

# CS 129 Computational Photography

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Instructor: James Hays

TAs: Sam Birch and Emanuel Zraggen

Some slides from Alexei  
Efros and Derek Hoiem

# Today

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- 1) Introductions
- 2) Syllabus
- 3) Why Computational Photography?



# A bit about me



# Thesis: Large Scale Scene Matching for Graphics and Vision

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## Thesis

[hays\\_thesis.pdf](#), 107MB

## Committee

- **Alexei A. Efros** (chair)
- **Martial Hebert**
- **Jessica K. Hodgins**
- **Takeo Kanade**
- **Richard Szeliski**, Microsoft Research



# My Research

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IM2GPS: estimating geographic information from a single image



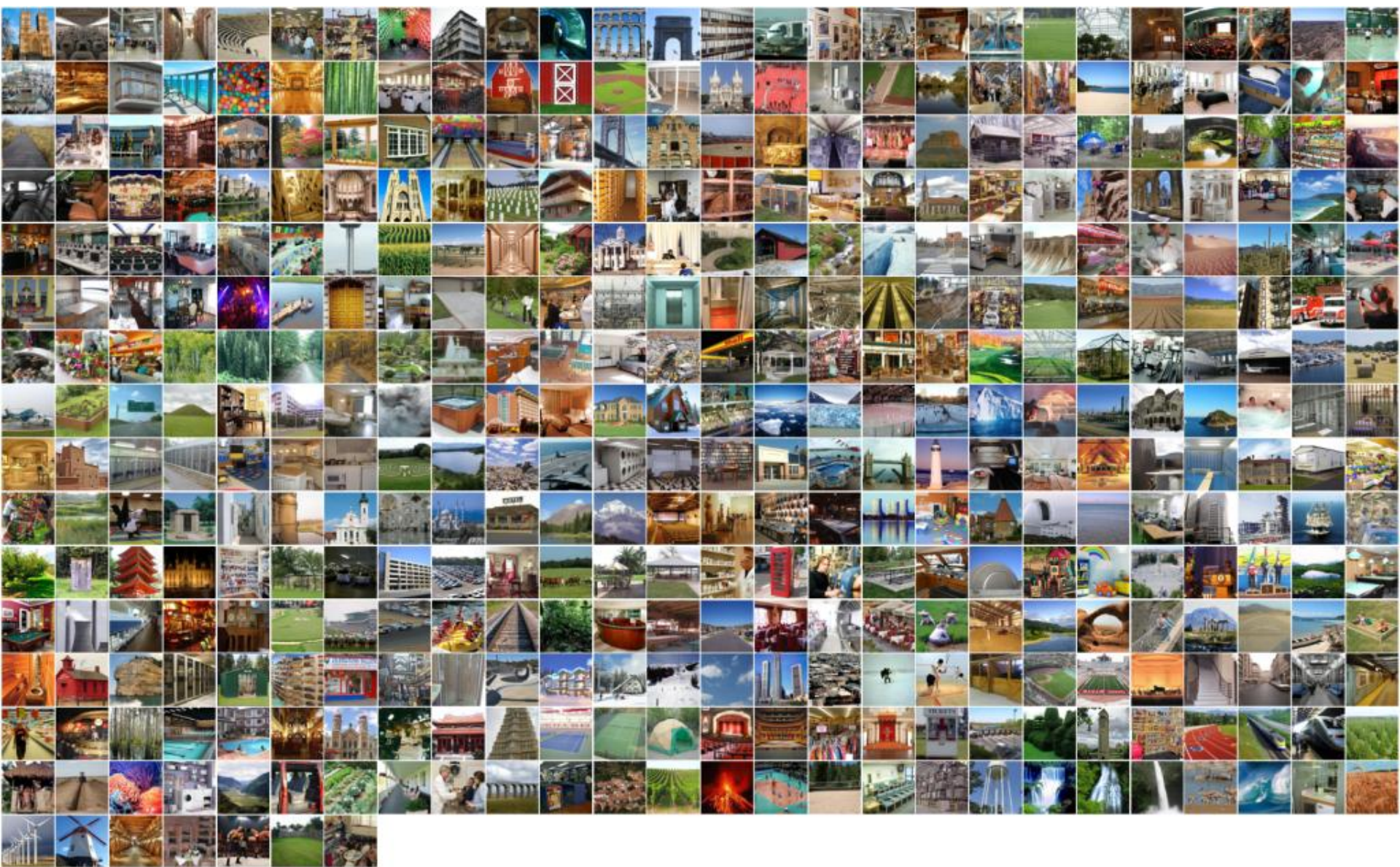
An Empirical Study of Context in Object Detection



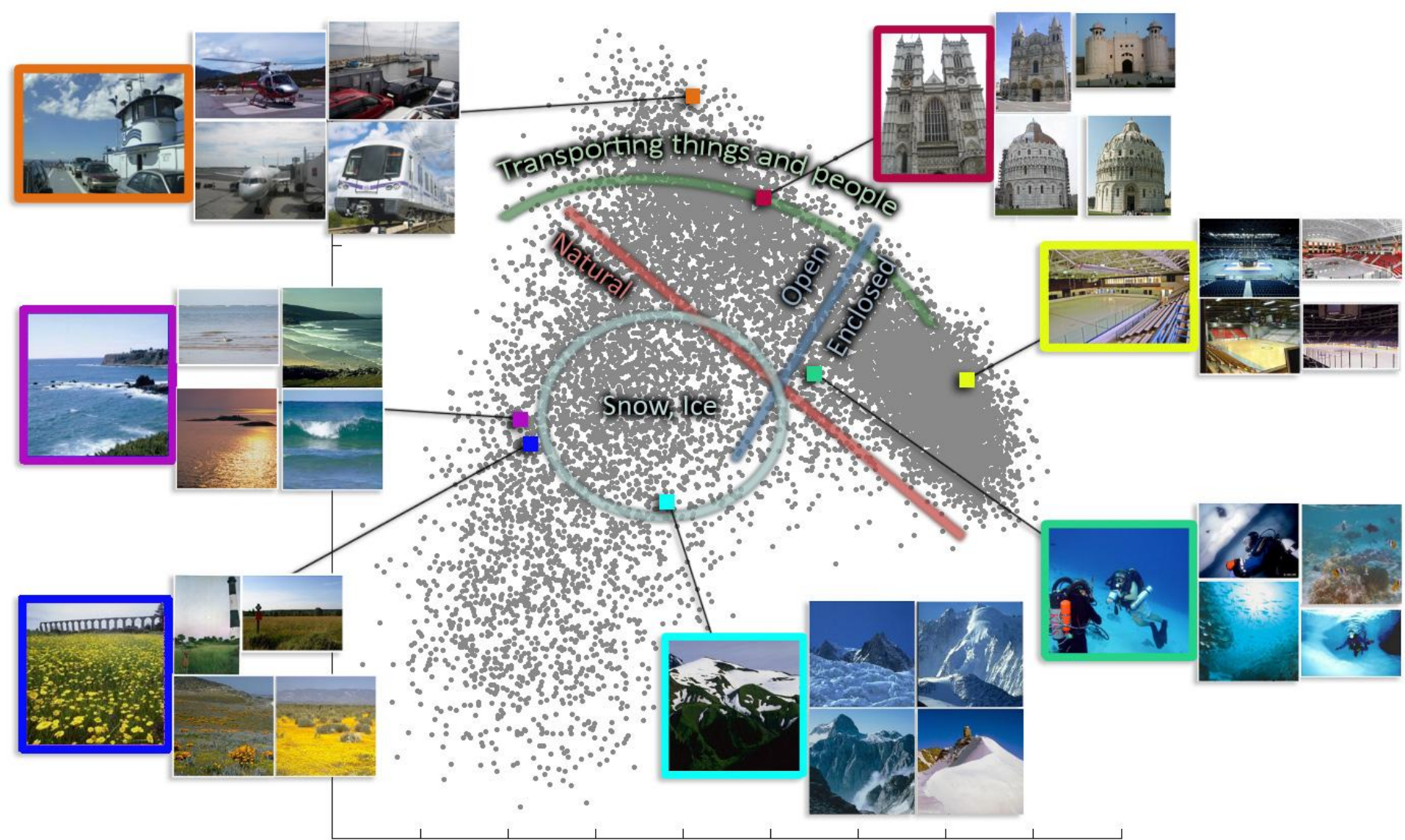


# Categories of the SUN database

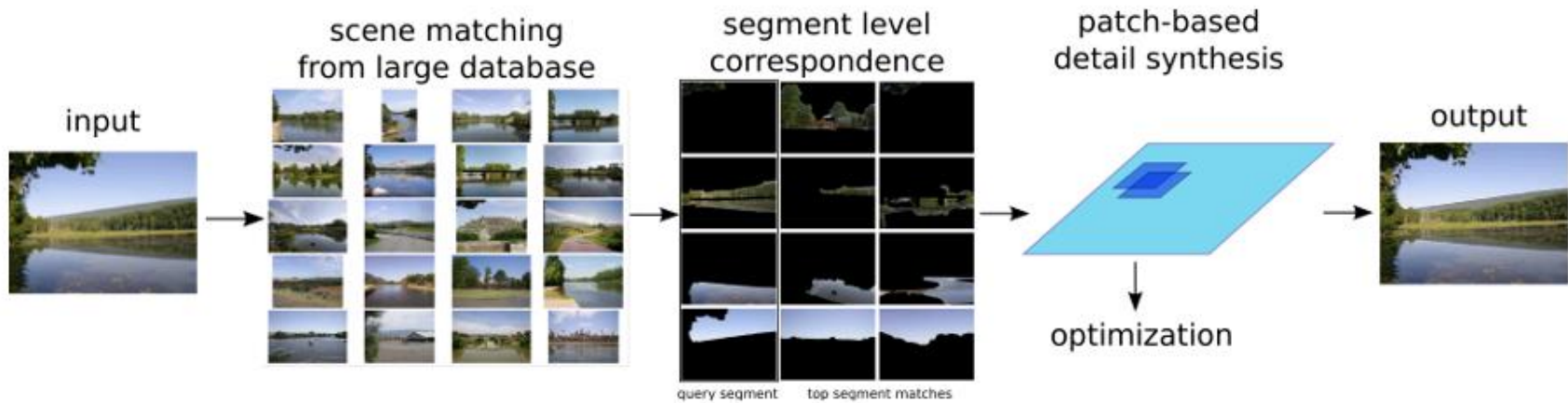
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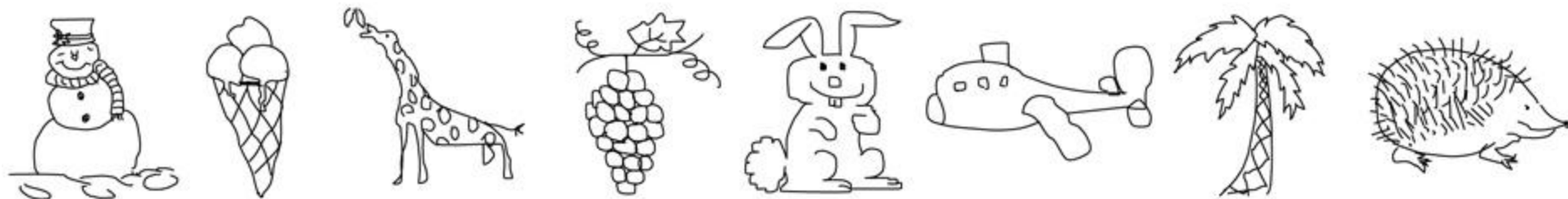




Genevieve Patterson, James Hays. SUN Attribute Database: Discovering, Annotating, and Recognizing Scene Attributes. Proceedings of CVPR 2012.



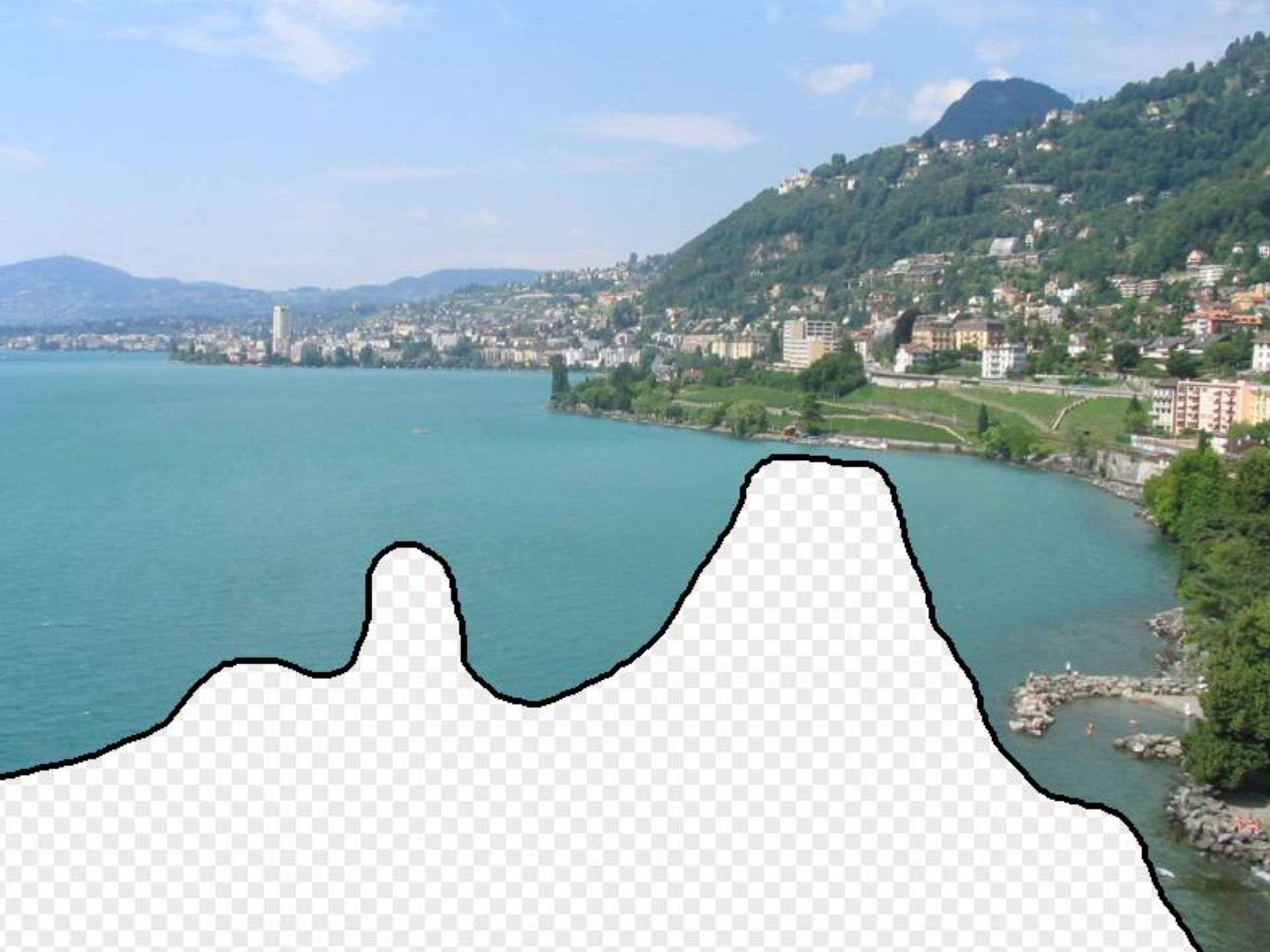
Libin Sun, James Hays. Super-resolution from Internet-scale Scene Matching. Proceedings of the IEEE Conf. on International Conference on Computational Photography (ICCP), 2012.



Mathias Eitz, James Hays and Marc Alexa. How Do Humans Sketch Objects? ACM Transactions on Graphics (Proc. SIGGRAPH 2012)



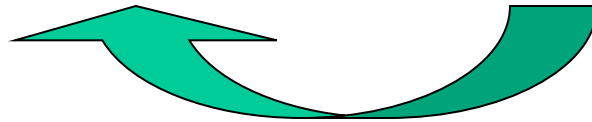
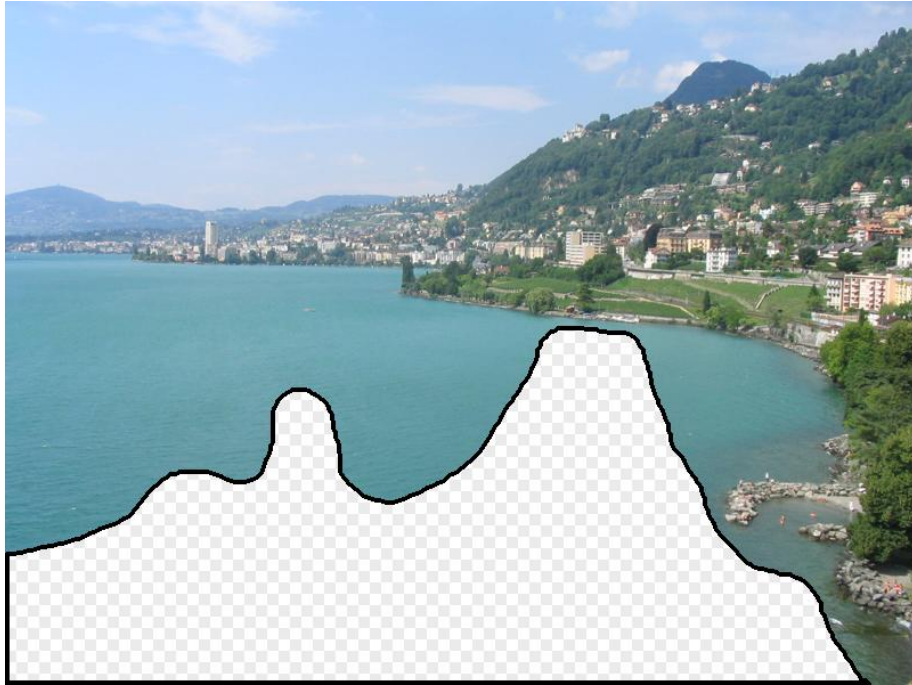
















# CS 129 TAs

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Sam Birch



Emanuel Zraggen





# Why Computational Photography?

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A Brief History of Visual Media

# Depicting Our World: The Beginning

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



# Depicting Our World: Middle Ages

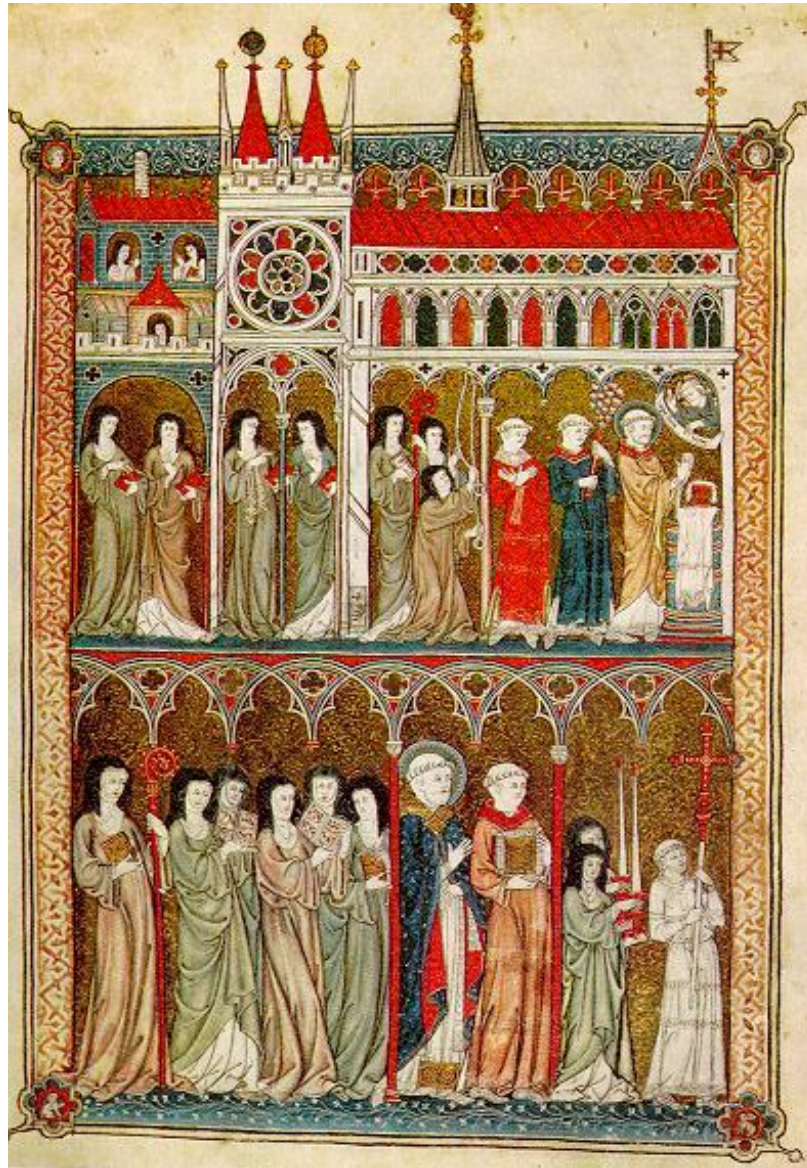


The Empress Theodora with her court.  
Ravenna, St. Vitale 6th c.



# Depicting Our World: Middle Ages

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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

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***Paolo Uccello,  
Miracle of the Profaned Host (c.1467-9)***



# Depicting Our World: Toward Perfection

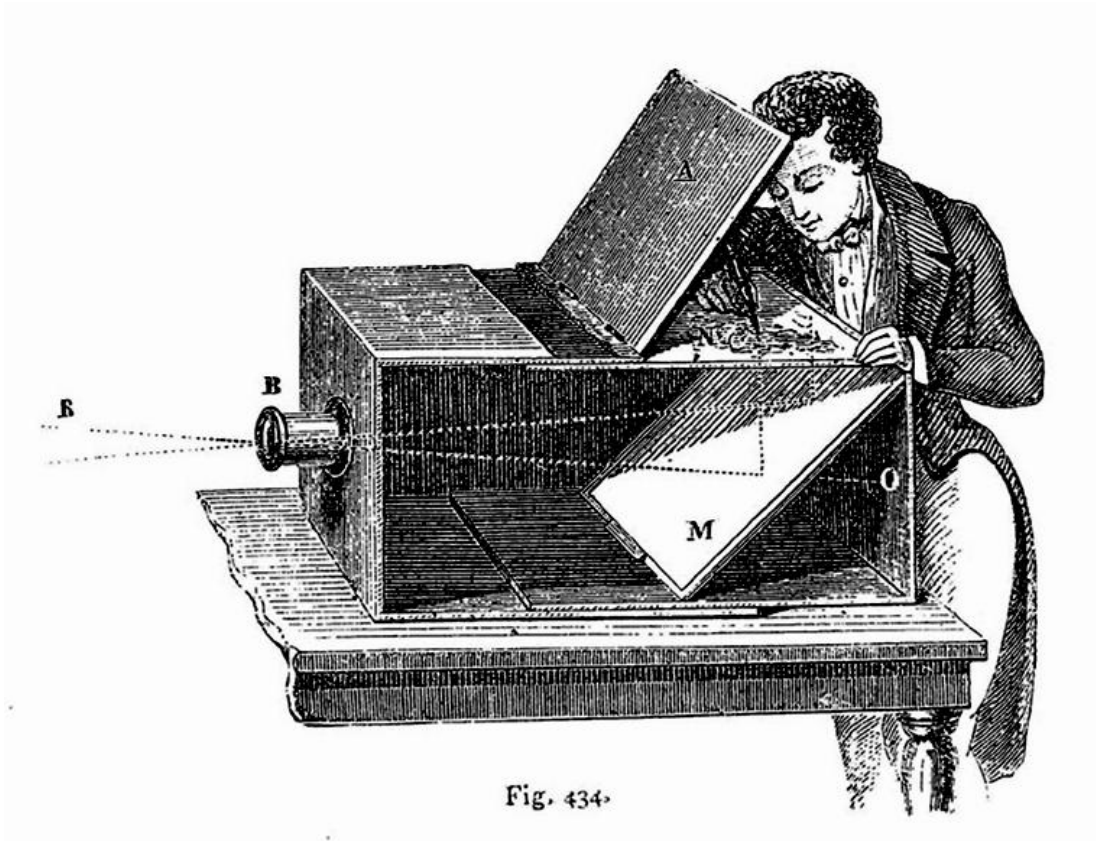
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**Jan van Eyck, *The Arnolfini Marriage* (c.1434)**

# Depicting Our World: Toward Perfection

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Lens Based Camera Obscura, 1568



# Depicting Our World: Perfection!

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*Still Life*, Louis Daguerre, 1837

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‘Still photographs are the most powerful  
weapon in the world.’

Eddie Adams, Pulitzer Prize winning  
photographer.





# Earth from ISS

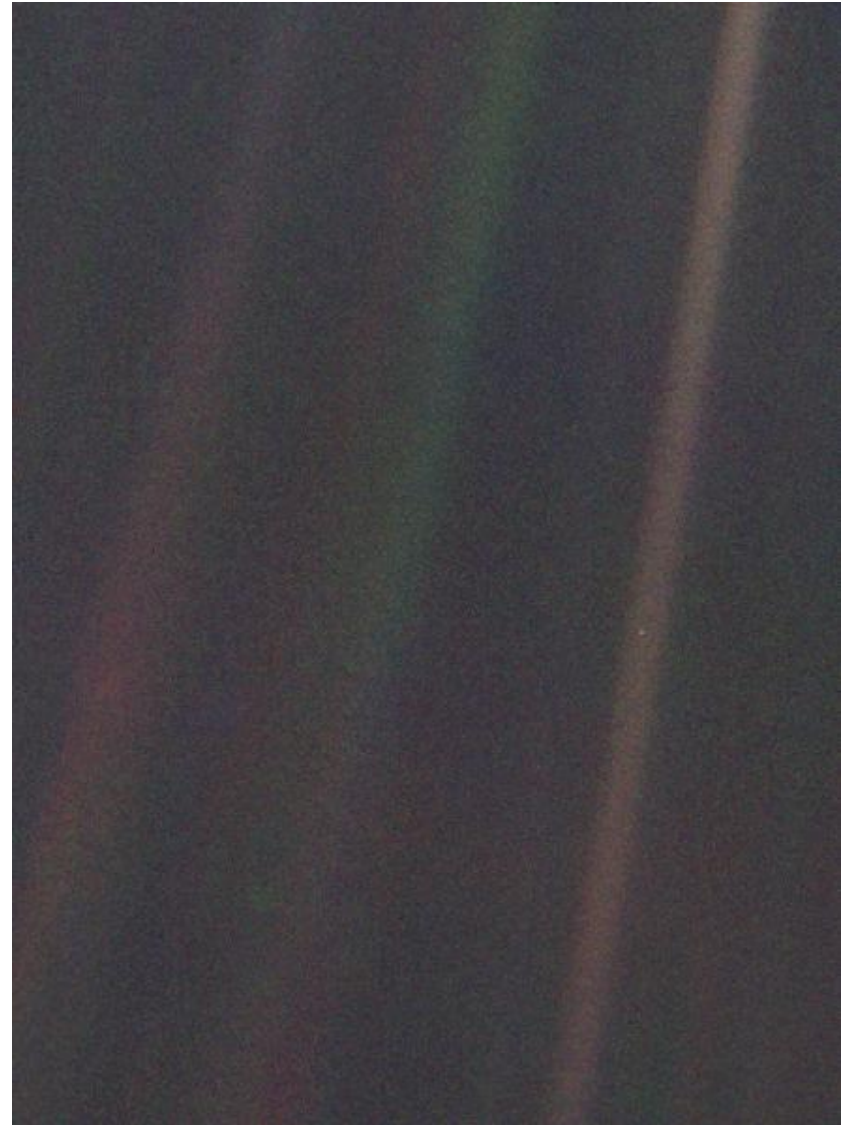
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# Pale Blue Dot

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... Look again at that dot. That's here, that's home, that's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there – on a mote of dust suspended in a sunbeam. ...

Carl Sagan





# Depicting Our World: Ongoing Quest

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Pablo Picasso



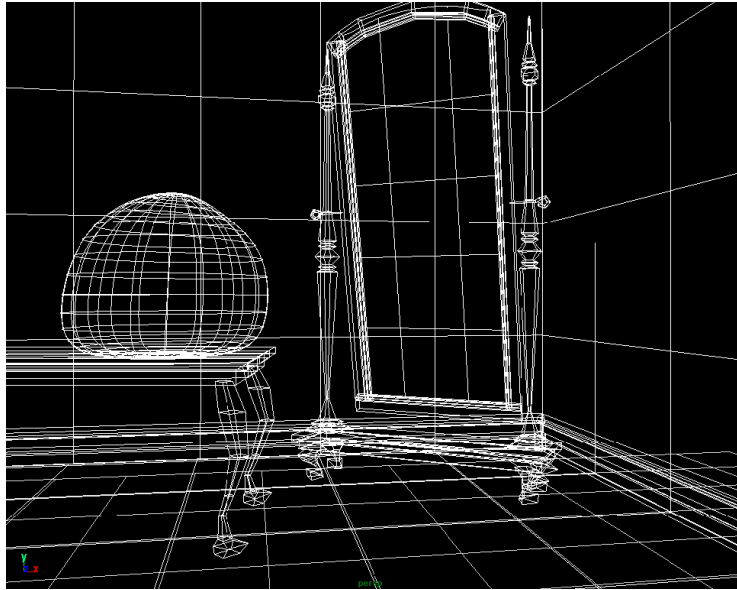
David Hockney



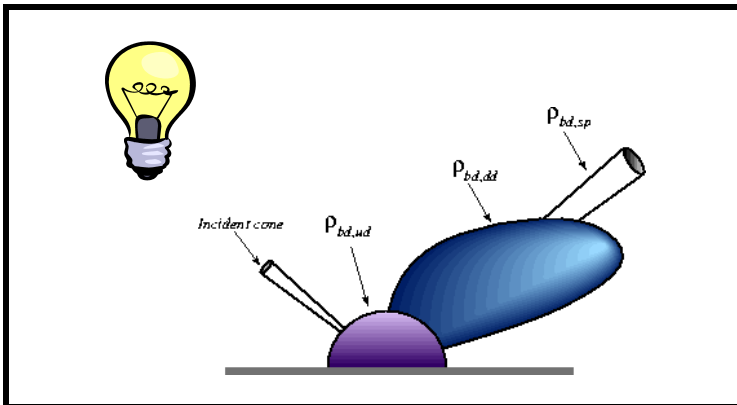
Enter Computer Graphics...



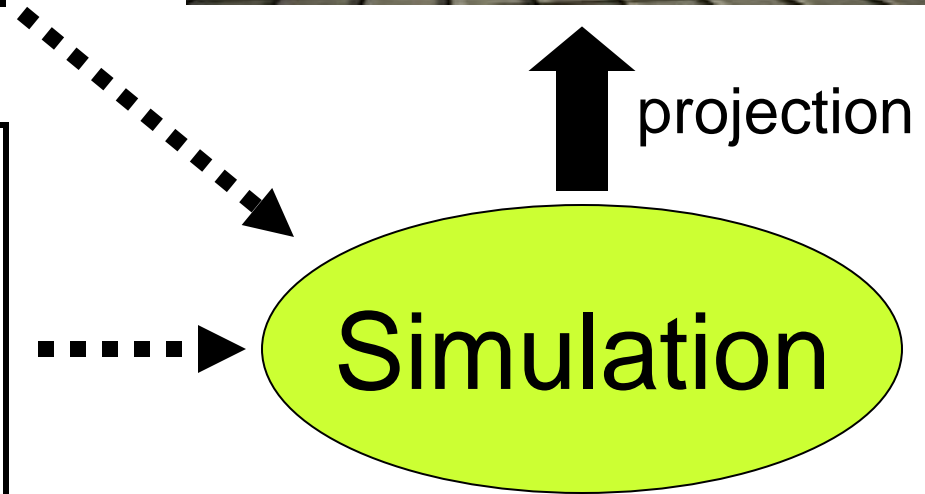
# Traditional Computer Graphics



3D geometry



physics



# State of the Art (10 years ago)

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



# The richness of our everyday world

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Photo by Svetlana Lazebnik

# Which parts are hard to model?

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Photo by Svetlana Lazebnik



# People

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From "Final Fantasy"

On the Tube, London



# Faces / Hair

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From "Final Fantasy"



Photo by Joaquin Rosales Gomez





# Creating Realistic Imagery

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## Computer Graphics



- + great creative possibilities
- + easy to manipulate objects/viewpoint
- Tremendous expertise and work for realism

## Computational Photography

→ Realism  
Manipulation  
Ease of capture ←

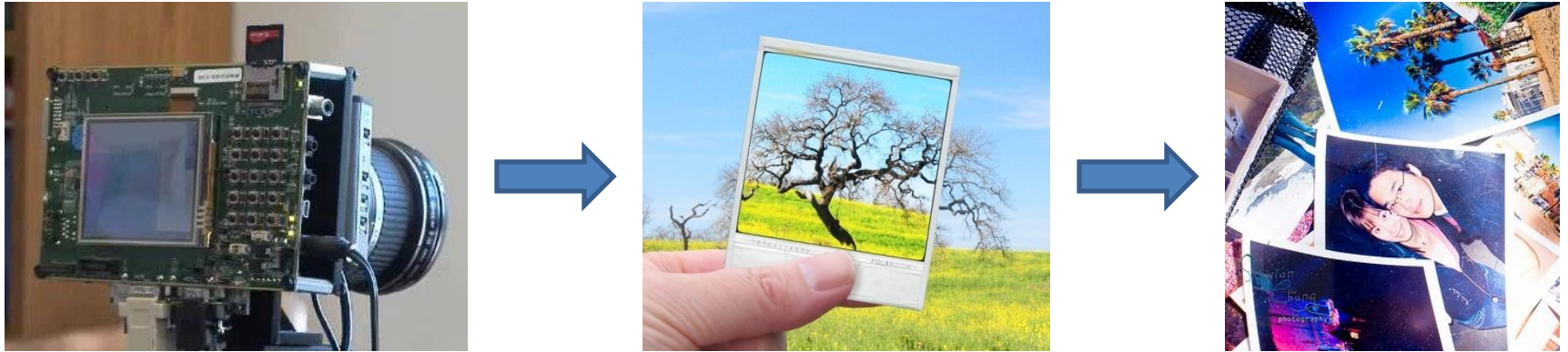
## Photography



- + instantly realistic
- + easy to acquire
- very hard to manipulate objects/viewpoint



# Computational Photography



How can I use computational techniques to capture light in new ways?

How can I use computational techniques to breathe new life into the photograph?

How can I use computational techniques to synthesize and organize photo collections?

# Comp Photo and Related Fields

- Computer Graphics: Models to Images
- Comp. Photography: Images to Images
- Computer Vision: Images to Models



# Building Rome in a Day

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Sameer Agarwal, University of Washington  
Yasutaka Furukawa, University of Washington  
Noah Snavely, Cornell University  
Ian Simon, University of Washington  
Steve Seitz, University of Washington  
Richard Szeliski, Microsoft Research

# Patchmatch

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# Course objectives

1. You will have new abilities for visual creation.

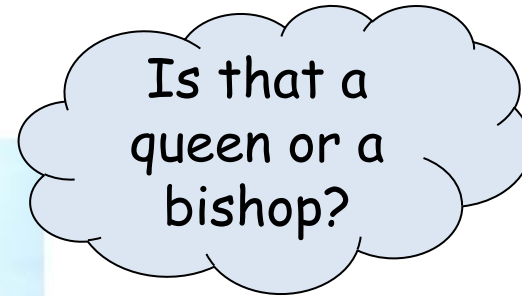






# Course objectives

3. You'll better appreciate your own visual ability.



# Course objectives

4. You'll have fun doing cool stuff!



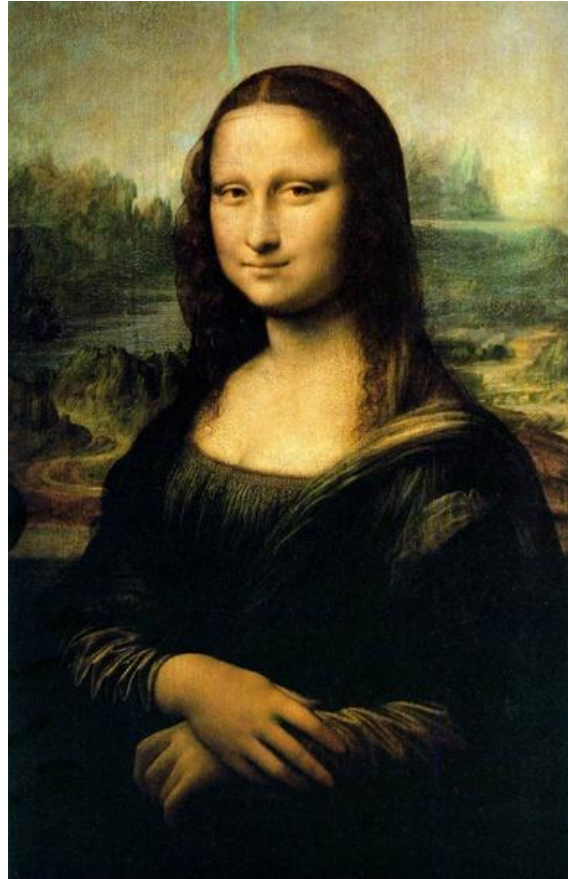
# Project 1: Image alignment to Colorize the Prokudin-Gorskii photo collection



# Project 2: Poisson Blending



# Project 2: Poisson Blending



By Evan Wallace



# Project 3: Image Retargeting with Seam Carving

- Movie

# Project 4: Texture Synthesis and Transfer with Image Quilting



input images

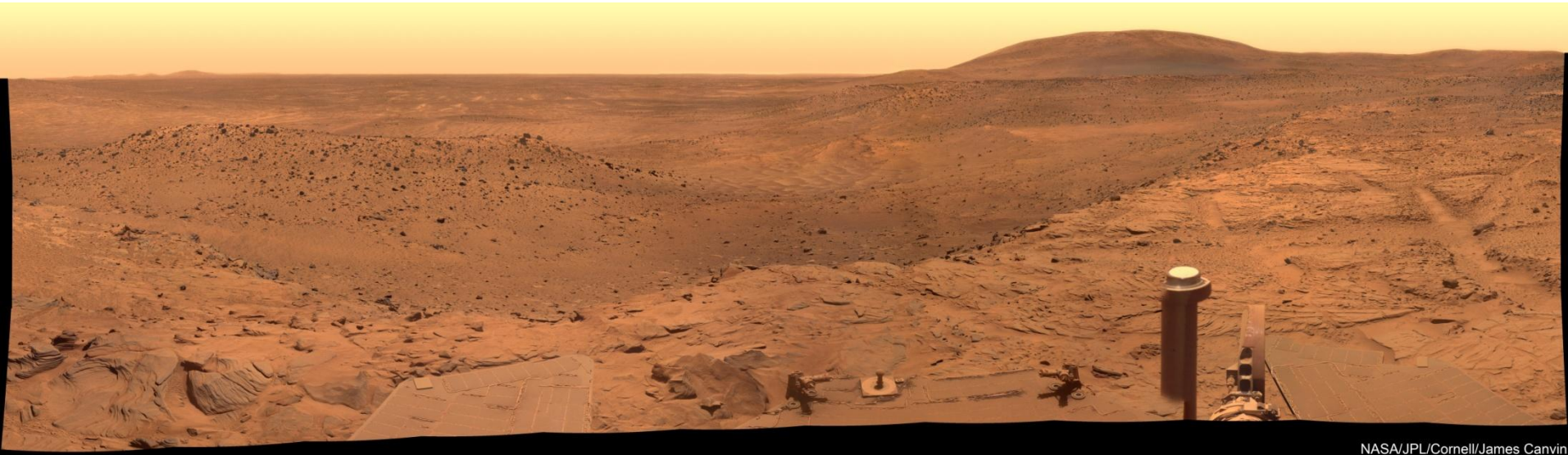
quilting results

# Project 5: High Dynamic Range Imaging





# Project 6: Automatic Panorama Construction



NASA/JPL/Cornell/James Canvin

Final Project: your choice