Learning to see: How machines learn to understand images?

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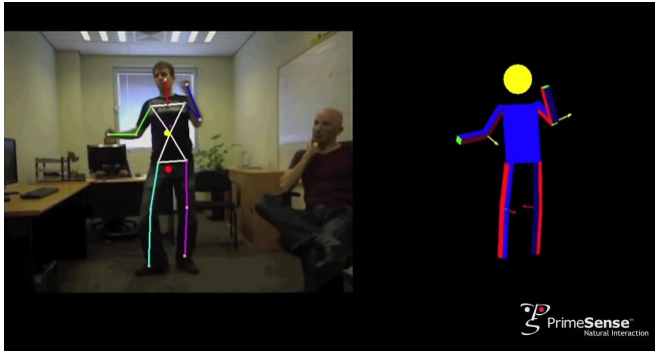
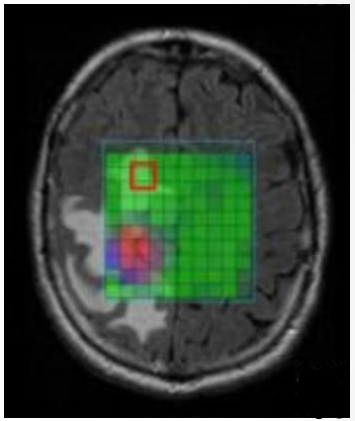
This talk

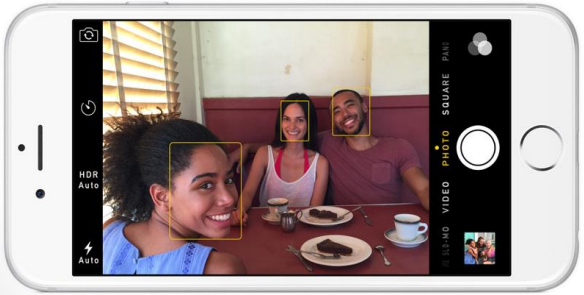
- Introduction
- How does a computer see?
- What is an image?
- Extracting useful information
- How does a computer learn?
- Applications
- Demos (if time allows)


COMPUTER VISION
IS EVERYWHERE
memegenerator.net

Some applications…



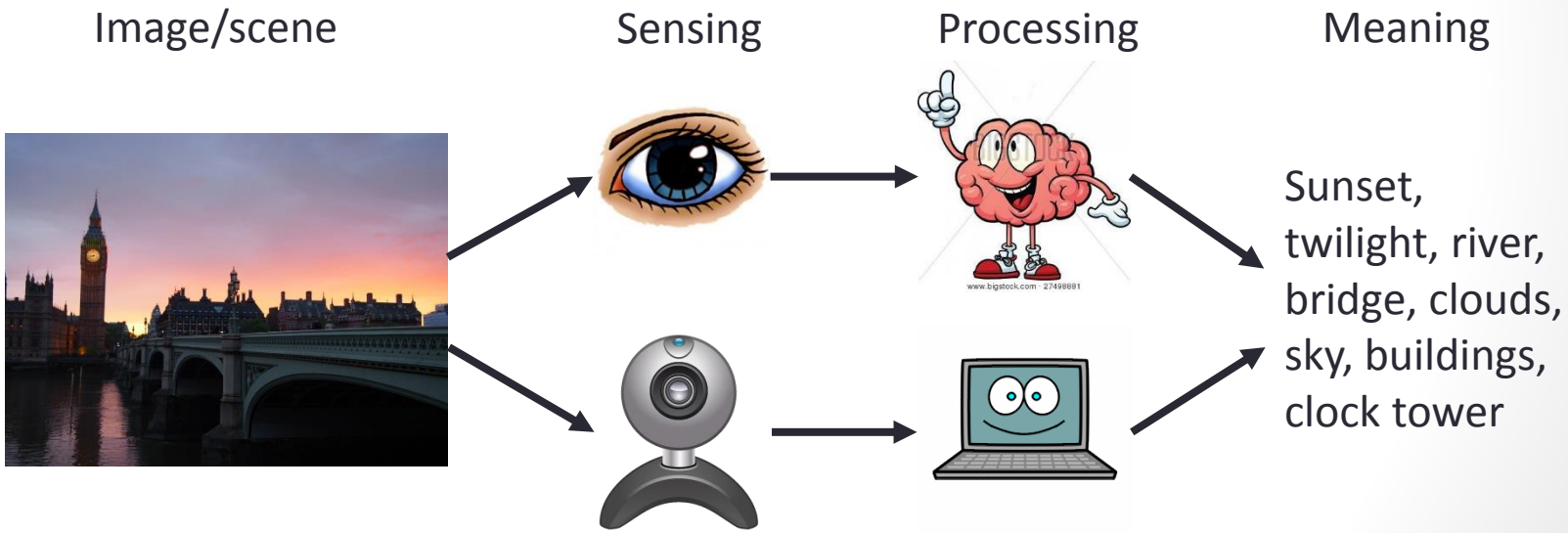




A person riding a motorcycle on a dirt road.

How does a computer see?

- How do we “see” something? What processes does it involve?
- How does a computer achieve the same task?



https://www.cs.princeton.edu/courses/archive/spring07/cos424/lectures/li-guest-lecture.pdf

What is an image?

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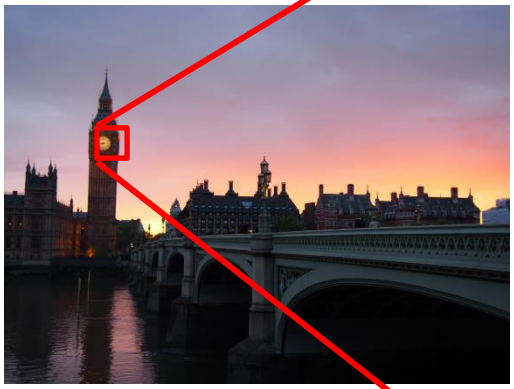

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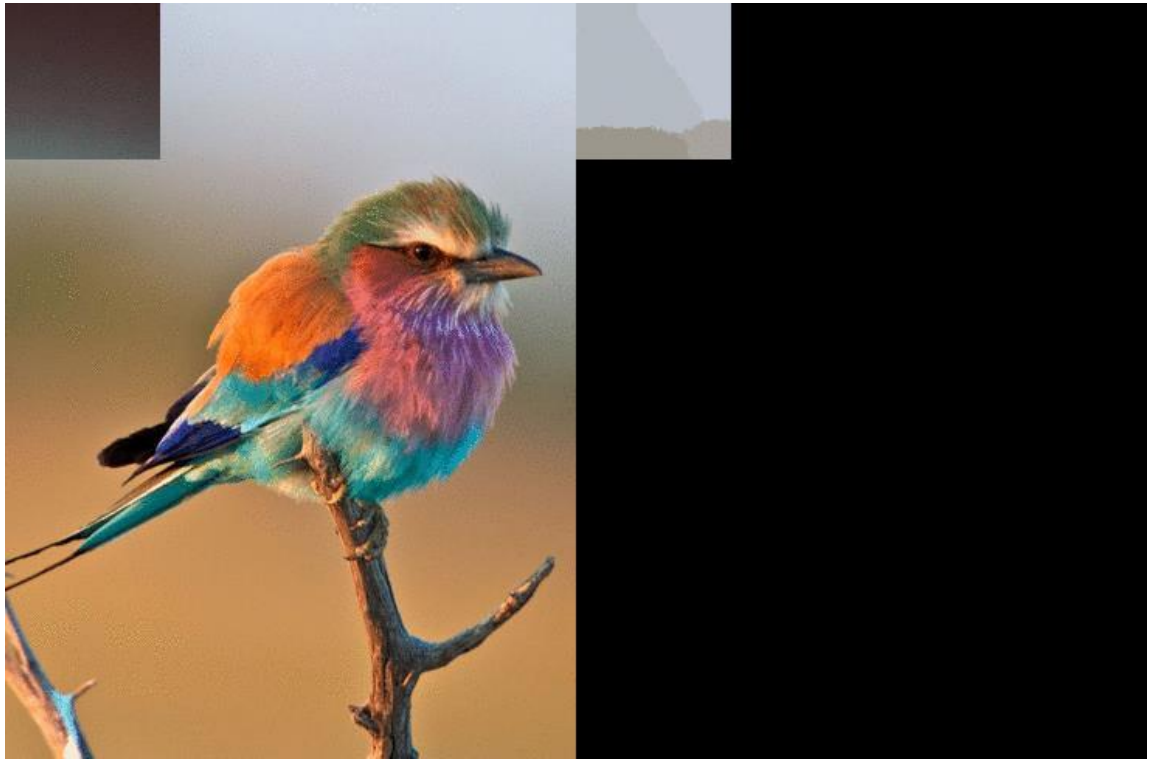
Useful information

- Problems with images
  - Too much information

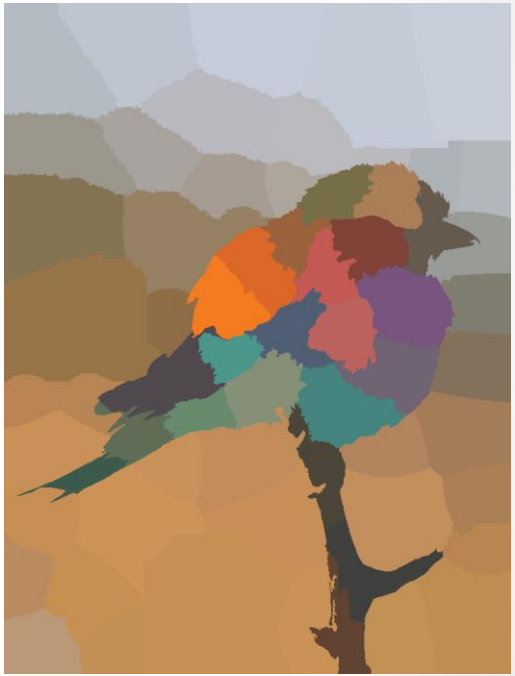
- Features of interest are extracted using a set of mathematical operations that represent:
  - Shape Information
  - Color(s) Information
  - Texture Information

https://uk.pinterest.com/explore/hummingbird-photos/

How are the features extracted?



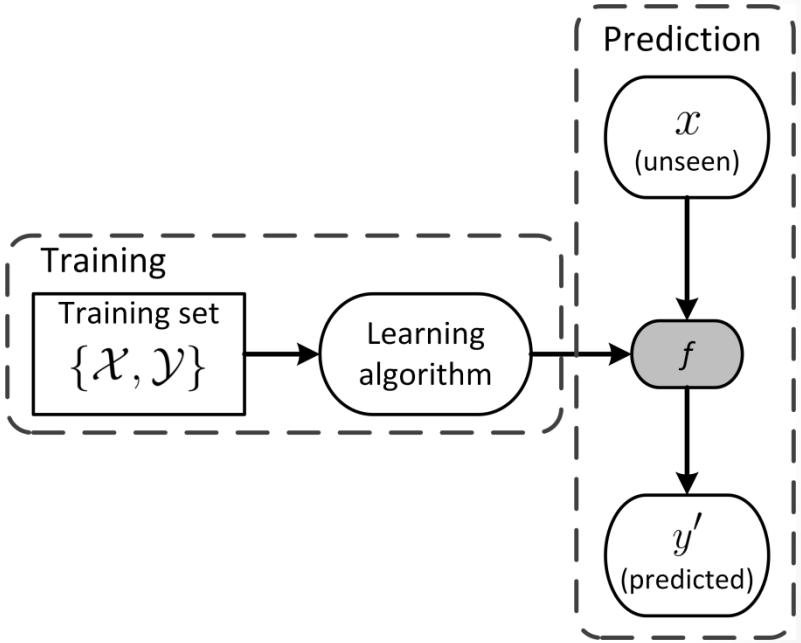
Feature extraction



https://uk.pinterest.com/explore/colourful-birds/

How does a computer learn?

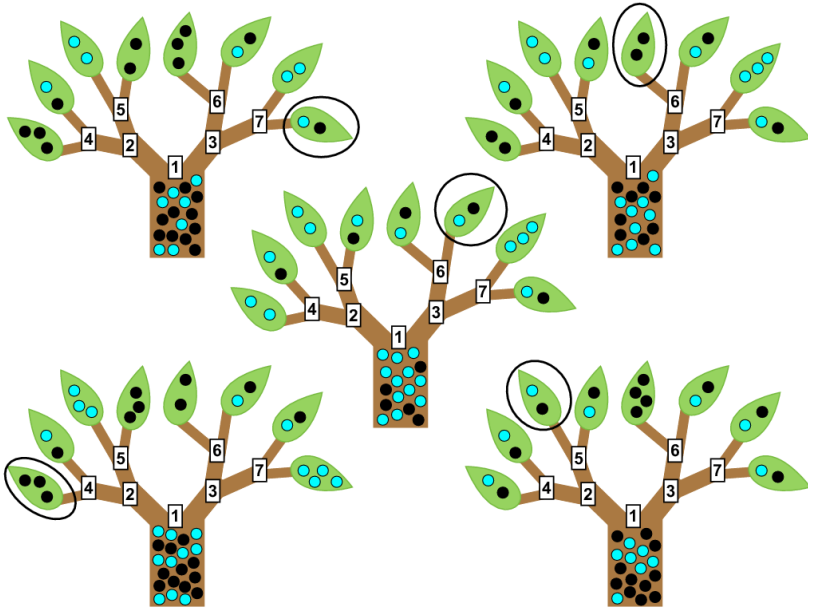
- Given a training set $\{\mathcal{X}, \mathcal{Y}\}$
  - x - Input features
  - y - Target labels
- Learn function $f : \mathcal{X} \mapsto \mathcal{Y}$
  - f could be a regression or classification based on y

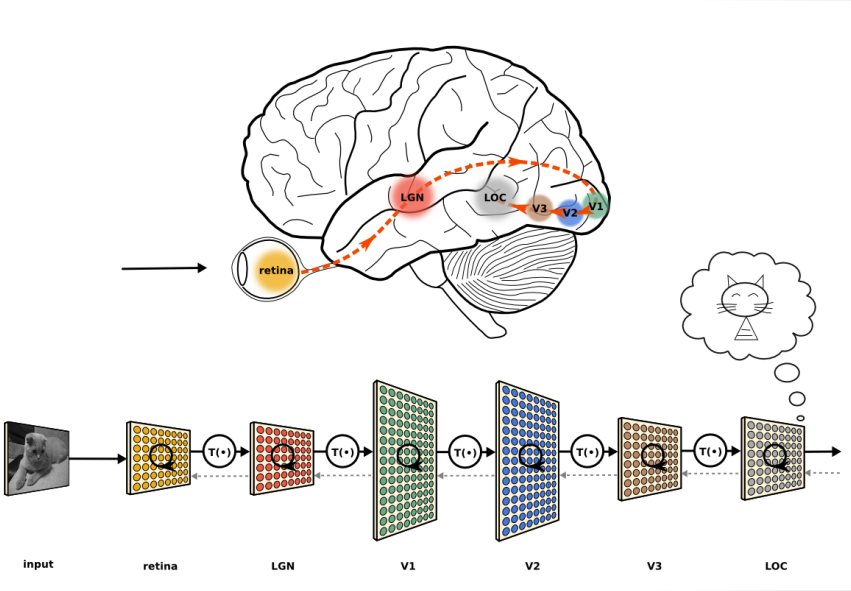


Inspiration from nature…

http://machinelearningmastery.com/tune-machine-learning-algorithms-in-r/
http://scicurious.scientopia.org/2011/05/04/science-101-the-neuron/

Inspiration from nature…

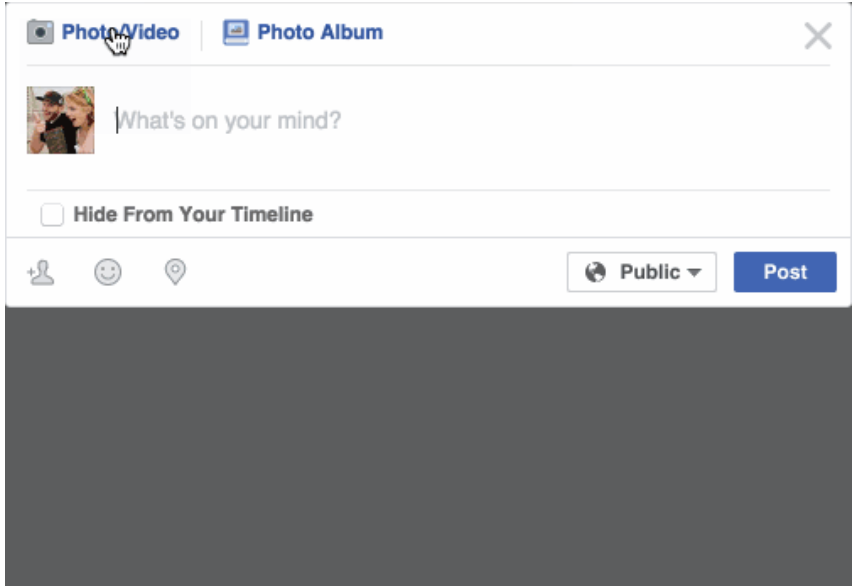


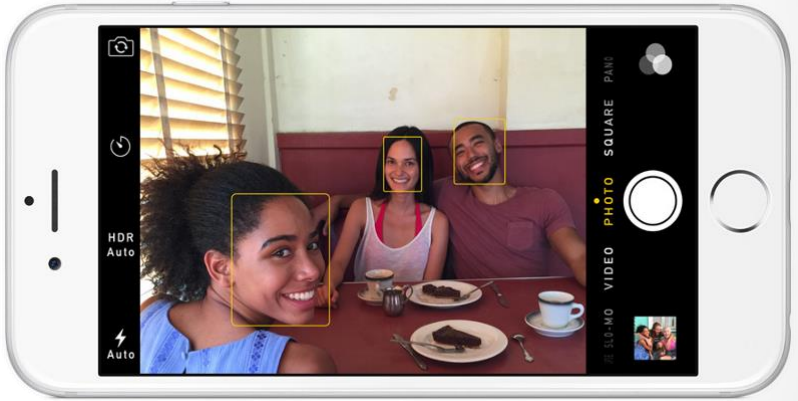


https://inspirehep.net/record/1335130/plots
https://neuwritesd.org/2015/10/22/deep-neural-networks-help-us-read-your-mind/

Applications

Face recognition…





Machine Learning is Fun! Part 4: Modern Face Recognition with Deep Learning
https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78

Recognizing objects…

https://aiexperiments.withgoogle.com/

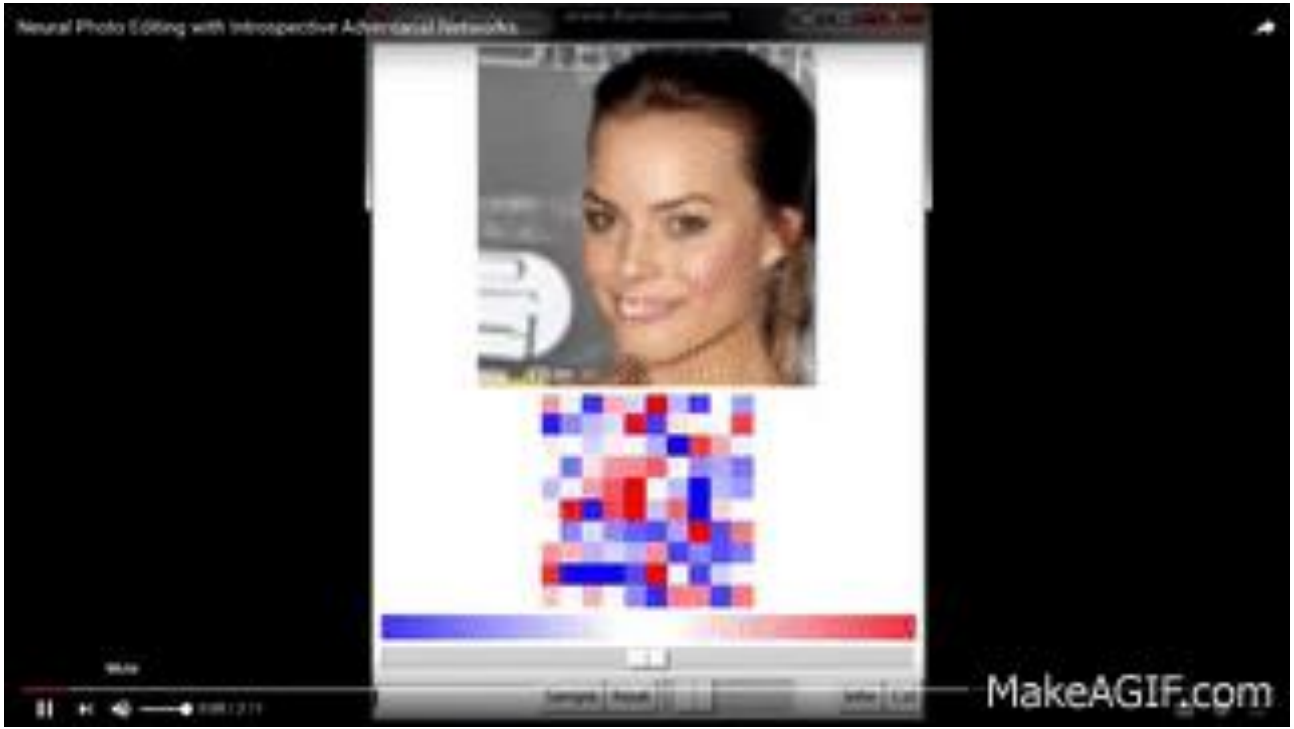
Recognizing drawings…

https://aiexperiments.withgoogle.com/

Photo editing…

NIPS 2016 – Generative Adversarial Networks – Ian Goodfellow
https://www.youtube.com/watch?v=AJVyzd0rqdc

Photo editing…



NIPS 2016 – Generative Adversarial Networks – Ian Goodfellow
https://www.youtube.com/watch?v=AJVyzd0rqdc

Style transfer from art…

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https://deepart.io/

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Image captioning…

A person riding a motorcycle on a dirt road.

A picture is worth a thousand (coherent) words: building a natural description of images
https://research.googleblog.com/2014/11/a-picture-is-worth-thousand-coherent.html

Image captioning…

A herd of elephants walking across a dry grass field.

A picture is worth a thousand (coherent) words: building a natural description of images
https://research.googleblog.com/2014/11/a-picture-is-worth-thousand-coherent.html

Image captioning…

A refrigerator filled with lots of food and drinks.

A picture is worth a thousand (coherent) words: building a natural description of images
https://research.googleblog.com/2014/11/a-picture-is-worth-thousand-coherent.html

Self driving cars…

Nick's Tesla –Self Driving Car Demo Video Analyzed
https://www.youtube.com/watch?v=YntM3bVVago

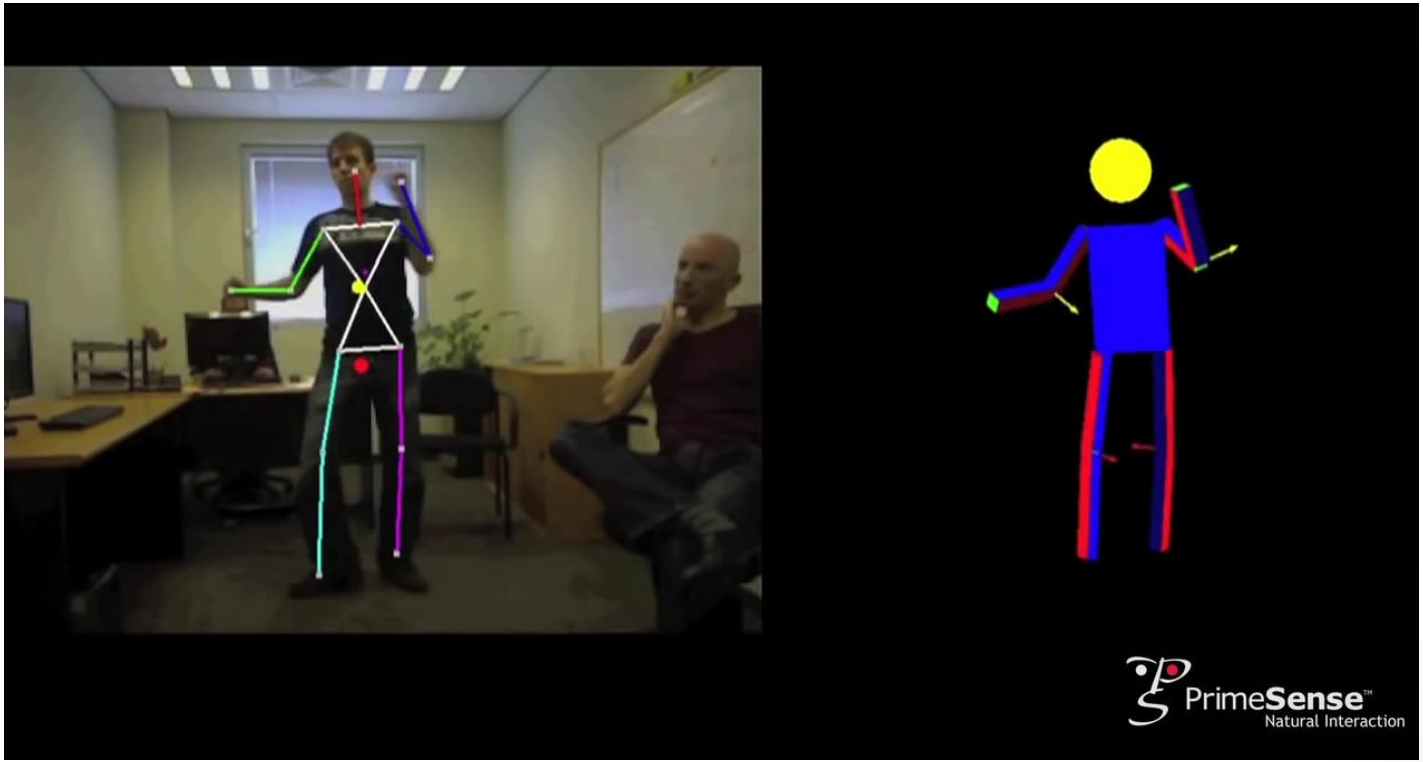

MEDIUM RANGE VEHICLE CAMERA
MakeAGIF.com

Augmented Reality…

Revealing invisible changes…

Revealing invisible changes in the world
https://www.youtube.com/watch?v=e9ASH8IBJ2U

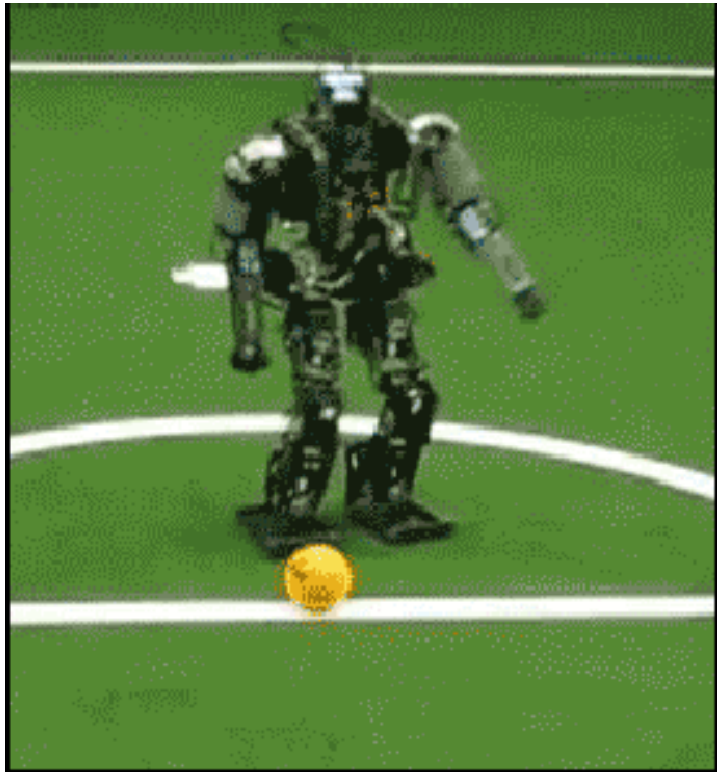
Understanding human motion…



Demos

- https://quickdraw.withgoogle.com/
- http://cs.stanford.edu/people/karpathy/convnetjs/demo/image_regression.html
- https://aiexperiments.withgoogle.com/

Thank you!



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http://masadcv.github.io/