Introduction to CS 181m

Outline

- Intro to me
- Intro to computer vision
- History of visual media
- Intro to computer graphics
- Intro to computational photography
- Course details

Who am I?

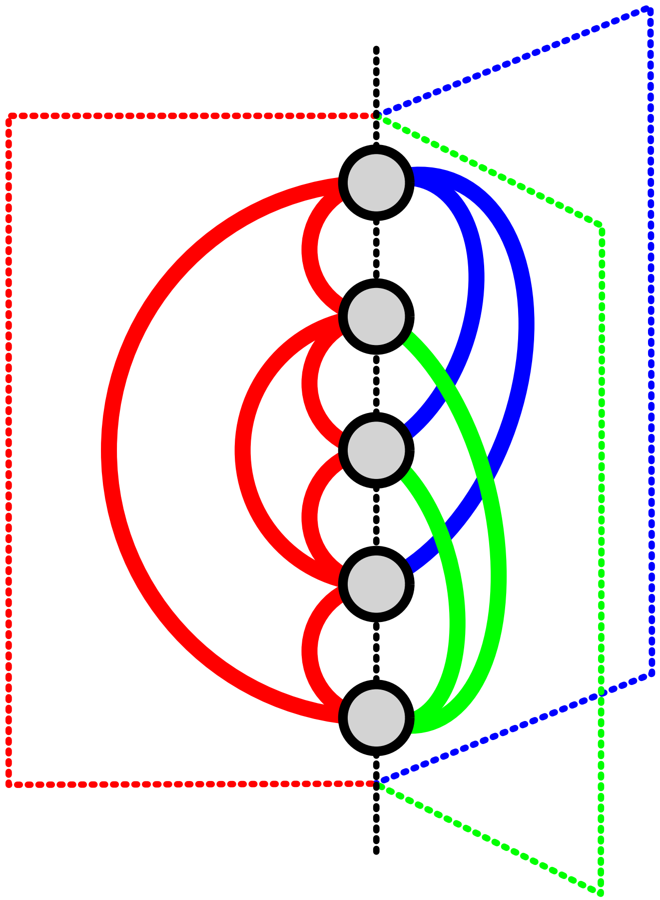
Education

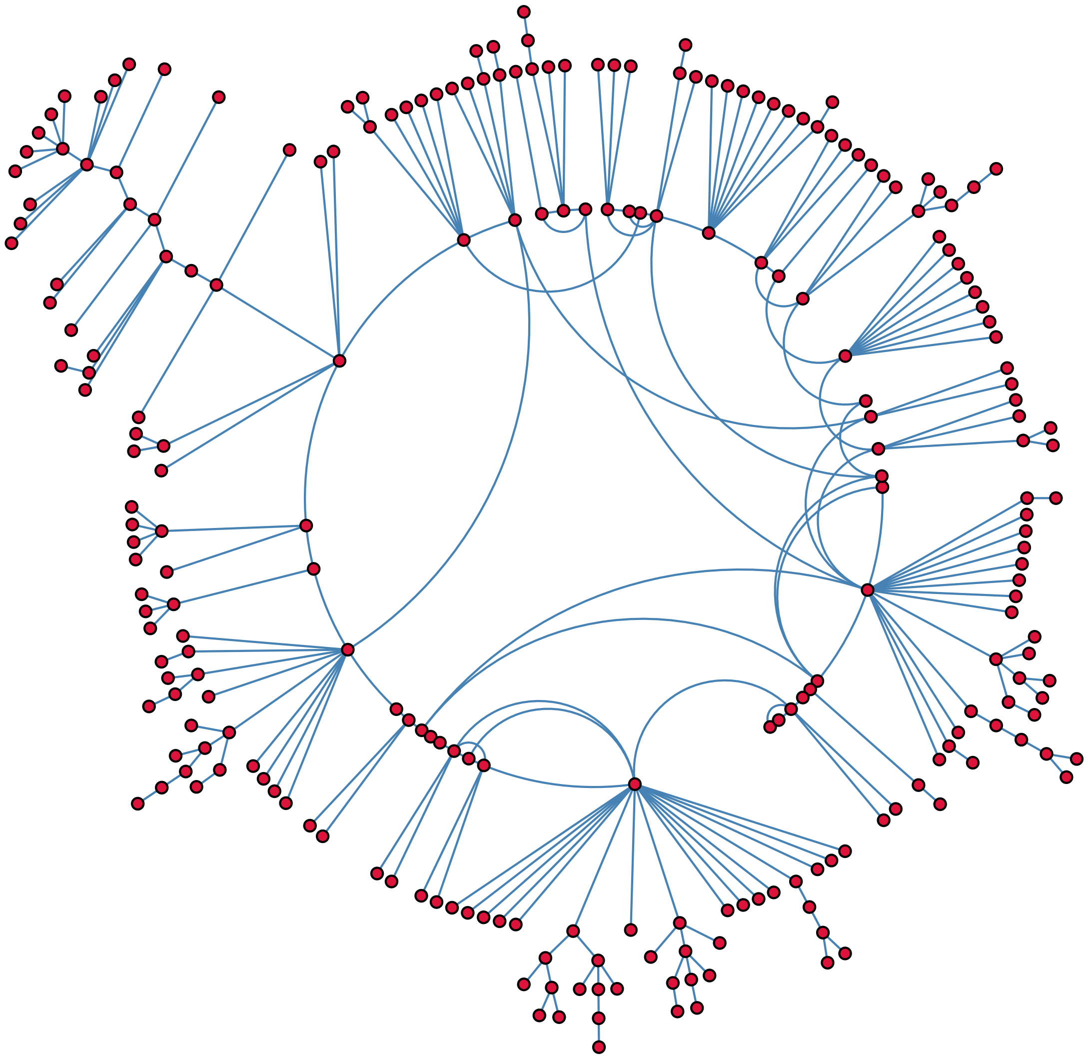
Center for Algorithms and Theory of Computation

Donald Bren School of Information and Computer Sciences
University of California, Irvine

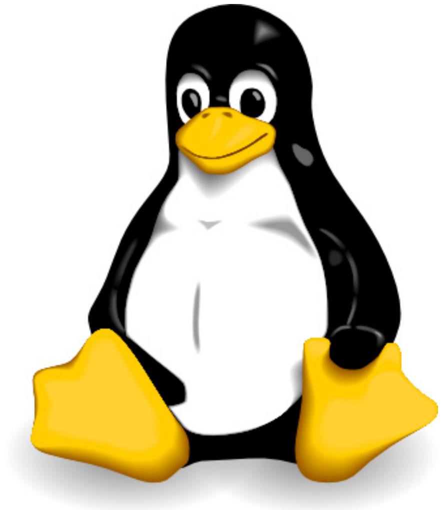
Ucla
MATHEMATICS

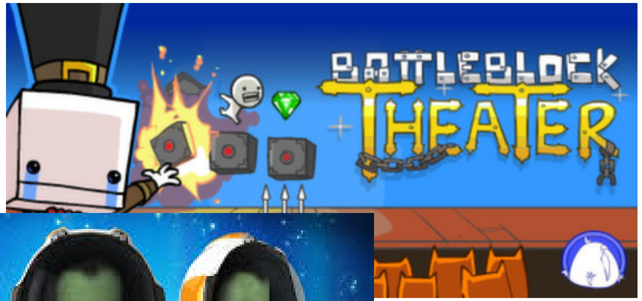
Research



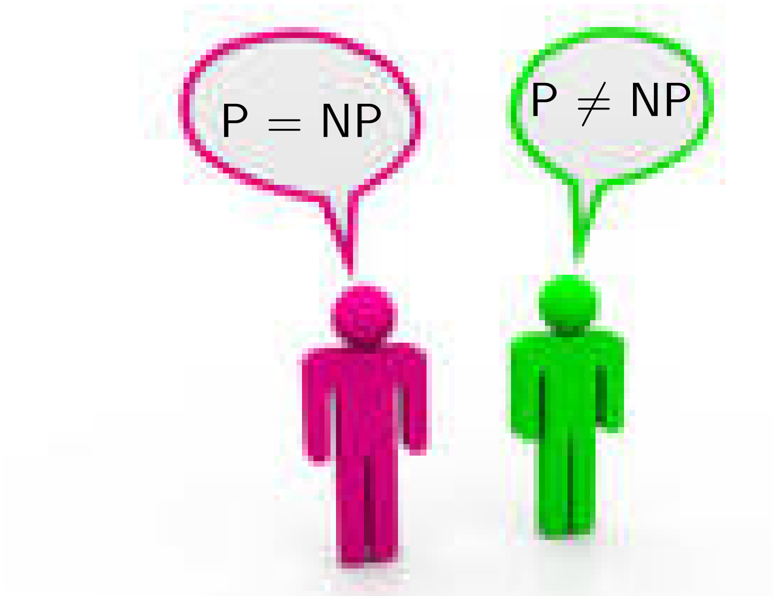


Hobbies




BATTLEBLOCK
THEATER


KERBAL
SPACE PROGRAM

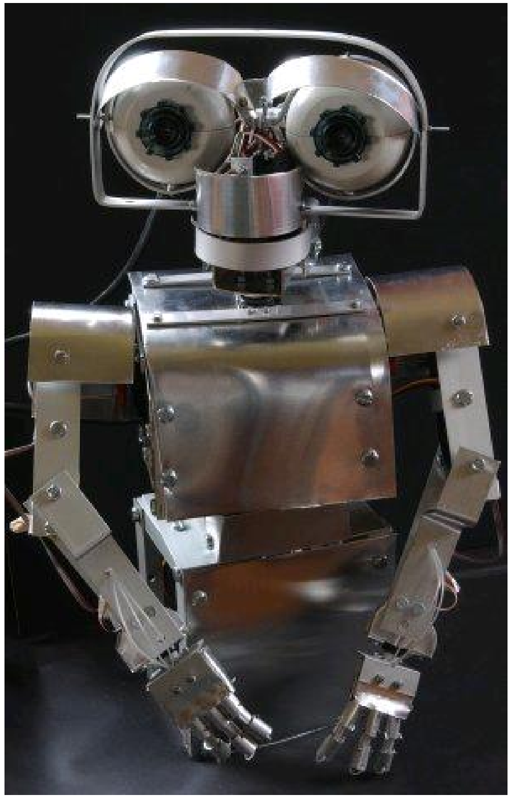

$\mathrm{P} = \mathrm{NP}$
$\mathrm{P} \neq \mathrm{NP}$

Computer Vision

Every picture tells a story

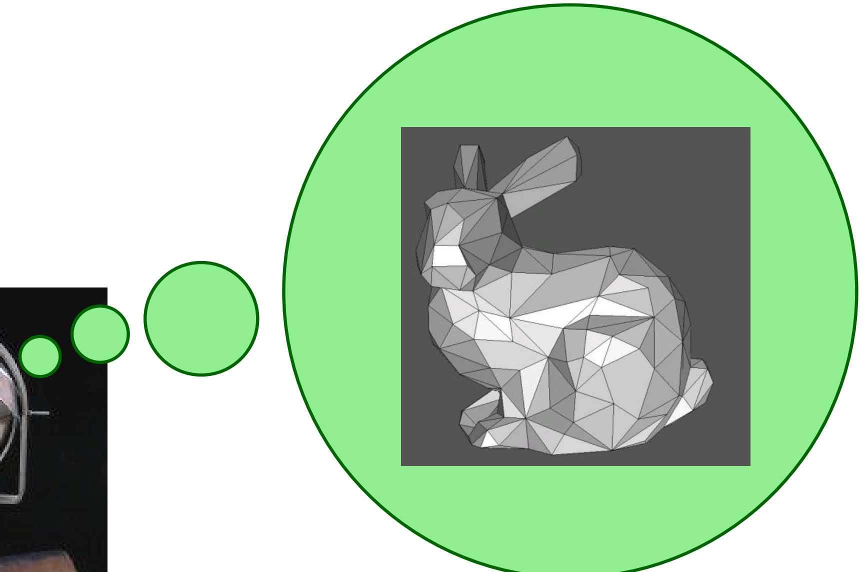
Computer vision

How can we build artificial systems that can make sense of what is in an image?



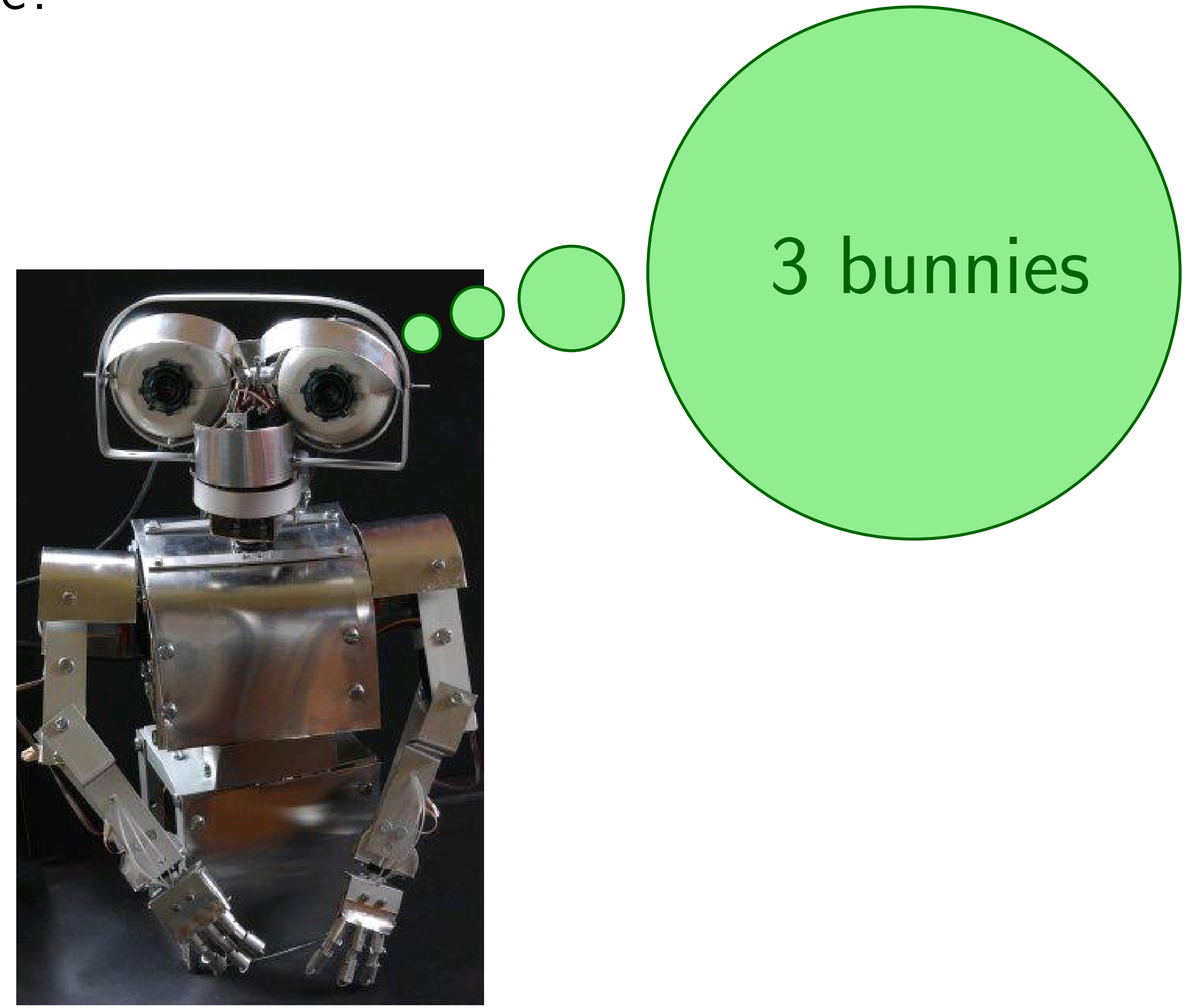
Computer vision

How can we build artificial systems that can make sense of what is in an image?



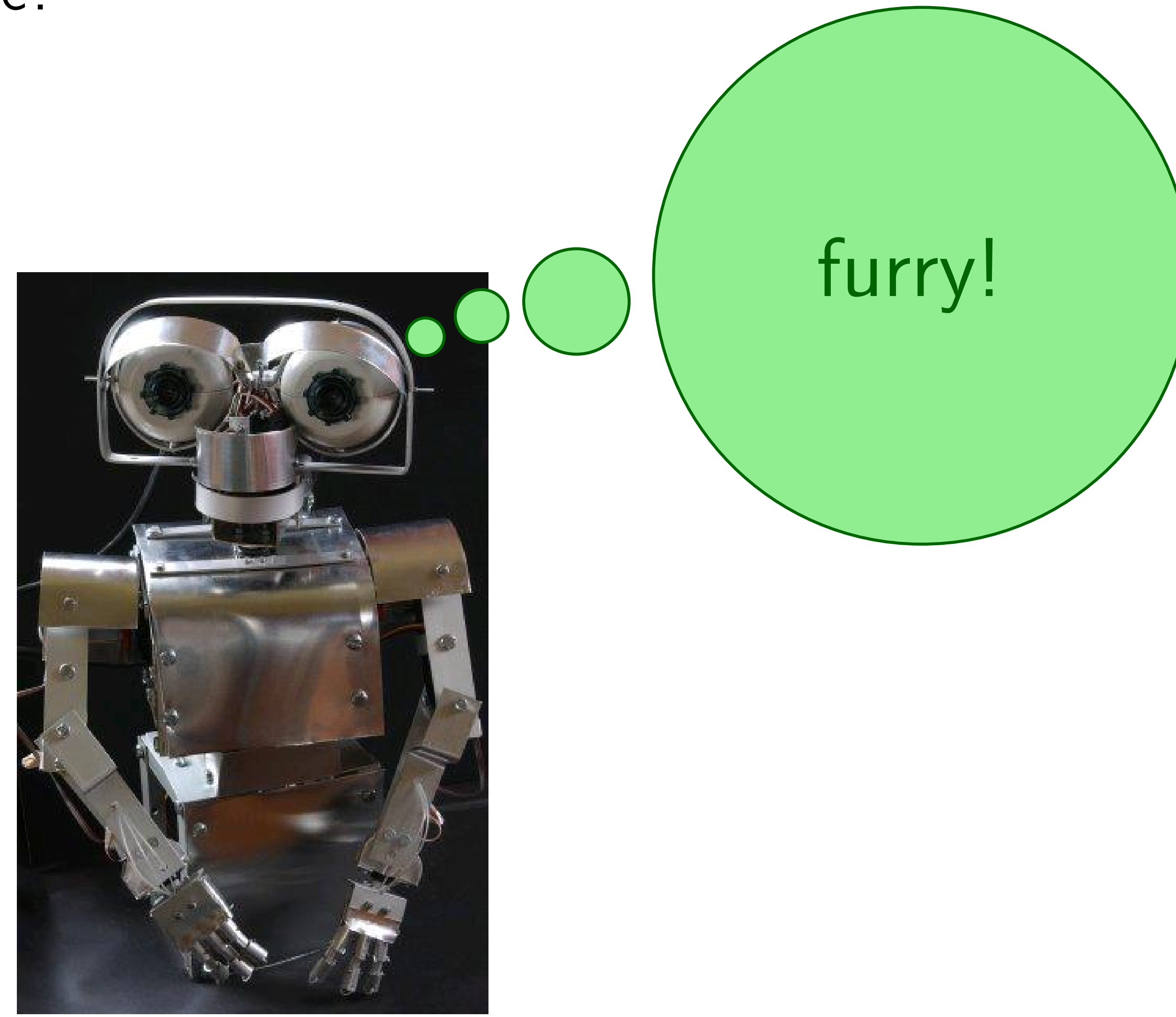
Computer vision

How can we build artificial systems that can make sense of what is in an image?



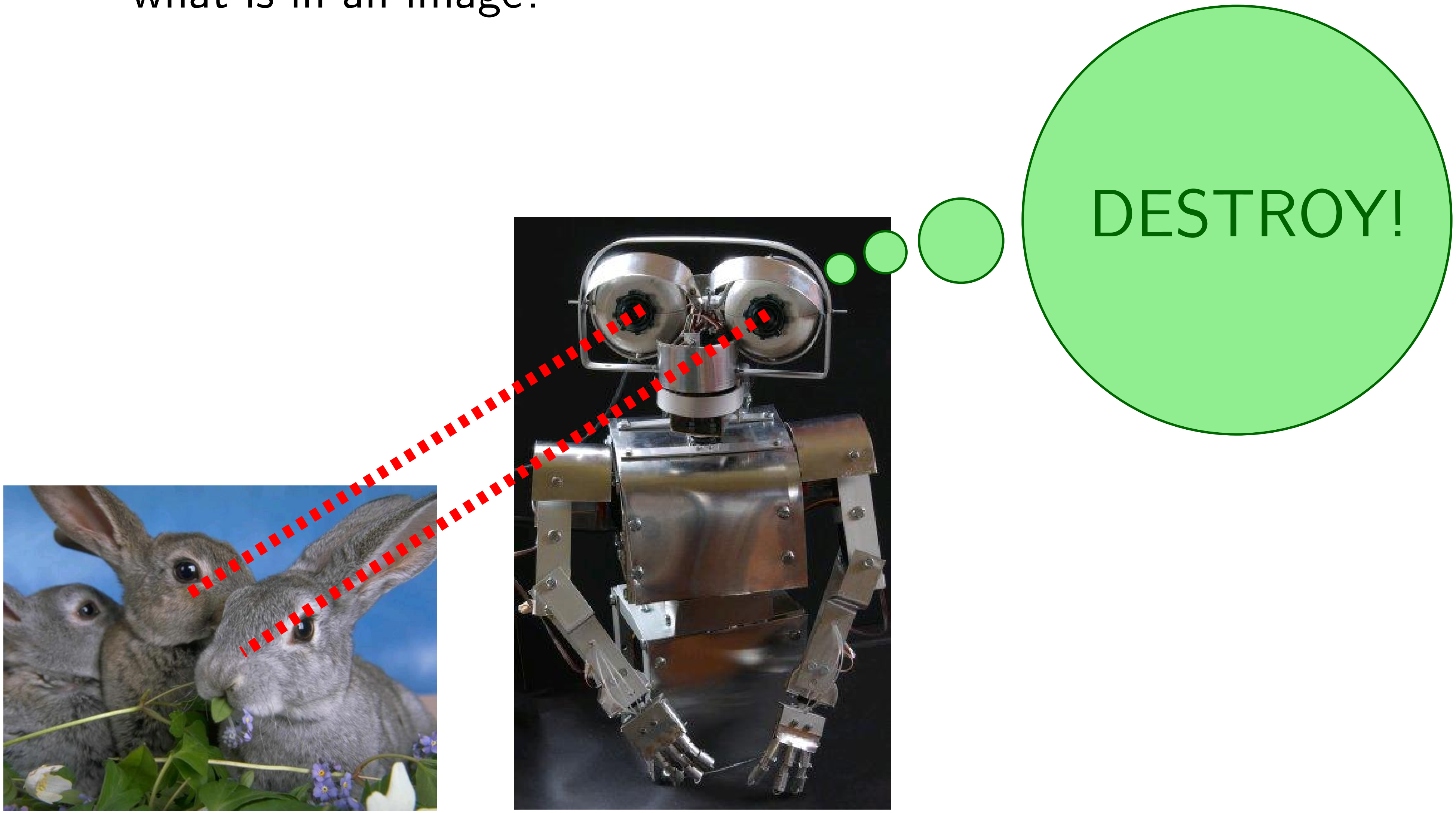
Computer vision

How can we build artificial systems that can make sense of what is in an image?



Computer vision

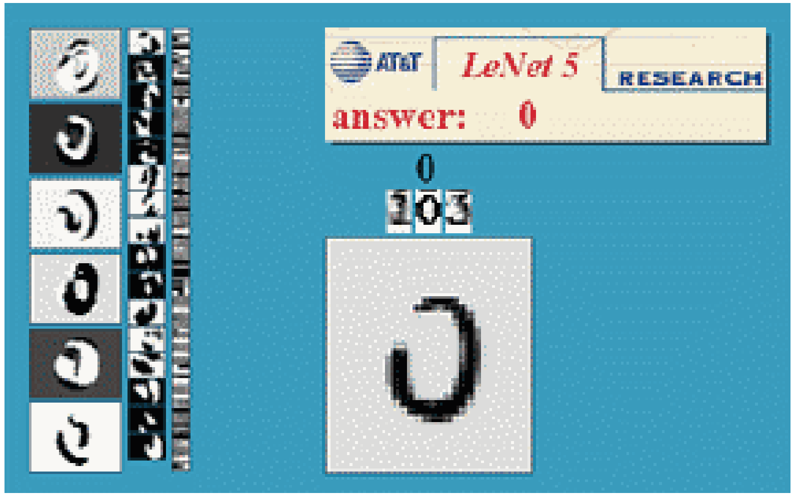
How can we build artificial systems that can make sense of what is in an image?



Optical character recognition (OCR)

Technology to convert scanned docs to text

- If you have a scanner, it probably came with OCR software



Digit recognition, AT&T labs
http://www.research.att.com/~yann/

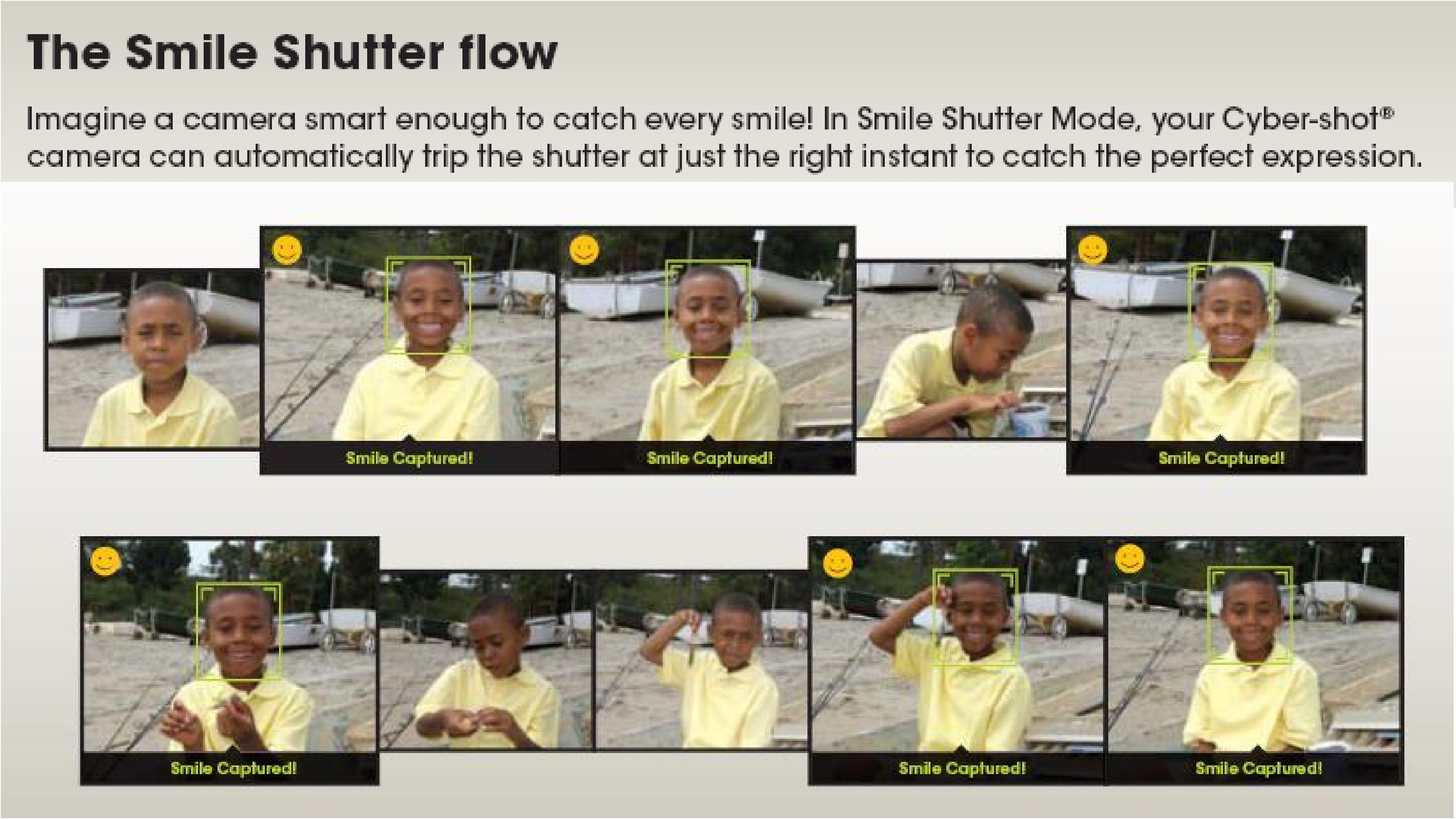
License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Face detection

Many digital cameras now detect faces

Online photo organization (Google, Facebook, etc.)

Smile detection



Sony Cyber-shot T70

Login without a password

Fingerprint scanners on
many new laptops,
other devices

Face recognition systems now
beginning to appear more widely
http://www.sensiblevision.com/

Landmark recognition

This is starting to work well:

- Google Goggles identifies books, cd, dvds

Recover a story

Not even close!

Telling Stories with Images

We tell stories

Modern depiction of cavemen telling stories from Family Guy?

Cave painting

Lascaux Cave, France 15,000–13,000 BC

More cave paintings

Cova dels Cavalls, Valltorta 10,000–4,000 BC

Middle ages painting

The Last Supper by Ugolino da Siena 1300 AD

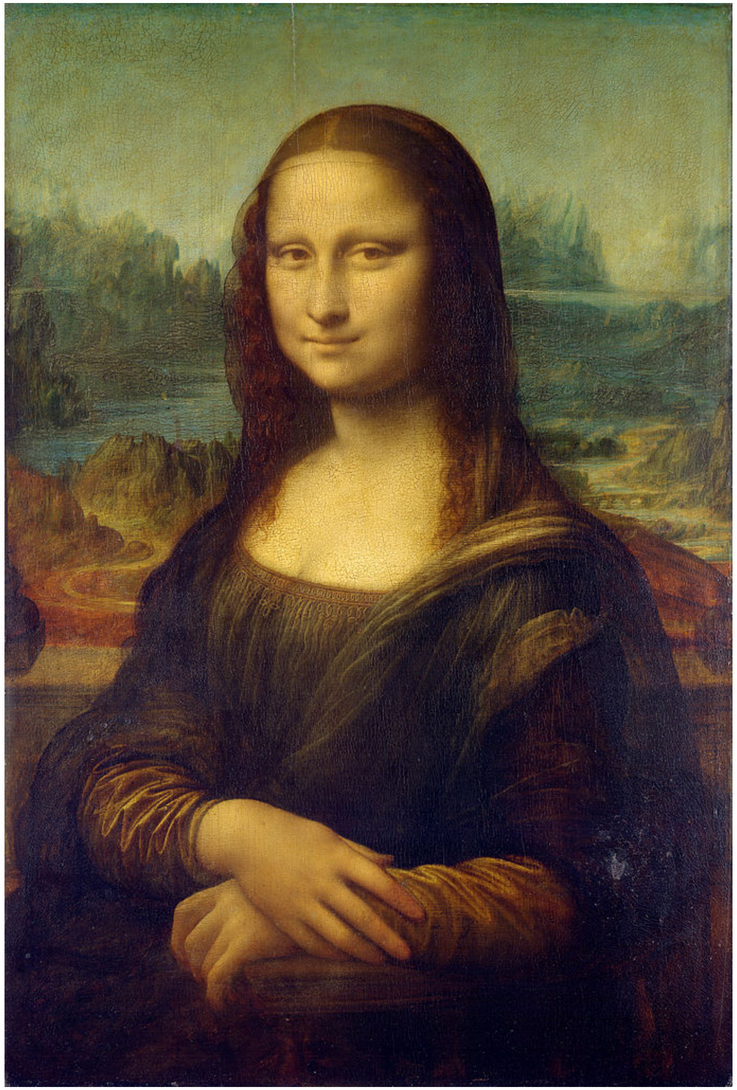
More middle ages paintings

Saint Lucy and Her Mother at the Shrine of Saint Agatha
by Giovanni di Bartolommeo Cristian 1400AD

Renaissance painting

The School of Athens by Raphael 1500AD

More renaissance paintings

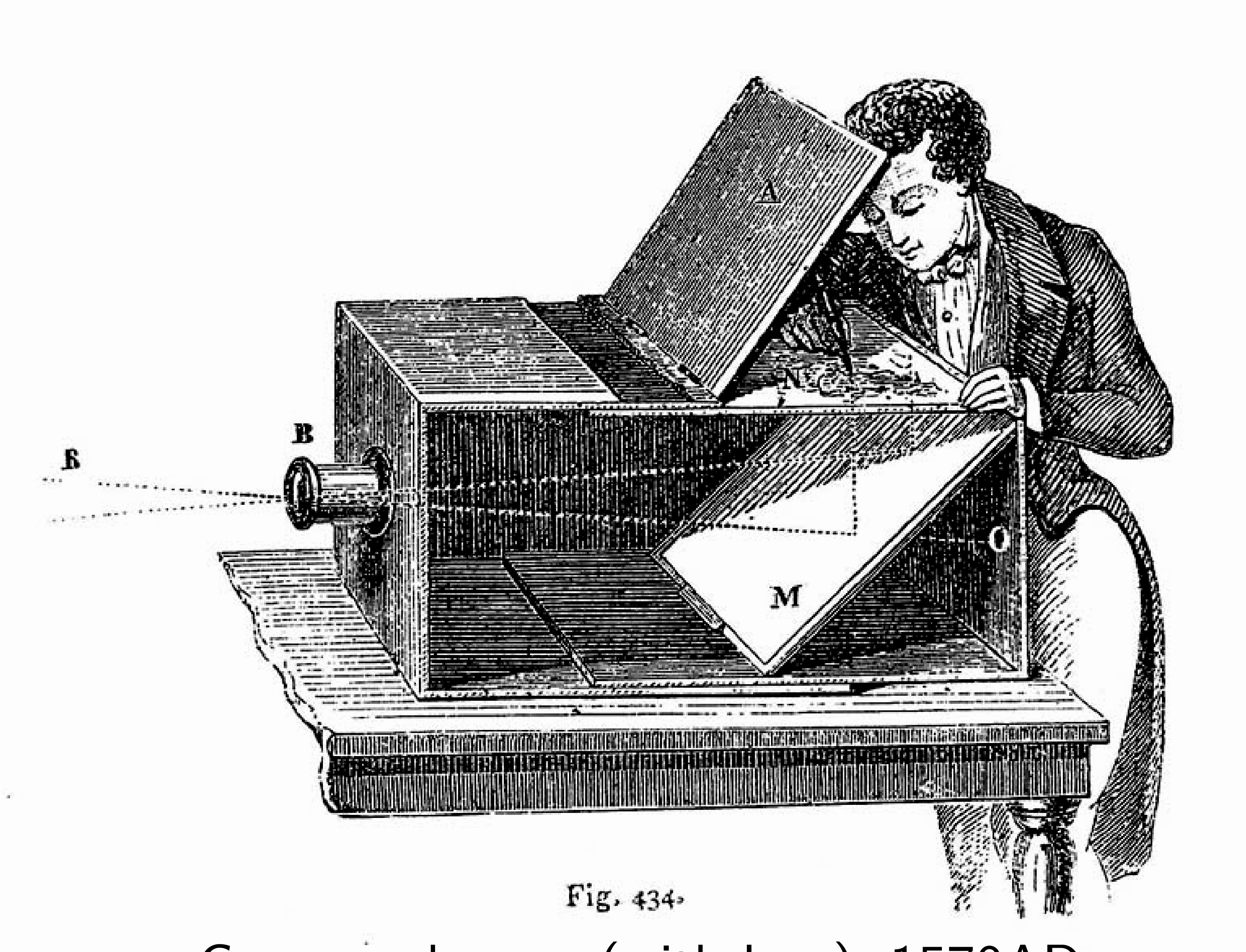


Mona Lisa by Leonardo da Vinci 1500AD

Realist painting

Bonjour, Monsieur Courbet by Gustave Courbet 1850AD

Approaching perfection



Camera obscura (with lens), 1570AD

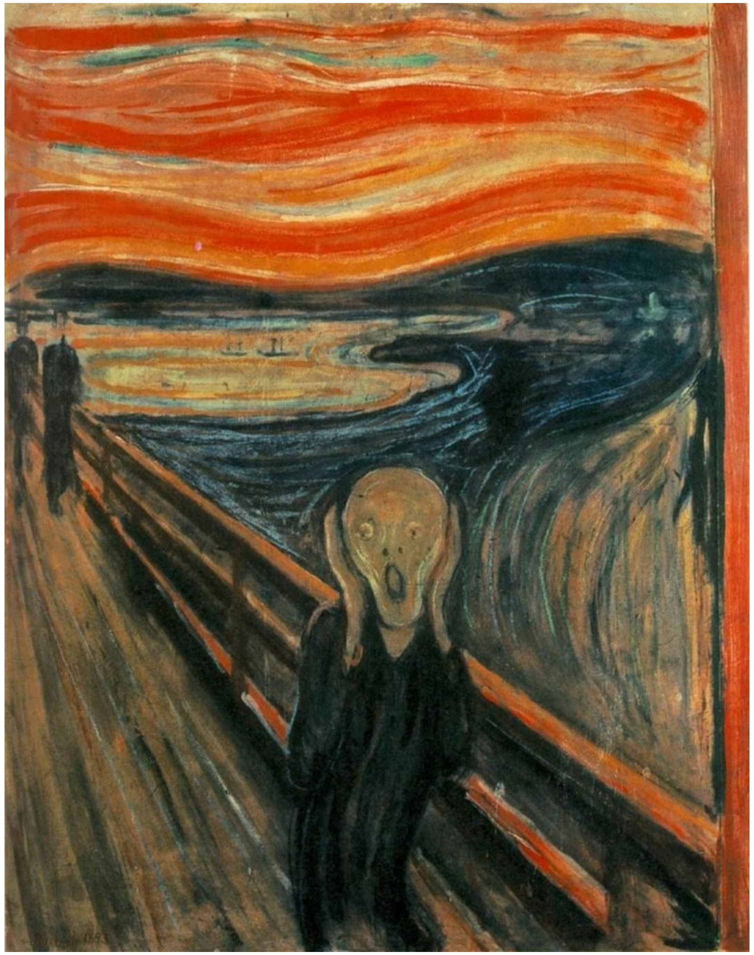
Perfection achieved

Louis Jaques Mande Daguerre 1837

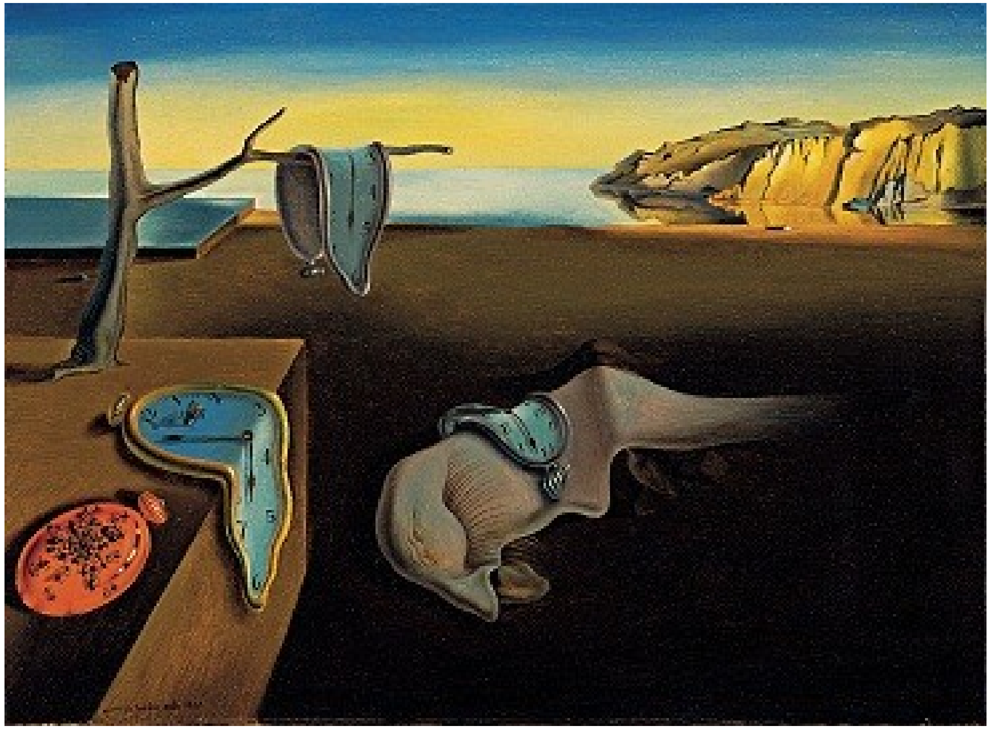
Post-perfection

The tetons and the Sanke River, Ansel Adams 1940

Post-post-perfection

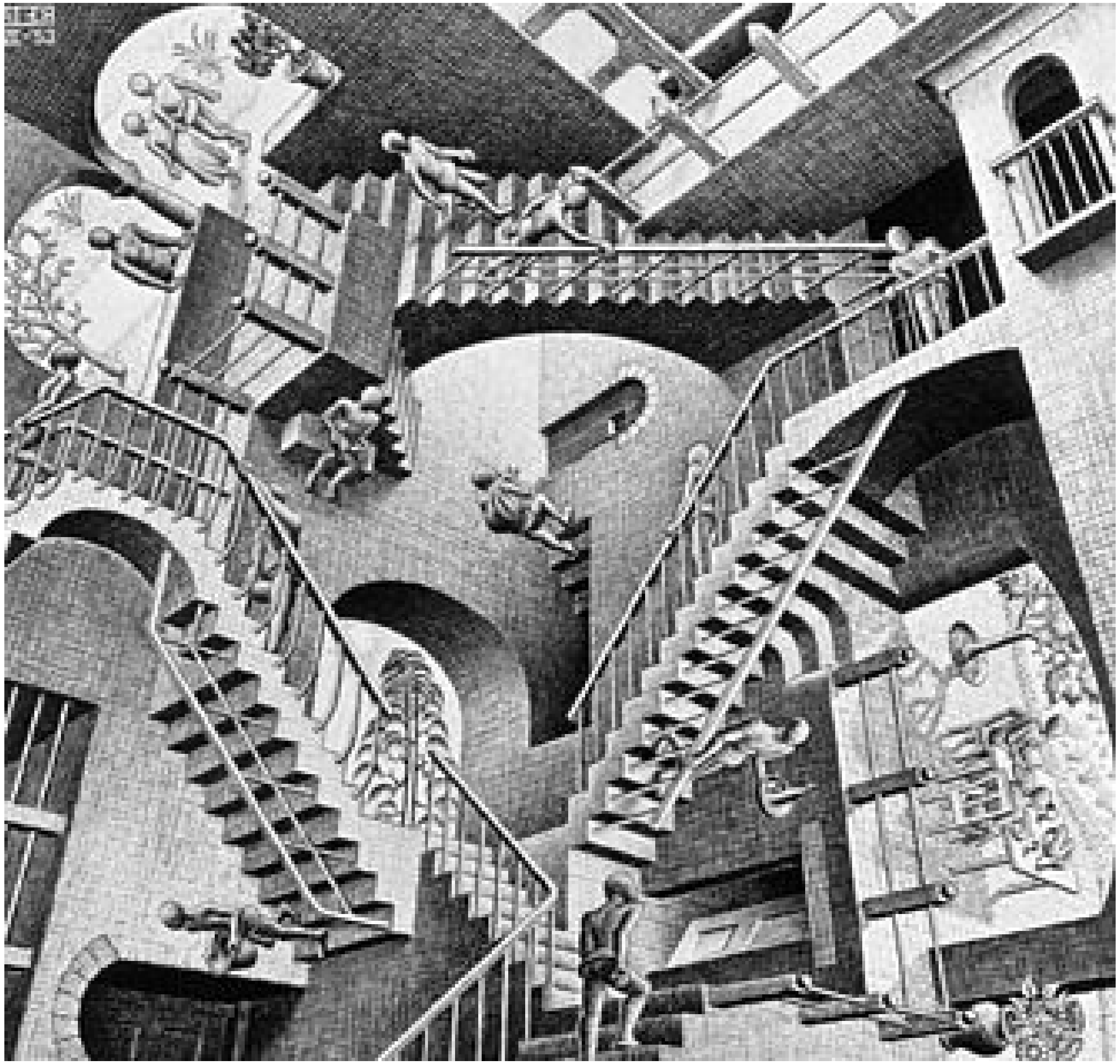


The Scream
Der Schrei de Natur 1890



The Persistence of Memory
Salvador Dali 1930

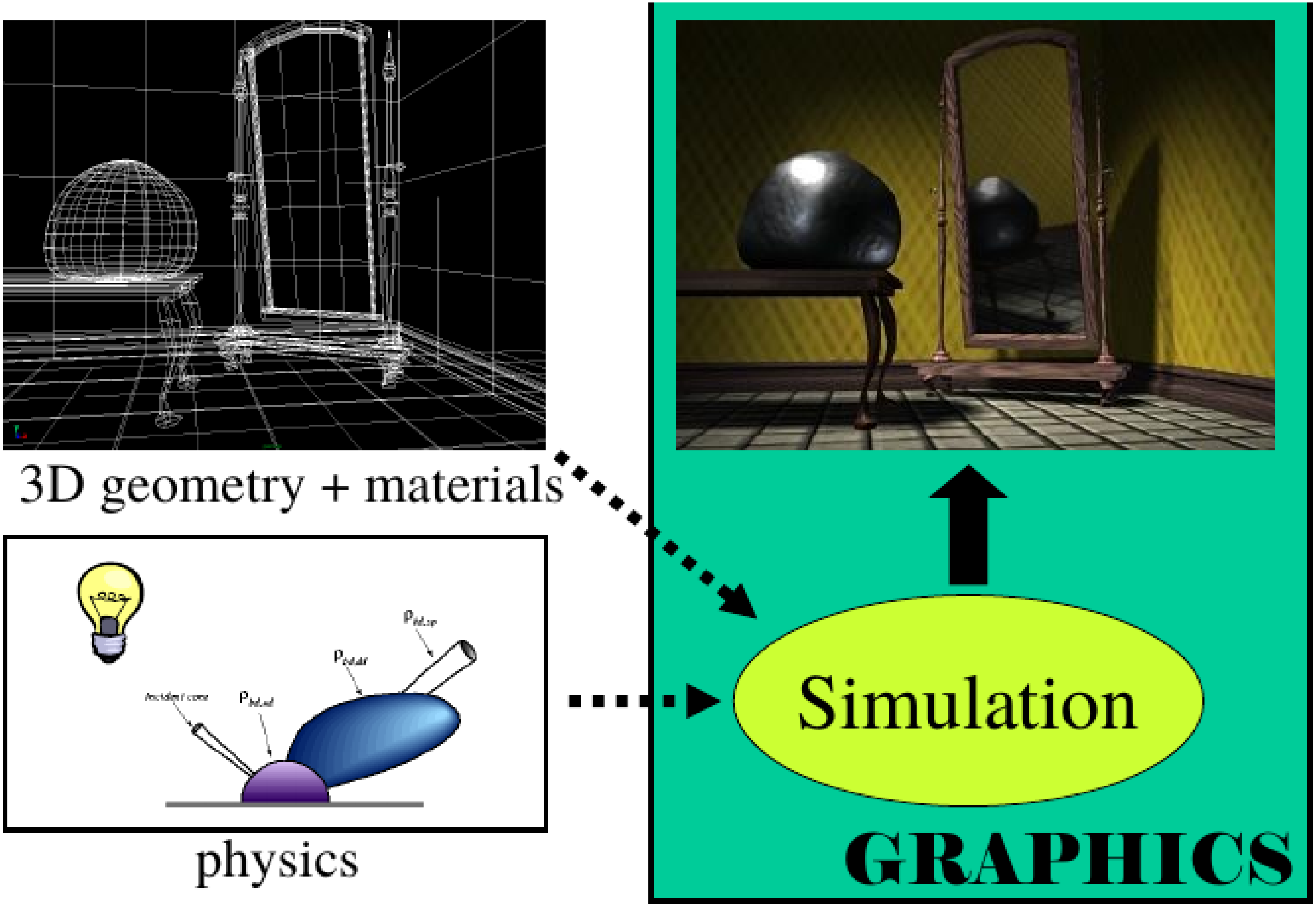
The impossibe



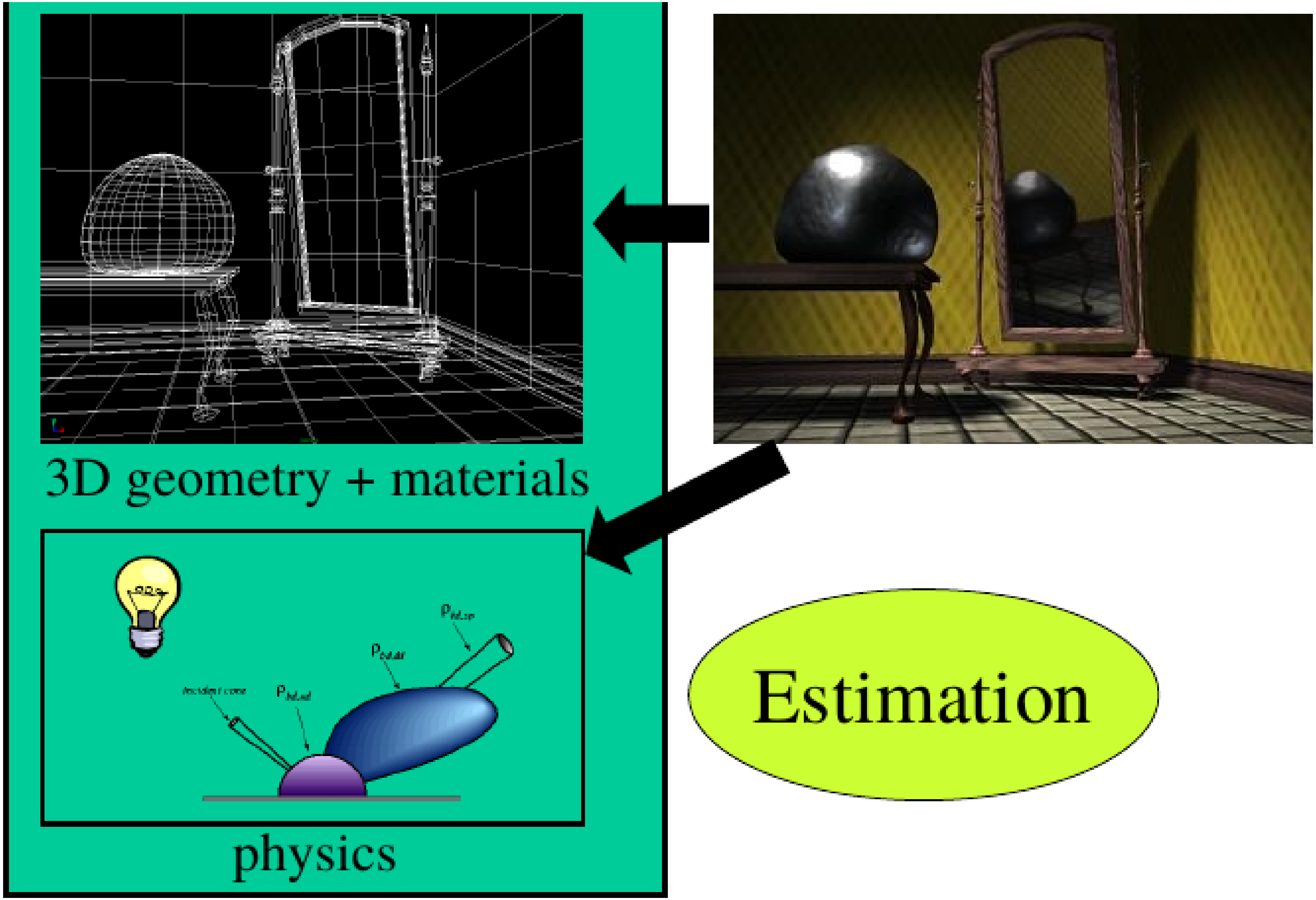
Relativity by MC Escher 1950

Computer Graphics

What is computer graphics?



What is computer vision?



Rendered scence

Impressively real, but too sterile and lifeless!

The richness of out everyday world

Pomona College's Bridges Hall of Music

Beauty in complexity

People

Crysis 3 facial rendering

Scene from Breaking Bad

Faces and hair

Final Fantasy

Photo by Joaquin Rosales Gomez

Urban Scenes

Nature

The realism spectrum

Computer Graphics

- great creative possibilities
- easy to manipulate objects/viewpoint
- very hard to look realistic
- must specify every detail

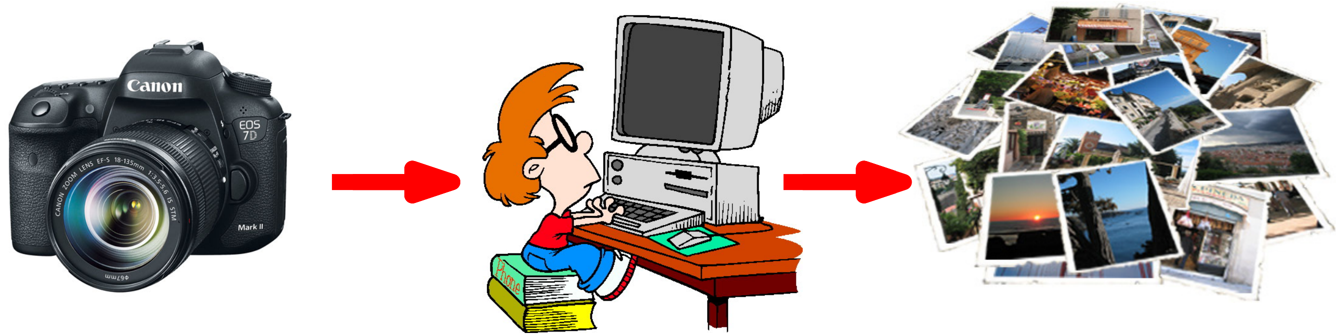
Photography

- instantly realistic
- easy to capture
- very hard to manipulate objects/viewpoint

Computational Photography

Computational Photography

Computational photography



The convergence of: image processing, computer vision, computer graphics and digital photography

Digital photography:

- replace film with digital sensor
- makes image processing easier

Computational photography:

- deep understanding of the capture process
- elaborate image manipulation
- new media (panorama, 3D, 360, etc.)
- new camera design

Sports

Sportvision first down line. Since 1998

http://www.howstuffworks.com/first-down-line.htm

Autostitch

iPhone/Android apps performs automatic panorama stitching on the camera

Smartphones are a combined computer and camera so make an interesting platform for computational photography!

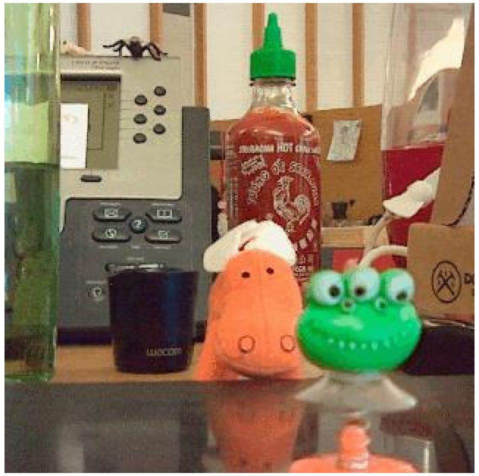
Photo tourism

http://phototour.cs.washington.edu/
http://photosynth.net

Special effects: bullet time

Lightfield camera

Lytro camera captures a richer light field than a traditional camera and then reassembles it into a re-focusable/shiftable image



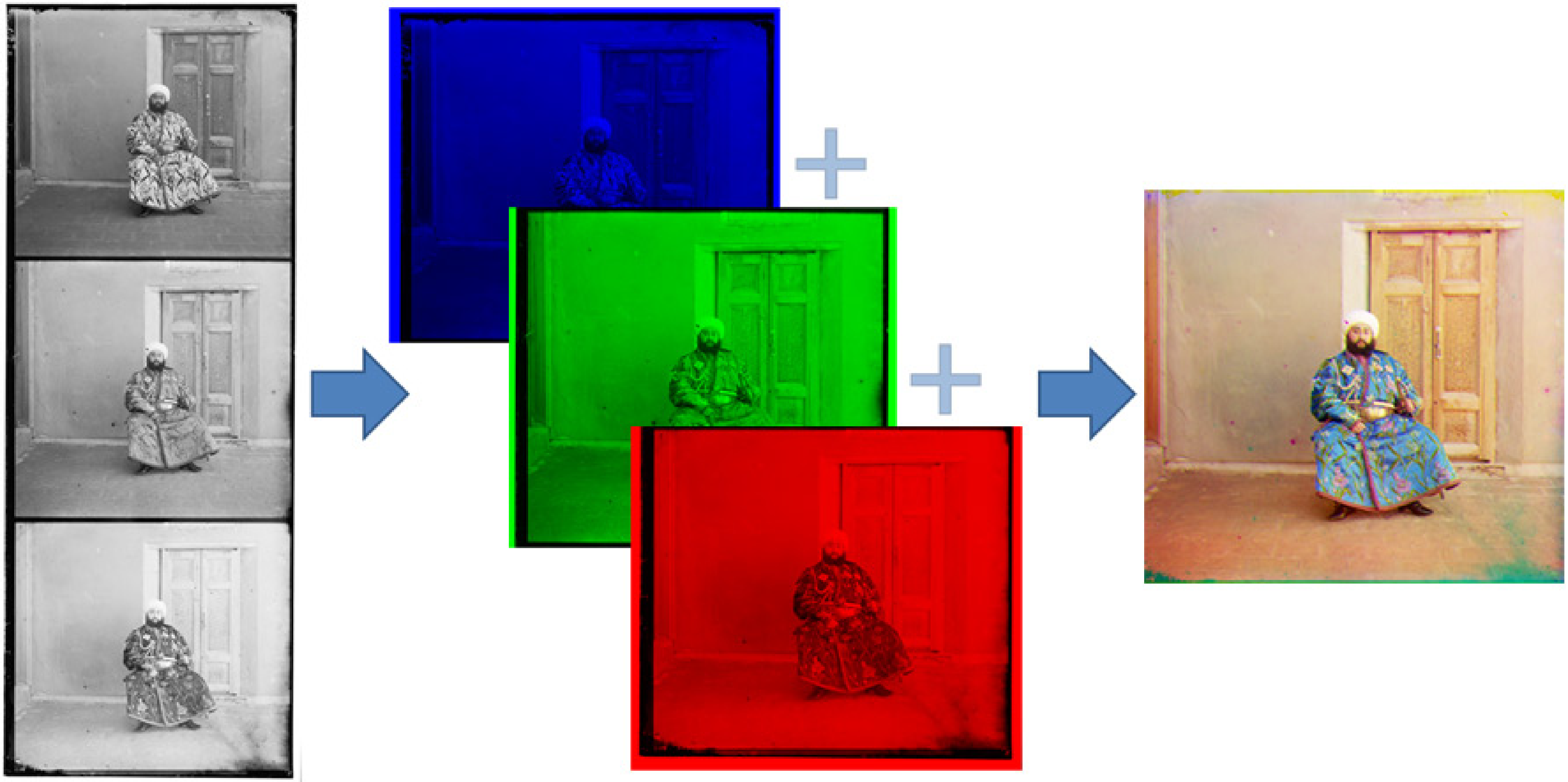
Kinect 3D camera

Course Details

Course objectives

- Understand image capture and processing
- Learn the mathematical and algorithmic techniques of computational photography
- Learn how to preform low-level manipulations of images in code
- Be creative and have fun!

Project 1: Images of the Russian Empire



Sergey Prokudin-Gorsky's Color Photography (1907)

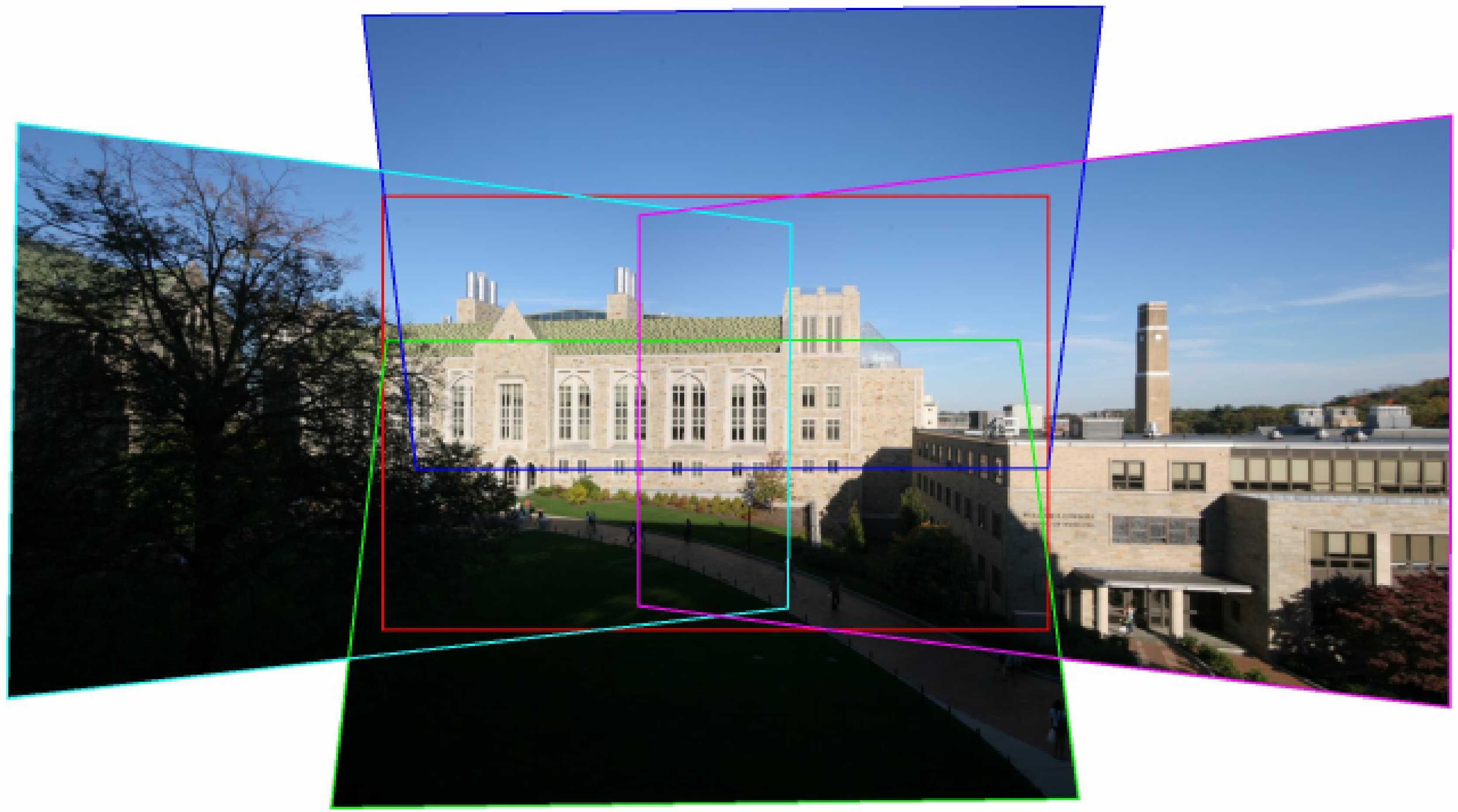
Project 2: Compositing

sources/destinations

cloning

seamless cloning

Project 3: Photo mosaics



Project 4: High dynamic range

Project 5: Final project

?

You will pick the topic for the final project, and present the results of your project at the end of the semester.

Camera

You will be encouraged to use your own photos for many assignments.

Getting the most from the class

No established curriculum. This is an area of active research and the material is fresh and diverse. Only way to learn is to get your hands dirty.

Minimize frustration, start assignments early!

Slides will be posted online but dont let that be an excuse for not taking notes or attending class.

Interesting applications are a good motivation to remember or relearn all that math youve forgotten.

Web page

www.michaeljbannister.com/teaching/181m-f15/