FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	**COMPUTER SCIENCE 3B** CSC3B10
CAMPUS	AUCKLAND PARK CAMPUS (APK)
SPECIAL SUPPLEMENTARY EXAM	JANUARY

DATE: 2018-01 **SESSION:** main

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DURATION: 180 MINUTES **MARKS:** 150

Please read the following instructions carefully:

1. Answer **all** the questions.
2. Answer questions in order.
3. Answer only in the examination books provided.
4. The use of calculators is *not* permitted.
5. Write *cleanly* and *legibly*.
6. This paper contains 9 questions.
7. This paper consists of 5 pages.

QUESTION 1

(a) **Discuss** the *common components* in a computer that an ***operating system*** manages. [04]

(b) **Discuss** the *role* of an ***operating system*** as *a resource manager*. [04]

(c) **Describe *CPU pipelining***. [02]

(d) **Discuss** the ***advantages*** and ***disadvantages*** of *monolithic kernels* and *microkernels*. [04]

(e) **Describe** the *role* of an ***interrupt***. [01]

Total: 15

QUESTION 2

(a) **Name** the two (2) ***types of threads***. **Discuss** performance considerations, with respect to scheduling, for each of these thread types. [04]

(b) **Describe** three (3) solutions that achieve ***mutual exclusion*** with *busy waiting*. [06]

(c) Consider the following processes in a *preemptive* system: [05]

Process	Priority	Burst Time
A	4	6
B	1	7
C	2	10
D	3	2

(Highest priority = 0)

Using the ***priority scheduling with priority decrease*** algorithm with a 5msec quanta provide the order execution in the following format (copy and complete the table into your answer sheet):

Time Spent	...	...
Process	...	...
Priority when run	...	...

Total: 15

~~Exam continues on the next page.~~

QUESTION 3

(a) Given a fictional CPU. **Determine the 7-bit physical memory address in decimal** for the following 8-bit virtual address, given the following page table. [06]

Virtual address: 219.

Index	Page Frame	Present
7	00	0
6	10	1
5	00	1
4	00	0
3	01	1
2	11	1
1	00	0
0	00	0

Show all the steps from converting from decimal to binary and then from looking up the address to converting back from binary to decimal.

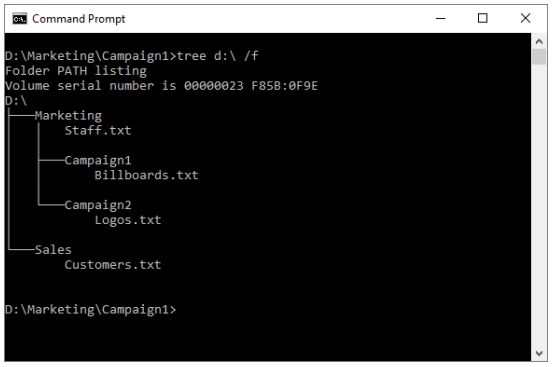
(b) **Discuss** the ***first-in, first-out (FIFO)*** page-replacement algorithm. Your discussion must include the *data structure* that the algorithm uses and the *operation* of the algorithm as well as the *disadvantage* of the algorithm. [05]

(c) **Describe** the use of an inverted page table. Include in your discussion how virtual to physical translation occurs as well as what happens when collisions occur. [04]

Total: 15

QUESTION 4

(a) Given the command prompt below, **answer** the following questions:



i. **Provide** the *absolute path* for the ***working directory***. [02]

ii. **Provide** the *relative path name* for the file called `Customers.txt` from the current working directory [02]

(b) **List** three models that describe how files can be structured. [03]

(c) **Describe**, with the aid of a diagram, how ***linked allocation using a table in memory*** works for storing files. [04]

(d) **Describe** where the *MBR (Master Boot Record)* resides in a file system ***and*** describe how the boot sequence knows ***where*** the operating system files reside in the file system. [04]

Total: 15

~~**Exam continues on the next page.**~~

QUESTION 5

(a) **Describe** the four steps taken by a computer when transferring data from a disk drive to Memory using ***Direct Memory Access (DMA)*** [04]

(b) By using a diagram, **name and draw** the ***four*** layers of the IO software system. [05]

(c) On an imaginary disk with 40 cylinders a request comes in to read cylinder 14. While the hard disk is busy servicing the request on cylinder 14, requests to the following cylinders come in: ***9, 7, 37, 20, 30 and 25***. [02]

Given these cylinders, if the operating system uses the ***elevator*** algorithm, **write** the order in which the cylinders will be serviced.

The directional bit for the elevator algorithm is currently set to 1, which indicates an upwards direction.

Write only the cylinder numbers in order of service.

(d) **Discuss** the concept of cylinder skew in hard disks. Focus your discussion on what cylinder skew is and what problem cylinder skew addresses. [04]

Total: 15

QUESTION 6

(a) Consider memory in a computer:

i. Is memory a preemptable or non-preemptable resource? [01]

ii. Justify your answer in (i) [03]

(b) **Draw** a ***resource allocation graph*** for the state provided below, **and** specify whether the system is in a deadlock. [04]

- Process A holds W and holds X and requests Y
- Process B holds Y and requests Z
- Process C holds Z and requests X

(c) **List** three strategies for dealing with deadlocks. [03]

(d) Consider the following resource matrices and vectors (E - existing resources, A - available resources): [04]

	Tape Drives	Plotters	Scanners	CD ROMs
E =	5	2	3	2

	Tape Drives	Plotters	Scanners	CD ROMs
A =	1	0	1	0

Current allocation matrix

Process 1	2	1	2	1
Process 2	2	0	0	0
Process 3	0	1	0	1

Request matrix

	1	0	1	0
	2	1	1	0
	4	0	1	1

Use the deadlock detection algorithm to determine if the current state is in a deadlock. For each round of the algorithm provide the available resource vector (A vector).

After the final round of the algorithm state whether system is **deadlocked or not**.

Total: 15

QUESTION 7

(a) With the aid of a **diagram**, **describe** the difference between a ***Type-1 hypervisor*** and a ***Type-2 hypervisor*** [06]

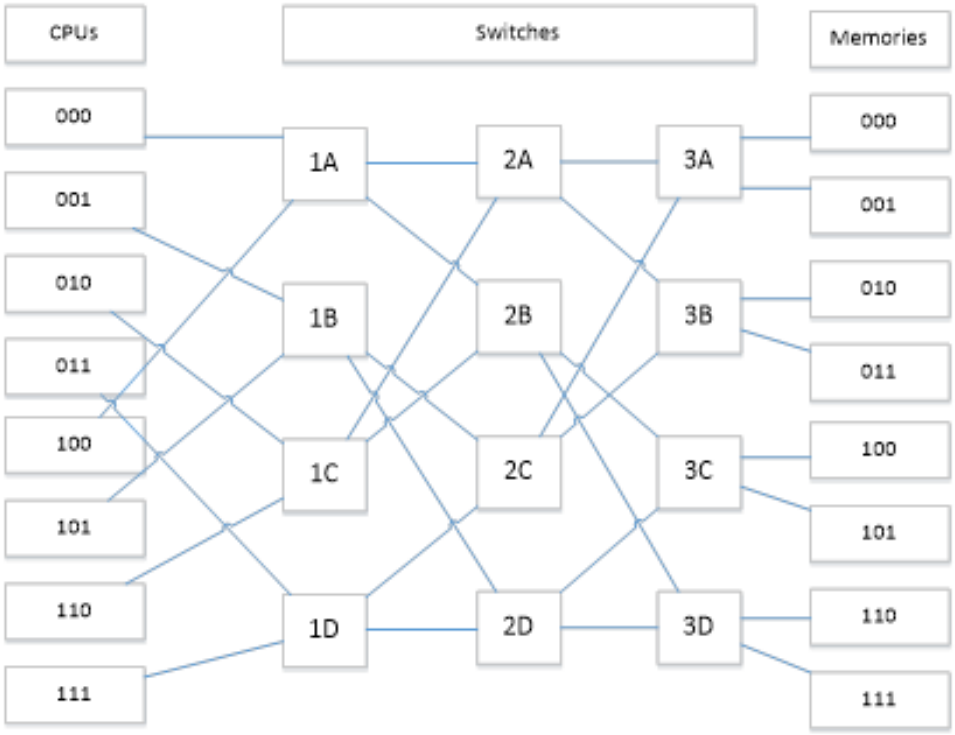
(b) **List** four characteristics that define cloud computing [04]

(c) **Briefly describe** infrastructure as a service (IAAS). [02]

(d) **Describe** the concept of symmetrical multi-processing (SMP). Include in your discussion the following aspects: [04]

- The number of copies of the operating system in memory.
- How SMP synchronises critical operating system code.

(e) Given the following ***omega switching network*** answer the questions which follow:



i. **Which** switches will be accessed when CPU 001 needs to access Memory 010. [01]

ii. **Which** switches will be accessed when CPU 101 needs to access Memory 101. [01]

iii. Can the request in (i) and (ii) be simultaneously processed? Justify your answer. [02]

Total: 20

~~**Exam continues on the next page.**~~

QUESTION 8

(a) **Discuss**, with the aid of a diagram, how basic ***encryption and decryption*** works. [04]

(b) Given the following protection matrix. **List** the ***Access Control List (ACL)*** for the files described in the matrix. [03]

	Summary.doc	Notes.doc	ToDo.xls
User 1	Read		Read,Write
User 2	Read, Write	Read	
User 3	Read	Read, Write	

(c) **List** the three general principles of user authentication. [03]

Total: 10

QUESTION 9

(a) When calling a function ***the standard calling convention*** can be used. **Discuss** this convention, include in your discussion details about *the stack*, *the parameters to a function*, and *the local variables for a function*. [05]

(b) **Draw** the stack as it will exist after the following function in the C programming language is called (after the stack frame is set up). The function contains no local variables. [05]

```
1 int simpFunc(int* x, int y, int* z)
```

(c) **Show** the conversion of 44.9375_{10} into ***IEEE Single-Precision Representation***. Show *all the steps of your calculation* and show the final result as a *hexadecimal number*. [05]

(d) **Write** an 80x86 assembly program that contains the following function: [15]

```
1  .386
2  .MODEL flat
3  .STACK 4096
4  ExitProcess PROTO NEAR32 stdcall, dwExitCode : DWORD
5  .DATA
6  .CODE
7    ; function code here
8  _start:
9    ; code omitted
10 PUBLIC start
11 END
```

A ***mul*** function that takes the following parameters:

arr array address
size array size

The function will multiply each element in the array by 3. The function operates iteratively.

Note: the ***mul*** function must make use of iteration. (If you provide a solution that does not use iteration you will not be eligible for the full allocation of marks)

Total: 30

~~ **THE END** ~~