

HOW DO *YOU* SEE THE *FUTURE* OF AI ?



• Science Fiction has explored many issues associated with AI

RISE OF ARTIFICIAL INTELLIGENCE

CAN WE (ECONOMISTS) SAY MORE THAN SCIENCE FICTION?

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WHAT IS AI?

WHAT IS AI

- AI can be:
 - a field
 - a set of technologies including
 - machine learning
 - deep learning
 - reinforcement learning
 - a philosophical concept
- Usual definition of AI:
 - mimic human intelligence:
 - *problem solving*: achieve goal without being explicitly told how
 - *learning*: gets better over time
 - without emotions

HOW TO MAKE THE DIFFERENCE BETWEEN A ROBOT AND A ?

- Check whether it thinks like a human being
- Turing test:
 - a machine discussing with a human must be recognized as a 7 years old human 50% of the time
 - can machines emulate human behaviour?
- Chinese Room thought experiment:
 - how to differentiate somebody who speaks chinese and somebody who follows rules to speak?
 - turing test cannot determine whether machines think
- What do you think of these tests?

IMPRESS ME?

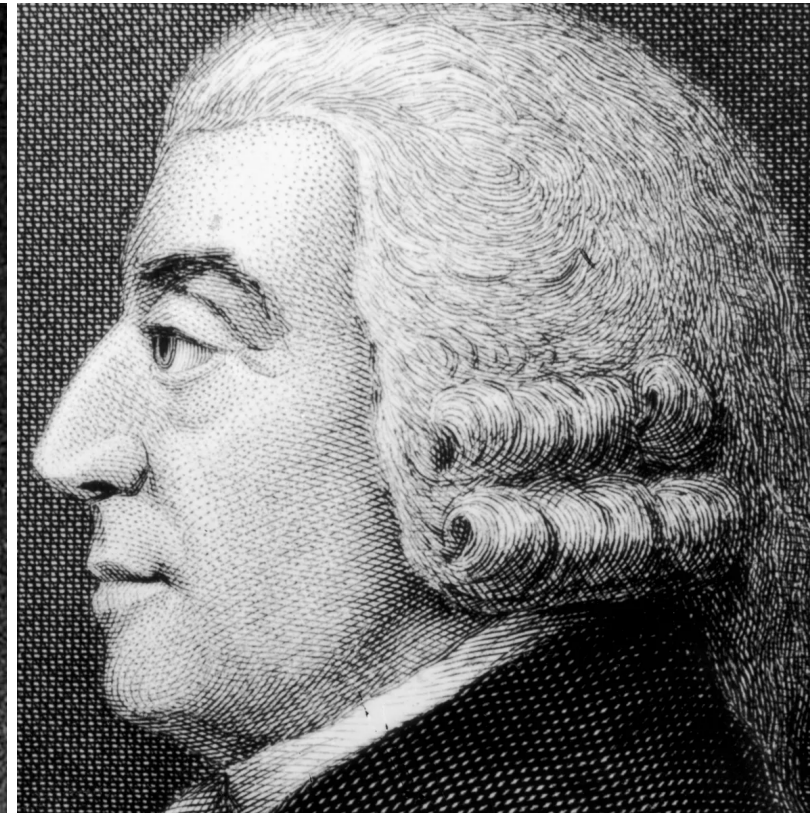
- So, what can machines do that is really intelligent?
 - speech recognition, language translation
 - drive a car
 - play chess better than a human
 - play go, better than a human, without being a specialist, by learning on its own
 - create, imagine
 - have empathy
 - talk

AI EFFECT

- people have a way to discount achievements of AI as "not AI"
 - because not impressive enough
 - because humans do it in "a different way"
- Larry Tesler theorem: "AI is whatever hasn't been done yet"
- Nick Bostrom: "once something becomes useful enough and common enough it's not labeled AI anymore"
- keep human special
 - interestingly that didn't seem to be a concern before the 70s

THE CLASSICAL VIEW

"THIS TIME IT'S DIFFERENT" OR "SAME OLD, SAME OLD..."?

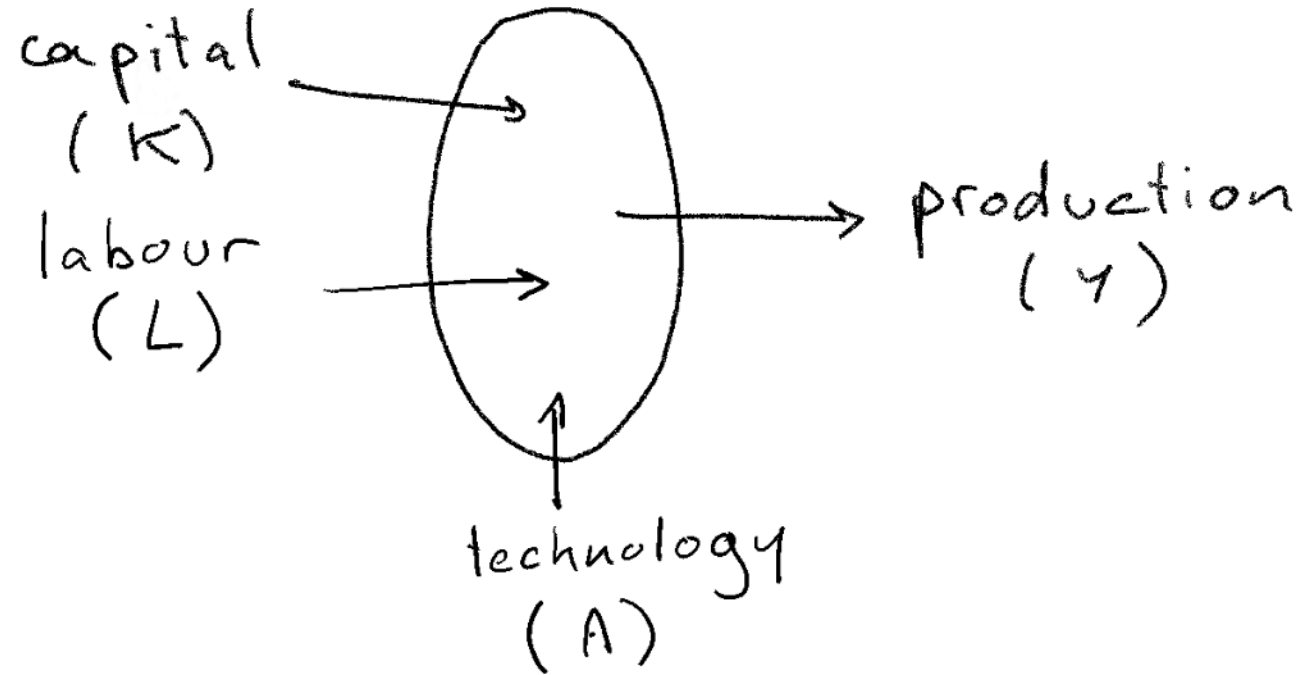


THE (NEO)CLASSICAL PRODUCTION FUNCTION

What are its main properties?

- production takes several **factors** as inputs
 - capital
 - labour
 - ... (natural resources, land, ...)
- each factor has a **market price**
- marginal returns w.r.t. each factor are **decreasing**
- factors are paid according to their **marginal productivity**
- the **technology** is the particular process through which inputs are combined

AI AND THE (NEO)CLASSICAL PRODUCTION FUNCTION



- the precise description depends on the problem under consideration
- what could you change to take into account the effect of AI?
 - data, technological change ?

THREE HYPOTHESES ABOUT THE ECONOMIC NATURE OF AI

- A technological change
- A new kind of factor: Data
- Yet another kind of factor: Robots
- Something else Completely

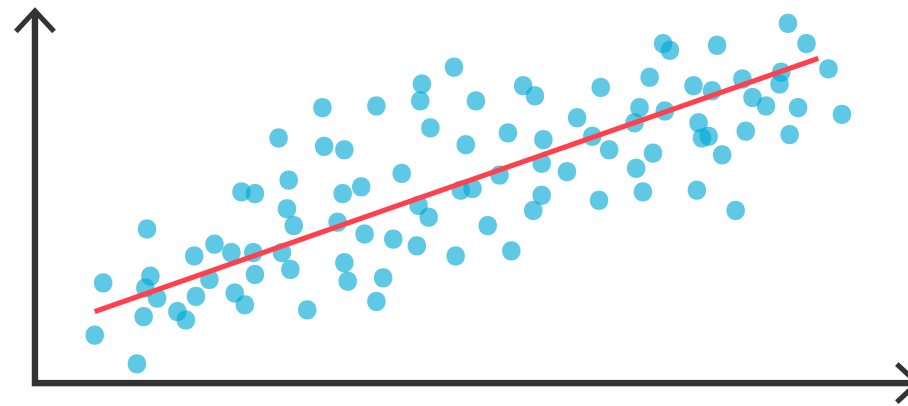
AI IS A CHANGE IN THE COST STRUCTURE





Ajy Agrawal, Joshua Gans and Avi Goldfarb: *Prediction Machines: The Simple Economics of Artificial Intelligence*
2018

PREDICTION MACHINES

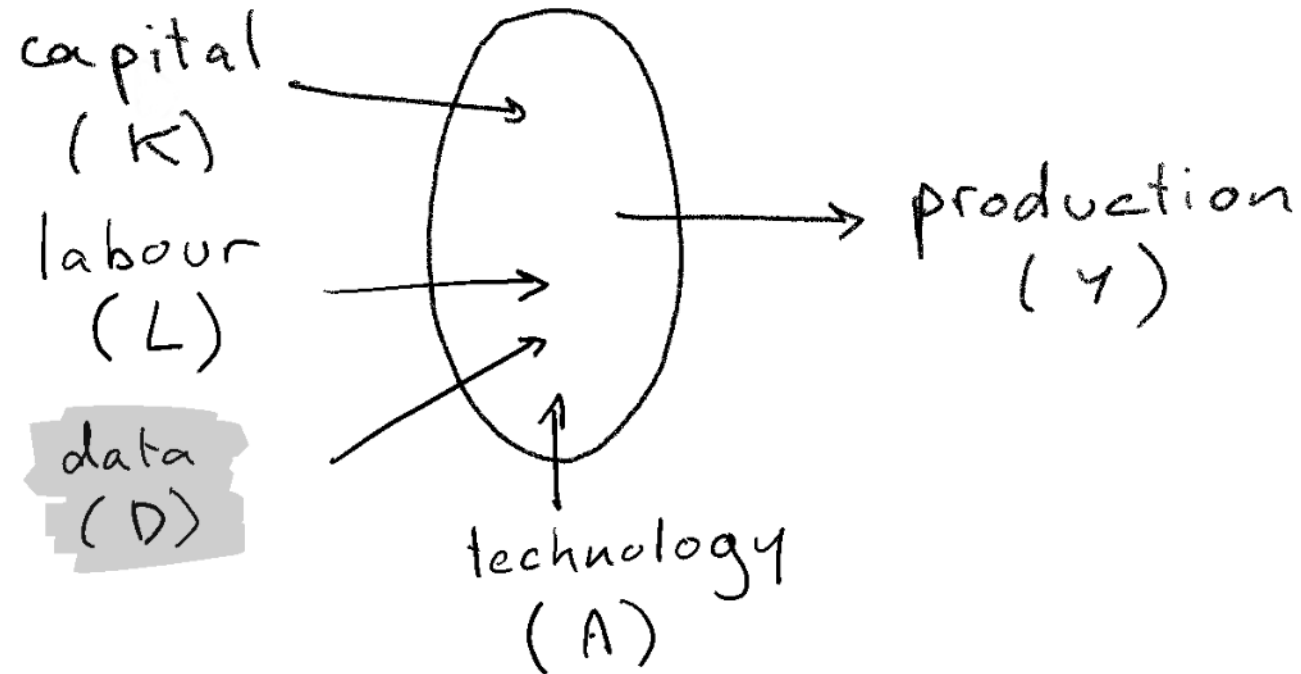


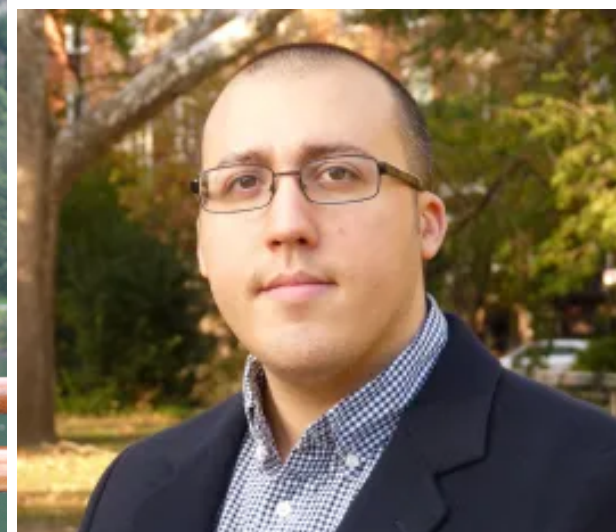
• many production tasks can be formulated as prediction problems

WILL I LOOSE MY JOB ?

- AI is a decrease in the **cost** of predictions
- The demand for all prediction-intensive tasks will rise (**law of demand**)
- The salary of workers with prediction-intensive tasks will rise (**market price**)
- Value of other tasks will fall (**general equilibrium effect**)
- More precisely:
 - demand for tasks that are **substitute** to predictions will be low
 - demand for tasks that are **complement** to predictions will be high

AI IS DATA





Chad Jones and Christopher Tonetti (Stanford) *Nonrivalry and the Economics of Data* (Sep 2020, American Economic Review)

DATA IS A FACTOR NOT A TECHNOLOGY

- Data is a **factor**, not a **technology**
 - Can you explain it ?
- The difference between an idea and a factor? Exemples:
 - idea: use machine learning to build self driving cars
 - factor: each car-maker gathering his own data to train cars
- Data (even anonymous) improves quality of existing products

WHAT KIND OF GOOD IS DATA ?

- Remember the **classification of goods**?
 - **nonrival**: can be used with leftovers
 - **excludable**: use can be limited to paying customers
 - data is a: **club good**
- Nonrivality implies **increasing returns to scale**
 - marginal value of new data increases more than proportionally

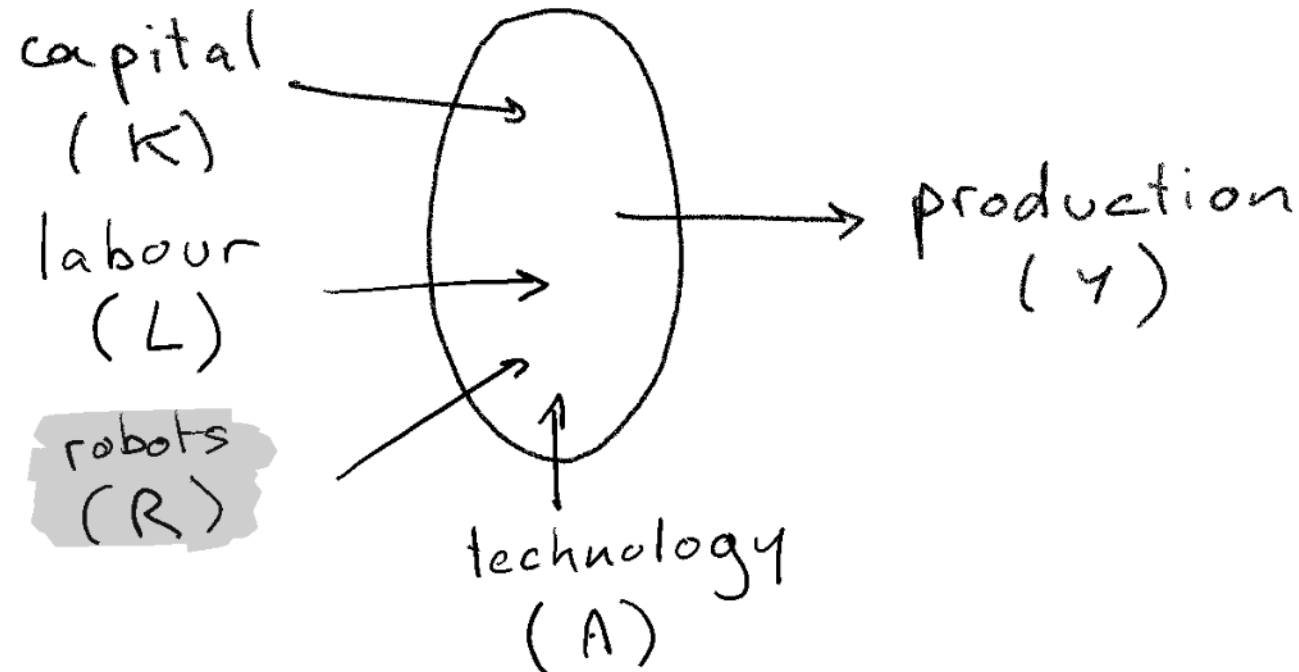
AI: ADDS DATA TO THE PRODUCTION FUNCTION (CONSEQUENCES)

- increasing returns to scale implies **natural monopoly**
 - ->GAFAMs
 - increasing suboptimal **monopoly rents** (already a problem before existence of AI...)
 - should you regulate a monopoly?
 - it depends what is the barrier to entry: data-gathering or data-processing
- other relevant questions
 - where are the markets? (empirically it seems "undertraded")
 - who owns the data ? Consumer, producer.

HOW DO YOU REGULATE A DATA-MONOPOLY ?

- solutions:
 - split the monopolies (if deadweight loss is too big)
 - outlaw data gathering (big productivity loss)
 - force data-sharing: make it a public good
 - let the consumer be free to decide whether to rent his data (remove externalities)

AI: COMPETITION BETWEEN HUMANS AND ROBOTS



ECONOMIC SINGULARITY

- In the very long run, could technology be **bad**?
- Recall the neoclassical world
 - market economy
 - technological progress reduces production cost
 - always good for consumers. Increase (real) total income.
 - becomes an inequality problem
- But
 - whether technology reduces salaries depends on whether growth is **labour augmenting** or **capital augmenting**
 - if AI is a close enough substitute, salaries of "humans" as a whole are at risk
 - there is an economic *singularity* when salary of humans arrives below the **subsistence level**



• Two sets of authors reach very similar conclusions

SOME VERY LONG RUN SCENARIOS

- Analysis taken from Gilles Saint Paul
- *Main hypothesis*: all humans can be replaced by more productive robots
- **Comparative advantage** logic:
 - humans specialize in work where their comparative disadvantage is lowest (services, art, crafting...)

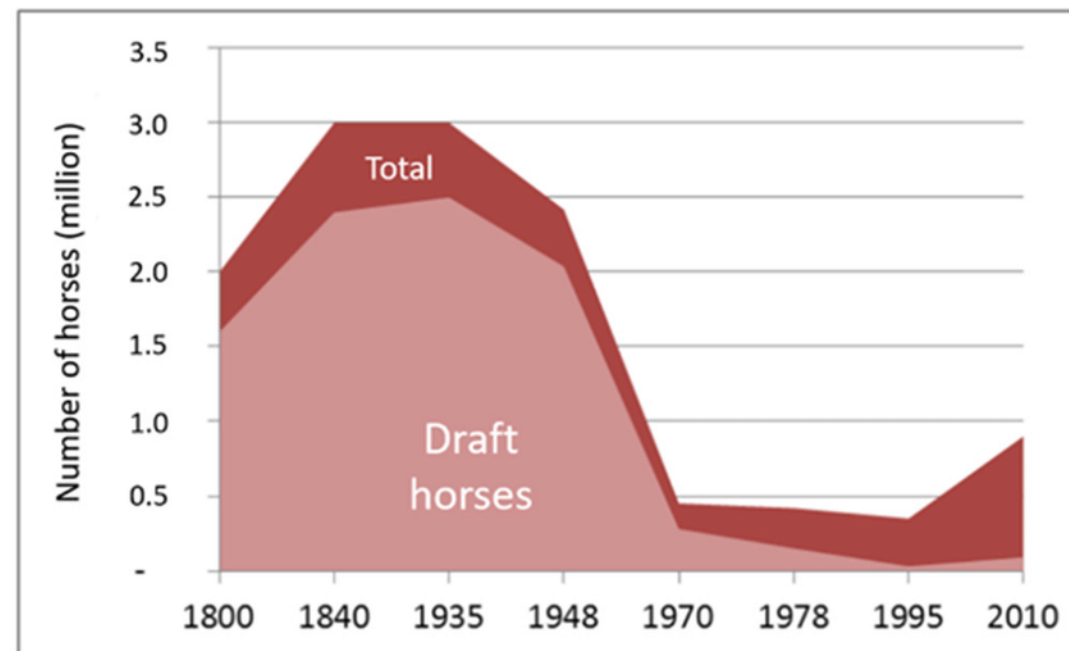
SCENARIO 1: SOCIETY REDISTRIBUTES INCOME FROM ROBOTS



Four political subscenarios

- welfare state
 - robot-owners are taxed, income is redistributed
 - for instance as universal income
 - some productivity losses
 - what about international competitiveness?
- rentiers society
 - robot owners invest the rent over many generations
 - capital concentration increases
- neo fordism
 - Firms pay huge salaries for essentially useless jobs (powerpoint presentations, 😊 ...)
 - Useful to sustain demand
- new roman empire
 - robot owners: *patricians* (top 2%)
 - rest of population: *plebeians*
 - survive thanks to clientelism
 - robots: slaves

SCENARIO 2: WARS, STARVATION, EPIDEMIC



• human income (marginal productivity) falls below subsistence levels

SCENARIO 3: THE MATRIX



• human wage decrease

SOMETHING ELSE COMPLETELY?

- Right now AI is a technology (or a factor)
- What if it becomes another intelligent agent?
 - has its own goals
 - its own preferences
 - with superhuman thinking abilities...
- Response in the literature (if curious):
 - Anton Korinek: *if* market economy survives
 - malthusian and non-malthusian scenarios
 - At that stage humans might be something different completely
 - transhumanism

CONCLUSION

- Research on AI is very speculative: especially about the long run
- But concepts from classical economics still help
- For next time:
 - make sure you understand all concepts in bold

MORE READINGS

- Chad Jones and Christopher Tonetti: *Nonrivalry and the Economics of Data*, American Economic Review
- Avi GoldFarb: *Prediction Machines: The Simple Economics of Artificial Intelligence* 2018
- Gilles Saint Paul: *Robots Vers la fin du travail ?*
- Anton Korinek, Joseph E. Stiglitz: *Artificial Intelligence and Its Implications for Income Distribution and Unemployment*, chapter in *Artificial Intelligence and Its Implications ...*, NBER
 - also on [coursera](#)