Winter 2010: ECE 241 Multimedia Compression
Text Coverage and Additional References

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Text: K. Sayood, *Introduction to Data Compression*, 3rd edition, 2006.

This course covers Multimedia Compression standards for voice, audio, still images, and video, with an emphasis on developing the key underpinnings, performance results, functionalities, and applications. The selected textbook is unique in that it provides an introduction to data compression methods, but with the great advantage that it includes introductions to the digital signal processing methods that play a pivotal role in lossy source coding for practical sources. The topical coverage of the course will align primarily with Chapters 11 and 13-18. We will need bits and pieces of the other chapters in the book, particularly for those students who have not taken ECE 242. The text has perhaps the best tutorial treatment of lossless source coding available in any one reference to date. Since lossless coding methods are important components of many standards, those chapters are invaluable.

Additional References: Selected readings from the literature and the standards themselves will also be cited as needed. The following references will augment the text in the areas noted.

J. D. Gibson, T. Berger, T. Lookabaugh, D. Lindbergh, and R. L. Baker, *Digital Compression for Multimedia: Principles and Standards*, 1998.

This book is conceptually more targeted toward the current course, but it is dated now in terms of the treatments of recent standards. It also does not have as complete a development of lossless source coding methods as contained in Sayood.

T. Berger and J. D. Gibson, "Lossy Source Coding," *IEEE Trans. on Information Theory*, Vol. 44, pp. 2693-2723, Oct. 1998.

This article gives an overview of rate distortion theory and its role in lossy source coding, plus an elaboration on important research directions in lossy source coding.

T. Berger. *Rate Distortion Theory: A Mathematical Basis for Data Compression*. Prentice-Hall, Englewood Cliffs, NJ, 1971.

This is the classic textbook on rate distortion theory and has many powerful results very clearly developed, including differential entropy, the Shannon lower bound, the Shannon backward channel, and *R(D)* for Gaussian sources with memory.

C. E. Shannon. *Coding Theorems for a Discrete Source with a Fidelity Criterion*. In IRE International Convention Records, Vol. 7, pages 142–163. IRE, 1959.

The seminal paper on rate distortion theory.

N. S. Jayant and P. Noll. *Digital Coding of Waveforms*. Prentice-Hall, 1984.

The classic textbook on waveform coding with a good treatment of scalar quantization and discrete transforms.

H. S. Malvar. *Signal Processing with Lapped Transforms*. Artech House, Norwood, MA, 1992.

The definitive book on filter banks and transforms. Essential reading for those that work in audio compression and with the standards.

M. Bosi and R. E. Goldberg. *Introduction to Digital Audio Coding and Standards*. Kluwer Academic Press, 2003.

The best single reference on audio coding and the standards as they are practiced today. An understanding of the filter banks and transforms discussed and used will require a reading of the Malvar book.

D. Taubman and M. Marcellin. *JPEG 2000: Image Compression Fundamentals, Standards and Practice*. Kluwer Academic Press, 2001.

The essential reference on JPEG 2000 by two of the primary contributors to the standard, with a nice treatment of the underlying fundamentals, although perhaps not tutorial.

J. L. Mitchell, W. B. Pennebaker, C. E. Fogg, and D. J. LeGall. *MPEG Video Compression Standard*. Chapman and Hall, 1997.

A summary of the MPEG1 and MPEG2 compression standards, including the MPEG system standards commonly used today such as transport streams.

B. G. Haskell, A. Puri, and A. N. Netravali, *Digital Video: An Introduction to MPEG-2*, Chapman & Hall, 1997.

Exhaustive treatment of MPEG-2 with many useful details.

W. B. Pennebaker and J. L. Mitchell, *JPEG: Still Image Data Compression Standard*, 1992.

An overview of the JPEG compression standard from two of the standards body participants.