CO3096 Compression Methods for Multimedia

Credits: *20* **Convenor:** *Prof. R. Raman* **Semester:** *2nd*

Prerequisites:	*Essential: CO1012 or CO1011*	*Desirable: CO1016,CO2016*	
Assessment:	*Coursework: 50%*	*Two hour exam in January: 50%*	
Lectures:	*30 hours*	**Problem Classes:**	*5 hours*
Surgeries:	*5 hours*	**Class Tests:**	*3 hours*
		Private Study:	*107 hours*

Subject Knowledge

Aims To study methods for compression of symbolic data as well as audio, image and video data. To gain an appreciation of the ubiquity and importance of compression technologies.

Learning Outcomes Students should achieve: broad knowledge of compression techniques as well as the mathematical foundations of data compression; factual knowledge about existing compression standards or commonly-used compression utilities; understanding of the ubiquity and importance of compression technologies in today's environment; elementary understanding of the need for modeling data and the underlying issues.

Methods Class sessions together with course notes, recommended textbooks, problem classes with worksheets and model solutions, web support.

Assessment marked courseworks, class tests using Blackboard VLE, traditional written examination.

Skills

Aims To teach students how to compute basic statistics of data, and how to apply nontrivial algorithms to real-world problems.

Learning Outcomes Students will be able to: understand and describe various models of data; understand the basic data compression algorithms and show how they work on a particular input; implement these algorithms; compare their efficiency in terms of speed and compression ratio.

Methods Class sessions and problem classes.

Assessment marked coursework, class tests, traditional written examination.

Explanation of Prerequisites There are two main prerequisites. Firstly, students should have some knowledge of how data of various kinds (numbers, characters, images and sound) are represented digitally in uncompressed format. This will be reviewed rapidly at the start of the course. Some elementary mathematics is also required. In particular, trigonometry: basic functions–cos,sin and measuring angles in radians; probability: basic definitions and expected values; matrices: transposition and multiplication and recurrence relations: basic familiarity. Basic familiarity with the elements of computer systems and networks is also desirable.

Course Description Data compression is about finding novel ways of representing data so that it takes very little storage, with the proviso that it should be possible to reconstruct the original data from the compressed version. Compression is essential when storage space is at a premium or when data needs to be transmitted and bandwidth is at a premium (which is almost always). The first thing that one learns about compression is that it is not "one size fits all" approach: the essence of compression is to determine characteristics of the data that one is trying to compress (typically one is looking for patterns that one can exploit to get a compact representation). This gives rise to a variety of data modeling and representation techniques, which is at the heart of compression. The convergence of the communications, computing and entertainment industries has made data compression a part of everyday life (e.g. MP3, DVD and Digital TV) and has thrown up a number of exciting new opportunities for new applications of compression technologies.

Detailed Syllabus Introduction: Raw multimedia data representation, Transmission medium characteristics, Data compression, Adaptive and non-adaptive methods, Lossy and lossless compression, Introduction to information theory and Theoretical limits of compressibility. Compressing symbolic data: Run-length coding, Entropy coders: Huffman coding, arithmetic coding, Dictionary coders: LZ77, LZW, Other text compression methods: Block-sorting. Standard text compression utilities: compress, zip. Image compression: Monochrome, facsimile and grayscale compression, GIF compression, JPEG compression, Video compression: Frame-by-frame compression: M-JPEG. Inter-frame compression: MPEG. Audio compression: Speech coding: ADPCM; CD-quality audio: MPEG layer 3.

Reading List

[B] Ze-Nian Li and Mark S. Drew, *Fundamentals of Multimedia; ISBN: 0130618721,* Pearson Prentice Hall, 2004.

[B] Khalid Sayood, *Introduction to Data Compression; ISBN: 1558605584,* Morgan Kaufmann Publishers, 2006 (3rd edition).

[C] Roy Hoffman, *Data compression in digital systems; ISBN: 0412085518,* Chapman and Hall Digital Multimedia Standards Series, 1997.

[C] Andrew S. Tanenbaum, *Structured Computer Organization; ISBN: 0130204358,* Prentice Hall, 1999 (5th edition).

[C] Jean-loup Gailly, *The comp.compression FAQ,* www.faqs.org/faqs/compression-faq/.

Resources Course notes, web page, study guide, worksheets, handouts, lecture rooms with a computer to CFS, data projector, two OHPs, past courseworks and examination papers.

Module Evaluation Module questionnaires, course review.