Computer graphics 2

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Content and form

- It follows the course *Computer Graphics 1*
  - It assumed knowledge of terms and algorithms of *Computer Graphics 1* (vector, coord. system, projection, ...)
- Main topic:
  - shading
  - illumination models
  - global illumination
- 2C/2Ex, the course ends with oral exam
  Exercises are provided by Mgr. Marcel Makovník
  (assigments are submitted on exercises, optionally a presentation)

Course syllabus

1) Light and Radiometry
2) Light reflection, BRDF
3) Shading algorithms
4) Ray tracing
5) Global illumination models
6) Monte Carlo methods
7) Rendering equation, Path tracing
8) Radiosity
9) Texture mapping
10) Shadow display methods
11) *Irradiance caching, Photon mapping*

Grading

- 60 points oral exam / 40 points exercises
- Final exam: 2 x 30 points (2 questions, oral)
- Exercises:
  12 pts – math (written) assignments
  8 pts – practical assignments in Blender
  20 pts – programming assignments in C#
  5 bonus pts – presentation of scientific paper
- Penalty of 50% pts for delay in delivering any assignment, “deadline” is last exam
- In order to pass, students must obtain at least 50% of points for each item (30p, 6p, 4p, 10p)

Evaluation

- The final evaluation:
  “A” 90 - 100 points
  “B” 80 - 89 points
  “C” 70 - 79 points
  “D” 60 - 69 points
  “E” 50 - 59 points

Literature

- Jiří Žára, Bedřich Beneš, Jiří Sochor, Petr Felkel: *Moderní počítačová grafika*, Computer Press, 2004
- Alan Watt: *3D Computer Graphics*, Addison-Wesley, 2000
- Samuel Buss: *3-D Computer Graphics - A Mathematical Introduction with OpenGL*, Cambridge University Press, 2003
- Hughes, van Dam, McGuire, Sklar, Foley, at all : *Computer Graphics: Principles and practice*, Addison-Wesley, 2013
- Shirley, Ashikhmin, Marschner: *Fundamentals of Computer Graphics*, A K Peters, 2009

Areas of using rendered images

- Creation of animated movies
- Visual effects
- Games
- Simulations
- Industrial design (engineering, architecture, …)
- Virtual reality and augmented reality
- Data & process visualization (medicine, …)
- Cultural heritage
- Geovisualization
- virtual showrooms

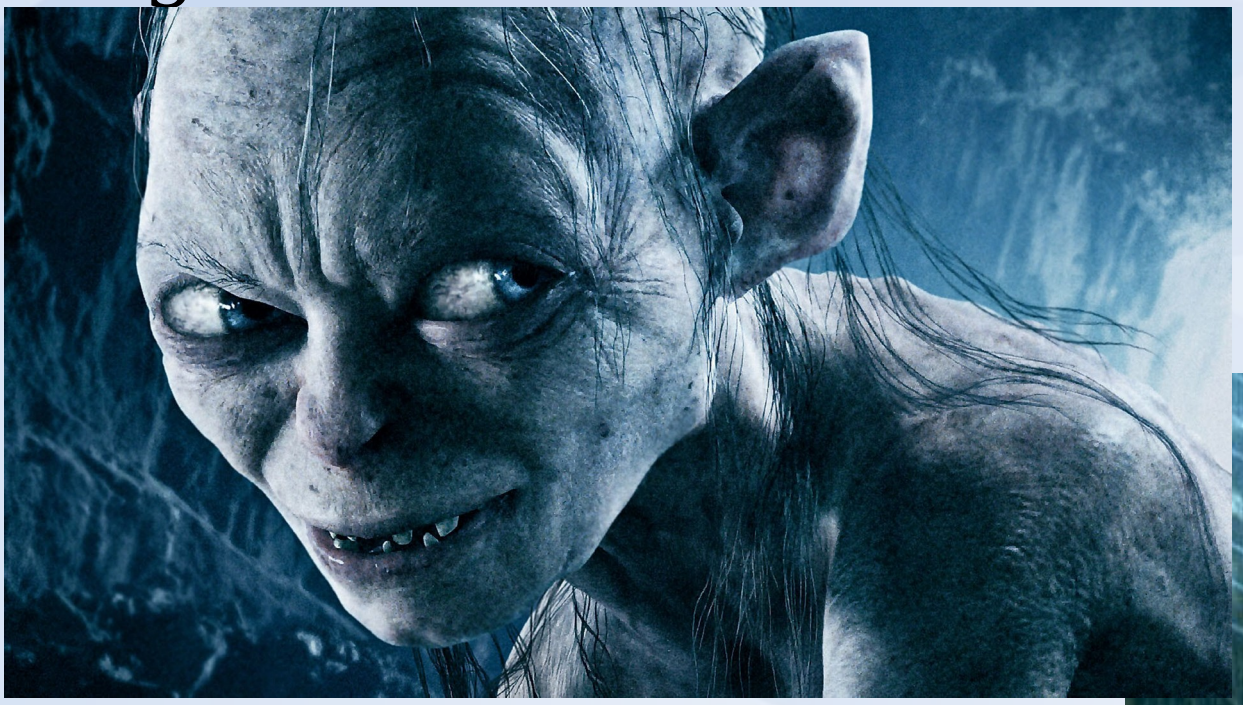
Using other areas

- Physics
  - Radiometry
  - Models of light interaction with objects
  - Light transport theory
- Mathematics
  - Integral equations
  - Monte Carlo methods
- Informatics
  - Computational geometry
  - Programming, software engineering
- Visual perception
- Art

Animated movies

Visual effects

Mixture of real scene and computer-generated images



Games

Interaction with story, fun/entertainment

Simulators

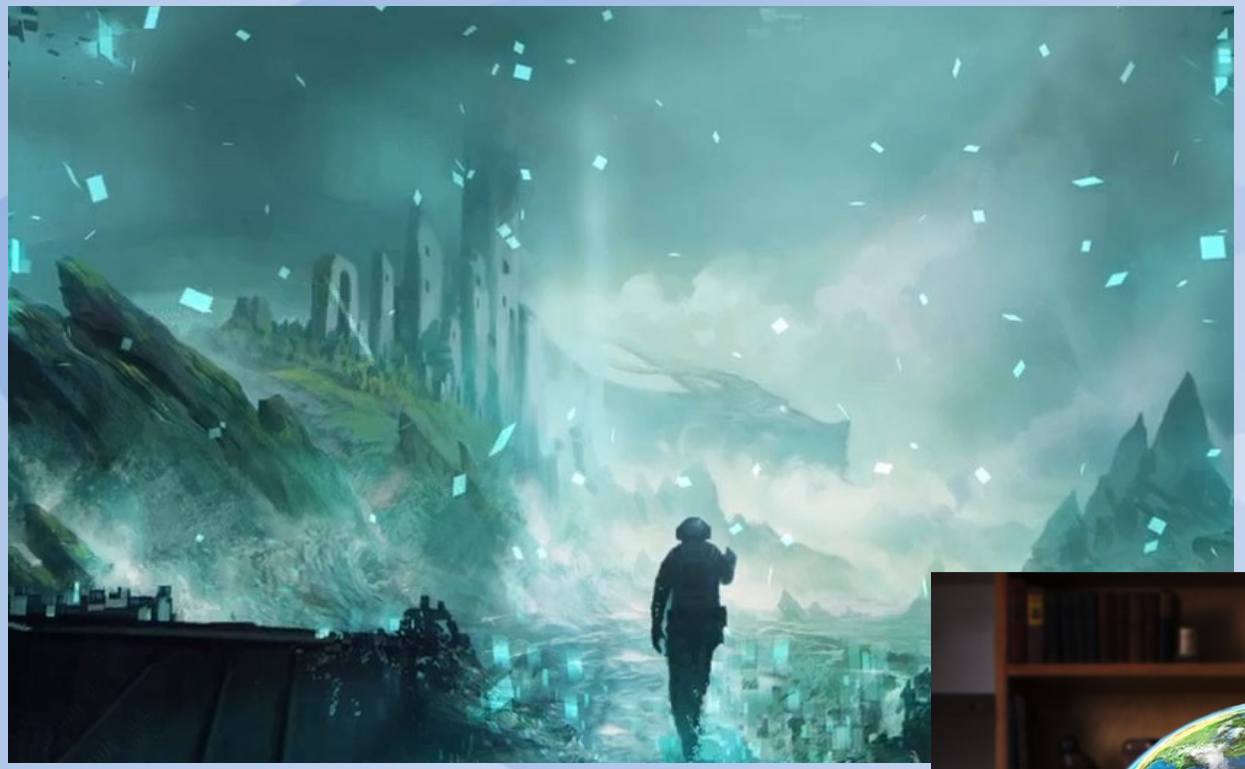
Testing of processes, people teaching / training

Industrial design

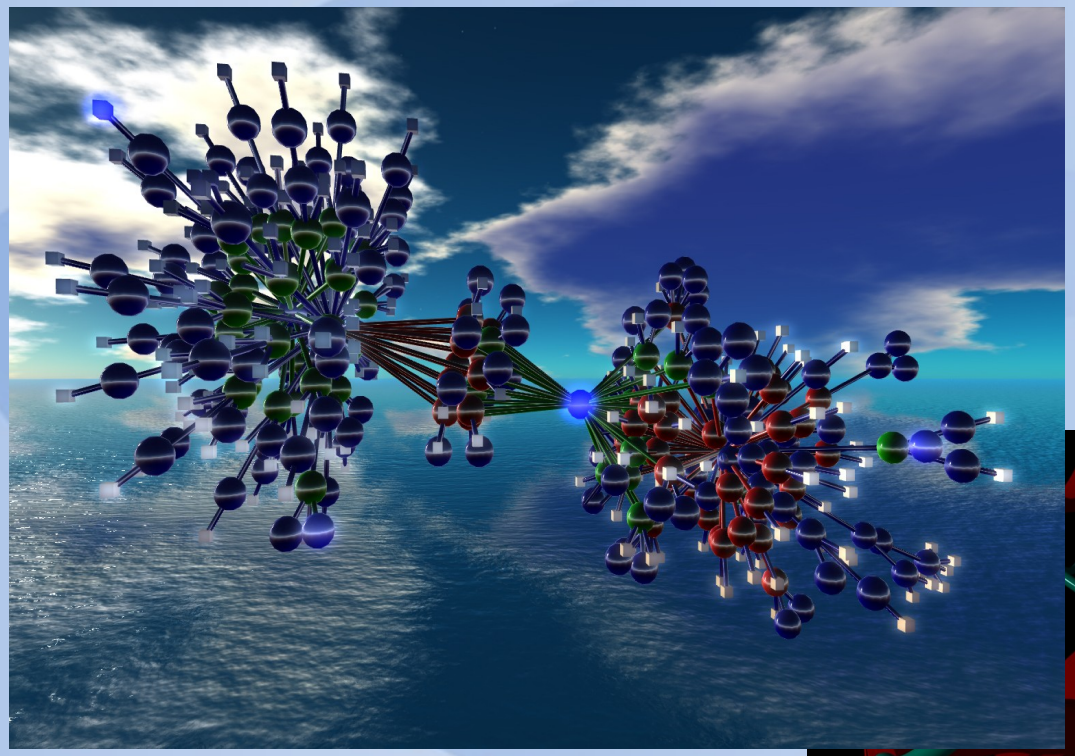
Design and creation of new products/models

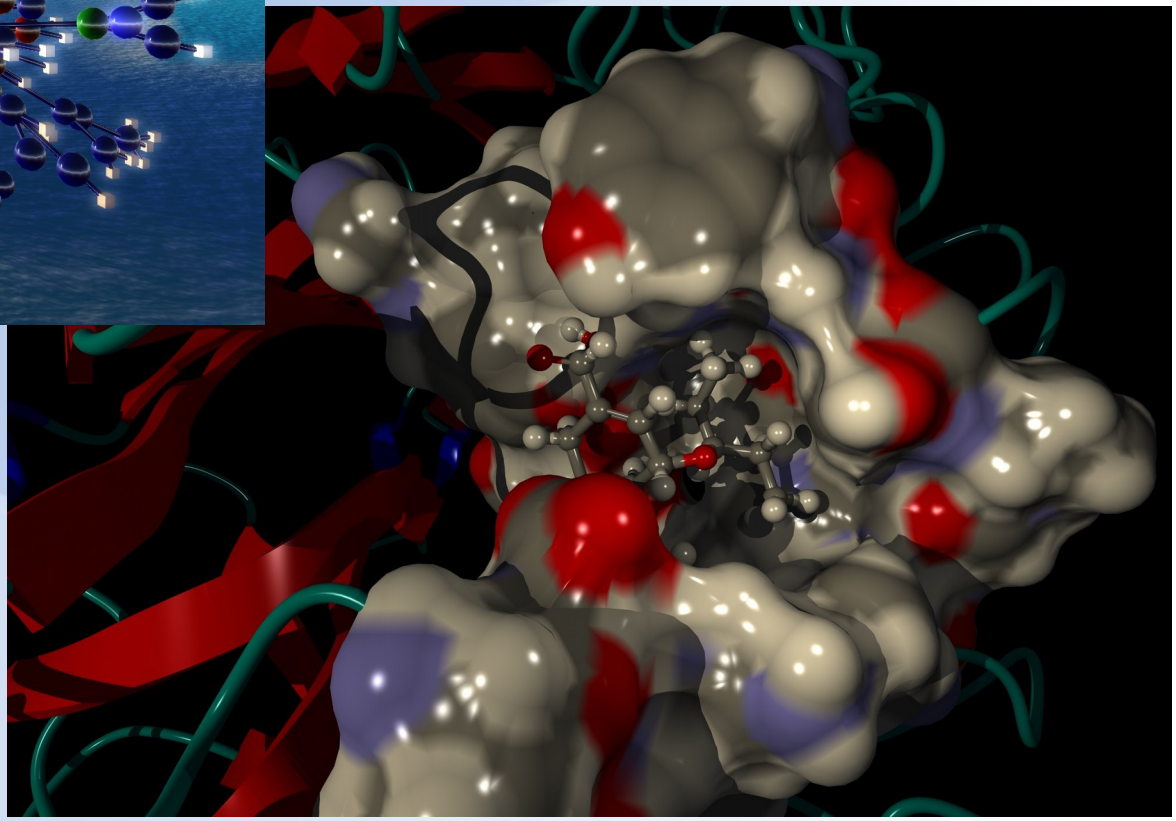
Architecture

Virtual and augmented reality



Data and process visualization

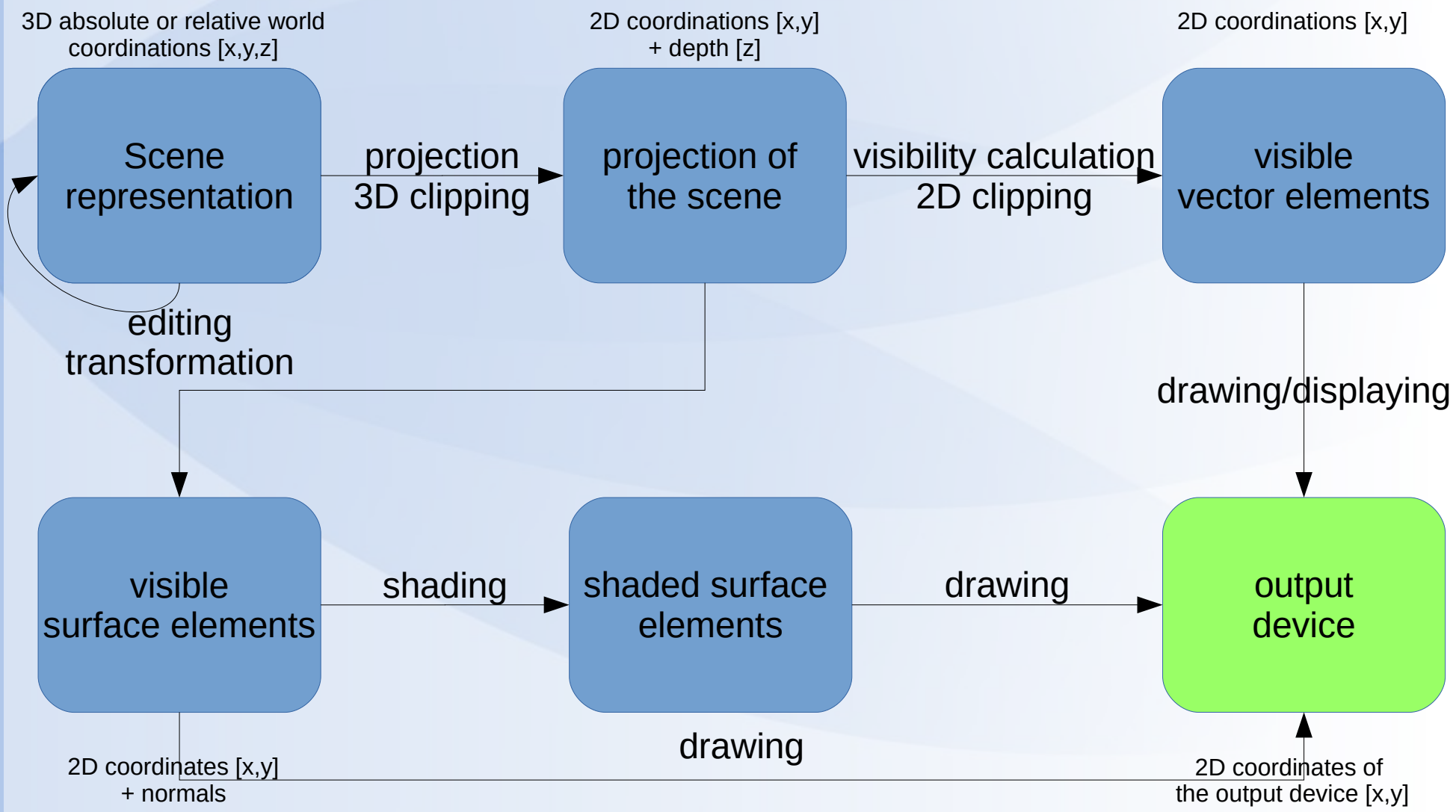




Cultural heritage

Geovisualization

3D graphics system



Stages of scene processing

- **editing, transformation** (working with 3D data)
  - basic functions of many 3D modeling applications(CAD , animation software, ...)
  - editing feature missing in pure displaying applications (simulators, games, ...)
- **projection** (+3D clipping)
  - transformation of 3D world coordinates to a given plane (we also need a depth information because of visibility calculation)
  - it allows to change the point and angle of view

For reflection

- What is the difference between 2D and 3D software and between 2D and 3D rendered images in such softwares?
- What are the possibilities to display 3D objects in the scene? Arrange these possibilities from the simplest to the most complex.