Algorithmics	Student information	Date	Number of session
	UO:294039	15/02/2024	1.2
	Surname: Rodriguez		
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Activity 1. Some iterative models

N	TLoop1(ms)	tLoop2 (ms)	tLoop3 (ms)	tLoop4 (ms)
100	0,0110	0,072	1,44	1,25
200	0,0208	0,361	5,19	9,04
400	0,0445	1,385	24,54	71,86
800	0,1052	7,240	108,73	553,27
1600	0,2544	30,576	458,13	Out of time
3200	0,5587	Out of time	Out of time	Out of time
6400	1,1923	Out of time	Out of time	Out of time
12800	2,5368	Out of time	Out of time	Out of time
25600	5,4602	Out of time	Out of time	Out of time
51200	Out of time	Out of time	Out of time	Out of time

Theoretical values of Loop1:

The complexity of Loop1 is n * log(n). To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

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

We are going to calculate the theoretical times of the last 5 iterations:

1. For n1 = 1600 and n2 = 3200

$$t2 = \frac{3200 \cdot \log(3200)}{1600 \cdot \log(1600)} \cdot 0.2544 = 0.5566$$

Theoretical value: 0.5566

Experimental value: 0.5587

2. For n1 = 3200 and n2 = 6400

$$t2 = \frac{6400 \cdot \log(6400)}{3200 \cdot \log(3200)} \cdot 0.5587 = 1.2133$$

   Theoretical value: 1.2133

   Experimental value: 1.1923

3. For n1 = 6400 and n2 = 12800

$$t2 = \frac{12800 \cdot \log(12800)}{6400 \cdot \log(6400)} \cdot 1.1923 = 2.5731$$

   Theoretical value: 2.5731

   Experimental value: 2.5368

4. For n1 = 12800 and n2 = 25600

$$t2 = \frac{25600 \cdot \log(25600)}{12800 \cdot \log(12800)} \cdot 2.5368 = 5.4454$$

   Theoretical value: 5.4454

   Experimental value: 5.4602

As we can see, the experimental values are very similar to the theoretical values as expected.

Theoretical values of Loop2:

The complexity of Loop2 is n^2 * log(n). To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

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

We are going to calculate the theoretical times of the last 5 iterations:

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1. For n1 = 100 and n2 = 200

$$t2 = \frac{200^2 \cdot \log(200)}{100^2 \cdot \log(100)} \cdot 0.072 = 0.331$$

Theoretical value: 0.331

Experimental value: 0.361

2. For n1 = 200 and n2 = 400

$$t2 = \frac{400^2 \cdot \log(400)}{200^2 \cdot \log(200)} \cdot 0.361 = 1.6329$$

Theoretical value: 1.6329

Experimental value: 1.385

3. For n1 = 400 and n2 = 800

$$t2 = \frac{800^2 \cdot \log(800)}{400^2 \cdot \log(400)} \cdot 1.385 = 6.1809$$

Theoretical value: 6.1809

Experimental value: 7.240

4. For n1 = 800 and n2 = 1600

$$t2 = \frac{1600^2 \cdot \log(1600)}{800^2 \cdot \log(800)} \cdot 7.240 = 31.9629$$

Theoretical value: 31.9629

Experimental value: 30.576

As we can see, the experimental values are very similar to the theoretical values as expected.

Theoretical values of Loop3:

<table>
<tr><td rowspan="4">Algorithmics</td><td>Student information</td><td>Date</td><td>Number of session</td></tr>
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The complexity of Loope is n^2 * log(n). To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

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

We are going to calculate the theoretical times of the last 5 iterations:

1. For n1 = 100 and n2 = 200

$$t2 \ = \frac{200^2 \cdot \log(200)}{100^2 \cdot \log(100)} \cdot 1.44 \ = \ 6.62$$

   Theoretical value: 6.62

   Experimental value: 5.19

2. For n1 = 200 and n2 = 400

$$t2 \ = \frac{400^2 \cdot \log(400)}{200^2 \cdot \log(200)} \cdot 5.19 \ = \ 23.47$$

   Theoretical value: 23.47

   Experimental value: 24.54

3. For n1 = 400 and n2 = 800

$$t2 \ = \frac{800^2 \cdot \log(800)}{400^2 \cdot \log(400)} \cdot 24.54 \ = \ 109.516$$

   Theoretical value: 109.516

   Experimental value: 108.73

4. For n1 = 800 and n2 = 1600

$$t2 \ = \frac{1600^2 \cdot \log(1600)}{800^2 \cdot \log(800)} \cdot 108.73 \ = \ 480.01821$$

Theoretical value: 480.01821

Experimental value: 458.13

As we can see, the experimental values are very similar to the theoretical values as expected.

Theoretical values of Loop4:

The complexity of Loop4 is n^3. To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

$$t2 = \frac{n2^3}{n1^3} \cdot t1$$

We are going to calculate the theoretical times of the last 5 iterations:

1. For n1 = 100 and n2 = 200

$$t2 = \frac{200^3}{100^3} \cdot 1.25 = 10$$

Theoretical value: 10

Experimental value: 9.04

2. For n1 = 200 and n2 = 400

$$t2 = \frac{400^3}{200^3} \cdot 9.04 = 72.32$$

Theoretical value: 72.32

Experimental value: 71.86

3. For n1 = 400 and n2 = 800

$$t2 = \frac{800^3}{400^3} \cdot 71.86 = 524.88$$

Theoretical value: 524.88

Experimental value: 553.27

As we can see, the experimental values are very similar to the theoretical values as expected.

Activity 2. Creation of iterative models of a given time complexity

N	tLoop5 (ms)	tLoop6 (ms)	tLoop7 (ms)
100	0,134	1,05	31,8
200	0,488	7,00	485,2
400	1,822	55,89	Out of time
800	6,726	421,31	Out of time
1600	26,414	Out of time	Out of time
3200	Out of time	Out of time	Out of time
6400	Out of time	Out of time	Out of time

Theoretical values of Loop5:

The complexity of Loop5 is $n^2 \log^2(n)$. To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

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

We are going to calculate the theoretical times of the last 5 iterations:

1. For n1 = 100 and n2 = 200

$$t2 = \frac{200^2 \cdot \log^2(200)}{100^2 \cdot \log^2(100)} \cdot 0.134 = 0.7094$$

Theoretical value: 0.7094

Experimental value: 0.488

2. For n1 = 200 and n2 = 400

$$t2 = \frac{400^2 \cdot \log^2(400)}{200^2 \cdot \log^2(200)} \cdot 0.488 = 2.4961$$

Theoretical value: 2.4961

Experimental value: 1.822

3. For n1 = 400 and n2 = 800

$$t2 = \frac{800^2 \cdot \log^2(800)}{400^2 \cdot \log^2(400)} \cdot 1.822 = 9.0718$$

Theoretical value: 9.0718

Experimental value: 6.726

4. For n1 = 800 and n2 = 1600

$$t2 = \frac{1600^2 \cdot \log^2(1600)}{800^2 \cdot \log^2(800)} \cdot 6.726 = 32.7727$$

Theoretical value: 32.7727

Experimental value: 26.414

As we can see, the experimental values are very similar to the theoretical values as expected.

Theoretical values of Loop6:

The complexity of Loop6 is n^3 log(n). To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

$$t2 \ = \frac{n2^3 \cdot \log(n2)}{n1^3 \cdot \log(n1)} \cdot t1$$

We are going to calculate the theoretical times of the last 4 iterations:

1. For n1 = 100 and n2 = 200

$$t2 \ = \frac{200^3 \cdot \log(200)}{100^3 \cdot \log(100)} \cdot 1.05 \ = \ 9.6643$$

Theoretical value: 9.6643

Experimental value: 7

2. For n1 = 200 and n2 = 400

$$t2 \ = \frac{400^3 \cdot \log(400)}{200^3 \cdot \log(200)} \cdot 7 \ = \ 63.3261$$

Theoretical value: 63.3261

Experimental value: 55.89

3. For n1 = 400 and n2 = 800

$$t2 \ = \frac{800^3 \cdot \log(800)}{400^3 \cdot \log(400)} \cdot 55.89 \ = \ 498.8469$$

Theoretical value: 498.8469

Experimental value: 421.31

As we can see, the experimental values are very similar to the theoretical values as expected.

Theoretical values of Loop7:

The complexity of Loop7 is n^4. To know if the times we have obtain agree with the theoretical ones, we are going to calculate the theoretical times using the following formula:

$$t2 = \frac{n2^4}{n1^4} \cdot t1$$

We are going to calculate the theoretical times of the last iteration:

1. For n1 = 100 and n2 = 200

$$t2 = \frac{200^4}{100^4} \cdot 31.8 = 508.8$$

Theoretical value: 508.8

Experimental value: 485.2

As we can see, the experimental values are very similar to the theoretical values as expected.

Activity 3. Comparison of two algorithms

N	tLoop1(ms)	tLoop2 (ms)	T1/t2
100	0,0110	0,361	0,0304
200	0,0208	1,385	0,0150
400	0,0445	7,240	0.0061
800	0,1052	30,576	0.0034
1600	0,2544	Out of time	~0
3200	0,5587	Out of time	~0
6400	1,1923	Out of time	~0
12800	2,5368	Out of time	~0
25600	5,4602	Out of time	~0
51200	Out of time	Out of time	--

The quotient in all the cases tends to 0 as expected because it means that the algorithm of Loop1 is better than the algorithm of Loop2 because the complexity is better.

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N	tLoop3(ms)	tLoop2 (ms)	T3/t2
100	1,44	0,361	3,9889
200	5,19	1,385	3,7472
400	24,54	7,240	3,3895
800	108,73	30,576	3,5560
1600	458,13	Out of time	~0
3200	Out of time	Out of time	--
6400	Out of time	Out of time	--
12800	Out of time	Out of time	--
25600	Out of time	Out of time	--
51200	Out of time	Out of time	--

The quotient in all cases tends is greater than 1. Loop3 and Loop2 have the same complexity and because the quotient is greater than 1 the algorithm of Loop2 is better as expected.

n	tLoop4(Python)	tLoop4(Java without optimization)	tLoop4(Java with optimization)	T42/t41	T43/t42
200	6,494	9,04	0,1073	1,3920	0.0118
400	54,212	71,86	6,6603	1,3255	0,0926
800	487,258	553,27	4,5534	1,1354	0.0082
1600	Out of time	Out of time	26,3230	--	~0
3200	Out of time	Out of time	Out of time	--	--
6400	Out of time	Out of time	Out of time	--	--

The quotient in the division T42/T41 tends to 0 as expected, which means that the Loop4 with optimization is better than the Loop4 without optimization.