
Computer Graphics

- Introduction -

Philipp Slusallek

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

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 1			Assignment Released				
Week 2			Q&A Session				
Week 3			Q&A Session Next Assignment Released				Assignment Deadline 23:59
Week 4/1			Presentation Session Next Q&A Session				

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



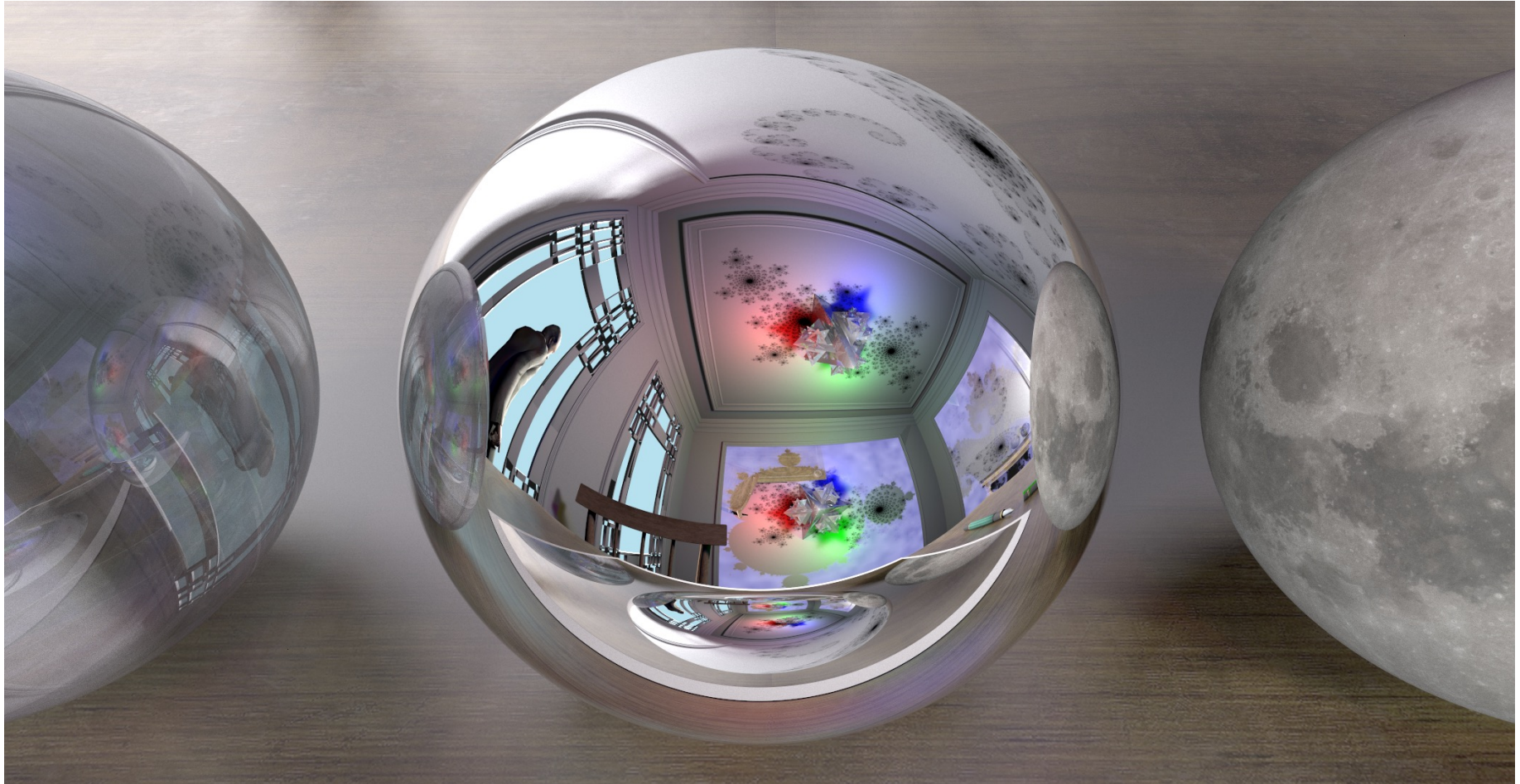
Rendering Competition



Rendering Competition



Rendering Competition



Text Books

- **Suggested Readings:**

- Matt Pharr, Wenzel Jakob, Greg Humphreys: **Physically Based Rendering : From Theory to Implementation**, Morgan Kaufmann Series, 3. Ed., 2016, now freely available: <http://www.pbr-book.org/>
- Peter Shirley: **Fundamentals in CG**, 5. Ed, AK Peters, 2016
- John Hughes, et al.: **Computer Graphics – Principles and Practice**, Addison-Wesley, 3. Ed, 2013
- Eric Haines and Tomas Akenine-Möller: **Ray-Tracing Gems**, <http://www.realtimerendering.com/raytracinggems>
- Thomas Akenine-Möller, Eric Haines, et al., **Real-Time Rendering**, AK Peters, 4th Ed., 2018

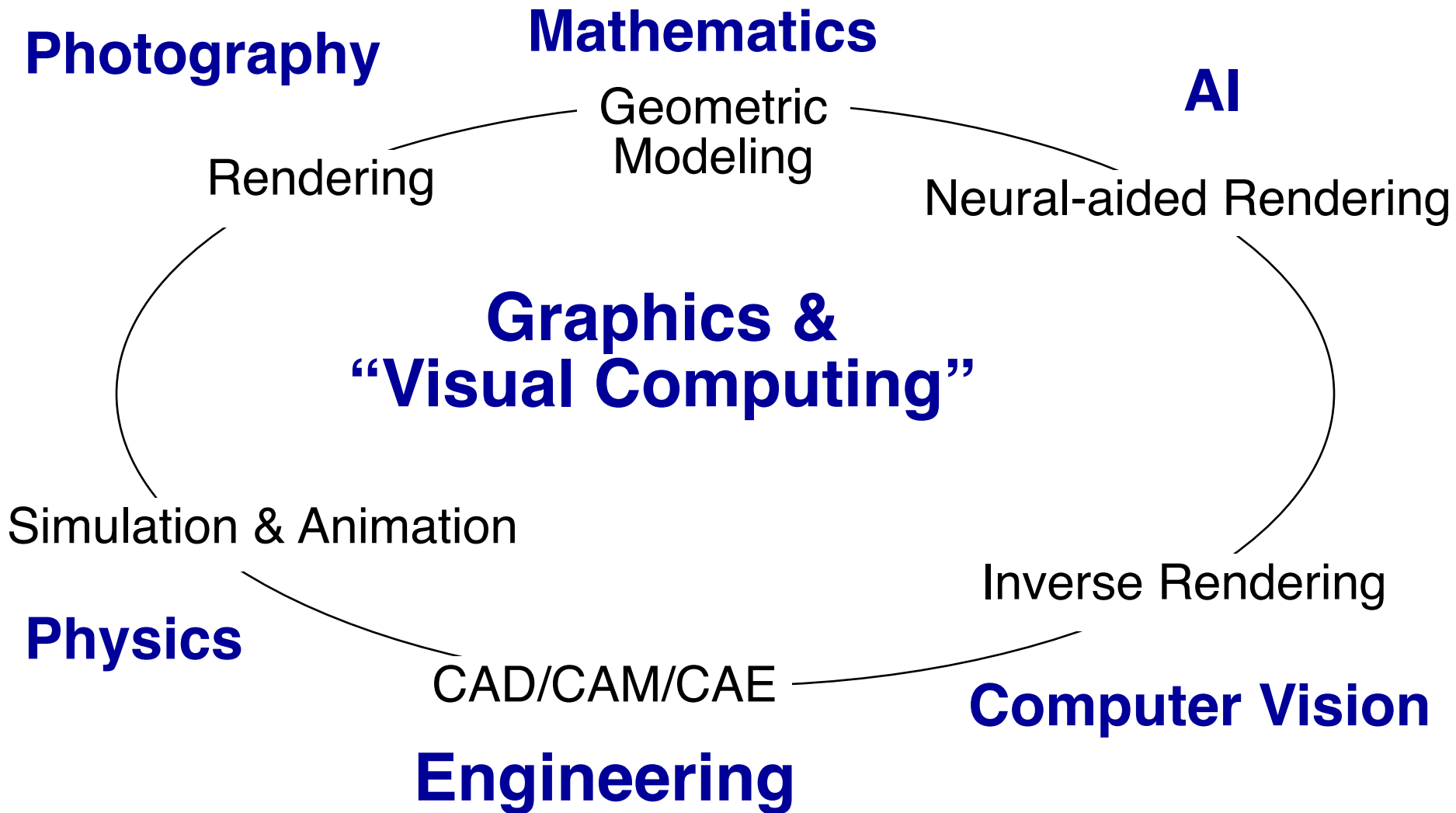
- **Older**

- A. Glassner: **An Introduction to Ray-Tracing**, Academic Press, '89
- D. Ebert: **Texturing & Modeling – A procedural approach**, MK, '03

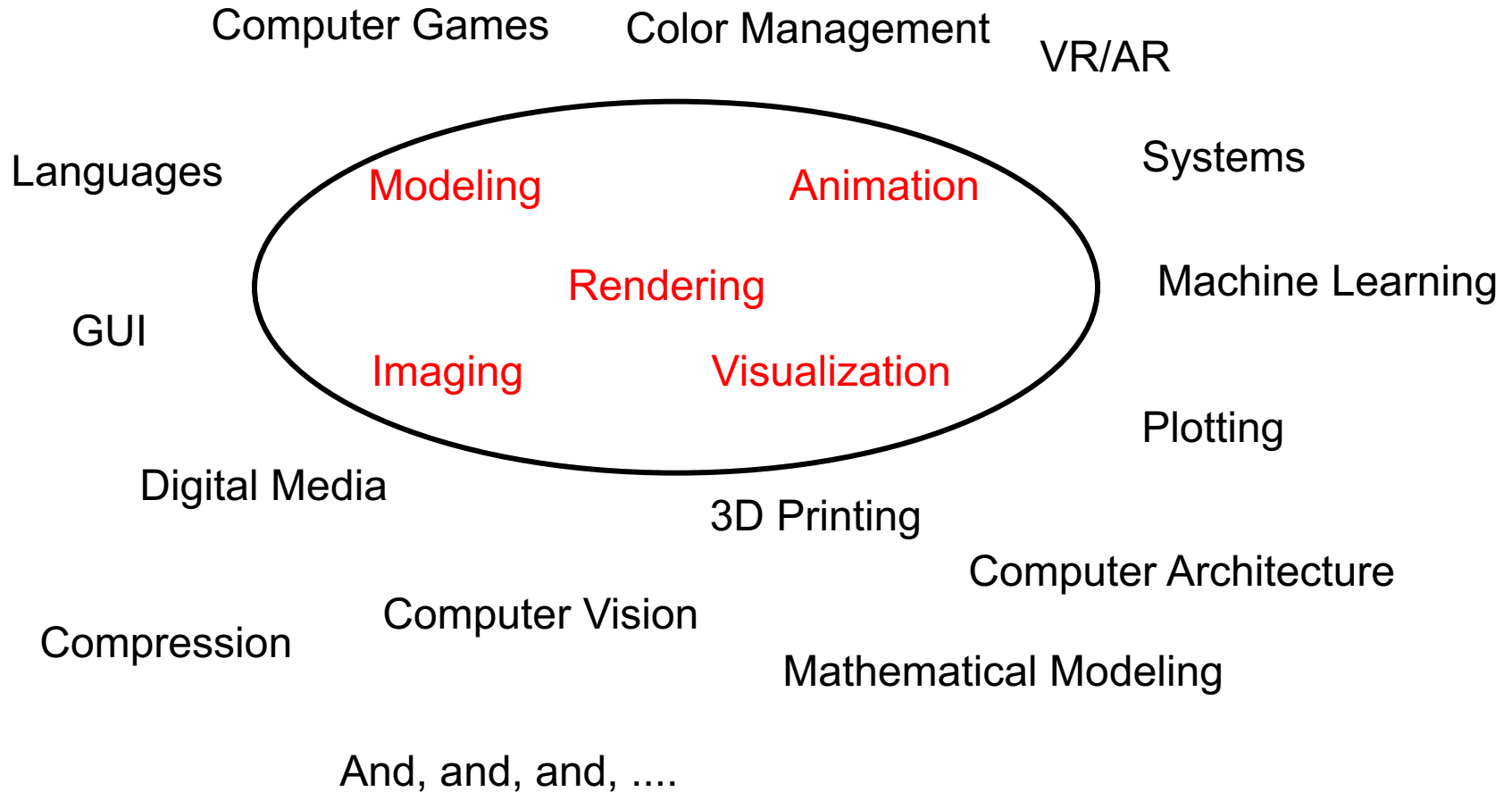
Course Syllabus (Tentative)

- **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 ?

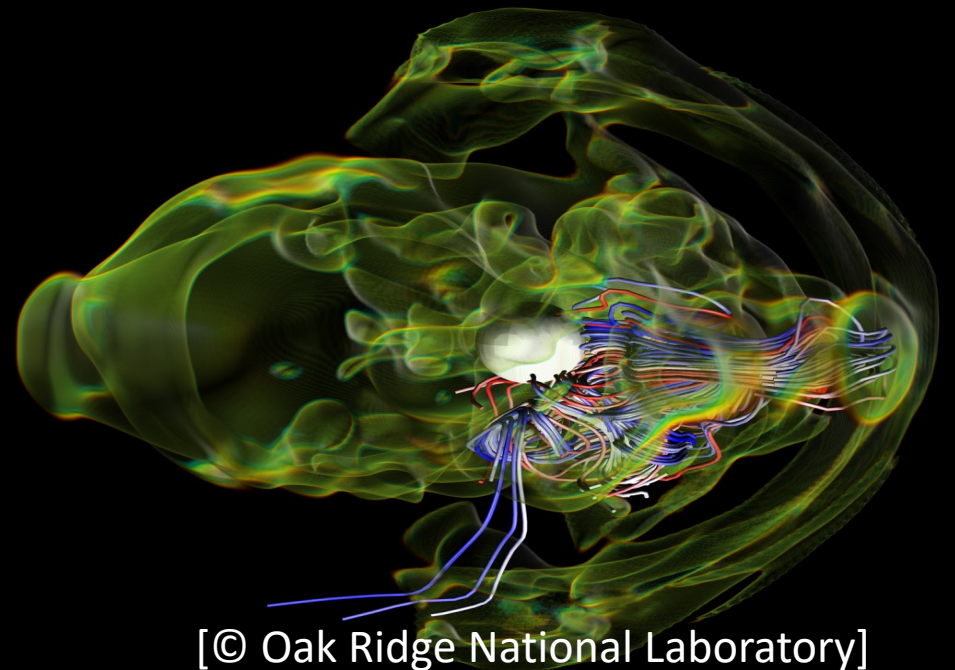
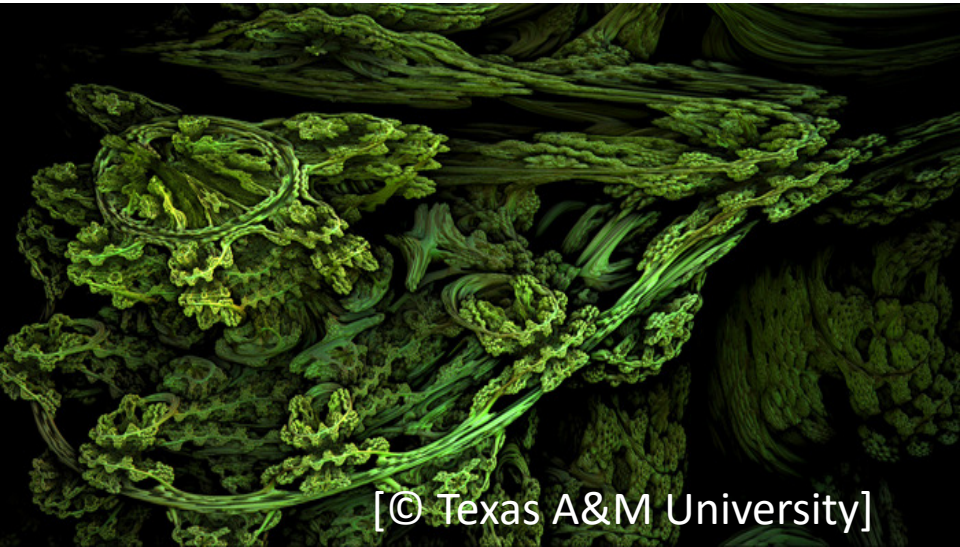
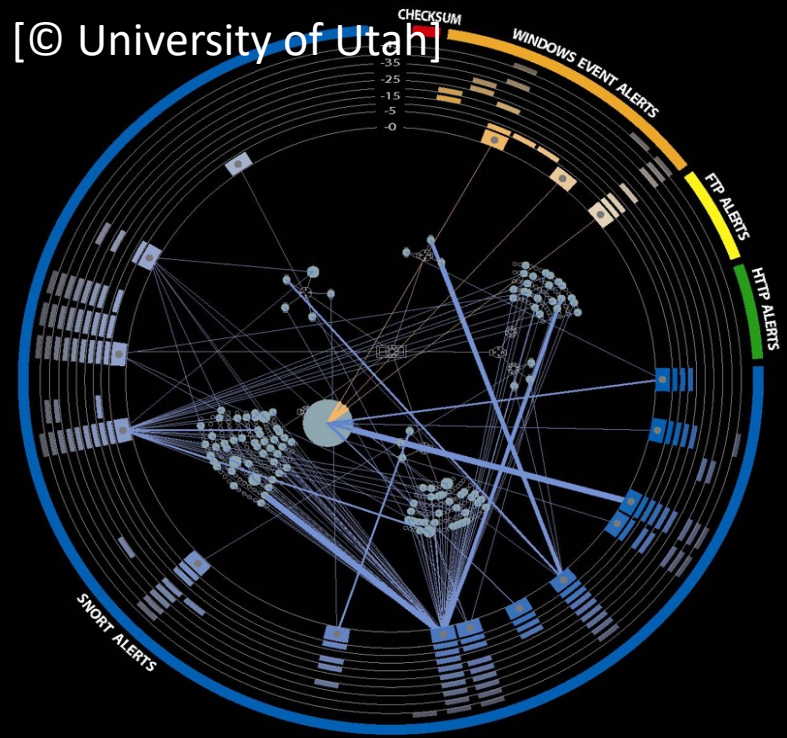
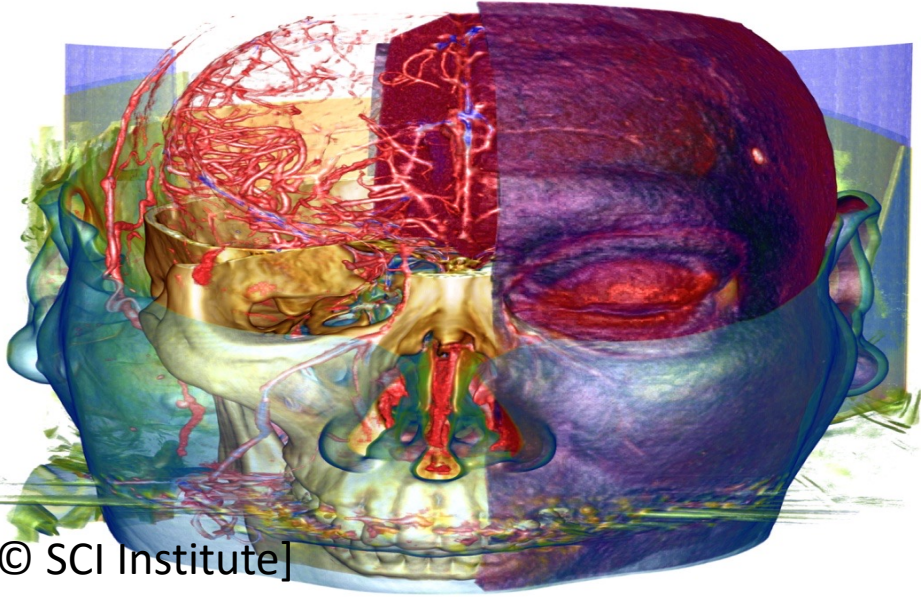


What is Computer Graphics?



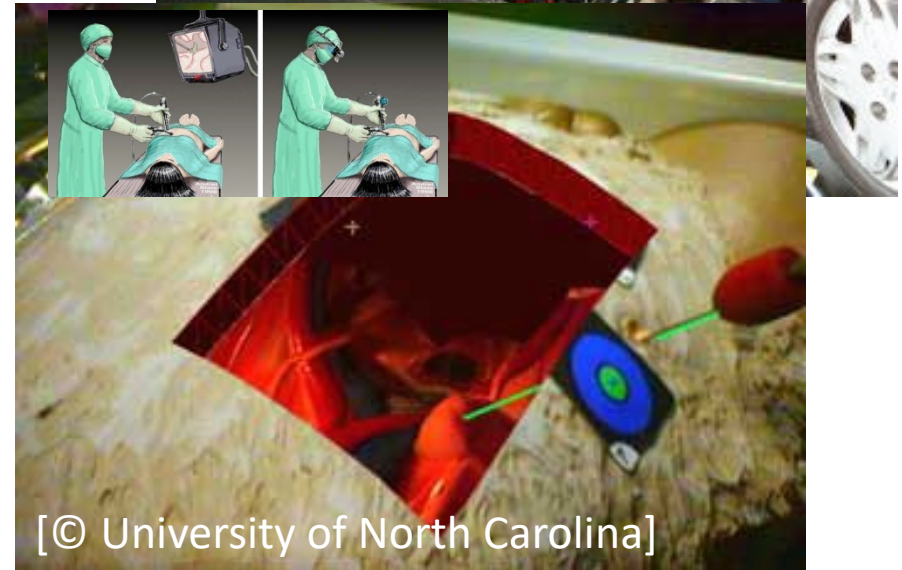
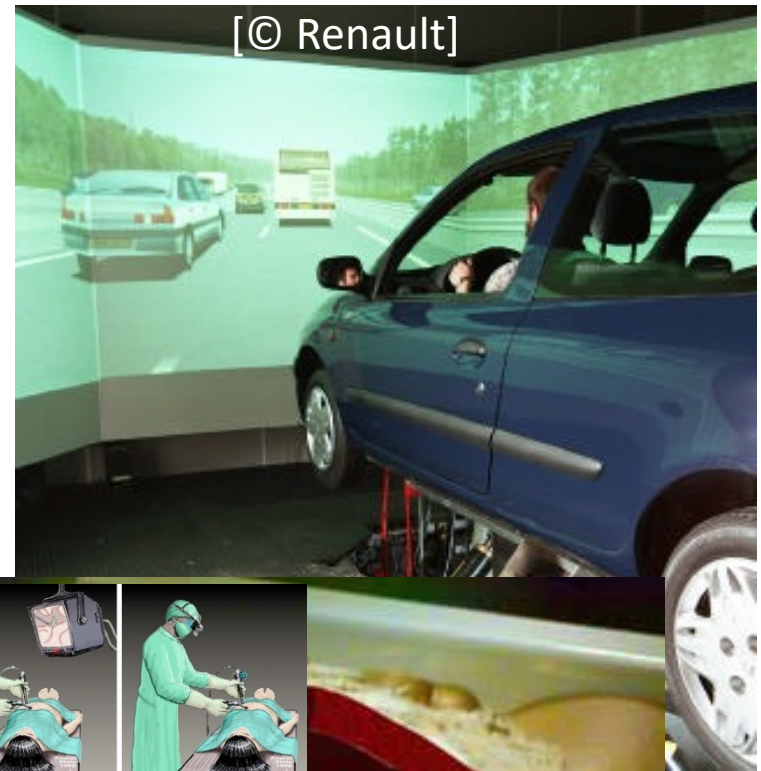
Related Applications

- Scientific/Information Visualization



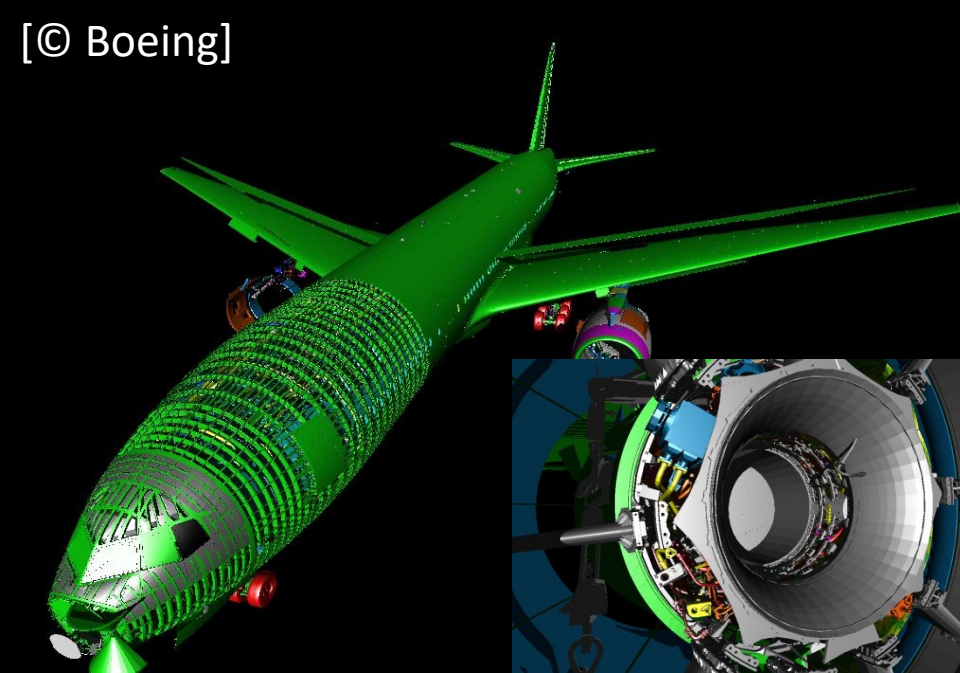
Related Applications

- Simulation & Augmented Reality



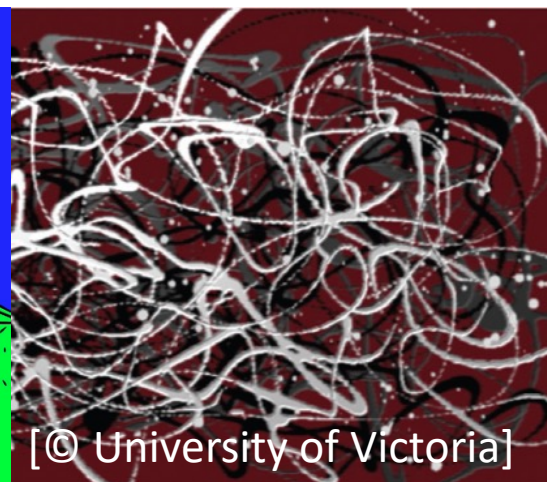
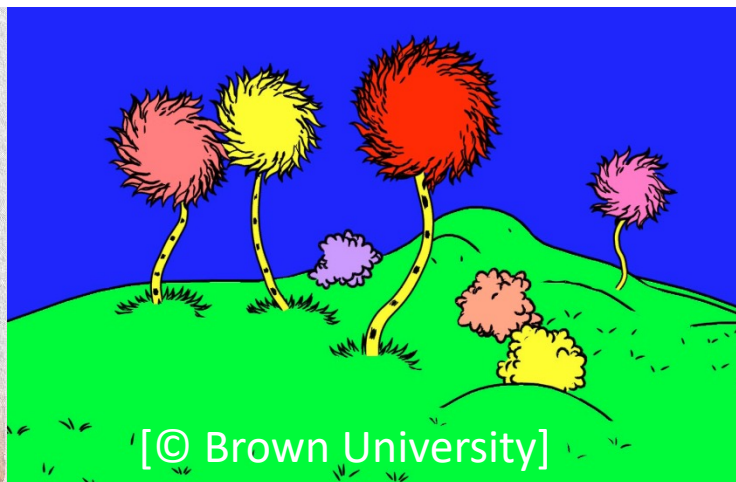
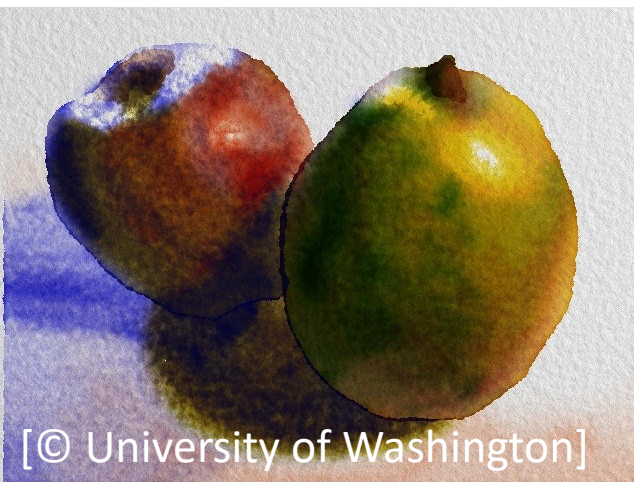
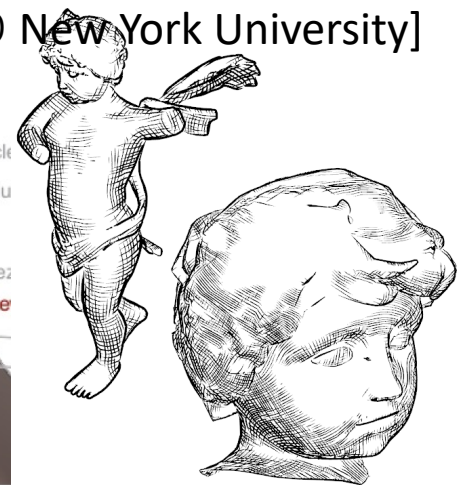
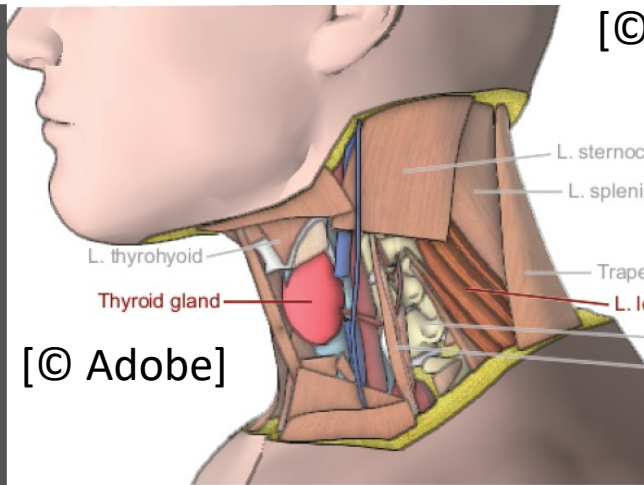
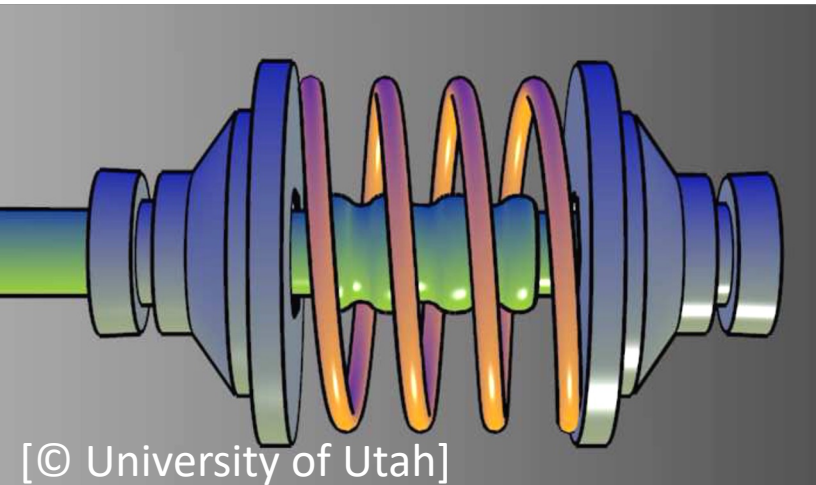
Related Applications

- Industrial Design & Engineering: Automotive / Aerospace



Related Applications

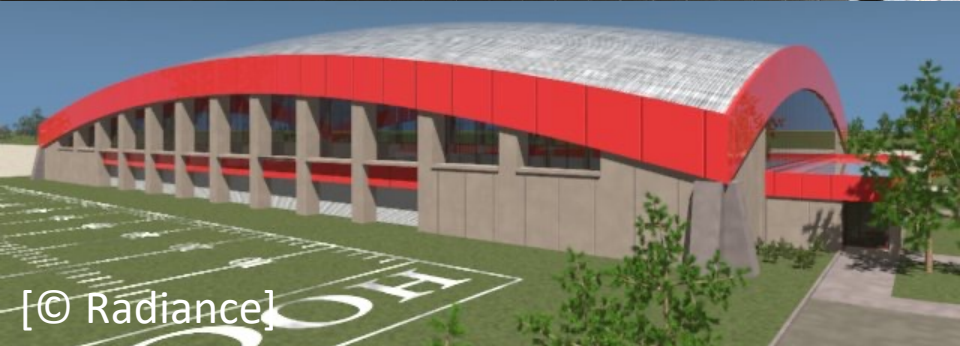
- Non-photorealistic rendering: art/stylized/pen&ink illustration
- Painterly/Toon Shading, Computational Aesthetics



Target Applications

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

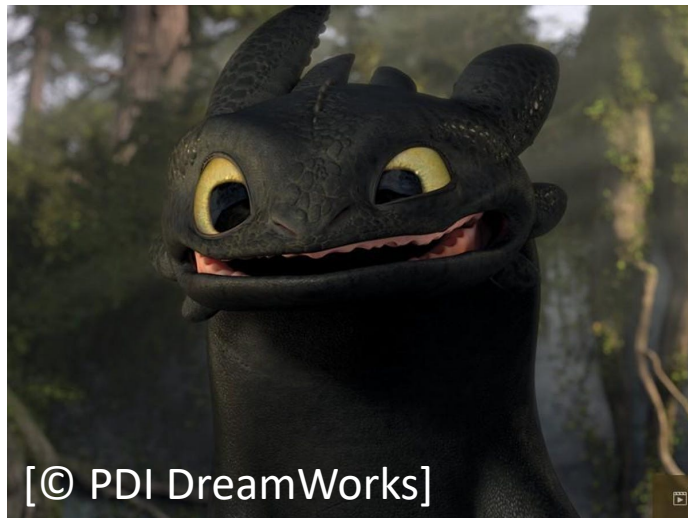
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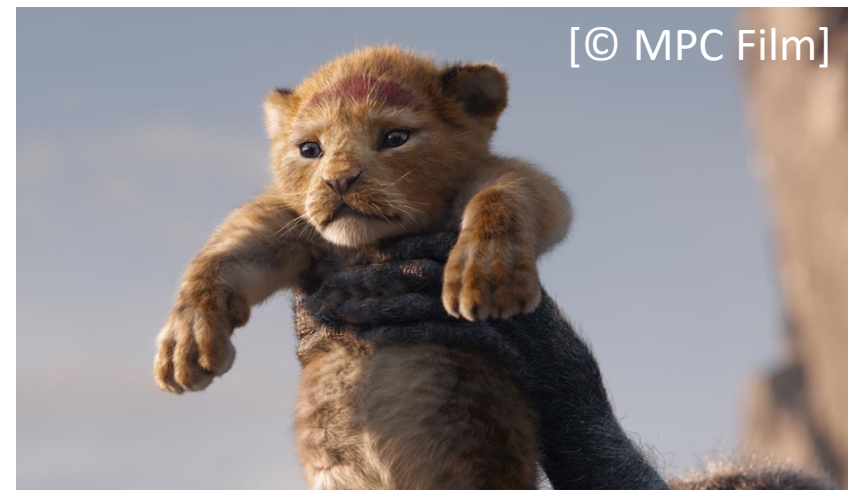
Target Applications

- Entertainment Industry: Animated films



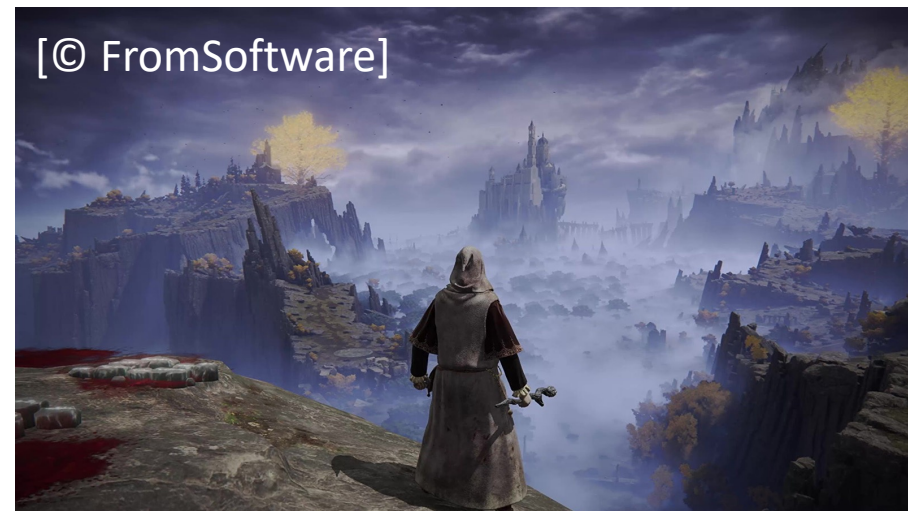
Target Applications

- Entertainment Industry: Special effects for motion pictures



Target Applications

- Entertainment Industry: Video games



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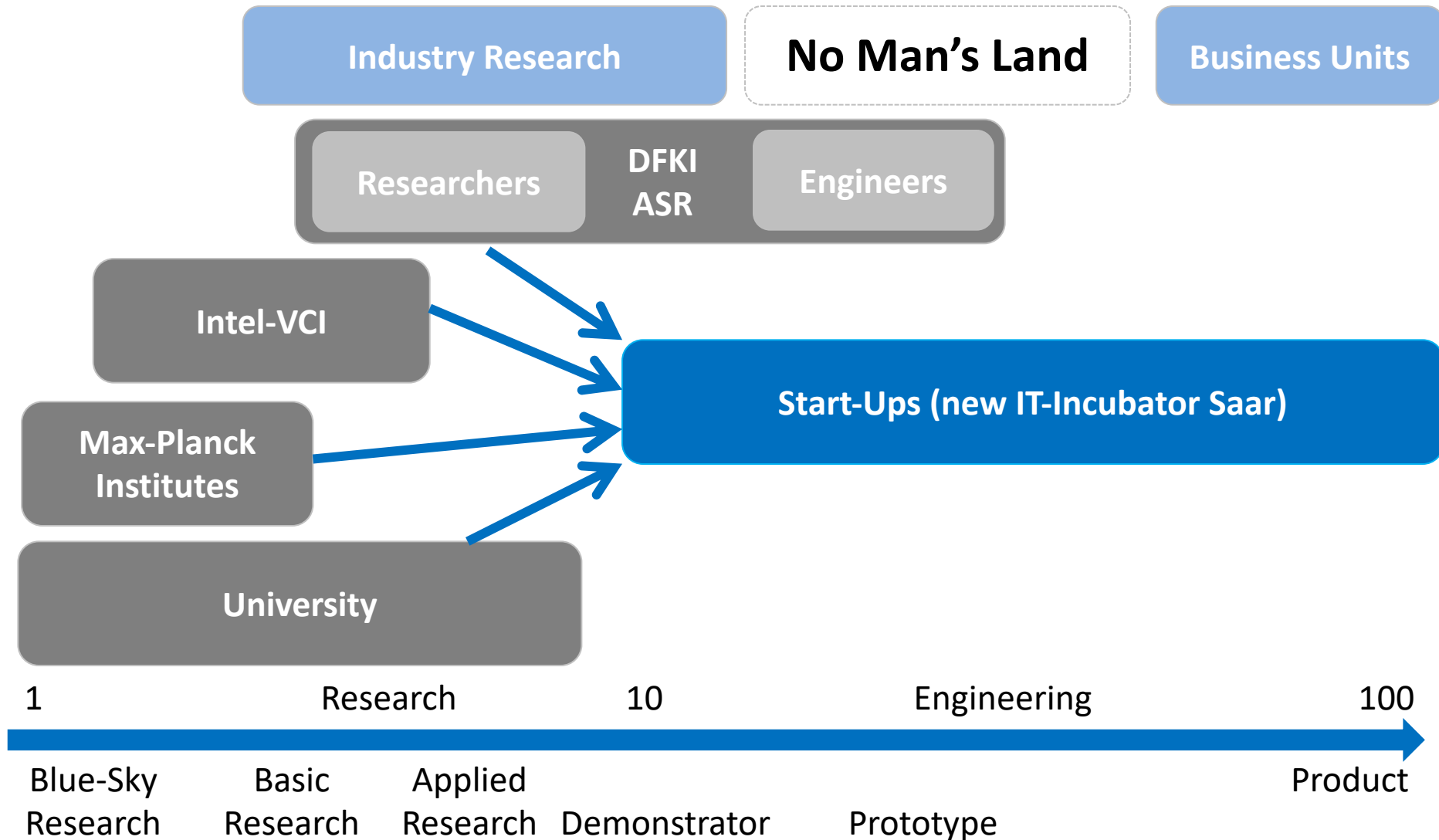
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Currently 35 Professors are Working for DFKI

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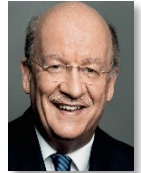
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Wolfgang
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Prof.
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Germany Has a Head-Start

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?