UNIVERSITY OF DUBLIN

TRINITY COLLEGE

Faculty of Engineering and Systems Sciences
Department of Computer Science

B.A.(Mod.) Computer Science
Junior Sophister Examination

Trinity Term 2002

3BA3– Systems Software

Tuesday 21st May MANSION HOUSE 09.30 - 12.30

Attempt five questions, at least two questions from each section.

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Section A – Operating Systems

1. Part a) counts for 40%, and part b) counts for 60%.

   a. Explain and also compare and contrast user-level threads, kernel-level threads and processes. When is it appropriate to use each of these concepts?

   b. For the following CPU bursts compare the performance of (i) Preemptive Shortest Job First scheduling (α=0.3), (ii) Round Robin with a time quantum of 5ms and (iii) First-Come-First-Served. What conclusions can you draw from this comparison?

Process	T_0 (= t_0)	First CPU burst	I/O burst	Second CPU burst
P_1	8ms	10 ms	1 ms	5 ms
P_2	5ms	5 ms	3 ms	5 ms
P_3	4ms	4 ms	10 ms	4 ms
P_4	7ms	8 ms	5 ms	8 ms

2. Equal marks are given for each part of this question

   a. In the following scenarios what IPC mechanism (or mechanisms) would you use to communicate relatively large amounts of data (eg. 1K bytes)? Justify your choices
      - Thread to thread communication (within the same user process)
      - Process to process communication (where the processes are related)
      - Process to process communication (where the processes are unrelated)

   b. In terms of computations and memory accesses required to get to a random position in a file compare the following file allocation schemes:
      i. Contiguous allocation
      ii. Linked Allocation
      iii. FAT
      iv. Multi-level indexed Allocation

      What other things need to be considered when evaluating what allocation scheme to use for a file system?

3. Part a) counts for 25%, part b) for 25% and part c) for 50% of this question.

   a. The Intel 80386 uses segmentation with a two level page table for memory management. Explain the concepts of segmentation and multilevel page table and how they can be combined.

   b. Determine the effective access time for the Intel 80386 given
      - a memory cycle time of 100ns
      - an associate lookup time of 10ns
      - a hit ratio for the associative registers of 95%

   c. Given the following queue of disk access requests (to particular cylinders on the disk) compare the performance of the FCFS, SSTF and C-LOOK disk scheduling algorithms. You should assume that you can only see three requests in the queue at a time, and that the disk head starts at cylinder 50 (out of 100).

      45, 98, 78, 1, 16, 82, 54, 28, 40, 60

4. Equal marks are given for each part of this question

   a. Determine whether deadlock exists in the following systems using the appropriate algorithm (You should write down the algorithm and show the steps as you apply it in each case).
      Note that you should assume that there are a total of 7 resources of type A, 4 resources of type B and 5 resources of type C.

i.

	Allocation			Request		
	A	B	C	A	B	C
P_1	0	0	2	2	0	0
P_2	2	0	1	1	1	0
P_3	1	0	0	1	0	0
P_4	1	2	1	0	0	1
P_5	1	2	1	1	0	1

ii.

	Allocation			Request		
	A	B	C	A	B	C
P_1	0	0	0	2	0	0
P_2	2	2	2	0	1	2
P_3	1	0	0	1	0	0
P_4	1	2	2	0	0	2
P_5	1	0	1	1	0	1

b. Compare the performance of the FIFO and LRU algorithms for page replacement against the Optimal algorithm, for the following page references. Assume that you have just 3 frames available in main memory

Page references: 1, 2, 1, 3, 4, 3, 4, 1, 5, 3, 5, 1

c. Very few computers provide sufficient hardware support for full LRU. Instead various approximations are used. Explain one of these approximations.

Section B – Data Communications

5. Equal marks are given for each part of this question

a. Transmission over long distances suffers from problems of distortion. Explain the different types of distortion which affect signals. Also explain how these distortions can be compensated for when using (i) a digital signal or (ii) an analogue signal. Using Shannon-Hartley's Law determine what S/N ratio is required in order to achieve the maximum downstream data rates used by the V.90 modem?

b. Explain how HDLC deals with the following issues:

i. Preventing the flag (indicated end of frame) occurring in the data
ii. Error detection with the frame
iii. Throttling the sender
iv. Rejection of incorrect frames

In each case ensure that you fully describe the mechanism used.

6. Equal marks are given for each part of this question

   a. In the following situations decide which media should be used. Justify your choices.
      i. Data communication into the home. Available choices: Twisted pair or coaxial cable or optical fibre
      ii. Mobile telecommunications in a remote environment. Available choices: Radio waves or microwaves
      iii. LAN in a university department which has 20 staff. Available choices: Coaxial cable or CAT-5 cabling, or optical fibre
      iv. Trunk line between Dublin and Cork. Available choices: Optical fibre or Microwave

   b. Compare and contrast CSMA/CD (802.3) networks with Token Ring (802.5) networks in terms of.
      i. Network topology
      ii. Performance
      iii. Determinism/Fairness
      iv. Management of the network

7. Equal marks are given for each part of this question

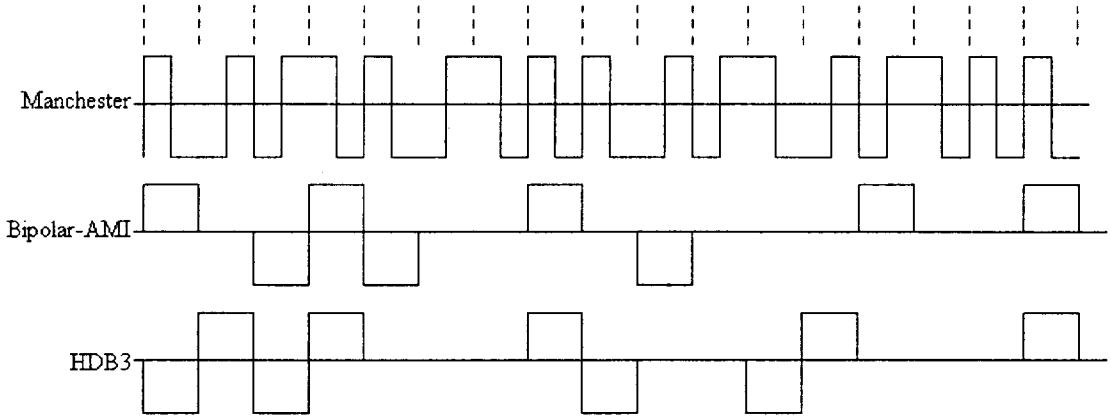
   a. Most telecommunications software is written in layers which allow the layers to be altered independently. Explain how these software layers are used in telecommunications. Also provide a detailed explanation of the functionality of each layer in the OSI model.

   b. First generation mobile phones used FDM to communicate. The second generation uses a combination of TDM and FDM. Explain how TDM and FDM work, and how they are used in the first and second generation of mobile phones.

   c. Given a set of codes (00000011, 01010100, 10101000, 11111111) determine (using the Hamming Distance) corrections for the following codes (if possible). Justify your corrections.
      i. 00010100
      ii. 00000000
      iii. 00011111

8. Part a) counts for 40%, and part b) counts for 60%.

a. How would the following signals be interpreted? For each signal provide the bit patterns and also provide an explanation of the encoding mechanism.



b. Compare and contrast the use of a parity bit for error detection with the use of a cyclic redundancy check (CRC). Ensure that you explain how both techniques work and also compute parity bit and the CRC for the following frame of data:

0 1 0 0 1 0 1 1 0 1 0 1