

NATIONAL SCHOOL OF BUSINESS MANAG

Mahenwaththa, Pitipana, Homagama,

AGEMENT 2 MAR 2017

Name of the Degree Programme	}	BSc in Computer Security-16
Module Code	}	CS 106.3 Algorithms and Data Structures Data Structures and Algorithms
	3	Algorithms and Data Structures
Module Title	}	Dota Structures and Algorithms
Index Number		BSC-PLY-com-16.1-118

Directions to Candidates

- (1) Write on both sides of the paper
- (2) Write the number of each question on the top of each page in the space provided
- (3) Cross out all rough work and blank pages
- (4) Fasten any supplementary papers, books, outline maps, etc. at the end of this book so that it may provide continuous reading matter to the examiner
- (5) Do not tear off any part of this answer book
- (6) In no circumstances must this book, used or unused, be removed from the Examination Hall by a candidate
- (7) Any candidate who is found to be in possession of any written, printed or pictorial matter not authorized by the Registrar will be required to give an explanation in writing, and he / she will be considered as he / she has committed an examination offence and will be referred to a disciplinary committee

For the use of Candidate

Write here the numbers of questions you have attempted in the order in which they have been written

1 2 3 4 5

Annexures:

Number of books attached and any other answers such as maps, graph papers, etc

This book should be handed over personally to the invigilator, it should not be left on the desk.

For Examine	r's Use Only
Question No	Marks
91	19
02	20
0-3	20
04	18
05	20
Total	97



98 9 <i>8 - 4</i> - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -	
(<u>a</u>)	An algorithm is a way of solving a
	problem. It contains step(s) which
	are necessary to ochieve a particular
W	task. Examples of represting an algorithm
47	are flowcharts and pseudocodes.
	· · · · · · · · · · · · · · · · · · ·
b)	
***************************************	exact memory and time required for an
*************************	algorithm isn't/important but rather
************************	we identify how they change with
	increasing problem size (ratio). Ex:
	In one platform on algorithm has O(n/2)
	complexity while in another platform it
hdyn	has O(1/4) complexity but ultimately
	both have O(n) complexity.
c)	$i. = O(n^3)$
	$ii. = O(n^2)$
44-4	iii = 0 (n log(n))
	iv = 0 (n)
	v. = 0(n)
<u>d)</u>	* The if statement in the function has
	O(1) complexity.
***************************************	* The function will call itself (n-1)
Edd-14	no of times.
	# final complexity = O(n-1) * \ O(1)
7	= o(n)
\(\)	



column.					TOWN
¢h46ag B4a4anna nu nu nak44g ppan					***************************************
2. /a.	int bsea	rch (int	key, int	size	t array[])
6,	1. // Initi	alize f	irst to	0	221111111111111111111111111111111111111
	2. // Initia	lize 1	ast to	Siz volue	of size-1.
074H7080H4H81-44840410-47FF	3. // Initi				98 88 88 84 4 7 7 7 7 7 7 7 7 7 7 7 7 7 7
***************************************	A. // Initi				,
\$666402 beauties \$442 1 % FT 4 <i>66</i> FF	6, // Set	while 1	oop cond	ition.	
	7. 11 Calc	*			
			to 4 if		
4 1 hay han hin 41 kan n kan 1 ha ka ka	9.11 Set	position	to midd	le if	keg is
	foun	•		y - ju - y - vanound hulld did did he ha da h d'H h q Pildle	######################################
	10. 11 Set				
14	key	is les	s than	arroy Cr	niddle].
\mathcal{I}	11, // Els.	e, 5et/	first d	to value	of (
4 **** *******	mì	ddle +1.	1 Mg 2 Ma 114 (Mpail 11 ora Hanasagunia 11 da 11 a 12 a pa pa pa		
	12 // (10	se the	loop.	DA 35.46.288363384464.26445554 2644 2674 PROS	
			volue o	•	on and
	tei	minate	the fund	tion.	MINIMINIA NA 1973 I I INTERPRENDE DE DE DESCRIPCIO I I INTERPRENDE DE CONTRACTOR DE CONTRACTOR DE CONTRACTOR D
######################################	***************************************		After	t After	T.Atter
C	Variable	Initially	Iteration 1	. Iteration 2	
	key	23	23	23	23
P # \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	Size	15	15	15	15
444594 19411 011 141 141 174 111 14	Arst	0	8	8/	8
***************************************	lost	14	14	20	8
	found	U	9	0	0
	position	-1	-1	<u>-7</u>	-1
***************************************	(!found &c &	true.	true	true	true
[¬] Бандавачицинга Бильгеара инсп.	first <= last)	₩ A			***************************************
***************************************	middle	NA	(19	70	25
	array [middle]	NA	17	30	7.2
***************************************	***************************************				***************************************
1	l				



3. a.	int min Index (floot dCJ, int size) {
******************************	int min In = 0 , $i=1$;
	Float min = d Coj;
	& for (; / < size ; i++)
	2
***************************************	if (dCiJ < min)
	A min = d CiJ;
7	min In = i;
****************	7
# ## 4-10 , 4-2-1 du b40+ 2005400 au	To hum only To h A
221472024 HAD HARDES GO HARA SON	return min In;
الله الله الله الله الله الله الله الله	
27227272727272222222222222222222222222	void swap (float *p1, float *p2) {
	float temps
<u></u>	temp = * p1;
******************************	$p_1 = /p_2;$
	* p2 =/temp; }
2414 1910 1914 114 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1	void selection Sort (float d[], int size) {
+8hvvvddh4advapavasano = pana	F(size==1) return;
医结肠性 衛衛 医腹膜病 医原络氏试验 计 医血液水素 医水杨二氏	if (size > 1) {
11	Swap (&d[min Index (d, size)],d)
	return selection Sort (&d [1], size-1); }}
	**

***************************************	·
\$0400000000000000000000000000000000000	3-



woll by are of rate of	
Ь,	* In the minIndex function, statements
	outside the for loop hore O(1) complexity.
	and inside the
	* Even though the for loop runs for decreasing
######################################	sizes, the complexity of it is still o(n).
	* Final complexity = 0(n) * 0(1) + 0(1).
	& The swop function has = O(n).
	* All statements in swap function have O(2)
ARAMINE AND 1 112 1712 50 74 FEE	complexity.
	\$ So, final complexity = O(n). 0(1).
/	& In the selection Sort function the Swap
AEEPAONA-12-17-17-17-17-17-17-17-17-17-17-17-17-17-	function has (O(2) complexity as
PR 10 10 10 10 10 10 10 10 10 10 10 10 10	already mentioned, but since it calls
d 加加斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯	* Dough the function calls itself for
4624011	decreasing sizes the min Index function
######################################	complexity is o(n).
	* The selection Sort function calls itself
	(n-1) of times though it is for decreasing
1	sizes, ultimately complexity is O(n) here.
	Thus final complexity is = Oforth
	$O(n) * O(n) = O(n^2)$

44 464-40-40-40-40-40-40-40-40-40-40-40-40-40	



4. a. stacks & \$ \$	E
BD	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
5 P	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
node.	
$\begin{array}{c c} \hline \\ \hline $	
	2.0] 0] data next
b. struct node make node	(float item) {
struct mode * p = (struct v	node +) malloc (size of)
struct node * p = (struct node +) mallo	c (size of (struct node));
if (1p) return 0;	
p -> data = item	1
$p \rightarrow next = 0$	1.
return pj	
void init (Struct stac	k/*s) {
5 -> sp = 0;	/
int Full (struct stack	* s) {
return 1;	<u></u>
int empty (struct sta	
return S -> Sp	==0;



column.	
1948 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -	int push (struct stock s, float item) {
**************************************	struct node * p = makenode (item)
1 m w p w 2 - 4 5 5 5 6 6 6 o r w 4 o 1 n 1 n 1 n 2 o m 1	if (!p) return 0;
444556-64	if (empty(s)) s -> sp = P;
* = minea weathfuld = 207044 hube st	else
***************************************	$\{p\rightarrow next=s\rightarrow sp;$
ði þiðiððikkón everen sá eftöði	$s \rightarrow s p = p \rightarrow s$
22 habita	return 1;

Tā en Silvennana an an a ne a ne a ne a ne a	float pop (struct stack *s) {
	to cempty (s))
	float temp = s -> sp -> data;
440000000000000000000000000000000000000	struct node p= s-> sp;
)/	$S \rightarrow Sp = S \rightarrow Sp \rightarrow next;$
	free (p);
***************************************	return temp; }
	float top (struct stock +s) {
th think the section was a side of high the de-	return s -> sp -> data; }
######################################	Y-E torn 3 -> SIV-> OLA EA)

44 4488411000000000000000000000000000000	
感用為外質 かか 出出的なかる ショッセ マ からせ 出っせかな せ	
³ ने नुर्केश करात कारकारण प्रचल शास का वचका शकत श	
=4.016.5mi makeri 11 al 2 h 6 a 2 4 9 a 6 2 H	
4 日本日本日本の中央会議会の対対はよりのからから、日本日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本	
· · · · · · · · · · · · · · · · · · ·	
722 6 days a production of the contract of the	

Write the number of the question in this column.	MSBE? GREEN UNIVERSITY TOWN
5. 8.	(23)
18844481444814	(12) 4 3 (A5)

	(4) (<u>3</u>)(9) (<u>2</u> 4) (<u>56</u>)

	(3) (9) (15) (6)
494844	
5.5 6.5 6.4 4 5.5 8 7 8 7 8 8 7 8 8 7 8 8 8 8 8 8 8 8 8	
1	1. 23, 12, 4, 3, 9, 13, 18, 45, 24, 56,
<u>b.</u>	1. 23, 12, 4, 3, 9, 13, 15, 45, 24, 56,
44444444444	11. 3,4,9,12,13,15,23,24,45,56,

	111. 3, 9, 4, 15, 13, 12, 24, 56, 45/23.
FI 11 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
a.	(23)

######################################	(12) (AS)

<u> </u>	(4) (3) (24) (56)
	(3) (9) (15)

<u>C.</u>	struct node [int data;
	Struct node *left, *right; };
-49,4	



column.	TOWN
<u>d)</u>	void preorder (struct node tree) {
***************************************	if (!tree) redurn o
***************************************	print (("/i" tree > dota);
	printf ("-/i)t" tree -> data);
	return preorder (tree -) left);
	return preorder (tree -) right); }
7-10102000000000000000000000000000000000	
e).	struct node * find (struct node * tree, int key) {
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Struct node + temp;
bd Wallamann wanna wa un un awan na is	if (!tree) return 0;
THERMONIST OF THE STATE OF THE	if (tree -> data = = key) return tree;
	if (key < tree -> data) temp= find (tree -> left, key);
11/	if (I temp) temp = find (tree -) right, key);
	return temp; }
***************************************	***************************************
**	
# # # # # # # # # # # # # # # # # # #	
***************************************	1839484017113rd \$25000000000000000000000000000000000000
мародора вереда салана напл	

"40070110418440+COO4140C4V44T	

ânnanangquyw teacholmicus sán à	
~^12****************************	

** normanicality of property of \$4.05	

Write the number of the question in this column.	GREEN GREEN UNIVERSITY TOWN
. 24 - 2 22, 40 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
. 20 22 22 24 40 25 - 2 - 20 40 25 4 4 22 42	
. 24 2002-011 2424 2424 241 2 ⁻ 11011 242 240	

f lain meet meet le la manag dan mikerenaked 18 mm de	
1 DA DA II DA BOGOA PAGA HOGINA II DUGGG	

74H H077 L7 P7 AH H7 HD 1 P4H PH H70H	

Write the number of the question in this column.	NSBM? GREEN UNIVERSIT
4 n E 94 n 4 9 m va m n h 4 9 4 h 9 4 p m m 4	

748 20 24 24 24 24 24 24 24 24 24 24 24 24 24	
4 1 HHAMHHINN I BU NU N PU NON PO J 4 B	
HHH HHHPP\$\$49\$2 HV7 H 24 H 1 H 79 hH	
0 h H G d h w boron - o o o o o o o o o o o o o o o o o o	
(¥F ¢ ====================================	
y y - ap z y zádod plated bi b b b b b b b b b b b b b b b b b b	
T P	
I II I I I I I I I I I I I I I I I I I	

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	***************************************
d 4 - 2	
- Abar an out of the control of the	
- 1864 da - 1404 gay 2 742 b 42 7 42 b 42 6 4 b	
THere == == = = = = = = = = = = = = = = =	
14017814455-1-4-2	

Write the number of the question in this column.	GREEN UNIVERSITY
102564444544021441444	
PAN PROPENSIA NA SANTENIA NA SANTA	
. 44 4 5 6 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
***************************************	
-41-411A11A11A11	
PA4613164331433P4P448VP4*P41	
**********************************	
pri novelety o group & Life & A, A, B ii & B ii & B ii & B	
医阿拉克氏结肠 医阿拉克氏 医克尔克氏 医皮肤 化甲烷基 化甲烷基 化二烷基 化二烷基 化二烷基 化二烷基 化二烷基 化二烷基 化二烷基 化二	
43464846464666666868686868686	
***************************************	



# **National School of Business Management** BSc in Management Information Systems (UGC) -16.1

BSc in Software Engineering (UGC) -16.1

## BSc in Software Engineering /Computer Networks / Security (Ply) 16.1

**BSc in Computer Science – 16.1** 1st Year 2nd Semester Examination

Algorithms and Data structures - CS106.3

Time: 03Hrs

Date: 29th Mar 2017

## Answer all Questions.

Question 1 - 20 Marks

(a) Briefly explain what an algorithm is in the context of Computing.

[5 Marks]

- (b) Briefly explain, giving an example, how asymptotic analysis can isolate the algorithm efficiency from the machine and platform dependency. [5 Marks]
- (c) Simplify the following Big-O expressions

[5 Marks]

- i.
  - $O(2n^3+5n-10)$
  - ii.  $O(2n^2+10^2n)+O(n)$
  - iii.  $O(n)*O(\log(n))$
  - iv.  $O(n)+O(\log(n))$
  - n*O(1)
- (d) Giving reasons, evaluate the time complexity of the following function. int fact(int n)

[5 Marks]

if(n==1) return 1; return n*fact(n-1); }

#### Question 2 - 20 Marks

Following code segment implements the binary search algorithm.

```
1
       first = 0;
       last = size -1; |5-1=14
2
3
       found = 0:
4
       position = -1:
                                               8+19=11 8+10= 9
       while(!found && first <=last) {
6
       middle = \frac{\text{first+last}}{2}; \frac{1}{4} + 0 = 7
7
       if(array[middle] == key) {     found = 1;
8
9
               23 19 3 25
                                                   position = middle; }
10
       else if(key<array[middle]) last = middle - 1;
11
       else first = middle + 1;
                                           9-2
                                  07
12
       ł
13
       return position;
```

- (a) If the above code segment to write inside a function called bsearch() what will be the return type and required arguments for the function? Give your answer by writing the function header including return data type and argument declarations. [5 marks]
- (b) Write down a comment line you would include in the above code against each line to illustrate the function of each line or statement. You do not have to copy the code just put the line number and your comment in your answer script. [5marks]
- (c) Copy the following table into your answer script and complete it for each iteration for the problem scenario given below to carry out a desk-check of the code given above.

Variable	initially	After	After	After
•		iteration 1	iteration 2	iteration 3
key	23			
size	15			
first	0			
last	14			
found	0			
position	-1			
(!found && first <=last)	true			
middle	NA			
array[middle]	NA			

14
45
Ţ

### Question 3 - 20 Marks

The following is a skeleton of a selection sort implementation in C.

```
int minIndex(float d[], int size){

// return the index of

// the min in the given array

// swap two vars

// swap two
```

- (a) Write C code to implement the above selection sort algorithm.
- [10 Marks]
- (b) Evaluate step by step, giving reasons, the time complexity of each of the above functions in terms of the Big-O notation. [10 Marks]

### **Question 4 - 20 Marks**

Following code intends to implement a dynamic stack.

struct node{ float data: struct node* next; struct stack{ struct node* sp; }; struct node* makenode(float item){ // make a new node with item } void init(struct stack * s){...} // initialize sp int full(struct stack * s){...} // return 1 if full int empty(struct stack * s){...} // return 1 if empty 7.0,62,20 int push(struct stack *s, float item){ ... float pop(struct stack *s){ ... float top(struct stack *s){...}

- Write a clear diagram to show the status of the stack structure instance, nodes, stored values and node linking after pushing the values 2.0, 6.2 and 7.0. [6 marks]
- Write code for each function above to complete the stack implementation. [14 Marks]

### Question 5 - 20 Marks

(a) Draw a binary search tree generated by inserting the following items in the given order.

23, 45, 12, 4, 56, 9, 13, 15, 24, 3 [4 Marks]

- (b) Draw the sequence of items you process, if the BST is traversed by,
  - pre-order, ( KULR)
  - in-order, ( \ \ \ \ P)
  - post-order, (LRV) tree walking methods. [6 marks]
- (c) Write down a node structure in C, suitable to implement the above BST. [2 marks]
- (d) Write a C function to display the above BST in pre-order traversal. [4 Marks]
- (e) Write a C function to find a value (key) in the BST by traversing the BST in pre-order manner. [4 Marks]

*****End of the paper****

5 (r)