University of California, San Diego | **P. Venkat Rangan**
CSE 228: Multimedia Systems | **Homework 2**
Spring 03 | **Due: May 29, 2003**

This homework is due at the beginning of class on May 29; no late homeworks will be accepted. Typed homeworks are preferred. If you do turn in handwritten material it must be extremely legible. Please use a stapler. You will be able to do this homework easily if you attended and understood the relevant lectures. Alternatively, you can try and refer to the following papers:

Paper 1: Continuity and Synchronization in MPEG
Link: (http://www-cse.ucsd.edu/groups/multimedia/papers/rsr96.pdf)

Paper 2: Designing File Systems for Digital Video and Audio ()
Link: (http://www-cse.ucsd.edu/groups/multimedia/papers/rv91.pdf)

Make sure you understand all of the concepts behind these problems, since the final may contain several problems on each of those concepts.

1. **[3 points]** In transmission of MPEG-1 streams on a network with maximum and minimum delays of delta-max and 0, extra buffering is needed to avoid both starvation and overflow. Derive the buffering needed, clearly with help of figures.
2. **[3 points]** Describe the structure of packets and packs for a mpeg-1 stream. Clearly mention the various time stamps that are present and their purpose. Assume one packet of audio and corresponding number of video packets in one pack. Audio bandwidth is A and Video Bandwidth is V. Ignore bandwidth consumed by headers. Describe the sequence of first 26 packets when the ratio of V (video bandwidth) to A (audio bandwidth) is 4.2. You need to show the packet sequence(in terms of video or audio packet) with the PACK boundaries. How many bits are allocated to each of the timestamps and why?
3. **[5 points]** In the process of MPEG editing, you have to convert a B frame to a P frame. The B frame has two reference frames, a preceding P frame and a succeeding I frame. The first task in this is to remove the dependency between macroblocks within the B frame and 16x16 regions of the I frame (i.e., get rid of the backward motion vectors). Describe this process with figures for one macroblock of B using the following steps: first show a 16x16 reference region within the I frame from which a backward motion vector might exist for the macroblock being considered in the B frame. Then show why you need to find the DCT of this 16x16 reference region. Lastly, describe the sequence of operations in order to compute the DCT of that 16x16 region. We don't need the exact set of equations, but only the general sequence of operations at a high conceptual level to show that you understand how this is accomplished.
4. **[3 points]** What is the need for buffering in multimedia storage and retrieval from disk? How do calculate it for an arbitrary placement of media blocks on disk? Clearly show using figures and graphs.

5. **[3 points]** Derive the formula for calculating the length of media blocks and separation between them in constrained placement of blocks on disk.
6. **[3 points]** What is the maximum number of users that can be supported by a disk with transfer bandwidth of 20MBytes/s and maximum seek time of 10ms? Assume multimedia files are stored in constrained manner on the disk, with block size = 2 frames = 40KBytes, separation between blocks of 1ms. Assume playback rate of 30 frames/sec.