
Visual Computing *- Course Presentation -*

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Overview

- Motivation
- Tentative syllabus
- Evaluation
- Class organization
- Some useful books

MOTIVATION

What is Visual Computing ?

- Did you watch the **videos** ?

What is Visual Computing ?

- Generic term for computer science disciplines handling **images** and **3D models**
- I.e., **computer graphics**, **image** and video **processing**, visualization, computer vision, virtual and augmented reality
 - Common algorithms, methods and applications
- Core challenges are the **acquisition**, **processing**, **analysis** and **rendering** of visual information

[Wikipedia]

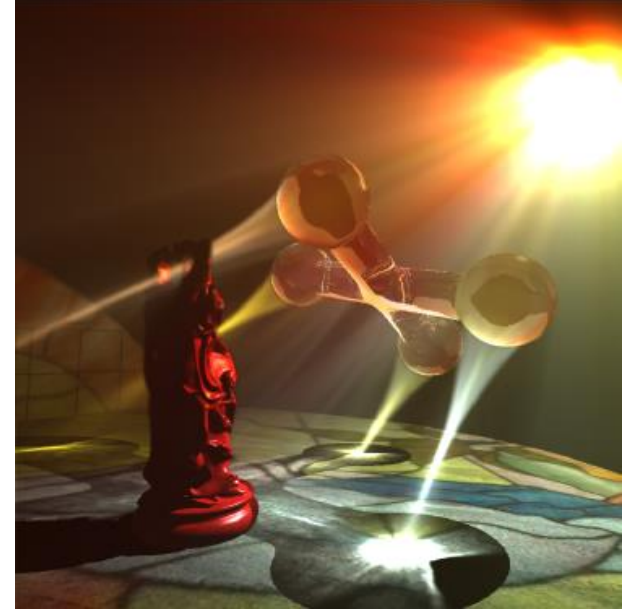
What is Visual Computing ?

- Visual imagery
 - Most important **sensory information** for humans
- Use computers for
 - Image **acquisition**
 - Image **analysis**
 - Image **synthesis**

Application Examples



Realistic image synthesis



Global illumination effects



Reflection editing

[<http://www.master-visual-computing.de/>]

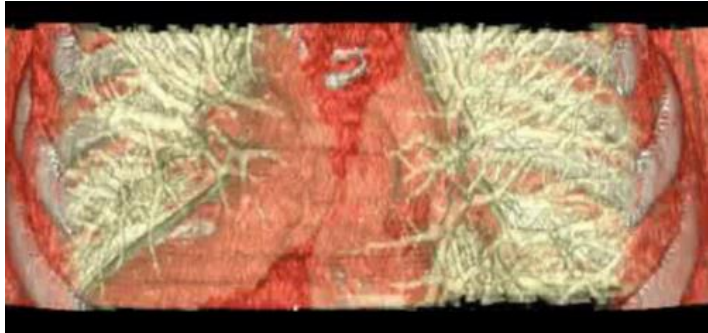
Application Examples

- From **real-world** images to synthetic **models**



[<http://www.master-visual-computing.de/>]

Application Examples



Data Visualization



Internet Security



Virtual / Augmented Reality

Application Examples

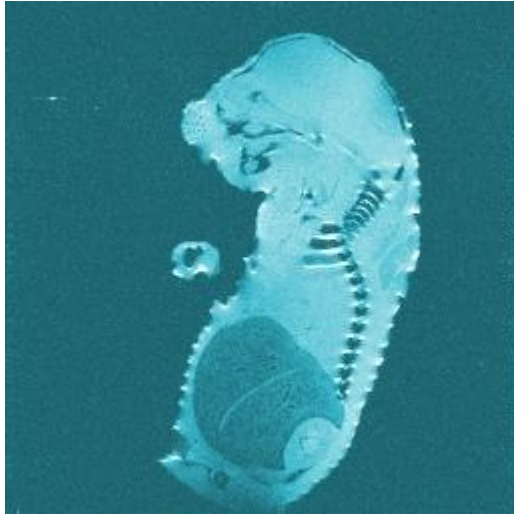


Image Acquisition (MRI)

Image Deblurring

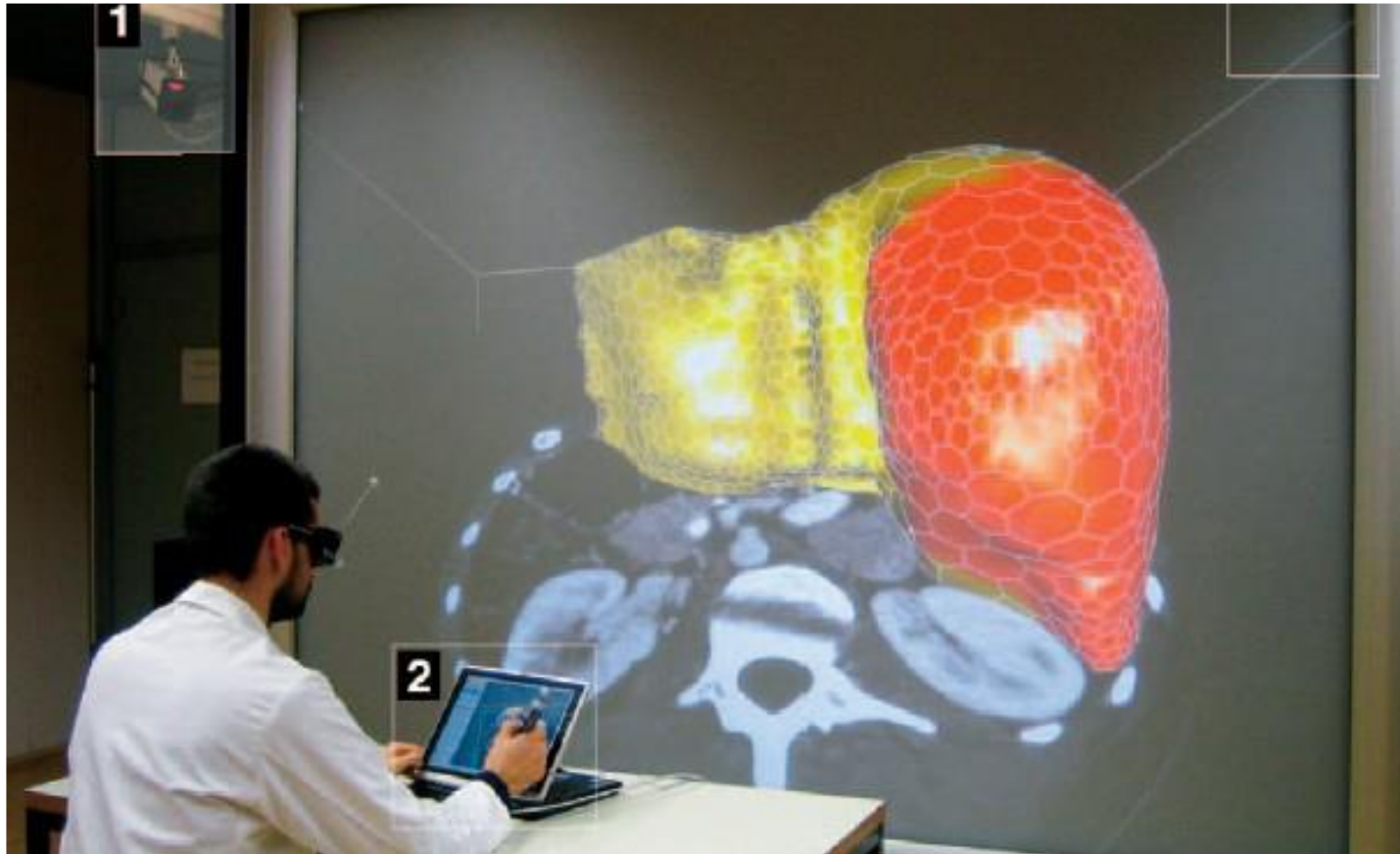


[<http://www.master-visual-computing.de/>]

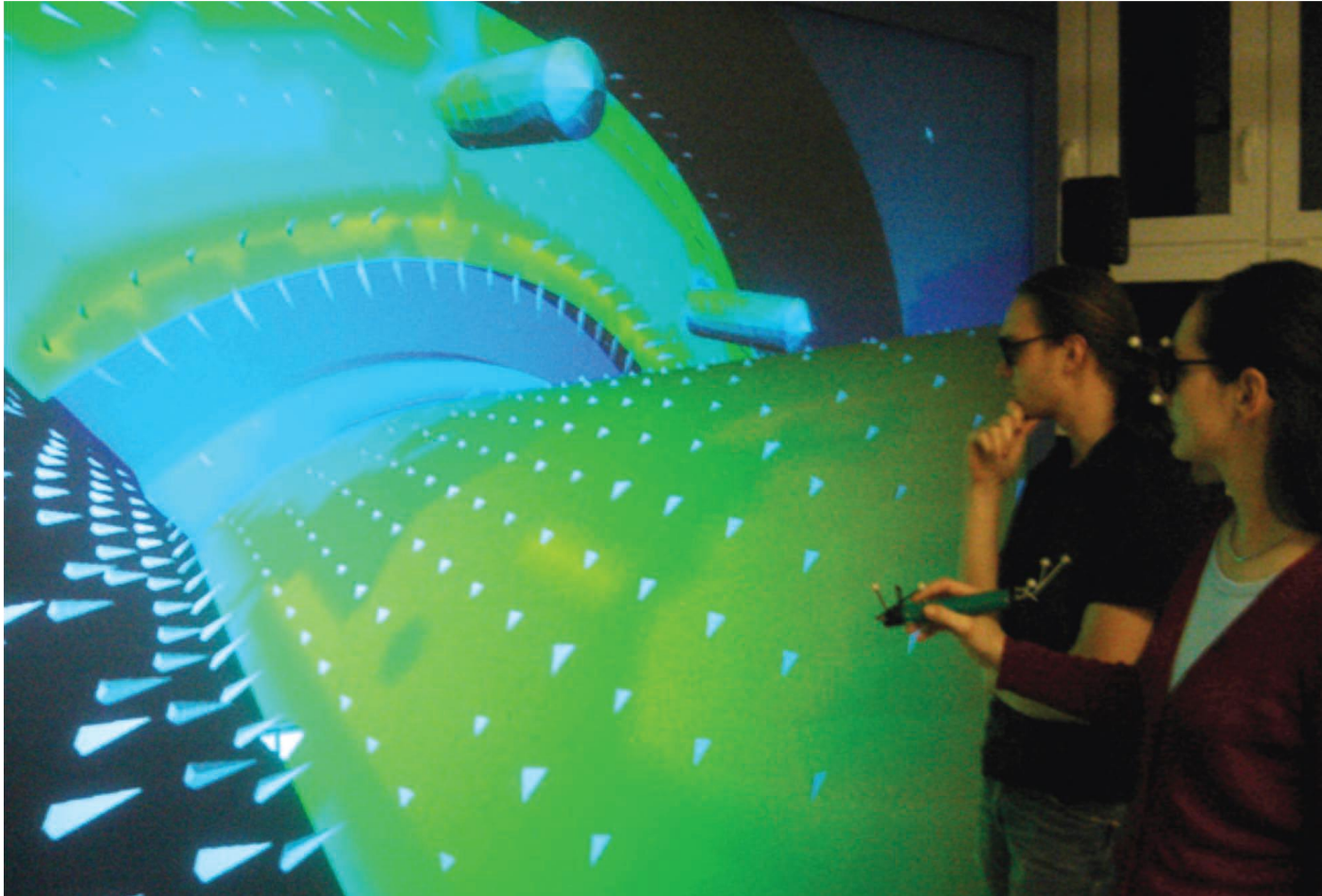
What is Visual Computing ?

- Digital Images / Models
- Visual Simulations
- Interdisciplinary area
 - Computer Science / Mathematics / Physics / Cognitive Sciences / ...

Medical Visualization



VR / AR Visualization



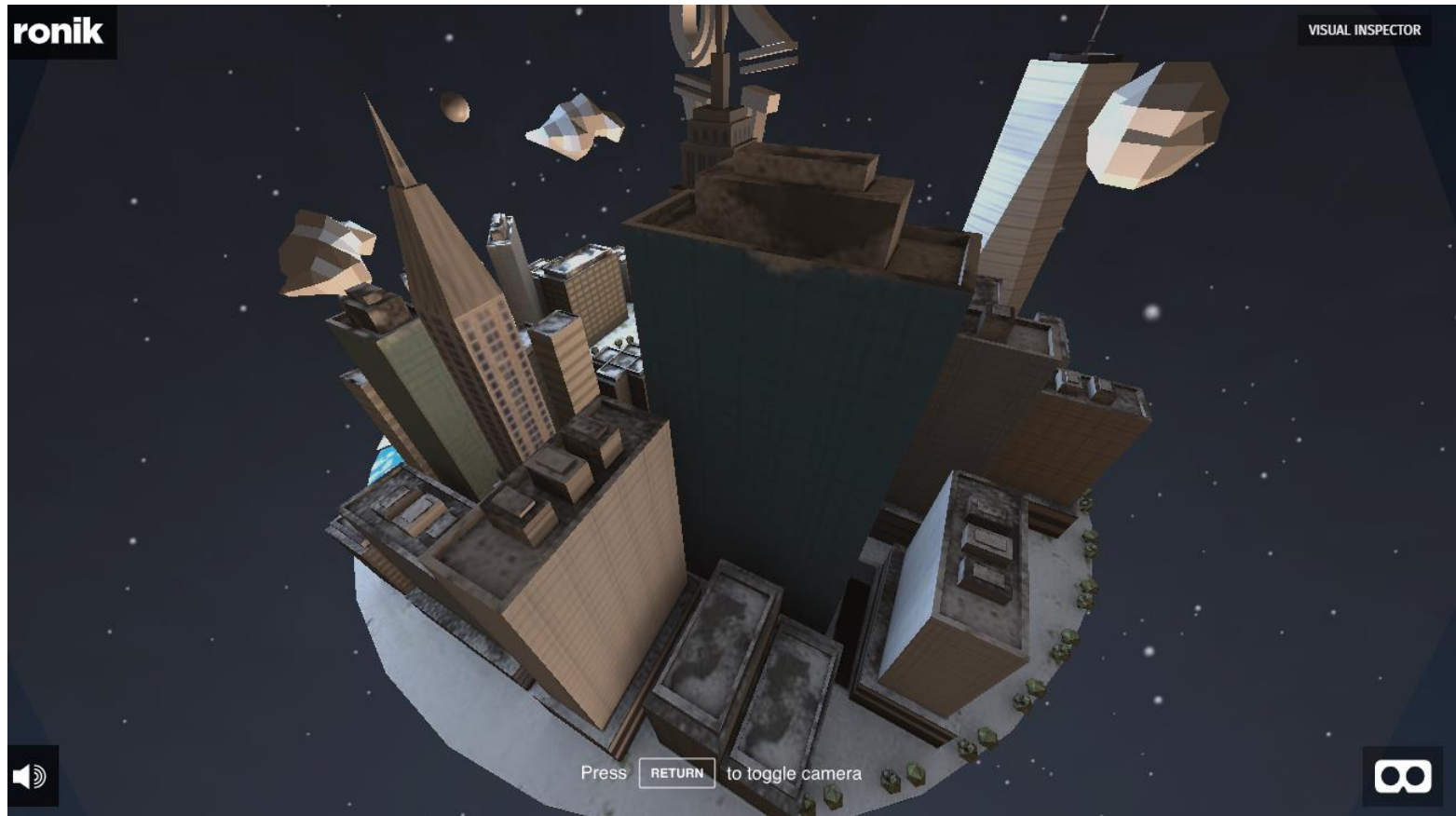
[Weidlich et al, 2008]

Mobile Graphics



[SIGGRAPH Asia 2017 Course Notes]

Web-based VR



<https://aframe.io/examples/showcase/snowglobe/>

Reconstructing Ancient Sculptures



[\[https://spectrum.ieee.org/computing/software/ancient-sculptures-return-to-mosul-as-digitally-reconstructed-replicas\]](https://spectrum.ieee.org/computing/software/ancient-sculptures-return-to-mosul-as-digitally-reconstructed-replicas)

Fashion line designed to trick cameras

**The
Guardian**



The fashion line designed to trick surveillance cameras

Adversarial Fashion garments are covered in license plates, aimed at bamboozling a device's databases

Alex Hern in Las Vegas

Wed 14 Aug 2019 06.00 BST

[\[https://www.theguardian.com/world/2019/aug/13/the-fashion-line-designed-to-trick-surveillance-cameras\]](https://www.theguardian.com/world/2019/aug/13/the-fashion-line-designed-to-trick-surveillance-cameras)

Fashion line designed to trick cameras



License Plate
PEOPL California

Vehicle Type
Motorcycle

License Plate
PPDRTE

Vehicle Color
Blue

Vehicle Type
Motorcycle

Vehicle Orientation


License Plate
PERSON

Vehicle Type
Motorcycle

First holographic 5G call in Portugal



Realizada a primeira chamada holográfica 5G em Portugal

14 AGO 2019 · NOTÍCIAS

39 COMENTÁRIOS

A Vodafone e a TVI realizaram a primeira transmissão holográfica 5G em tempo real, um marco inédito no nosso País.

[\[https://www.youtube.com/watch?v=9zoC5iT6dXI\]](https://www.youtube.com/watch?v=9zoC5iT6dXI)

VR headsets for cows

Russian cows fitted with VR headsets show 'reduced anxiety and improved emotional mood'



A Russian dairy farm has strapped virtual reality headsets to its cows in an experiment to "improve their wellbeing" CREDIT: @GLOLINTACH/TWITTER

NEWS WEBSITE OF THE YEAR
The Telegraph

Coronavirus News Politic

Follow

By **Matthew Bodner**, MOSCOW
26 NOVEMBER 2019 • 7:37PM

AR goggles for dogs

The US military is trialing augmented reality goggles for dogs

By Sara Spary, CNN Business

Updated 1623 GMT (0023 HKT) October 9, 2020



The technology, which the US Army says is the first of its kind, works by letting a handler see everything the dog can see and then provide specific commands using visual cues that show up in the dog's line of vision.

[\[https://edition.cnn.com/2020/10/09/tech/army-dogs-goggles-scli-intl/index.html\]](https://edition.cnn.com/2020/10/09/tech/army-dogs-goggles-scli-intl/index.html)

What is Visual Computing ?

- Numerous **application fields**

- ❑ Computer games
- ❑ Industrial quality control
- ❑ Medical imaging
- ❑ Multimedia systems
- ❑ Robot navigation
- ❑ ...

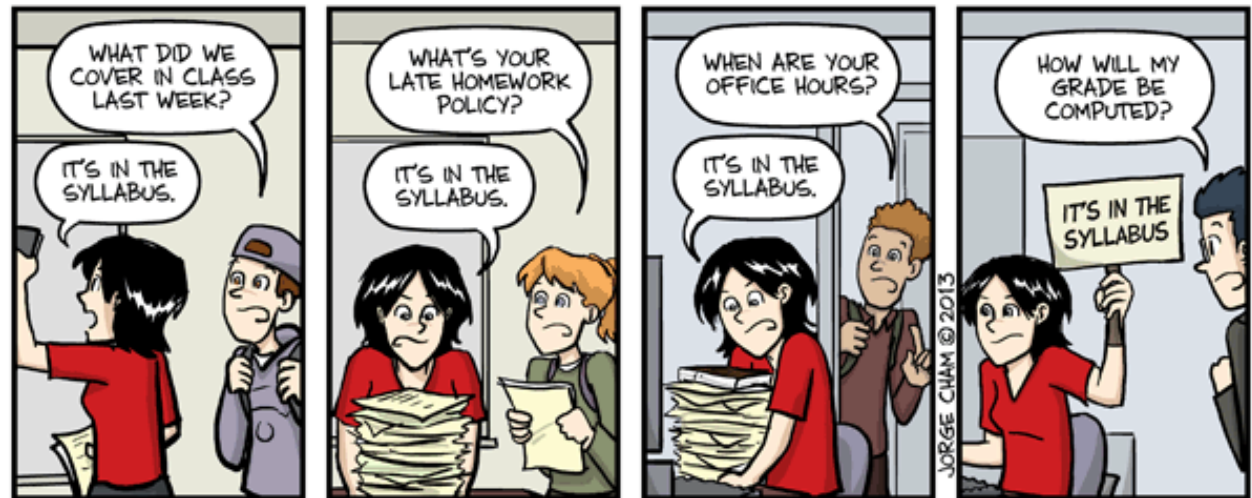
Computer Graphics vs ...

		Output	
		Model	Image
Input	Model	Geometric Modeling	Computer Graphics
	Image	Computer Vision	Image Processing

The Visual Computing course

Computer Graphics + Digital Image Processing

<https://elearning.ua.pt/>



[phdcomics.com]

SYLLABUS

Lectures: tentative planning

Oct 12 – Presentation. Introduction to CG.

Oct 19 – Visualization pipeline. 2D transformations.

Oct 26 – 3D transformations.

Nov 02 – Visualization. Projections.

Nov 09 – Illumination.

Nov 16 – Shading.

Nov 23 – Modeling using triangle meshes.

Nov 30 – Visibility. Introduction to GPUs.

Dec 07 – Introduction to Image Processing.

Dec 14 – Edge detection. Image segmentation.

Dec 21 – Morphological operations.

Jan 04 – Application examples.

Jan 11 – Advanced Techniques

Jan 18 – Project presentations (?)

Lab classes

- WebGL – Computer Graphics
- OpenCV – Image Processing
- Examples + Simple code development
- 2 projects
- Don't miss more than 50% of the lab classes!
 - If you do that, you fail!



[irinstitutes.org]

EVALUATION

Grading

- Mixed grading / Avaliação discreta
 - Exam (“normal” or “recurso”) : 50 %
 - 2 projects (WebGL + OpenCV) : 50%
- Minimum grading : 8,5 (for each component)

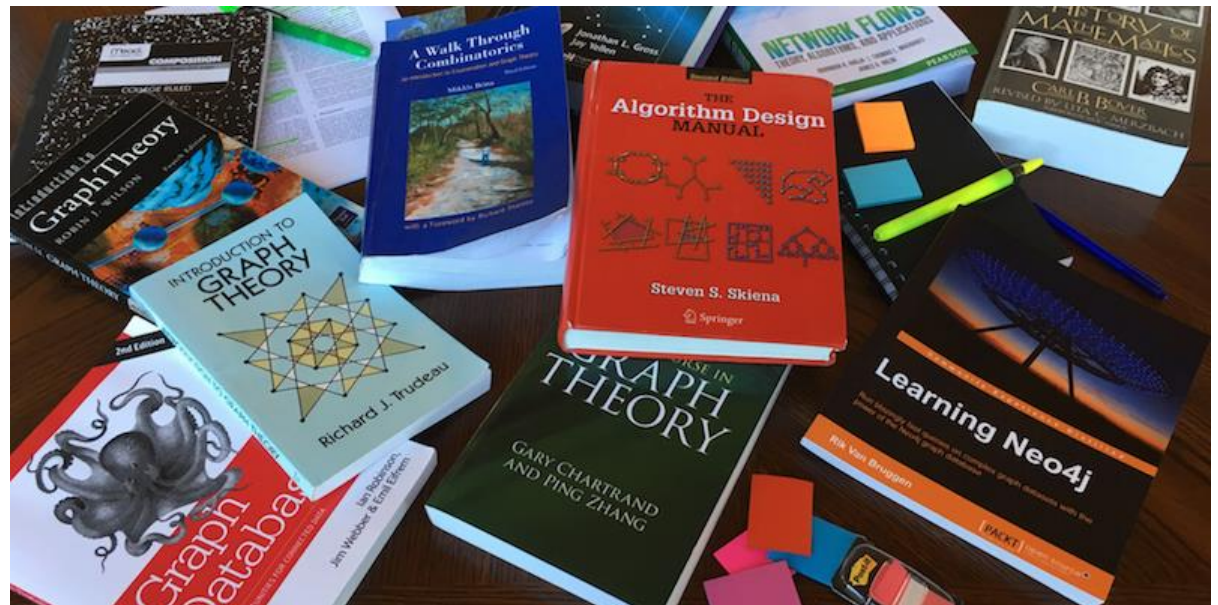
ORGANIZATION

Lecture Organization

- Remote lectures on Zoom
 - They are not recorded !!
- Preparatory materials: videos, etc.
 - View them before the lecture !
- 1st part : Recap / discussion
- 2nd part : Lecture / presentation / examples
- 3rd part : Additional exercises / videos / papers

Lecture Organization

- Remote lectures on Zoom
 - They are not recorded !!
- Preparatory materials: videos, etc.
 - View them before the lecture !
- 1st part (approx. 1 hour) : Lecture / presentation
- 2nd part : Design / programming / testing
- Weekly OT on Zoom
 - Fridays : 12:00 to 13:00



[hackernoon.com]

USEFUL BOOKS

Reference books

Edward Angel, Dave Shreiner

Interactive Computer Graphics, 7th Ed.

Addison-Wesley, 2015

Wilhelm Burger, Mark J. Burge

Principles of Digital Image Processing

Vol. 1 – Fundamental Techniques

Vol. 2 – Core Algorithms

Springer, 2009

Um livro recente

J M Pereira, J Brisson, A Coelho, A Ferreira e M R Gomes
Introdução à Computação Gráfica.
FCA, 2018



Additional books

- Hughes, J. F., A. van Dam, et al., *Computer Graphics – Principles and Practice*, 3rd ed., Addison-Wesley, 2014
- Foley, J., A. van Dam, et al., *Introduction to Computer Graphics*, Addison Wesley, 1993
- Rogers, D., J. Adams, *Mathematical Elements for Computer Graphics*, 2nd ed., McGraw-Hill, 1989
- Watt, A., F. Policarpo, *The Computer Image*, Addison-Wesley, 1998
- Gonzalez, R., R. Woods, *Digital Image Processing*, 2nd ed., Prentice-Hall, 2002
- ...

Course materials on-line

- CS 123 – Introduction to Computer Graphics
 - Brown University, USA – Andy van Dam
- CS 581 – Graphics Programming
 - Philipps-Universität Marburg, Germany
- ...

Udacity free course

- Interactive 3D Graphics
 - ❑ Eric Haines and Gundega Dekena
 - ❑ Autodesk

SIGGRAPH University on YouTube

- Fundamentals Seminar
- Introduction to 3D Computer Graphics
- Introduction to "Physically Based Shading in Theory and Practice"
- An Introduction to WebGL Programming

Warnings

- Lectures are not mandatory !
 - But you should always be present...
- PACO : choose how you want to be graded...

Acknowledgment

- To Professor Beatriz Sousa Santos, for making available teaching materials from previous course editions.