WOMEN IN AI

Duke SCIENCE & SOCIETY

UNESCO

Written by:

Shangrong Chi, Isabela Latorre, Huixiang Shi, Jiayi Zhou

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Women's Participation in AI Roles Within Industry, Academia, and What We Can Learn From Other Nations

Introduction:

The field of Artificial Intelligence (AI), has grown rapidly, reshaping not only academia but also industries worldwide.[1] Despite significant growth, women and gender-diverse individuals remain underrepresented in AI. Understanding the factors contributing to this disparity is crucial for addressing gender-based AI inequality. This review explores the current landscape of women's participation in AI and highlights key efforts to promote gender inclusivity and innovation in the field. In particular, women's contribution rates to Python open-source AI-related libraries are examined, revealing a substantial disparity between the number of male and female contributors. Additionally, the gender breakdown of students and faculty members at the top five universities within each of the five UNESCO regions (Africa, the Arab States, Asia and the Pacific, North America and Europe, and Latin America and the Caribbean) is documented. The updated country-level gender breakdown for the top companies in the AI field is also reported, with particular attention to whether women are represented in high-ranking positions. Throughout, effective policies for promoting women's inclusion in AI are highlighted.

AI-related programming language top library contributors

Understanding the distribution of contributors and the gender gap within the AI development community is crucial for advancing gender equality and promoting inclusivity in this rapidly evolving field. Python is the most widely used programming language for AI-related projects.[2] Developers leverage libraries with diverse functionalities to streamline AI project development and avoid writing code from scratch. Coursera identifies the best Python libraries for AI and machine learning as NumPy, Scikit-learn, Pandas, TensorFlow, Keras, and PyTorch.[3] These open-source libraries are critical for streamlining AI project development, making it essential to understand who is contributing to them.

Given these contributors' significant role in developing and maintaining these libraries, their geographic distribution and gender information are studied. Understanding the gender and geographic location of contributors is crucial for several reasons. It highlights the diversity within the AI development community, identifies potential gaps in representation, and promotes

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[1] Georgieva, Kristalina. "Ai Will Transform the Global Economy. Let's Make Sure It Benefits Humanity." IMF, January 14, 2024. https://www.imf.org/en/Blogs/Articles/2024/01/14/ai-will-transform-the-global-economy-lets-make-sure-it-benefits-humanity.

[2] According to Stack Overflow, approximately 45.32% of developers use Python for AI development. Fore, Preston. "AI Programming Languages Power Today's Innovations like CHATGPT. These Are Some of the Relevant Languages." *Fortune Education*, Fortune. Accessed July 9, 2024. https://fortune.com/education/articles/ai-programming-languages/.

[3] "9 Best Python Libraries for Machine Learning." Coursera. Accessed July 9, 2024. https://www.coursera.org/articles/python-machine-learning-library.

inclusivity, particularly for women in AI. By examining this information, a better understanding of the current landscape can be achieved, allowing for the advocacy of more equitable participation across different regions and genders.

Using the GitHub API, data on contributors is retrieved. Python libraries are then employed to infer the geographic information and gender of contributors, with uncertain inferences supplemented and verified using information from LinkedIn profiles, Google Scholar, and personal websites. The analysis involved plotting figures to examine the data, which revealed significant gender and geographic disparities. Out of 367 contributors, 346 are male and only 21 are female. According to Figure 1, the map indicates that most contributors are based in the United States, European countries, India, China, and Japan. Female contributors are predominantly from the United States, Germany, and France.

Figure 1: Map for Python top libraries contributors

Figure 1: This map is built based on the geographic and gender distribution of contributors for the most widely used Python AI libraries: NumPy, Scikit-learn, Pandas, TensorFlow, Keras, and PyTorch. From the map, it is evident that most contributors are located in the United States, Europe, India, China, and Japan. Additionally, the majority of female contributors are from the United States, Germany, and France.

Overall, our analysis highlights a stark disparity between male and female contributors in AI-related libraries and language, with only 21 out of 367 contributors being female. Some countries show more female representation than others. This significant gender gap underscores the need for greater representation of women in AI. This understanding is a critical step toward promoting gender equality and diversity in the future of AI.

Though Python remains the dominant language for AI development, and contributions come mainly from global northern countries and China, there is a notable disparity in gender representation among contributors. Understanding and promoting diversity within this community ensures that AI technologies are developed by a workforce that reflects the diversity of its users, ultimately benefiting society as a whole.

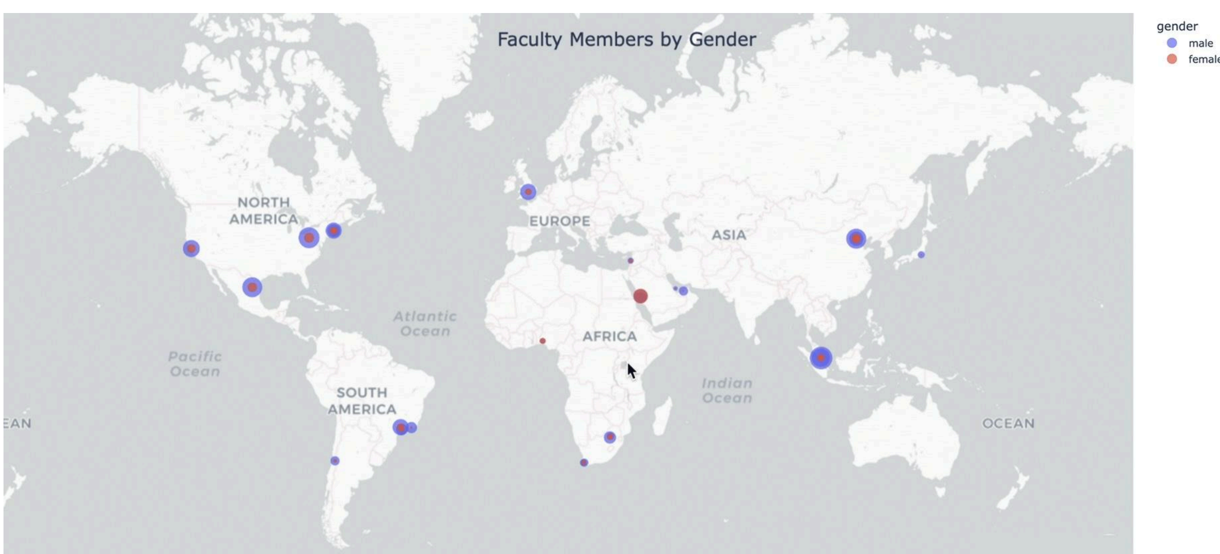
Education:

Women in Computer Science and AI Across UNESCO's Five Regions

The pursuit of gender diversity in Artificial Intelligence (AI) and Computer Science (CS) is a global endeavor, with each region facing unique challenges and showing varied progress.[4] Research highlights significant gender disparities, particularly in higher education and employment within these fields. Examining the representation of women faculty in CS departments offers valuable insights into these disparities, serving as a proxy for understanding broader trends in Africa and other regions. By focusing on faculty data, we aim to highlight the academic pipeline's role in shaping the professional landscape and emphasize the need for more targeted interventions to support gender diversity in AI and CS.

Gender diversity in CS faculty is examined across universities from UNESCO's five regions: the Arab States, Asia and the Pacific, Latin America, Europe and North America, and Africa. This analysis highlights persistent disparities and regional challenges. We analyzed the top 5 CS programs in these regions, encompassing over 1100 faculty members, to provide a comprehensive overview. Here are the resulting graphs.

Figure 2: Map for Faculty Members by Gender from the Top 25 CS majors



[4] Avolio, Beatrice, Jessica Chávez, and Carlos Vílchez-Román. "Factors that contribute to the underrepresentation of women in science careers worldwide: A literature review." Social Psychology of Education 23, no. 3 (2020): 773-794.

Figure 2: According to Unesco's 5 regions–Arab States, Asia and the Pacific, Latin America, Europe and North America, and Africa, only 2 universities' CS majors have more women faculty than men. (21s) These 2 universities are from arab states and Africa.

Figure 3: Graph for women and men faculty in the top 25 cs majors

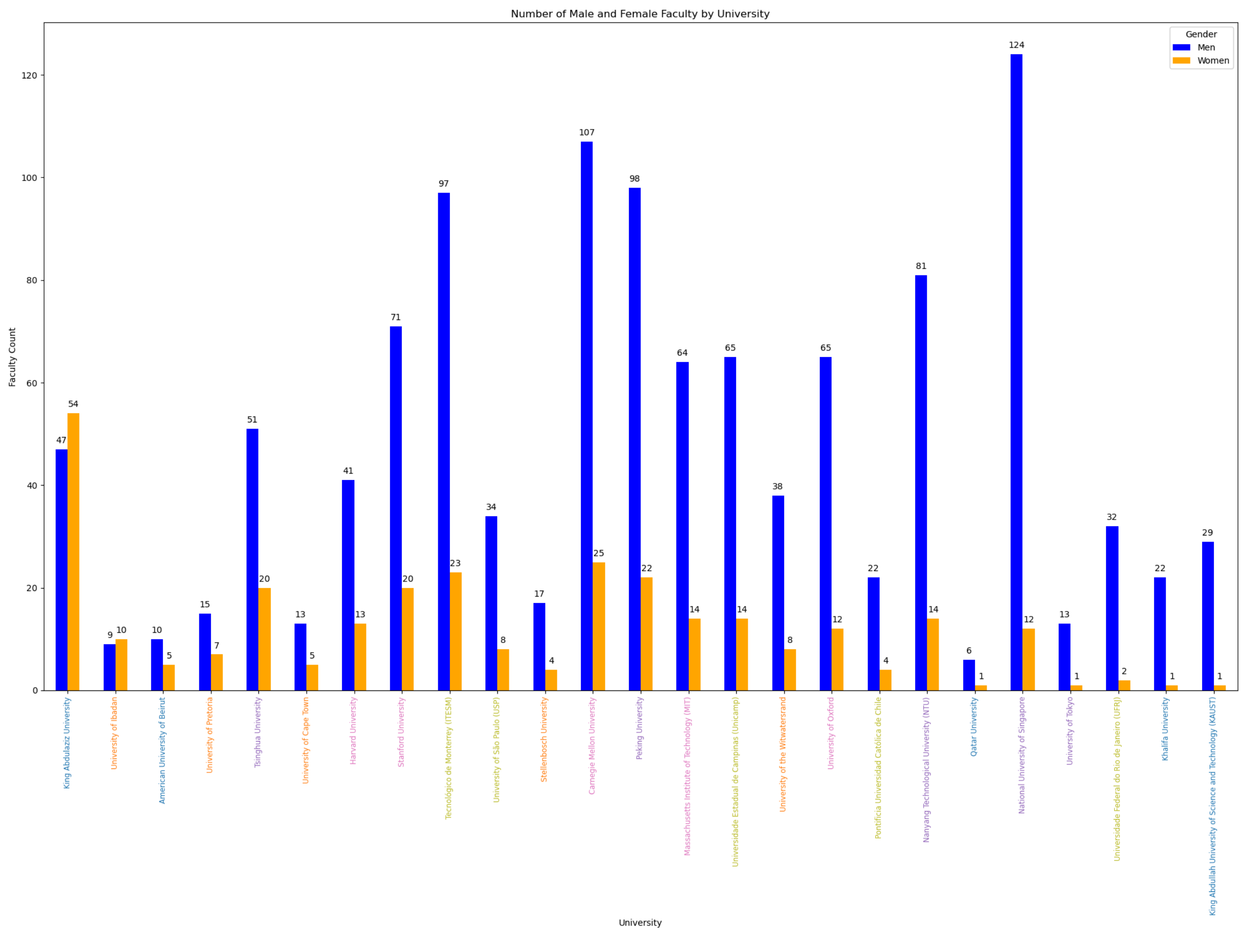


Figure 3: 25 CS majors are ranked from high to low according to gender ratio. The Arab states have the highest and lowest gender ratios, showing a polarized pattern. Africa has the most balanced gender ratio among the five regions, followed by Europe and North America. Asia and the Pacific and Latin America are in the middle.

Africa

In Africa, the importance of including women in CS and AI is increasingly recognized, but representation remains low due to socioeconomic and cultural barriers. Significant gender inequalities are highlighted in accessibility and skills development in South Africa, noting significant inequalities in accessibility and skills development between genders.[5] Women in South Africa, Kenya, Nigeria, and Ghana face limited access to relevant education and training in AI. Meanwhile, women are also underrepresented in AI roles due to limited access to relevant education and training.[6] Cultural biases, limited educational resources, and a lack of mentorship are identified as critical challenges to women's participation in AI. Women's participation is lacking in AI education and the workforce.[7]

However, faculty representation tells a different story. Among the top 25 Computer Science programs, the University of the Witwatersrand and Stellenbosch University in South Africa have low women representation ratios (0.211 and 0.235, respectively). In contrast, the University of Ibadan in Nigeria stands out with a higher ratio (1.149), indicating nearly equal representation. These disparities underscore the impact of socioeconomic and cultural factors, as well as limited access to education and mentorship, on gender diversity in AI and CS.

Arab States

Initiatives in the Arab States aim to increase women's participation in STEM fields, including AI, but challenges persist.[8] AI's potential for women's empowerment in Bahrain demonstrates how AI can offer new opportunities for women but also highlights existing barriers.[9] For instance, while both women and men have the potential to access frontier knowledge, persistent inequalities in the use of electronic devices create barriers for women. These disparities hinder women's ability to engage with new knowledge as effectively as men, maintaining the gender gap in technological proficiency. Gender-based differences are highlighted in AI adoption among Egyptian students and revealed in AI adoption and use.[10] Socio-cultural norms, gender bias in education, and insufficient support systems for women in STEM are demonstrated as significant obstacles in this region. For instance, universities like King Abdullah University of Science and Technology (KAUST) and Khalifa University have extremely low gender ratios (0.034 and 0.046), indicating significant underrepresentation of women. Cultural norms and socio-economic barriers contribute to these disparities.

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[5] Adams, Rachel. "The gendered impact of artificial intelligence and the fourth industrial revolution in South Africa: Inequality, accessibility and skills development." Social Justice and Education in the 21st Century: Research from South Africa and the United States (2021): 365-379.
[6] Ahmed, Shamira. "A gender perspective on the use of artificial intelligence in the African fintech ecosystem: case studies from South Africa, Kenya, Nigeria, and Ghana." (2021).
[7] Neupane, Bhanu, and Prateek Sibal. *Artificial intelligence needs assessment survey in Africa*. UNESCO Publishing, 2021.
[8] BOUZID, Merouane. "The future of artificial intelligence in the Arab world The experience of some Arab countries." *IJEP* 6, no. 1 (2023): 257-271.
[9] Al Shehab, Noor, and Allam Hamdan. "Artificial intelligence and women empowerment in Bahrain." *Applications of Artificial Intelligence in Business, Education and Healthcare* (2021): 101-121.
[10] Strzelecki, Artur, and Sara ElArabawy. "Investigation of the moderation effect of gender and study level on the acceptance and use of generative AI by higher education students: Comparative evidence from Poland and Egypt." *British Journal of Educational Technology* 55, no. 3 (2024): 1209-1230.

Asia and the Pacific

Efforts in Asia and the Pacific focus on integrating AI into various sectors, with women increasingly participating, though disparities remain.[11] In Indian higher education, significant barriers such as societal expectations, a lack of women role models, and limited encouragement from family and educational institutions have been identified.[12] Gender stereotypes further limit women's access to advanced AI education and discourage them from pursuing AI-related careers, contributing to a gender imbalance in the field. Additionally, institutional support for women in AI research is often lacking, with many universities and research institutions not providing adequate policies or resources to support women researchers, leading to fewer women participating in AI projects.[13] While there are slight improvements, significant gaps persist. For example, the University of Tokyo and the National University of Singapore have low women representation ratios (0.077 and 0.097, respectively), whereas Peking University and Tsinghua University display better ratios (0.224 and 0.392). These barriers, including societal expectations and limited institutional support, continue to hinder women's participation in AI and Computer Science.

Europe and North America

Europe and North America have made strides in promoting gender diversity in AI and CS. However, the Stanford AI Index report notes that the AI workforce remains predominantly male, with women accounting for less than 19% of AI and CS PhD graduates over the past decade.[14] To better understand why underrepresented students, including women, are less likely to study machine learning and AI, it is essential to explore systemic barriers in education. Systemic barriers in education have been found as one of the reasons.[15] Women researchers in AI in the Czech Republic, for instance, examine these challenges and propose potential solutions.[16] Persistent gender biases, lack of visibility for women's contributions, and insufficient support

[11] Collett, Clementine, Livia Gouvea Gomes, and Gina Neff. *The effects of AI on the working lives of women*. UNESCO Publishing, 2022.

[12] Sharma, Silky, Gurinder Singh, Chandra Shekhar Sharma, and Shikha Kapoor. "Artificial intelligence in Indian higher education institutions: a quantitative study on adoption and perceptions." *International Journal of System Assurance Engineering and Management* (2024): 1-17.

[13] Shahbazi, Hafizullah, Musawer Hakimi, Helena Ulusi, Behnaz Rahimi, and Tamanna Quraishi. "Exploring the Impact of Artificial Intelligence on Women's Empowerment: A Comprehensive Survey." *EDUTREND: Journal of Emerging Issues and Trends in Education* 1, no. 2 (2024): 108-120.

[14] Zhang, Daniel, Saurabh Mishra, Erik Brynjolfsson, John Etchemendy, Deep Ganguli, Barbara Grosz, Terah Lyons et al. "The AI index 2021 annual report." *arXiv preprint arXiv:2103.06312* (2021).

[15] Barretto, Daphne, Julienne LaChance, Emanuelle Burton, and Soohyun Nam Liao. "Exploring why underrepresented students are less likely to study machine learning and artificial intelligence." In *Proceedings of the 26th ACM Conference on Innovation and Technology in Computer Science Education V. 1*, pp. 457-463. 2021.

[16] Lhotska, Lenka, and Olga Stepankova. "Artificial Intelligence and Women Researchers in the Czech Republic." *Applied Sciences* 12, no. 3 (2022): 1465.

programs are ongoing issues. Notably, MIT and Carnegie Mellon have moderate women faculty representation ratios (0.219 and 0.233, respectively), with Harvard showing a higher ratio (0.317). In contrast, Oxford and Stanford have lower ratios (0.185 and 0.282). These disparities highlight the impact of educational barriers and the need for improved support programs to enhance gender diversity in AI and CS.

Latin America

In Latin America, efforts to encourage women in AI and CS face cultural and structural barriers.[17] Research highlights the need for gender-inclusive policies to address these challenges. Key determinants for women's engagement with emerging technologies like AI include confidence and educational factors.[18] Prominent challenges in the region encompass socio-economic barriers that limit women's access to education and training in AI, gender stereotypes and cultural norms that discourage women from pursuing STEM careers, and the limited availability of gender-specific support programs and initiatives.[19] Diversity in faculty representation varies significantly; for instance, the Federal University of Rio de Janeiro (UFRJ) has a low women-faculty ratio (0.063), while the University of São Paulo (USP) and Tecnológico de Monterrey (ITESM) have moderate ratios (0.235 and 0.237). These disparities highlight the profound impact of cultural and structural barriers on gender diversity in AI and CS.

Conclusion:

Common challenges such as cultural biases, limited access to education, and lack of mentorship hinder women's participation in CS and AI across all regions. While some universities show progress, overall women's representation in CS faculty still needs to improve. Addressing these disparities requires targeted policies, support programs, and continuous efforts to create inclusive academic environments. Further research is essential to understand and bridge the gender gap in CS and AI globally.

Industry Positions:

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[17] Attracting more young women into stem fields1. Accessed July 10, 2024. https://documents1.worldbank.org/curated/en/257831642743451543/pdf/Attracting-More-Young-Women-into-Stem-Fields.pdf.

[18] Pedro, Francesc, Miguel Subosa, Axel Rivas, and Paula Valverde. "Artificial intelligence in education: Challenges and opportunities for sustainable development." (2019).

[19] Samuel, Yana, Jean George, and Jim Samuel. "Beyond stem, how can women engage big data, analytics, robotics and artificial intelligence? an exploratory analysis of confidence and educational factors in the emerging technology waves influencing the role of, and impact upon, women." *arXiv preprint arXiv:2003.11746* (2020).

Overview:

The tech industry, particularly the AI sector[20], is a significant driver of modern economies. Despite its rapid expansion and influence, women remain underrepresented in leadership roles within AI companies. To understand this disparity, we are using PitchBook to collect and analyze gender data from AI-focused companies in different locations.

Methodology:

To address the gender disparity in AI leadership, we implemented the following methods:

- PitchBook[21] Data Collection: We utilized PitchBook to collect gender data from AI-focused companies across different locations. PitchBook provided detailed insights into the gender composition of executive teams, boards of directors, and other senior roles in these companies.

Current Findings:

1. AI-Focused Companies from PitchBook:

Using PitchBook, we manually collected gender data from various AI-focused companies across different locations. This data will provide insights into the representation of women and men in high-ranking positions globally within the AI industry.

In the meantime, we applied several analytical metrics to this data to generate unique and actionable insights tailored to UNESCO's goals. These metrics include:

- Representation Index: This metric measures the proportion of women in leadership positions compared to their male counterparts. By calculating the representation index for each company and region, we can identify areas with the highest and lowest gender disparity.
- Sector Comparison: This involves comparing the gender representation in AI companies with other sectors, such as finance, healthcare, and education. This helps to contextualize the gender disparities within the AI industry against broader industry trends.
- Geographic Analysis: We conducted a regional analysis to highlight geographic trends and disparities in gender representation. This includes identifying

[20] https://aiindex.stanford.edu/report/
[21] https://library.fuqua.duke.edu/dukeonly/pitchbook-info.htm

countries or regions with progressive policies or initiatives that have successfully increased women's representation in AI leadership.

- UNESCO Alignment: We aligned our findings with UNESCO's strategic objectives on gender equality and inclusive innovation. This alignment ensures that our analysis not only highlights disparities but also supports UNESCO's mission to foster diversity and inclusion in STEM fields.

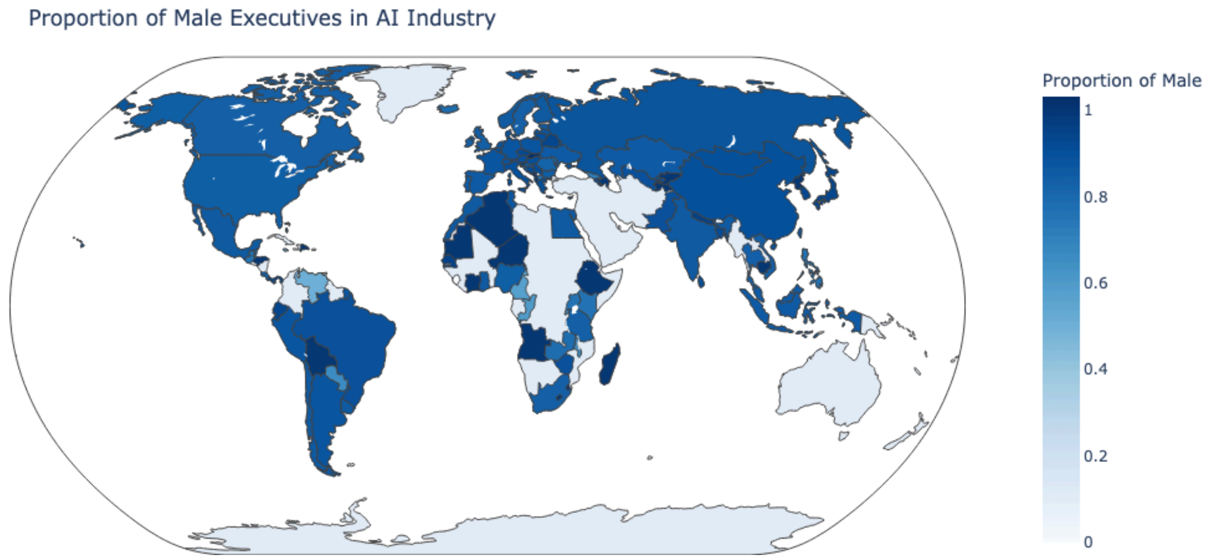
These comprehensive insights will aid UNESCO in crafting targeted interventions and policies to promote gender equality in the AI sector globally.

Figure 4: Global data with different filters like positions, and firm types.

	All	US	Canada	Europe	Americas	Asia	Africa	Middle East	Oceania
Overall	292,446	87,247	8,200	57,477	99,271	31,232	1,671	8,323	3,533
Overall - Female	40,451	13,027	1,236	7,263	14,717	3,210	269	957	536
Overall - Male	250,273	73,784	6,913	49,789	84,061	27,780	1,391	6,614	2,978
% of Female	13.8%	14.9%	15.1%	12.6%	14.8%	10.3%	16.1%	11.5%	15.2%
% of Male	85.6%	84.6%	84.3%	86.6%	84.7%	88.9%	83.2%	79.5%	84.3%
Active Position Status	191,612	75,124	7,165	52,207	85,873	29,955	1,580	6,998	3,201
Active Position Status - Female, Active	25,710	11,230	1,112	6,630	12,773	3,097	258	869	486
Active Position Status - Male, Active	164,703	63,503	6,005	45,185	72,654	26,640	1,311	6,083	2,696
% of Female	13.4%	14.9%	15.5%	12.7%	14.9%	10.3%	16.3%	12.4%	15.2%
% of Male	86.0%	84.5%	83.8%	86.5%	84.6%	88.9%	83.0%	86.9%	84.2%
Position - Tech	31,294	8,580	911	6,824	10,021	2,493	188	1,040	375
Position - Tech, Female	1,223	374	43	234	444	95	8	52	10
Position - Tech, Male	29,897	8,165	863	6,538	9,531	2,377	179	980	360
Position - Tech, Female, Active	826	331	40	221	398	91	7	52	10
Position - Tech, Male, Active	19,562	7,227	786	6,128	8,484	2,261	168	919	333
% of Female	3.9%	4.4%	4.7%	3.4%	4.4%	3.8%	4.3%	5.0%	2.7%
% of Male	95.5%	95.2%	94.7%	95.8%	95.1%	95.3%	95.2%	94.2%	96.0%
Position - Engineering	3,100	872	55	256	939	113	4	25	16
Position - Engineering, Female	144	51	1	8	53	5	-	-	-
Position - Engineering, Male	2,949	818	53	248	882	109	4	25	14
Position - Engineering, Female, Active	54	39	1	8	41	4	-	-	-
Position - Engineering, Male, Active	1,085	601	41	214	652	89	4	19	11
% of Female	4.6%	5.8%	1.8%	3.1%	5.6%	4.4%	0.0%	0.0%	0.0%
% of Male	95.1%	93.8%	96.4%	96.9%	93.9%	96.5%	100.0%	100.0%	87.5%

Figure 4: Excel data manually collected from PitchBook about different positions and firm types across the world.

Figure 5: Comparison Proportion of Women's & Men's Participation in AI Industry



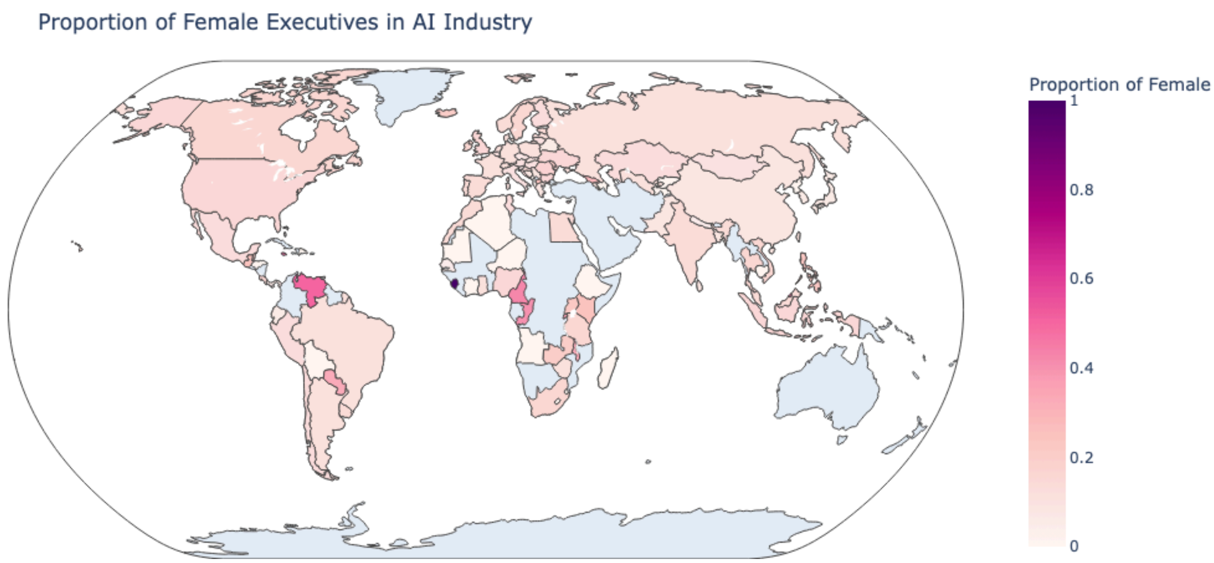


Figure 5: These maps are built based on the geographic and gender distribution of the proportion of females or males across the world, with darker colors representing more proportion. While this map illustrates the proportion of female executives in the AI industry globally, please note that data from certain regions, especially in Africa, may be skewed due to a smaller sample size, resulting in potential biases.

The two maps provide a stark visual comparison of gender representation in AI executive roles globally. The first map, depicting the proportion of male executives, shows the widespread dominance of men in executive roles, especially in North America, Europe, and Asia, indicated by dark blue shades. Conversely, the second map illustrates the proportion of female executives, with darker shades of pink and purple highlighting regions such as Kenya and Colombia where female representation is relatively higher. The comparison underscores a significant global gender disparity in AI leadership, with men overwhelmingly occupying executive positions, and only a few regions showing higher female representation. This visual disparity highlights the urgent need for targeted policies and initiatives to enhance gender diversity in the AI sector.

Conclusion:

Our initial analysis of AI-focused companies in Pitchbook data reveals a persistent gender gap in senior roles. Although some companies have made progress toward greater gender diversity, there is still much work to be done.

Policy Implications:

Policy:

Various factors perpetuate gender inequality within STEM and AI fields.[22] Although many believe discrimination on the part of grant agencies contributes to gender inequality in STEM and AI, scholars have argued persuasively that the factors at play in perpetuating gender disparity are in fact much broader. These factors may include, for example, differences in career preferences and goals between men and women, societal and cultural influences shaping employment choices, challenges in maintaining work-life balance, and the importance of having role models and mentorship. As such, only a holistic approach to addressing gender inequity, which recognizes the complexity of the factors at play, will help us to secure gender diversity in science and related fields.

Measuring gender equity in workplaces across countries involves analyzing a variety of key metrics. First, measuring the gender pay gap within different nations and UNESCO regions shows the variance in wage disparities. Second, looking at the overall representation of women in AI leadership roles provides a key metric for assessing workplace gender inclusivity. Then, looking at workforce participation rates, which reflect employment trends including promotion and retention rates, measure women's career progression. Finally, analyzing the representation of women and men in the overall STEM field not only reveals industry dynamics, but also reflects underlying policies such as parental leave, and flexible work arrangements that support gender equity.

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[22] Ceci, Stephen J., and Wendy M. Williams. Understanding current causes of women's underrepresentation in science. Accessed July 10, 2024. https://www.pnas.org/doi/10.1073/pnas.2300582121.

On average, the top 3 Nordic countries (Iceland, Finland, Norway) fare best when measuring gender equity in the workplace.[23][24] The metrics used for this report include economic participation and opportunity, educational attainment, health and survival, and political empowerment. When looking at legal barriers as a metric, The Council on Foreign Relations created a report titled “Women’s Workplace Equality Index” based on World Bank data.[25] This report looks at legal barriers women face that hinder economic participation around the world, such as access to institutions, building credit, the ability to get a job, going to court, gender-based violence, incentives, and the use of property.[26] Unfortunately, the World Bank also reported that despite the recent progress, “more than one-third of economies have laws constraining women’s decision to join and remain in the labor force.”[27]

The World Economic Forum also provided various statistics on gender parity by country and region of the world. According to their 2023 Global Gender Gap Index, “no country has yet achieved full gender parity, although the top nine countries (Iceland, Norway, Finland, New Zealand, Sweden, Germany, Nicaragua, Namibia and Lithuania) have closed at least 80% of their gap.[28] For the 14th year running, Iceland (91.2%) takes the top position. Iceland also continues to be the only country to have closed more than 90% of its gender gap. When looking at the issue by region (Europe, North America, Latin America, and the Caribbean, Eurasia and Central Asia, East Asia and the Pacific, Sub-Saharan Africa, Southern Asia, and the Middle East and North Africa), Europe had the highest gender parity of all regions at 76.3%. Additionally, one-third of countries in the region ranked in the top 20, and 20 out of 36 countries ranked with at least a 75% parity. Lastly, “The Population Connection” used data from the United Nations’ Gender Inequality Index (GII) to rank countries based on how well they fared. The top ten countries were: Denmark, Norway, Switzerland, Sweden, the Netherlands, Finland, Singapore, Iceland, Luxembourg, and Belgium.[29] The countries with the poorest GII scores, ranked from highest to lowest, include Mauritania, Sierra Leone, Haiti, Liberia, Chad, Central African Republic, Afghanistan, Nigeria, Papua New Guinea, and Yemen, which ranked lowest among countries with available data. Finally, The Council on Foreign Relations used data from the McKinsey Global Institute to measure the overall negative impact on the global economy outputs that countries with gender inequity in the workforce bring. They state that “Closing the gender gap in

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[23] Statista created a report derived from “The World Economic Forum” data that places Iceland as the number one country for gender parity, followed by Finland, and Norway.
[24] Fleck, Anna, and Felix Richter. “Infographic: Best and Worst Countries for Gender Equality.” Statista Daily Data, June 25, 2024. https://www.statista.com/chart/20364/best-and-worst-countries-for-gender-equality/.
[25] “Top and Bottom Countries in Women’s Workplace Equality.” Council on Foreign Relations. Accessed July 10, 2024. https://www.cfr.org/legal-barriers/country-rankings/. (The Council on Foreign Relations this report titled “Women’s Workplace Equality Index” based on World Bank data).
[26] The top 10 countries identified by the report that best honor those are (in order): Australia, Canada, New Zealand, Spain, Mexico, Bosnia and Herzegovina, United Kingdom, Lithuania, Iceland, and Latvia.
[27] “Indicator Data.” World Bank. Accessed July 10, 2024. https://wbl.worldbank.org/en/data/exploretopics/wbl_sj.
[28] “Global Gender Gap Report 2023.” World Economic Forum. Accessed July 10, 2024. https://www.weforum.org/publications/global-gender-gap-report-2023/digest/.
[29] Nater, Olivia. “What Are the Top Countries for Gender Equality?” Population Connection, April 25, 2024. https://populationconnection.org/blog/what-are-the-top-countries-for-gender-equality/#:~:text=1.

the workforce could add a staggering $28 trillion to the global GDP."[30] The next part of the analysis will focus on what the top countries listed throughout these sources have in common and what specific policies and initiatives they enacted to approximate full gender parity.

Recommendations:

Based on the aforementioned research and data collection on gender equity in AI and STEM fields, several policy recommendations have emerged to promote inclusivity and support women's participation:

Firstly, introducing AI and STEM concepts early in primary and secondary education is crucial to ensuring equal access for all students, regardless of gender. By embedding these concepts into the curriculum from an early age, we can cultivate interest and skills among young girls, paving the way for their future involvement in these critical fields. Secondly, establishing networks and affinity groups for women in AI and STEM is essential. These networks provide ongoing support, mentoring, and advocacy, creating a supportive community where women can share their experiences, access and share resources, and advance their careers through networking. Thirdly, developing educational materials that highlight diverse role models in AI and STEM fields is vital. By showcasing women's contributions and achievements, we can inspire the next generation of female leaders and dismantle stereotypes about who can succeed in these fields.

Furthermore, enacting inclusive policies such as parental leave, flexible work hours, and childcare facilitative services is crucial to supporting women's participation and retention in tech careers. Such inclusive policies help foster a work-life balance that is oftentimes critical for women navigating professional and personal responsibilities. Additionally, establishing or strengthening anti-discrimination and sexual harassment policies in the workplace is essential. By ensuring a safe and respectful work environment, several socio-cultural barriers that hinder women's advancement in AI and STEM fields can be mitigated. Furthermore, enforcing strict policies on equal pay and transparent promotion criteria is also essential to eliminate gender disparities, and encourage an equitable view on work contributions. Providing tax incentives for companies that prioritize gender diversity in their AI teams and leadership can also further incentivize progress toward gender parity. Additionally, implementing bias training for coders and programmers specifically focused on combating bias in code helps mitigate the perpetuation of gender stereotypes and biases embedded in the technology.

Moreover, establishing quotas to ensure a fairer distribution of genders within programming teams, boards, and leadership positions can promote diversity and inclusive decision-making, driving innovation and effectiveness in closing the gender gap. For example, Iceland's mandatory gender quota for executive boards, which states "... (if) board-members are more than three, the percentage of women or men cannot be under 40%" shows their commitment to

[30] "Growing Economies through Gender Parity." Council on Foreign Relations. Accessed July 10, 2024. https://www.cfr.org/womens-participation-in-global-economy/.

closing the gap, with the use of the formal legal system to achieve that goal.[31] Finally, by encouraging media outlets and educational institutions to promote positive portrayals of women in AI and STEM and implementing comprehensive strategies to prevent and respond to violence and harassment against women, including shelters, hotlines, legal aid services, and public awareness campaigns, women can exist in an environment that allows them to feel valued, respected, and empowered to thrive in AI and STEM fields. These policy recommendations, grounded in data and research, are crucial steps toward achieving gender equity and creating a more inclusive and diverse tech industry.

[31] Government of Iceland. "Equality Legislation." Government of Iceland. Accessed July 22, 2024. https://www.government.is/topics/human-rights-and-equality/equality/legislation/#:~:text=Gender%20Quotas&text=138%2F1994)%2C%20and%20partnerships,men%20cannot%20be%20under%2040%25.

Figure 6: Policy Recommendations

UNESCO

Policy Implications

PROJECT NAME: Women in AI-UNESCO

PROGRAM: Duke Applied Ethics+ **DATE:** July 2024

EDUCATION	1. Introduce AI and STEM concepts early in primary and secondary education curriculum, ensuring equal access for all students regardless of gender. 2. Establish and promote networks and affinity groups for women in AI and STEM to provide ongoing support, mentoring, and advocacy. 3. Develop educational materials that highlight diverse role models in AI and STEM fields, showcasing women's contributions and achievements.
WORKFORCE	1. Enact inclusive policies, such as parental leave, flexible work hours, and child-care facilitative services. 2. Establish or strengthen anti-discrimination polices in the workplace. 3. Establish or strengthen policies to address sexual harassment in the workplace. 4. Enforce strict policies on equal pay for equal work and ensure transparent promotion criteria to eliminate gender disparities.
TECHNOLOGY	1. Provide tax incentives for companies that demonstrate efforts to increase gender diversity in their AI teams and leadership. 2. Establish bias training for coders and programmers specifically relating to combating bias in code. 3. Establish quotas for ensuring a fairer distribution of genders within programming teams, boards, and leadership positions.
SOCIAL	1. Encourage media outlets and educational institutions to promote positive portrayals of women and challenge gender stereotypes that perpetuate inequality. 2. Implement comprehensive strategies to prevent and respond to violence/harassment against women, including shelters, hotlines, legal aid services, and public awareness campaigns.

Figure 6: This graphic shows the policy implications we identified after looking at our data and prior research. It includes a very basic framework of policies that nations can adopt to increase women's participation in both AI roles but also the workforce as a whole.

Figure 7: Case Studies

Figure 7: This graphic shows the best countries in each category relating to our research: Gender equality, workforce equality, AI development, and women in S.T.E.M. It includes a brief description of why each country excels in each area.

Conclusion:

In today's rapidly evolving tech landscape, promoting gender equality and inclusivity in AI development is more important than ever. Recognizing the distribution and gender gap among AI contributors is crucial for this endeavor. Python, the primary language for AI, relies on key open-source libraries like NumPy, Scikit-learn, Pandas, TensorFlow, Keras, and PyTorch. Our analysis reveals a significant gender disparity, with only 21 out of 367 contributors being female, primarily located in the United States, Europe, India, China, and Japan. This gap highlights the urgent need for more female representation in AI.

Achieving gender diversity in AI and CS is a worldwide effort, with each region encountering distinct challenges and experiencing different levels of progress. Significant gender disparities persist, particularly in higher education and employment. Analyzing the representation of women faculty in CS departments offers important insights into these disparities and reflects broader trends across regions. By analyzing faculty data, we underscore the influence of the academic pipeline on the professional landscape and highlight the necessity for targeted measures to enhance gender diversity in AI and CS.

Promoting women to high-ranking positions in the AI sector is also essential for building an inclusive and innovative industry. Implementing targeted policies and learning from successful global models can help the tech industry move toward a more balanced and equitable future. Restrictive policies, such as those limiting women's employment opportunities based on cultural or societal norms, inadequate maternity leave, and lack of parental leave provisions, hinder women's participation in the workforce. Conversely, progressive policies, such as federal anti-discrimination laws and generous maternity leave, encourage and enable women to participate in the workforce, especially in male-dominated sectors like STEM.

In conclusion, comprehensive and targeted measures are required to address gender disparities in AI and STEM. These include parental leave, flexible work hours, and robust anti-discrimination laws. Establishing support networks and highlighting female role models can foster a more inclusive and supportive community for women in these fields. By enhancing policies, expanding educational opportunities, and gaining a deeper understanding of programming contributor dynamics, the tech industry can work toward a more balanced and equitable future, ultimately reflecting the diversity of its users and benefiting society as a whole.