

Intro to Computer Vision



Yoni Chechik
Computer Vision course

contents

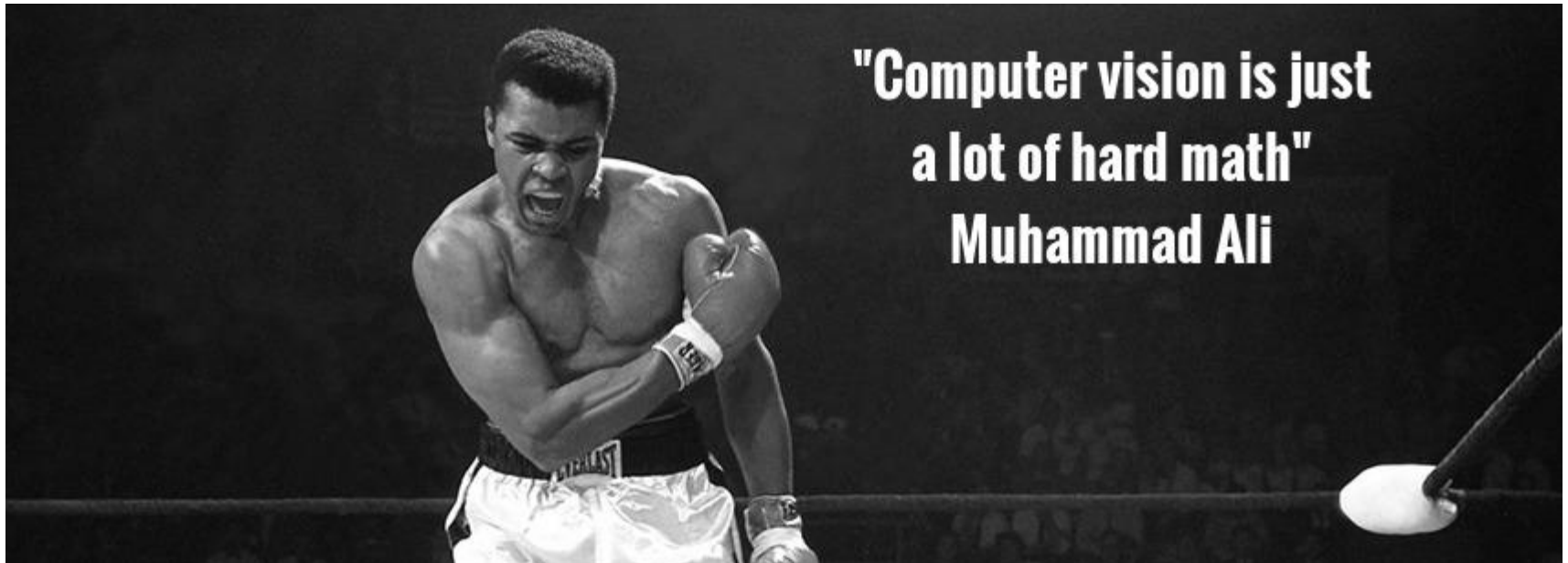
- **Course details**
- What is computer vision (CV)?
- Course outline
- Intro to Python

References

- Lectures Based on the book: **Computer Vision: Algorithms and Applications**, 2010, Richard Szeliski (<http://szeliski.org/Book/>)

Prerequisites

- No prior knowledge in signal/image processing is assumed.
- Heavy use in algebra and calculus- mathematical maturity **is assumed.**

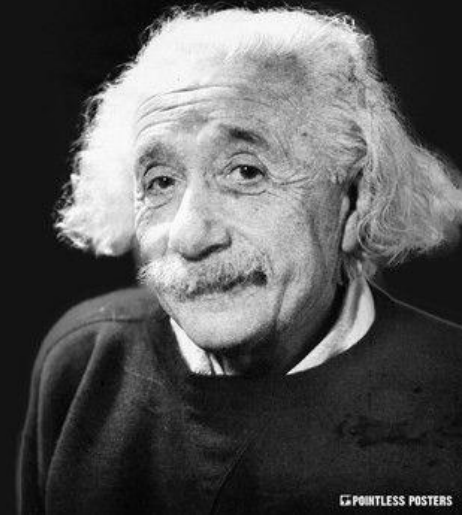


contents

- Course details
- **What is computer vision (CV)?**
- Course outline
- Intro to Python

Don't believe
everything you read
on the internet just
because there's a
picture with a quote
next to it.

ALBERT EINSTEIN

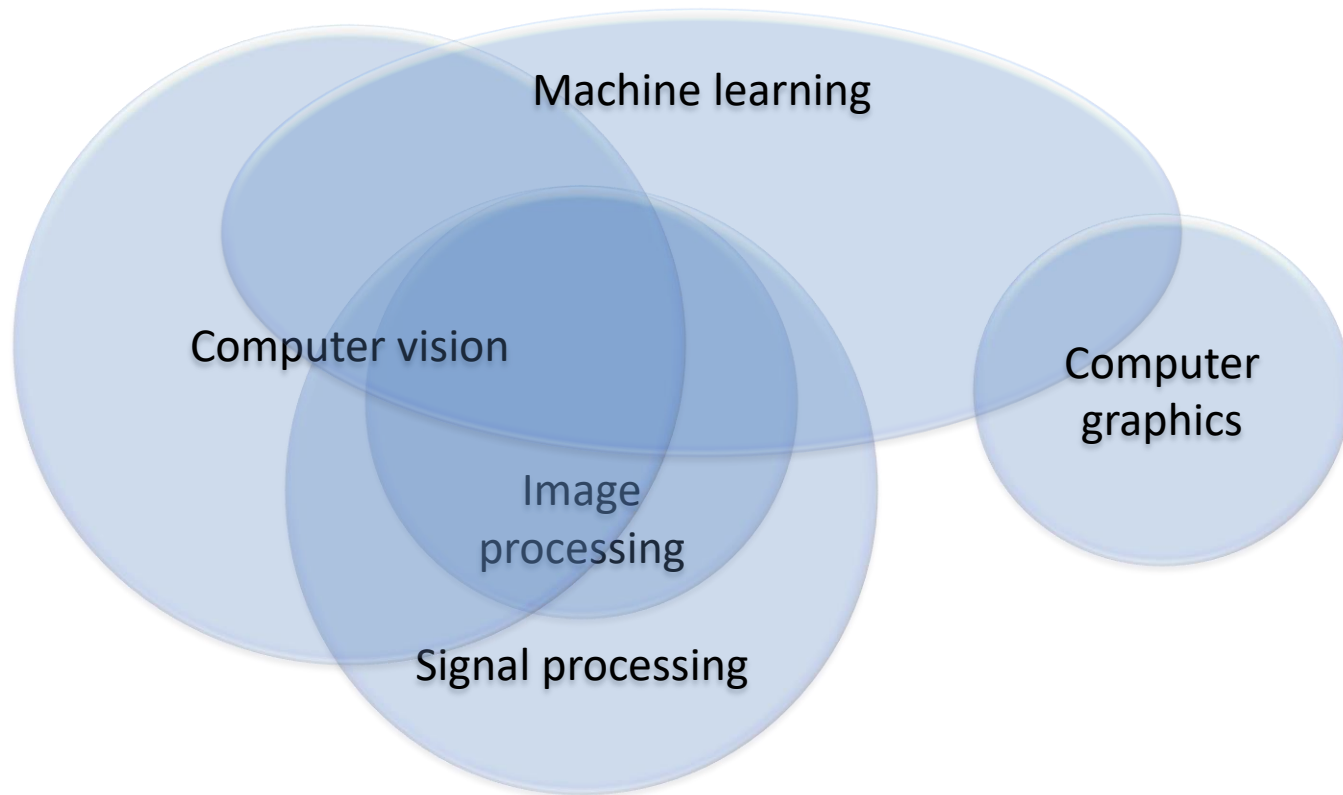


What is CV?

- **Computer vision** is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos. [Wikipedia]
- **Image processing** is an umbrella term for many functions that analyze images or convert one representation of an image into another.

What is CV?

Input \ Output	Data	Image
Data	Signal processing	Computer graphics
Image	Computer vision	Image processing



Why CV?

IT'S
F***ING
COOL

Why CV?

Top Public Company Acquirors

Company	Embedded Vision/Computer Vision M&A			
	 October – 2012 \$45.0M	 March – 2013 NA	 July – 2016 NA	 October – 2016 NA
	 November – 2013 \$360.0M	 January – 2016 NA	 January – 2016 NA	 February – 2017 NA
	 May – 2005 \$115.0M	 July – 2008 \$3.0M	 August – 2016 \$2.4M	 November – 2016 \$4.7M
	 April – 2012 \$31.0M	 May – 2016 NA	 September – 2016 \$392.1M	 September – 2017 \$15,300.0M
	 January – 2014 NA	 September – 2014 NA	 August – 2017 NA	

PrimeSense == Kinect

- *Kinect for Xbox 360*: 3D scanner system using **Light Coding** approach for 3D reconstruction.
- KinectFusion [Newcombe et al., 2011] :
<https://www.youtube.com/watch?v=KOUSSIKUJ-A>



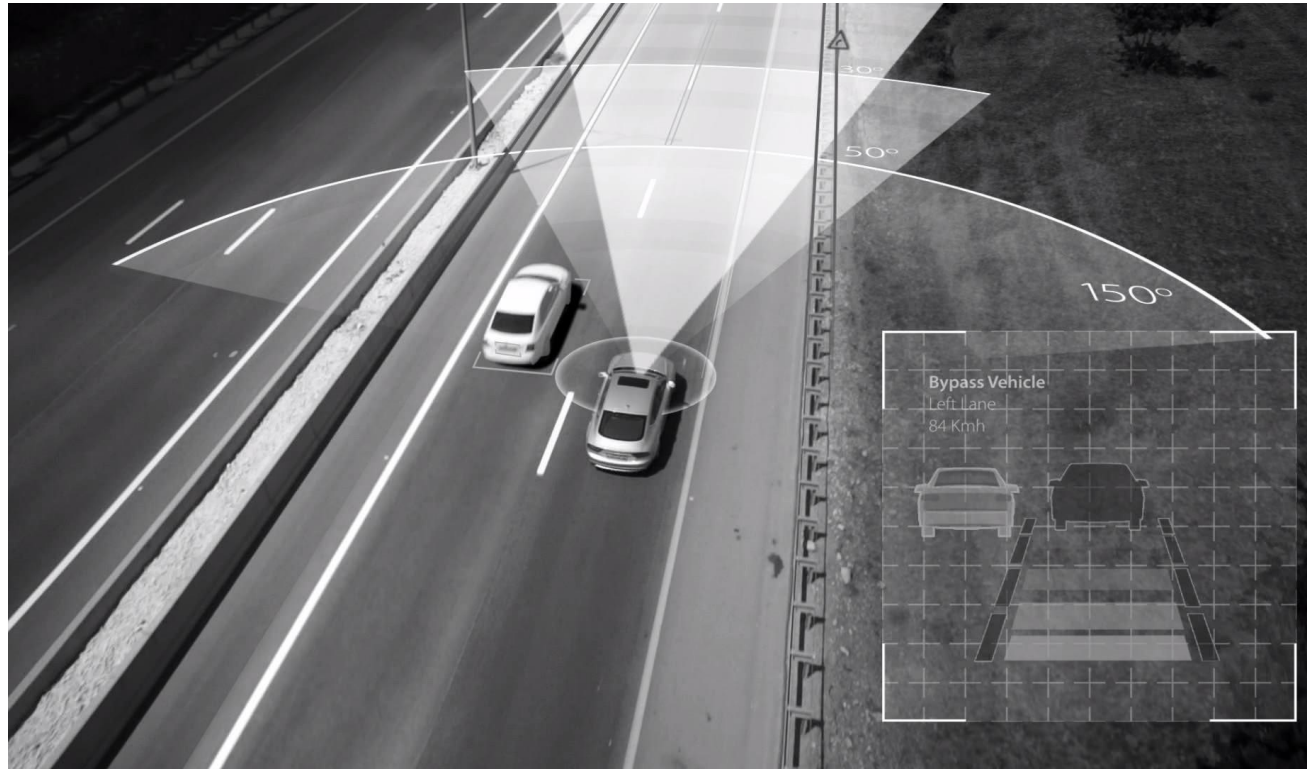
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	 January – 2014 NA	 September – 2014 NA	 August – 2017 NA	

Mobileye

- **Mobileye** is an Israeli subsidiary of Intel corporation that develops vision-based advanced driver-assistance systems (ADAS) providing warnings for collision prevention and mitigation. [Wikipedia]
- <https://www.youtube.com/watch?v=JDUb6CurYJM>



Why CV?

StartupHub.ai

ISRAEL'S COMPUTER VISION STARTUPS

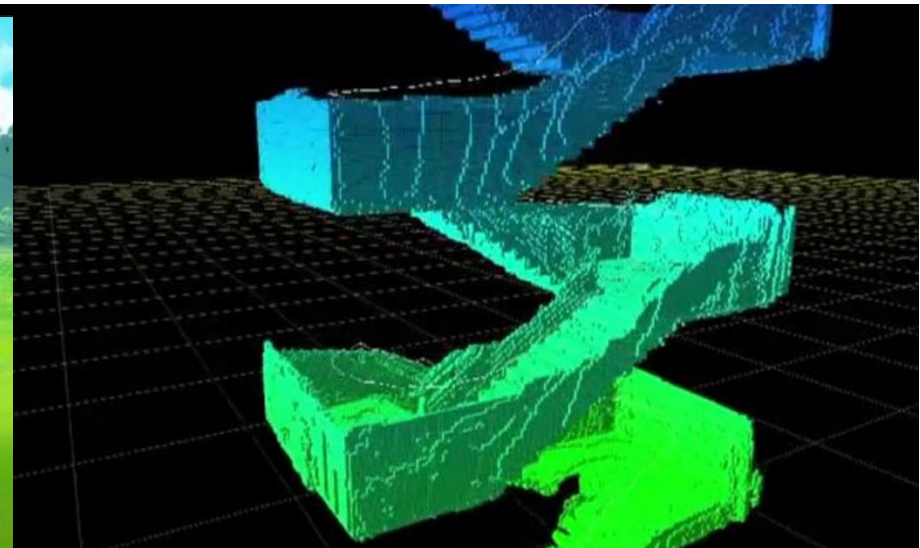


COMPUTER VISION TECHNOLOGY		HEALTHCARE	AUTOMOTIVE	AGRICULTURE	INDUSTRIAL	RETAIL	SECTORS					
CHIPS	VIDEO INTELLIGENCE	MEDICAL IMAGING	AUTONOMOUS	CROP MANAGEMENT	ROBOTICS & UTILITIES	MONITORING & ANALYTICS	SMART CITY					
<div><div> Hailo Empowering Intelligence</div><div> INNUVIT</div></div>	<div><div> AGENT2</div><div> EyeSafe</div></div> <div><div> QUANTUM RGB</div><div> D Vision</div></div> <div><div> viisights</div><div> GETALERT</div></div> <div><div> VIDEOinFORM</div><div> SENSORITY</div></div> <div><div> videocites</div><div> ZyroBot</div></div> <div><div> XR Vision</div><div> anyvision.1702ai</div></div>	<div><div> zebra</div><div> iz.ai</div></div> <div><div> Healthy.io</div><div> aidoc</div></div> <div><div> BODY VISION</div><div> DIA</div></div> <div><div> MobileODT</div><div> maxQ</div></div> <div><div> sight</div><div> Biomedical</div></div> <div><div> FDNA</div><div> innoging</div></div> <div><div> HT</div><div> DeePathology.ai</div></div> <div><div> ORCA DENTAL AI</div><div> PerSimoO</div></div> <div><div> RADLogics</div><div> TECHMED</div></div> <div><div> IBEX</div><div> XPRINT XRAY</div></div> <div><div> MAGENTIQ</div><div> IMedis</div></div> <div><div> Deep Oncology</div><div> nucleai</div></div> <div><div> SCOPIO</div><div> MedHub-AI</div></div>	<div><div> arbe</div><div> Imagry</div></div> <div><div> INNOVIZ TECHNOLOGIES</div><div> Kodiak</div></div> <div><div> i4drive</div><div> ADASKY</div></div> <div><div> oryx</div><div> Vectoraic</div></div> <div><div> RIDEVISION</div><div> RAM</div></div> <div><div> StreetLight.ai</div><div> CRadar.AI</div></div> <div><div> BWV</div><div> RFISSE</div></div> <div><div> IONTERRA</div><div> VAYAVISION</div></div> <div><div> VOYAGE 81</div></div> <div><div> meshek (76)</div></div>	<div><div> TARANIS</div><div> prospera</div></div> <div><div> See Tree</div><div> SKYX</div></div> <div><div> fieldin</div><div> AgroScout</div></div> <div><div> saillog</div><div> arugga</div></div> <div><div> GemmaCert</div><div> SeedX</div></div> <div><div> VIBE</div><div> HiGrade</div></div> <div><div> meshek (76)</div></div>	<div><div> Planet Watchers</div><div> KITOV SYSTEMS</div></div> <div><div> DLR</div><div> COGNITEAM</div></div> <div><div> MOVIX</div><div> SKYLINE ROBOTICS</div></div> <div><div> IPV</div><div> ORCA AI</div></div> <div><div> pzartech</div><div> BladeRanger</div></div> <div><div> meshek (76)</div></div>	<div><div> trax</div><div> trigo</div></div> <div><div> eyezon</div><div> WISE SHELF</div></div> <div><div> memomi</div><div> MYSTOR-E</div></div> <div><div> X</div></div> <div><div> meshek (76)</div></div>	<div><div> nanit</div><div> intuition robotics</div></div> <div><div> temi</div><div> RES</div></div> <div><div> SCIO</div></div> <div><div> FITSCANNER</div><div> MyselfFit</div></div> <div><div> meshek (76)</div></div>	<div><div> Lightricks</div><div> Magisto</div></div> <div><div> Photomyne</div><div> WIBBITZ</div></div> <div><div> tunity</div><div> DEEPPEN</div></div> <div><div> meshek (76)</div></div>	<div><div> XTEND AerialGuard</div><div> AIROBOTICS</div></div> <div><div> skywatch.ai</div><div> EDGY BEES</div></div> <div><div> Sightec</div><div> HIGH LANDER</div></div> <div><div> third eye</div><div> CIVDRONE</div></div> <div><div> vHive</div><div> PERCEPTO</div></div> <div><div> meshek (76)</div></div>	<div><div> interflyo</div><div> minereye</div></div> <div><div> applitools</div><div> tuqqi</div></div> <div><div> INTELLIGO</div><div> voca.ai</div></div> <div><div> ActiView</div><div> TechSee</div></div> <div><div> meshek (76)</div></div>	<div><div> Taboola</div><div> anyclick</div></div> <div><div> Brand Total</div><div> AdVerif.ai</div></div> <div><div> CHEQ</div><div> minute.</div></div> <div><div> cedate</div><div> COMIGO</div></div> <div><div> meshek (76)</div></div>	<div><div> LYNXIGHT</div><div> DEEP VISION</div></div> <div><div> CORAL</div><div> EDUCATION, RAIL & TRAVEL</div></div> <div><div> RailVISION</div><div> Anima</div></div> <div><div> SeeVoov</div></div> <div><div> meshek (76)</div></div>
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<div><div> Brodmann</div><div> Edgify</div></div> <div><div> REDFALCON</div></div>							<div><div> syte</div><div> clonde</div></div>					
OPTICAL & SENSOR							CONSUMER ROBOTICS & TECH					
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DEVELOPMENT			IN-CAR MONITORING				FITNESS					
<div><div> missinglink.ai</div><div> allegro.ai</div></div> <div><div> dataloop</div><div> Clay Sciences</div></div>			<div><div> MDGO</div><div> eyesight</div></div> <div><div> netera</div><div> CLAIR LABS</div></div> <div><div> GUARDIAN</div><div> JUNGO</div></div> <div><div> SAVERONE</div><div> CAARESYS</div></div>				<div><div> FITSCANNER</div><div> MyselfFit</div></div> <div><div> meshek (76)</div></div>					
DATA CREATION		OPTICAL	TRAFFIC & MOBILITY				REAL ESTATE					
<div><div> INNEREYE</div><div> DataGen Technologies</div></div> <div><div> edgecase.ai</div></div>		<div><div> camerayes</div><div> BIO EYE</div></div> <div><div> NOVASIGHT</div><div> 6 over 6</div></div> <div><div> RetiSpec</div></div>	<div><div> VALERANN</div><div> NOTRAFFIC</div></div> <div><div> AGENT-TECH</div><div> EyeWay</div></div> <div><div> cognata</div><div> The Wholly AI</div></div>				<div><div> Leaperr</div><div> Flatspace</div></div> <div><div> meshek (76)</div></div>					
PLATFORM		AUGMENTED REALITY	DEVELOPMENT				FASHION					
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EYE TRACKING							WATER VISION					
<div><div> Blink</div></div>							<div><div> LYNXIGHT</div><div> DEEP VISION</div></div> <div><div> CORAL</div><div> EDUCATION, RAIL & TRAVEL</div></div> <div><div> RailVISION</div><div> Anima</div></div> <div><div> SeeVoov</div></div> <div><div> meshek (76)</div></div>					

More CV related topics

- Virtual/augmented reality
- navigation
- Gaming
- medicine
- And much more...

Segmentation Results



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- **Course outline**
- Intro to Python

Course outline

#	subject
1	Introduction to CV + Python: numpy, matplotlib.
2	Image processing recap: convolutions, LPF, HPF, morphology, connected components, gamma correction, histogram equalization.
3	Edge detection: gradient (roberts, prewitt, sobel), Laplacian, DoG (derivative of Gaussian), canny edge detector.
4	Shape detection: template matching, Hough transform.
5	Digital cameras: image formation, transformation, interpolation.
6	Camera calibration: extrinsic, intrinsic, radial distortion.
7	Stereo vision :dual camera rectification, triangulation.
8	3D cameras: LIDAR, KINECT, structured light, planoptic
9	Line fit: least squares, total least squares, RANSAC,
10	Feature extraction: SIFT, image stitching (scale space).
11	Neural networks: intro, CNN, MNIST, Alexnet.
12	Final project 1
13	Final project 2

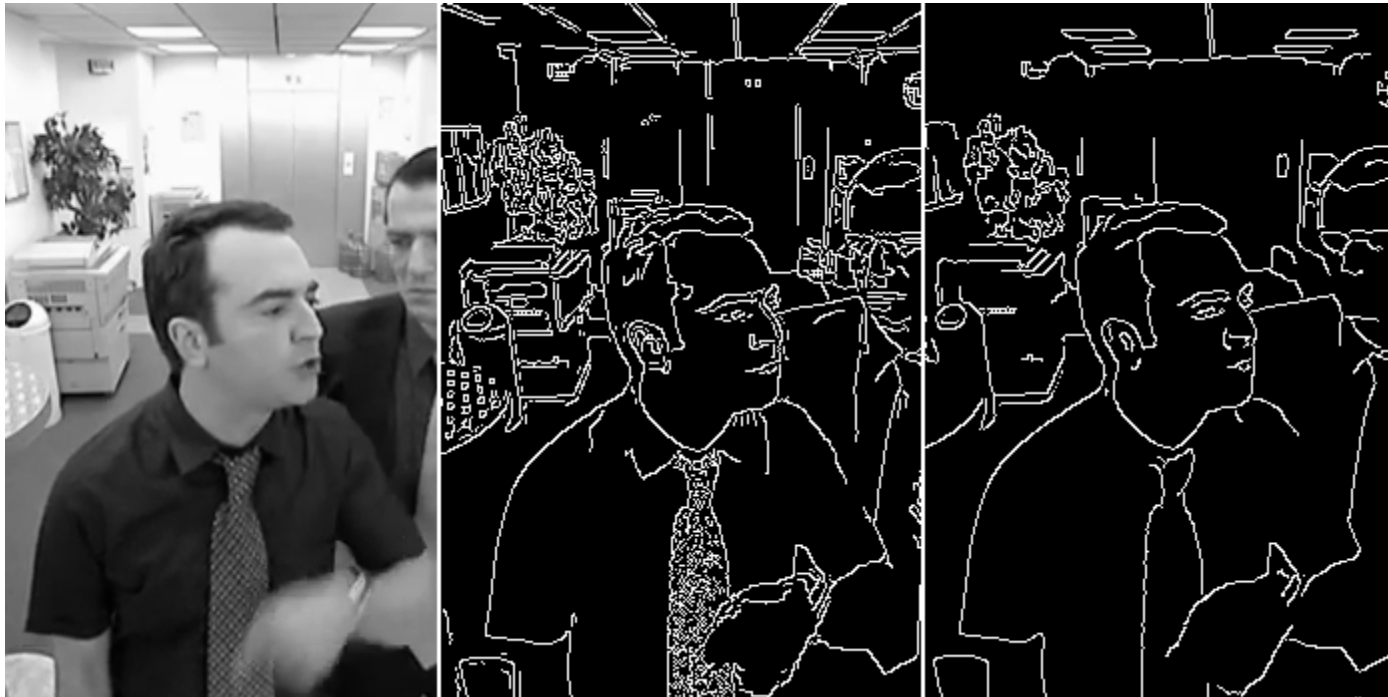
Image processing

- Read more about Lenna – the standard test image:
<https://en.wikipedia.org/wiki/Lenna>

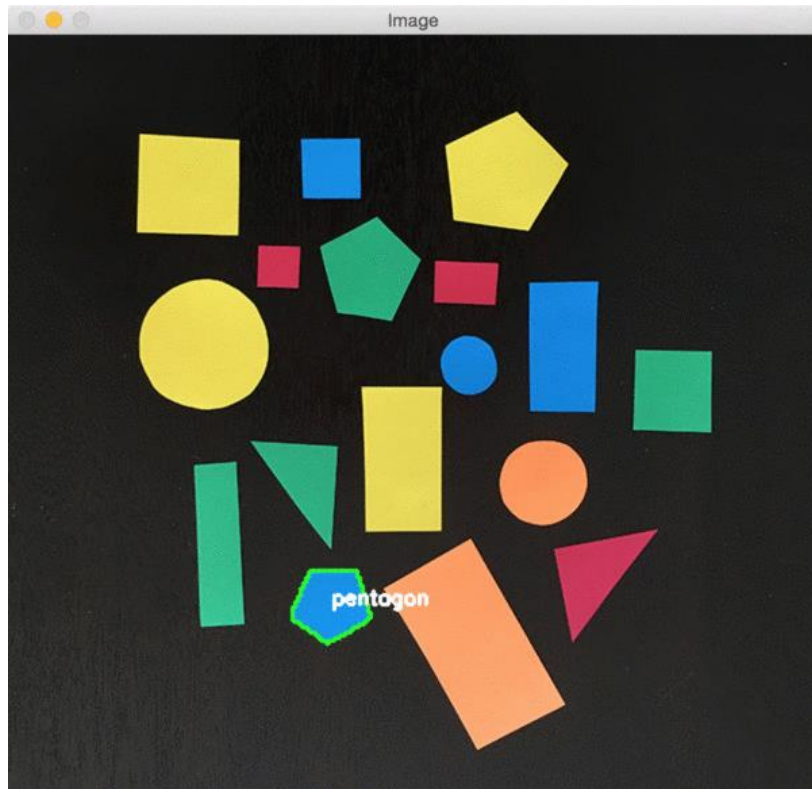


Edge Detection

- <https://www.youtube.com/watch?v=hQ-bpfdWQh8>
- <https://pinetools.com/image-edge-detection>



Shape detection



Digital cameras

- Image formation:
<https://www.youtube.com/watch?v=dY0K65eXhkA>
- Transformation and interpolation.



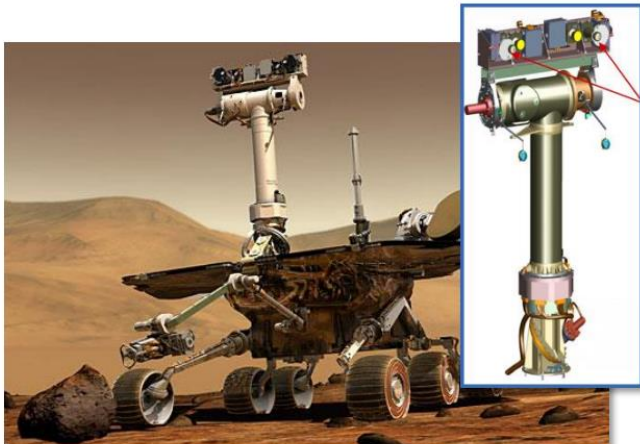
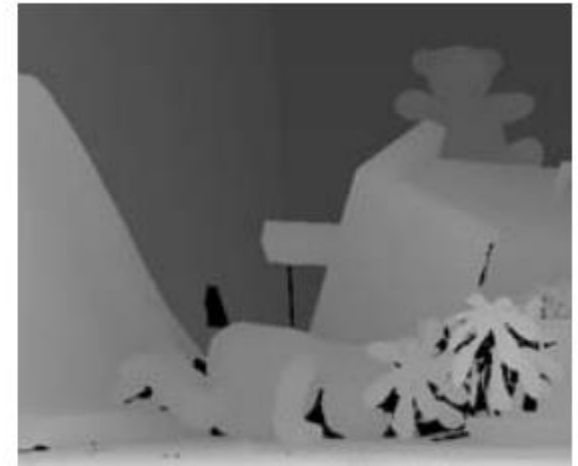
Image calibration

- Fisheye correction from go-pro for example



Stereo & 3d cameras

- https://www.youtube.com/watch?v=PySBQ8Q_R8k



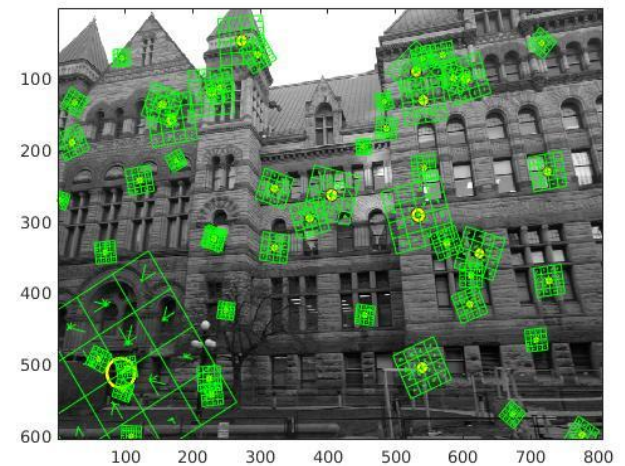
(a)



(b)

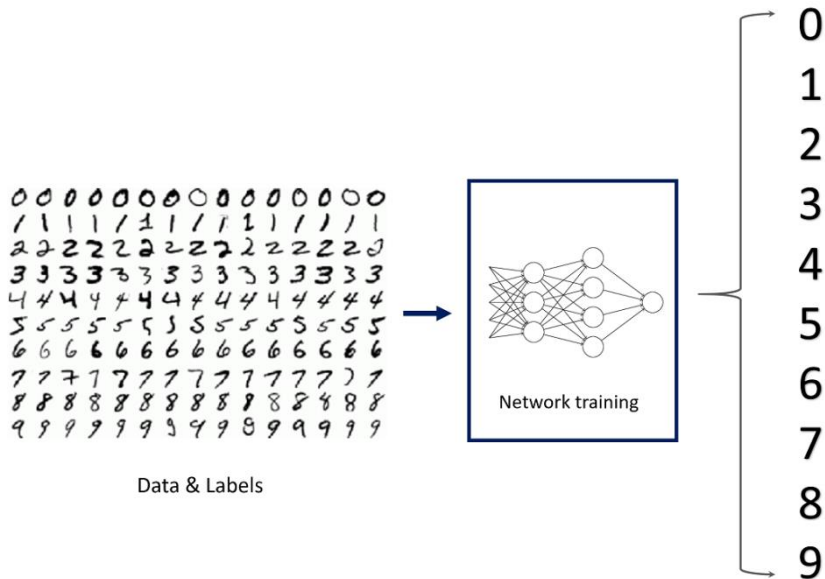
Fitting & Feature extraction

- Extract interesting points from image for later recognition, stitching, learning and more.
- <http://www.in2white.com/>



Neural networks

- <https://deepdreamgenerator.com/generator>
- <https://quickdraw.withgoogle.com>



Dream generator- style transfer



Dream generator- style transfer



And some more AI stuff

- Deep fake
 - <https://www.youtube.com/watch?v=cQ54GDm1eL0>
 - <https://www.youtube.com/watch?v=-QvIX3cY4lc>
- Nvidia GauGAN
 - <https://www.youtube.com/watch?v=p5U4NgVGAWg&t=40s>
 - <http://nvidia-research-mingyuliu.com/gaugan>

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