

CENG 477

Introduction to Computer Graphics

Introduction

Computer Graphics

- What is Computer Graphics (CG)?

Any use of computers to create and
manipulate images

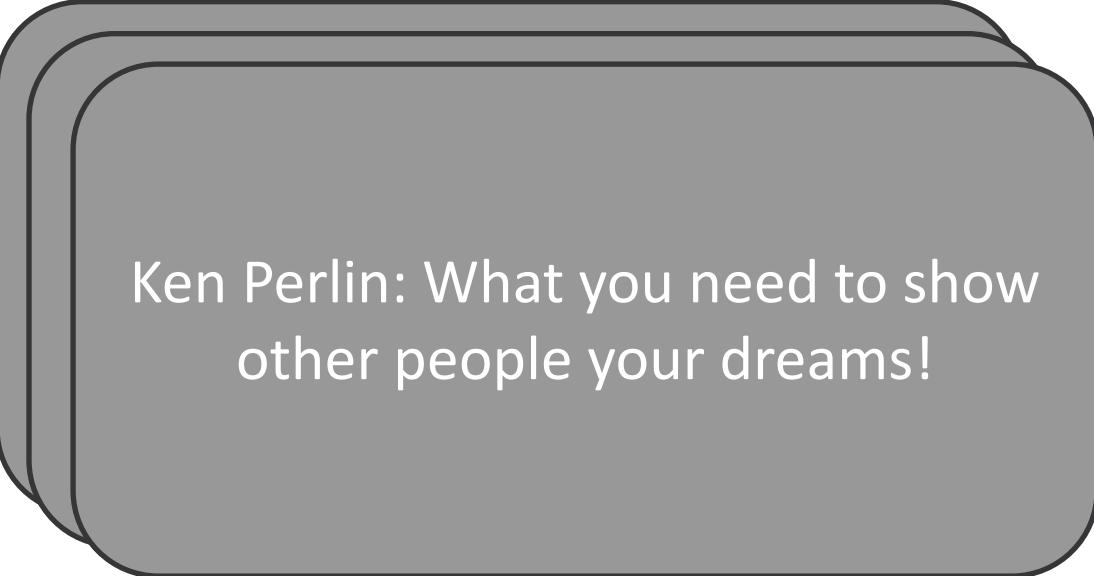
Computer Graphics

- What is Computer Graphics (CG)?

Tools and algorithms used to make
such pictures, software, and
hardware

Computer Graphics

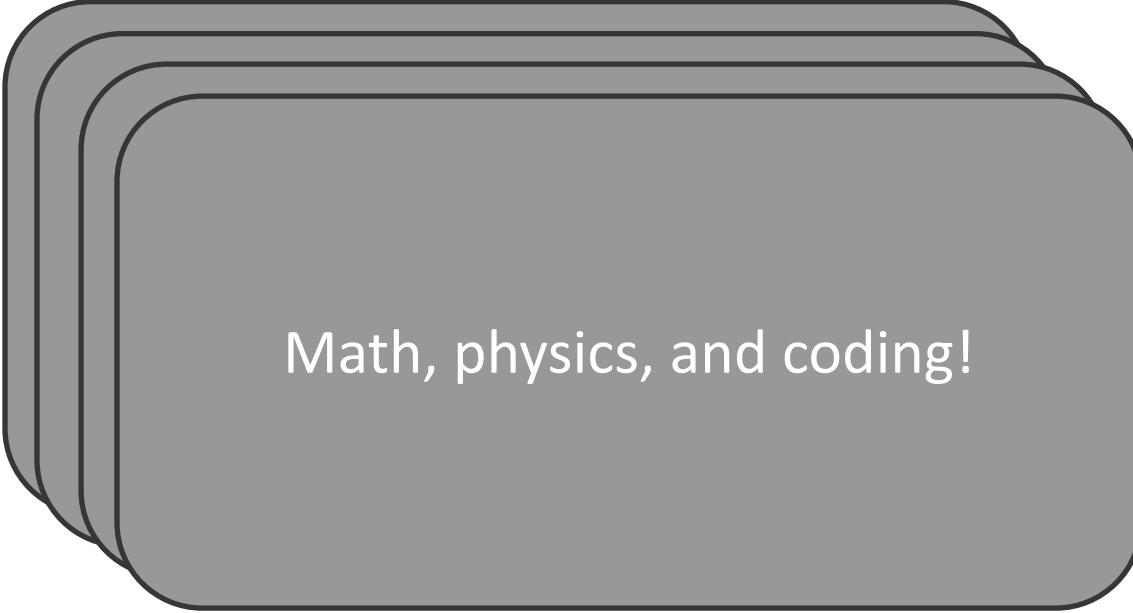
- What is Computer Graphics (CG)?



Ken Perlin: What you need to show
other people your dreams!

Computer Graphics

- What is Computer Graphics (CG)?



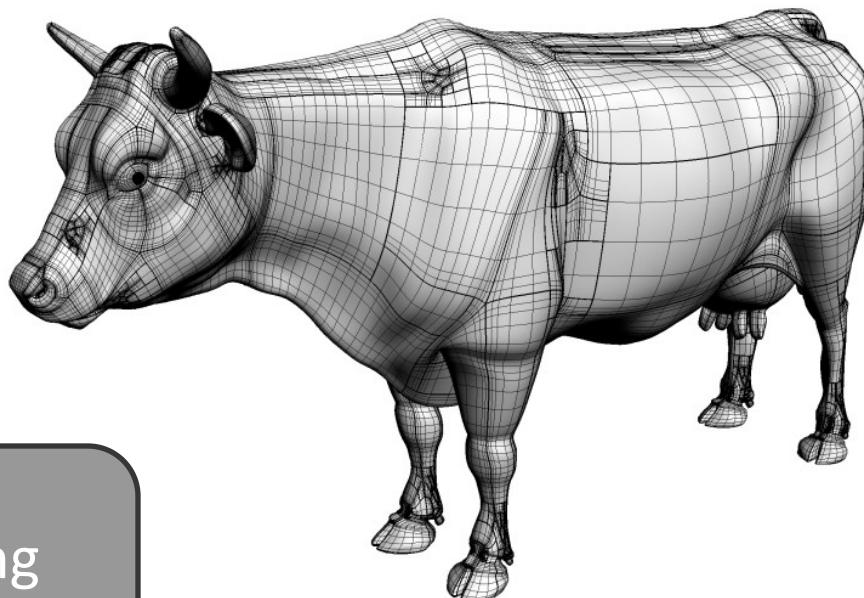
Math, physics, and coding!

Computer Graphics

- CG consists of three main subfields:
 - Modeling
 - Rendering
 - Animation

Modeling

- Modeling is the process of representing 3D shapes



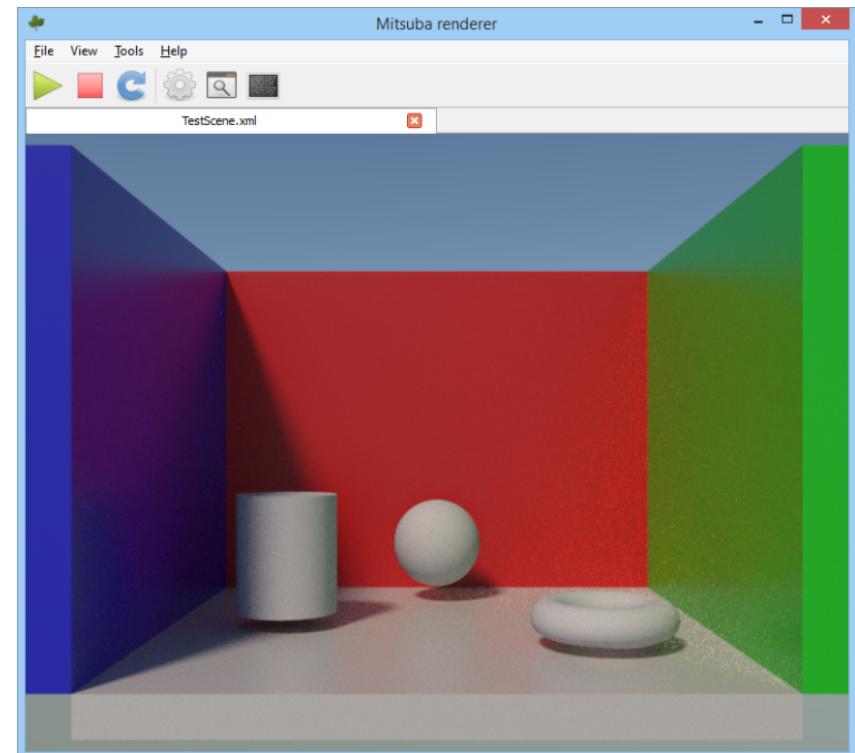
Many modeling
techniques exist

Headus COW Model

Rendering

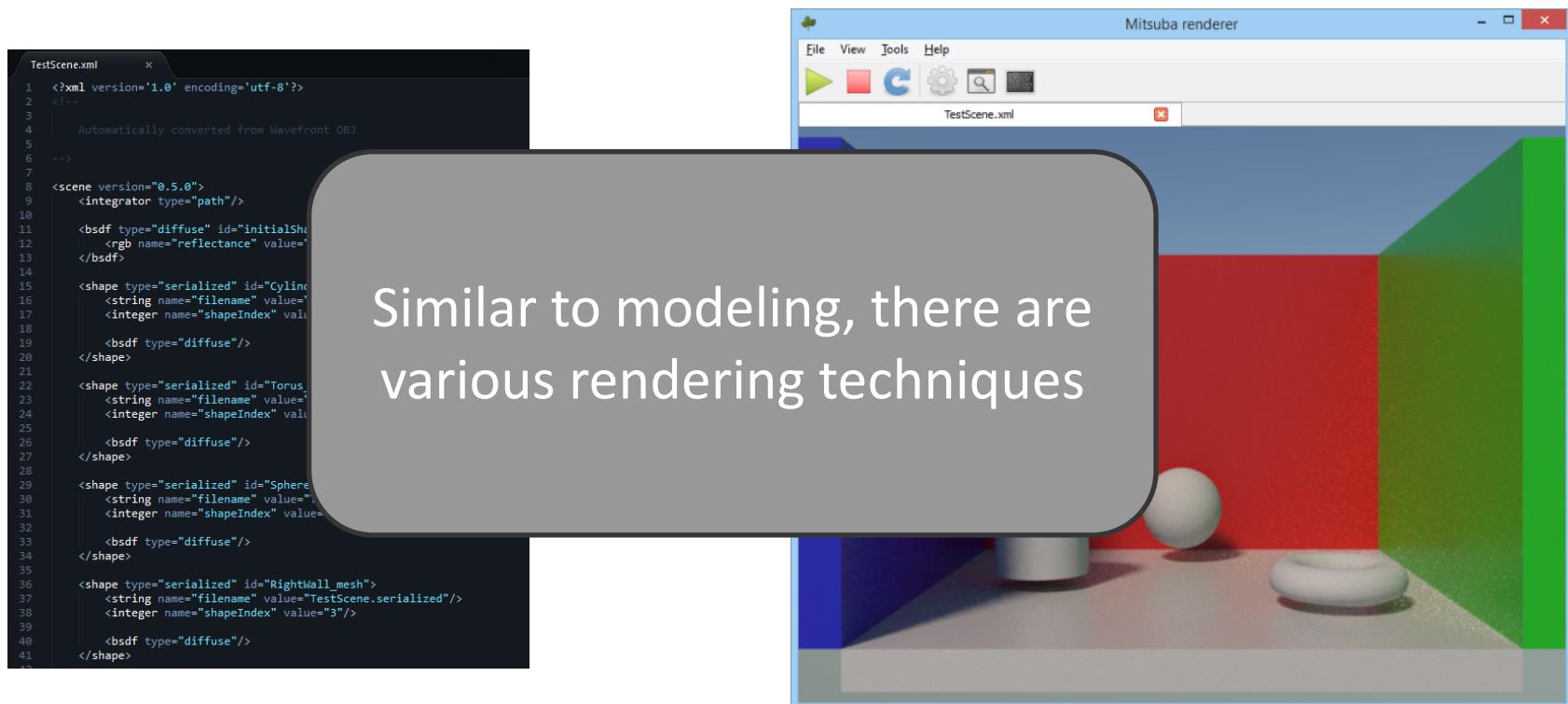
- Rendering is the actual process of generating an image from a scene definition file

```
TestScene.xml
1  <?xml version='1.0' encoding='utf-8'?>
2  <!
3
4      Automatically converted from Wavefront .OBJ
5
6  -->
7
8  <scene version="0.5.0">
9      <integrator type="path"/>
10
11     <bsdf type="diffuse" id="initialShadingGroup_material">
12         <rgb name="reflectance" value="0.214041 0.214041 0.214041"/>
13     </bsdf>
14
15     <shape type="serialized" id="Cylinder_mesh">
16         <string name="filename" value="TestScene.serialized"/>
17         <integer name="shapeIndex" value="0"/>
18
19         <bsdf type="diffuse"/>
20     </shape>
21
22     <shape type="serialized" id="Torus_mesh">
23         <string name="filename" value="TestScene.serialized"/>
24         <integer name="shapeIndex" value="1"/>
25
26         <bsdf type="diffuse"/>
27     </shape>
28
29     <shape type="serialized" id="Sphere_mesh">
30         <string name="filename" value="TestScene.serialized"/>
31         <integer name="shapeIndex" value="2"/>
32
33         <bsdf type="diffuse"/>
34     </shape>
35
36     <shape type="serialized" id="RightWall_mesh">
37         <string name="filename" value="TestScene.serialized"/>
38         <integer name="shapeIndex" value="3"/>
39
40         <bsdf type="diffuse"/>
41     </shape>
42
43
```



Rendering

- Rendering is the actual process of generating an image from a scene definition file



Animation

- Animation is the process of bringing life to virtual objects



The logo for UNIGINE, featuring the company name in a bold, sans-serif font with a double colon before it. Below the name, it says "3D Simulation and VR". To the right of the text is a large, stylized number "2" enclosed in a square bracket-like frame, with the word "Sim" positioned next to it.

The Goal

- The main goal of CG is to create realistic images as fast as possible



The Goal

- This often requires vast computational resources



A photo of the LucasFilm Rendering Farm (by Peter Sciretta)

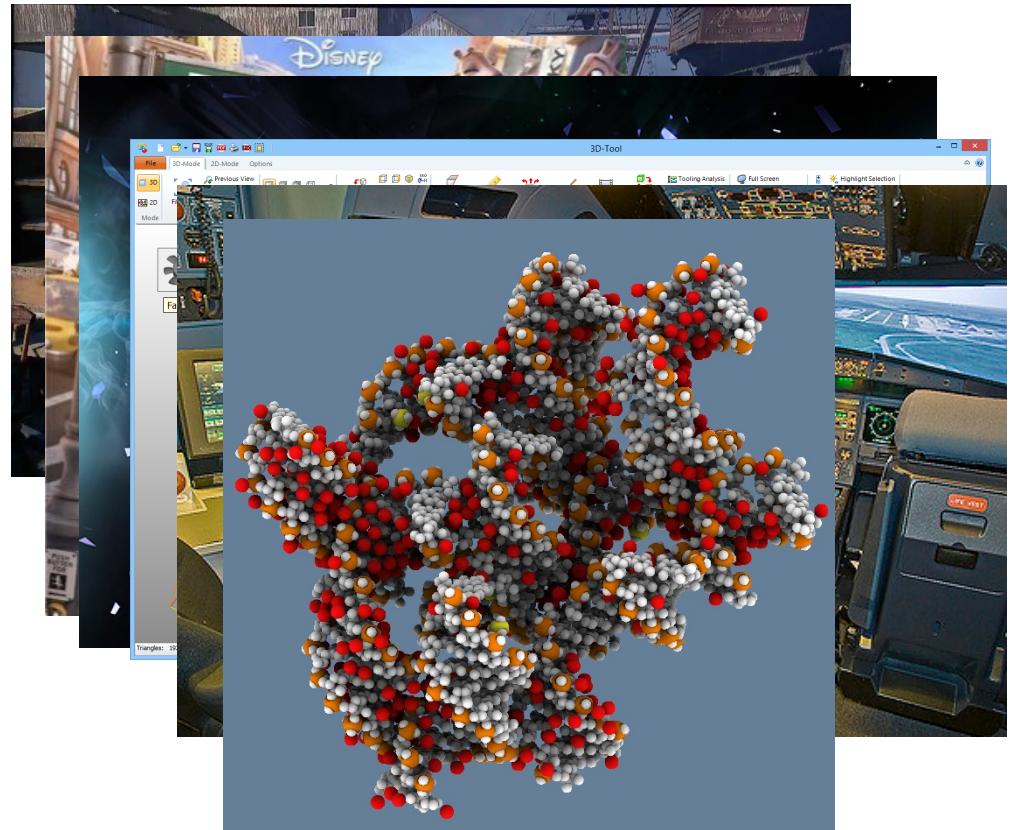
Other Goals

- Besides creating realistic images CG also aims to create
 - informative technical illustrations
 - architectural drawings
 - nonphotorealistic images
 - geeky (and very cool) art



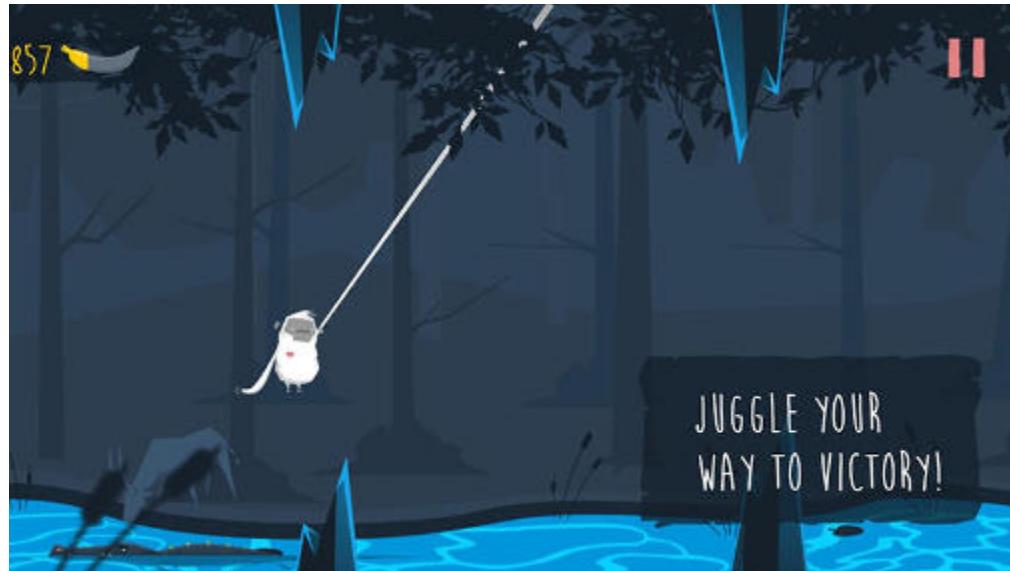
Application Areas

- CG is extensively used for:
 - video games
 - animation movies
 - visual effects
 - CAD/CAM tools
 - simulation/training
 - scientific visualization



2D vs 3D

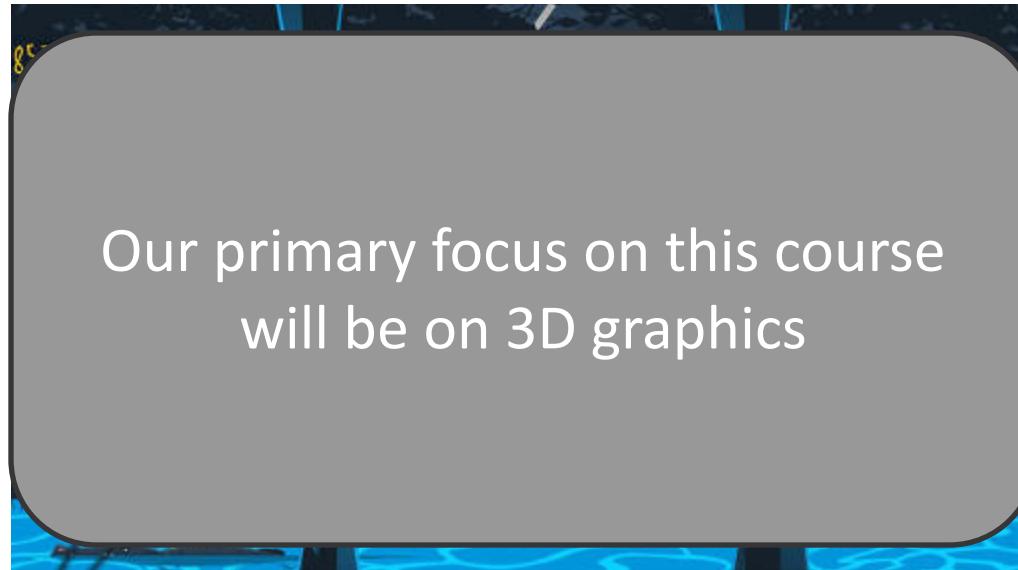
- Both 2D and 3D rendering falls in the realm of computer graphics
- Many mobile games are in fact 2D



MoBu by Panteon Games

2D vs 3D

- Both 2D and 3D rendering falls in the realm of computer graphics
- Many mobile games are in fact 2D



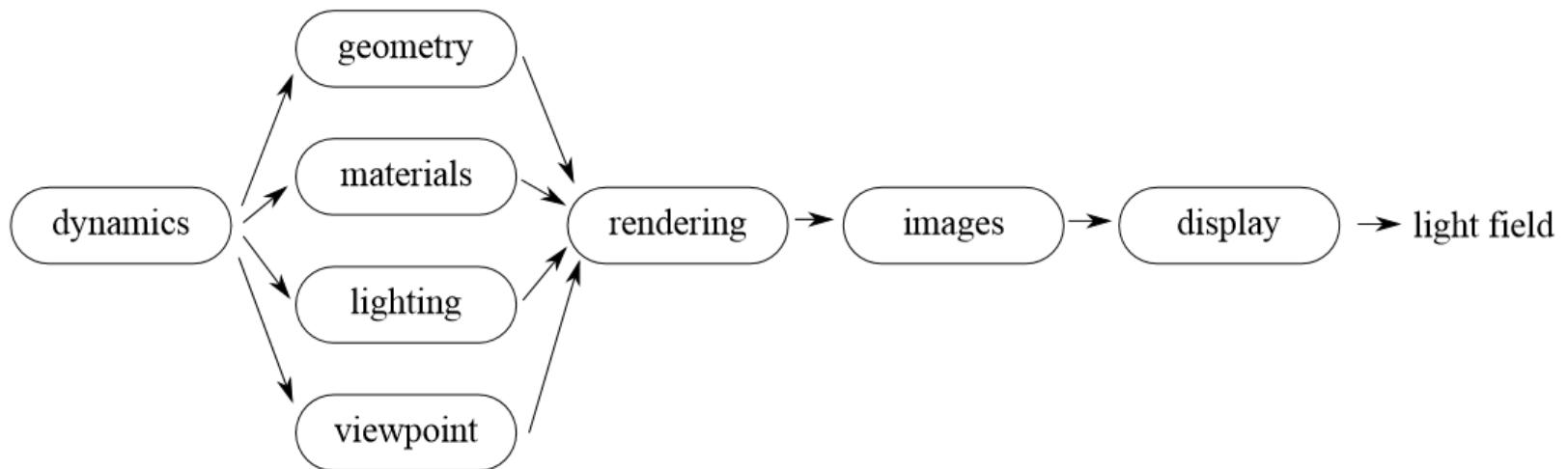
MoBu by Panteon Games

This Course

- In this course, we will learn a little bit about all three subfields within CG
- Our focus will be on 3D rendering but we will touch upon modeling and animation as well

The Overall Pipeline

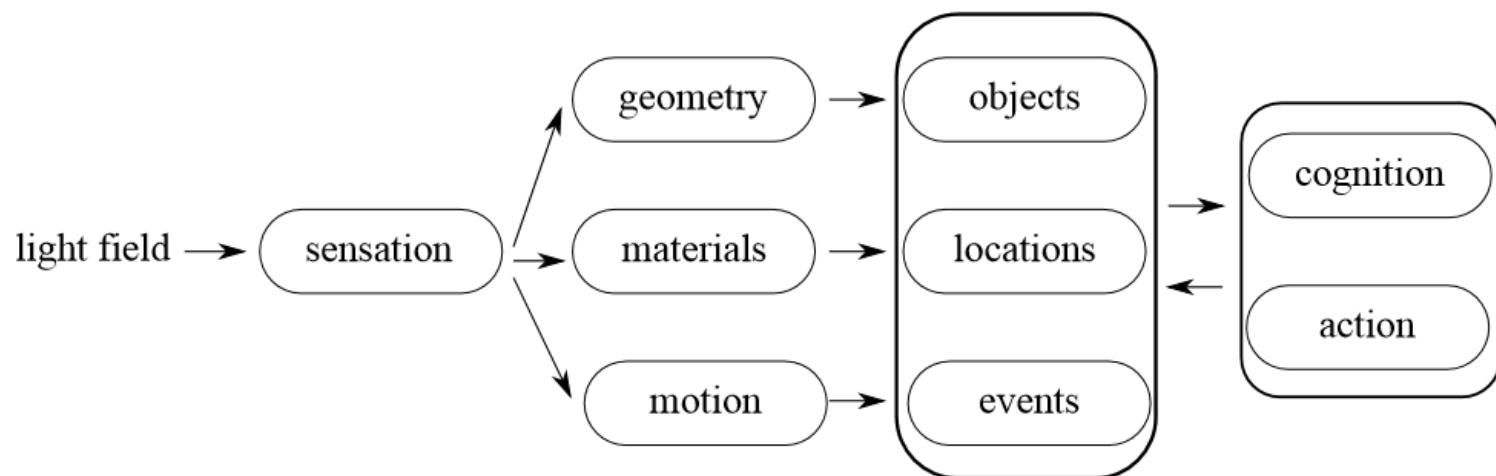
- Image generation is a result of scene definition realized by rendering which ultimately is sent to a display device



William Thompson et al. Visual perception from a computer graphics perspective. CRC Press, 2011.

The Overall Pipeline

- The output is perceived by a human observer, who may then interact with the system



Display Devices and Perception

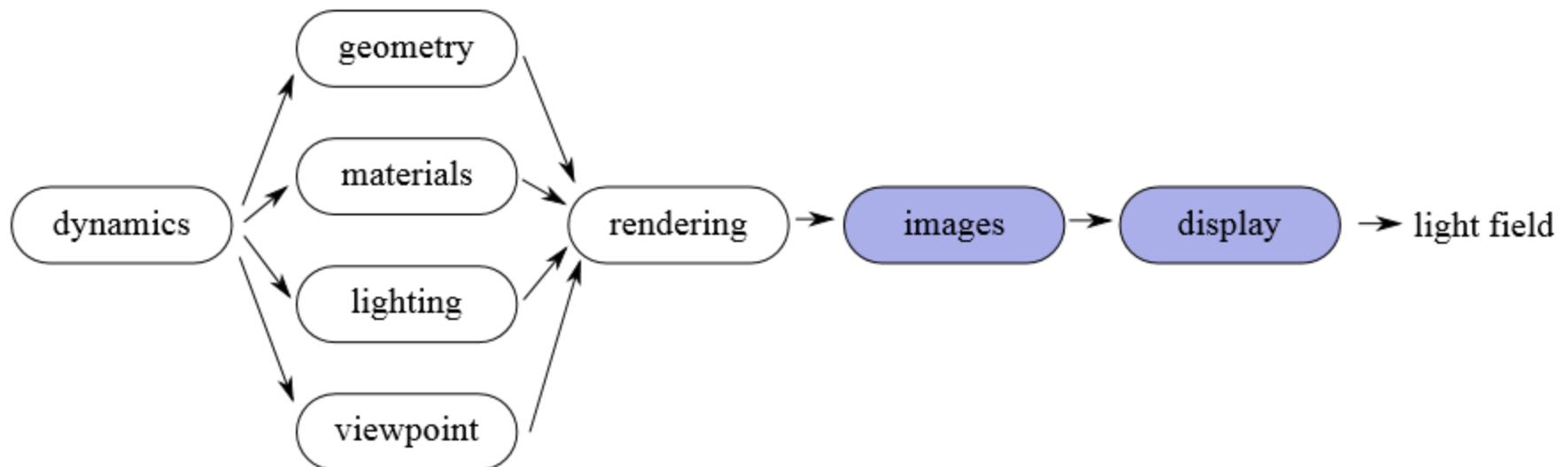
- Therefore, graphic algorithms must take into consideration the target **display device** and the viewers' capabilities
 - No need to render an 8K image if the target display device is 2K
 - No need to render tiny details that cannot be perceived by a human

Images and Video

- Also, the output of rendering is an **image**, also known as a **frame**, which can be directly sent to a display device (real-time rendering) or saved for offline viewing as an image or a sequence of images stored in a **video**
- Therefore, as a starting point, it is important to understand the basic properties of
 - images,
 - display devices,
 - and the human visual system

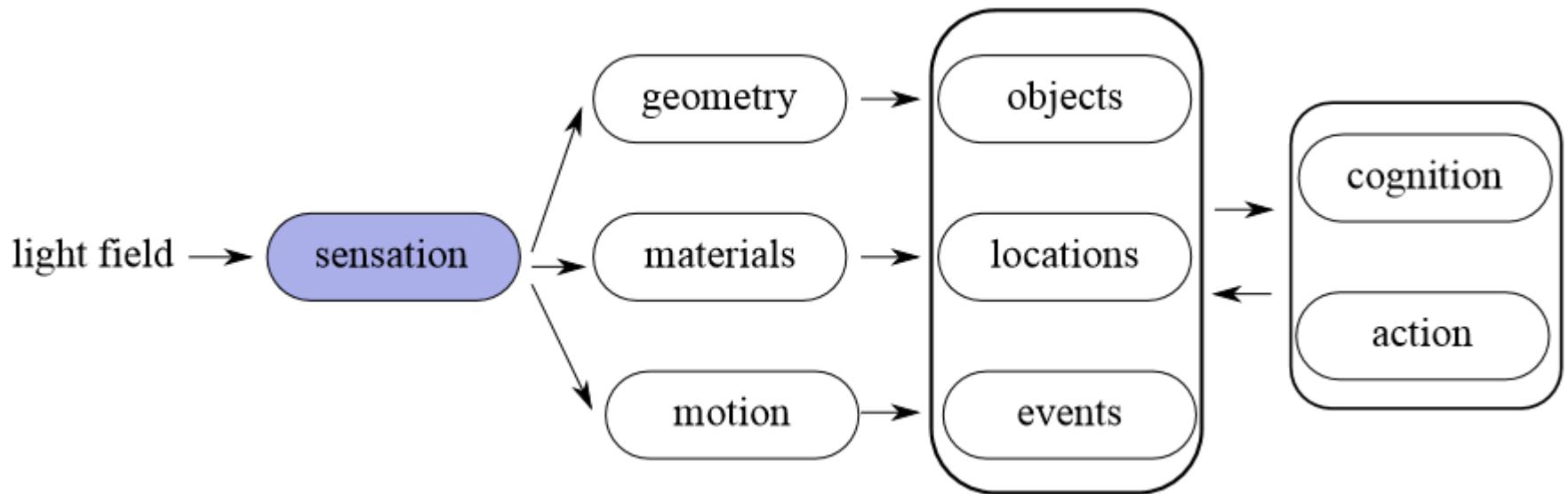
Course Progression

- We will first start with images and displays



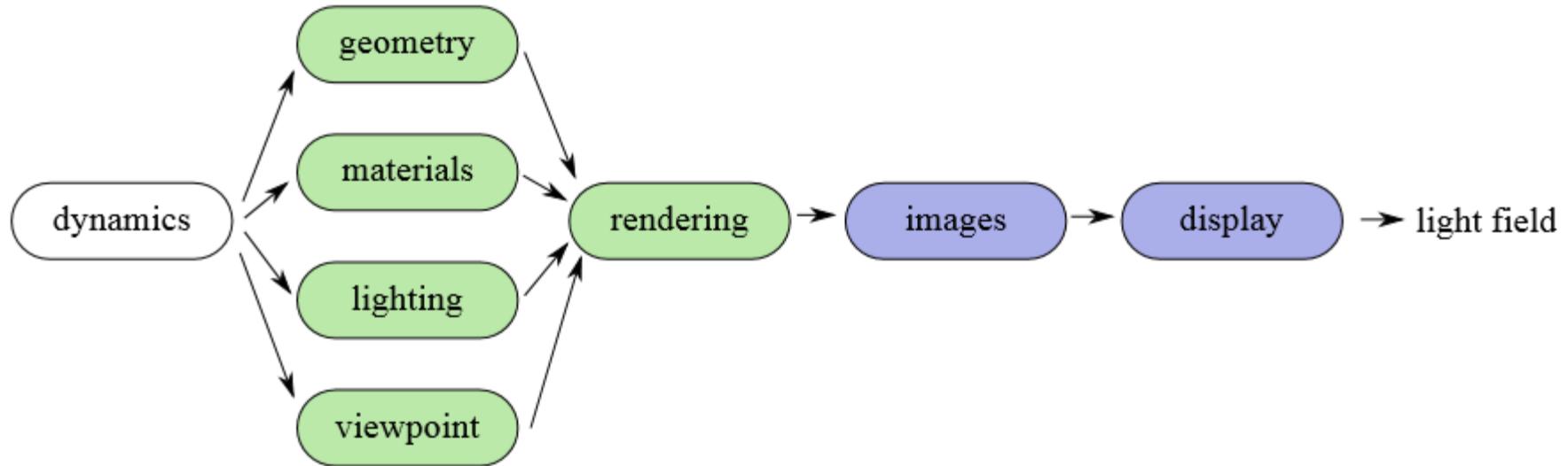
Course Progression

- We will then talk a little bit of visual perception



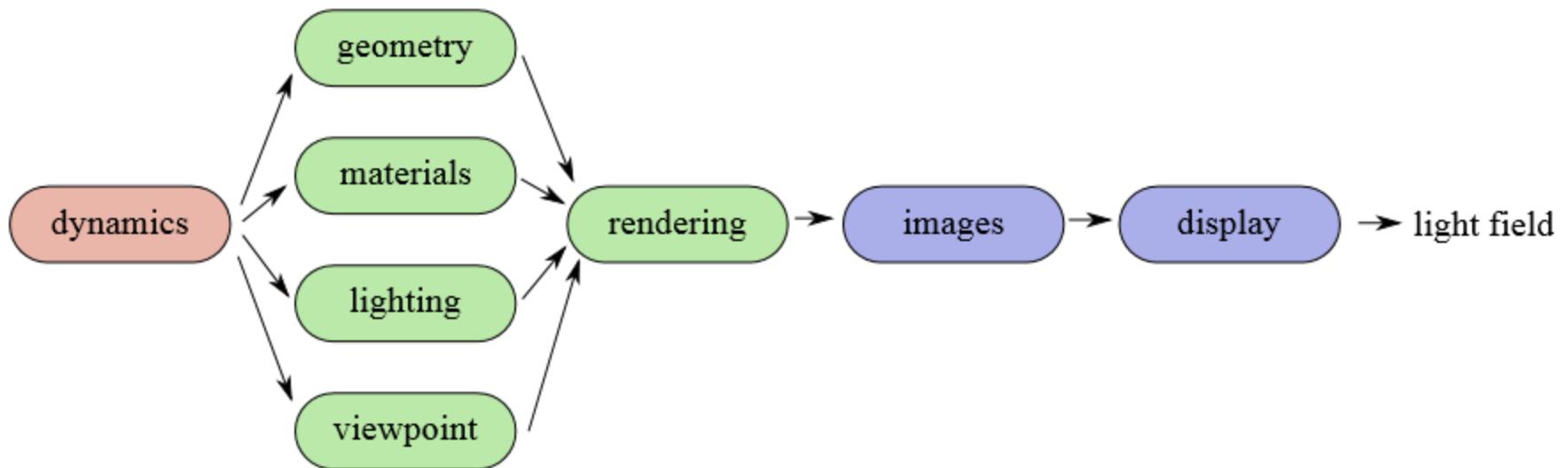
Course Progression

- Next, we will learn about modeling and rendering



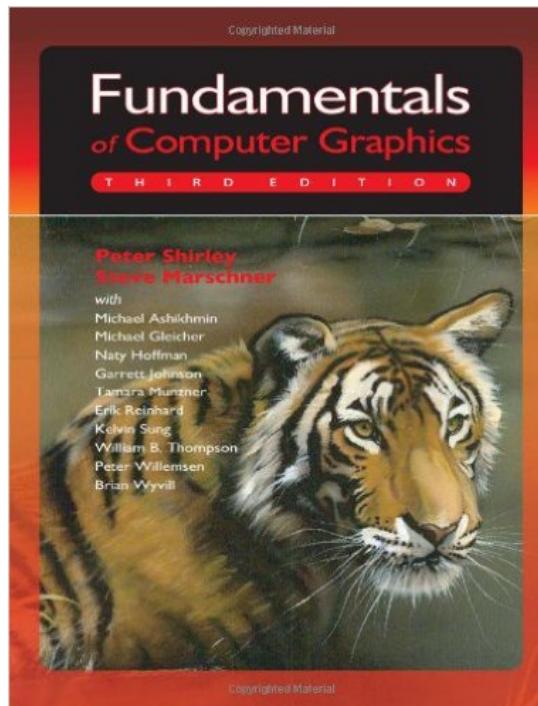
Course Progression

- We will finally touch upon animation



Text Book

- Our text book will be Fundamentals of Computer Graphics by Shirley et al.



Website

- Our course website is located at:
 - www.ceng.metu.edu.tr/courses/ceng477
- Check it out for important news and updates
- We will use ODTUCLASS (<https://odtuclass.metu.edu.tr>) for homeworks, discussions, and announcements

Grading

- 1 midterms
- 1 final
- 4 programming assignments
 - Must use C/C++
 - Can be done in pairs
 - We will learn and use OpenGL in some assignments
- The up-to-date syllabus can be reached through ODTUSyllabus, ODTUClass, and the course website