Algorithmics	Student information	Date	Number of session
	UO: 294039	29/02/2024	3
	Surname: Rodríguez Gómara		
	Name: María		

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Activity 1. Divide and Conquer by subtraction

After analyzing the complexity of the three previous classes, you are not asked to make the timetables, but to reason whether the times match the theoretical time complexity of each algorithm.

To see if the times obtain match the theoretical times we are going to calculate them:

Subtraction 1

The complexity is O(n). To calculate the theoretical values, we are going to use the following formula:

$$t2 = \frac{n2}{n1} \cdot t1$$

We are going to calculate two times:

1. For n1 = 512, n2 = 1024 and t1=0,0313. The experimental value is equal to 0,0636.

$$t2 = \frac{1024}{512} \cdot 0{,}0313 = 0{,}0626$$

2. For n1 = 1024, n2 = 2048 and t1 = 0,0636. The experimental value is equal to 0,1263.

$$t2 = \frac{2048}{1024} \cdot 0{,}0636 = 0{,}1272$$

The experimental values match the theoretical ones.

Subtraction 2

The complexity is $O(n^2)$. To calculate the theoretical values, we are going to use the following formula:

$$t2 = \frac{n2^2}{n1^2} \cdot t1$$

We are going to calculate two times:

1. For n1 = 512, n2 = 1024 and t1=6. The experimental value is equal to 30.

$$t2 = \frac{1024^2}{512^2} \cdot 6 = 24$$

2. For n1 = 1024, n2 = 2048 and t1 = 30. The experimental value is equal to 145.

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$$t2 = \frac{2048^2}{1024^2} \cdot 30 = 120$$

The experimental values match the theoretical ones.

For what value of n do the Subtraction1 and Subtraction2 classes stop giving times (we abort the algorithm because it exceeds 1 minute)? Why does that happen?

Subtraction 1 -> 8192

Subtraction 2 -> 8192

The stack overflow occurs because each method is doing so many recursive calls that it can't handle it.

How many years would it take to complete the Subtraction3 execution for n=80?

N1 = 20 and t1 = 61

N2 = 80 and t2 = ?

$$t2 = \frac{2^{80}}{2^{20}} \cdot 78 = 9 \cdot 10^{19}$$

In years - > 2.85 * 10^9

Subtraction 4

n	Subtraction 4
100	5
200	39
400	298
800	2330
1600	19052

Subtraction 5

n	Subtraction 5
30	701
32	2819
34	7874

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36	20132

Activity 2. Divide and conquer by division

Division 1

The complexity is O(n). To calculate the theoretical values, we are going to use the following formula:

$$t2 = \frac{n2}{n1} \cdot t1$$

We are going to calculate two times:

1. For n1 = 524288, n2 = 1048576, t1 = 23. The experimental value is t2 = 43.

$$t2 = \frac{1048576}{524288} \cdot 23 = 46$$

2. For n1 = 1048576, n2 = 2097152, t1 = 43. The experimental value is t2 = 97.

$$t2 = \frac{2097152}{1048576} \cdot 43 = 86$$

Division 2

The complexity is O(nlog(n)). To calculate the theoretical values, we are going to use the following formula:

$$t2 = \frac{n2 \cdot \log(n2)}{n1 \cdot \log(n1)} \cdot t1$$

We are going to calculate two times:

1. For n1 = 524288, n2 = 1048576, t1 = 449. The experimental value is t2 = 900.

$$t2 = \frac{1048576 \cdot \log(1048576)}{524288 \cdot \log(524288)} \cdot 449 = 945$$

2. For n1 = 1048576, n2 = 2097152, t1 = 900. The experimental value is t2 = 1879.

$$t2 = \frac{2097152 \cdot \log(2097152)}{1048576 \cdot \log(1048576)} \cdot 900 = 1890$$

Division 3

The complexity is O(n). To calculate the theoretical values, we are going to use the following formula:

$$t2 = \frac{n2}{n1} \cdot t1$$

We are going to calculate two times:

1. For n1 = 524288, n2 = 1048576, t1 = 177. The experimental value is t2 = 359.

$$t2 = \frac{1048576}{524288} \cdot 177 = 354$$

2. For n1 = 1048576, n2 = 2097152, t1 = 359. The experimental value is t2 = 691.

$$t2 = \frac{2097152}{1048576} \cdot 359 = 718$$

Division 4

n	Division4
1000	19
2000	78
4000	297
8000	1212
16000	4831
32000	19550
64000	OoT

Division 5

n	Division5
1000	60
2000	228
4000	967
8000	3884
16000	14426
32000	58344

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64000	OoT

Activity 3. Two basic examples

Vector sum

n	VectorSum - 1	VectorSum - 2	VectorSum - 3
3	0.000082	0.000093	0.000133
6	0.000092	0.000371	0.000235
12	0.000161	0.000456	0.000484
24	0.000267	0.000551	0.001319
48	0.000464	0.001102	0.002203
96	0.000893	0.002310	0.004429
192	0.001674	0.006380	0.008514
384	0.003348	0.010654	0.017290
768	0.006569	0.021462	0.033889
1536	0.013634	0.041586	0.070179
3072	0.028316	0.090492	0.139697
6144	0.054480	0.178623	0.287881
12288	0.103282	Out of memory	OoT

Fibonacci

n	Fibonacci-1	Fibonacci-2	Fibonacci-3	Fibonacci-4
10	0.000142	0.000181	0.000258	0.00313
15	0.000179	0.000245	0.000345	0.03380
20	0.000262	0.000318	0.000435	0.37337
25	0.000272	0.000392	0.000536	4.42178
30	0.000322	0.000467	0.000716	OoT

35	0.000369	0.000540	0.000718	OoT
40	0.000435	0.000614	0.000855	OoT
45	0.000460	0.000686	0.000977	OoT
50	0.000520	0.000771	0.001055	OoT
55	0.000563	0.000983	0.001159	OoT
59	0.000613	0.001155	0.001237	OoT

Activity 4. Another task

n	T ordered	T reverse	T random
31250	52	51	55
62500	108	115	117
125000	231	225	238
250000	468	448	486
500000	945	944	998
1000000	2090	1991	2068
2000000	4124	4000	4244
4000000	9035	9004	8753
8000000	19226	20338	18753
16000000	38681	38923	42327
32000000	OoT	OoT	OoT

n	T Mergesort (t1)	T Quicksort (t2)	T1 / T2
250000	486	121	4,0165
500000	998	254	3,9291
1000000	2068	542	3,8154
2000000	4244	1432	2,9636

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4000000	8753	3168	2,7629
8000000	18753	6280	2,9861