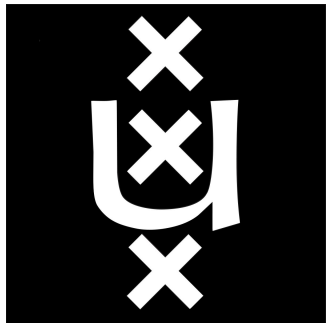
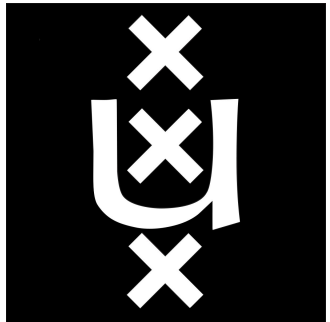
AI for Society

BSc AI 2020/21



Week 4: AI Economics

Giovanni Colavizza

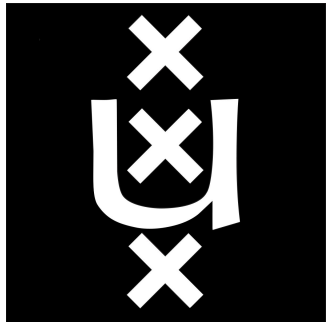


Topics

1. The economic impact of automation
2. A framework to think about AI economics
3. Predicting the automation of work
4. Concluding remarks
5. Assignment

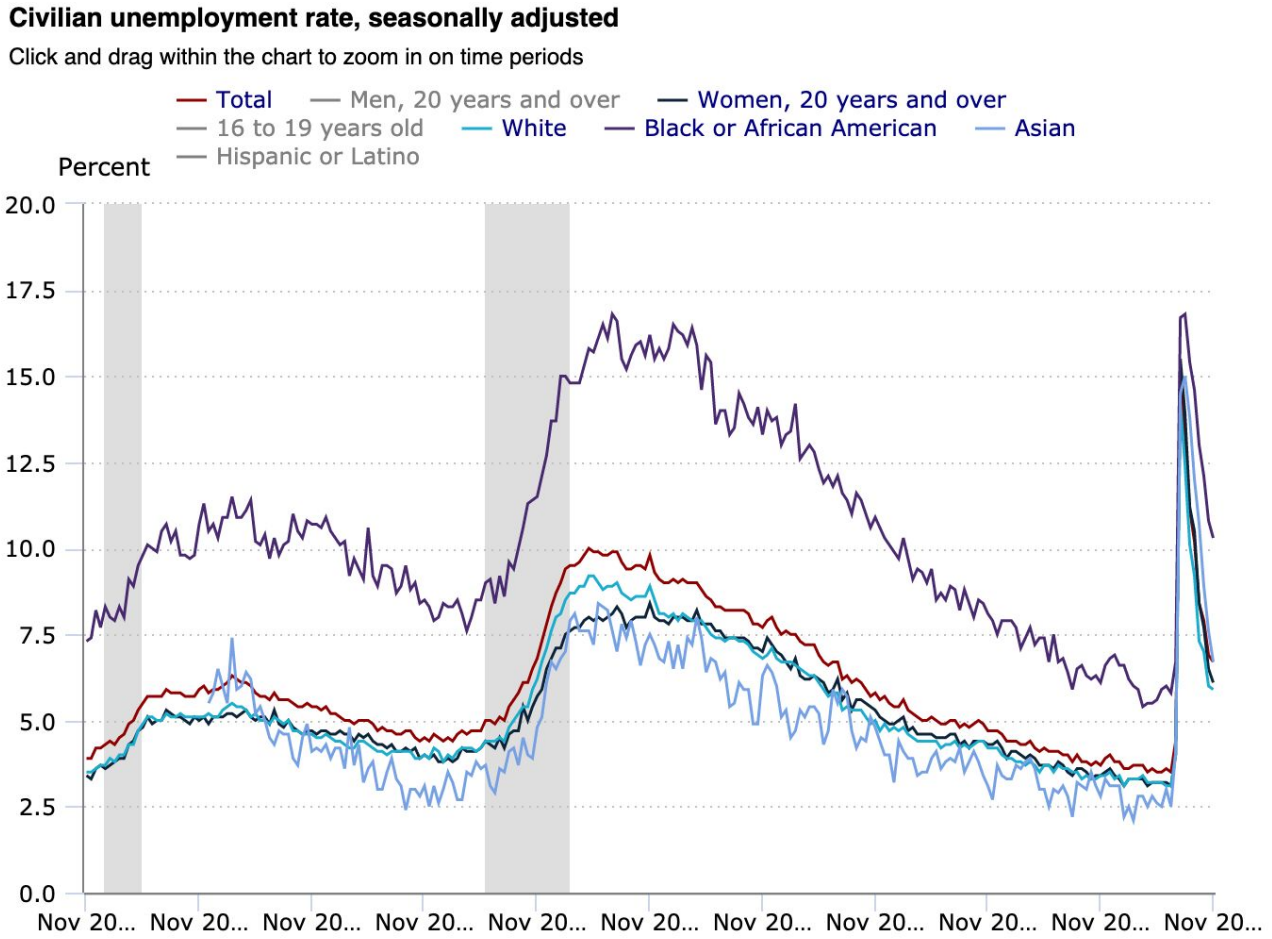
PART 1: The economic impact of automation

Giovanni Colavizza



US unemployment

2000-2020

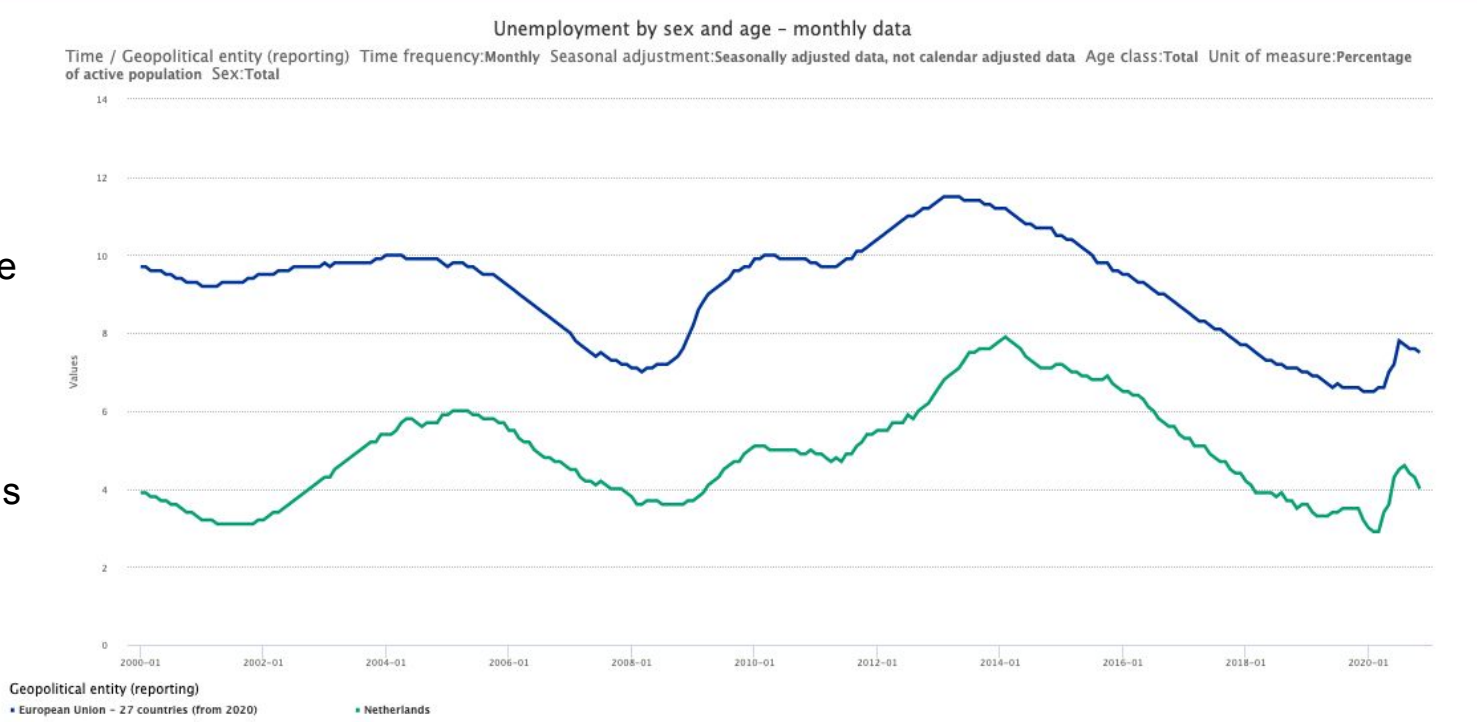


https://www.bls.gov/charts/employment-situation/civilian-unemployment-rate.htm

EU unemployment 2000-2020

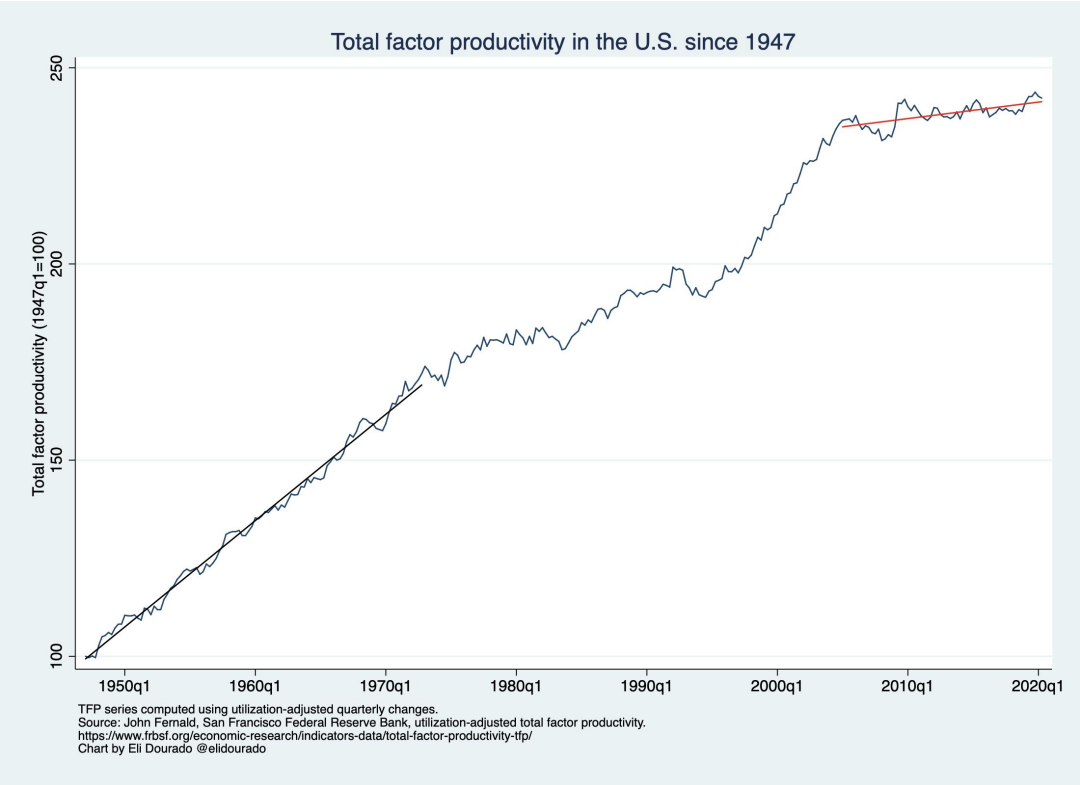
EU average

Netherlands



https://ec.europa.eu/eurostat/databrowser/bookmark/45b163cf-4d2c-4415-a5c6-53bcf0ae39a0?lang=en

US Productivity



https://elidourado.com/blog/notes-on-technology-2020s

High structural unemployment, why?

Three views:

- Economic cycles
- Long-term stagnation in innovation
- “End of work” (Rifkin, 1995): not too little, but too much innovation

Brynjolfsson and McAfee. 2012. *Race against the machine*

High structural unemployment, why?

Three views:

- Economic cycles
- Long-term stagnation in innovation
- **“End of work”** (Rifkin, 1995): not too little, but too much innovation

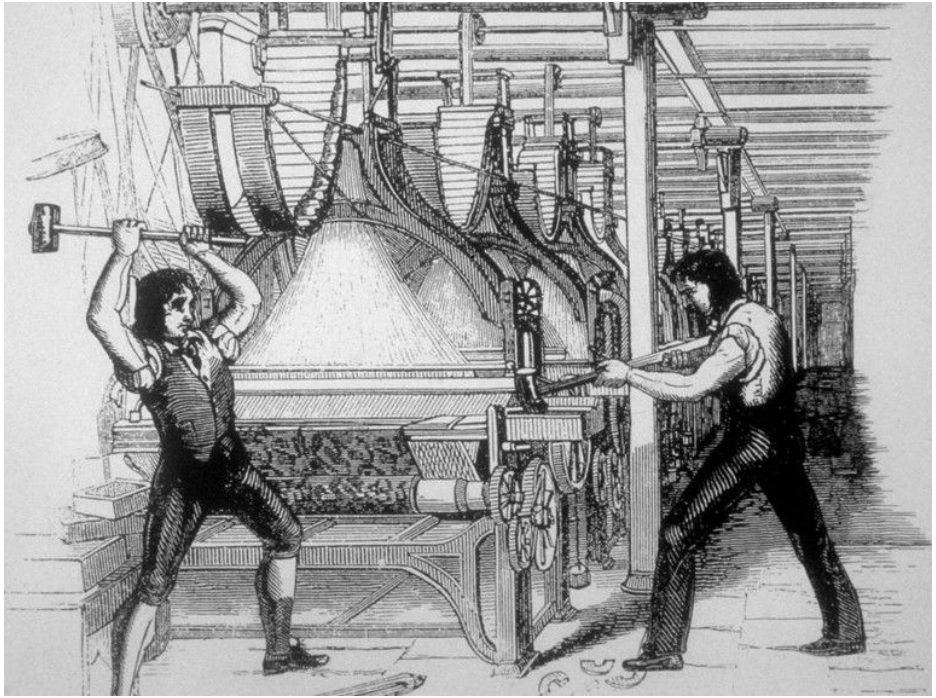
Two attitudes:

- **Pessimistic**: automation brings an overall reduction in employment and quality of labour, while increasing the concentration of wealth: problem of distribution.
- **Optimistic**: automation, while displacing on the short term, brings higher employment and overall wealth growth on the medium and longer term.

Brynjolfsson and McAfee. 2012. *Race against the machine*

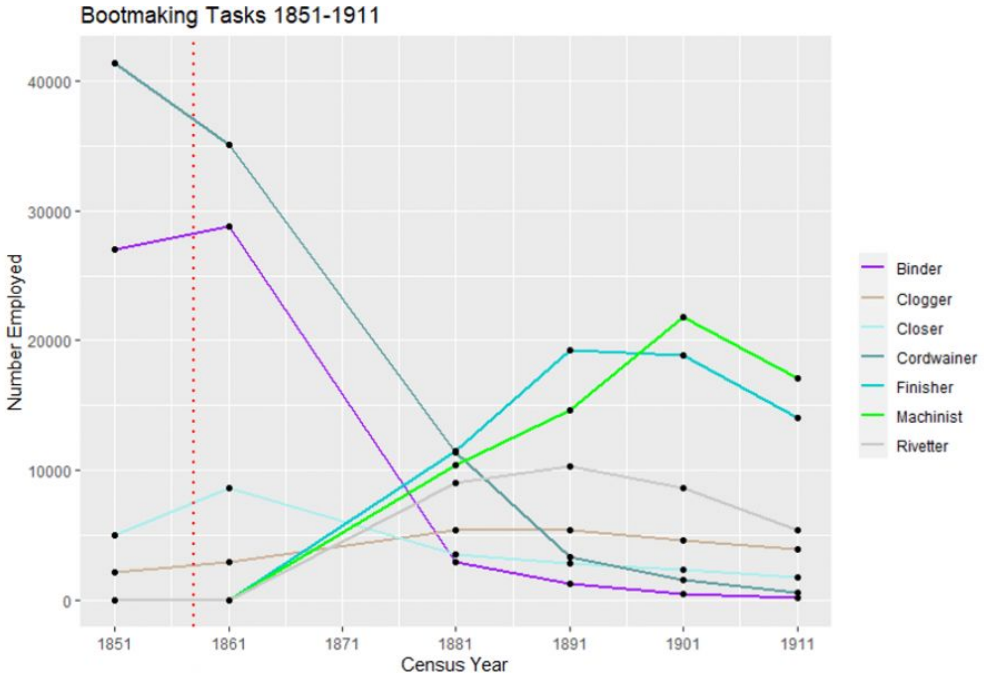
A historical recurrence: Luddism

The most famous historical reaction to mechanization happened in early XIX-century Britain, in the textile sector.



A historical recurrence: Luddism

Then (like now, probably), mechanization was mostly labour *displacing* rather than replacing, *in the long term*.



Vipond. 2020. *Technological unemployment in Victorian Britain*, https://ehs.org.uk/technological-unemployment-in-victorian-britain

Far (or near?) future speculation

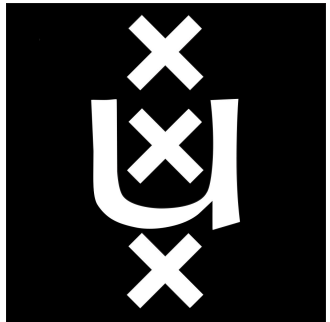
Limit scenarios for AI development:

- **Merge of humans and machines via enhancement**. Technology and not biology will increasingly determine capabilities. Rich get richer dynamics to skyrocket.
  - Yuval Noah Harari. 2015. *Homo Deus.*
- **AI entities develop separately from humans**. Unclear what might happen, likely obsolescence of humans.
  - Nick Bostrom. 2014. *Superintelligence.*
  - Max Tegmark. 2017. *Life 3.0*.

Q&A

PART 2: A framework to think about AI economics

Giovanni Colavizza



AI as prediction

- “**PREDICTION** is the process of filling in missing information. Prediction takes information you have, often called ‘data’, and uses it to generate information you don’t have.”
- AI is ostensibly good at improving predictions (i.e., reducing uncertainty) for **routine** tasks with abundant and **uniform** data generating processes.
- While this consideration still holds, AI is getting better, i.e., what falls under ‘routine’ and ‘uniform’ is expanding rapidly.

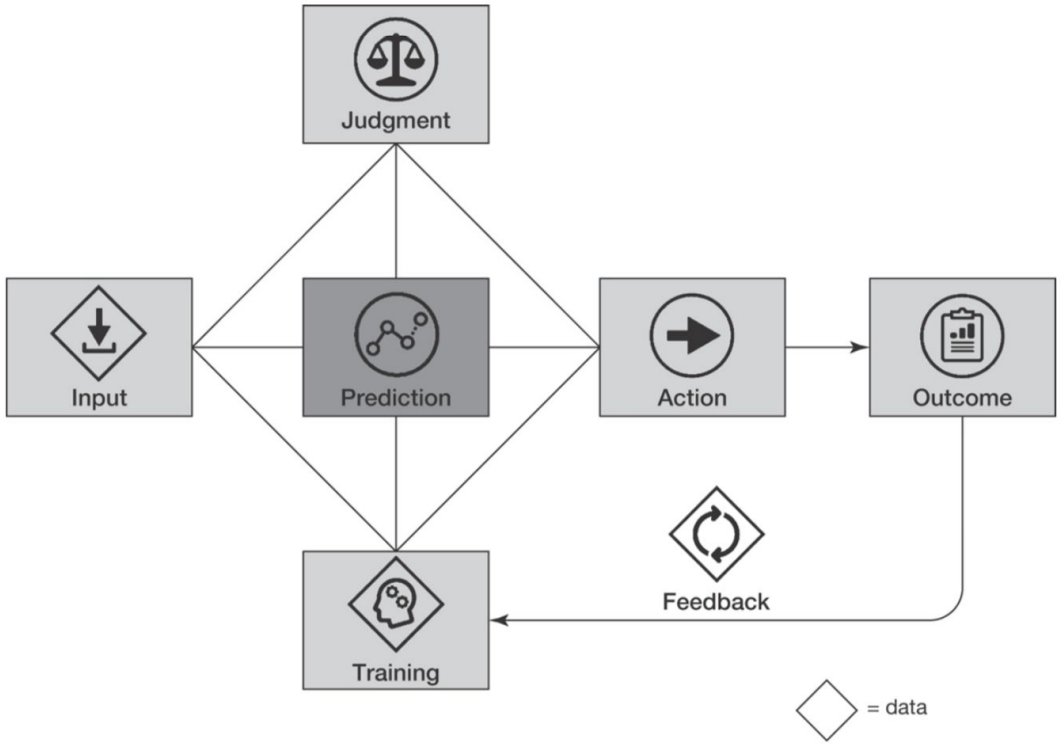
Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

Anatomy of a decision

“Prediction facilitates decisions by reducing uncertainty, while **judgment assigns value**. In economists’ parlance, judgment is the skill used to determine a payoff, utility, reward, or profit. **The most significant implication of prediction machines is that they increase the value of judgment**.”

Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

Anatomy of a decision

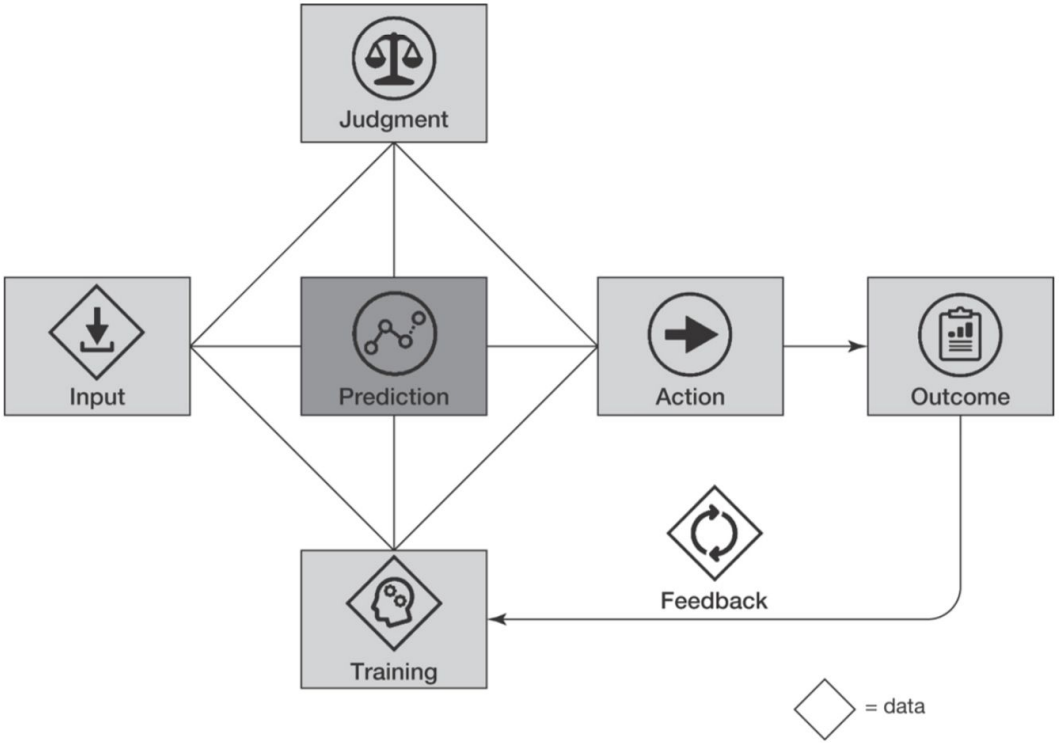


Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

How AI impacts decisions

Tasks that focus on routine predictions are easier to automate.

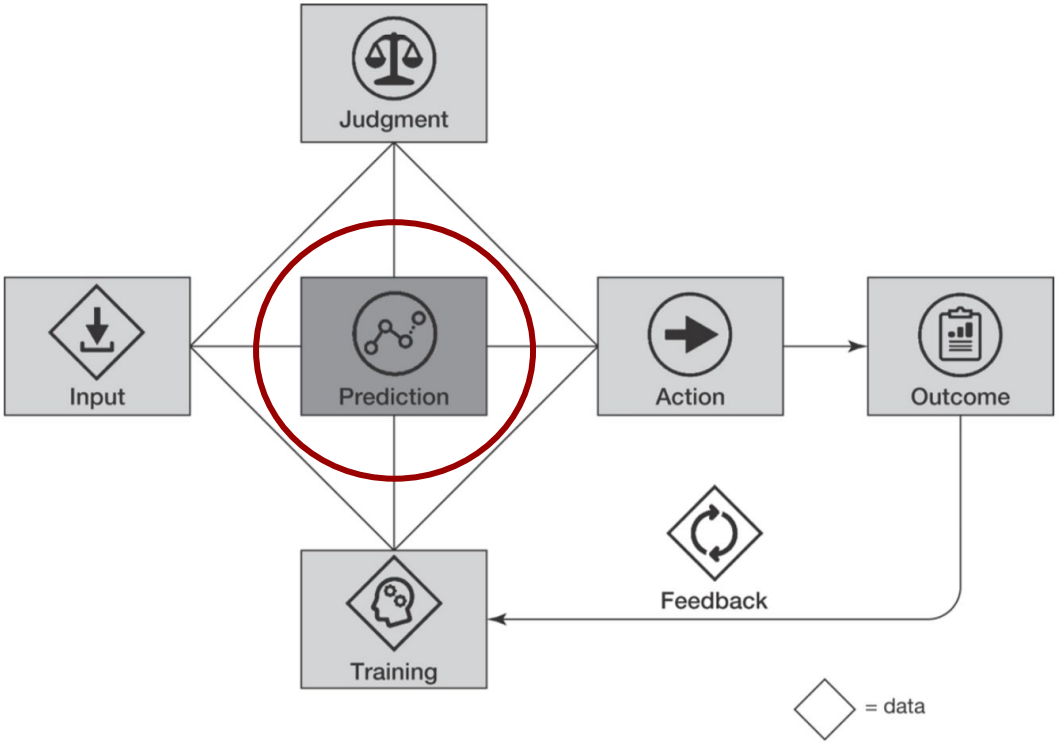
Tasks that focus on judgements and complex actions are harder to automate, yet can be complemented.



Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

How AI impacts decisions

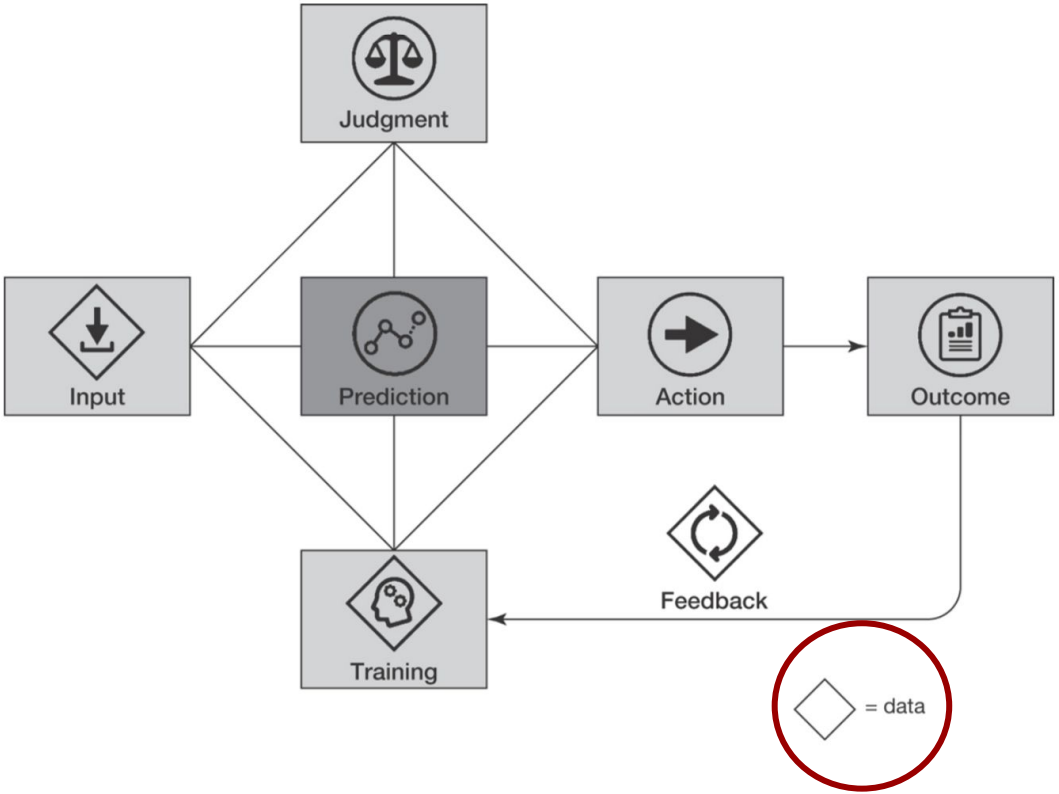
- Improve predictions (e.g., image recognition)
- Automate predictions which were previously not automatable (e.g., translation). I.e., broaden what we consider ‘routine’.



Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

How AI impacts decisions

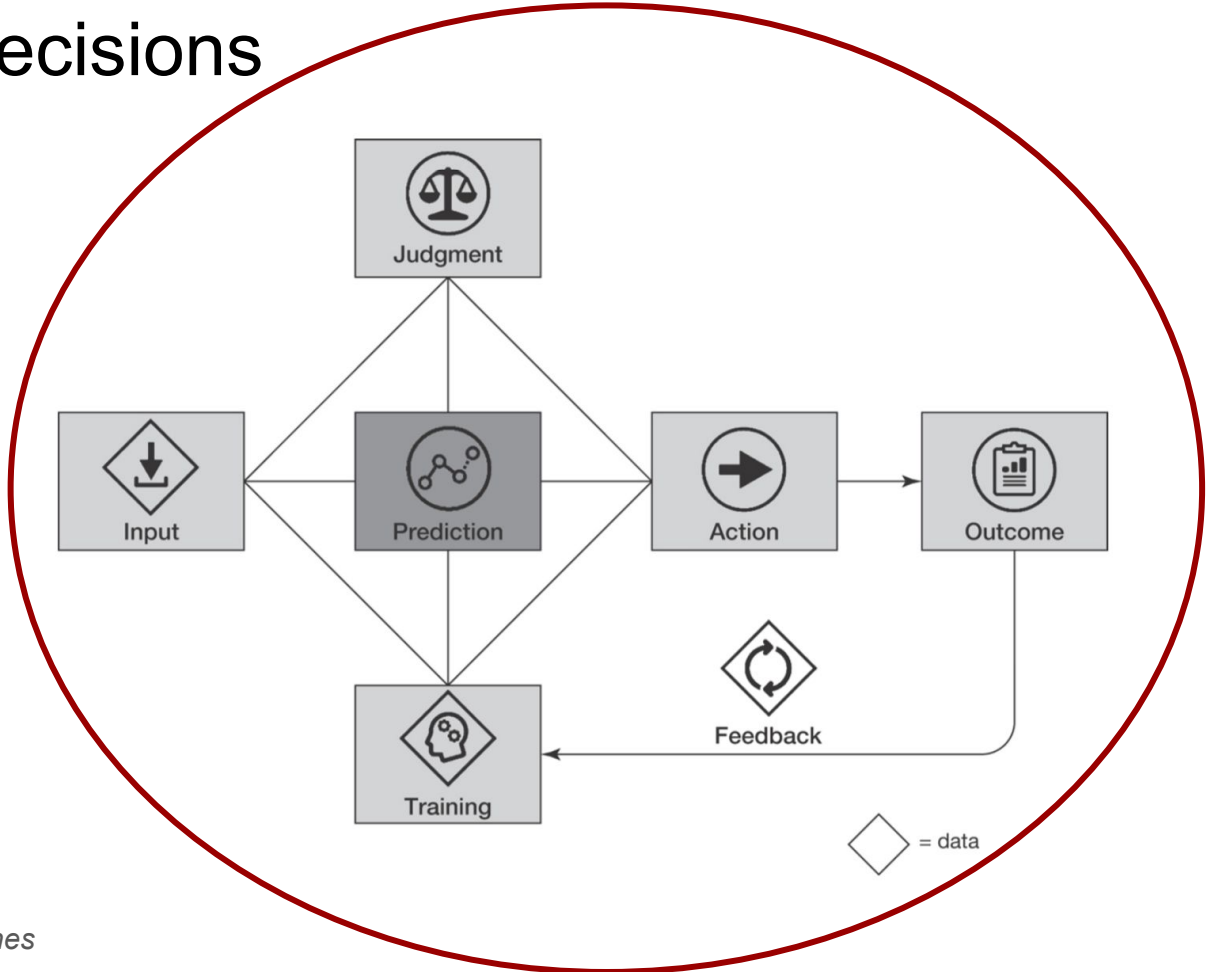
- Build or tap into a controlled data-generating process which can be used to make predictions (e.g., ads or sales)



Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

How AI impacts decisions

- Build fully autonomous decision systems (e.g., self-driving cars)



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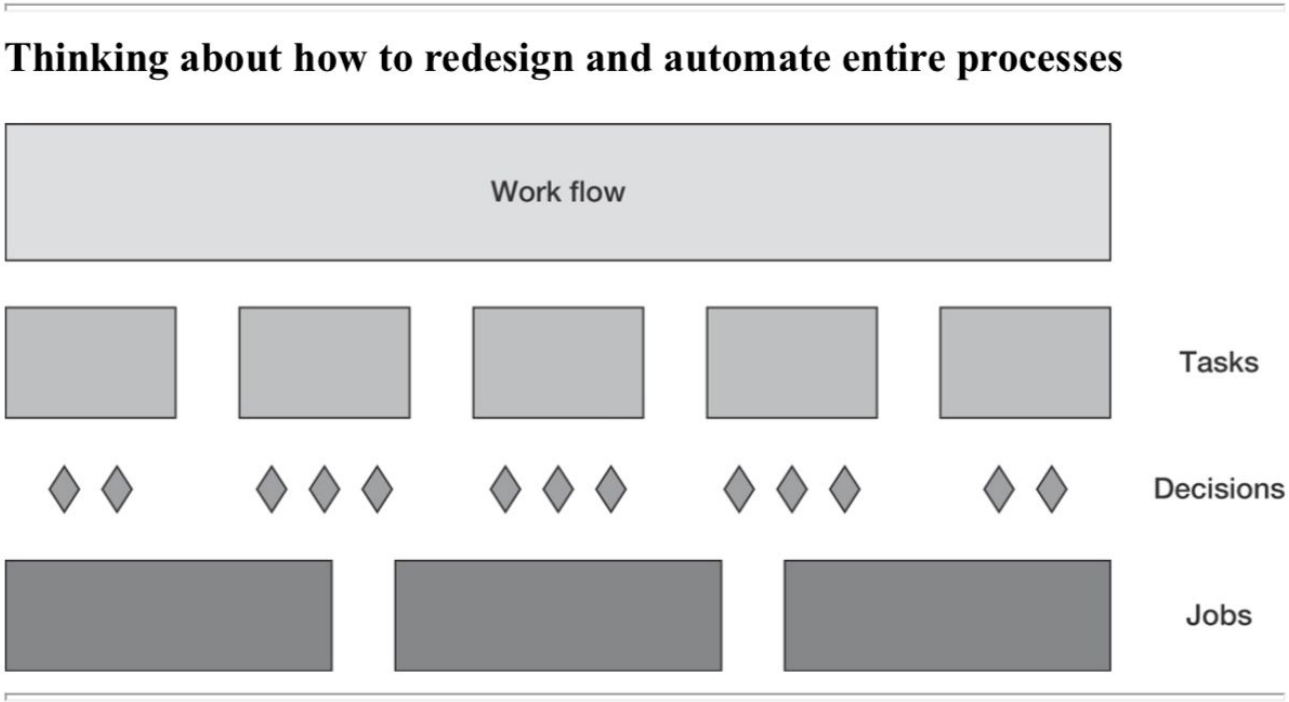
What is the impact on jobs?



Agrawal, Gans, Goldfarb. 2018. *Prediction machines*

Q&A

PART 3: Predicting the automation of work

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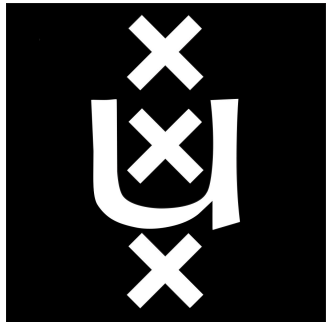
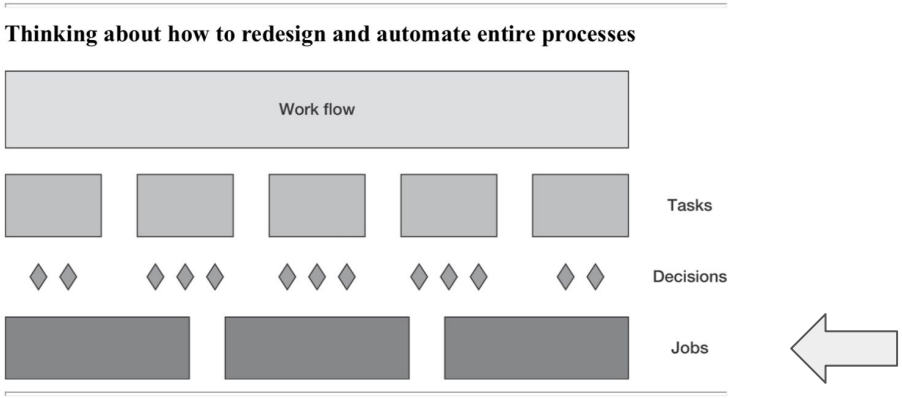


How susceptible are jobs to computerisation?

Idea: use job descriptions in terms of their requirements and presence of computational bottlenecks, in order to predict how likely they are to be automated in the near future.

Approach: supervised learning.



Frey and Osborne. 2013. *The future of employment*, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

How susceptible are jobs to computerisation?

O*NET OnLine

Occupation Quick Search:

Help | Find Occupations | Advanced Search | Crosswalks | Share | O*NET Sites

Summary Report for:
15-2051.00 - Data Scientists

Updated 2020
Bright Outlook

Develop and implement a set of techniques or analytics applications to transform raw data into meaningful information using data-oriented programming languages and visualization software. Apply data mining, data modeling, natural language processing, and machine learning to extract and analyze information from large structured and unstructured datasets. Visualize, interpret, and report data findings. May create dynamic data reports.

Also see: Business Intelligence Analysts, Clinical Data Managers

View report: Summary | Details | Custom

Tasks | Detailed Work Activities | Credentials | Wages & Employment | Job Openings

Tasks

5 of 16 displayed

- Analyze, manipulate, or process large sets of data using statistical software.
- Apply feature selection algorithms to models predicting outcomes of interest, such as sales, attrition, and healthcare use.
- Apply sampling techniques to determine groups to be surveyed or use complete enumeration methods.
- Clean and manipulate raw data using statistical software.
- Compare models using statistical performance metrics, such as loss functions or proportion of explained variance.

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Detailed Work Activities

5 of 16 displayed

- Advise others on analytical techniques.
- Analyze business or financial data.
- Analyze data to identify or resolve operational problems.
- Analyze data to identify trends or relationships among variables.
- Analyze data to inform operational decisions or activities.

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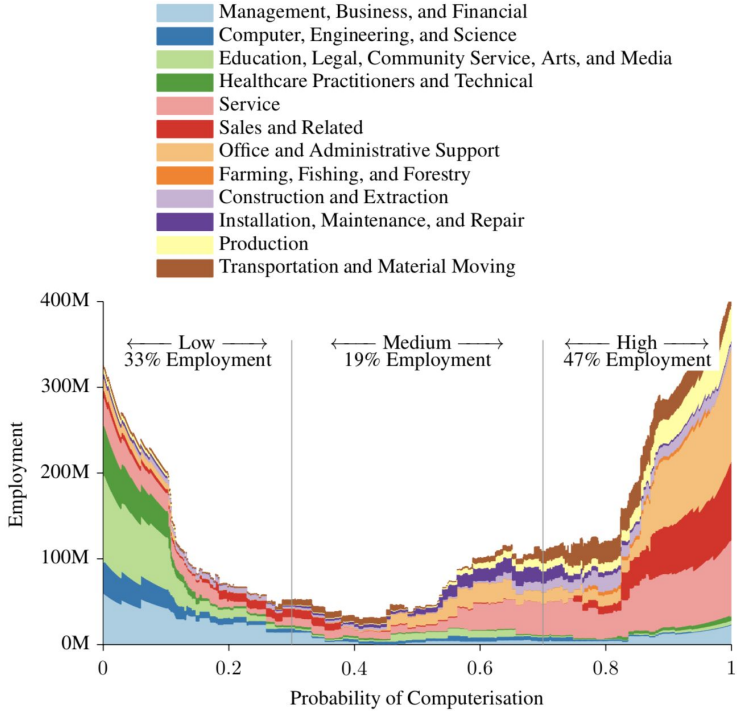
Frey and Osborne. 2013. *The future of employment*, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

How susceptible are jobs to computerisation?

Computerisation bottleneck	O*NET Variable	O*NET Description
Perception and Manipulation	Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
	Manual Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
	Cramped Work Space, Awkward Positions	How often does this job require working in cramped work spaces that requires getting into awkward positions?
Creative Intelligence	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
	Fine Arts	Knowledge of theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.
Social Intelligence	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
	Negotiation	Bringing others together and trying to reconcile differences.
	Persuasion	Persuading others to change their minds or behavior.
	Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.

Frey and Osborne. 2013. *The future of employment*, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

How susceptible are jobs to computerisation?



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How susceptible are jobs to computerisation?

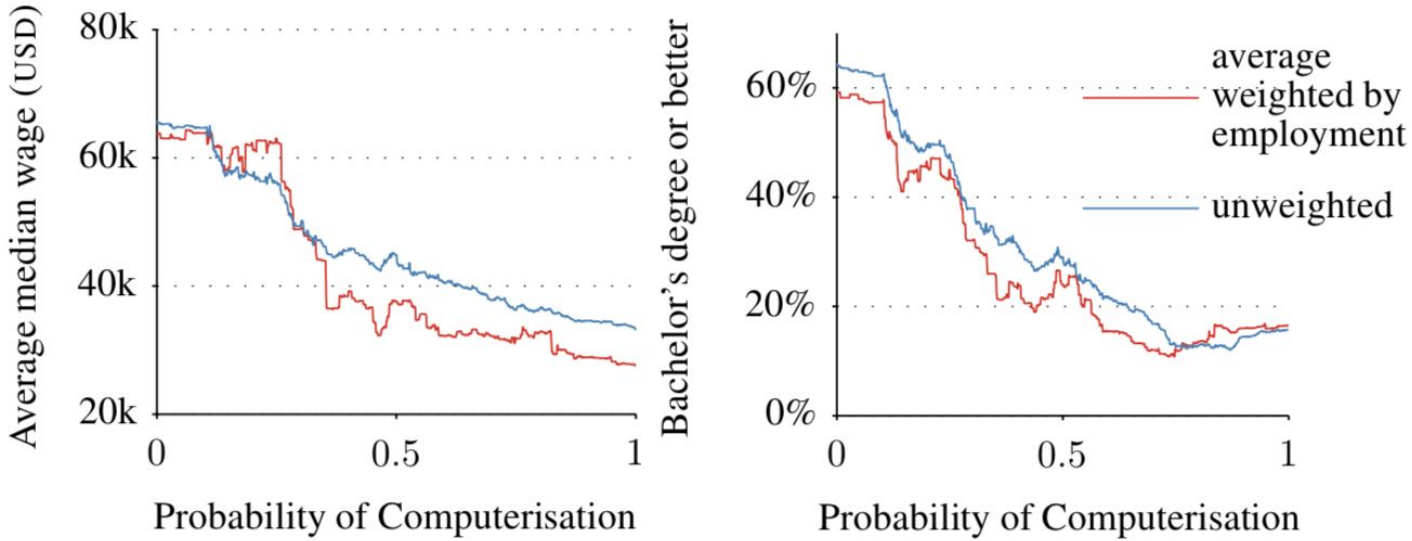


FIGURE IV. Wage and education level as a function of the probability of computerisation; note that both plots share a legend.

Frey and Osborne. 2013. *The future of employment*, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

How susceptible are jobs to computerisation?

The current wave of automation, largely driven by AI and robotics, seems to impact low-skilled workers most and to favour high-skilled workers more.

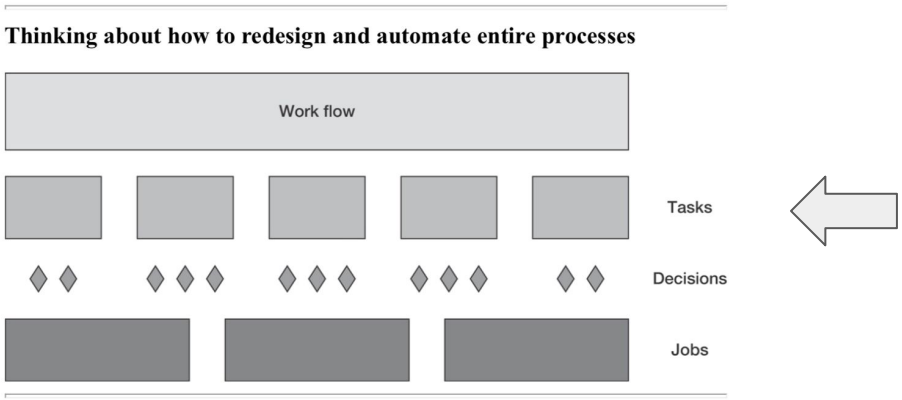
“The balance between job conservation and technological progress therefore, to a large extent, reflects the balance of **power in society**, and how gains from technological progress are being distributed.”

Frey and Osborne. 2013. *The future of employment*, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?link=mktw

What can machines learn?

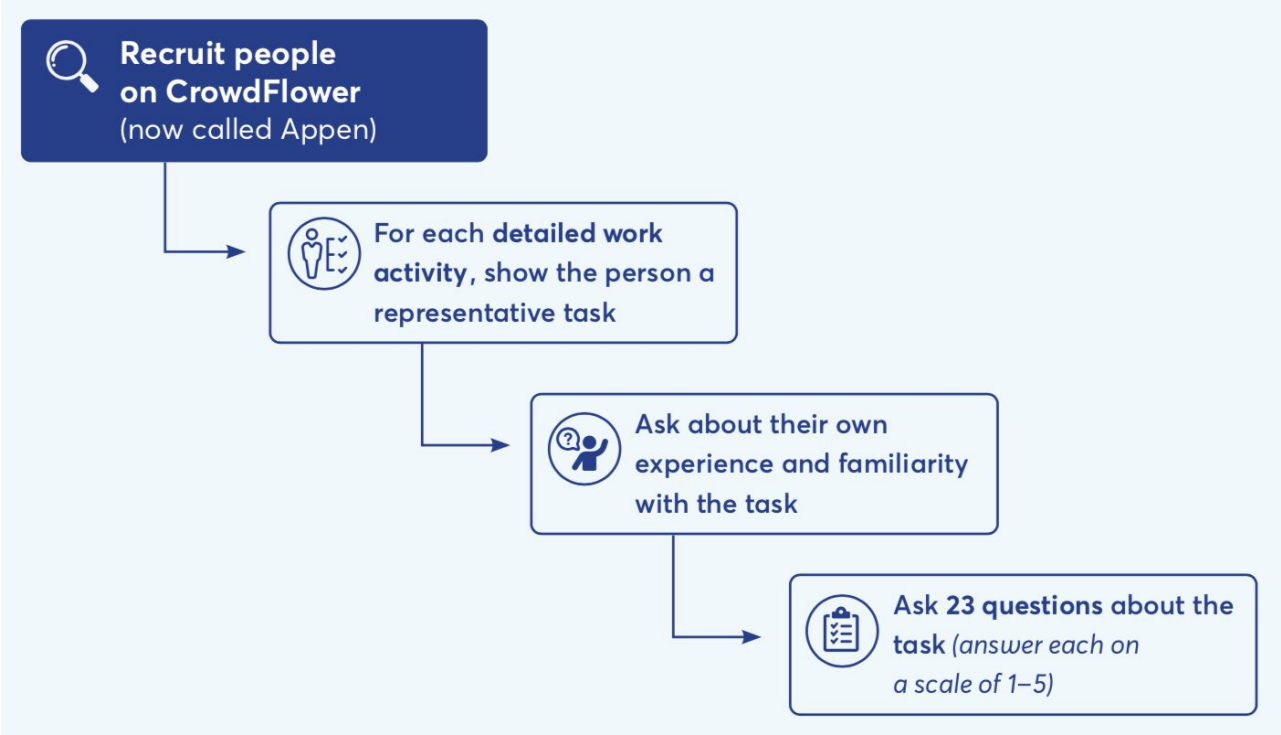
Same question, but different method: instead of using job requirements, consider the tasks it is made of. How automatable are they?

Approach: collective intelligence (crowdsourcing).



Brynjolfsson et al. 2018. *What can machines learn* https://www.aeaweb.org/articles?id=10.1257/pandp.20181019

What can machines learn?



Nesta report. 2020. *Mapping career causeways* https://www.nesta.org.uk/report/mapping-career-causeways-supporting-workers-risk

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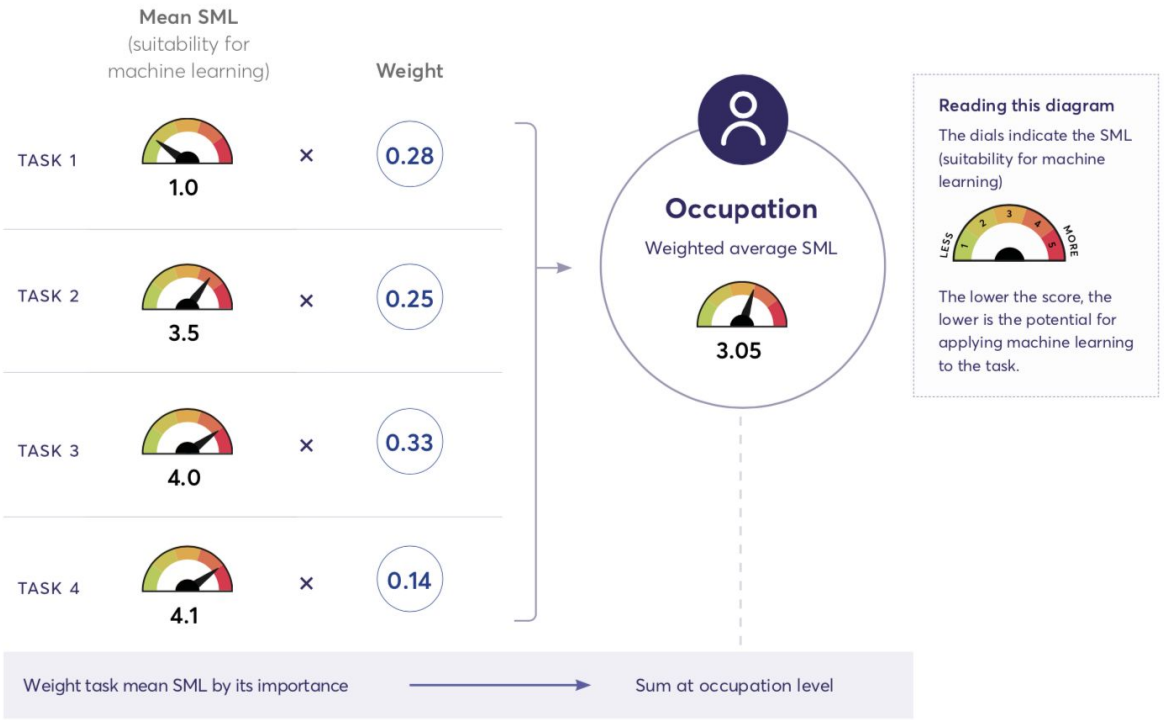

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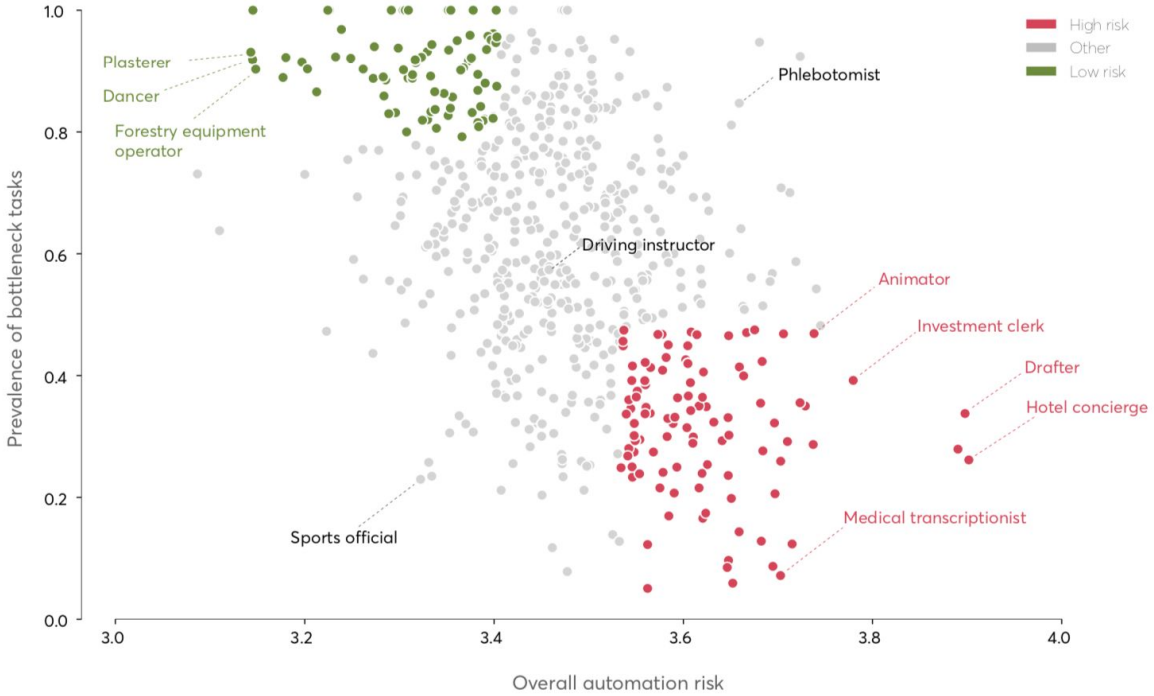

Interactive maps: https://data-viz.nesta.org.uk/career-causeways/index.html

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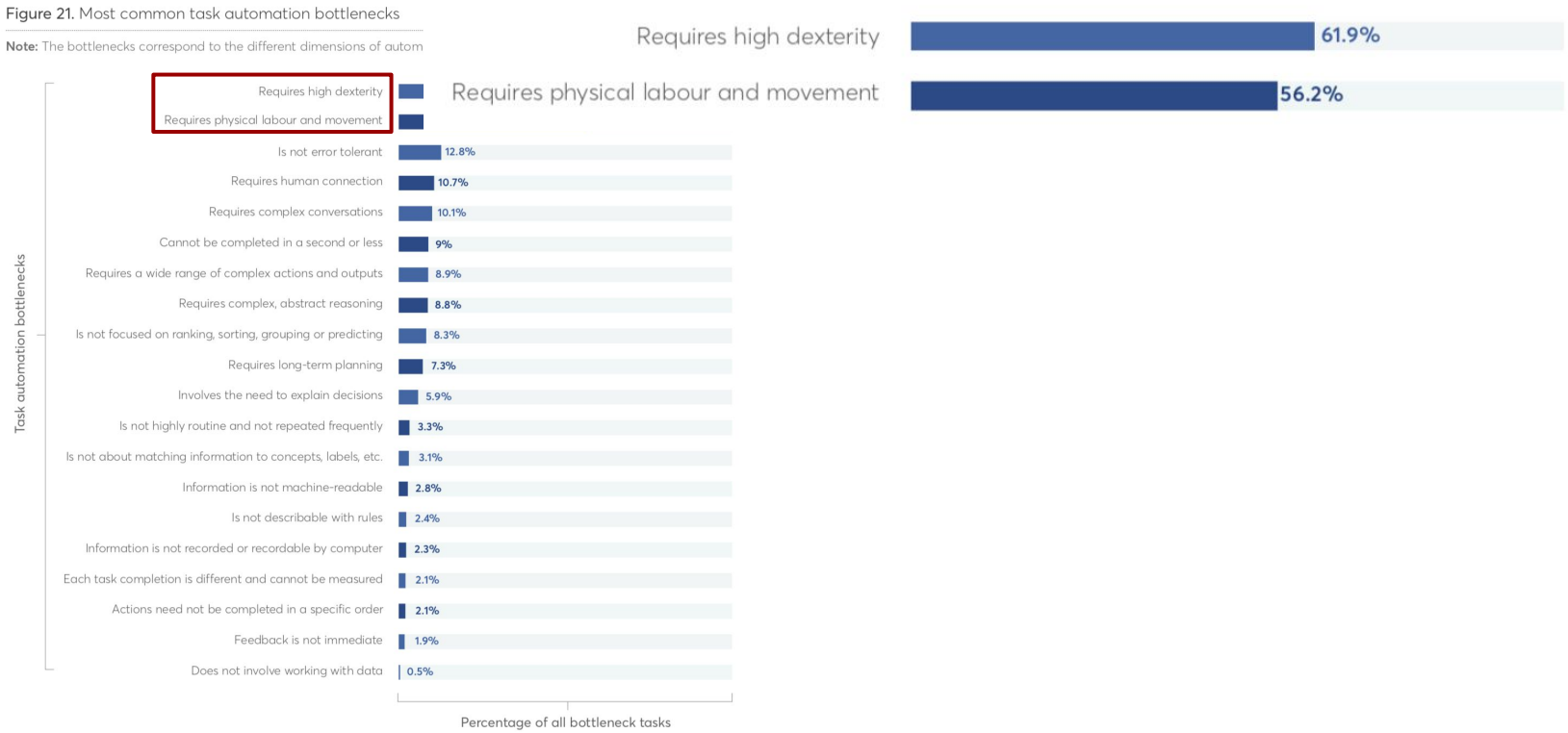


Nesta report. 2020. *Mapping career causeways* https://www.nesta.org.uk/report/mapping-career-causeways-supporting-workers-risk

What can machines learn?

"We find that 1) most occupations in **most industries have at least some components that are suitable for machine learning (SML)**, 2) **few if any occupations have all tasks that are SML** and 3) unleashing ML potential will require significant redesign of the task content of jobs, as SML and non-SML tasks within occupations are unbundled and rebundled.

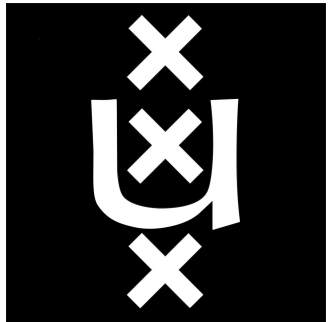
Our findings suggest that a shift is needed in the debate about the effects of AI on work: away from the common focus on full automation of jobs and pervasive occupational replacement **toward the redesign of jobs and reengineering of business processes**."

Brynjolfsson et al. 2018. *What can machines learn* https://www.aeaweb.org/articles?id=10.1257/pandp.20181019

Q&A

PART 4: Concluding remarks

Giovanni Colavizza



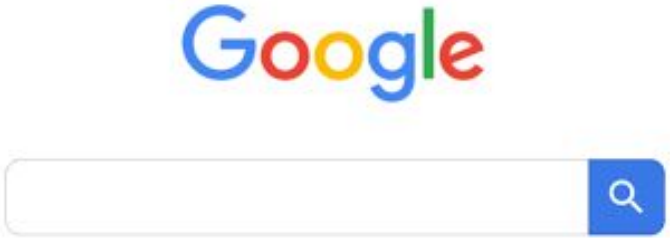
Where is AI best applied to innovate?

AI is best applied to tasks that:

- map well-defined inputs to well-defined outputs
- have data or where data can be created
- have clear feedback and goals
- do not have long chains of reasoning depending on background knowledge or common sense
- do not need detailed explanations
- are tolerant to error
- do not change much over time
- do not require specialized dexterity or mobility

Brynjolfsson and Mitchell. 2017. *What can machine learning do?* https://science.sciencemag.org/content/358/6370/1530

Example: Search



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Brynjolfsson and Mitchell. 2017. *What can machine learning do?* https://science.sciencemag.org/content/358/6370/1530

Example: Biometric authentication

AI is best applied to tasks that:

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Example: Uber

AI is best applied to tasks that:

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Example: Self-driving car

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Brynjolfsson and Mitchell. 2017. *What can machine learning do?* https://science.sciencemag.org/content/358/6370/1530

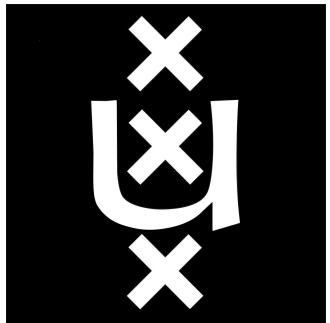
What we did not cover

- Philosophical and psychological foundations
- Sociological and historical foundations
- Anonymity and privacy
- Profiling and security
- Misinformation and disinformation
- Accountability and regulatory frameworks
- Diversity and inclusion
- Existential risk
- …

Q&A

PART 5: Assignment

Giovanni Colavizza



Charting the debate on the automation of work

Charting the debate on the automation of work

- Goal: understand how the debate on the automation of work has or is unfolding.
- How: use news, social and online media data, find relevant debates, map what they say (top keywords, topics, sentiment).
- This is an **open assignment**: you will choose which data and methods to use. We provide some ideas, but you are welcome to propose your own approach.

Set-up

You will work into groups. Motivated requests to change group can be made.

Let’s check the course repository for more info (assignment 4):
https://github.com/Giovanni1085/UvA_AIforSociety_2021

Note: we will assume you can clone a GitHub repository, set-up a working Python environment (ideally virtual, e.g., via Conda) and work with Jupyter notebooks. If you need some pointers/help, we have included a guide to setting up your working environment in the repo.

Q&A