15-463 (15-862): Computational Photography

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Staff

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Web Page

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

Discussion Forum:

- Googlegroups ???

Today

Introductions

Why Computational Photography?

Overview of the course

Administrative stuff

A bit about me

Alexei (Alyosha) Efros

- Associate Professor in Robotics and CSD
- also work with colleagues in Paris and Oxford

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, Computer Graphics, Machine Learning, Visual Perception

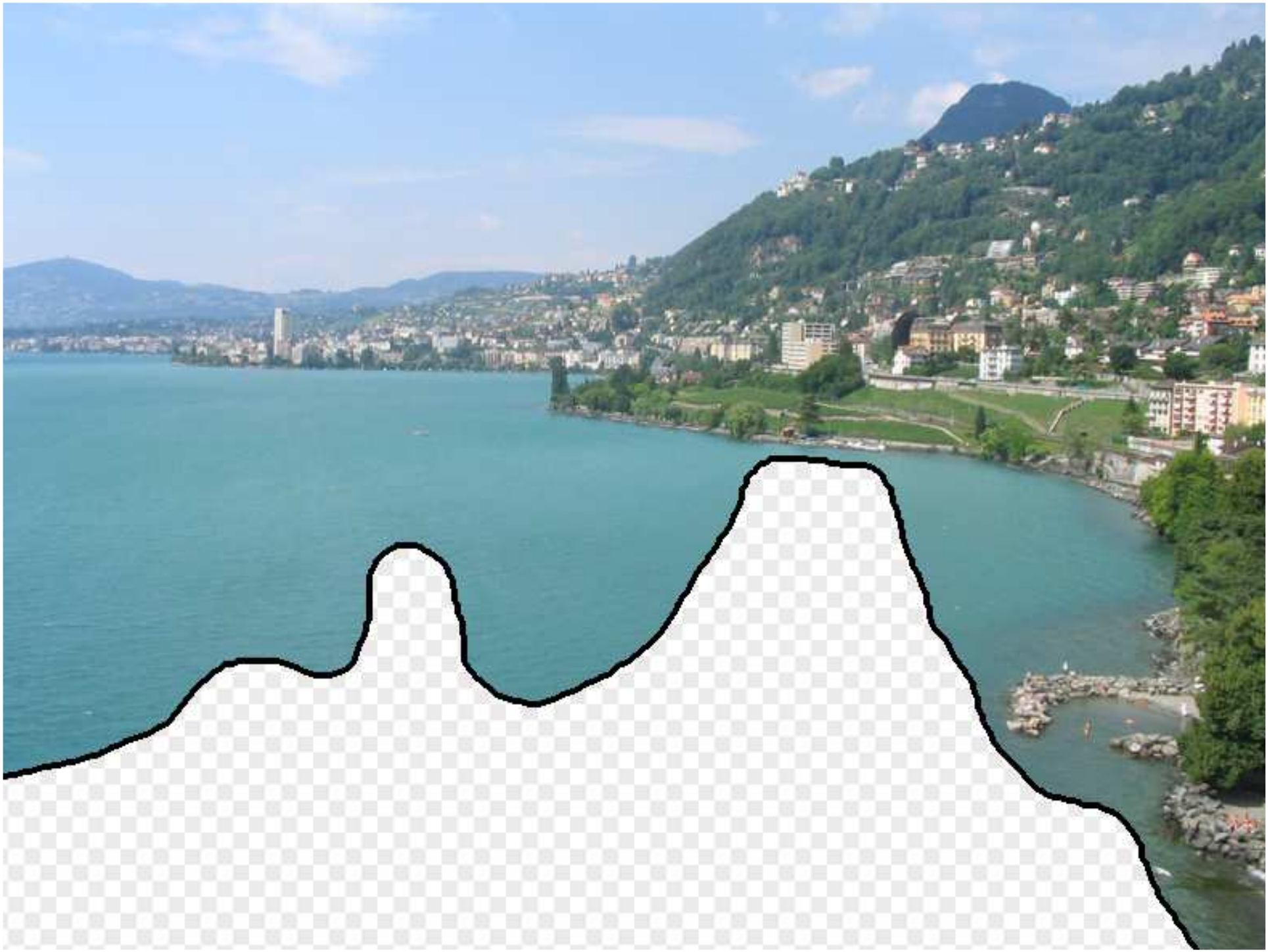
PhD Thesis on Texture and Action Synthesis

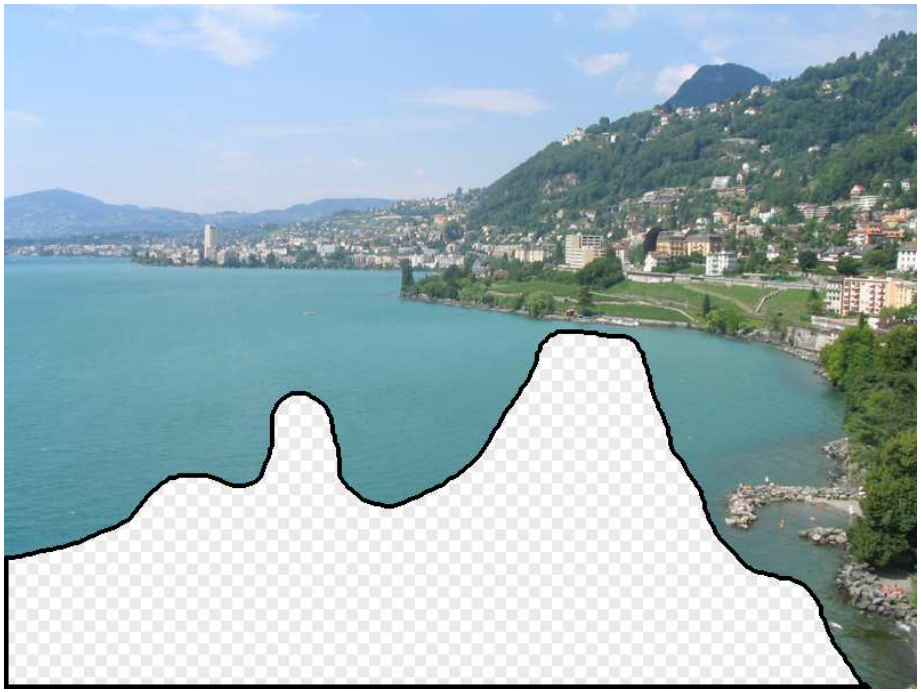
Smart Erase button in MS Digital Image Pro:

Antonio’s son cannot walk but he can fly☺

More previous work

Automatic Photo Pop-Up (SIGGRAPH 2005)





Amateur Photographer

What is Computational Photography?

- “computational techniques that enhance or extend photography”

- Another medium for visual expression

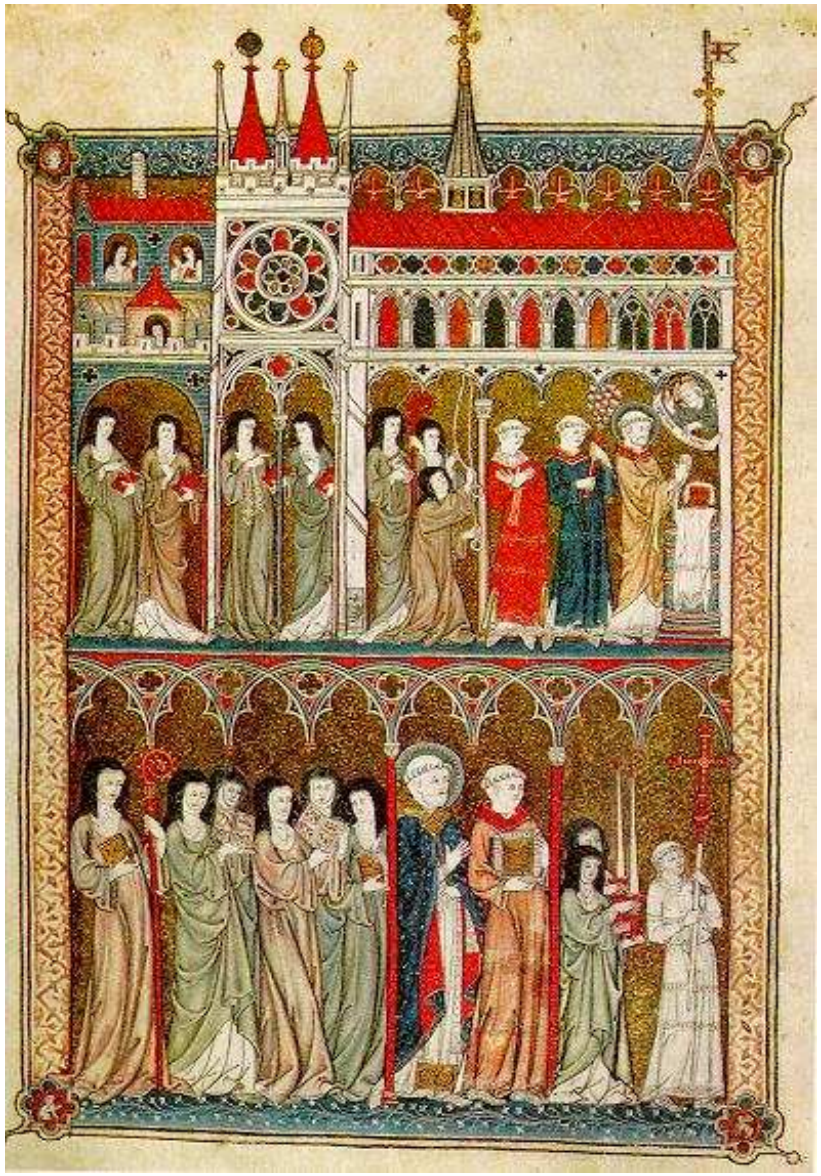
Depicting Our World: The Beginning

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



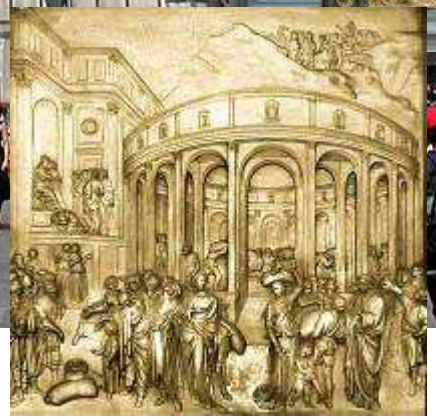
Nuns in Procession. French ms. ca. 1300.

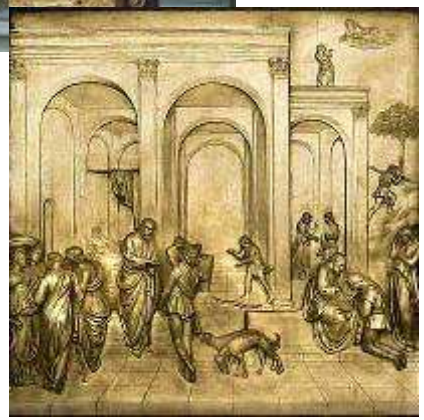
Depicting Our World: Renaissance

North Doors (1424)

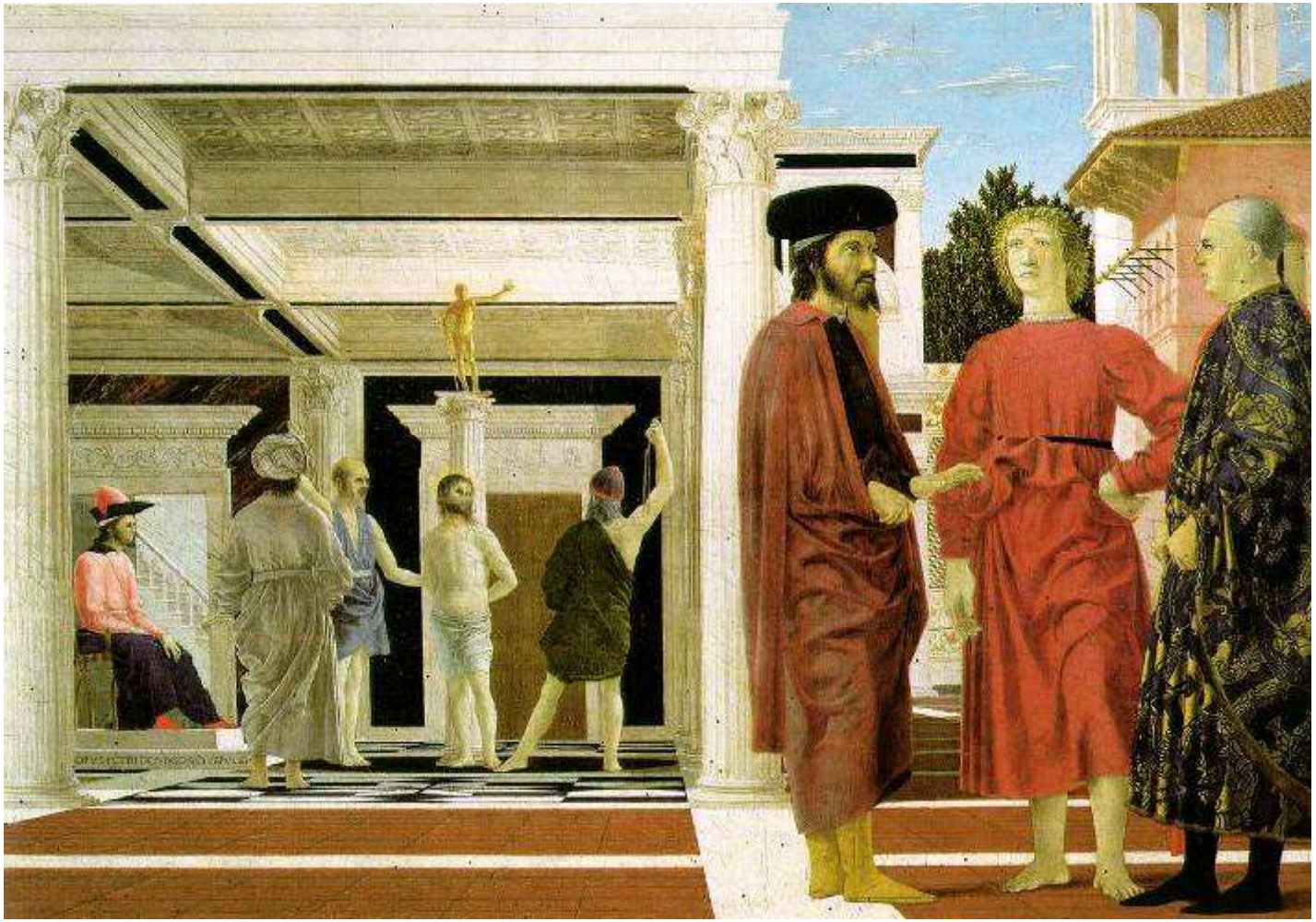
Lorenzo Ghiberti (1378-1455)

East Doors (1452)



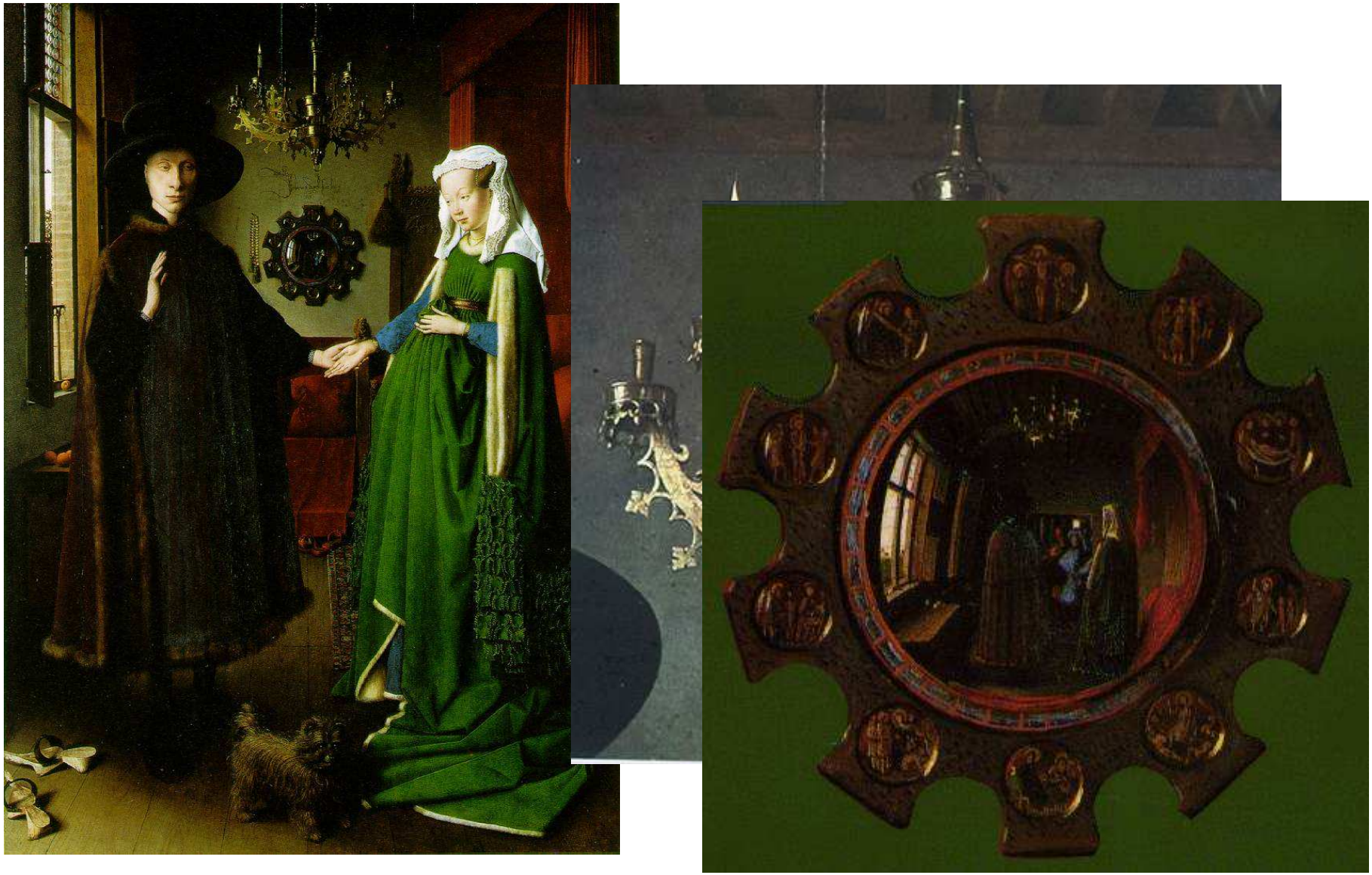


Depicting Our World: Renaissance



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

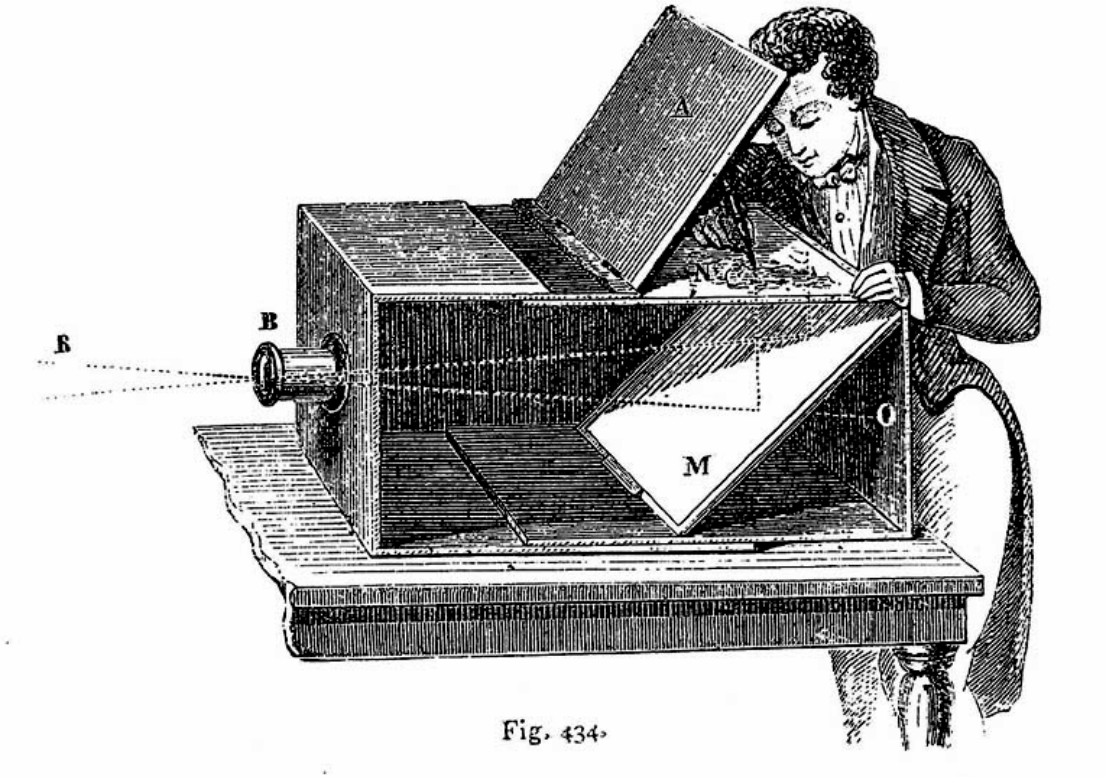


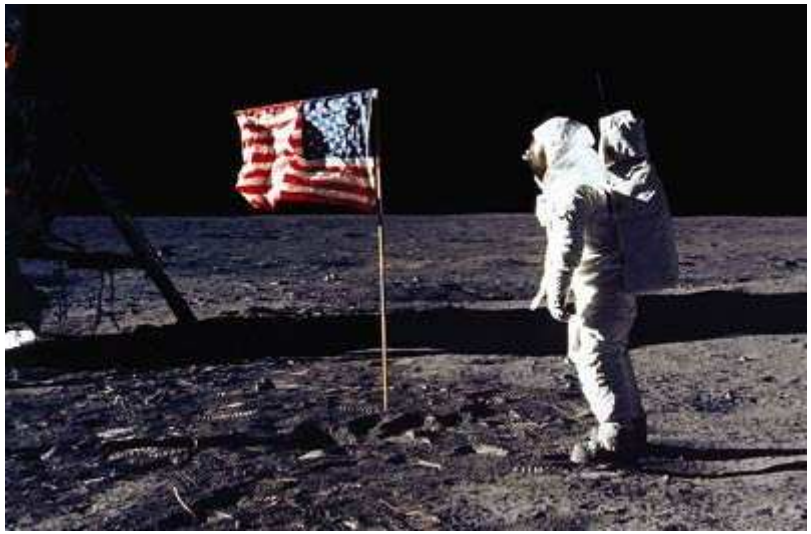
Fig. 434.

Lens Based Camera Obscura, 1568

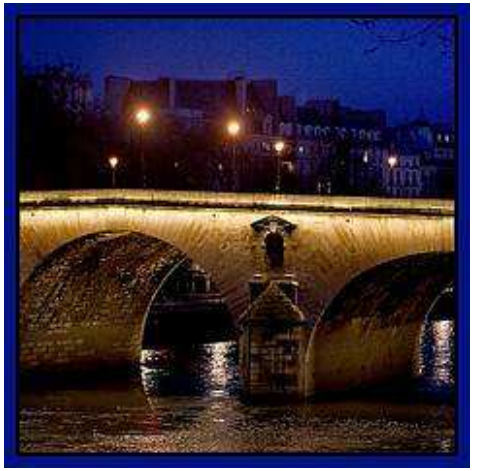
Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

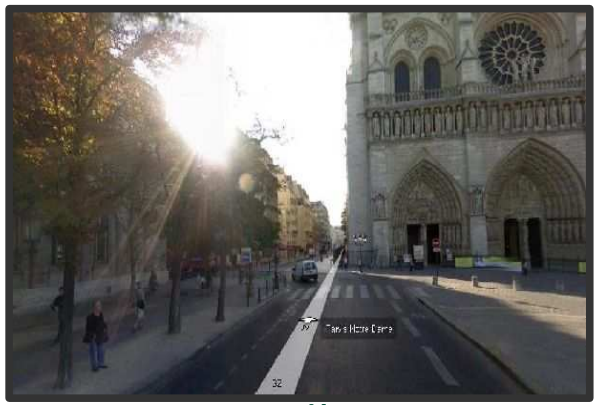
Depicting Our World: Realism?



Paris, according to Flickr



Paris, according to Google StreetView



Knopp, Sivic, Pajdla, ECCV 2010

Paris, according to me

After realism…

Monet,
La rue Montorgueil

Depicting Our World: Ongoing Quest

Pablo Picasso

David Hockney

Better than realism?

David Hockney, Place Furstenberg, (1985)

Which one is right?

Multiple viewpoints

David Hockney,
Place Furstenberg, 1985

Single viewpoint

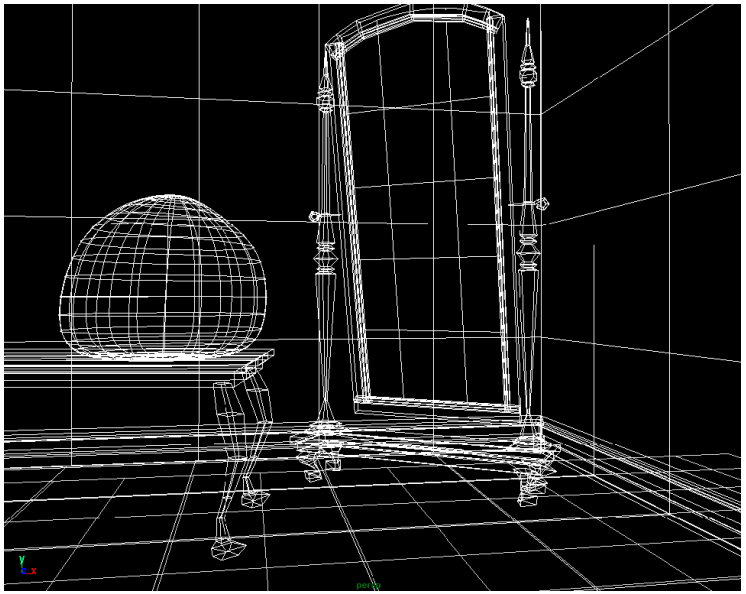
Alyosha Efros
Place Furstenberg, 2009

Depicting Our World: Ongoing Quest

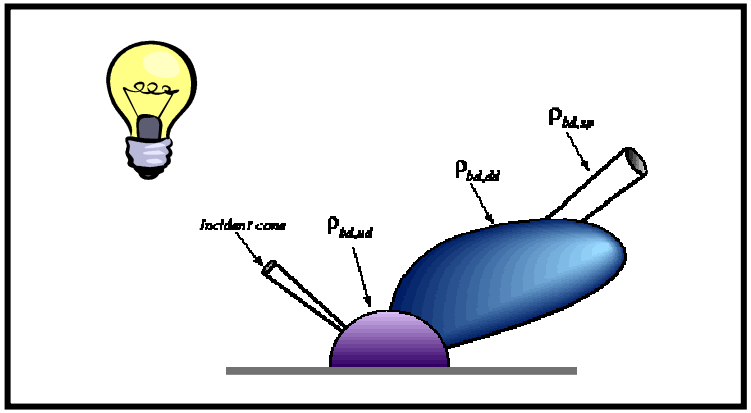
Antonio Torralba & Aude Oliva (2002)

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

Hyper-humans

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

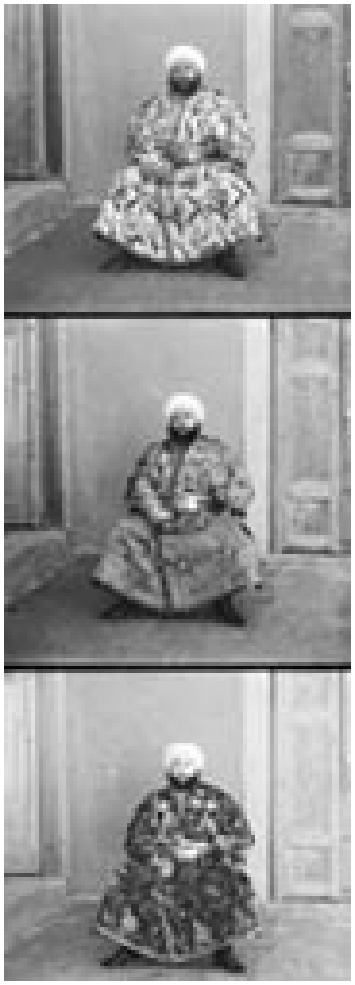
http://www.debevec.org/Campanile/

Course Outline

- (cool) Image Processing
- Lots of Visual Data
- Cameras and 3D

Project 1

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



Programming Project 2

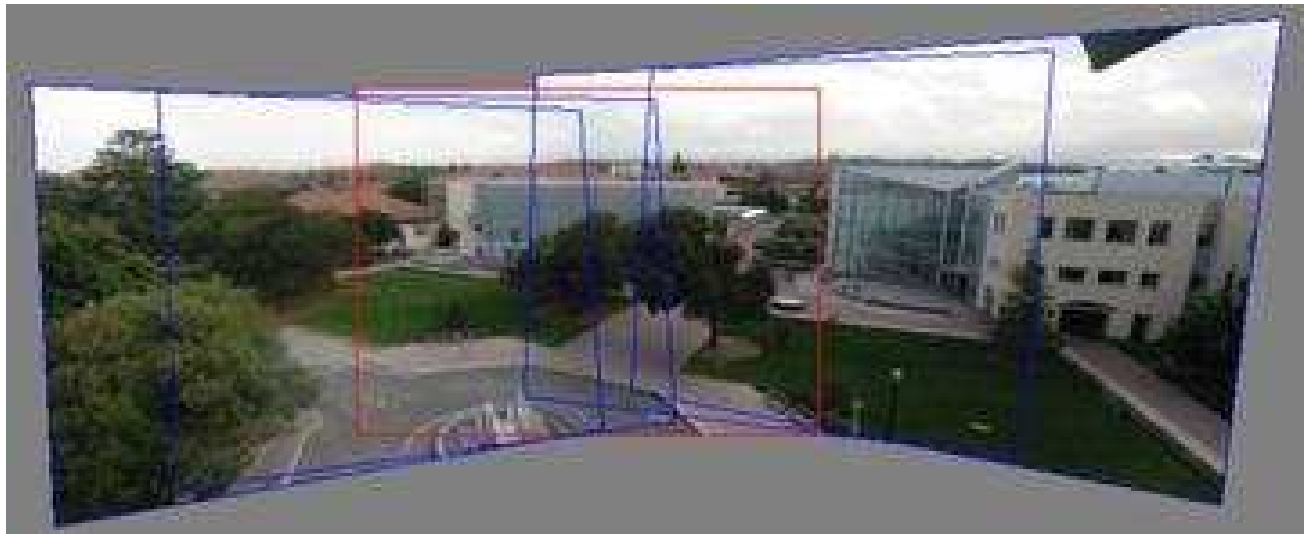
TBD

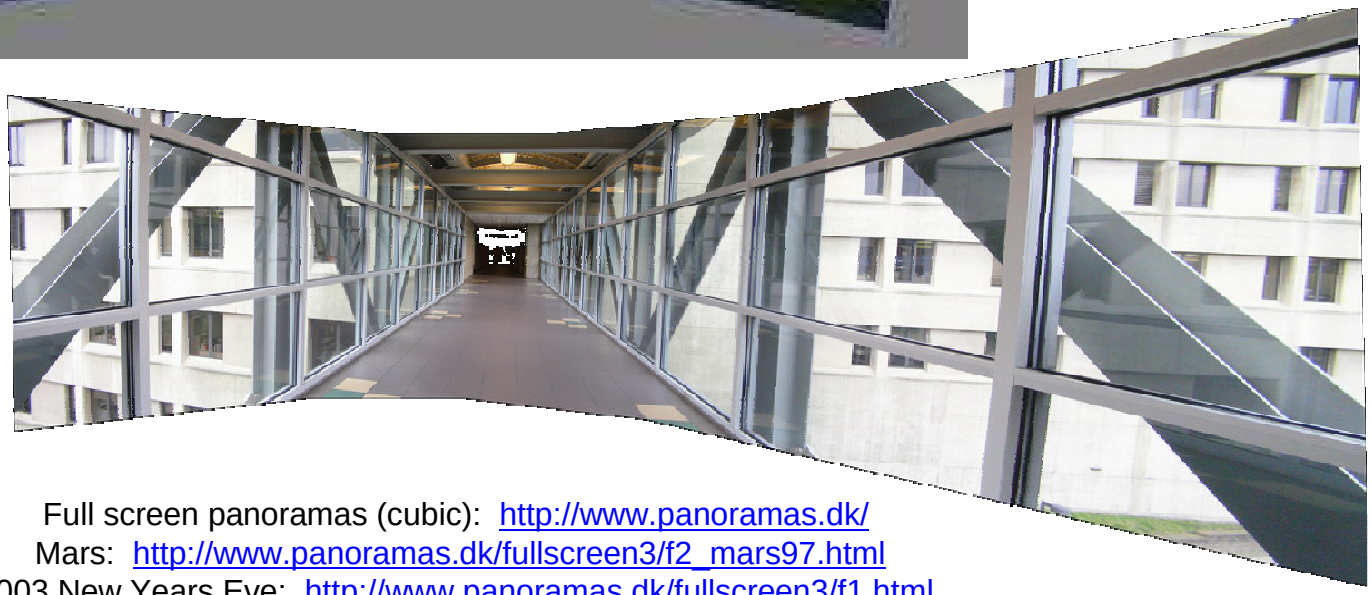
Programming Project 3

Face warping and morphing

Programming Project 4

Photo Mosaics

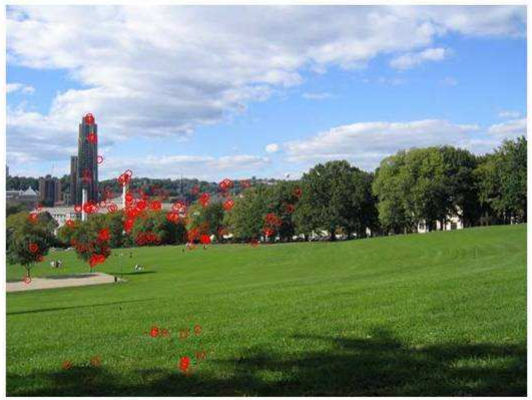
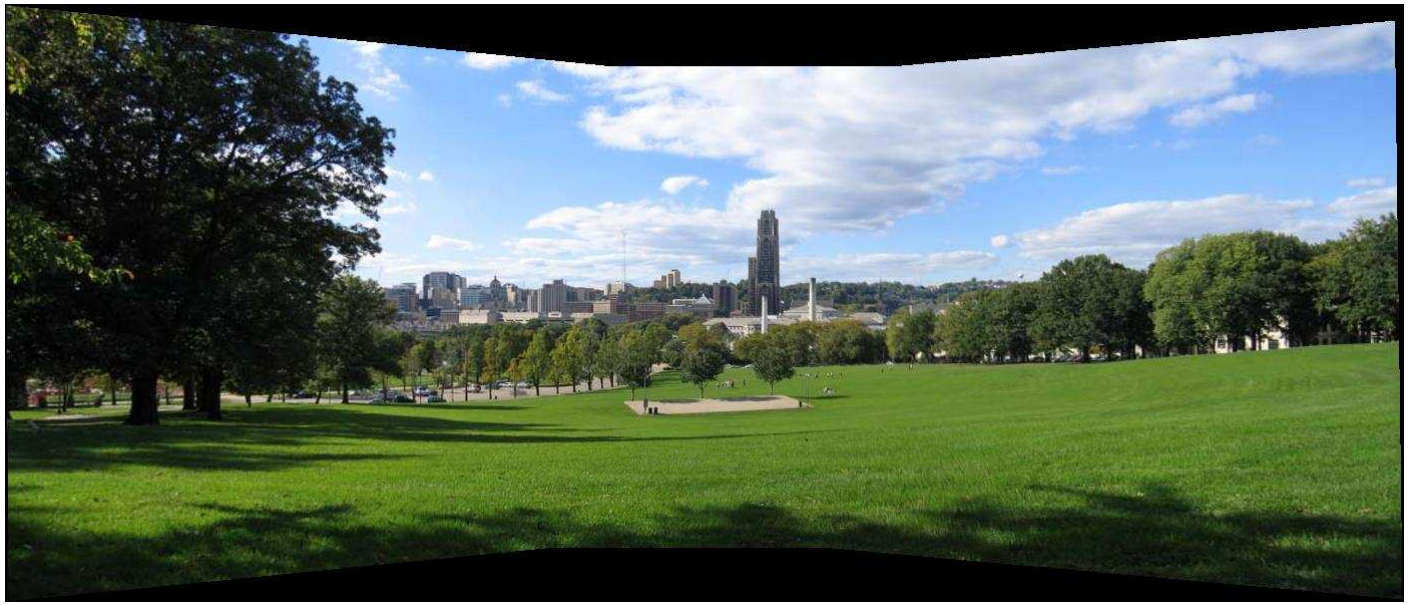




Full screen panoramas (cubic): http://www.panoramas.dk/
Mars: http://www.panoramas.dk/fullscreen3/f2_mars97.html
2003 New Years Eve: http://www.panoramas.dk/fullscreen3/f1.html

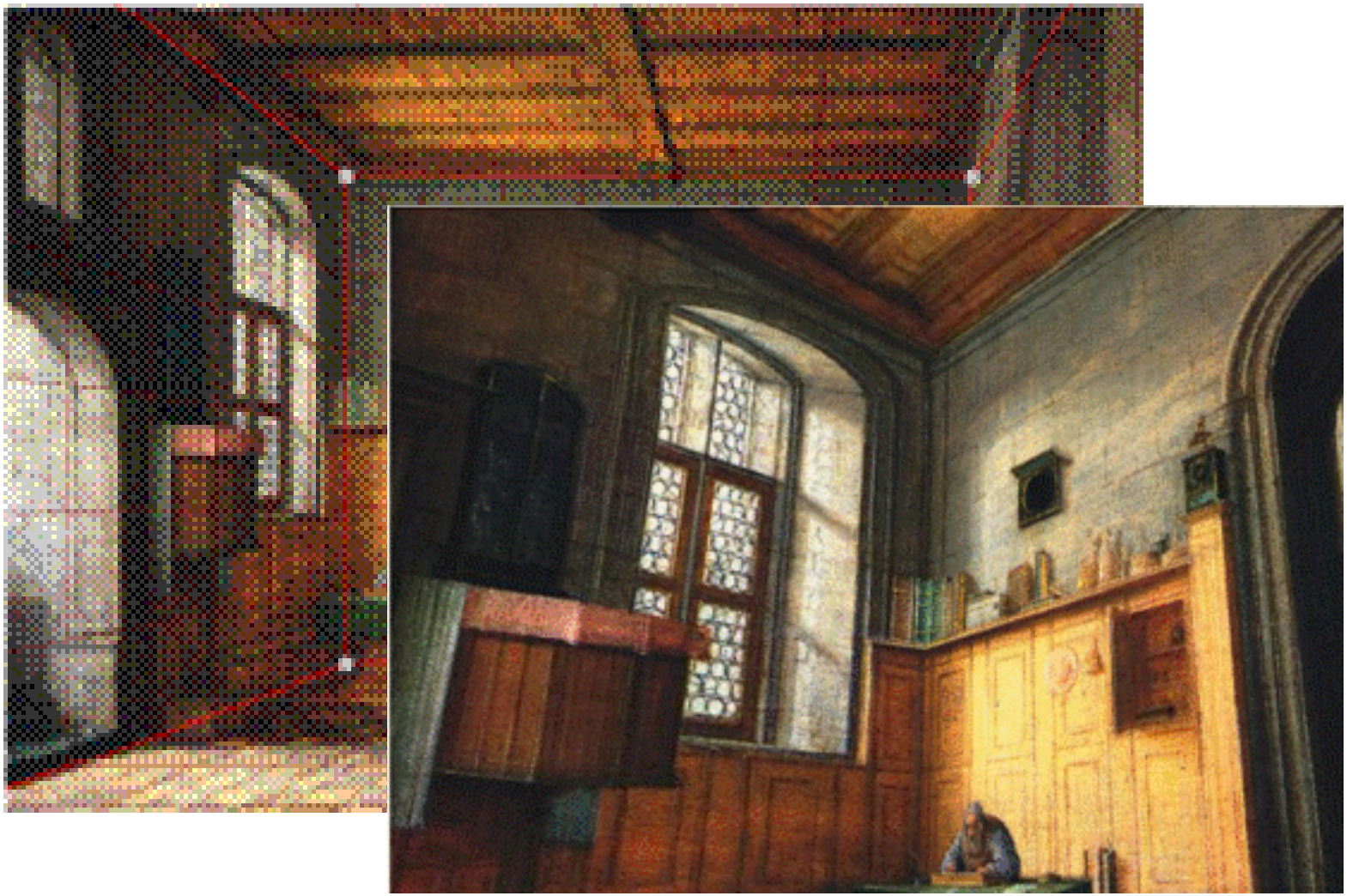
Programming Project 4

Automatic Mosaic Stitching

Programming Project 5

Tour Into the Picture



Final Project

Something cool!!!

Administrative Stuff

Grading

- Written and Programming Assignments (60%)
- Exam (20%)
- Final Project (20%)
- Class Participation: priceless

Late Policy

- Five late days total, to be spent wisely
- 20% off from each extra late day

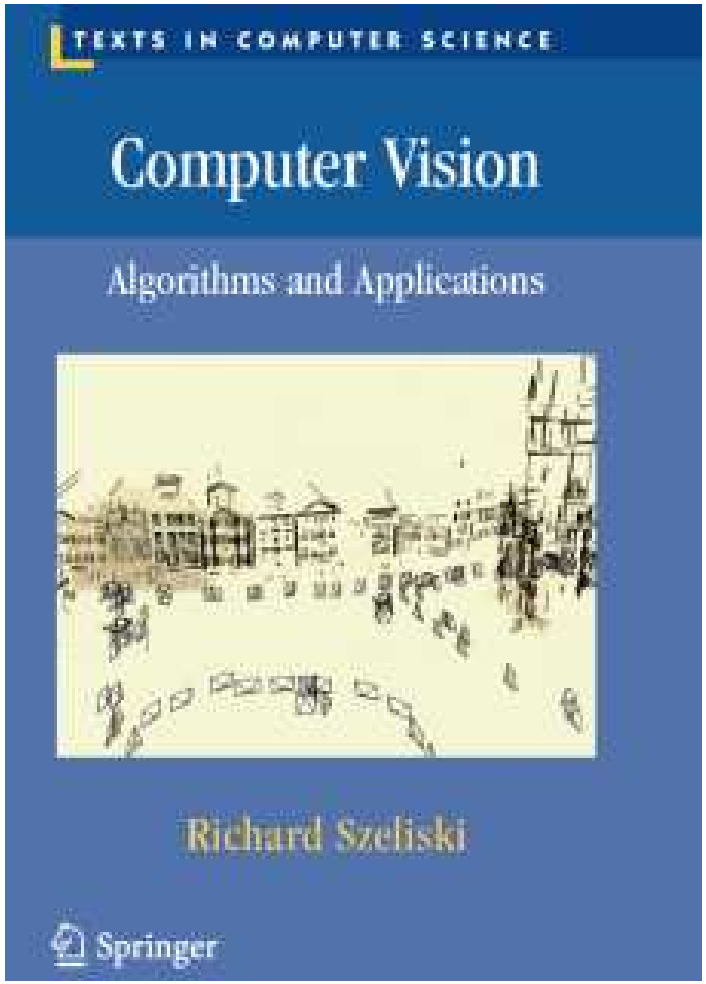
Cheating

- Let’s not embarrass ourselves

Hardware/Software

- CMU clusters
- MATLAB

Textbook



http://szeliski.org/Book/

Cameras

Really cool

Not too expensive nowadays (<$150)

e.g. Canon A1100

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

Graduate Version:

- Need to do more on each project, plus a final paper

Misc:

- No laptops, no cell phones, smartphones, etc.

A Fair Warning…

Reasons not to take the class:

- Lots of work
- Need time to think, not just follow instructions
- Not worth it if you don’t enjoy it
- Not for these who care too much about their grade

Reasons to take the class:

- It’s your reward after 3 grueling years ☺
- You get to create pictures, unleash your creative potential
- Interested in grad school?