

## Problem 1:

In this problem, two functions are tested.

**The first function** swaps the values of two integer variables using pass-by-point.

In the first function, the parameters are the memory location of the variables. So, when the function does the swap, it changes the values saved in the memory.

**And in the second function**, pass-by-reference is used. It allows a function to modify a variable without having to create a copy of it. It is basically another name of the parameters. The memory location of the passed variable and parameter is the same and therefore, any change to the parameter reflects in the variable as well.

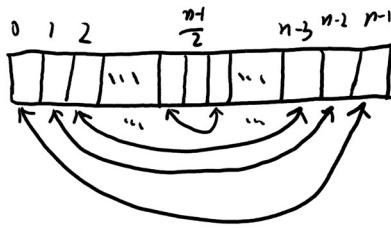
**Result:**

```
-bash-4.2$ ./q1.out
Original value of a and b:4 7
Pass by pointer:7 4
Original value of a and b:4 7
Pass by reference:7 4
```

## Problem 2:

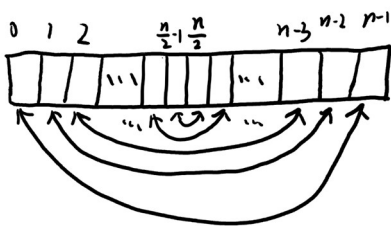
In this problem, the function mirror mirrors the content of the array v. The function has two parameters: the array a and the integer n. Array a is the array we want to mirror. Integer n means there are n numbers in the array a. The array can be reversed by reading the integer from the two ends of the array and swapping

them. If  $n$  is even, then the function makes  $n/2$  swaps. If  $n$  is odd, then the function also makes  $n/2$  swaps. The median in odd do not need to change its position.



$$\text{times} = \lceil \frac{n}{2} \rceil = \frac{n}{2} \text{ (only integer part)}$$

even:



$$\text{times} = \frac{n}{2} - 1 + 1 = \frac{n}{2}$$

Result:

```
-bash-4.2$ ./q2.out
1
2
8
7
6
5
```

### Problem 3:

In this problem, after the teacher input the names and grades of students, the program will print the following information:

1. The complete list of students along with their grades in a descending order of the grades. (Implemented in the "Sort" function)
2. The average and median of the students' grades. (Implemented in the "Average" function)
3. The name of the student with the maximum grade and displays this grade. (Implemented in the "Max" function)
4. The name of the student with the minimum grade and displays this grade. (Implemented in the "Min" function)

A struct is defined to store students' names and grades.

```
struct StuSco {  
    string Name;//student's name  
    int Grade;//student's grade  
};
```

#### **In the main function:**

First ask the teacher to enter the number of students (num). And the program will check the input. if num is negative or non-integer, program will ask the teacher to input again until the input is correct. Then using function "new" to create an array using dynamic memory. The type of array is StuSco. Input students' names and grades in order. When the grades are non-integer or out of the range of 0 to 100, the program will ask the teacher to input again.

#### **In the Sort function:**

Using the insertion sort to sort in a descending order. It iterates from stu[0] to stu[n-1] over the array. And it compares the current grade to its predecessor. If

the grade is greater than its predecessor, compare it to the elements before. Move the smaller elements one position up to make space for the swapped element.

**In the Average function:**

Average is the quotient obtained by dividing the sum of grades by the number of grades. Median is the middle number in a sorted. If there is an even amount of students, the middle pair is determined, added together, and divided by two to find the median value.

**In the Max function:**

Because the array is sorted in the Sort function, program simply print `stu[0].Name` and `stu[0].Grade`. If more than one student got the best grade, print them all.

**In the Min function:**

Because the array is sorted in the Sort function, program simply print `stu[n-1].Name` and `stu[n-1].Grade`. If more than one student got the worst grade, print them all.

## Result:

```
-bash-4.2$ g++ -std=c++11 q3.cpp -o q3.out
-bash-4.2$ ./q3.out
Please input the number of students(only a number): -5
Please input the number bigger than 0!
Please input the number of student(only a number) again: asd
Please input the number bigger than 0!
Please input the number of student(only a number) again: Please input the number bigger than 0!
Please input the number of student(only a number) again: Please input the number bigger than 0!
Please input the number of student(only a number) again: 5
Please input the name of student1: Aaron
Please input the grade of student1: 68
Please input the name of student2: Dylan
Please input the grade of student2: 87
Please input the name of student3: Evan
Please input the grade of student3: 111
Please input a number between 0 and 100!
Please input the grade of student3: 100
Please input the name of student4: Bette
Please input the grade of student4: 97
Please input the name of student5: Ella
Please input the grade of student5: 73
name    Grade
Evan    100
Bette   97
Dylan   87
Ella    73
Aaron   68
The average grade is: 85
The median grade is: 87
Aaron gets the worst grade. The grade is: 68
Evan gets the best grade. The grade is: 100
-bash-4.2$
```