199: The Natural World & Computer Graphics

Course web site:

`http://www.dgp.toronto.edu/~karan/courses/199/fall2013`

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Administrivia

Grading:

- 60%: 4 written assignments handed out every other week.
- 40%: group project.

Lecture slides & course notes: on web, after class.

What is Computer Graphics?

Computers:

accept, process, transform and present information.

Computer Graphics:

accept, process, transform and present information

in a visual form.

Ok but… what is the course really about?

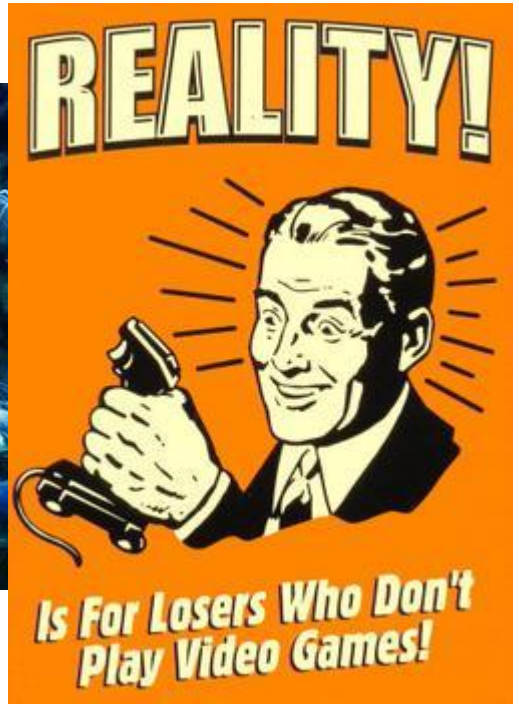
The art and science of understanding and transforming the world around us into one that is computationally synthesized but equally real!

Disclaimer: many of the images (such as the one above) in this and subsequent presentations have been randomly googled off the internet and used here simply for pedagogical purposes.

Ok but… what is the course really about?

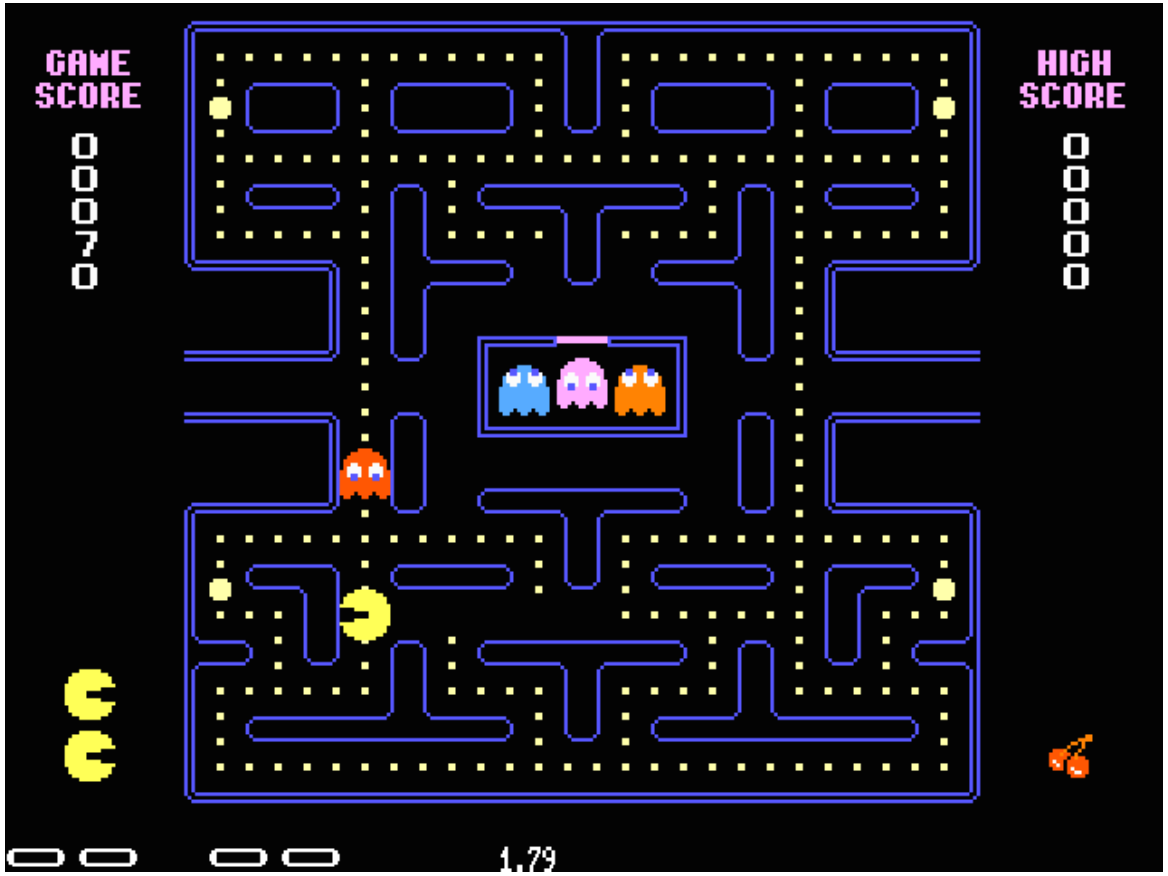
The art and science of understanding and transforming the world around us into one that is computationally synthesized but equally real!

What is reality anyway!

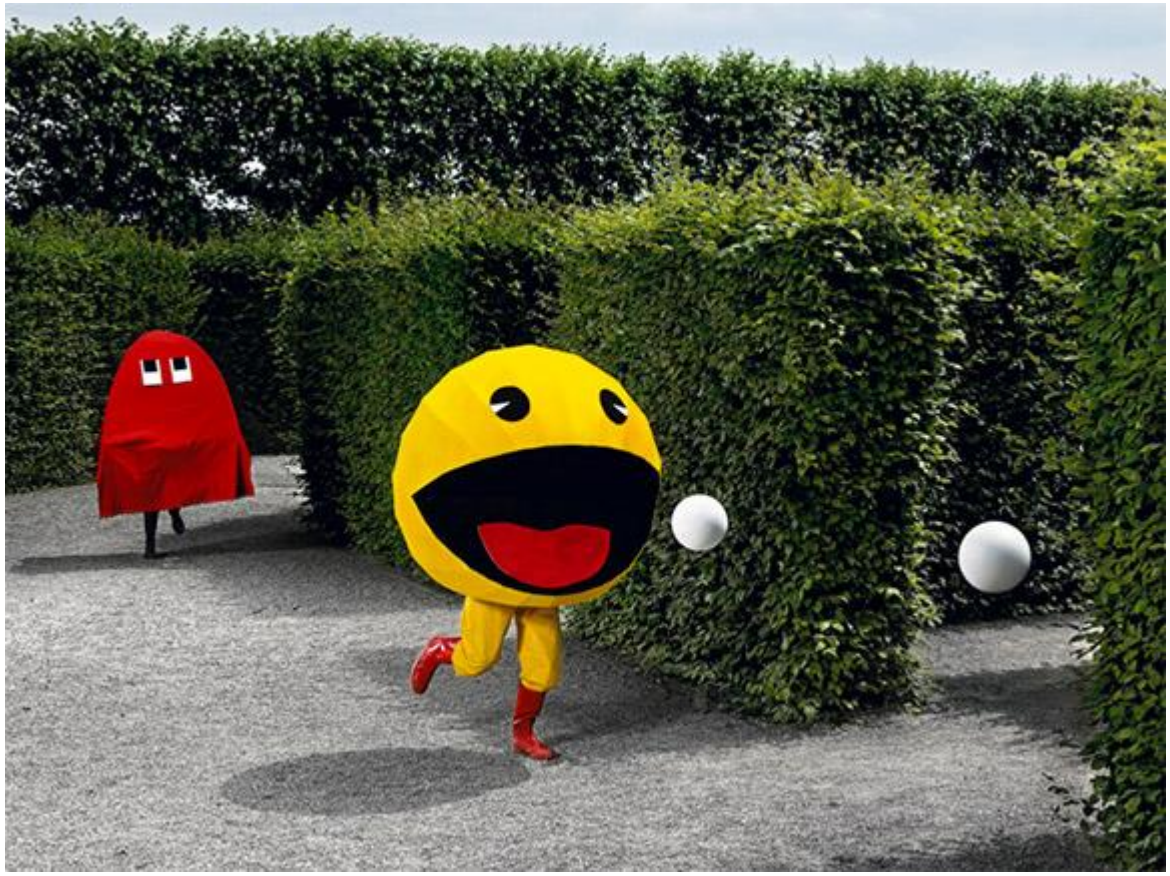


…the end

CG is Games



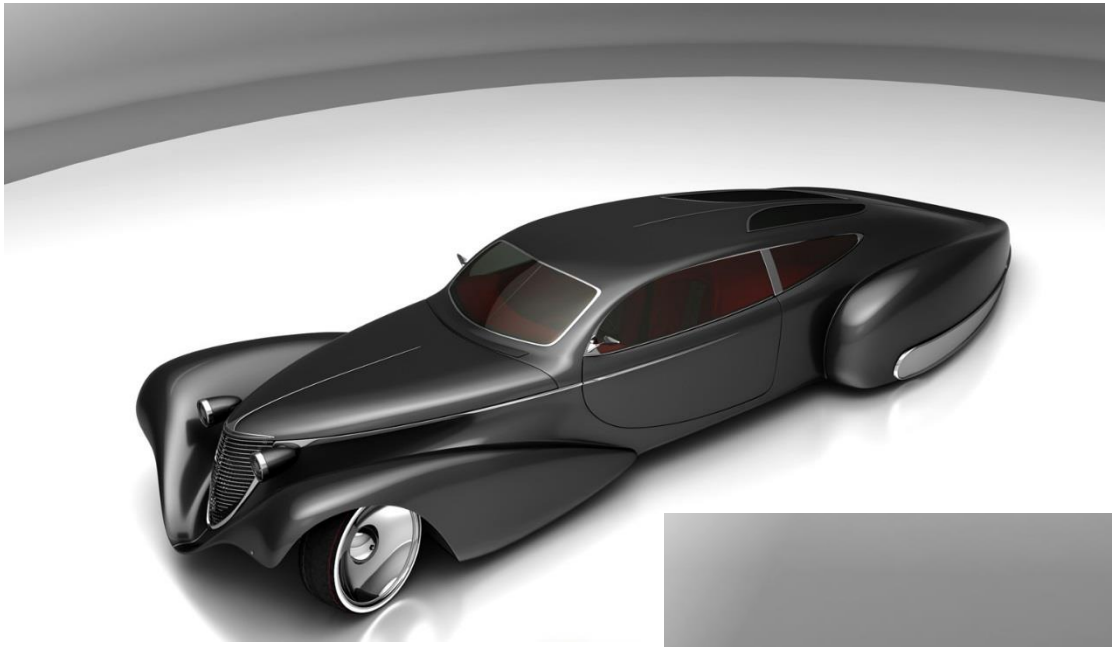
CG is Games

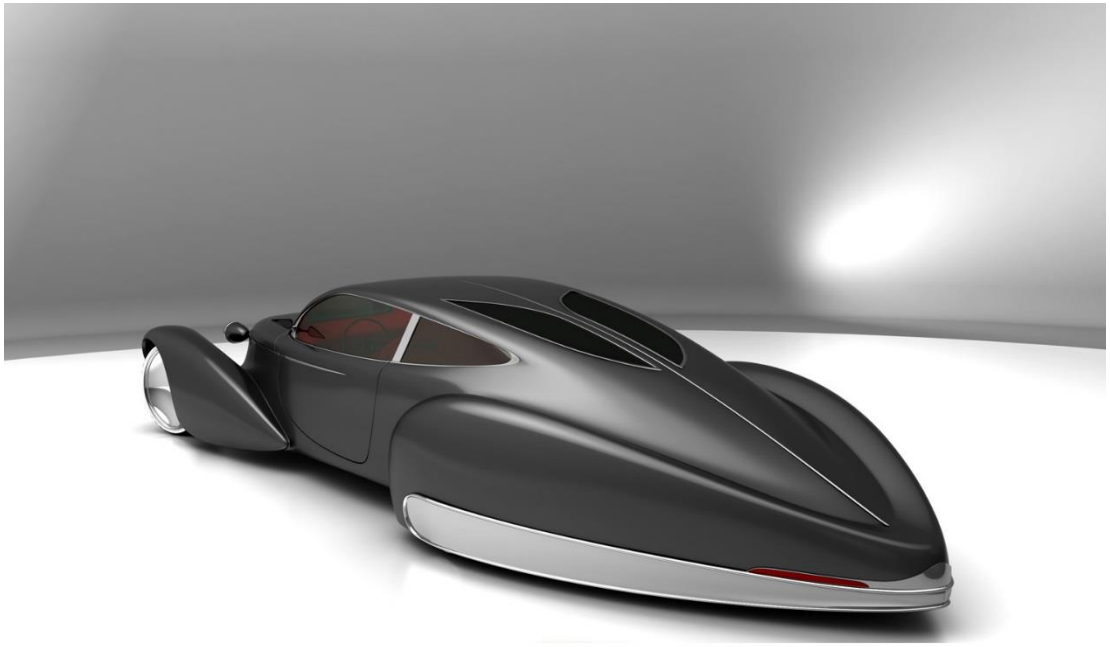


CG is Games

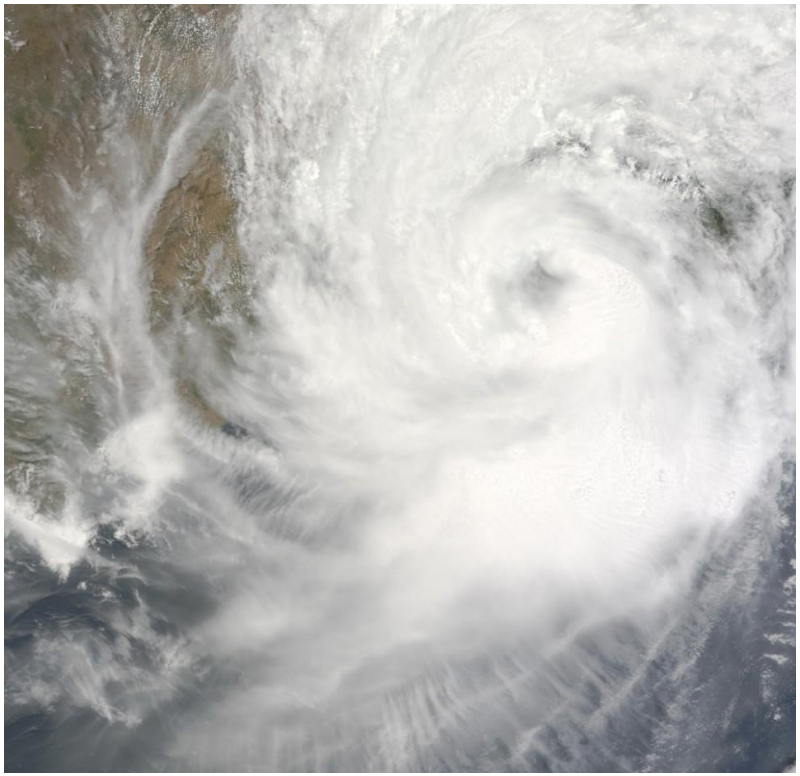
CG is Movies

CG is Design

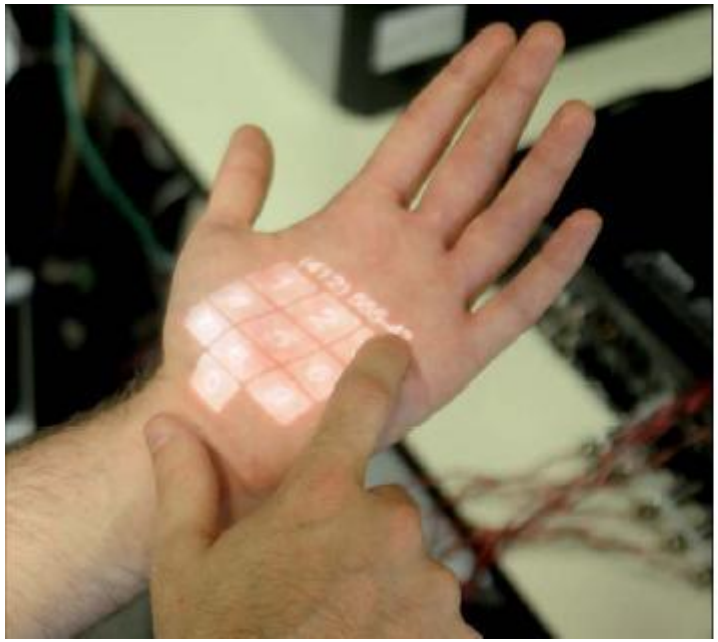




CG is visualization



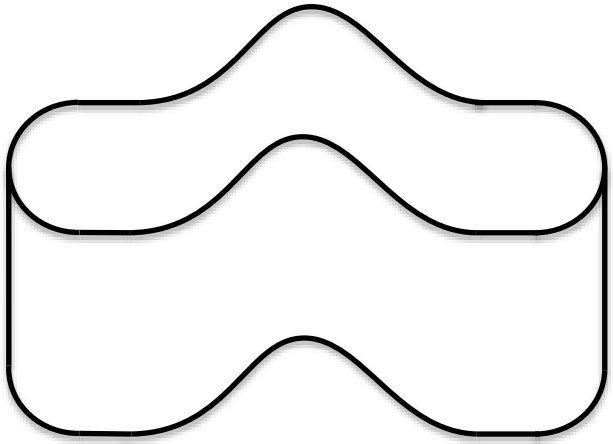
CG is interaction



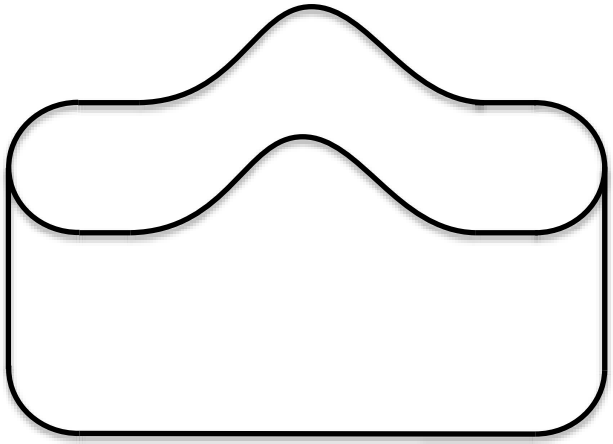
Sketchpad (Ivan Sutherland 1963)

Humans have an audio IN and OUT,
a video IN but no explicit video OUT!

video IN: Projection & Perception



video IN: Projection & Perception



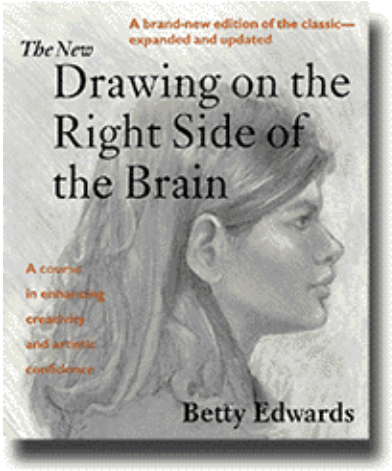
video IN: Images

Image = distribution of light energy on 2D “film”

Digital images represented as rectangular arrays of pixels

video OUT: sketch, sculpt, words, hands

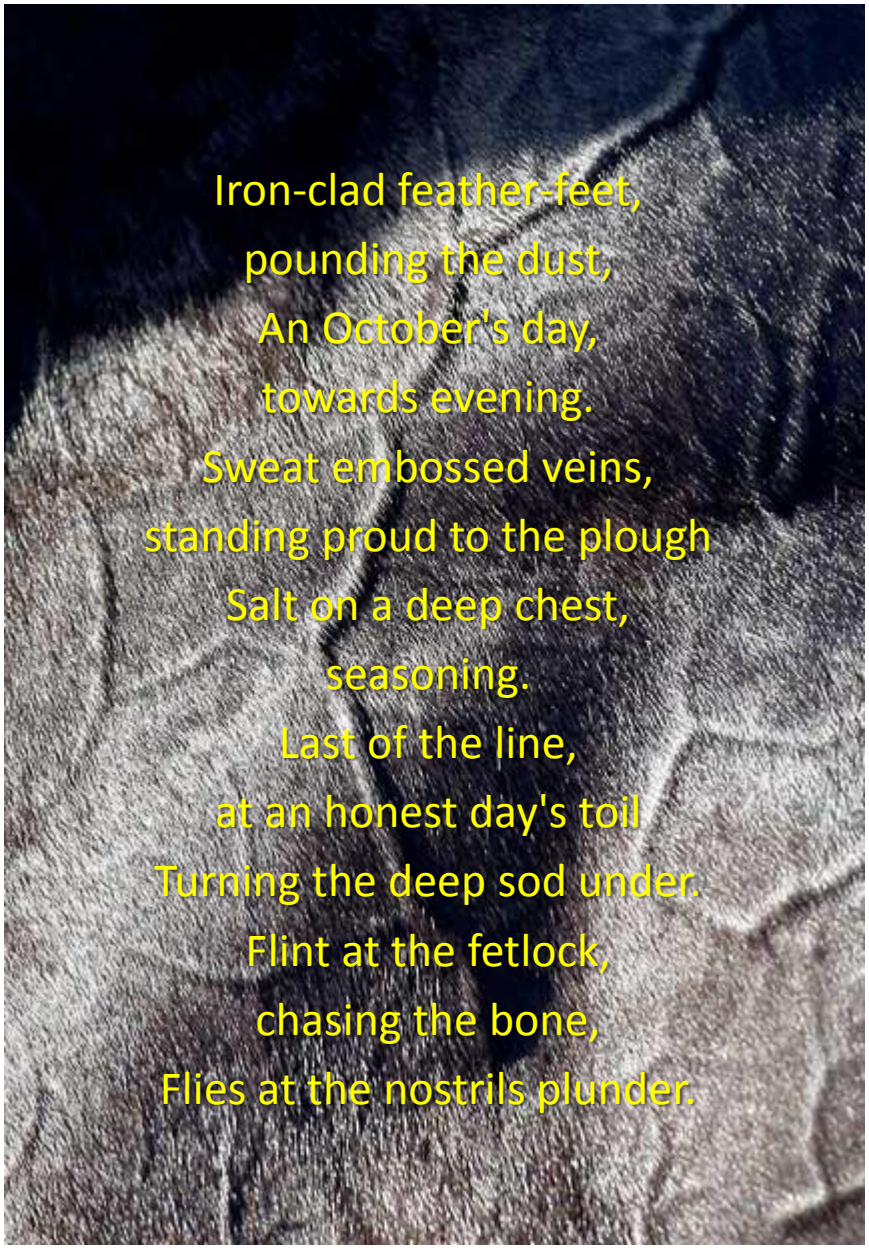
Most children between the ages of about 9-11 have a passion for realistic drawing.



…many adolescents say, “This is terrible! I have no talent for art. I’m not doing it anymore.”

…regardless, we all mould, gesture and doodle!

What is natural?



What is real?


Jonas Thornqvist 2006
CGNetworks.com | CGTalk.com
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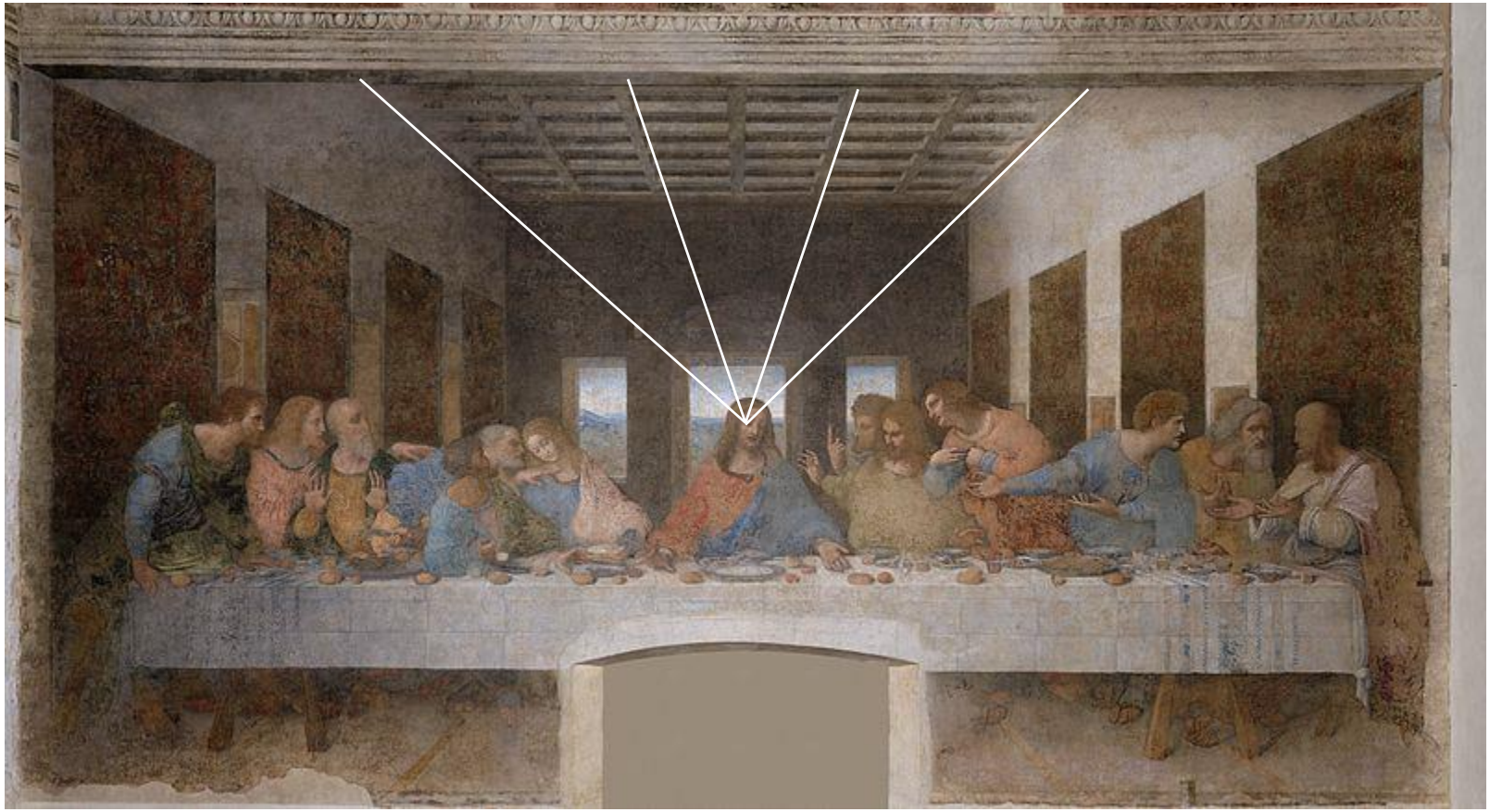
The pursuit of realism: 1490's Last Supper



The pursuit of realism: 1642 Night Watch

The pursuit of realism: 1959 Picasso

The pursuit of realism: 1874 del Caso

The pursuit of realism: 2000's

The pursuit of realism: 2000's

The pursuit of realism: 2012 Koi

The pursuit of realism: 2012 Koi

How real is real?

How real is real?

How real is real?

Do we care if it is real?

CG: the research agenda

CG researchers develop the tools that enable others to tell stories, to express their thoughts, to communicate information, all through a computational visual medium.

CG: the measure of success

CG has always been a “service” to other fields.

It adopts and adapts other fields.

It succeeds when others use CG tools.

CG is pragmatic and not about scientific “purity”: the look counts.

We do it because it’s beautiful.

It is flexible, adaptable, egalitarian.

Scientific Bedfellows

1960s: computer engineering.

1970s: computer systems, applied mathematics.

1980s: software engineering, engineering sciences.

1990s: computer vision, engineering physics.

2000s: computer engineering, AI, machine learning, statistics, computer vision, biology, chemistry, medicine, materials science, ...

Where are we now?

Interactive hardware assisted realistic graphics is within reach.

Interactive (physical) simulation is next.

It is no longer about polygons per second rendered.

It is about interaction, integration, participation, intelligence, sensory and cognitive engagement.

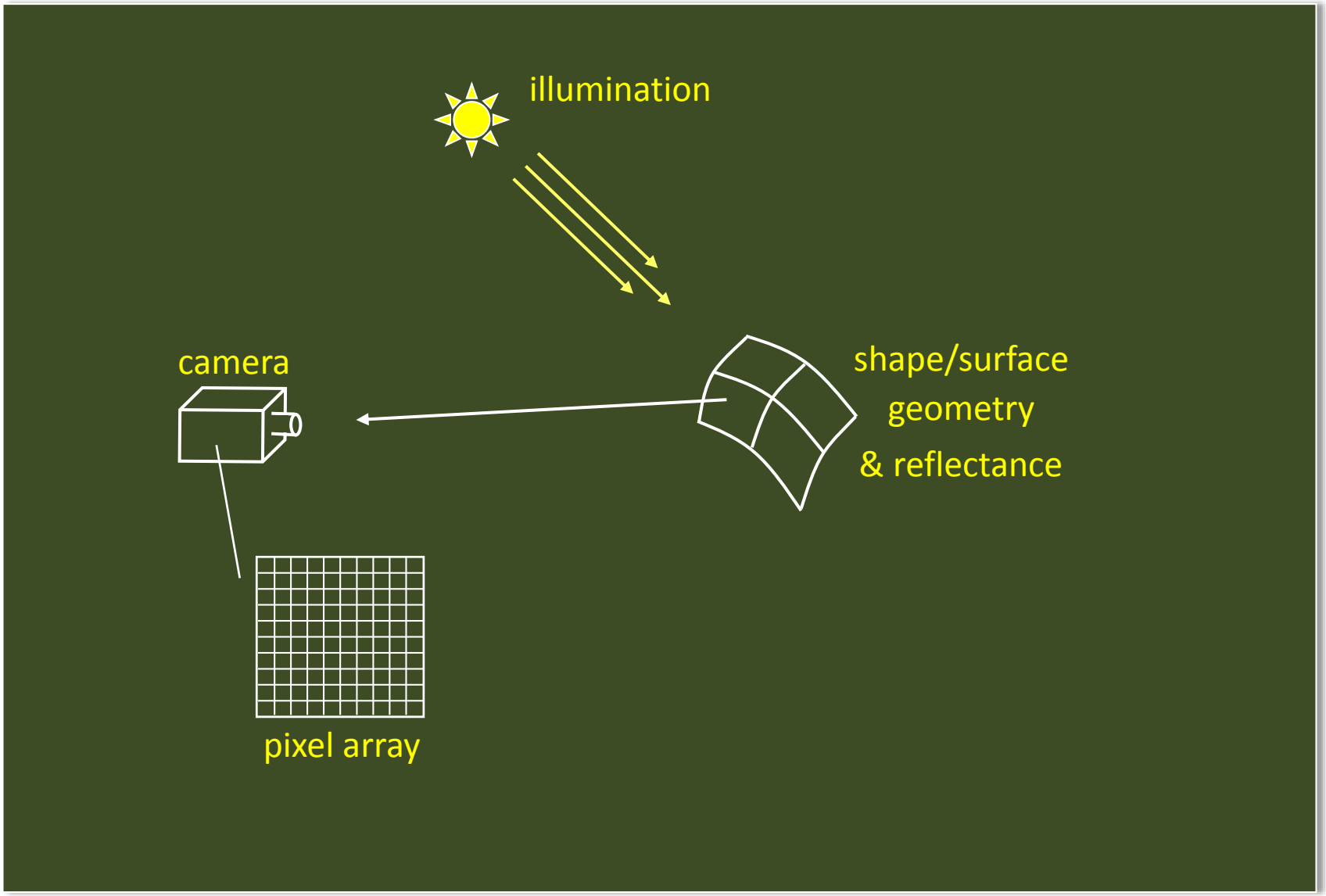
…in other words:

It is all

about

content.

Form & Appearance in CG



Computer Graphics: the trinity

- Form (modeling)

  How do we represent (2D or 3D) objects & environments?

  How do we build these representations?

- Function (animation)

  How do we represent the way objects move?

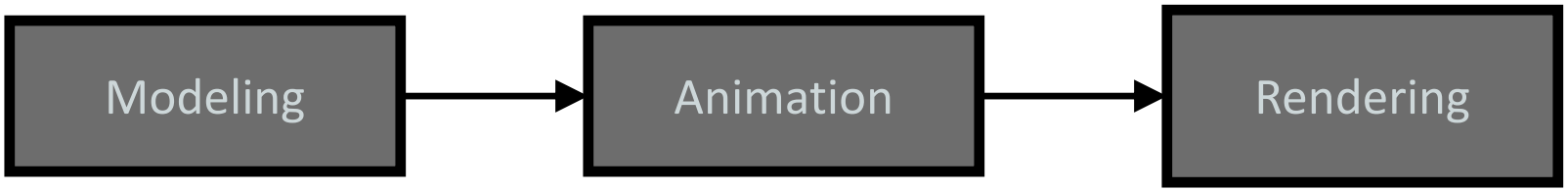
  How do we define & control their motion?

- Appearance (rendering)

  How do we represent the appearance of objects?

  How do we simulate the image-forming process?

The Graphics Pipeline



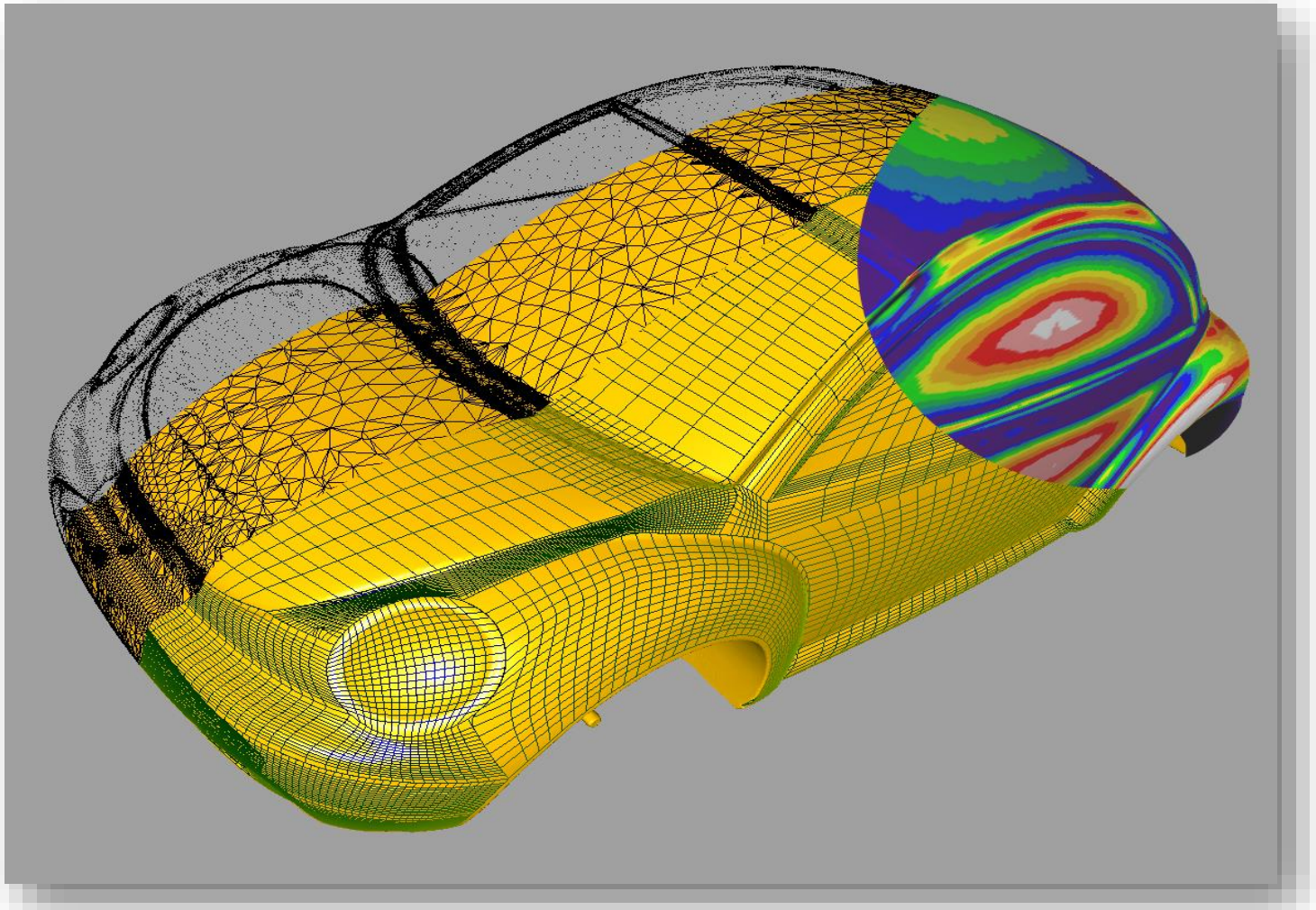
- Geometry: points, curves, & surfaces
- Scene Objects: parts, relations, & pose
- Texture and reflectance (e.g., color, diffusivity, opacity, refractions)
- …

- Key-frame, motion capture, inverse kinematics, dynamics, behaviors, motion planning, …

- Visibility
- Simulation of light (e.g., illuminants, emissive surfaces, scattering, transmission, diffraction, …)
- Special effects (e.g., anti-aliasing, motion blur, non-photorealism)

Graphics Pipeline: Modeling

How do we represent an object geometrically on a computer?



Modeling: www.meshmixer.com