15-463 (15-862): Computational Photography

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Staff

- Prof: Alexei Efros (efros@cs), 4207 NSH
- TA: Jim McCann (jmccann@cs), Graphics Lab

Web Page

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

Discussion Forum:

- TBD

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

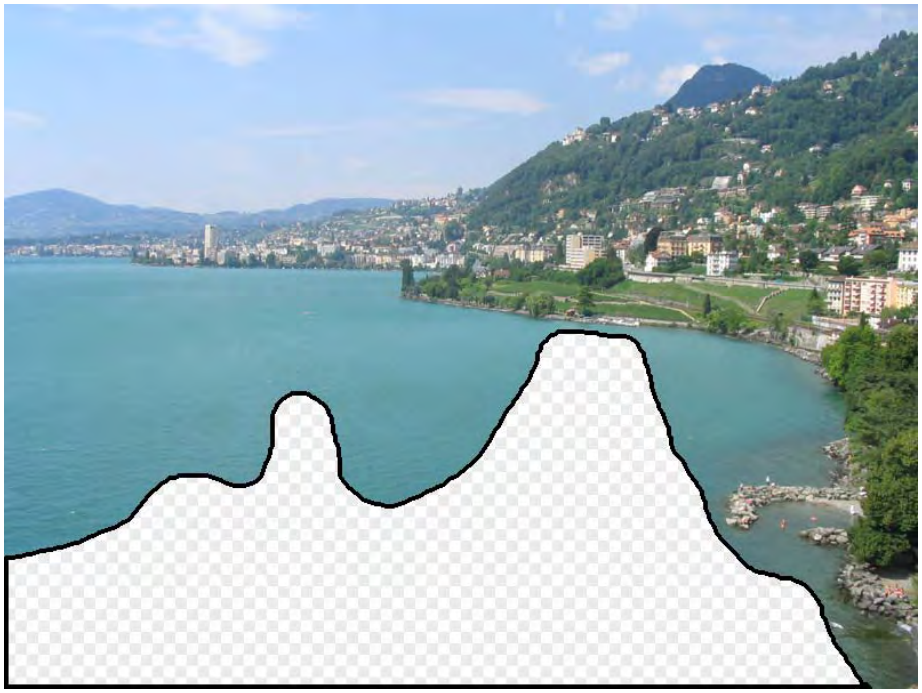
PhD Thesis on Texture and Action Synthesis

Smart Erase button in MS Digital Image Pro:

Antonio’s son cannot walk but he can fly☺

More recent work

Derek Hoiem, Alexei Efros, Martial Hebert

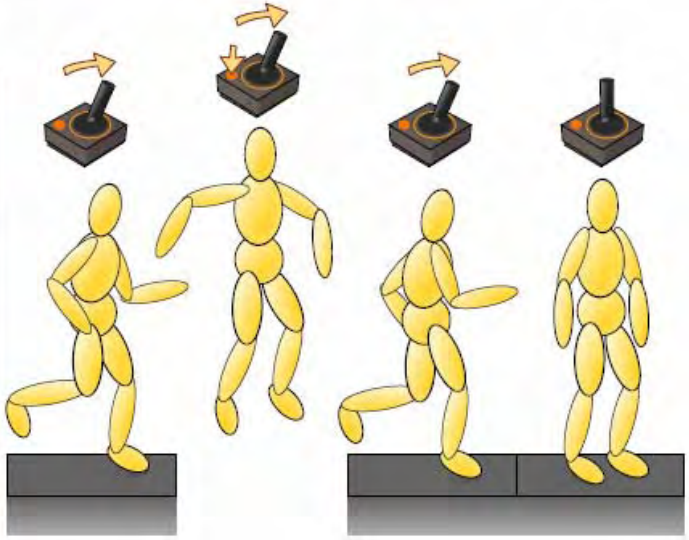


Jim’s latest stuff

Responsive Characters from Motion Fragments

James McCann*
Carnegie Mellon University

Nancy Pollard†
Carnegie Mellon University



Computational Photography

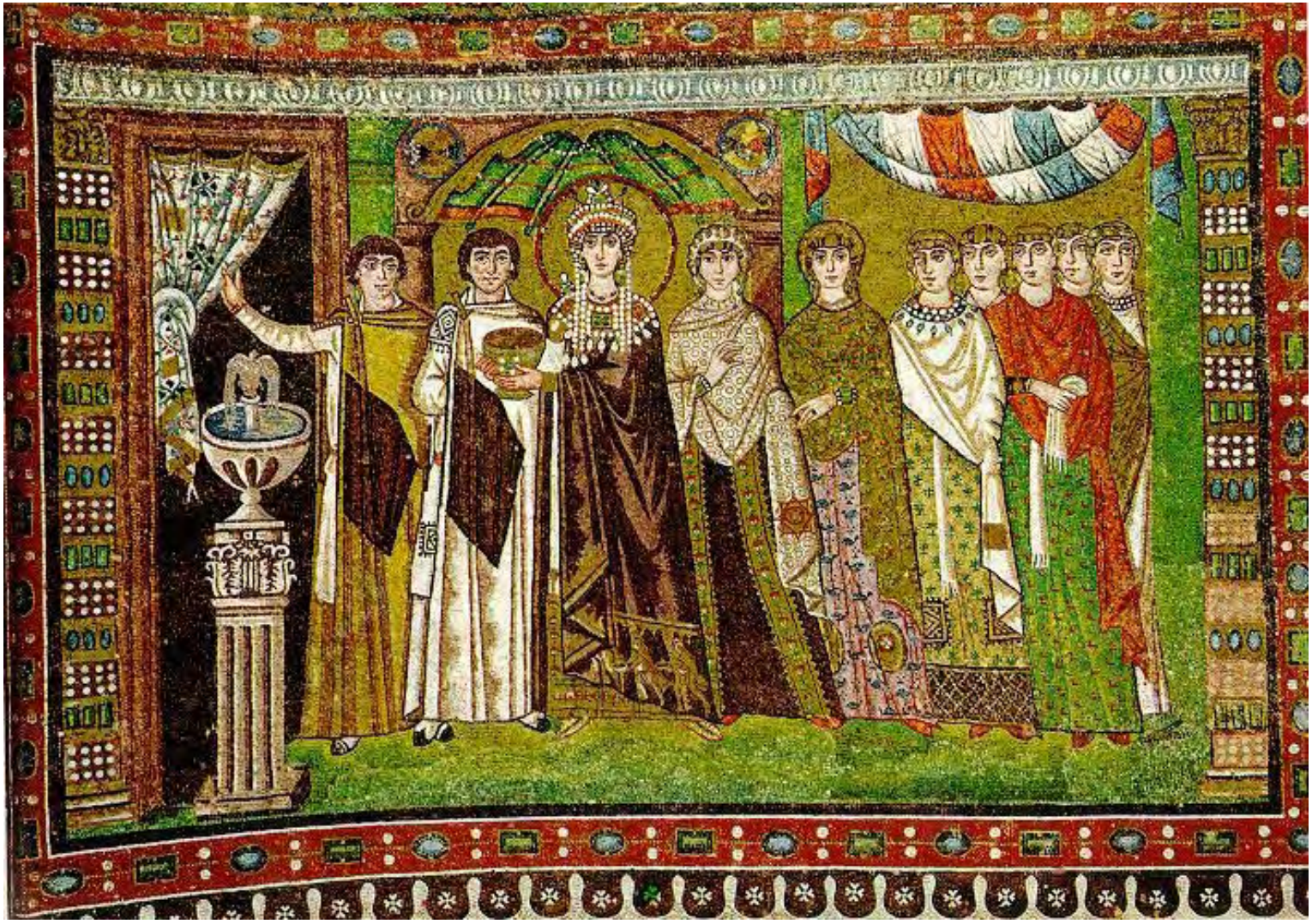
The Story So Far…

(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

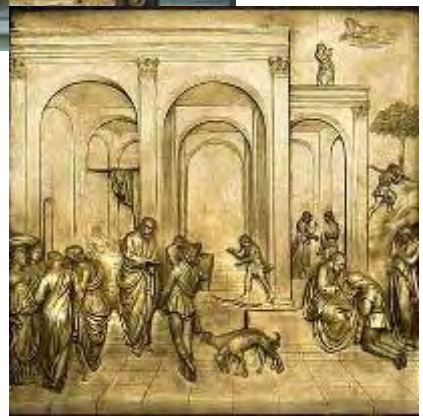
Nuns in Procession. French ms. ca. 1300.

Depicting Our World: Renaissance

North Doors (1424)

Lorenzo Ghiberti (1378-1455)

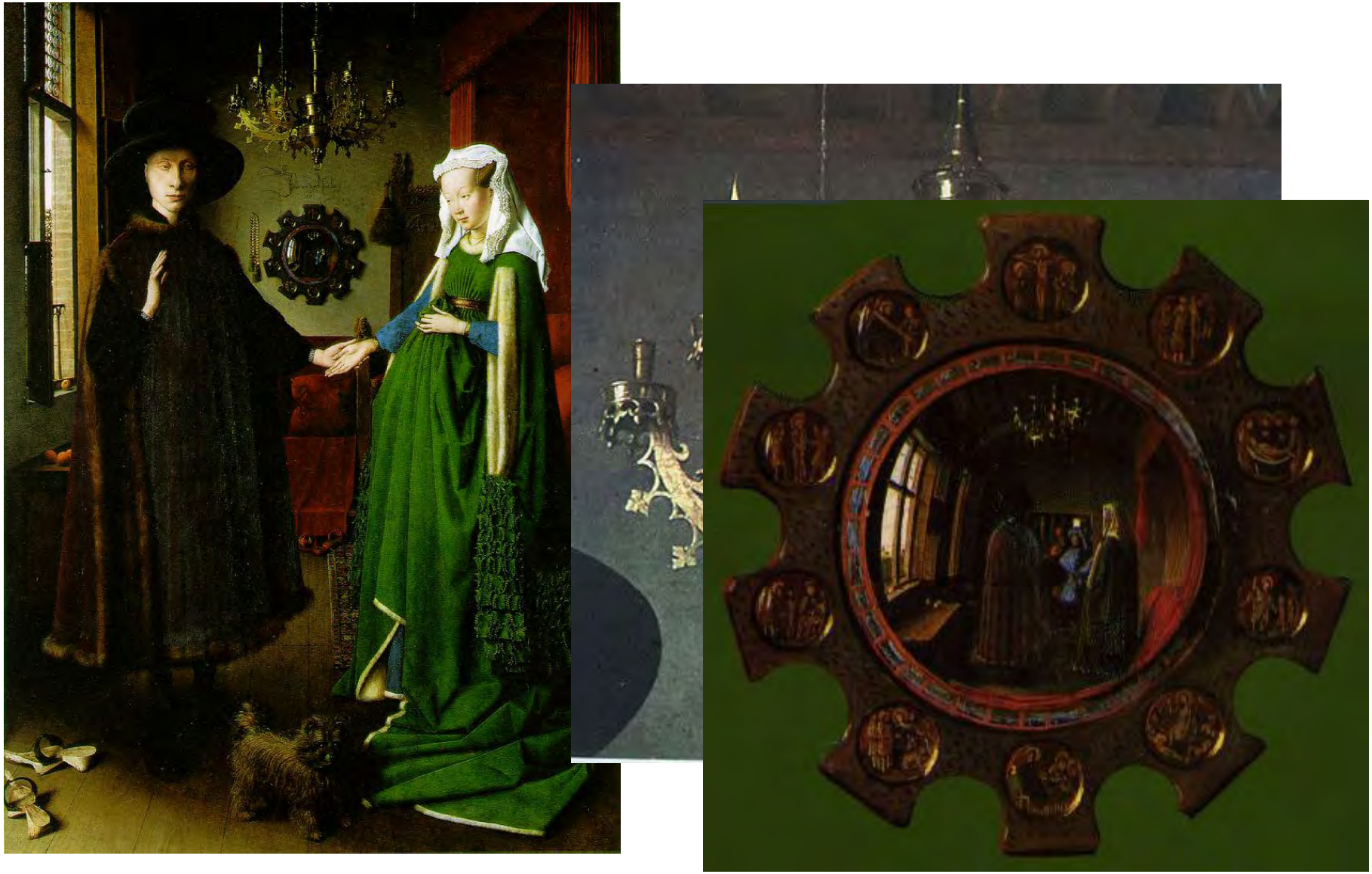
East Doors (1452)



Depicting Our World: Renaissance

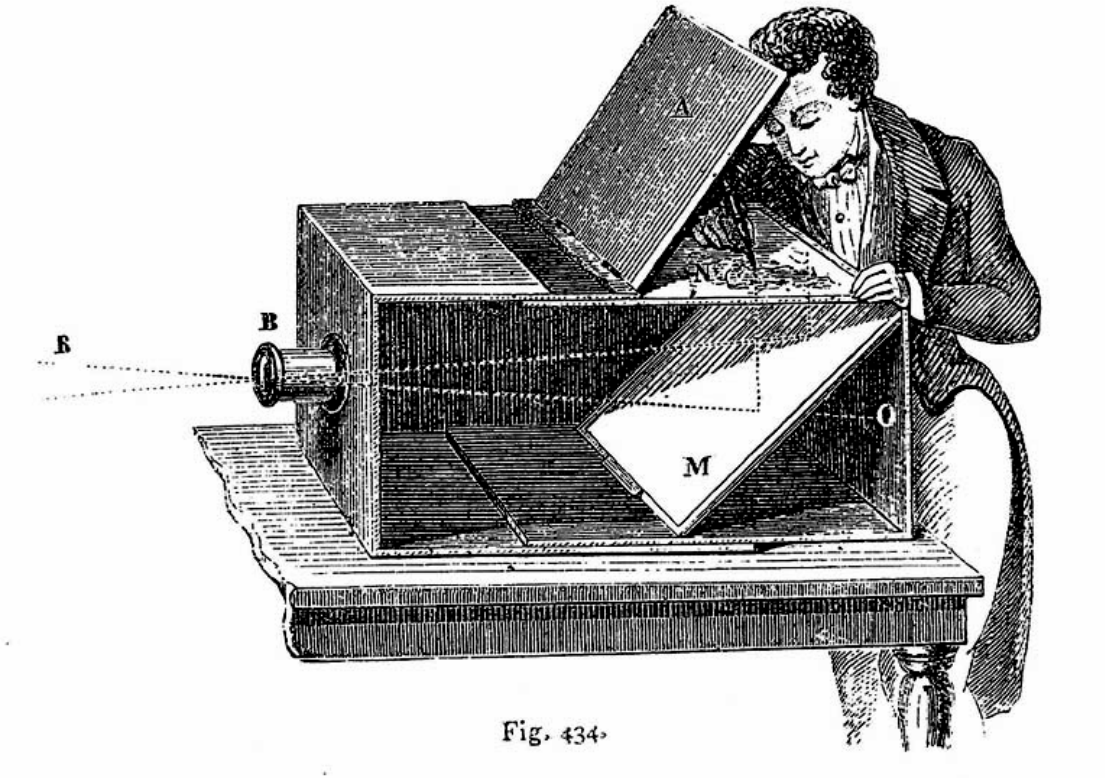
Piero della Francesca,
The Flagellation (c.1469)

Depicting Our World: Toward Perfection



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

Depicting Our World: Toward Perfection

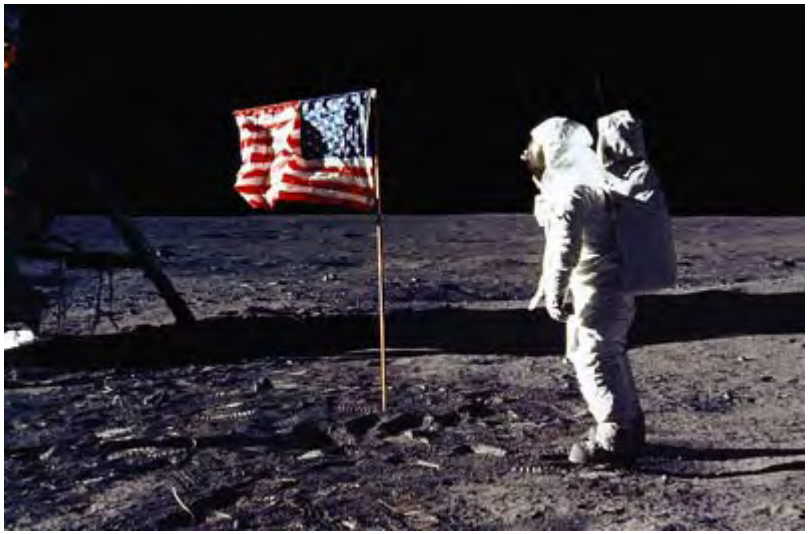


Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

Depicting Our World: Perfection?



Depicting Our World: Ongoing Quest

Pablo Picasso

Marc Chagall

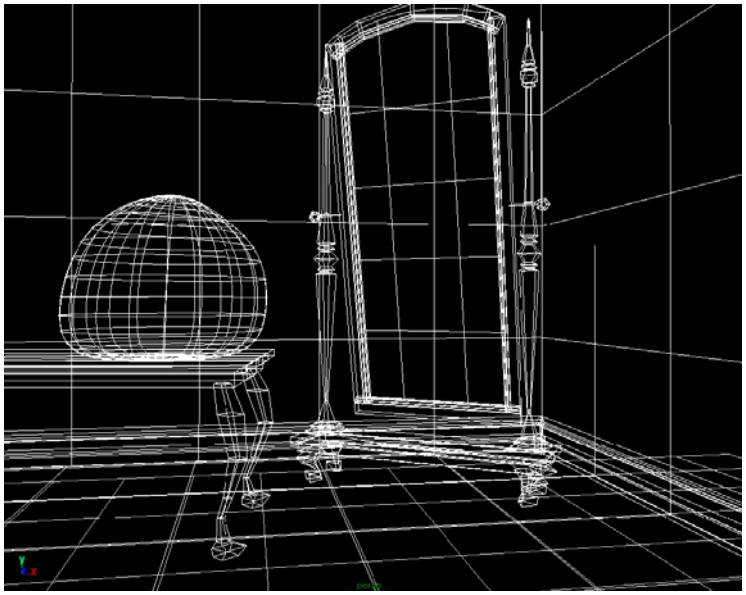
Depicting Our World: Ongoing Quest

David Hockney, 1985

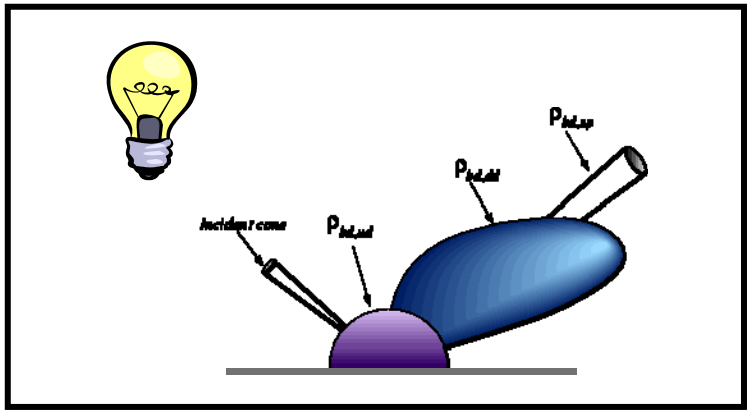
Antonio Torralba & Aude Oliva (2002)

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

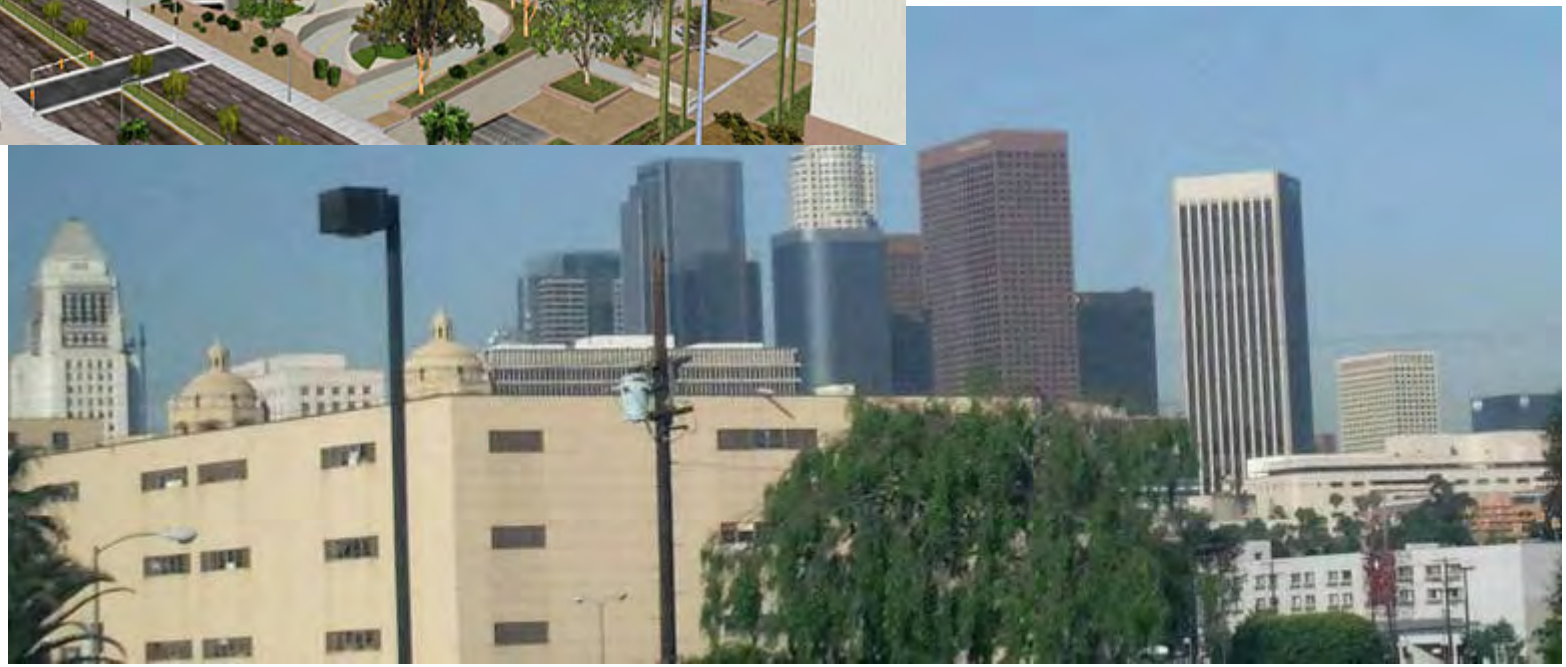
From “Final Fantasy”

Photo by Joaquin Rosales Gomez

Urban Scenes

Virtual LA (SGI)

Photo of l LA



Nature

River Cherwell, Oxford

The Realism Spectrum

Computer Graphics

+ easy to create new worlds

+ easy to manipulate objects/viewpoint

- Very hard to look realistic

Computational Photography

Realism
Manipulation
Ease of capture

Photography

+ instantly realistic

+ easy to aquire

- very hard to manipulate objects/viewpoint

Virtual Real World

Campanile Movie

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

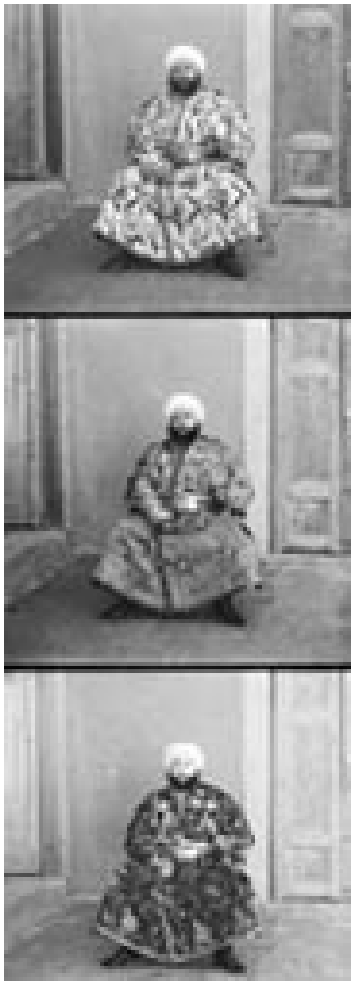
Course Outline

Programming Project 0

The *Vertigo* Effect

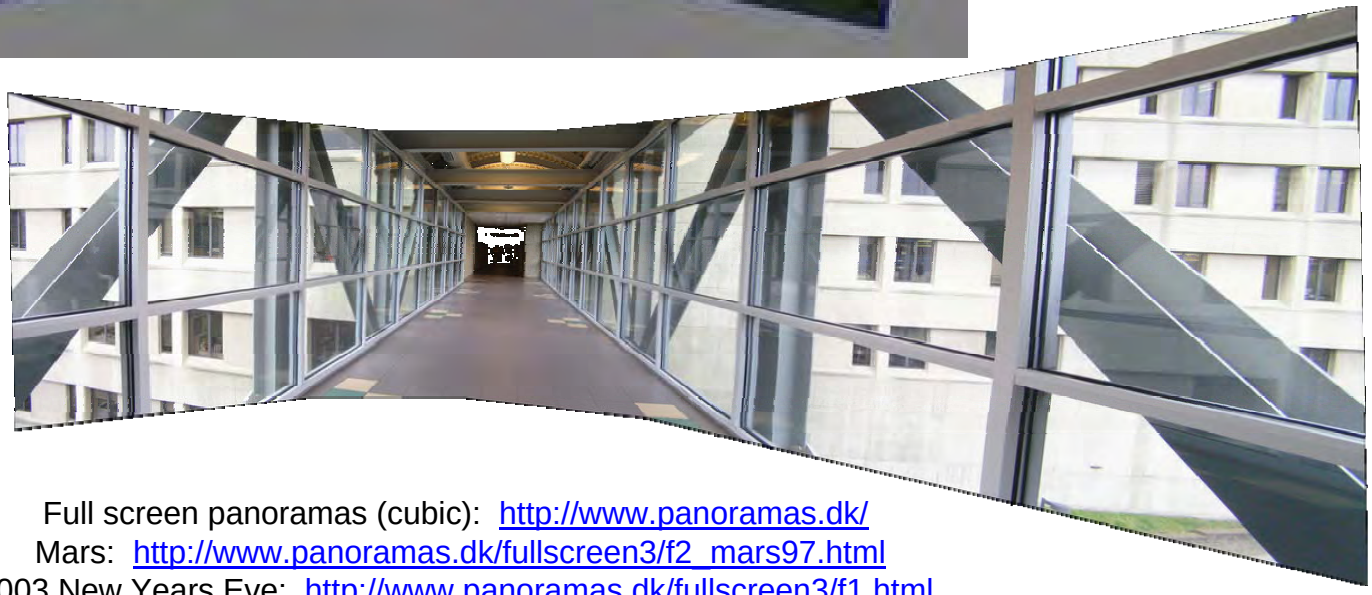
Programming Project 1

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



Programming Project 2

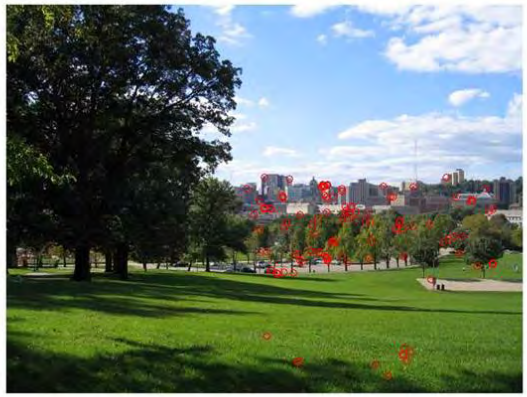
Photo Mosaics

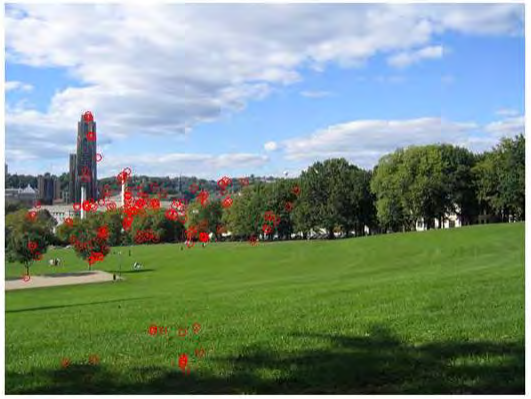


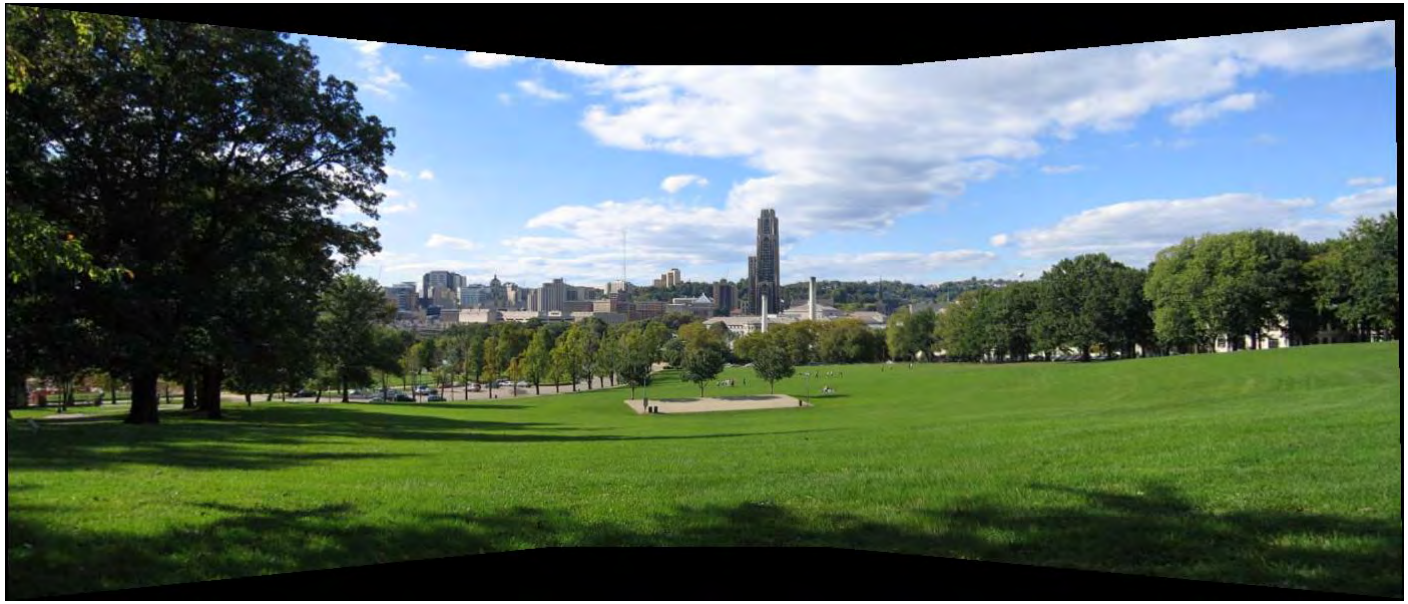
Full screen panoramas (cubic): http://www.panoramas.dk/
Mars: http://www.panoramas.dk/fullscreen3/f2_mars97.html
2003 New Years Eve: http://www.panoramas.dk/fullscreen3/f1.html

Programming Project 2

Automatic Mosaic Stitching







Programming Project 3

Image Resizing by Scene Carving

Programming Project 3

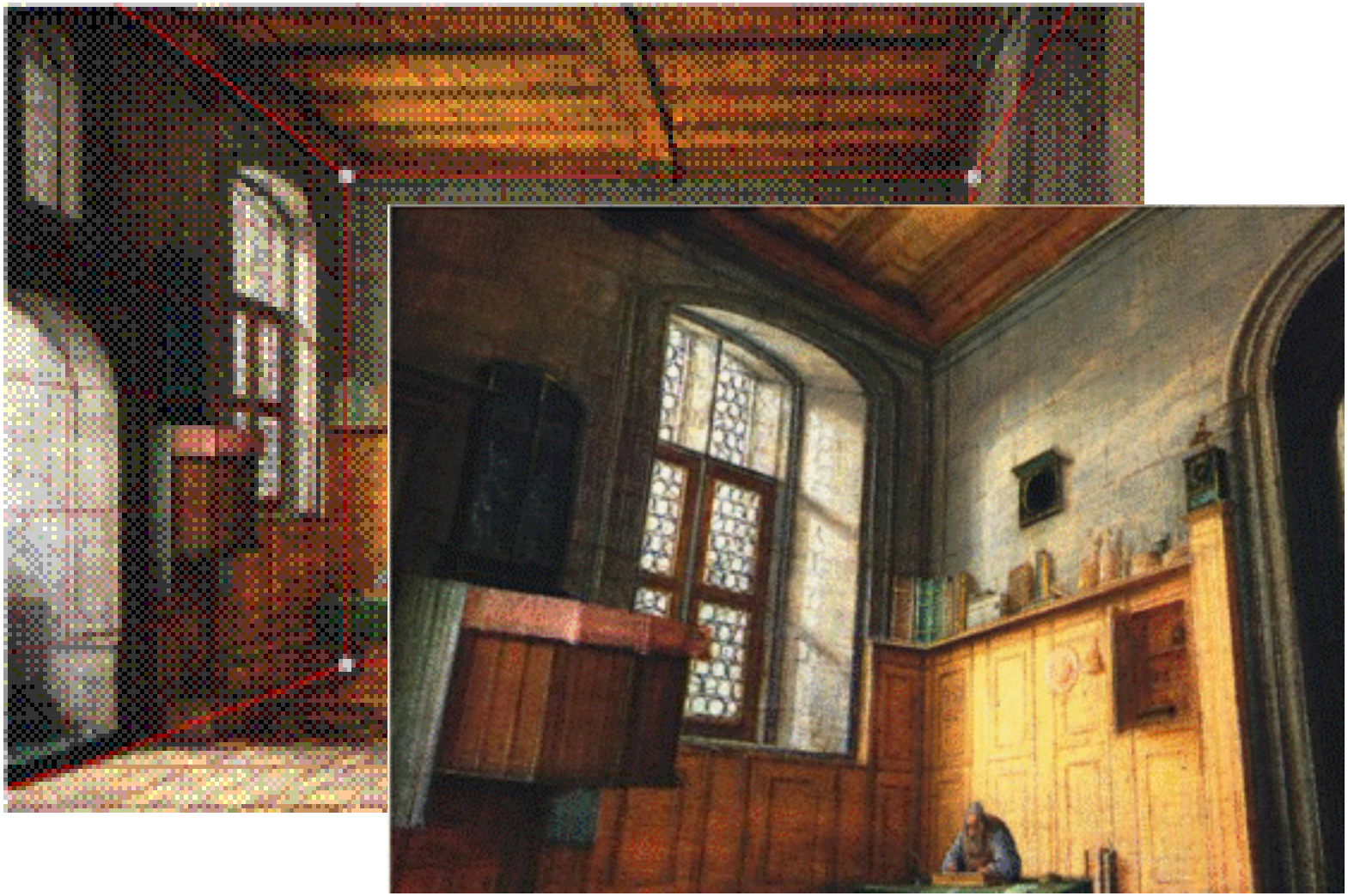
Image Resizing by Scene Carving

Programming Project 4

Face warping and morphing

Programming Project 5

Tour Into the Picture



Final Project

Something cool!!!

Administrative Stuff

Grading

- Written and Programming Assngments (60%)
- Exam (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)

e.g. Canon A550