Computer Graphics

- Introduction -

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Philippe Weier
Alexander Rath
Overview

• Today
  – Administrative stuff
  – What is Computer Graphics?
  – A Primer on Rendering
  – Introduction to our Rendering Framework: Lightwave

• Next lecture
  – Overview of Ray Tracing
General Information

• Core Lecture (Stammvorlesung)
  – Applied Computer Science (Praktische Informatik)
  – Lectures in English

• Time and Location
  – Mon 10:15 - 11:45 , E1.3, HS 001
  – Thu 8:30 - 10:00 , E1.3, HS 001

• ECTS:
  – 9 credit points

• Web Page
  – http://graphics.cg.uni-saarland.de/courses/
  – Schedule, slides as PDF, etc.

• Teams
  – Literature, assignments, other information

• Sign up by joining the Teams link on our Web page now
People

• Lecturers
  – Prof. Dr.-Ing. Philipp Slusallek, slusallek@cg.uni-saarland.de

• Assistants
  – Philippe Weier, weier@cg.uni-saarland.de
  – Alexander Rath, rath@cg.uni-saarland.de
  – Ömercan Yazici, yazici@cg.uni-saarland.de

• Tutors
  – Eric Windholz, s8erwind@uni-saarland.de
  – Tobias Dick, s8todick@uni-saarland.de
  – Leonard Butz, s8lebutz@uni-saarland.de
  – David Hares, s8dahare@uni-saarland.de
Grading

- **Practical/Theoretical Assignments**
  - Counts 35% towards final grade
  - Minimum: 50% to pass

- **Exams**
  - No mid-term
  - Final exam counts 50% towards final grade
  - Minimum: 50% to pass

- **Rendering Competition (exam prerequisite)**
  - Counts 15% towards final grade
  - Grading based on implemented features
  - Bonus points for **Artistic quality**

- **Cheating**
  - 0% of assignment grade on first attempt
  - Possibility to fail the entire course if repeated

- **Chance for Repeated Exam**
  - Oral exam (if possible) at the end of the semester break
Exercise Groups

• Potential tutorial slots are
  – 12:00-14:00 Wednesday
  – 14:00-16:00 Wednesday
  – 16:00-18:00 Wednesday
  – 14:00-16:00 Thursday
  – 16:00-18:00 Thursday

• Mandatory poll in Teams to assign your group a slot
  – (Optional but encouraged) Indicate your partner (groups of 2 max)
  – Choose 3 slots in order of preference
  – We assign you a slot/tutor which tries to meet your preferences
  – If NONE of the provided slots works for you let us know ASAP

• Hard Deadline to fill in poll: Thursday 2. Nov 23:59
Practical Assignments

• Build your own Rendering Engine!
  – Three large programming assignments in which you gradually build your own renderer
  – This will be the basis for the Rendering Competition (more on that later)

• Grading
  – Results of the assignments will contribute to the final grade
  – Bonus points (towards the exam) by implementing advanced features are sometimes possible

• Handing in assignments
  – Via Teams before the deadline indicated on the assignment sheet
  – Submit the Git Tag associated with the last commit of the completed assignment

• Tutorial slots
  – Two Q&A sessions per assignment.
  – One presentation session. During that session, a few groups are randomly chosen to answer a few questions and present their work. Those sessions are therefore mandatory.
## Practical Assignments Schedule

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<th>Week</th>
<th>Monday</th>
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<td>Q&amp;A Session</td>
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<td>Assignment Deadline 23:59</td>
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<td>Presentation Session</td>
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<td>Next Q&amp;A Session</td>
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**Note:** Times are in 24-hour format.
Theoretical Assignments

• Theoretical assignment sheets
  – Weekly assignments
  – Starts after practical assignments

• Grading
  – Results of the exercises will contribute to the final grade
  – Bonus points (towards the exam) are sometimes possible

• Handing in assignments
  – Via Teams before the deadline
  – Submit a 300dpi PDF with your solutions. Solutions can be hand-written, but we encourage Latex generated PDFs to ease correction.

• Tutorial slots
  – Weekly Q&A sessions
  – Discuss lectures and any issues you might have with your tutor
Rendering Competition

• **Add features to your path tracer**
  – Implement rendering features from our provided list or your own!
  – Every feature gives points based on its implementation difficulty
  – If a feature you like is not provided you can discuss it with us, and we will attribute points to it if feasible.
  – Tip: choose features based on the scene you want to render for the competition!

• **Create a realistic image of a virtual environment**
  – We provide you with a "Theme"
  – Create a realistic and aesthetic 3D scene that follows that theme
  – Deadline towards end of the course (will be announced).

• **Results:**
  – One rendered image
  – Web page or Markdown Document with technical details info
Rendering Competition
Rendering Competition
Rendering Competition
Rendering Competition
Rendering Competition
Text Books

• Suggested Readings:

• Older
  – A. Glassner: An Introduction to Ray-Tracing, Academic Press, ´89
  – D. Ebert: Texturing & Modeling – A procedural approach, MK, ´03
Course Syllabus (Tentative)

• Overview of Ray Tracing
• Geometry Intersections
• Spatial Index / Acceleration Structures
• Vector Algebra Review
• Geometric Transformations
• Light Transport / Rendering Equation
• Material Models
• Shading
• Texturing
• Volumes
• Spectral Analysis / Sampling Theory
• Anti-Aliasing
• Distribution Ray Tracing
• Human Vision
• Color

• Splines
• Clipping
• Rasterization
• OpenGL & Shading Language
What is Computer Graphics?

- Photography
- Mathematics
  - Geometric Modeling
  - Neural-aided Rendering
- AI
- Rendering
- Graphics & “Visual Computing”
- Simulation & Animation
- Physics
- CAD/CAM/CAE
- Computer Vision
- Engineering
Related Applications

• Scientific/Information Visualization

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Related Applications

- Simulation & Augmented Reality

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Related Applications

- Industrial Design & Engineering: Automotive / Aerospace

© Daimler

© Volkswagen

© Boeing

© EADS
Related Applications

- Non-photorealistic rendering: art/stylized/pen&ink illustration
- Painterly/Toon Shading, Computational Aesthetics
Target Applications

- Architectural / Interior Design
- Landscape / Urban Planning
- Archeological Reconstruction
Target Applications

- Entertainment Industry: Animated films

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[© Sony Pictures Imageworks]

[© PDI DreamWorks]
Target Applications

- Entertainment Industry: Special effects for motion pictures

[© Industrial Light & Magic]

[© Framestore]

[© Weta Digital]

[© MPC Film]
Target Applications

- Entertainment Industry: Video games

- [© Hazelight Studios]

- [© Larian Studios]

- [© FromSoftware]

- [© Crytek]
Currently 35 Professors are Working for DFKI

15 Associated and Supernumerary Professors

20 DFKI Heads of Research Labs

Prof. Rolf Drechsler
Executive Director Kaiserslautern

Prof. Andreas Dengel
Executive Director Saarbrücken

Prof. Frank Kirchner
Executive Director Bremen

Prof. Antonio Krüger
CEO Saarbrücken

Prof. Philipp Slusallek
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Prof. Joachim Hertzberg
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Prof. Gesche Joost
Executive Director Osnabrück/Oldenburg

Prof. Joachim Hertzberg
Executive Director Osnabrück/Oldenburg

Prof. Volker Markl
CEA

Prof. Wolfgang Wahlster
CEA

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Prof. Robert Wille

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Prof. Jana Koehler

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Executive Director Berlin

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Prof. Stephan Busemann

Prof. Martin Ruskowski

Prof. Hans Schotten

Prof. Didier Stricker

Prof. Oliver Thomas

Prof. Josef van Genabith

Prof. Oliver Zielinski
Germany Has a Head-Start
DFKI: The World’s Largest Center for Research & Application in AI
Wrap-Up

• **Computer Graphics**
  – Rendering, Modeling, Visualization, Animation, Imaging, …

• **Young, dynamic area**
  – “Everything is possible” mentality
  – Progress driven by research & technology
  – Flexible transfer between research and industry

• **Big industry !**
  – Intel, Nvidia, AMD, Apple, ARM, Meta, …
  – Automotive, aerospace, engineering, …
  – Entertainment: games, film, TV, animations, …

• **Innovation areas**
  – Digital Reality, Visualization, Industrie-4.0, Big Data, Smart Cities, …

• **Interdisciplinary field**
  – Relations to mathematics, physics, engineering, psychology, art, entertainment, …
Questions?