

Algorithms mandatory assignment 1

2 Runtimes

- First, it's the function 3^n , this is the algorithm that has the most exponential growth, which means it's the algorithm that takes the most time. After that we have x^3 , which is almost as slow as the previously mentioned. Now there are 3 algorithms that share almost the same runtime, but there is a slightly difference between them. The slowest of them are 1.8^n , this one has a very similar curve as the first function. After 1.8^n we have $n \cdot (\log_2(n))^2$, and after that we have n^2 . All these mentioned algorithms have an exponential growth which means the runtime will increase drastically with the n . N is the next algorithm, and then we have \sqrt{n} , which is the second fastest. The fastest algorithm is $\log_2(n)$ which won't increase much runtime when the n increment.
- If the computers can compute 100 times faster in the future, \sqrt{n} and $\log_2(n)$ will still be almost the same runtime due to the runtime capping and not incrementing much with the change of n .

3 Min and Max

- Here I will write a pseudo code for finding the maximum and minimum value.

```
1. minimum = first object in the list
2. While(list has more objects){
3.     If(current object in list < minimum){ minimum = current object }
4. }
5. return minimum
```

```
1. Maximum = first object in the list
2. While(list has more objects){
3.     If(current object in list > maximum){ maximum = current
       object }
4. }
5. Return maximum
```

Line	Memory cost	How many times	Total
1.	1	1	1
2.	2	N	2*N
3.	1	K	K
4.	-	-	0
5.	1	1	1
			2+2*N+K

Assuming operations, except the loop, takes 1 cost the total cost of the program $2N+K+2$.

Worst case for $n=5$:

Line	Memory cost	How many times	Total
1.	1	1	1
2.	2	5	10
3.	1	4	4
4.	-	-	0
5.	-	-	1
			15

Worst case the program must change the minimum object every time, which means the n is 5 and the k is 4. This gives us a total cost of 15. Worst case for maximum means that the list is sorted ascending and sorted descending for the minimum program. Best case for these algorithms means that the k is reduced to 0, which means sorted ascending for minimum and descending for the maximum algorithm.

4 Binary counter

The changing in 0's and 1's is 1, 2, 1, 3, 1, 2, 1, n . For each time you must change all the previous 1's and change one 0 you the cost is n .