

# Selection Sort & HeapSort

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[Repositorio Github](#)

# Selection Sort -- $\Theta(n^2)$

```
selectionSort(A):
```


```
    for i = 0 to A.size
        min = selectMin(A, i, A.size)
        swap(A[min], A[i]);
    return
```

```
selectMin(A, start, end):
```

```
    min = start;
    for i = start to end
        if A[i] < A[min]
            min = i
    return min
```

```
swap(a, b):
```

```
    aux = a
    a = b
    b = aux
    return
```



# Selection Sort -- $\Theta(n^2)$

|  | Repeticiones               |
|--|----------------------------|
| <code>selectionSort(A):</code>             | <code>1</code>             |
| <code>for i = 0 to A.size</code>           | <code>n</code>             |
| <code>min = selectMin(A, i, A.size)</code> | <code>t<sub>1</sub></code> |
| <code>swap(A[min], A[i]);</code>           | <code>t<sub>2</sub></code> |
| <code>return</code>                        | <code>1</code>             |

```
selectMin(A, start, end):  
    min = start;  
    for i = start to end  
        if A[i] < A[min]  
            min = i  
    return min
```

```
swap(a, b):  
    aux = a  
    a = b  
    b = aux  
    return
```



# Selection Sort -- $\Theta(n^2)$

|                                  | Repeticiones |
|----------------------------------|--------------|
| <b>selectionSort(A):</b>         |              |
| <b>for</b> $i = 0$ to $A.size$   | $n$          |
| $min = selectMin(A, i, A.size)$  | $t_1$        |
| $swap(A[min], A[i]);$            | $t_2$        |
| <b>return</b>                    | $1$          |
| <br>                             |              |
| <b>selectMin(A, start, end):</b> | $1$          |
| $min = start;$                   | $1$          |
| <b>for</b> $i = start$ to $end$  | $n$          |
| <b>if</b> $A[i] < A[min]$        | $1$          |
| $min = i$                        | $1, 0$       |
| <b>return</b> $min$              | $1$          |
| <br>                             |              |
| <b>swap(a, b):</b>               |              |
| $aux = a$                        |              |
| $a = b$                          |              |
| $b = aux$                        |              |
| <b>return</b>                    |              |

# Selection Sort -- $\Theta(n^2)$

|                                      | Repeticiones |
|--------------------------------------|--------------|
| <b>selectionSort(A):</b>             | 1            |
| for i = 0 to A.size                  | n            |
| min = selectMin(A, i, A.size)        | $t_1$        |
| swap(A[min], A[i]);                  | $t_2$        |
| return                               | 1            |
| <br><b>selectMin(A, start, end):</b> | 1            |
| min = start;                         | 1            |
| for i = start to end                 | n            |
| if A[i] < A[min]                     | 1            |
| min = i                              | 1, 0         |
| return min                           | 1            |
| <br><b>swap(a, b):</b>               | 1            |
| aux = a                              | 1            |
| a = b                                | 1            |
| b = aux                              | 1            |
| return                               | 1            |



# Selection Sort -- $\Theta(n^2)$

|  | Repeticiones |                        |
|--|--------------|------------------------|
| <code>selectionSort(A):</code>             | 1            | }                      |
| <code>for i = 0 to A.size</code>           | $n$          |                        |
| <code>min = selectMin(A, i, A.size)</code> | $t_1$        |                        |
| <code>swap(A[min], A[i]);</code>           | $t_2$        |                        |
| <code>return</code>                        | 1            | $T(n) \in \Theta(n^2)$ |
|  |              |                        |
| <code>selectMin(A, start, end):</code>     | 1            | }                      |
| <code>min = start;</code>                  | 1            |                        |
| <code>for i = start to end</code>          | $n$          |                        |
| <code>if A[i] &lt; A[min]</code>           | 1            |                        |
| <code>min = i</code>                       | $1, 0$       |                        |
| <code>return min</code>                    | 1            | $t_1 = nc_2 + c_1$     |
|  |              |                        |
| <code>swap(a, b):</code>                   | 1            | }                      |
| <code>aux = a</code>                       | 1            |                        |
| <code>a = b</code>                         | 1            |                        |
| <code>b = aux</code>                       | 1            |                        |
| <code>return</code>                        | 1            |                        |
|  |              | $t_2 = c_3$            |



# Selection Sort -- $\Theta(n^2)$

|   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 5 | 2 | 6 | 9 | 3 | 1 | 4 | 0 | 7 |
|---|---|---|---|---|---|---|---|---|---|



# HeapSort -- $\Theta(n \log(n))$

```
heapSort(A):  
    for i = (A.size/2) to 1  
        sink(A, i)  
    for i = A.size to 2  
        swap(A[1], A[i])  
        sink(A, i)  
    return
```





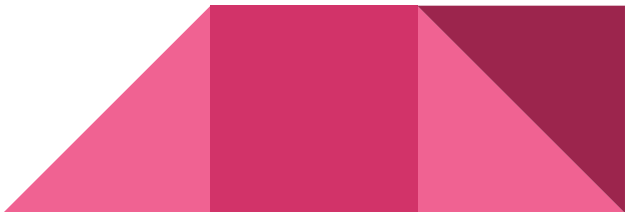
# HeapSort -- $\Theta(n \log(n))$

|                         | Repeticiones   |
|-------------------------|----------------|
| heapSort(A):            | 1              |
| for i = (A.size/2) to 1 | n/2            |
| sink(A, i)              | t <sub>1</sub> |
| for i = A.size to 2     | n-1            |
| swap(A[1], A[i])        | t <sub>2</sub> |
| sink(A, i)              | t <sub>1</sub> |
| return                  | 1              |



# HeapSort -- $\Theta(n \log(n))$

|                         | Repeticiones |                                 |
|-------------------------|--------------|---------------------------------|
| heapSort(A):            | 1            | } $T(n) = nt_1c_3 + nc_4 + c_5$ |
| for i = (A.size/2) to 1 | $n/2$        |                                 |
| sink(A, i)              | $t_1$        |                                 |
| for i = A.size to 2     | $n-1$        |                                 |
| swap(A[1], A[i])        | $t_2$        |                                 |
| sink(A, i)              | $t_1$        | }                               |
| return                  | 1            |                                 |



# HeapSort -- $\Theta(n \log(n))$

```
sink(A, i):  
    x = A[i-1]  
    while 2i <= A.size  
        left = 2i  
        right = 2i+1  
        if (left == A.size) or (A[left] > A[right])  
            max = left  
        else  
            max = right  
        if (A[max] <= x)  
            break  
        else  
            swap(A[i], A[max])  
            i = max  
    return
```



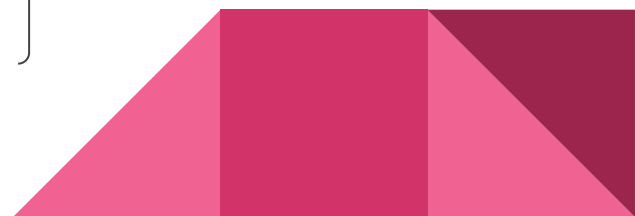
# HeapSort -- $\Theta(n \log(n))$

|   | Repeticiones |
|---|--------------|
| <code>sink(A, i):</code>                                    | 1            |
| <code>x = A[i-1]</code>                                     | 1            |
| <code>while 2i &lt;= A.size</code>                          | $\log n$     |
| <code>left = 2i</code>                                      | 1            |
| <code>right = 2i+1</code>                                   | 1            |
| <code>if (left == A.size) or (A[left] &gt; A[right])</code> | 1            |
| <code>max = left</code>                                     | 1            |
| <code>else</code>   |              |
| <code>max = right</code>                                    | 1            |
| <code>if (A[max] &lt;= x)</code>                            | 1            |
| <code>break</code>  | 1            |
| <code>else</code>   |              |
| <code>swap(A[i], A[max])</code>                             | $t_2$        |
| <code>i = max</code>  | 1            |
| <code>return</code>   |              |

# HeapSort -- $\Theta(n \log(n))$

|   | Repeticiones |
|---|--------------|
| <code>sink(A, i):</code>                                    | 1            |
| <code>x = A[i-1]</code>                                     | 1            |
| <code>while 2i &lt;= A.size</code>                          | $\log n$     |
| <code>left = 2i</code>                                      | 1            |
| <code>right = 2i+1</code>                                   | 1            |
| <code>if (left == A.size) or (A[left] &gt; A[right])</code> | 1            |
| <code>max = left</code>                                     | 1            |
| <code>else</code>   |              |
| <code>max = right</code>                                    | 1            |
| <code>if (A[max] &lt;= x)</code>                            | 1            |
| <code>break</code>  | 1            |
| <code>else</code>   |              |
| <code>swap(A[i], A[max])</code>                             | $t_2$        |
| <code>i = max</code>  | 1            |
| <code>return</code>   |              |

$$t_1 = \log(n)c_1 + c_2$$



# HeapSort -- $\Theta(n \log(n))$

$$T(n) = nt_1c_3 + nc_4 + c_5$$

$$t_1 = \log(n)c_1 + c_2$$

$$T(n) \in \Theta(n \log(n))$$

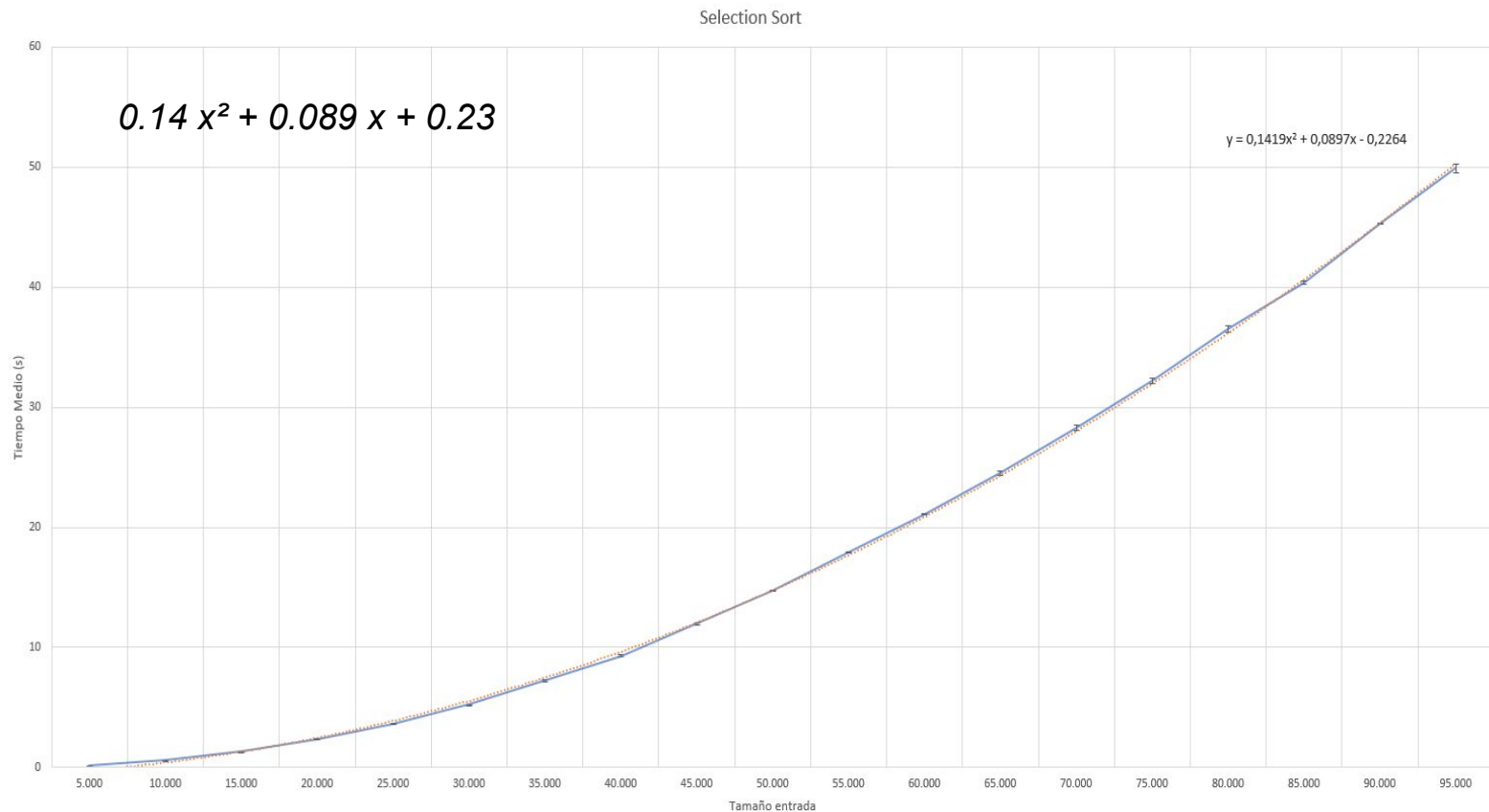


# HeapSort -- $\Theta(n \log(n))$

6 5 3 1 8 7 2 4



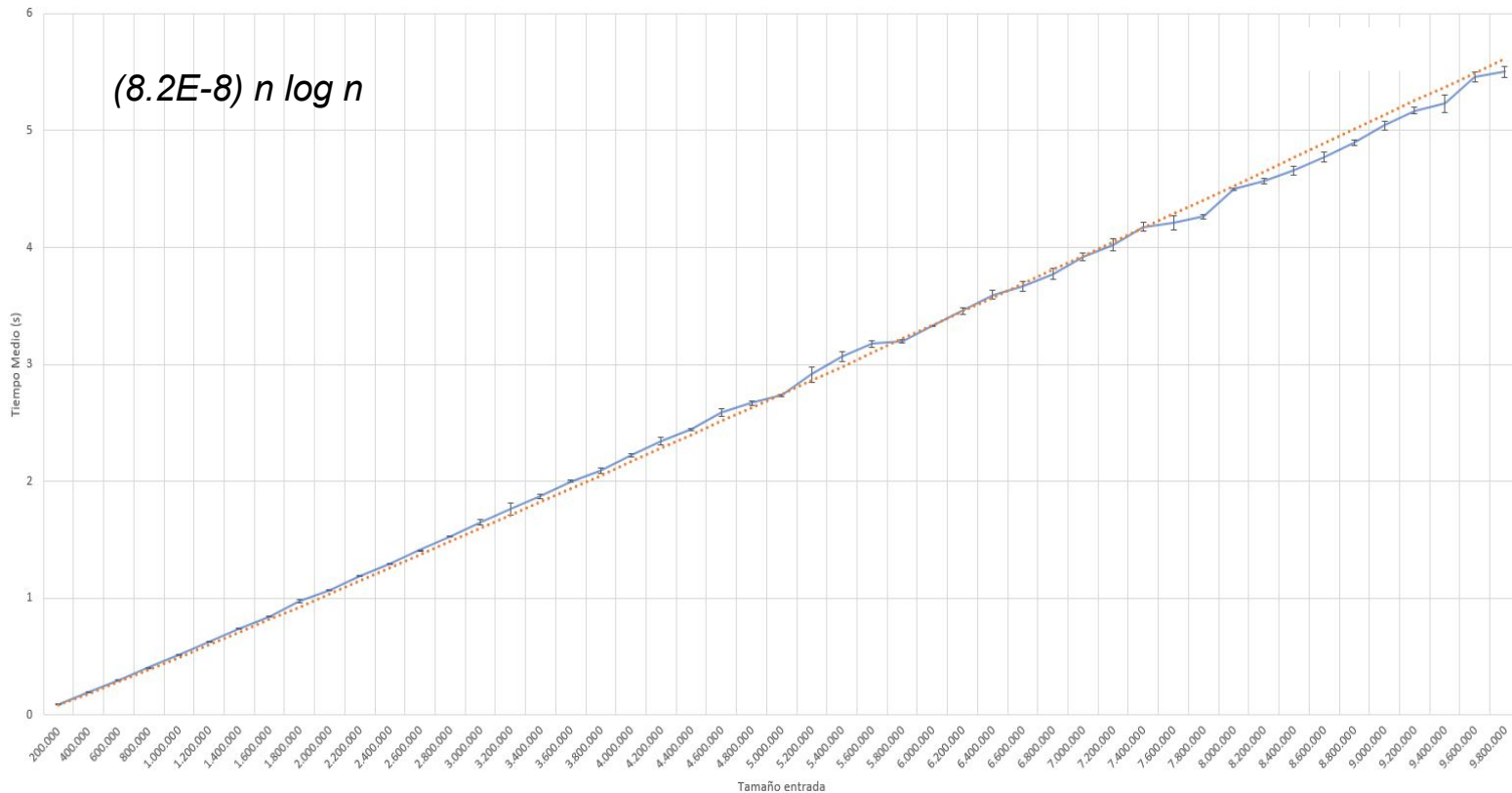
# Caso real -- Selection Sort -- $\Theta(n^2)$



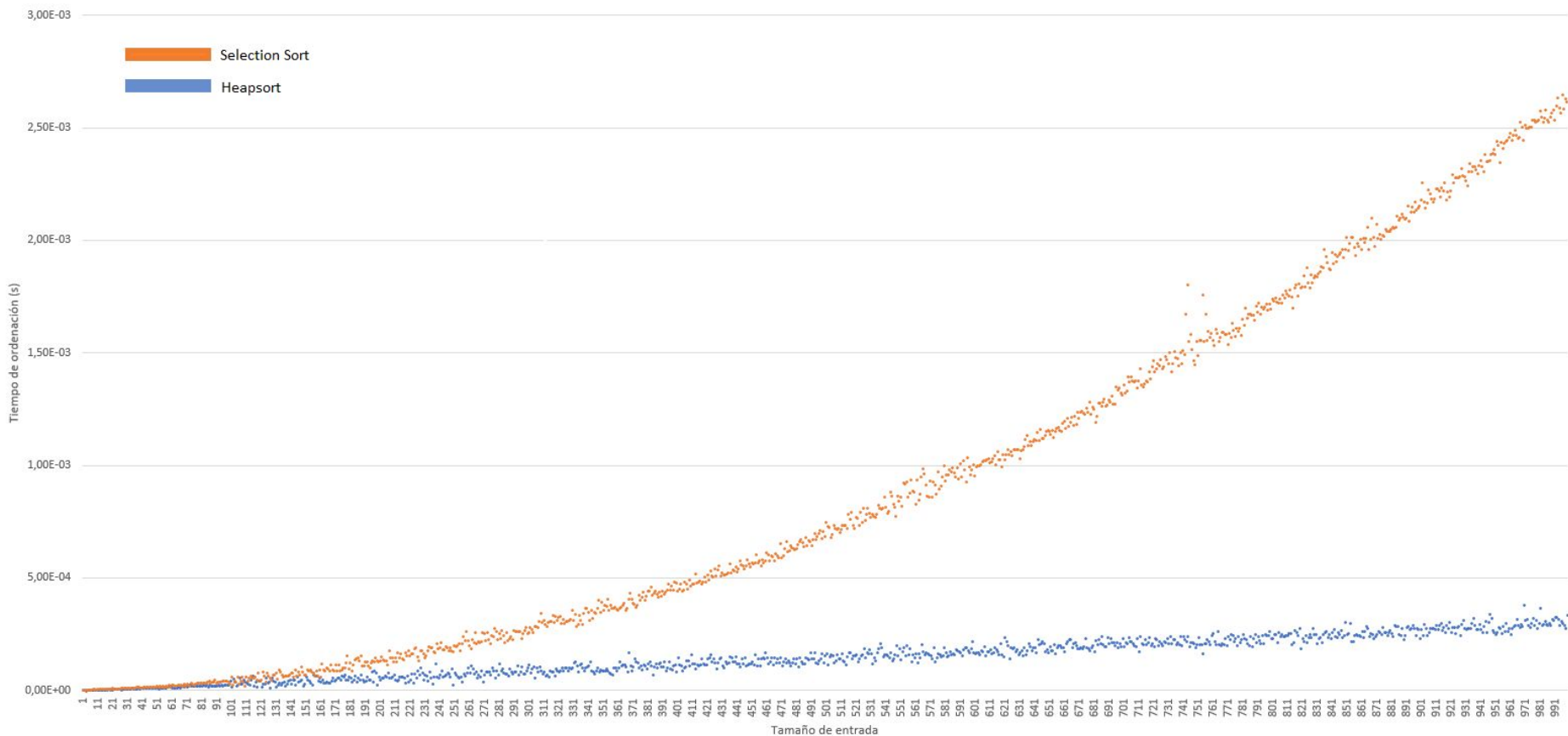


# Caso real -- HeapSort -- $\Theta(n \log(n))$

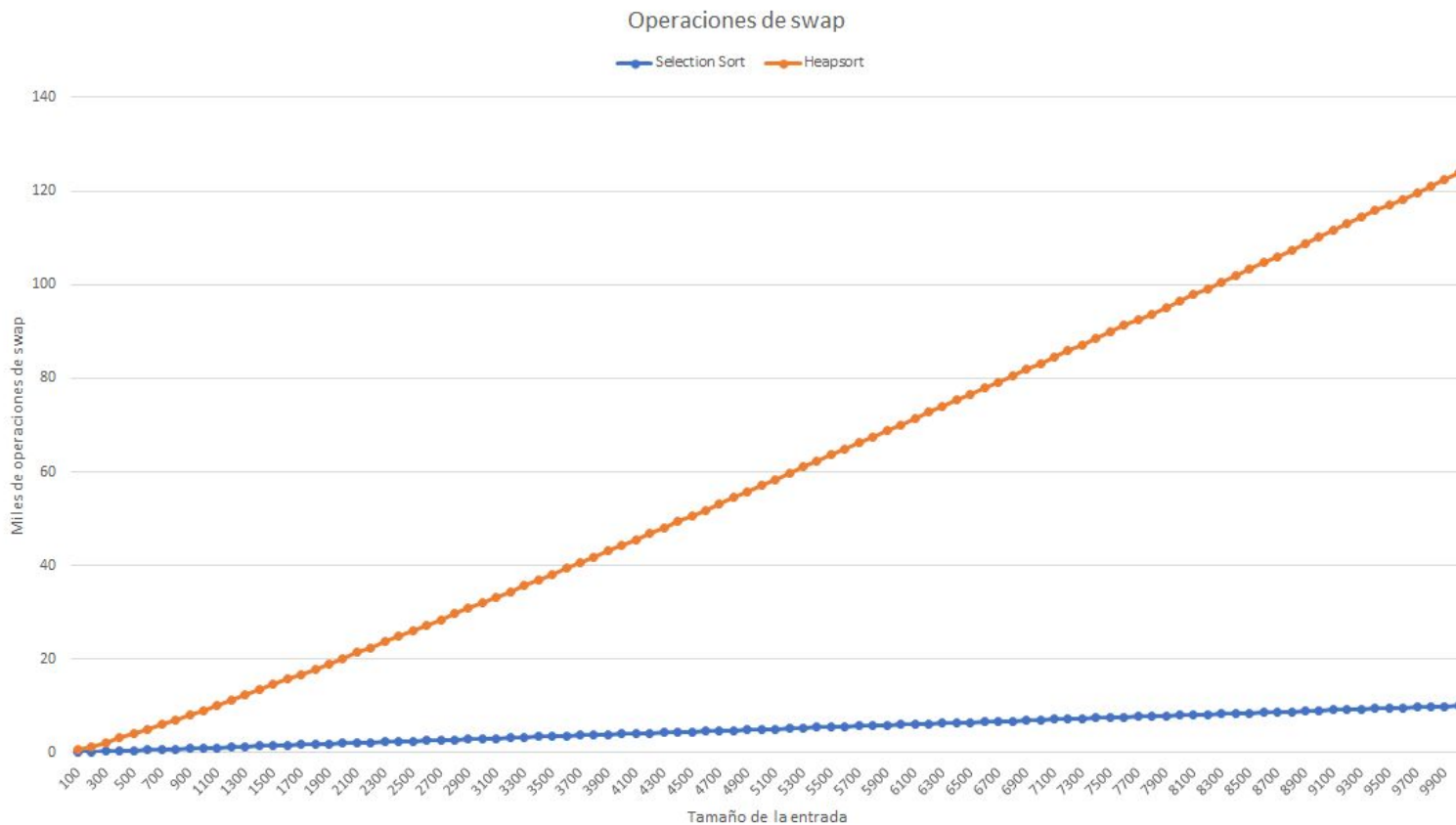
Heap Sort



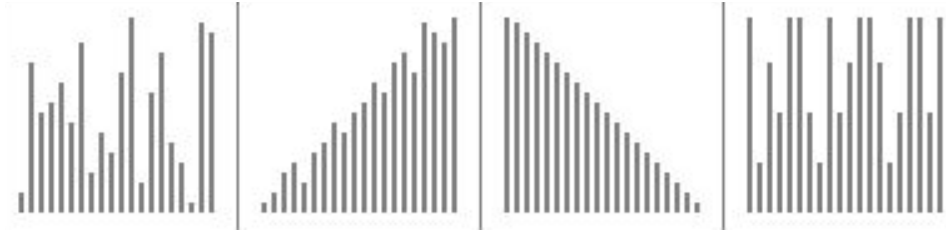
# Heapsort vs Selection Sort



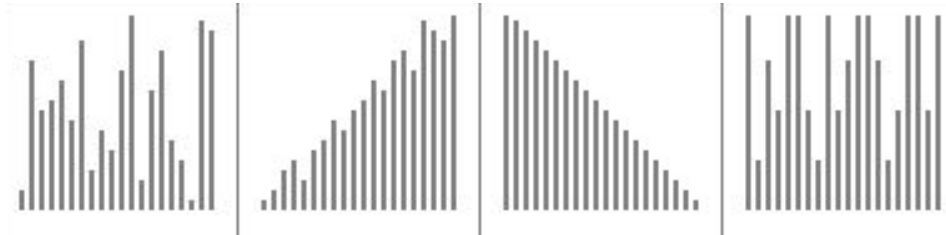
# Operaciones de swap



# Comparación



Selection Sort



HeapSort

*Random*

*Nearly sorted*

*Reversed*

*Few Unique*



# Bibliografía

<https://www.toptal.com/developers/sorting-algorithms/>

[https://en.wikipedia.org/wiki/Selection\\_sort](https://en.wikipedia.org/wiki/Selection_sort)

<https://en.wikipedia.org/wiki/Heapsort>

PDF's: Diapositivas Tema 1 DAA



FIN

