

Intro. to Intro. to Computer Vision

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Intro. to Computer Vision (MC949/MO446)
2º Semester 2017

- Guatemalan
- B.Sc. Computer Science and Systems, USAC



- Professor, UDP, Chile

- Professor, UNICAMP, Brazil

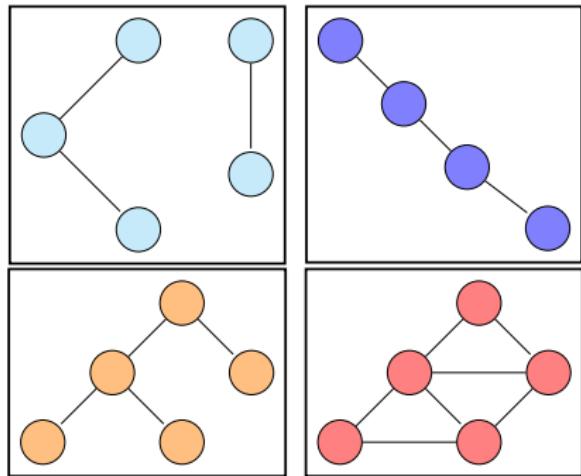
- M.Sc. Computer Vision,
- Ph.D. Computer Vision, KHU, South Korea



What is learning?

What is learning?

- Cognitive process that **requires work/effort**
- Create a cognitive conflict and solve it
- Accommodate mental structures
- Different types of knowledge
 - ▶ What to look for?
 - ▶ How to build it?



Which learning paradigm do you use?

Teaching based

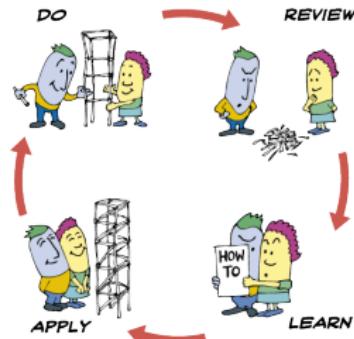
- Professor needs to teach me
 - ▶ Contents need to be covered
 - ▶ Contents are the center
- Focus on **contents** (and remembering them)



Waiting for superman. <https://vimeo.com/19329550>

Learning based

- I have to learn
 - ▶ Search for understanding
 - ▶ Several ways of learning
- Active learning, focus on **understanding**



[https://asmaaahnahrawy.wordpress.com/2015/05/29/
active-learning/](https://asmaaahnahrawy.wordpress.com/2015/05/29/active-learning/)

Our own way

- Learning-based paradigm: **flipped classroom**
- Search for active learning
 - ▶ Activities
 - ▶ Discussions
 - ▶ Work to cement knowledge
- Develop critical thinking
- Result-based activities
 - ▶ Theory is **important**,
 - ▶ but correct **practice** is also important
- If we change the paradigm, we need to change our way of doing things

Data \Rightarrow Knowledge

- Information = $\square \neq \square$ Knowledge

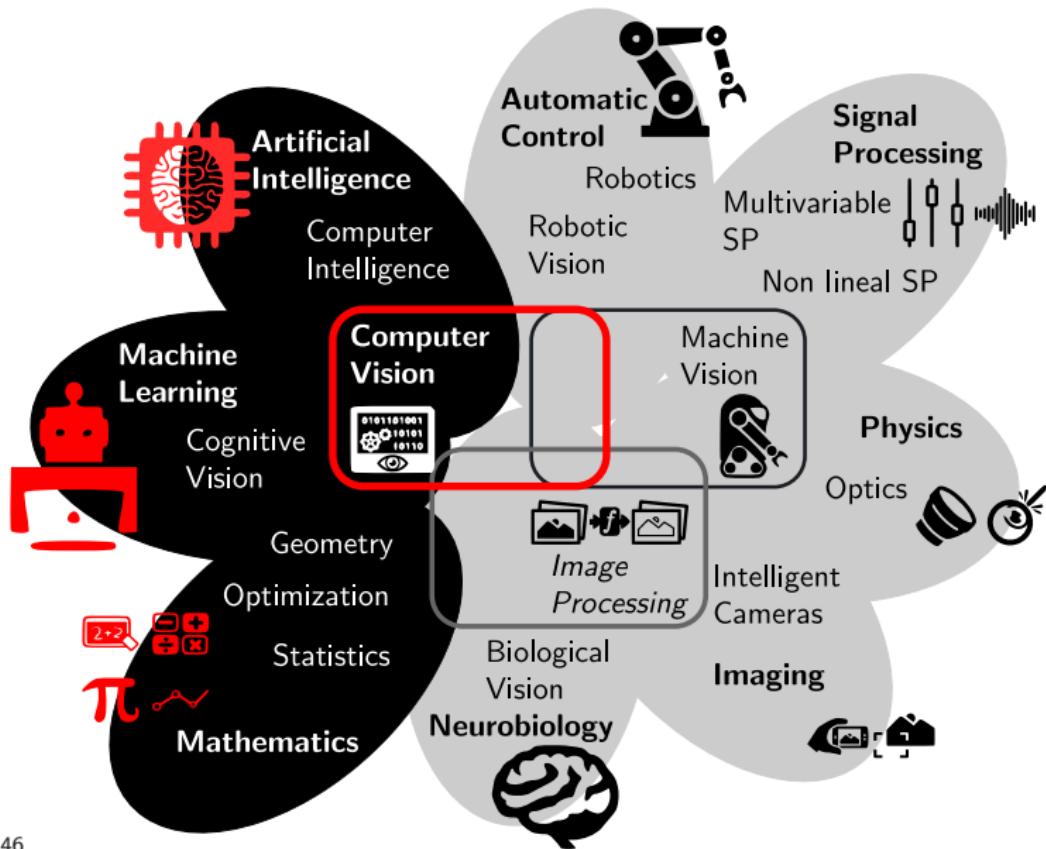
Data \Rightarrow Knowledge

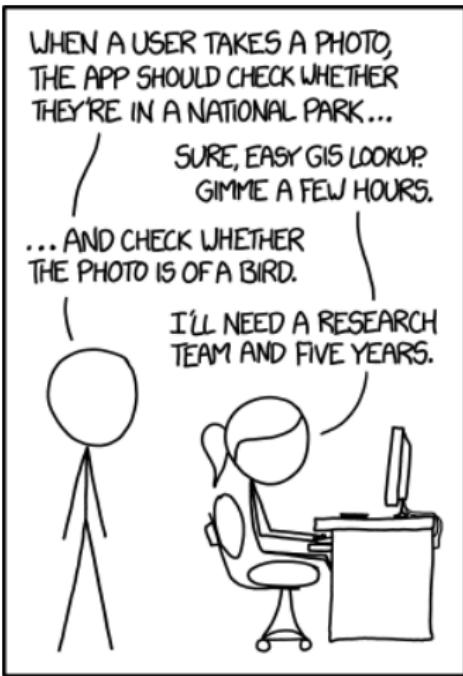
- Information = Knowledge
- How is knowledge created?
 - ▶ Absorb data
 - ▶ Understand information
 - ▶ Infer based on information
- Apply knowledge
 - ▶ How to apply something you don't have?
 - ▶ How to fix something that you don't understand?

It is a process

- Read to understand information
- Process (individually and collectively) to create knowledge
 - ▶ Takes time
 - ▶ It must mature
- Our course will work if everyone is on the same page
 - ▶ **Read**
 - ▶ Discuss and analyze
 - ▶ **Take notes!**
 - ▶ Code and develop
 - ▶ **Feedback**
- **It is a process** (like “Money Ball,” did you watch it?)

Visión por Computador y campos afines





IN CS, IT CAN BE HARD TO EXPLAIN
THE DIFFERENCE BETWEEN THE EASY
AND THE VIRTUALLY IMPOSSIBLE.



EXAMPLE PHOTOS



Photo credits

PARK or BIRD

Want to know if your photo is from a U.S. national park? Want to know if it contains a bird? Just drag it into the box to the left, and we'll tell you. We'll use the GPS embedded in your photo (if it's there) to see whether it's from a park, and we'll use our super-cool computer vision skills to try to see whether it's a bird (which is a hard problem, but we do a pretty good job at it).

To try it out, just drag any photo from your desktop into the upload box, or try dragging any of our example images. We'll give you your answers below!

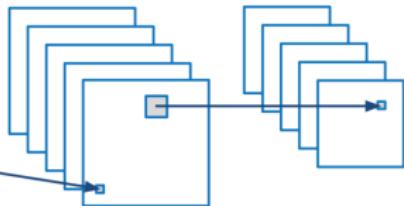
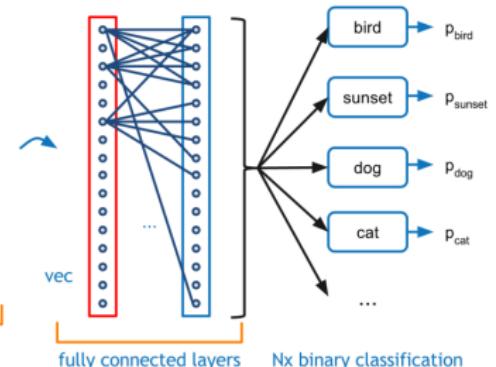
Want to know more about PARK or BIRD, including why the heck we did this? Just click here for more info → [?](#)

PARK? YES

Bare! I hear there's bears in Bryce Canyon.

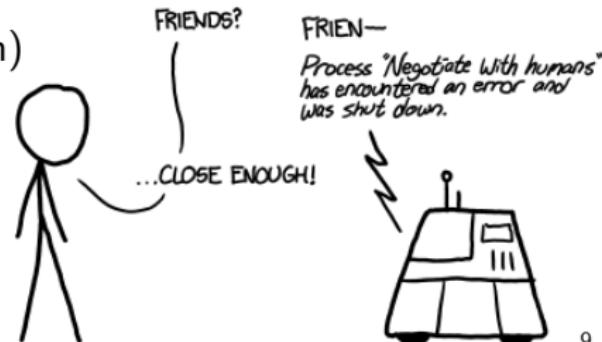
BIRD? NO

Beautiful clouds, but I don't see any birds flying up there.

convolution +
nonlinearityconvolution +
pooling layers

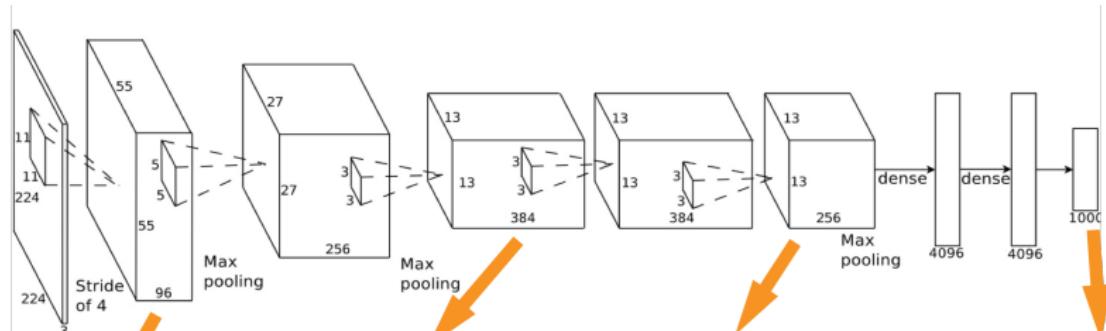
Brief History of Computer Vision

- 1960: synthetic world interpretation
- 1966: Minsky assigns a homework, connect a camera to a computer and make it see
- 1970: progress interpreting selected images
- 1980: ANNs come and go, geometry and math
- 1990: face recognition, and statistical analysis
- 2000: wider recognition, databases show up, and video processing starts
- 2010: deep learning (ANNs again)
- 2030: robot revolution?

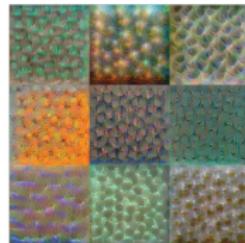


Convolutional Neural Networks (CNN)

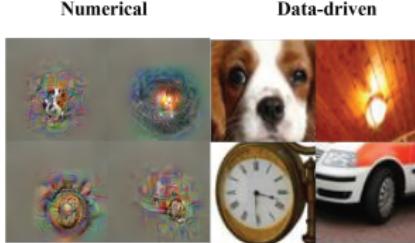
Feature learning



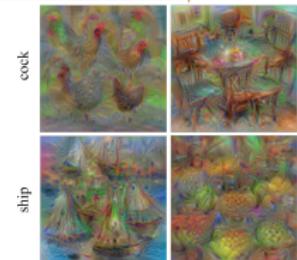
Conv 1: Edge+Blob



Conv 3: Texture



Conv 5: Object Parts



Fc8: Object Classes

Understanding the insides of a CNN

Google DeepDream



Horizon



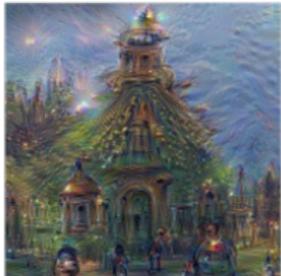
Trees



Leaves



Towers & Pagodas



Buildings



Birds & Insects

Understanding the insides of a CNN

Google DeepDream



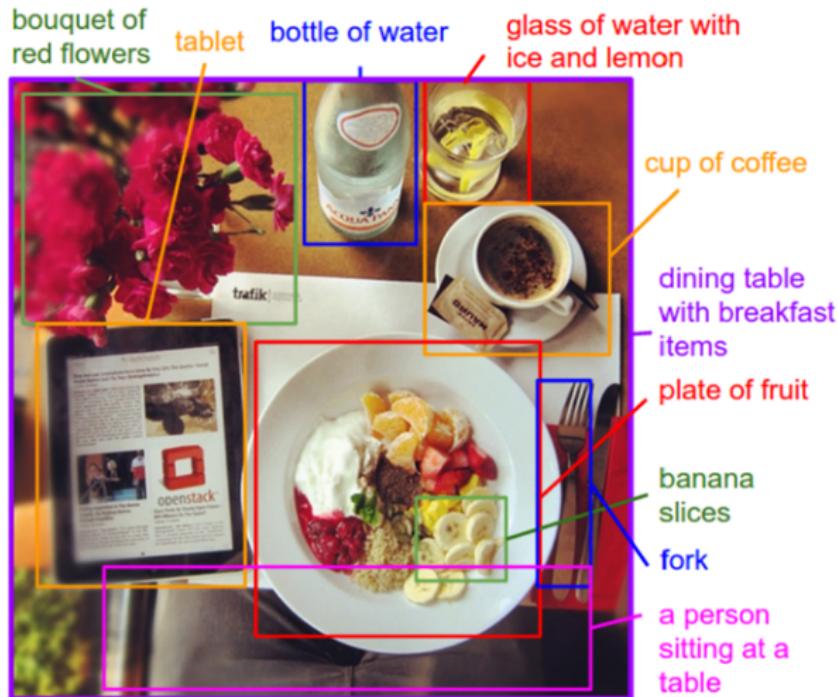
Style Transfer CNN



Style Transfer CNN++



Dense Object Detection



Example output of the model

Generative Adversarial Networks

Next revolution

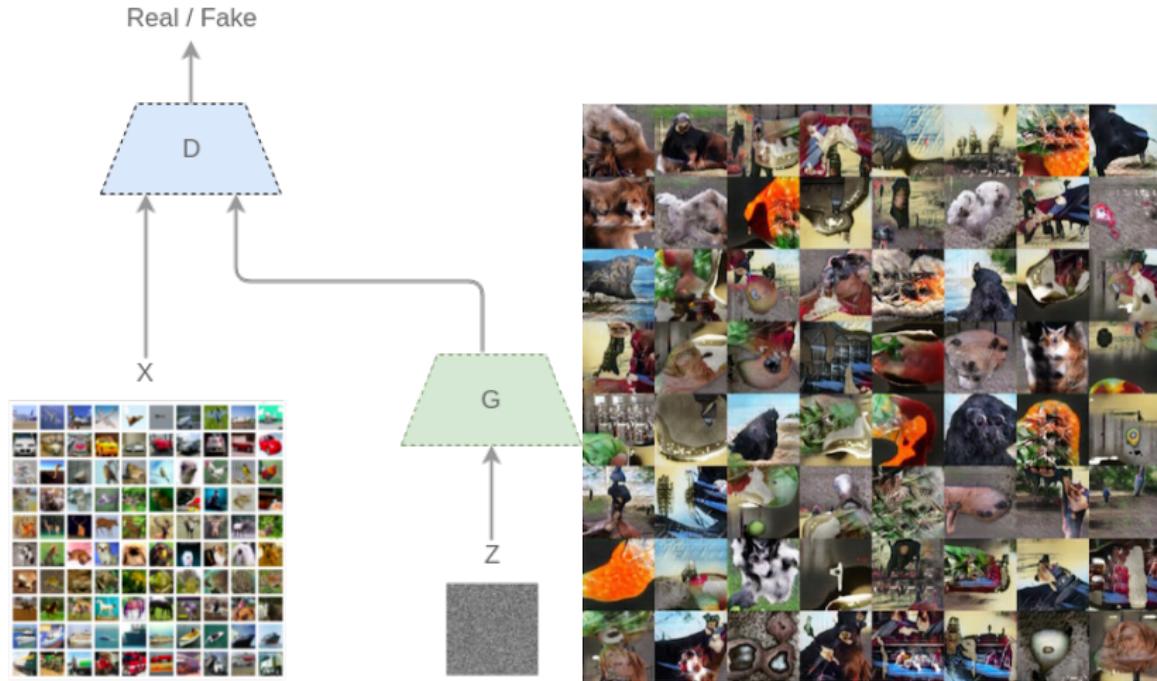


Image Synthesis

this small bird has a pink breast and crown, and black primaries and secondaries.



this magnificent fellow is almost all black with a red crest, and white cheek patch.



the flower has petals that are bright pinkish purple with white stigma



this white and yellow flower have thin white petals and a round yellow stamen



Image to Image Synthesis

Labels to Street Scene



input

Aerial to Map



input

Labels to Facade



input

Day to Night



input

BW to Color



input

Edges to Photo



input

output

Super Resolution

original

bicubic
(21.59dB/0.6423)SRGAN
(20.34dB/0.6562)

Current Companies



Google DeepMind

IA

UBER AI Labs



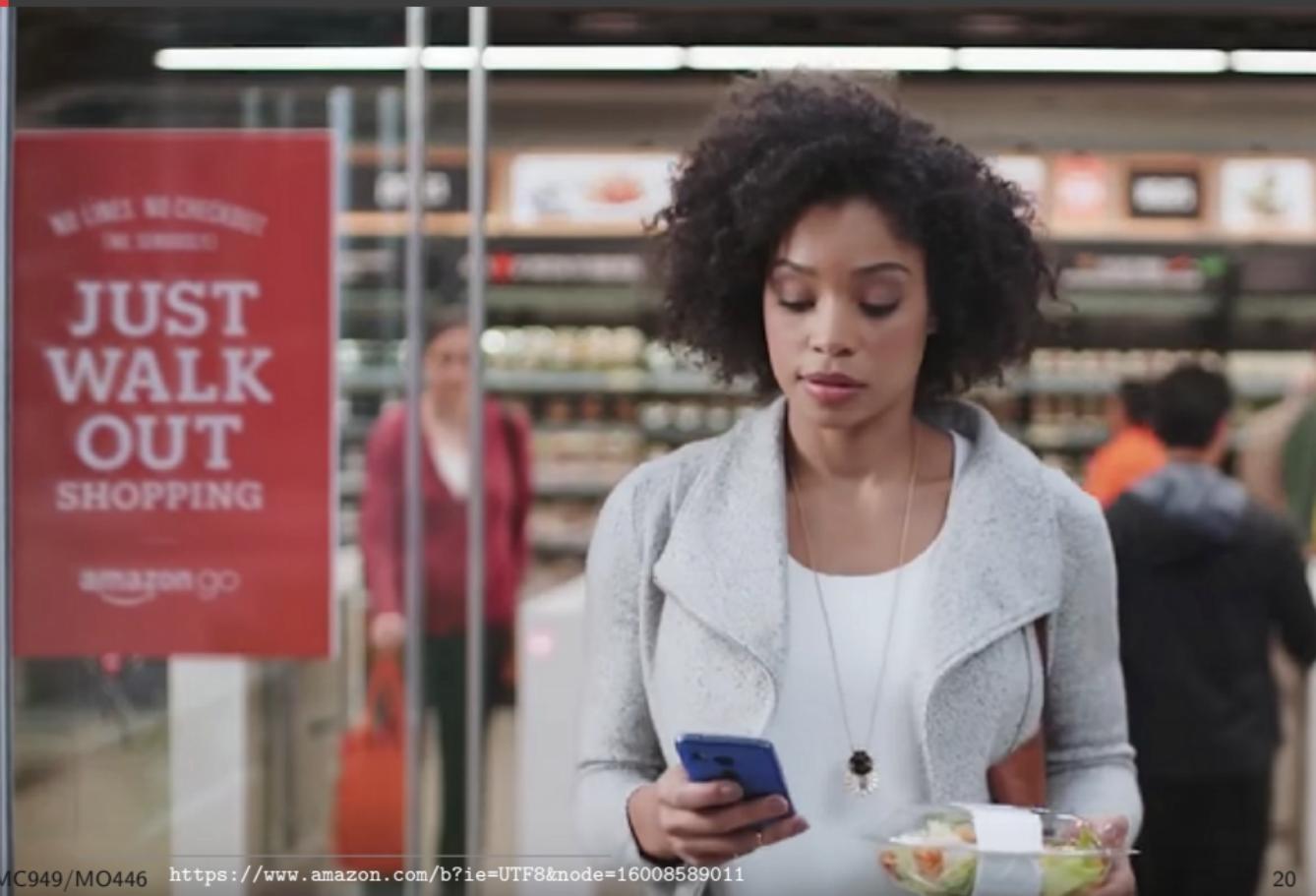
Facebook AI Research



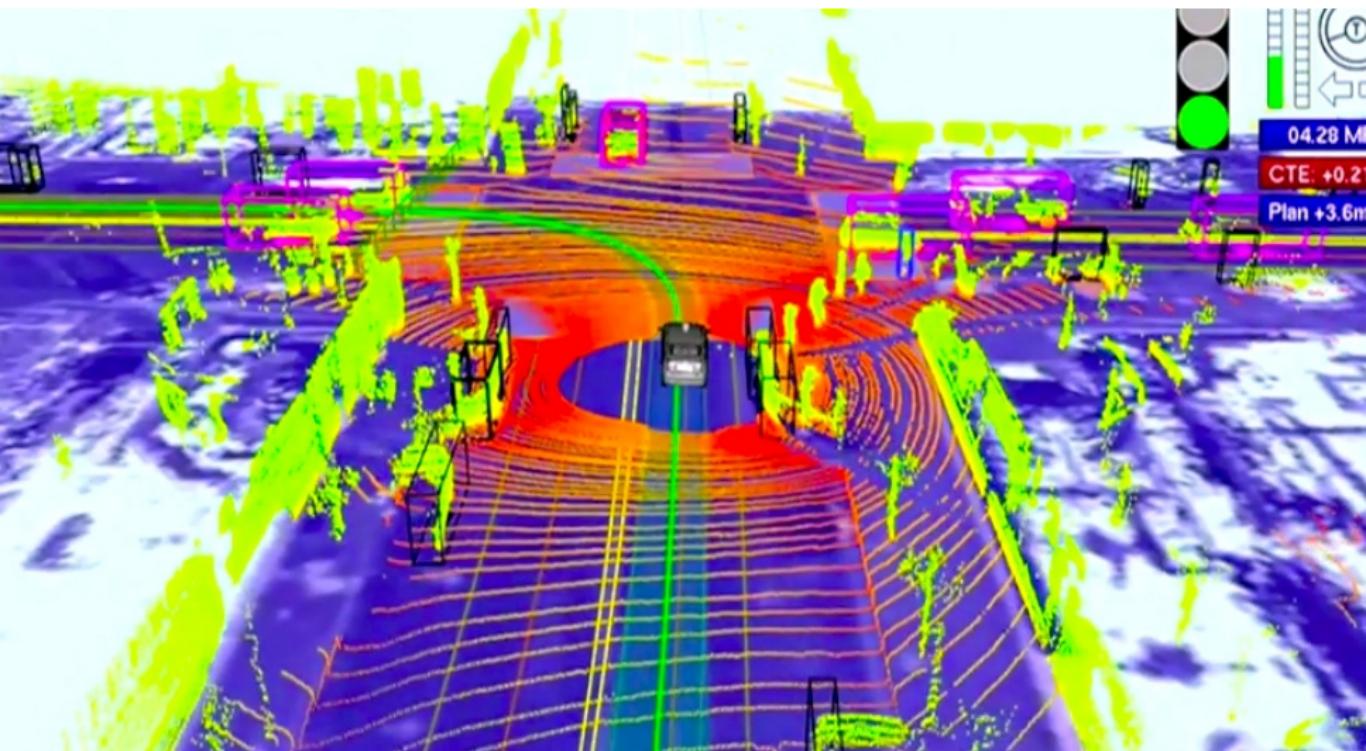
Baidu
MACHINE LEARNING

amazon.com[®]

Exciting times!



Exciting times!



Expectation vs. Reality

Relevant xkcd



UNLIKELY



LIKELY

Take out ideas

- ✍ Not everything is **deep learning**
- ✍ Lots of open problems
- ✍ Study! Lots of things on the internet
- ⚠ Open source everywhere
- ⚠ **Stand on the shoulders of giants**
- ⚠ Lots of interesting problems



Schedule

- Discussion class
 - ▶ Tuesday and Thursday from 10:00 to 12:00
 - ▶ Readings and topics schedule on Moodle ([register today!](#))
- Evaluation
 - ▶ Discussion in and outside class (Moodle)
 - ▶ 5 projects (continuous development)
 - ▶ Just projects, participation, and readings
- Want to discuss?
 - ▶ Email: adin@ic.unicamp.br
 - ▶ IC Room 11

Evaluations

- Four small projects (lets call them homeworks) (15% each)
- One big project (your proposal) (25%)
- Miscellaneous (quizzes, reading evaluations, Moodle participation, etc.) (15%)
- **Late policy**
 - ▶ Due dates are hard deadlines (closes at 23:55 due to Moodle inner workings)
 - ▶ Second deadline 3 days after (50% marks only)
 - ▶ Manage your time!
 - ▶ **Calendar on Moodle**
- **There is no final exam**
- **You need an average of 50% marks on HW and project to pass**

Team Work

■ Why?

- ▶ Helps to solve bigger and more complex problems
- ▶ Teaches team work skills
 - Set milestones
 - Productive workflow
 - Administration

■ Coding in teams \neq *software engineering*

- ▶ Requirement analysis
- ▶ *Releases, design, ...*
- ▶ Software cycles

Problems with your teammates

- If **you** have problems with your team
 - ▶ Try to talk and solve them right away
 - ▶ Most of the time you can talk things through
 - ▶ If you **can't**, talk to me immediately
 - I can help, but I need time to re-organize the work and the other teams

Website

- Moodle: ggte.unicmap.br/eam
- Course:
G_MC949A e P_MO446A 2oS_2017 Visão Computacional
- Password: computer vision (mind the space in between the words, is required)
- **Register now!**
 - ▶ All communication is through there
 - ▶ Q&A forum is there too
 - ▶ Project releases and submissions are there too