# Laboratory practice No. 2: NOTATION BIG O

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## 3) Practice for final project defense presentation

**3.1** Time measurement for 20 different sizes taking into account that the measurement will be made in milliseconds; This will be done with two types of algorithms: INSERTION SORT AND MERGE SORT.

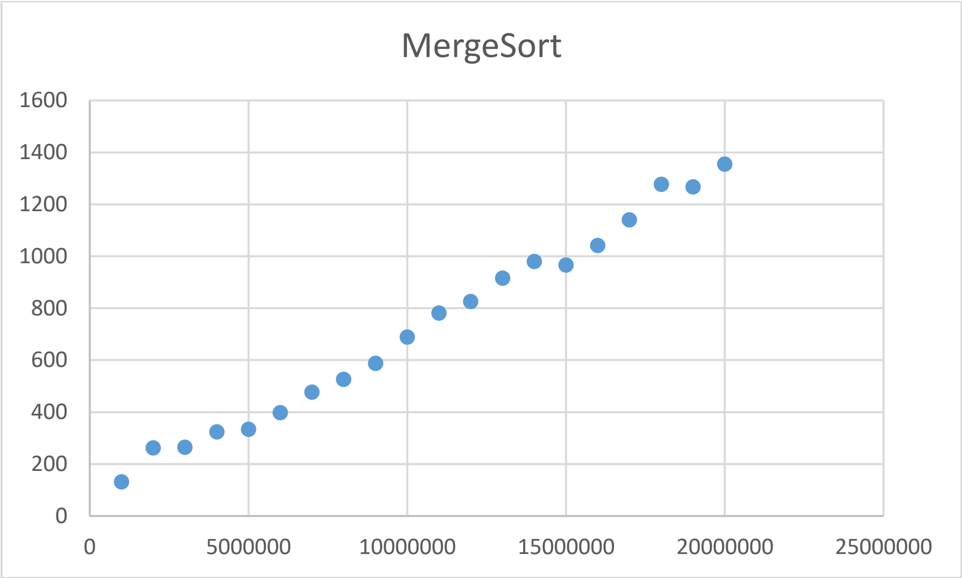
**INSERTION SORT**

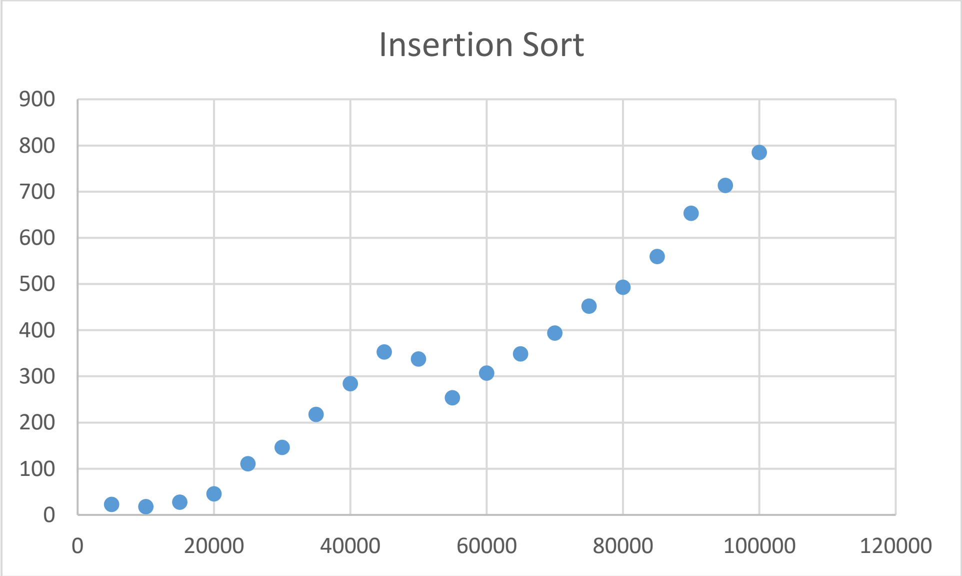
| Size | Time |
|---|---|
| 5000 | 23 |
| 10000 | 18 |
| 15000 | 28 |
| 20000 | 46 |
| 25000 | 111 |
| 30000 | 146 |
| 35000 | 218 |
| 40000 | 284 |
| 45000 | 353 |
| 50000 | 338 |
| 55000 | 254 |
| 60000 | 307 |
| 65000 | 349 |
| 70000 | 394 |
| 75000 | 452 |
| 80000 | 493 |
| 85000 | 560 |
| 90000 | 653 |
| 95000 | 714 |
| 100000 | 785 |

**MERGE SORT**

| SIZE | TIME |
|---|---|
| 1000000 | 132 |
| 2000000 | 263 |
| 3000000 | 265 |
| 4000000 | 324 |
| 5000000 | 334 |
| 6000000 | 398 |
| 7000000 | 477 |
| 8000000 | 526 |
| 9000000 | 588 |
| 10000000 | 689 |
| 11000000 | 782 |
| 12000000 | 826 |
| 13000000 | 916 |
| 14000000 | 980 |
| 15000000 | 967 |
| 16000000 | 1042 |
| 17000000 | 1141 |
| 18000000 | 1277 |
| 19000000 | 1267 |
| 20000000 | 1355 |

### 3.2 Graphs where we can define the size and execution time

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**3.3** Based on the case of large arrays, it is more efficient to use the mergesort because it separates the elements of the array into several parts that allow optimal and more efficient use than the insertionsort, as this visits each position of arrays, having a slower runtime, which makes it possible to use mergesort for large arrays.

**3.4** Using insertionsort in a video game would not be optimal, since it takes a long time to execute, which leads to occupy a large space of memory, and a late execution for the game**.**

**3.5** To ensure that the use of the insertion sort in large arrays has efficiency, it is required that the array elements be ordered, to allow efficient use of it.

**3.6 Explanation of the algorithm MaxSpan:**

MaxSpan is an algorithm which, given an array of integers, the algorithm searches which is the largest space that exists in the array between two equal numbers and will return the number of elements between these two numbers included.

Functionality:
For the algorithm to search for this space, we first have two variables in our case, which will be a temporary counter which will have the value of the space between the numbers that will be evaluated at the moment and that will be the final value of the largest space, which will come back. The algorithm works through two cycles for nests, the first one will go from 0 to the length of the array with a variable i and the second one will go from the length of the array to 0 with the variable j, this will automatically evaluate all possible combinations of spaces between the arrangement from the first to the last position. Then we have a yes which will verify if the number of the i is equal to that of the j, if it is the case that this condition is met our variable s (temporary container) will be equal to the subtraction of the positions plus 1, which it is the size between the two equal numbers, and then it will be another if it is verified if the evaluated vector is larger than the previous vector, if s is larger am, if it is the case m will be equal to that it is the new largest size found .
In the end the algorithm returns the value of m which is the largest size between two equal numbers in the array.

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### *3.7) Complexity Big O Array2 and Array3*

***ARRAY2***

- 

```java
public int countEvens(int[] nums) {

  int cont = 0;

  for(int i = 0; i<nums.length; i++){

    if(nums[i]%2==0)
    cont++;
  }

  return cont;
}
```

***The notation Big O is= O(n)***

- 

```java
public int sum13(int[] nums) {

  int a = 0;

  for(int i = 0; i<nums.length; i++){

    if(nums[i]==13 && i<nums.length-1){

    nums[i+1]=0;
    }

    if(nums[i]!=13){

    a+=nums[i];
    }
  }

  return a;
}
```

***The notation Big O is= O(n)***

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- 

```
public int bigDiff(int[] nums) {

  int a = nums[0];
  int b = nums[0];

  for(int i = 0; i<nums.length; i++){

    a = Math.max(a, nums[i]);
    b = Math.min(b, nums[i]);

  }
  return a-b;
}
```

***The notation Big O is= O(n)***

- 

```
public boolean sum28(int[] nums) {

    int x =0;

  for(int i= 0; i < nums.length; i++){

    if(nums[i]==2){
      x+=2;
    }
  }

 return x == 8;
}
```

***The notation Big O is= O(n)***

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- 

```
public boolean has12(int[] nums) {

  boolean h1 = false;
  boolean h2 = false;

  for(int i = 0; i < nums.length; i++){
    if(nums[i]==1){
      h1 = true;
    }
    if(nums[i]==2 && h1){
      h2 = true;
    }
  }

  return h2;
}
```

***The notation Big O is= O(n)***

***ARRAY3***

- 

```
public int maxSpan(int[] nums) {

int m = 0;
int s = 0;

for(int i = 0; i<nums.length; i++){
    for(int j = nums.length-1; j>=0; j--){


     if(nums[i]==nums[j])

    s = j-i+1;

     if (s>m) m =s;

    }

  }

   return m;
}
```

***The notation Big O is= O(n^2)***

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- 

```java
public boolean linearIn(int[] outer, int[] inner) {

  int a = 0;

  for(int i =0; i<inner.length; i++){
    for(int j =0; j<outer.length; j++){

 if(i<inner.length){
    if(inner[i]==outer[j]){

a++;
i++;
}
  }
  }
  }
  return a==inner.length;
}
```

***The notation Big O is= O(i*o)***

- 

```java
public int[] squareUp(int n) {

    int [] a = new int [n*n];

    int b = 0;

    for(int i =1; i<=n; i++){
        for(int j = n; j>=1; j--){

            a[b++]=j;

            if(i<j)
                a[b-1] = 0;

        }
    }

    return a;

}
```

***The notation Big O is= O(m^2)***

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•

```
public int[] seriesUp(int n) {

  int [] a = new int [n*(n + 1)/2];

  int b = 0;

  for(int i = 1; i<=n; i++){
          for(int j = 1; j<=i; j++){

            a[b++]=j;
          }
  }


      return a;
}
```

*The notation Big O is= O(m^2)*

•

```
public int countClumps(int[] nums) {
 int a = 0;
 int b = -1;
  for(int i = 0; i < nums.length - 1; i++) {
    if(nums[i] == nums[i + 1] && nums[i] != b) {
       b = nums[i];
       a++;
   }

   for(int j = 0; j < nums.length - 1; j++) {
       if(nums[i] !=b) {
        b = -1;
       }
    }
  }

  return a;
}
```

*The notation Big O is= O(n^2)*

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***3.8) The variables that are considered in the notation Big O, they directly influence the algorithms; its meaning is:***

n = Array length
m = Variable for the array creation

o = Outer length
i = Inner length

***4) Practice for midterms***

4.1 C
4.2 D
4.3 B
4.4 B
4.5 D
4.6 A

4.7 Q
4.7.1 T(n) = T(n - 1) + c
4.7.2 O(n)

4.8 A
4.9 D
4.10 C
4.11 C
4.12 B
4.13 C
4.14 A

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