Homework 7 and Final Review
Computer Systems Organization II, V22.0202.003 Spring 2005, Professor Yap

Out: Apr 26.
Due: Nothing.

INSTRUCTIONS:

- This last homework also serves as review for the final exam. We strongly recommend trying to work through these questions.
- Try to solve the problems yourself, before you read the solution which we will publish next week.
- We continue in the style of the midterm review: for each chapter, we tell you what to emphasize, what to deemphaize (or ignore).
- The information up to midterm is applicable for Chapters 1 to 4. No more than 20 % of the question will involve the midterm material. We shall skip Chapter 5 on Input/Output.

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1 Chapter 6, File Systems

1. Read the chapter up to page 424 (end of Section 6.3.6). The organization of FAT files and I-Nodes files must be mastered. In Section 6.3.6, concentrate only on the File Consistency problem. Skip the rest of Chapter 6 except for Sections 6.4.5 (Unix file systems).
2. Describe the two main methods of implementing file systems: FAT and I-Node. What the relative advantages of each? Illustrate your discussion by considering how the two methods would require for a 60 GB disk.
3. Assume that files are broken up into blocks. Let each block be 1 KB (1024 bytes), and each disk block number be 32 bits. We maintain a linked list L of all the free blocks, using free blocks themselves as nodes of L. Assume that we hold only head node of L in main memory. Getting a new block B from this list, or releasing a block B to this free list, are done by the instructions: $B = GetBlock()$ and $FreeBlock(B)$. Write the algorithms for FreeBlock and GetBlock. Be sure that your algorithms avoid I/O thrashing (which could happen when there is alternating FreeBlock/GetBlock Requests).
4. What are the File Consistency and Block Consistency problems? Describe the algorithms to check file and/block consistency, repairing if necessary.

2 Chapter 7, Multimedia

1. Read Chap 7 up to page 475. Topics to focus on: basics of audio encoding, video encoding (including JPEG, MPEG), simple calculations of frequencies and bandwidths, rate monotonic scheduling and EDF scheduling.
2. What is the Nyquist Sampling Rate? Suppose we want to capture audio frequencies up to 20 KHz, and we sample at 16-bits, what is the bandwidth necessary to transmit such signals?
3. Problem 5 on page 500 (Chapter 7). A CD holds 74 minutes of music or 650 MB of data. Estimate the compression factor for music. NOTE: audio CD Sampling rate is 44.1KHz at 16-bits.
4. Problem 12 on Page 500 (Chapter 7). Two realtime processes are running. The first runs every 25 msec for 10 msec. The other runs every 40 msec for 15 msec. Will RMS always work?
5. Problem 14 on Page 500. Figure out when the CPU will first go idle in an EDF Scheduling (see Figure 7-13).

6. Outline the major steps of JPEG encoding.

7. (a) Give scenarios where the uses of P- and B- frames in MPEG encoding would be result is substantial compression. (b) The MPEG Standard does not tell us how to encode: suggest algorithms to search for P- and B-frames during encoding.

3 Chapter 8, Parallel Computation

1. Read Chapter 8 up to page 559 (end of Section 8.3.3). Some key concepts to learn are routing algorithms, network topology (see my lecture notes), and distributed shared memory (Section 8.2.5). I use the general term "parallel computer" to describe any system that has more than one processing unit (PE).

2. Describe the book's classification of parallel computers. Describe Flynn's classification of parallel computers (this is not in the Textbook).

3. Interprocessor communation can be done in one of two ways: using STORE/LOAD primitives or using SEND/RECEIVE primitives. Discuss the differences in these two paradigms, and when one is be more appropriate than the other.

4. Draw the Omega-network for 8 processors. Describe the routing scheme is such networks, and show that it is correct.

5. Describe the routing scheme for hypercube topology. Show that it is correct.

6. In a general computer network, what are the two principle ways for communication?

7. Describe the various network topology and discuss their pros and cons. Use concepts such as diameter, cut width, degree.