Lecture 4. Edge Detection

Overview

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CS131 Computer Vision: Foundations and Applications

CS 131 Roadmap

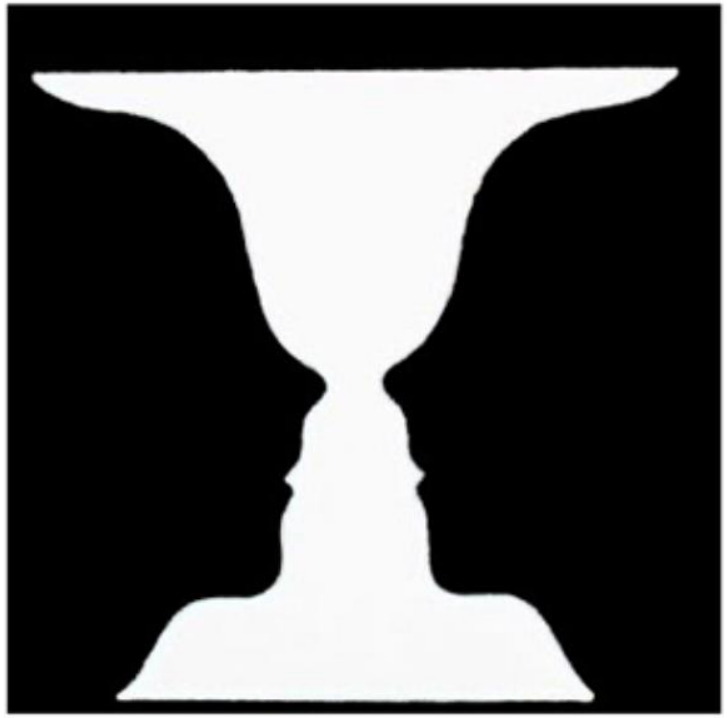
Pixels	Images	Recognition	Videos	Cameras
Convolutions	Priors	Machine learning	Motion	Pinhole Camera
Edges	Color	Classification	Tracking	Camera Parameters
Features	Segmentation	Detection		Stereo Vision
	Resizing			

What will we learn today?

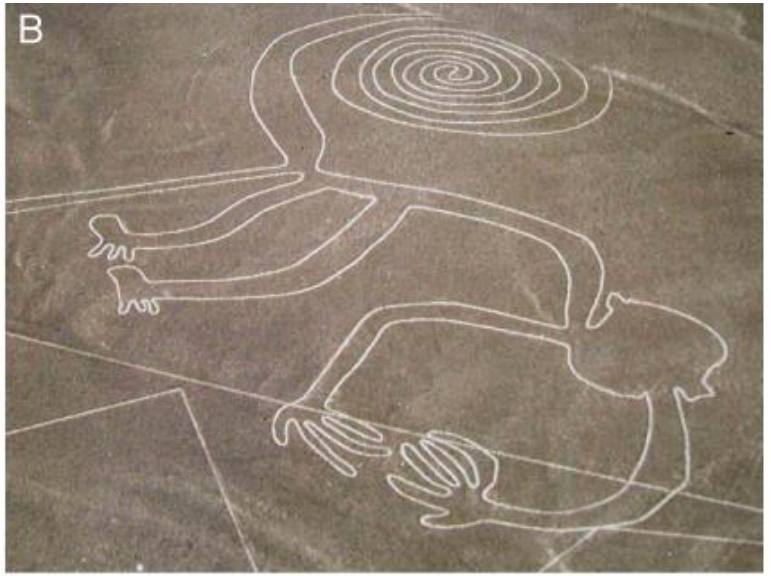
- Edge detection overview

Some background reading:
Forsyth and Ponce, Computer Vision, Chapter 8

Edges



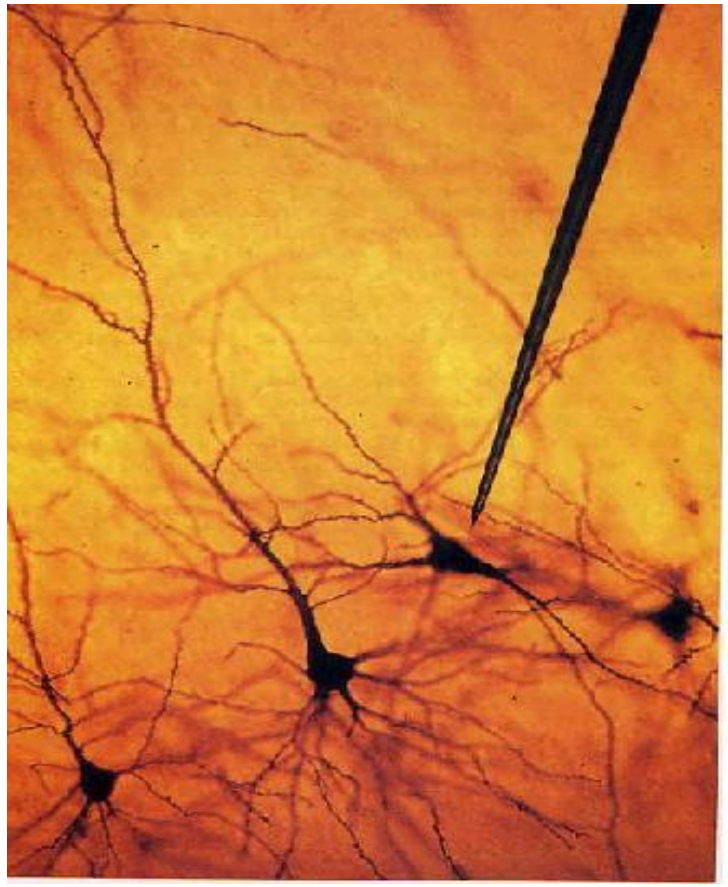
Edges

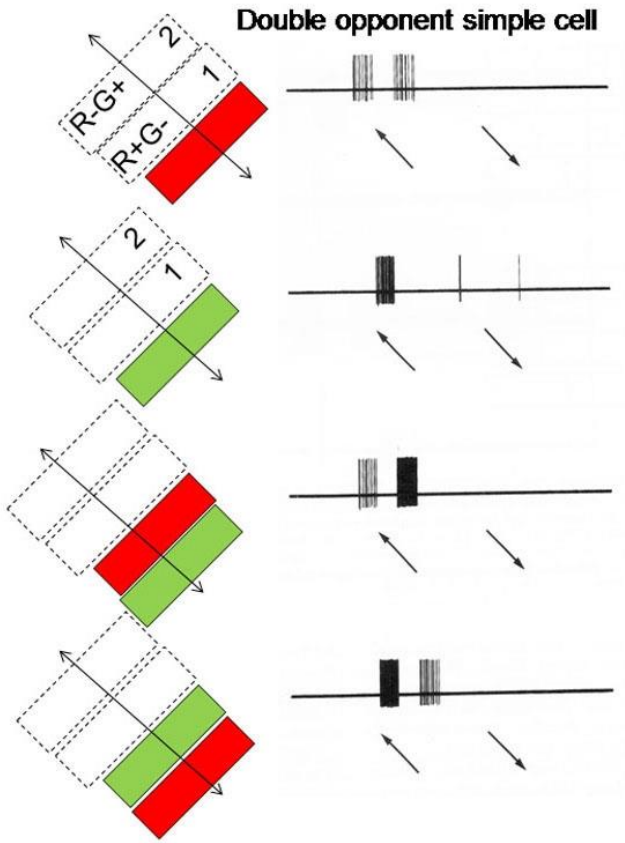


(A) Cave painting at Chauvet, France, about 30,000 B.C.;
(B) Aerial photograph of the picture of a monkey as part of the Nazca Lines geoglyphs, Peru, about 700 – 200 B.C.;
(C) Shen Zhou (1427-1509 A.D.): Poet on a mountain top, ink on paper, China;
(D) Line drawing by 7-year old I. Lleras (2010 A.D.).

Hubel & Wiesel, 1960s

We know edges are special from human (mammalian) vision studies





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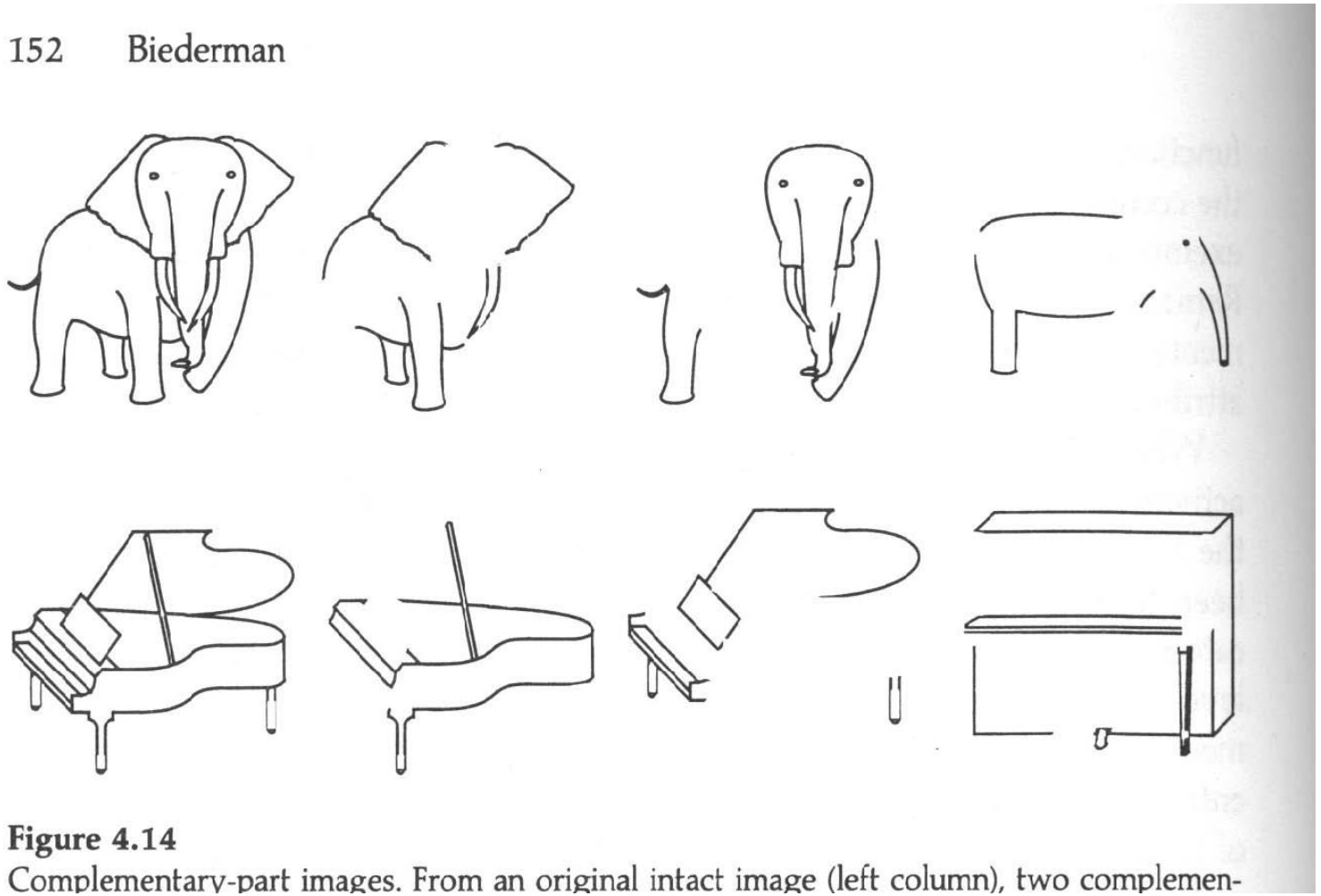
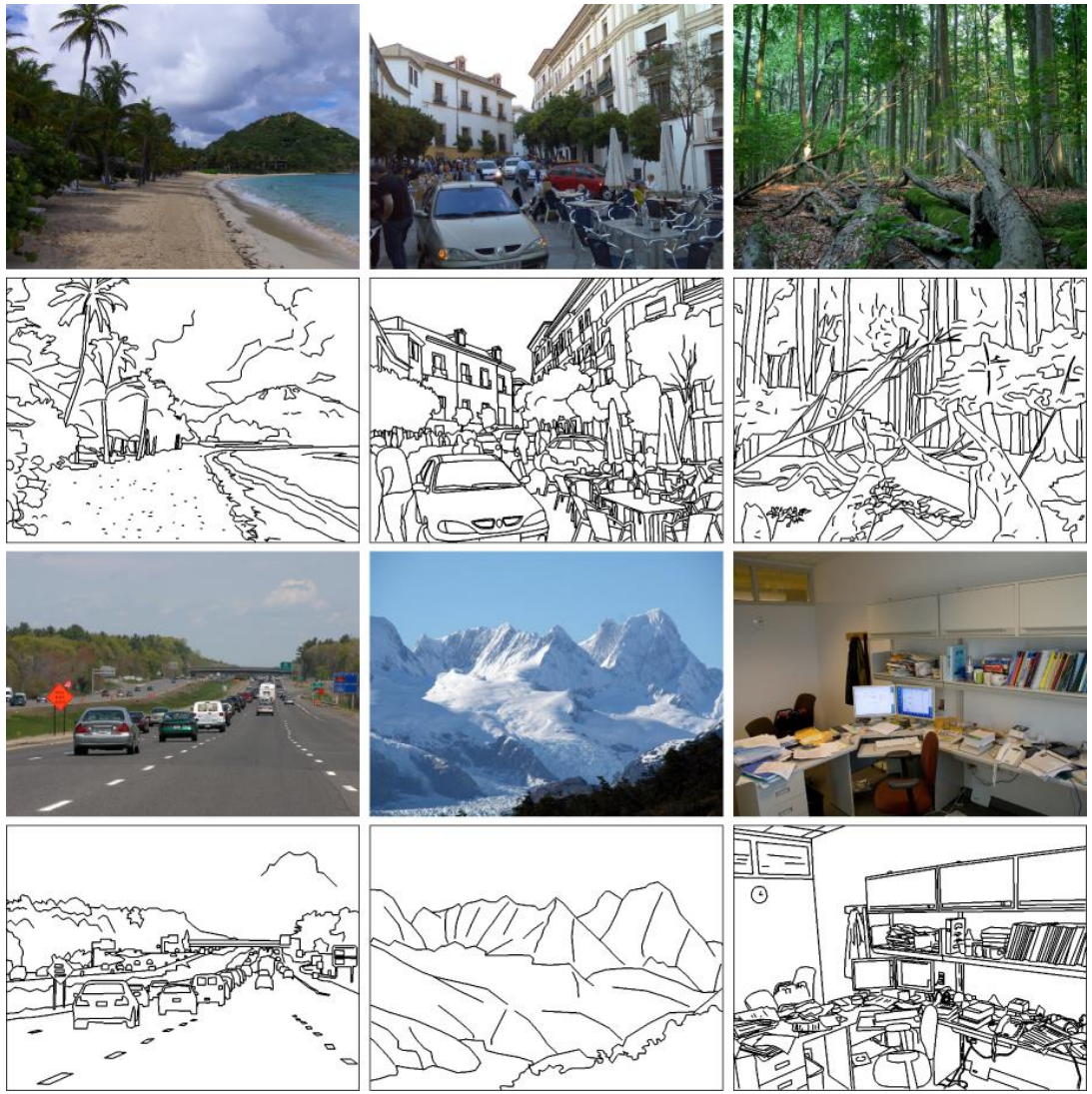
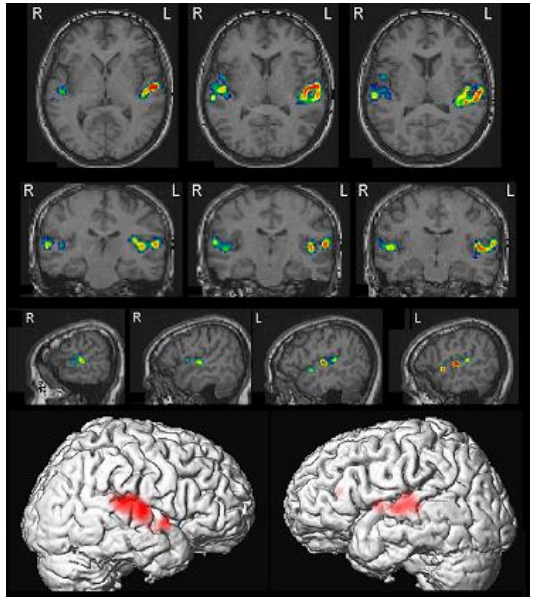
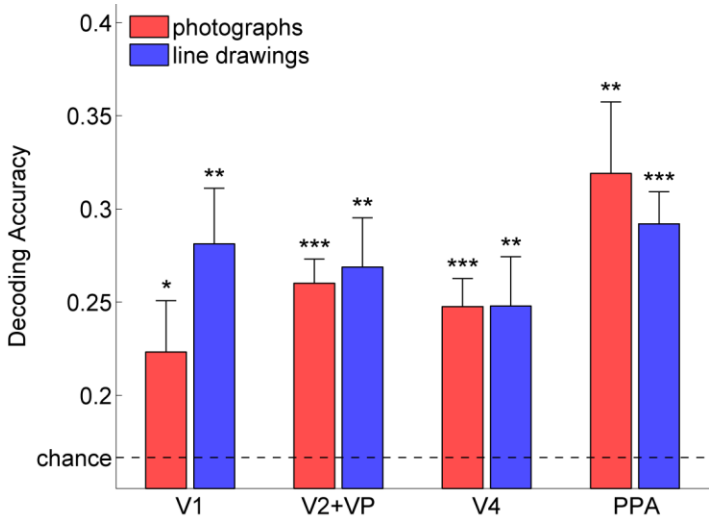


Figure 4.14
Complementary-part images. From an original intact image (left column), two complemen-







Walther, Chai, Caddigan, Beck & Fei-Fei, *PNAS, 2011*

Edge detection

- **Goal:** Identify sudden changes (discontinuities) in an image
  - Intuitively, most semantic and shape information from the image can be encoded in the edges
  - More compact than pixels

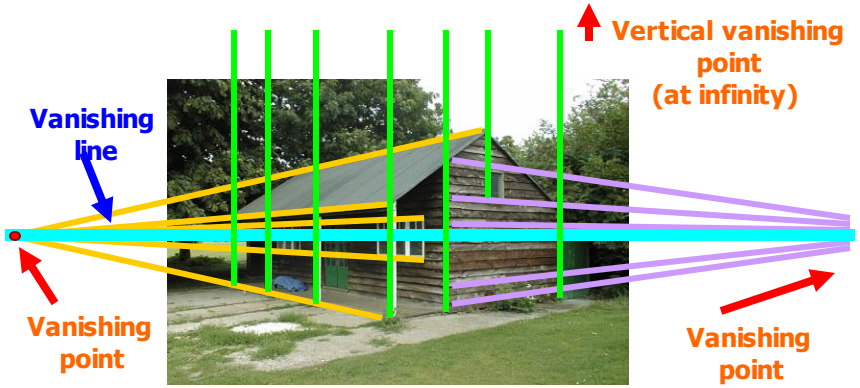
- **Ideal:** artist's line drawing (but artist is also using object-level knowledge)

Source: D. Lowe

Why do we care about edges?

- Extract information, recognize objects

- Recover geometry and viewpoint



Source: J. Hayes

Origin of edges

surface normal discontinuity

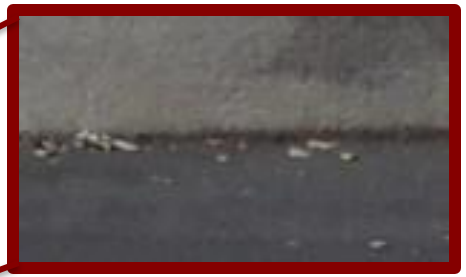
depth discontinuity

surface color discontinuity

illumination discontinuity

Closeup of edges

Surface normal discontinuity



Closeup of edges

Depth discontinuity

Closeup of edges

Surface color discontinuity

Closeup of edges

Illumination discontinuity

Summary

- Edge detection overview