Operating Systems Qualifying Exam
Spring 2011

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Note: Please attempt all questions. Justify all your answers. This examination is open book and notes. You may feel free to use whatever additional reference material you wish, but no electronic aids are allowed. Please note the following instructions:

- show your work whenever appropriate. There can be no partial credit unless you show how you derived your answers
- be succinct. You may lose points for facts that, while true, are not relevant to the question at hand

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[1.] The following table gives the arrival times, execution times, and deadlines for some processes in a real-time system. Answer the following questions. [15 pts + 15 pts = **30 pts**].

Process	Arrival	Execution	Deadline
P1	0	10	20
P2	5	10	15
P3	10	5	30
P4	15	5	25

- Identify when each process is going to end if a Round-Robin scheduling without preemption is used with a time quantum of two. You are encouraged to draw the time line to illustrate your answer.
- Does the RR scheduling above meet the deadline of the processes? If not, **assign** the processes priorities which will result in all deadlines being met, assuming a strict priority-based preemptive scheduling algorithm. **Identify** when each process is going to end.

[2.] Assume you have a computer system with four page frames, using an LRU page replacement strategy. Initially, the page frames are all empty. Simulate this page replacement strategy on the following page reference string: 6 7 3 7 2 6 5 9 2 4. [**10 pts**]

[3.] The string 1010110101010 includes a message and CRC bits, computed using a generating polynomial of $1 + X^2 + X^3$. **Does the message contain any errors? Show the steps you followed to come to your conclusion.** The message is given with its highest-order bit on the left. [**15 pts**]

[4.] Answer the following general questions:

- Heres a question that appeared recently on Usenet, in the context of Unix-like operating systems:

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Subject: Knowing execed
Newsgroups: comp.os.linux.development.apps
Date: Sun, 19 Jul 2009 22:37:10 +0000 (UTC)

How can I determine that my application has been execed from another program?
(Specifically execv() if it makes any difference.)
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How would you respond to his question? [**5 pts**]

- In a uniprocessor system, comment on the efficiency of using a *spin lock* to achieve mutual exclusion between two processes. Can you improve the efficiency? Explain. [**10 pts**]
- Why is the page table size chosen to be a power of 2? Can you the size be a power of 3? [**10 pts**]
- Explain what is thrashing in the context of memory. Propose a technique to reduce thrashing. [**5 pts**]

[5.] Some computer system uses a virtual memory scheme with the following characteristics:
Type: Hierarchical Forward Mapped
Virtual Memory Address Width: 45 bits
Page Size: 16K
Page Table Entry Size: 8 Bytes
Bits of Physical Frame Number in Page Table Entry: 40

- How large is the virtual memory? [**5 pts**]
- How wide is a physical address? [**10 pts**]