

15/16 Media Technology (CSY3010)

Introduction

- What are we going to learn?
- Module outline.
- Some details.
- Assessment.

Who, Where and When?

- Who am I? – Dr. Mu Mu
- PhD in Computer Science, Lancaster University
- 40+ research papers – IEEE Transactions on Multimedia, IEEE Communications Magazine, IEEE Multimedia, IEEE IWQoS, ACM Multimedia, ACM Multimedia Systems...
- Technical programme committee and reviewer - SpringerMMSJ, MTAP, IEEE TMM, ACM MMSYS, ACM TVX, IEEE ICC, IEEE CCNC, ElsevierCOMNET, COMCOM...
- Interested in doing research as a PhD?

Who, Where and When?

- My office – Rm. NW307
- Email - mu.mu@northampton.ac.uk
- Course notes – find everything in NILE (progressively updated)

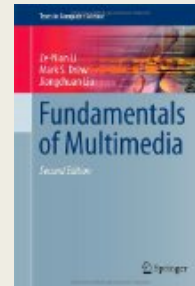
Module outline

1. Introduction
2. Audio (Req. Headphones)
3. Graphics.
4. Bitmap Images 1 (Introduction)
5. Bitmap Images 2 (Colour)
6. Image manipulation and processing
7. Overview of compression techniques
8. Audio-visual compression 1
9. Audio-visual compression 2
10. Advanced topics
11. Revision
12. Time constrained assignment.

Module outline

- New topic (almost) every other week
- Assignment 1 – Issued before Xmas break, hand in after the break.
- Assignment 2 – Time constrained assignment.

Reading list



Fundamentals of Multimedia

Ze-nian Li, Mark S. Drew, Jiangchuan Liu 2014

<http://link.springer.com/book/10.1007/978-3-319-05290-8>

Digital Multimedia

Nigel Chapman, Jenny Chapman 2009

Multimedia Systems

Ralf Steinmetz, Klara Nahrstedt 2014

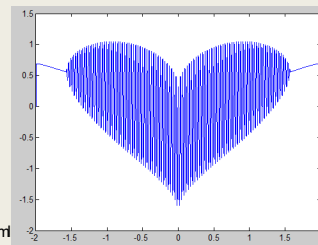
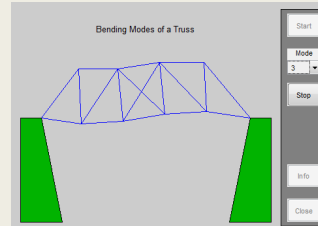
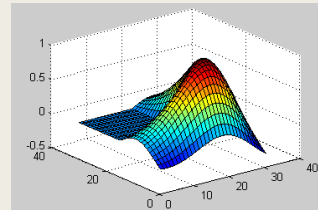
How is it taught? (Hello Matlab)

- We use Matlab for video and audio.
- Matlab is high level and we can look at audio and video media without having to do a lot of programming (which we would otherwise need).
- Matlab uses standard programming constructs.
- It is new to you, so you have to learn the syntax. So that's fair to everyone.
- The university cannot supply you with a personal copy, so if you want it at home you will have to "obtain" it.

How is it taught?

(Hello Matlab)

- Matlab is widely used in the scientific world.
- It is normal to start off hating Matlab, before you see the benefits of using it.
- This is not intended as a Matlab course.



http://www.divilabs.com/2013/10/some-matlab-unusual-commands-that-you_19.html

Is there any/much maths?

- Yes, because all media involves representation by numbers and manipulation will involve some maths.
- Any maths used will be explained (principle).
- Matlab will do most necessary calculations for you.
- So don't be scared off.
- At the same time accept that you will need some maths for this course.

Media Technology

- We will see how media is represented in file formats and in the computer.
- How to manipulate and process images and sound files as done in commercial software.
- Why compression is needed and how it works.

What use is all of this?

- Any applications involving media.
 - Sound / Video / Image editing (number plate recognition, intrusion detection, voice recognition / control, image stabilization, ...)
 - Online photo library (Google photo, Instagram, ...)
 - Online media streaming (Netflix, BBC iPlayer, BT TV, YouTube, Spotify, ...)
- Is it interesting?



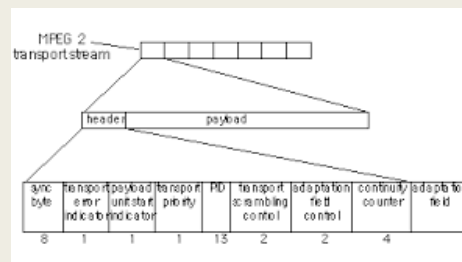
<http://www.aertia.com/docs/capvidia/LPRS.jpg>

Media Technology (outlook)

- Primarily concerned with the following digital media:
 - *Graphics*
 - *Synthesised Sound (Headphones)*
 - *Digitised Sound (Headphones)*
 - *Digitised Images*
 - *Video*

Media Data Files

- Most media data files contain and start with “headers” (labels on the tin).
- “Headers” contain information about the file such as:
 - *How long it is.*
 - *How it should be played.*
 - *How it is coded.*
- Media files also contain specially coded forms of the original data.



Graphics - Vector Images

- Image composed and stored as a sequence of pre-set shapes or objects.
- Lines, rectangles, ellipses, text etc.
- Described in terms of size, position, drawing colour, fill colour.
- Each object's characteristics can be edited independently while in this graphical form.

Graphics – Vector Images

- Often called vector graphics.
- Common drawing packages allow the creation of this form of image.
- Compactly storable in files. PDF
- We will look at typical commands and file editing.

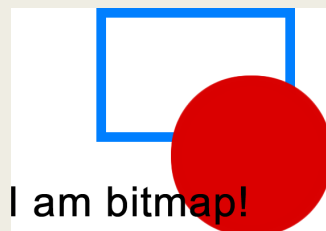
Graphics – Vector Images

- Example of a graphic vector image created using “Autoshapes”.
- Other popular vector graphic tools are Paint shop pro, Adobe Fireworks, Photoshop.



Bitmaps - Raster Images

- Does not use individual shapes.
- Whole image contains many pixel elements (pixels).
- So every pixel (about 300,000 in a 480 x 640 image) is described by position and colour.



Bitmaps - Raster Images

- We cannot edit or change any shape drawn without changing all of the pixels concerned.
- Microsoft Paint produces Bitmap images.
- We can manipulate/create the bitmaps in the computer.

Bitmaps or Vector?

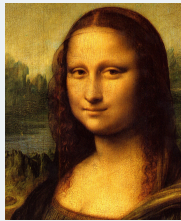
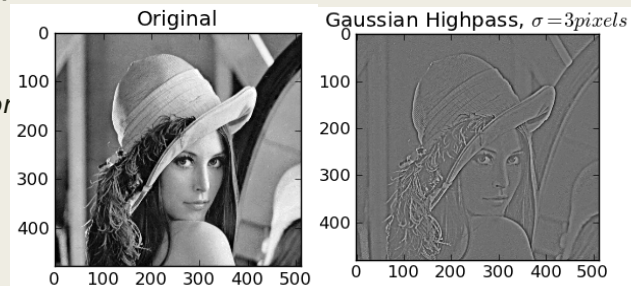
	Bitmap graphics	Vector graphics
Format of presentation?	Pixels of diff. colours	Objects
What can be edited?	Individual pixels	Individual objects
Mostly used for?	Photos 	Cartoons 
What happens when they are resized?	They lose quality	They do not lose quality
Common file formats	.bmp, jpeg, gif, tiff	.svg, .odg, .eps, .xml



Image Processing

- A short introduction to image processing.
- Filters.
- Convolution or complications.
- Simple applications

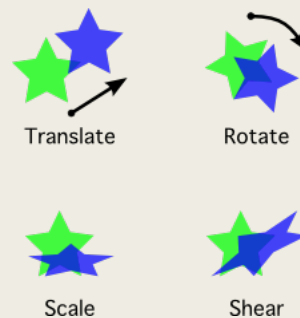
- *Sharpening*
- *Softening*
- *Edge detection*



<http://stackoverflow.com/questions/6094957/high-pass-filter-for-image-processing-in-python-by-using-scipy-numpy>

Image Manipulation

- Affine transformations
- Scaling
- Rotating
- Translating images
- Compound transformation



Sound (midi)

- Just like images we can have two forms in the computer.
- One form remembers the pitch, duration and loudness and individual sound of the notes.
- This is stored as MIDI (musical instrument digital interface) form.
- Like vector graphics the sound can be edited by changing the individual characteristics of the notes.

Sound (midi)

- We can edit a MIDI file to change:
 - *Instruments*
 - *Timing*
 - *Notes*
 - *Loudness*

[Online Sequencer](#)

Sound

- The other form relies on digitisation of real life sounds.
- Sampled sound.
- A common example of this are “wav” sound wave sounds.
- Like bitmap images we cannot edit individual notes without changing all of the samples which the note is comprised of.

Sound

- But we can manipulate it.
 - *Speed it up.*
 - *Make it louder.*
 - *Join sounds.*
 - *Mix sounds.*
- Using Matlab

Sample rates and Bandwidth.

- The bandwidth of audio and video signals can be considered to be the highest frequency carried by the signal.
 - *In sound “crispness”.*
 - *In vision “sharpness”.*

8,000 Hz	Telephone, walkie-talkie
44,100 Hz	Audio CD
192,000 Hz	DVD-Audio

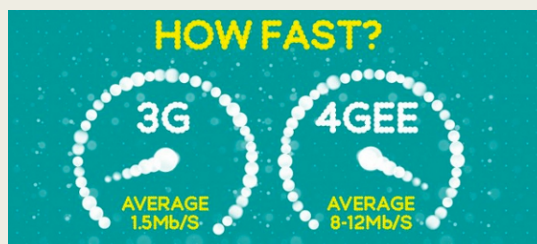
Compression

- Digitised sound and video produces a lot of data.
- In particular digitised television quality pictures produce data at over 1000 Mbits/second* which is faster than many hard disks, CD ROMs and networks devices can accommodate.
- We need to compress data for use on computers.

*720p HDTV uncompressed;
10 bit @ 1280 x 720 @ 59.94 field = 140 MB per/sec, or 494 GB per/hr.

Compression.

- Original CD ROM could only deliver data at 1.2 Mbps.
- 40x is therefore 48 Mbps.
- DVD data rate (single speed) 11 Mbps.
- 16x DVD gives 176 Mbps.
- Online streaming?

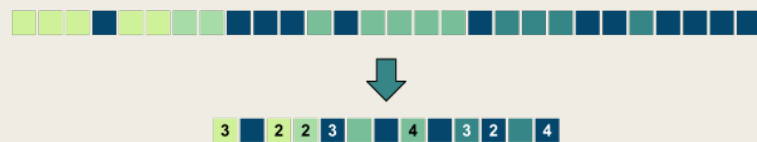


http://www.store-4g.co.uk/sites/store-4g.co.uk/files/article_images/ee-3g-compared-to-4g.jpg

Compression

- We have two types of compression.
- Lossy compression and lossless compression.
- As the names suggest lossy compression loses some of the original signal, while lossless does not.
- Lossless techniques such as run-length encoding and Huffman coding achieve compression by creating shorter codes. This is not always possible.

Lossless compression of a pixel row



Compression

- Lossy techniques rely on throwing away some information which the viewer or listener will not notice too much.
- Involves changing the data to some other form.
- Most lossy techniques are noticeable.
- The more lossy compression that is applied, the more the compression effect will be noticeable.

Example of Lossy Compression

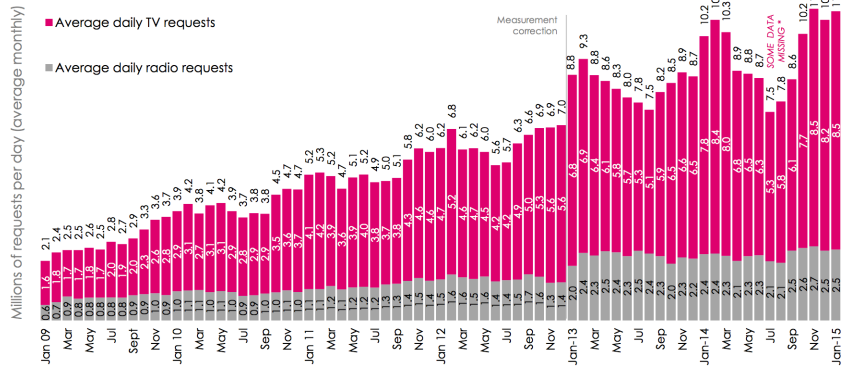


<https://proxish.wordpress.com/2013/02/07/learning-outcome-1-computer-graphics-graphic-compression-systems/>

Let's not forget video streaming

Average daily BBC iPlayer online requests

Average daily requests reached over 11 million daily in January for only the second time ever – at **11.1 million per day** across both TV and radio.

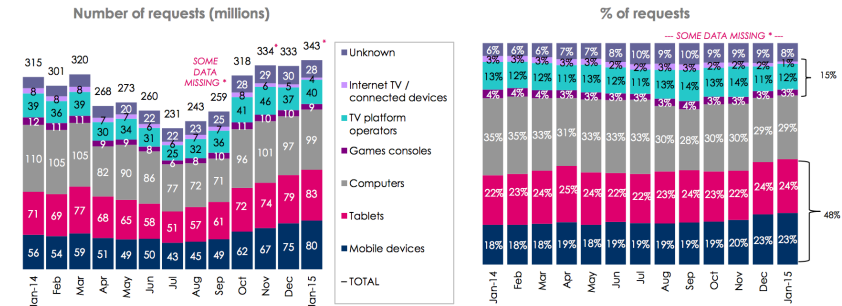


* Please refer to slide 9 for guide notes Slide 5 BBC Marketing & Audiences

Let's not forget video streaming

TV and radio: Requests for programmes by device type

Following the festive period **requests from mobiles and tablets increased to 48%** in January, to their **highest-ever level**, driven by growth for both TV viewing and radio listening



Notes:
Internet TV / connected devices include Freeview and Freesat smart TVs, set-top-boxes and devices like Roku and blu-ray DVD players.
TV platform operators include Virgin Media, Sky, YouView and BT Vision. Games consoles comprise Sony Playstation, Nintendo Wii and Microsoft Xbox.
Unknown devices are mostly due to online radio services such as the Tunein radio app, which we are currently unable to classify accurately by device.

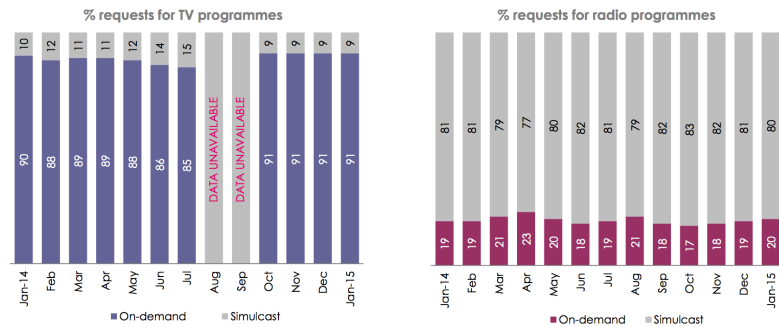
* Please refer to slide 9 for guide notes Slide 6 BBC Marketing & Audiences

Let's not forget video streaming

TV and radio requests: live vs catch-up online requests

This data excludes Virgin Media cable and Sky data for BBC iPlayer (see page 9 for more details).

The proportion of live requests to TV remained at 9% in January, due to the strength of the winter TV schedules. For radio, live requests were at 80%.



Please refer to slide 9 for guide notes

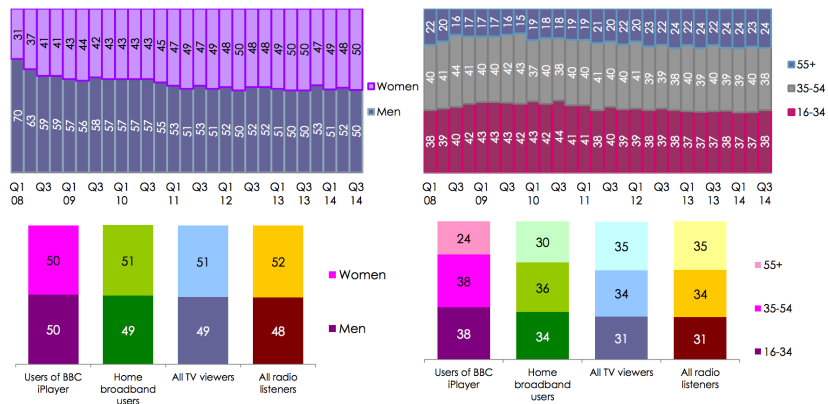
Slide 13

BBC Marketing & Audiences

Let's not forget video streaming

BBC iPlayer use by demographic

The profile of users of the BBC iPlayer is measured on a monthly survey of 700+ UK adults, and has remained stable across 2014.



Please refer to slide 9 for guide notes

User profiles - TV from BARB (Q2 14), radio from RAJAR (Q2 14), broadband from BARB (Q2 14)

BBC Marketing & Audiences

Let's not forget video streaming

- Cisco VNI – Visual Networking Index:
- Globally, Internet video traffic will be **55 percent of all consumer Internet traffic** in 2016, up from 51 percent in 2011

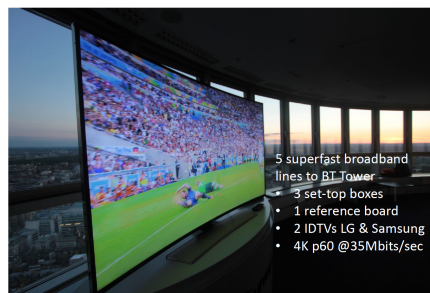
Examples of research topics

High definition online TV over adaptive streaming

Adaptive media streaming is becoming the most popular vehicle for online video services.

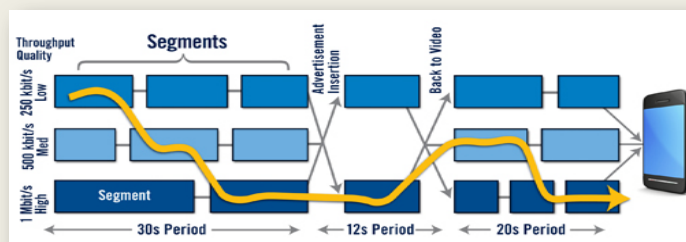
Content providers and network operators carry out trials that broadcast live sports events in ultra HD and 35Mbit/s.

World Cup Final - BT Tower Demonstration



<http://nem-initiative.org/wp-content/uploads/2014/10/5-Phil-Layton-Barry-Cmb-tee-NEM-BT-BBC-key-note.pdf>

HAS and MPEG-DASH

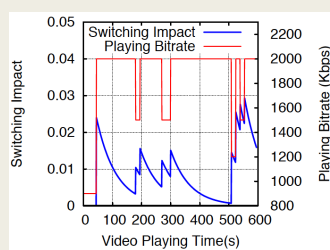


Thomas Stockhammer,
Qualcomm Incorporated

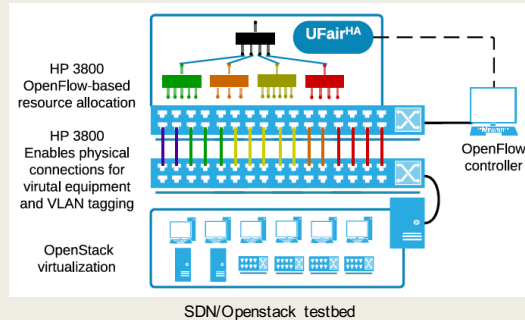
- HTTP adaptive streaming (HAS)
 - Adobe Dynamic Streaming for Flash, Apple HTTP Adaptive Streaming, Microsoft Smooth Streaming
- MPEG-DASH: Dynamic Adaptive Streaming over HTTP
 - Chunked media facilitates swapping between bitrates.
 - Standardised and has support from industry.
 - Works in browsers (with Media Source Extension support)
- A Media Presentation Description (MPD) file describes segments information:
 - Timing, URL, resolution, bit rates.
- Clients request appropriate bitrate chunk according to estimated bandwidth, buffer level, QoE, etc.

Multimedia networking

- QoE-aware adaptive media streaming and resource allocation
 - *HTTP adaptive streaming optimisation*
- MPEG-DASH ABR using buffer occupancy, impact of quality adaptation, HTTP/2 server push, QUIC, ICN, etc.
 - *User-level fairness in resource provisioning*
 - *Software defined networking (Openflow) applications*
 - *Research papers appeared in IEEE TMM, ACM MM, IEEE/ACM IWQoS, etc.*



"Forgiveness effect" in quality adaptation



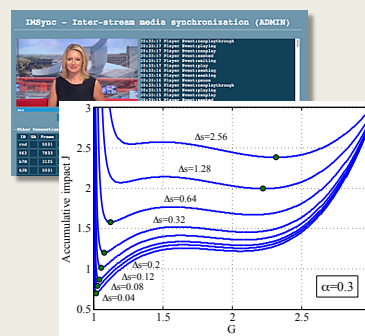
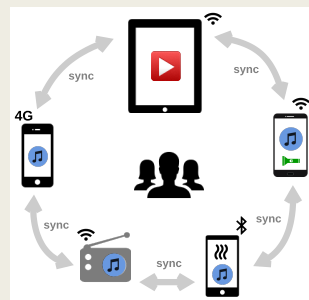
Multimedia networking

Immersive experience through media orchestration

Inter-device media synchronization in N-screen device cloud.

Open Javascript framework (WebSocket, timing elements, latency measurement, etc.) integrating a perception model.

MediaSync, W3C



Social TV and data mining

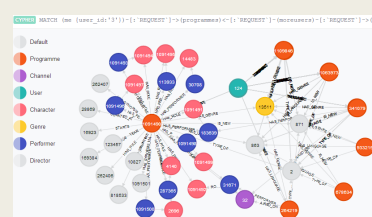
Vision Online TV

Research and experimentation platform

Personalized media service, data mining of user activity data

Collaboration with the BBC (on iPlayer features), Bell Labs, and TU-Berlin

VISION



Graph database (Neo4j)

Vision online TV

end of slides