15-463 (15-862): Computational Photography

Staff

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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

- My second time… still learning
- 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 hot-off-the-press stuff

Automatic Photo Pop-up: The World Behind the Image

Computational Photography

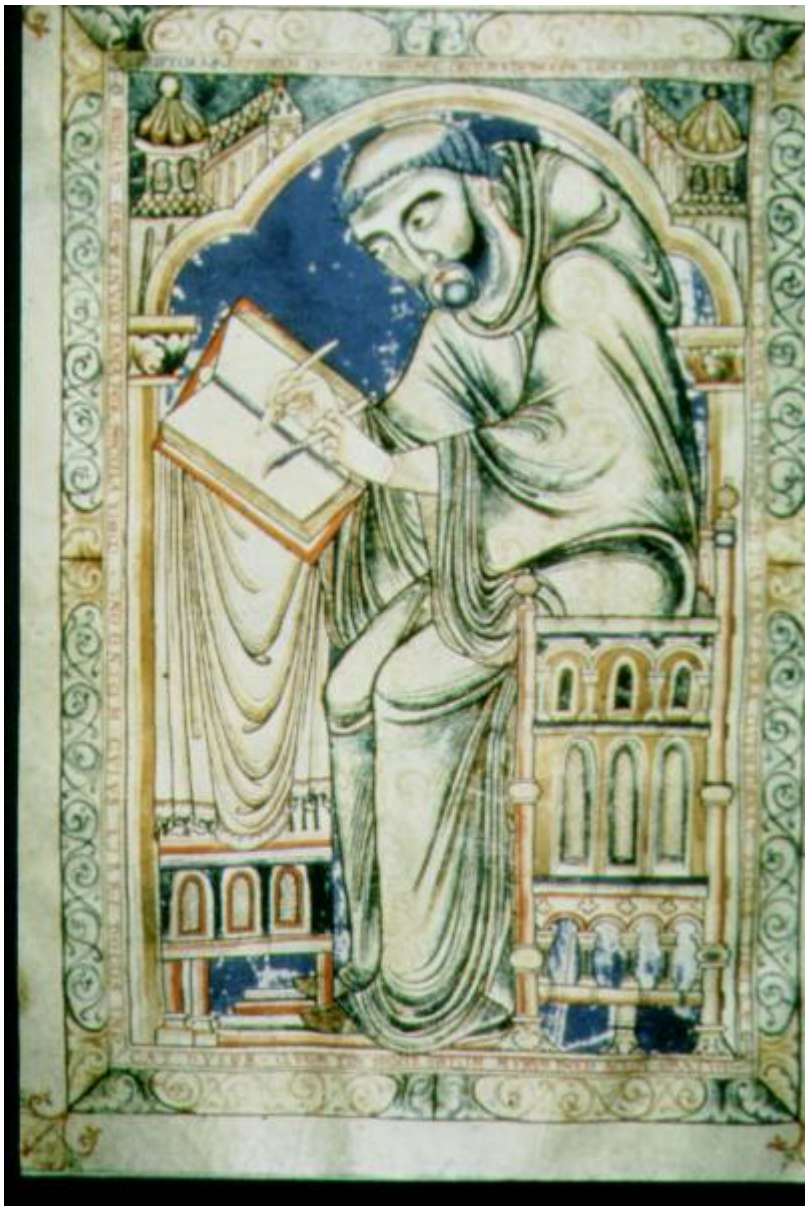
The Story So Far…

(brief overview of prior work)

Depicting Our World

Prehistoric Painting, Lascaux Cave, France

Depicting Our World: The Middle Ages



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

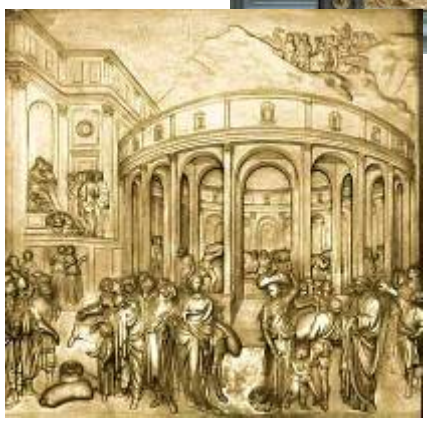
Cimabue Madonna Enthroned (c.1280-1290)

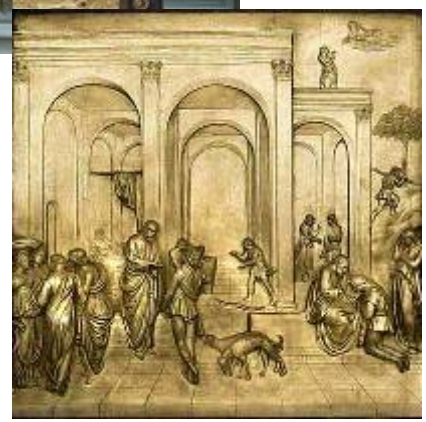
Depicting Our World: Renaissance

North Doors (1424)

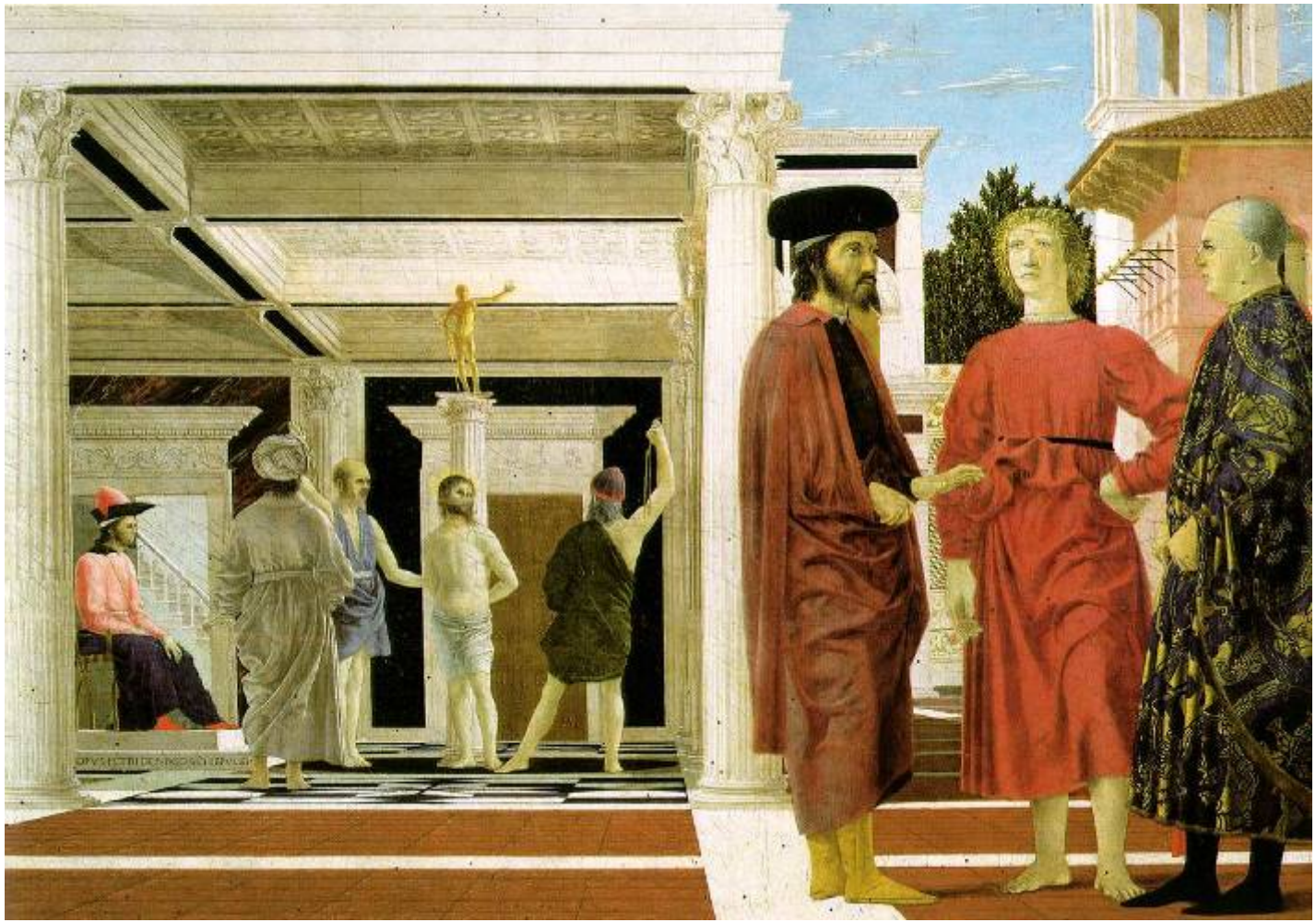
Lorenzo Ghiberti (1378-1455)

East Doors (1452)



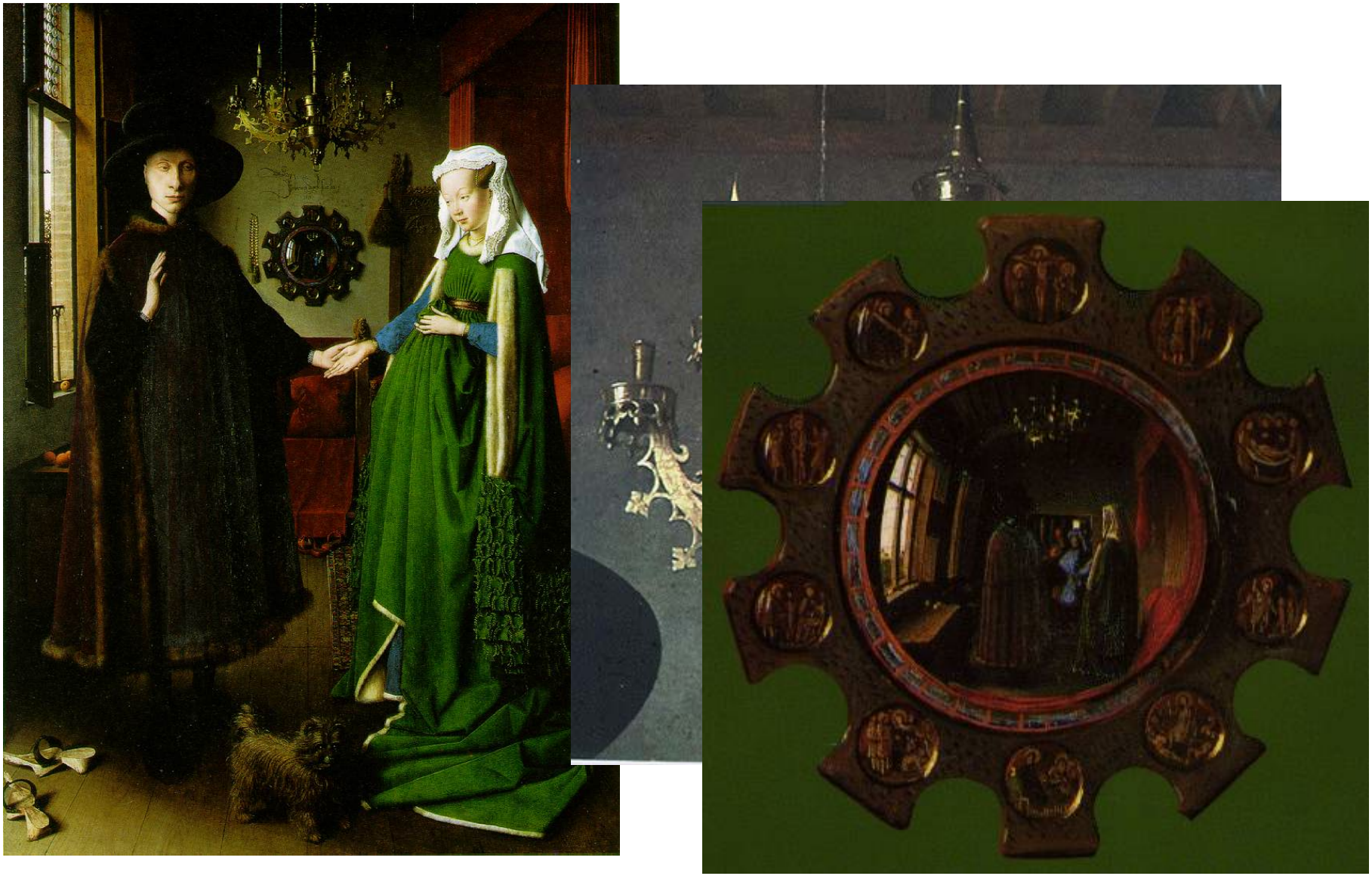


Depicting Our World: Renaissance



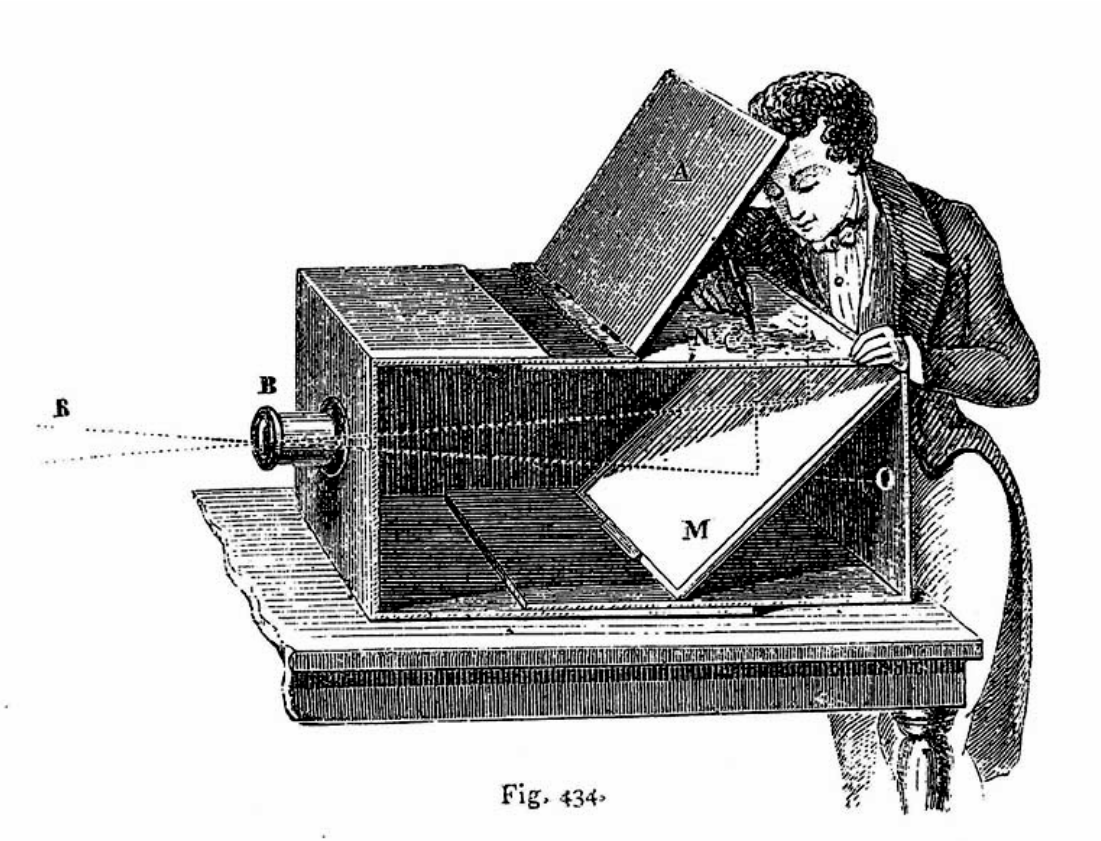
Piero della Francesca,
The Flagellation (c.1469)

Depicting Our World: Toward Perfection



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

Depicting Our World: Toward Perfection

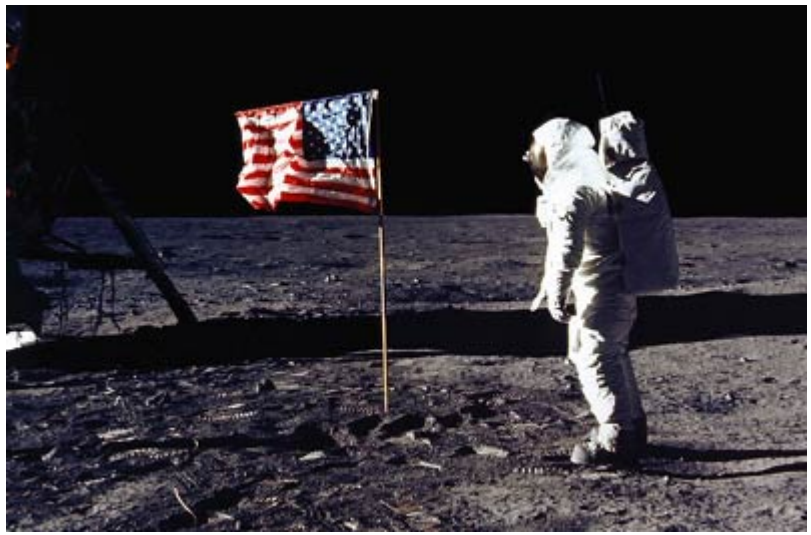


Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

Depicting Our World: Perfection?



Depicting Our World: Ongoing Quest

Pablo Picasso

Marc Chagall

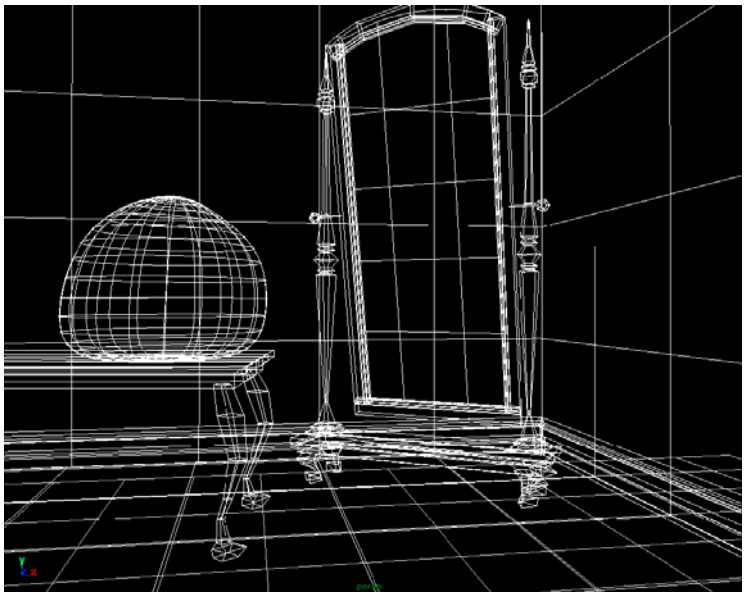
Depicting Our World: Ongoing Quest

David Hockney, 1985

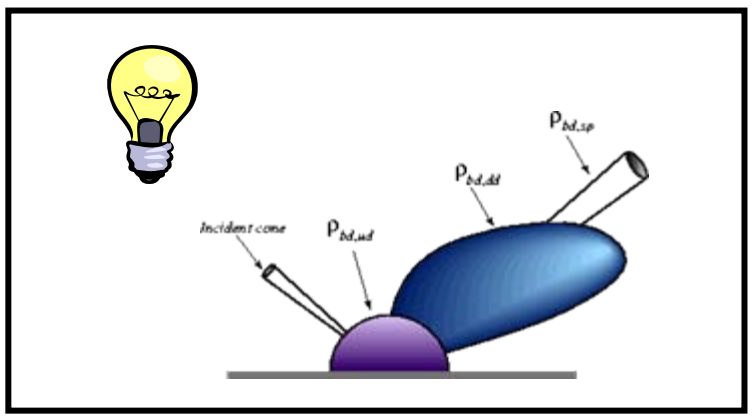
Antonio Torralba & Aude Oliva (2002)

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

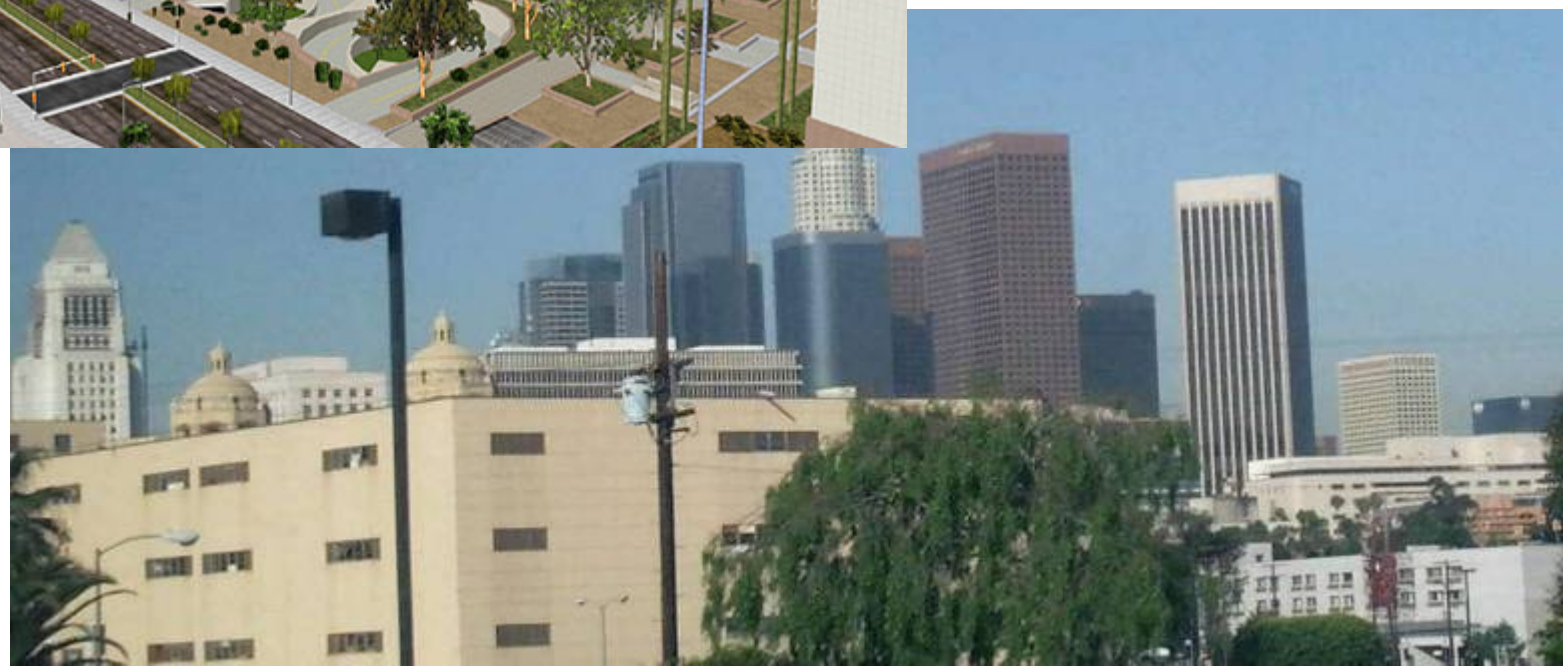
From “Final Fantasy”

Photo by Joaquin Rosales Gomez

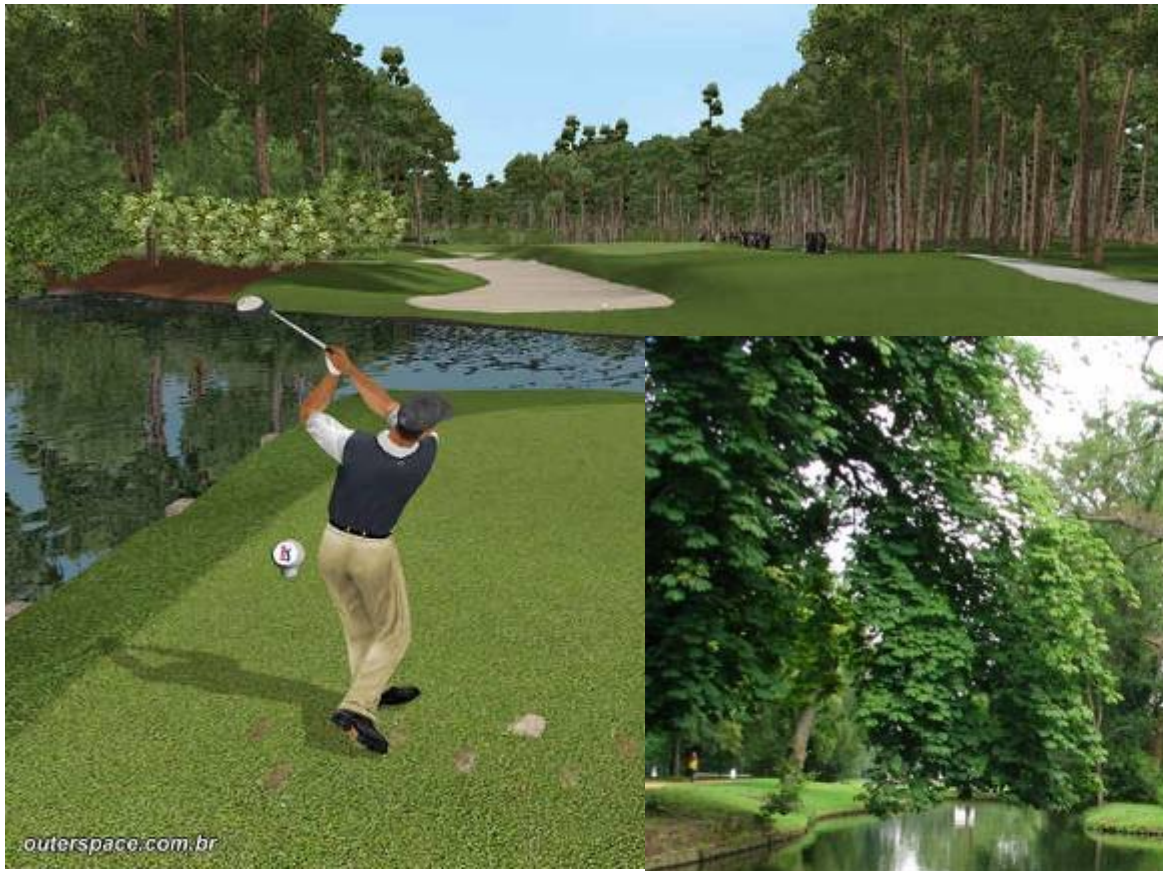
Urban Scenes

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)
- Learned it all in 15-462!

Graphics is still hard:

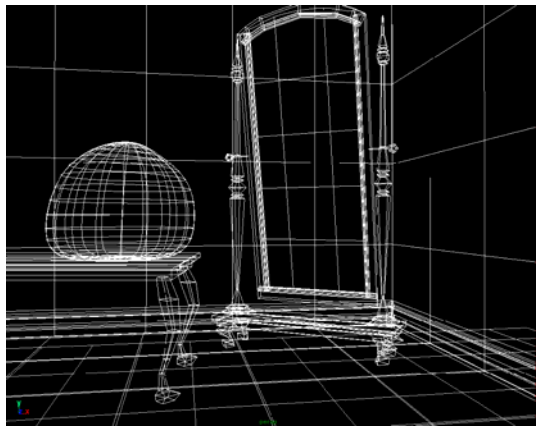
- We want to model our world (visual realism!)
- How do we create *enough* geometry?
- How do we find reflectance properties for *all* materials?
- Is it feasible? It is even needed? (human perception)
- Can we use texture maps?
- **Where do we get all this DATA?**

Capture it from the real world –

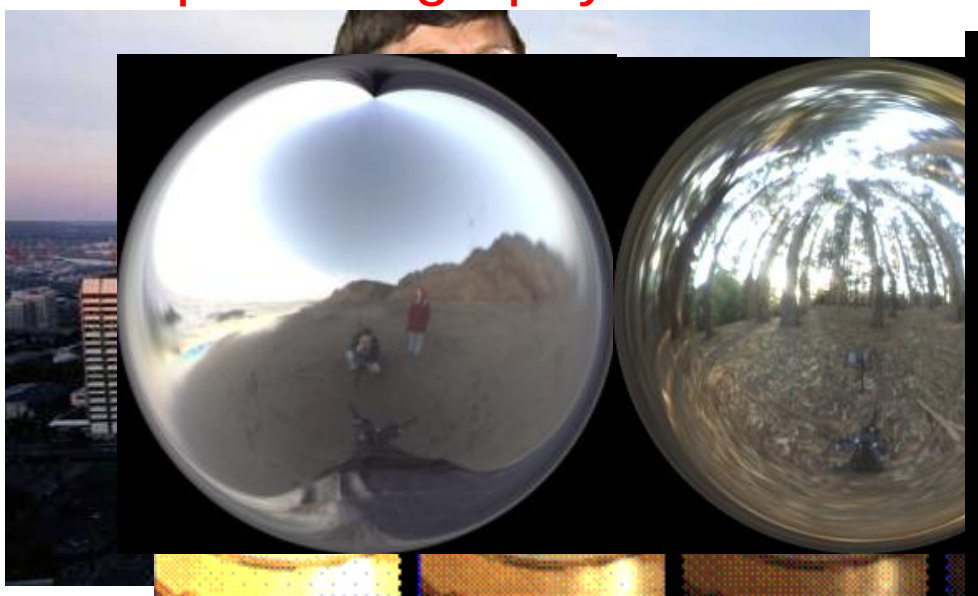
Computational Photography!

Virtual World vs. the Real World

Traditional Graphics: we played in our little sandbox



Comp. Photography: Now we are ready to embrace the world!



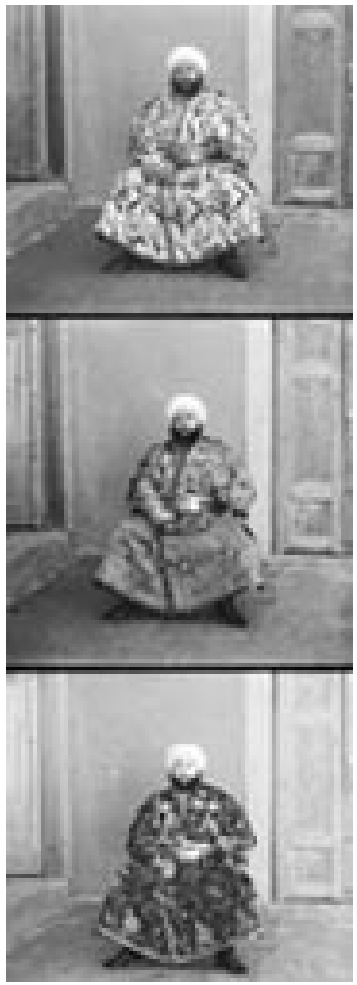
Virtual Real World

Campanile Movie

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

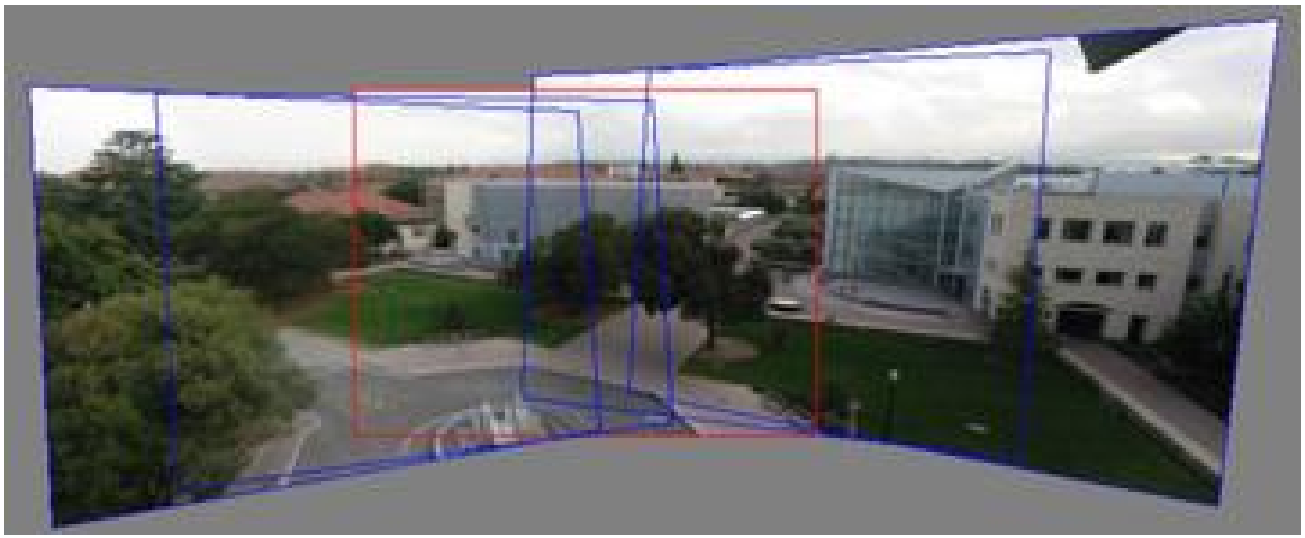
Programming Project 1

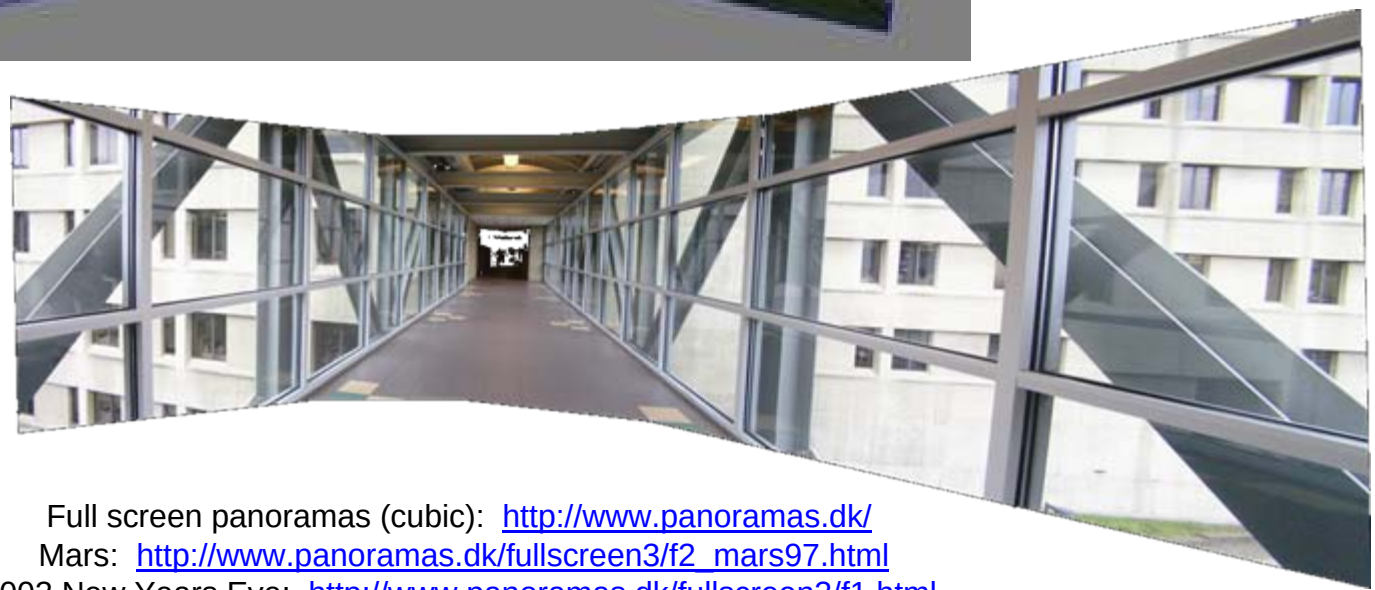
Images of the Russian Empire -- colorizing the Prokudin-Gorskii photo collection



Programming Project 2

Photo Mosaics

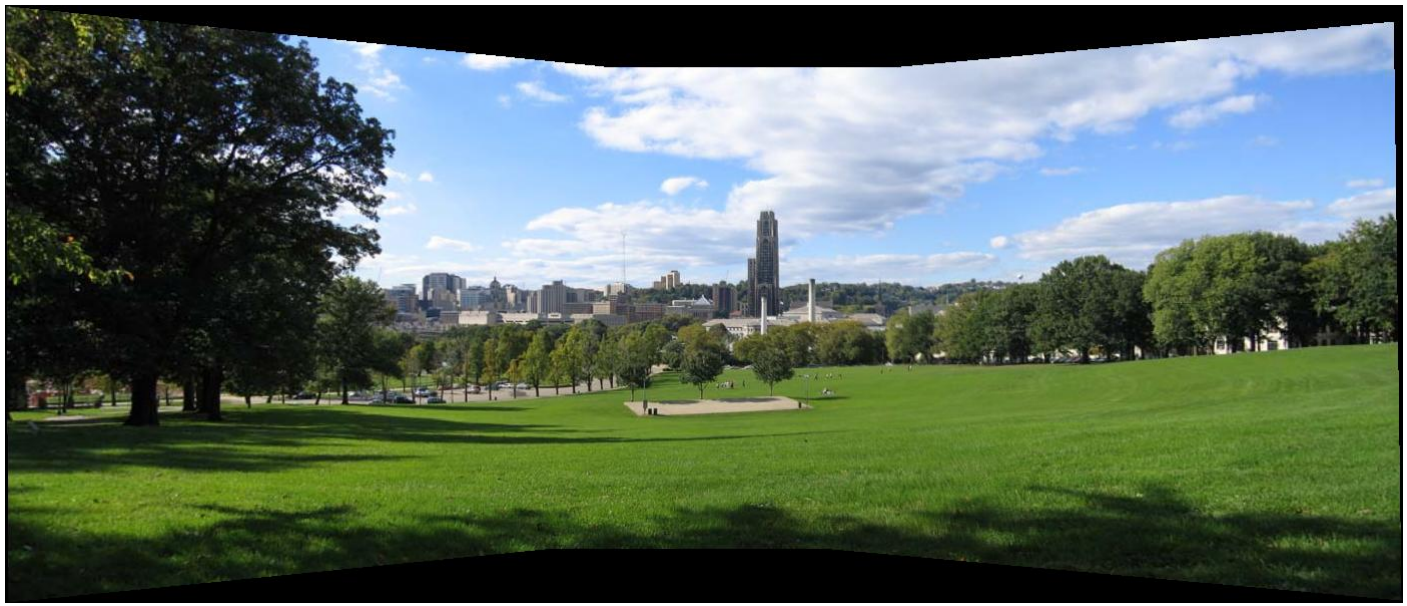




Full screen panoramas (cubic): http://www.panoramas.dk/
Mars: http://www.panoramas.dk/fullscreen3/f2_mars97.html
2003 New Years Eve: http://www.panoramas.dk/fullscreen3/f1.html

Programming Project 3

Automatic Mosaic Stitching

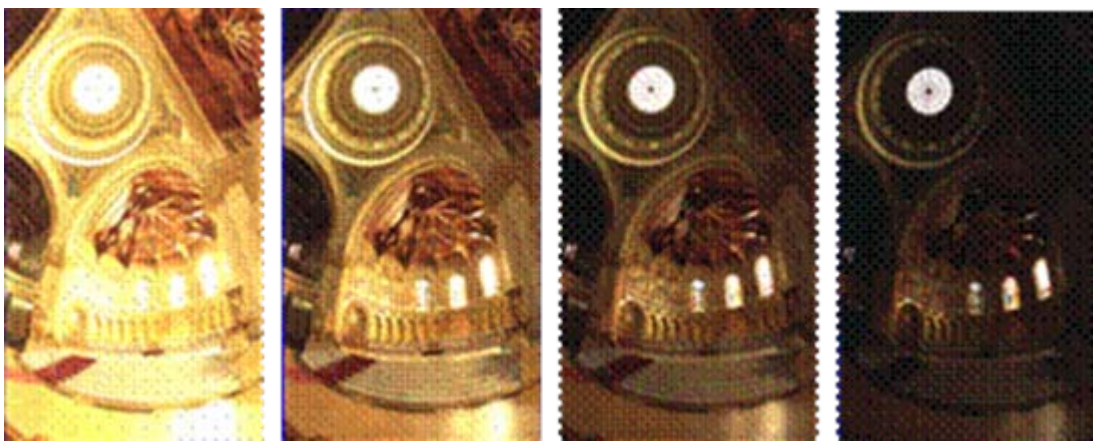


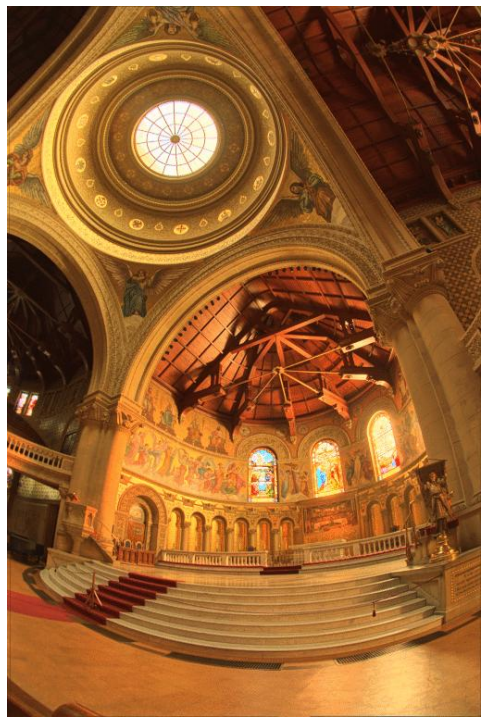
Programming Project 4

Face warping and morphing

Programming Project 5

Fun with Image Stacks





Programming Project 6

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 or vision (or talk to me)

Emphasis on programming projects!

- Building something from scratch (Matlab!)

Cameras

Really cool

Not too expensive nowadays (<$250)

Canon A520