15-463 (15-862): Computational Photography

Staff

- Prof: Alexei Efros (efros@cs), 4207 NSH
- TA: Mohit Gupta (mohitg@cs)

Web Page

- http://graphics.cs.cmu.edu/courses/15-463/

Newsgroup:

- cmu.cs.class.cs463

Today

Introduction

Overview of the course

Administrative stuff

A bit about me

Alexei (Alyosha) Efros

Relatively New faculty (RI/CSD)

- Ph.D 2003, from UC Berkeley *(signed by Arnie!)*
- Research Fellow, University of Oxford, ’03-’04

Teaching

- The plan is to have fun and learn cool things, both you and me!
- Social warning: I don’t see well

Research

- Graphics, Vision, Machine Learning

PhD Thesis on Texture and Action Synthesis

Smart Erase button in MS Digital Image Pro:

Antonio's son cannot walk but he can fly☺

Some recent stuff

Automatic Photo Pop-up: The World Behind the Image

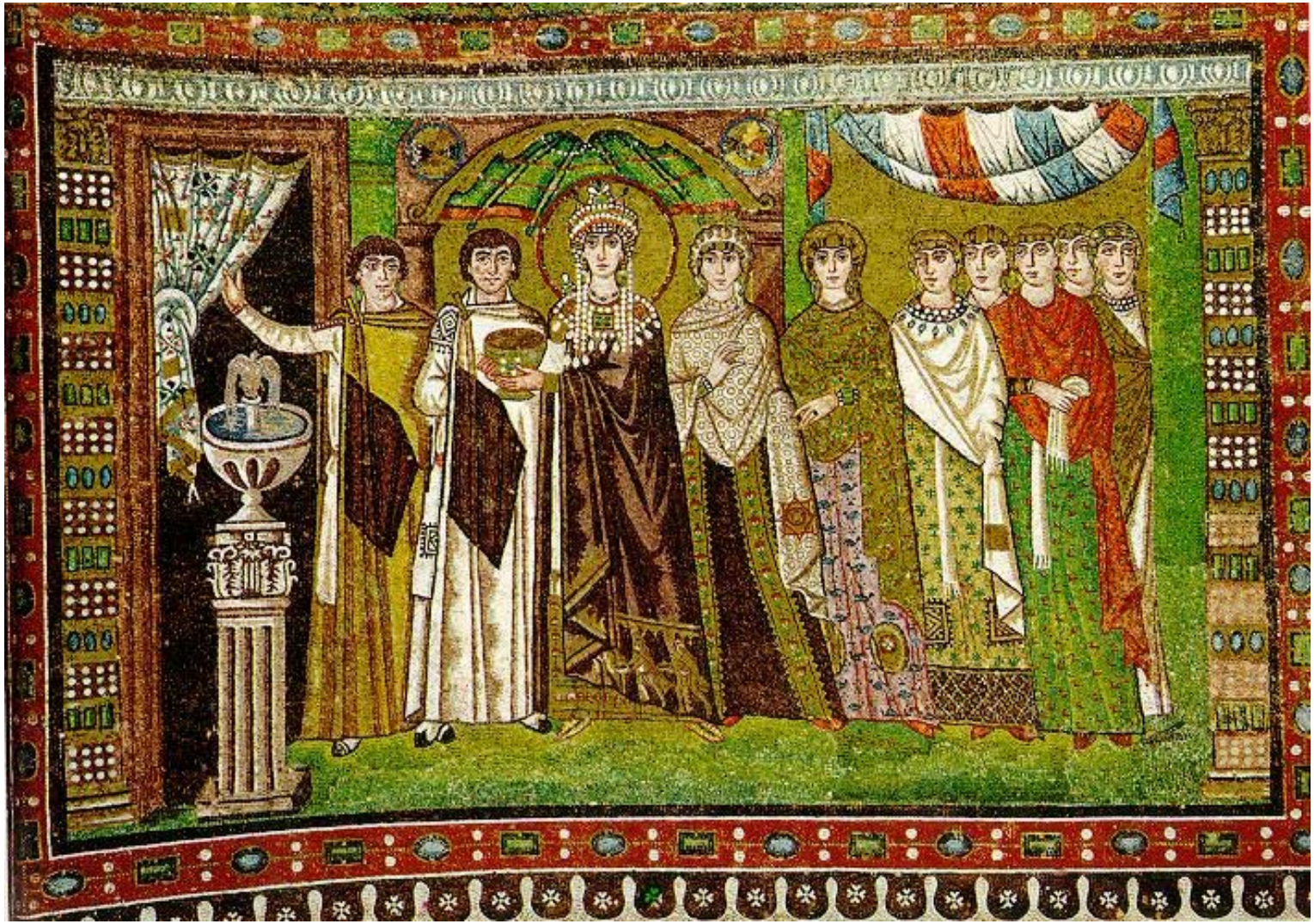
The Story So Far…

(brief overview of prior work)

Depicting Our World: The Begining

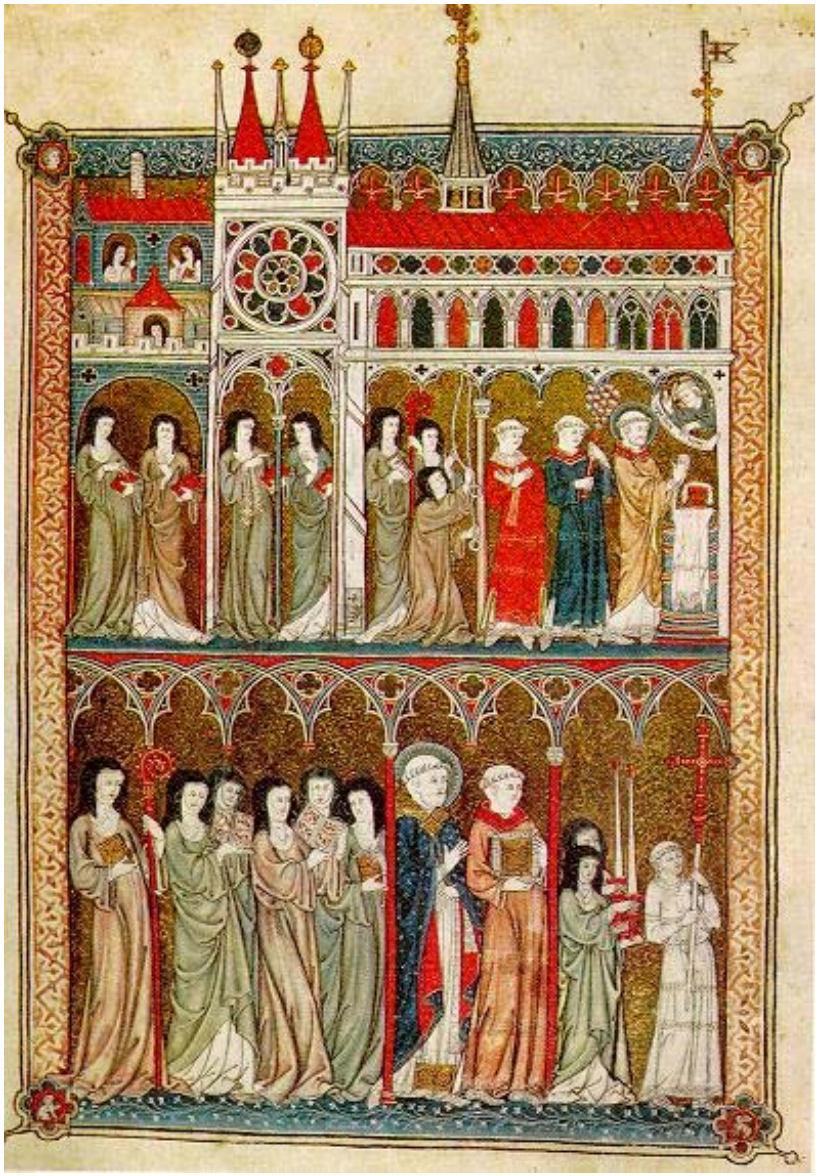
Prehistoric Painting, Lascaux Cave, France
~ 13,000 -- 15,000 B.C.

Depicting Our World: Middle Ages



The Empress Theodora with her court.
Ravenna, St. Vitale 6th c.

Depicting Our World: Middle Ages



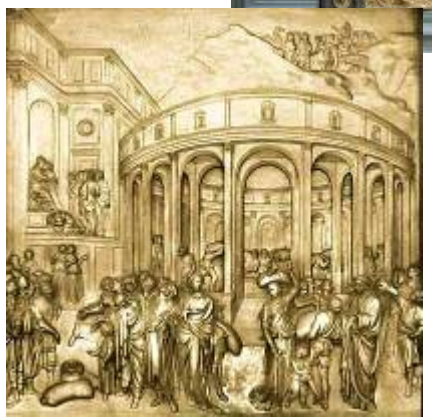
Nuns in Procession. French ms. ca. 1300.

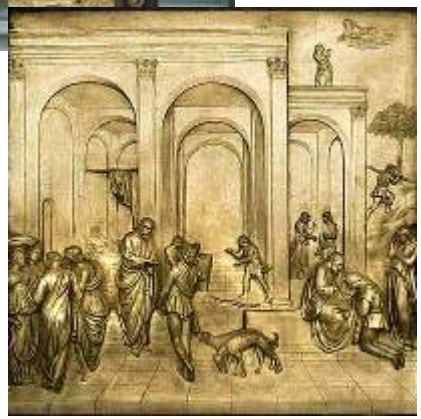
Depicting Our World: Renaissance

North Doors (1424)

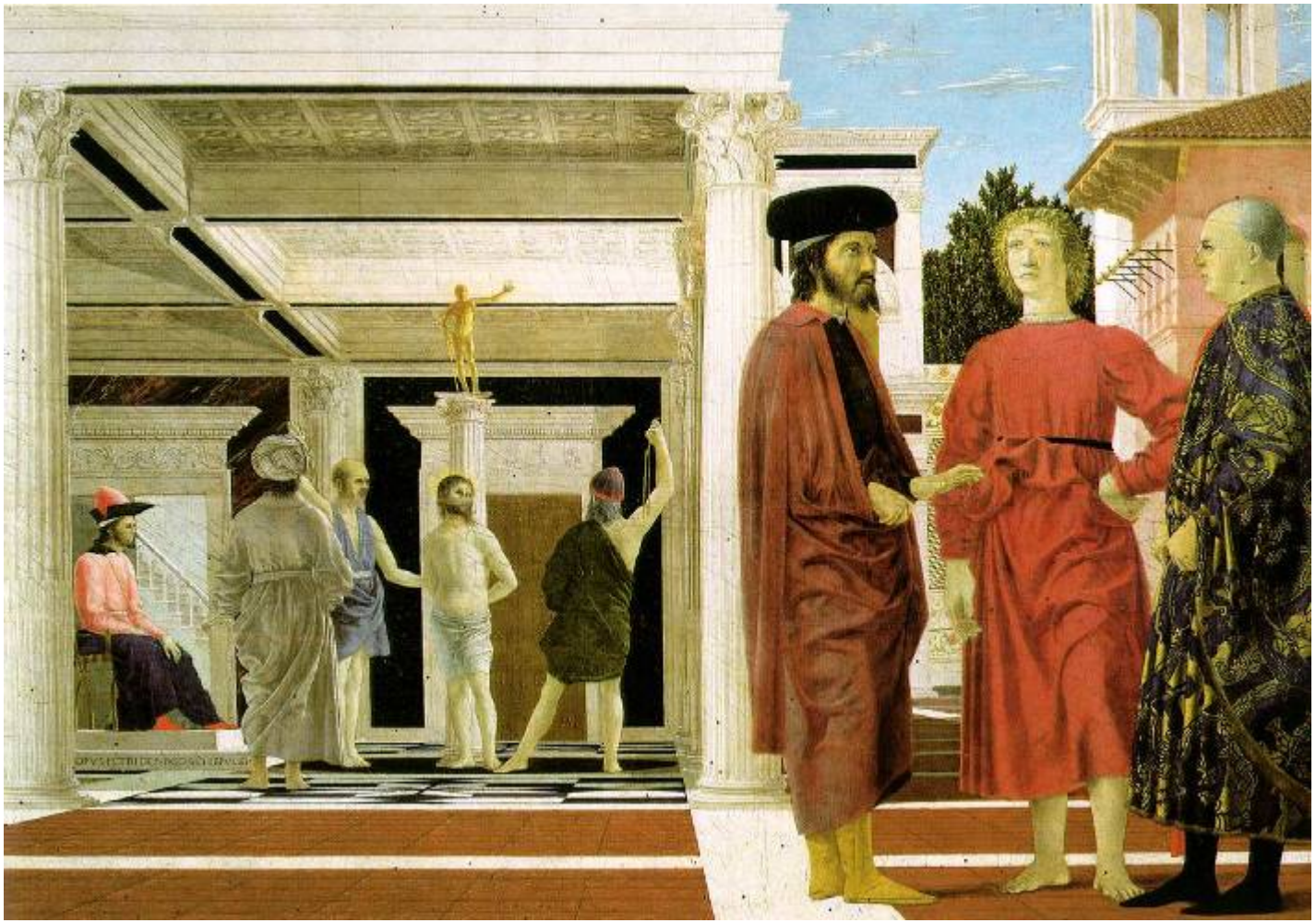
Lorenzo Ghiberti (1378-1455)

East Doors (1452)



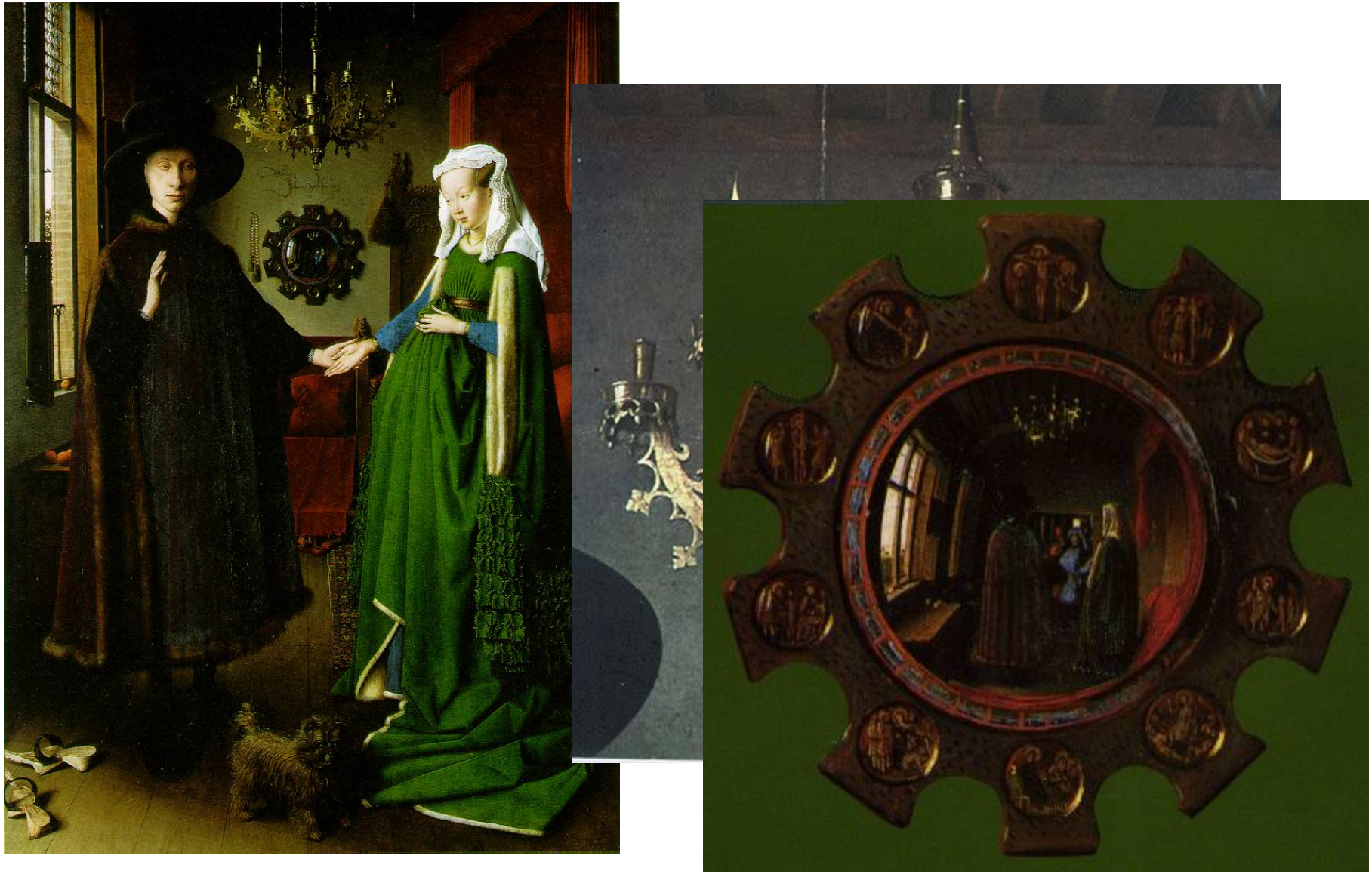


Depicting Our World: Renaissance



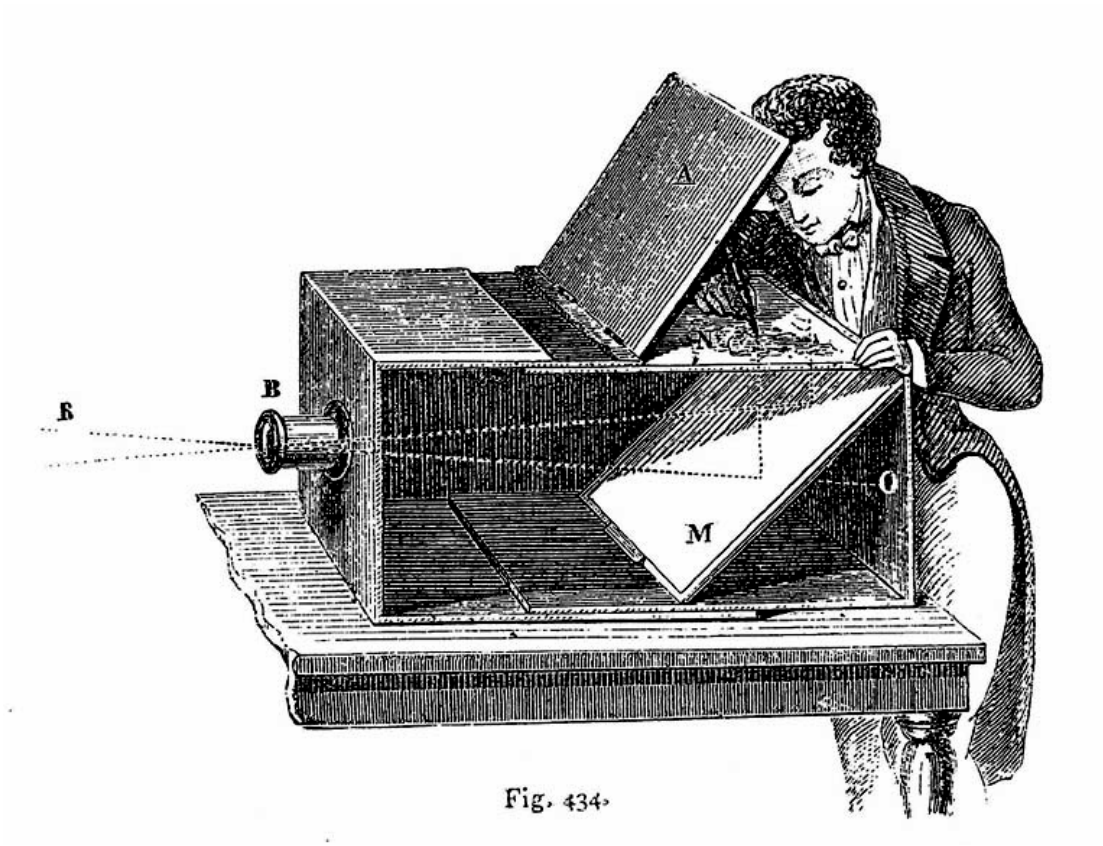
Piero della Francesca,
The Flagellation (c.1469)

Depicting Our World: Toward Perfection



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

Depicting Our World: Toward Perfection

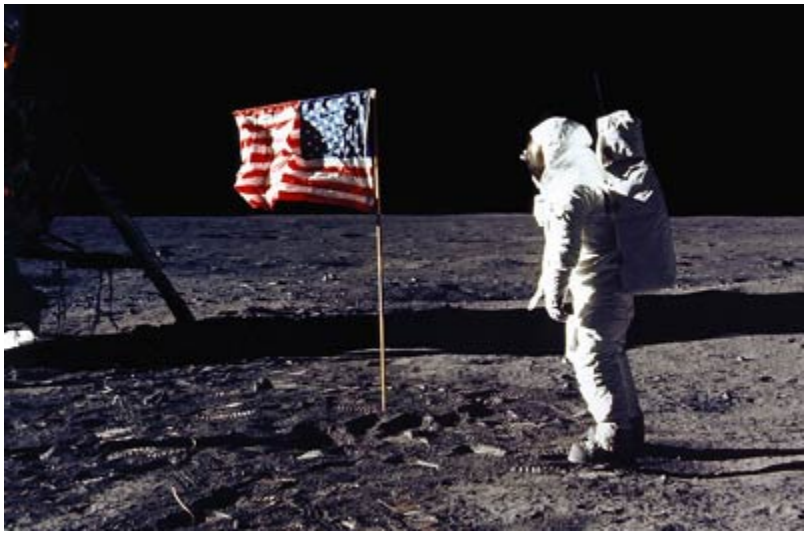


Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

Depicting Our World: Perfection?



Depicting Our World: Ongoing Quest

Pablo Picasso

Marc Chagall

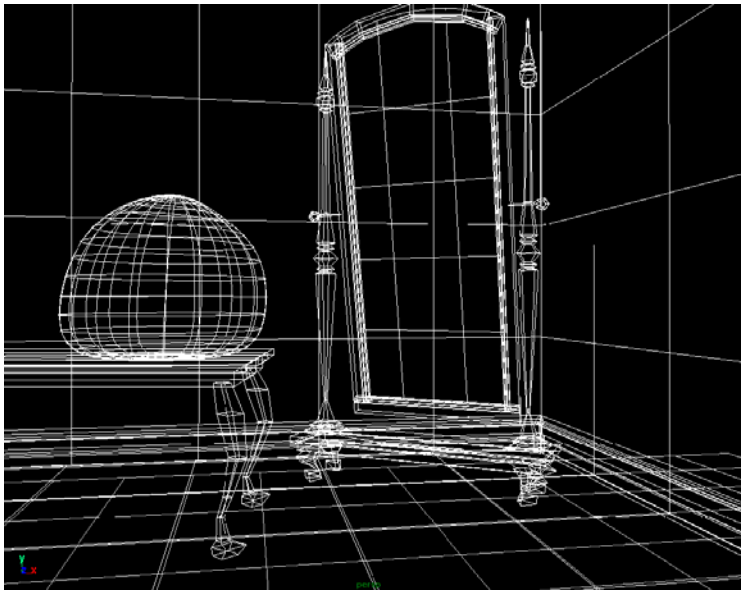
Depicting Our World: Ongoing Quest

David Hockney, 1985

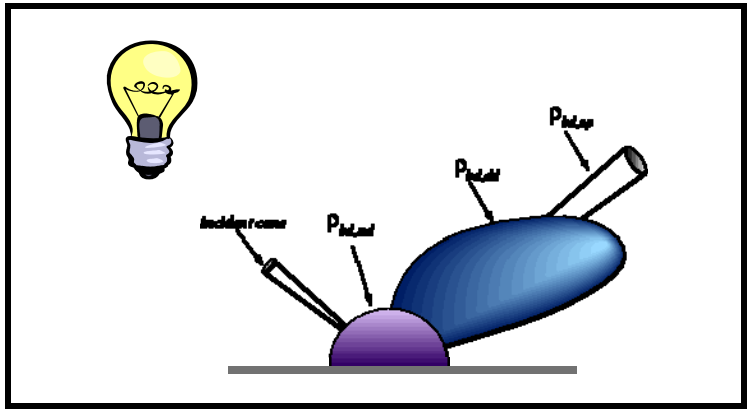
Antonio Torralba & Aude Oliva (2002)

Enter Computer Graphics...

Traditional Computer Graphics



3D geometry



physics

projection

Simulation

GRAPHICS

State of the Art

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

The richness of our everyday world

Photo by Svetlana Lazebnik

Beauty in complexity

University Parks, Oxford

Which parts are hard to model?

Photo by Svetlana Lazebnik

People

From “Final Fantasy”

On the Tube, London

Faces / Hair

From “Final Fantasy”

Photo by Joaquin Rosales Gomez

Urban Scenes

Virtual LA (SGI)

Photo of l LA

Nature

River Cherwell, Oxford

In search of realism…

Graphics is easy:

- We know how to represent geometry (polygonal meshes, splines, subdivision surfaces, CSG, etc.)
- Physics of light transport worked out (ray tracing, radiosity, Monte Carlo techniques, etc.)
- Good progress in participating media (e.g. subsurface scattering)
- Can learn it all in 15-462!

Graphics is still hard:

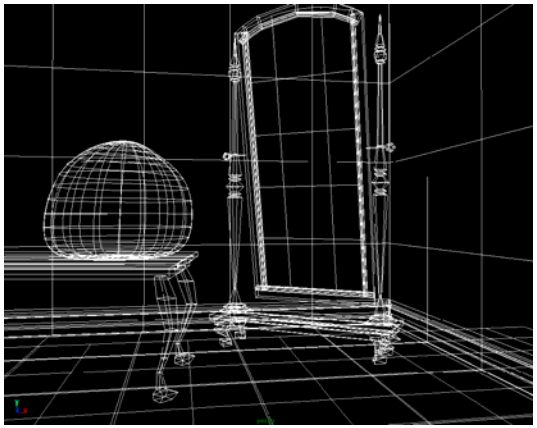
- We want to model our world (visual realism!)
- How do we create *enough* geometry?
- How do we find reflectance properties for *all* materials?
- Is it feasible? It is even needed? (human perception)
- **Where do we get all this DATA?**

Capture it from the real world –

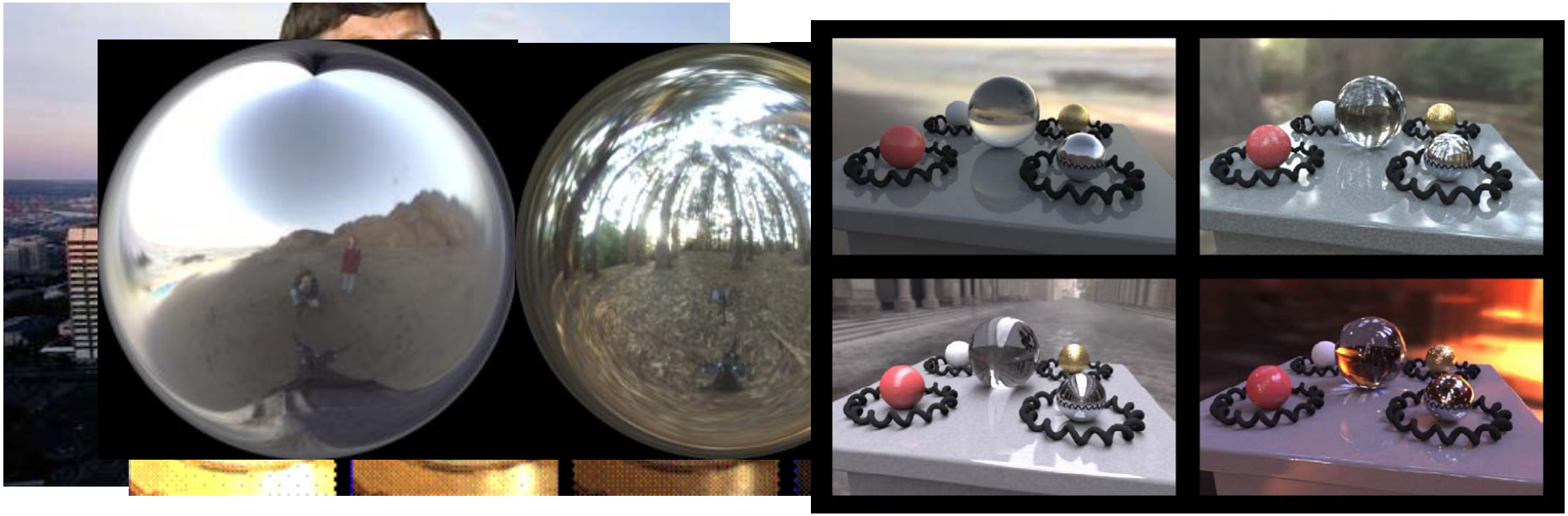
Computational Photography!

Virtual World vs. the Real World

Traditional Graphics: plays in its little sandbox



Comp. Photography: ready to embrace the world!



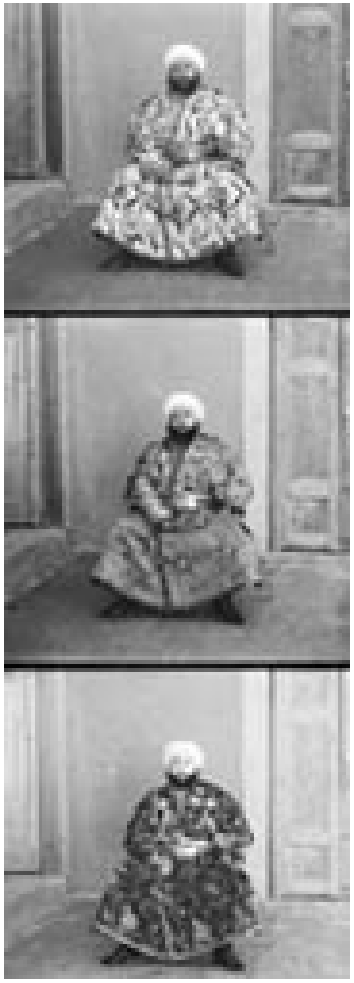
Virtual Real World

Campanile Movie

http://www.debevec.org/Campanile/

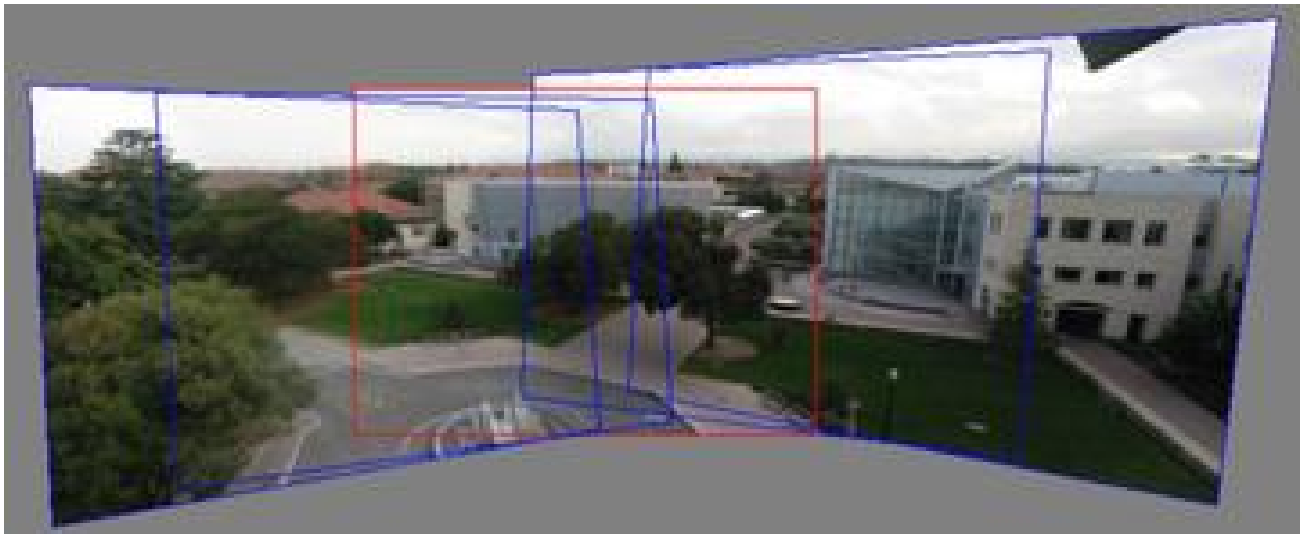
Programming Project 1

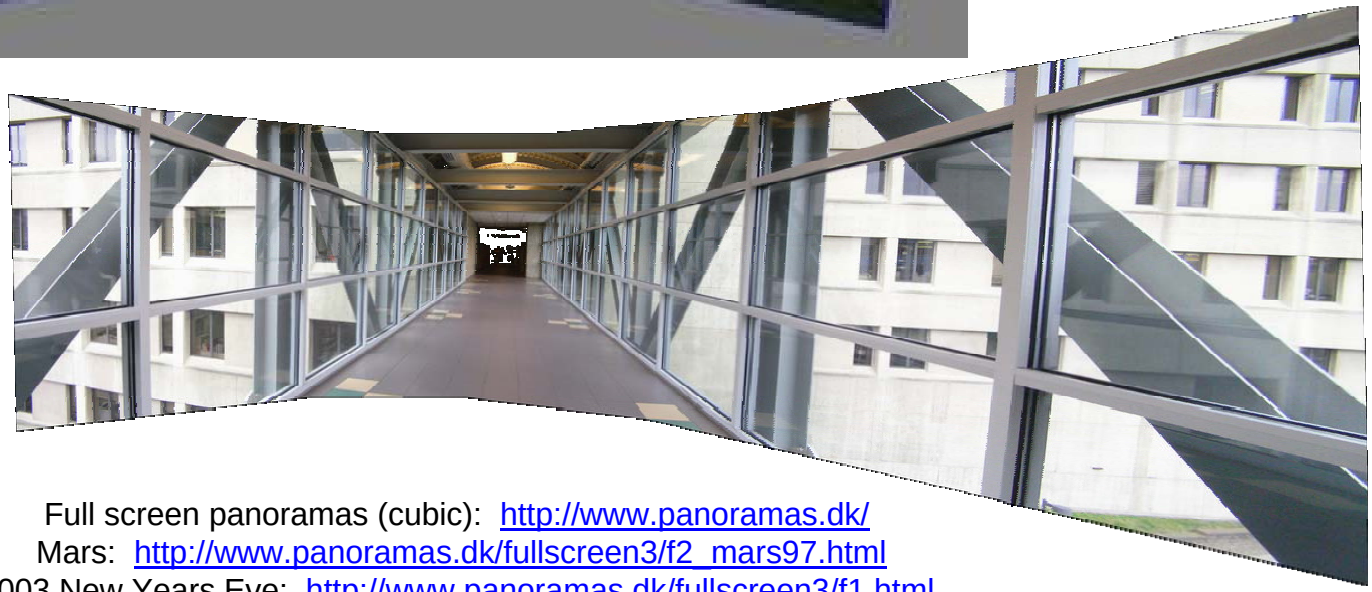
Images of the Russian Empire -- colorizing the Prokudin-Gorskii photo collection



Programming Project 2

Photo Mosaics





Full screen panoramas (cubic): http://www.panoramas.dk/
Mars: http://www.panoramas.dk/fullscreen3/f2_mars97.html
2003 New Years Eve: http://www.panoramas.dk/fullscreen3/f1.html

Programming Project 3

Automatic Mosaic Stitching

Programming Project 4

Face warping and morphing

Programming Project 5

Tour Into the Picture

Final Project

Something cool!!!

Administrative Stuff

Grading

- Programming Projects (60%)
- Midterm + Quizzes (20%)
- Final Project (20%)

Late Policy

- Five late days total, to be spent wisely

Cheating

- Let’s not embarrass ourselves

Hardware/Software

- Graphics cluster, Wean 5336 (should have card access and login by now)
- MATLAB!!!

General Comments

Prerequisites

- Linear algebra!!!
- Some computer graphics, vision, or image processing is useful, but not required.

Emphasis on programming projects!

- Building something from scratch (Matlab!)

References

There is no required text. Various course notes and papers will be made available. Furthermore, there is an optional textbook that you might find helpful. It will be placed on reserve at the Wean Hall library:

Computer Vision: The Modern Approach, Forsyth and Ponce

There is a number of other fine texts that you can use for general reference:

Photography (8th edition), London and Upton,
Vision Science: Photons to Phenomenology, Stephen Palmer
Digital Image Processing, 2nd edition, Gonzalez and Woods
Multiple View Geometry in Computer Vision, Hartley & Zisserman
The Computer Image, Watt and Policarpo
Linear Algebra and its Applications, Gilbert Strang

Cameras

Really cool

Not too expensive nowadays (<$200)

Canon A530