TÉCNICO LISBOA

AUDIOVISUAL COMMUNICATION

Fernando Pereira


RANDOM42
scientific communication

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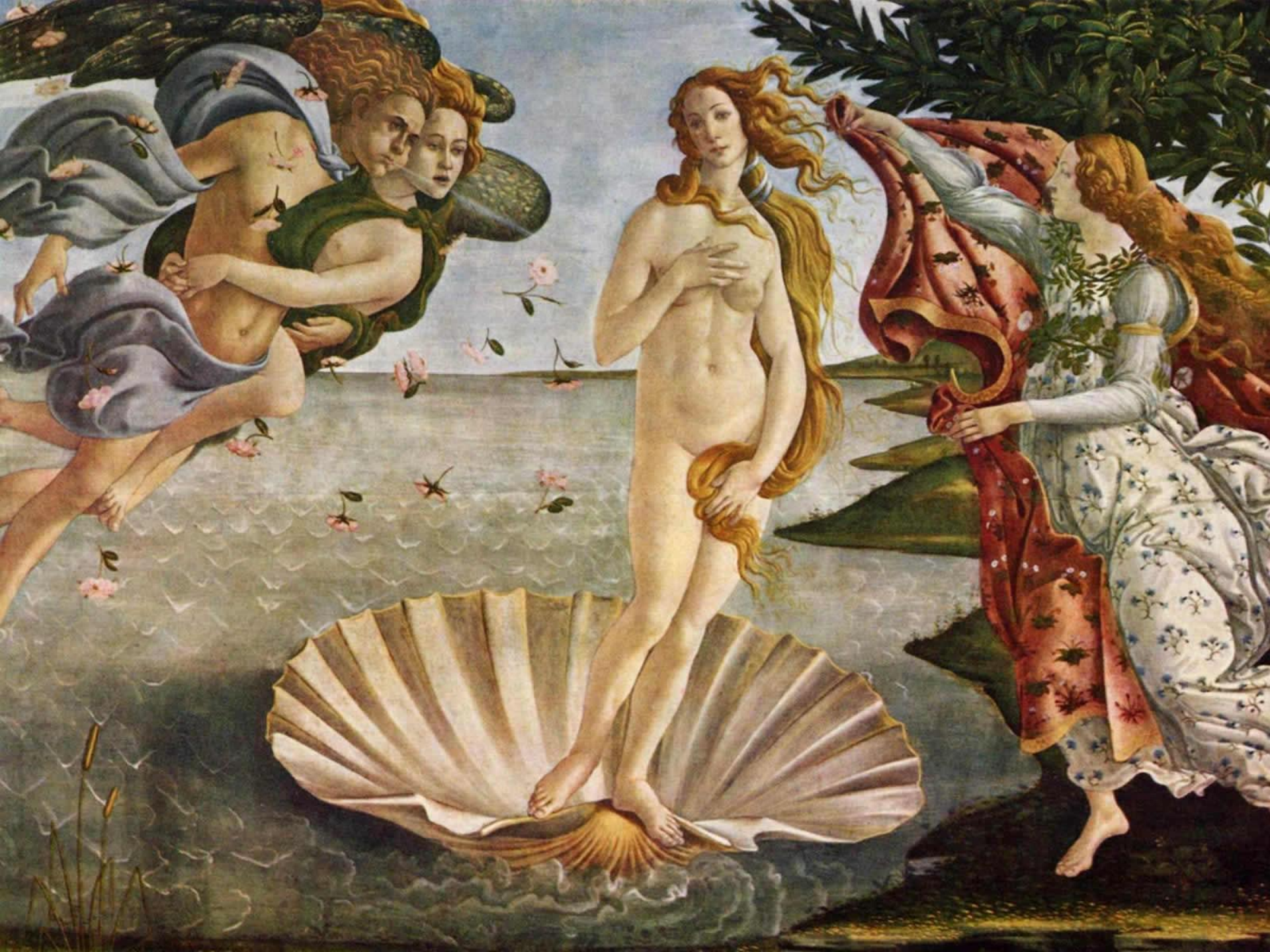
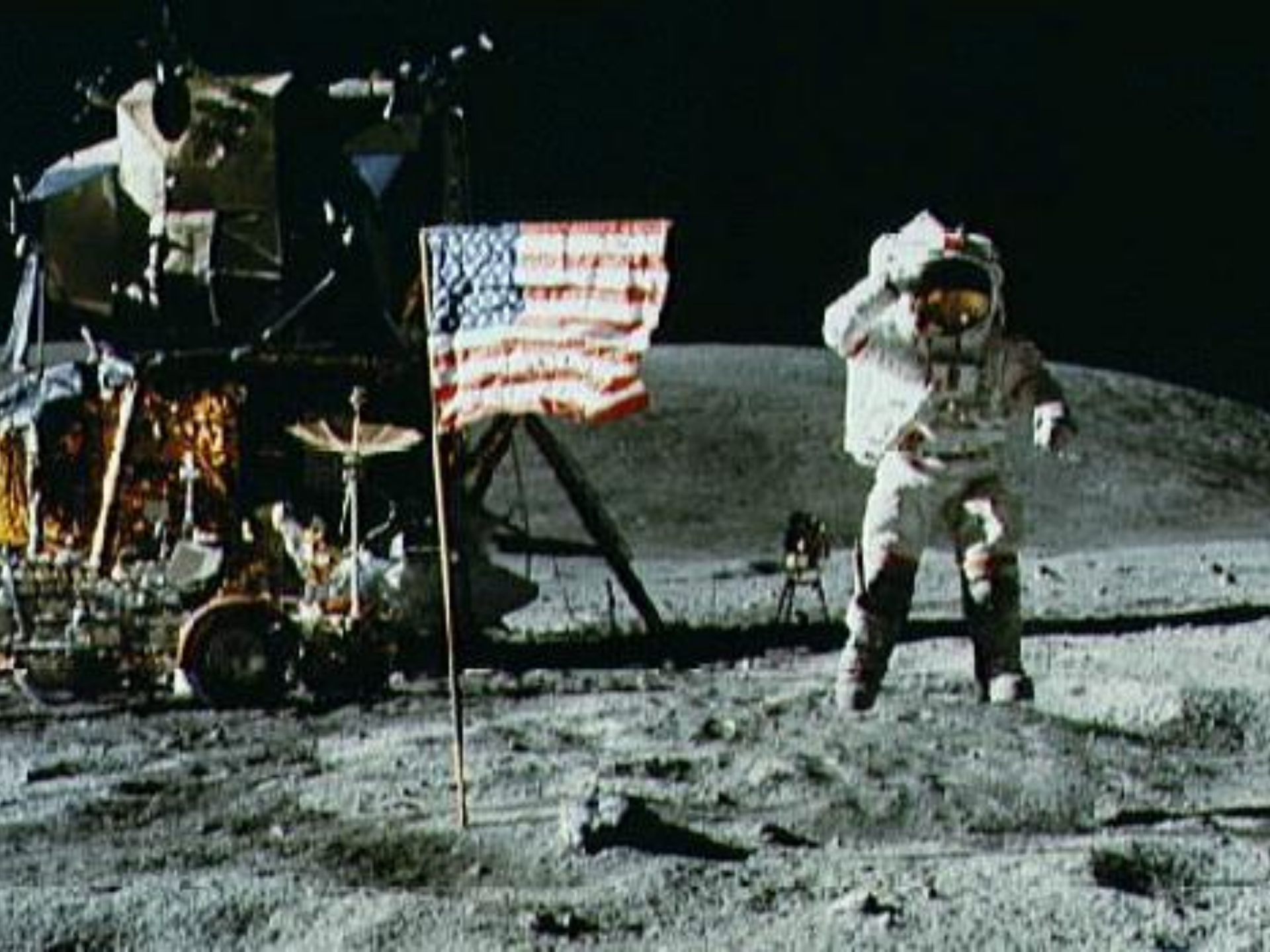
But this is a Long Story …






LFP
REAL MADRID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Relation and Logistics

TÉCNICO LISBOA

Nothing great was ever achieved without enthusiasm.

Ralph Waldo Emerson

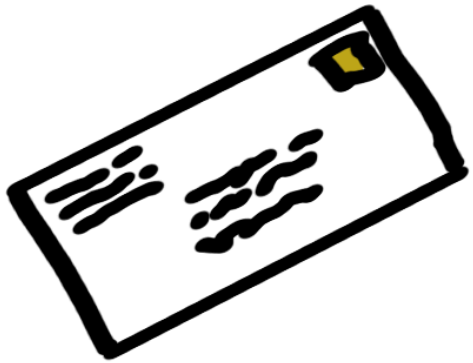
US essayist & poet (1803 - 1882)

Web Page and Mailing List

http:\\www.img.lx.it.pt\~fp\cav\Welcome_CAV.htm

To subscribe the course mailing list send a message to fp@lx.it.pt

Mailing list address: CAV_MEEC@lx.it.pt



Lectures Schedule

Theoretical Lectures

- 2 lectures of 90 minutes per week – Monday, 9.30am, room EA4, and Wednesday, 9.30am, room FA2

Practical Lectures (in weeks with no lab)

- 1 lecture of 90 min per week – Monday, 2 pm (room E1)

Laboratory Sessions (in weeks with no practical)

- 1 lecture of 90 min per week – Monday, 2 pm, room LT4

The weeks with practical lectures or lab sessions will be announced in the CAV mailing list.

Studying Material

Studying material made available consists in:

- **Book "Comunicações Audiovisuais: Tecnologias, Normas e Aplicações", IST Press, 2009 (details at the CAV Web Page)**
- **Slides from theoretical lectures (available at CAV Web Page)**
- **Additional supporting texts for each topic (available at the CAV Web Page)**
- **Collection of exercises with the corresponding solutions (available at CAV Web Page)**
- **Laboratory guides (available at CAV Web Page)**
- **Exams from previous years with solutions (available at CAV Web Page)**

Evaluation Method

The evaluation method includes four components (one opcional):

1. **WRITTEN EXAM**
   - After the end of the lecturing period (weight 70%) – *10th and 28th January 2020*;
2. **PROJECT** (in groups of 2)
   - About a selected topic; to be finished by *13th December 2019* (weight 30%) with a preliminary table of contents by *25th October 2019*
3. **ONLINE QUESTIONS AT THEORETICAL LECTURES (see next page)**
4. **LABORATORY PARTICIPATION** (in groups of 2)
   - Just filling a form during the laboratory session.

The final mark is computed as:

Final_Mark = round (0.7×Exam + 0.3×Project)

Evaluation Method: The Rules …

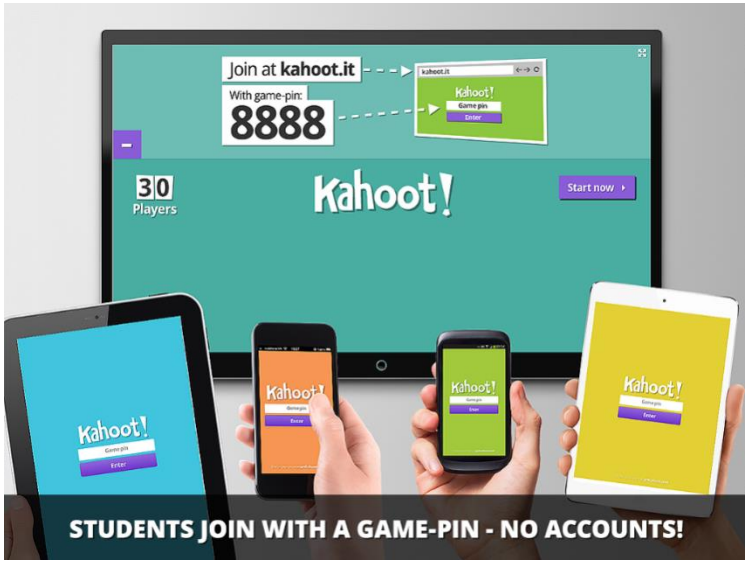
- **Written exam**
  - The minimum mark for the exam is **9.5**.
- **Project**
  - The minimum mark for the project is **9.5**.
  - The project should be made in groups of **2 students**.
  - The project mark is **individua**l even if the project is a group work.
  - The evaluation of the project may include a **self-assessment component**; it may also include a presentation and/or discussion, if found necessary.
- **Questions at theoretical lectures**
  - For the students who have answered more than 50%, 75% and 90% of the theoretical lectures short questions, the minimum marks for the exam and project are 9.0, 8.5 and 8.0, respectively.
- **Final mark**
  - The students who will answer above 75% of the theoretical lectures short questions with more than 75% correct answers (measured over the total questions at the lectures they were present), will get an **increase of the final mark resulting from the project and exam by 1 point**.
  - The students with a final mark higher than 17 may have to make an oral exam to confirm the mark; not making this oral exam, if requested, **implies getting a mark of 17.**

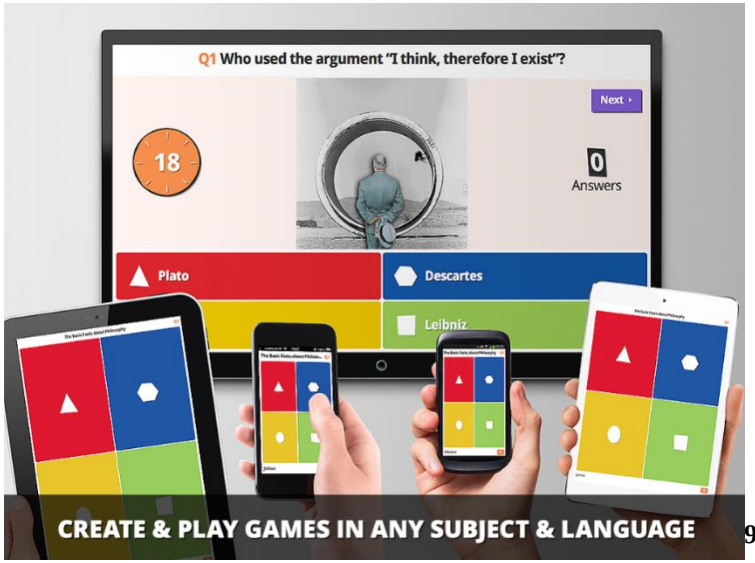
Evaluation Method: Project Self-Assessment

- By the project deadline date, each student (not each project) will provide to a previously identified student representative, his/her 'estimate' of the mark for his/her project. The professor will have NO access to these 'score estimates'.
- The professor will score the projects in a 0-20 scale.
- The students which estimated mark is **the same** as the professor's mark will get a **bonus of 1 point** in the project mark.
- The students which estimated mark is **± 1 point** regarding the professor's mark will get **a bonus of 0.5 point** in the final project mark.

Testing Kahoot Application

1. Pick your mobile phone or laptop
2. Enter in ***kahoot.it***
3. Insert the Game PIN
4. Use your student number as your ID
5. Choose an answer before the time is over
6. Check the result





About the Project

- **The project shall provide the most relevant information about a topic related to multimedia communication. The project content does not have to be original but should provide a good summary of the topic using appropriate references.**
- **The project targets to stimulate in the students the contact with bibliographical research and also with the reality including relevant products and companies.**
- **The project will be produced in two versions:**
  1. **Paper version** which shall not have more than **8 PAGES** using the template made available at the CAV Web Page.
  2. **Web version** with a similar content of the paper version but exploiting HTML capabilities typical of Web content, e.g. including video and audio material, and interactivity. *Must include a **3 minutes video** where the group summarizes the topic by just speaking (using at most one single slide).*
- **Deadlines**
  - **25th October 2019** – 2 pages pdf file (by email) with the paper table of contents (the topic should have been selected before)
  - **13th December 2019** – Paper (printed) and Web (by email) versions

Project: Example Topics

- YouTube
- Skype
- Netflix
- Spotify
- WhatsApp
- Amazon multimedia
- Facebook multimedia
- Over-the-top multimedia
- Multimedia in social networks
- Personal audiovisual communications
- Videosurveillance
- Tablets
- Royalty free video coding
- Visual description and searching
- Music description and searching
- Interactive TV
- Terrestrial TV
- UHD TV
- 3D TV
- Video in the cloud
- Internet video
- Mobile video
- 360 video
- Virtual reality
- Augmented reality
- Light fields
- Point clouds
- Holography
- Multimedia immersion
- …

Explaining the Project …

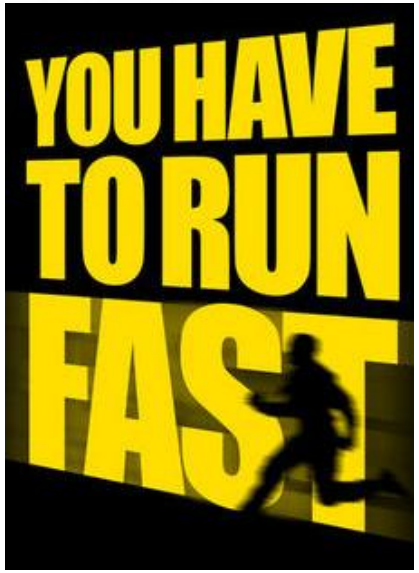
Today

2pm (room E1)

Students should register the project topic by sending an email to fp@lx.it.pt with the topic and the names and numbers of the students.

Lab Registration

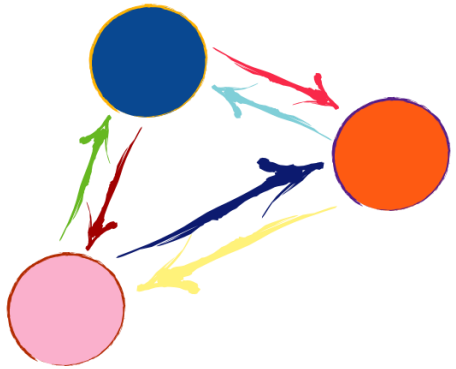
Monday, 2pm, room LT4



Send email to fp@lx.it.pt with (2 names+numbers)/group.

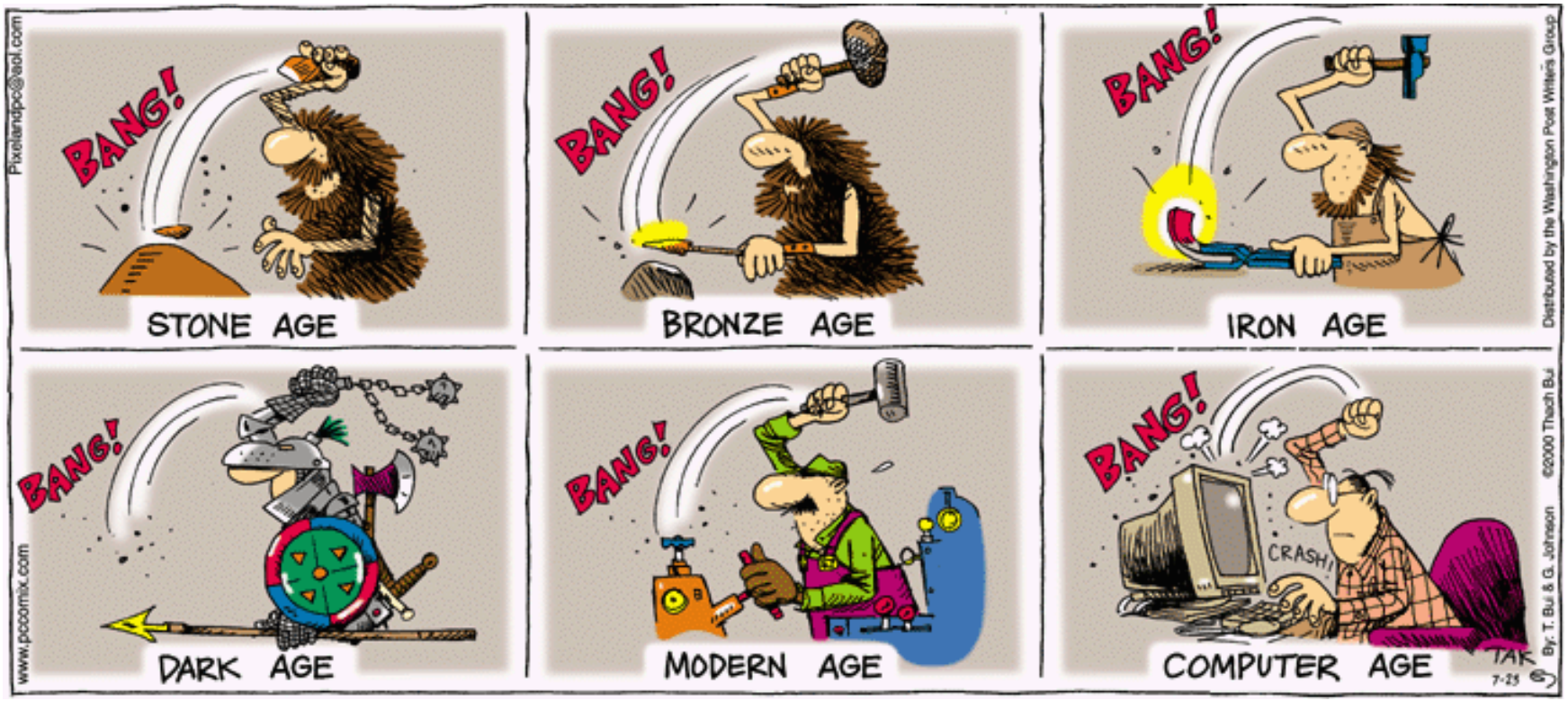
The Course Contents

Course Objectives



- To understand the main concepts and tools in video and audio representation, especially targeting compression
- To understand how the concepts and tools build complete solutions to address the needs and requirements of relevant applications
- To study some relevant compression solutions, both standard and non-standard based
- To discuss future trends in audio and video compression technology and services

Program: an Evolutive Perspective

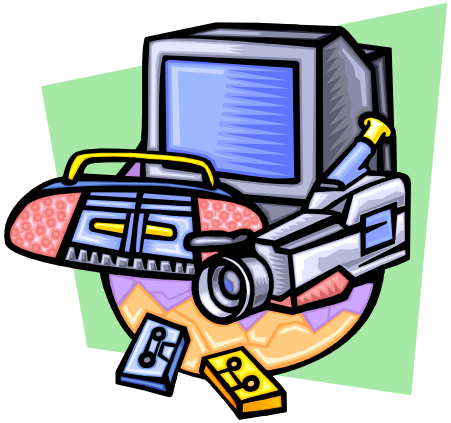


Program: a Summary

1. **Introduction to Audiovisual Communication**

2. **Audiovisual Representation Basics**

3. **Audiovisual Communication Systems**



3.1 Still imaging: 1st generation

3.2 Personal communications: 1st generation

3.3 Audiovisual storage: 1st generation

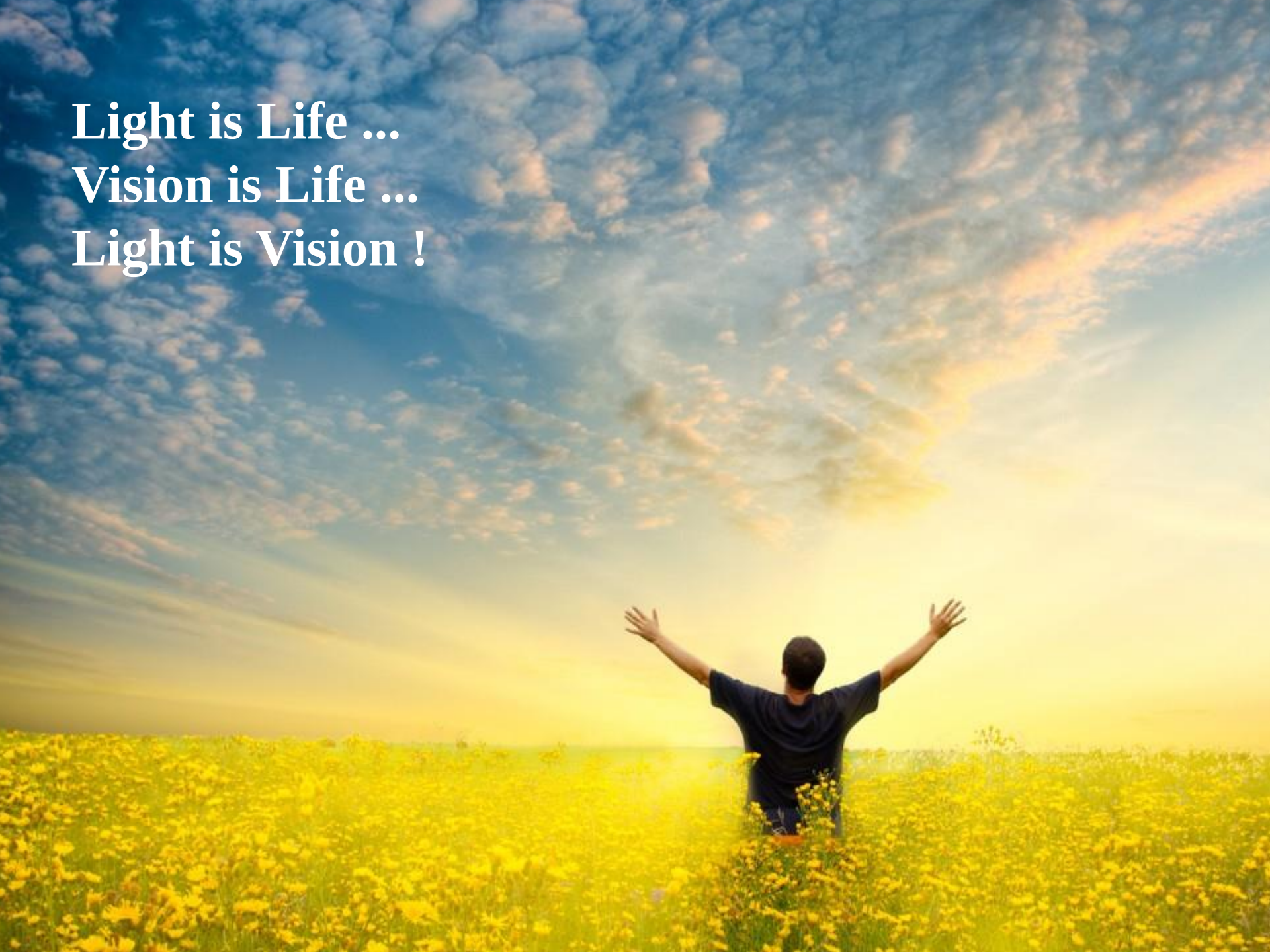
3.4 Digital television: 1st generation

3.5 Multi-application video coding: targeting HD and 4K

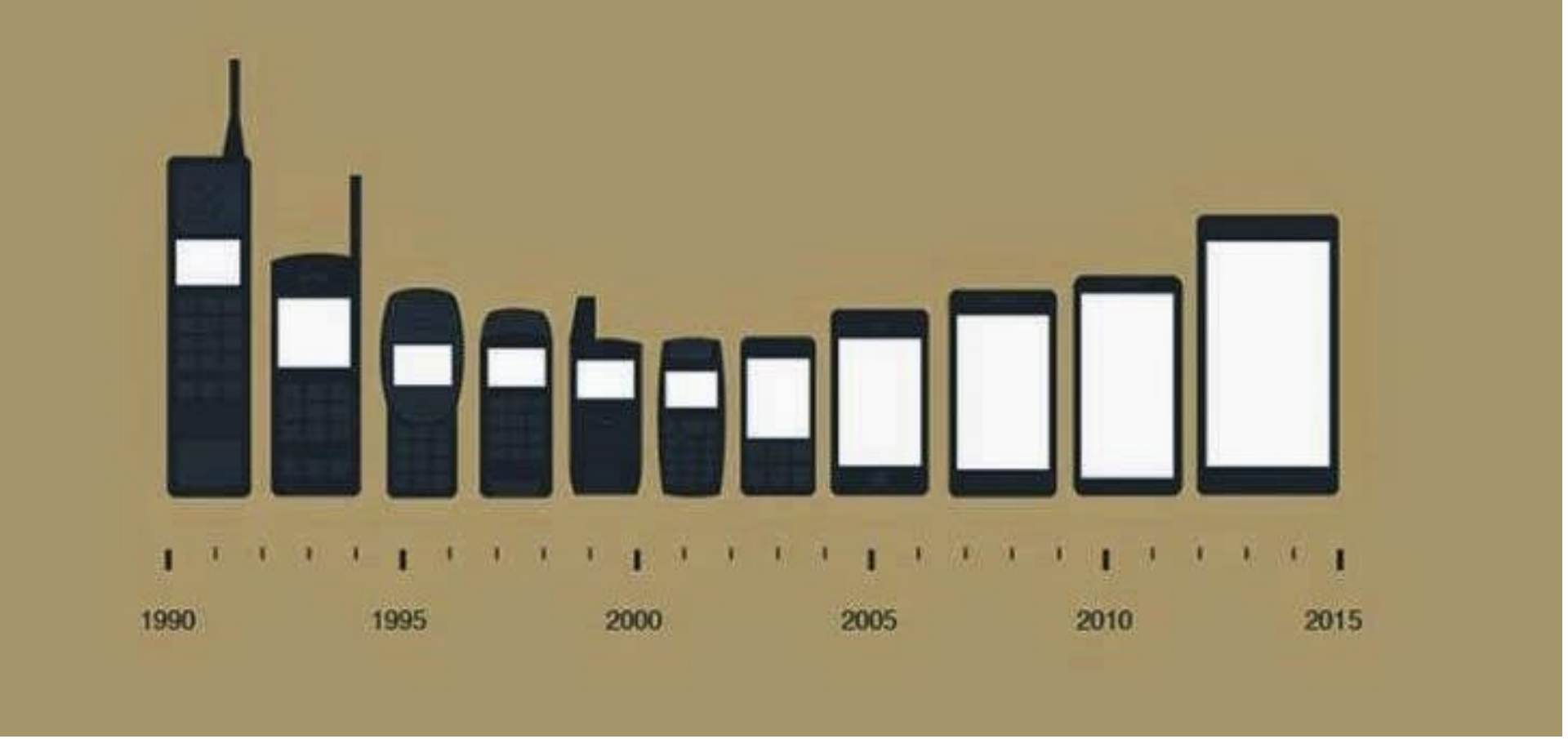
3.6 3D video: concepts, tools and systems

3.7 Virtual and augmented reality

The Course Content: a Quick Trip Around

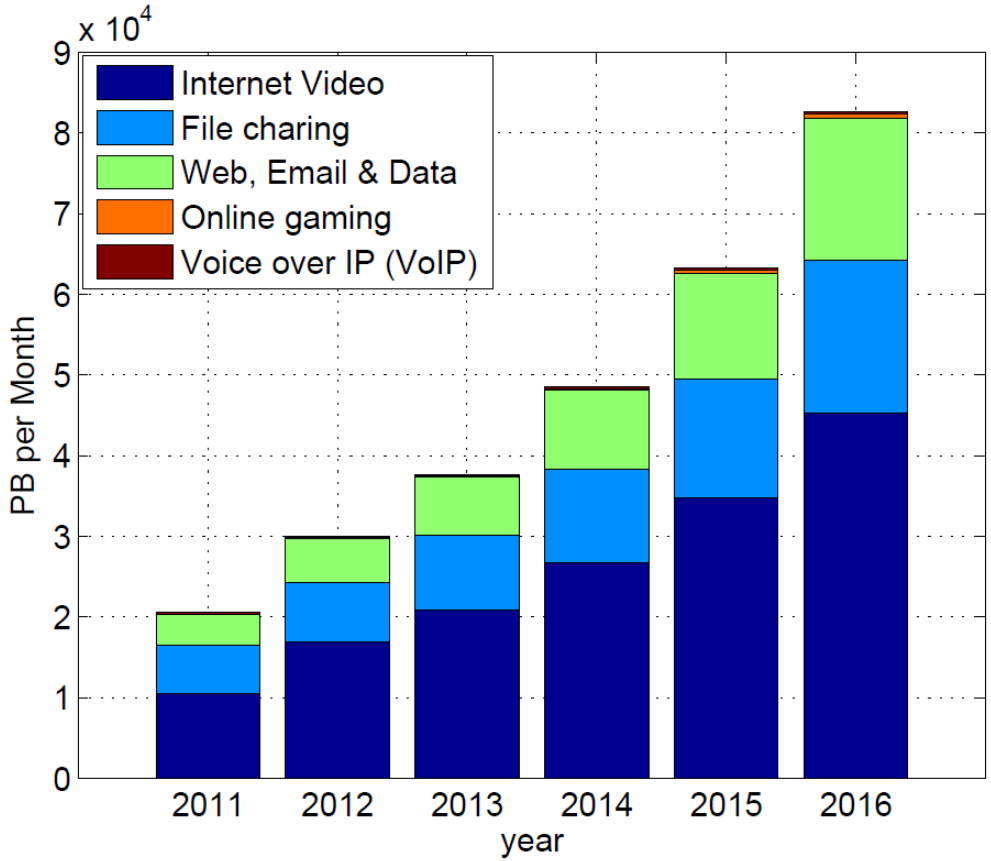

Light is Life ...
Vision is Life ...
Light is Vision !


Let’s replicate the world !



Any doubts on the real importance of image and video ?

Video Traffic is Exploding …



- **The sum of all forms of IP video will ultimately reach 86% of total IP traffic.**
- **Only Internet video (excluding file sharing and gaming) will account for 55% of consumer Internet traffic in 2015.**
- **Every second, 1.2 million minutes of video content crossed the network in 2016.**

from Cisco Visual Networking Index (VNI), Tech. Rep., 2012

Audio and Video Communication

Transference of image, audio and video information through space, time, or space and time simultaneously.

facebook

flickr

YouTube
Broadcast Yourself

The Importance of the User …

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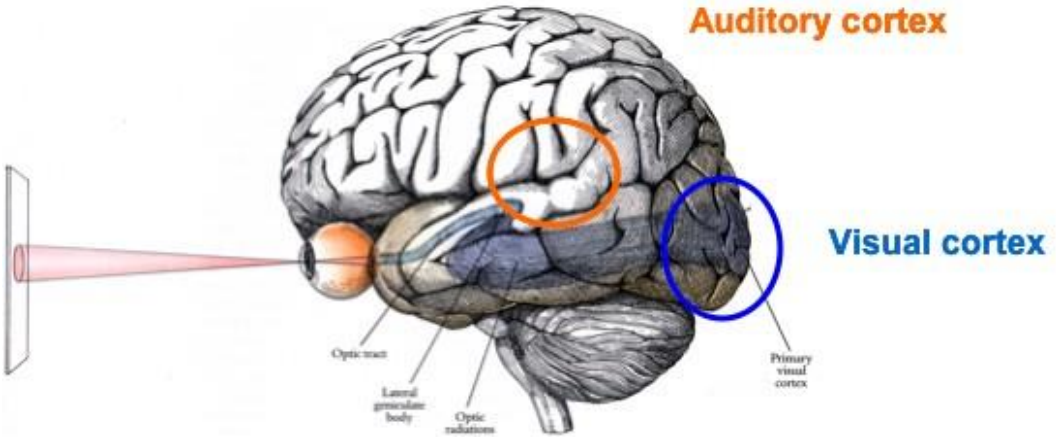
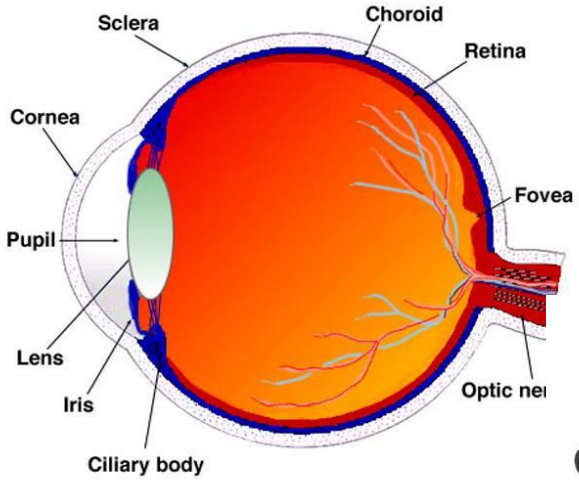
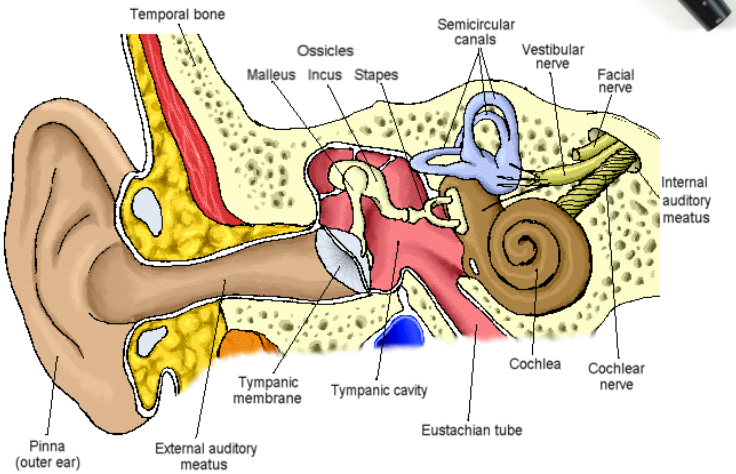
We All Communicate …

Sensations, Perceptions and Emotions …







Communicating Since a Long Time Ago …

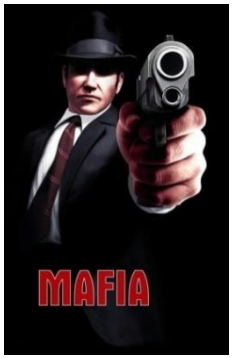
And After Telecommunicating …

What do the Users Want ?

- Information
- Entertainment
- Communication
- Games
- Education
- Shopping
- …

How can Clients be Convinced ?

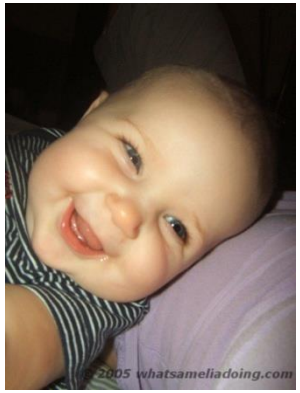
- Satisfaction of personal needs
- Added value, new capabilities
- Interoperability
- Quality and robustness
- Content variety
- (Low) cost of equipment and usage
- Easy usage
- …



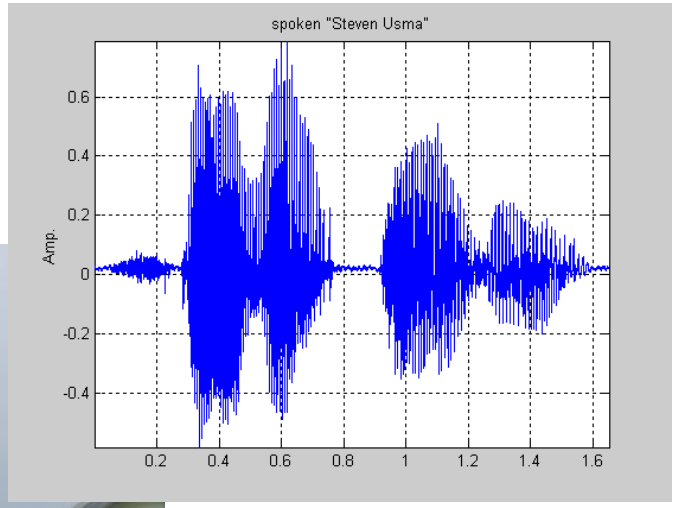
Satisfaction: Quality versus Service

The minimum required quality of service/experience depends on the service:

- **Videotelephony**
- **Videoconference**
- **Television**
- **High definition digital television**
- **Ultra high definition television**
- **3D TV**
- **…**



An Analogue World …

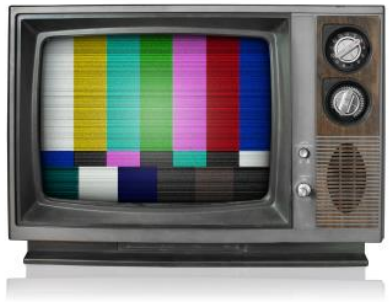


Analogue Communications World …

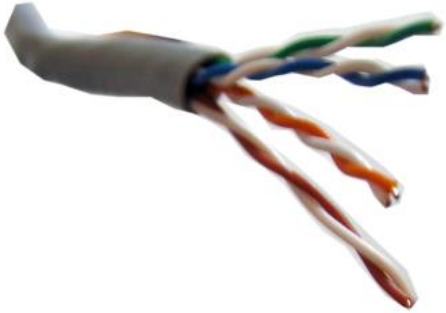
±1880

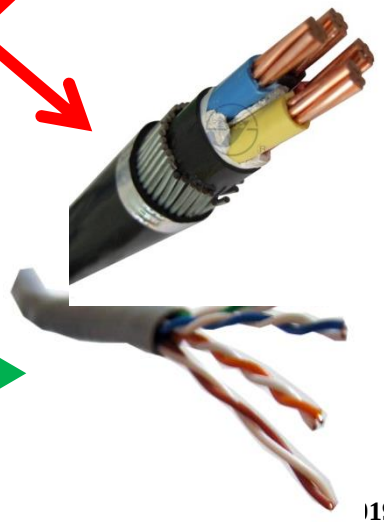
±1905

±1920

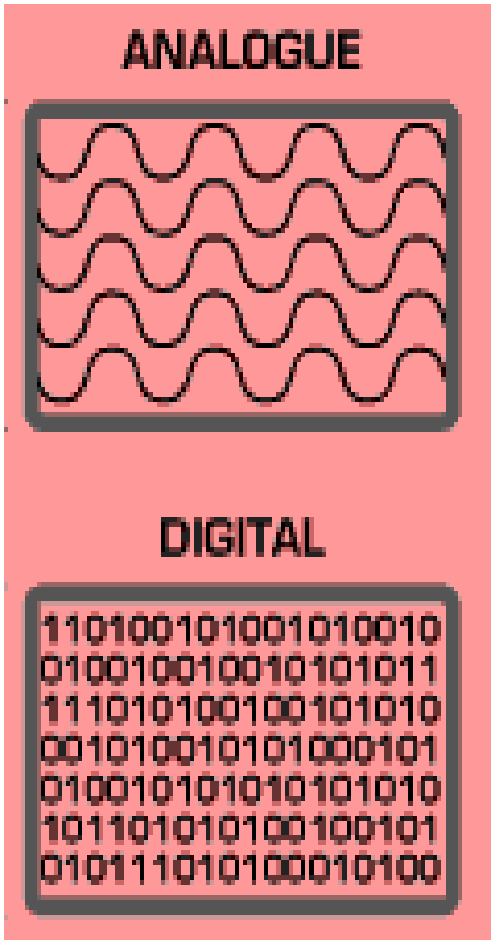


The World is Made of Change…





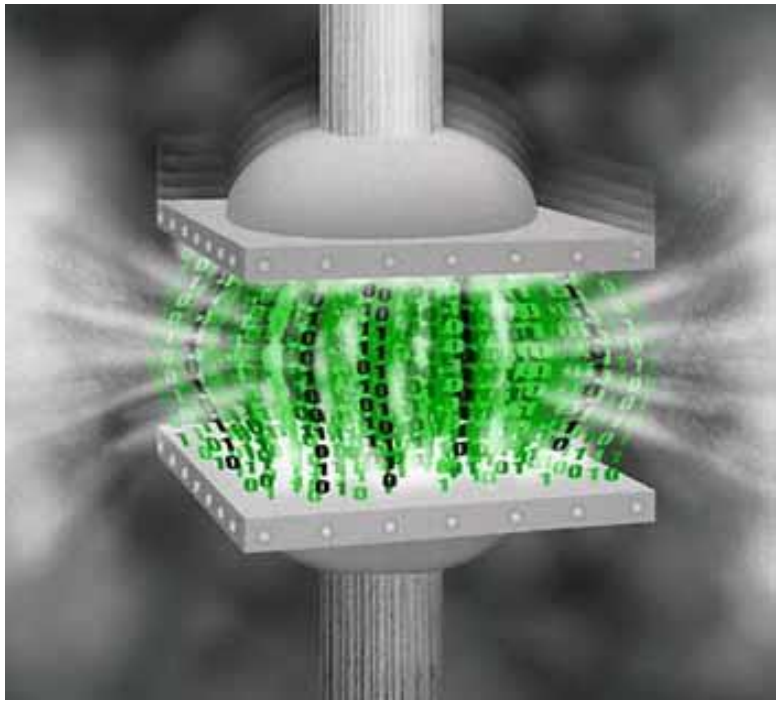
Bit Jumping …


ANALOGUE
DIGITAL
11010010100101001010
01001001001010101011
11101010010010101010
00101001010100010101
01001010101010101010
10110101010010010101
01011101010001010100

Many, Really Many, Bits …

- **Speech – 2×4000 samples/s with 8 bit/sample – 64000 bit/s = 64 kbit/s**
- **Music – 2×22000 samples/s with 16 bit/sample – 704000 bit/s=704 kbit/s**
- **Video – (576×720+2×576×360)×25 (20736000) samples/s with 8 bit/sample – 166000000 bit/s = 166 Mbit/s**
- ***Full HD* 1080p - (1080×1920+2×1080×960)×25 (103680000) samples/s with 8 bit/sample – 829440000 bit/s = 830 Mbit/s**

We Need a Miracle !



Digital TV: Only an Example

- **ITU-R 601 standard: 25 images/s with 720 × 576 luminance samples and 360 × 576 samples for each chrominance, at 8 bit/sample**

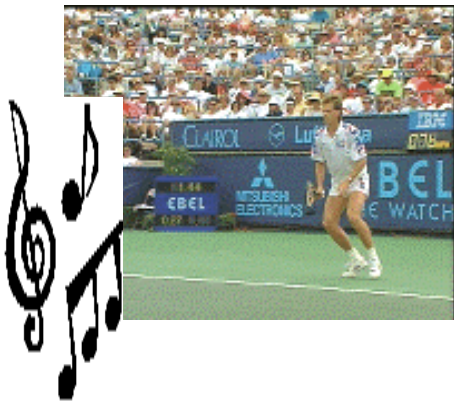
$$[(720 \times 576) + 2 \times (360 \times 576)] \times 8 \times 25 = \mathbf{166\ Mbit/s}$$

- **Practical bitrate with H.264/MPEG-4 AVC codec: 2 Mbit/s**

=> Required Compression Factor: 166/2 ≈ 80

The difference between compressing or not implies the existence or not of many largely used services.

The Compression Miracle …



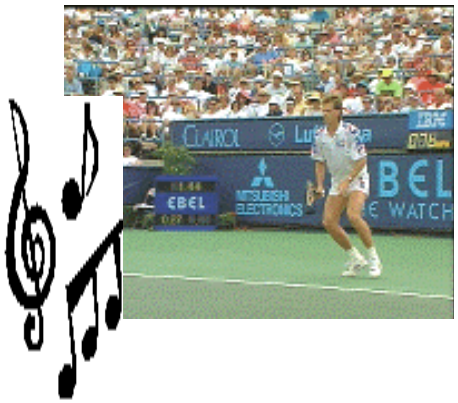
Non Compressed Bits

Encoder

Compressed Bits

Much less bits !!!

Decoder



The Consequences of the Miracle (1) …

The Consequences of the Miracle (2) …

Multimedia Data is Exploding …

- 300 hours of video are uploaded to YouTube every minute
- There are 3.25 billion hours of video watched each month
- More than half of YouTube views come from mobile devices
- The average mobile viewing session lasts more than 40 minutes
- On average, there are 1,000,000,000 mobile video views per day
- The time people spend watching YouTube on their TV has more than doubled in the last year
- 6 out of 10 people prefer online video platforms to live TV
- You can navigate YouTube in a total of 76 different languages (covering 95% of the Internet population)


TRIDELITY


10
10


360°
HOMIDO
VR 3D Glasses supported
VIDEO 360
Windows Apps

From Hunger to Plenty or Drowning in Data ...

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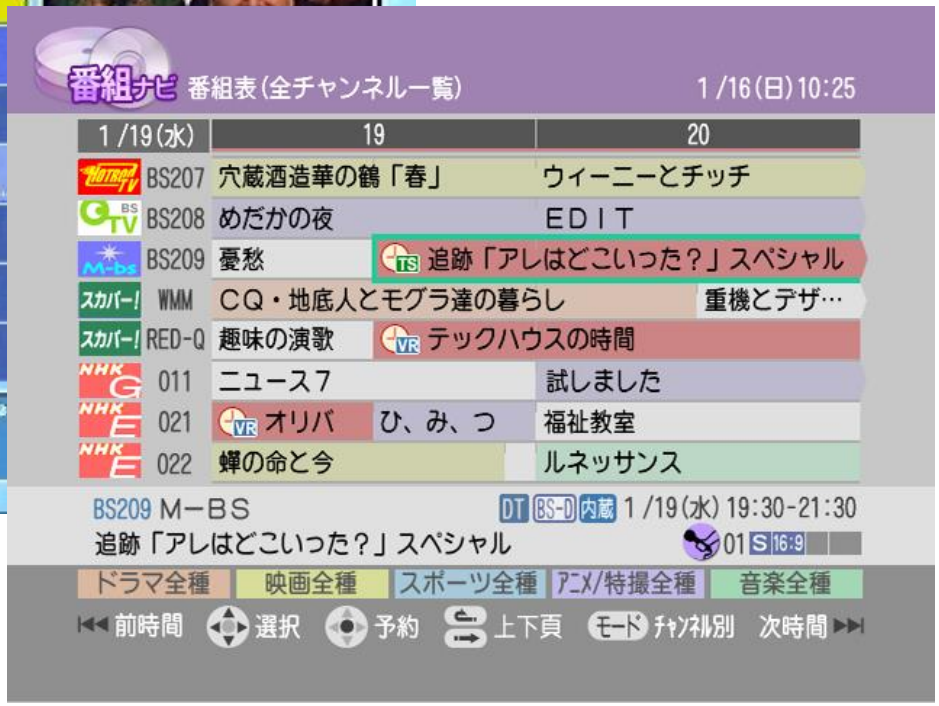
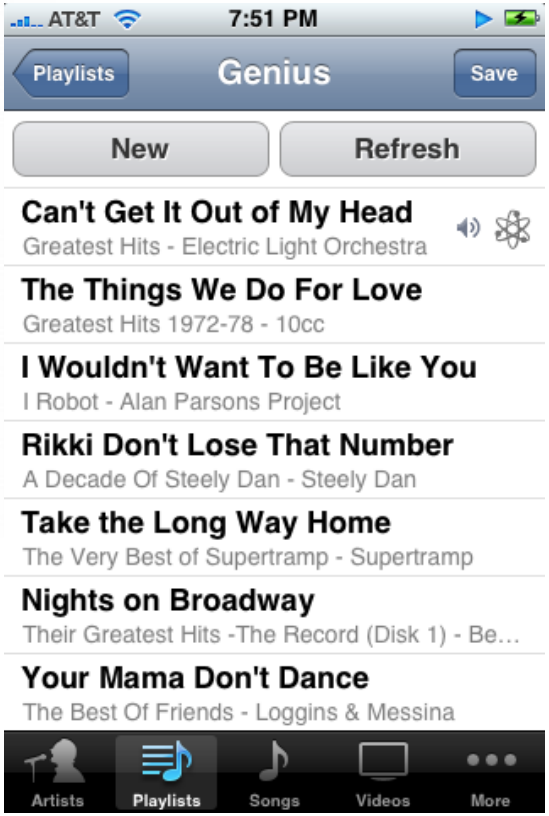
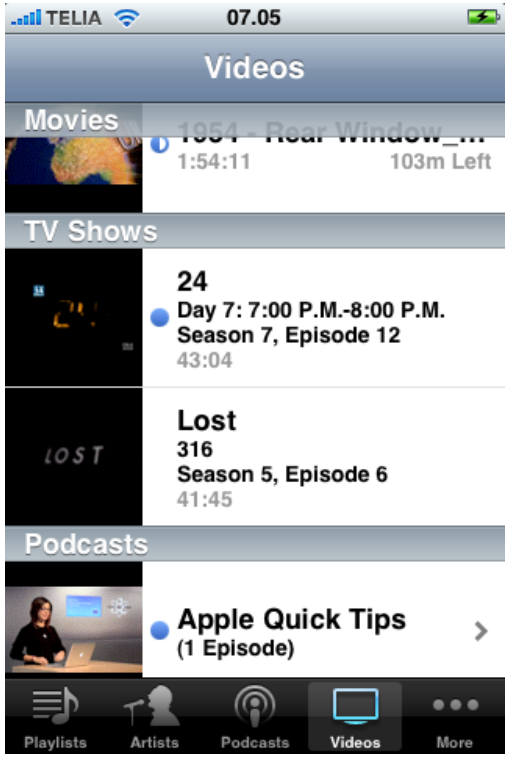
Filtering TV …



Managing iPods Data …





Data and Metadata Make a Great Couple ...

Digital is Easy: The Piracy Effect

Patents and Copyright …

Intellectual property (IP) enjoys legal protection and stems from the exercise of the mind. IP regards patents, trademarks, copyright, design protection and some minor rights.

- **A patent for an invention is granted to the applicant, and gives him the right for a limited period to stop others from making, using or selling the invention without permission.**

- **Copyright is a legal right (usually of the author or composer or publisher of a work) to exclusive publication production, sale, distribution of some work.**

Business Model: The Key to Success ...

A business model is the method of doing business by which a product/service can sustain itself - that is, generate revenue.

Some business models are quite simple. Other models can be more complex such as free television. The broadcaster is part of a complex network of distributors, content creators, advertisers, and listeners or viewers. Who makes money and how much is not always clear at the outset.

- Digital representations and networks give rise to new kinds of business models, since acquiring, transmitting, and storing information (now just bits) became much easier.
- But it is also likely to reinvent 'old' models such as auctions. New and interesting variations of old models should be expected in the future.

Multimedia in Portugal

- **It is today much easier than before to create and sell multimedia related products and services (mainly software based).**
- **Internet helps the success of small, innovative companies created without much investment.**
- **The competition between companies may stimulate also the operators to more easily embrace more innovative challenges.**
- **Users are increasingly open to new services.**
- **International contact is changing old habits and prejudices …**

In summary, multimedia technology is an interesting field for Portuguese young engineers with initiative to launch their own companies !