Java 程序设计实验报告

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实验四：面向对象程序设计

一、实验目的

1）掌握面向对象的基本概念（成员变量、成员函数等）
2）掌握类的定义、内部类的定义
3）掌握对象的声明
4）掌握对象数组的使用
5）基本算法的设计

二、实验内容

1）编写 OOBMI 类文件；并在该类文件中定义另一个类 Student，该类包含学号、姓名、身高、体重和 bmi 等属性，为 Student 类定义创建函数。

2）在 Student 类中，增加 public String toString()函数，该函数可以返回一个字符串，该字符串包含学号、姓名、身高、体重、bmi 值和胖瘦健康状况，他们之间用制表符(\t)隔开；

3）在 OOBMI 中增加成员属性 Student[] students；在 OOBMI 中增加 genStudents 函数，参数为整数，能够随机生成指定数量的名学生对象，并保存到 students 数组中。（注意，学号、姓名、身高、体重等均需随机生成，数值均需保留两位小数存储）

4）在 OOBMI 类中增加 public boolean isExists(String id) 函数，判断该学生是否已经在 students 数组中，函数返回值为 boolean 类型，如果已经存在，返回 false；否则，返回 true。并在 genStudents 函数，调用 isExists 函数避免输入或生成重复的学号的学生。

5）在 OOBMI 中增加 4 个函数，分别统计 bmi 的均值、中值、众数、方差等统计信息。

6）在 OOBMI 中增加 printStatics 函数，该函数首先打印所有学生基本信息，然后打印 bmi 的均值、中值、众数、方差等统计结果信息。

7）增加 menu 函数提供随机生成学生、打印学生、5 种排序、打印统计信息、退出执行等 9 个菜单功能，用户输入指定选项后，运行相应函数功能。

8）在 OOBMI 的 main 函数中，调用 menu 函数，测试运行各项功能。

注意，身高、体重、及 bmi 等数值均需保留两位小数的格式进行存储和显示。

三、实验代码

```
package edu.hit.java.exp2.hit1170300725;
import java.math.BigDecimal;
import java.util.*;

class Student{
    private String id;
    private String name;
    private float height;
    private float weight;
    private float BMI;
    private String health;

    public void setId(String id){
        this.id = id;
    }

    public String getId(){
        return id;
    }

    public void setName(String name){
        this.name = name;
    }

    public String getName(){
        return name;
    }

    public void setHeight(float height){
        this.height = height;
    }

    public float getHeight(){
        return height;
    }

    public void setWeight(float weight){
        this.weight = weight;
    }

    public float getWeight(){
        return weight;
    }

    public void setBMI(float BMI){
        this.BMI = BMI;
    }

    public float getBMI(){
        return BMI;
    }

    public void setHealth(String health){
        this.health = health;
    }

    public String getHealth(){
```

```java
        return health;
    }

    public String toString(){
        return getId() + "\t" + getName() + "\t" +
                String.format("%.2f", getHeight()) + "\t" +
                String.format("%.2f", getWeight()) + "\t" +
                String.format("%.2f", getBMI()) + "\t" + getHealth();
    }
}
public class OOBMI {
       private static Random random;
       /*
        * define universe random
        */
/**
 *
 * @param args
 */
       public static void main(String[] args) {

            random = new Random();
            /*
             * creat new rondom
             */
            Student[] students=null;
            /*
             * shouid not be undefined
             */
               menu(students);

 }
/**
 *
 * @return
 */
 public static int printmenu() {
     Scanner sc=new Scanner(System.in);
     System.out.println("1:generrate student's information");
     System.out.println("2:print stuent's information");
     System.out.println("3:sort by ID");
     System.out.println("4:sort by height");
     System.out.println("5:sort by weight");
     System.out.println("6:sort by name");
    System.out.println("7:sort by bmi");
    System.out.println("8.print statics");
    System.out.println("9:exit");
    int choice=sc.nextInt();
    return choice;
}
/*
 * get choice
 */
/**  函数名: menu
 * function:
 * 1.choose which to function
 * 2. get the student number
 * 3.exit the program
 * @param ids
 * @param names
 * @param heights
 * @param weights
 * @param bmis
 */
public static void menu(Student[] students) {
    Scanner sc=new Scanner(System.in);
    int[] sortedIndex=null;
    boolean quit=false;
    /**
     * if quit = false,continue
     * else if quit = true,quit the program end
     */
    while(!quit) {
        int choice=printmenu();
        if(choice==1) {
            System.out.println("please input student's number");
           int num=sc.nextInt();
           students=new Student[num];
           for(int i=0;i<num;i++) {
               students[i]=new Student();
           }
           sortedIndex=genStudents(num,students);
           /*
            * random students' data
            */
        }else if(choice==2) {
            printStudents(sortedIndex,students);
        }else if(choice==3) {
             sortedIndex=sortByID(students);
         }else if(choice==4) {
             sortedIndex=sortByHeight(students);
         }else if(choice==5) {
             sortedIndex=sortByWeight(students);
         }else if(choice==6) {
             sortedIndex=sortByName(students);
         }else if(choice==7) {
             sortedIndex=sortByBmi(students);
         }else if(choice==8) {
             printStatics(sortedIndex,students);
         }
         else if(choice==9) {
             quit=true;
             /*
              * quit the program
              */
         }
     }
 }
 /**
  *
  * @param num
  * @param students
  * @return
  */
 private static int[] genStudents(int num,Student[] students) {
     int[] index=new int[num];
     for(int i = 0; i < num; i ++){
         String tempId = String.valueOf(random.nextInt(1000) + 1000);
         while(isExists(num,tempId,students)){
             tempId = String.valueOf(random.nextInt(1000) + 1000);
         }
         students[i].setId(tempId);
         String chars = "abcdefghijklmnopqrstuvwxyz";
         students[i].setName(String.valueOf(chars.charAt(random.nextInt(26)))
+ chars.charAt(random.nextInt(26)) + chars.charAt(random.nextInt(26)) +
chars.charAt(random.nextInt(26)));
         students[i].setHeight(random.nextFloat() * 50f + 150f);
         //height ranges from 150 to 200
         students[i].setWeight(random.nextFloat() * 25f + 50);
         //weight range from 50 to 74

students[i].setBMI(students[i].getWeight()*10000/students[i].getHeight()/st
udents[i].getHeight());
         //calculate the bmi using the given height and weight
         index[i]=i;
         students[i].setHealth(checkHealth(students[i].getBMI()));
         //check the health and store
     }
     return index;
 }
 /**
  *
  * @param mt
  * @return
  */
 private static float round(float mt){
     BigDecimal bmt = new BigDecimal(mt);
     float nmt =
             bmt.~~setScale~~(2, BigDecimal.~~ROUND_HALF_UP~~).floatValue();
     return nmt;
 }
 /**
  *
  * @param num
  * @param id
  * @param students
  * @return
  */
 private static boolean isExists(int num,String id,Student[] students){
     for(int i = 0; i < num; i ++){
         if(students[i].getId() == null){
             break;
         }else if(students[i].getId().equals(id)){
             return false;
         }
     }
     return false;
 }
 /**
  *
  * @param sorted
  * @param students
  */
 private static void printStatics(int[] sorted,Student[] students){
     printStudents(sorted,students);
     //System.out.println();
```

```
int number=students.length;
float[] bmis = new float[number];
float sum = 0;
float average;
/*
    calculate the sum of bmi
 */
for(int i = 0; i < number; i ++){
    bmis[i] = students[i].getBMI();
    sum += bmis[i];
}
average = round(sum / number);
Arrays.sort(bmis);  //sort the bmi
float midNum;
/*
    get the mid number
 */
if(number % 2 == 0){
    midNum = (bmis[number / 2] + bmis[number / 2 + 1]) / 2;
}else{
    midNum = bmis[number / 2 + 1];
}
/*
    using the HashSet because it cannot store the duplicated data
 */
HashSet<Float> uniqueData = new HashSet<>();
HashMap<Integer, Float> mass = new HashMap<>();
for(int i = 0; i < number; i ++){
    uniqueData.add(bmis[i]);
}
int[] count = new int[uniqueData.size()];
int j = 0;
/*
    calculate the frequency of every number
 */
for(float f1 : uniqueData){
    for(float f2 : bmis){
        if(f1 == f2){
            count[j]++;
        }
    }
    mass.put(count[j], f1);
    j ++;
}
```

```
        int k = 0;
        for(int i : count){
            k = Math.max(k, i);
        }
        float massNum = mass.get(k);
        float variance;
        float tempSum = 0;
        for(int i = 0; i < number; i ++){
            tempSum += Math.pow(bmis[i] - average, 2);
        }
        variance = tempSum / number;
        System.out.println("Average: " + String.format("%.2f",average));
        System.out.println("Mediant: " + String.format("%.2f",midNum));
        System.out.println("Mode: " + String.format("%.2f",massNum));
        System.out.println("Variance: " + String.format("%.2f",variance));
    }

    private static void printStudents(int[] sortedindex,Student[] students){
        for(int tempInt : sortedindex){
            System.out.println(students[tempInt].toString());
        }
    }
    /**函数名: sortByBmi
     * funcition:
     * 1.sort students by bmi
     * 2.return the array
     * @param bmis
     * @return
     */
    public static int[] sortByBmi(Student[] students) {
        int num=students.length;
        int[] sortedIndex=new int[num];
        int tmp=0;
        for(int i=0;i<num;i++)
            sortedIndex[i]=i;
        float[] tempArray = new float[num];
        for(int i = 0; i < num; i ++){
            tempArray[i] = students[i].getBMI();
        }
        for(int x=0;x<num;x++) {
            for(int y=x+1;y<num;y++) {
                if(tempArray[x]>tempArray[y]) {
                    Float tempHeight = tempArray[y];
                   tempArray[y] = tempArray[x];
```

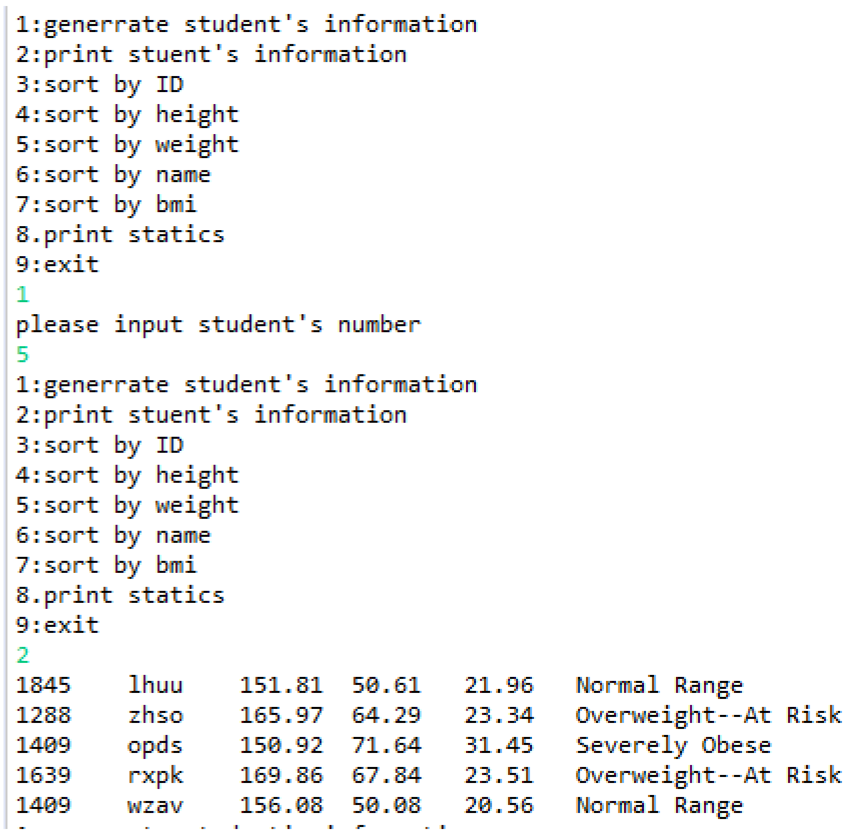
```
                    tempArray[x] = tempHeight;
                     tmp=sortedIndex[y];
                     sortedIndex[y]=sortedIndex[x];
                     sortedIndex[x]=tmp;
                }
            }
        }
           return sortedIndex;
    }
    /**函数名: sortByNmae
     * funcition:
     * 1.sort students by name
     * 2.return the array
     * @param bmis
     * @return
     */
    public static int[] sortByName(Student[] students) {
        int num=students.length;
        int[] sortedIndex=new int[num];
        int tmp=0;
        for(int i=0;i<num;i++)
            sortedIndex[i]=i;
        String[] tempArray = new String[num];
        for(int i = 0; i < num; i ++){
            tempArray[i] = students[i].getName();
        }
        for(int x=0;x<num;x++) {
            for(int y=x+1;y<num;y++) {
                if(tempArray[x].compareTo(tempArray[y]) > 0) {
                    String tempHeight = tempArray[y];
                    tempArray[y] = tempArray[x];
                    tempArray[x] = tempHeight;
                     tmp=sortedIndex[y];
                     sortedIndex[y]=sortedIndex[x];
                     sortedIndex[x]=tmp;
                }
            }
        }
           return sortedIndex;
    }
    /**函数名: sortByweight
     * funcition:
     * 1.sort students by weight
     * 2.return the array
```

```
 * @param weights
 * @return
 */
public static int[] sortByWeight(Student[] students) {
    int num=students.length;
    int[] sortedIndex=new int[num];
    int tmp=0;
    for(int i=0;i<num;i++)
        sortedIndex[i]=i;
    float[] tempArray = new float[num];
    for(int i = 0; i < num; i ++){
        tempArray[i] = students[i].getWeight();
    }
    for(int x=0;x<num;x++) {
        for(int y=x+1;y<num;y++) {
            if(tempArray[x]>tempArray[y]) {
                Float tempHeight = tempArray[y];
               tempArray[y] = tempArray[x];
               tempArray[x] = tempHeight;
                tmp=sortedIndex[y];
                sortedIndex[y]=sortedIndex[x];
                sortedIndex[x]=tmp;
            }
        }
    }
       return sortedIndex;
}
/**函数名: sortByheight
 * funcition:
 * 1.sort students by height
 * 2.return the array
 * @param heights
 * @return
 */
public static int[] sortByHeight(Student[] students) {
    int num=students.length;
    int[] sortedIndex=new int[num];
    int tmp=0;
    for(int i=0;i<num;i++)
        sortedIndex[i]=i;
    float[] tempArray = new float[num];
    for(int i = 0; i < num; i ++){
        tempArray[i] = students[i].getHeight();
    }
    for(int x=0;x<num;x++) {
        for(int y=x+1;y<num;y++) {
            if(tempArray[x]>tempArray[y]) {
                Float tempHeight = tempArray[y];
               tempArray[y] = tempArray[x];
               tempArray[x] = tempHeight;
                tmp=sortedIndex[y];
                sortedIndex[y]=sortedIndex[x];
                sortedIndex[x]=tmp;
            }
        }
    }
       return sortedIndex;
}
/**函数名: sortByID
 * funcition:
 * 1.sort students by ID
 * 2.return the array
 * @param ids
 * @return
 */
public static int[] sortByID(Student[] students) {
    int num=students.length;
    int[] sortedIndex=new int[num];
    int tmp=0;
    for(int i=0;i<num;i++)
        sortedIndex[i]=i;
    String[] tempArray = new String[num];
    for(int i = 0; i < num; i ++){
        tempArray[i] = students[i].getId();
    }
    for(int x=0;x<num;x++) {
        for(int y=x+1;y<num;y++) {
            if(tempArray[x].compareTo(tempArray[y]) > 0) {
                String tempHeight = tempArray[y];
               tempArray[y] = tempArray[x];
               tempArray[x] = tempHeight;
                tmp=sortedIndex[y];
                sortedIndex[y]=sortedIndex[x];
                sortedIndex[x]=tmp;
            }
        }
    }
       return sortedIndex;
 }
 /**函数名: inputstudents
  * function
  * 1.get the information
  * 2.caculate the bmi
  * 3.show the healthy condition
  * @param num
  * @param ids
  * @param names
  * @param heights
  * @param weights
  * @param bmis
  * @return
  */

 /**函数名:  checkhealth
  * function
  * 1.get bmi
  * 2.choice the healthy condition
  * 3.renturn result
  * @param bmi
  * @return
  */
 public static String checkHealth(float bmi) {
      if (bmi <= 18.5) {
          return "Underweight";
      } else if (bmi <= 23) {
          return "Normal Range";
      } else if (bmi <= 25) {
          return "Overweight--At Risk";
      } else if (bmi <= 30) {
          return "Overweight--Moderately Obese";
      } else {
          return "Severely Obese";
      }
}
}
```

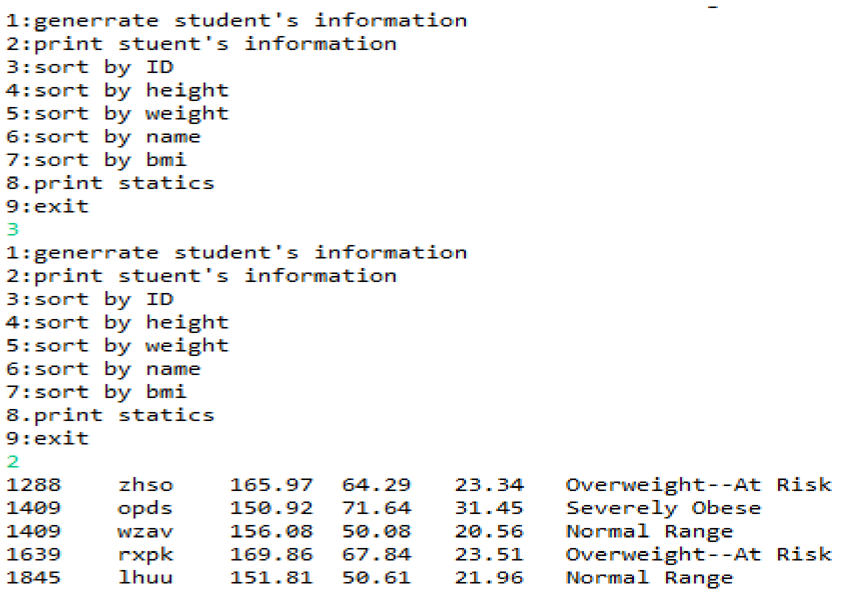
截图展示:

1.随机生成学生信息并打印



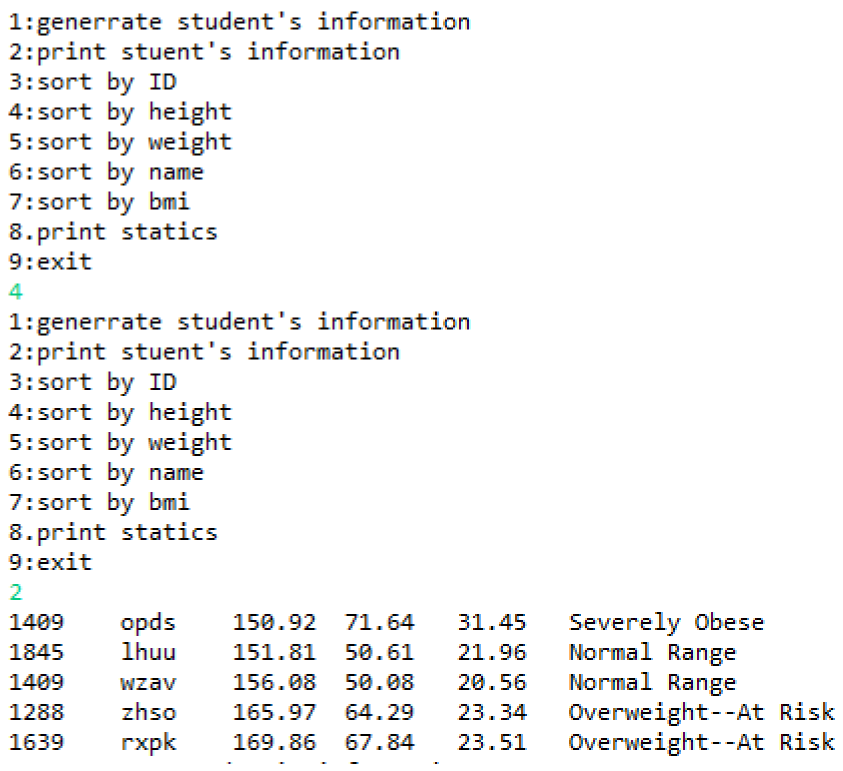
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
1
please input student's number
5
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1845    lhuu    151.81  50.61   21.96   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1409    opds    150.92  71.64   31.45   Severely Obese
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1409    wzav    156.08  50.08   20.56   Normal Range
```

2.按学号排序并打印



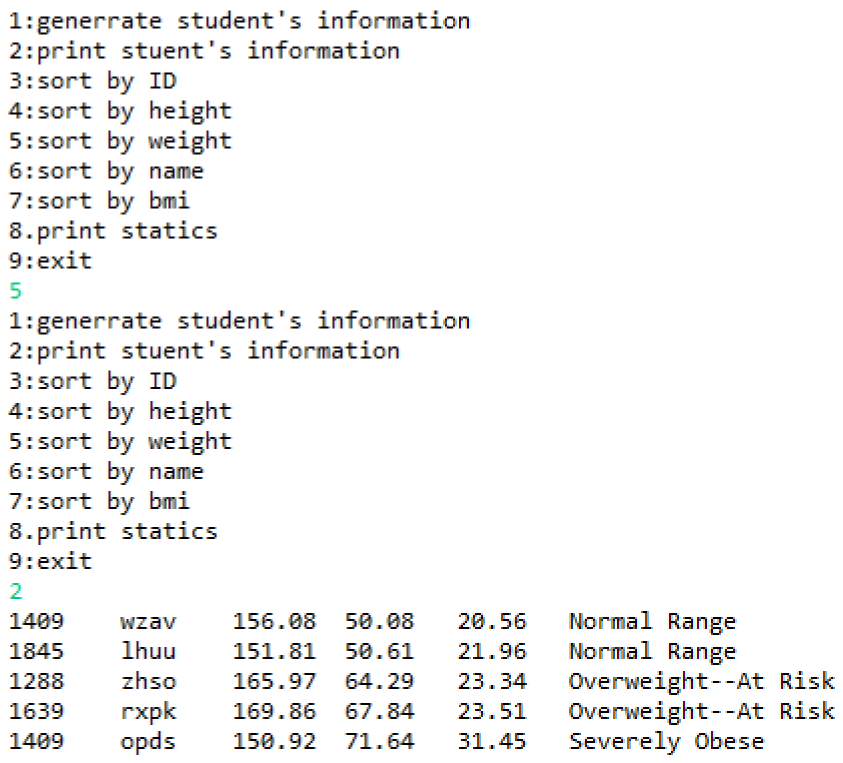
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
3
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1409    opds    150.92  71.64   31.45   Severely Obese
1409    wzav    156.08  50.08   20.56   Normal Range
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1845    lhuu    151.81  50.61   21.96   Normal Range
```

3.按身高排序并打印



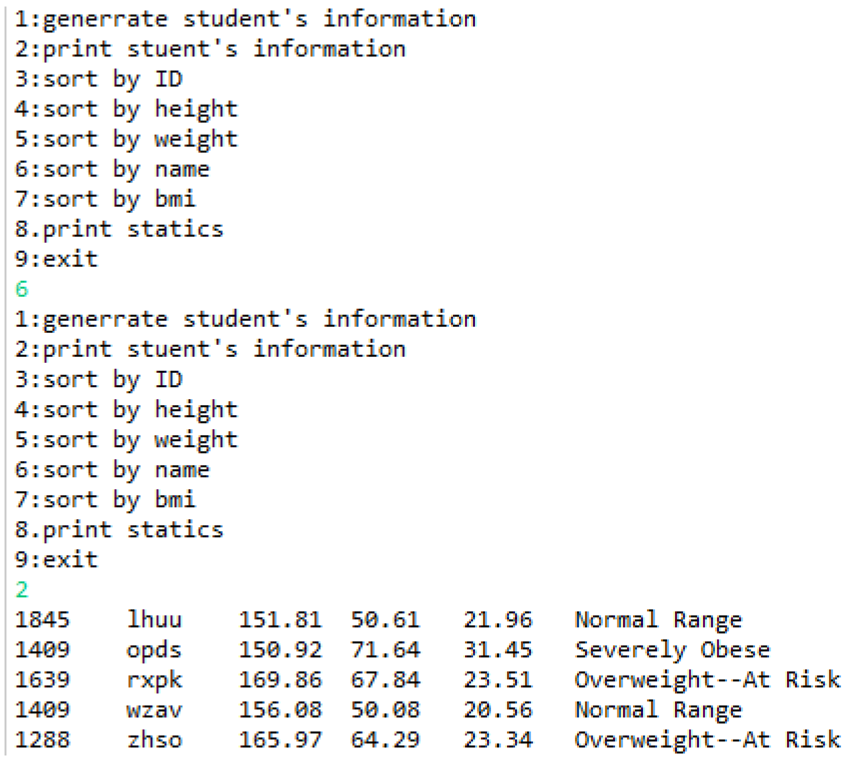
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
4
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1409    opds    150.92  71.64   31.45   Severely Obese
1845    lhuu    151.81  50.61   21.96   Normal Range
1409    wzav    156.08  50.08   20.56   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
```

4.按体重排序并打印



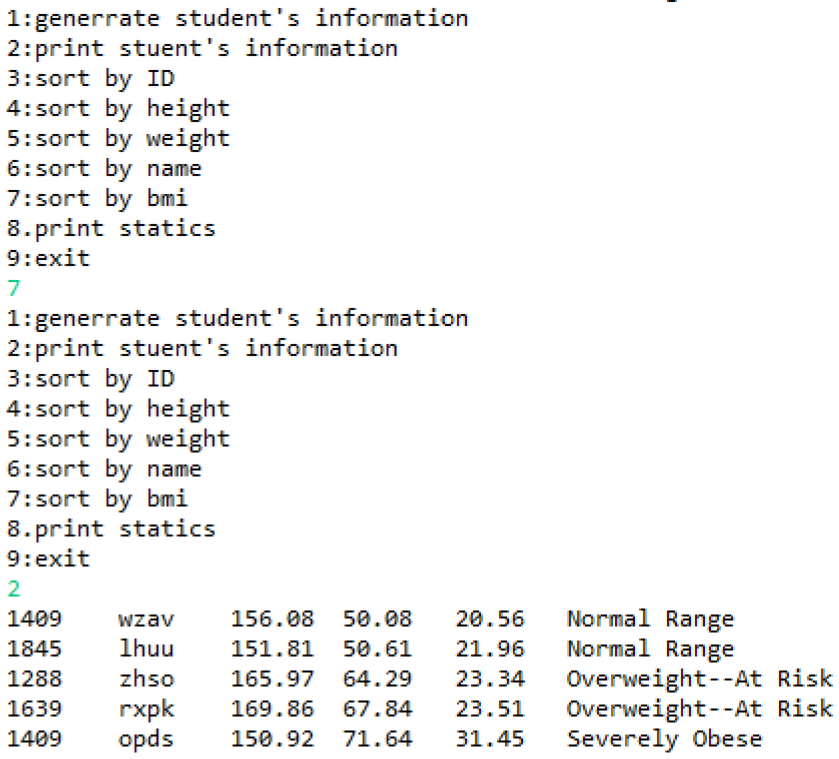
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
5
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1409    wzav    156.08  50.08   20.56   Normal Range
1845    lhuu    151.81  50.61   21.96   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1409    opds    150.92  71.64   31.45   Severely Obese
```

5.按姓名排序并打印



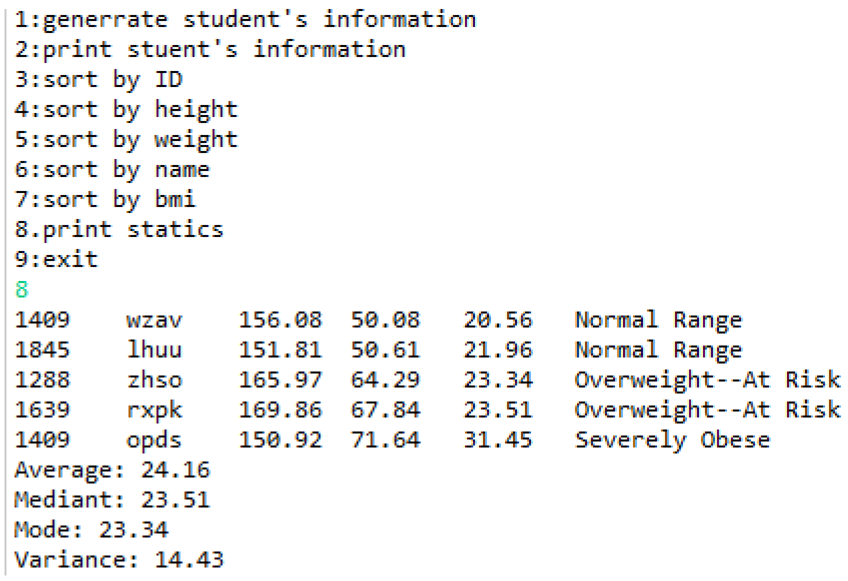
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
6
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1845    lhuu    151.81  50.61   21.96   Normal Range
1409    opds    150.92  71.64   31.45   Severely Obese
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1409    wzav    156.08  50.08   20.56   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
```

6.按 BMI 值排序并打印



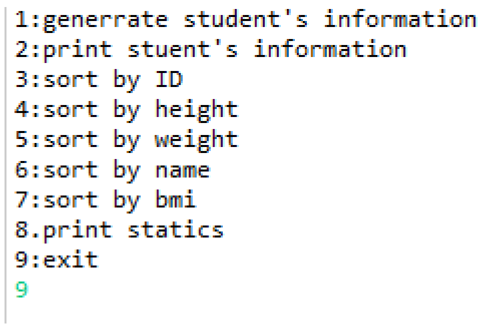
```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
7
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
2
1409    wzav    156.08  50.08   20.56   Normal Range
1845    lhuu    151.81  50.61   21.96   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1409    opds    150.92  71.64   31.45   Severely Obese
```

7.打印所有学生数据及 BMI 中位数，众数，平均数，方差



```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
8
1409    wzav    156.08  50.08   20.56   Normal Range
1845    lhuu    151.81  50.61   21.96   Normal Range
1288    zhso    165.97  64.29   23.34   Overweight--At Risk
1639    rxpk    169.86  67.84   23.51   Overweight--At Risk
1409    opds    150.92  71.64   31.45   Severely Obese
Average: 24.16
Mediant: 23.51
Mode: 23.34
Variance: 14.43
```

8.退出程序



```
1:generrate student's information
2:print stuent's information
3:sort by ID
4:sort by height
5:sort by weight
6:sort by name
7:sort by bmi
8.print statics
9:exit
9
```