array=[J, a, v, a,  , G, o, o, d, !]
char Array=[J, a, v, a,  , G, o, o, d, !] to Character Array=[J, a, v, a,  , G, o, o, d, !]
Character Array=[J, a, v, a,  , G, o, o, d, !] to ArrayList=[J, a, v, a,  , G, o, o, d, !]
ArrayList=[J, a, v, a,  , G, o, o, d, !] to New Character Array=[J, a, v, a,  , G, o, o, d, !]
New Character Array=[J, a, v, a,  , G, o, o, d, !] to New char Array=[J, a, v, a,  , G, o, o, d, !]
New char Array=[J, a, v, a,  , G, o, o, d, !] to New String="Java Good!"
```

Object-Oriented Programming

- Welcome to the 2nd Part of Java Programming …
- Chapter 10: Objects and Classes
- Chapter 11-14: Object-Oriented Programming
  - Object-Thinking
  - Inheritance and Polymorphism
  - Abstract Class and Interfaces
  - File and I/O
- Chapter 15-17 Algorithms

enum Type

(Similar to C, Non-AP Topic)

LECTURE 4

enum Data Type (List of Constants)

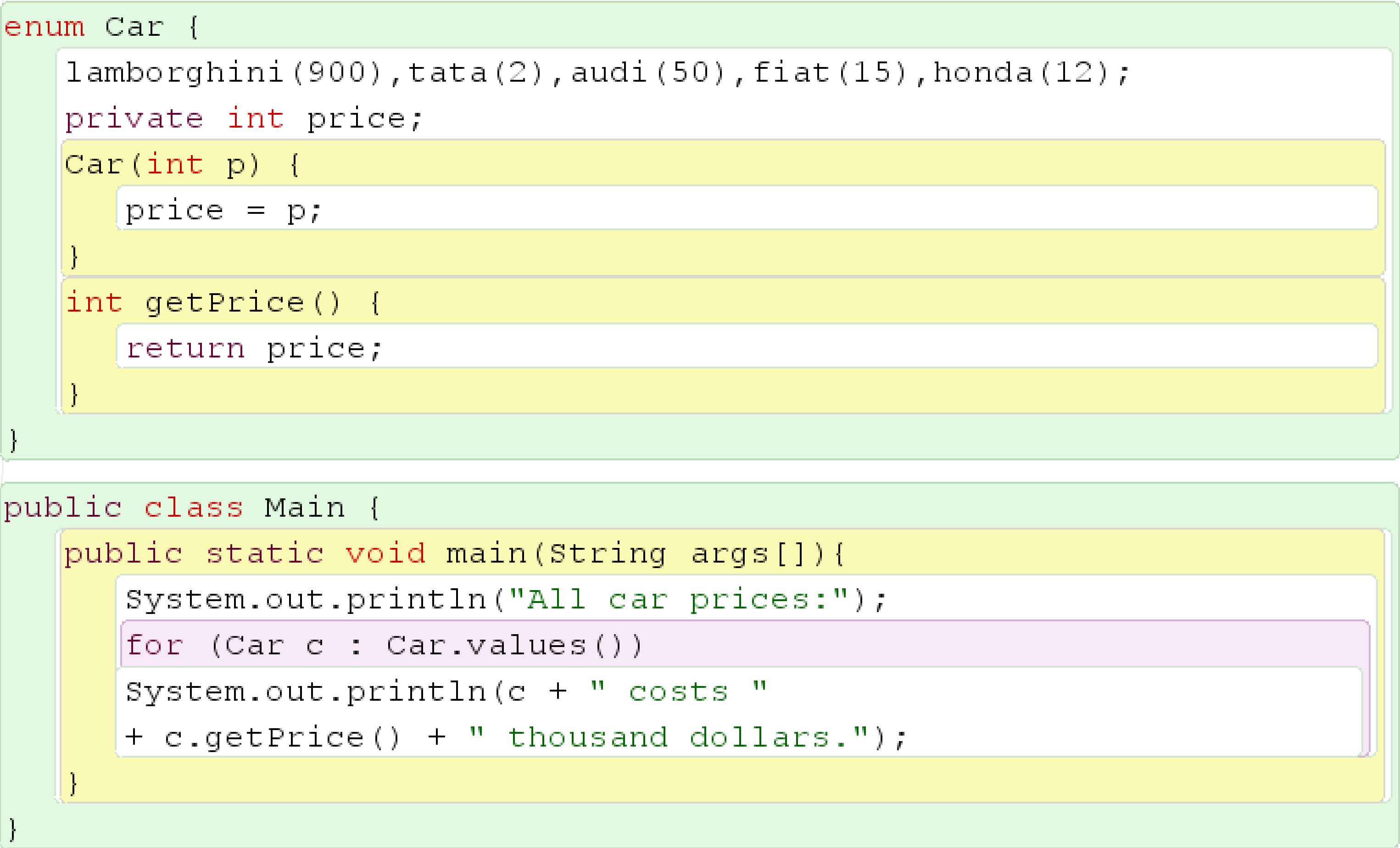
enums are lists of constants. When you need a predefined list of values which do not represent some kind of numeric or textual data, you should use an **enum**. For instance, in a chess game you could represent the different types of pieces as an **enum**:

```
enum ChessPiece {
  PAWN,
  ROOK,
  KNIGHT,
  BISHOP,
  QUEEN,
  KING;
}
```

You should always use **enum**s when a variable (especially a method parameter) can only take one out of a small set of possible values. Examples would be things like type constants (contract status: “permanent”, “temp”, “apprentice”), or flags (“execute now”, “defer execution”).

Example:

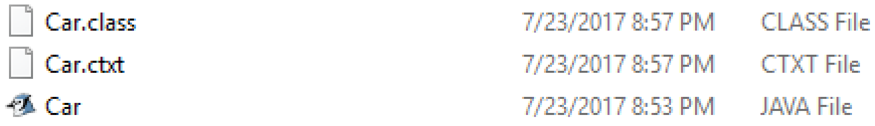
This example initializes enum using a costructor & getPrice() method & display values of enums. (Main.zip)



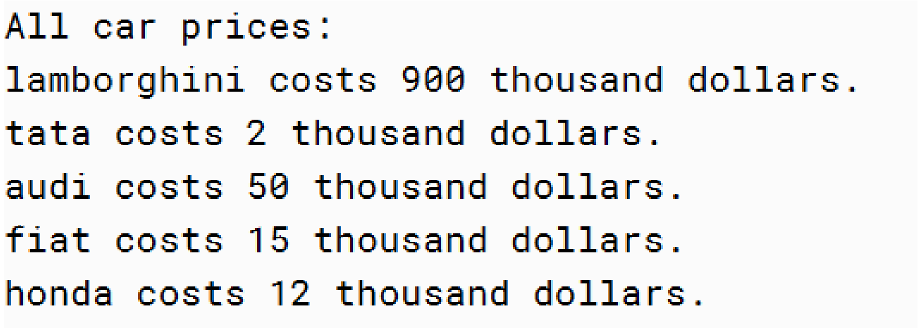
```
enum Car {
    lamborghini(900),tata(2),audi(50),fiat(15),honda(12);
    private int price;
    Car(int p) {
        price = p;
    }
    int getPrice() {
        return price;
    }
}

public class Main {
    public static void main(String args[]){
        System.out.println("All car prices:");
        for (Car c : Car.values())
        System.out.println(c + " costs "
        + c.getPrice() + " thousand dollars.");
    }
}
```

Note: Apparently, **enum** behaves like a class. It has data field, methods and Constructor. It also has a list of constant.



Car.class	7/23/2017 8:57 PM	CLASS File
Car.ctxt	7/23/2017 8:57 PM	CTXT File
Car	7/23/2017 8:53 PM	JAVA File



```
All car prices:
lamborghini costs 900 thousand dollars.
tata costs 2 thousand dollars.
audi costs 50 thousand dollars.
fiat costs 15 thousand dollars.
honda costs 12 thousand dollars.
```

enum Definition

- The list of constant are written in the following format:

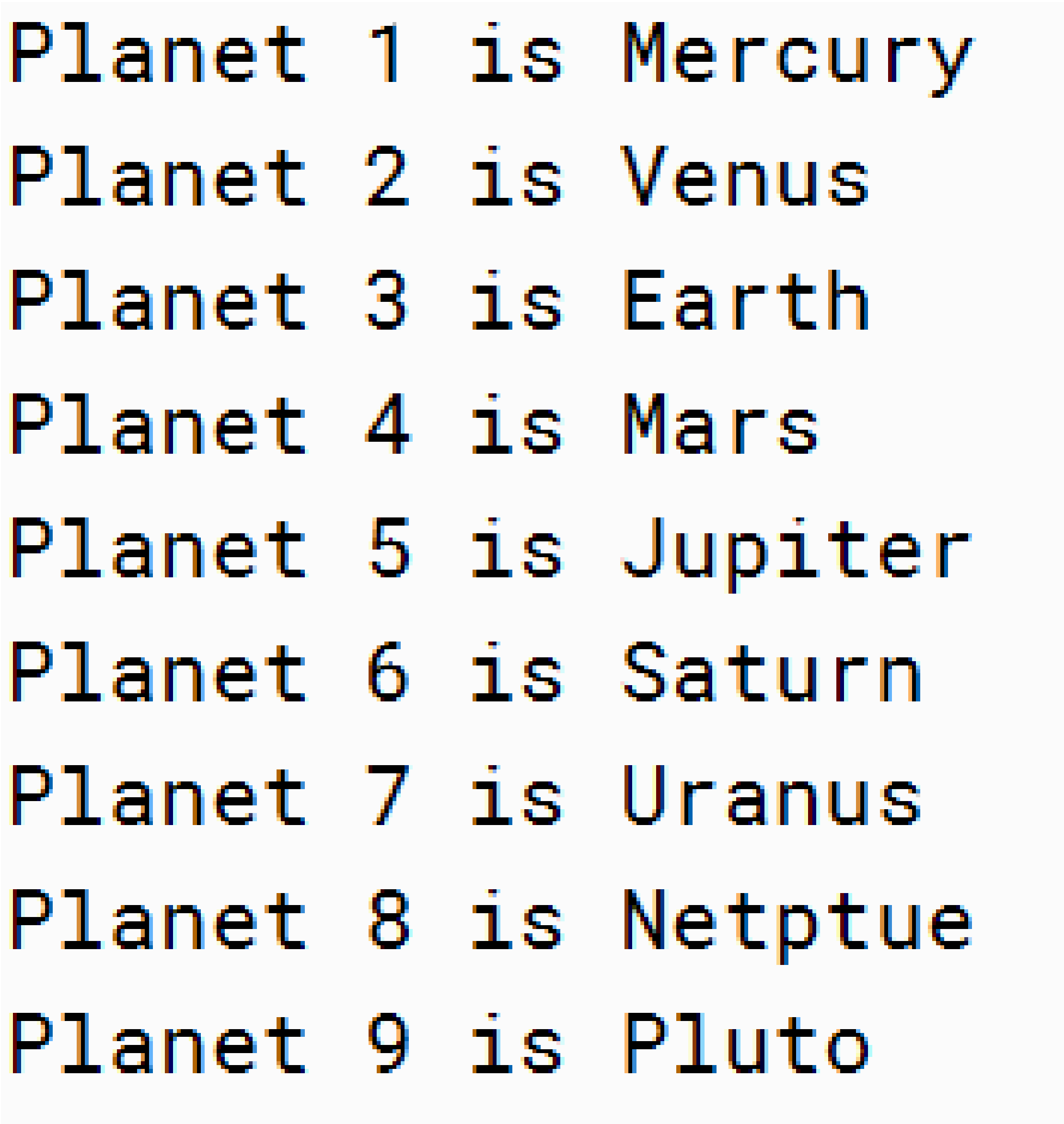
  CONSTANTNAME(integer_value_of_arbitrary_order)

- The **integer_value_of_arbitrary_order** works like parameters to the Constructor.

- So, Car is an **enum** type which is like an element is a list. While Car.values() is a list-like data structure. The price is the data field for the Car **enum** type.

Demonstration Program

MAIN.JAVA+CAR.JAVA+PLANETS.JAVA



```
Planet 1 is Mercury
Planet 2 is Venus
Planet 3 is Earth
Planet 4 is Mars
Planet 5 is Jupiter
Planet 6 is Saturn
Planet 7 is Uranus
Planet 8 is Netptue
Planet 9 is Pluto
```

Demo Program: Planets.java

Lab Project:

Student List of Washington High School

LECTURE 5

Background Information

ArrayList<E> alist = new ArrayList<E>();

<E>: generic type.

ArrayList itself can also be an element to another arraylist. In this way, we can create some sort of 2-D arraylist. That is arraylist of arraylists.

Lab Project:

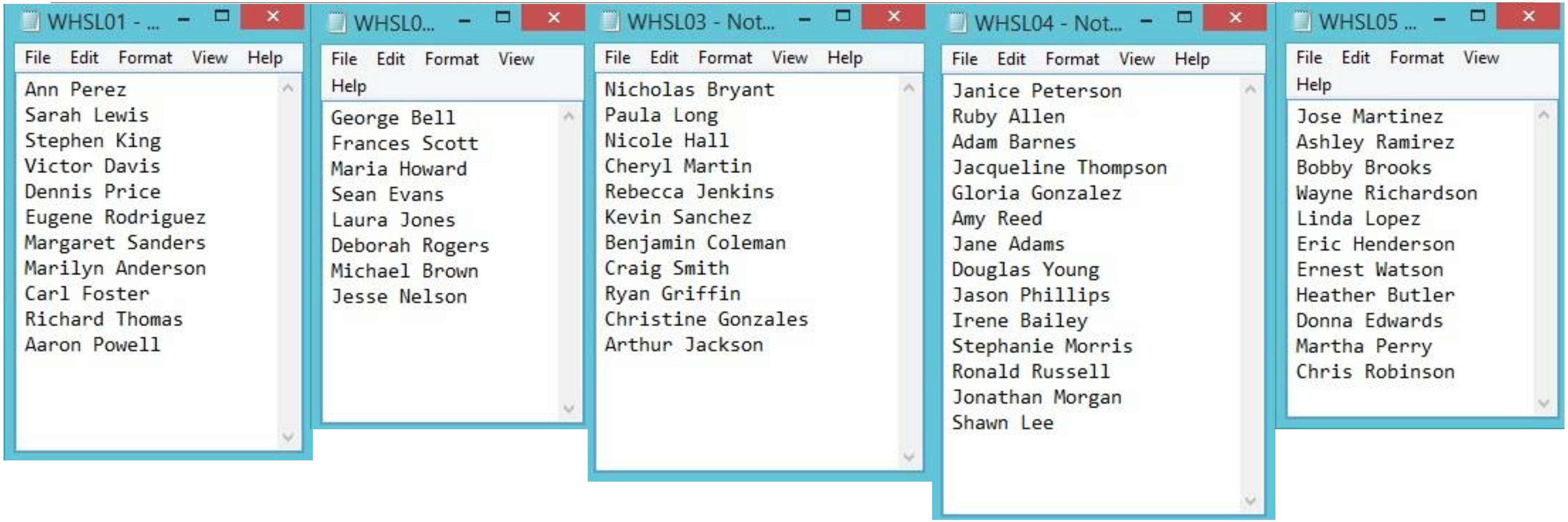
Washington.java (sample answer)

Write a program to create an arraylist of arraylists. Five files of student names are given (WHSL01.txt, WHSL02.txt, WHSL03.txt, WHSL04.txt, WHSL05.txt). Each file contains a list of student names. Each student name is a line (use input.nextLine to read it in as String is fine).

Then, put these arraylists to another arraylist.

```
ArrayList<ArrayList> schoolList = new ArrayList<ArrayList>();
ArrayList<String>  classList = new ArrayList<String>();
```

Five Student List Files


WHSL01 - ...
File Edit Format View Help
WHSL0...
File Edit Format View Help
WHSL03 - Not...
File Edit Format View Help
WHSL04 - Not...
File Edit Format View Help
WHSL05 ...
File Edit Format View Help

```
Ann Perez
Sarah Lewis
Stephen King
Victor Davis
Dennis Price
Eugene Rodriguez
Margaret Sanders
Marilyn Anderson
Carl Foster
Richard Thomas
Aaron Powell
```

```
George Bell
Frances Scott
Maria Howard
Sean Evans
Laura Jones
Deborah Rogers
Michael Brown
Jesse Nelson
```

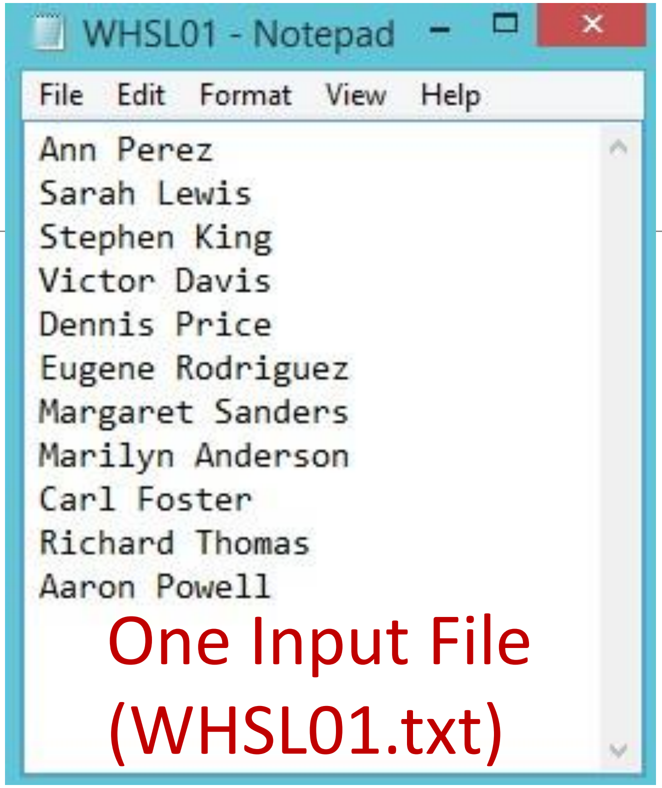
```
Nicholas Bryant
Paula Long
Nicole Hall
Cheryl Martin
Rebecca Jenkins
Kevin Sanchez
Benjamin Coleman
Craig Smith
Ryan Griffin
Christine Gonzales
Arthur Jackson
```

```
Janice Peterson
Ruby Allen
Adam Barnes
Jacqueline Thompson
Gloria Gonzalez
Amy Reed
Jane Adams
Douglas Young
Jason Phillips
Irene Bailey
Stephanie Morris
Ronald Russell
Jonathan Morgan
Shawn Lee
```

```
Jose Martinez
Ashley Ramirez
Bobby Brooks
Wayne Richardson
Linda Lopez
Eric Henderson
Ernest Watson
Heather Butler
Donna Edwards
Martha Perry
Chris Robinson
```

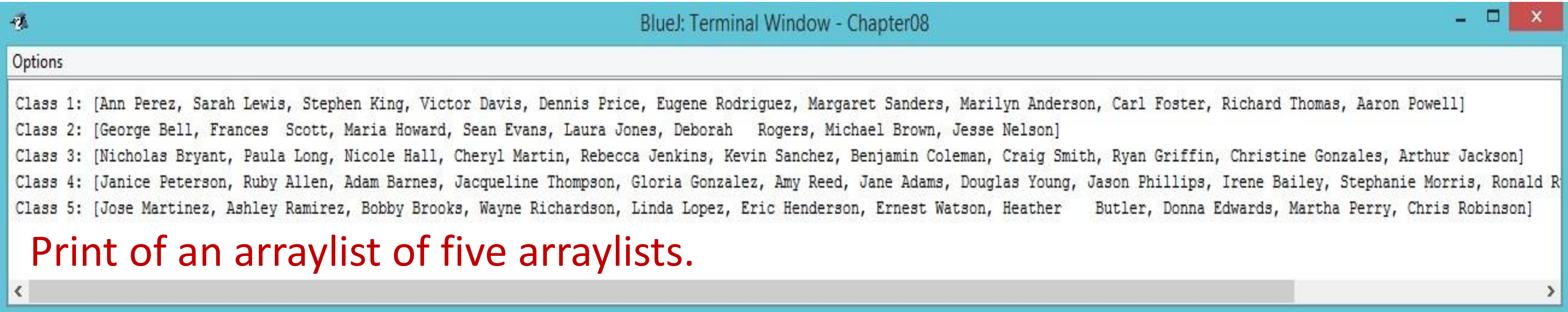
The number of Files can change, and the number of student in a file can also change.

Expected Results:



```
Ann Perez
Sarah Lewis
Stephen King
Victor Davis
Dennis Price
Eugene Rodriguez
Margaret Sanders
Marilyn Anderson
Carl Foster
Richard Thomas
Aaron Powell
```

One Input File (WHSL01.txt)



```
Class 1: [Ann Perez, Sarah Lewis, Stephen King, Victor Davis, Dennis Price, Eugene Rodriguez, Margaret Sanders, Marilyn Anderson, Carl Foster, Richard Thomas, Aaron Powell]
Class 2: [George Bell, Frances  Scott, Maria Howard, Sean Evans, Laura Jones, Deborah   Rogers, Michael Brown, Jesse Nelson]
Class 3: [Nicholas Bryant, Paula Long, Nicole Hall, Cheryl Martin, Rebecca Jenkins, Kevin Sanchez, Benjamin Coleman, Craig Smith, Ryan Griffin, Christine Gonzales, Arthur Jackson]
Class 4: [Janice Peterson, Ruby Allen, Adam Barnes, Jacqueline Thompson, Gloria Gonzalez, Amy Reed, Jane Adams, Douglas Young, Jason Phillips, Irene Bailey, Stephanie Morris, Ronald R
Class 5: [Jose Martinez, Ashley Ramirez, Bobby Brooks, Wayne Richardson, Linda Lopez, Eric Henderson, Ernest Watson, Heather    Butler, Donna Edwards, Martha Perry, Chris Robinson]
```

Print of an arraylist of five arraylists.

Chapter Project:

Sorting the Words in Bible by their Occurrence

LECTURE 6

Data to be sorted:

biblecountunsorted.txt

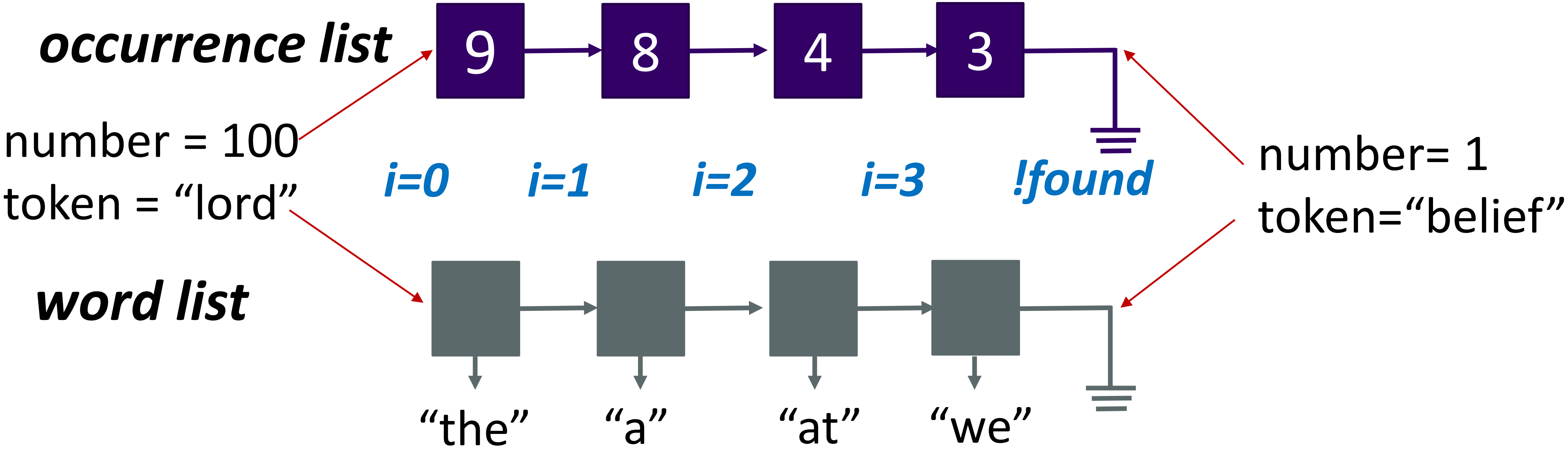
- The biblecountunsorted.txt is copied from biblecount.txt which is generated by WordCountArrayList.java.
- Only the occurrence information of each word in Bible is used to be sorted. (The data field that is used to perform sorting is called **key** field.) So, that we can have a complete listing of words in Bible (in descending order of their occurrence).

Chapter Project:

- Write a program to read in the biblecountunsorted.txt file which has the occurrence and word listing of the whole bible. Read in this file line by line and put the occurrence in one arraylist and the word in another arraylist in a sorted format.
- Then, print the sorted occurrence and word information back to a file named **biblecountsorted.txt**

Pseudo code

- When you add the element, check the existing arraylist for the right location that the occurrence and the word should be inserted by traversing through the occurrence list.



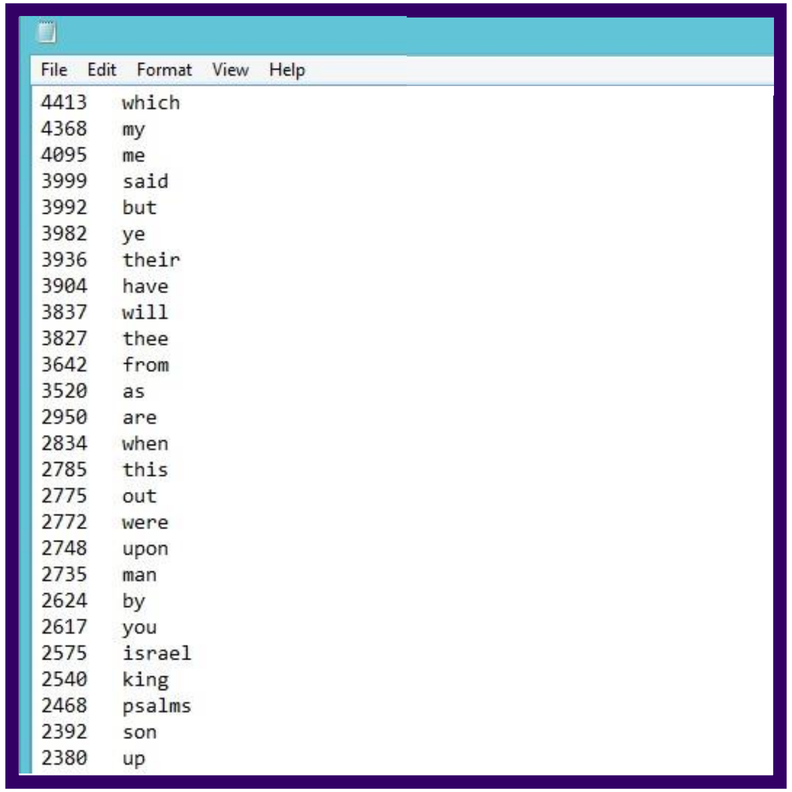
Pseudo code

```
while (input.hasNext()){
    number is a occurrence number read from file.
    token is the word read in from file.
    found = false
    for (int i = 0; i<list.size() && !found; i++){
        i is the index number to insert the number and token into the lists.
        if (number > bible_word_occurrence.get(i) && !found) {
            add the number at word_occurrence arraylist with index i;
            also add the token to bible_arraylist word at the same index i.
            found = true;
         } // this index i has anything before this location is greater than number
     }
     if (!found) add the occurrence and word to the end of the arraylists.
}
```

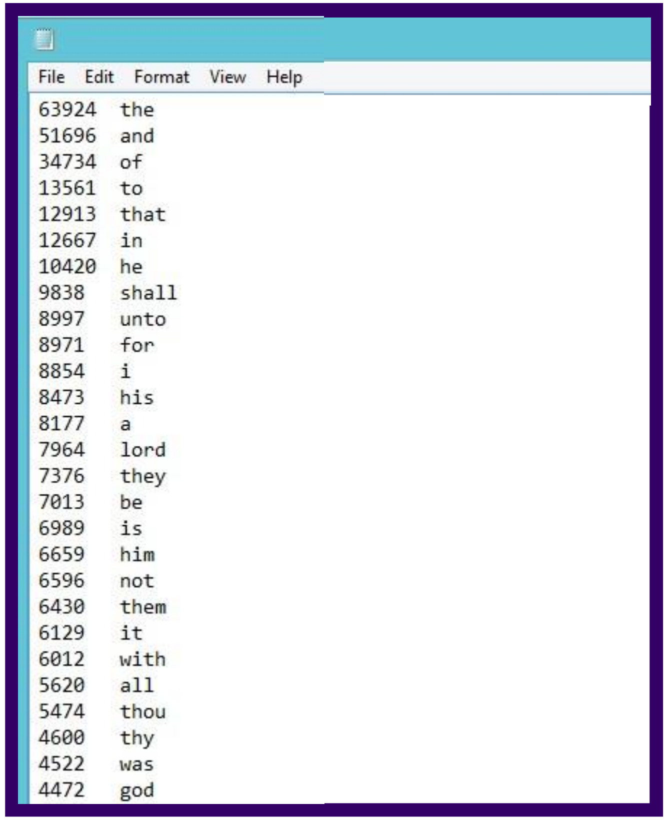
Traversing through the two arraylists and print them out.

Expected Results: **print the output to bibilecountsorted.txt**

(sample answer: WordCountBibleSorted.java)



```
4413   which
4368   my
4095   me
3999   said
3992   but
3982   ye
3936   their
3904   have
3837   will
3827   thee
3642   from
3520   as
2950   are
2834   when
2785   this
2775   out
2772   were
2748   upon
2735   man
2624   by
2617   you
2575   israel
2540   king
2468   psalms
2392   son
2380   up
```



```
63924  the
51696  and
34734  of
13561  to
12913  that
12667  in
10420  he
9838   shall
8997   unto
8971   for
8854   i
8473   his
8177   a
7964   lord
7376   they
7013   be
6989   is
6659   him
6596   not
6430   them
6129   it
6012   with
5620   all
5474   thou
4600   thy
4522   was
4472   god
```

Lab

WORDCOUNTBIBLESORTED.JAVA