### NATIONAL UNIVERSITY OF SINGAPORE

# SCHOOL OF COMPUTING EXAMINATION FOR CS1020

Semester 1: AY2013/14

#### CS1020 - Data Structures and Algorithms I

Nov 2013	7	Time allow	ed: 2 hours	3
Matriculation number:				

#### **INSTRUCTIONS TO CANDIDATES**

- 1. This examination paper consists of EIGHTEEN (18) questions and comprises THIRTEEN (13) printed pages.
- 2. This is a **CLOSED BOOK** examination. You are NOT allowed to refer to any material during the exam.
- 3. Fill in your Matriculation Number above clearly with a pen.
- 4. Answer all questions.
- 5. For MCQs (Q1 to Q12), use the OCR form provided. Shade and write down your matriculation number on the OCR form. You must use 2B pencil to shade/write on the OCR form.
- 6. For short questions (Q13 to Q18), write your answers in the space provided. You may use pencil to write your answers.
- 7. You must submit <u>both the OCR form and this document</u>. It is your responsibility to ensure that you have submitted both to the invigilator at the end of the examination.

	EXAMINER	'S USE ONLY	
Section / Question	Possible	Marks	Check
A. MCQs 1-12	36		
B. Q 13	6		
B. Q 14	12		"
B. Q 15	12		
B. Q 16	12		
B. Q 17	13		
B. Q 18	9		
Total	100		

## **SECTION B (7 Short Questions: 64 Marks)**

13. Given the following function where n is an integer,

$$f(n) = \begin{cases} f(n-1) + n - 1 & \text{if } n > 1 \\ 0 & \text{if } n = 1 \end{cases}$$

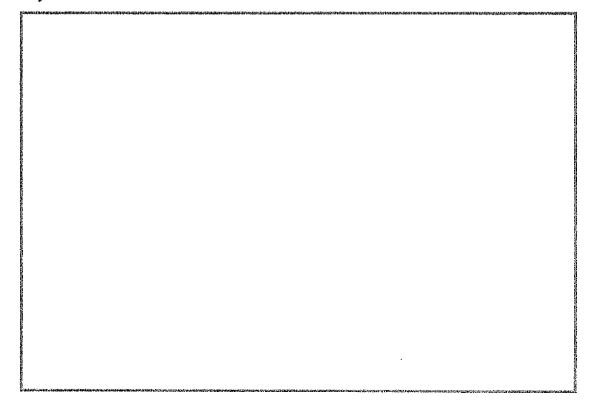
In trying to implement the function iteratively, a student makes some mistakes. Help him to correct all the mistakes in his codes. You should have the same number of statements as the codes provided.

(6 marks)

Wrong implementation

```
float calculate(n) {
    int result = 0;
    for (i = 2; i < n; i+=2)
        result = result + (i - 1);
    return result;
}
```

your correction

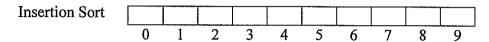


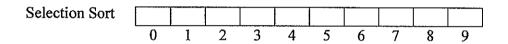
14a. Given the following array,

32	41	12	27	49	87	55	62	38	74
0	1	2	3	4	5	6	7	8	9

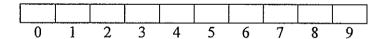
If we apply Insertion Sort, Selection Sort and the improved version of Bubble Sort to the array, what will be the content of the array after 3 passes of the respective sorting process?

(6 marks)



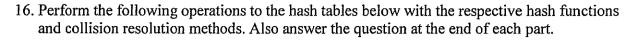


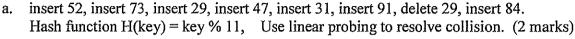
Improved Bubble Sort

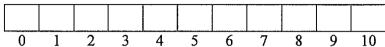


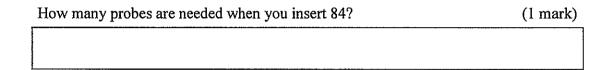
members according to their age. Propose an efficient sorting algorithm to do club. Take note that the member list is already sorted alphabetically according	I like to sort the the job for the job for the ing to their
hat is the complexity of your sorting algorithm?	(1 mark)
	are organizing some activities for different age groups and hence they would members according to their age. Propose an efficient sorting algorithm to do club. Take note that the member list is already sorted alphabetically according names. Your algorithm should ensure that in the age groups, the names are s

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-11-1 1				l							J
should become	4	4	5	6	6	7	9	9	8	8	
a) Create an O(1	n²) algo	rithm									(4 marks)
b) Create an O(1	ı) algor	ithm									(8 marks)
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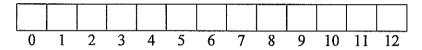






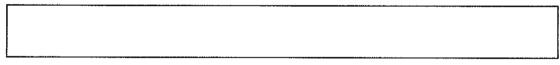


b. insert 56, insert 73, insert 29, insert 47, insert 31, insert 95, delete 29, insert 82. Hash function H(key) = key % 13. Use Quadratic probing to resolve collision. (2 marks)

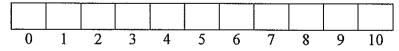


What is the probe sequence when you insert 82?

(1 mark)



c. insert 56, insert 73, insert 39, insert 47, insert 31, insert 99, insert 82.
 Hash function H(key) = key % 11, using G(key) = 9 - key % 9 as secondary hash function to resolve collision. (2 marks)



What can you conclude about the hash function for the given set of keys? (1 marks)

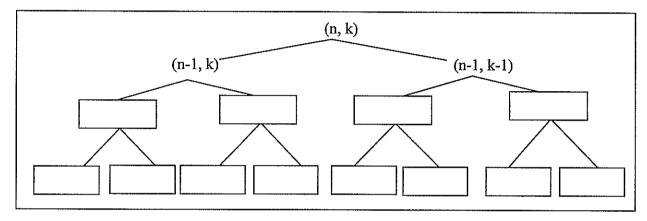


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	or "Odd" or "Same" a			(6 marks)
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nemod in 17a a	and print the result retu			(2 marks)
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			a and then print th	ne result.
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18. The nchoosek algorithm is given below. A partial recursive tree of the algorithm is also given. Complete the next two levels of the recursive tree. (3 marks)

```
int nchoosek(int [] arr, int n, int k) {
    if (n == k) return 1;
    if (k == 0) return 1;
    return nchoosek(arr, n-1, k) + nchoosek(arr, n-1, k-1);
}
```



What is the maximum level of the tree?	(3 marks)

What is the worst case complexity of the algorithm? Give you answer in Big-O. (3 marks)

=== END OF PAPER ====