CSE 490 GZ
Final Exam
March 19, 2002

For each problem give as brief an answer as possible. The questions can be answered in any order.

1) Answer each of these questions True or False.
   a) JPEG 2000 may block the transformed image to allow for different bit allocation for different blocks.
   b) JPEG blocks the image where each block is transformed using the wavelet transform.
   c) In audio coding some transform coefficients can be ignored (set to zero) because the human ear cannot perceive their presence or not.
   d) In group-of-frames video coding the previous frame is used to predict the current frame.
   e) In image and video coding the chrominance data is sampled at a higher rate than the luminance data.
   f) Finding the closest codeword among n codewords to an input vector requires time linear in n on average.
   g) Blocked lapped transforms when applied to images leave *no* blocking artifacts.
   h) In motion compensation in video coders motion vectors can be compressed using predictive coding.
   i) Resolution scalability in image compression means that images can be shown in good fidelity, depending on the bit rate, in various sizes.
   j) Bit-plane coding of DCT coefficients leads to a higher PSNR than does the JPEG style run-length coding.
   k) SPIHT, GTW, and EBCOT each produce an embedded code, which can be truncated to any length to remain a valid code at a lower bit rate and fidelity.
   l) Frame-by-frame video coding is error resilient.
   m) In JPEG, predictive coding us used for the DC coefficient but not the AC coefficients.
   n) Audio coding does not use the PSNR metric for fidelity.
   o) Each B frame in MPEG-1 are predicted by the previous I or P frame and the successive I or P frame.

2) For each of the following methods explain briefly what happens in encoding but not in decoding that makes encoding slower than decoding.
   a) LZ77
   b) Burrows-Wheeler Transform
   c) MPEG – 1

3) Assuming an initial dictionary

   0   a
   1   b
   2   c

   decode the following sequence using LZW with the doubling strategy showing the decoder's dictionary at each step.

   0010011100010

4) Decode the following using the Burrows-Wheeler Transform: L = bbabbaa and X = 2. In the process compute the mapping T and use it in the decoding.

5) Consider the probabilities on the symbols a : ¼ , b : ¾ . Use arithmetic coding with scaling to decode the sequence 011 that encodes 4 symbols. Show the steps along the way.

6) Do one iteration of the Lloyd algorithm with initial codewords 2 and 3 on the data

pixel value	0	1	2	3	4	5	6	7
frequency	200	100	100	50	50	100	200	200

Compute the before and after distortion as well as the steps in the iteration.

7) Consider the following symbols and their frequencies

symbol	a	b	c	d	e	f	g	h
frequency	3	8	10	1	5	7	20	4

   a) Design an optimal Huffman tree for these symbols with their frequencies.
   b) What is the average bit rate for the code?

8) Consider the Sequitur algorithm in the state after the prefix abaab of abaabaaba has been processed.

   a b a a b a a b a

   S → AaA
   A→ ab

   Show the remaining steps in the Sequitur algorithm.

9)