Artificial Intelligence in Business

SMUG2019

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Outline

1. What is Artificial Intelligence (AI)?

2. AI, Machine Learning (ML) and Statistics – what's the difference?

3. What ML can do?

4. Using, misusing and abusing ML;

5. The future of AI.

WHAT IS AI?

What is AI?

There's a lot of definitions of AI.

- E.g.:
  - "making a machine behave in ways that would be called intelligent if a human were so behaving"
    - (McCarthy, Minsky, Rochester, & Shannon, 1955)
  - "the science of making machines do things that would require intelligence if done by men"
    - (Minsky, 1968, p. v)
  - "the study of the design of intelligent agents"
    - (Poole et al., 1998)

What does this mean?

What is AI?

- Intelligence is the ability to adapt to change.
  - Stephen Hawking?
  - Tom Faranda?

"The trouble with quotes on the Internet is that you can never know if they are genuine."

Abraham Lincoln

What is AI?

Is Artificial Intelligence = Natural Intelligence (NI)?

- Some advocate for the term "Computational Intelligence" instead of "AI" (Poole et al., 1998).
  - AI does not replicate NI.
  - AI does not duplicate NI.
  - In fact, AI is not a real "Intelligence"!
  - Artificial pearl is a fake pearl, not a real one.

- Can computers really think?

What is AI?

- How can we create a flying machine?

What is AI?

Take some birds, study them...

...and reproduce the principle

What is AI?

Or study the principles of flying, without restricting ourselves with what we see...

- Can aeroplanes really fly?

- ...

- Can computer really think?

What is AI?

So, what is AI? ([Kaplan & Haenlein, 2019](#))

- AI is a system's ability:
  - to correctly interpret external data,
  - to learn from such data,
  - and to use those learnings to achieve specific goals…
  - …through flexible adaptation.
- The key elements are:
  - "interpretation",
  - "learning",
  - "adaptation",
  - "goals".

What is AI?

Again, is Artificial Intelligence = Natural Intelligence?

1. Can we interpret the external data? ✓

   - Do we understand the SMUG talks?

2. Can we learn from it? ✓

   - Have we learnt anything from what we have heard so far?

3. Do we adapt to changes? ✓

   - Have any talks been challenging?

4. Do we have a specific goal? ✗

   - Why are we here? ✓
   - What's the meaning of life? ?

AI, ML AND STATISTICS

CMAF

AI, ML and Statistics

Is AI = Machine Learning?

- AI is broader than Machine Learning.

- **Machine learning** describes methods that help computers learn without being explicitly programmed.

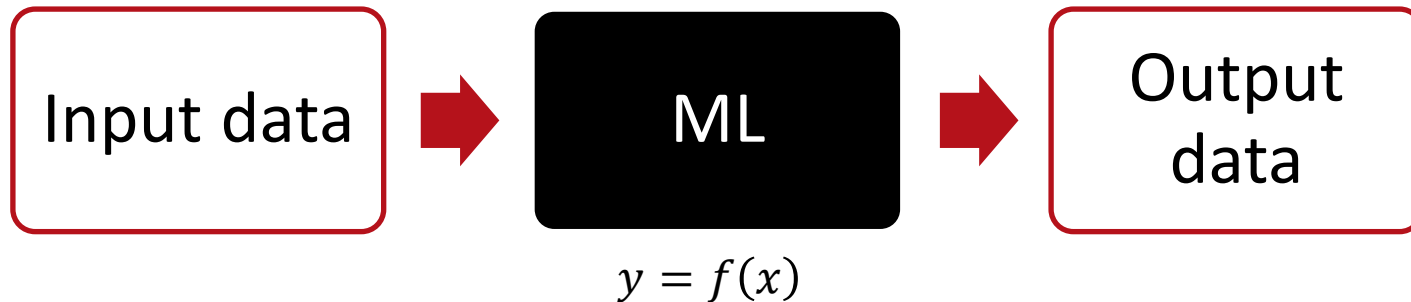- No strict structure, no strict models.
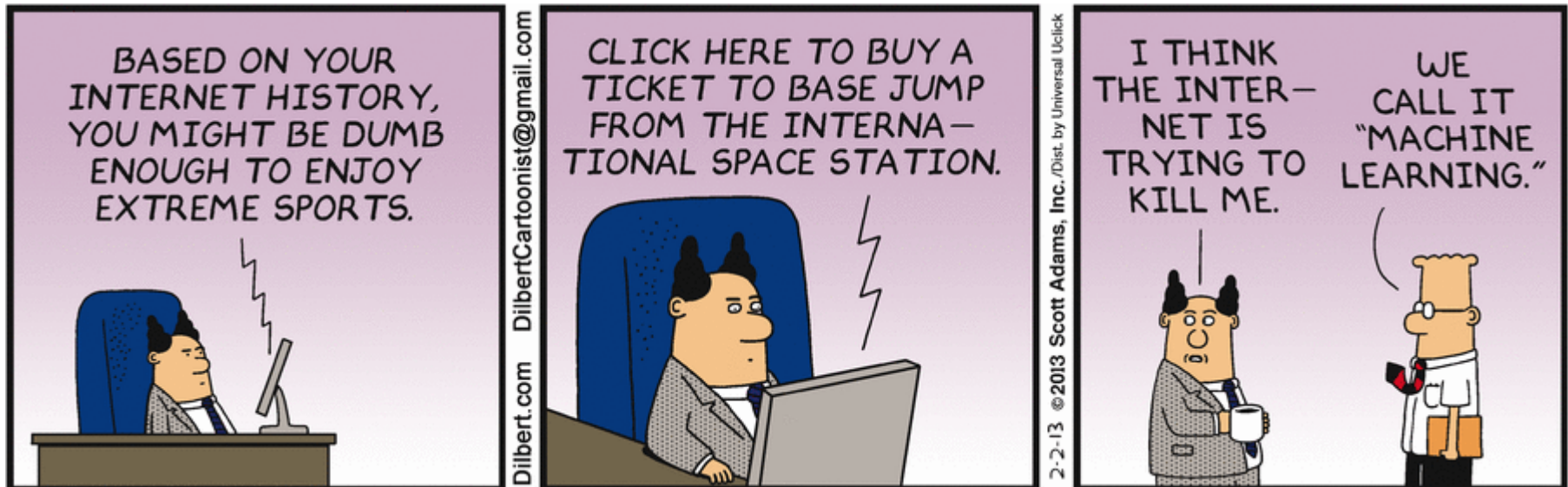
AI, ML and Statistics

- Methods of ML include:

  - Regression,

  - Support Vector Machines,

  - Random Forest,

  - EM and MM algorithms,

  - Artificial Neural Networks (ANN),

  - …

- Often, when you hear people saying "ML", they refer to "ANN".

- All of them need big clean data.

AI, ML and Statistics

- ML-based methods are "black box" methods:

| Input data | → | ML | → | Output data |

$$y = f(x)$$

- An example:
  - Inputs: promotions, prices, previous sales,…
  - ML: ANN
  - Outputs: future sales.
- The main idea: nobody knows how the inputs are transformed into outputs in the box.

- The main issue: you can get meaningless results (overfit the data)

So, why AI ≠ ML?

- ML is focused on working with data via the "black box" approach.
    - It has "learning", "adaptation" and "goals" aspects of AI.
    - But it does not include "interpretation"!

- We might have ML for speech / visual recognition.
- But this is "learning" for specific "goals".

AI, ML and Statistics

What's the difference between Statistics and ML?

- Statistical methods use "grey box" approach:

| Input data | → | Statistical model | → | Output data |

$$y = a + bx + e$$
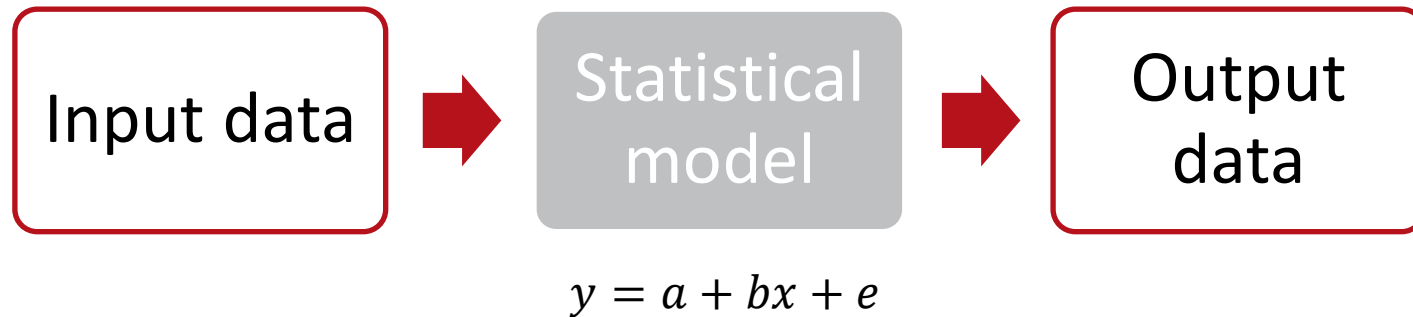
- We know the model in the box;

- The "grey" appears because of the white noise "e".

- Examples:

  - Regression,

  - Exponential smoothing,

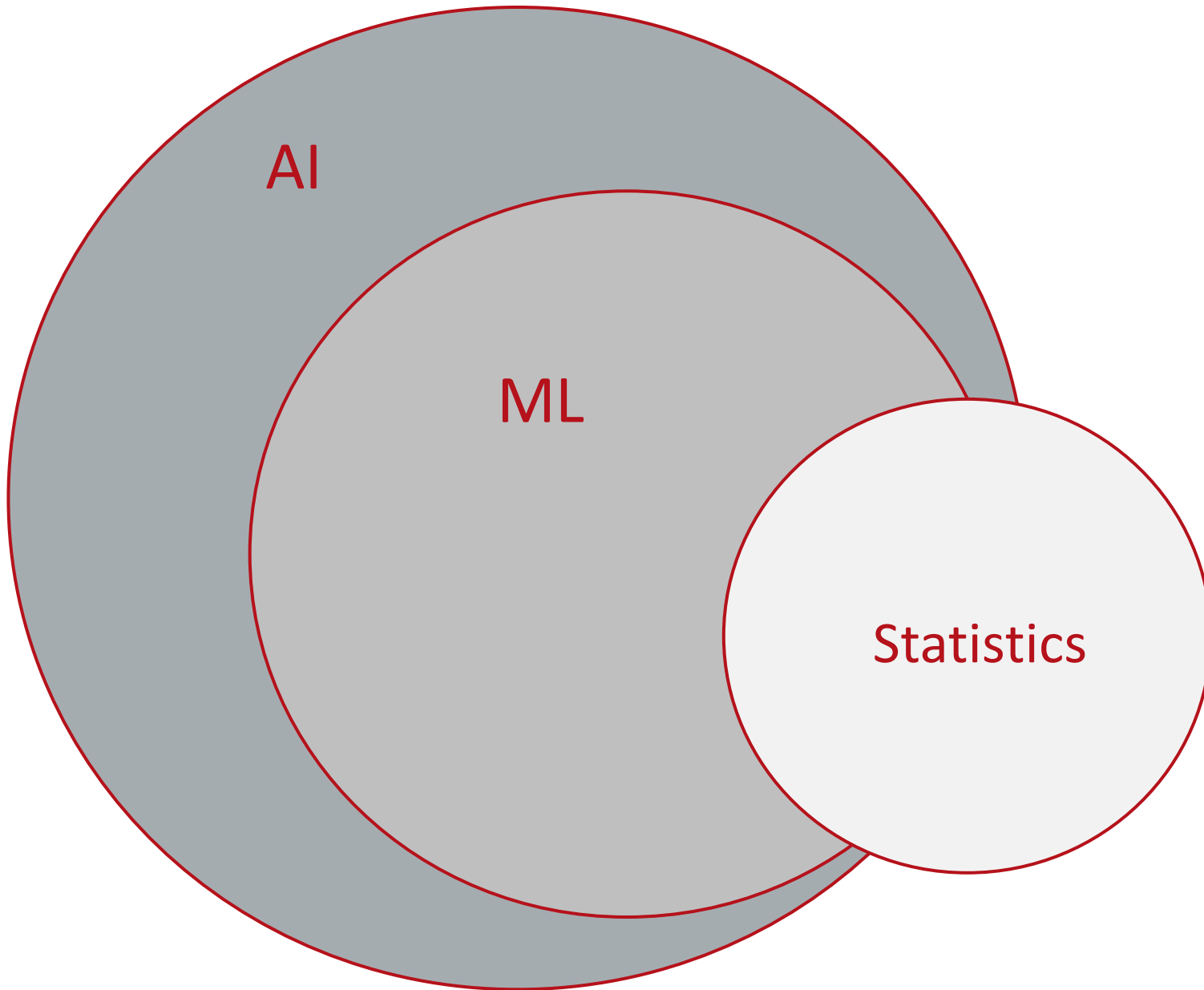 - ARIMA

AI, ML and Statistics

ML can use statistical methods in order to achieve specific goals.

Statistics can use ML methods for its purposes as well.

- ML is more focused on predictive analytics:

    - The sales of our product next week will be 10k;

- Statistics can explain relations:

    - With the increase of price by $1, the sales go down on average by 1000 units.
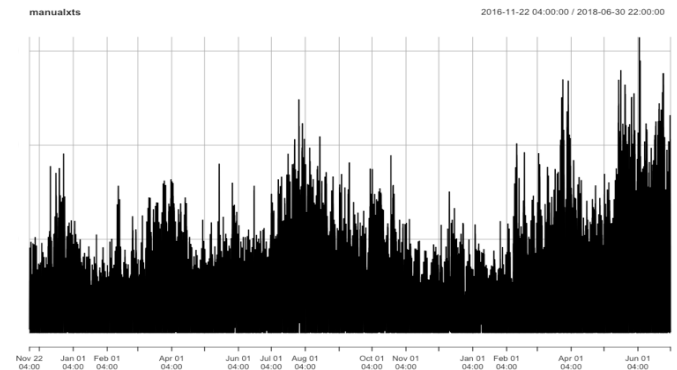
AI, ML and Statistics

WHAT ML CAN DO?

What ML can do?

The areas of application of ML in business:

- Supervised learning:

- We have data, we need to make predictions.

  - Forecasting using Neural Networks:

    - High frequency data;

    - Forecasting grouped data;

  - Classification task:

    - Credit scoring;

    - Pattern recognition;

    - Speech / text / image recognition;

What ML can do?

- Unsupervised learning:

- We have data, we need to extract some features

  - Clustering:
    - Group SKUs with similar patterns;
    - Group products with similar characteristics;
  - Anomaly detection:
    - Outliers detection;
    - Intrusion detection systems;
  - Latent variables:
   - Deal with missing data;

What ML can do?

- Reinforcement learning:

- We have rules for an agent. It interacts with the environment, and learns on its own, given the constraints.

- Something like trial-and-error problem.

- Decision making process.

  - Personalised news / products recommendations;

  - Traffic light control;

What ML can do?

Examples of ML in real world:

- Face recognition

- "People you may know"

- Online support bots
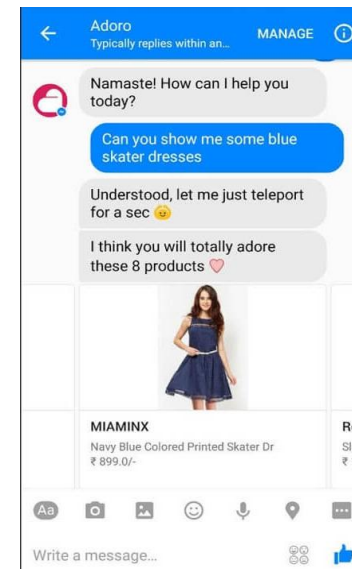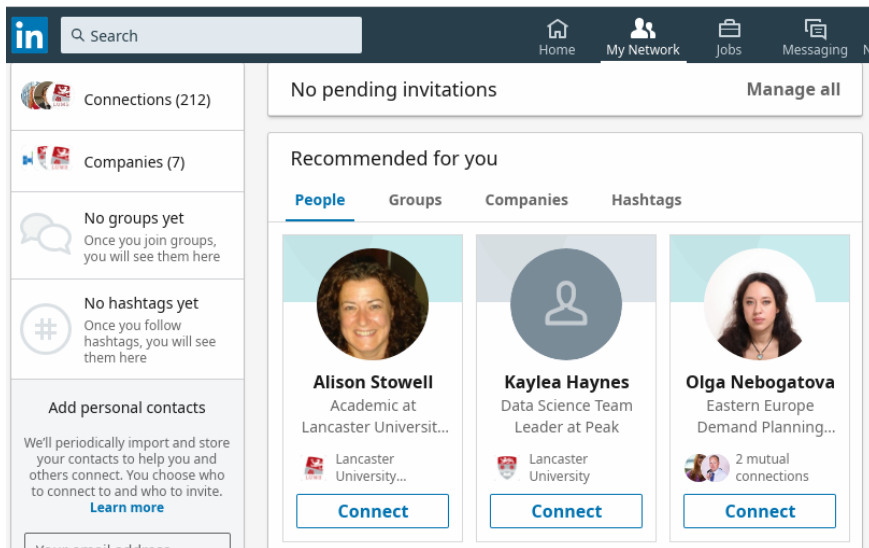
What ML can do?
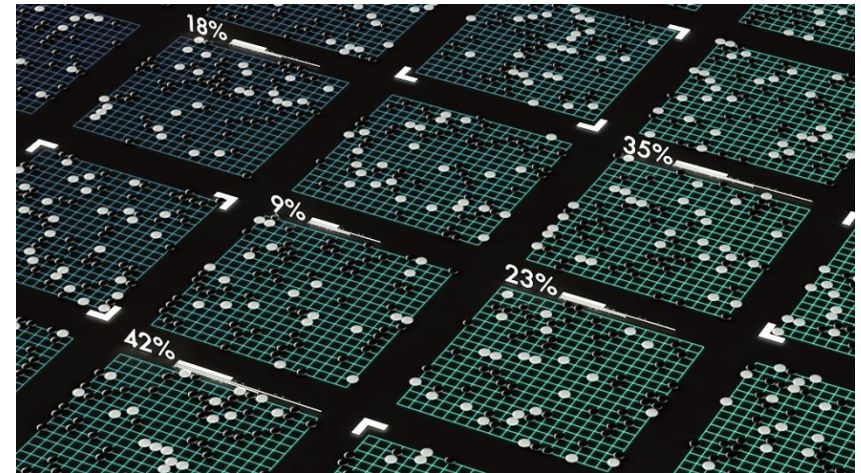
Reinforcement learning example:

- AlphaGo by Google;

- Training in computer games

Google's DeepMind AI Just Beat Two Pros At *StarCraft II*

Nathan Grayson
1/24/19 9:00pm • Filed to: STARCRAFT

53.8K   65   6

USING, MISUSING AND ABUSING ML

Using, misusing and abusing ML

Questions to ask yourselves before using ML:

- Do you need ML?

  - Can you solve the same problem using statistics?

- Do you know how to use it?

  - Do you understand the principles behind ML methods?

- Do you know what the results of ML really mean?

  - What do those numbers represent?

Using, misusing and abusing ML

- Is your data suitable?

    - Do you expect non-linearity in the data?

    - If not, use statistics!

- Do you have enough data?

    - "Enough" might mean a 1k observations per series.

- Can you estimate ML methods on time?

    - If done properly and smartly, one ANN applied to a time series might take ~half a minute for the estimation.

Using, misusing and abusing ML

Examples of misuse - BBC: Machine learning 'causing science crisis'.

- ML software identifies non-existent patterns in the data;

- People write papers based on that, claiming new findings;

- Given that those patterns only exist in the data, the results cannot be reproduced;

- ML is evil because it contributes towards the reproducibility crisis in science;

- Can we really trust the ML-based findings?

Using, misusing and abusing ML

- Fair points of the article:

    - ML is misused for different purposes (publications, fame, money…);

    - There is a reproducibility problem in science.

- Issues with the article:

    - ML does not cause the crisis, people do;

    - Statistics is misused as well, causing even worse problems in different fields;

    - People need to be educated in scientific principles and best practices.
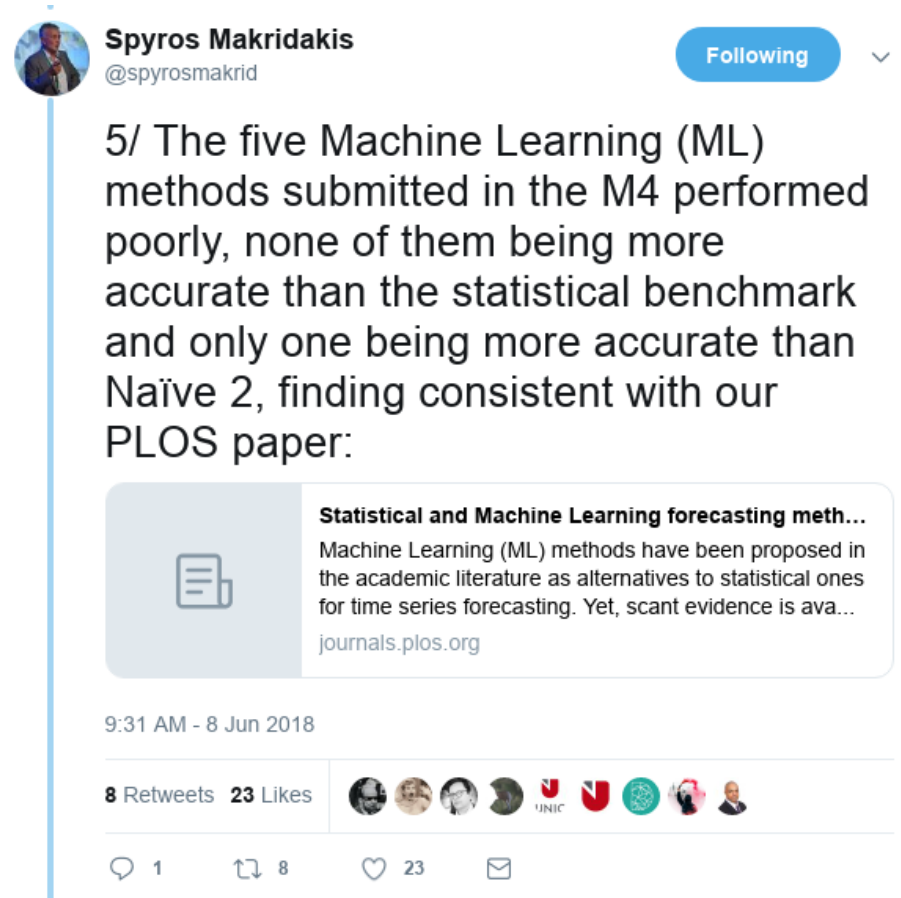
Examples of misuse - M4 competition:

- The official aim of the competition – try out new methods and find the most accurate;

- The unofficial aim – show that ML doesn't work;

- …

- No specialists in ML among the organisers;

Using, misusing and abusing ML

- 2 benchmark Artificial Neural Networks;

- 4 submissions of pure ML methods;

- ~30 combination methods submitted;

- 100k time series:

  - Yearly, quarterly, monthly dominate the dataset (95k);

  - 359 weekly, 4227 daily and 414 hourly.

- Results:
  - ML performs poorly;

  - But! The winning method is a hybrid of ML and statistics.

Spyros Makridakis
@spyrosmakrid

Following

5/ The five Machine Learning (ML) methods submitted in the M4 performed poorly, none of them being more accurate than the statistical benchmark and only one being more accurate than Naïve 2, finding consistent with our PLOS paper:

> **Statistical and Machine Learning forecasting meth...**
> Machine Learning (ML) methods have been proposed in the academic literature as alternatives to statistical ones for time series forecasting. Yet, scant evidence is ava...
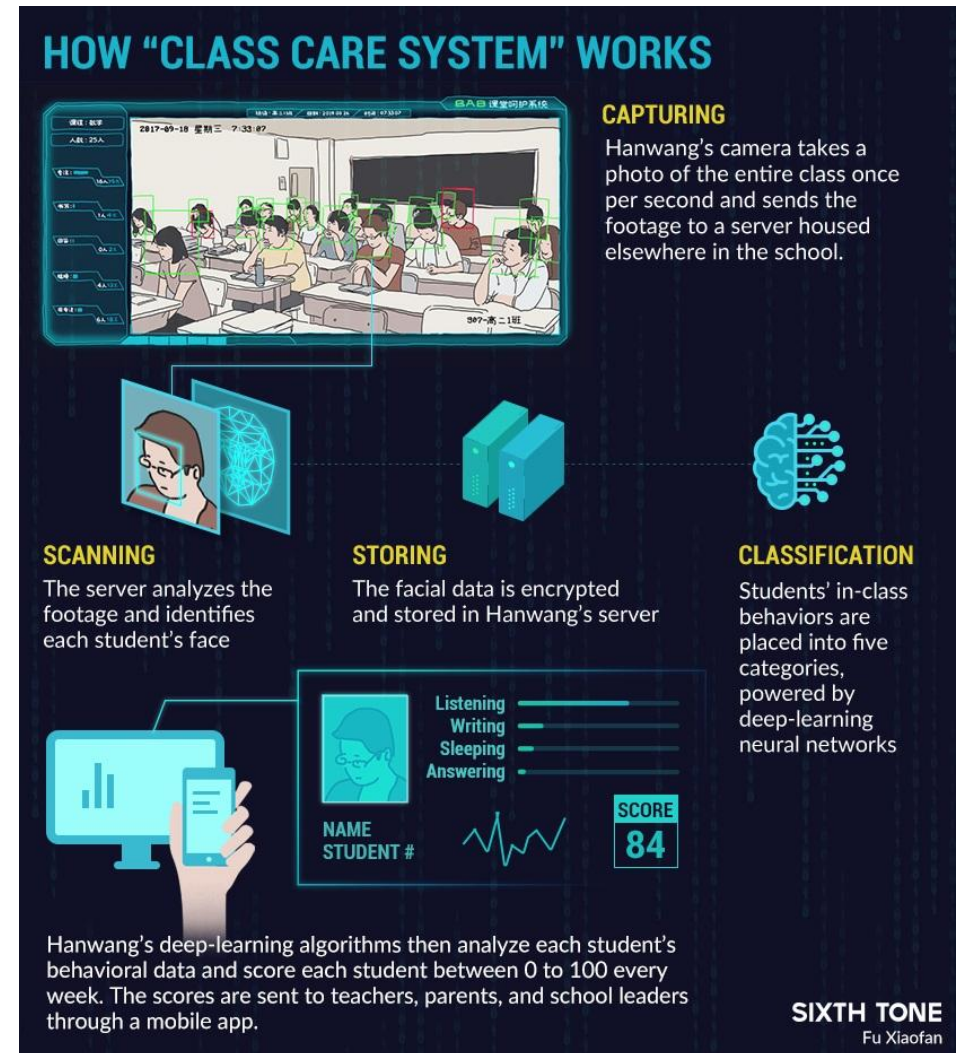> journals.plos.org

9:31 AM - 8 Jun 2018

8 Retweets **23** Likes

💬 1   🔁 8   ♡ 23   ✉

Examples of abuse:

- A lot of examples from China;

- Class care system…

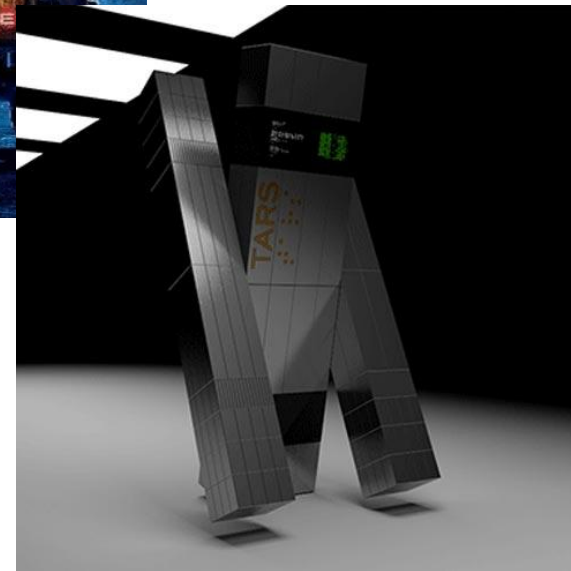# THE FUTURE OF AI
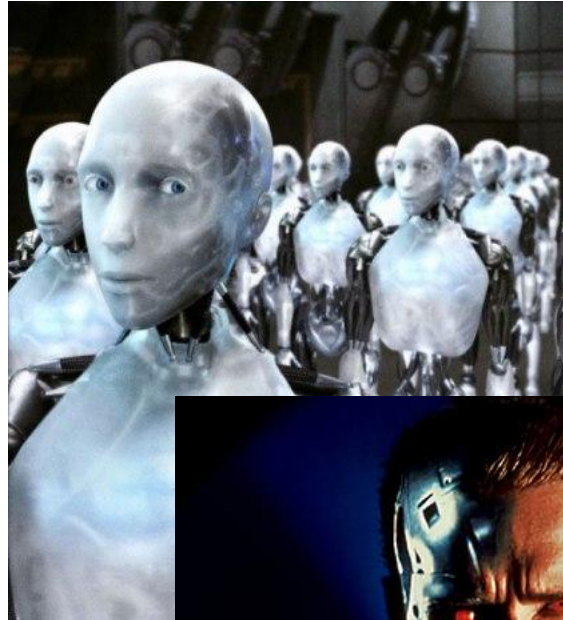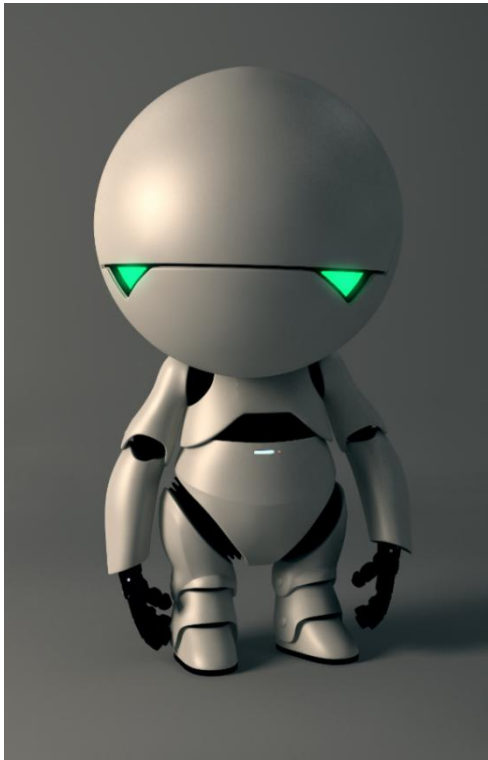
The future of AI

There are three large categories of AI (in theory):

- ANI – Artificial Narrow Intelligence,
    - Specific systems for specific tasks.
        - Siri, Alexa, Image recognition tools, etc.

The future of AI

- ## AGI – Artificial General Intelligence,

  - Systems being able to do what any human can.

    - Speech recognition, drive a car, write a poem, produce forecasts, write reports…
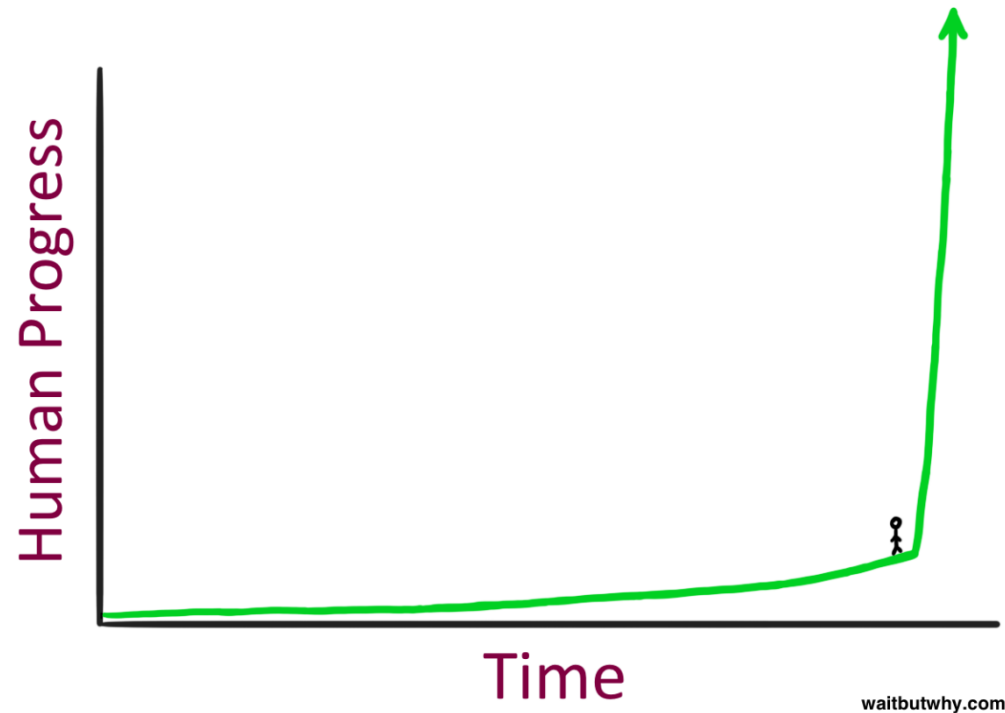
The future of AI

- ## ASI – Artificial Super Intelligence.

  - ### Systems that can do what no man can do

    - Change the matter on atom level, manipulate time,…

Skynet is a huge misconception!

The future of AI

- How far are we from ASI?

- A nice graph from "waitbutwhy.com":

- The step from AGI to ASI is very small…

The future of AI

We have a danger of creating a "God"...

When will we have ASI?

- A questionnaire among 100 most cited AI authors:

- By which year the machines will be able to "carry out most human professions at least as well as a typical human"?

- With 50% confidence, the median is 2050;

- Keep in mind the optimism bias and the underestimation of the progress...

CONCLUSIONS

Conclusions

- AI is becoming increasingly popular,

- It will change the way we live,

- Companies start using AI for different analytical purposes,

  - E.g. see last year CMAF workshop,

- AI is getting better in lots of things...

  - People will loose jobs because of it in ~5 – 10 years,

  - You might need to change your profession at some point...

Conclusions

- ML is solving a lot of problems these days,

- Advances in image and speech recognition, classification problems etc,

- Very flexible, very non-linear,

- No need to bother about the model form:
  - Feed the stuff to a ML method,
  - Train it properly,
  - …
  - Profit!

Conclusions

- Still, AI is not a panacea,

- You need a proper data,

- You need a lot of data,

- ML is good for non-linearity,

- Misuse ML and get poor results,

Conclusions

- A lot of problems can be efficiently solved using statistics,

    - If in doubt, use statistics!

- People don't understand what AI and ML are,

- "AI" and "ML" are now catchy phrases,

- Too much hype...

Thank you for your attention!

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