

Intro to Computer Vision



Yoni Chechik
Computer Vision course

contents

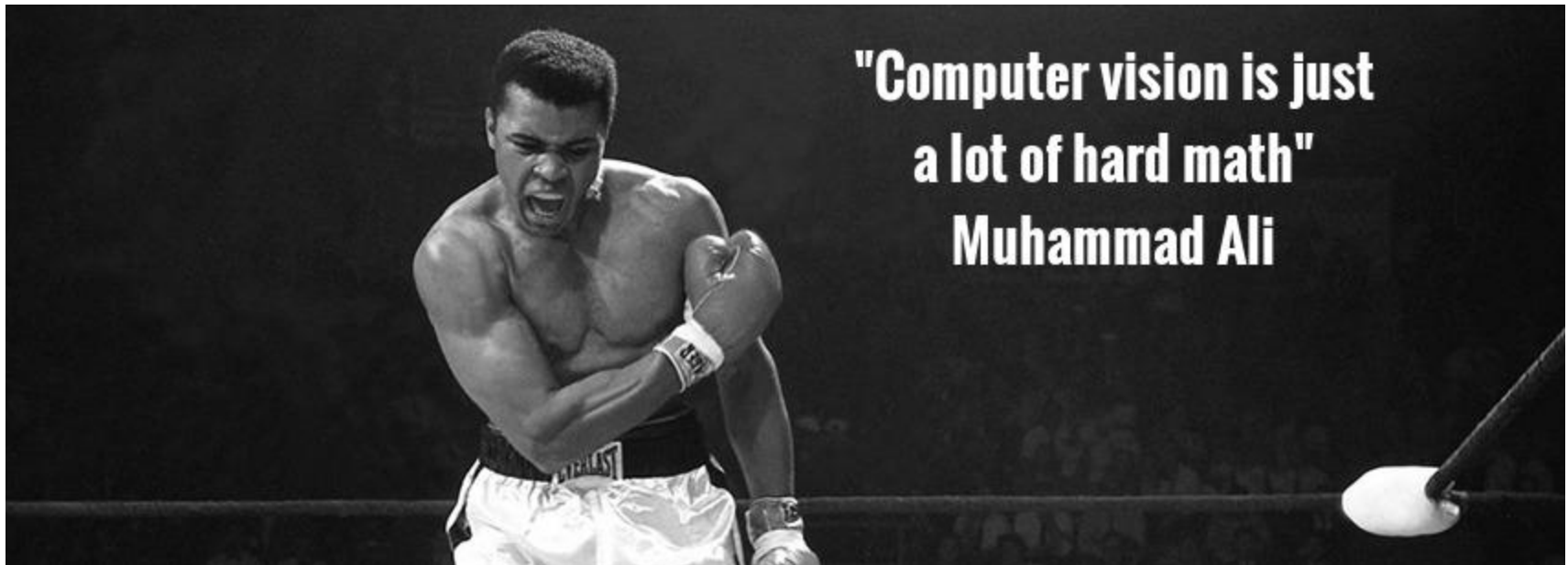
- **Course details**
- What is computer vision (CV)?
- Course outline
- Intro to Python

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.**

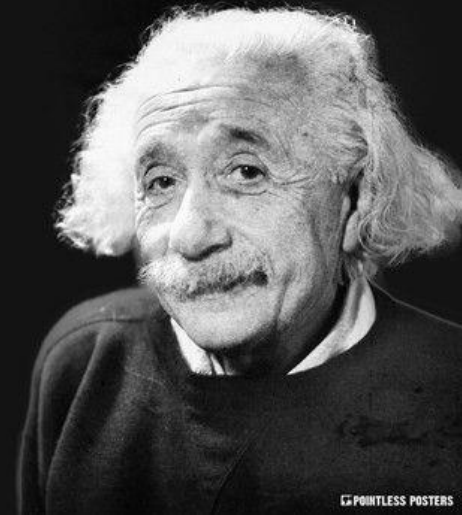


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- **What is computer vision (CV)?**
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Don't believe
everything you read
on the internet just
because there's a
picture with a quote
next to it.

ALBERT EINSTEIN

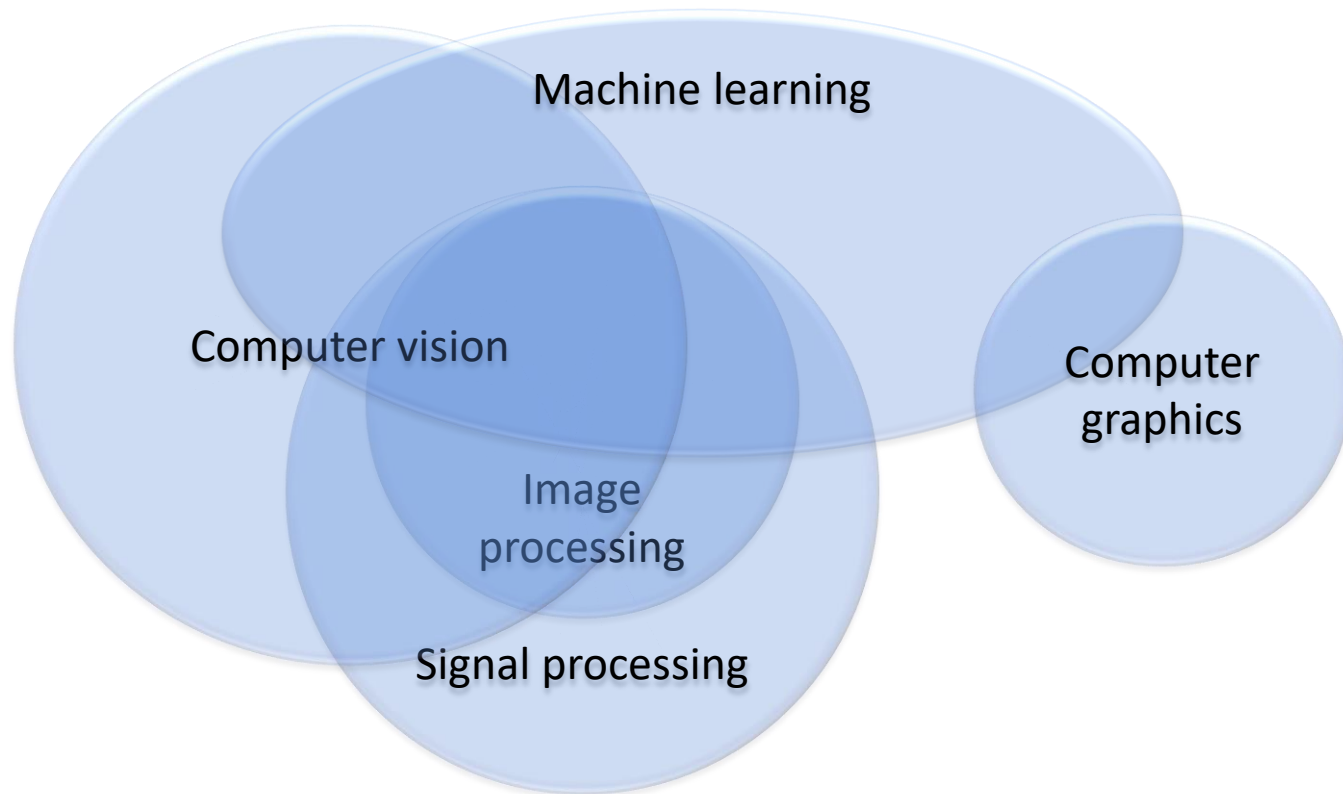


What is CV?

- **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	 Undecidable! October – 2016 NA
	 November – 2013 \$360.0M	 January – 2016 NA	 January – 2016 NA	 REALFACE 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>



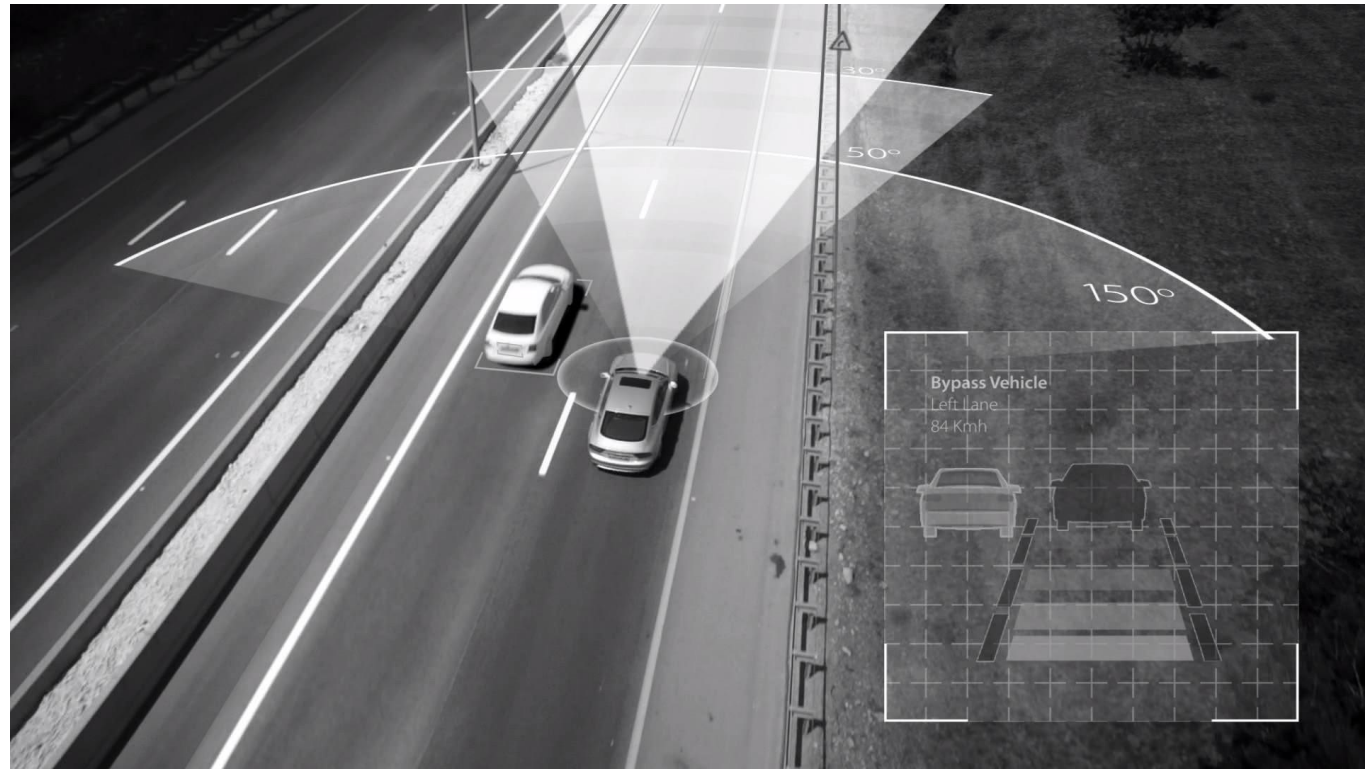
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Mobileye

- **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

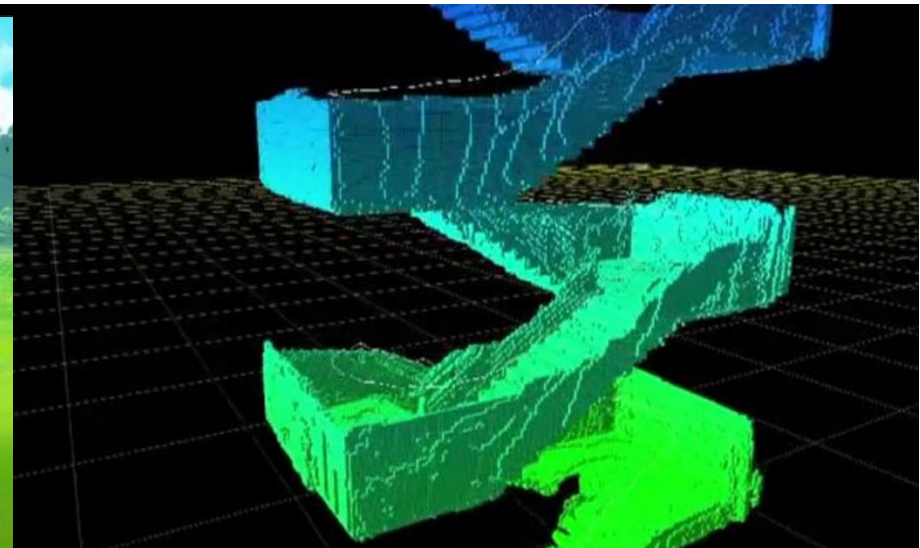
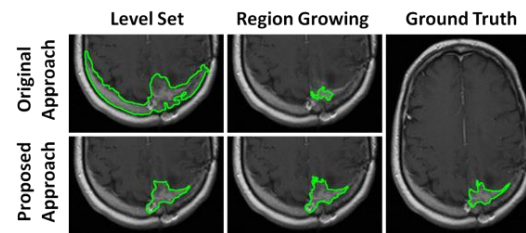


COMPUTER VISION TECHNOLOGY		HEALTHCARE	AUTOMOTIVE	AGRICULTURE	INDUSTRIAL	RETAIL	SECTORS
CHIPS	VIDEO INTELLIGENCE	MEDICAL IMAGING	AUTONOMOUS	CROP MANAGEMENT	ROBOTICS & UTILITIES	MONITORING & ANALYTICS	SMART CITY
Hailo INTEL INUIVE	AGENT EyeSafe QUANTUM Dvision viisights GETALERT VIDEOform SENSORITY videocites ZyroBot XRvision anyvision 1702ai	zebra iz.ai Healthy.io aidoc BODY VISION DIA MobileODT maxQ sight Biomedical FDNA innogy HT DeePathology.ai ORCA PerSimo RADLogics TECHSOMED IBEX XPRINT XRAY MAGENTIQ IMedis Deep Oncology nucleai SCOPIO MedHub-AI	arbe Imagray INNOVIZ Kodiak i4drive ADASXY oryx Vectorai RIDEVISION RAM StreetLight.ai CRadar.AI BWV RFISEE IONTERRA VAYAVISION VOYAGE 81	TARANIS prospera See Tree SKYX fieldin AgroScout saillog arugga GemmaCert SeedX VIBe HiGrade	Planet Watchers KITOV DLR COGNITEAM MOVI SKYLINE ROBOTICS IPV ORCA AI pzartech BladeRanger	trax trigo eyezon WISE SHELF memomi MYSTOR-E SPORTS ANALYTICS & CONTENT playsight TRACK160 WSC Sports PhysiMax SenSwim Zone7 LVISION Baseline	SPATIAL LOGIC UTILIS VISUAL SEARCH syte clonde CONSUMER ROBOTICS & TECH nanit intuition robotics t e m i RES scio FITNESS FITSCANNER MyselfFit
PROCESSING	FACIAL RECOGNITION	OPTICAL	IN-CAR MONITORING	HARVESTING	DRONES	ENTERPRISE	REAL ESTATE
Brodmann Edgify REDFALCON vayyar KAYA INSTRUMENTS TRIEYE NEWSIGHT IMAGING unispectral	FACEPTION D-ID VIKI sense TECHNOLOGIES verifyoo Facetrom FABG BrighterAI IDENTITYTECH	camerEyes BIO EYE NOVASIGHT 6 over 6 RetiSpec IMPAIRMENT AID SESAME ENABLE ORCAM ICI VISION RenewSenses eyecontrol	MDGO eyesight neteera CLAIR LABS GUARDIAN JUNGGO SAVERONE CAARESYS VALERANN NOTRAFFIC AGENT-TECH EyeWay cognata The Wholly Ecce VR, SURGERY & MONITOR ContinUse Biometrics Augmedics VRHealth	METOMOTION AUTOMATO meshek (76); NEW MEDIA PHOTO & VIDEO CREATION Lightricks Magisto Photomyne WIBBITZ tunity DEEPNEN TELEOPERATION Phantom Auto ottopia INSPECTION UVEYE NEOMATIX Visual Intelligence DASHCAM & ROUTING WHITE RAVEN VIA Parkam flexar	XTEND AerialGuard AIROBOTICS skywatch.ai EDGYBEES ClearVuze Sightec HIGH LANDER thirdeye CIVDRONE vHive PERCEPTO CONSTRUCTION INSPECTION & MANAGEMENT INTSITE astralink OKIBO Datumate CLONE ARCadia Buildots LIGHTYX CONSTRU	SECURITY, DEV. & SUPPORT intervyo minereye appltools tuqqi INTELLIGO voca.ai ActiView TechSee MARKETING VIDEO, CONTENT & SECURITY Taboola anyclip BrandTotal AdVerif.ai CHEQ TAILOR BRANDS minute cedate COMIGO	Leaperr Flatspace FASHION SIZER fitfully ZEEKIT WATER VISION LYNXIGHT DEEP VISION CORAL DETECTION SYSTEMS EDUCATION, RAIL & TRAVEL RailVISION Anima SeeVoov
OPTICAL & SENSOR	DEVELOPMENT	DATA CREATION	PLATFORM	EYE TRACKING	CONSUMER ROBOTICS & TECH	ENTERPRISE	WATER VISION
vayyar KAYA INSTRUMENTS TRIEYE NEWSIGHT IMAGING unispectral	missinglink.ai allegro.ai dataLoop Clay Sciences	INNEREYE DataGen technologies edgecase.ai	Voyager Labs cortica ADSHIR Reality human-eyes RESTAR SUPER REALITY MANTIS VISION SPECTALIX	Blink	nanit intuition robotics t e m i RES scio FITNESS FITSCANNER MyselfFit	SECURITY, DEV. & SUPPORT intervyo minereye appltools tuqqi INTELLIGO voca.ai ActiView TechSee MARKETING VIDEO, CONTENT & SECURITY Taboola anyclip BrandTotal AdVerif.ai CHEQ TAILOR BRANDS minute cedate COMIGO	Leaperr Flatspace FASHION SIZER fitfully ZEEKIT WATER VISION LYNXIGHT DEEP VISION CORAL DETECTION SYSTEMS EDUCATION, RAIL & TRAVEL RailVISION Anima SeeVoov

More CV related topics

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

Segmentation Results



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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>

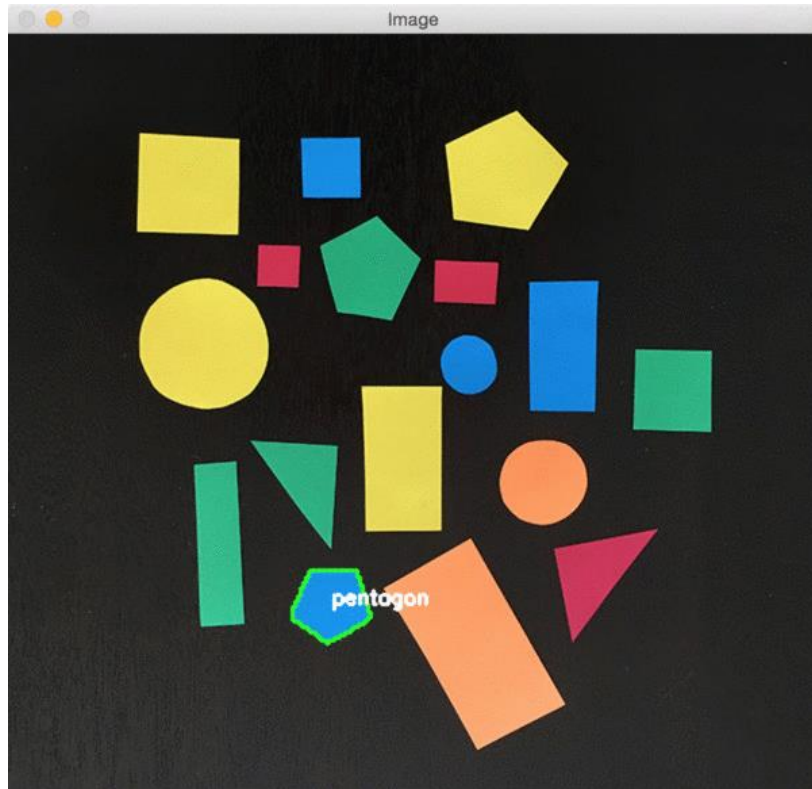


Edge Detection

- <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.



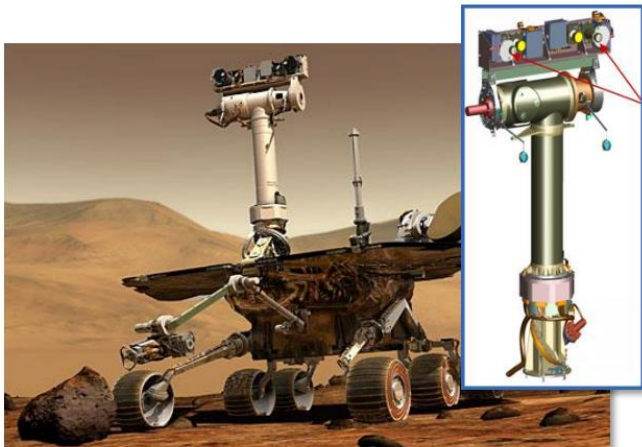
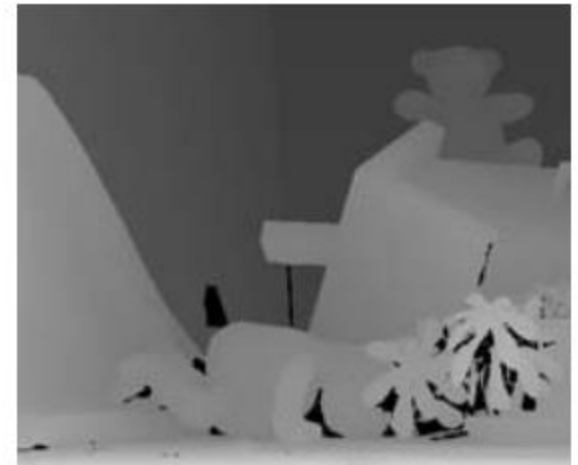
Image calibration

- Fisheye correction from go-pro for example



Stereo & 3d cameras

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



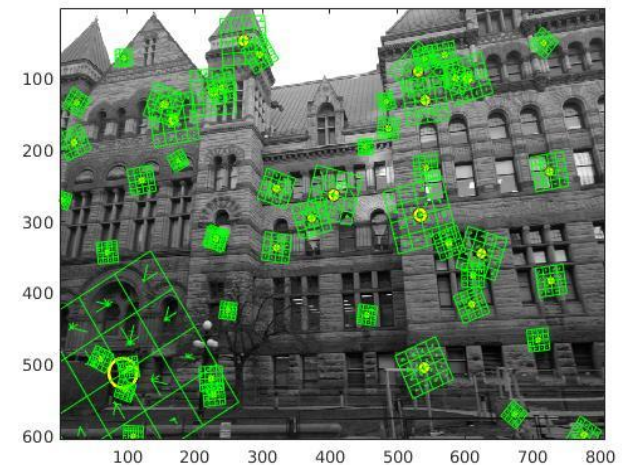
(a)



(b)

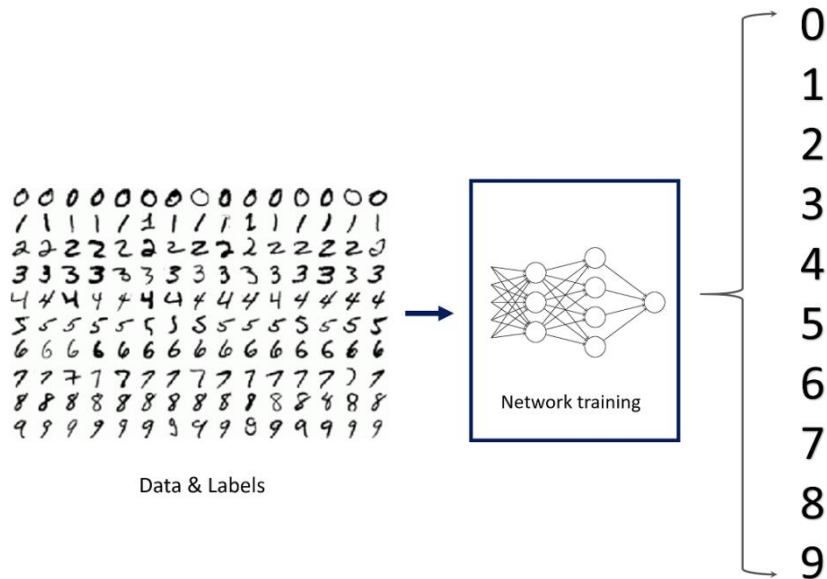
Fitting & Feature extraction

- 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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