```java
public class Course {
    private String courseID,grade;
    private int unit;
    public Course() {

    }
    public Course(String id, int u, String g) {
        this.courseID =id;
        this.unit =u;
        this.grade =g;
    }

    public String getGrade() {
        return grade;
    }

    public int getUnit() {
        return unit;
    }

    public String toString() {
        String mix ="";
        mix += "        "+this.courseID+"            "+this.unit+"                "+this.grade;
        return mix;
    }
}
```

```java
package lad9;


public class MajorCourse extends Course{
    protected int year;
    public MajorCourse(String id, int u, String g, int y) {
        super(id,u,g);
        this.year = y;

    }


    public String toString() {
        return ""+super.toString()+"    Year "+this.year;
    }
}
```

```java
public class GenEdCourse extends Course{
    protected String school;
    public GenEdCourse(String id, int u ,String g, String s) {
        super(id,u,g);
        this.school = s;
    }


    public String toString() {
        return ""+super.toString()+"      "+this.school;
    }
}
```

```java
package lab9;
import java.util.ArrayList;


    public class GraduationCheckArrayList {
        public static void main(String[] args) {

            int keep1 = 0, keep2 = 0;
            ArrayList<Course> mix = new ArrayList<Course>();
            mix.add(new GenEdCourse ("GEN61-127",3,"C", "School of liberal Arts"));
            mix.add(new GenEdCourse ("GEN61-152",4,"D", "School of Science"));
            mix.add(new GenEdCourse ("GEN61-127",2,"C+", "School of Science"));
            mix.add(new MajorCourse("SWE62-123",2,"W",1));
            mix.add(new MajorCourse ("SWE62-205",3,"F",2));
            mix.add(new MajorCourse ("SWE-214",3,"C+",2));
            mix.add(new MajorCourse ("SWE-215",2,"F",2));
            for(int i= 0;i< 3; i++) {
                if(mix.get(i).getGrade() != "W" && mix.get(i).getGrade() != "F")
                    keep1 += 1;

            }
            for(int i= 3;i< mix.size(); i++) {
                if(mix.get(i).getGrade() != "W" && mix.get(i).getGrade() != "F")
                    keep2 += 1;

            }
            System.out.println("General Education Course : ");
            displayGraduation (mix);
            System.out.printf("Total enroll 7 courses; Pass %d courses\n", (keep1+keep2));
            double a = calGPA(mix);
            System.out.printf("GPA = %.2f", a);

        }
    public static void displayGraduation (ArrayList<Course> o) {
        for(int i= 0;i< o.size(); i++) {
            if(o.get(i) instanceof GenEdCourse)
                System.out.printf("%s\n",(((GenEdCourse).get(i)).toString());
            }
            System.out.println("Enroll: 3 Pass : 3");
            System.out.println("==========================================");
            for(int i= 0; i< o.size(); i++) {
                if(o.get(i) instanceof MajorCourse)
```

```java
                System.out.println("=======================================");
                for(int i= 0; i< o.size(); i++) {
                    if(o.get(i) instanceof MajorCourse)
                        System.out.printf("%s\n", (((MajorCourse)o.get(i)).toString()));
                }
                System.out.println("Major Course : ");
                System.out.println("Enroll: 4 Pass : 1");
                System.out.println("=======================================");
                }

    public static double calGPA(ArrayList<Course> 0) {
        double gpa=0.0 , sumG= 0.0, sumU= 0.0, unit, num;
        for(int i= 0; i< o.size();i++) {
            if (o.get(i).getGrade().equals("A"))
                num = 4;
            else if (o.get(i).getGrade().equals("B+"))
                num = 3.5;
            else if (o.get(i).getGrade().equals("B"))
                num = 3;
            else if (o.get(i).getGrade().equals("C+"))
                num = 2.5;
            else if (o.get(i).getGrade().equals("C"))
                num = 2;
            else if (o.get(i).getGrade().equals("D+"))
                num = 1.5;
            else if (o.get(i).getGrade().equals("D"))
                num = 1;
            else if (o.get(i).getGrade().equals("F"))
                num = 0;
            else
                continue;
            unit =o.get(i).getUnit();
            sumG += num*unit;
                sumu += unit;
        }
        gpa = sumG/ sumU;
        return gpa;
    }

}
```

```
General Education Course :
        GEN61-127            3              C        School of liberal Arts
        GEN61-152            4              D        School of Science
        GEN61-127            2              C+       School of Science
Enroll: 3 Pass : 3
============================================
        SWE62-123            2              W        Year 1
        SWE62-205            3              F        Year 2
        SWE-214          3          C+      Year 2
        SWE-215          2          F       Year 2
Major Course :
Enroll: 4 Pass : 1
============================================
Total enroll 7 courses; Pass 4 courses
GPA = 1.32
```

```java
public class Employee extends Person{
    protected boolean isMarried;
    protected int salary;

    public Employee (String n , int b , boolean i , int s ) {
        super(n,b);
        this.isMarried = i;
        this.salary = s;
    }

    public String marry (boolean i){
        String a = "";
        if (i==true)
            a = "Married";
        else
            a = "Single";
    return a;
    }

    public String toString() {
        String mashE = "";
        String a = marry(this.isMarried);
        mashE += super.toString() + " Status : " + a + ", Salary : " + this.salary;
        return mashE;
    }
}
```

```java
import java.util.Calendar;

public class Person {
    protected String name;
    protected int birthYear;

    public Person(String name, int year) {
        this.name = name;
        this.birthYear = year;
    }

    public int getAge() {
        int cur = Calendar.getInstance().get(Calendar.YEAR);
        int age = cur - (this.birthYear + 543);
        return age;
    }

    public String toString() {
        String mix="";
        mix += "Name : "+this.name+", Birth Year : "+this.birthYear+", Age : "+ getAge();
        return mix;
    }
}
```

```java
public class Student extends Person{
    protected String studentID;
    protected String major;

    public Student(String n , int b , String id , String m){
        super(n,b);
        this.studentID = id;
        this.major = m;
    }

    public String toString() {
        String mashS = "";
        mashS += super.toString() + " Student Id : " + this.studentID + " Major : " + this.major;
        return mashS;
    }
}
```

```java
public class PersonDemoArrayList {

    public static void main(String[] args) {
        ArrayList<Person> mix = new ArrayList<Person>();
        mix.add(new Student("Aaa bbb",1996,"60100010","SWE"));
        mix.add(new Student("Rachest",1997,"60100011","SWEE"));
        mix.add(new Student("I am hungry",1999,"60100012","SWEEE"));
        mix.add(new Employee("zzz zzz",1988,true,28000));
        mix.add(new Employee("ddd fff",1970,false,40000));
        mix.add(new Employee("I am very hungry now",1969,false,500));
        displayAllPerson(mix);


    }


    public static void displayAllPerson(ArrayList<Person> o) {
        double sumA1= 0,sumA2= 0,avgA1= 0,avgA2= 0, sumSa= 0;
        int num1= 0,num2= 0;
        for(int i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Student)
                num1 += 1;
            if(o.get(i) instanceof Employee)
                num2 += 1;
        }
        System.out.println("No. of Student = "+num1);
        for(int i= 0;i <o.size();i++) {
            if(o.get(i) instanceof Student) {
                System.out.printf("%d %s\n",(i+1),((Student)o.get(i)).toString());
                sumA1 += ((Student)o.get(i)).getAge();
            }
        }
        for(int i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Student)
                avgA1= sumA1/num1;
        }

        System.out.printf("Average Age of Student = %.0f\n",avgA1);
        System.out.println("=================================================");
        System.out.printf("No. of Employee = %d\n",num2);
        int i, j= 0;
        for(i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Employee) {
                System.out.printf("%d. %s\n",(j+1),((Employee)o.get(i)).toString());
                sumSa += ((Employee)o.get(i)).salary;
                sumA2 += ((Employee)o.get(i)).getAge();
```

```java
        for(int i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Student)
                avgA1= sumA1/num1;
        }

        System.out.printf("Average Age of Student = %.0f\n",avgA1);
        System.out.println("--------------------------------------------------------");
        System.out.printf("No. of Employee = %d\n",num2);
        int i, j= 0;
        for(i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Employee) {
                System.out.printf("%d. %s\n",(j+1),((Employee)o.get(i)).toString());
                sumSa += ((Employee)o.get(i)).salary;
                sumA2 += ((Employee)o.get(i)).getAge();
                j++;
            }
        }
        for(i =0;i< o.size();i++) {
            if(o.get(i) instanceof Employee)
                avgA2 = sumA2/num2;
        }

        System.out.printf("Average Age of Student = %.0f\n",avgA2);
        System.out.printf("Average Salary = %.0f\n",(sumSa/num2));
        System.out.println("--------------------------------------------------------");
        System.out.printf("Average Age of 6 Person = %.0f\n",calAverageAge(o));

    }

    public static double calAverageAge(ArrayList<Person> o) {
        double sumA= 0,avgA = 0;
        for(int i=0;i< o.size();i++)
            sumA += o.get(i).getAge();
        for(int i= 0;i< o.size();i++)
            avgA = sumA/o.size();
    return avgA;
    }
```

```
No. of Student = 3
1 Name : Aaa bbb, Birth Year : 1996, Age : 25 Student Id : 60100010 Major : SWE
2 Name : Rachest, Birth Year : 1997, Age : 24 Student Id : 60100011 Major : SWEE
3 Name : I am hungry, Birth Year : 1999, Age : 22 Student Id : 60100012 Major : SWEEE
Average Age of Student = 24
=================================================================
No. of Employee = 3
1. Name : zzz zzz, Birth Year : 1980, Age : 41 Status : Married, Salary : 28000
2. Name : ddd fff, Birth Year : 1970, Age : 51 Status : Single, Salary : 40000
3. Name : I am very hungry now, Birth Year : 1969, Age : 52 Status : Single, Salary : 500
Average Age of Student = 48
Average Salary = 22833
=================================================================
Average Age of 6 Person = 36
```

```java
package lab009;

public abstract class Shape {
    protected String color;
    abstract double getArea();
    public void setColor(String color) {
        this.color = color;
    }

    public String toString() {
        return "color : " + color;
    }
}
```

```java
public class Square extends Shape{
    protected int width;

    public Square(String color, int width) {
        super.setColor(color);
        this.width = width;
    }

    public double getArea() {
        return width*width;
    }

    public double getPerimeter() {
        return 4*width;
    }

    public String toString() {
        return super.toString()+" width : "+width+" \nArea : " + (int)getArea() + ", Perimeter : "+(int)getPerimeter();
    }

}
```

```java
public class Circle extends Shape{
    protected int radius;

    public Circle(String color, int radius) {
        super.setColor(color);
        this.radius = radius;
    }

    public double getArea() {
        return 3.14*radius*radius;
    }

    public double getCircumference() {
        return 2*3.14*radius;
    }

    public String toString() {
        return super.toString()+" radius : "+ radius+" \nArea : "+ (int)getArea() + ", Circumference : "+(int)getCircumference();
    }

}
```

```java
public class TestShapeObject {

    public static void main(String[] args) {
        ArrayList<Shape> mix = new ArrayList<Shape>();
        mix.add(new Square("Orange",4));
        mix.add(new Square("Orange",10));
        mix.add(new Square("Orange",5));
        mix.add(new Circle("Violent",3));
        mix.add(new Circle("Violent",6));
        mix.add(new Circle("Violent",10));
        displayAllShape(mix);
        findMax(mix);
        findMin(mix);
    }

    public static void displayAllShape(ArrayList<Shape> o) {
        System.out.println("Class Square");
        for (int i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Square)
                System.out.printf("%d. %s\n",(i+1),((Square)o.get(i)).toString());
        }

        System.out.println("===============================================================");
        System.out.println("Class Circle");
        int i, j= 0;
        for (i= 0;i< o.size();i++) {
            if(o.get(i) instanceof Circle)
                System.out.printf("%d. %s\n",(i+1),((Circle)o.get(i)).toString());
                j++;
        }
        System.out.println("===============================================================");
        int[] max = findMax(o);
        int[] min = findMin(o);
        System.out.println("Square : ");
        System.out.println("Max Perimeter is   "+max[0]);
        System.out.println("Min Perimeter is   "+min[0]);
        System.out.println("Circle : ");
        System.out.println("Max Circumference is   "+max[1]);
        System.out.println("Min Circumference is   "+min[1]);

    }
}
```

```java
public static int[] findMax(ArrayList<Shape> o) {
    double max1= 0,max2= 0;
    int[] ans1= new int[2];
    for(int i= 0;i< o.size();i++) {
        if (o.get(i) instanceof Square) {
            if ((((Square)o.get(i)).getPerimeter()) > max1)
                max1 = ((Square)o.get(i)).getPerimeter();
            ans1[0] = (int)max1;
        }
        if (o.get(i) instanceof Circle) {
            if ((((Circle)o.get(i)).getCircumference()) > max2)
                max2 = ((Circle)o.get(i)).getCircumference();
            ans1[1] = (int)max2;
        }
    }
    return ans1;
}

public static int[] findMin(ArrayList<Shape> o) {
    double min1= 0,min2= 0;
    int[] ans2= new int[2];
    for(int i= 0;i< o.size();i++) {
        if (o.get(i) instanceof Square) {
            if ((((Square)o.get(i)).getPerimeter()) > min1)
                min1 = ((Square)o.get(i)).getPerimeter();
            ans2[0] = (int)min1;
        }
        if (o.get(i) instanceof Circle) {
            if ((((Circle)o.get(i)).getCircumference()) > min2)
                min2 = ((Circle)o.get(i)).getCircumference();
            ans2[1] = (int)min2;
        }
    }
    return ans2;
}
```

```
Class Square
1. color : Orange width : 4
Area : 16, Perimeter : 16
2. color : Orange width : 10
Area : 100, Perimeter : 40
3. color : Orange width : 5
Area : 25, Perimeter : 20
============================================================
Class Circle
4. color : Violent radius : 3
Area : 28, Circumference : 18
5. color : Violent radius : 6
Area : 113, Circumference : 37
6. color : Violent radius : 10
Area : 314, Circumference : 62
============================================================
Square :
Max Perimeter is  40
Min Perimeter is  40
Circle :
Max Circumference is  62
Min Circumference is  62
```