Computer Graphics

Computer graphics – what and why

"To understand nature, incorporate science and art with technology to create virtual environments that exist or never could have existed."

"Computer graphics is science and art of communicating visually via computer display and its interaction devices"*

"A collaboration between art and technology"**

* Book: principles and practices
** Pixar

Keyword: image

- Visual communication

Where is computer graphics used?

- Games: https://www.guerrilla-games.com/games (array of images generated based on user input)
- Animated film: https://www.pixar.com/feature-films-launch (array of images for given timeline)
- Science visualization: https://www.youtube.com/watch?v=adhTmwYwOiA
- Manufacturing and Engineering: https://www.autodesk.de/products/fusion-360/features#3d-modeling
- Film and Visual Effects: https://www.wetafx.co.nz/, https://www.ilm.com/
- Architecture: https://www.unrealengine.com/en-US/solutions/architecture
- Ergonomic Design of Buildings and Offices
- Lighting Engineering
- Predictive Simulations
- Advertising
- Flight and Car Simulators
- Art: https://refikanadol.com/

User interfaces

Image processing and digital drawing

Digital media

Computer aided design

Scientific Visualization

Film and VFX

- Fluids: liquids and gases
- Solids
- Characters/creatures
- Motion capture

AR/VR

Simulation

- Medicine
- Space travel

Interdisciplinarty of computer graphics

Bit of history

Computer graphics and you

- You like physics and would like to see its practical applications in generating amazing imagery and effects.
- You like mathematics: computer graphics is applied mathematics. Enough said.
- You like programming: computer graphics is exciting application that employs complex architectures for modeling and rendering and in return gives very gratifying results.
- You like art and design: Computer graphics is not only about tools which serve for simulating and rendering 3D scenes - it is also how we use those tools to create something that exists or never existed
- You like animated films or VFX: yes there is a lot of computer graphics there combined with other disciplines to support stories to remember
- You like computer games: amazing application of computer graphics combined with different disciplines
- You like visualization: biology? Chemistry? Geology? Astronomy? Computer graphics is there for you!

About you

- Your background
- Your interests
- Your experience

About lecturer

- My background
- My interests
- My experiences

About course

- This course is not about art, design, game-development, film, visualization in engineering and science domains but it gives foundations for making those with right domain knowledge. Computer graphics is a tool to create beautiful imagery but tool alone is not enough to create those images! Therefore, if you are interested in applying graphics to specific domain area (game, film, sci-vis, etc.) I encourage you to obtain the required domain knowledge as well!

Course outcomes

Outcomes

- Understand foundational ideas: those are immortal
- Typically mathematics, algorithms and methods used in computer graphics
- Map of the computer graphics

Map of computer graphics

- Point of lectures is to give structure and it is up to you to fill it.

Course content

- 10 lectures, 3h each
- Project: through all lectures
- Exam: end of lectures, 30min, Moodle questions

Lectures syllabus

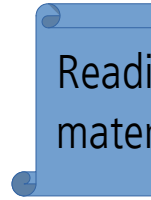
- Lecture 1: introduction (this) and rendering overview
- Lecture 2: 3D scene - shapes and materials
- Lecture 3: 3D scene - lights and cameras
- Lecture 4: Rendering - rendering introduction and raytracing
- Lecture 5: Rendering - rasterization
- Lecture 6: Images - images + project
- Lecture 7: More on 3D scene + project
- Lecture 8: More on 3D scene + project
- Lecture 9: More on rendering + project
- Lecture 10: More on image + project
- https://github.com/lorentzo/IntroductionToComputerGraphics/wiki/Syllabus

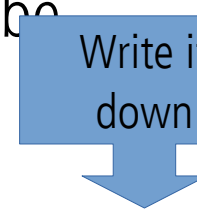
Lectures

- The point of lectures is to give the big picture and give highlights on foundations
  - They are starting point, a map, which is for you to explore.
  - Consultations are always possible!
- During lectures write down important points ask if anything is unclear
  - Feel free to interrupt! If something is not clear for you it is a high possibility it is also not clear for someone else – it is good to repeat!

Note for slides

- Note for slides
  - Slides were intended for both lectures and as reading material. Therefore, some slides contain a lot of text which is intended for student to read at home. Those slides will have special icon.
  - Important elements will be highlighted and noted that they should be written down by hand
  - Your interaction is crucial for best learning experience





Learning material

- These presentations and your notes
- https://github.com/lorentzo/IntroductionToComputerGraphics
- All materials are available in advance
  - TIP: read materials before lecture – it helps for following the lecture

Additional learning material

- Books
- Useful sites

Projects

- TODO: shortly describe projects + add images of what results might look like
  - Low level of abstraction: coding and focus on rendering
  - High level of abstraction: modeling, animation and interaction in DCC or game engine
- https://github.com/lorentzo/IntroductionToComputerGraphics/wiki/Projects
- Projects: a time dedicated to experience real-life development (and research).
  - Projects can be started even after this lecture: decide on topic and start investigating!.
  - Projects should be time for you to research and work on your own - consultations are always possible!
  - Projects are made to be fun and engaging: choose what you like!

Course grading

- Project
  - Based on solved steps
- Exam
  - 30min, online, Moodle

Glimpse into image generation

- Analogy: taking a photograph
  - World → **3D scene**
  - Image formation → **rendering**
  - **Image**