E669 Course Syllabus

Term: Spring 2012

Course Title: Multimedia Data Compression

Lecture: 9:00 - 11:50 am, Friday, OHE 122

Discussion: 8:30 - 9:20 am, Wednesday, Room: TBA

Instructor:

Prof. C.-C. Jay Kuo
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Website: http://den.usc.edu

1. Course materials, project assignment and announcements are available on the website.
2. Homework submissions and returns are handled electrically (no paper copies).
3. FAQ regarding homework will be posted by TA on the discussion board.

Instructor Office Hours:

Monday and Tuesday 8:30-10am
(For homework-related issues, please consult with the TA or grader first.)

Teaching Assistants:

Jiangyang Zhang
Room: PHE 330, Phone (213) 740-4372
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Office Hours: Wednesday, 1:00 - 3:00 pm

Hang Yuan
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Graders:

Sanjay Purushotham
E-mail: spurusho@usc.edu
Office Hours: by appointment only

Sachin Chachada
E-mail: chachada@usc.edu
Office Hours: by appointment only

Textbook:

None. About 50% of the course material is prepared in Power-point slides. The PDF files corresponding to any other topics will be available on the DEN course website.

Prerequisites:

Familiarity with C/C++ programming.
Students are expected to comprehend existing C/C++ programs and modify the code for various goals. The students may also be required to write small programs from scratch. Provided sample code comes with makefiles for compilation under a Unix environment. Either familiarity with basic unix commends or the ability to covert the codes to a windows project is required.

Projects:

3 programming projects will be given as homework. No late submissions are accepted.

Project 1: Lossless Compression I (Huffman Coder, LZW Coder)
Project 2: Lossless Compression II (QM Coder) and Vector Quantization
Project 3: Image and Video Compression

Oral Test of the Computer Projects:

An oral test will be held at the end of the semester. The students will be asked about their implementation of the three projects.

Mid-term Exam:

Time: March 30 (Friday) 9:00 am - 11:50 am.

Term Paper:

Details of the term paper assignment will be given later.
Due: April 27 (Friday) in class.

Grading Policy:

1. Projects: 45%
2. Oral Test: 10%
3. Mid-term Exam: 30%
4. Term Paper: 15%

Reference Books:

General References:

1. Anil K. Jain: Fundamentals of Digital Image Processing, Prentice Hall, 1989.
2. Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing, Addison-Wesley, 1992
3. Gilbert Held: Data and Image Compression, John Wiley & Sons Ltd., 1996
4. Majid Rabbani (Edited): Selected Papers on Image Coding and Compression, SPIE Milestone Series, 1992

Lossless Comression (Lectures 1-3)

5. Robert M. Gray: Source Coding Theory, Kluwer Academic Publishers, 1991
6. Tomas M. Cover and Joy A. Thomas: Elements of Information Theory, Wiley-Interscience Publication, John Wiley & Sons, Inc. 1991
7. Mark Nelson and Jean-Loup Gailly: The Data Compression Book, 2nd Edition, M&T Books, 1996
8. Khalid Sayood: Introduction to Data Compression, Morgan Kaufmann Publishers, Inc., 1996
9. Timothy C. Bell, John G. Cleary and Ian H. Witten: Text Compression, Prentice Hall PTR, Englewood Cliffs, 1990

Audio and Speech Compression (Lecture 4)

10. Dai Tracy Yang, Chris Kyriakakis and C.-C. Jay Kuo: High Fidelity Multichannel Audio Coding, Hindawi Publishing Corporation, 2004.

Scalar and Vector Quantization (Lectures 5-6)

11. Anil K. Jain: Fundamentals of Digital Image Processing, Prentice Hall, 1989.
12. Allen Gersho and Robert M. Gray: Vector Quantization and Signal Compression, Kluwer Academic Publishers, 1991

Still Image Compression (Lectures 7-8)

13. William B. Pennebaker and Joan L. Mitchell: *JPEG: Still Image Data Compression Standard*, Van Nostrand Reinhold, 1993.
14. K. R. Rao and P. Yip: Discrete Cosine Transforms: Algorithms, Advantages, Applications, Academic Press, 1990
15. John W. Woods: Subband Image Coding, Kluwer Academic
16. Paul M. Farrelle: Recursive Block Coding for Image Data Compression, Springer Verlag, 1990
17. Michael F. Barnsley and Lyman P. Hurd: Fractal Image Compression, Jones and Bartlett, 1993

Video Compression (Lectures 9-10)

18. A. Murat Tekalp: Digital Video Processing, Prentice Hall PTR, Upper Saddle River,1995
19. K. R. Rao and J. J. Hwang "Techniques and Standards for Image, Video and Audio Coding", Prentice Hall PTR, Upper Saddle River, 1996
20. Joan L. Mitchell, William B. Pennebaker, Chad E. Fogg and Didier J. LeGall: MPEG Video Compression Standard, Chapman, 1997.

Wired and Wireless Video Delivery (Lecture 12)

21. Yao Wang, Jörn Ostermann and Ya-Qin Zhang: *Video Processing and Communications*, Prentice Hall, 2002.

Note: In addition to the above reference books, some journal papers will be provided as reference reading material.

Tentative Schedule:

Lecture 1: Overview of image compression, important information theory concepts, entropy definition and interpretation, Shannon-Fano coding, Huffman coding,
Lecture 2: Adaptive Huffman coding, Lempel-Ziv codec
Lecture 3: QM codec, context-based QM coder, examples of lossless compression
Lecture 4: Scalar quantization, optimal scalar quantizer, compander
Lecture 5: Vector quantization
Lecture 6: Audio and speech compression
Lecture 7: JPEG & JPEG-2000 still image compression
Lecture 8: Video coding standards (A) MPEG-1, MPEG-2
Lecture 9: Video coding standards (B) H.264/AVC and HEVC
Lecture 10: Video coding techniques: motion estimation, rate control algorithms, pre & post-processing
Lecture 11: Video delivery/streaming over wired and wireless networks
Lecture 12: Mobile multimedia computing
Lecture 13: Multimedia content management and protection
Lecture 14: Future directions – Multi-view video coding, depth coding and others

Important Reminder:

Please refer to the following web sites for USC policy on academic integrity and the penalties for cheating and plagiarism. These rules will be strictly followed.

1. http://www.usc.edu/dept/publications/SCAMPUS/gov/gov05.html
2. http://www.usc.edu/dept/publications/SCAMPUS/gov/gov11.html
3. http://www.usc.edu/dept/publications/SCAMPUS/gov/gov12.html
4. http://www.usc.edu/dept/ARR/grades/