

## DEEP LEARNING METHODS AND APPLICATIONS

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# DESCRIPTION

Introduction to Deep Learning paradigm and architectures.  
Implementation issues.

## Outline

- 1 Introductory course
- 2 Artificial neural networks: Perceptrons and Multi Layer Perceptrons
- 3 Convolutional Neural Networks
- 4 Recurrent Neural Networks
- 5 Autoencoders
- 6 Transfer Learning
- 7 Matching Networks
- 8 Generative models
- 9 Deep Reinforcement Learning

# DESCRIPTION

## SCHEDULE

- ▶ Mondays 8:15-9:45: synchronous lecture (Zoom, slides)
- ▶ Fridays 8:15-9:45: practical implementation (by your own, with possible interactions by chat, zoom..)

**Implementation issues :** Python + dedicated libraries + Google Colab (Jupyter Notebooks).

**Materials:** lecture slides, supplementary slides + videos, Jupyter Notebooks.

### Evaluation and assignments

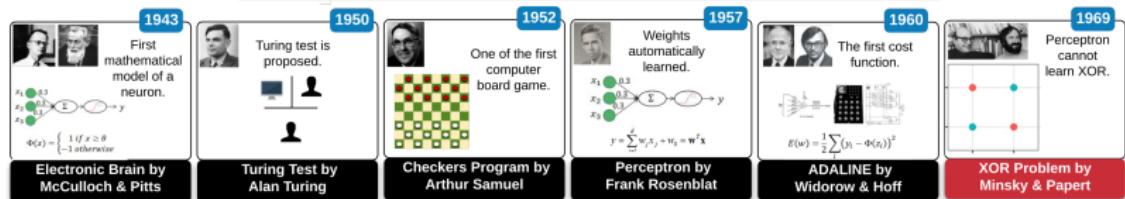
- ▶ Weekly programming assignments which should be done on an individual basis (not evaluated).
- ▶ Final exam: challenge (gathering knowledge collected during the programming assignments).



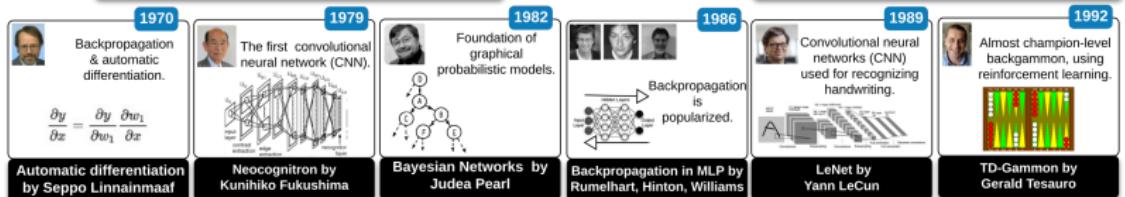
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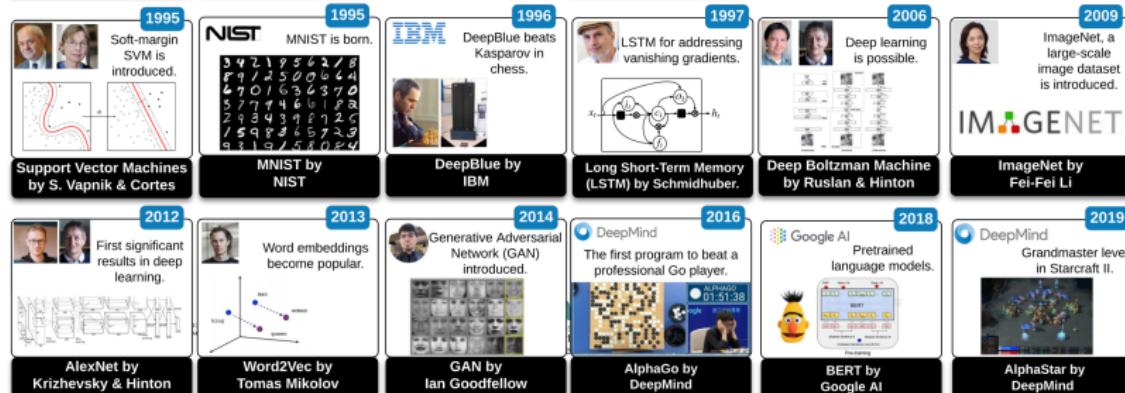
# A (VERY) SHORT INTRODUCTION TO DEEP LEARNING



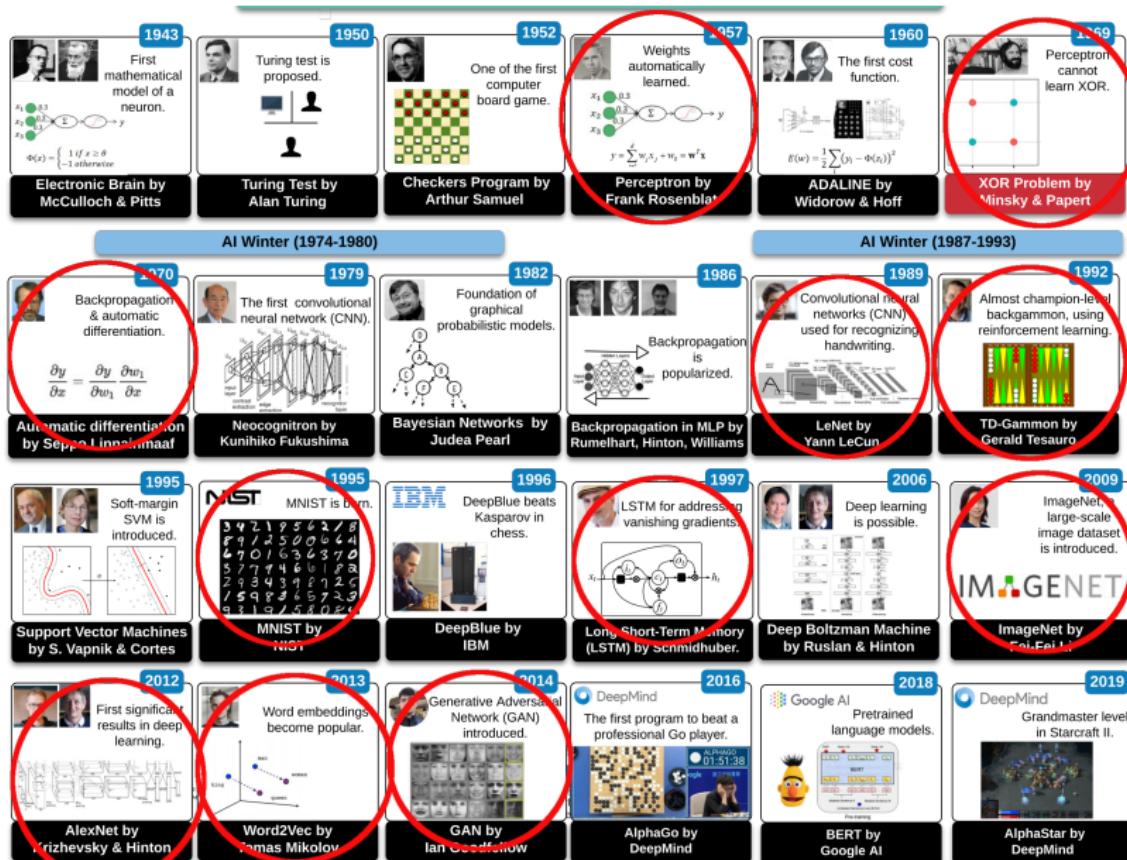
AI Winter (1974-1980)



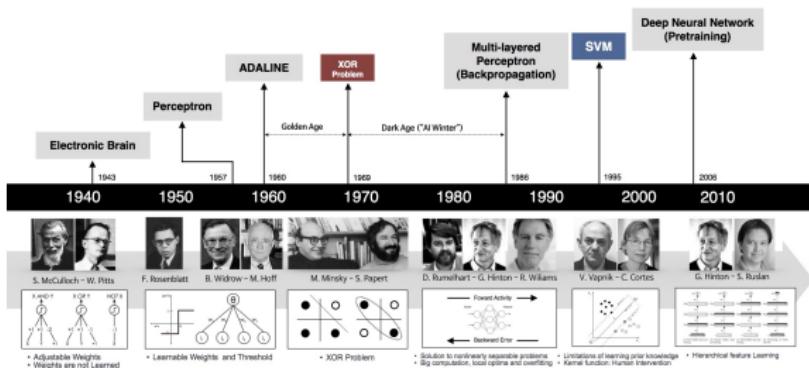
AI Winter (1987-1993)



# A (VERY) SHORT INTRODUCTION TO DEEP LEARNING

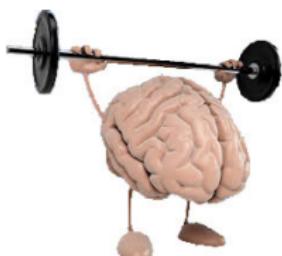


# CAN WE BUILD INTELLIGENT MACHINES ?



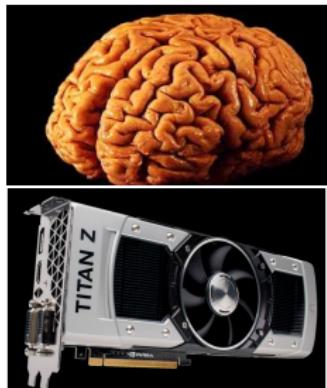
Can we artificially reproduce the human brain ?

- ▶ No, but it's a source of inspiration
- ▶ ⇒ Theoretical, technological and applicative issues



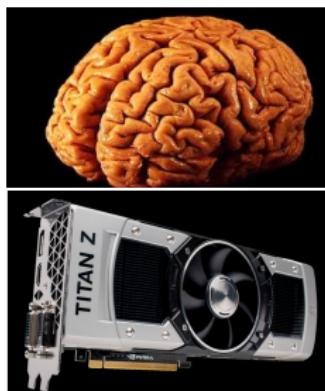
# BRAIN VS. COMPUTERS

	<b>Brain</b>	<b>Computer</b>
<b>"Cells"</b>	$\approx 10^{10}$ neurons	$\approx 6000$ cores
<b>Memory</b>	$\approx 10^{15}$ connexions	$\approx 1\text{To}$
<b>Consumption</b>	25 Watts	500 Watts
<b>Robustness</b>	plasticity	fault intolerant
<b>Computation</b>	$\approx 10^{16}$ flops/s	$\approx 8.10^{12}$ flops/s



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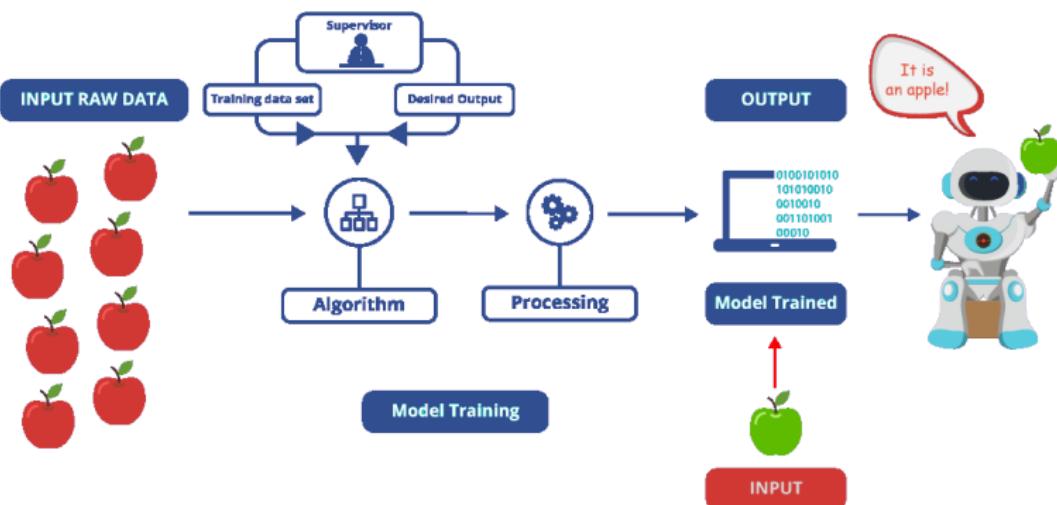
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And thus...

- ▶  $10^4$ -fold of the brain capacity
- ▶ 30 years (Moore's law)

# SUPERVISED LEARNING



## APPLICATIONS

Deep is everywhere ;-)

- ▶ Medicine
  - ▶ Security
  - ▶ Internet
  - ▶ Art
  - ▶ NLP
  - ▶ Games
  - ▶ Images and videos analysis
  - ▶ Vocal synthesis
  - ▶ Pattern matching
  - ▶ Autonomous driving
  - ▶ Robotics
  - ▶ Domotics
  - ▶ Many More



COURSE



WHAT IS DEEP LEARNING ?



APPLICATIONS



AND NOW ?



CONCLUSION



SOME ILLUSTRATIONS IN IMAGE/VISION

## ASSISTANCE

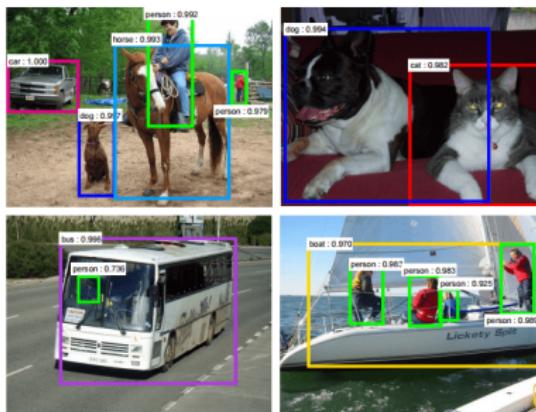
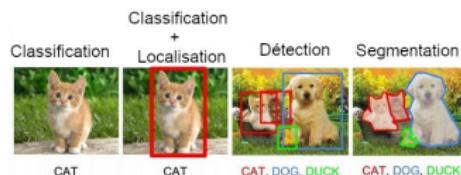


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## SOME ILLUSTRATIONS IN IMAGE/VISION

## OBJECT RECOGNITION



# ART

Let's do some art

- ▶ Neural Doodle ?
- ▶ GauGAN ?



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SOME ILLUSTRATIONS IN IMAGE/VISION

# SEMANTIC ANNOTATION

Linking words and images...

- ▶ Objets
- ▶ Actions
- ▶ Captionning



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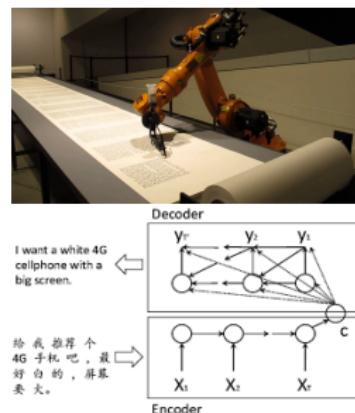


## SOME ILLUSTRATIONS IN NLP

## NLP

## Applications

- ▶ Automatic translation
- ▶ Text/music generation
- ▶ Automatic summarization
- ▶ Chatbots
- ▶ temporal series analysis/forecasting
- ▶ ...



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ROBOTICS

WHAT IS DEEP LEARNING ?

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APPLICATIONS

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AND NOW ?

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CONCLUSION

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# ROBOTICS



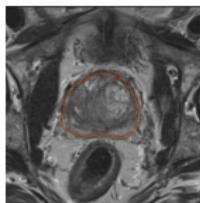
# AI IS AT THE HEART OF MEDICINE



Bones suppression



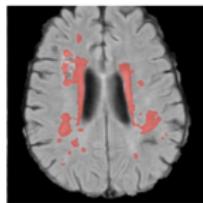
personalized medicine



Segmentation



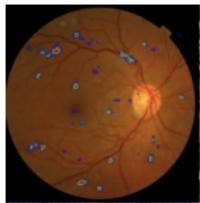
Oups...



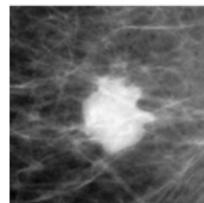
Brain Segmentation



melanoma classification



retinopathy Classification



mammography Classification

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WHAT IS DEEP LEARNING ?

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SOME ILLUSTRATIONS IN ENTERTAINMENT

APPLICATIONS

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AND NOW ?

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CONCLUSION

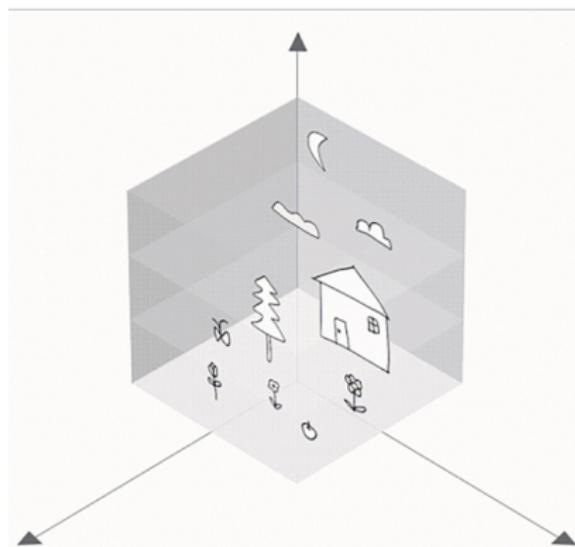
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## Games



## SOME ILLUSTRATIONS IN ENTERTAINMENT

## Talk and sketch



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FAKE NEWS ?

WHAT IS DEEP LEARNING ?

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APPLICATIONS

oooooooooooo

AND NOW ?

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CONCLUSION

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## Fake news ?

- ▶ Does this person exist ?
- ▶ Does this picture exist ?
- ▶ Does this video exist ?



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WHAT IS DEEP LEARNING ?

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AND NOW ?

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CONCLUSION

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## Fake news ?

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COURSE

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SOME TRENDS

WHAT IS DEEP LEARNING ?

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APPLICATIONS

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AND NOW ?

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CONCLUSION

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## Weak supervision

- ▶ Learning to learn
- ▶ Learn with few / no examples



# GARTNER CYCLE

