Department of Computer Science

Operating Systems Qualifying Exam

Spring, 2001

This examination is open book and open notes. The questions are equally weighted. On all questions, the reasoning you use to obtain your answer is more important than the actual answer; if your answer to any question is simply a number without justification, it is wrong (even if the number happens to be correct).

1. The following statement appeared in the `comp.arch` Usenet newsgroup recently:

```
Subject:  Re: AMD 64bit Hammer CPU and VM
Date:  12/19/2000
Author:  Alberto Moreira <junkmail@moreira.mv.com>
```

```
When paging was invented, large machines had 512K bytes of memory.
Those days, you know, are gone, we no longer need to be relocating
segments up and down, or to link applications in complex tree-like
overlay structures, to fit them in those 131K 36-bit memory I had
in my Univac 1108s. The problem that paging was invented to solve
is now a thing of the past, yet the scheme is still there even
though it doesn't buy us much except headaches and expenditure in
additional hardware and control software.
```

   Do you agree or disagree with this statement? Why?

2. Consider a set of processes in a Remote Procedure Call environment. The execution time model is $T = \sum P_i + \sum C_i$, where P_i is the processing time for process *i* and C_i is the time required to communicate all of the required data between process *i* and process *i+1* if the processes are not on the same processor (it is assumed that if two processes are on the same processor, the communication time is negligible). Since this is an RPC model, there is no parallelism between processes. Assume a task is to be performed with the following characteristics:

Processing Time	
P_0	10
P_1	20
P_2	10
P_3	5

Communication Time	
C_0	1
C_1	10
C_2	2

   Assume process *0* is anchored to processor A, and process *3* is anchored to processor B, while the remaining processes are free to migrate to any processor in the network (and the network has an infinite number of processors, and uses a crossbar for communication). Find a distribution of processes on processors that will minimize the total time required to accomplish the task.

3. Assume the following Resource, Maxclaim, and Allocation tables:

   Resource:

	Resource 1	*Resource 2*	*Resource 3*	*Resource 4*
Amount	9	3	5	7

   Maxclaim:

	Resource 1	*Resource 2*	*Resource 3*	*Resource 4*
Process 1	7	2	3	1
Process 2	3	1	2	4
Process 3	4	1	3	4

   Allocation:

	Resource 1	*Resource 2*	*Resource 3*	*Resource 4*
Process 1	3	2	3	1
Process 2	3	1	1	2
Process 3	3	0	1	3

   A. Is the current allocation possible?

   B. Is the current allocation safe?

   C. Suppose Process 1 requests two additional units of Resource 1. Can the request be granted? If there are no other pending requests, will a deadlock exist?

4. Given the following page reference string:

   1, 2, 9, 4, 9, 2, 7, 4, 7, 2, 6, 5, 6, 2, 1

   If the Clock page replacement algorithm is used, and the time window is five accesses (so the current access and four previous accesses are in the window), trace the virtual memory behavior (pages in and pages out) of this reference string.