FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

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

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

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MODERATOR: **EXTERNAL: PROF. S. GRUNER (UP)**

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 6 pages.

QUESTION 1

(a) **Discuss** the *differences* between ***user mode*** and ***kernel mode***. The discussion must address the aspects of *access* in these modes as well as *abstraction*. [04]

(b) The CPU ***processes*** instructions in *three (3) phases*. **Name** the *three phases* and **provide** a description of each. [06]

(c) *Input* and *output* can be done in three (3) different ways. One of the ways is through ***busy waiting***. **Discuss** the other two (2) ways of ***handling I/O***. [04]

(d) **Provide** an example of a *device* that has a ***embedded operating systems***. [01]

Total: 15

QUESTION 2

(a) **List** the four (4) *required conditions* to ***avoid race conditions*** when *accessing shared memory*. [04]

(b) **Discuss *monitors***, ***semaphores***, and ***locking variables*** as *methods of synchronisation*. [06]

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

Process	Priority	Burst Time
A	2	5
B	3	2
C	1	15
D	2	6

(Highest priority = 0)

Using the ***priority scheduling with round-robin equal priority*** 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: 253.

Index	Page Frame	Present
7	00	1
6	00	0
5	10	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 ***clock page-replacement*** algorithm. Your discussion must include the *data structure* that the algorithm uses and the *operation* of the algorithm as well as the *advantage* of the algorithm over ***second chance page-replacement.*** [06]

(c) **Name** and **briefly describe** a solution that minimises the size of a page table [03]

Total: 15

QUESTION 4

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

```
D:\StudentB\Movies>tree d:\ /F
Folder PATH listing
Volume serial number is 000000AA 9034:FDCF
D:\
├───StudentB
│       WeekendPlan.txt
│
│   ├───Music
│   │       ListOfMusic.txt
│   │
│   └───Movies
│           ListOfMovies.txt
│
└───StudentA
        MyNotes.txt
D:\StudentB\Movies>
```

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

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

(b) Answer the following questions related to directories

i. **Describe** the *purpose* of a directory. [02]

ii. **Describe** the *data* of a directory. [02]

(c) **Describe**, with the aid of a diagram, how ***linked-list allocation*** works for storing files. [04]

(d) **Describe** one caching solution that minimises the risk of losing data, when using a file cache. [03]

Total: 15

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

QUESTION 5

(a) **List** the five functions provided by ***device-independent I/O software***. [05]

(b) **Describe** the *concept* of a ***device driver***. Your discussion should include the ***role*** of the device driver, which ***layer*** device driver typically reside inside an operating system and who is typically ***responsible*** for writing device drivers? [04]

(c) On an imaginary disk with 40 cylinders a request comes in to read cylinder 11. While the hard disk is busy servicing the request on cylinder 11, requests to the following cylinders come in: [02]

12, 37, 7, 14, 26 and 32. Given these cylinders, if the operating system uses the ***shortest seek first*** algorithm,

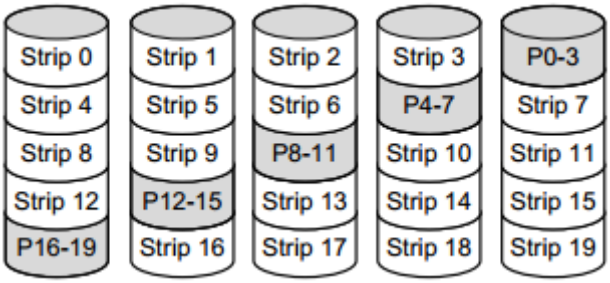
write the order in which the cylinders will be serviced.

Write only the cylinder numbers in order of service.

(Example if you think it will be cylinder 1 then 2 then 3 etc, write 1 2 3).

(d) Briefly **describe** three (3) factors that are affected by a disk arm scheduling algorithm. [03]

(e) **Name** the raid level depicted in the diagram below. [01]



Total: 15

QUESTION 6

(a) **List** the four (4) conditions for a deadlock to occur. [04]

(b) **Draw** a ***resource allocation graph*** for the following states **and** specify whether the system is in a deadlock: [04]

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

(c) With regards to deadlocks, resources can be classified as two different types. **List** and **discuss** both of these types of resources and the impact of these resource types on deadlocks. [03]

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

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

	Printers	DVD Roms	Scanners	Tape Drives
E = (	1	1	5	5)

	Printers	DVD Roms	Scanners	Tape Drives
A = (	0	0	1	1)

Current allocation matrix

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

Request matrix

R =	0	0	1	0
	1	0	5	0
	2	0	0	0

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) **Discuss** Type-2 Hypervisors. Include in your discussion the following aspects: [04]

- Where the hypervisor runs in context of the architectural layers.
- How it is possible to execute priviledge instructions inside a guest operating system.

(b) **Discuss** how paravirtualisation works. Include in your disucssion: [04]

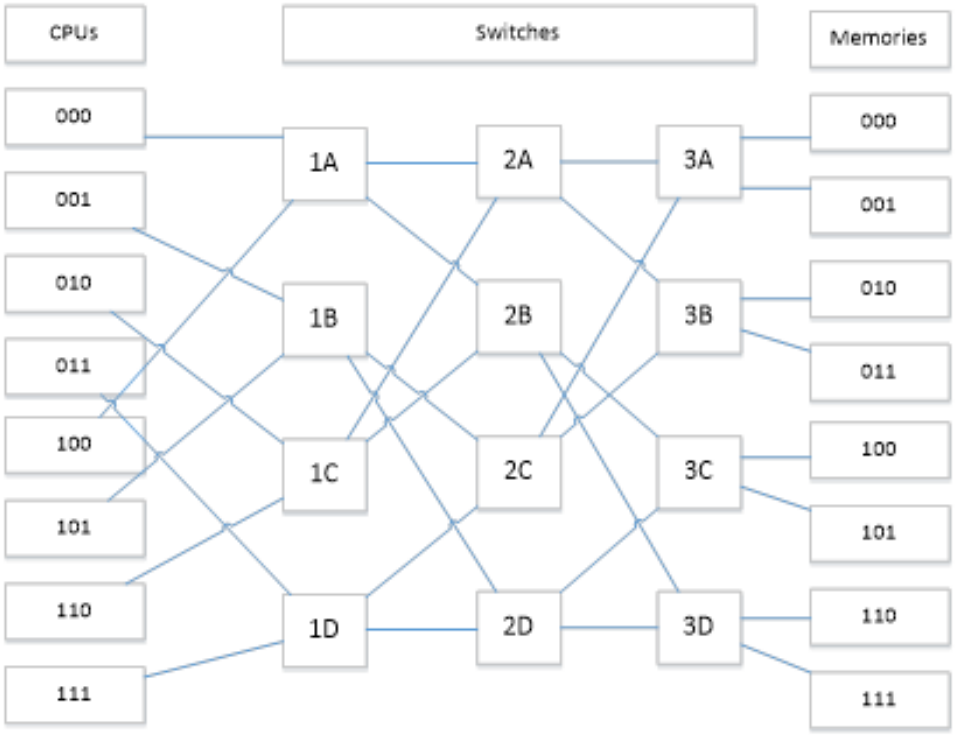
- A definition of paravirtualisation.
- How it is possible for guest operating systems to run on bare metal as well as hypervisors.

(c) **Discuss** multiprocessor synchronisation, along with considerations on how it can be achieved [06]

(d) **Briefly discuss** time sharing and space sharing in context of related and unrelated threads in a multi-processor environment [02]

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

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



i. **Which** switches will be accessed when CPU 011 needs to access Memory 010. [01]

ii. **Which** switches will be accessed when CPU 101 needs to access Memory 011. [01]

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

Total: 20

QUESTION 8

(a) **Describe** the differences between secret key (symmetric) cryptography and public-key (asymmetric) cryptography with regards to then *number* of keys in encryption and decryption. [04]

(b) Given the following protection matrix. **List** the ***capability lists (C-List)*** for the processes owned by users, User1, User2 and User3. [03]

	RA.docx	Summary.xlsx	Shooter.exe
Student 1		Read	Read, Execute
Student 2	Read, Write		Read, Execute
Student 3		Read,Write	

(c) **Briefly** describe what steganography is, and provide two examples of where it can be used. [03]

Total: 10

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

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 void getMax(int* a, int b)
```

(c) **Show** the conversion of -25.0625_{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 ***decrease*** function that takes the following parameters:

arr array address
size array size

The function will decrease each element in the array by 5. The function operates iteratively.

Note: the ***decrease*** 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** ~~