Computer Science 4SH3 Michael Soltys

DAY CLASS
DURATION OF EXAMINATION: 3 Hours
MCMASTER UNIVERSITY FINAL EXAMINATION April 23, 2002

THIS EXAMINATION PAPER INCLUDES 2 PAGES AND 5 QUESTIONS. YOU ARE RESPONSIBLE FOR ENSURING THAT YOUR COPY OF THE PAPER IS COMPLETE. BRING ANY DISCREPANCY TO THE ATTENTION OF YOUR INVIGILATOR.

No aids allowed.

[20] 1. (a) What is the purpose of paging in a virtual memory system?

(b) Describe the following page-replacement algorithms: FIFO, LRU, OPT.

(c) Consider the following sequence of page requests:

$$\sigma = 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6$$

Compute $\mathrm{FIFO}(\sigma), \mathrm{LRU}(\sigma)$, and $\mathrm{OPT}(\sigma)$, for the following cache sizes:

$$2, 3, 4, 5, 6, 7$$

(Present your answer as a table, for better readability.)

[20] 2. Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time. In answering the question, use nonpreemptive scheduling and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

(a) What is the average turnaround time for these processes with the FCFS scheduling algorithm?

(b) What is the average turnaround time for these processes with the SJF scheduling algorithm?

(c) The SJF algorithm is supposed to improve performance, but notice that we chose to run process P_1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P_1 and P_2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling.

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[20] 3. Write a multithreaded pseudo-code program that computes the product of two $n \times n$ matrices. Recall that if A, B are $n \times n$ matrices, and:

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \qquad B = \begin{pmatrix} b_{11} & b_{12} & \dots & b_{1n} \\ b_{21} & b_{22} & \dots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \dots & b_{nn} \end{pmatrix}$$

Then the (i, j)-th entry of $A \cdot B$ is given by:

$$\sum_{k=1}^{n} a_{ik} b_{kj}$$

Write the program at a high level; use the Pthreads functions:

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pthread_create
pthread_join
```

in your pseudo-code. You do not have to set thread attributes, and you do not have to show technical details. The emphasis should be on the algorithm. You should use three arrays:

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a[n][n]
b[n][n]
c[n][n]
```

to hold A, B, and $A \cdot B$, respectively.

[20] 4. (a) Explain why a doubling of the speed of the system on an Ethernet segment may result in decreased network performance.

(b) Under what circumstances is a token-ring network more effective than an Ethernet network?

(c) Why would it be a bad idea for gateways to pass broadcast packets between networks?

[20] 5. Suppose that your boss has heard about Linux, but does not know very much about it. He asks you to prepare a straightforward writeup of the main advantages and disadvantages of Linux; what would you write?

The End