

# Intro to Computer Vision



Yoni Chechik  
Computer Vision course

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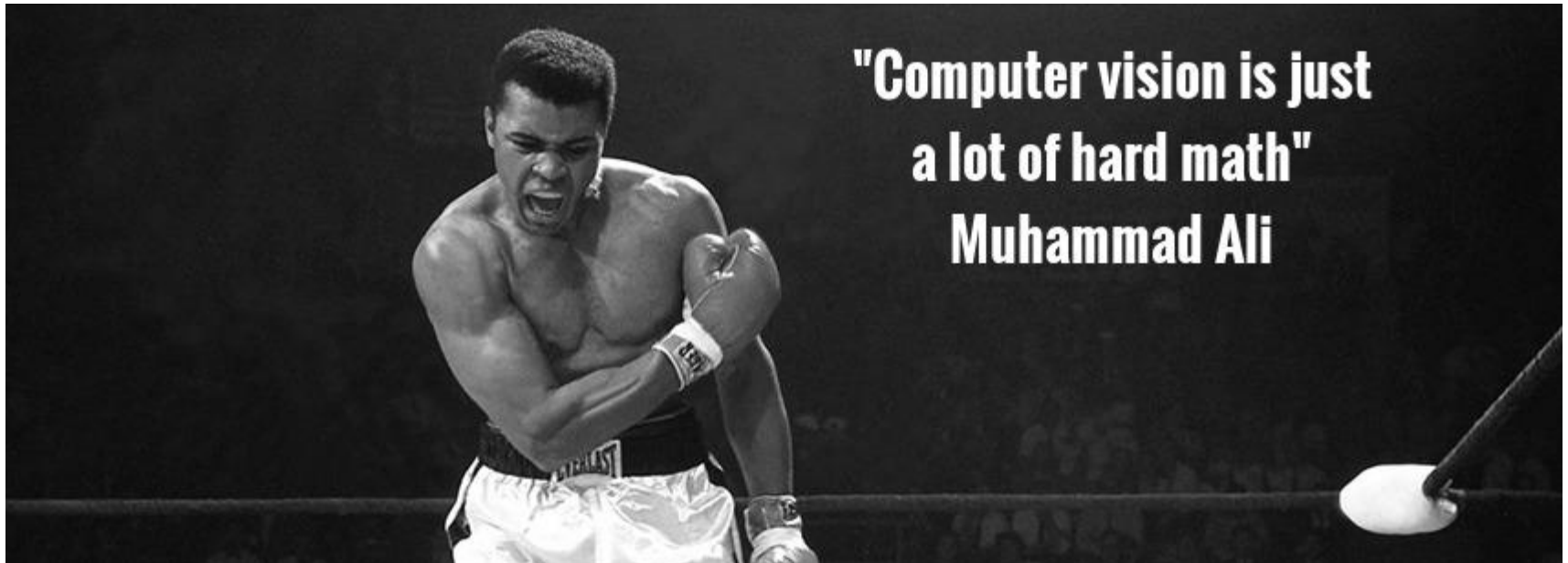
- **Course details**
- What is computer vision (CV)?
- Course outline
- Intro to Python

# 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.**

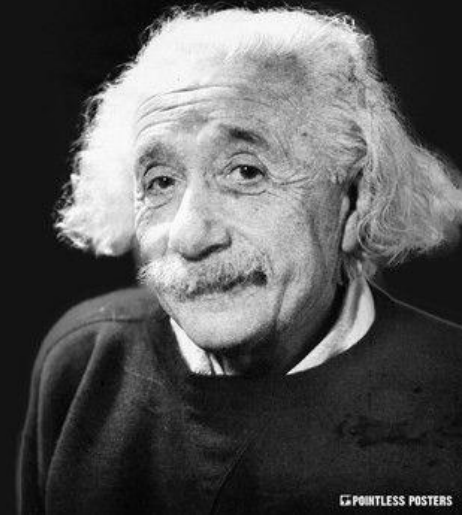


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Don't believe  
everything you read  
on the internet just  
because there's a  
picture with a quote  
next to it.

ALBERT EINSTEIN

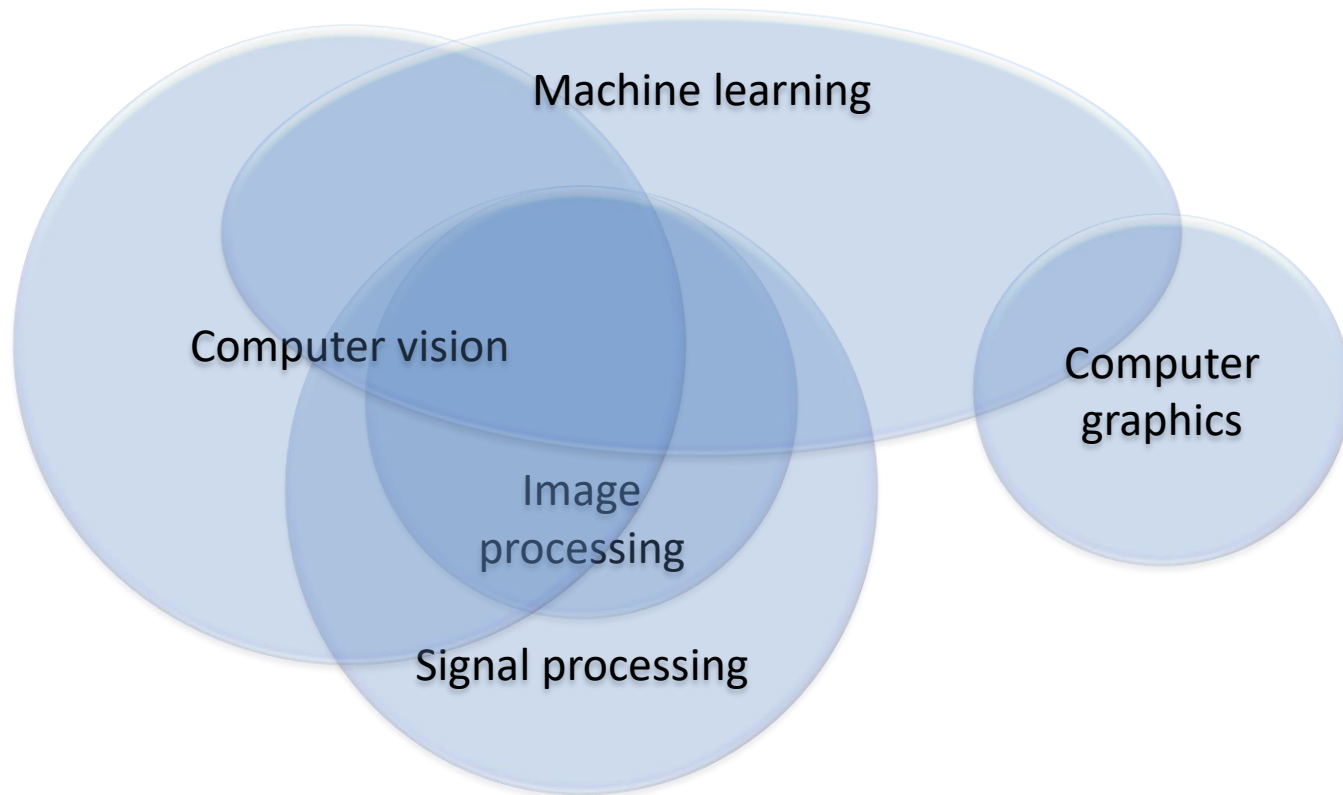


# What is CV?

- **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>



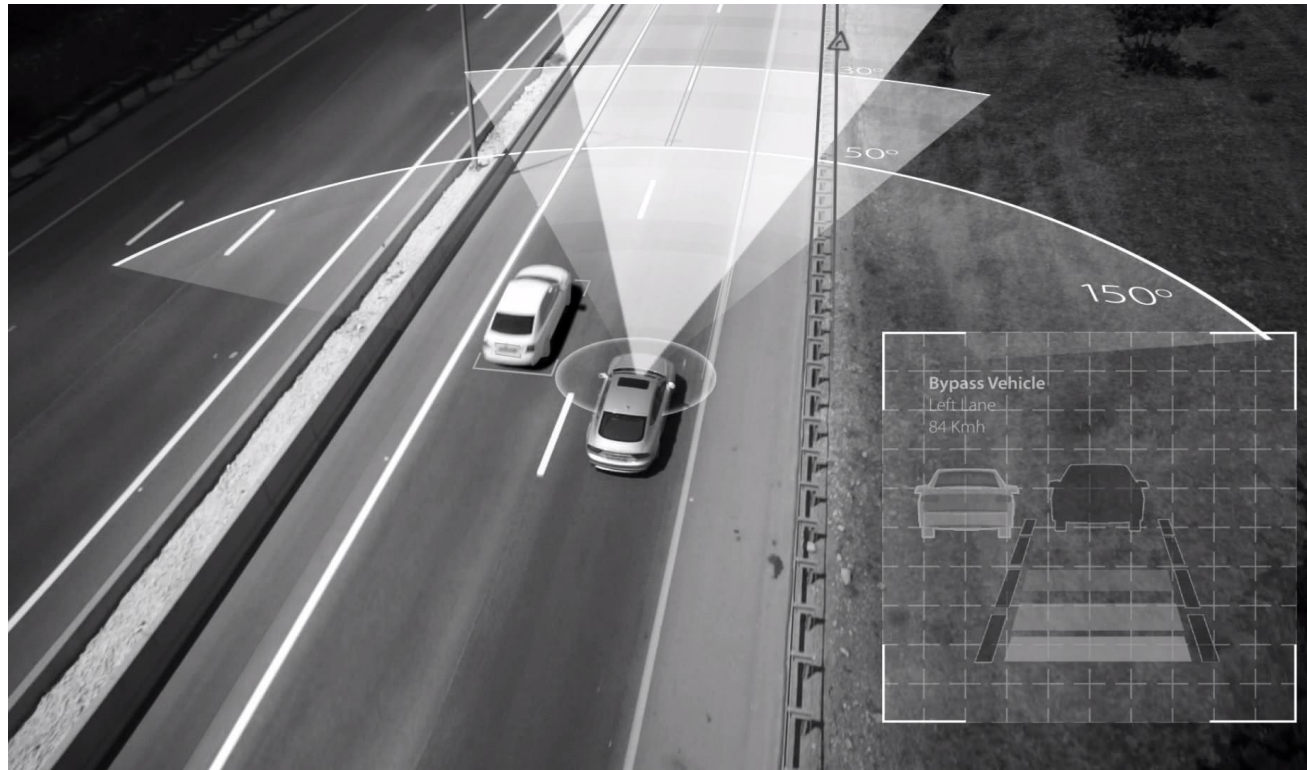
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# Mobileye

- **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>





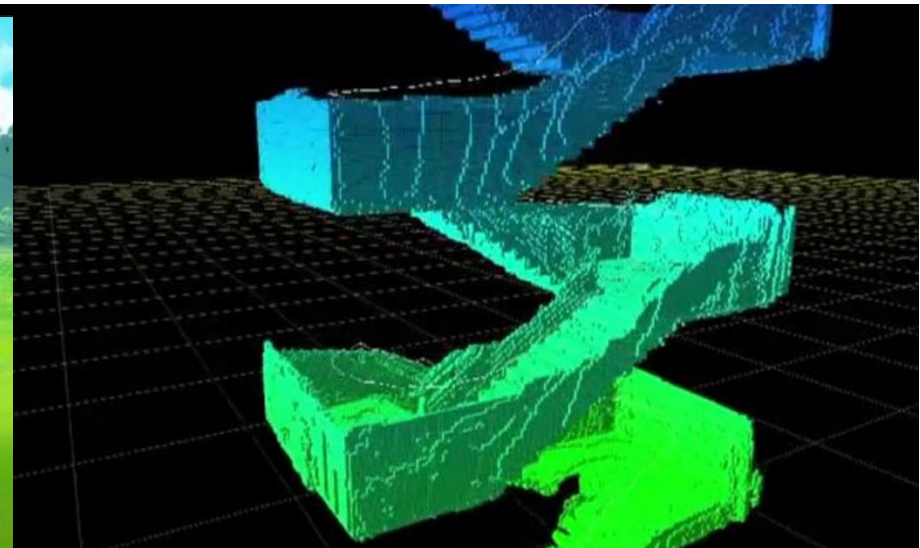
ISRAEL'S **COMPUTER VISION** STARTUPS

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# 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



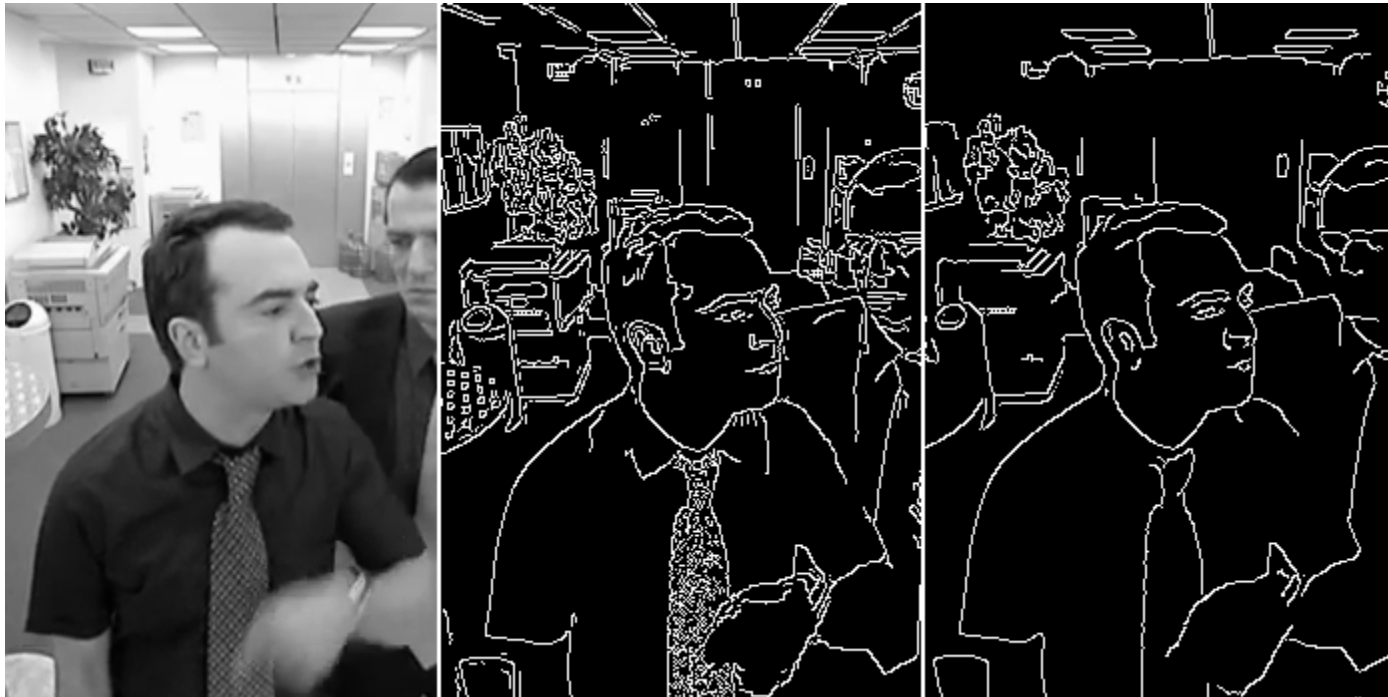
# Image processing

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

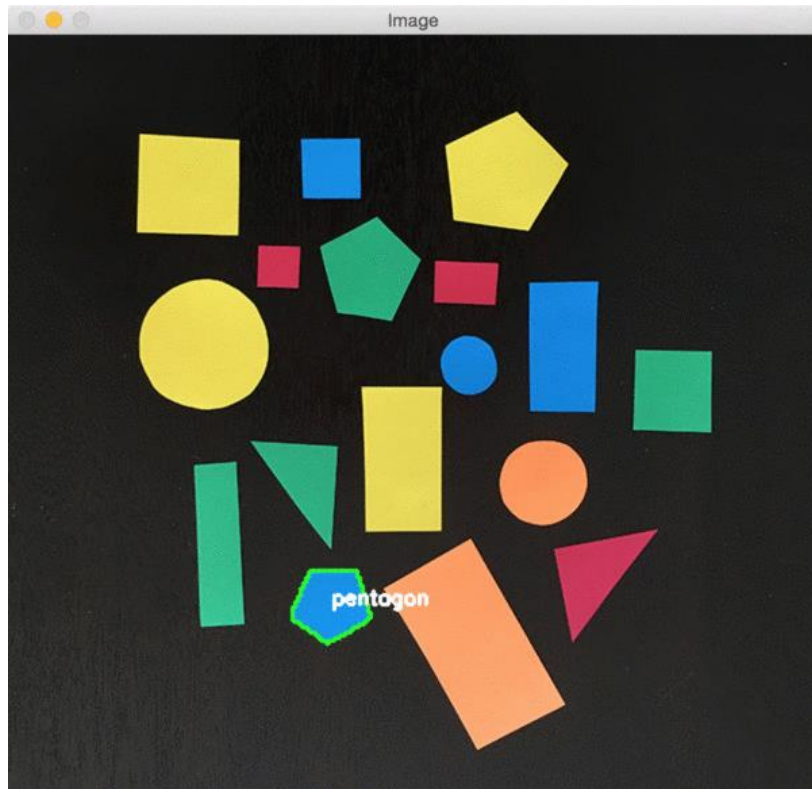


# Edge Detection

- <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.





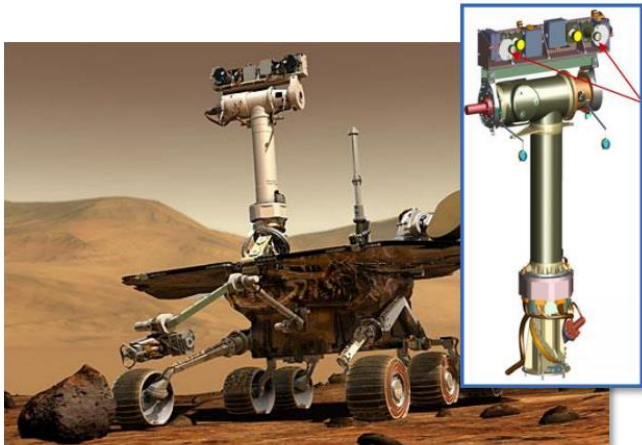
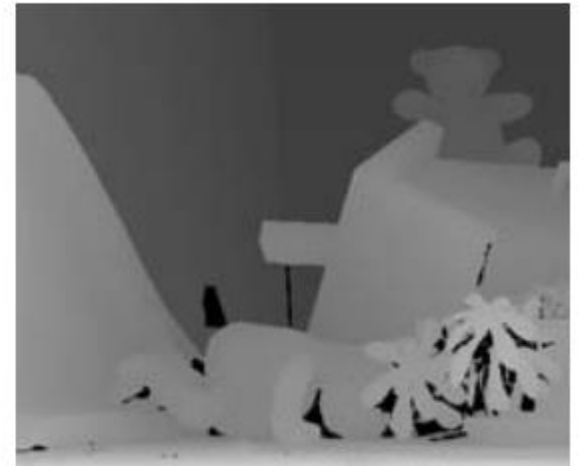
# Image calibration

- Fisheye correction from go-pro for example



# Stereo & 3d cameras

- [https://www.youtube.com/watch?v=PySBQ8Q\\_R8k](https://www.youtube.com/watch?v=PySBQ8Q_R8k)



(a)

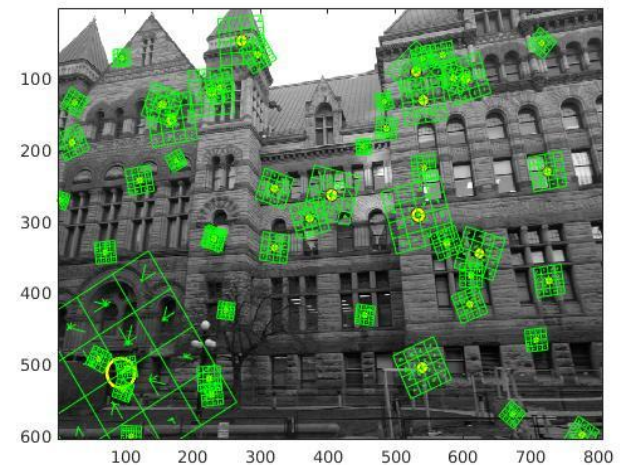


(b)



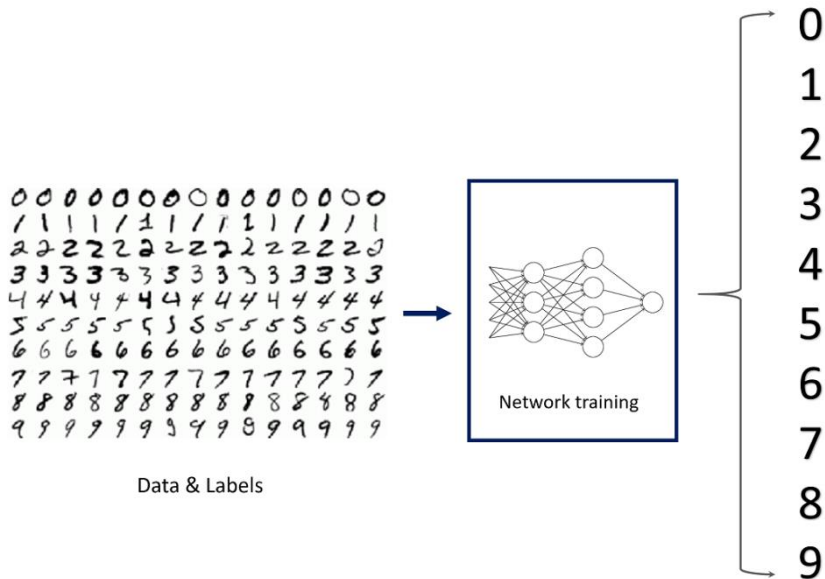
# Fitting & Feature extraction

- 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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