# COMPUTER VISION
## Lecture 1

Prof. Dr. Francesco Maurelli
2018-09-04

# CONTENTS

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1. Presentations
2. Logistics and Rules of the Game
3. Introduction to Computer Vision

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Chapter 1

# PRESENTATIONS

# ABOUT ME...

- Program Chair for Intelligent Mobile Systems BSc
- Professor in Marine Systems and Robotics
- PhD in Intelligent AUV Localisation
- Worked in tens of projects in which Computer Vision had a very important role, ranging from marine to manufacturing, from agriculture to healthcare
- Currently involved in international projects

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Chapter 2

# LOGISTICS AND RULES OF THE GAME

# LECTURES

- Tuesdays 08:15 - 09:30
- Fridays 09:45 - 11:00

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Any class on Friday after 11:00?

# LECTURES

- Attendance not mandatory
- **Direct** correlation between attendance and passing the exam
- **Direct** correlation between attendance and grade of the exam

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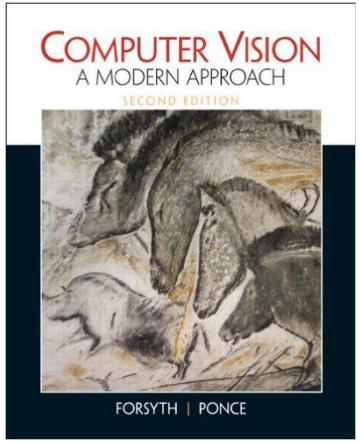
# TEACHING ASSISTANT

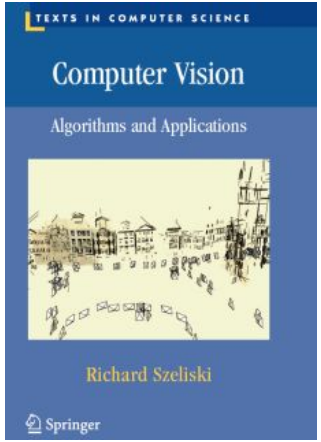
- **First** point of contact
- Looking for one!

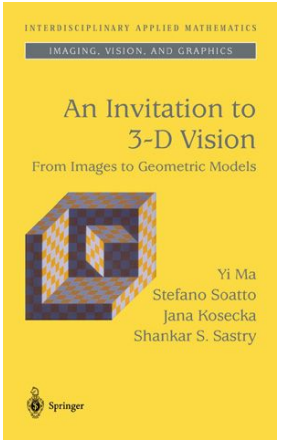
# TEXTBOOKS

- Slides - credits to Stanford University - Prof. Fei-Fei Li, Dr. Juan Carlos Niebles

- Useful, but not necessary:
  - *[Forsyth and Ponce, 2011], "Computer Vision: A Modern Approach". 2nd Edition.*
  - *[Szeliski, 2011], "Computer Vision: Algorithms and Applications". Available online: http://szeliski.org/Book.*
  - *[Ma et al., 2004], "An Invitation to 3-D Vision: From Images to Geometric Models".*



# COMMUNICATION

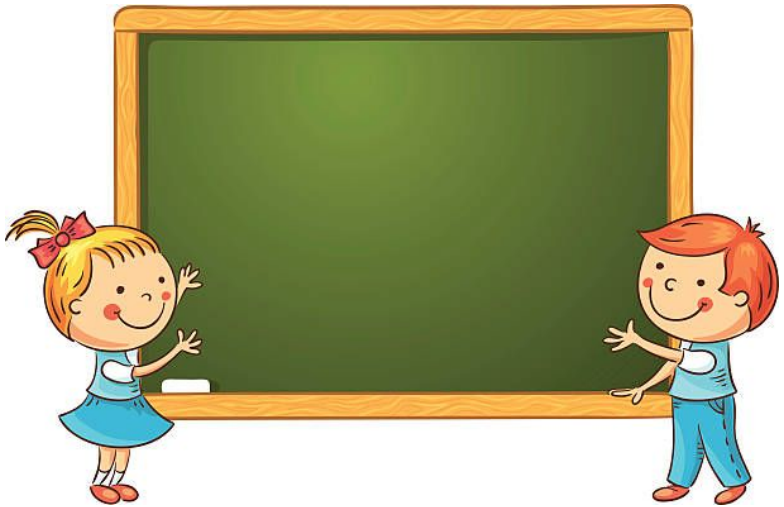
# COMMUNICATION

- **ACT!** Don’t wait until it is too late!
- If something not clear, google, ask your friends, contact the TA, contact me.
- Every professor is busy, but **will find time for you**!

- Participate in classes, ask questions, review slides, check if anything needs to be better clarified

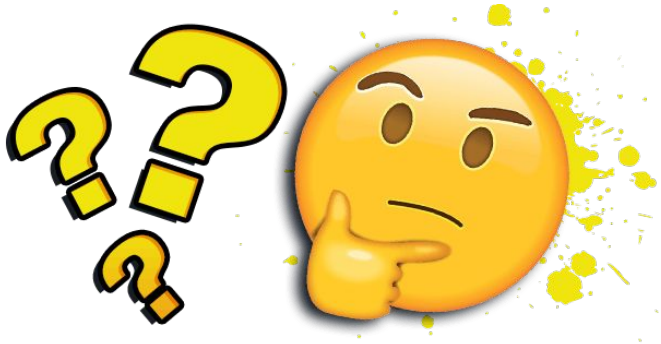
# BLACKBOARD / WHITEBOARD

- No guarantee that it will be copied into the slides!



# WORK

- Regular quizzes! (working on it… bring laptop / smartphone)
- Homeworks / project? → pre-requisite to take the final exam



# HEALTH EXCUSES

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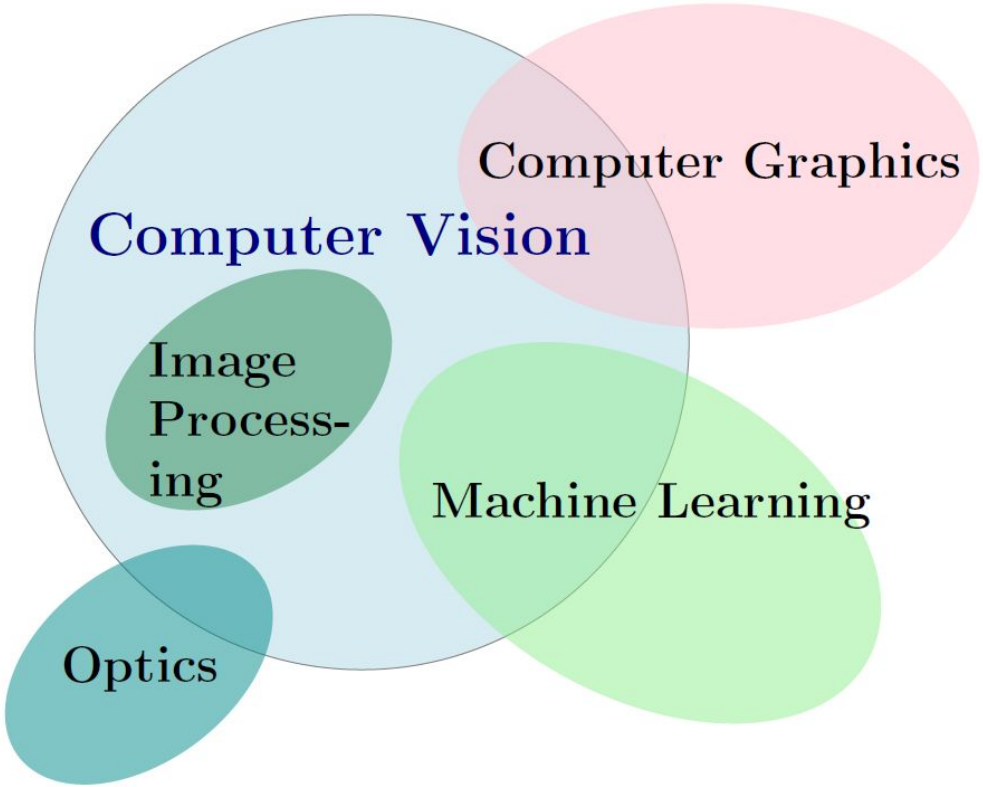
# RELATION TO OTHER AREAS



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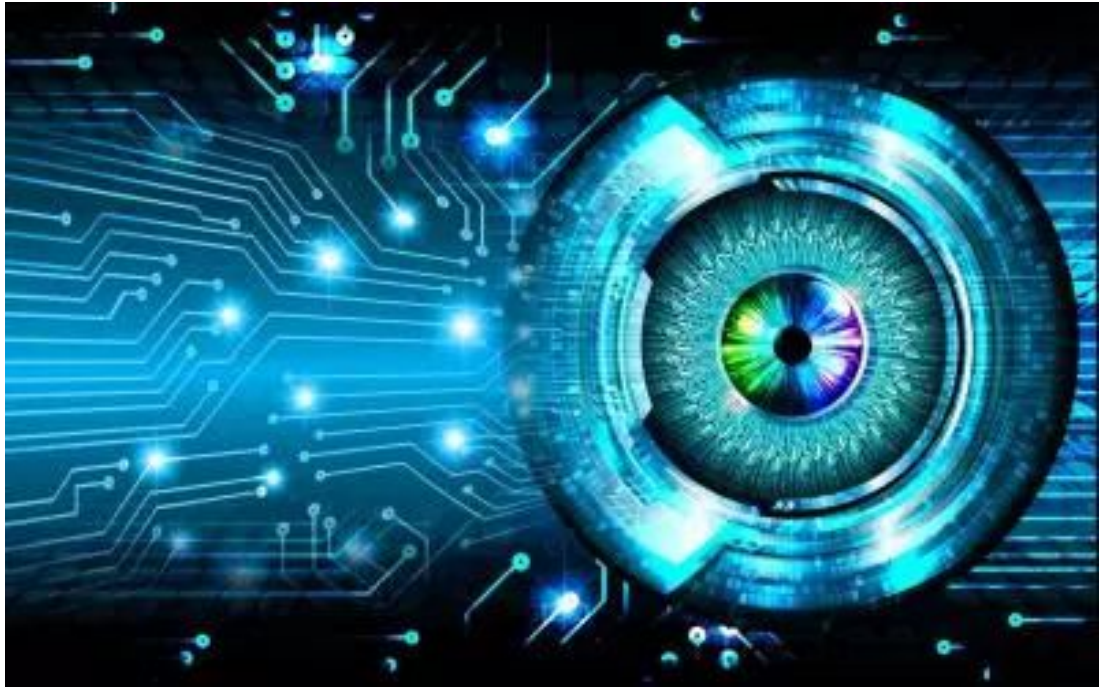
Chapter 3

# INTRODUCTION TO COMPUTER VISION



# THE GOAL OF COMPUTER VISION

*Bridging the gap between pixels and meaning*


| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | 3 | 2 | 5 | 4 | 7 | 6 | 9 | 8 |
| 3 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 1 | 0 | 3 | 2 | 5 | 4 | 7 | 6 |
| 5 | 2 | 3 | 0 | 1 | 2 | 3 | 4 | 5 |
| 4 | 3 | 2 | 1 | 0 | 3 | 2 | 5 | 4 |
| 7 | 4 | 5 | 2 | 3 | 0 | 1 | 2 | 3 |
| 6 | 5 | 4 | 3 | 2 | 1 | 0 | 3 | 2 |
| 9 | 6 | 7 | 4 | 5 | 2 | 3 | 0 | 1 |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

# WHAT IS (COMPUTER) VISION

Image (or video)

Sensing device



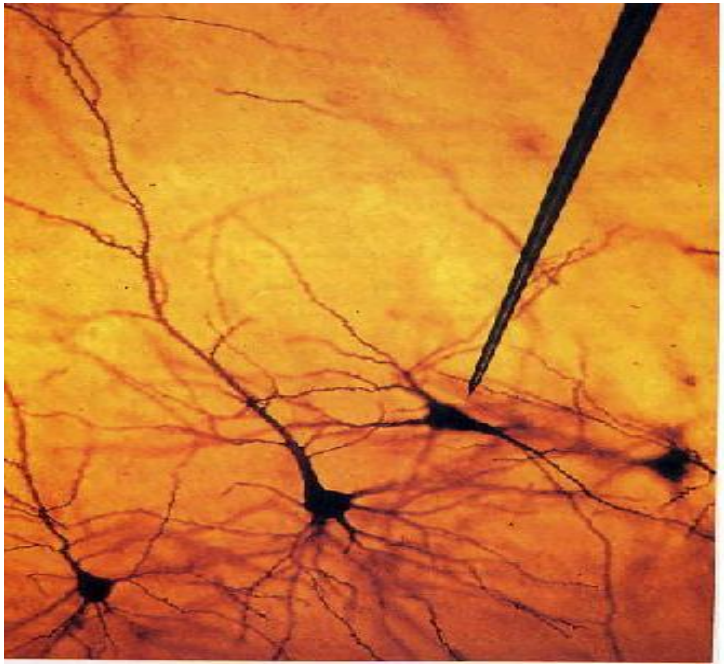
Interpreting device



**Interpretations**

garden, spring, bridge, water, trees, flower, green, etc.

Hubel & Wiesel
1981
Nobel Prize in Medicine

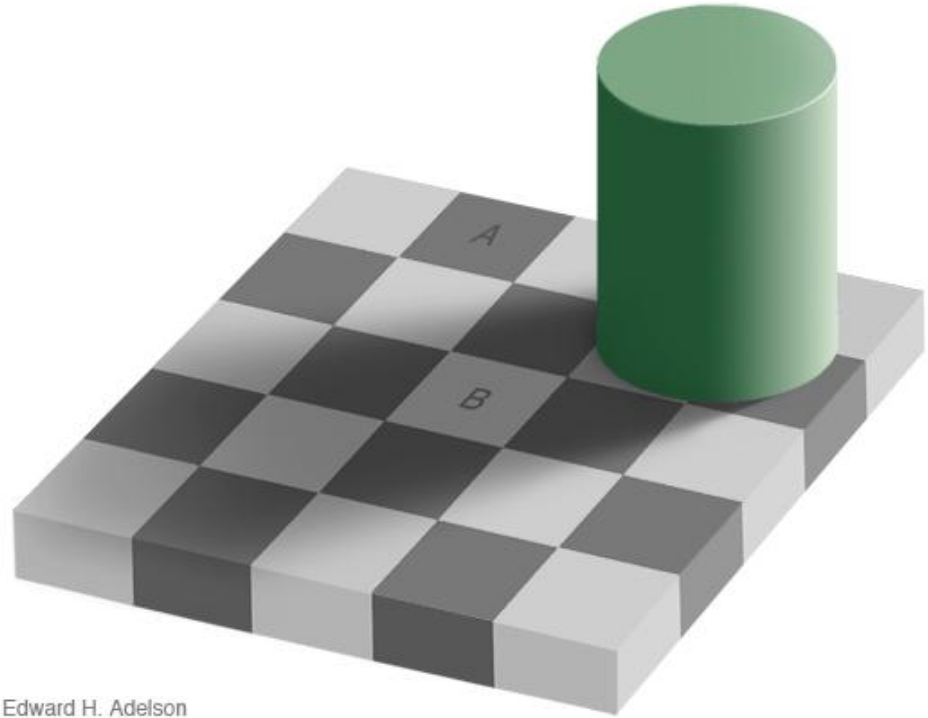


Potter, Biederman, *et al.*
1970

# ANIMAL VISION

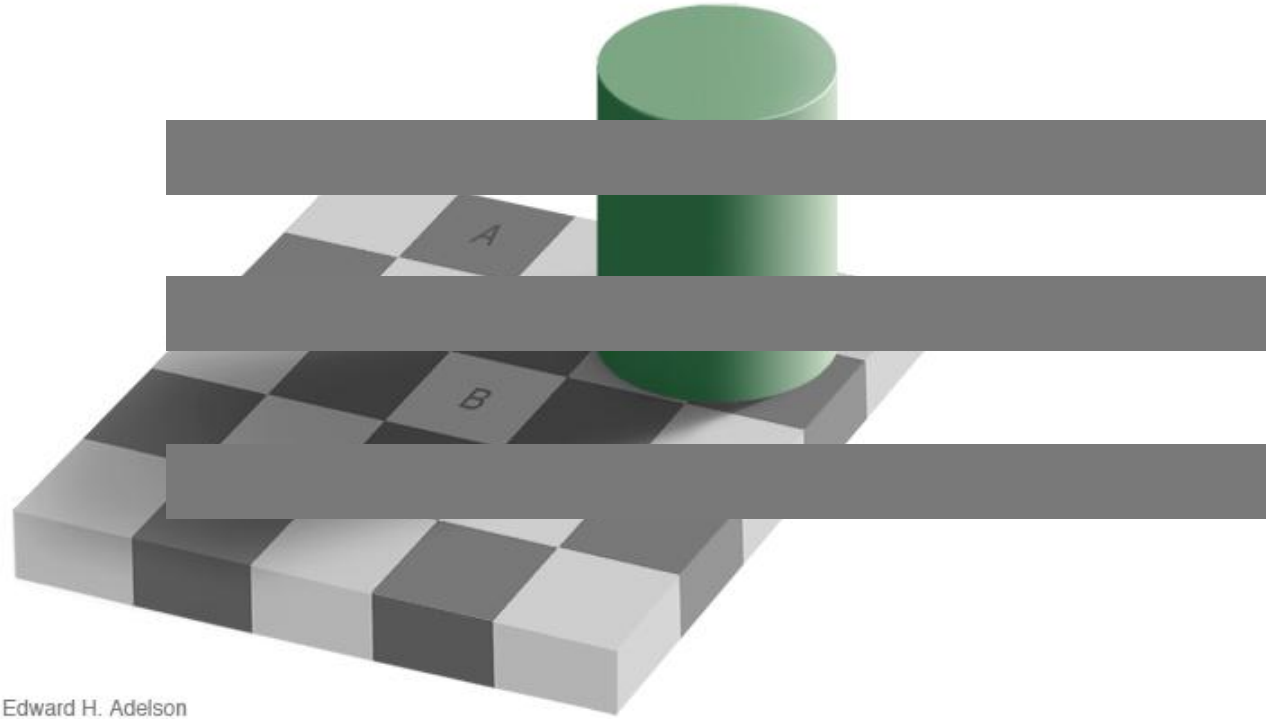
The Mantis Shrimp
Best Eyes in the
Animal Kingdom

# PERCEPTION




Edward H. Adelson

# PERCEPTION

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| 2 | 1 | 0 | 3 | 2 | 5 | 4 | 7 | 6 |
| 5 | 2 | 3 | 0 | 1 | 2 | 3 | 4 | 5 |
| 4 | 3 | 2 | 1 | 0 | 3 | 2 | 5 | 4 |
| 7 | 4 | 5 | 2 | 3 | 0 | 1 | 2 | 3 |
| 6 | 5 | 4 | 3 | 2 | 1 | 0 | 3 | 2 |
| 9 | 6 | 7 | 4 | 5 | 2 | 3 | 0 | 1 |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

# ORIGINS OF COMPUTER VISION

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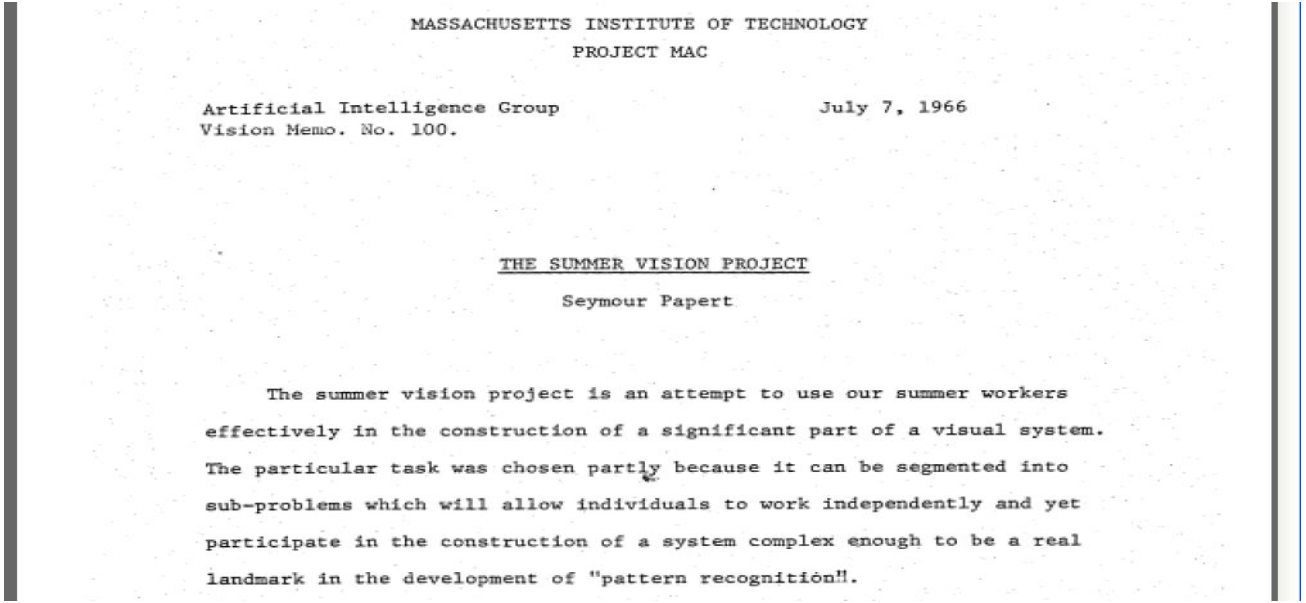
## *An MIT Undergraduate Summer Project...*



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PROJECT MAC

Artificial Intelligence Group
Vision Memo. No. 100.

July 7, 1966

THE SUMMER VISION PROJECT

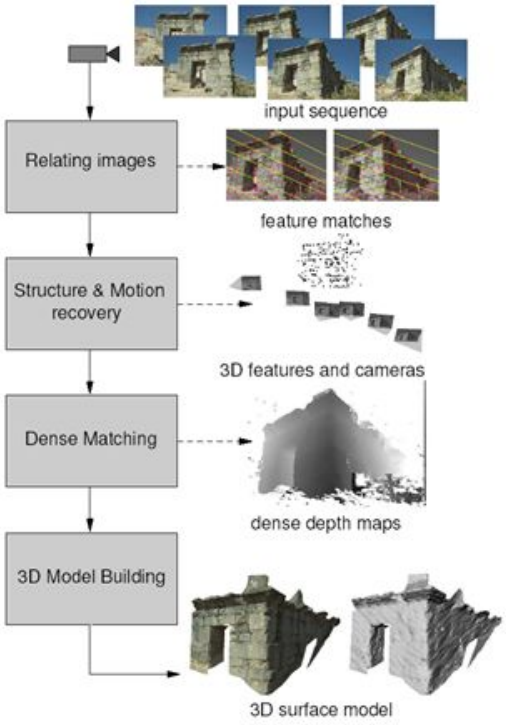
Seymour Papert

The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

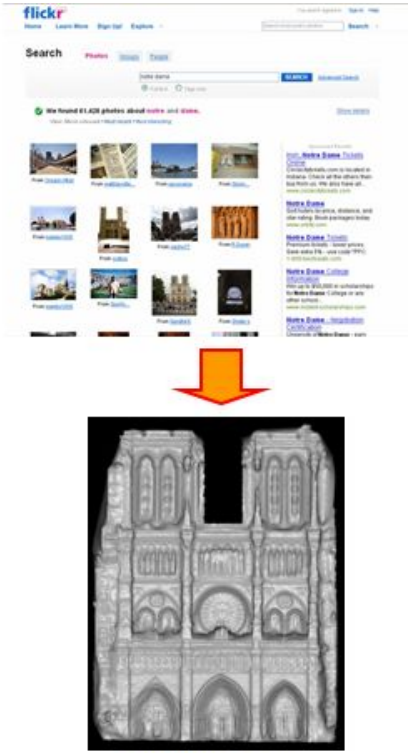
# WHAT INFORMATION TO EXTRACT

- Metric 3D Information
- Semantics

# VISION AS A MEAUREMENT DEVICE

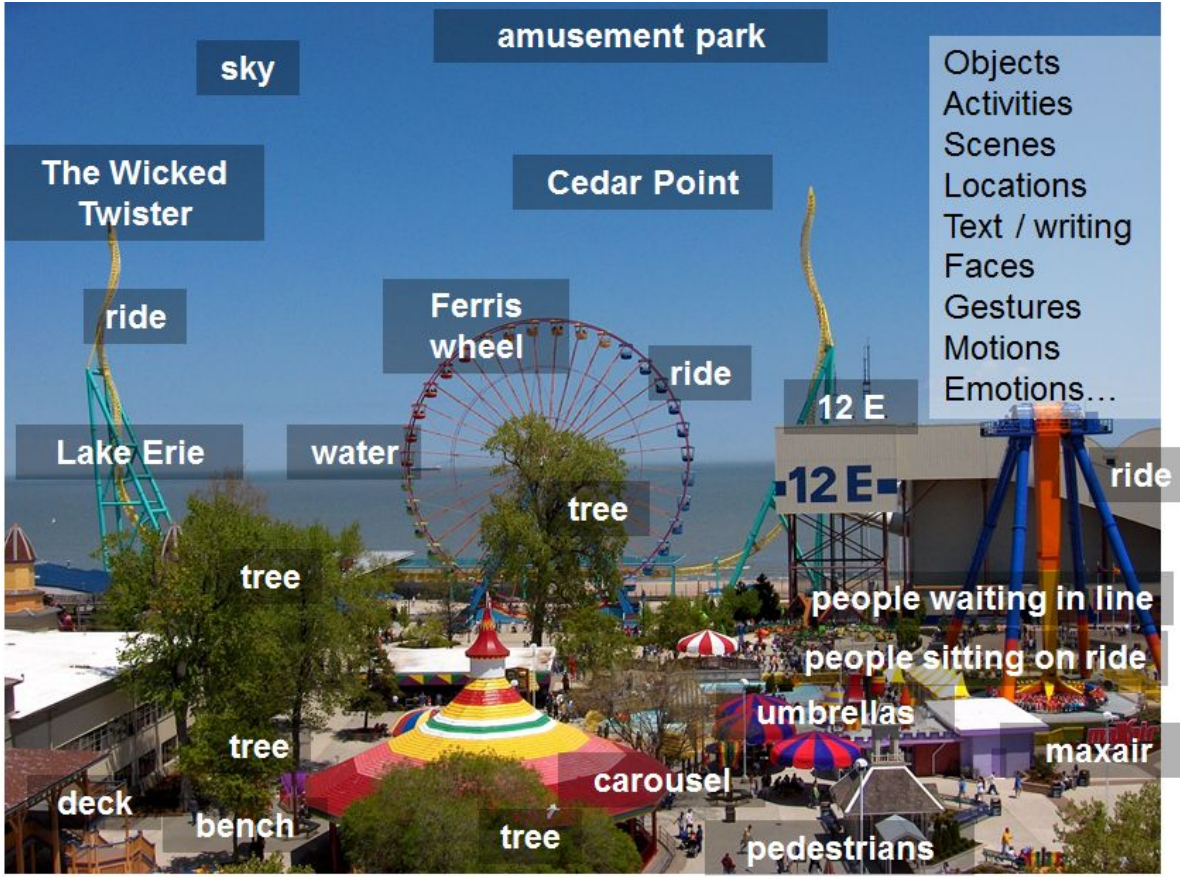



Pollefeys et al.

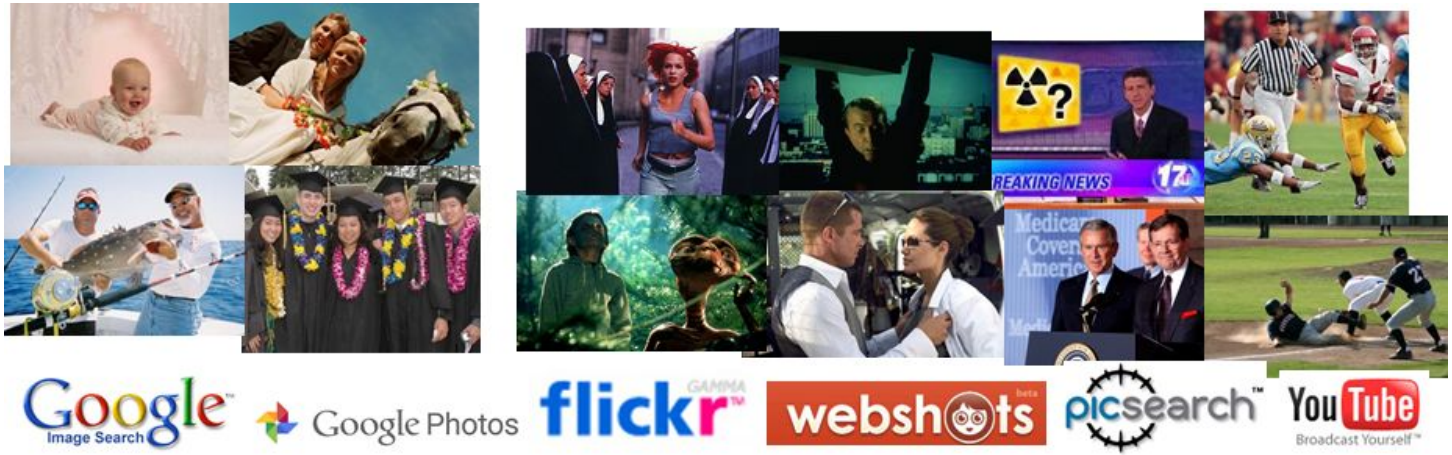



Goesele et al.

# VISION AS A SOURCE OF SEMANTIC INFORMATION



# WHY STUDYING COMPUTER VISION?



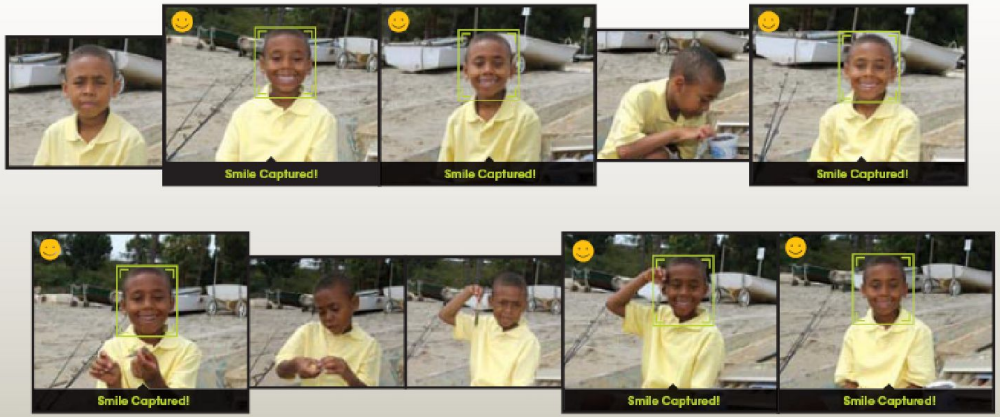

Surveillance and security

Medical and scientific images

# FACE DETECTION

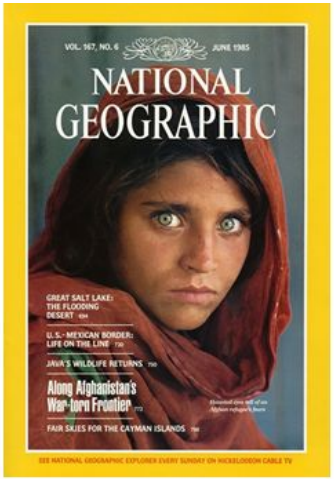

## The Smile Shutter flow

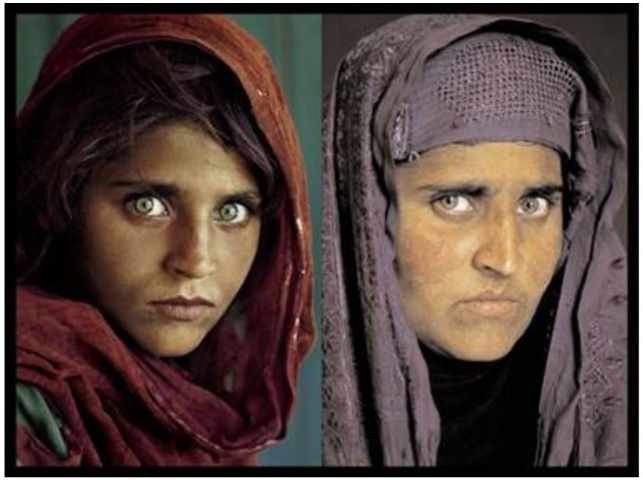
Imagine a camera smart enough to catch every smile! In Smile Shutter Mode, your Cyber-shot® camera can automatically trip the shutter at just the right instant to catch the perfect expression.



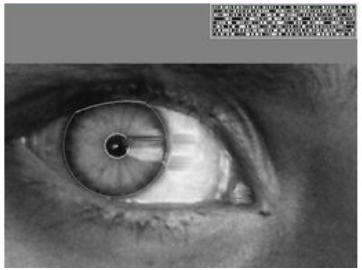
# FACE DETECTION

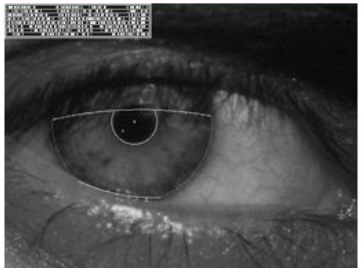
http://www.apple.com/ilife/iphoto/



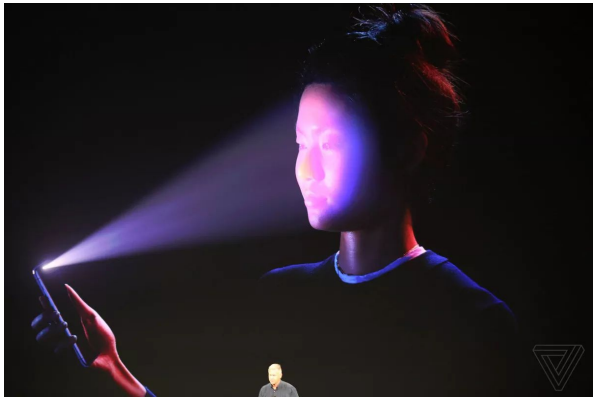
How the Afghan Girl was Identified by Her Iris Patterns





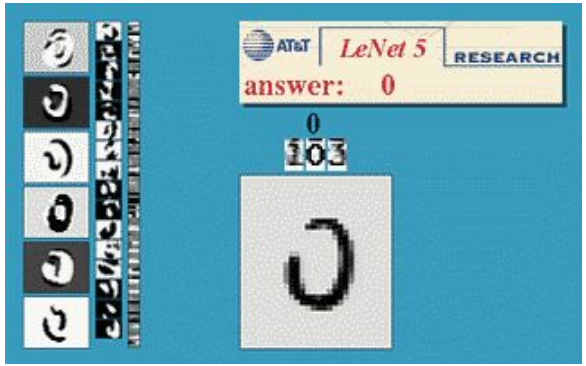
# BIOMETRICS


Fingerprint scanners on many laptops and other devices



Face recognition systems now beginning to appear more widely, also on smartphones

# OPTICAL CHARACTER RECOGNITION (OCR)

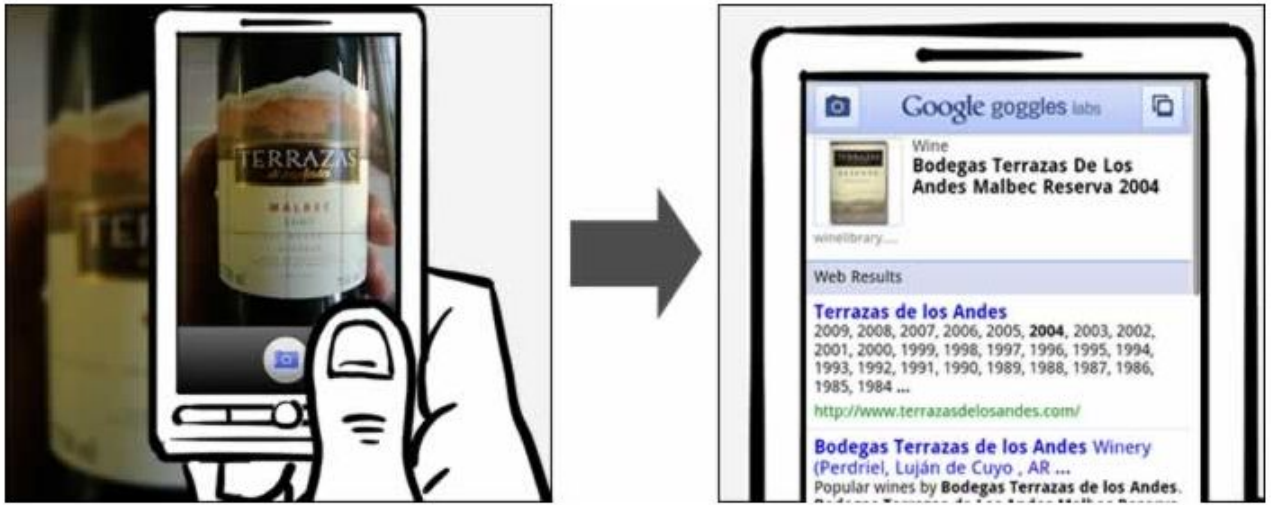



# ROBOTS

# MOBILE VISUAL SEARCH

**Google Goggles in Action**

Click the icons below to see the different ways Google Goggles can be used.


Google Goggles

# AUTOMOTIVE SAFETY

# VISION IN SUPERMARKETS


# SPACE EXPLORATION

"Computer Vision on Mars" by Matthies et al.

- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking

# MANUFACTURING AND AUTOMATION

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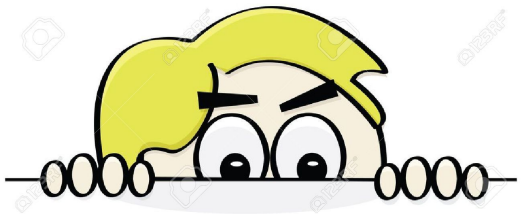
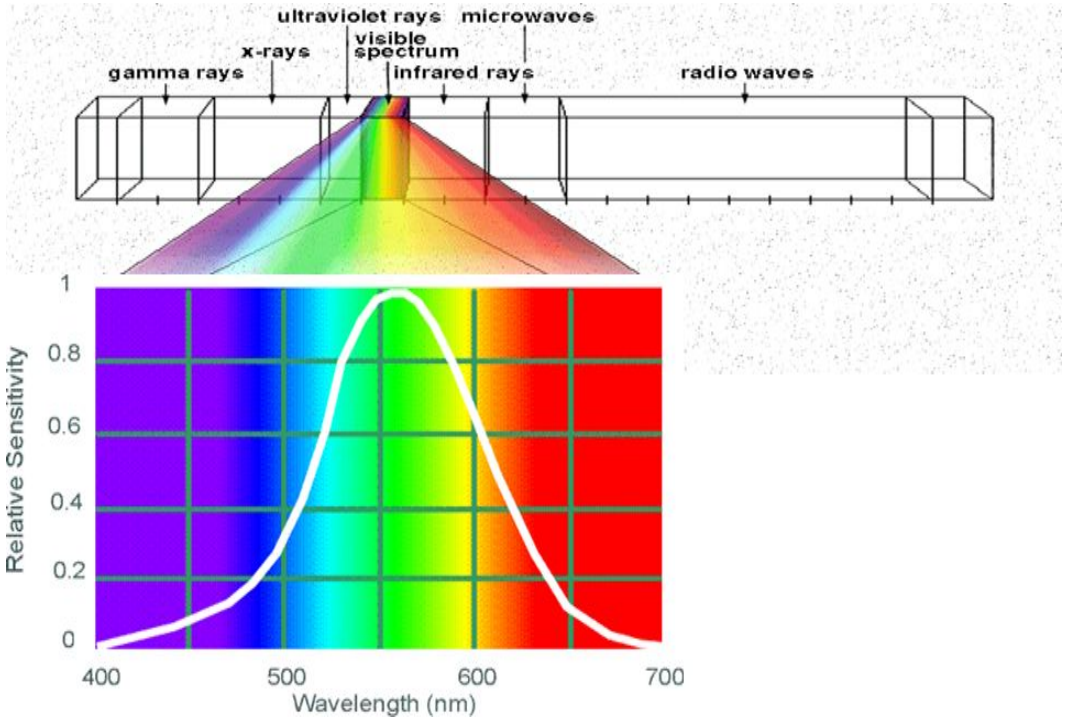
Lecture 2

# LET'S SNEAK A LOOK AT NEXT LECTURE



# LIGHT


ultraviolet rays
microwaves
visible spectrum
x-rays
gamma rays
infrared rays
radio waves
1
0.8
0.6
0.4
0.2
0
Relative Sensitivity
400
500
600
700
Wavelength (nm)

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# SEE YOU ON FRIDAY!