Yellow Cats meeting on
Artificial Intelligence

Amsterdam   24 April 2018

Overview

1. **Introduction BrainCreators**

2. **Deep learning: demo to get in the mood**

3. **Zooming out: how did we arrive here?**

4. **Intelligence: human and other**

5. **The future: applications and values**

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AMSTERDAM

MACHINES CAN DO THE THINKING

Your unique advantage is in data

Leverage artificial intelligence for your business

BrainCreators applies 20+ years
of experience in artificial intelligence to
business challenges across all verticals

Discover value

Compile a strategic
roadmap of viable
business cases

Deploy solutions

Implement scalable
solutions with maximum
business impact

Accelerate teams

Inherit skills & best
practices with
expert coaching

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Wolters Kluwer

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HENDRIX GENETICS

Runway Manhattan

orangevalley

a.s.r. de nederlandse verzekerings maatschappij voor alle verzekeringen

Eneco

thyssenkrupp

BNR NIEUWSRADIO

Rijkswaterstaat

DELA voor elkaar

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What is Artificial Intelligence?

Let's dive straight into an example:

Style transfer

between images, paintings, and other visual data

The old Dutch masters

Dutch School
circa 1640
"Portrait of a boy"
(cropped)

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Training data:

The old Dutch masters

What follows is a selection of the work of

Mario Klingemann

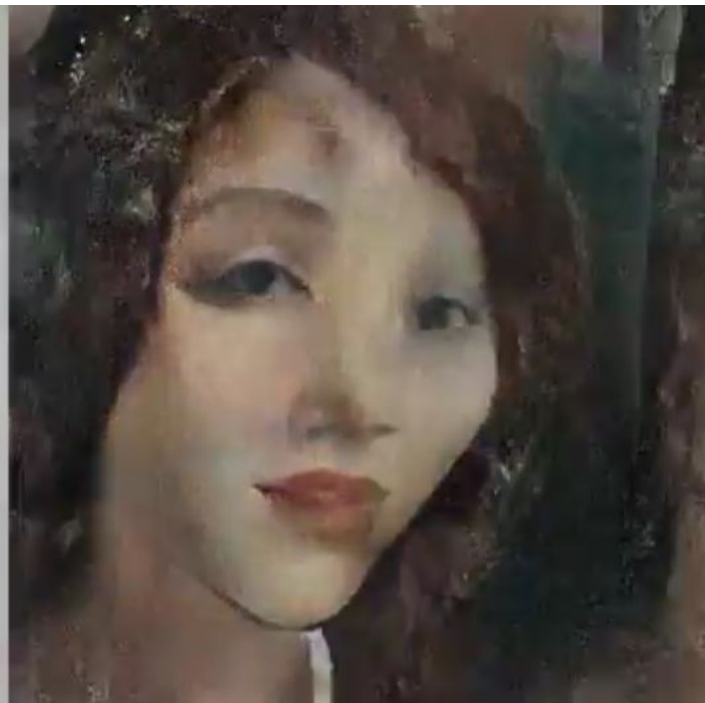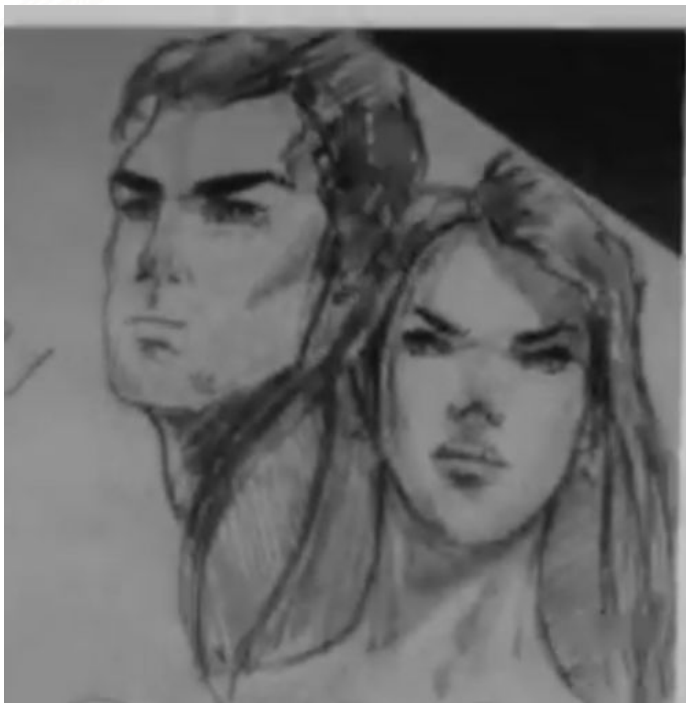**@quasimondo** on Twitter

Please check out his other work too!

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The old Dutch masters

The old Dutch masters
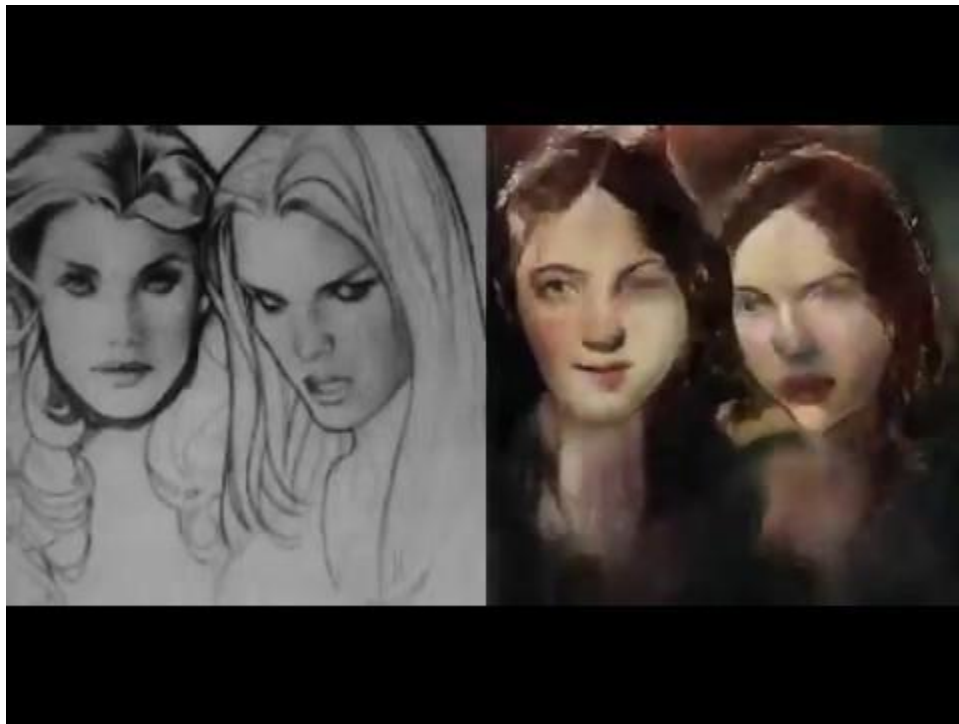
The old Dutch masters

The old Dutch masters

The old Dutch masters

link

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Style transfer

What are the longer term implications?

- Synthesizing data of any kind

- Based on nothing but examples

- Guided by human design, ...at first

- In the long term, perhaps fully autonomous

Zoom out

How did we get here?

A (very) short history of Artificial Intelligence.

...and how we confused our definitions

What follows is loosely based on the article on medium.com:
"Artificial Intelligence -- The Revolution Hasn't Happened Yet"
by Prof. Michael I. Jordan. Please check out the full article!

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History of AI

The phrase "AI" was coined in the 1950s

What was meant was
an imitation of **human** intelligence and **reasoning**

As opposed to
lower level abilities like pattern recognition and motor control

History of AI

Conscious human reasoning

Human cognition, unique in evolution,
  was seen as the **hardest** process that needed to be imitated
    to achieve generally intelligent machines

History of AI

The early research focus (1950s - 1970s)

The main research focus included, for example:

- automated reasoning
- strategic game play
- language processing
- machine translation

The first AI winter

The 1970s were a turning point

- Expectations had been impossibly high
- Difficulties were underestimated
- Large cuts in funding resulted

Where did it go wrong?

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Moravec's Paradox

"Contrary to traditional assumptions,
high-level reasoning requires very little computation,
while low-level sensor and motor skills
require enormous computational resources."

Marvin Minsky, Hans Moravec, and Rodney Brooks (1980s)

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Hans Moravec

"It is comparatively easy to make computers exhibit adult level performance on [...] playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility"

Marvin Minsky

"In general, we're least aware of what our minds do best [...] we're more aware of simple processes that don't work well than of complex ones that work flawlessly"

Steven Pinker

"[...] the hard problems are easy and the easy problems are hard. The mental abilities of a four-year-old that we take for granted – recognizing a face, lifting a pencil, walking across a room, answering a question – in fact solve some of the hardest engineering problems ever conceived."

The Language Instinct (1994)

Steven Pinker

"As the new generation of intelligent devices appears, it will be the stock analysts and petrochemical engineers and parole board members who are in danger of being replaced by machines. The gardeners, receptionists, and cooks are secure in their jobs for decades to come."

The Language Instinct (1994)

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The pendulum swings

We are now in a new spring season, again.

The most recent AI winter, (more perception than reality)
    lasted from after the dot.com bubble
    until the first ImageNet competitions (~2010)
    and the rise of **convolutional neural networks**

    This marked the beginning of the current era

The present day

So, what has really changed?

No AI winter for all these years
We must be doing something right,…. *right*?

What has changed since previous winters?

The present day

What has changed?

The availability of mass storage
...has started the big data era.

- Visual data
- Sensor data
- Financial data
- ... ...

The present day

What has changed?

The development of affordable GPU chips
                ...has lead to cheap compute power

- Powerful workstations
- Emergence of cloud computing
- Massive parallelization on GPU hardware
- ... ...

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The present day

What has changed?

The invention of new (or just better) algorithms
...has greatly increased model accuracies

- More advanced models
- *Convolutional Neural Networks*
- Efficient, open source implementations
- ... ...

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The present day

A remarkable reversal of expectations

After more than 60 years of research, there has been only modest success in high-level logical reasoning

Fundamental hurdles, like the required computational resources for automated reasoning have not been overcome

Logical reasoning is well understood, *but very expensive*.

The present day

The rise of machine learning

Instead, current day "Artificial Intelligence"
    has become almost synonymous with **machine learning**.

This is a field based on **statistics** and big data
    and is far removed from human cognition and formal logic

Strategic board games

Conquering games like Chess and Go

Traditionally seen as prime examples of
tasks that required human cognition and reasoning.

Today such games are performed better
by data driven, machine learning systems
than by imitating human cognition.

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Future intelligence

Is imitating conscious, human intelligence
the right goal for machine intelligence?

Perhaps not.

Examining the challenges ahead,
        there is a clear need a very different type of intelligence

Intelligent Infrastructure

Making our environments more supportive

Examples of Intelligent Infrastructures:

- Transportation
- Medicine
- Commerce and Finance
- *"Internet-of-Things"*

Transportation

Forget the so called "self-driving car"
    as if it were a singular unit, like today's cars.

Think more like "the fully autonomous fleet"
- intelligent roads, managing flow & intersections
- smart and efficient refueling infrastructure
- predictive maintenance of the combined system

This type of system has more in common with current air-traffic control systems than with human cognition

Medical Science and Practice

Think of a "societal-scale medical system"

- data flows between doctors and patient devices
- aware of relationships among all humans
- manage the vast scientific literature
- maintain notions of relevance, provenance and reliability,
- ...and privacy !

This type of system has more in common with how current banking systems manage similar challenges in finance and payment

Non-human Intelligence

These types of information processing typically involve:

- distributed repositories of knowledge
- rapidly changing and globally incoherent
- decisions based on cloud-edge interactions
- sharing data across administrative boundaries

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Intelligent Infrastructure

*"[These] systems must bring economic ideas such as **incentives** and **pricing** into the realm of the statistical and computational infrastructures that link humans to each other and to **valued goods**.*

*[These] systems can be viewed as not merely providing a service, but as **creating markets**.*

*There are domains such as music, literature and journalism that are crying out for the emergence of such markets, where data analysis links **producers** and **consumers**.*

*[All] done within the context of evolving **societal**, **ethical** and **legal** norms."*

Prof. Michael I. Jordan (medium.com 2018)

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Human centric engineering

Engineering of unprecedented scale and scope

A new, more human-centric engineering discipline is emerging that applies machine learning and data sciences on a **societal scale**.

The required type of intelligence may be beyond human, but the goals and methods if this project should be formulated with societal, ethical and human **values** at its core.

Values and ethical guidelines

The Asilomar AI principles

What set of values should future AI be aligned with?

What legal and ethical status should it have?

Values and ethical guidelines

The Asilomar AI principles   (a selection)

Judicial Transparency:

Any involvement by an autonomous system

in judicial decision-making should provide a satisfactory explanation

auditable by a competent human authority.

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Values and ethical guidelines

The Asilomar AI principles   (a selection)

Non-subversion:

The power conferred by control of highly advanced AI systems

should respect and improve, rather than subvert,

the social and civic processes on which the health of society depends.

Values and ethical guidelines

The Asilomar AI principles   (a selection)

AI Arms Race:

An arms race in lethal autonomous weapons should be avoided.

Values and ethical guidelines

The Asilomar AI principles   (a selection)

Responsibility:

Designers and builders of advanced AI systems

are stakeholders in the moral implications

of their use, misuse, and actions,

with a responsibility and opportunity to shape those implications.

Epilogue

What's in a name?
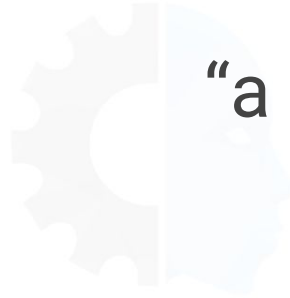
Epilogue

What's in a name?

Why call a TV,   "a color TV" ?
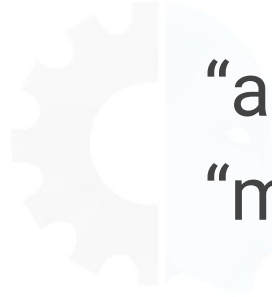
Epilogue

What's in a name?

Why call a TV,   "a color TV" ?
Why call power,   "mechanical power" ?

Epilogue

What's in a name?

Why call a TV,   "a color TV" ?
Why call power,   "mechanical power" ?
Why call intelligence,   "artificial intelligence" ?

Thank You

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