CSE 215L: Programming Language II Lab
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Lab 10 – Fall 2019

Objective:
After today's lab, the students should be able:

- To discover polymorphism
- To store, retrieve, and manipulate objects in an **ArrayList**
- To construct an array list from an array, to sort and shuffle a list, and to obtain max and min element from a list

Polymorphism

Polymorphism means that a variable of a supertype can refer to a subtype object.

The ArrayList Class

Since JDK 7, the statement
ArrayList<AConcreteType> list = **new** ArrayList<AConcreteType>();
can be simplified by

```
ArrayList<AConcreteType> list = new ArrayList<>();
```

java.util.ArrayList<E>	
+ArrayList()	Creates an empty list.
+add(o: E): void	Appends a new element o at the end of this list.
+add(index: int, o: E): void	Adds a new element o at the specified index in this list.
+clear(): void	Removes all the elements from this list.
+contains(o: Object): boolean	Returns true if this list contains the element o.
+get(index: int): E	Returns the element from this list at the specified index.
+indexOf(o: Object): int	Returns the index of the first matching element in this list.
+isEmpty(): boolean	Returns true if this list contains no elements.
+lastIndexOf(o: Object): int	Returns the index of the last matching element in this list.
+remove(o: Object): boolean	Removes the first element o from this list. Returns true if an element is removed.
+size(): int	Returns the number of elements in this list.
+remove(index: int): boolean	Removes the element at the specified index. Returns true if an element is removed.
+set(index: int, o: E): E	Sets the element at the specified index.

First, let us define two useful terms: subtype and supertype. A class defines a type. A type defined by a subclass is called a *subtype*, and a type defined by its superclass is called a *supertype*. Therefore, you can say that **Circle** is a subtype of **GeometricObject** and **GeometricObject** is a supertype for **Circle**.

```
public class PolymorphismDemo {
 /** Main method */
 public static void main(String[] args) {
 // Display circle and rectangle properties
 displayObject(new CircleFromSimpleGeometricObject (1, "red", false));
 displayObject(new RectangleFromSimpleGeometricObject(1, 1, "black", true));
```

```
}

/** Display geometric object properties */
public static void displayObject(SimpleGeometricObject object) {
System.out.println("Created on " + object.getDateCreated() +  ". Color is " + object.getColor());
}
}
```

```
Created on Mon Mar 09 19:25:20 EDT 2011. Color is red
Created on Mon Mar 09 19:25:20 EDT 2011. Color is black
```

Task – 1

(*Use ArrayList*) Write a program that creates an **ArrayList** and adds a **Loan** object, a **Date** object, a string, and a **Circle** object to the list, and use a loop to display all the elements in the list by invoking the object's **toString()** method.

Task – 2

(*Largest rows and columns*) Write a program that randomly fills in **0**s and **1**s into an n-by-n matrix, prints the matrix, and finds the rows and columns with the most **1**s. (*Hint*: Use two **ArrayList**s to store the row and column indices with the most **1**s.) Here is a sample run of the program:

```
Enter the array size n: 4
The random array is
0011
0011
1101
1010
The largest row index: 2
The largest column index: 2, 3
```

Task – 3

(*Sum ArrayList*) Write the following method that returns the sum of all numbers in an **ArrayList**:

```
public static double sum(ArrayList<Double> list)
```

Write a test program that prompts the user to enter 5 numbers, stores them in an array list, and displays their sum.

Task – 4

(*Combine two lists*) Write a method that returns the union of two array lists of integers using the following header:

```
public static ArrayList<Integer> union(
ArrayList<Integer> list1, ArrayList<Integer> list2)
```

For example, the union of two array lists {2, 3, 1, 5} and {3, 4, 6} is {2, 3, 1, 5, 3, 4, 6}. Write a test program that prompts the user to enter two lists, each with five integers, and displays their union. The numbers are separated by exactly one space in the output. Here is a sample run:

```
Enter five integers for list1: 3 5 45 4 3
Enter five integers for list2: 33 51 5 4 13
The combined list is 3 5 45 4 3 33 51 5 4 13
```

Task – 5

A polygon is convex if it contains any line segments that connects two points of the polygon. Write a program that prompts the user to enter the number of points in a convex polygon, then enter the points clockwise, and display the area of the polygon. Here is a sample run of the program:

```
Enter the number of the points: 7
Enter the coordinates of the points:
-12 0 -8.5 10 0 11.4 5.5 7.8 6 -5.5 0 -7 -3.5 -3.5
The total area is 250.075
```