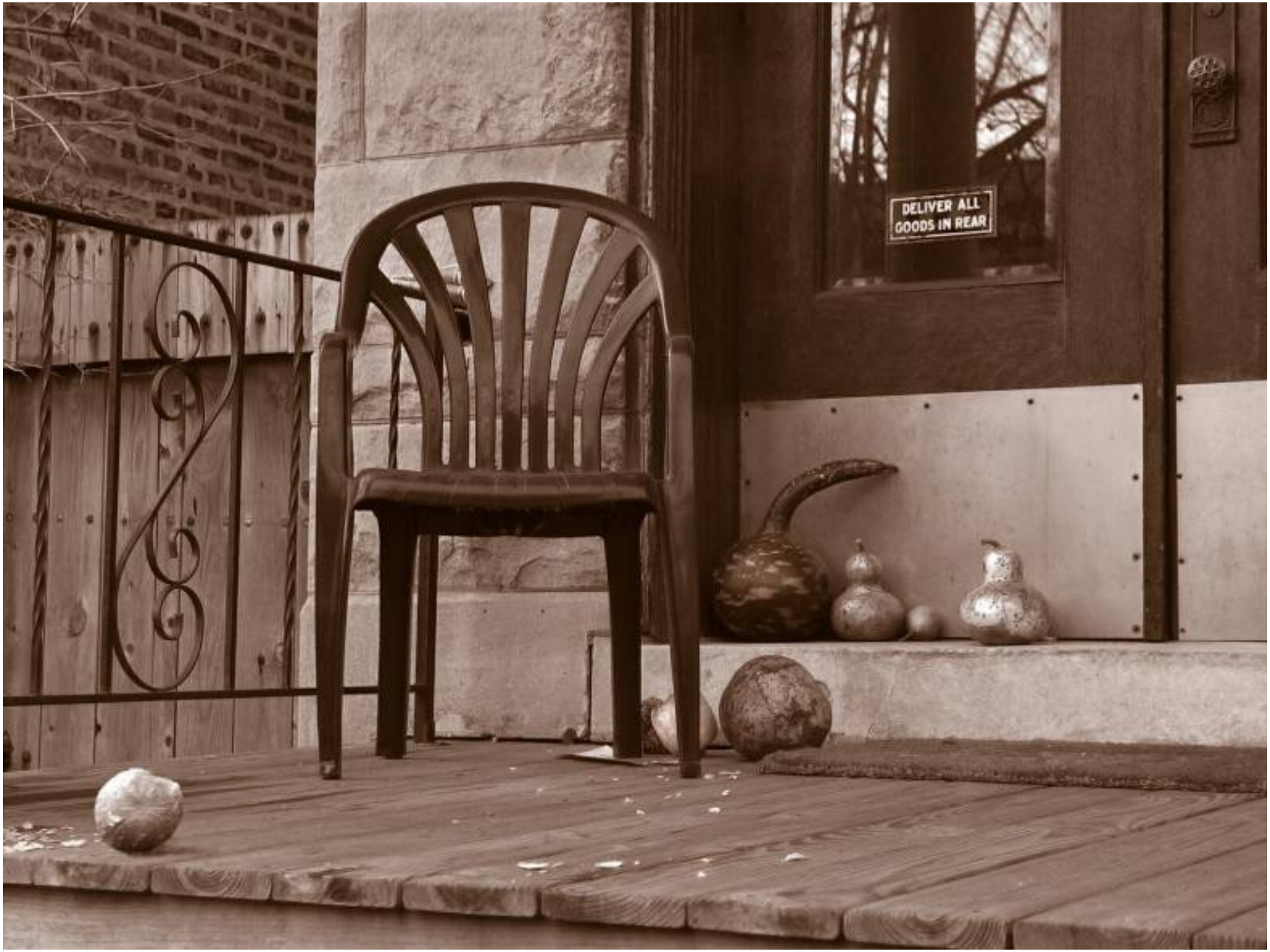
Graphics or Photo? Why?



From Alexei Efros

CSE160 – Intro Computer Graphics

Professor – James Davis

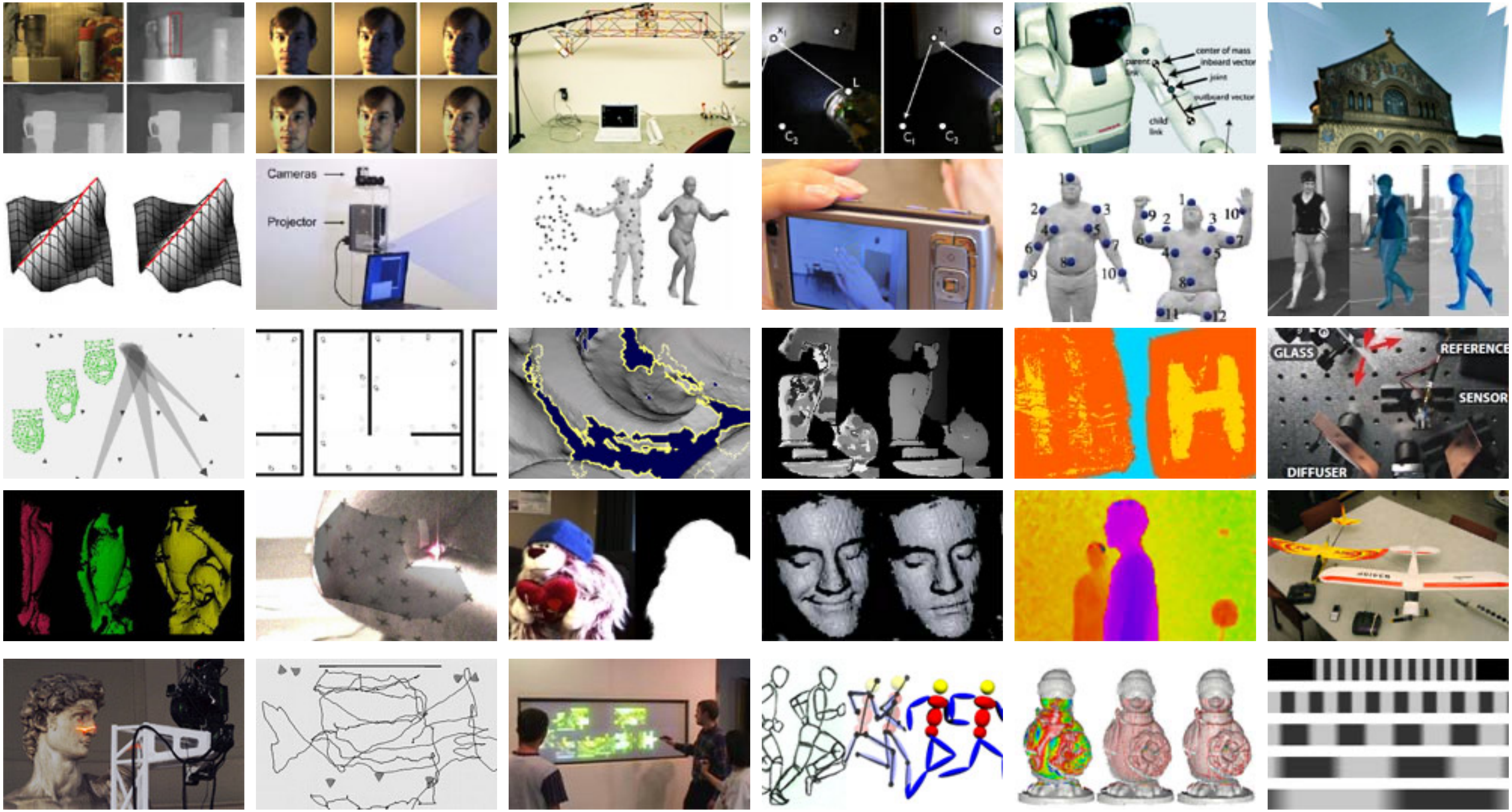
https://courses.soe.ucsc.edu/courses/cse160/

About your instructor

Prof. James Davis - davis@cs.ucsc.edu

Computer graphics, machine vision, computational photography

3D, laser scanning, mesh processing, calibration, animation, motion capture, mosaicing, tracking, time-of-flight, relighting, matting



Education

Stanford University. Ph.D. in Computer Science, June 2002
Dissertation: "Mixed Scale Motion Recovery"
Advisor: Pat Hanrahan

University of California, Davis. B.S. in Computer Science, June 1993
Diploma with Highest Honors

Research Interests

Human computation. Technology and entrepreneurship for addressing social issues. Information and communication technologies for global development. Computer graphics, computer vision, and computational photography.

Employment

Associate Professor, *University of California, Santa Cruz*. Teach today's students to become tomorrow's leaders. Imagine and invent technologies to change the world. 2008-present.

Assistant Professor, *University of California, Santa Cruz*. Teach today's students to become tomorrow's leaders. Imagine and invent technologies to change the world. 2005-2008.

Scientific Advisory Consultant, *Vsee Lab*. Function as outside technical advisor for a startup focused on video conferencing and remote collaboration. 2002-present.

Senior Research Scientist, *Honda Research Institute*. Developed real-time range scanning technology for use with robotic applications and biomechanical modeling. 2002-2004.

Research Assistant, *Stanford Computer Graphics Lab*. Research, dream, implement, and publish on a dozen different topics in computer graphics and computer vision. 1995-2002.

Teaching Assistant, *Stanford University*. Delivered many help session lectures on computer graphics. Designed, administered and graded course assignments, midterm, and final. Win 1999, Aut 2001.

Consulting Researcher, *Presenter, Inc*. Developed algorithms for image mosaicing which robustly find frame motion despite foreground motion and high levels of image noise. 1999-2000.

Research Intern, *Apple Computer, Inc*. Designed and implemented an algorithm for customizing standard geometrical meshes using texture maps derived from photographs. Summer 1995.

Research Assistant, *Stanford Database Group*. Designed and implemented a document matching system capable of efficiently finding duplicated text phrases in very large databases. 1993-1994.

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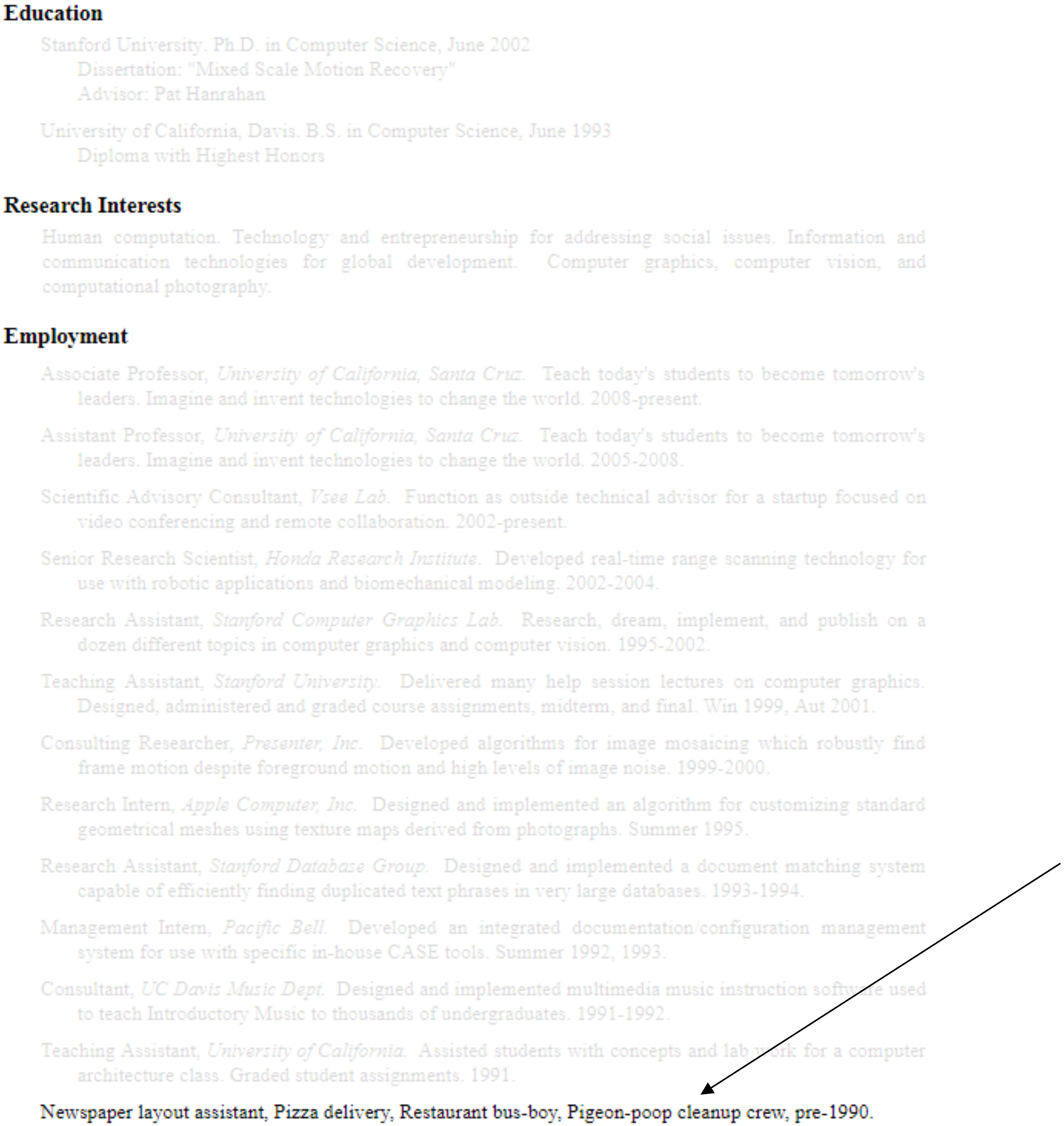
Newspaper layout assistant, Pizza delivery, Restaurant bus-boy, Pigeon-poop cleanup crew, pre-1990.



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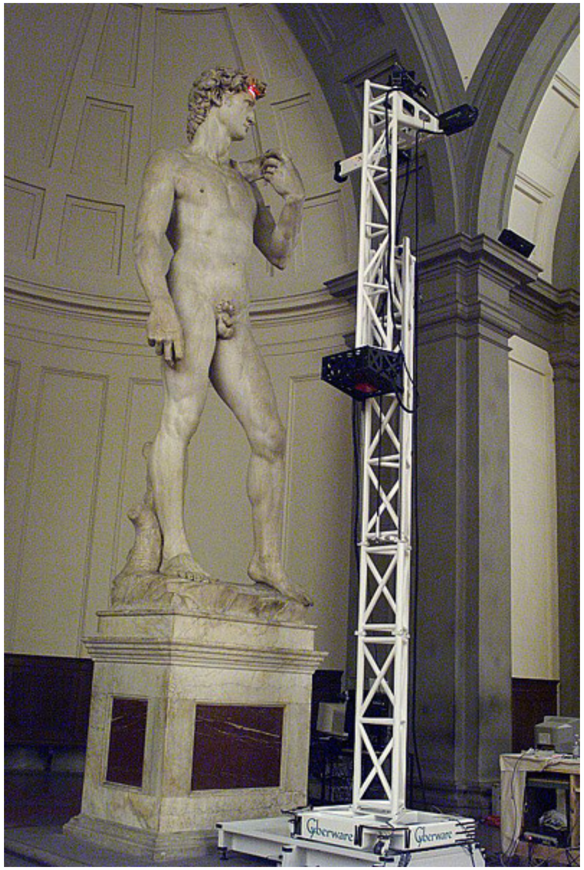
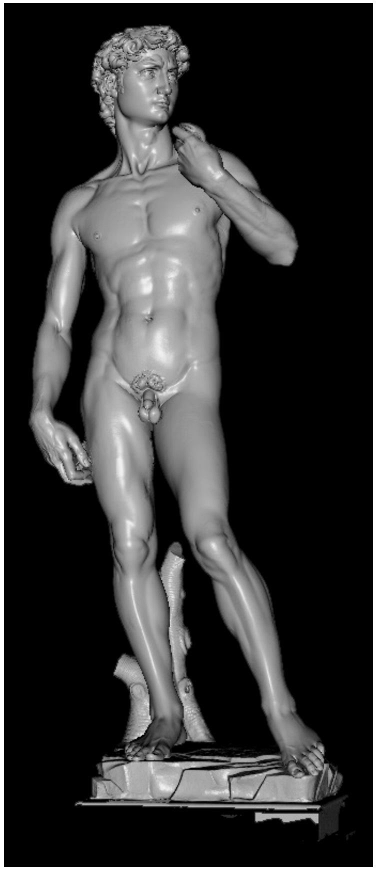
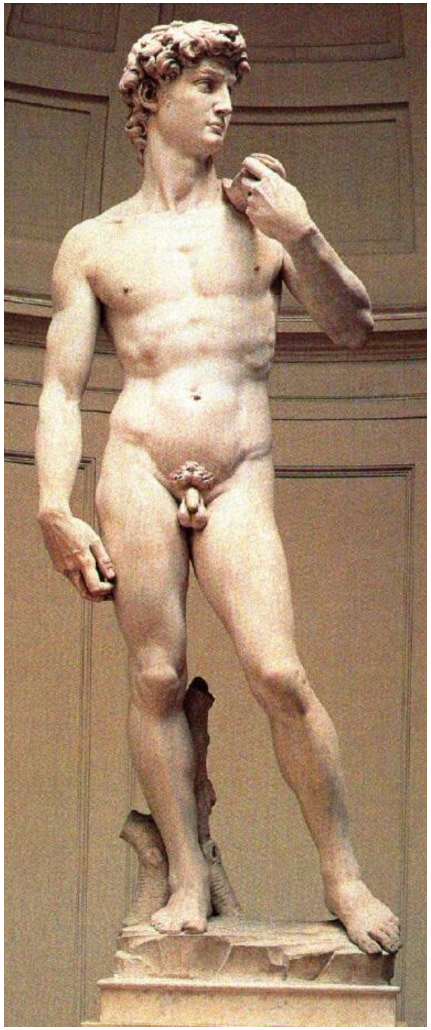
The Digital Michelangelo project obtained very large models at very high resolution

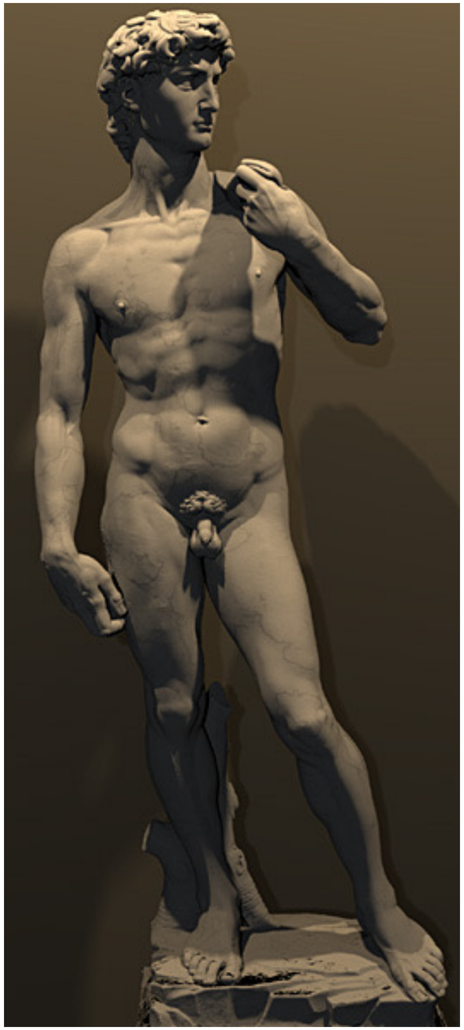




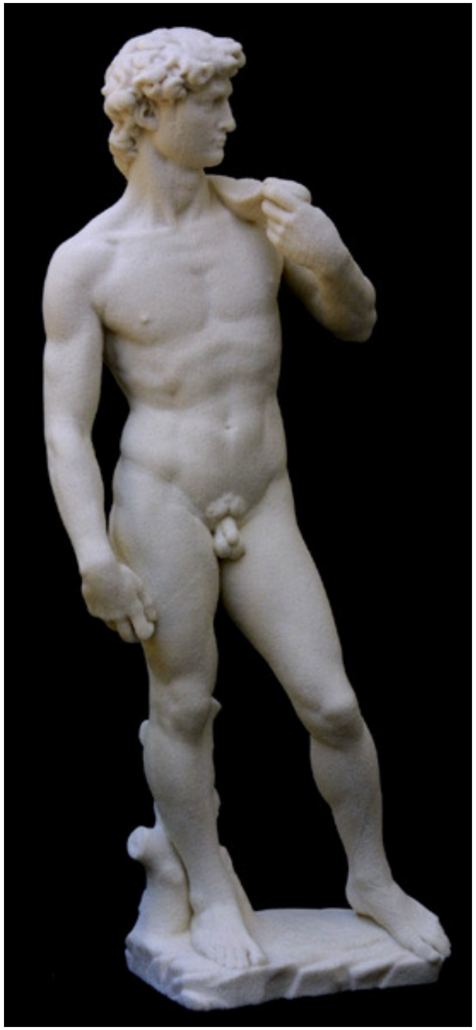
[Levoy, Pulli, Curless, Rusinkiewicz, Koller, Pereira, Ginzton, Anderson, Davis, Ginsberg, Shade, Fulk –
***Siggraph 2000* - The Digital Michelangelo Project: 3D scanning of large statues]**



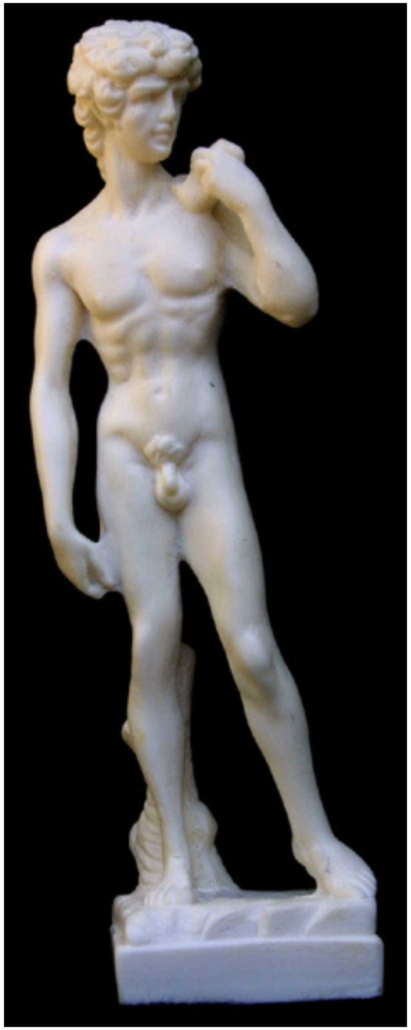
Real Statue



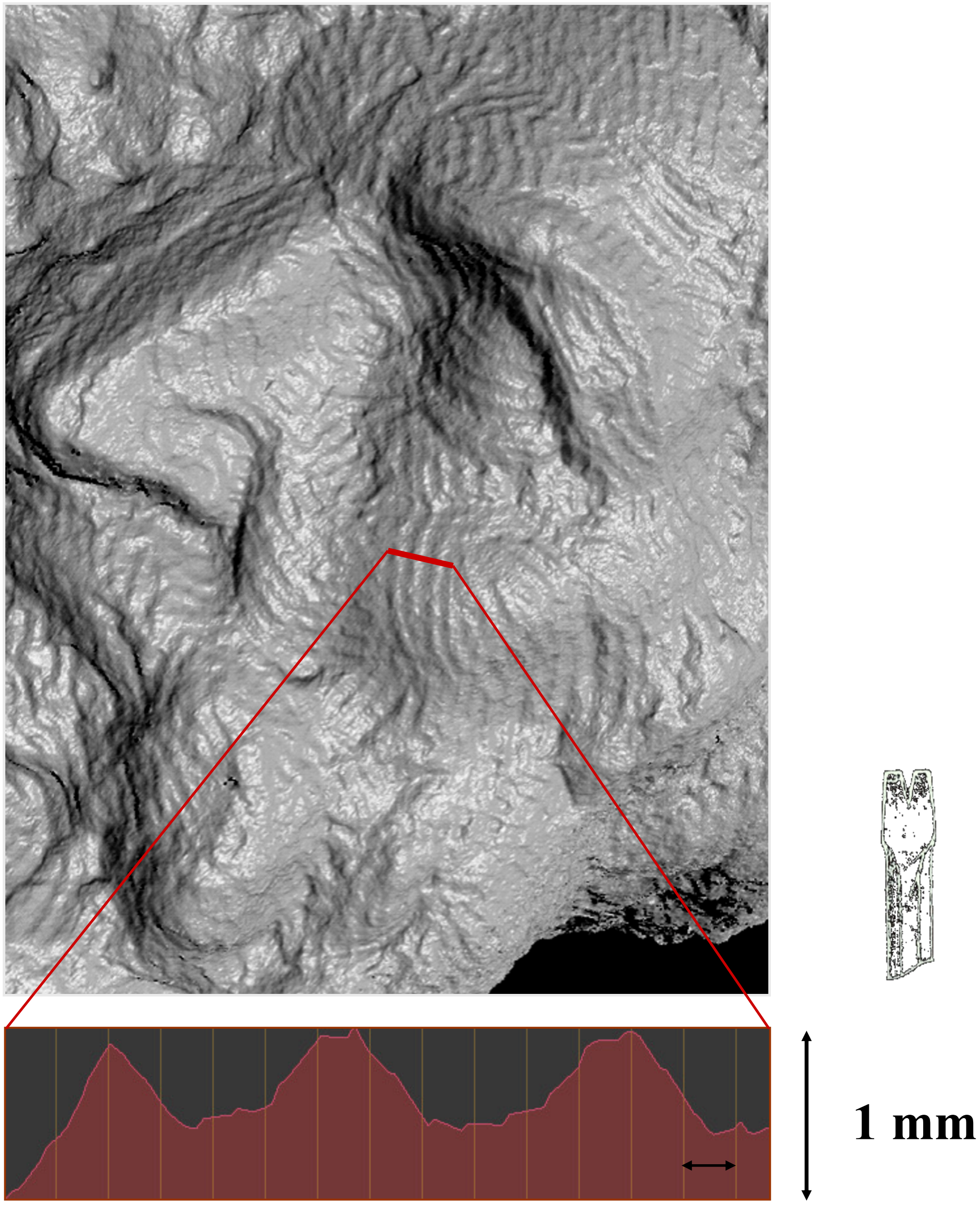
Our Model
Computer Graphics



Our Model
Physical Replica

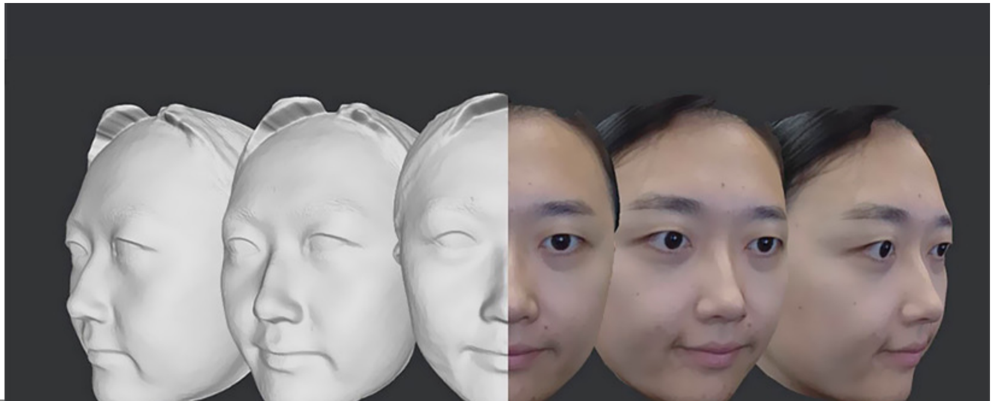


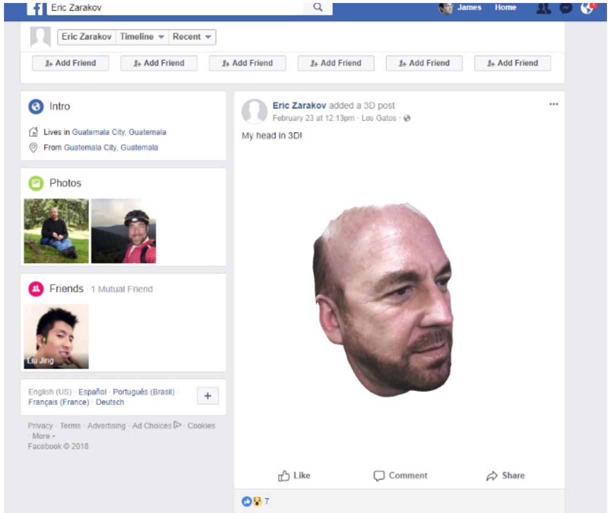
Purchased
Replica


1 mm

2015-2017

- Co-founded startup, Bellus3D





Eric Zarakov added a 3D post

February 23 at 12:13pm · Los Gatos ·

My head in 3D!

Intro

Lives in Guatemala City, Guatemala

From Guatemala City, Guatemala

Photos

Friends · 1 Mutual Friend

English (US) · Español · Português (Brasil) · Français (France) · Deutsch

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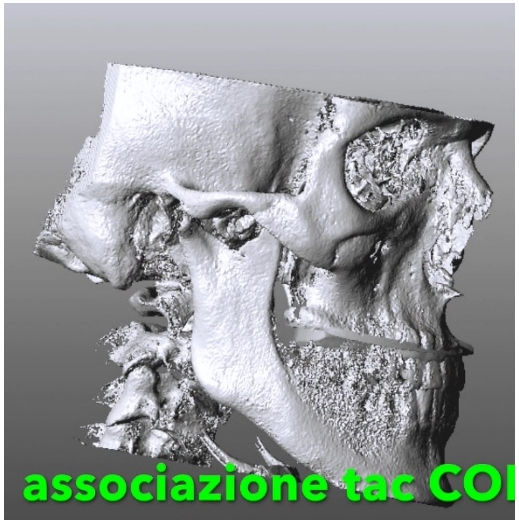
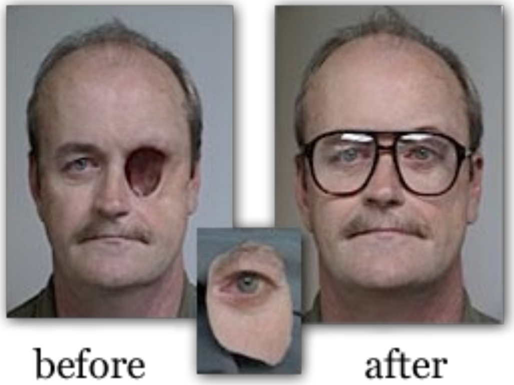
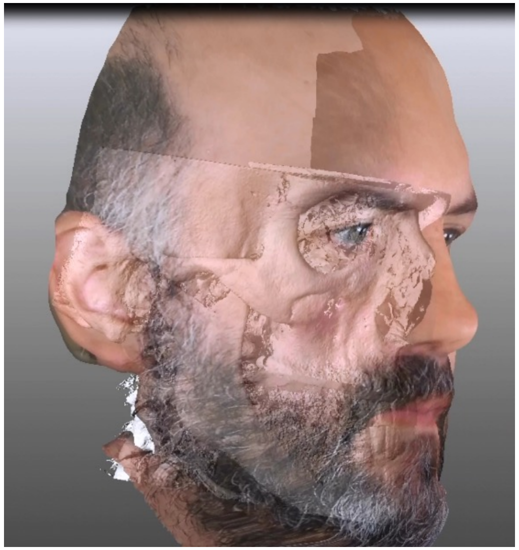






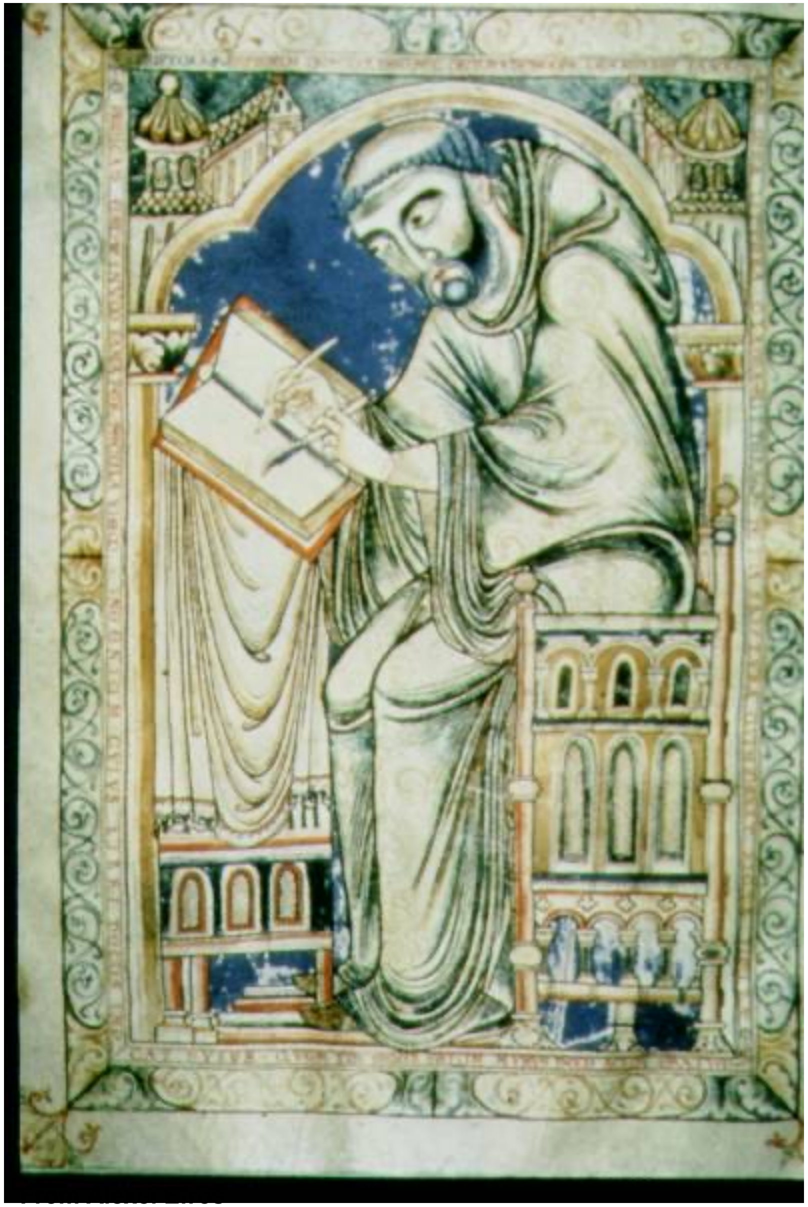
Intro to Graphics

Depicting Our World

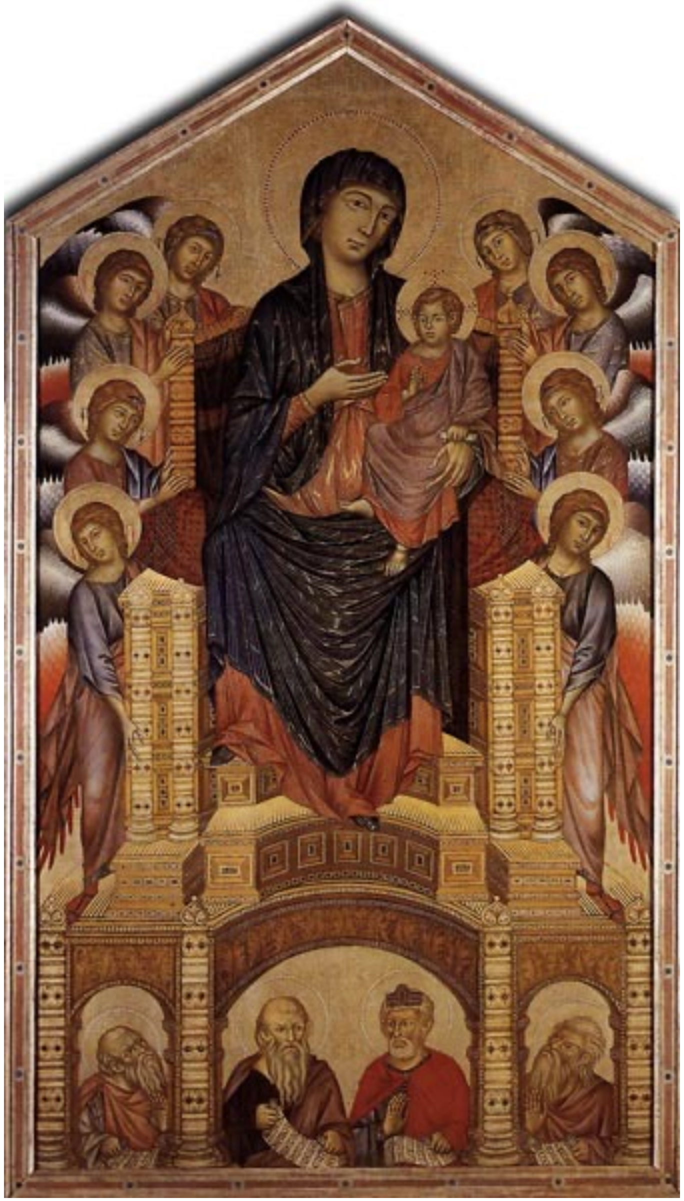
Prehistoric Painting, Lascaux Cave, France

From Alexei Efros

Depicting Our World: The Middle Ages

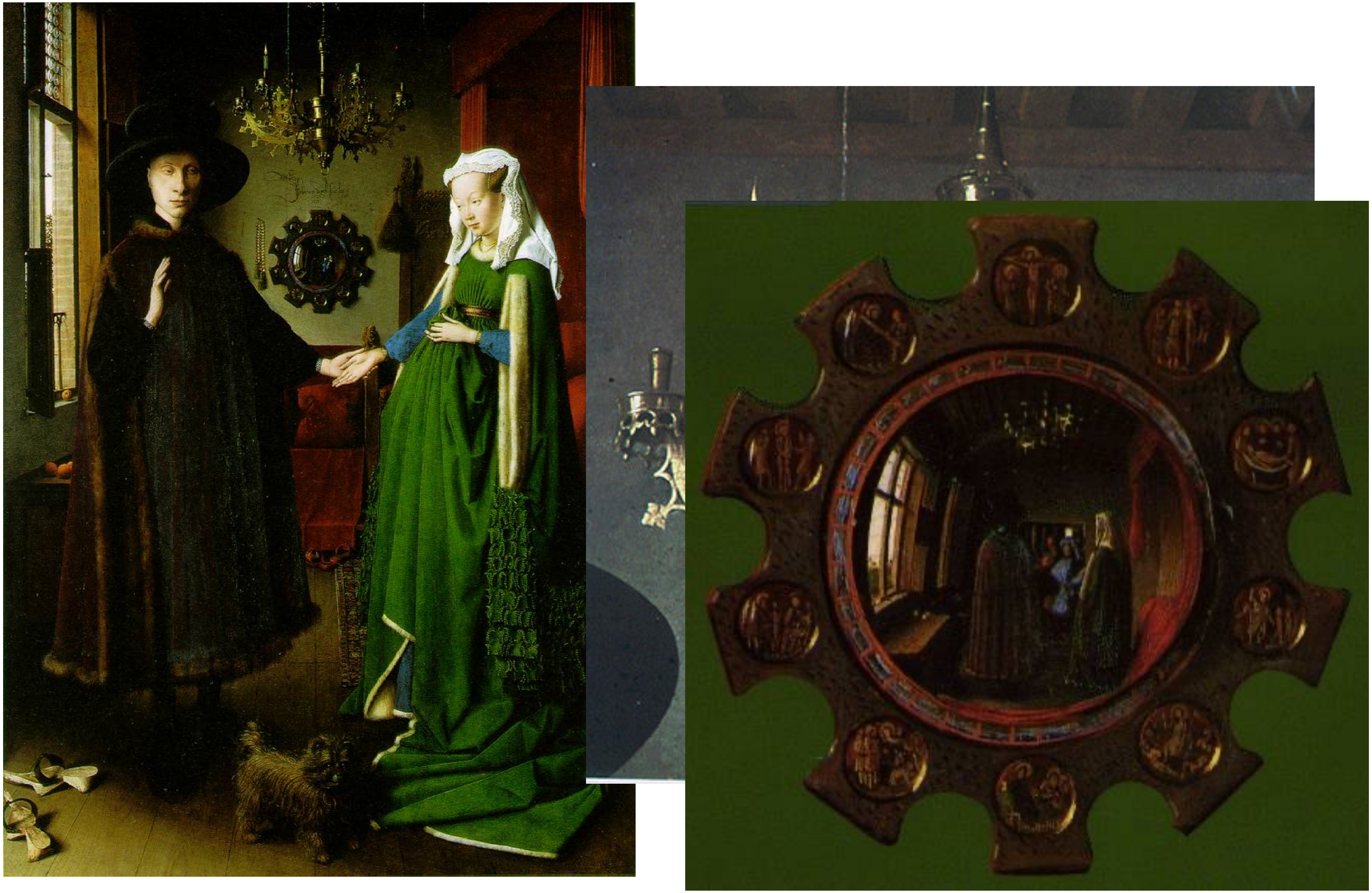


St. John
from the
Gospel Book
of Abbot
Wedricus
(1147)



Cimabue
Madonna
Enthroned
(c.1280-
1290)

Depicting Our World: Toward Perfection



Jan van Eyck, *The Arnolfini Marriage (c.1434)*

From Alexei Efros

Depicting Our World: Toward Perfection

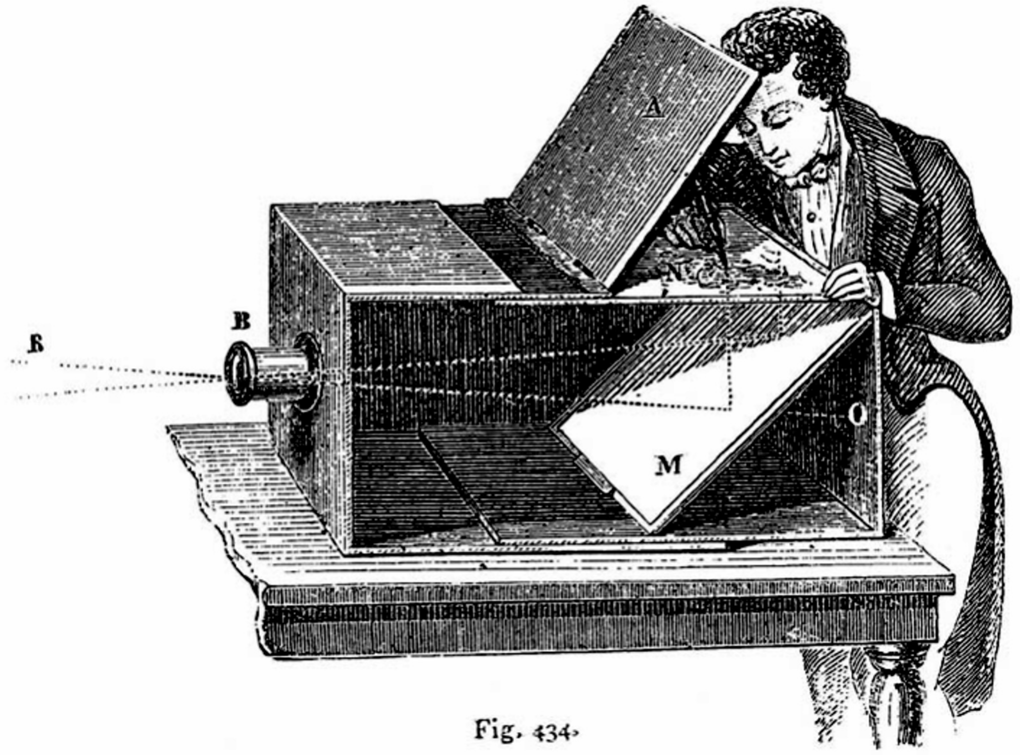
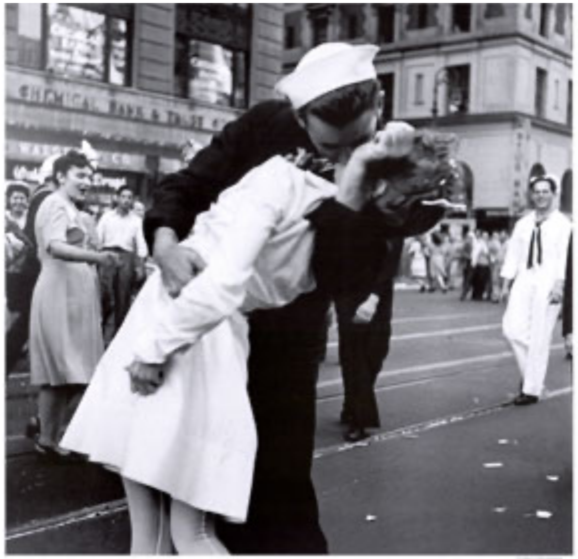


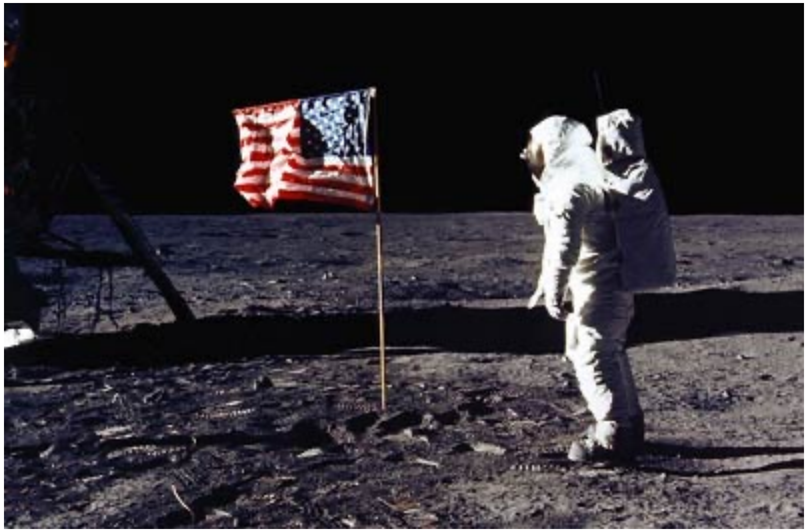
Fig. 434.

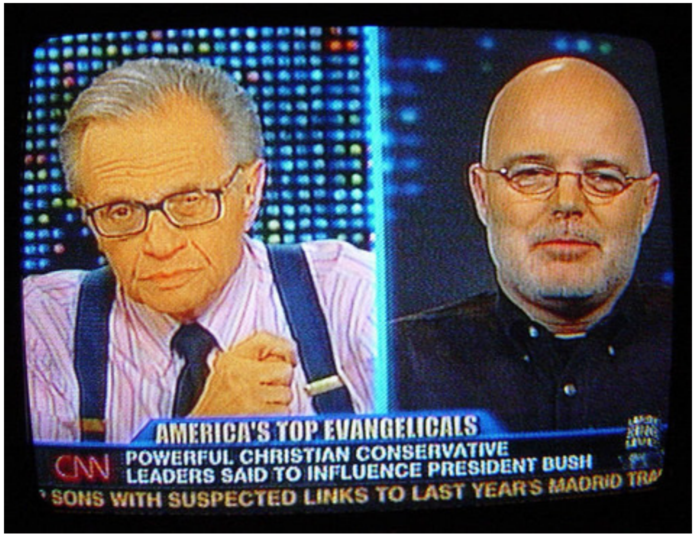
Lens Based Camera Obscura, 1568

From Alexei Efros

Depicting Our World: Perfection?






AMERICA'S TOP EVANGELICALS
CNN
POWERFUL CHRISTIAN CONSERVATIVE
LEADERS SAID TO INFLUENCE PRESIDENT BUSH
SONS WITH SUSPECTED LINKS TO LAST YEAR'S MADRID TRA
LARRY KING LIVE

From Alexei Efros

Depicting Our World: Ongoing Quest

Pablo Picasso

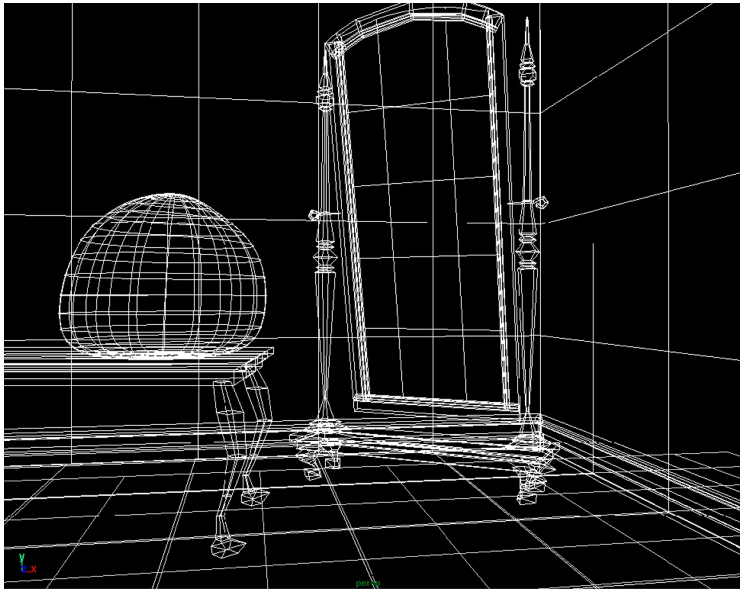
Marc Chagall

From Alexei Efros

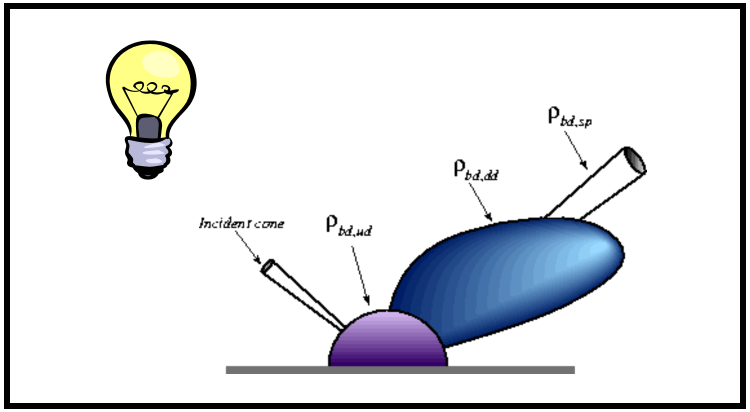
Enter Computer Graphics...

From Alexei Efros

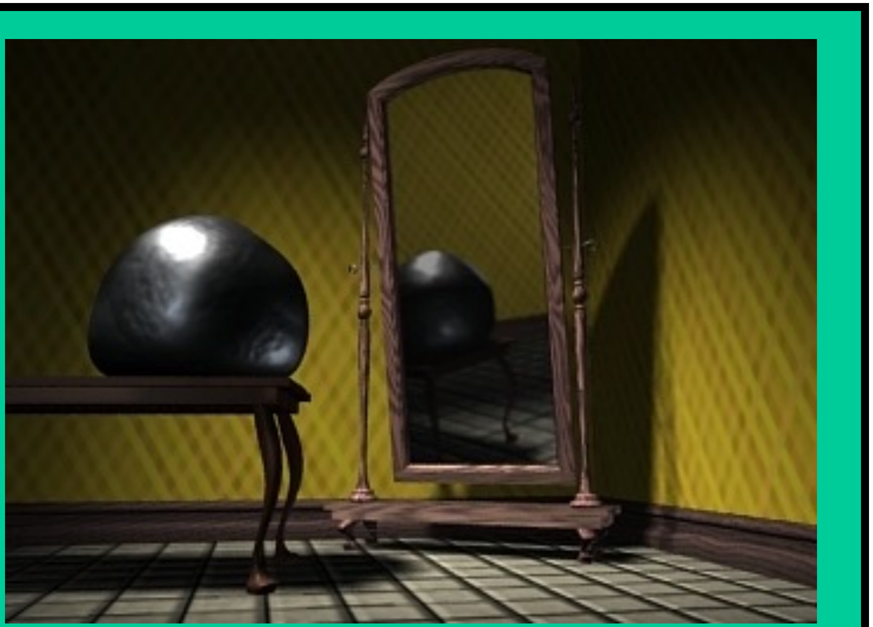
Traditional Computer Graphics



3D geometry



physics



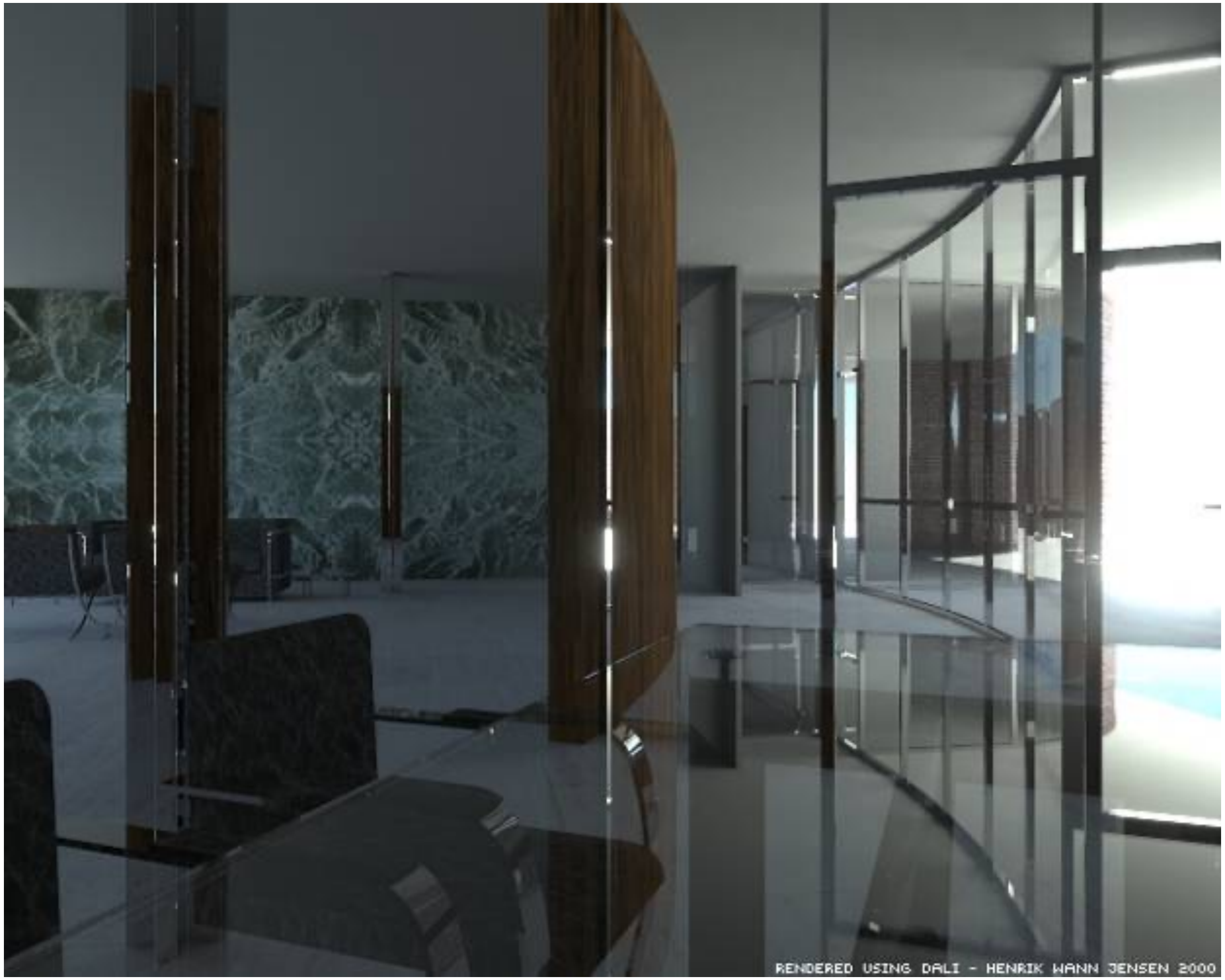
projection

Simulation

GRAPHICS

From Alexei Efros

State of the Art



- Amazingly real
- But so sterile, lifeless, *futuristic (why?)*

From Alexei Efros

The richness of our everyday world

From Alexei Efros

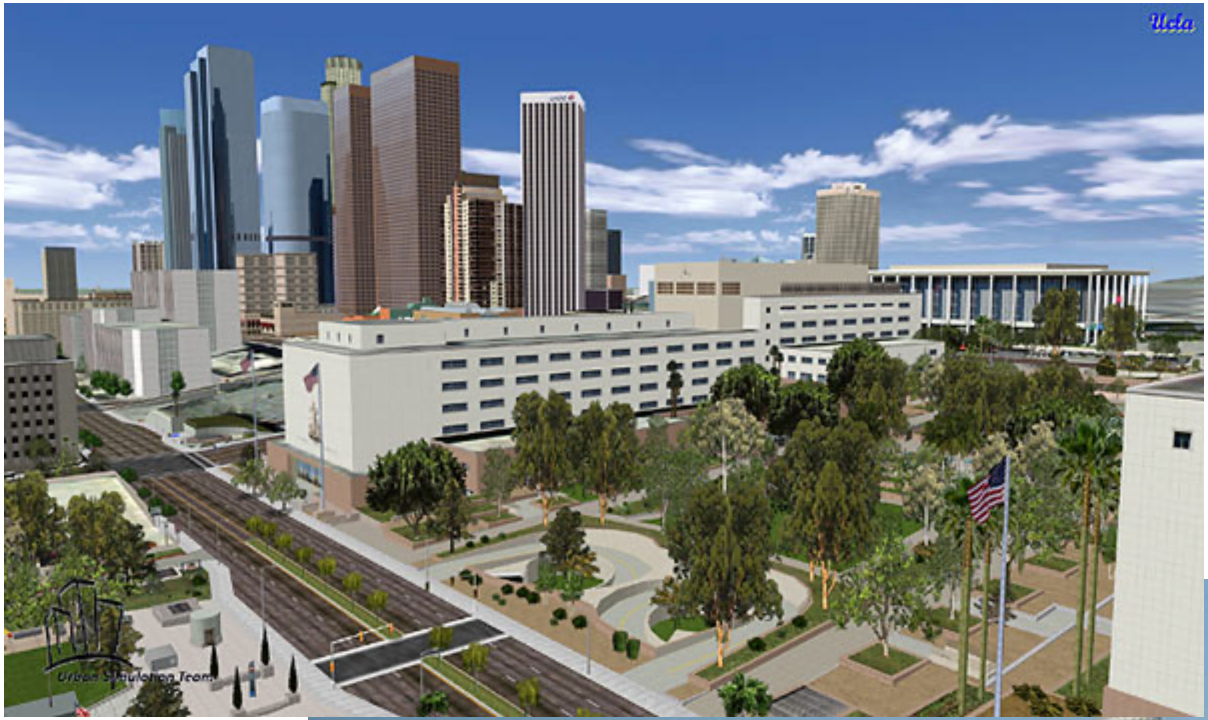
Photo by Svetlana Lazebnik

Beauty in complexity

From Alexei Efros

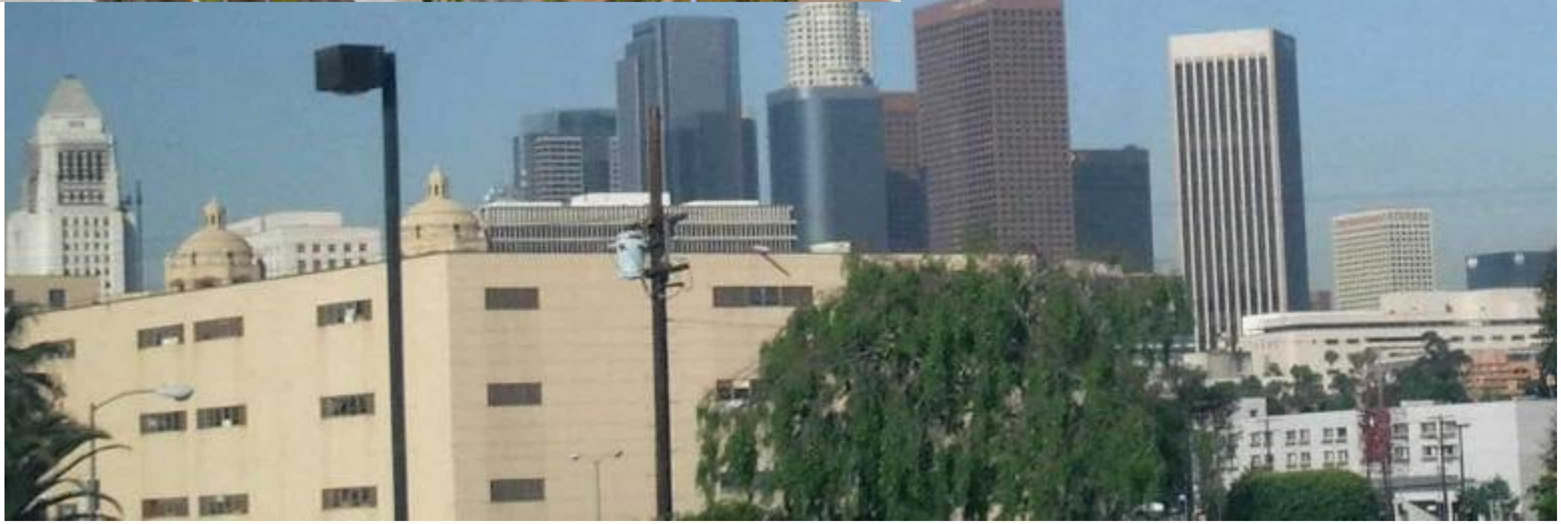
University Parks, Oxford

Urban Scenes



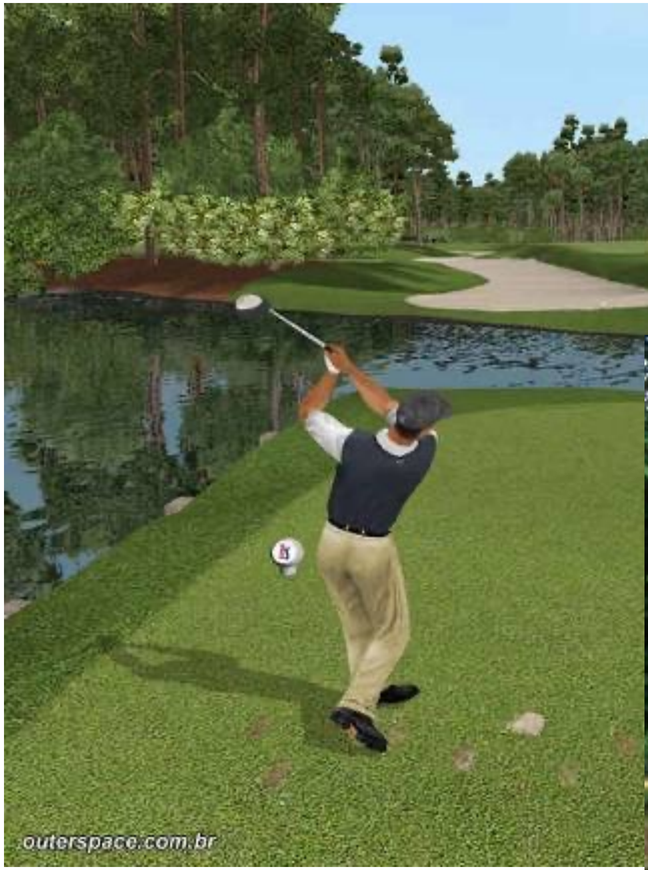
Virtual LA (SGI)

Photo of I LA

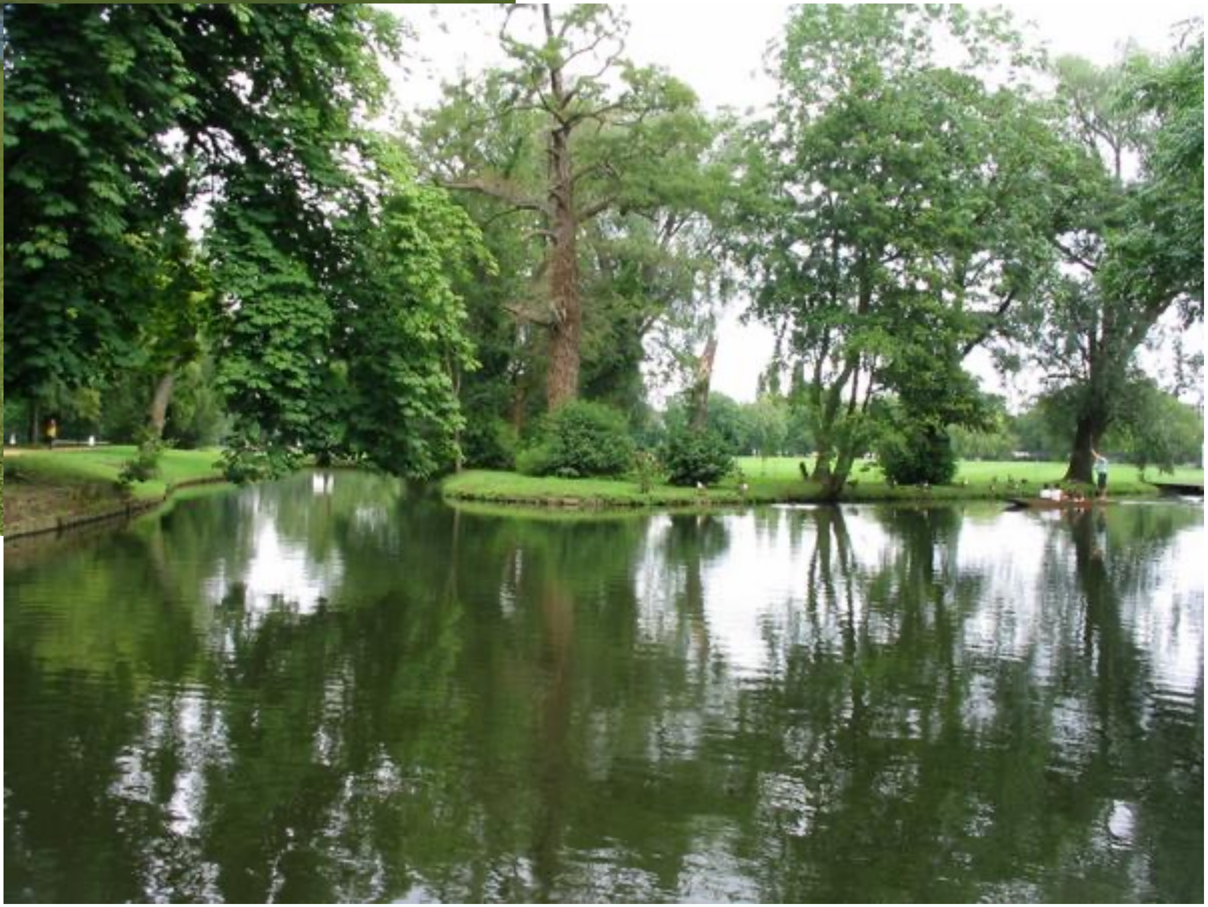


From Alexei Efros

Nature



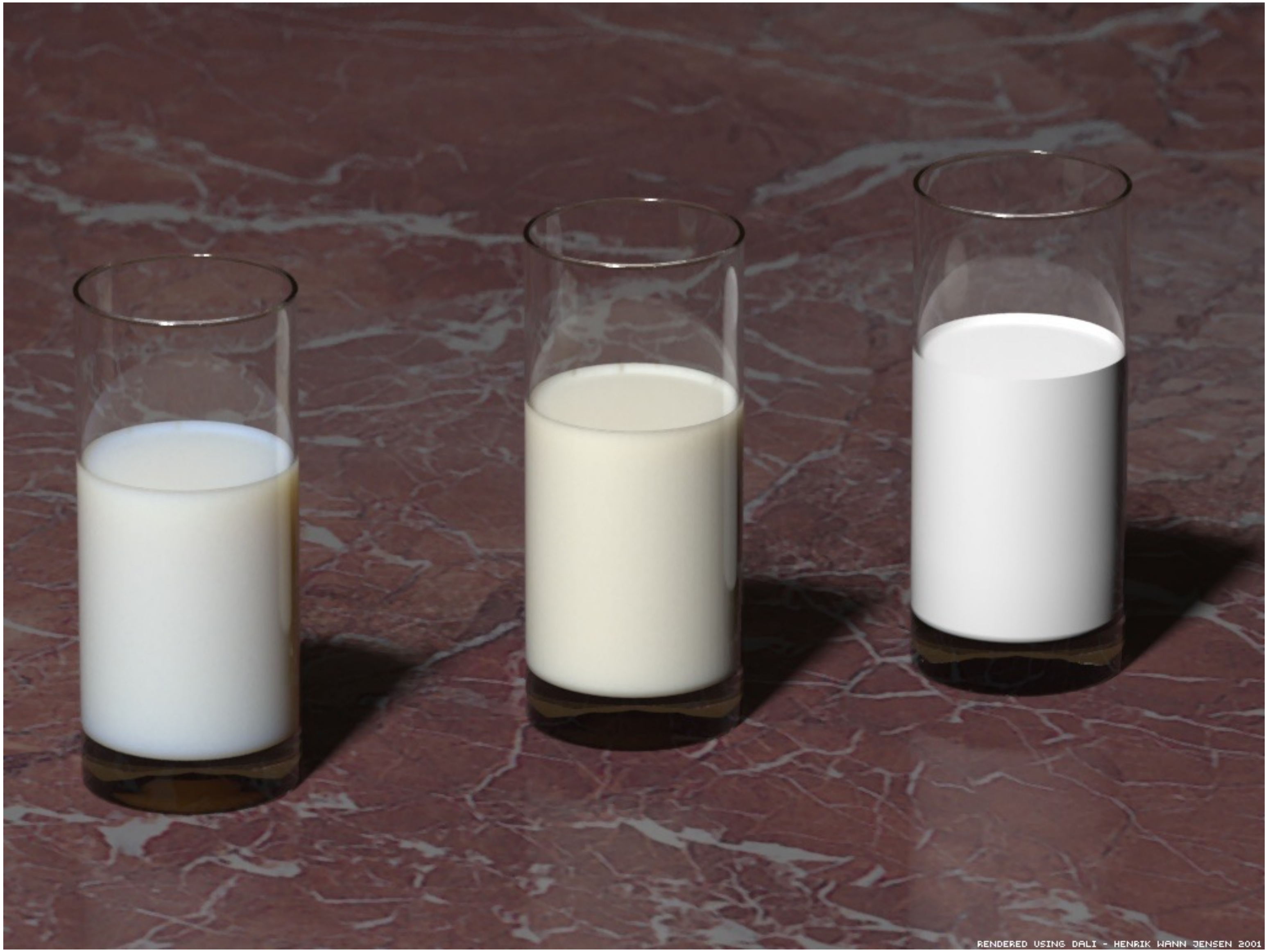
River Cherwell, Oxford



From Alexei Efros

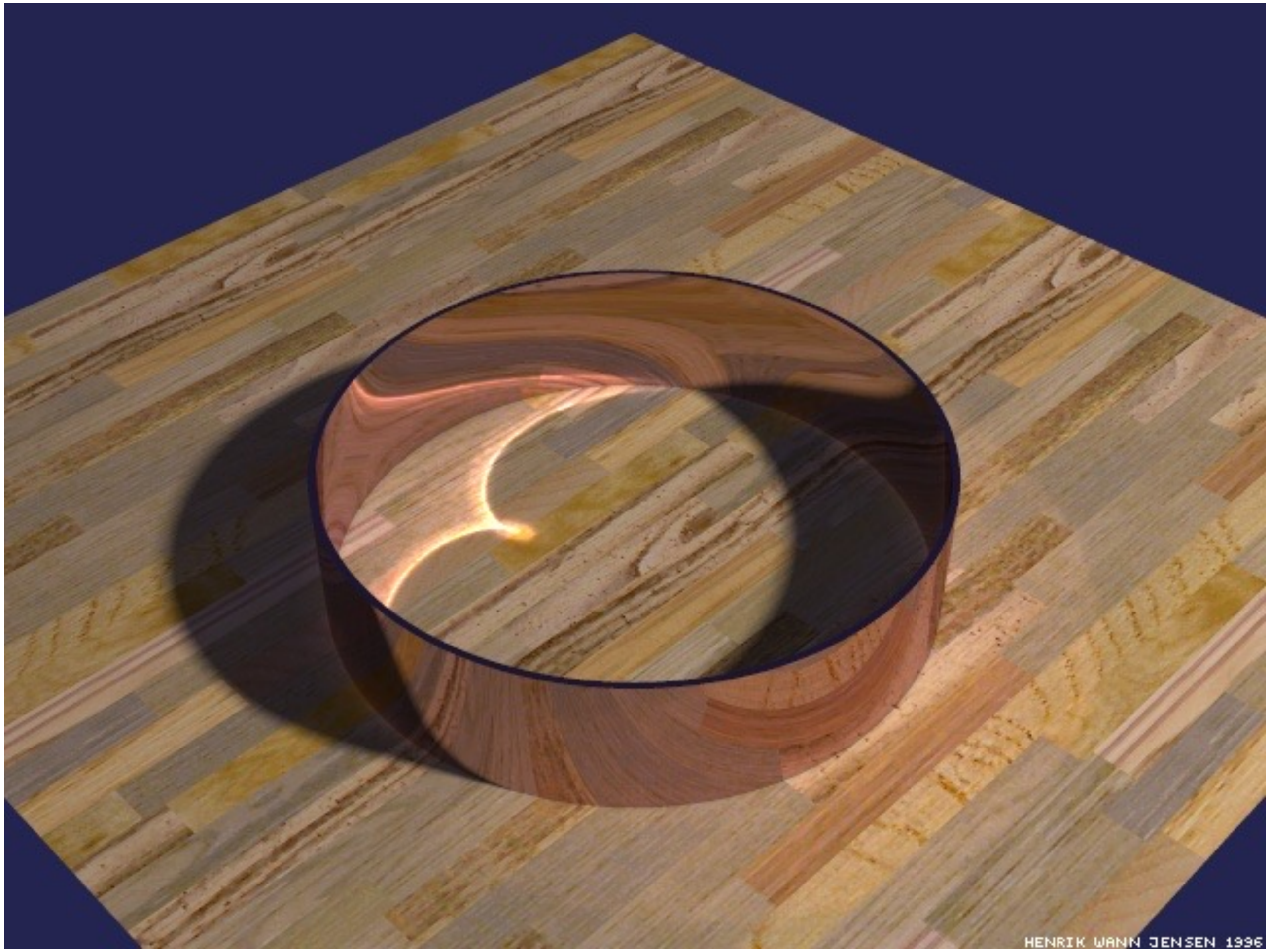
Rendering

Is milk “just” white stuff?

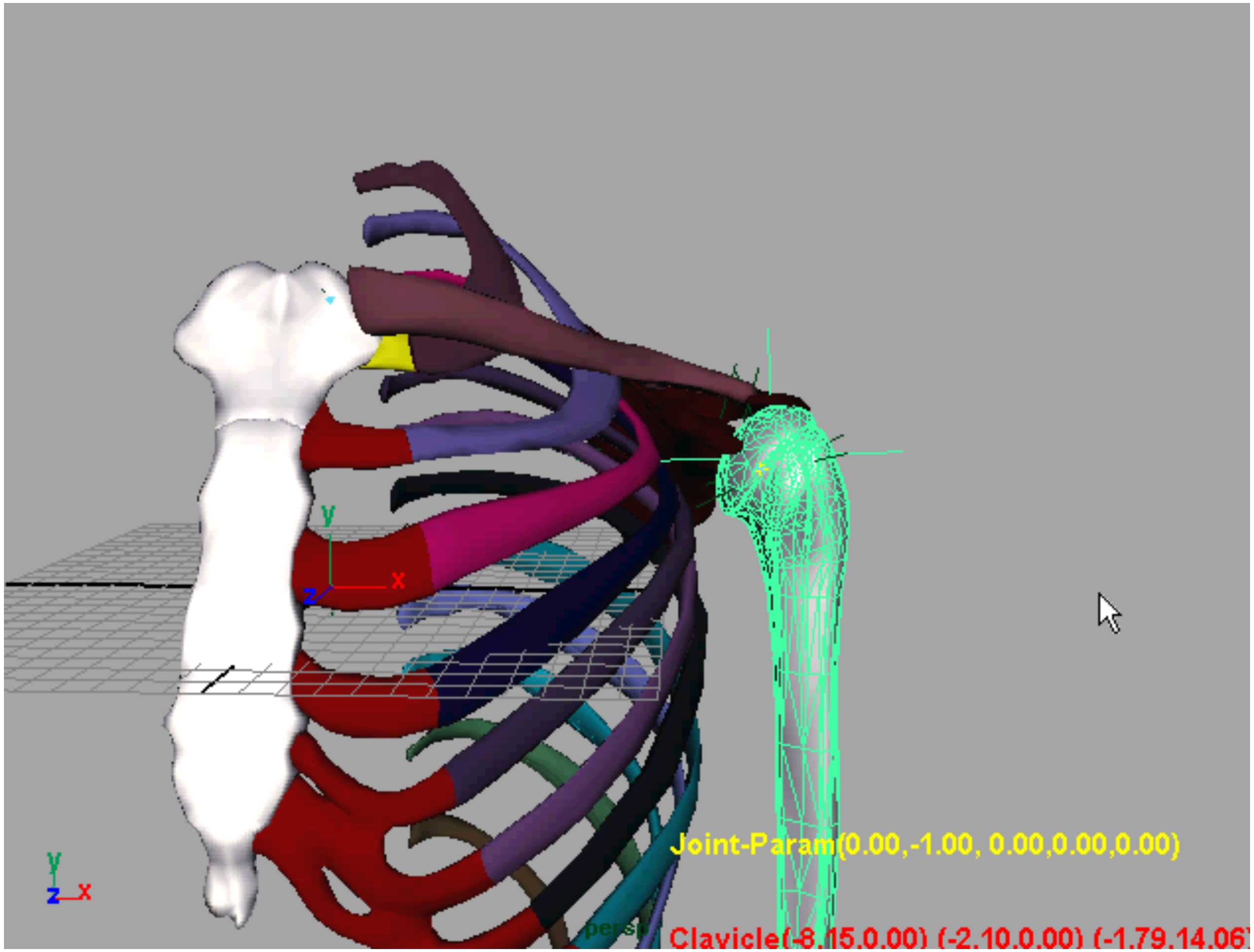


RENDERED USING DALI - HENRIK WANN JENSEN 2001

Where does the caustic come from?

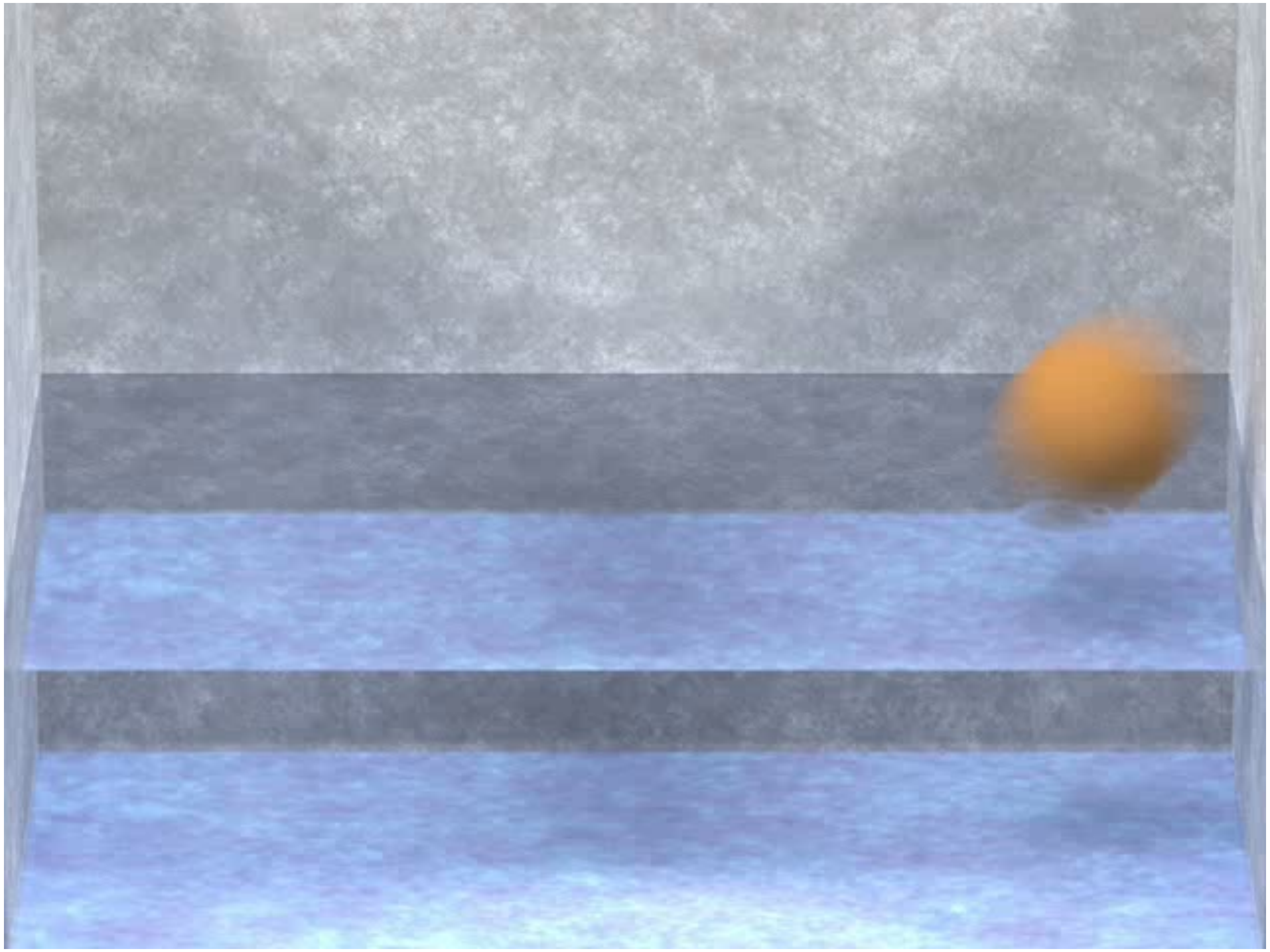


Modeling



```
Joint-Param(0.00,-1.00, 0.00,0.00,0.00)
Clavicle(-8.15,0.00) (-2.10,0.00) (-1.79,14.06)
```

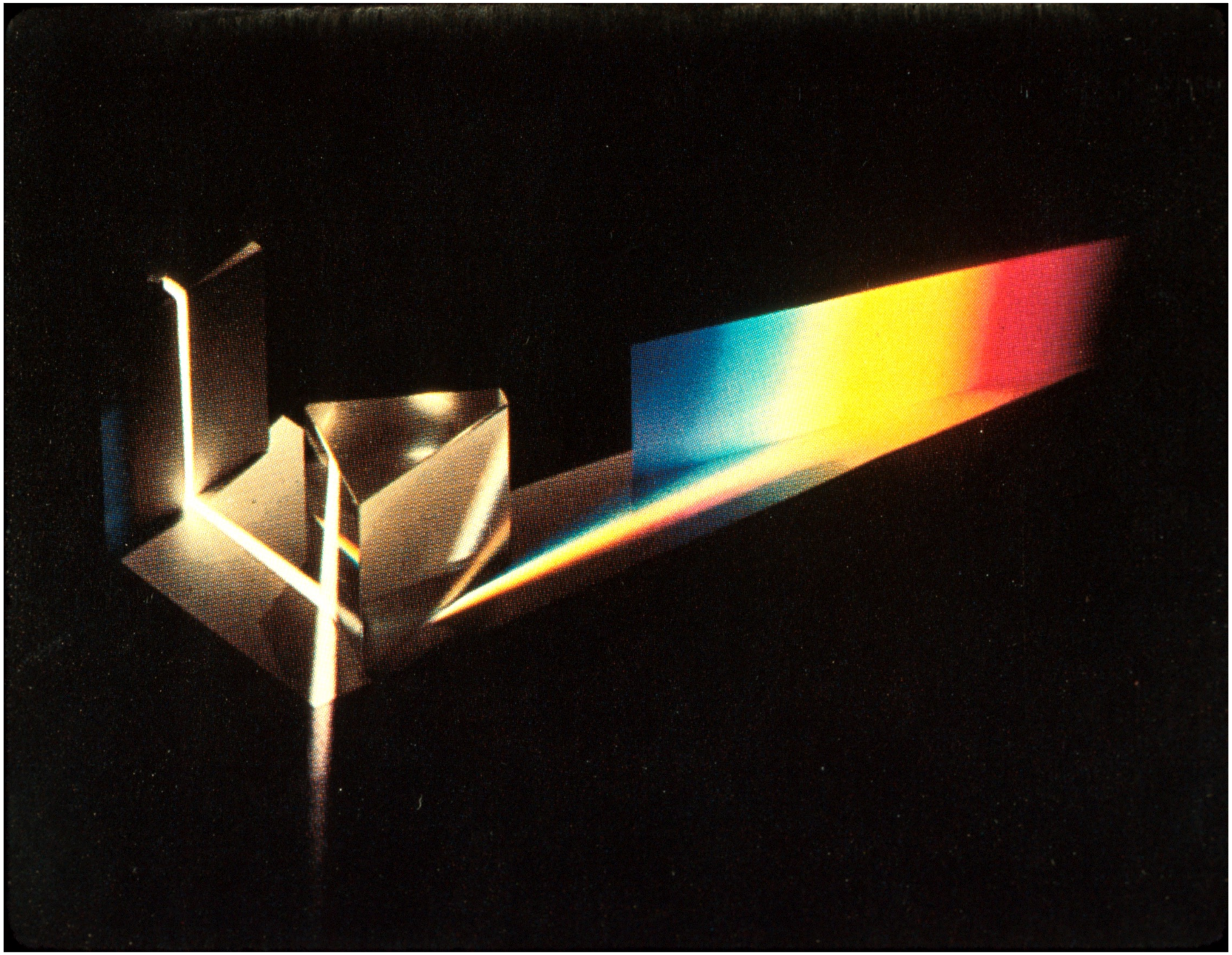
Physical Simulation



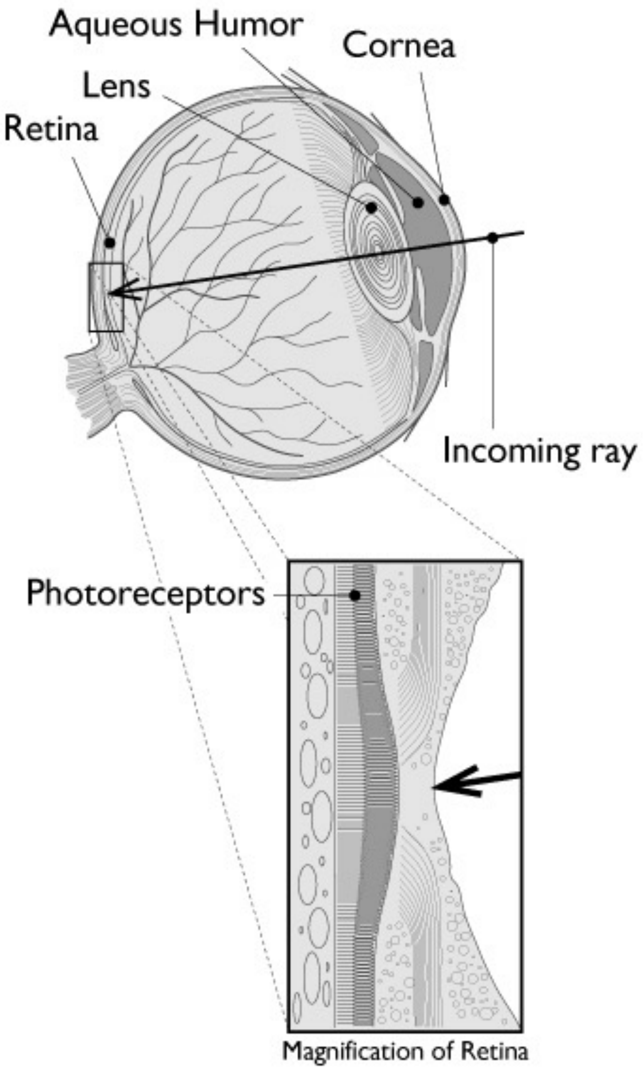
Topics in CSE160

Topics I will lecture:

- Perception
- Color
- Displays
- OpenGL
- Meshes
- Transforms
- Viewing
- Visibility
- Shading
- Texture
- Signal Processing
- Raytracing



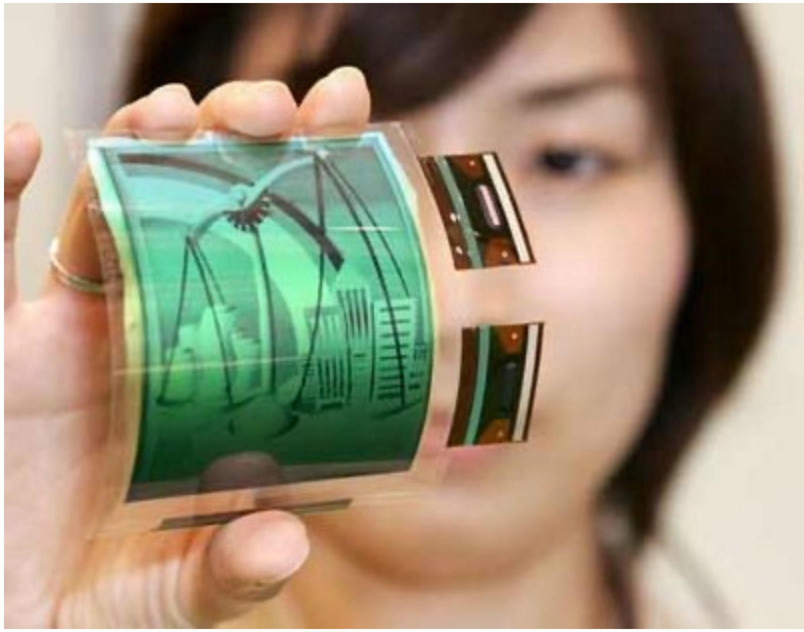
The eye as a measurement device



[Greger et al. 1995]

- We can model the low-level behavior of the eye by thinking of it as a light-measuring machine
  - its optics are much like a camera
  - its detection mechanism is also much like a camera
- Light is measured by the *photoreceptors* in the retina
  - they respond to visible light
  - different types respond to different wavelengths

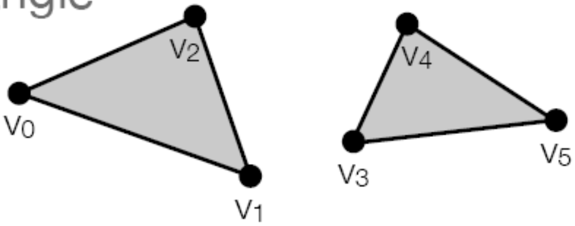
Displays



Triangles in OpenGL

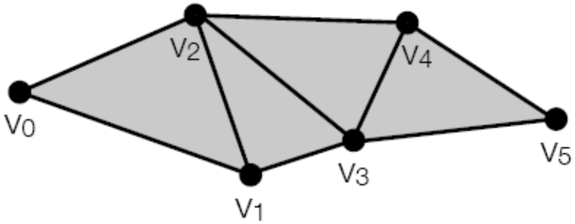
GL_TRIANGLES

- Successive vertex triples specify individual triangles
- Requires three vertices to be emitted for every triangle



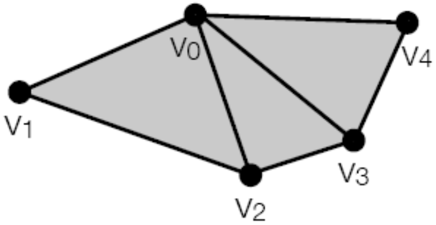
GL_TRIANGLE_STRIP

- First triple specifies first triangle
- Subsequent vertices *each* specify new triangle, along with previous two vertices
- One vertex emitted per triangle in long strips
- But stripifying meshes is nontrivial

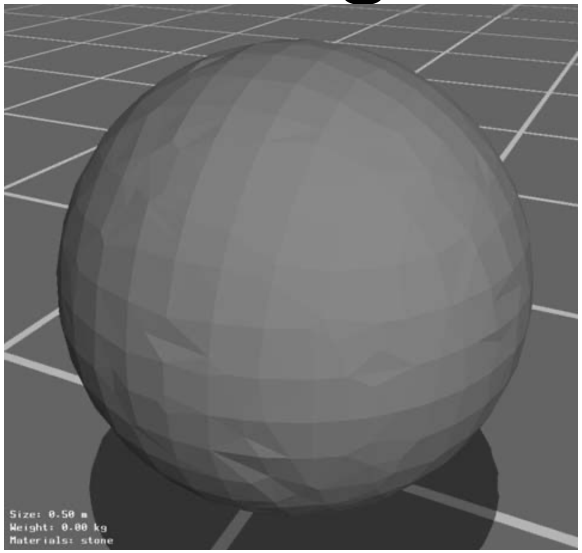


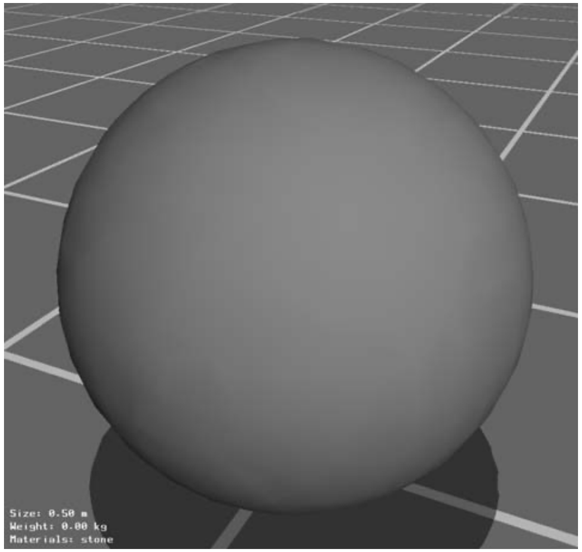
GL_TRIANGLE_FAN

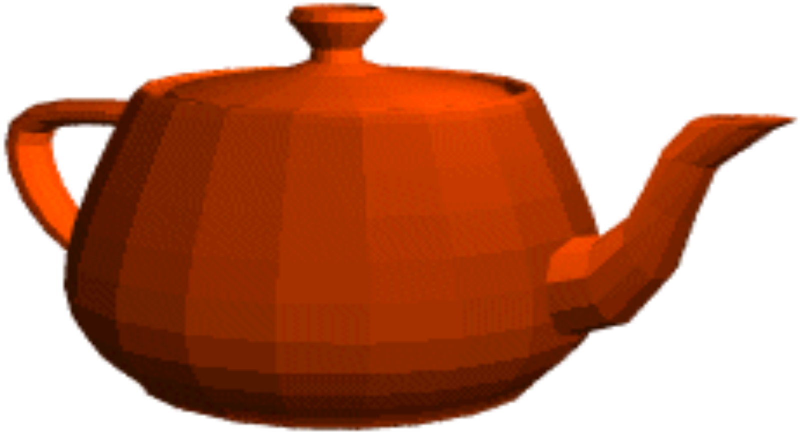
- First vertex is center of fan
- Subsequent vertices form ordered bounday
- One vertex emitted per triangle for dense fans
- But few such fans arise in practice

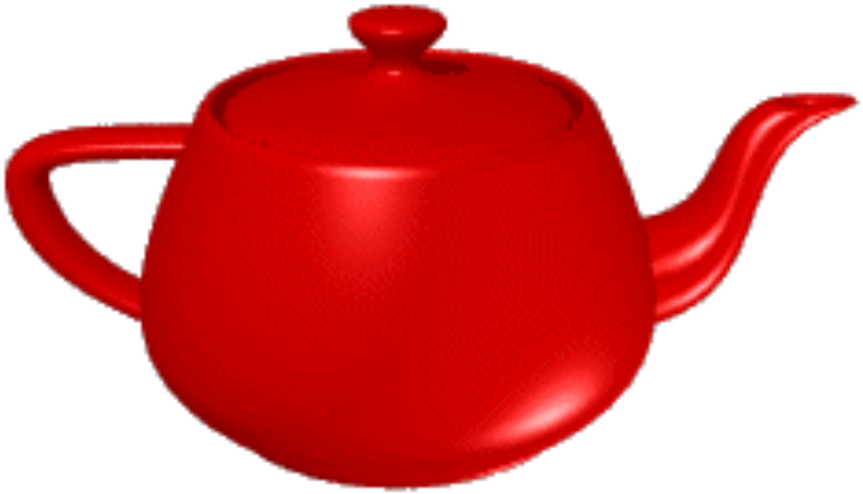


Can We Disguise the Facets?

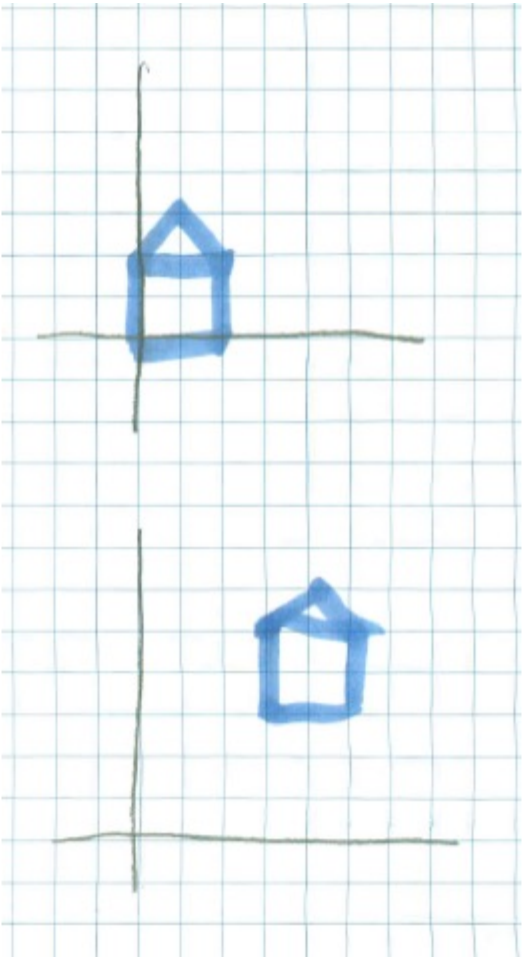








Transformations

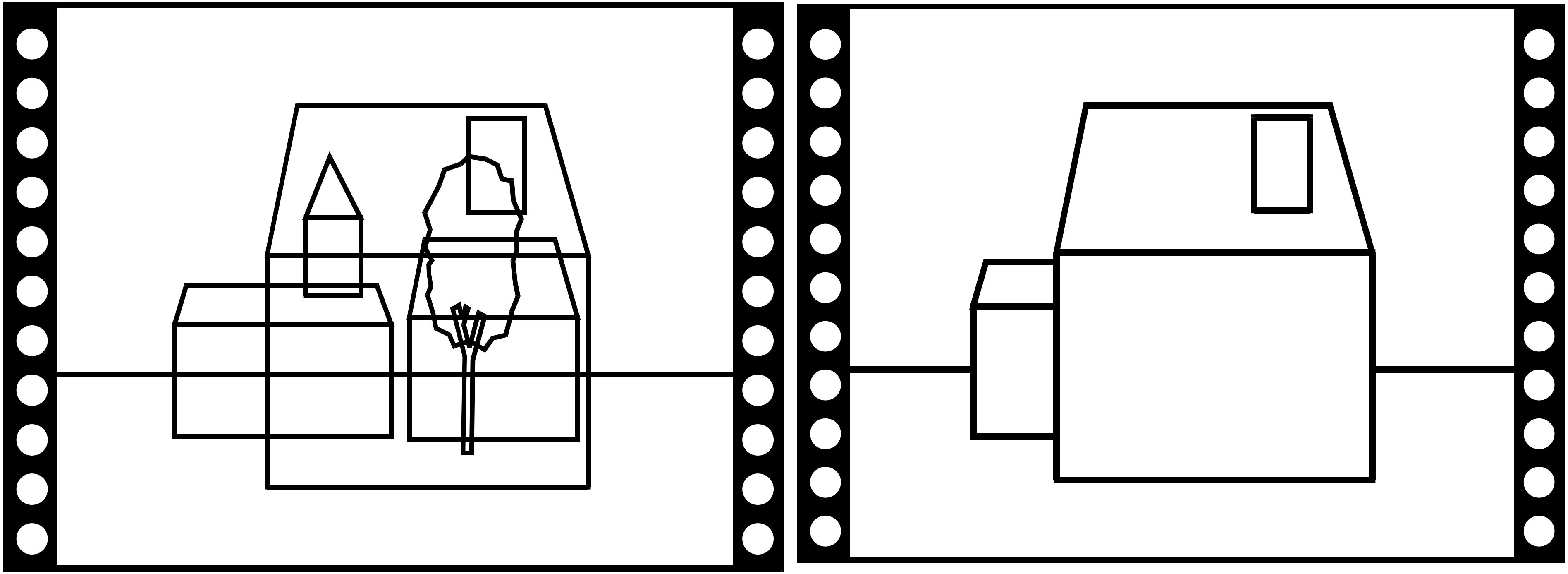


```
void drawHouse() {
 glBegin(GL_QUADS);
        vertex(0,0);
        vertex(0,1);
        vertex(1,1);
        vertex(1,0);
glEnd();
// …. Lots more stuff
}

void vertex(int x, int y) {
       glVertex2d(x,y);
}

void main() {
drawHouse();
}
```

Jovan Popovic at MIT

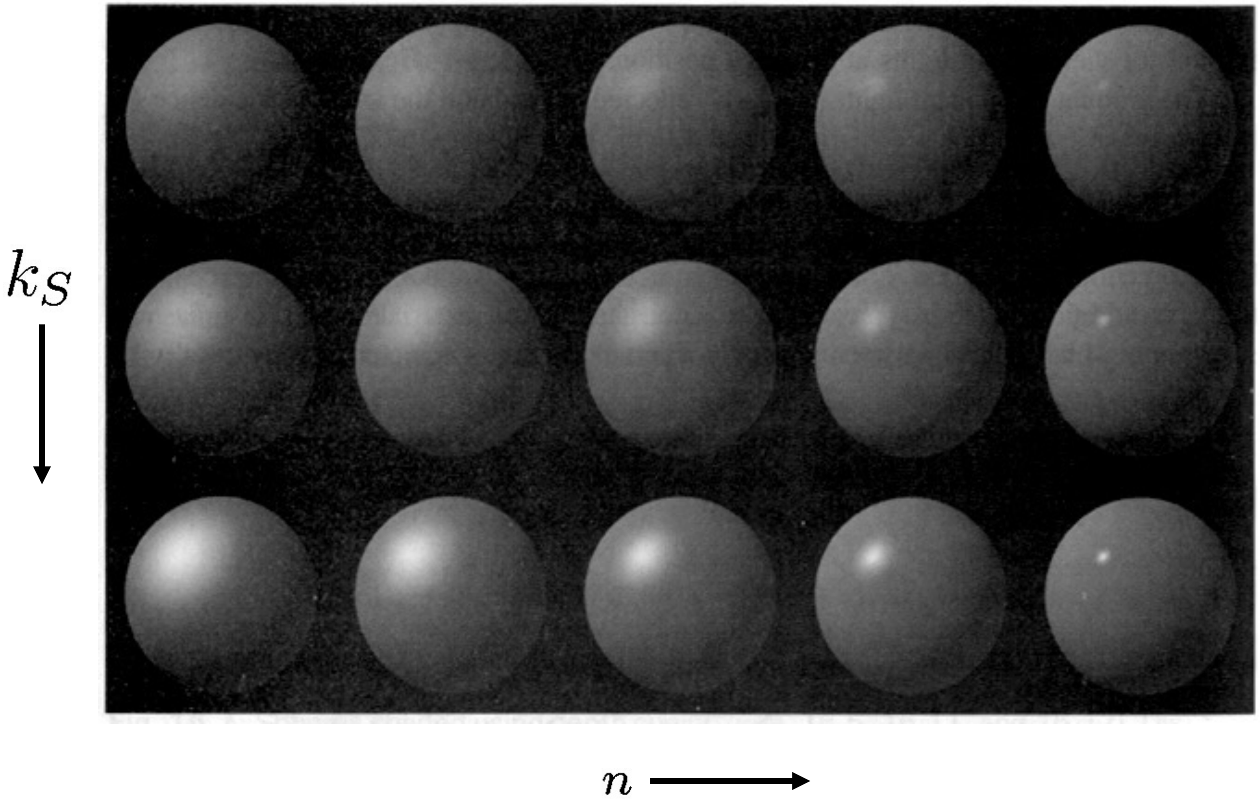
Visibility

- How do we know which parts are visible/in front?



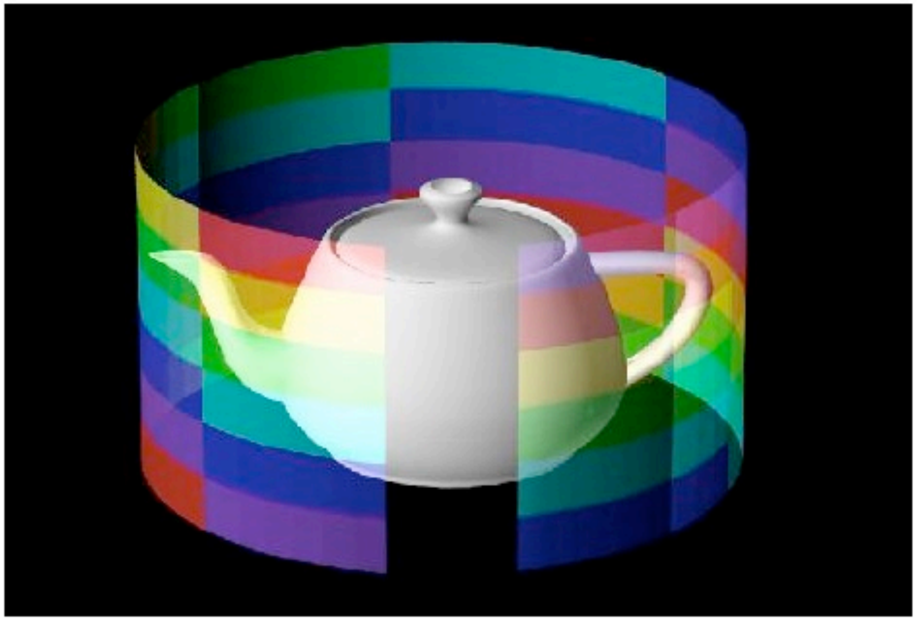
Specular shading

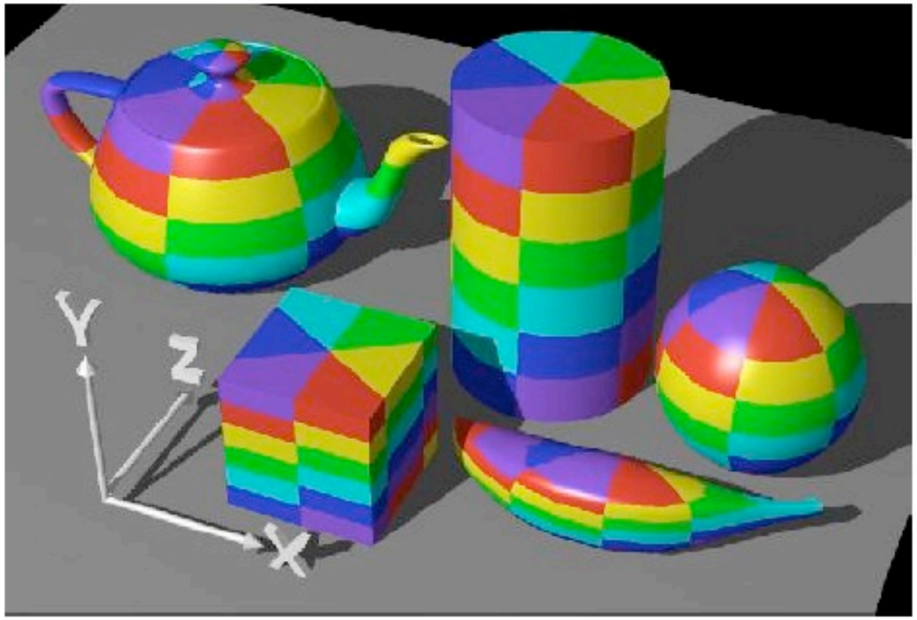
- Phong and Blinn-Phong



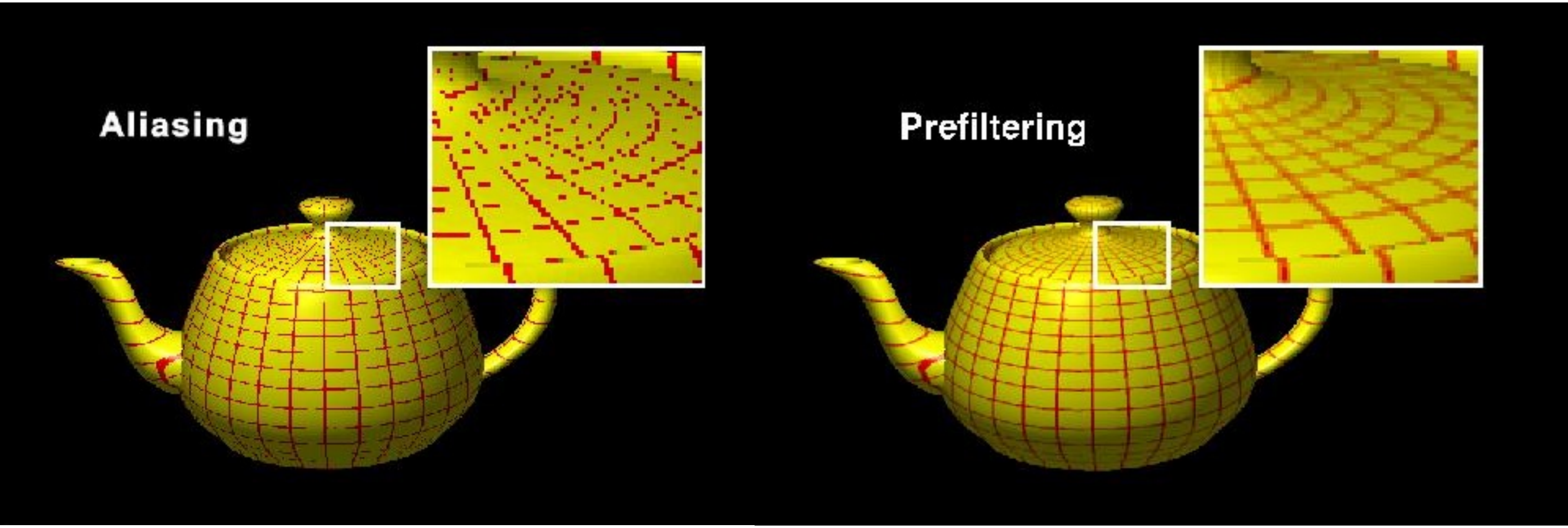
[Foley et al.]

Cylindrical Parameterization





$$f : (x,y,z) \to (r,\theta,h) \to (u_\theta, v_h)$$


Aliasing
Prefiltering

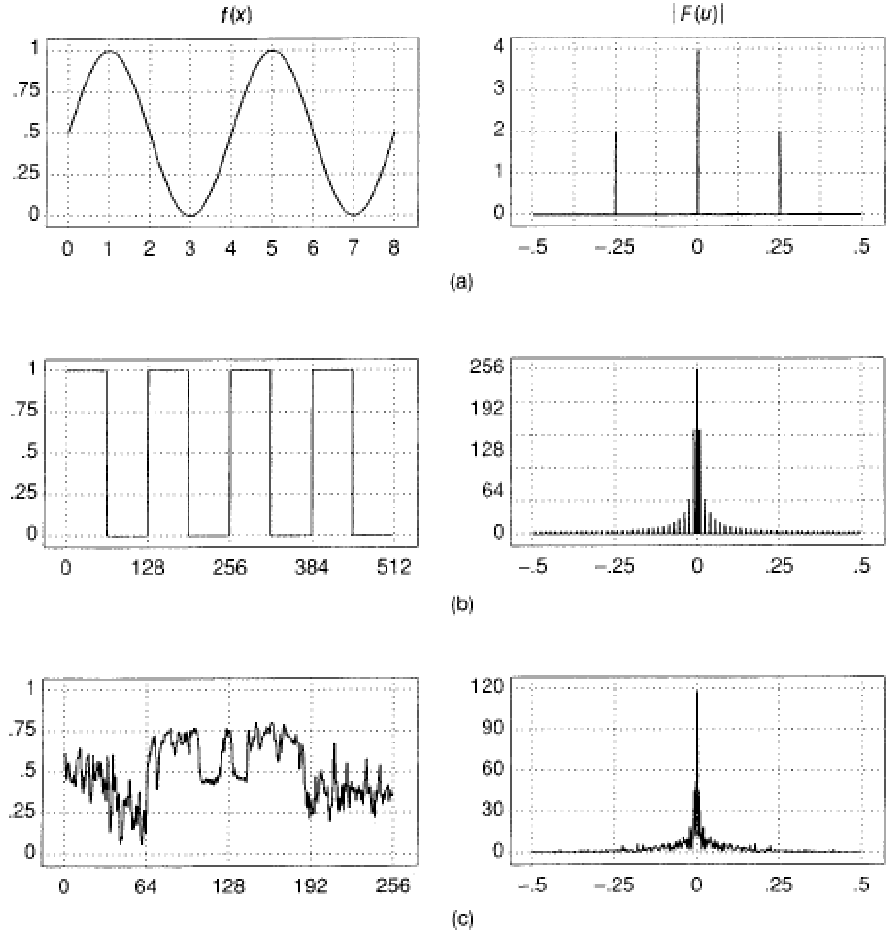
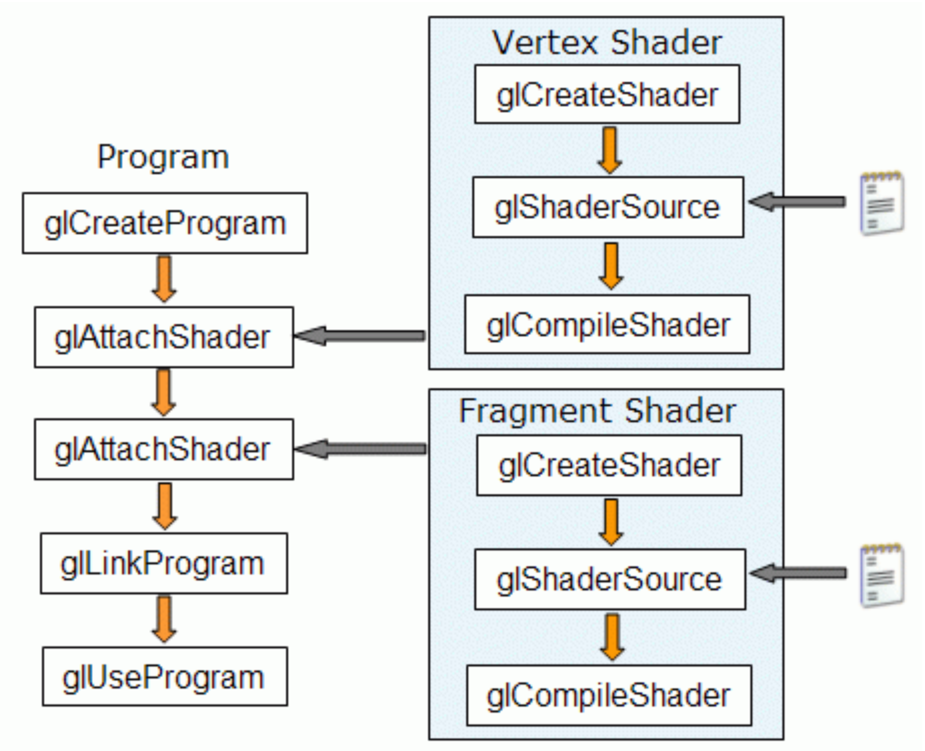


Fig. 14.15 Signals in the spatial and frequency domains. (a) Sine. (b) Square Wave. (c) Mandrill. (Courtesy of George Wolberg, Columbia University.)



Program

glCreateProgram

glAttachShader

glAttachShader

glLinkProgram

glUseProgram

Vertex Shader

glCreateShader

glShaderSource

glCompileShader

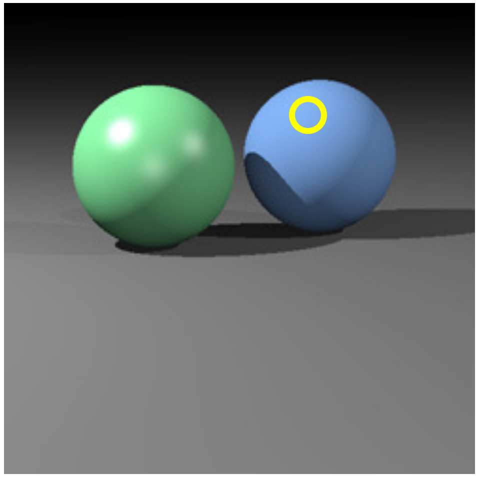
Fragment Shader

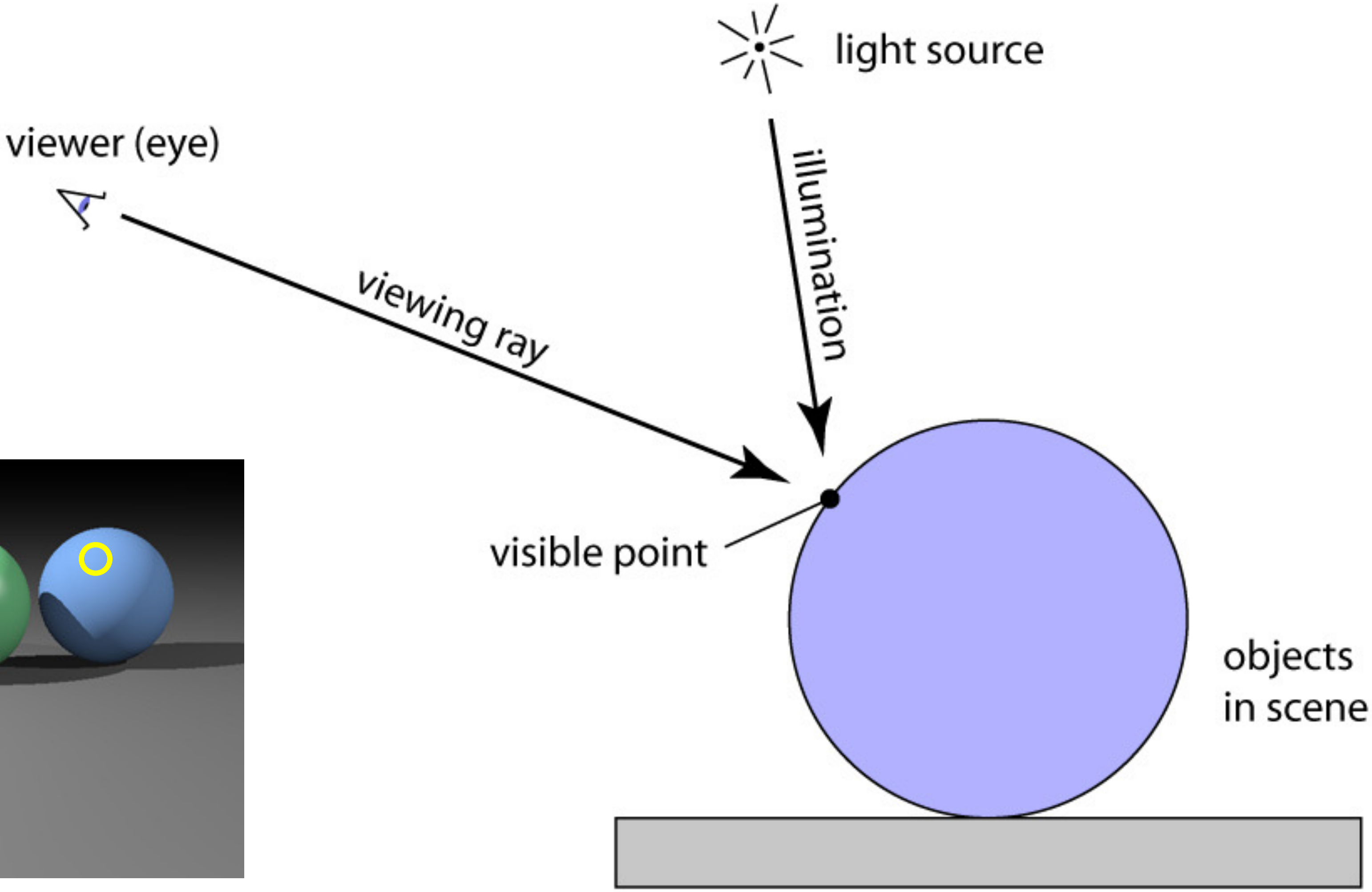
glCreateShader

glShaderSource

glCompileShader

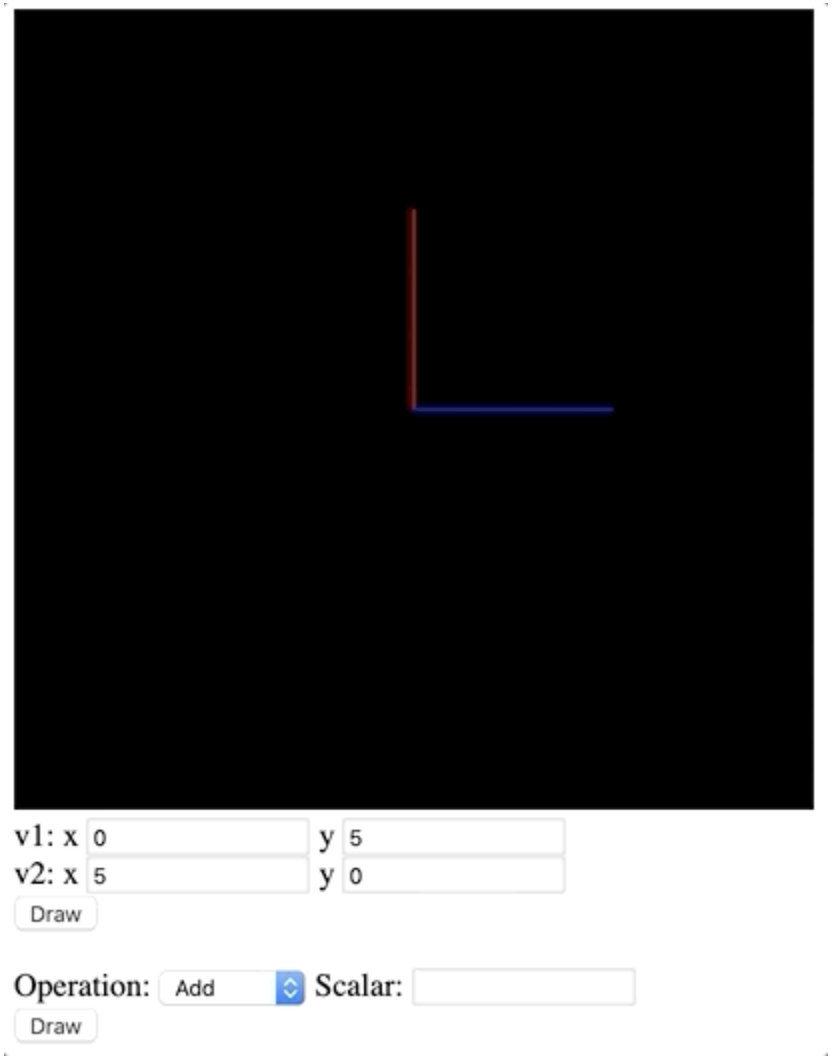
Ray tracing idea





Assignments in this class

Assignment 0 – Intro HTML, Javascript, Linear Algebra

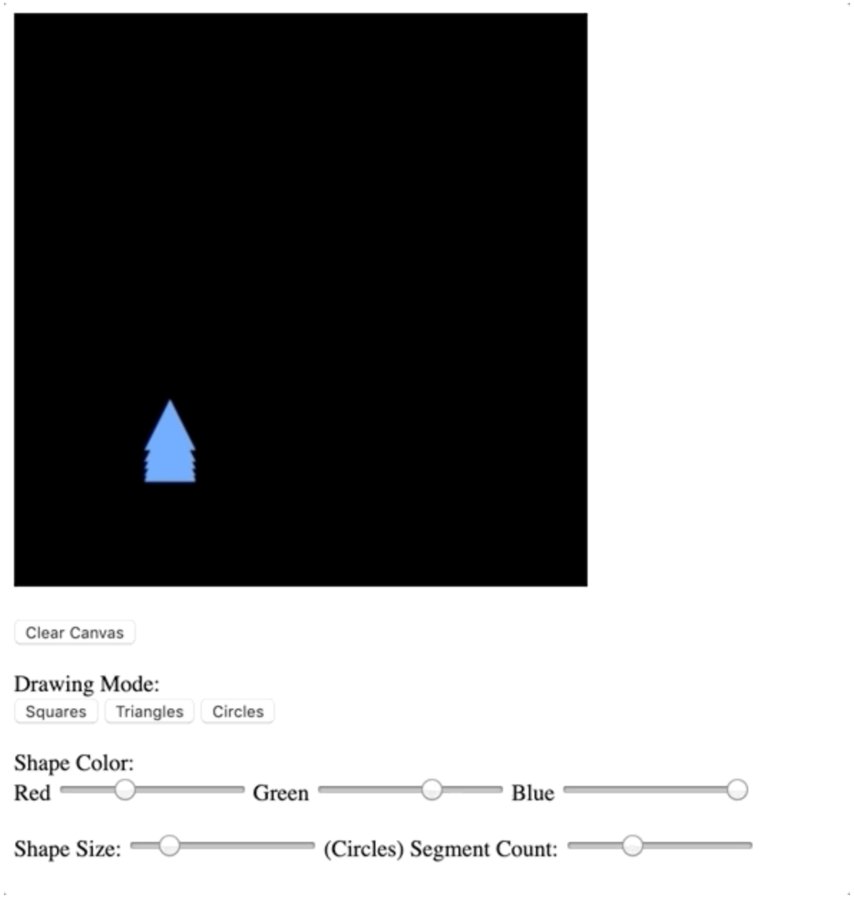


v1: x 0 y 5

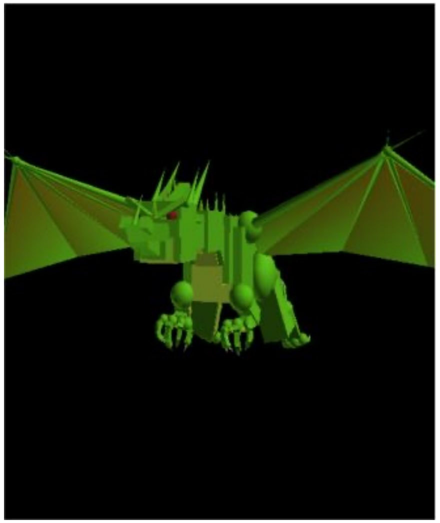
v2: x 5 y 0

Operation: Add Scalar:

Assignment 1 - Paint

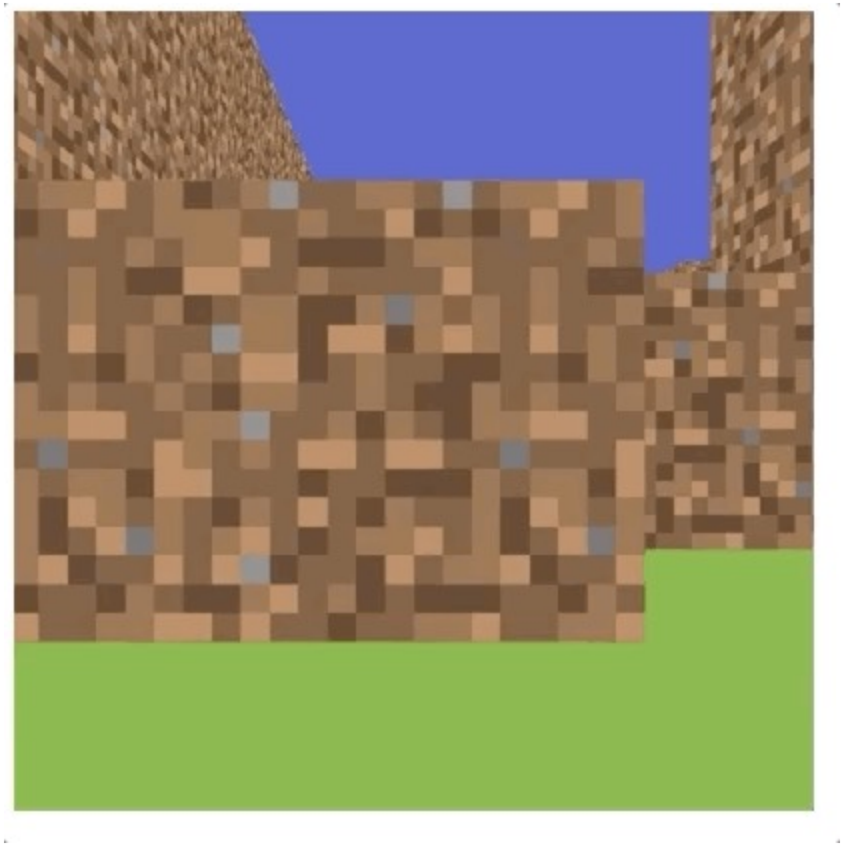


Assignment 2 – Blocky Animal

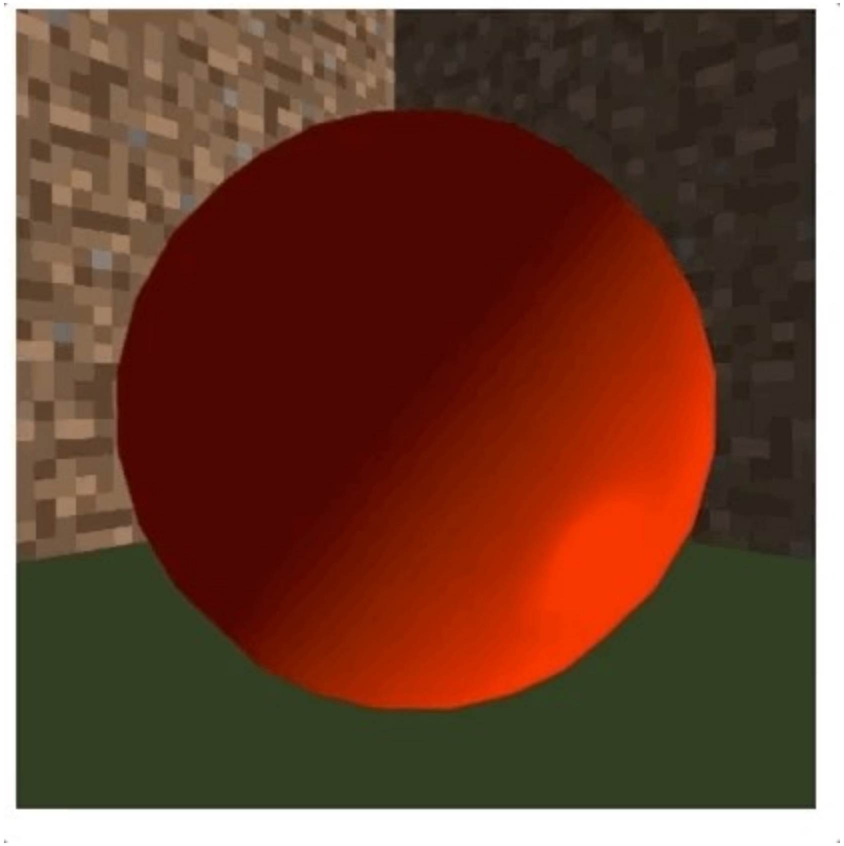


glevin.avi

Assignment 3 – Build a world



Assignment 4 - Lighting



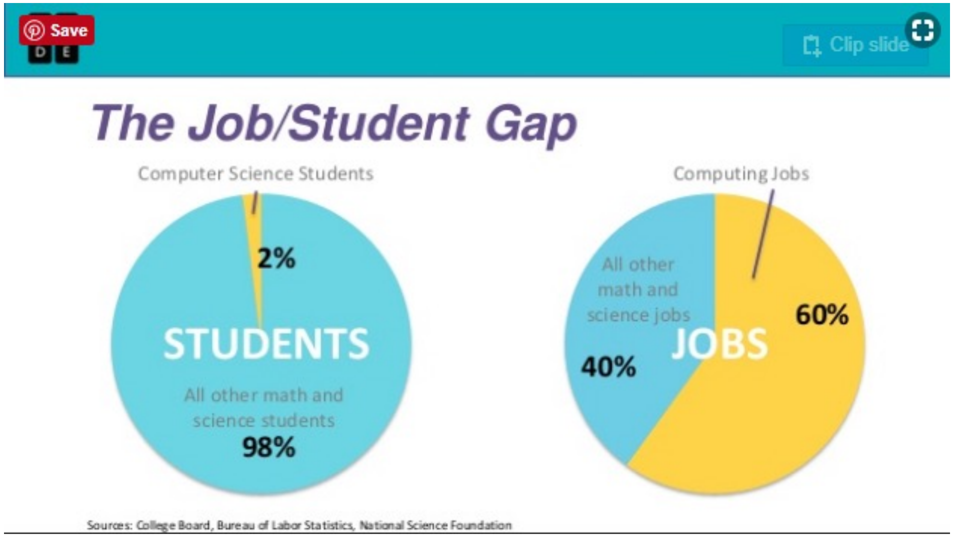
Why you should bother to learn in class

Why are you here?

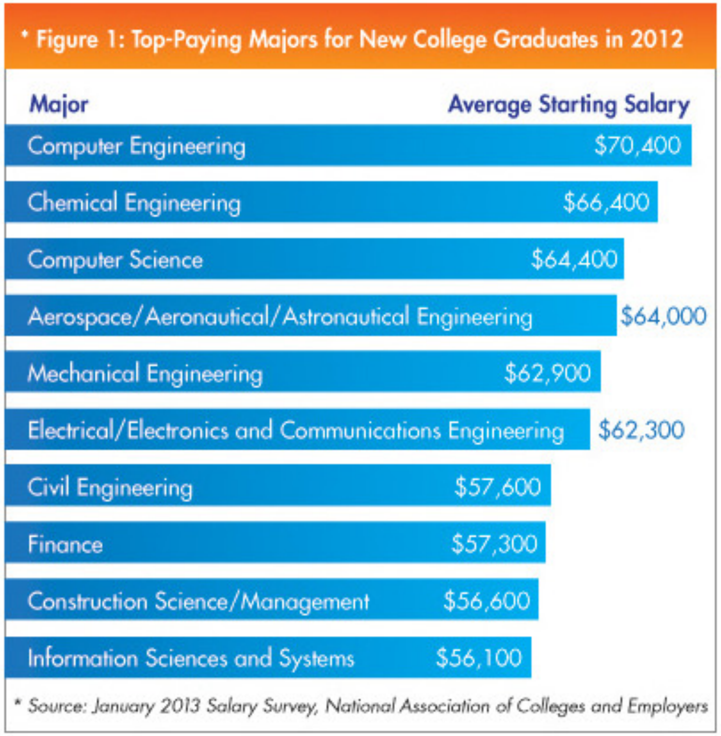
- Write it down on a piece of paper!
  - – (the truth)

Reason 1 – Really interesting work

Reason 2 - Lots of jobs Good pay



Sources: College Board, Bureau of Labor Statistics, National Science Foundation

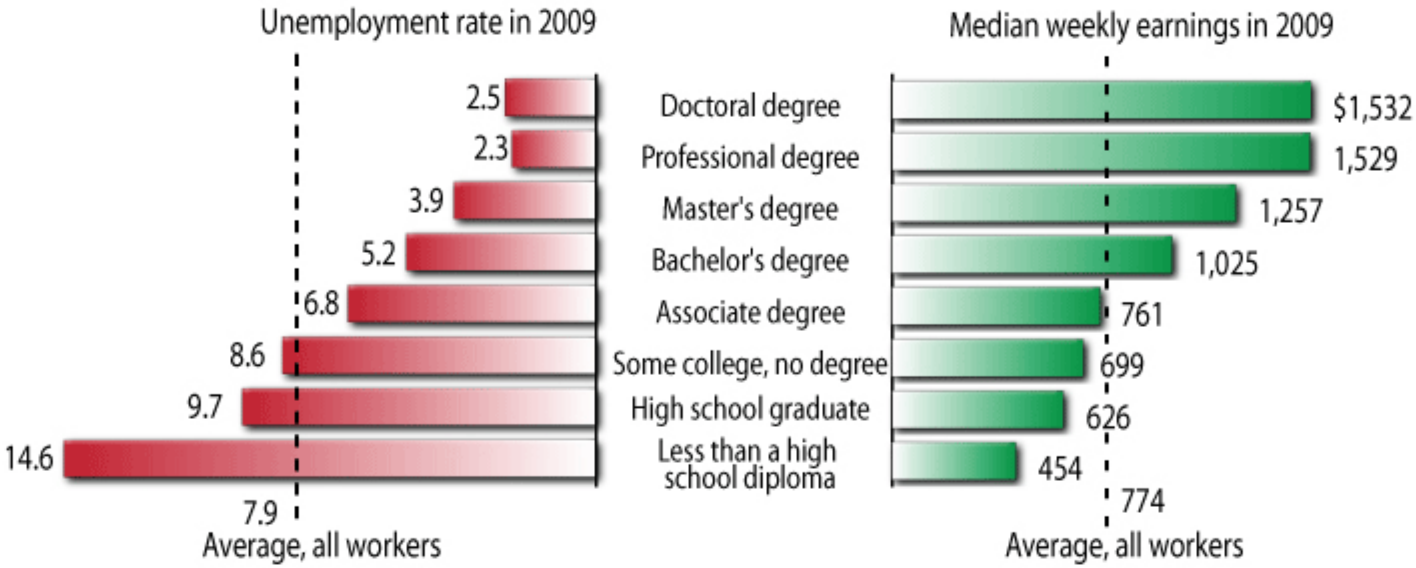


* Figure 1: Top-Paying Majors for New College Graduates in 2012

Major	Average Starting Salary
Computer Engineering	$70,400
Chemical Engineering	$66,400
Computer Science	$64,400
Aerospace/Aeronautical/Astronautical Engineering	$64,000
Mechanical Engineering	$62,900
Electrical/Electronics and Communications Engineering	$62,300
Civil Engineering	$57,600
Finance	$57,300
Construction Science/Management	$56,600
Information Sciences and Systems	$56,100

* Source: January 2013 Salary Survey, National Association of Colleges and Employers

Education pays

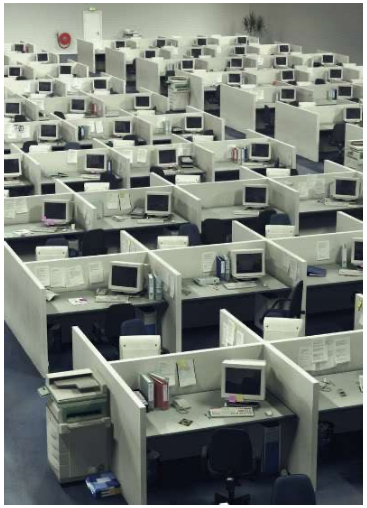


Source: Bureau of Labor Statistics, Current Population Survey

Reason 3 – Flexible jobs

Most jobs

- 8am-5pm Work



Computer Science jobs

- 8am-10am Surf
- 10am-3pm Work
- 3pm-4pm Dentist
- 4pm-8pm Work

#1 Advice from Faculty

1) Find a study group
2) Don’t work with other people – its cheating

#1 Advice from Faculty

1) Find a grou
2) Dor vith othe ople – its cheating

Make #$%&* sure you know the rules in each class. If you're cheating, it shouldn't be an accident.

Collaboration Policy (stolen from Luca)

- You can copy with clear attribution (give URL) all the code portions you want from the book, from StackOverflow, from the open web.
- You can ask you classmates advice, and exchange snippets of code.
- You cannot copy entire pieces of answers.
- You cannot use non-public web content (work-for-hire, homework exchanges, etc).
- In homeworks, you must turn in your own solution (no wholesale copying of solutions).
- For the project, you can copy code portions as stated above. You will be judged on your original content, but there is no problem if you also need thousands of lines of code from some library or framework.

So how much is studying for that test worth?

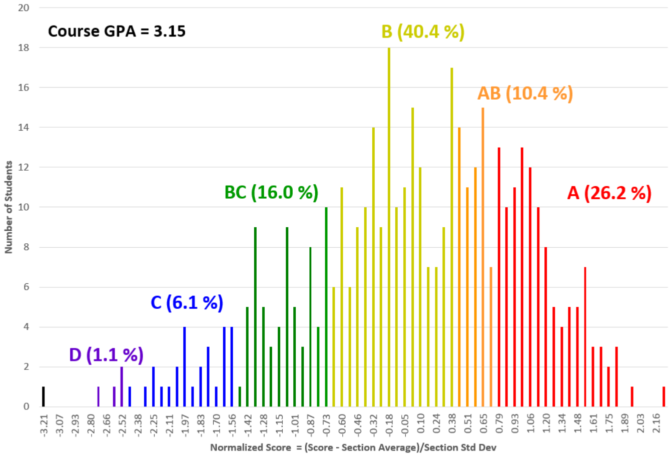
(actually getting the knowledge in your brain, you will be tested when you interview for jobs)

- Median life time earnings with CS degree - $2.0M
- Median life time earnings “some college no degree” - $0.7M
- Average classes to finish UCSC – 36
- Average tests per class – 2

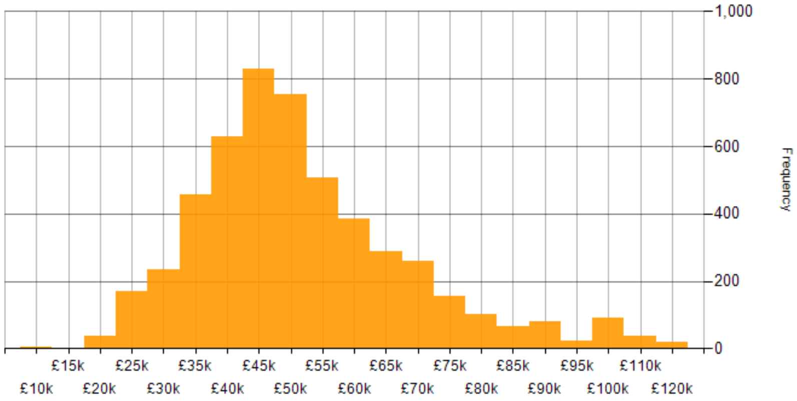
($2.0M-$0.7M)/(36*2) = **$18,055** ←

Lifetime value of just 1 test

Grades



Software Engineering Salaries



Short break

Participation form (will paste in Zoom chat)

Specifics of this class

Syllabus, HW, Tests, etc

Q&A