AI, Deep Learning, and New Opportunities

Piero Scaruffi

January 2020
Piero Scaruffi

- 30+ years in Silicon Valley
- Written 20+ books
- Pioneered A.I. and Internet applications
The Age of A.I.? 

- Recent conferences
  - NeurIPS | 2019
    - Vancouver CANADA
    - Dec 8th through the 14th
  - ICML | 2019
    - Thirty-sixth International Conference on Machine Learning
    - June 9 - 15
    - Long Beach
  - Forbes
    - Sep 5, 2018
    - The New Burning Man – The AI Conference That Sold Out In 12 Minutes
Deep Learning
Deep Learning

• Invented in 2006-07
  • Geoffrey Hinton
  • Yoshua Bengio
  • Yann LeCun

• The Year of Deep Learning: 2012
Deep Learning

Why did it take until 2012?
1. The computational power (the GPU!)
2. The training datasets
3. Open-source platforms

Deep Learning

- 2006: PASCAL VOC
- 2007: Tiny Images Dataset
- 2009: ImageNet
- 2013: Atari games
- 2014: COCO
- 2016: SQuAD
- 2016: MARCO

...
Status

ARTIFICIAL INTELLIGENCE

MACHINE LEARNING

NEURAL NETWORKS

DEEP LEARNING

CNN

RNN

LSTM

DRL

GAN
Status

• CNN = Convolutional Neural Networks (face recognition, object identification, disease detection)

• RNN/LSTM = Recurrent Neural Networks (speech recognition, translation, caption generation)

• DRL = Deep Reinforcement Learning (robot training, game playing)

• GAN = Generative Adversarial Networks (image generation, style transfer)
Deep Reinforcement Learning (DRL)

- AlphaGo (2016)
- AlphaZero (2017)
- AlphaStar (2019)
- OpenAI Five (2018)
- Robotic arm that solves Rubik’s Cube (2019)
Generative Adversarial Networks (GANs)

What does it mean to “learn” a concept?
If you know what a dog is, you can draw a picture of a dog that doesn’t exist:

GANs generate images

Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

Alec Radford, Luke Metz, Soumith Chintala

All images in this paper are generated by a neural network. They are NOT REAL.
Generative Adversarial Networks (GANs)

GANs generate images from descriptions

GANs generate videos from scripts

Figure 1. Examples of generated images from text descriptions. Left: captions are from zero-shot held-out categories. Right: captions are from training set categories.
Generative Adversarial Networks (GANs)

Style transfer

Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks
Jun-Yan Zhu* Taesung Park* Phillip Isola Alexei A. Efros
In ICCV 2017 UC Berkeley

Zebras ↔ Horses Summer ↔ Winter

Scene generation

Stroke of Genius: GauGAN Turns Doodles into Stunning, Photorealistic Landscapes

Nvidia’s GauGAN has been used to create 500,000 images
Natural Language Processing

Text Understanding
- Transformer (2017)
- ELMo (2018)
- BERT (2018)
- BiDAF++ (2018)

Text Generation
- PGNET (2017)
- GPT2 (2019)
### Natural Language Processing

#### Example: GTP2

<table>
<thead>
<tr>
<th>Question</th>
<th>Generated Answer</th>
<th>Correct</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who wrote the book the origin of species?</td>
<td>Charles Darwin</td>
<td>✓</td>
<td>83.4%</td>
</tr>
<tr>
<td>Who is the founder of the ubuntu project?</td>
<td>Mark Shuttleworth</td>
<td>✓</td>
<td>82.0%</td>
</tr>
<tr>
<td>Who is the quarterback for the green bay packers?</td>
<td>Aaron Rodgers</td>
<td>✓</td>
<td>81.1%</td>
</tr>
<tr>
<td>Panda is a national animal of which country?</td>
<td>China</td>
<td>✓</td>
<td>76.8%</td>
</tr>
<tr>
<td>Who came up with the theory of relativity?</td>
<td>Albert Einstein</td>
<td>✓</td>
<td>76.4%</td>
</tr>
<tr>
<td>When was the first star wars film released?</td>
<td>1977</td>
<td>✓</td>
<td>71.4%</td>
</tr>
<tr>
<td>What is the most common blood type in sweden?</td>
<td>A</td>
<td>✗</td>
<td>70.6%</td>
</tr>
<tr>
<td>Who is regarded as the founder of psychoanalysis?</td>
<td>Sigmund Freud</td>
<td>✓</td>
<td>69.3%</td>
</tr>
<tr>
<td>Who took the first steps on the moon in 1969?</td>
<td>Neil Armstrong</td>
<td>✓</td>
<td>66.8%</td>
</tr>
<tr>
<td>Who is the largest supermarket chain in the uk?</td>
<td>Tesco</td>
<td>✓</td>
<td>65.3%</td>
</tr>
<tr>
<td>What is the meaning of shalom in english?</td>
<td>peace</td>
<td>✓</td>
<td>64.0%</td>
</tr>
<tr>
<td>Who was the author of the art of war?</td>
<td>Sun Tzu</td>
<td>✓</td>
<td>59.6%</td>
</tr>
<tr>
<td>Largest state in the us by land mass?</td>
<td>California</td>
<td>✗</td>
<td>59.2%</td>
</tr>
<tr>
<td>Green algae is an example of which type of reproduction?</td>
<td>photosynthesis</td>
<td>✗</td>
<td>56.5%</td>
</tr>
<tr>
<td>Vikram samvat calendar is official in which country?</td>
<td>India</td>
<td>✓</td>
<td>55.6%</td>
</tr>
<tr>
<td>Who is mostly responsible for writing the declaration of independence?</td>
<td>Thomas Jefferson</td>
<td>✓</td>
<td>53.3%</td>
</tr>
<tr>
<td>What us state forms the western boundary of montana?</td>
<td>Montana</td>
<td>✗</td>
<td>52.3%</td>
</tr>
<tr>
<td>Who plays ser dawos in game of thrones?</td>
<td>Peter Dinklage</td>
<td>✗</td>
<td>52.1%</td>
</tr>
<tr>
<td>Who appoints the chair of the federal reserve system?</td>
<td>Janet Yellen</td>
<td>✗</td>
<td>51.5%</td>
</tr>
<tr>
<td>What is the process that divides one nucleus into two genetically identical nuclei?</td>
<td>mitosis</td>
<td>✓</td>
<td>50.9%</td>
</tr>
<tr>
<td>Who won the most mvp awards in the nba?</td>
<td>Michael Jordan</td>
<td>✗</td>
<td>50.2%</td>
</tr>
<tr>
<td>What river is associated with the city of rome?</td>
<td>the Tiber</td>
<td>✓</td>
<td>48.6%</td>
</tr>
<tr>
<td>Who is the first president to be impeached?</td>
<td>Andrew Johnson</td>
<td>✓</td>
<td>48.3%</td>
</tr>
<tr>
<td>Who is the head of the department of homeland security 2017?</td>
<td>John Kelly</td>
<td>✓</td>
<td>47.0%</td>
</tr>
<tr>
<td>What is the name given to the common currency to the european union?</td>
<td>Euro</td>
<td>✓</td>
<td>46.8%</td>
</tr>
<tr>
<td>What was the emperor name in star wars?</td>
<td>Palpatine</td>
<td>✓</td>
<td>46.5%</td>
</tr>
<tr>
<td>Do you have to have a gun permit to shoot at a range?</td>
<td>No</td>
<td>✓</td>
<td>46.4%</td>
</tr>
<tr>
<td>Who proposed evolution in 1859 as the basis of biological development?</td>
<td>Charles Darwin</td>
<td>✓</td>
<td>45.7%</td>
</tr>
<tr>
<td>Nuclear power plant that blew up in russia?</td>
<td>Chernobyl</td>
<td>✓</td>
<td>45.7%</td>
</tr>
<tr>
<td>Who played john connor in the original terminator?</td>
<td>Arnold Schwarzenegger</td>
<td>✗</td>
<td>45.2%</td>
</tr>
</tbody>
</table>
Reality Check: Not much “I” in “A.I.”
Reality Check: The “I” is often outside

What really "does it" is not the machine: it's the environment that we structure for the machine
Reality Check: How can you be so smart?

DeepMind’s AlphaGo

What else can AlphaGo do besides playing Go? Absolutely nothing.
What else can you do besides playing Go?

AlphaGo consumed 440,000 W to do just one thing
Your brain uses 20 W and does an infinite number of things
Reality Check: The self-crashing car

Tesla says crashed vehicle had been on autopilot prior to accident

Self-driving Uber car kills Arizona woman crossing street

Tesla Model 3 crashes into police car with Autopilot
Reality Check: No common sense

https://research.googleblog.com/2014/11/a-picture-is-worth-thousand-coherent.html
Reality Check: Unnatural Learning

Supervised Learning: requires a lot of data - **UNNATURAL**
Reinforcement Learning: requires a lot of self-play - **UNNATURAL**
Unsupervised Learning: the way humans and animals learn!

Self-Supervised Learning, Yann LeCun, Facebook AI Research

After a brief presentation of the state of the art in deep learning, some promising principles & methods for self-supervised learning will be discussed.

Wednesday, October 24, 2018
3:30pm-4:30pm
Carpenter 013
What can Deep Learning do?

• Disease detection
What can Deep Learning do?

- Genomic Analysis

Why is Hydra immortal?
Why can the Turritopsis reverse its life cycle and rejuvenate?
Why did Jeanne Calment live to 122?
What can Deep Learning do?

- Scientific discovery depends on
  - Studying the literature
    - More than 1.2 million papers are published yearly in life science journals alone, on top of the 25 million already in print
    - A new article is being published every 30 seconds
  - Experimenting new ideas
What can Deep Learning do?

• Drug discovery
  • It takes an average of 12 years and about $2.6 billion to put a new drug on the market.
What can Deep Learning do?

• Robots for an aging society
  • More than 1 million people in the USA require daily physical assistance to get dressed because of injury, disease, and old age
  • Examples: a robot that learns to dress people; assisted feeding; etc
Deep Learning & Telecom

Caution:

• There seem to be many more “Reports about Applications of A.I.” than there are actual applications
• Calling old-fashioned software A.I. is like calling a restaurant “Ristorante”
• If you are using A.I. as glorified statistics, you are probably wasting time and money
• Beware of any tech consultant who had no A.I. until recently (and maybe even discouraged investment in A.I.)

What is encouraging:

• Lots of data: from devices, networks, mobile applications, geolocation, customer profiles, service usage, billing data, …
Deep Learning & Telecom

• The hype

The Amazing Ways Telecom Companies Use Artificial Intelligence And Machine Learning
Deep Learning & Telecom

The Reality

- Network optimization (Sedona's NetFusion, Aria, ...)
- Preventive maintenance (Nokia's Ava, Avanseus CAN, ...)

PTCouncil #PTC20
Deep Learning & Telecom

The Reality

• Virtual Assistants (Vodafone’s TOBi, Nokia’s MIKA, Telefónica’s Aura ...)

• Fraud detection (CSG Detect, Oculeus, SKLOIS ...)

Published: 31 August 2018

Detecting telecommunication fraud by understanding the contents of a call

Qianqian Zhao, Kai Chen, Tongxin Li, Yi Yang & Xiaofeng Wang

State Key Laboratory Of Information Security

PTC’20
Deep Learning & Telecom

The Reality

• Anomaly detection
The End (for now ...)

piero@svairi.com
scaruffi@stanford.edu