COMPUTER VISION
Lecture 1

Prof. Dr. Francesco Maurelli
2019-09-03

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...

JACOBS UNIVERSITY

- 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 11:15 - 12:30
- Wednesdays 14:15 - 15:30

LECTURES

- Tuesdays 11:15 - 12:30
- Wednesdays 14:15 - 15:30

LECTURES

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LECTURES

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

LECTURES

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- **Direct** correlation between attendance and passing the exam
- **Direct** correlation between attendance and grade of the exam

TEACHING ASSISTANT

- **First** point of contact

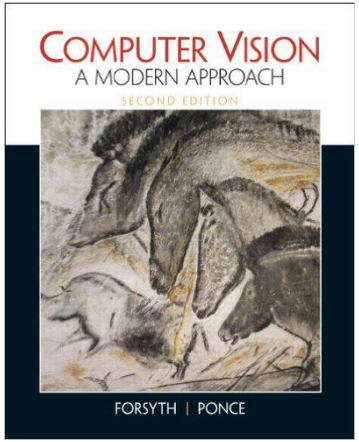
TEACHING ASSISTANT

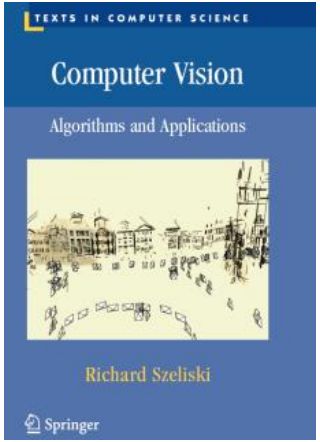
- Mark Ali

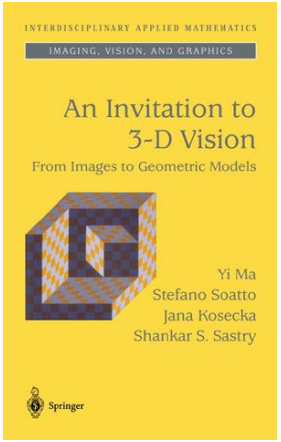
TEXTBOOKS

- 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

"Did you say 'buy-buy' or 'bye-bye'?"

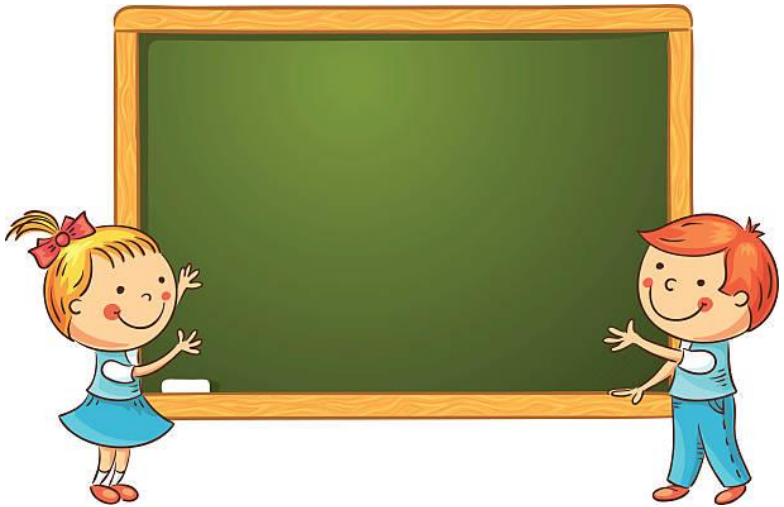
COMMUNICATION

- **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

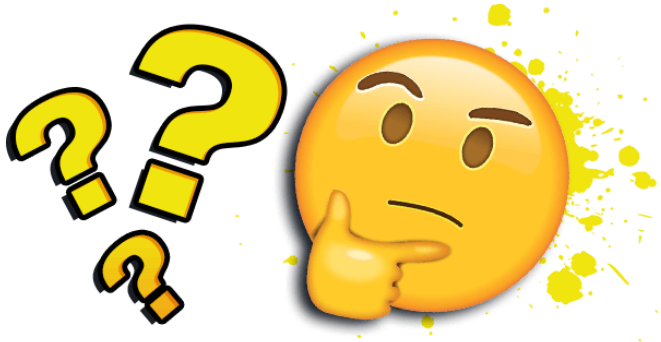
BLACKBOARD / WHITEBOARD

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



WORK

- Regular quizzes! (bring laptop / smartphone)
- Homework → pre-requisite to take the final exam: at least 50% of homework
- Final Exam: 100%



HOMEWORK

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HEALTH EXCUSES

HEALTH EXCUSES

Academic calendar 2019/20 plus September

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EXAMS

2019				2020								
September	October	November	December	January	February	March	April	May	June	July	August	September
1 Su	1 Tu	1 Fr	1 Su	1 We	1 Sa	1 Su	1 We	1 Fr	1 Mo Pentecost	1 We	1 Sa	1 Tu classes begin
2 Mo classes begin	2 We	2 Sa	2 Mo	2 Th	2 Su	2 Mo	2 Th	2 Sa	2 Tu	2 Th	2 Su	2 We
3 Tu	3 Th	3 Su	3 Tu	3 Fr	3 Mo classes begin	3 Tu	3 Fr	3 Su	3 We grades due/ graduation	3 Fr	3 Mo	3 Th
4 We	4 Fr	4 Mo	4 We	4 Sa	4 Tu	4 We	4 Sa	4 Mo	4 Th	4 Sa	4 Tu	4 Fr
5 Th	5 Sa	5 Tu	5 Th	5 Su	5 We	5 Th	5 Su	5 Tu	5 Fr	5 Su	5 We	5 Sa
6 Fr	6 Su	6 We	6 Fr classes end	6 Mo	6 Th	6 Fr	6 Mo	6 We	6 Sa	6 Mo	6 Th	6 Su
7 Sa	7 Mo	7 Th	7 Sa reading day	7 Tu	7 Fr	7 Sa	7 Tu SPRING	7 Th	7 Su	7 Tu	7 Fr	7 Mo
8 Su	8 Tu	8 Fr	8 Su reading day	8 We	8 Sa	8 Su	8 We BREAK	8 Fr	8 Mo	8 We	8 Sa	8 Tu
9 Mo	9 We	9 Sa	9 Mo exam	9 Th	9 Su	9 Mo	9 Th	9 Sa	9 Tu	9 Th	9 Su	9 We
10 Tu	10 Th	10 Su	10 Tu period	10 Fr break ends	10 Mo	10 Tu	10 Fr Good Friday	10 Su	10 We	10 Fr	10 Mo	10 Th
11 We	11 Fr	11 Mo	11 We	11 Sa	11 Tu	11 We	11 Sa	11 Mo	11 Th	11 Sa	11 Tu	11 Fr
12 Th	12 Sa	12 Tu	12 Th	12 Su	12 We	12 Th	12 Su	12 Tu	12 Fr graduation	12 Su	12 We	12 Sa
13 Fr	13 Su	13 We	13 Fr	13 Mo grades due/ intersession	13 Th	13 Fr	13 Mo Easter Monday	13 We	13 Sa	13 Mo	13 Th	13 Su
14 Sa	14 Mo	14 Th	14 Sa	14 Tu begins	14 Fr grades due make-ups	14 Sa	14 Tu	14 Th	14 Su	14 Tu	14 Fr diplomas & transcripts	14 Mo grades due make-ups
15 Su	15 Tu	15 Fr	15 Su	15 We	15 Sa	15 Su	15 We	15 Fr classes end	15 Mo	15 We	15 Sa due	15 Tu drop/add
16 Mo drop/ add	16 We	16 Sa	16 Mo	16 Th	16 Su	16 Mo	16 Th	16 Sa reading day	16 Tu	16 Th	16 Su	16 We
17 Tu	17 Th	17 Su	17 Tu	17 Fr	17 Mo drop / add	17 Tu	17 Fr	17 Su reading day	17 We	17 Fr	17 Mo	17 Th
18 We	18 Fr	18 Mo	18 We	18 Sa	18 Tu	18 We	18 Sa	18 Mo exam	18 Th	18 Sa	18 Tu	18 Fr
19 Th	19 Sa	19 Tu	19 Th	19 Su	19 We	19 Th	19 Su	19 Tu period	19 Fr	19 Su	19 We	19 Sa
20 Fr	20 Su	20 We	20 Fr	20 Mo	20 Th	20 Fr	20 Mo	20 We	20 Sa	20 Mo	20 Th	20 Su
21 Sa	21 Mo	21 Th	21 Sa	21 Tu	21 Fr	21 Sa	21 Tu	21 Th Christi Himmelfahrt	21 Su	21 Tu	21 Fr	21 Mo
22 Su	22 Tu	22 Fr	22 Su	22 We	22 Sa	22 Su	22 We	22 Fr	22 Mo	22 We	22 Sa make-up period	22 Tu
23 Mo	23 We	23 Sa	23 Mo break begins	23 Th make-up period	23 Su	23 Mo	23 Th	23 Sa	23 Tu	23 Th	23 Su	23 We
24 Tu	24 Th	24 Su	24 Tu	24 Fr	24 Mo	24 Tu	24 Fr	24 Su	24 We remaining grades due	24 Fr	24 Mo	24 Th
25 We	25 Fr	25 Mo	25 We Christmas Day	25 Sa	25 Tu	25 We	25 Sa	25 Mo	25 Th	25 Sa	25 Tu	25 Fr
26 Th	26 Sa	26 Tu	26 Th Boxing Day	26 Su	26 We	26 Th	26 Su	26 Tu	26 Fr	26 Su	26 We O-Week begins	26 Sa
27 Fr	27 Su	27 We	27 Fr	27 Mo	27 Th	27 Fr	27 Mo	27 We	27 Sa	27 Mo	27 Th	27 Su
28 Sa	28 Mo	28 Th	28 Sa	28 Tu	28 Fr	28 Sa	28 Tu	28 Th	28 Su	28 Tu	28 Fr	28 Mo
29 Su	29 Tu	29 Fr	29 Su	29 We	29 Sa	29 Su	29 We	29 Fr	29 Mo	29 We	29 Sa	29 Tu
30 Mo	30 We	30 Sa	30 Mo	30 Th		30 Mo	30 Th	30 Sa	30 Tu	30 Th	30 Su	30 We
	31 Th		31 Tu	31 Fr		31 Tu		31 Su summer recess		31 Fr	31 Mo O-Week ends	

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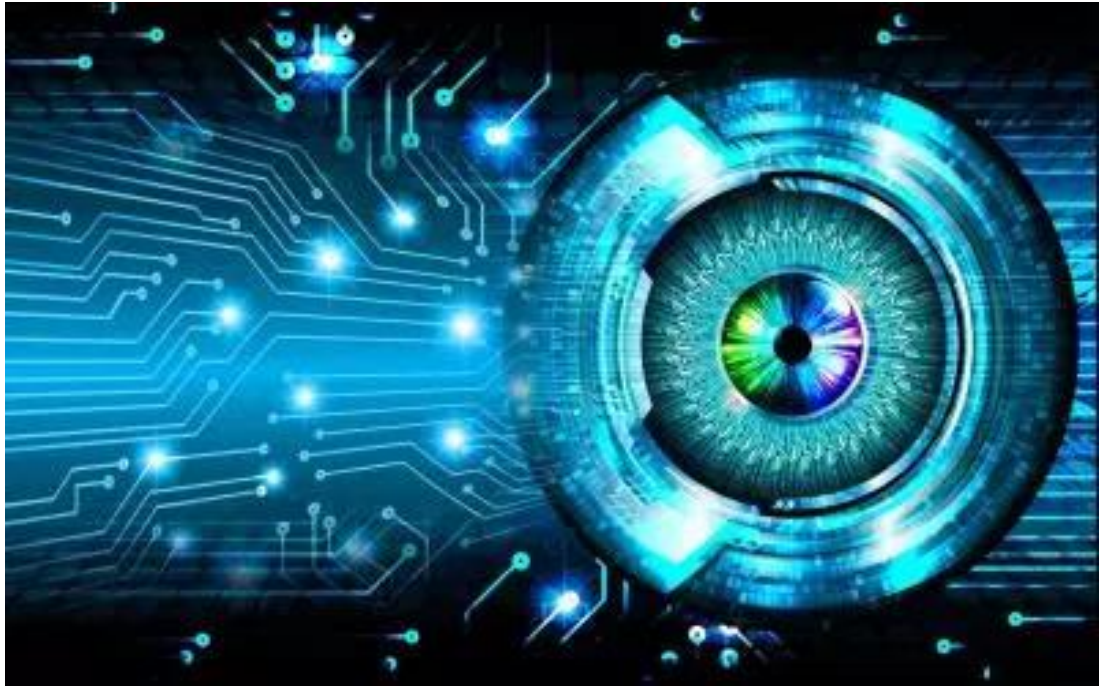
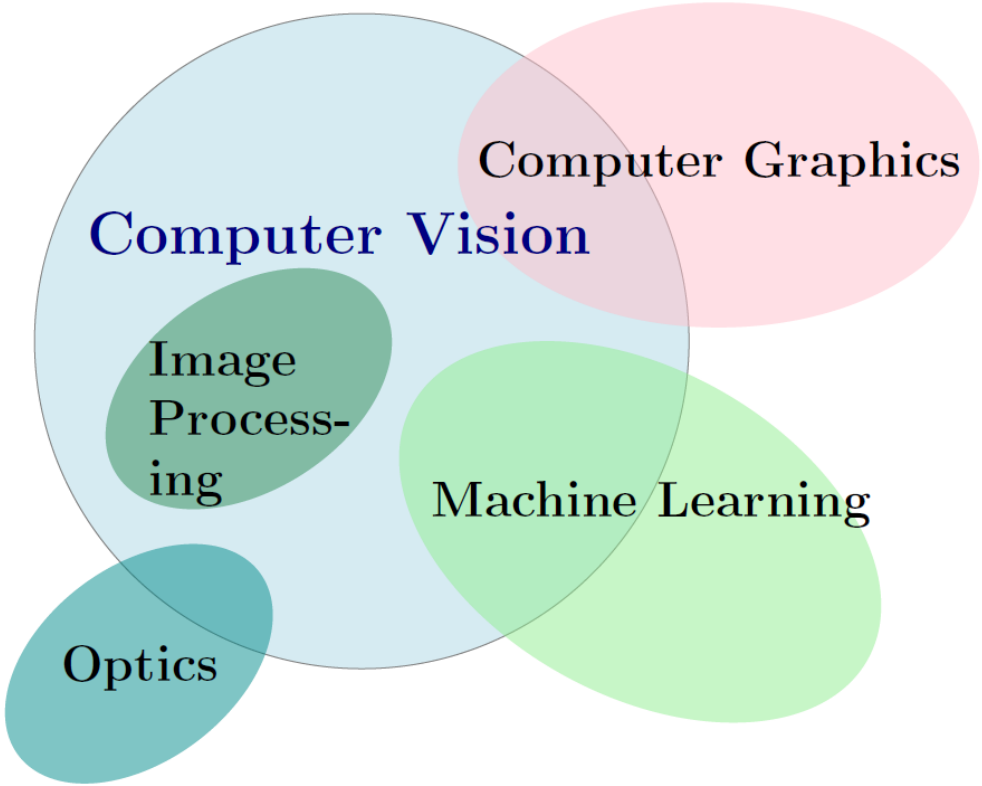
Chapter 3

INTRODUCTION TO COMPUTER VISION



RELATION TO OTHER AREAS



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)

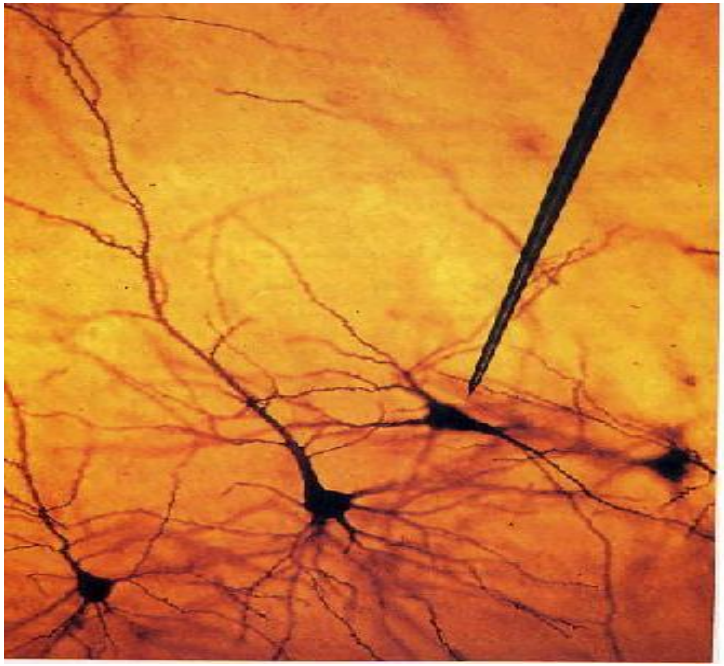
Sensing device

Interpreting device

Interpretations

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

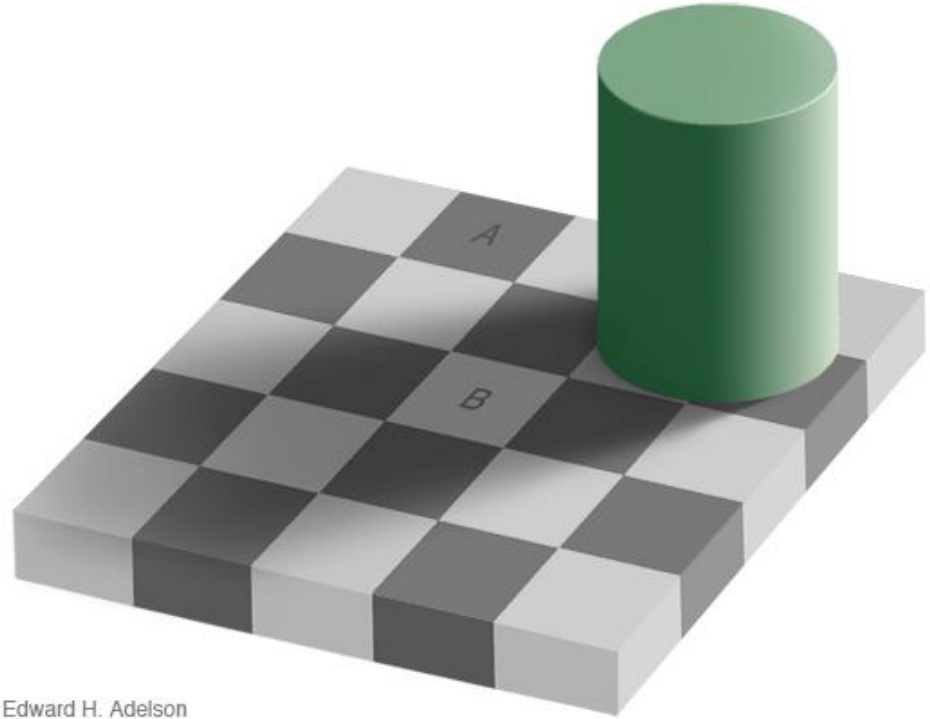
Hubel & Wiesel
1981
Nobel Prize in Medicine



ANIMAL VISION

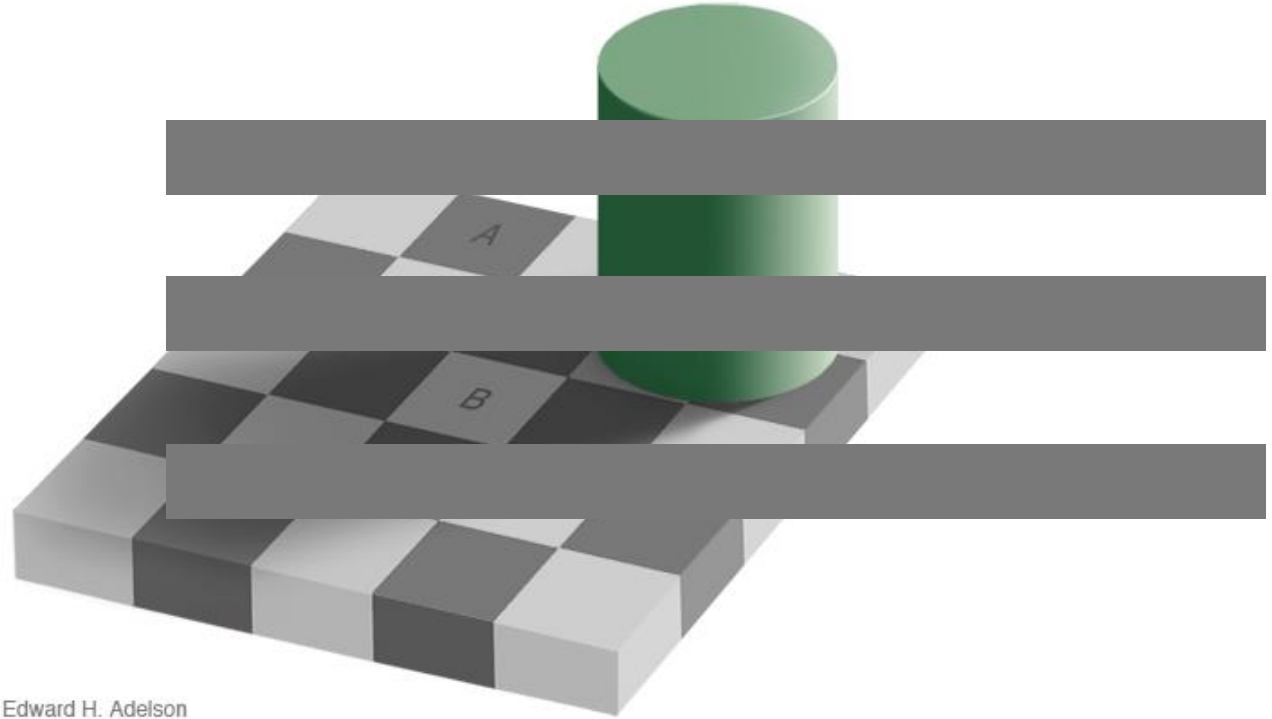
The Mantis Shrimp
Best Eyes in the
Animal Kingdom

PERCEPTION



Edward H. Adelson

PERCEPTION



Edward H. Adelson

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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

ORIGINS OF COMPUTER VISION

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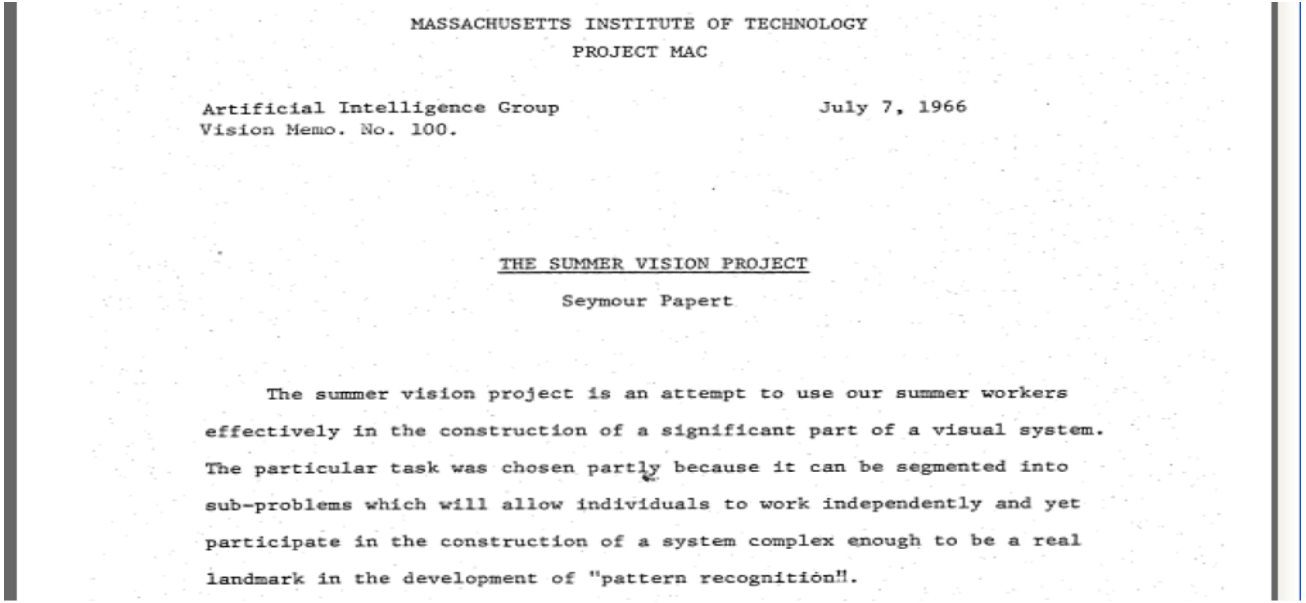
An MIT Undergraduate Summer Project...



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PROJECT MAC

Artificial Intelligence Group
Vision Memo. No. 100.

July 7, 1966

THE SUMMER VISION PROJECT

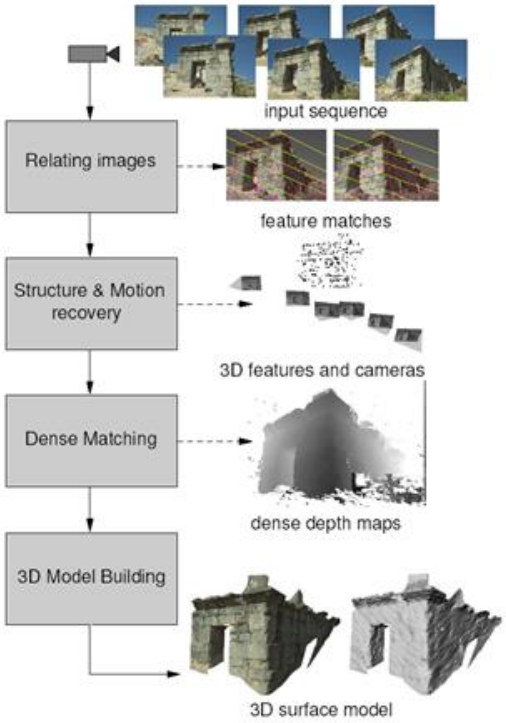
Seymour Papert

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".

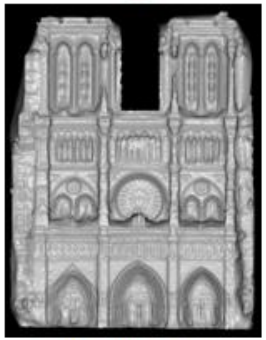
WHAT INFORMATION TO EXTRACT

- Metric 3D Information
- Semantics

VISION AS A MEAUREMENT DEVICE

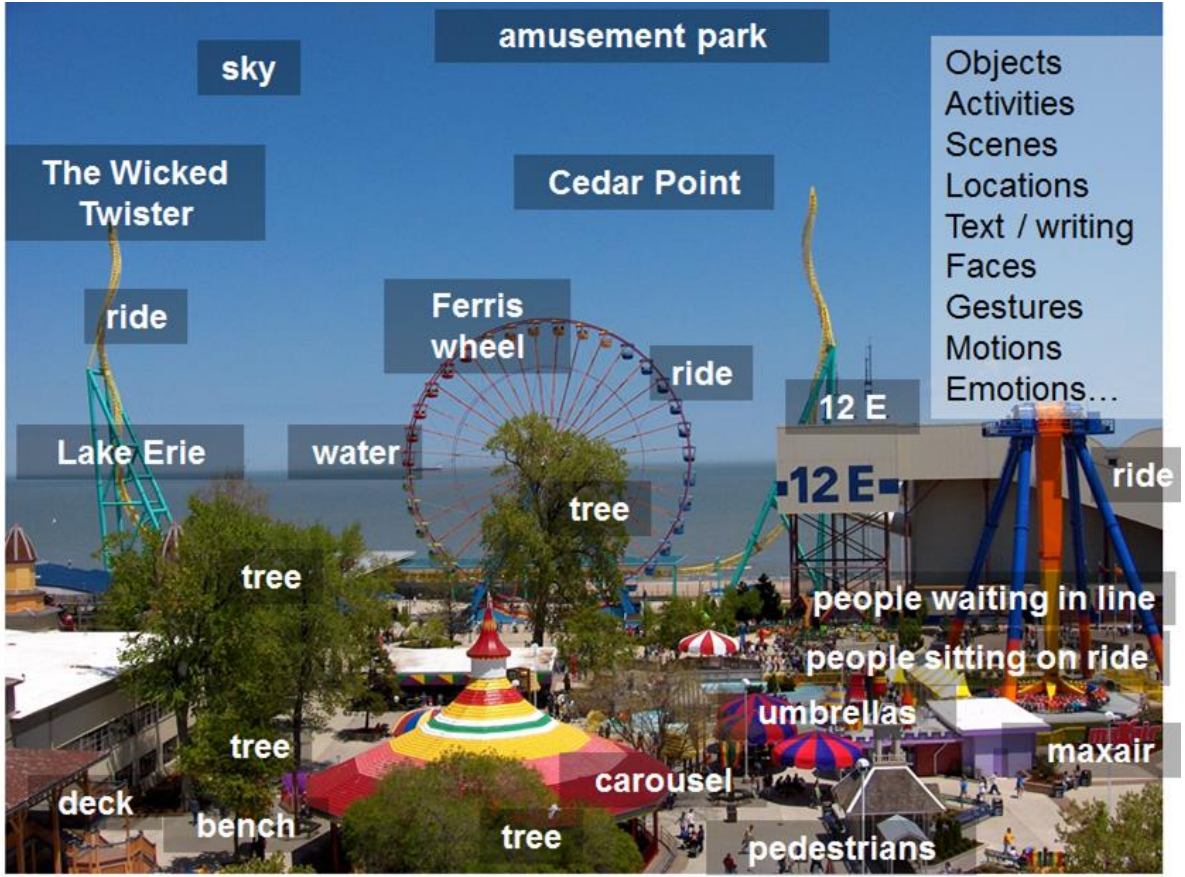


Pollefeys et al.



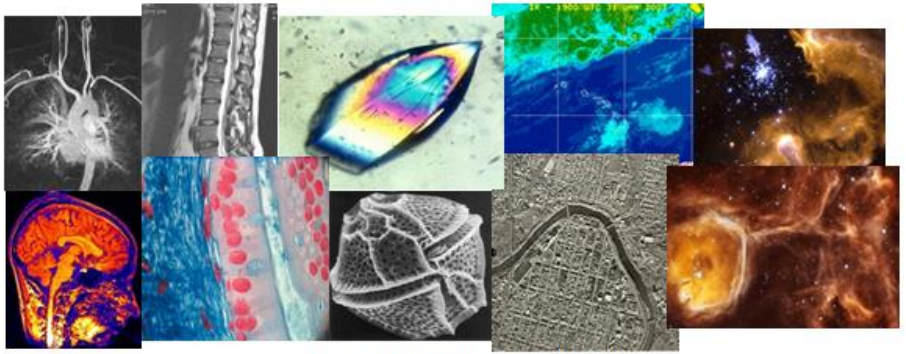
Goesele et al.

VISION AS A SOURCE OF SEMANTIC INFORMATION



WHY STUDYING COMPUTER VISION?

Surveillance and security

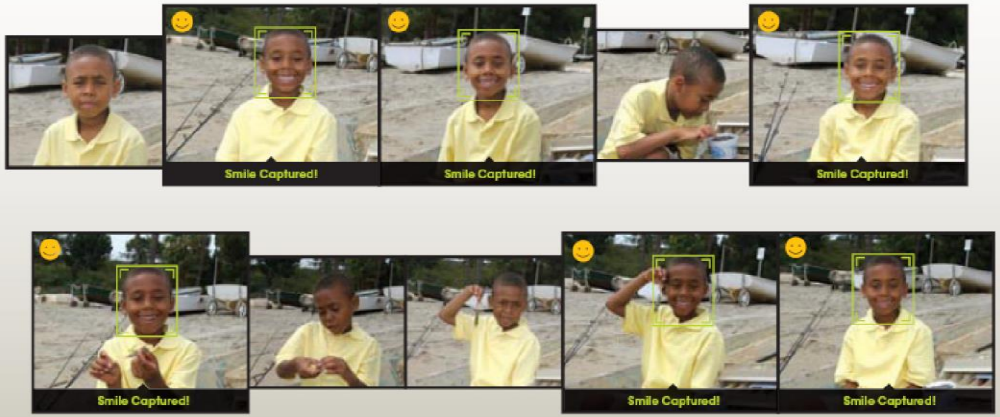


Medical and scientific images

FACE DETECTION

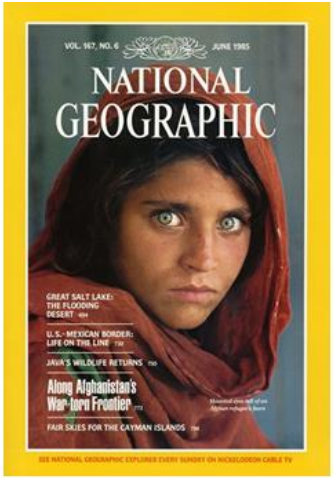
The Smile Shutter flow

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.

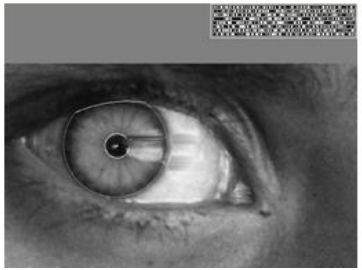


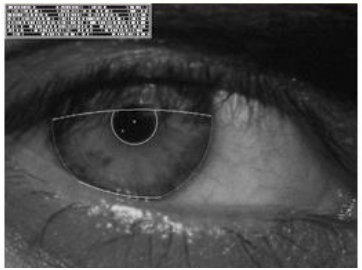
FACE DETECTION

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



How the Afghan Girl was Identified by Her Iris Patterns



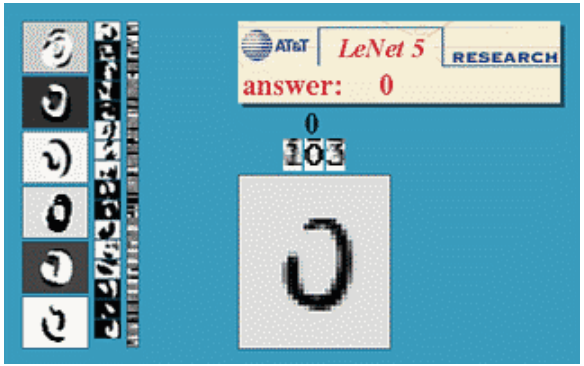


BIOMETRICS

Fingerprint scanners on many laptops and other devices

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

OPTICAL CHARACTER RECOGNITION (OCR)

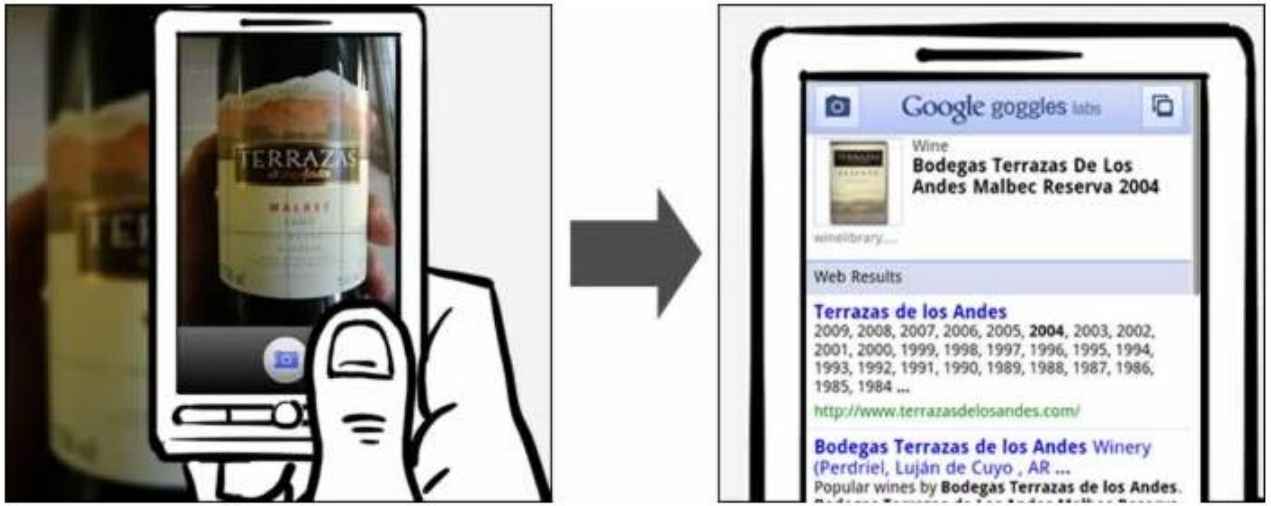


ROBOTS

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

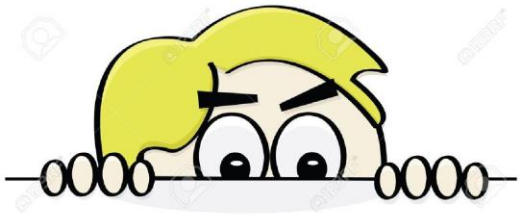
"Computer Vision on Mars" by Matthies et al.

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

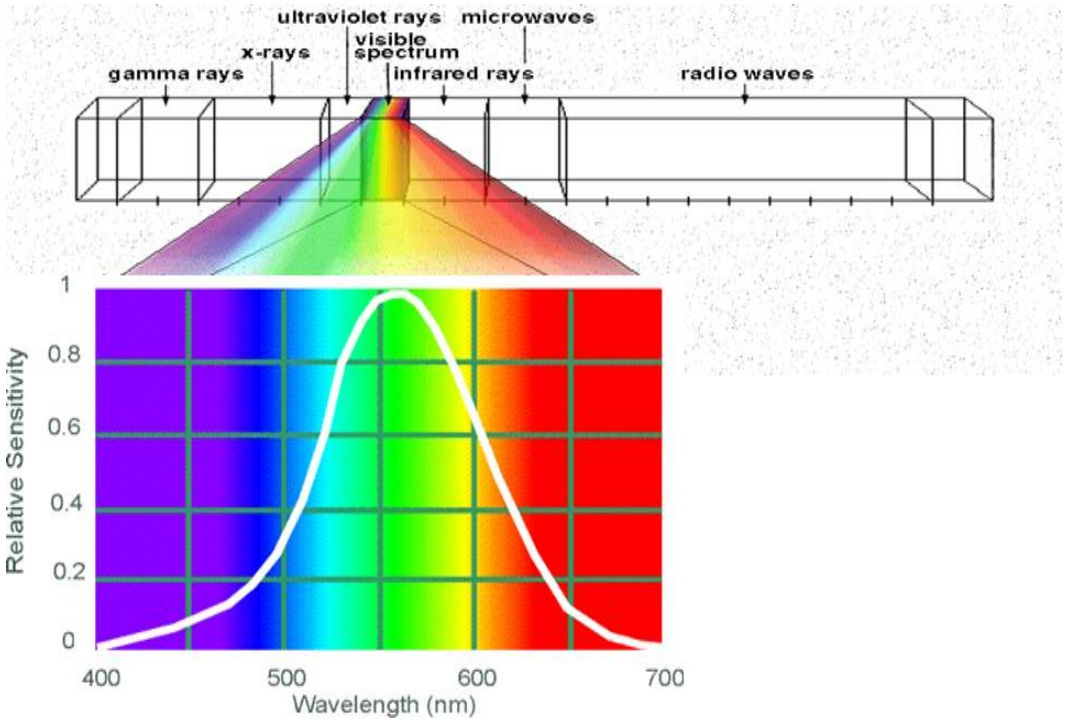
MANUFACTURING AND AUTOMATION

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 TOMORROW!