

COMP204: Computer Systems & Their Implementation (Sept. 2001)

Answer **four** questions

1.

(a) What is meant by a *context switch*? What actions occur during a context switch?
(6 marks)

(b) With the aid of suitable diagrams, describe the three scenarios for program execution under UNIX. For each scenario, describe the system calls used to implement it.
(12 marks)

(c) Which of the three scenarios you have just described correspond to the execution of the following UNIX commands? Explain your answers.

(i) `javac prog1.java`

(ii) `javac prog1.java &`

(7 marks)

2.

(a) In a certain producer-consumer situation, all of the producers and consumers communicate via a shared buffer, capable of holding a single, integer-valued item. Below is an attempt at representing this buffer in Java. Explain why this is not a good way of implementing the buffer.
(9 marks)

```
class Buffer {
private int v;

    public void insert(int x) {
        v = x;
    }

    public int remove() {
        return(v);
    }
}
```

(b) Explain how the buffer code given in (a) could be improved to solve the problems you have outlined. (Note: it is not sufficient simply to present Java code without explanation).
(16 marks)

3.

(a) Describe what is meant by the Principle of Locality. What is the explanation for this phenomenon?

Explain how the Principle extends to the notion of the working set $W(T,s)$. Give the formula for estimating the working set at a future time interval.
(7 marks)

(b) In an operating system that makes use of paging, page references are made in the following sequence (assume references are made at unit time intervals):

page	A	A	B	C	C	C	A	C	A	B	
time	0	1	2	3	4	5	6	7	8	9	10

What are the values of the following (explain your answers):

(i) $W(2, 3)$

(ii) $W(4, 4)$

By using the formula you gave in part (a), predict the working set $W(10, 3)$

(9 marks)

(c) Using the same sequence given in part (b), assume that page D is now accessed at time 10, and that one of the pages A, B, C must be discarded to make room.

For each of the page replacement policies below, say which page must be replaced and give your explanation.

(i) LRU

(ii) FIFO

(iii) LFU

(9 marks)

4.

A compiler is given the following expression as its input:

$$a * (b + c) ^ 2 - d$$

(a) Briefly describe the actions performed by the lexical analyser in processing this expression.

(5 marks)

(b) Show how you could develop a parsing algorithm to convert expressions to postfix notation. Apply your algorithm to the above expression and show the resulting postfix string.

(13 marks)

(c) Explain how your postfix string could be converted to machine code for a simple stack-based computer.

(7 marks)

5.

(a) Explain what is meant by a *network protocol*, and say why they are needed.

(5 marks)

(b) Draw a diagram of the ISO 7-layer protocol stack for network communication. Describe the role of each layer of the ISO stack in sending a message from one process to another.

(15 marks)

(c) Name a common alternative to the ISO model, and explain why it is more widely used in real network implementations.

(5 marks)