Computer Graphics

CS 354

Introductions

I am Dr. Sarah Abraham

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- office hours: TTh 3:00—5:00

The TA is Chen Song

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- office hours: W 1:00-3:00

Assignment and Grading

Homeworks (20%)

5 **projects** (50%)

- 2-3 weeks each

Final **project** (20%)

- Open-ended
- Includes a presentation on an “advanced” topic in graphics

Participation and **in-class quizzes** (10%)

Project Logistics

- Can work in pairs
  - Both students get same grade
  - Late slips shared (both must submit)
- First projects will be in C++ and remaining will be in WebGL
  - C++ projects must run on 3rd floor lab machines
  - WebGL projects must run in requested browser

Classroom Logistics

- Lecture time
- In-class discussions
  - Concepts stick better when they're hands-on!
- Attendance is mandatory
  - We will have periodic participation quizzes to check attendance and understanding

Attendance Side Note

- This is an upper division elective with a high workload
- What we discuss in class will directly relate to your projects
- But also you’re paying for the lectures with your tuition so why not come/
- And really, there is absolutely no reason to take this class unless you are actually interested in the material!

Prerequisites

Linear Algebra

- CG could be “applied linear algebra”
- Will show up over and over again
- We will review it in class and with worksheets
- **Stop and ask questions if something is unclear**

Prerequisites

Linear Algebra

Basic C++

- C++ is performant
- A common skill for working in computer graphics
- We are also working in Typescript/WebGL but A2 and A2 are C++
- Please help students with less C++ experience on Discord
    - It’s okay to share pieces of code so long as it’s not the whole solution!

Prerequisites

Linear Algebra

Basic C++

Engineering large software systems

- Debugging complex code
- Using poorly-documented libraries
- Time management
- Good project planning

What This Class is NOT About

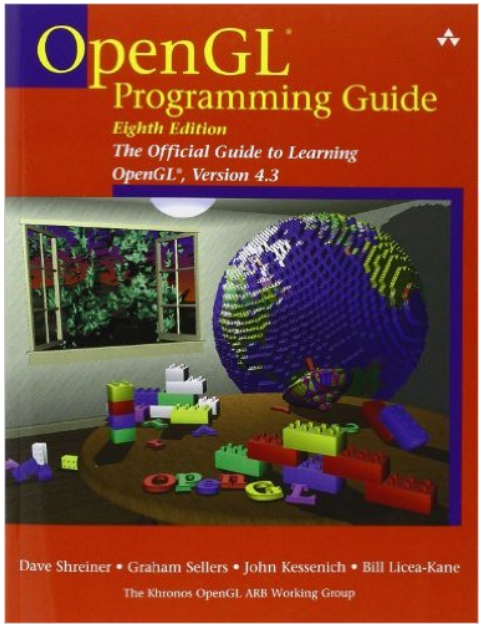
What This Class is NOT About

A 3D modeling tutorial…

What This Class is NOT About

A C++ or GLSL (shading language) tutorial

But I will recommend working through http://www.opengl-tutorial.org/ to help you get your bearings!



A Brief History of Graphics

Dark Ages: blinking lights, Teletype

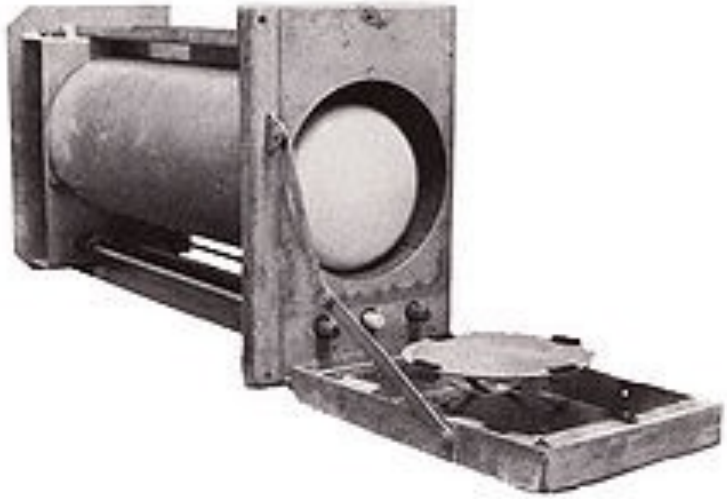
[UNIVAC I, 1951]

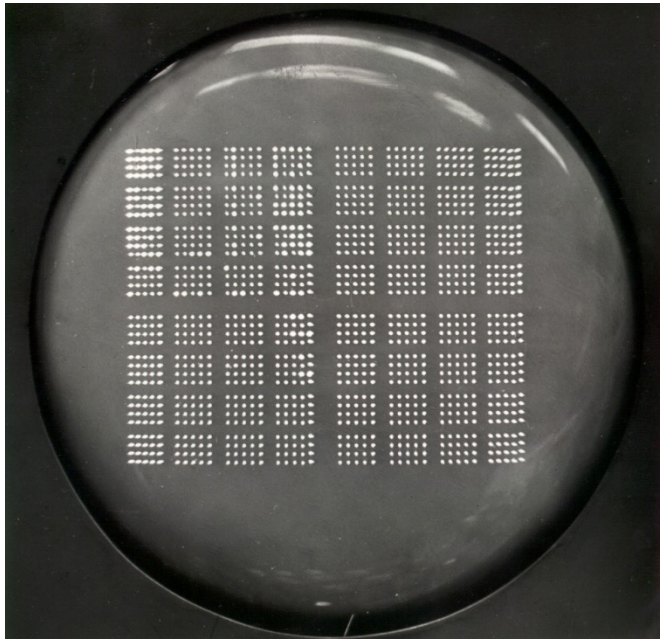
[Model 33, 1963]

Dark Ages

1940s: cathode ray tubes (CRTs)

- originally used as computer memory





1960s

CRTs can do basic vector graphics

[PDP-1 running “Spacewar!”, 1962]

real time by early 60s

1960s

CRTs can do basic vector graphics

[DataPoint 3300]

computer terminals
(“virtual teletype”)
mass-produced in ‘67

1960s

1968: Ray tracing invented

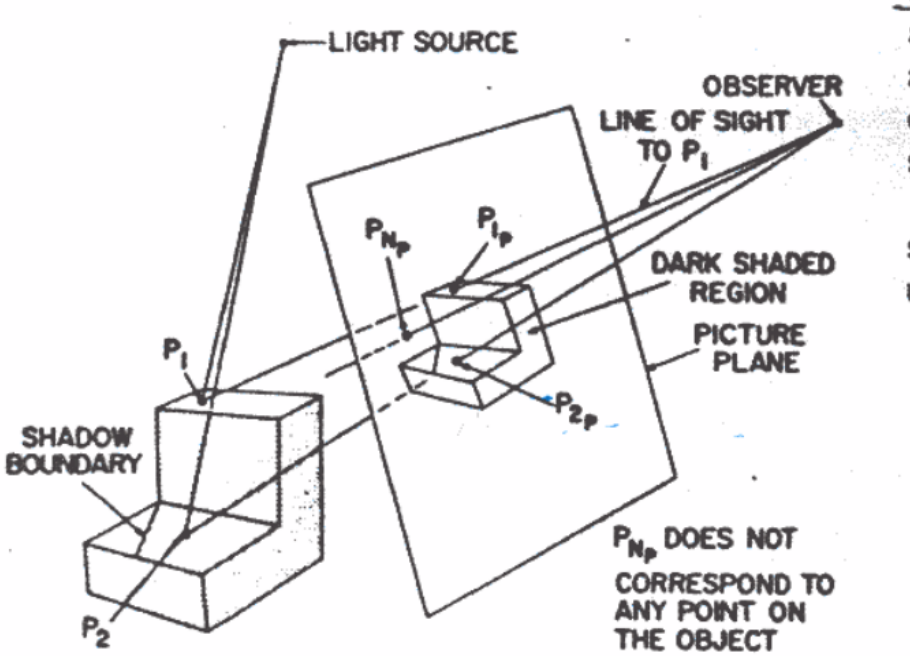
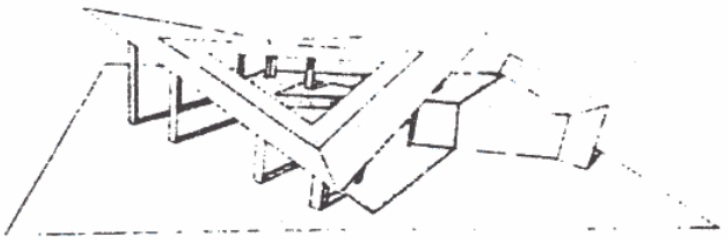


Figure 6 – Point by point shading

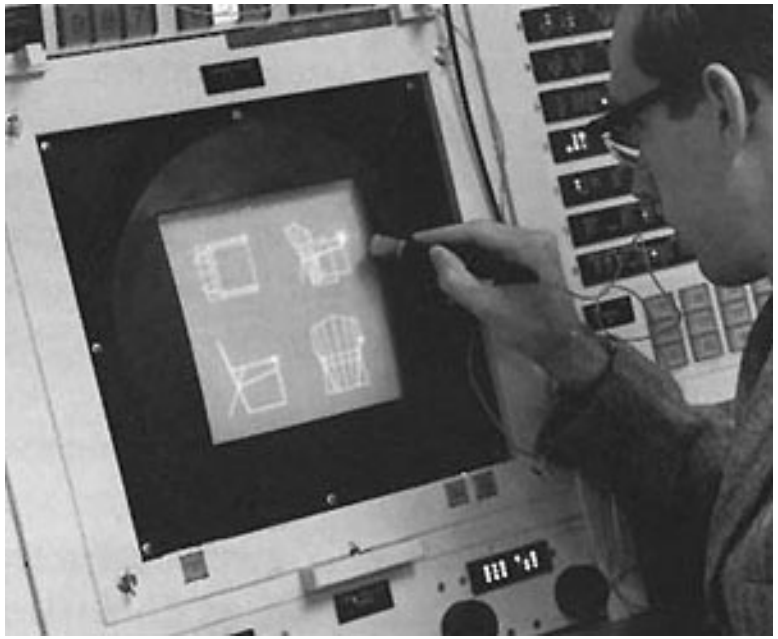
[Appel 1968]



[Ray traced building.
Render time: 30 mins]

1960s

1963: Sketchpad

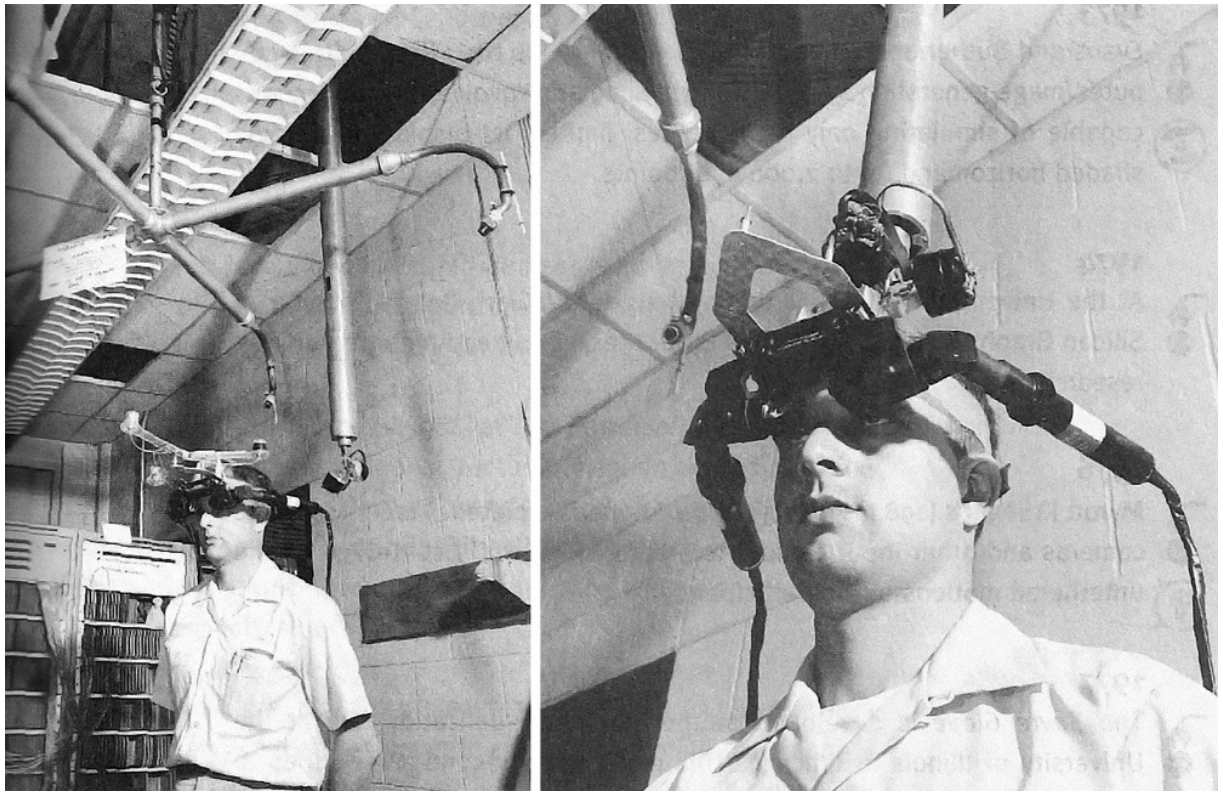


Ivan Sutherland

Father of Computer Graphics
Turing Award winner
Also pioneered: HUDs, OOP

1960s

1968: First VR headset

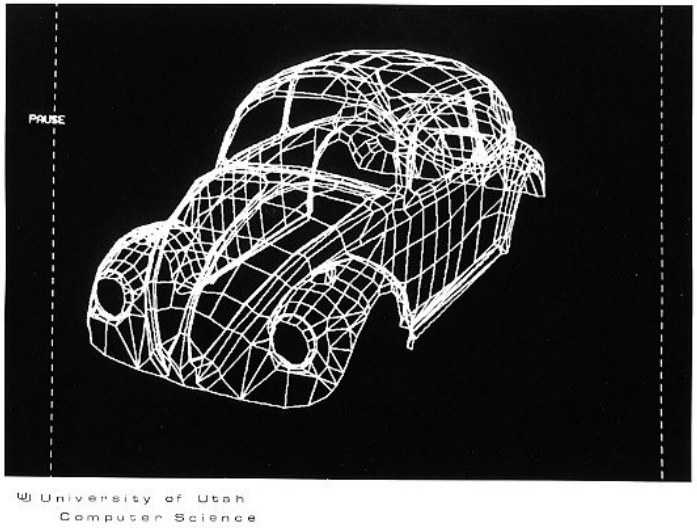


[Sutherland's "Sword of Damocles"]

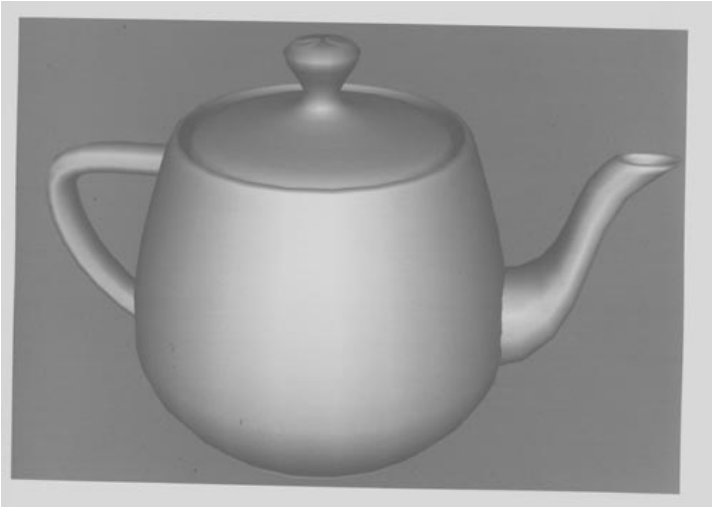
1970s

Sutherland founds research group at Utah

They invent rendering and 3D modeling



[First digitized model: Sutherland's VW]



["Utah Teapot", 1975]

1980s

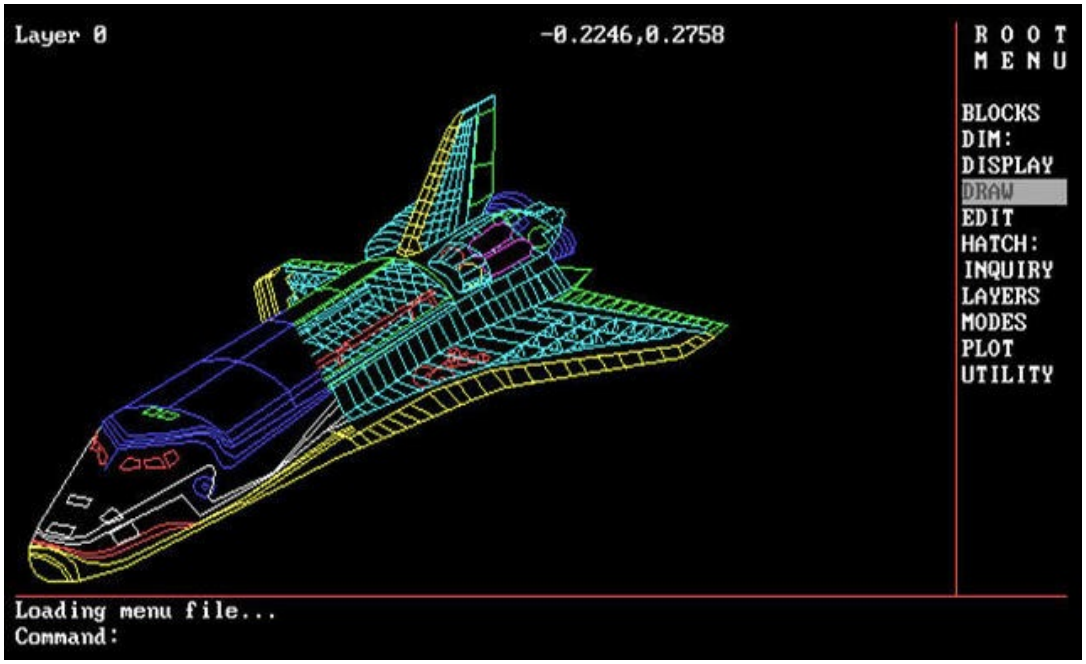
PC age begins

Silicon Graphics
manufactures graphics
workstations

[SGI IRIS 2400]

1980s

CAD (computer-aided design) is king and drives computer graphics research



[AutoCAD]

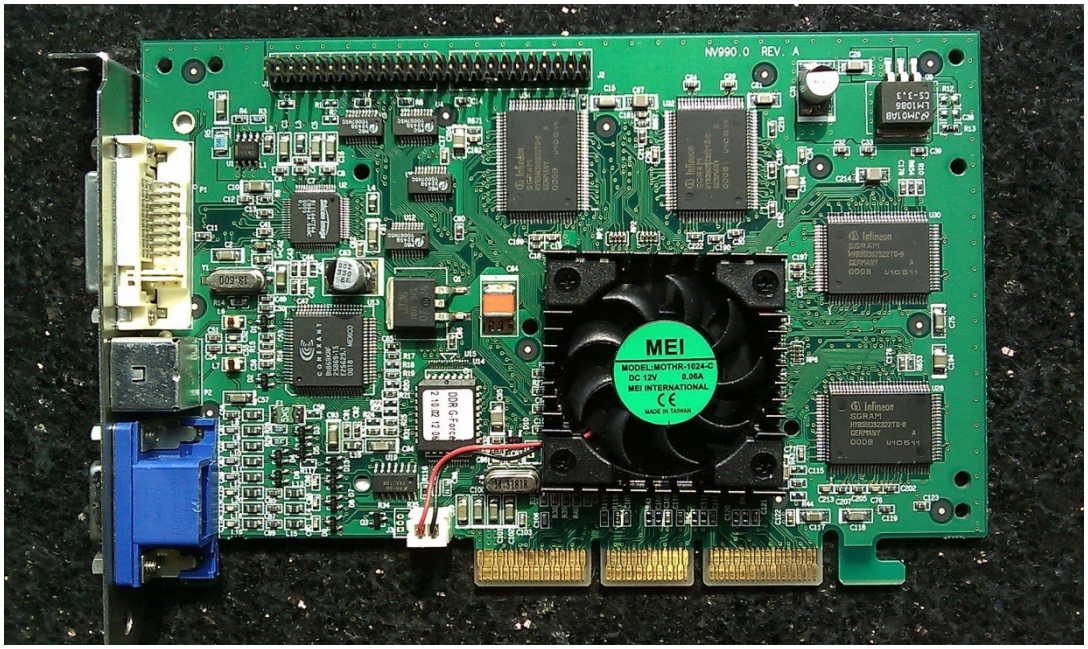
1980s

1982: First CG short, “Dream Flight”

1990s

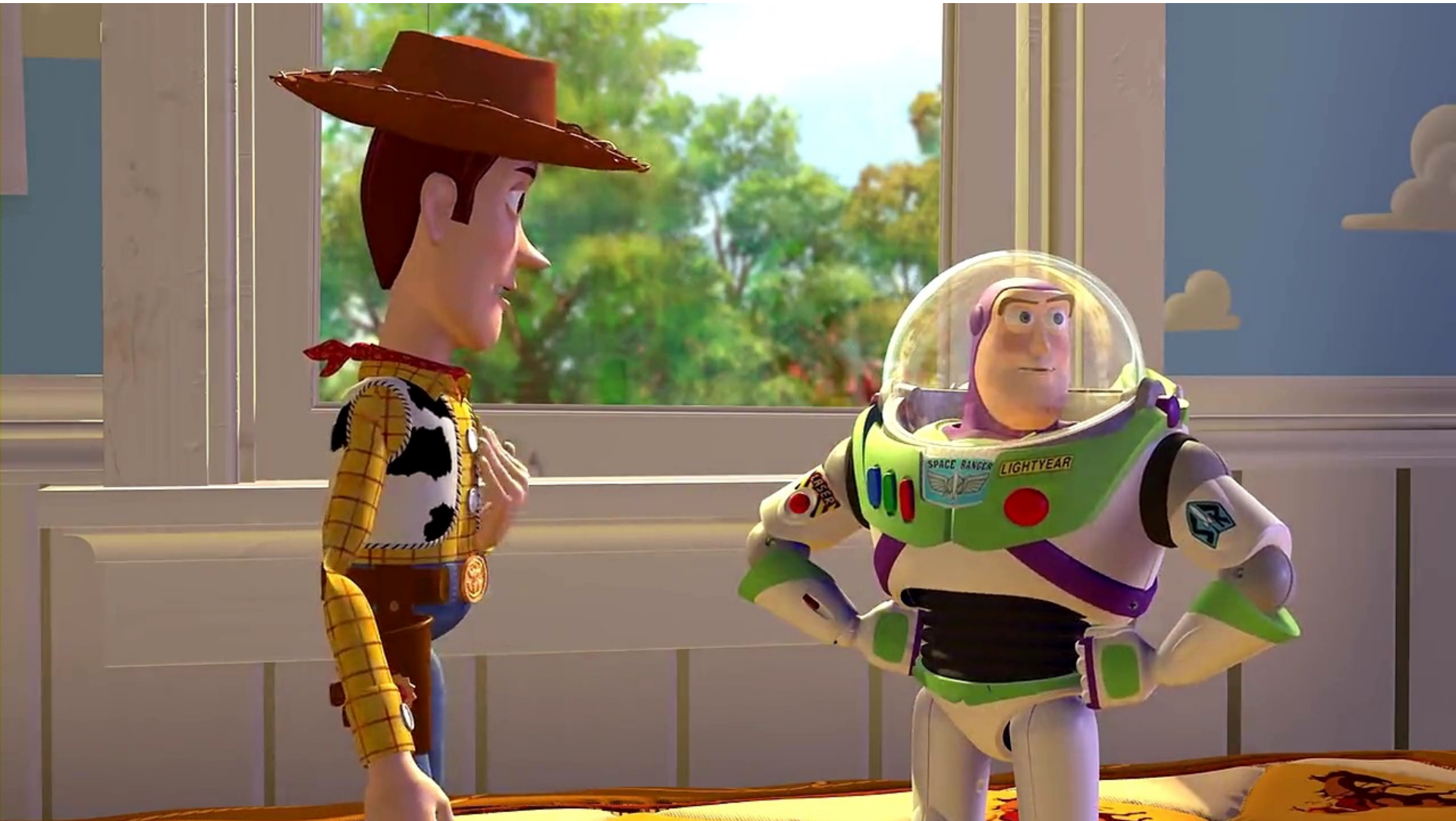
1992: OpenGL released

Graphics cards become common in PCs



[GeForce 256, first commercial Nvidia GPU, 1999]

1990s



2000s

GPUs become programmable

- GPU parallelization a huge fad

Large leaps in real-time graphics

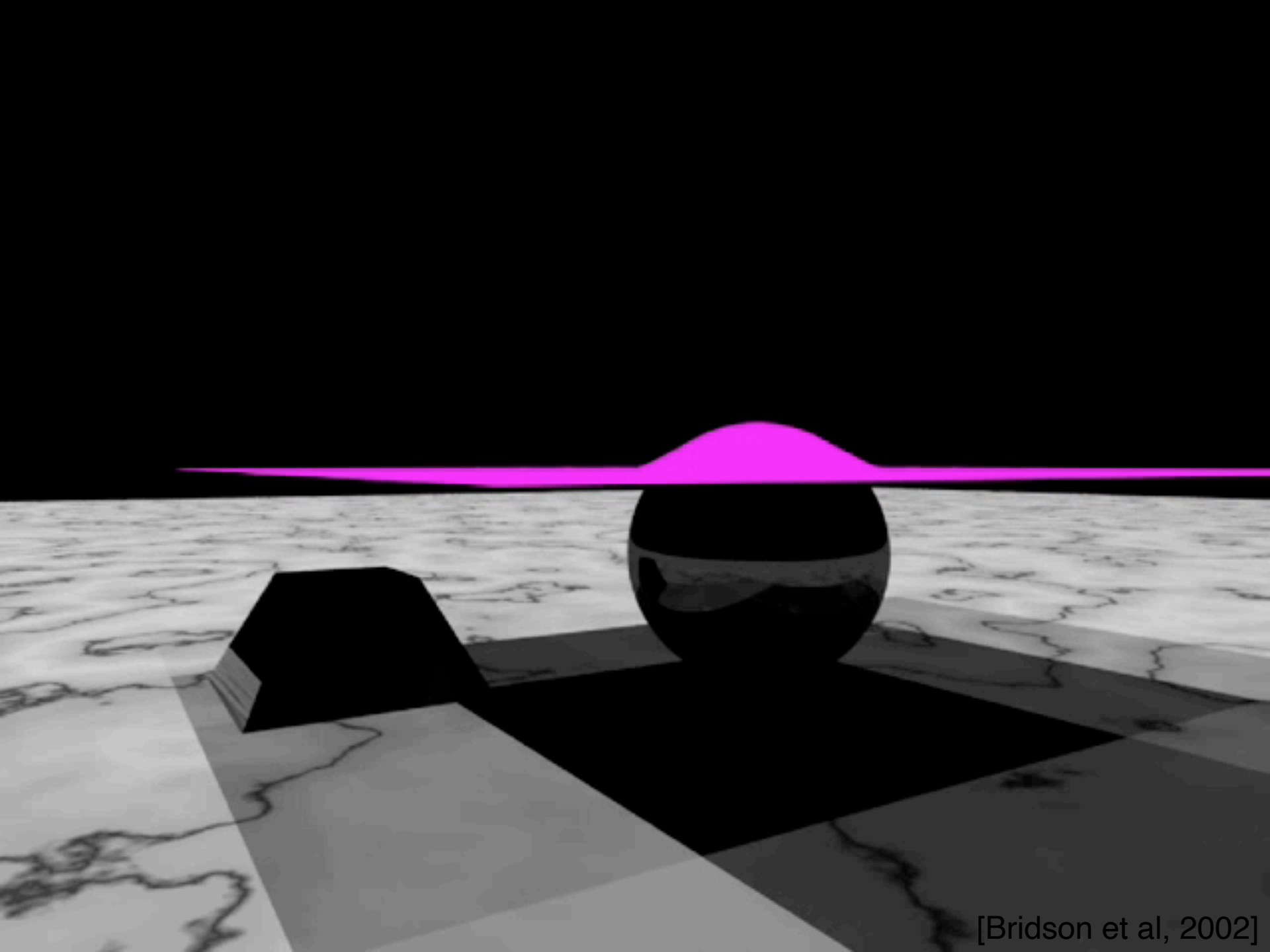
[Crysis, 2007]

[DOOM 3, 2004]

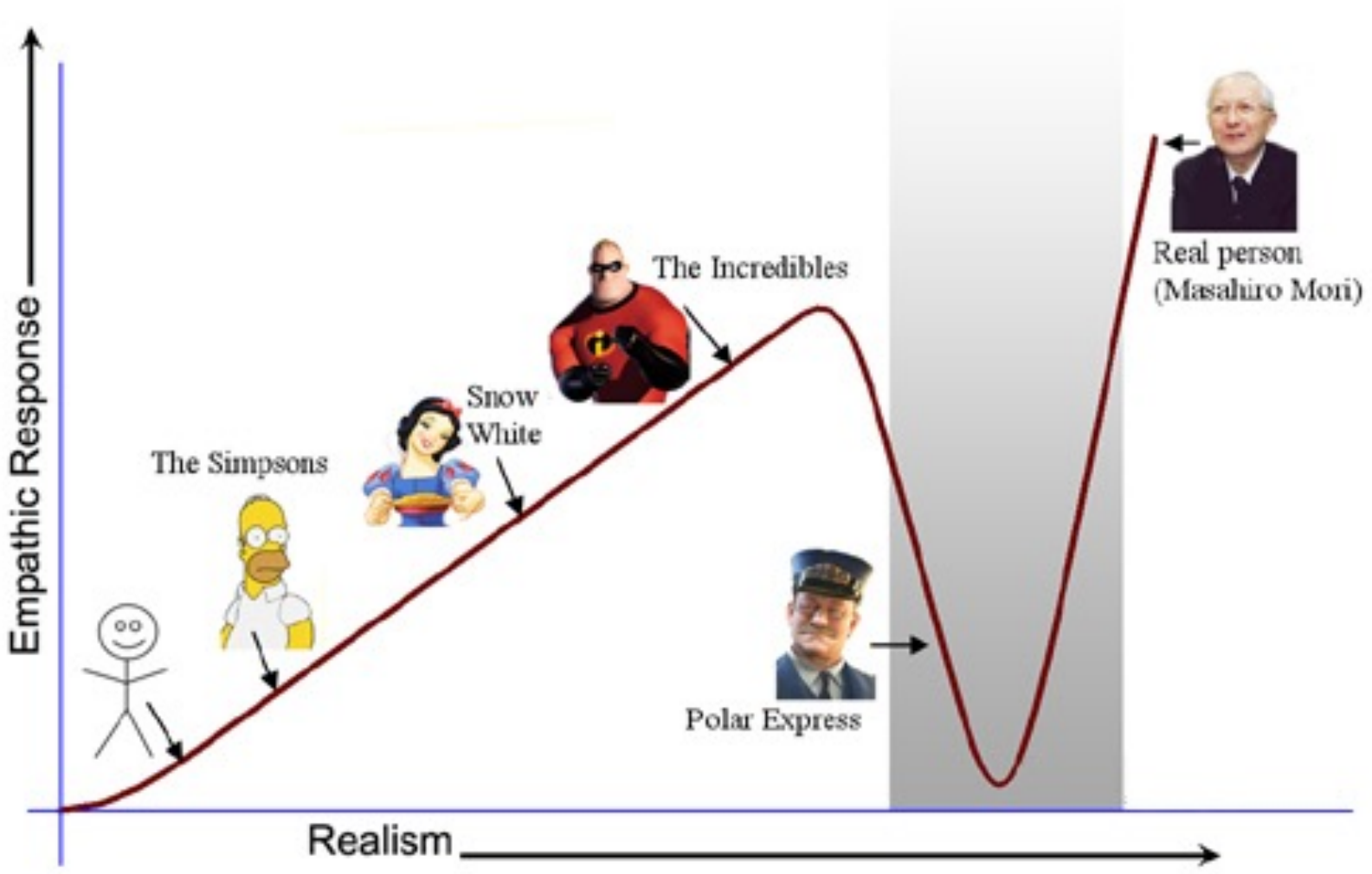
2000s

Movie industry rules graphics, drives research

- More realistic rendering, faster
- Physical simulation
- Motion capture


[Bridson et al, 2002]

Uncanny Valley of Eeriness



A Funny Thing Happens in 2009

Modern Graphics

“Rendering is a solved problem”

movie CG industry on the decline

RIP 2011

RIP 2015

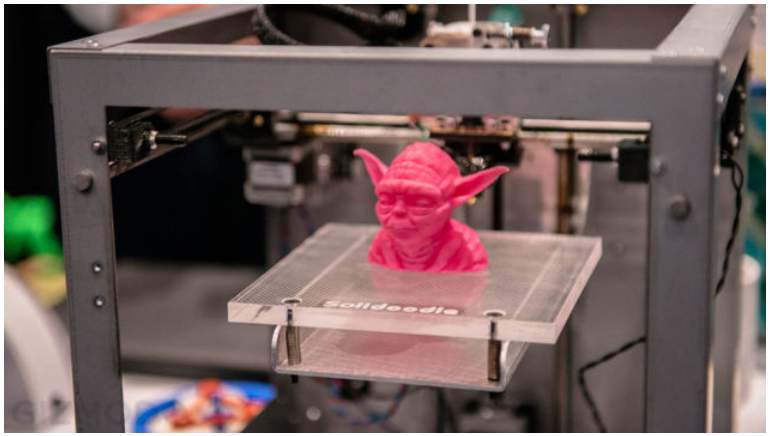
RIP 2013

Is Graphics Dead?

If not, what are “modern” graphics problems?

Modern Graphics

- Real-time rendering
- Physical simulation
- 3D printing
- Capture and tracking
- AR and VR
- …and more!



Modern Graphics: Learning More

~15,000 attendees

many videos online

Here at UT: **G**raphics **SEM**inar

- Undergrads welcome!
- Talk to me after class to join the mailing list!

What This Class IS About

20th century Computer Graphics

- Coordinate systems/transformations
- OpenGL & shaders
- Ray tracing
- Shading and texturing
- Animation

Also: overview of advanced topics