Complexity Analysis. Date No

) Little On notation (0)

o(9cn)) = { fcn): for any positive constant c>0, there exists: a constant no >0 such that o < fcn) K. cgcn) \forall n> no }

We use o-notation to denote an upper bound that is not asyptotically tight.

For an example, $2n = O(n^2)$, but $2n^2 \neq o(n^2)$

Another kind of definition, lim f(n) = 0

2) Big Omega notation (SZ)

sc(g(n)) = { f(n): ∃ positive constant coand no; o ≤ cg(n) ≤ f(n) \ \ n > no }

I - notation provides an asymptotic lower bound on a function.

Example fa)=n2, 9(n)=2n-1

For c = 1 & n = 1 $o \leq 9(n) \leq f(n)$ $\therefore f(n) = s_2(g(n))$

It is defined to analyze best case time complexity of an algorithm.

3) Little Omega Notation (w)

It is very similar to big Omega notation.

complexity disalynes

 $\omega(g(n)) = \{f(n): \forall c>0; \exists n_0>0 s.t$ $0 \leq c.g(n) < f(n) \forall n_0 \}$

: A loose lower bound is denoted by this.

Example, $\frac{n^2}{2} = \omega(n)$, but $\frac{n^2}{2} \neq \omega(n^2)$

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La - notation provides on asy policitic lower froms

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Another relation between f(n) and g(n) is

lim f(n) = 00

nyo g(n)

2) Sig Omega notation CRD

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7 50 2	C C C	3 2 7 8
2 4 6	w(9cn)= fto V C>0, 3 no) such that Such that OS C9cn) L Vn>nof N	Denstes an approximated best case time comple
18	\$\langle (\text{GCW}) = \frac{2}{5} \con \rangle \text{W} \text{W} \text{CSCN} = \frac{2}{5} \con \rangle \text{GW} \\ \$\langle (\text{GCW}) = \frac{2}{5} \con \rangle \text{To} \\ \$\langle (\text{GCW}) \\ \$\langle (G	1.2
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CBis omega. Asymptotic. Jower bound (may or may)	m = 11.2	Denotes best case time comple
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worst case		**************************************	
1) Algorithm . 1 Worst. Case	م	1	
	4	ost ;	Times
for j=A.length to 2 do	4,	C,	n
swapped = false.		C ₂	n-1.
for i=2 to j do.	6	C3	n(nti)
quespart à Marine	13		_
if (A[i-1] > A[i]) then	4	CA	n(n-1)
temp = A[i]	The state of the s	C5 -	n(n+)
ACIJ = A CI-IJ	3	C6.	n(n-1)
Acifo = temp	3	C	n(n-1)
swapped=true ?	10	C	n(n-1)
if (Iswapped) then 3:3	4.	Cgq	-n-1
break;	<u> </u>	C10 1	0.
	m		2.0
; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	A.	ength	
	() v	1	
$f(n) = \left(\frac{C_3}{2} + \frac{C_4}{2} + \frac{C_5}{2} + \frac{C_6}{2} + \frac{C_7}{2} + \frac{C_7}{2}\right)$	8) n	2	The state of the s
2 2 2 2 2	1.		
	3,		$c \rightarrow n$
(C1+C2+C3 - C4-C5-C6	,	7-7-2	+49):-
		1	2
$+\left(\frac{C_3}{2} - C_2 - \frac{C_4}{2} - \frac{C_5}{2} - \frac{C_5}{2}\right)$	<u>C6</u>	- <u>C7</u> -	C8 - 2
The state of the s			
= C' n² + c"n + c".			
$= O(n^2)$			
	KA.		2 3 1

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Algorithm 2 worst case!				
this en ad lie and the	Cost	Times		
n= A. length	Cı	•		
do	C2	n		
swapped = false	C3 : 3	1 n-1		
de vov formi=20 to nominabilizas	Cy	N n(n+1)		
	tirocks s	1/ n (n+)		
sviernos temp = AEIJ	10:11 C6	n(n+1)		
AEIJ = ACI-Do	~ . Ca. 21	ncn-v		
10 of ocon AcirD= tempos.	11:12C8	n(n-1)		
swappel= true.	5/1-C9) a	n(n-1)		
newLimit= i-1	C10	n(n-1)		
n= newLimit	Cıj	n-1		
while swapped	· C12	n		

$$f(n) = \frac{\left(C_4 + C_5 + C_6 + C_7 + C_8 + C_9 + C_{10}\right) n^2}{2} + \frac{\left(C_2 + \frac{C_4}{2} - \frac{C_5}{2} - \frac{C_6}{2} - \frac{C_7}{2} - \frac{C_8}{2} - \frac{C_{10}}{2} + C_{11} + C_{12}\right) n}{2} + \frac{\left(C_1 - C_3 + \frac{C_4}{2} - \frac{C_5}{2} - \frac{C_6}{2} - \frac{C_7}{2} - \frac{C_8}{2} - \frac{C_9}{2} - \frac{C_{10}}{2} - C_{11}\right)}{2} + \frac{C_6}{2} n^2 + \frac{C_6}{2} n + \frac{C_6}{2} n$$

2) As both versions have the same worst case complexity, there will be no difference.

Without considering each and every step of the algorithm we can consider only the loops and their nested loops, and recursive terms. In this way we can calculate the worst case time complexity easily as we need the largest term of the function.

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