Computer Science Applications to Cultural Heritage

Introduction
About this course

Official UNIVE course page:
http://www.unive.it/data/course/281949

Unofficial course page:
http://www.dsi.unive.it/~bergamasco/csa2ch_2018_2019.html

• 48 hours frontal lessons

Timetable:
– Monday 14:00 - 15:30 (Aula B)
– Tuesday 15:45 - 17:15

• Code: CM0512
About the teacher

Filippo Bergamasco

http://www.dais.unive.it/~bergamasco

• I’m currently a postdoctoral research fellow at DAIS (Dipartimento di Scienze Ambientali, Informatica e Statistica)
• Member of the KiiS research group. Research interests: 3D reconstruction, camera calibration, ego-motion estimation, photogrammetry etc.
About the teacher

Filippo Bergamasco

http://www.dais.unive.it/~bergamasco

Currently teaching:

- This course (of course :)
- Computer Vision
- Tecnologie e applicazioni web

Previously:

- Discrete Mathematics
- Matematica di base
- Master Digital Humanities
About the teacher

Filippo Bergamasco

http://www.dais.unive.it/~bergamasco

For any question regarding this course, please contact me via mail: filippo.bergamasco@unive.it

Or come visit me at my office (Building Z, Room 7)
Referral Texts

- Alfredo M. Ronchi, "eCulture: Cultural Content in the Digital Age", Springer-Verlag Berlin Heidelberg, 2009
  (DOI: 10.1007/978-3-540-75276-9)
Referral Texts

  (DOI: 10.1007/978-3-319-05290-8)
Referral Texts

  (DOI: 10.1007/978-1-4471-5601-7)
Final assessment will be in the form of a written exam with 6 open questions (one optional)

- Questions can comprise all the topics discussed during the course
- Some questions may require solving short exercises (especially regarding databases or metadata)
- Evaluation is valid indefinitely (1 year guaranteed, following years may depend to possible different Professors)
“ICTs are the most powerful means to produce, preserve and communicate the fruits of human creativity, including information, know-how, knowledge, and works of art.”

Passage from the “Vienna Conclusions” of the conference “ICT and Creativity: Towards a Global Cooperation for Quality Content in the Information Society”, held in Vienna, Austria, 23 June 2005
Why this course?

We won’t restrict on the mere information and communication technologies, but on a broader range of computer science applications, to:

- Acquire
- Analyze (to extract knowledge!)
- Visualize and disseminate

...fruits of human creativity, which will be generally referred in this course as content
Before looking in depth at the relationship between cultural heritage and computer science/technology, we should try to define which class of objects (content) we associate with the words “cultural heritage”.

Works of art typically associated with “cultural heritage”:  
• Paintings  
• Frescoes  
• Sculptures  
• Monuments
However, most cultural heritage consists of “minor” cultural and artistic objects, such as medals, coins, plasters, silver, furniture, musical instruments, knick-knacks, ethnographic collections, etc.

...To which we can also add:

- Movies and TV recordings
- Pictures
- Speech/Recordings
- Etc.
Content and cultural heritage

Cultural heritage should be considered to be the sum of the experiences that shaped a society...

... and so it should include a broad range of content from different domains.
Tangible/Intangible heritage

At a higher level, we can divide the cultural heritage to **tangible** (like tangible objects and works of art we listed before) and **intangible** which is transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment and **provides** them with a **sense of identity** and continuity, thus promoting respect for cultural diversity and human creativity.
Intangible heritage: a definition

The **practices, representations, expressions**, as well as the knowledge and skills, that communities, groups and, in some cases, individuals recognise as being part of their cultural heritage

**Synonym: living cultural heritage**

Comprise the following domains:

- Oral traditions and expressions, including language as a vehicle of intangible cultural heritage
- Performing arts
- Social practices, rituals and festive events
- Traditional craftmanship
- etc.
Intangible heritage

Safeguarding intangible cultural heritage is a critical aspect which can take great advantage of computer science applications, including methods and technologies to:

- Identify
- Document
- Research
- Preserve
- Promote
- Transmit

...such kind of content
Heritage taxonomy

- **Heritage**
  - Cultural Heritage
  - Mixed Heritage
  - Natural Heritage
    - Tangible Heritage
      - Immovable
    - Intangible Heritage
      - Movable
Content and the digital age

Over the centuries, mankind has produced an ever-increasing amount of content in multiple formats, using multiple techniques and technologies.

- Some content becomes obsolescent and disappears
- Some content will survive to become our legacy to future generations

How is it has been typically preserved?

- Oral traditions
- Performing arts and rituals
- Signs, symbols, ideograms and alphabets (written)
The printing press was one of the last true revolutions in content management as it enabled the unlimited reproduction of texts at limited cost.

Today we are facing a new revolution (even bigger than the printing) thanks to the Digital Age.

Digital Age enables not only the reproduction, but also the transfer, dissemination, analysis, and preservation of the content.
Computer Science applications

Computer Science is the driving force of this digital revolution and can be effectively used to assist and enhance the three main activities usually associated with cultural heritage:

- Conservation
- Research
- Exploitation
The path from the “originals” to the dissemination and exploitation of cultural content through ICT usually starts with the creation of so-called digital originals via digitisation.

The first part of this course will be devoted to the acquisition (digitization) of the content to different media:

- Text
- Images
- Audio
- Video
- 3D shapes
Course syllabus

One of the main applications of computer science to cultural heritage concerns the selection of appropriate filing systems and data structures.

The second part of this course will be devoted to the storage and organization of the digitized content:

- **Databases**
  - Relational
  - Object oriented
  - GIS
- **Metadata**
  - Ontologies
Probably the most important aspect of computer science is in the (possibly automatic) extraction of knowledge from data collections.

The third part of the course will give a practical overview of data science applications:

- **Data Mining**
  - KDD
  - Supervised/Unsupervised learning
- **Analysis**
  - Visualization
  - Inference
Finally, recent advances in multimedia technologies can improve the way in which content is exploited and disseminated for future generations.

The last part of the course will explore fruition and advanced visualization of cultural heritage content and knowledge, including:

- Web technologies and mobile apps
- Computer graphics
- Virtual and Augmented Reality
- Serious games
Case studies

Omeka is an open-source CMS for online digital collections (like wordpress for museums)

http://omeka.org/
Project Gutenberg is a volunteer effort to digitize, archive and distribute cultural works, to encourage the creation and distribution of eBooks.

https://www.gutenberg.org/
Case studies

Founded in 1971 by Michael S.Hart, it is the oldest digital library!

Contains over 57000 full-text e-books.
Case studies

Google Cultural Institute is "an effort to make important cultural material available and accessible to everyone and to digitally preserve it to educate and inspire future generations."

https://www.google.com/culturalinstitute/about/partners/
Case studies

One interesting part of Google Cultural Institute is the **Google Arts and Culture** (formerly Google Arts Project) which is an online platform to access high-resolution artworks hosted by a network of partner museums.

[https://www.google.com/culturalinstitute/beta/?hl=it](https://www.google.com/culturalinstitute/beta/?hl=it)
Case studies

Mapping Paintings is a geographical database to explore the provenance records of paintings. The trajectory of each painting across time and space can be viewed in dedicated pages or on a map

http://www.mappingpaintings.org
Ca’ Foscari case studies

Interactive tables developed by the computer vision group for the Ca’ Foscari exhibition “William Congdon in Venice (1948-1960): An American Look” – May 2012
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Scanning of a limestone Roman sundial discovered in Aquileia (Italy) at the end of the 19th century.
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Ca’ Foscari case studies

Sundial reverse engineering (ie. Recovering the gnomon shape and its most probable geographic position)
Ca’ Foscari case studies

Georeferencing historical maps

Bergamasco F, Traviglia A, Torsello A, «Saliency driven variational retargeting of Historical Maps», VISART IV, 2018
History

In February 1995, the European Commission organised the first meeting on the Information Society, in Brussels.

11 pilot projects was approved:

1. Global Inventory (of projects)
2. Global Interoperability
3. Cross-Cultural Education and Training
4. Bibliotheca Universalis
5. Multimedia Access to World Cultural Heritage
6. Environment
7. Global Emergency
8. Government Online
9. Global Healthcare
10. Global Marketplace for SMEs

The aim of these projects was to trace the guidelines of the Information Society.
History

Later on, in June 1995, a worldwide G7 summit approved and adopted such projects

In May 1996, during the *Information Society and Developing Countries* conference, held in South Africa, 4 demo projects were selected representing the four principal sections identified by the project *Multimedia Access to World Cultural Heritage*:

- 3D Acquisition, a laser camera presented by the National Research Council, Ottawa;
- Filing, of the Museo di Storia della Scienza in Florence;
- Visualisation of the Nefertari Tomb, developed by Infobyte, Rome;
- “SUMS” Navigation, developed by SUMS Corporation, Toronto.
In 1997, a new “agency” called the MEDICI Framework was launched with the goal of promoting the use of advanced technologies to access, understand, preserve and to promote the economics of cultural heritage. (Partnership with the European Council)

The MEDICI Framework closely cooperated with the World Wide Web Conference initiative exploring how multimedia technology could be employed to improve the way that visitors presently perceive a visit to a museum or art gallery.
History

In 1999, the event “Culture Counts Financing, Resources and the Economics of Culture in Sustainable Development” took place in Florence.

The main focus of the conference was economics, but related concepts such as sustainability, access and the digital divide were also considered and discussed in depth too.

Specific emphasis was placed on archives, because both current records and historical archives document the actions of individuals and states.
History

In 2000, delegates of the European Council launched a guideline document entitled e-Europe containing guidelines with the following objectives:

- To bring every citizen and every business and administration into the digital age, and enabling them to get online
- To create a digitally literate Europe supported by an entrepreneurial culture that is ready to finance and develop new ideas;
- To ensure that the whole process is socially inclusive, building consumer trust and strengthening social cohesion.
More recently, a number of different global initiatives aimed at predicting and possibly solving different problems related to the provision of universal access to information have been further activated, including:

- UNESCO’s Intangible Heritage Task Force
- UNESCO OCCAM’s Infopoverty Programme
- World Summit on the Information Society (WSIS)
- The creation of the Global Alliance for ICT and Development (GAID)
- Many more...