NATIONAL UNIVERSITY OF SINGAPORE **CS2040 – Data Structures and Algorithms**

(Semester 1: AY2022/23) **ANSWER SHEET**

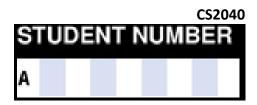
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Section 1

O1 a	[2]

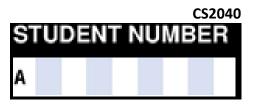
Q1a [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	O(N ^{1.5})	O(N ^{1.5} log(N))	○ O(N²)	O(N ² log(N))	○ O(N³)
Q1b [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	O(N ^{1.5})	O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)
Q1c [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	O(N ^{1.5})	\bigcirc O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)
Q1d [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	○ O(N ^{1.5})	O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)
Q1e [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	O(N ^{1.5})	O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)
Q1f [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	○ O(N ^{1.5})	O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)
Q1g [2]					
O(log(log(N))	O(log(N))	O((log(N)) ²)	\bigcirc O(\sqrt{N})	\bigcirc O($\sqrt{N}\log(N)$)	○ O(N)
O(N log(N))	O(N ^{1.5})	\bigcirc O(N ^{1.5} log(N))	○ O(N²)	\bigcirc O(N ² log(N))	○ O(N³)

Q2 [3]												
O 0	<u></u>) 1				(3			O 4		
O up to twice		O to the				moon	!					
Q3 [3]						•						
○ None		○ Ali only			O Balu only			○ CI	narlie or	ıly		
Ali & Balu only		○ Ali & C	harlie	e only	Ов	alu &	Charlie d	only	O Al	i, Balu a	ind Charlie	
Q4 [3]												
O Disagree with all	13	Agree with X only			() A	gree \	with Y or	nly	O A	gree wit	h Z only	
Agree with X, Y o	only	○ Agree	with 2	X, Z only	О A	gree v	with Y, Z	only	O A	gree wit	h X,Y,Z	
Q5 [3]								<u>, </u>				
O Disagree with all	13	○ Agree	with 2	X only	() A	gree v	with Y or	nly	O A	gree wit	h Z only	
Agree with X, Y o	only	O Agree with X, Z only			Agree with Y, Z only			○ Agree with X,Y,Z				
Q6 [3]												
O Disagree with all 3		Agree with X only			Agree with Y only			nly	Agree with Z only			
Agree with X, Y o	O Agree with X, Y only		Agree with X, Z only			○ Agree with Y, Z only			○ Agree with X,Y,Z			
Q7 [3]												
O Disagree with all	۱3	Agree with X only			O Agree with Y only			nly	O A	gree wit	h Z only	
Agree with X, Y o	only	Agree with X, Z only			Agree with Y, Z only			only	O A	gree wit	h X,Y,Z	
Section 2 [15] Q8a												
○ S1	0) S2			○ S4				○ S5			
○ S6	0	S7		○ S8		○ S9			○ S10			
Q8b				<u> </u>								
O(log(log(N))	0	O(log(N))	00	O((log(N))	\bigcirc O(\sqrt{N}) \bigcirc O			00($O(\sqrt{N}\log(N))$		○ O(N)	
O(N log(N))	0	$O(N^{1.5}) \qquad \bigcirc O(N^{1.5} \log($			N))) O(N²) O			N ² log	g(N))	○ O(N³)	



Q9a									
○ S1	○ S2		○ S3		○ S4		○ S5		
○ S6	○ S7		○ S8		○ S9	○ S9)	
Q9b									
O(log(log(N))	O(log(N))	○ O(log(N)) ○ O(00	$O(\sqrt{N})$	\bigcirc O($\sqrt{N}\log(N)$)		○ O(N)	
O(N log(N))	○ O(N ^{1.5})	\bigcirc c	$O(N^{1.5}\log(N))$		O(N²)	O(N ² log(N))		\bigcirc O(N ³)	
Q10a									
○ S1	○ S2		○ S3		○ S4		○ S5		
○ S6	○ S7		○ S8		○ S9		O S10)	
Q10b	1		l						
O(log(log(N))	O(log(N))	○ O(log(N)) ○ O		00	$O(\sqrt{N})$	\bigcirc O($\sqrt{N}\log(N)$)		○ O(N)	
O(N log(N))	O(N ^{1.5})	\bigcirc c	O(N ^{1.5} log(N))		O(N²)	\bigcirc O(N ² log(N))		○ O(N³)	
Q11a									
○ S1	○ S2		○ S3		○ S4		○ S5		
○ S6	○ S7		○ S8		○ S9	○ S10		0	
Q11b	-1		1				1		
O(log(log(N))	O(log(N))	\bigcirc c	O((log(N)) ²)		$O(\sqrt{N})$	\bigcirc O($\sqrt{N}\log(N)$)		○ O(N)	
O(N log(N))	O(N ^{1.5})	O C	O(N ^{1.5} log(N))		O(N ²)	O(N ² log(N))		○ O(N³)	
Q12a									
○ S1	○ S2		○ S3		○ S4	○ S5			
○ S6	○ S7		○ S8		○ S9	○ S10)	
Q12b	•		1		I		ı		
O(log(log(N))	O(log(N))	\bigcirc c	O((log(N)) ²)	00	$O(\sqrt{N})$	\bigcirc O($\sqrt{N}\log(N)$)		○ O(N)	
O(N log(N))	\bigcirc O(N ^{1.5}) \bigcirc O		$O(N^{1.5} \log(N))$		D(N ²)	\bigcirc O(N ² log(N))		○ O(N³)	

Q13a [2]					_								_	
O 1	\bigcirc 2	2 3	04	ı	O 5	\bigcirc 6	5	O 7	(8 (O 9) 10		
Q13b [2]		•											_	
O 1	\bigcirc 2	2 3	04	ļ	5	\bigcirc 6	5	O 7	(8	9) 10		
Q13c [2]						_		1						_	
O 1	\bigcirc 2	2 3	04	l	○ 5	\bigcirc 6	5	O 7	(8	9) 10		
Q13d [2]															
O 1	\bigcirc 2	2 3	04	ļ	5	\bigcirc 6	5	O 7	(8	9) 10		
	_													_	
Q14a [2]					Q14b [.2]		<u> </u>			_ Q	14c	[2]		
○ Shar)	○ Ro	und		○ Tall			◯ Sh	ort			Far	•	0	Near
Q14d [2]		1		Т										
○ Black	. & W	hite'	○ Gray	/scal	e	○ C	olou	r	0	No imag	ge, what	ima	age?		
Q15a [2]]		Q1	L5b [[2]			Q15	c [2]	_		Q15d	l [2]	
○ Yes	0	No	0	Yes	○ No			0	Yes	○ No)		○ Y	es	○ No
Q15e [2]						I								
O(N)		\bigcirc O(\mathbb{N}^2)	O(I	N ³)	00(N ⁴)	0	Other	wor	se polyr	nomial ti	me	in N		
С Ехро	nenti	al in N	○ Fac	ctori	al in N		0	Could	be v	vorse th	an O(N !) ev	en wh	en	
			·												
Q16a [2]]					<u> </u>									
O(N)		O(N le	og N)	0	O(N ²)	0	O(N	² log N		O(AN)		O(AN logN)		N)	
O(A	N ²)	O(A N	l ² log N)	0	O(A ² N)	0	O(A	² Nlogi	N)	\bigcirc O($\mathbf{A}^2\mathbf{N}^2$)		\bigcirc O($\mathbf{A}^2\mathbf{N}^2$ log \mathbf{N})			
Q16b [2	Q16b [2]														
○ O(N)		O(N le	og N)	0	$O(N^2)$	0	O(N	² log N))	O O(#	AN)	0	O(AN	log	N)
O(A	N ²)	O(A N	l² log N)	0	O(A ² N)	0	O(A	² Nlogi	N)	O O(#	A^2N^2)	0	O(A ² l	N ² lc	g N)
Q16c [2]]					1				1		I			
O(N)		O(N l	og N)	0	O(N ²)	0	O(N	² log N))	O 0(A	AN)	0	O(AN	log	N)
○ O(A)	N ²)	O(AN	l ² log N)		O(A ² N)		O(A	² Nlogi	N)	() O(#	(N^2)	\cap	O(A ² I	N ² lo	og N)



Q17 [1]

○ O(log N)	\bigcirc O($\sqrt{\mathbf{N}}$))	○ O(N)	O(N logN)
O(N ^{1.5})	\bigcirc O(N ²)	\bigcirc O(N ² logN)	\bigcirc O(N ³)

BONUS (+3?)		

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