

# CS440/ECE448

## Lecture 34:

# The Future of Work

Mark Hasegawa-Johnson

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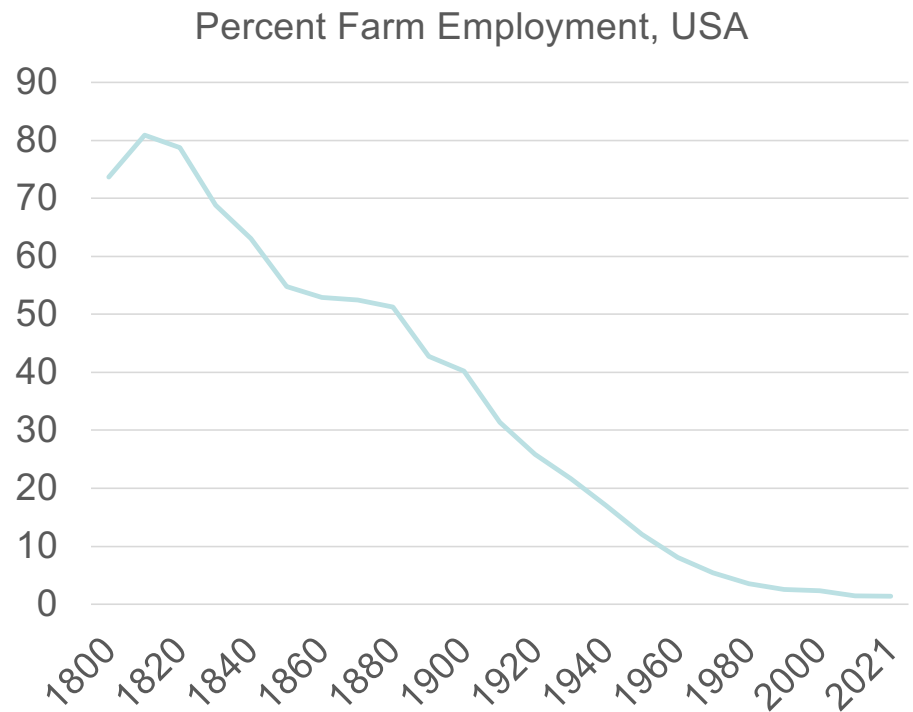
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# Outline

- The history of work
- Universal basic income
- FlexTime
- Income inequality
- Say's Law
- AI-Human collaboration and the future of work

# Percentage of the labor market employed on farms, USA, 1800-2025

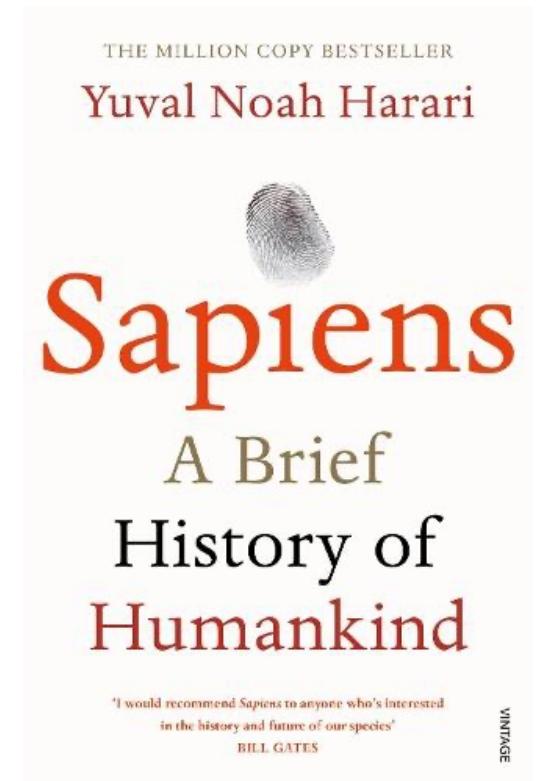
- From 9000BCE until 1880, more than half of all people worked on farms
- In 2025, 1.4% of people in the USA work in farming, forestry, or mining



Stanley Lebergott, "Labor Force and Employment, 1800-1960," 1966

# A brief history of humankind

- **100,000–10,000ya: Hunters & Gatherers**
  - If hungry: go to nearest bush, pick fruit
  - World population: 10,000
- **10,000–100ya: Farmers**
  - If hungry: plant, water, weed, harvest, store, cook
  - World population: 10,000,000
- **100ya – now: Employers & Employees**
  - If hungry: work, earn money, buy food
  - World population: 10,000,000,000



# Brief history of work

- “Work” meaning “employment” is a recent invention: about 150 years old
- It need not be what it currently is.

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# Universal basic income

- In “Utopia,” Thomas More’s imaginary country, theft is abolished by giving every citizen enough to eat.
- Philosophers including Thomas Paine and Bertrand Russell wrote about UBI.
- William Beveridge was perhaps the first economist to support it; it then became popular in the United States during discussions of Lyndon Johnson’s “New Deal”



Utopia by Thomas More. Transferred from it.wikipedia by User:Marcok., Public Domain, <https://commons.wikimedia.org/w/index.php?curid=3893696>

# Experimental tests of UBI and related ideas

[https://en.wikipedia.org/wiki/Universal\\_basic\\_income](https://en.wikipedia.org/wiki/Universal_basic_income)

- **Health**: Residents receiving UBI are 27% less likely to get sick.
- **Work**: Residents receiving negative income tax are slightly disincentivized to work, e.g., one study showed that those receiving negative income tax worked 5% fewer hours.
- “Negative income tax” = a type of unemployment insurance, i.e., paid only to people without income.

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# ☆ Average Hours of Work Per Week, Total, Household Survey for United States (M08354USM310NNBR)

Observations ▾

Jan 1970: 39.1

Updated: Aug 17, 2012 2:31 PM CDT

Next Release Date: Not Available

Units:

Hours per Week,

Not Seasonally  
Adjusted

Frequency:

Monthly

1Y

5Y

10Y

Max

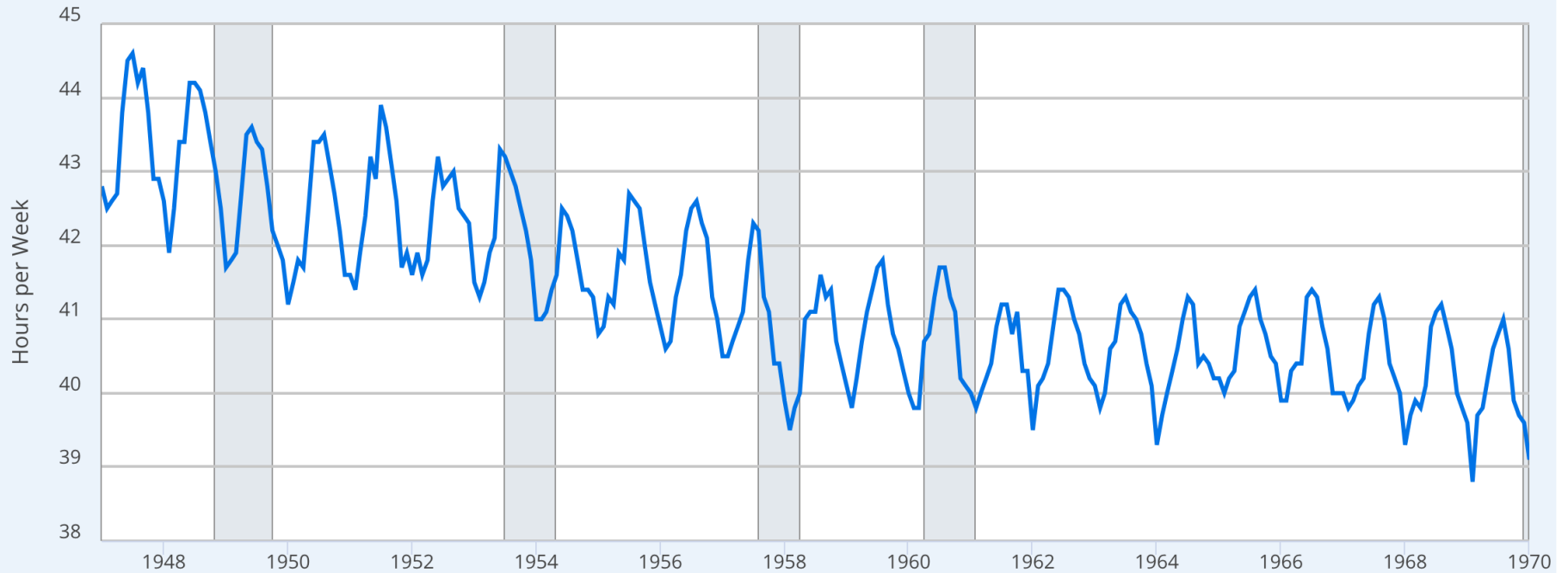
Edit Graph

1947-01-01

to 1970-01-01

Download

**FRED** — Average Hours of Work Per Week, Total, Household Survey for United States



Source: National Bureau of Economic Research via FRED®

Shaded areas indicate U.S. recessions.

fred.stlouisfed.org

Fullscreen

# Flextime—the New Work Schedule?

*By Edgar T. Busch\**

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*In this article the author discusses flextime, an alternative to today's working conditions. Flextime is a developing trend and one which is being tried in some work—most notably in West Germany. [Reprinted from the December 1973 issue of the U.S. Army Audit Agency Pamphlet.]*

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The CPA Journal 44:57, 1974,

<https://www.proquest.com/docview/214923720>

# 4-Day Week

“Netherlands is among the nations with the shortest work weeks, according to *CNN Money*. Netherlands has an average of 29 working hours per week and an average annual income amounting to \$47,000.” –

<https://nltimes.nl/2013/07/11/worlds-shortest-work-weeks>

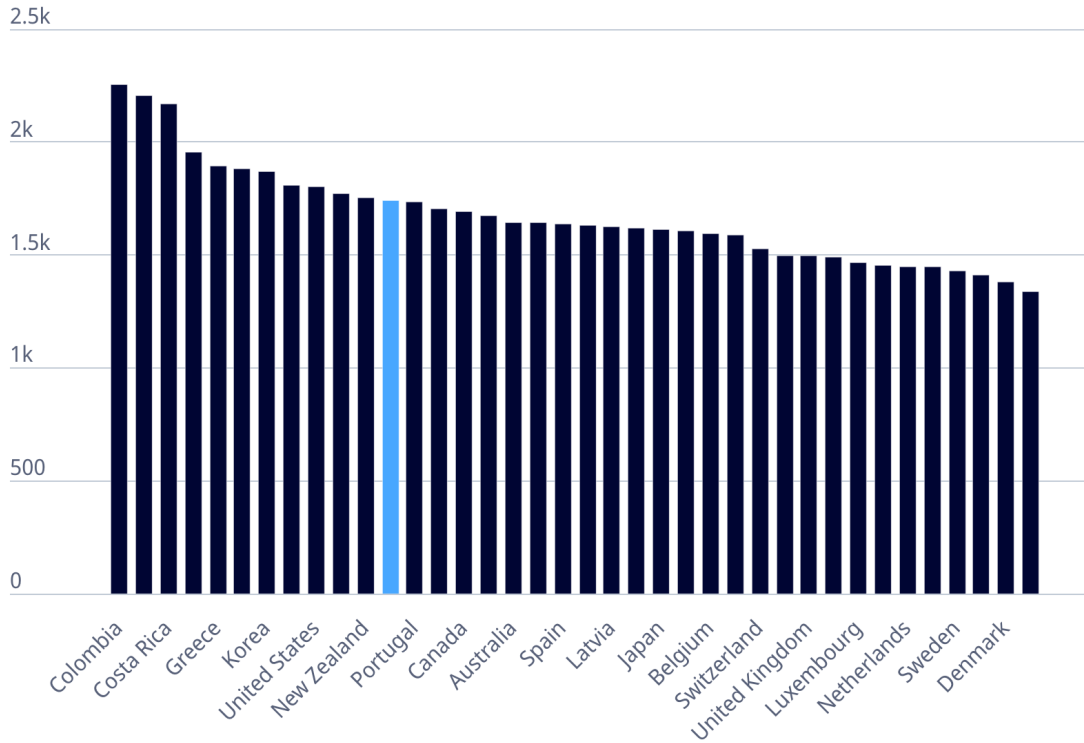


### Hours worked

Hours/worker, 2023



Australia, Austria, Belgium, Canada, Chil... x | Q

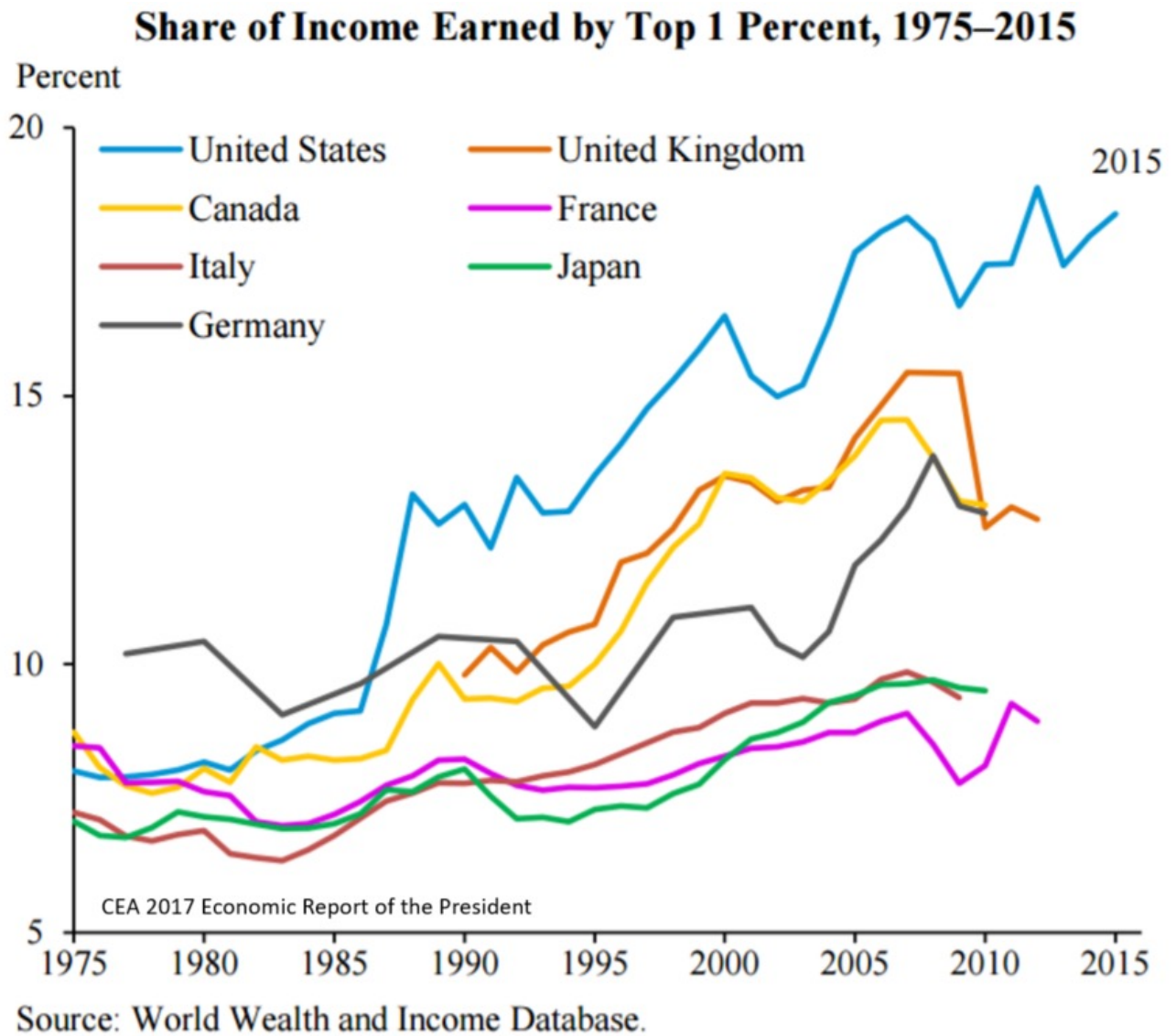


# Outline

- The history of work
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- **Income inequality**
- **Say's Law**
- **AI-Human collaboration and the future of work**

# Income Inequality

By U.S. Council of Economic Advisers - 2017 Economic Report of the President - 2017 Economic Report of the President, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=54550890>



# Some advantages and disadvantages of income inequality

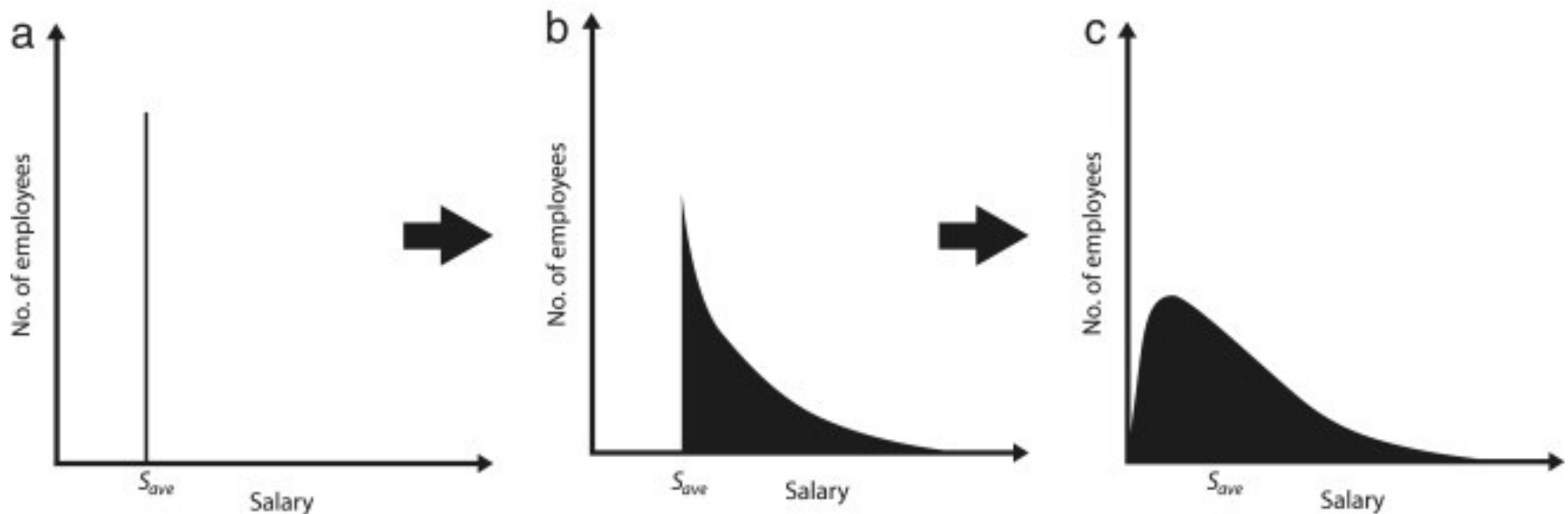
- Advantages:
  - Income concentrated in the hands of the most creative individuals tends to encourage economic growth
  - A rational agent takes risk only if  $(\text{probability of success}) \times (\text{possible gain}) > 1$ , so income inequality encourages people to take risks
- Disadvantages:
  - Income concentrated in the hands of non-creative individuals stifles growth
  - Inequality decreases trust in society
  - Inequality increases crime
  - Inequality is correlated with the probability of violent revolution

# Try the quiz!

- Try the quiz!

# How much inequality in income is fair? A microeconomic game theoretic perspective

Venkat Venkatasubramanian, Yu Luo & Jay Sethuraman, 2015



- Fairest inequality of income is a lognormal distribution under ideal conditions.
- Ideal free market can “discover” the fairest distribution in practice, if allowed.
- Most countries show greater inequality than that predicted by the free market.

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# Technological Unemployment vs. Say's Law

- Technological unemployment results when a new machine puts people out of work.
- Say's Law introduced the idea that the efficiency of the new machine creates the opportunity for new products that will employ people in new jobs.

# The Luddites

- The Luddites were craftsman weavers who lost work because of new weaving factories.
- They organized a secret army to smash factory looms.



[https://commons.wikimedia.org/wiki/File:Blue\\_Plaque\\_for\\_Westhoughton\\_Mill.JPG](https://commons.wikimedia.org/wiki/File:Blue_Plaque_for_Westhoughton_Mill.JPG)

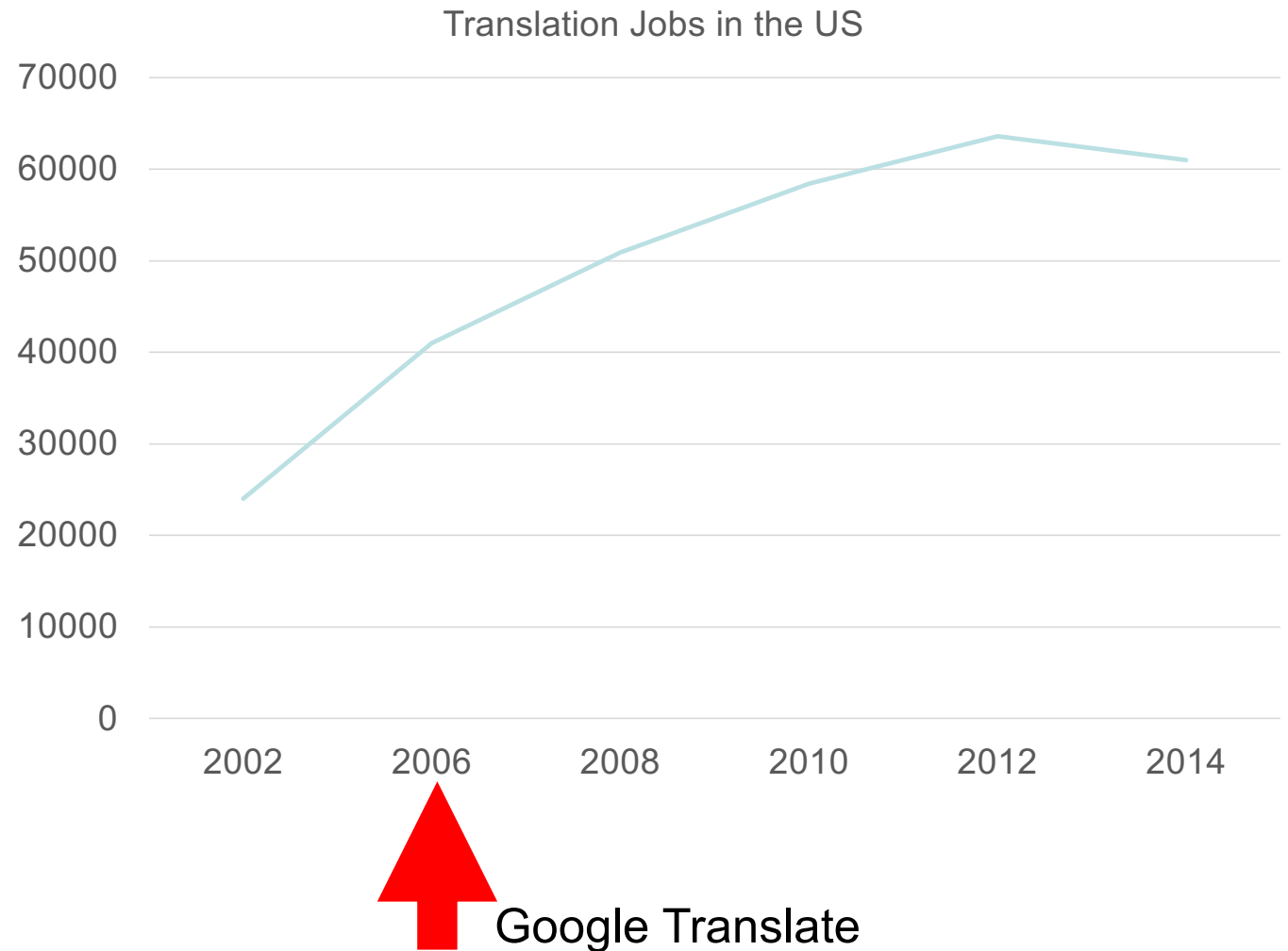
# Say's Law

A product is no sooner created, than it, from that instant, affords a market for other products to the full extent of its own value. – Jean-Baptiste Say, 1834

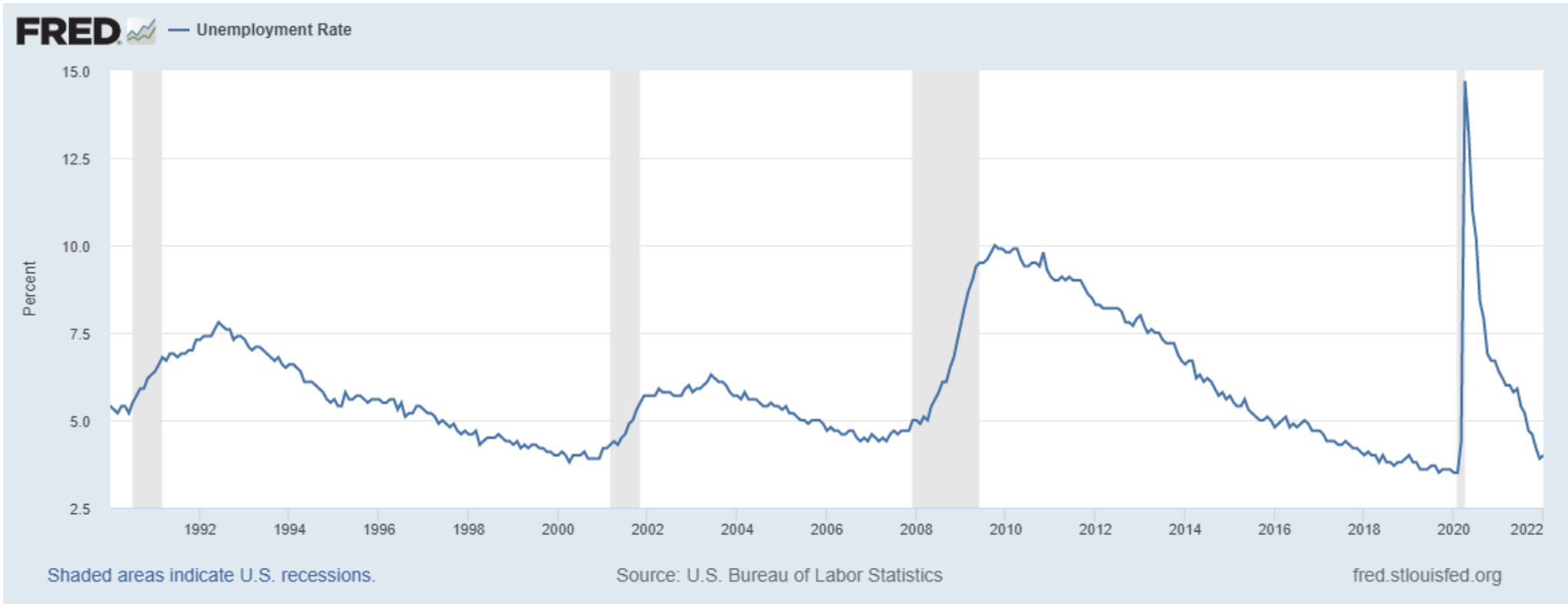


[https://commons.wikimedia.org/wiki/File:Jean-baptiste\\_Say.jpg](https://commons.wikimedia.org/wiki/File:Jean-baptiste_Say.jpg)

- ‘Labor-saving’ technologies can, in some cases, result in a significant increase in the number of available jobs.
- Example: Google Translate.
- Data from Tamara Cabrera, “The Translating and Interpreting Industry in the United States,” 2014

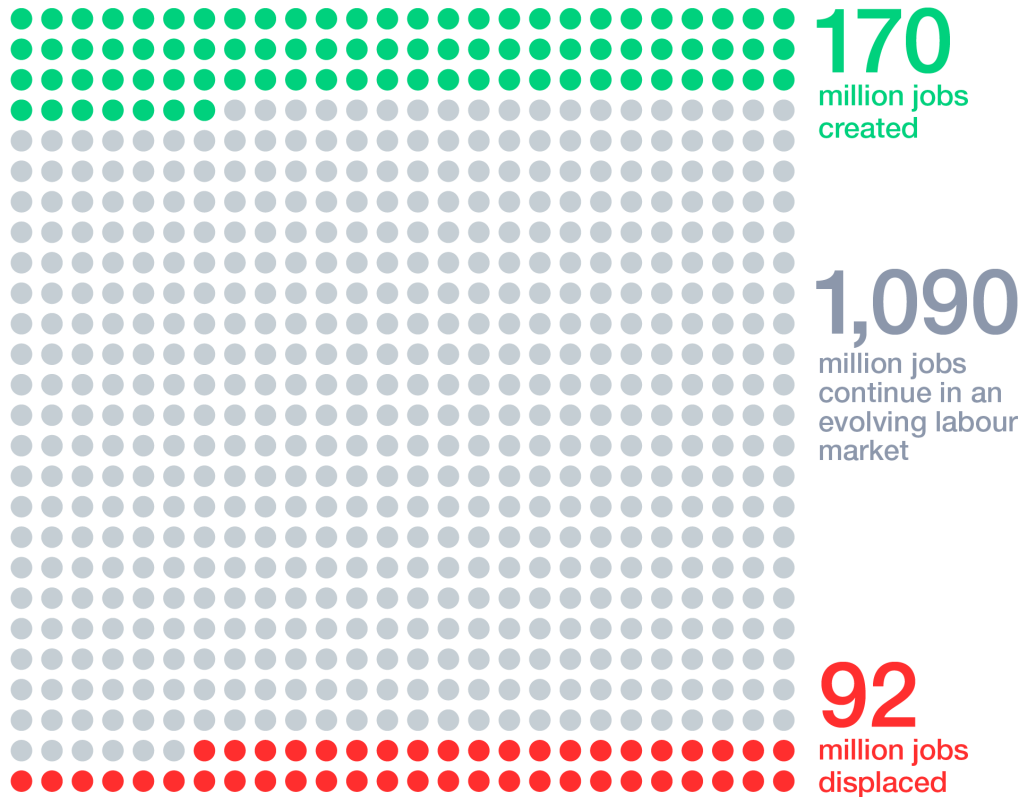


# The cost of Say's law: The economic cycle



US Unemployment rate, January 1990 to December 2022. Public domain image, <https://fred.stlouisfed.org/graph/?g=FfBh>

## Total job growth and loss



Source: World Economic Forum. (2025). *Future of Jobs Report 2025*.

# What new jobs will be created?

WEF predicts increased employment by 2030 in these occupations:

1. Farmers
2. Delivery drivers
3. Software developers
4. Builders
5. Salespeople
6. Food processing
7. Nursing & social work

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# Mina Lee, Percy Liang and Qian Yang, “Co-Author: Designing a Human-AI Collaborative Writing Dataset for Exploring Language Model Capabilities,” CHI 2022

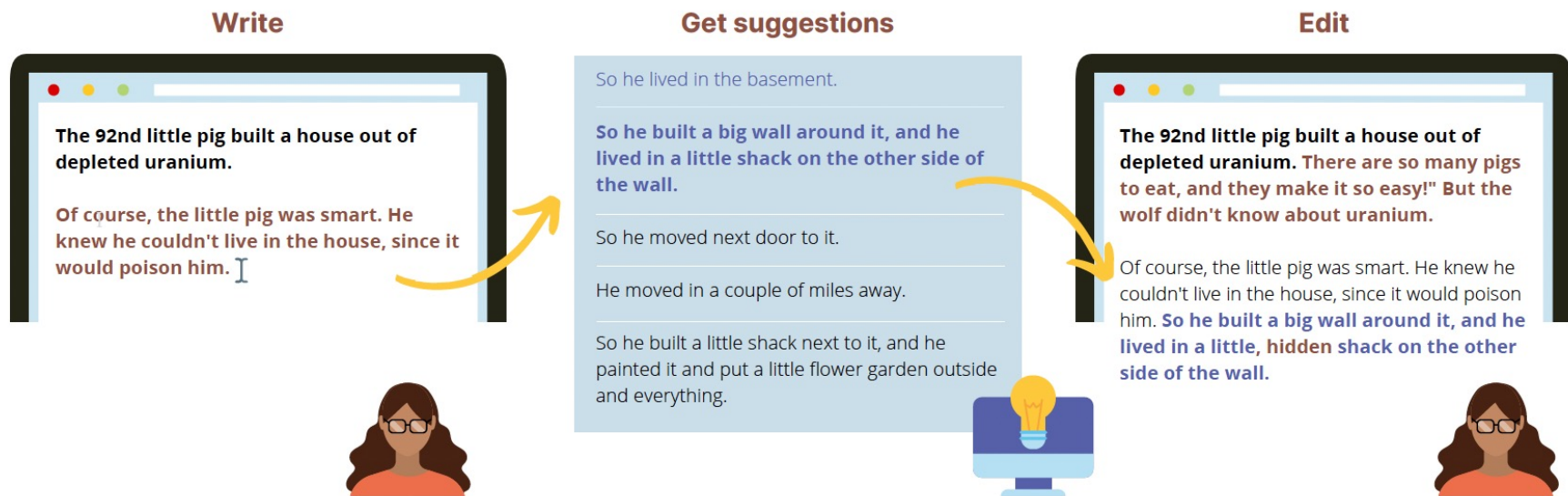


Figure 1: We present CoAUTHOR, a dataset designed for revealing GPT-3’s generative capabilities for interactive writing. It contains rich interactions between 63 writers and 4 instances of GPT-3 across 1445 writing sessions. Each session starts with a prompt (black text). Writers then freely write (brown), request suggestions from GPT-3 (blue), accept or dismiss suggestions, and edit accepted suggestions or previous texts in any order they choose.



EDUCATION AND SKILLS

# 4 ways to enhance human-AI collaboration in the workplace

Jan 13, 2025



# When is collaboration useful?

If human > AI, then collab is better than either alone.

- Human can tell when the AI's contribution is useful
- Example: most deep analysis tasks, but not all

If AI > human, then AI > collab.

- Human contributes badly-motivated biases
- Example: many decision tasks, but not all

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### When combinations of humans and AI are useful: A systematic review and meta-analysis

[Michelle Vaccaro](#), [Abdullah Almaatoug](#) & [Thomas Malone](#) [✉](#)

*Nature Human Behaviour* **8**, 2293–2303 (2024) | [Cite this article](#)

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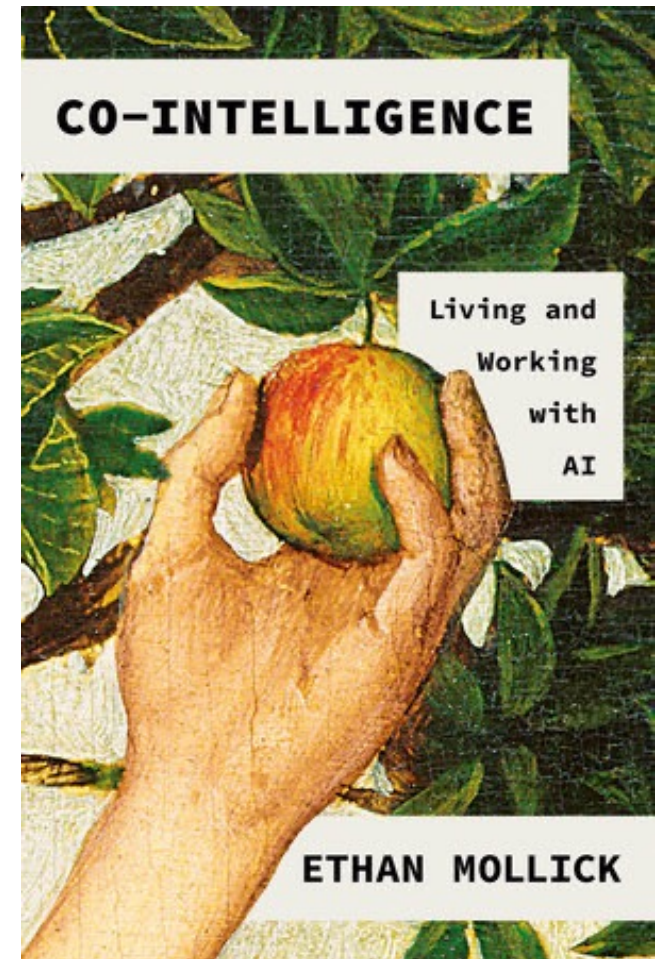
#### Abstract

Inspired by the increasing use of artificial intelligence (AI) to augment humans, researchers have studied human–AI systems involving different tasks, systems and populations. Despite such a large body of work, we lack a broad conceptual understanding of when combinations of humans and AI are better than either alone. Here we addressed this question by conducting a preregistered systematic review and meta-analysis of 106 experimental studies reporting 370 effect sizes. We searched an interdisciplinary set of databases (the Association for Computing Machinery Digital Library, the Web of Science and the Association for Information Systems eLibrary) for studies published between 1 January 2020 and 30 June 2023. Each study was required to include an original human-participants experiment that evaluated the performance of humans alone, AI alone and human–AI combinations. First, we found that, on average, human–AI combinations

# When is collaboration useful?

In many tasks,

- Expert human  $>$  Expert+AI
- Average human  $<$  Average human+AI



# How can expertise be learned?

- If ordinary humans don't outperform AI, how can expertise be learned?
- A possible strategy: Pair programming as a kind of two-way apprenticeship?



<https://commons.wikimedia.org/wiki/File:Apprenticeship.jpg>



[https://commons.wikimedia.org/wiki/File:Wocintech\\_\(microsoft\)\\_-\\_61\\_\(25926639341\).jpg](https://commons.wikimedia.org/wiki/File:Wocintech_(microsoft)_-_61_(25926639341).jpg)

# Call for action: Benchmarks for AI-human collaboration

“When you look at AI research, and you look at the benchmarks that are used pretty much universally, they’re all tied to matching or comparing to human performance. Benchmarks are super important to AI developers—especially for young scientists, who are entering *en masse* into AI and asking, ‘What should I work on?’”

- Katya Klinova, Technology Review, April 2022

“But benchmarks for the performance of human-machine collaborations are lacking.”

- David Rotman, Technology Review, April 2022

# Summary

- The history of work: it's only about 150 years old
- Universal basic income
  - Poverty reductions, but also work reductions
- FlexTime
  - Average hours/week = function of culture and technology
- Income inequality
  - A free market can converge to an efficient income distribution
  - Market inefficiencies can increase income inequality
- Say's Law
  - “A product is no sooner created, than it, from that instant, affords a market for other products”
- AI-Human collaboration and the future of work
  - Call for benchmarks!