



Community of Practice on Composite Indicators and Scoreboards  
Joint Research Center (JRC), European Commission  
November 7-8, 2019

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# AI raises many questions

- What countries, universities, companies, etc are leading in AI R&D?
- What AI tasks are easy, which hard?
- Are we training enough people with AI skills?
- Are companies making use of AI?
- How much are governments investing in AI and is it making a difference?
- Will AI destroy jobs?
- When will self-driving cars own half the market?
- Why are there so few women in AI?
- How fair are face recognition algorithms?

# AI Index Project

## Intended Content

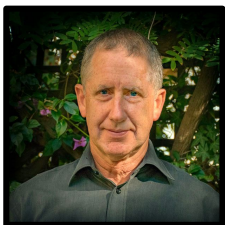
- A set of measures that capture the state of AI and track it over time
- Aims to be well informed and provide quantitative basis for AI discussions
- Data are public and analyses should be reproducible

## Target Audience

- Researchers in AI and other fields
- Industry
- Policymakers
- Media and general public



# AI Index Steering Committee



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Harvard



**Saurabh Mishra**  
Program Manager



# AI Index - Annual Report



**2017**



**2018**



**Est. Dec. 2019**

- > 150K downloads in 60 days
- > 30 press mentions

[www.aiindex.org](http://www.aiindex.org)

# Areas Covered in 2019 Report

- Research and Development (28+24)
- Investment (18+12)
- Technical Performance (38+17)
- Education (13+8)
- Jobs (13+36)
- Conferences (10)
- Autonomous vehicles (8+1)
- Robotics (4+2)
- Public Perception (25+8)
- Societal Considerations (7+4)
- National Strategies (4+1)
- AI Vibrancy Index: National Scoreboards and Composite Measure Tool

# Selected Collaborators



ELSEVIER  
Scopus



Microsoft Academic Graph (MAG)  
Analytics

crunchbase

indeed®

WIML  
Women in Machine Learning



Google



YouTube



LinkedIn



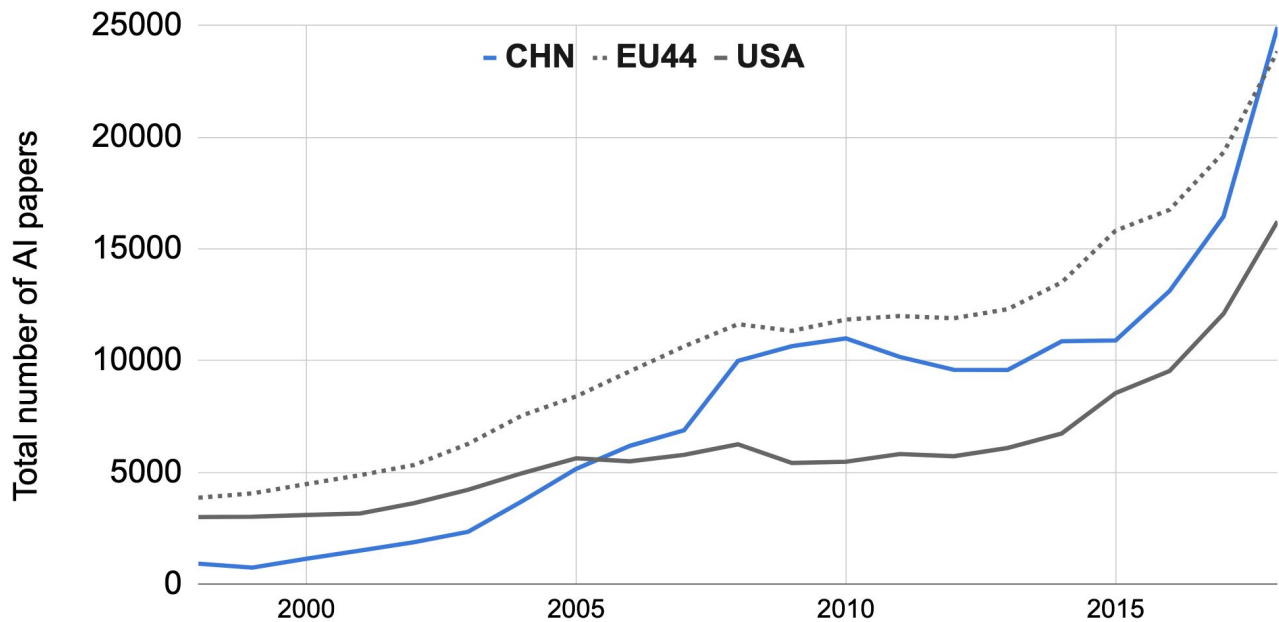
Carnegie  
Mellon  
University



# China has passed US, caught up with EU in pubs...

Annual Number of AI Papers on Scopus

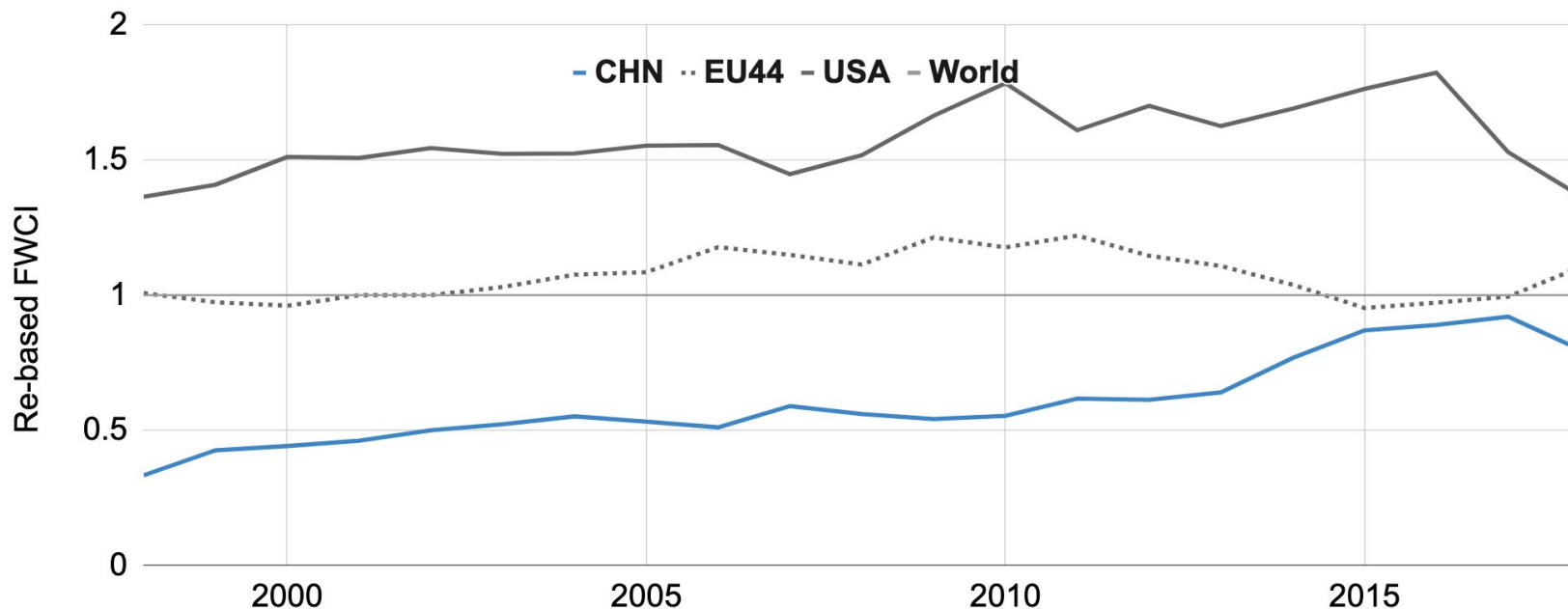
Source : Elsevier, 2019.



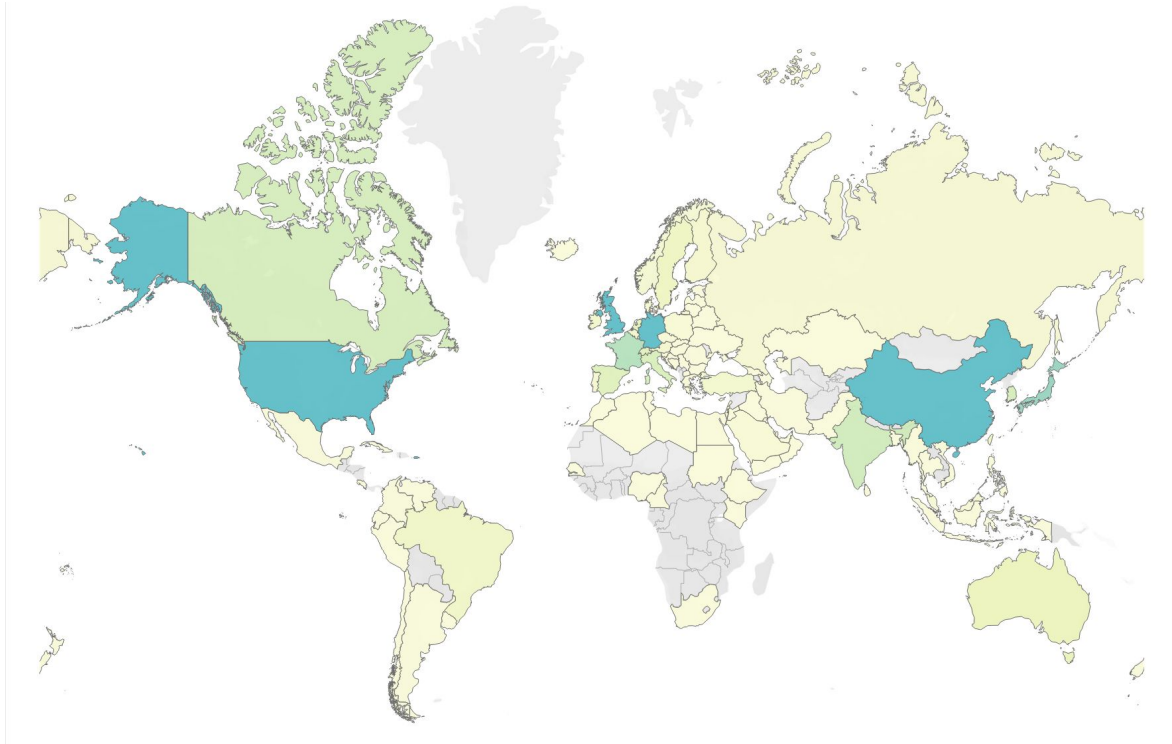
# ... but US still gets more citations

Field-Weighted Citation Impact of AI authors by region, (1998-2018)

Source: Elsevier, 2019.

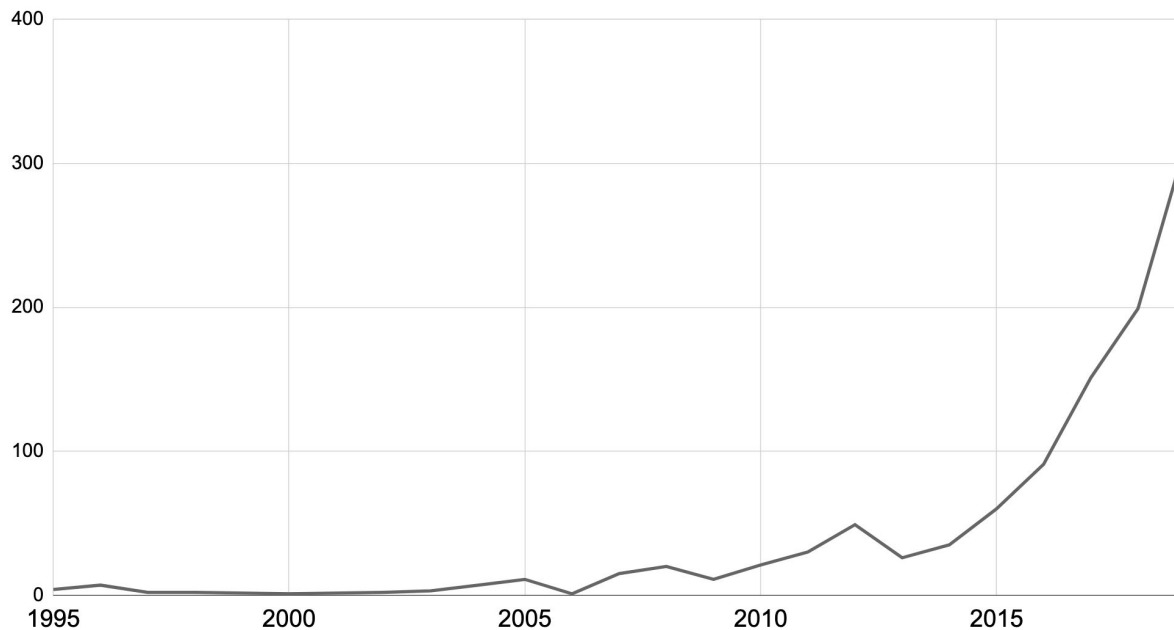


# US, China, France, Germany and UK lead in corporate-university collaborations



# Ethics and morals of AI are increasingly important

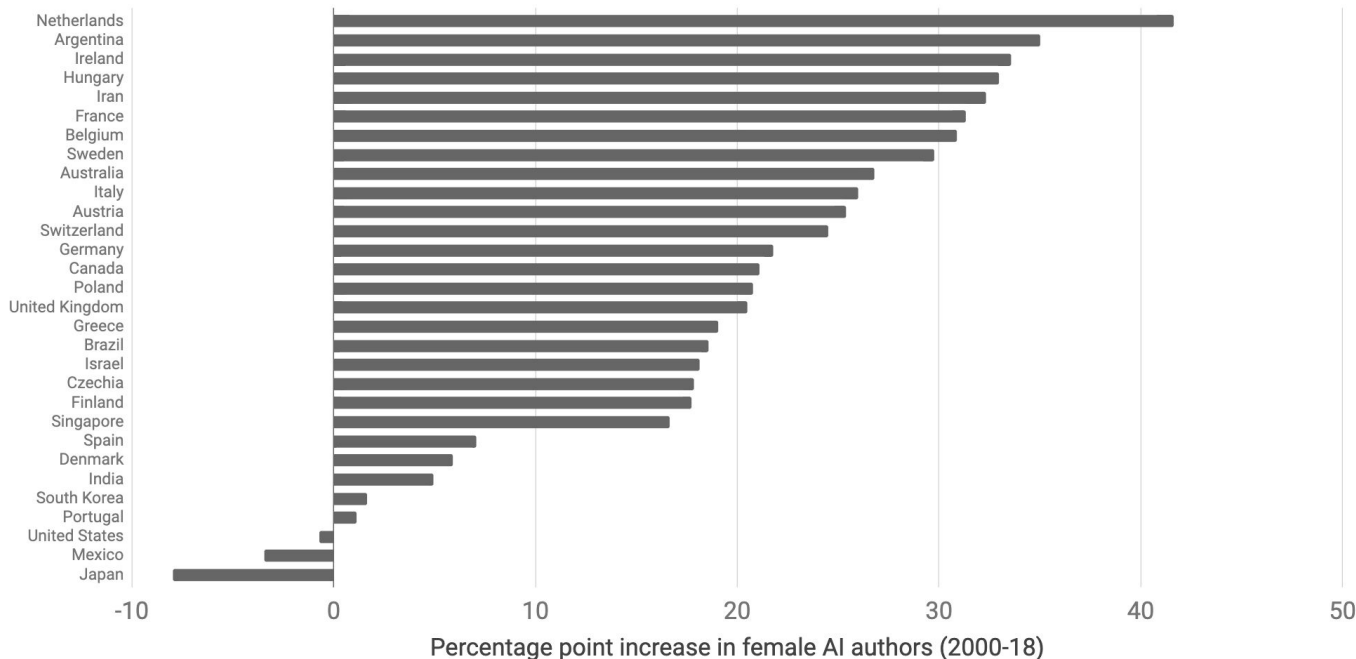
Number of Ethics/Morals Papers in CS AI on arXiv



# Portion of female authors increasing ... ... but not in US or Japan. China unknown.

Growth in female authorship of AI paper, 2000-18

Source: NESTA, 2019.



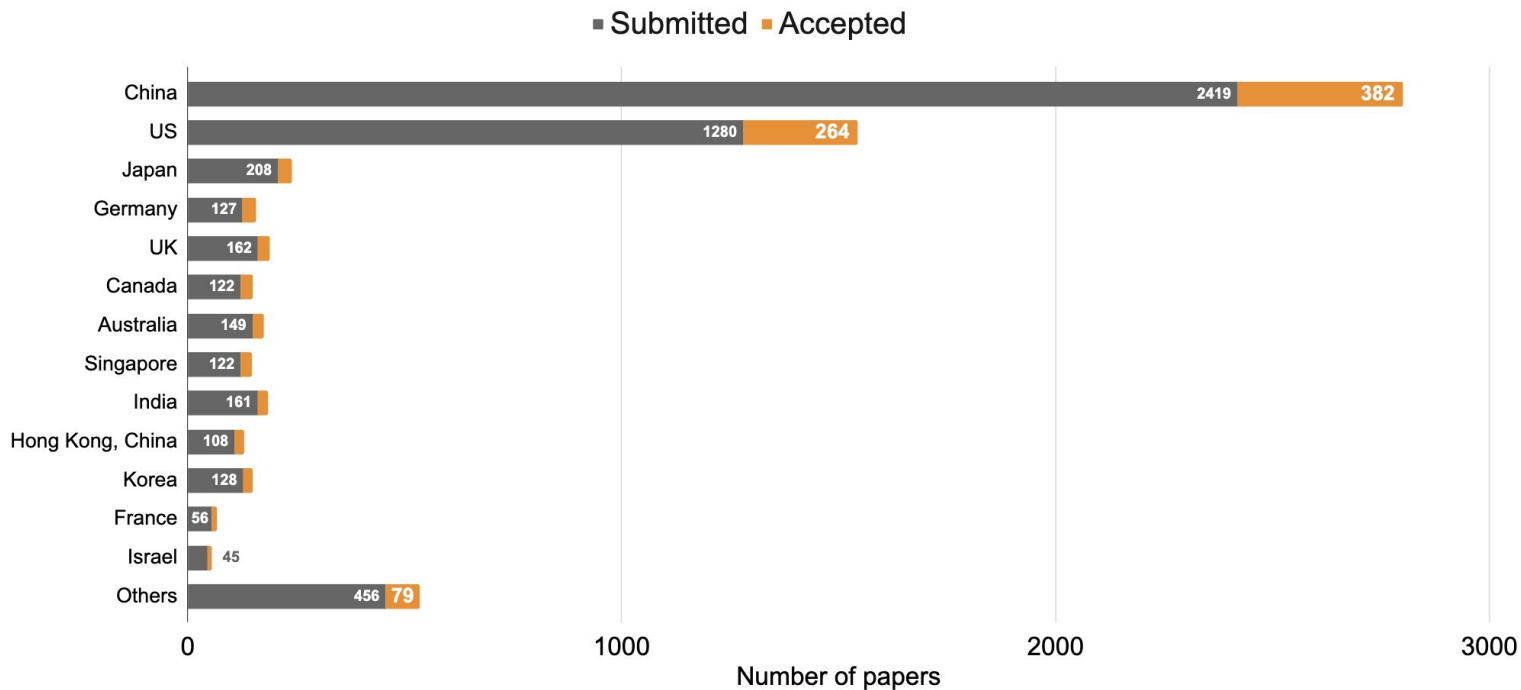


# AI Conferences are becoming unmanageable

## *25% increase in submissions year over year*

AAAI Papers Statistics by Country, 2019

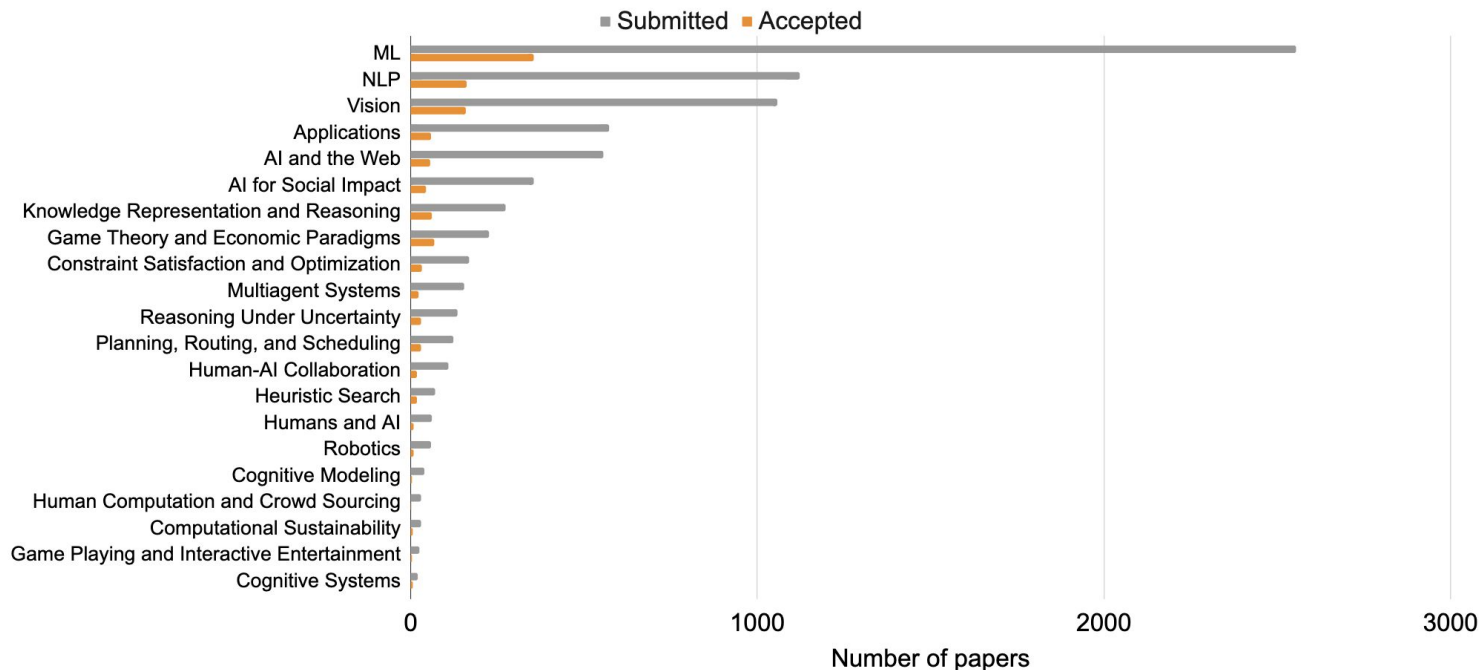
Source: AAAI, 2019.



# Broad conferences are dominated by Machine Learning

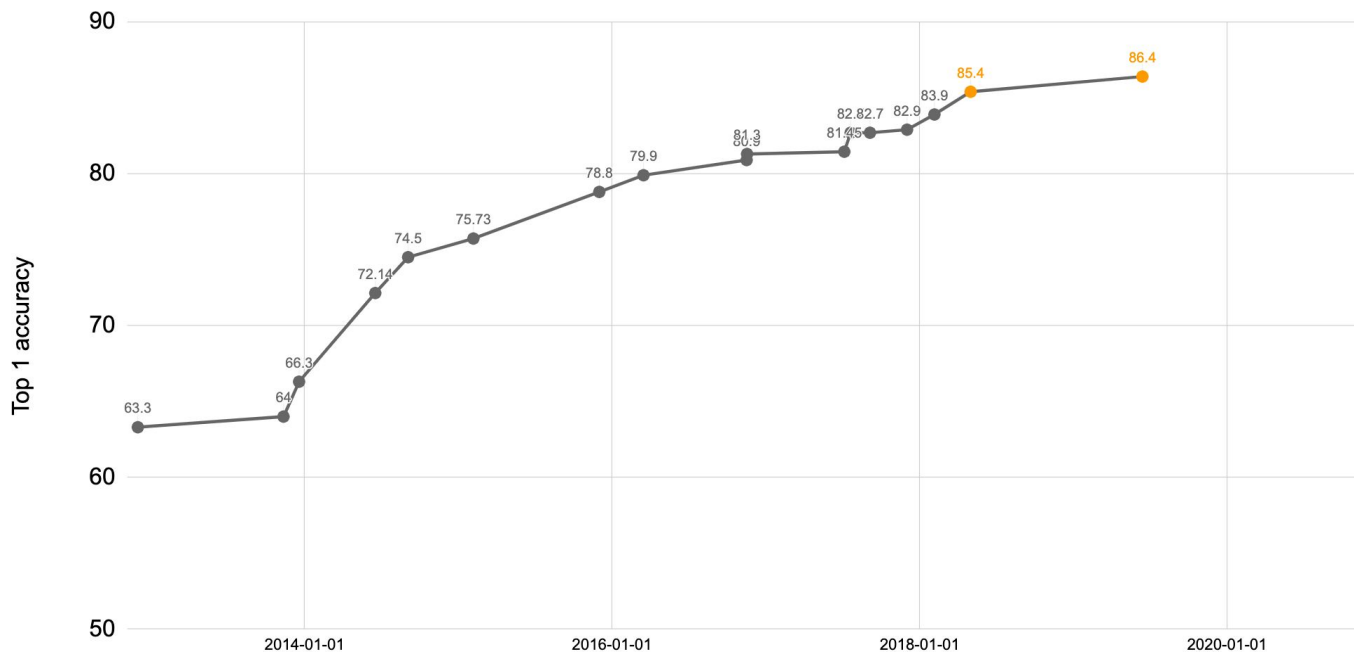
AAAI Paper Statistics by Subject Area, 2019

Source: AAAI, 2019.



# Machines outperform humans on many tasks...

Image Classification: ImageNet

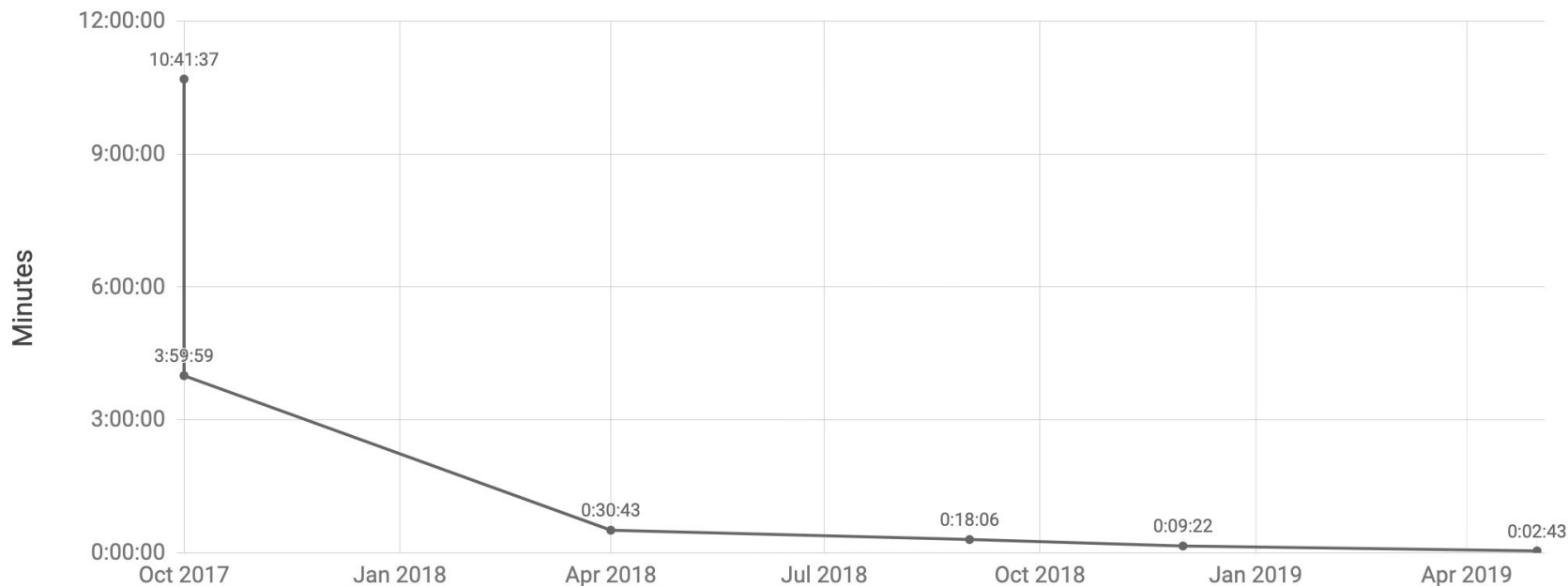


# ... and there is also progress on compute costs

## *ImageNet training time has fallen 60x since 2017*

ImageNet training time (October 2017 – November 2019)

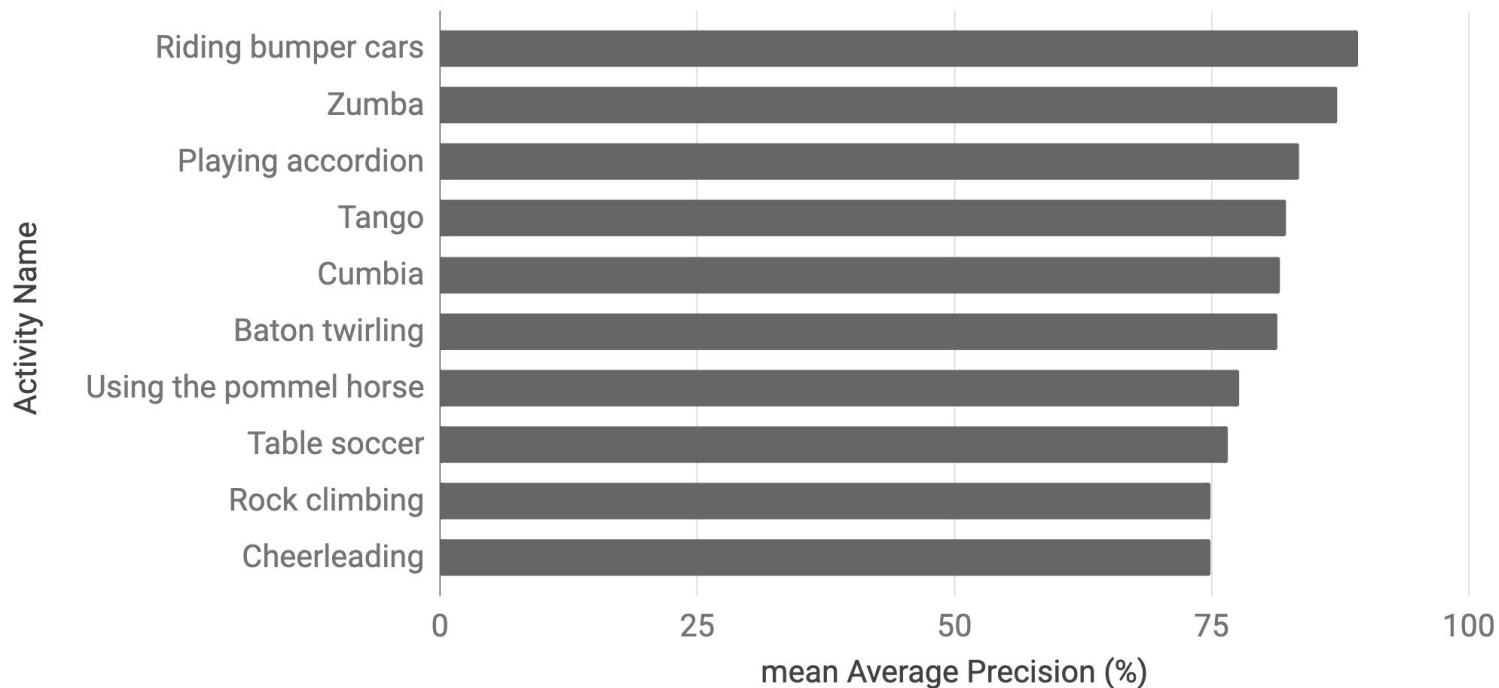
Source: Stanford DAWN Project, 2019.



# Some Video Activity Recognition tasks are easy...

Easiest Activities (2019 Model)

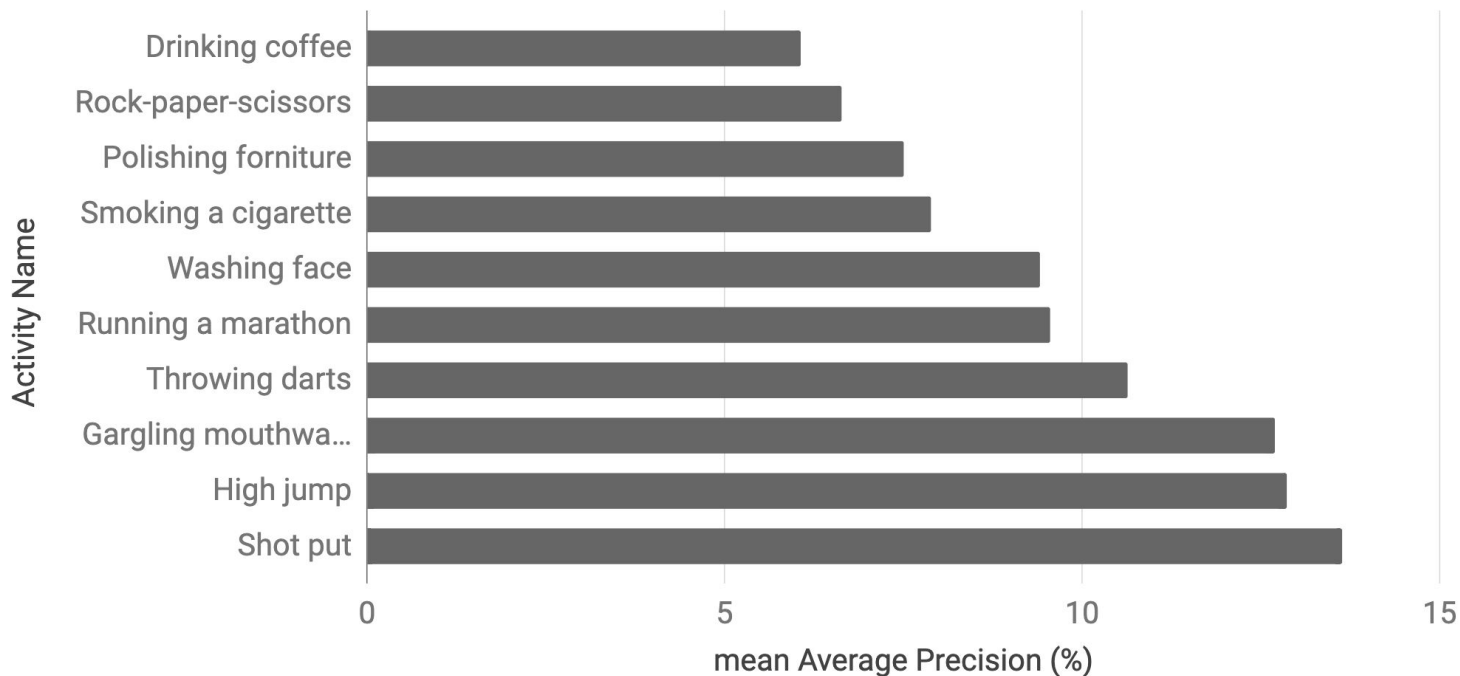
Source: ActivityNet, 2019.



# ... but some are still very hard

## Hardest Activities (2019 Model)

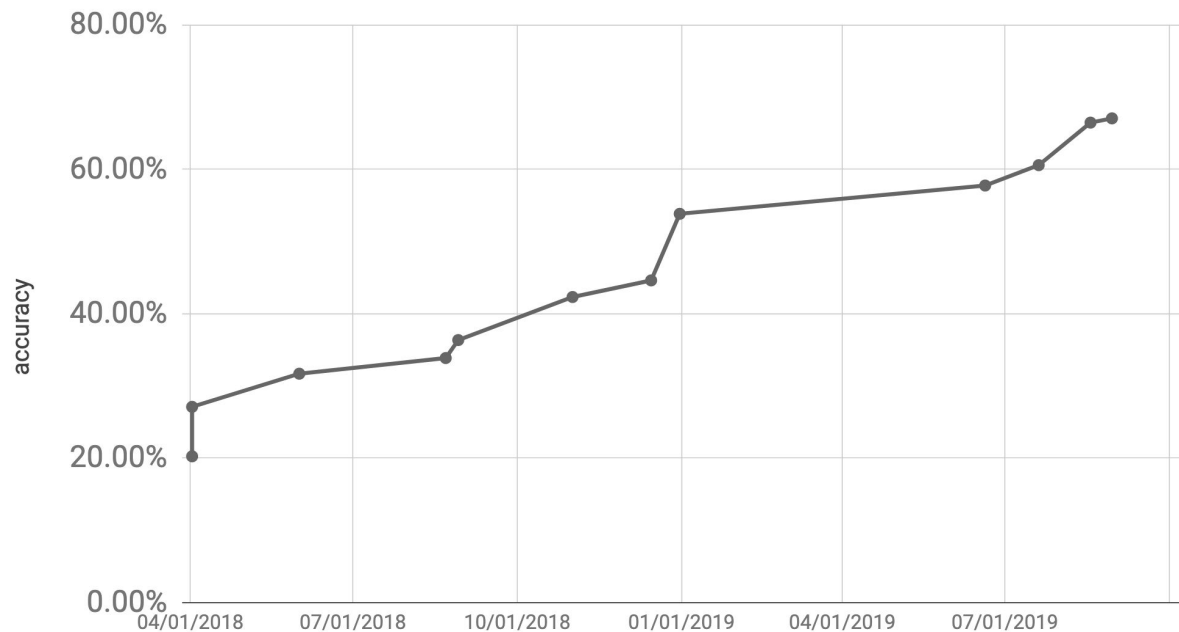
Source: ActivityNet, 2019.



# Reasoning Tasks are still quite hard

## *Elementary school multiple-choice science questions*

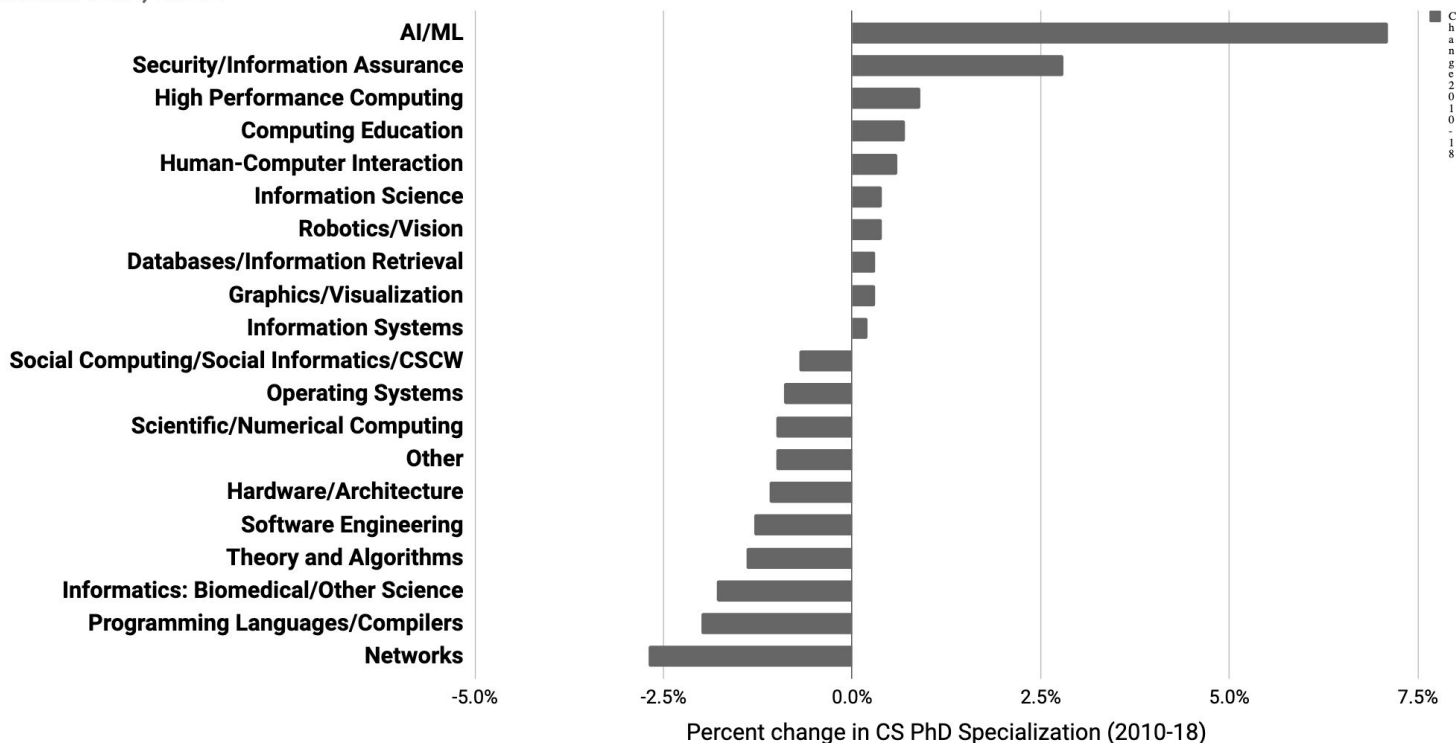
Allen Institute for Artificial Intelligence: ARC Reasoning Challenge



# In US, new PhDs in AI are up 7% from 2010-2018

## Changing Landscape of Computer Science Doctoral Specialization

Source: CRA, 2019.

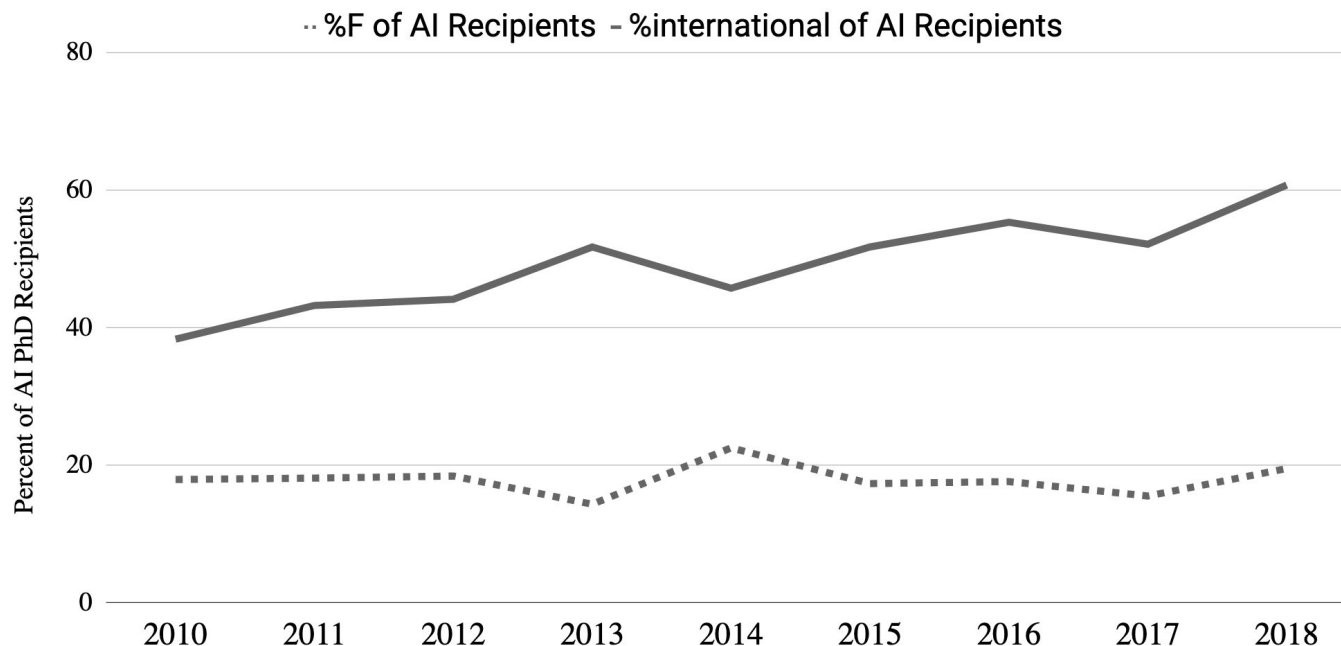




# In US, % of foreign-born PhD recipients is up, % of women is flat

Percent of AI PhD Recipients, International and Female

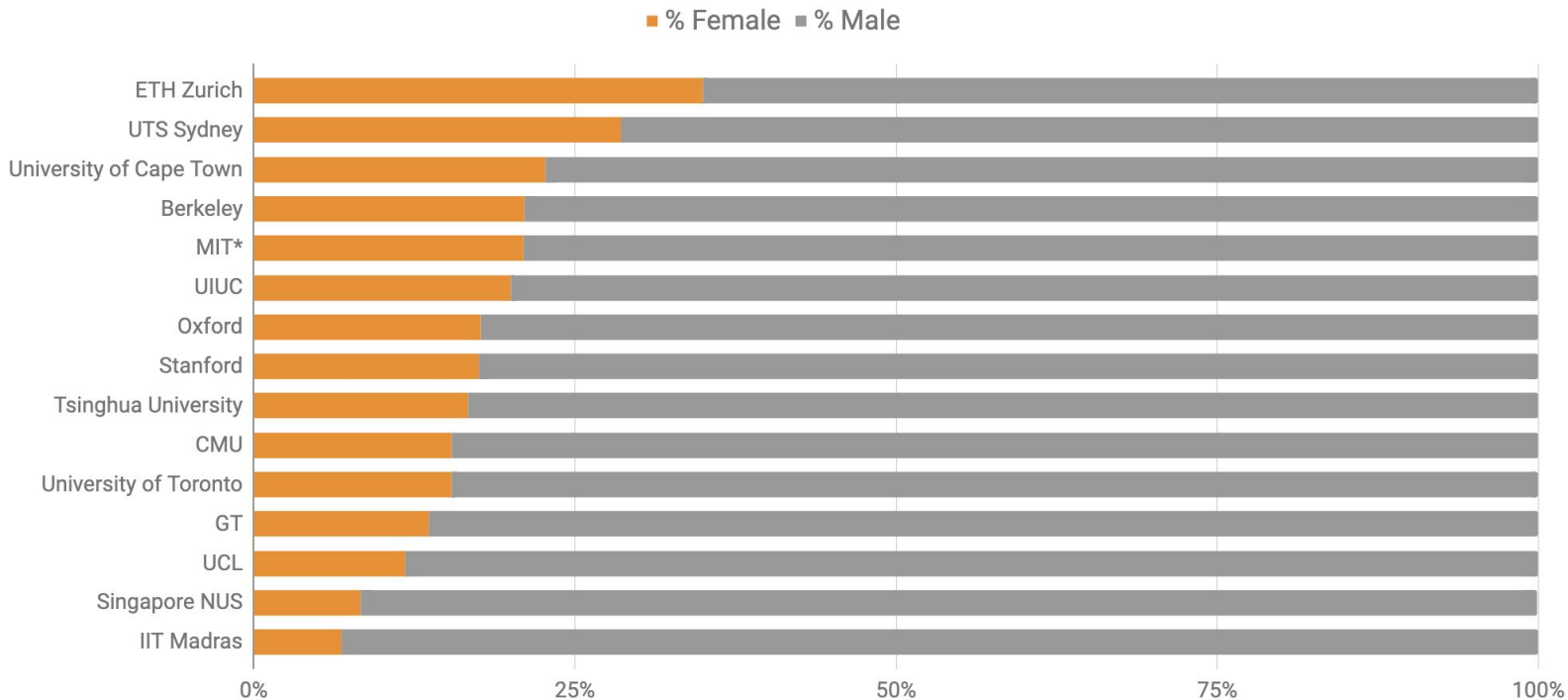
Source: CRA, 2019.



# Gender breakdown of AI faculty is variable, but low

## Gender Breakdown of Professors, CS Departments

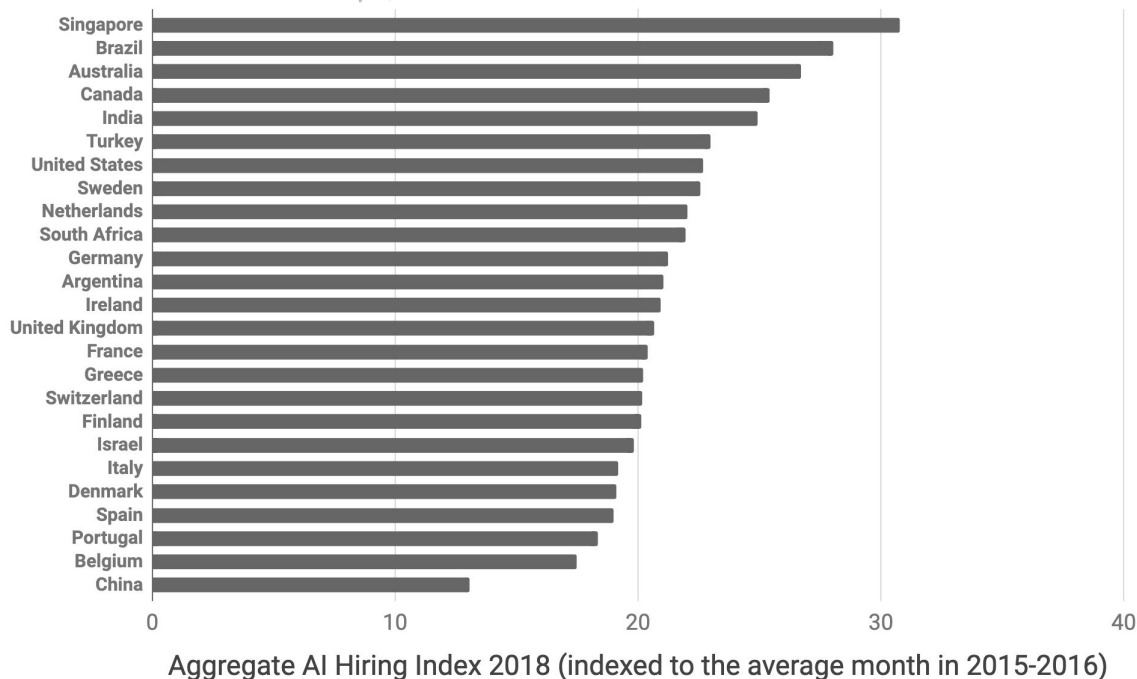
Source: Department websites, 2019.



# Several Countries are hiring more than USA

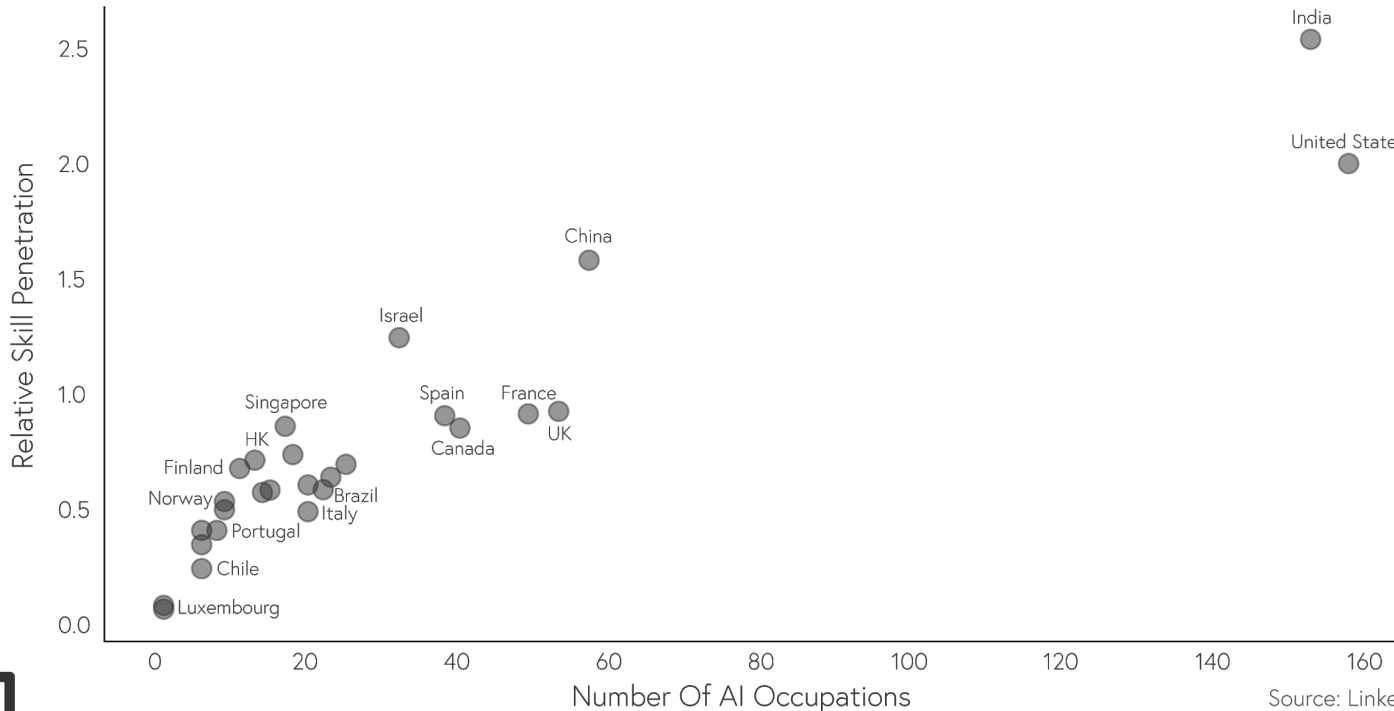
AI Hiring Index, 2015-2018

Source: LinkedIn Economic Graph, 2019.



# AI skill penetration is high in India

National Comparison of Skill Penetration and Number of Unique AI Occupations

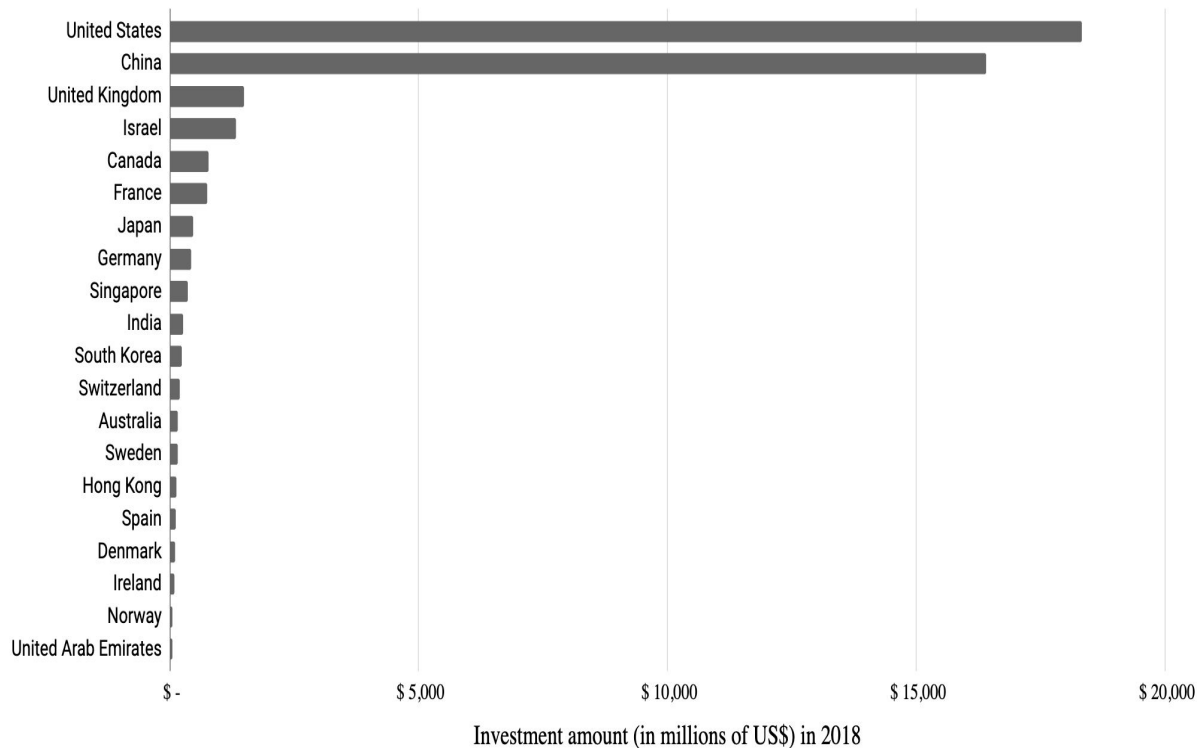


Source: LinkedIn, 2019

# US and China lead startup investment...

Investment amount (in US\$) in 2018

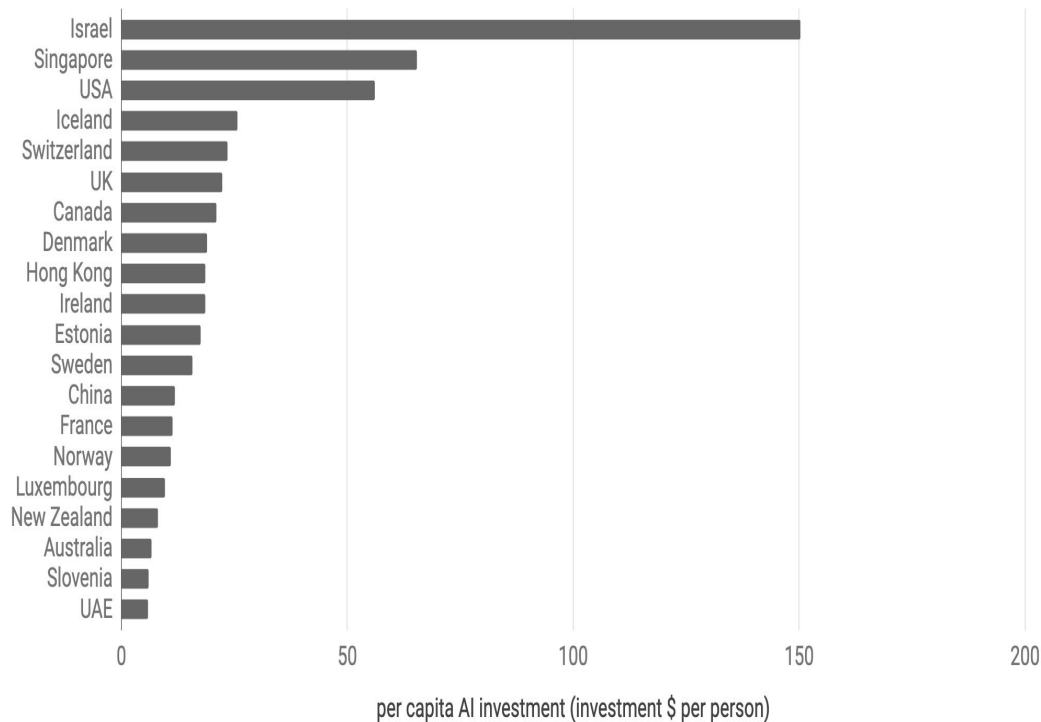
Source: Crunchbase, CAPIQ, Quid, 2019.



# ... but Israel and Singapore ahead per capita

Per capita Investment amount (\$ per person) in 2018

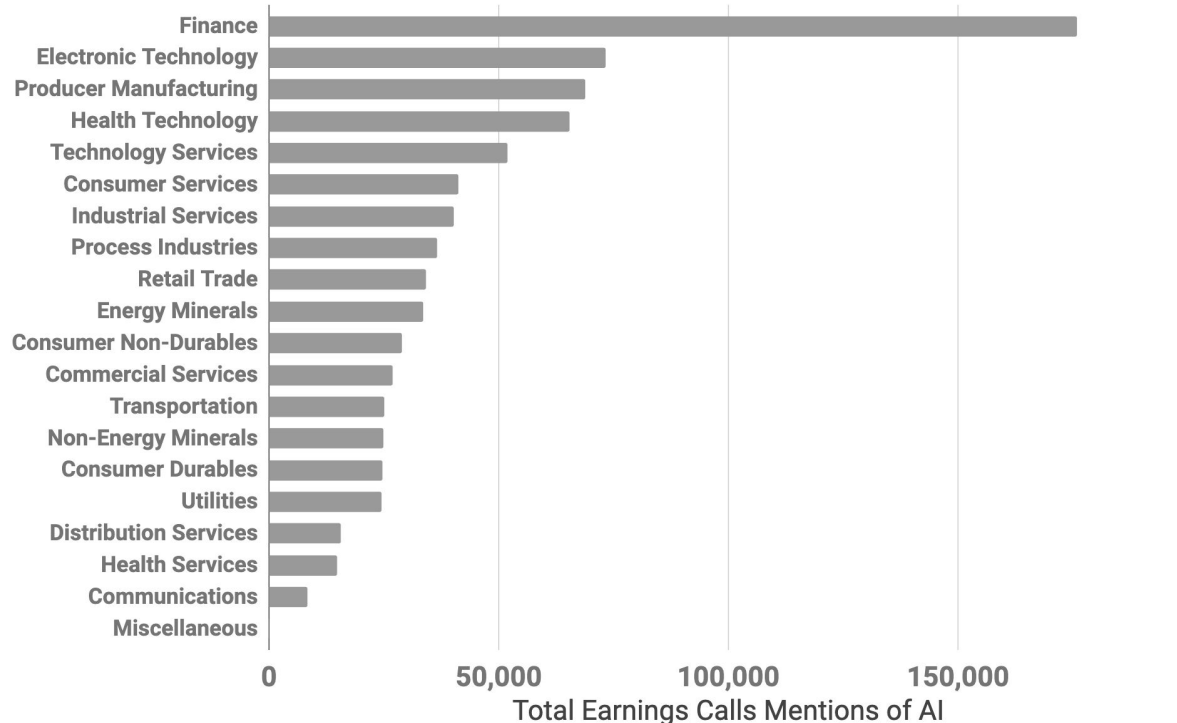
Source: Crunchbase, CAPIQ, Quid, 2019.



# AI Mentions in Earnings Calls indicate Sector Interest

AI Total Earnings Calls Mentions by sectors, 2018-19

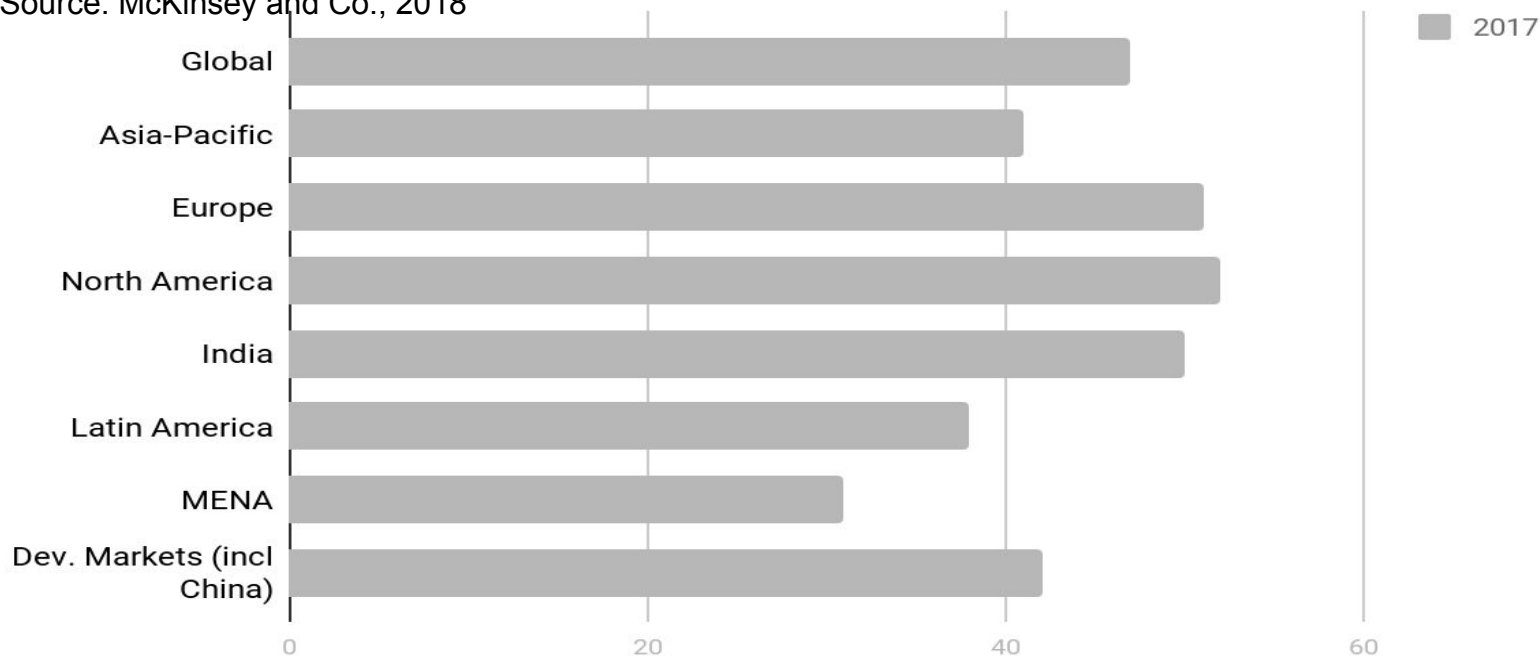
Source: Prattle, 2019.



# AI Adoption by Global Corporations is similar across most regions

## AI Capabilities Embedded in at least one Function

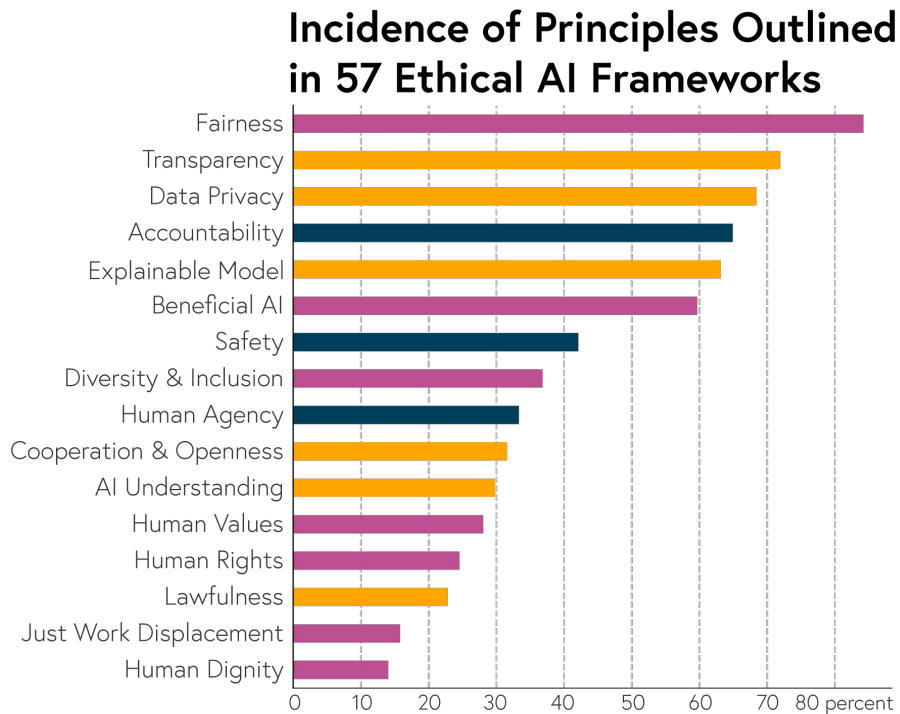
Source: McKinsey and Co., 2018





# Growing Industry of Ethical AI Frameworks

## *Fairness is twice as important as Safety*



Source: PWC, 2019

# AI Vibrancy Index: Composite Measure

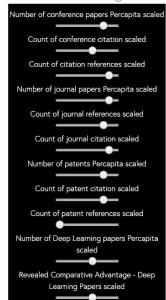
## Country Weighting Tool

### AI Vibrancy Index: Composite Measures

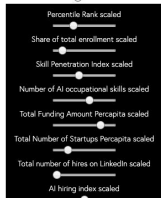
Cross-country comparison ☐ Single-country deep dive

Drag the sliders to change the weight for a variable, then click update to see the new weights reflected in the chart below.

#### Research and Development



#### Economy



Update

#### Inclusion



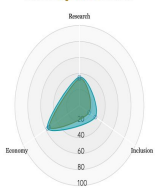
## Prioritize Country Specific Policies

### AI Vibrancy Index: Composite Measures

Cross-country comparison ☐ Single-country deep dive

Switzerland

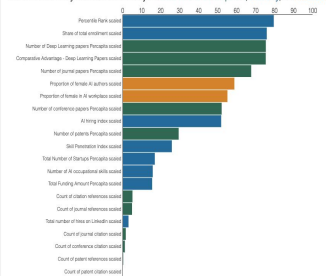
#### AI Vibrancy in Switzerland vs. Average AI Vibrancy Scores in High Income Countries



#### Setting Trends: AI Vibrancy Changes 2015-2018

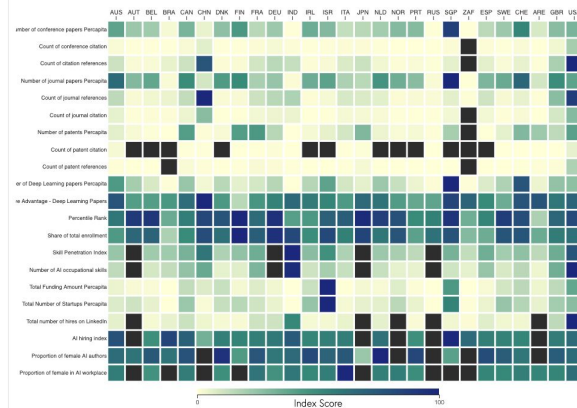


#### Switzerland's Policy Priorities: AI Vibrancy in Research and Development, Economy, and Inclusion



## Compare countries across dimensions

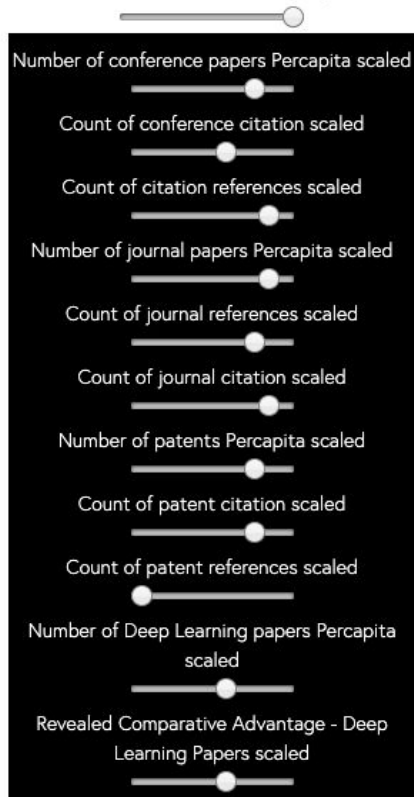
### Cross-country AI Vibrancy in 21 Variables



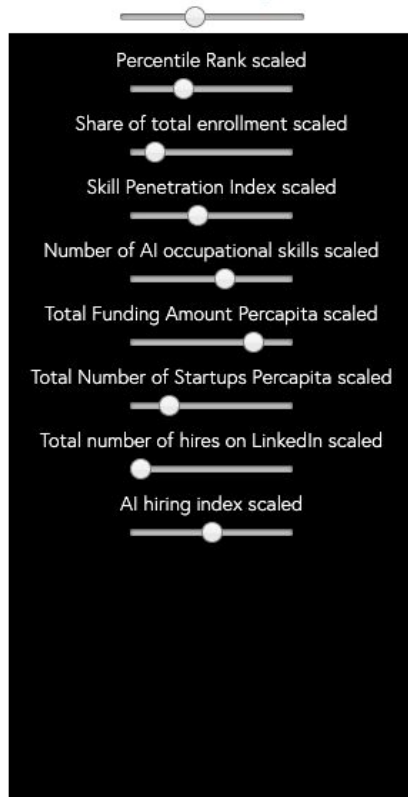
# Country Weighting Tool

- 22 variables, in > 50% of countries
- 28 countries, in > 70% of variables

## Research and Development



## Economy

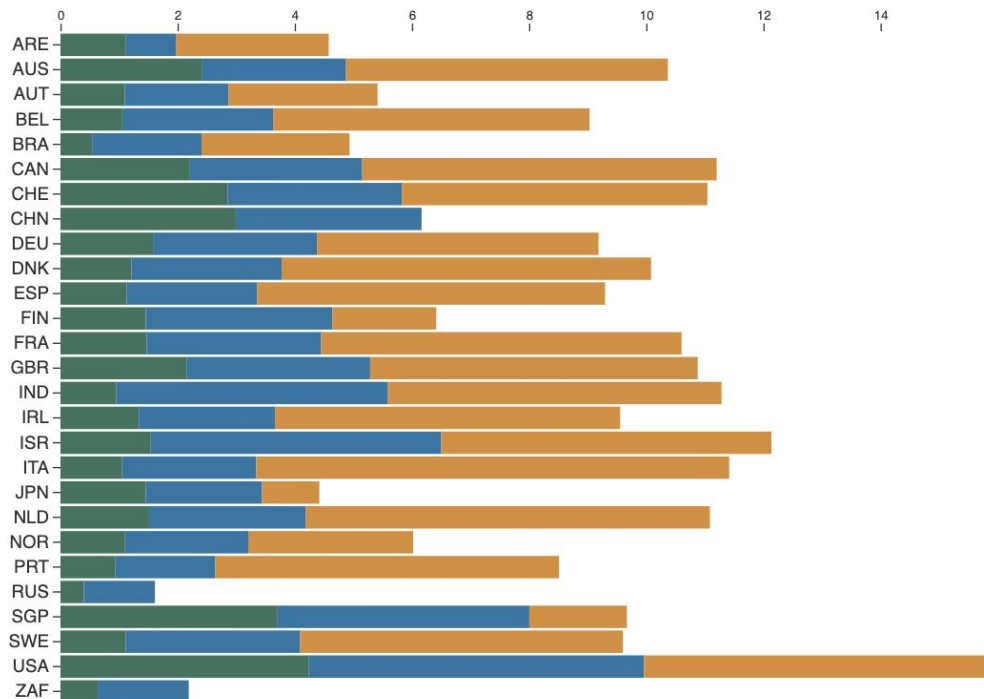


## Inclusion



# Cross-country AI Vibrancy in Three Pillars

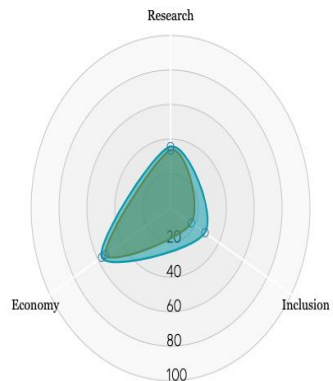
Cross-country AI Vibrancy in Three Pillars: Research and Development, Economy, and Inclusion



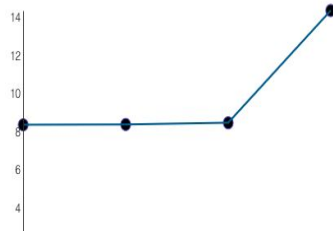
# Country View

Switzerland

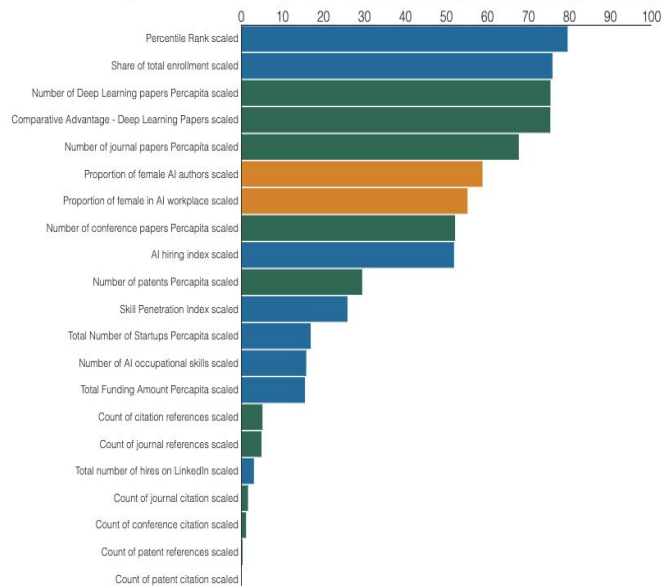
AI Vibrancy in **Switzerland** vs. Average AI Vibrancy Scores in **High Income** Countries



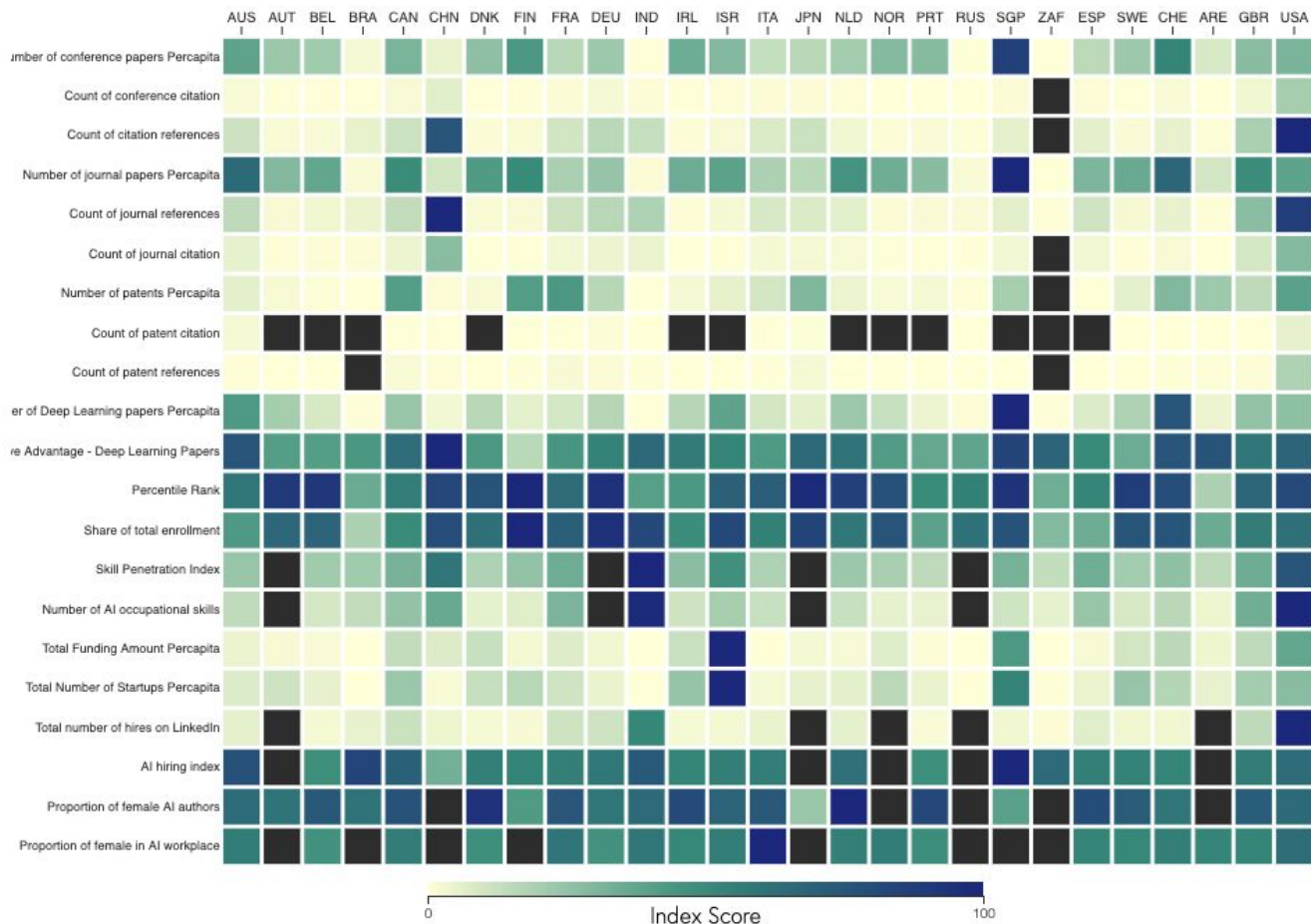
Setting Trends: AI Vibrancy Changes 2015-2018



Switzerland's Policy Priorities: AI Vibrancy in Research and Development, **Economy**, and **Inclusion**



# Country Comparison across Variables



# Measuring AI is Hard

- Reflected in broad range of areas of interest
- Hard to circumscribe
- Little help from national statistics
- Few high-quality, public, centralized sources
- Unclear what stakeholders want to do with the data

# What next?

- Encourage development of a practical definition of AI
- Improve gender statistics for Asians
- Improve tracking of researchers over their careers
- Get better sense of what stakeholders might want to do with the data

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