

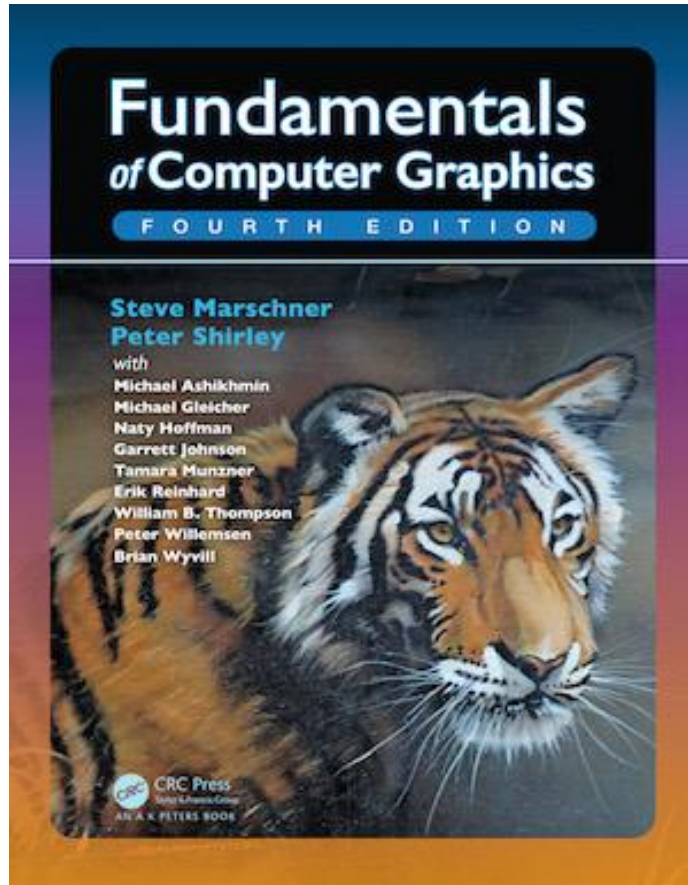
CSE4203: Computer Graphics
Chapter – 1
Introduction

Mohammad Imrul Jubair

Outline

- What is CG
- CG Areas
- Major Applications
- Graphics API

Credit



CS4620: Introduction to Computer Graphics

Cornell University

Instructor: Steve Marschner

<http://www.cs.cornell.edu/courses/cs4620/2019fa/>

What is CG? (1/1)

- The term computer graphics describes any use of computers to **create** and **manipulate** images.
 - Graphics can be 2D or 3D
 - Images can be completely synthetic or can be produced by manipulating photographs.

CG Areas (1/4)

- **Modeling:**
 - deals with the **mathematical specification:**
 - shape and appearance properties in a way that can be stored on the computer.

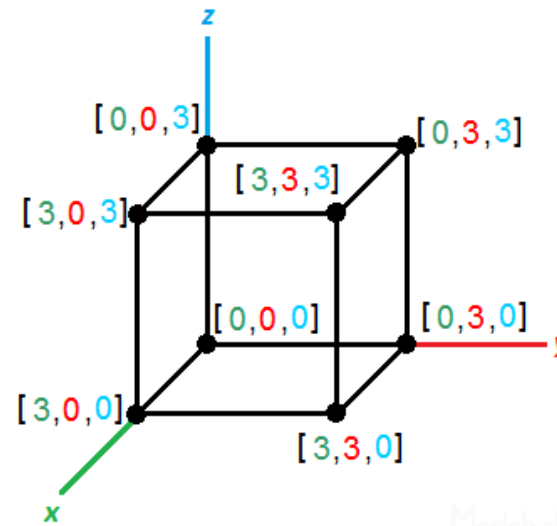
CG Areas: Metaphor



Source: <https://youtu.be/6Sv4oXSTAmS>

CG Areas (2/4)

- **Modeling:** Example –
 - an object can be described as 3D coordinates:
[0, 0, 3], [0, 3, 3], [0, 3, 0], [0, 0, 0],
[3, 0, 3], [3, 3, 3], [3, 3, 0], [3, 0, 0]
 - connect the points



Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

CG Areas (3/4)

- **Rendering:**
 - a term inherited from art
 - deals with the **creation of shaded images** from 3D computer models.

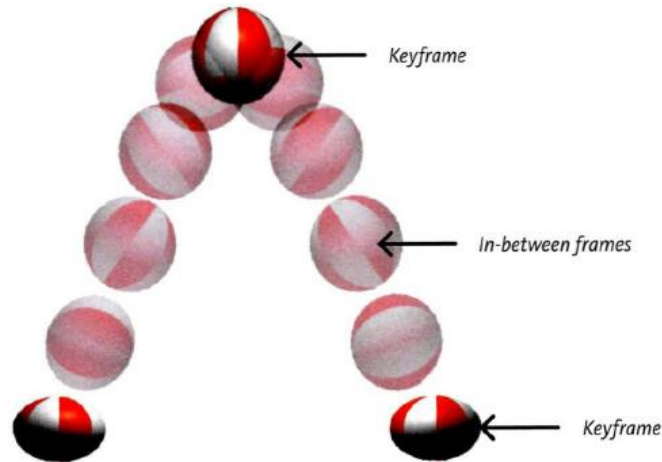


Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

CG Areas (4/4)

- **Animation:**

- creates an **illusion of motion** through sequences of images.
- uses modeling and rendering but adds **movement** over time



Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

Major Applications (1/12)

- Video games
- Cartoons
- Visual effects
- Animated films
- CAD/CAM
- Simulation
- Medical imaging
- Information visualization

Major Applications (2/12)



Games (2D)

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Major Applications (3/12)



Games (3D)

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Major Applications (4/12)



Movies (VFX)

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Major Applications (5/12)



Movies (Animated)

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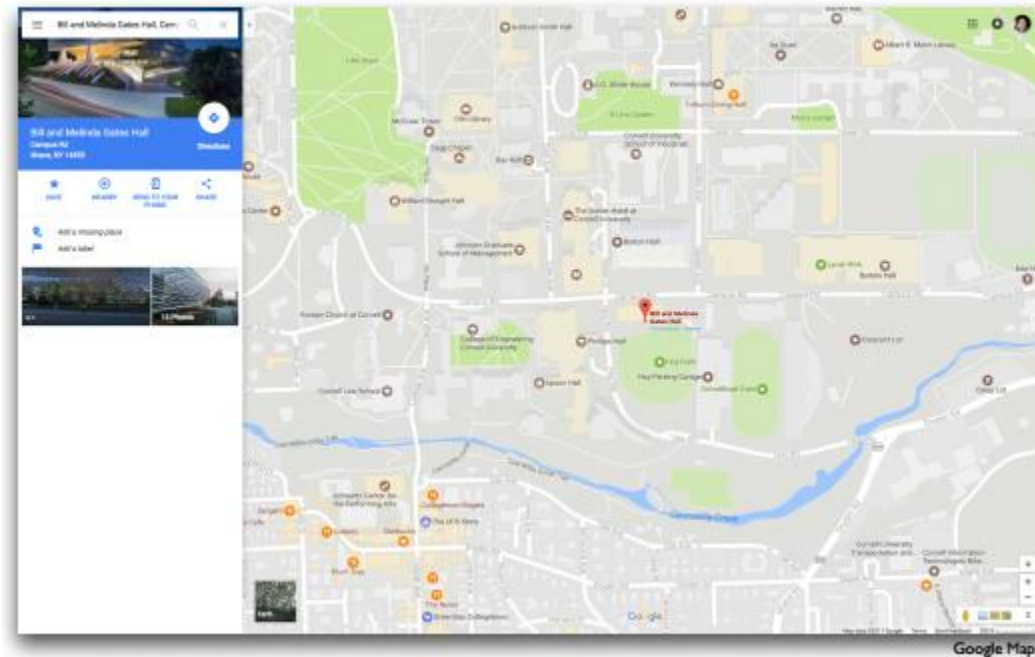
Major Applications (6/12)



Fonts

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Major Applications (7/12)



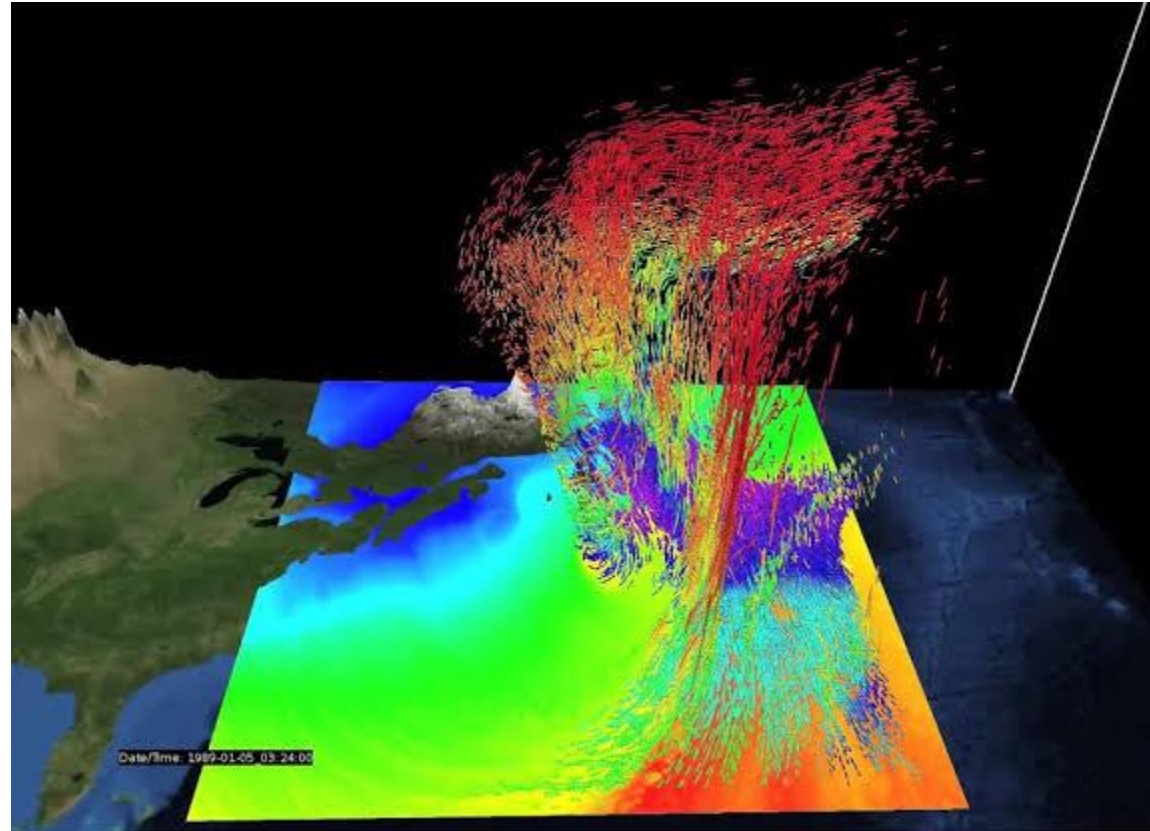
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(with previous iterations, jsmv/fab)

Google Maps

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Major Applications (8/12)



Scientific Visualization (SciVis)

Source: <https://youtu.be/eJy5dHMY-S4>

Major Applications (10/12)



U. of Utah—Alpha 1

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(with previous instructors James/Babe)

CAD (3D modeling)

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Major Applications (11/12)



Simulation

Source: <https://www.aircharterservice.com/about-us/news-features/blog/are-vr-flight-simulators-the-future-of-pilot-training>

Major Applications (12/12)



Simulation

Source: <https://www.financialexpress.com/sports/what-is-drs-all-the-the-rules-number-of-chances-and-components-explained/578996/>

Graphics API (1/2)

- A **graphics API** is a set of functions that perform basic operations such as –
 - drawing images and 3D surfaces into windows on 2D screen.

Graphics API (2/2)

Every *graphics program* needs to be able to use two related APIs

–

– **Graphics API** for visual output.

- Ex:

- i.e. command for drawing lines, circles etc.

– **User-interface API** to get input from the user.

- Ex:

- Window

- Receiving mouse and keyboard input

Graphics Pipeline (1/5)

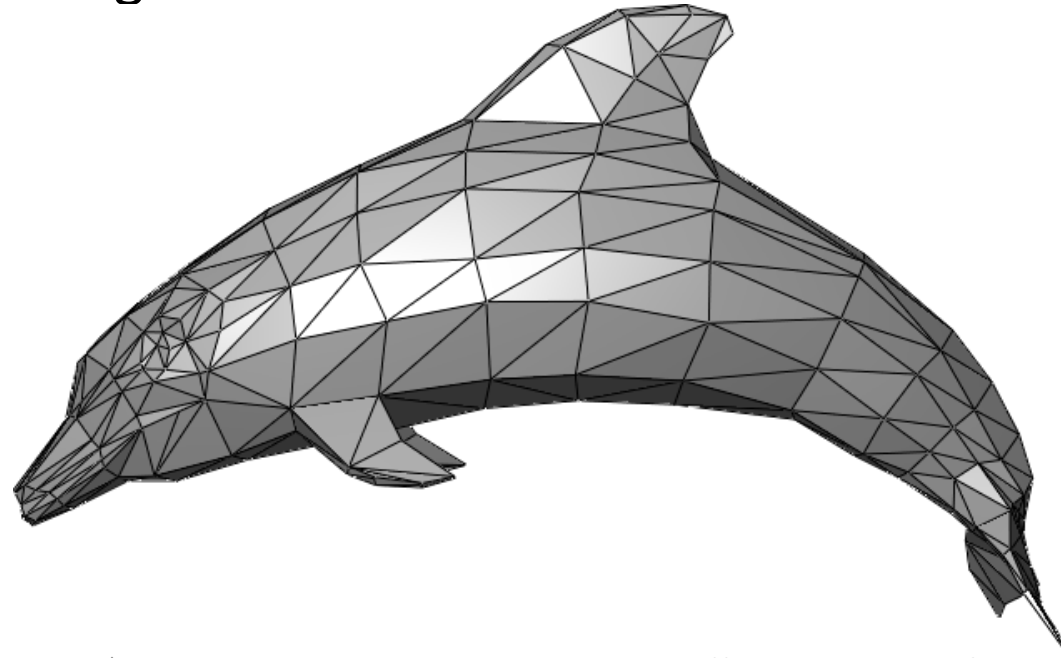
- Special software/hardware subsystem that maps the **3D vertex** locations to **2D screen**.
- From modeling to rendering.
 - Shade the triangles –
 - Realistic
 - Proper back-to-front order.

Graphics Pipeline (2/5)

- Use **3D triangles**.
 - Why triangles?
 - It is the **simplest** universal surface element
 - A line or a point are even simpler, but do not create surfaces.
 - **Q: Why not quads or higher?**

Mesh (1/2)

- A polygon mesh is a collection of vertices, edges and faces that defines the shape of a polyhedral object.
 - Ex. *Quad* mesh, Triangle mesh.



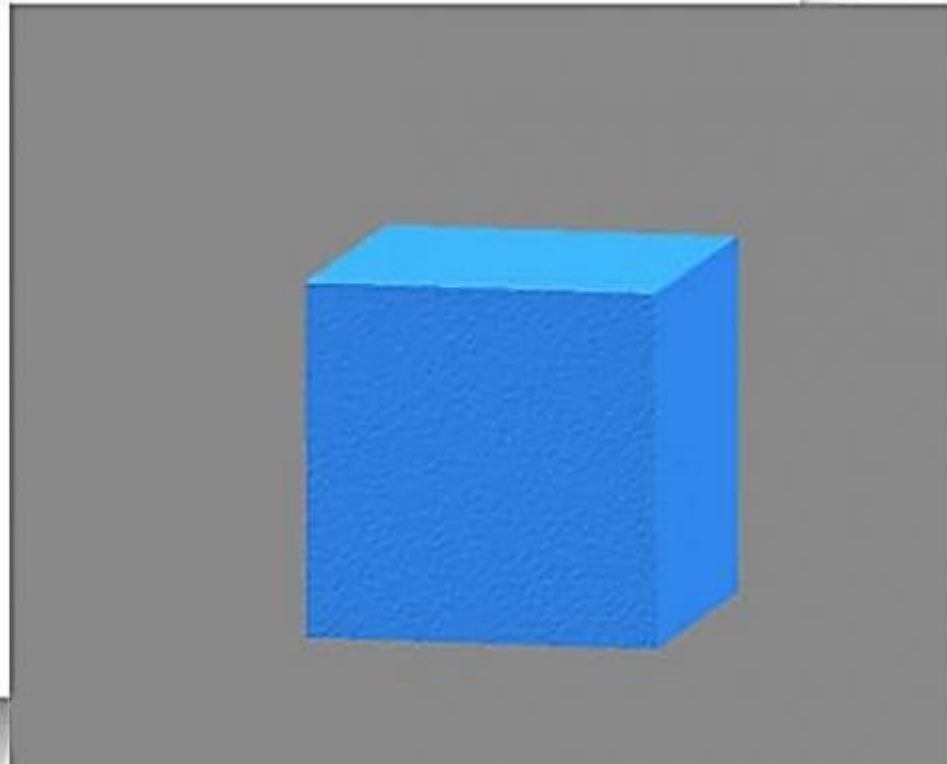
Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/> | https://en.wikipedia.org/wiki/Triangle_mesh

Mesh (2/2)

.obj file

```
v 1.000000 1.000000 0.000000
v 1.000000 0.000000 0.000000
v 0.000000 0.000000 0.000000
v 1.000000 1.000000 1.000000
v 0.000000 0.000000 1.000000
v 0.999999 -0.000000 1.000000
v 0.000000 1.000000 1.000000
v 0.000000 1.000000 0.000000

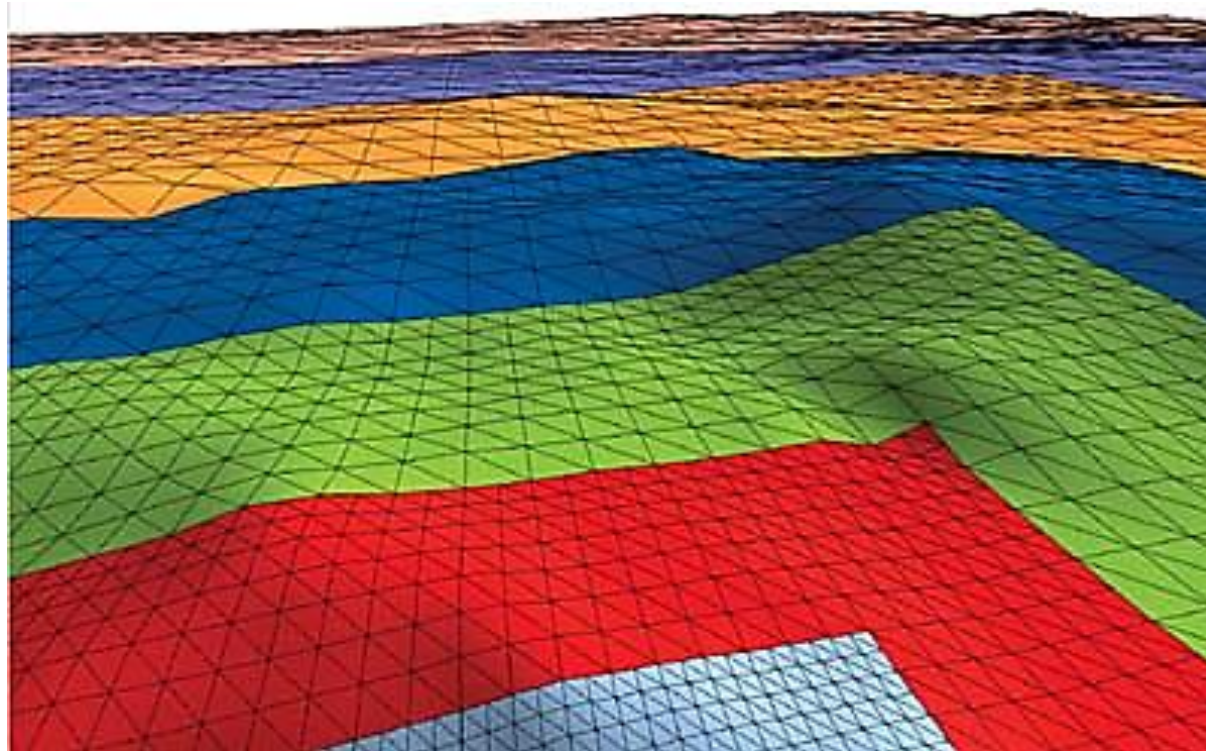
f 1 2 3
f 1 3 8
f 4 7 5
f 4 5 6
f 1 4 6
f 1 6 2
f 2 6 5
f 2 5 3
f 3 5 7
f 3 7 8
f 4 1 8
f 4 8 7
```



Source: <https://www.sculpteo.com/en/glossary/obj-file-3d-printing-file-format/>

LoD

- Rendering speed \leftrightarrow number of triangles being drawn.
- *Level-of-Detail:*



Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>
Source: <https://developer.nvidia.com/gpugems/gpugems2/part-i-geometric-complexity/chapter-2-terrain-rendering-using-gpu-based-geometry>

Additional Reading

- 1.7: Designing and Coding Graphics Programs

Thank You