CSE-170 Computer Graphics

Lecture 1

Course Introduction

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Who are we?

- Instructor: Dr. Renato Farias
  - UCM alumnus
  - Graduated with a PhD in Computer Graphics in 2020 under the advisory of Prof. Marcelo Kallmann
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- TAs
  - Ritesh Sharma (2L, 5L)
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Why Computer Graphics?

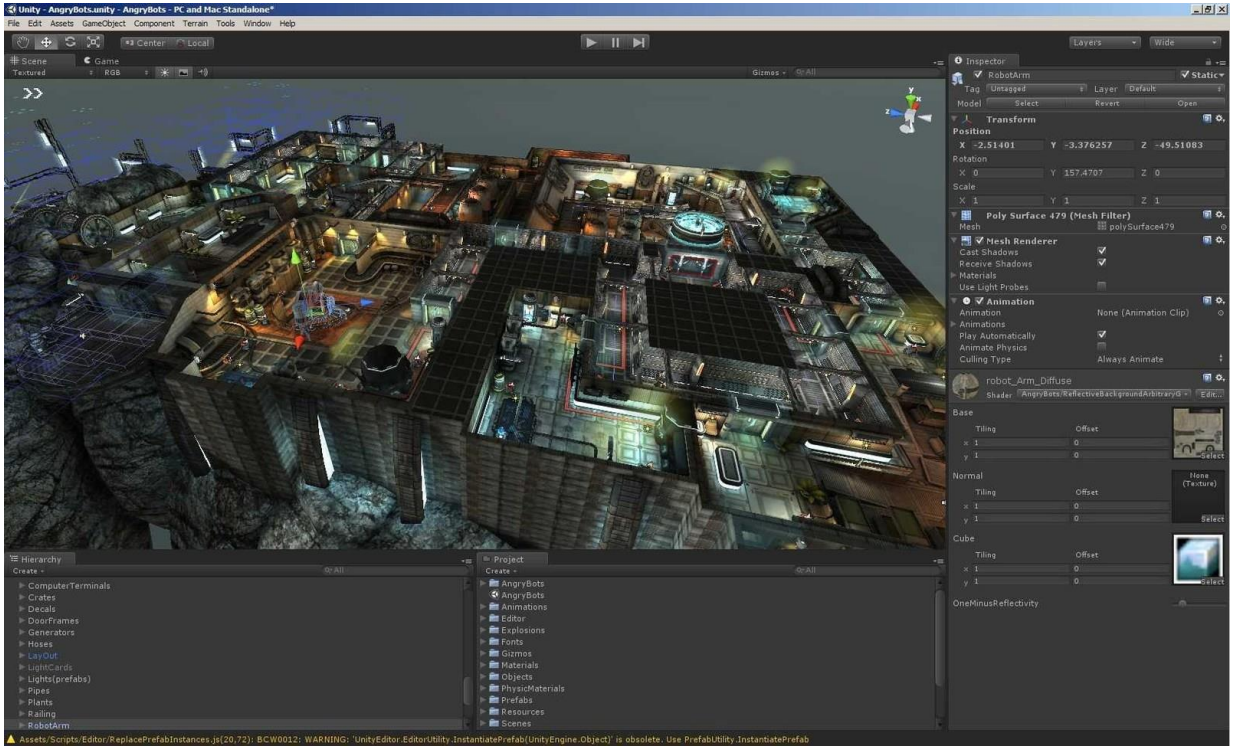
- Movies
- Games
- CAD/CAM (Computer-Aided Design & Computer-Aided Manufacturing)
- Simulation and Training
- Data Visualization
- Human-Computer Interaction
- Virtual Reality
- Medical Imaging
- etc.

Movies


Disney · PIXAR
MONSTERS, INC.
WALL·E
PIXAR
ANIMATION STUDIOS
TOY STORY

Games

Game Engines



Simulators

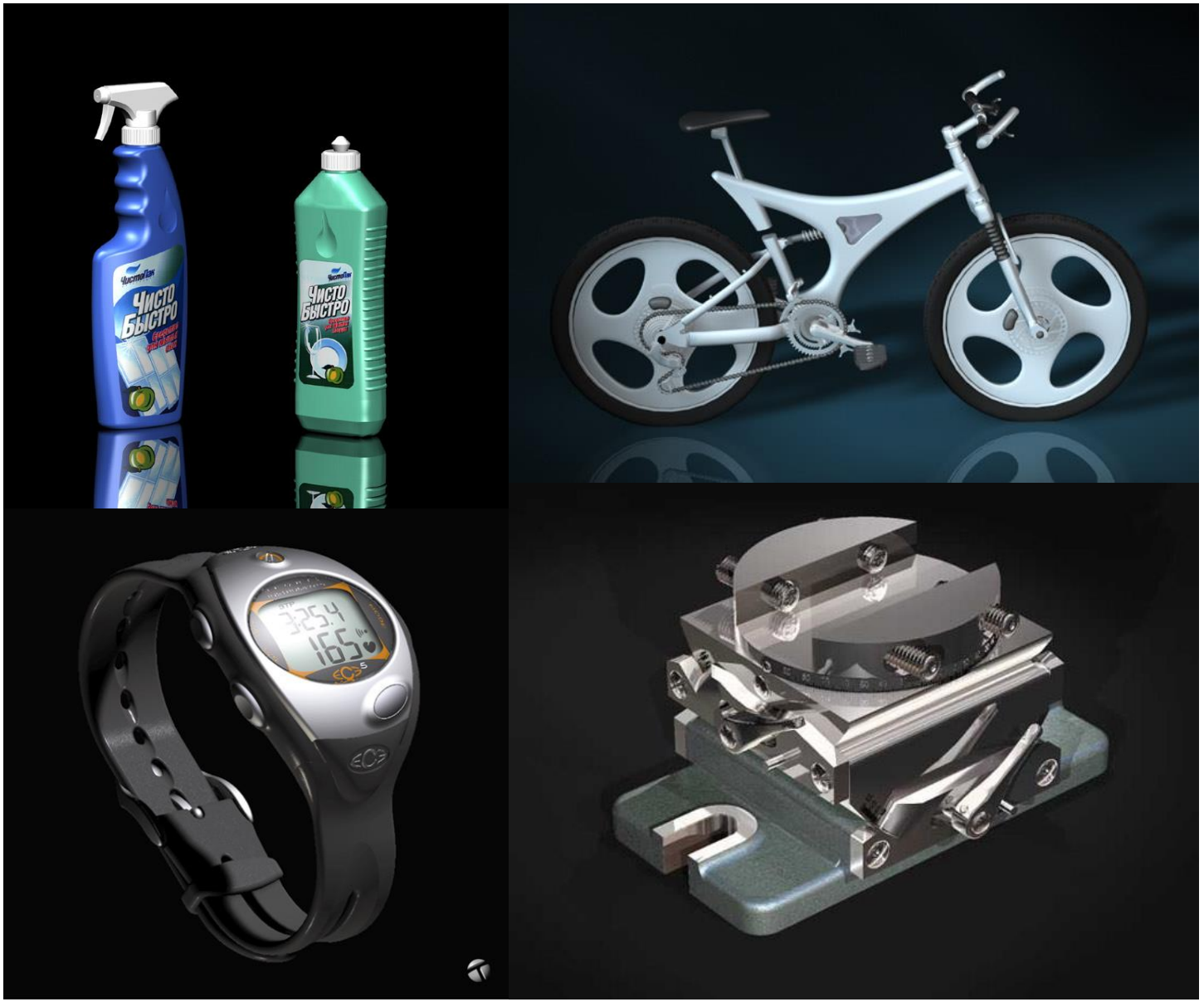
Microsoft Flight Simulator

Simulators

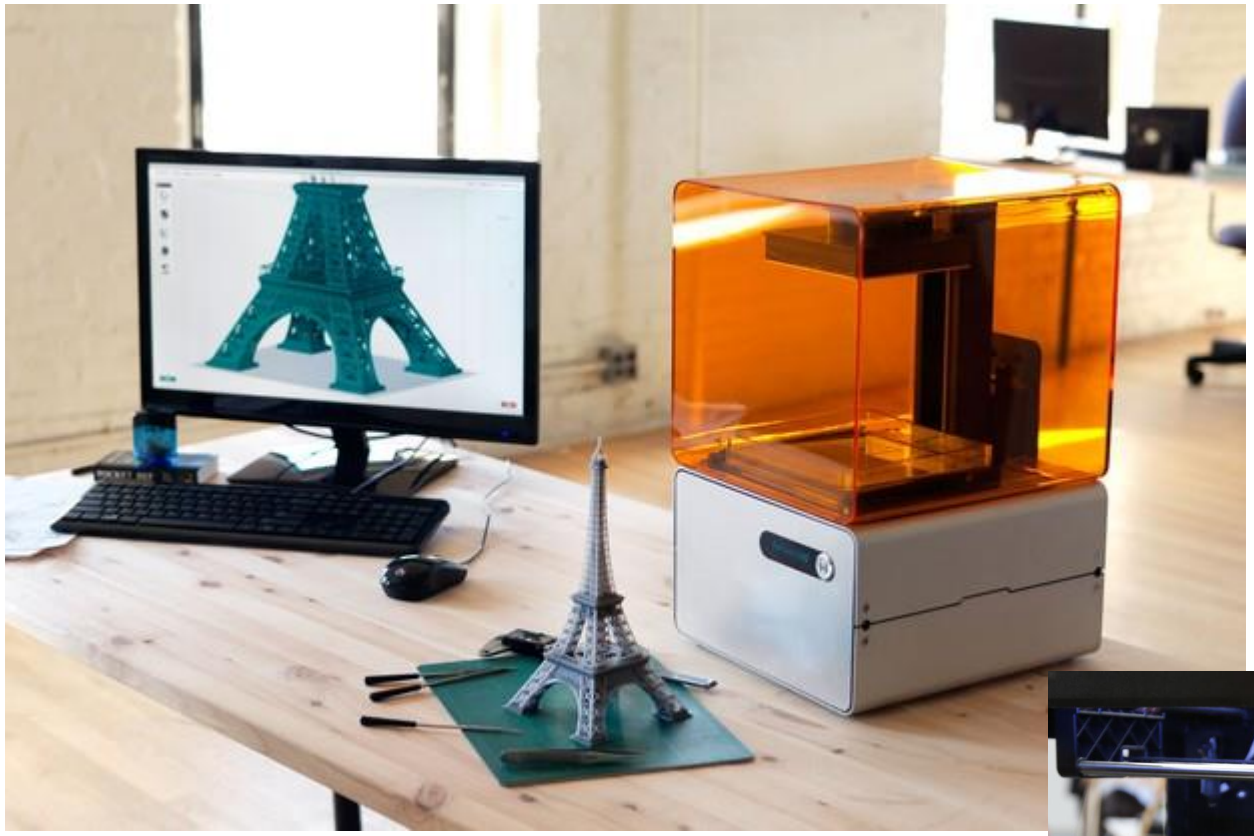
Delta Flight Museum Simulator in Atlanta, Georgia

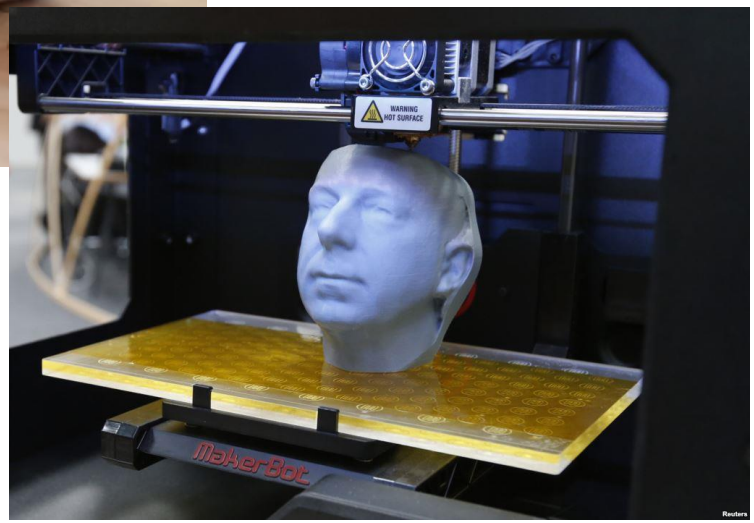
Training

CAD/CAM, Modeling, Design

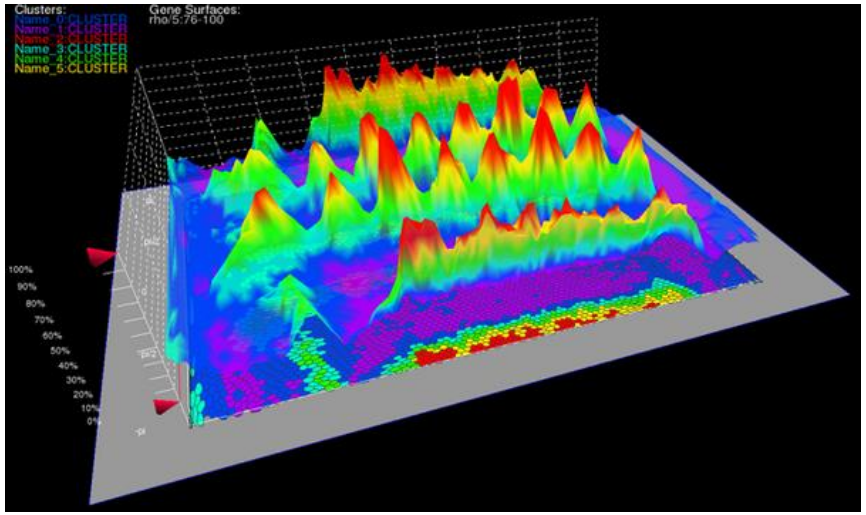


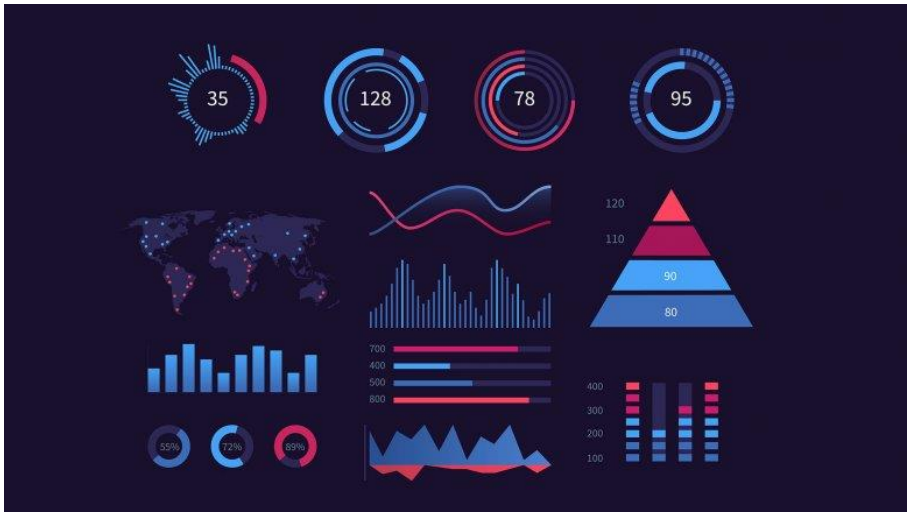
CAD/CAM, Modeling, Design

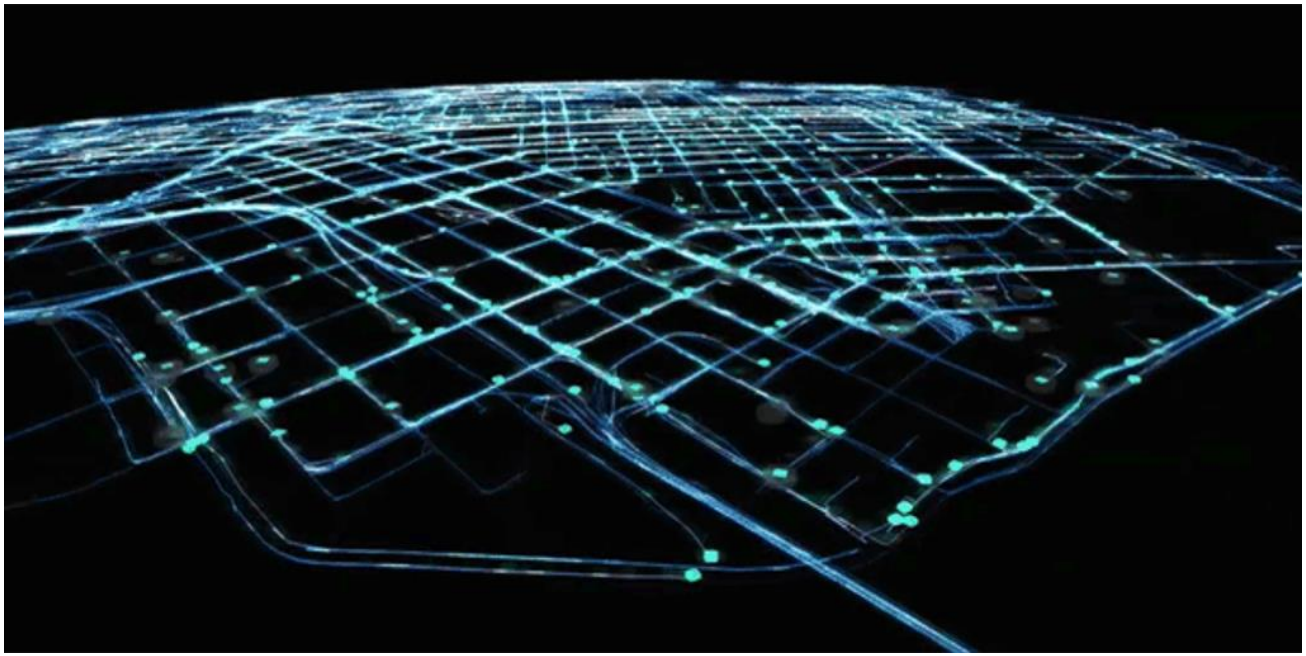




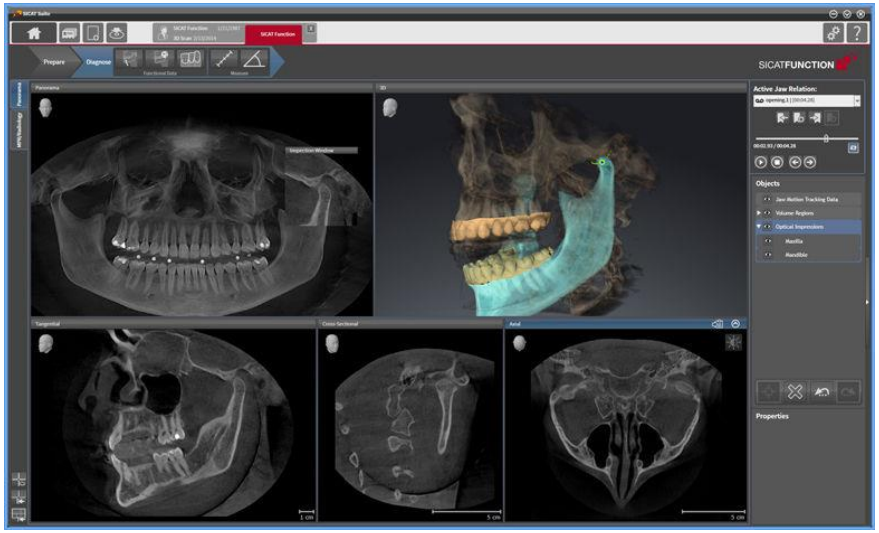
Data Visualization

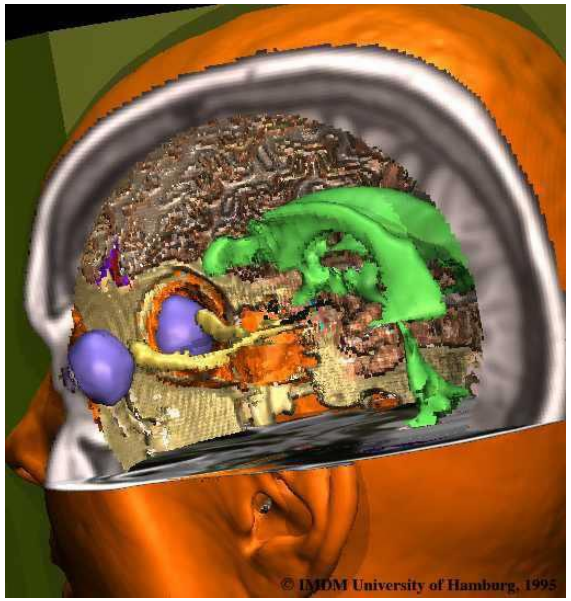




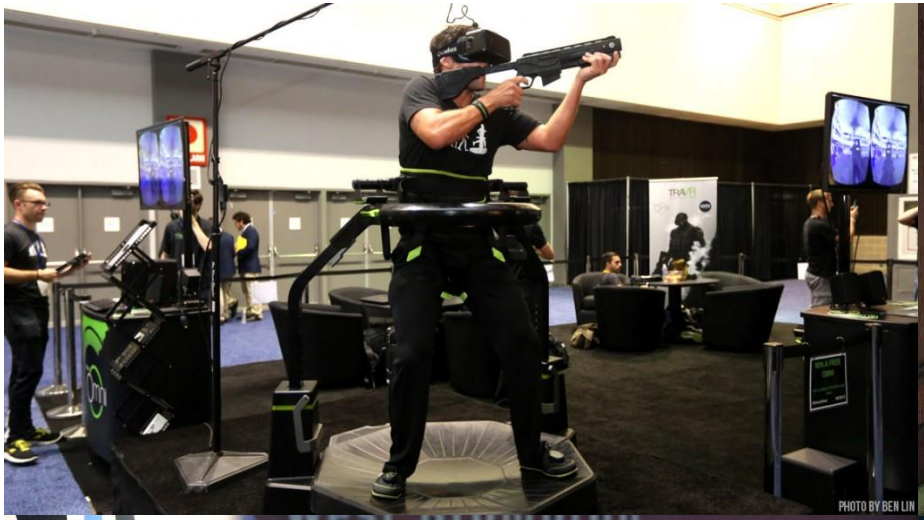


Medical Applications

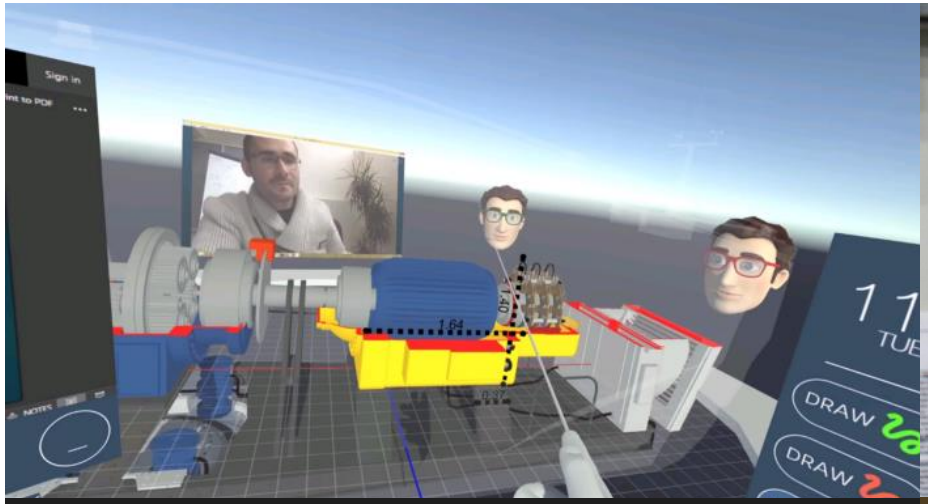


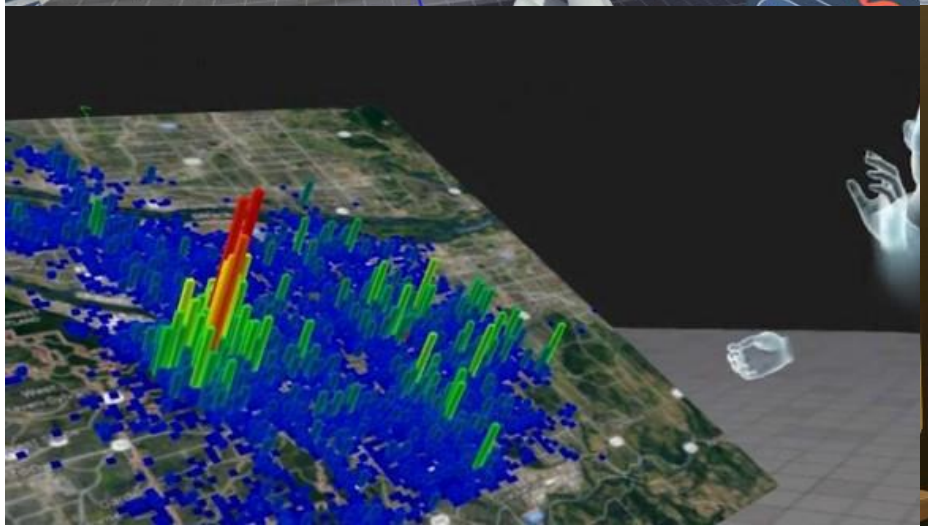


Virtual Reality



Virtual Reality





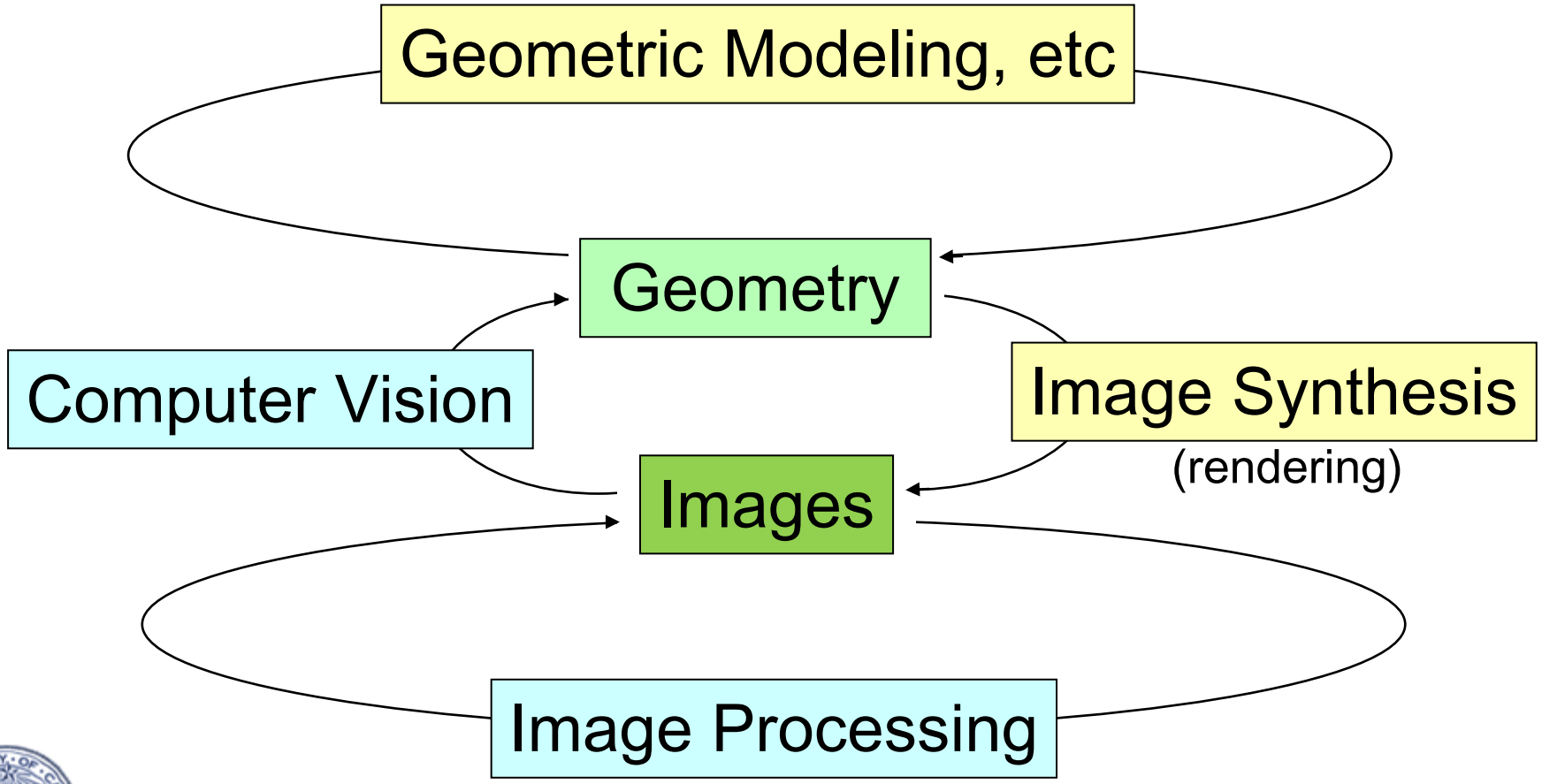
UC Merced WAVE

Wide Area Visualization Environment

- http://www.ucmerced.edu/news/2016/massive-vr-system-links-merced-world
- https://it.ucmerced.edu/Research-Computing-Visualization/WAVE

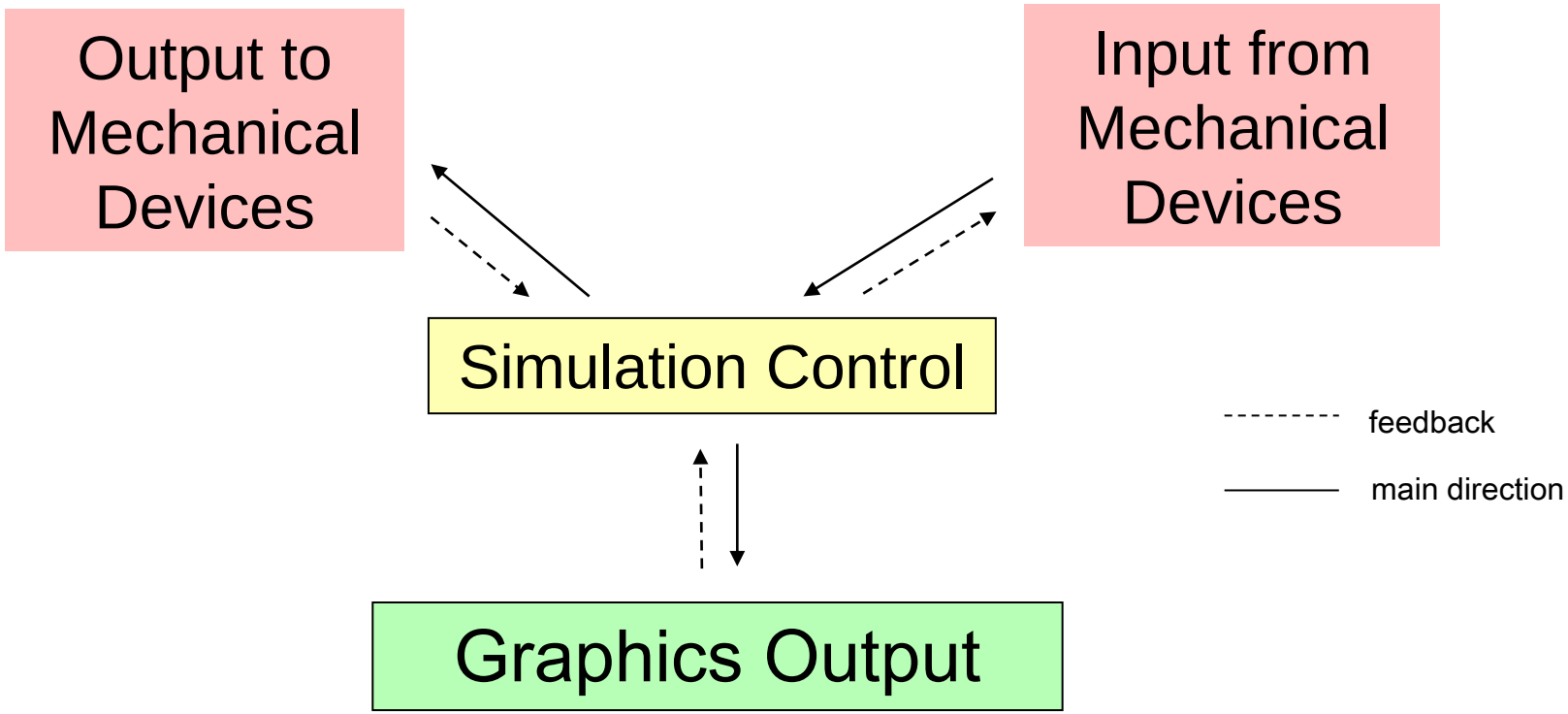
What is Computer Graphics?

- Computer Graphics is multidisciplinary: related to vision and image processing



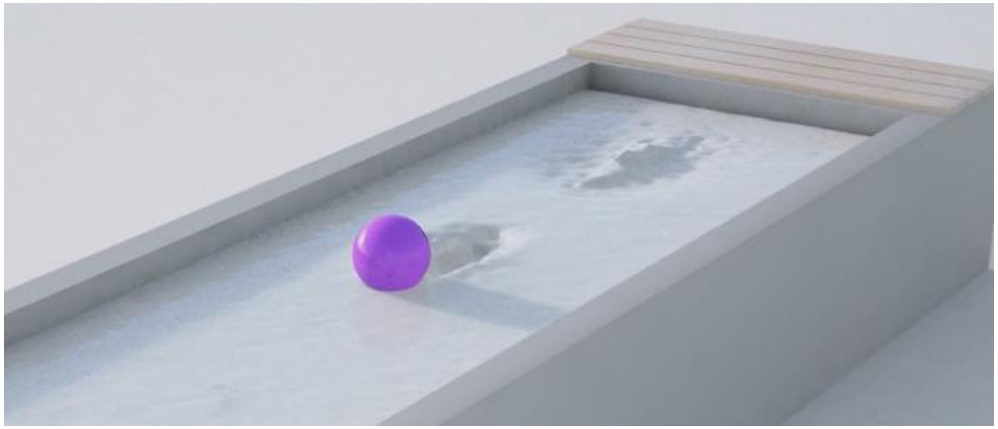
What is Computer Graphics?

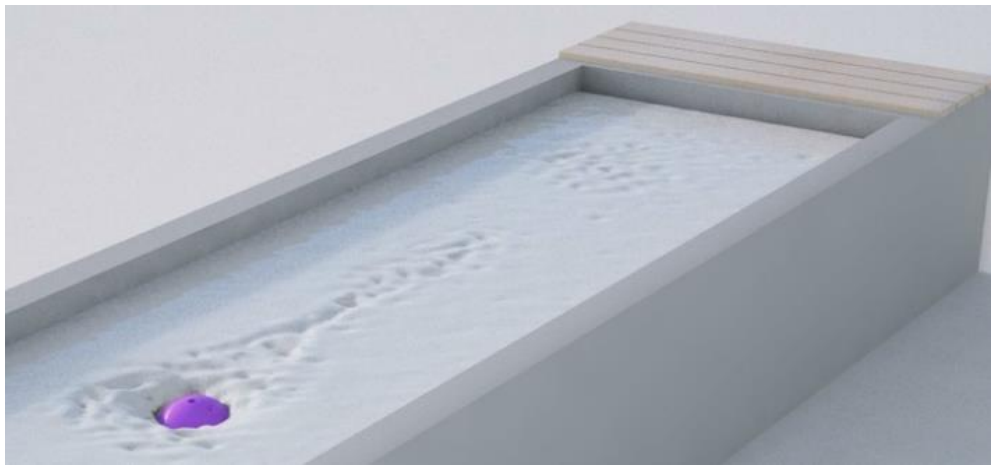
- It is often needed in applications connected to mechanical devices: simulators, VR, robotics applications, etc.



What is Computer Graphics?

- Very important for developing simulation models in animation, physics, ME, etc.





What is Computer Graphics?

- It is also related to algorithms
  - In particular:
    - Computational Geometry/Geometric algorithms
      - Triangulations, spatial search, mesh generation, path planning, mesh processing for 3D printing, etc.

Course Information

What will you learn in CSE-170?

- Fundamentals of computer graphics algorithms and techniques
- Understand how graphics APIs work
  - How to implement graphics applications with OpenGL and freeglut
  - What shaders are
  - Dealing with multi-file C++ projects
- For you to know what it takes to implement most of the applications mentioned today

What you will not learn:

We will not focus on:

- Software packages
  - AutoCAD, 3ds Max, Maya, Blender...
  - Photoshop, Unity, Unreal Engine...
- Artistic skills
- Game design
- Graphics APIs in depth
  - Only OpenGL basics
  - No Direct3D or Vulcan

What you should already know

- Basic data structures and algorithms
  - lists, trees, sorting, etc.
- C++
  - All assignments are in C++
- Linear Algebra
  - Vectors, matrices, solving systems of equations, inversion
- 3D Vector Algebra
  - Vector manipulation, cross and dot products, etc.
- We will quickly review some of the required math during the course

Course Content

- Geometric transformations
  - 2D, 3D, matrix/vector algebra
- Rendering pipeline (algorithms and models)
  - Rasterization, clipping, hidden surface removal, textures, color, lights, shading
- Curves and surfaces
  - Splines, Béziers, B-splines, etc.
- Solid modeling
  - B-Rep, CSG, Octrees, etc.
- Other topics
  - Ray tracing, etc.

Assignments and Grading

- Exams 40%
  - Midterm 20%
  - Final 20%

- 1 Project 20%
  - You will choose the topic

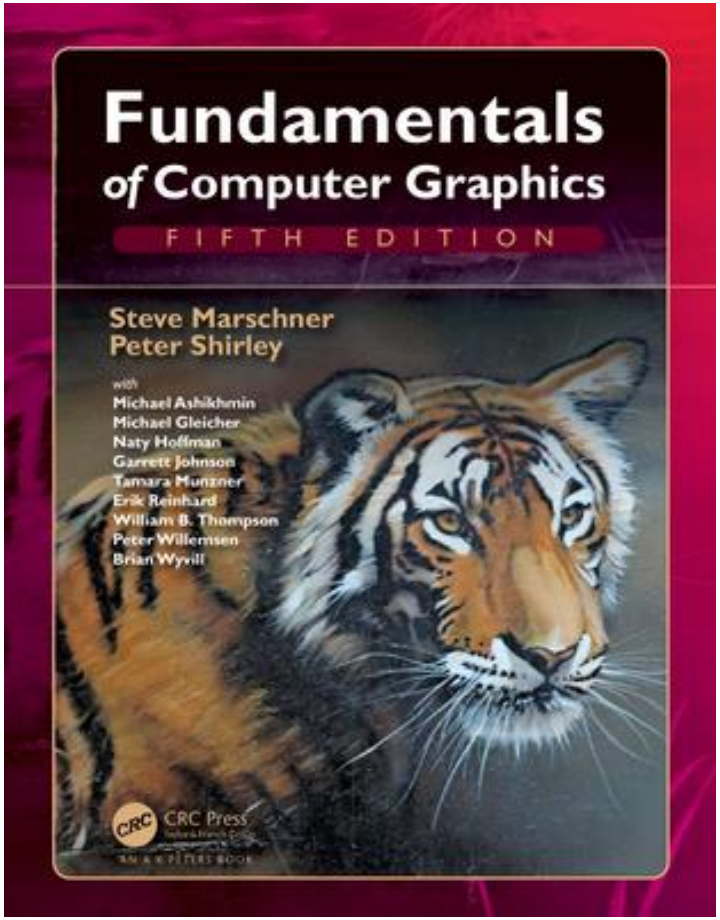
- Several Programming Assignments 40%
  - You will generally have 2 lab sessions to complete each PA:
    - Full schedule on CatCourses
    - Each PA is submitted and demonstrated to the TA before deadline
    - Late PAs (by max 1 week) is only accepted twice (with 20% penalty)
  - Read **parules.txt** on CatCourses
  - Read **Academic Honesty Policy.pdf**

Support

- Lecture slides
  - Slides will be uploaded to CatCourses
- Support code
  - Support code will be provided in the future for things such as working with GLSL shaders
- Consult the book!

Textbook

– Fundamentals of Computer Graphics (5th Edition)
Peter Shirley et al



General Polices

- Attendance is not mandatory
- Emails will generally be answered in less than 48 hours
  - I will likely not be able to answer emails late in the day, or on weekends and holidays, so plan accordingly!
  - Please include your class and lab section somewhere in the email
- Office hours will be announced on CatCourses in the near future

Questions?