

Welcome to Computational Vision CSCI 4270 and 6270: Technical Introduction

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Definition of Computer Vision

[Wikipedia \(1/23/2021\):](#)

Definition [edit]

Computer vision is an [interdisciplinary field](#) that deals with how computers can be made to gain high-level understanding from [digital images](#) or [videos](#). From the perspective of [engineering](#), it seeks to automate tasks that the [human visual system](#) can do.^{[1][2][3]} Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of a theoretical and algorithmic basis to achieve automatic visual understanding.^[4] As a [scientific discipline](#), computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a [medical scanner](#).^[10] As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

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Closely Allied Fields

- Machine learning
- Image processing
- Pattern recognition
- Computer graphics
- Algorithms

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Techniques Used

- Linear algebra
- Multivariable calculus
- Probability and statistics
- Optimization
- Machine learning and in particular
 - Deep learning, deep learning, deep learning!
 - So why not start with deep learning?

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The Deep Neural Network Revolution

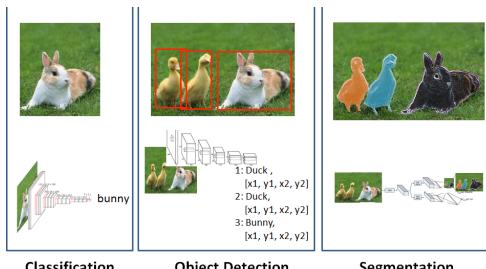
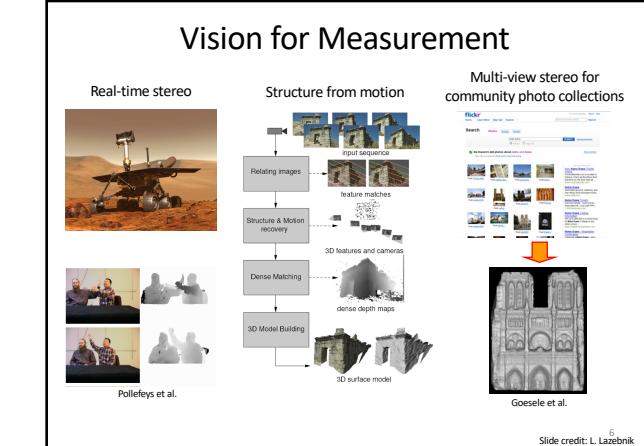


Image downloaded from ataspinar.com

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Slide credit: L. Lazebnik

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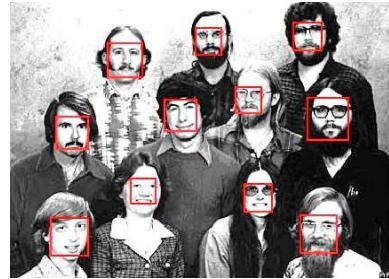
Vision for Recognition and Labeling



What can you recognize in these images?
 • Water? Trees? Buildings? Sky?
 • How can you recognize the sky?
 • Do you know where these were taken?

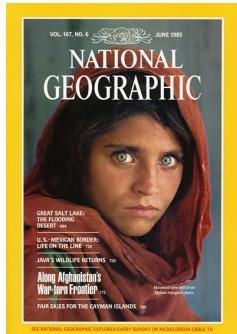
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Drilling Down... Face Detection and Recognition



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Who is the “Afghan Girl”?



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Identified Through Her Iris Patterns



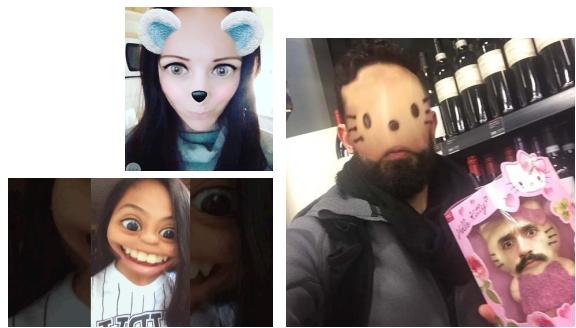
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Other Biometrics



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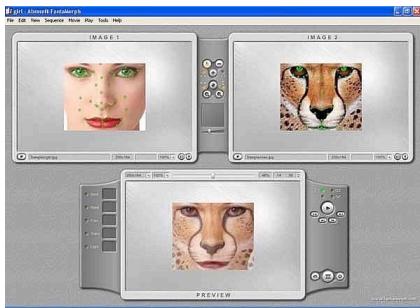
Snapchat...



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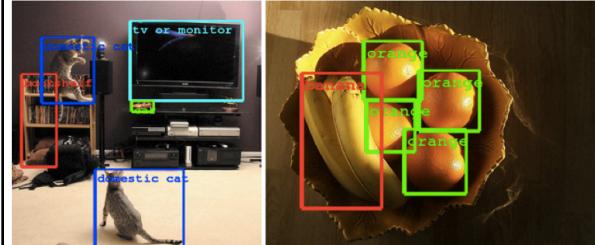
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Special Effects: Face Morphing



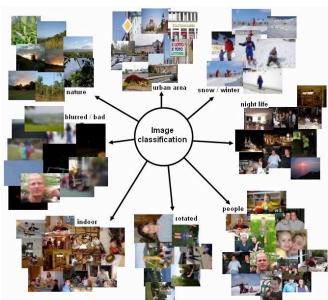
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Object Detection and Recognition



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Category Recognition



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Mobile Robots



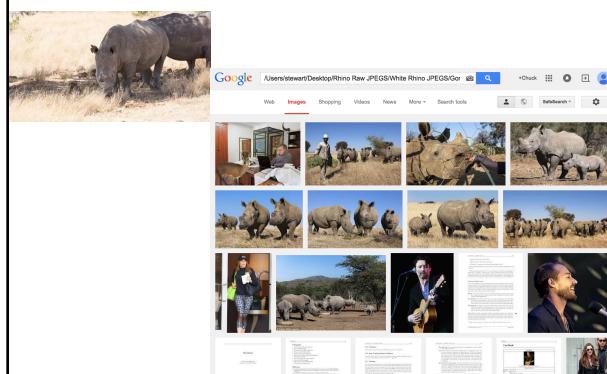
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Self-Driving Cars



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Search by Image



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PhotoTourism and Photosynth



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Gaming



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Red Light Cameras



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Many, Many Other Applications

- HCI
- Image-based search
- Biomedical image analysis and robotic surgery
- Industrial inspection
- ...

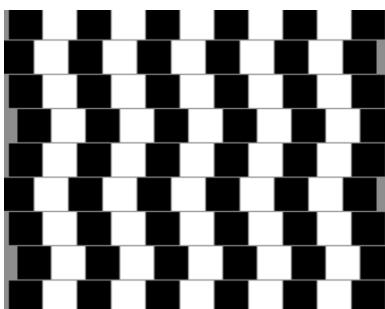
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Is There a Downside?

- Loss of privacy?
- Job loss, job quality?
- Safety?
- Bias and profiling?
- Loss of autonomy?
- We will look at some of these questions in more detail as we proceed through the semester, but especially when we study face detection and autonomous driving.

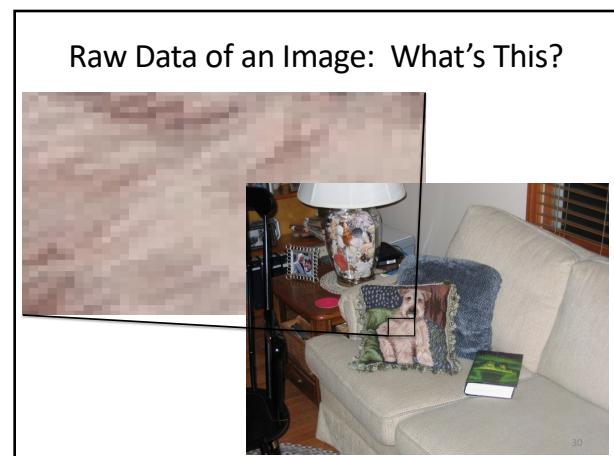
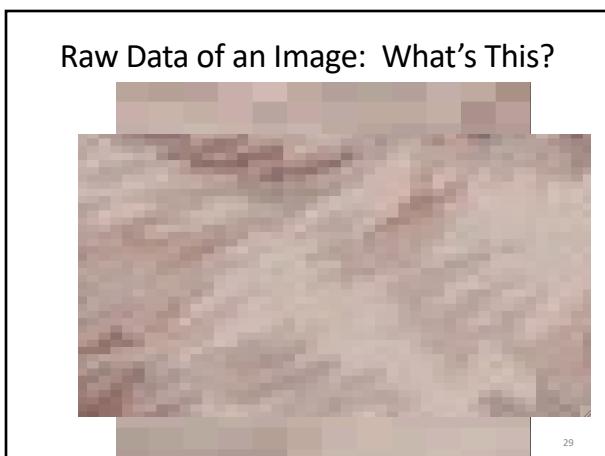
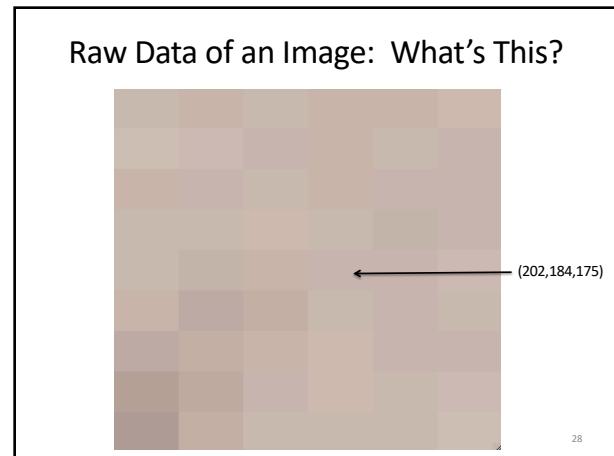
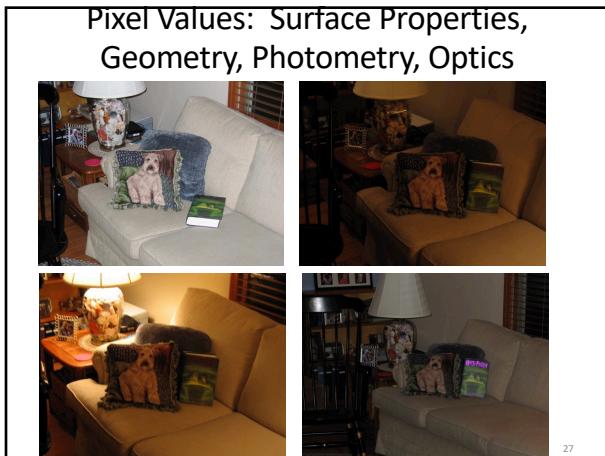
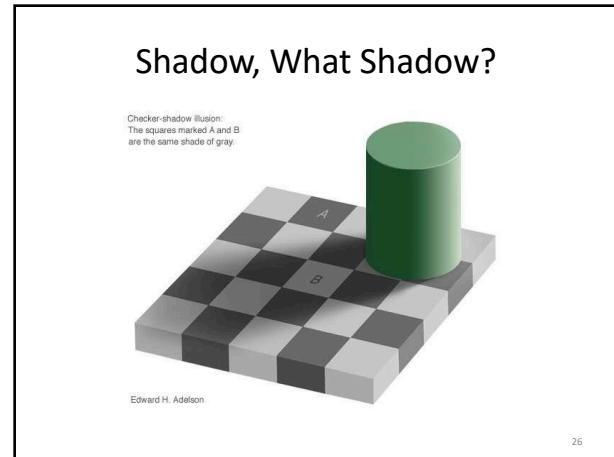
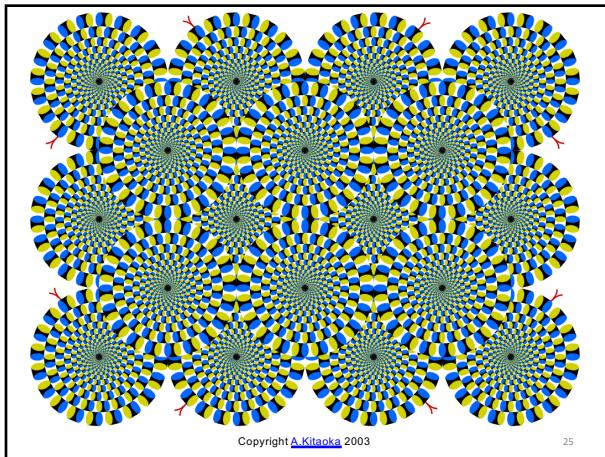
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Thinking About Human Vision: Optical Illusions



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Illumination Affects Brightness and Color



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Perspective Affects Size and Angles



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Fun Optical Illusions Videos

- Ames Window illusion
<https://www.youtube.com/watch?v=aHjQe8EuKhc>
- 10 illusions:
<https://www.youtube.com/watch?v=-IWk5NkxQF8>

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Can We Find Big Ben Among These Pictures of London? How?



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Ignore Illumination and Perspective!



But still, somehow, "match" these images and discard the others!

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Before Next Class

- Install on your computer (suggest using Anaconda):
 - Python 3.8
 - OpenCV
 - Numpy, Scipy, Matplotlib
 - Use a virtual environment and perhaps anaconda
- Login to Submitt and perhaps
 - Introduce yourself and start a discussion about computer vision, or
 - Contribute to an existing discussion
- Work on a NumPy tutorial!
 - See Submitt!
- Lecture 2 notes will be posted on Submitt soon
- Homework 1 will be posted before class

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