ISSN 1831-9424

Diversity in Artificial Intelligence Conferences

An analysis of indicators for gender, country and institution diversity from 2007 to 2023

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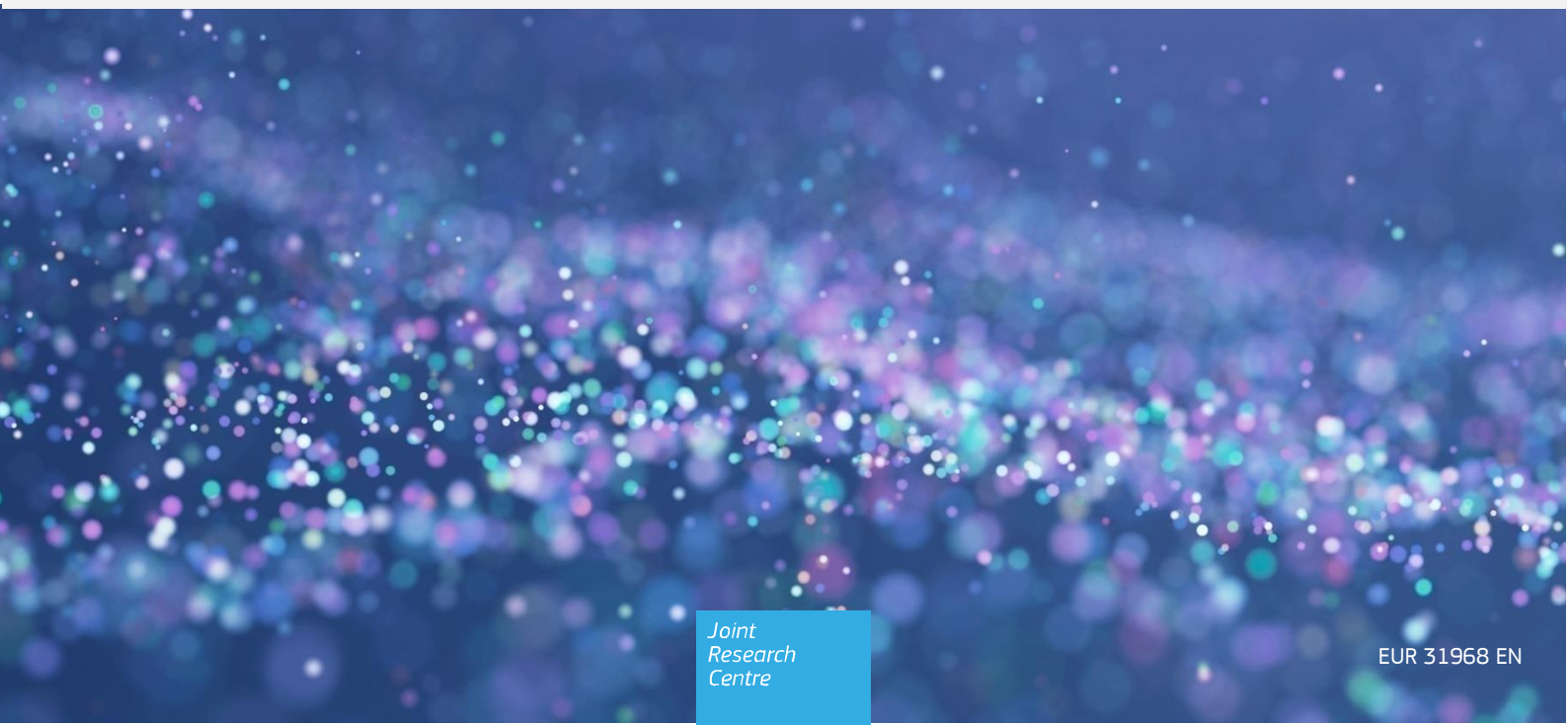
2024



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JRC137550

EUR 31968 EN

PDF ISBN 978-92-68-17675-7 ISSN 1831-9424 doi:10.2760/796551 KJ-NA-31-968-EN-N

Luxembourg: Publications Office of the European Union, 2024

How to cite this report: European Commission, Joint Research Centre, Gomez, E., Porcaro, L., Frau Amar, P. and Vinagre, J., *Diversity in Artificial Intelligence Conferences*, Publications Office of the European Union, Luxembourg, 2024, https://data.europa.eu/doi/10.2760/796551, JRC137550.

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Abstract

This report provides an overview of the divinAI project and provides a set of diversity indicators for seven core artificial intelligence (AI) conferences from 2007 to 2023: the International Joint Conference on Artificial Intelligence (IJCAI), the Annual Association for the Advancement of Artificial Intelligence (AAAI) Conference, the International Conference on Machine Learning (ICML), Neural Information Processing Systems (NeurIPS) Conference, the Association for Computing Machinery (ACM) Recommender Systems (RecSys) Conference, the European Conference on Artificial Intelligence (ECAI) and the European Conference on Machine Learning/Practice of Knowledge Discovery in Databases (ECML/PKDD) .

We observe that, in general, Conference Diversity Index (CDI) values are still low for the selected conferences, although showing a slight temporal improvement thanks to diversity initiatives in the AI field. We also note slight differences between conferences, being RecSys the one with higher comparative diversity indicators, followed by general AI conferences (IJCAI, ECAI and AAAI). The selected Machine Learning conferences NeurIPS and ICML seem to provide lower values for diversity indicators.

Regarding the different dimensions of diversity, gender diversity reflects a low proportion of female authors in all considered conferences, even given current gender diversity efforts in the field, which is in line with the low presence of women in technological fields. In terms of country distribution, we observe a notable presence of researchers from the EU, US and China in the selected conferences, where the presence of Chinese authors has increased in the last few years. Regarding institutions, universities and research centers or institutes play a central role in the AI scientific conferences under analysis, and the presence of industry seems to be more notable in machine learning conferences. An online dashboard that allows exploration and reproducibility complements the report.

Acknowledgements

The authors would like to acknowledge the work of past and present contributors to the divinAI project. We also thank the European Commission for granting the divinAI project a Diversity Award in 2023, ¨Innovation and External Initiative¨ Category.

We thank Alberto Burgarin Díaz for providing relevant insights about ECAI and Ulises Cortés for his valuable feedback and reflections on the report.

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1 Introduction

Diversity, non-discrimination and fairness are considered as one of the key requirements to develop trustworthy Artificial Intelligence (AI) technologies. Under this lens, the diversity of the workforce behind its development is one of the pillars needed to foster responsible practices (West et al., 2019).

The **divinAI** (Diversity in Artificial Intelligence) project[1] started in 2019 with the idea of monitoring diversity in the AI research community. The project proposes a set of indicators to investigate the participation in major AI conferences, measuring the distribution of researchers (authors, keynote speakers and conference organizers) in a given scientific community (represented by a scientific conference or journal) with respect to gender, geographical location and type of organization (e.g. academia vs industry). These indicators are then combined into a global diversity indicator of each conference, providing a way for comparative analysis of different research communities.

DivinAI indicators may then be exploited for awareness raising in the different communities and to assess the impact of diversity policies.

The project is designed as a science for policy, collaborative initiative lead by the JRC and framed within its Human Behaviour and Machine Intelligence (HUMAINT) project[2], which contributes to the recently founded European Centre for Algorithmic Transparency (ECAT)[3]. DivinAI methodologies have been applied to different research communities, notable Affective Computing research (Hupont et al., 2023) and the Recommender Systems community (Porcaro et al., 2023). These indicators have been also adopted in key research communities (e.g., European Conference on AI) as a tool to reflect on their diversity needs and the impact of their activities, as well as being integrated in broader monitoring tools such as the EU AIWatch index[4].

This report presents a long-term analysis on divinAI indicators for a set of core AI conferences, providing an analysis and discussion on their evolution from 2007 to 2023. The report is accompanied by an online dashboard that allows for comparative analysis with other conferences and years.

1.1 Diversity efforts in the artificial intelligence field

There are many diversity initiatives that have been designed by the Artificial Intelligence (A) and Machine Learning (ML) communities. They are presented in detail in (Hupont et al., 2023) in the context of the Affective Computing domain, and we summarize them as follows, with a focus in the broader AI field and the efforts linked to the conferences analysed in this report.

Table 1 lists a number of affinity groups linked to the promotion of certain underrepresented groups in the general AI and ML field and particular domains or areas such as recommender systems (Recsys), computer vision (CV), natural language processing (NLP) or music information retrieval (MIR).

Table 1. Diversity affinity groups in the AI field

Diversity affinity group	Since	Focus	URL
Women in ML (WiML)	2007	Enhance the experience of women in machine learning, in order to help them succeed professionally and increase their impact in the community.	https://wimlworkshop.org/

[1] https://ai-watch.ec.europa.eu/humaint/divinai_en
[2] https://ai-watch.ec.europa.eu/humaint_en
[3] https://algorithmic-transparency.ec.europa.eu/index_en
[4] https://ai-watch.ec.europa.eu/ai-watch-index-2021_en

Women in MIR (WiMIR)	2012	Promote the role of, and increase opportunities for, women, trans or non-binary at any career stage in the field of music information retrieval (MIR).	https://wimir.wordpress.com/
Women in RecSys	2014	Foster diversity and celebrate female role models in the recommender systems research community.	https://recsys.acm.org/recsys21/women-in-recsys/
Women in CV (WiCV)	2015	Foster the career and mitigate the isolation of female researchers working on computer vision (CV).	https://www.wicv.org/
Black in AI	2017	Increasing the presence and inclusion of Black people in the field of AI.	https://blackinai.github.io/#/
Widening NLP (WiNLP)	2017	Help to promote and support ideas and voices of underrepresented groups in the Natural Language Processing (NLP) community.	http://www.winlp.org/
LatinX in AI	2018	Latin professionals working on AI, ML and Data Science.	https://www.latinxinai.org/
Queer in AI	2019	People with diverse non-normative sexual orientations, romantic orientations and/or genders, corresponding to acronyms like LGBTQ+.	https://sites.google.com/view/queer-in-ai
{Dis}Ability in AI	2019	All those who experience barriers in accessing education due to having or being considered to have an impairment (e.g. physical or sensory impairments, people with learning difficulties, people with mental health or autism spectrum conditions).	https://elesa.github.io/ability_in_AI/#
Indigenous AI	2019	Design and create AI from an ethical position that centers Indigenous concerns. The Indigenous term covers diverse communities in Aotearoa, Australia, North America and the Pacific.	https://www.indigenous-ai.net/
African Women in AI (AWAI)	2022	Promote knowledge sharing within the African women AI and ML community.	http://wawiai.org/

Source: Adapted from Hupont et al., 2023.

We observe that these groups have notably been led by female researchers and members of other minorities in the field, which currently cover different diversity dimensions such as ethnic, country of origin or disabilities. Those affinity groups have been behind a series of initiatives, summarized as follows:

— Specific scientific events, such as workshops, usually as satellite events of conferences and sometimes with an unconference format. Notable examples are WiML workshop series in NeurIPS, ICML or AAAI, Black in AI workshop collocated with NeurIPS, AWAI workshop in RecSys and other satellite gatherings in scientific conferences,. This allows members of the target group to connect and present their work to the research community in a specific event.

— Social events at major conferences such as breakfasts, diners or meetups, also intended for networking and interaction. They usually involve members of the target groups but can as well include other conference attendees.

— Dedicated panel or session on the topic diversity at the main conference. These kind of events are intended to outreach and involve the wider community of researchers attending the conference, and not only those that might attend the specific scientific or social event.

- Call for diversity and inclusion activities at conferences, as proposed in AAAI 2021, with the goal as well of engaging with the research community attending the conference providing as space to organize diversity activities.
- Diversity and Inclusion chair: some conferences such as ICML, NeurIPS or Recsys, have appointed a diversity, inclusion and/or accessibility chair to make sure diversity is incorporated in conference organization, including selection of keynotes for instance.
- Visibility efforts, including open repositories of researchers belonging to the target groups, profiles of outstanding researchers with interviews, blogposts or invited talks.
- Mentoring programs directed towards participants in the target groups for networking and support.
- Research programmes, including funding schemes and specific journal or conference tracks.
- Other networking strategies for asynchronous interaction such as mailing lists or social media spaces.

These efforts are currently having a direct impact that we observe, for instance, on a greater diversity of keynote speakers, panellists, conference committees and session chairs. This is found already in a previous analysis of diversity indicators, including keynote speakers and conference organizers, carried out by Freire, Porcaro and Gómez (2021) for consecutive years of NeurIPS, RecSys and ICML (2017-2020). Their study shows the efforts of these AI conferences to balance gender among keynote speakers, reflected as well in recent conferences such as IJCAI 2023 where the list of 9 invited speakers included researchers from diferente genres, geographical origins and organization types.[5] In addition, Freire et all. (2021) found out that women are more present into organizing committees than as authors, due to the fact that those conferences are as well balancing gender among organizers for instance. This reflects that there is still a need to assess and foster diversity into AI scientific production.

[5] https://ijcai-23.org/invited-speakers/

2 Methodology

2.1 Selected scientific conferences

For this study we consider four top transversal international venues in AI and Machine Learning: AAAI and IJCAI as general AI conferences and ICML, and NeurIPS as ML counterparts in the period 2007-2023. We added ECAI and ECML/PKDD as providing the EU perspective. Finally, we consider recommender systems as an application domain relevant for the EU Digital Services Act. The selected six conferences are presented in the following sections.

2.1.1 International Joint Conference on Artificial Intelligence (IJCAI)

The International Joint Conferences on Artificial Intelligence is defined as a non-profit corporation founded in California, in 1969, with the goal of carrying out scientific and educational activities, with a focus on scientific publications in proceedings, books, videos and other education material. IJCAI hosts a series of conferences and the AI Journal.

Conference topics include all aspects of AI, with a focus on novel research problems, AI techniques used in different domains. The inclusion of studies in cross-discipline boundaries and the definition of several special tracks such as AI for Good, AI the Arts and Creativity, and Human-Centred AI in the last editions[6] reflect the current evolution of the AI field from a fully technical domain towards a more interdisciplinary research field.

Since 2016, IJCAI conferences are held annually and location is rotating from different geographical areas (America, EU and Asia-Pacific). In editions of IJCAI that take place in Europe, IJCAI is co-located with the European Conference on Artificial Intelligence (ECAI), considered in this study as well.

2.1.2 Association for the Advancement of Artificial Intelligence conference (AAAI)

AAAI is the annual conference of the Association for the Advancement of Artificial Intelligence.[7] The conference started in 1980 hosted by Stanford University, has been organized annually, and is designed as a major forum on research on AI. The conference takes place in North-America. The current topics[8] include specific tracks on deployed highly innovative applications of AI, emerging applications of AI, deployed innovative tools for enabling AI applications, innovative inter-disciplinary AI integration, and AI incidents and best practices.

2.1.3 International Conference on Machine Learning (ICML)

The International Conference on Machine Learning[9] is recognized as one of the most relevant conferences in machine learning. Its first edition took place as a workshop in 1980 in Pittsburgh, US and the conference is organized annually. Its location changes in the different editions covering different geographical areas in the world (e.g. ICML 2024 in Vienna, Austria, ICML 2025 in Vancouver, Canada and ICML 2026 in Seoul, Korea)[10]. The conference topics span different areas, such as general ML, deep learning, learning theory, optimization, probabilistic inference, trustworthy ML and its application to different domains from healthcare to climate science.[11]

[6] https://ijcai24.org/call-for-papers/
[7] https://aaai.org/conference/aaai/
[8] https://aaai.org/aaai-conference/iaai-24-program/
[9] https://icml.cc/
[10] https://en.wikipedia.org/wiki/International_Conference_on_Machine_Learning
[11] https://icml.cc/Conferences/2024/CallForPapers

2.1.4 Conference on Neural Information Processing Systems (NeurIPS)

The Conference and Workshop on Neural Information Processing Systems was setup in 1986 as a machine learning and computational neuroscience conference held annually.[12,13] Until 2000 the conference was held in Denver, US, and since then it has been held in different countries mainly in Canada, US and twice in Spain.

The call for paper 14 emphasizes the interdisciplinarity of the conference, bringing together researchers from machine learning, neuroscience, statistics, optimization, computer vision, natural language processing, life sciences, natural sciences, social sciences, as well as other related fields. Topics of interest include applications, deep learning, evaluation, general ML and ML for different domains, including social and economic aspects such as fairness, privacy or safety.

2.1.5 European Conference on Artificial Intelligence (ECAI)

The European Conference on Artificial Intelligence is one of the main activities of the European Association for Artificial Intelligence EurAI.[15] The Association is composed of active scientific associations in European Countries concerned with artificial intelligence.

The ECAI conference was organize on a biannual basis conference until 2023, having one every two editions in conjunction with IJCAI, as mentioned in Section 2.1.1. Since 2023 it is an annual conference. In 2024, ECAI is hosting its 50th edition.[16] The call for papers is broad and includes all relevant aspects of AI research, having a strong technical focus but, similarly to IJCAI, incorporating interdisciplinary considerations, e.g. *fairness, ethics and trust*, *humans in AI* or *multidisciplinary topics* in the call for papers.[17]

2.1.6 European Conference on Machine Learning / Practice of Knowledge Discovery in Databases (ECML/PKDD)

The European Conference on Machine learning (ECML) and Practices of Knowledge Discovery in Databases (PKDD) were two relevant European conferences that ran separately during the 1990s, until they merged in 2001 into a single yearly event with a common program[18]. Since then, the conference has taken place in multiple European countries. The conference calls for contributions in all fields of Machine Learning, Knowledge Discovery, and Data Mining and is currently the largest European event dedicated to these topics.

2.1.7 ACM Conference on Recommender Systems (RecSys)

The ACM Conference on Recommender Systems[19] is the most relevant international conference related to recommender systems. RecSys started in 2007 and is currently organized annually in locations originally between North America, Asia and Europe. Given the recent development in the field, it has a strong AI focus, including aspects such as the use of natural language processing as part of recommender systems and the incorporation of machine learning approaches in recommendation algorithms.[20]

[12] https://proceedings.neurips.cc//
[13] https://en.wikipedia.org/wiki/Conference_on_Neural_Information_Processing_Systems
[14] https://neurips.cc/Conferences/2023/CallForPapers
[15] https://www.eurai.org/
[16] https://www.ecai2024.eu/
[17] https://www.ecai2024.eu/calls/main-track
[18] https://ecmlpkdd.org/
[19] https://recsys.acm.org
[20] https://recsys.acm.org/recsys24/call/

2.2 Data gathering and processing

We benefitted from public data available at SCOPUS where we **gathered** the following information for each paper published in the conference proceedings: authors (names and IDs), year, URL, affiliation, keywords and correspondence address.

Data was **processed** to obtain from each author three features relevant for monitoring diversity: estimated gender, affiliation's country and type of organization, according to the following categories and procedures. Personal data was then discarded for further processing.

- Name-based gender information was derived using Namsor.[21]
- Country information was derived from the correspondence address, as country is usually explicitly mentioned.
- Affiliations were classified according to the Research Organisation Registry (ROR),[22] a dataset of information of the majority of entities in the research community in several fields. ROR establishes 8 different affiliation types:
    - *Education*: A university or similar institution involved in providing education and educating/employing researchers.
    - *Healthcare*: A medical care facility such as hospital or medical clinic. Excludes medical schools, which should be categorized as "Education".
    - *Company*: A private for-profit corporate entity involved in conducting or sponsoring research.
    - *Archive*: An organization involved in stewarding research and cultural heritage materials. Includes libraries, museums, and zoos.
    - *Non-profit*: A non-profit and non-governmental organization involved in conducting or funding research.
    - *Government*: An organization that is part of or operated by a national or regional government and that conducts or supports research.
    - *Facility*: A specialized facility where research takes place, such as a research centre, institute, or any other dedicated research institution.
    - *Other*: any organization that does not fit the categories above.

It is important to note that each author is considered only once, even if they contribute to different papers in a given conference. From the extracted data, we compute a series of indicators, summarized in the following section. Given the sensitivity of the information as connected to personal data, the project follows a minimization procedure for personal data, so only aggregated data is available for further analysis.

Finally, it is important to note that the quality of the paper metadata is not consistent across conferences and editions (e.g. past editions tend to be more problematic). The most prominent problems were related to the affiliation field, which impacts the extracted country of affiliation and the type of affiliation. While we corrected the most frequent problems in the data collection phase, we note that a considerable amount of noise remains in the final datasets. However, by manually correcting some cases, we verify that although this noise could have some interference in a fine-grained analysis, it does not significantly change the overview and results we present in this report.

[21] https://namsor.app/
[22] https://ror.org/

2.3 Indicators

The divinAI project has been working on a set of indicators for diversity, which are based on existing measuring the heterogeneity of elements in a given set in relation to a class that takes different values, such as species in an eco-environment, or ethnicity in a population. As explained in (Hupont et al., 2023), our project considers three basic components of diversity as proposed in the scientific literature: Variety, which refers to the number of classes in a set; Balance, which refers to the evenness of the distribution of elements across classes; and Disparity, which refers to the degree of difference or distance between all classes. Indicators of balance would be lower if a larger share of the elements are concentrated in only a few classes. We consider that each component is necessary but individually insufficient for diversity, as we expect higher levels of diversity as classes increase, as the distribution of elements between classes become more even or if the difference (or distance) between classes becomes wider. In this report, we present the indicators described as follows.

2.3.1 GDI: Gender diversity index

This indicator refers to the distribution of the research community involved in a scientific conference with respect to gender. We simplify the gender dimension in three classes: "male", "female" and "other", which may incorporate "non-binary" or unknown. In terms of indicators, we compute both the share of each class (in % of authors) and the Shannon evenness by means of the Pielou diversity index as defined in (Freire et al. 2021).

$$GDI = \quad - \frac{\sum_{\{i=1\}}^{S} p_i \ln(p_i)}{\ln(S)}$$

Equation 1. Gender diversity index (GDI)

Where p is the proportion of authors for a particular class i divided by the total number of classes S. The index takes a value between 0 and 1, meaning 1 the highest evenness.

2.3.2 GeoDI: Geographic diversity index

This indicator relates to the distribution of the research community in terms of geographical location, where we consider the place of employment or affiliation as opposed to the national origin of researchers. Considering S as the number of countries present by each scientific community, this indicator measures the richness together with the evenness in country distribution. For this dimension, we consider both the distribution of countries (in %) and the weighted average of the Shannon Index, and is further described in (Freire et al. 2021).

$$GeoDI = \quad - \frac{\sum_{\{i=1\}}^{S} p_i \ln(p_i)}{3.5}$$

Equation 2. Geographic diversity index (GeoDI)

Where p is the proportion of individuals of one particular class divided by the total number of classes S. The typical values for the Shannon index are between 1.5 and 3.5 in most diversity studies being rarely greater than 4. Therefore, GeoDI is normalized between 0 and 1 dividing by 3.5.

2.3.3 BDI: Business diversity index

This indicator represents the distribution of researchers with respect to different type of organizations, which provide an idea of funding sources and objectives definition. divinAI considers eight different classes (S = 8) in the business dimension: "education", "healthcare", "company", "archive", "nonprofit", "government", "facility" and "other". For this dimension, we compute both the data distribution in terms of type of organization (in %) and an indicator based on Shannon evenness by means of the Pielou diversity index as defined in (Freire et al., 2021).

$$BDI = \quad - \frac{\sum_{\{i=1\}}^{S} p_i \ln(p_i)}{\ln(S)}$$

Equation 3. Business diversity index (BDI)

Where p is the proportion of individuals of one particular class found divided by the total number of classes. The index takes a value between 0 and 1, meaning 1 the highest evenness. However, it is worthy to note here that the selection of a comprehensive set of eight classes, where more than half of them are rare in terms of research affiliations, heavily pushes this index down.

2.3.4 CDI: Conference diversity index

Finally, we compute a global conference diversity index for each scientific conference considering gender diversity index, geographic diversity index and business diversity index using the following weights:

$$CDI = \frac{GDI + GeoDI + BDI}{3}$$

Equation 4. Conference diversity index (CDI)

3 Results

3.1 General observations

Figure 1 provides the overall distribution of the Conference Diversity Index (CDI), Gender Diversity Index (GDI), Geographical Diversity Index (GeoDI), and Business Diversity Index (BDI) over the considered period spanning 16 years.

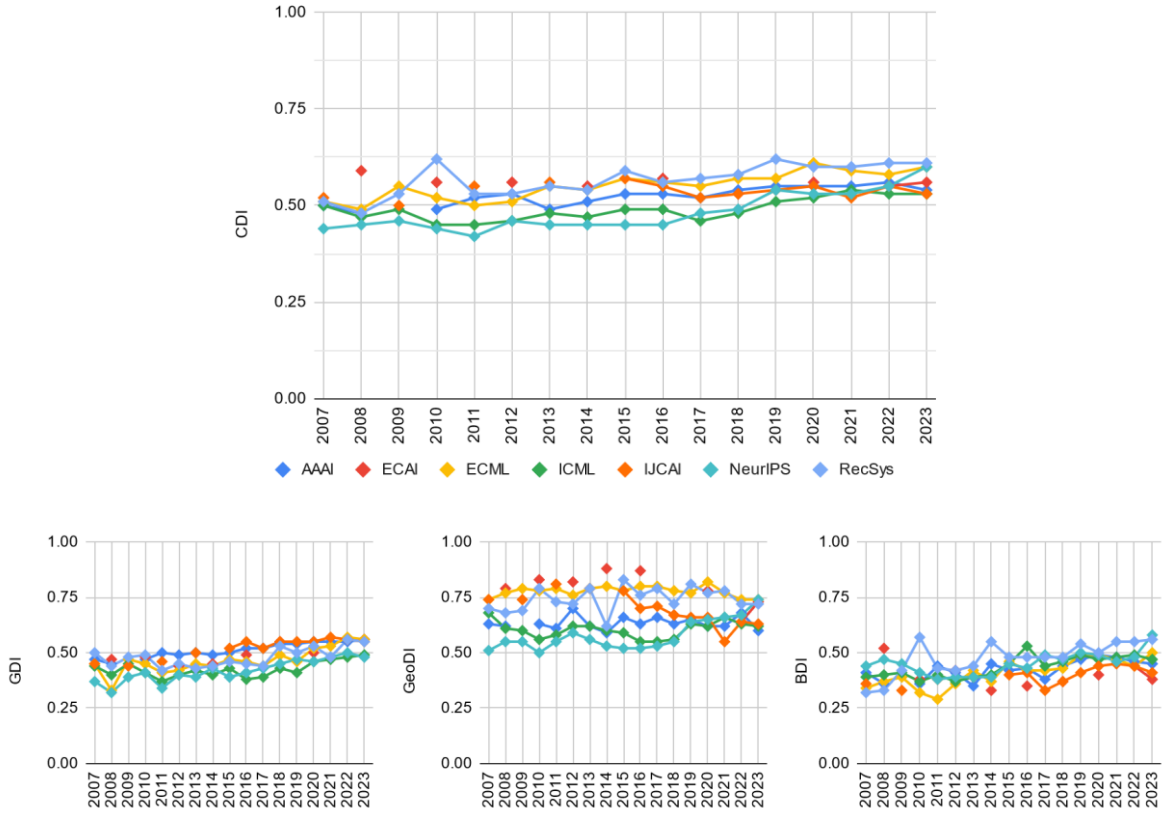

Figure 1. Conference Diversity Index (top), Gender Diversity Index (bottom-left), Geographical Diversity Index (bottom-centre), and Business Diversity Index (bottom-right) distributions. Source: Own Elaboration

We observe that the CDI values are centred on 0.5, and a slight increasing behaviour through time. We note slight differences between conferences, being RecSys, ECAI and ECML among the ones with a higher overall diversity. NeurIPS and ICML seem to be the less diverse ones. In order to better understand the origin of these small differences, we need to look at the individual diversity criteria, which are commented hereafter.

Regarding the **gender** dimension, Figure 2 summarizes the evolution of the proportion of female authors publishing in the considered conferences, which is reflected in the values of the gender diversity indicator.

Table 2 presents the average and standard deviation of this indicator for the considered period and scientific events.

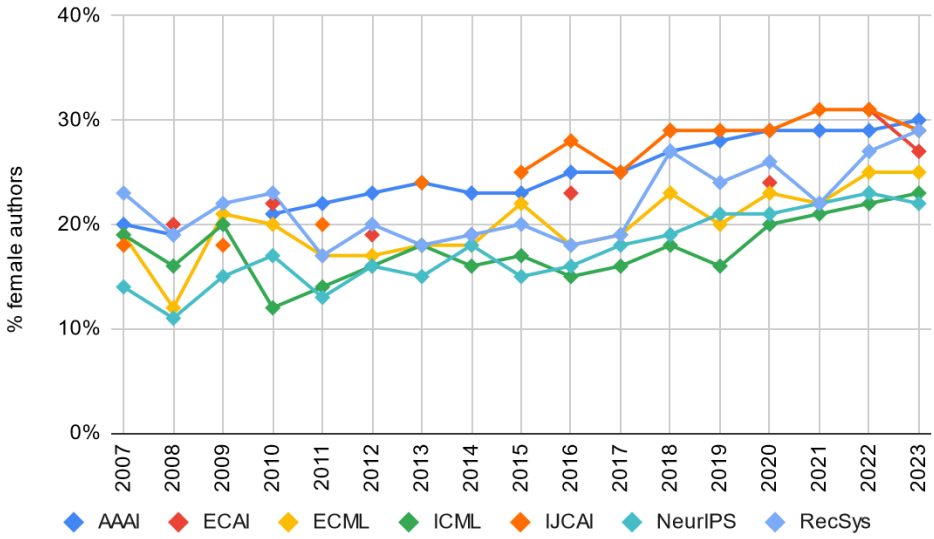

Figure 2. Proportion of female authors in the analysed conferences.
Source: Own elaboration

Table 2. Average and Standard deviation of the Gender Diversity Index (GDI) along the different editions of the selected conferences.

GDI	AAAI	ECAI	ECML / PKDD	ICML	IJCAI	NeurIPS	RecSys
Avg (std)	0.51 (±0.03)	0.50 (±0.04)	0.47 (±0.06)	0.43 (±0.03)	0.52 (±0.04)	0.42 (±0.05)	0.48 (±0.04)

Source: JRC data.

We observe that the proportion of female researchers is between 0.1 and 0.31, with machine learning conferences, especially NeurIPS and ICML, situated in the lower range, AI conferences AAAI, IJCA and ECAI in the upper bound and RecSys and ECML/PKDD in the middle, generally with a small tendency to increase along the years. In the last years, we have witnessed the definition of different strategies to improve gender diversity in the AI field, including affinity groups, specific conference chairs, mentoring programmes and other support schemes, as summarized in Section 1.1. However, the poor values of these indicators, which is linked as well to the overall presence of women in technology, show the need to continue working towards a greater gender diversity in the AI field by assessing and reinforcing the impact of current initiatives on authorship.

The second considered dimension is the geographical origin of authors in terms of affiliation, which is reflected in the geographic diversity index (GeoDI).

Figure 3 presents the temporal evolution of GeoDI in the considered conferences. We observe that the evolution of the indicator is quite stable along the years, with small differences between conferences.

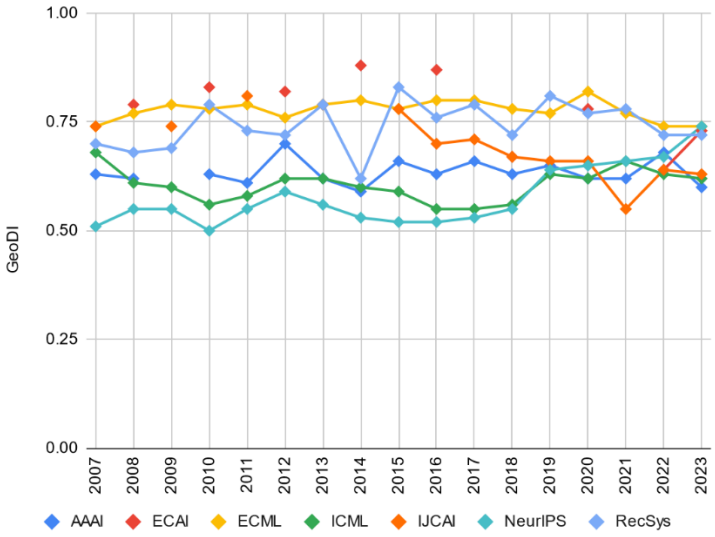

Figure 3. Distribution of GeoDI within the analysed conferences.
Source: Own elaboration

In terms of geographical areas, we illustrate in Figure 4 the proportion of authors that come from US, EU (we consider current EU Member States[23]) and China in the selected scientific venues. These three regions cover an average of 75% of authors in ECML/PKDD, 73% of authors in RecSys, 70% of authors of AAAI, ECAI and NeurIPS, 67% in ICML and IJCAI, being the remaining author proportion shared among other countries and geographical areas. It is worthy to note the presence of researchers from China and the EU in AAAI, which is organized in North America. In the same way, we see the influence of researchers from the US and China in ECAI and ECML/PKDD, which are European scientific events. This reflects the internationalisation of the AI scientific field and the link between EU and international conferences. For instance ECAI coordinates with IJCAI to allow rejected papers from IJCAI to submit to ECAI their original reviews together with a statement about how the paper was revised.

If we look specifically to general AI conferences (AAAI, IJCAI and ECAI), we observe a strong proportion of US authors, and an increase in the participation of Chinese researchers in the last years. In particular, for ECAI, we observe that, while the majority of authors are from the EU, recent editions have strong proportion of researchers from China as well, with a major increase since 2016. This can be due, on the one hand, to the increase in research collaborations between Chinese researchers and those from other countries, and, on the other hand, to the connection mentioned above between ECAI and IJCAI review procedure.

Considering Machine Learning conferences, our data shows the same tendency bias towards US researchers in ICML and NeurIPS and a recent increase in the representation of China, especially in recent years, since 2021. In ECML we observe the same rapid increase in the proportion of authors affiliated with Chinese institutions as we see in ECAI, although, contrary to ECAI, the majority of authors up to 2023 still come from EU-based institutions.

Finally, RecSys country data shows a more balanced distribution between US and EU researchers, which are the two geographical areas leading lead in terms of author participation.

[23] This analyses includes current EU Member States, including Croatia (starting EU membership in 2013) and excluding UK (ending its EU membership in 2016)

Figure 4. Overview of the proportion of authors from AI Conferences in US, China and EU.
Source: Own elaboration

Regarding Business Diversity, the distribution of institutions where authors are employed is illustrated in the next Figures. We observe that the selected conferences are very similar

in terms of BDI, ranging from 0.3 to 0.6, with no noteworthy differences among scientific venues. If we check the raw data including the proportion of authors in different type of institutions, we observe a high proportion of academic institutions involved (education and research centres, represented by the *facility* category) and a recent rise of industry researchers, especially in Machine Learning and Recommender Systems conferences (ICML, NeurIPS, RecSys), compared to broader AI conferences. This reflects an increased industry focus on these areas.

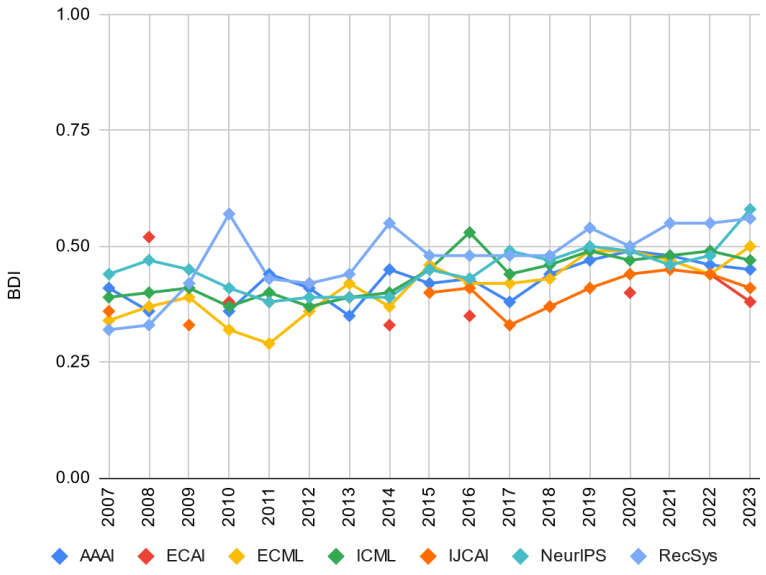

Figure 5. Business Diversity Index (BDI) evolution.
Source: Own elaboration

Figure 6. Overview of the distribution of authors per institution.
Source: Own elaboration

3.2 DivinAI dashboards

This report is accompanied by the raw data used for the plots, presented in Annex, plus a series of online dashboard, which present precise indicators in terms of individual countries, distribution and editions in the period 2007 until 2023. The next figures provide some snapshots of the dashboards for AAAI conference, which can be found in

https://web.jrc.ec.europa.eu/dashboard/DIVINAI

For a particular conference, AAAI in 2007, we provide the following visualizations:

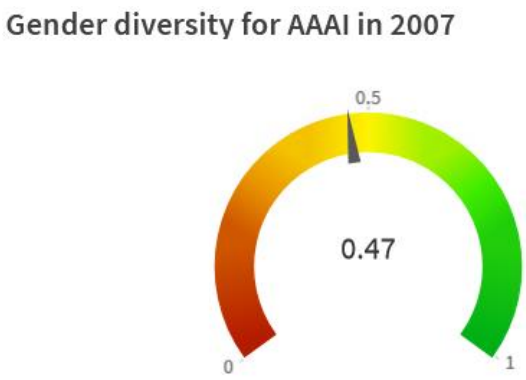

Figure 7. Visualization of the Conference Diversity Index (CDI) for AAAI 2007.
Source: Own elaboration

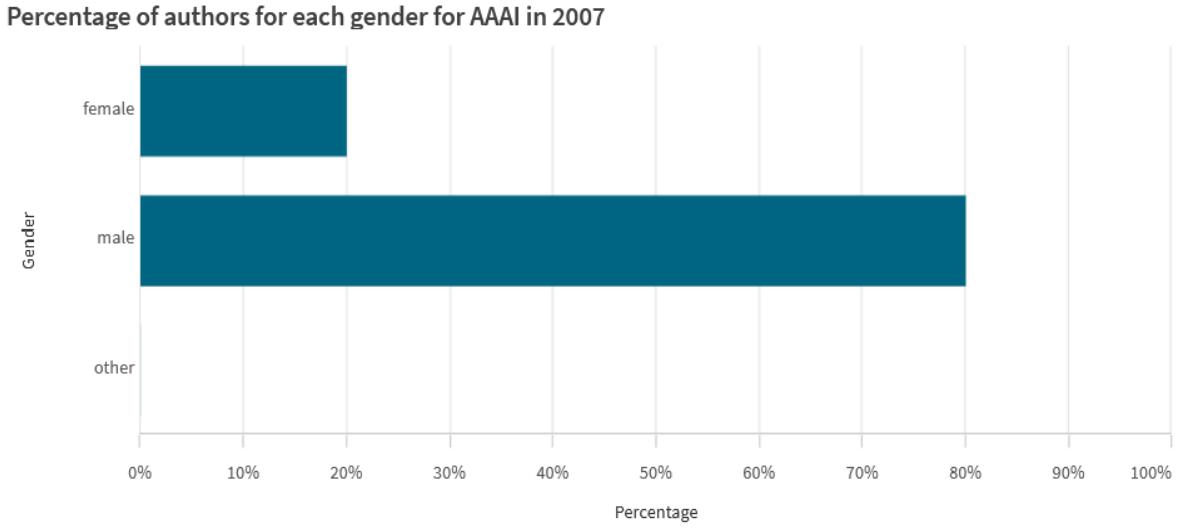

Figure 8. Visualization of the gender distribution of authors for AAAI 2007.
Source: Own elaboration

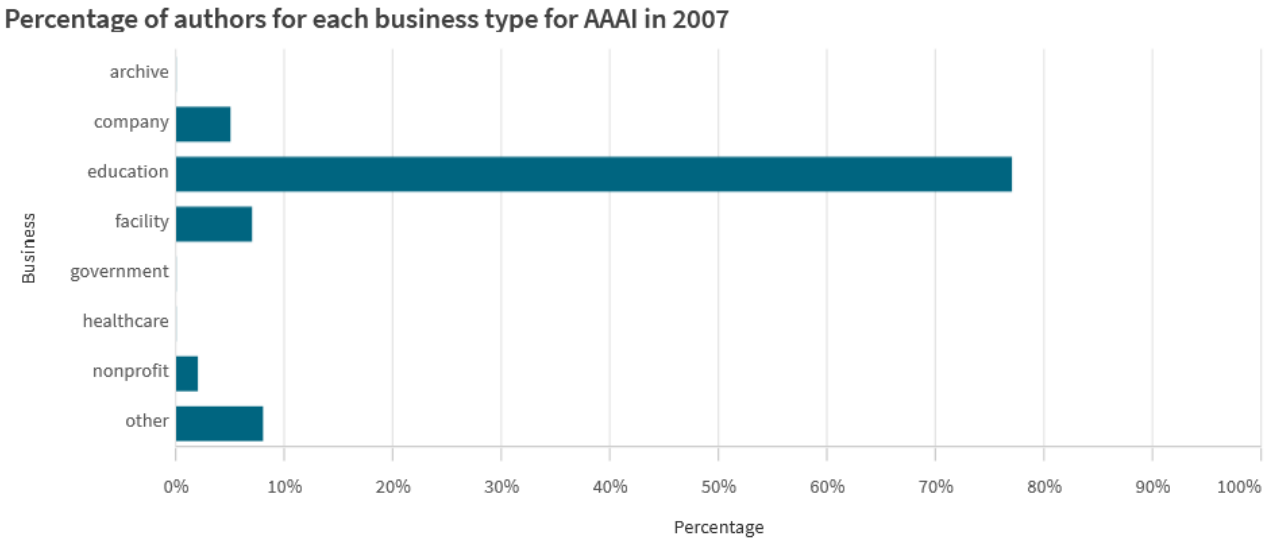

Figure 9. Visualization of the distribution of authors in different institutions for AAAI 2007.
Source: Own elaboration

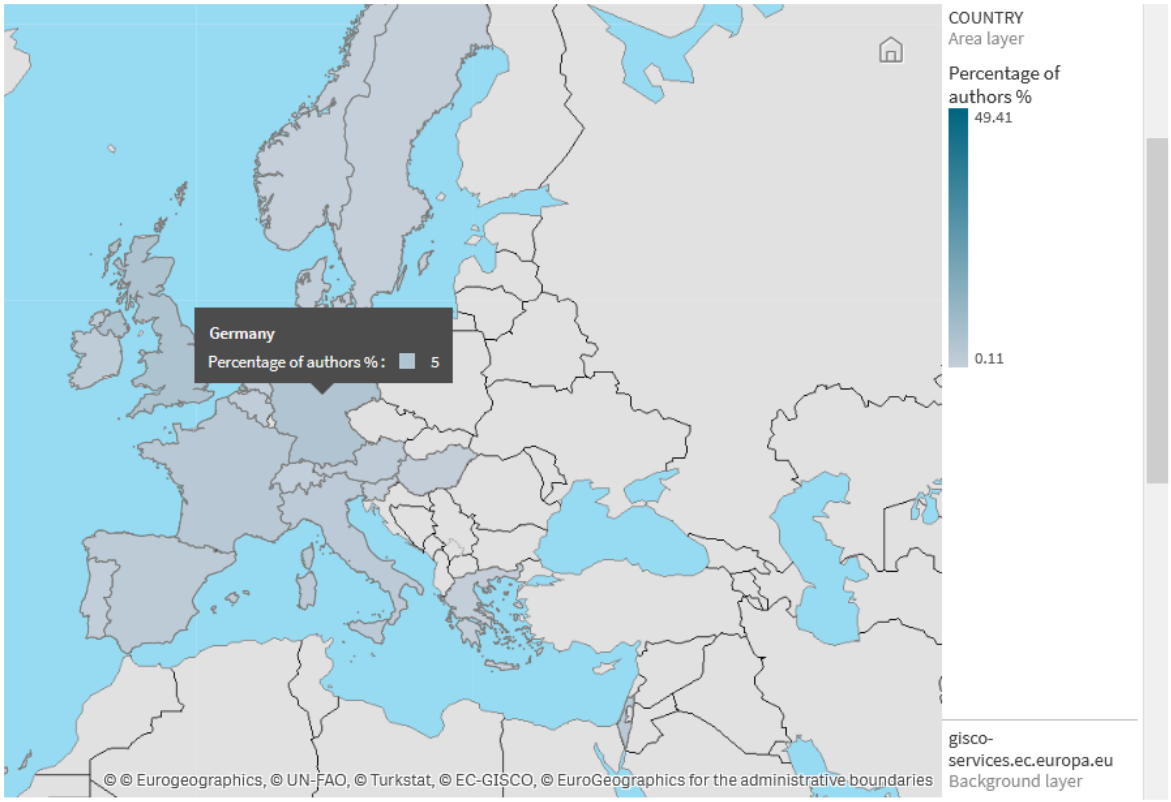

Figure 10. Visualization of the country distribution of authors for AAAI 2007.
Source: Own elaboration

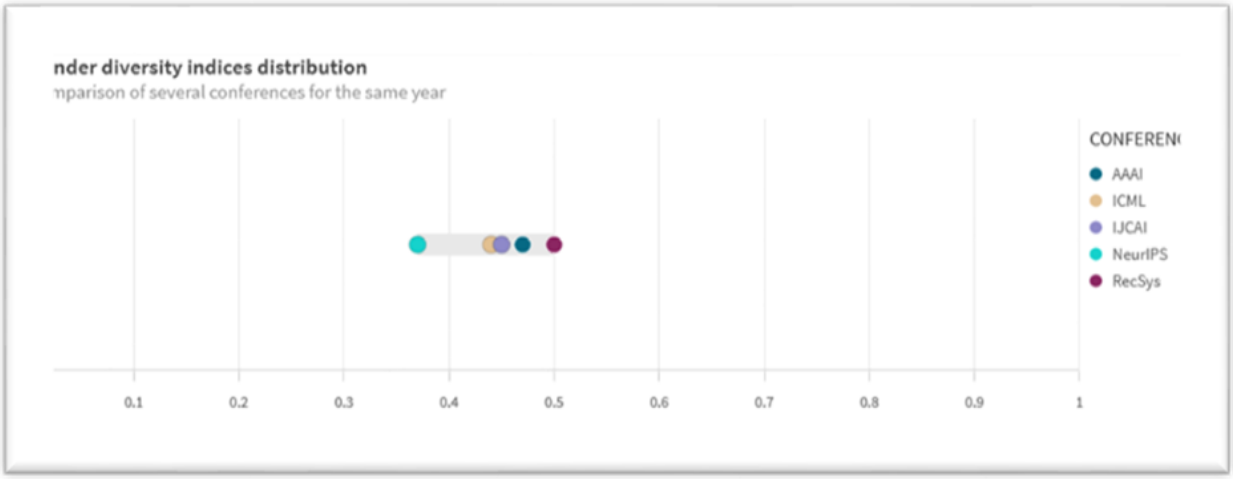

Figure 11. Visualization of the distribution of gender diversity index (GDI)
Source: Own elaboration

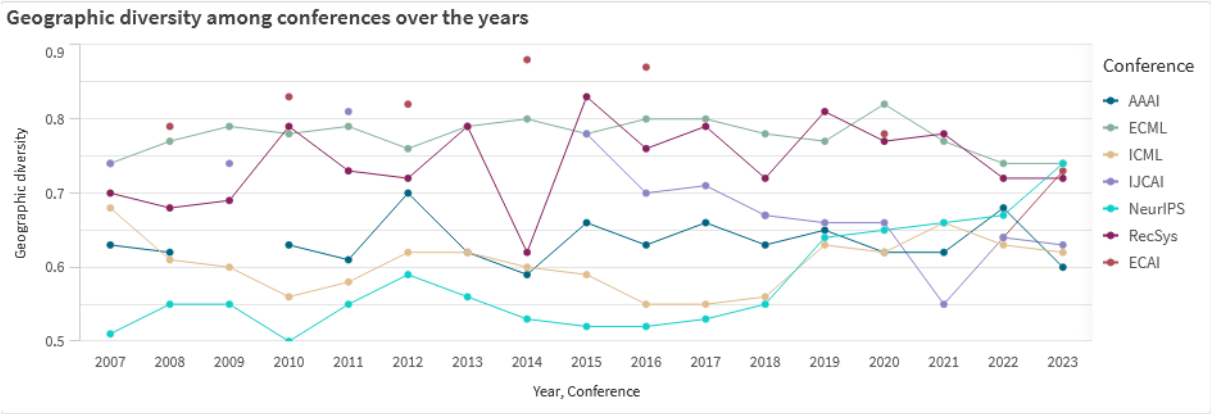

Figure 12. Visualization of the temporal evolution of geographic diversity index (GeoDI) among conferences
Source: Own elaboration

4 Conclusions

This reports provides an overview of diversity indicators for a set of AI conferences in the period from 2007 to 2023, in the context of the divinAI project. We observe that, despite recent diversity initiatives in the AI field linked to the selected conferences, diversity indicators have only slightly increased. We also note that different research communities and conferences show slightly different behaviours, with lower diversity indicators found in the selected machine learning conferences.

Regarding the different dimensions of diversity, our data reflects the low presence of women in the AI field, the dominant presence of researchers from the EU, US and China in the selected conferences, and a leading role of universities and research centers, with a notable presence of industry in the selected machine learning venues.

These indicators need to be analyzed as linked to broader considerations of diversity in the broader research context, such as the low presence of women in the technological field or the recent consolidation of research exchanges between the EU, US and China. In addition, there are some diversity aspects which are interlinked, such as the relationship between country presence and gender or institution distributions.

Despite of these limitations, we conclude that the monitoring of diversity by relevant indicators as those proposed by divinAI are relevant both for the research community (Prabhakaran et al. 2022) and for related policy considerations (Young, Wajcman and Sprejer, 2021) as input to the design of evidence based policies.

Future work in the divinAI project will be devoted to improve the methodological foundations of the indicators in terms of evaluation of reliability and robustness, link with the base rates, and the development of a relevant composite indicator in line with relevant methodologies and tools (Nardo et al., 2008).

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List of abbreviations and definitions

Abbreviations	Definitions
AAAI	Association for the Advancement of Artificial Intelligence
IJCAI	International Joint Conference on Artificial Intelligence
ICML	International Conference on Machine Learning
NeurIPS	Neural Information Processing Systems
RecSys	Association for Computing Machinery (ACM) Recommender Systems
ECAI	European Conference on Artificial Intelligence
ECML/PKDD	European Conference on Machine Learning and Practice of Knowledge Discovery in Databases
GDI	Gender diversity index
GeoDI	Geographic diversity index
BDI	Business diversity index
CDI	Conference diversity index

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Appendix

Table 3. Most relevant data for AAAI including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,8	0,2	0,47	0,49	0,04	0,18	0,63	0,05	0,77	0,07	0	0	0,02	0,08	0,41	0,5
2008	0,81	0,19	0,45	0,48	0,07	0,14	0,62	0,05	0,81	0,05	0,01	0	0,02	0,07	0,36	0,48
2009																
2010	0,79	0,21	0,47	0,46	0,11	0,14	0,63	0,07	0,81	0,06	0,01	0	0,01	0,03	0,36	0,49
2011	0,78	0,22	0,5	0,49	0,11	0,12	0,61	0,05	0,74	0,07	0,02	0	0,01	0,11	0,44	0,52
2012	0,77	0,23	0,49	0,4	0,1	0,18	0,7	0,06	0,77	0,07	0,01	0	0,01	0,08	0,41	0,53
2013	0,76	0,24	0,5	0,44	0,17	0,15	0,62	0,05	0,81	0,06	0	0	0,01	0,07	0,35	0,49
2014	0,77	0,23	0,49	0,51	0,05	0,16	0,59	0,04	0,74	0,04	0,02	0,01	0,01	0,13	0,45	0,51
2015	0,77	0,23	0,5	0,42	0,15	0,12	0,66	0,05	0,77	0,09	0,02	0	0,01	0,07	0,42	0,53
2016	0,75	0,25	0,52	0,42	0,21	0,1	0,63	0,05	0,75	0,1	0,01	0	0,01	0,07	0,43	0,53
2017	0,75	0,25	0,52	0,35	0,25	0,11	0,66	0,06	0,8	0,08	0,01	0	0,01	0,04	0,38	0,52
2018	0,73	0,27	0,54	0,35	0,29	0,08	0,63	0,08	0,74	0,08	0,01	0	0,01	0,08	0,44	0,54
2019	0,72	0,28	0,54	0,26	0,33	0,07	0,65	0,08	0,72	0,08	0,01	0	0,01	0,1	0,47	0,55
2020	0,71	0,29	0,55	0,24	0,3	0,06	0,62	0,1	0,7	0,07	0,01	0	0,01	0,12	0,49	0,55
2021	0,71	0,29	0,55	0,31	0,34	0,08	0,62	0,1	0,7	0,07	0,01	0	0	0,11	0,48	0,55
2022	0,71	0,29	0,55	0,22	0,31	0,09	0,68	0,08	0,72	0,06	0,01	0	0	0,12	0,46	0,56
2023	0,7	0,3	0,56	0,21	0,45	0,09	0,6	0,09	0,73	0,05	0,01	0	0	0,11	0,45	0,54
Average	0,75	0,25	0,51	0,38	0,21	0,12	0,63	0,07	0,76	0,07	0,01	0,00	0,01	0,09	0,43	0,52
Standard deviation	0,03	0,03	0,03	0,10	0,12	0,04	0,03	0,02	0,04	0,01	0,01	0,00	0,01	0,03	0,04	0,02

Source: Own elaboration.

Table 4. Most relevant data for ECAI including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007																
2008	0,8	0,2	0,47	0,02	0,01	0,56	0,79	0,02	0,59	0,05	0,01	0,01	0,02	0,29	0,52	0,59
2009																
2010	0,78	0,22	0,48	0,06	0,01	0,63	0,83	0,02	0,8	0,07	0,02	0	0,02	0,08	0,38	0,56
2011																
2012	0,81	0,19	0,44	0,08	0,01	0,66	0,82	0,03	0,75	0,07	0,03	0	0	0,11	0,42	0,56
2013																
2014	0,81	0,19	0,45	0,05	0,04	0,63	0,88	0,02	0,83	0,06	0,02	0	0,01	0,06	0,33	0,55
2015																
2016	0,77	0,23	0,49	0,09	0,12	0,47	0,87	0,03	0,83	0,06	0,01	0,01	0,01	0,05	0,35	0,57
2017																
2018	0,71	0,29	0,55	0,15	0,35	0,13	0,67	0,06	0,8	0,07	0,01	0	0,01	0,06	0,37	0,53
2019																
2020	0,76	0,24	0,5	0,09	0,3	0,38	0,78	0,03	0,77	0,07	0,01	0	0,01	0,11	0,4	0,56
2021																
2022	0,69	0,31	0,56	0,13	0,44	0,14	0,64	0,07	0,75	0,06	0,02	0	0	0,09	0,44	0,55
2023	0,73	0,27	0,56	0,1	0,38	0,27	0,73	0,03	0,8	0,06	0,02	0	0,02	0,06	0,38	0,56
Average	0,76	0,24	0,50	0,09	0,18	0,43	0,78	0,03	0,77	0,06	0,02	0,00	0,01	0,10	0,40	0,56
Standard deviation	0,04	0,04	0,04	0,04	0,17	0,20	0,08	0,02	0,07	0,01	0,01	0,00	0,01	0,07	0,05	0,02

Source: Own elaboration.

Table 5. Most relevant data for ECML/PKDD including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,81	0,19	0,45	0,27	0,07	0,4	0,74	0,05	0,81	0,09	0	0	0	0,01	0,34	0,51
2008	0,88	0,12	0,33	0,23	0,08	0,41	0,77	0,08	0,78	0,11	0	0	0	0,02	0,37	0,49
2009	0,79	0,21	0,47	0,25	0,11	0,36	0,79	0,04	0,78	0,12	0,01	0	0,01	0,03	0,39	0,55
2010	0,8	0,2	0,45	0,26	0,03	0,47	0,78	0,04	0,83	0,1	0,02	0	0	0,02	0,32	0,52
2011	0,83	0,17	0,41	0,22	0,03	0,45	0,79	0,04	0,84	0,09	0,02	0	0	0,01	0,29	0,5
2012	0,83	0,17	0,42	0,24	0,1	0,43	0,76	0,08	0,81	0,07	0,01	0,01	0,01	0,02	0,36	0,51
2013	0,82	0,18	0,45	0,24	0,12	0,45	0,79	0,1	0,74	0,12	0,02	0	0	0,01	0,42	0,55
2014	0,82	0,18	0,44	0,25	0,07	0,45	0,8	0,07	0,8	0,07	0,03	0	0	0,03	0,37	0,54
2015	0,78	0,22	0,47	0,24	0,04	0,44	0,78	0,14	0,72	0,08	0,01	0	0,01	0	0,46	0,57
2016	0,81	0,18	0,46	0,19	0,11	0,46	0,8	0,08	0,74	0,14	0,01	0	0	0,02	0,42	0,56
2017	0,81	0,19	0,44	0,25	0,08	0,43	0,8	0,12	0,75	0,07	0,01	0	0,02	0,03	0,42	0,55
2018	0,77	0,23	0,49	0,23	0,06	0,46	0,78	0,15	0,74	0,05	0,01	0,01	0	0,03	0,43	0,57
2019	0,8	0,2	0,46	0,19	0,05	0,5	0,77	0,12	0,7	0,1	0,02	0,01	0	0	0,49	0,57
2020	0,77	0,23	0,52	0,14	0,2	0,39	0,82	0,1	0,69	0,08	0,02	0	0	0,11	0,49	0,61
2021	0,77	0,22	0,53	0,2	0,19	0,34	0,77	0,09	0,69	0,06	0	0	0	0,15	0,47	0,59
2022	0,74	0,25	0,57	0,14	0,27	0,35	0,74	0,06	0,74	0,1	0,01	0	0,01	0,08	0,44	0,58
2023	0,74	0,25	0,56	0,14	0,3	0,34	0,74	0,1	0,69	0,07	0,01	0	0,01	0,12	0,5	0,6
Average	0,80	0,20	0,47	0,22	0,11	0,42	0,78	0,09	0,76	0,09	0,01	0,00	0,00	0,04	0,41	0,55
Standard deviation	0,03	0,03	0,06	0,04	0,08	0,05	0,02	0,03	0,05	0,02	0,01	0,00	0,01	0,04	0,06	0,03

Source: Own elaboration.

Table 6. Most relevant data for ICML including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,81	0,19	0,44	0,29	0,08	0,13	0,68	0,08	0,78	0,06	0,01	0	0	0,08	0,39	0,5
2008	0,84	0,16	0,4	0,46	0,04	0,14	0,61	0,09	0,76	0,07	0	0	0	0,07	0,4	0,47
2009	0,8	0,2	0,45	0,46	0,08	0,2	0,6	0,06	0,76	0,11	0,01	0	0	0,07	0,41	0,49
2010	0,86	0,12	0,41	0,53	0,03	0,16	0,56	0,07	0,8	0,05	0	0,01	0,01	0,06	0,37	0,45
2011	0,86	0,14	0,37	0,5	0,02	0,19	0,58	0,07	0,78	0,06	0,01	0,01	0,01	0,07	0,4	0,45
2012	0,84	0,16	0,4	0,46	0,03	0,17	0,62	0,06	0,8	0,05	0,01	0	0	0,06	0,37	0,46
2013	0,82	0,18	0,42	0,48	0,04	0,14	0,62	0,08	0,78	0,04	0,01	0	0,01	0,09	0,39	0,48
2014	0,84	0,16	0,4	0,5	0,06	0,11	0,6	0,09	0,78	0,05	0	0	0,01	0,07	0,4	0,47
2015	0,82	0,17	0,43	0,48	0,05	0,12	0,59	0,09	0,73	0,07	0,01	0	0	0,08	0,45	0,49
2016	0,85	0,15	0,38	0,56	0,03	0,12	0,55	0,11	0,64	0,05	0,02	0	0	0,16	0,53	0,49
2017	0,84	0,16	0,39	0,55	0,06	0,11	0,55	0,08	0,7	0,02	0,01	0	0	0,18	0,44	0,46
2018	0,82	0,18	0,43	0,53	0,06	0,12	0,56	0,08	0,69	0,03	0,01	0	0	0,17	0,46	0,48
2019	0,84	0,16	0,41	0,45	0,06	0,11	0,63	0,11	0,68	0,05	0,01	0	0,01	0,15	0,49	0,51
2020	0,8	0,2	0,46	0,43	0,07	0,1	0,62	0,12	0,69	0,03	0,01	0	0,01	0,14	0,47	0,52
2021	0,79	0,21	0,47	0,41	0,11	0,11	0,66	0,14	0,68	0,04	0,01	0	0	0,12	0,48	0,54
2022	0,78	0,22	0,48	0,43	0,16	0,13	0,63	0,12	0,69	0,05	0,01	0,01	0,01	0,11	0,49	0,53
2023	0,77	0,23	0,49	0,44	0,16	0,12	0,62	0,14	0,7	0,04	0,01	0	0,01	0,11	0,47	0,53
Average	0,82	0,18	0,43	0,47	0,07	0,13	0,60	0,09	0,73	0,05	0,01	0,00	0,00	0,11	0,44	0,49
Standard deviation	0,03	0,03	0,03	0,06	0,04	0,03	0,04	0,02	0,05	0,02	0,00	0,00	0,00	0,04	0,05	0,03

Source: Own elaboration.

Table 7. Most relevant data for IJCAI including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,82	0,18	0,45	0,34	0,04	0,29	0,74	0,04	0,81	0,05	0,02	0	0	0,08	0,36	0,52
2008																
2009	0,82	0,18	0,44	0,33	0,08	0,24	0,74	0,04	0,84	0,05	0,01	0	0,02	0,04	0,33	0,5
2010																
2011	0,8	0,2	0,46	0,24	0,11	0,3	0,81	0,05	0,79	0,08	0,02	0	0	0,06	0,38	0,55
2012																
2013	0,76	0,24	0,5	0,2	0,2	0,26	0,79	0,04	0,8	0,08	0,02	0,01	0,01	0,06	0,39	0,56
2014																
2015	0,75	0,25	0,52	0,22	0,23	0,24	0,78	0,05	0,79	0,07	0,03	0	0,01	0,05	0,4	0,57
2016	0,72	0,28	0,55	0,29	0,26	0,17	0,7	0,06	0,78	0,08	0,02	0	0,01	0,05	0,41	0,55
2017	0,75	0,25	0,52	0,23	0,3	0,16	0,71	0,05	0,83	0,06	0,02	0	0	0,04	0,33	0,52
2018	0,71	0,29	0,55	0,15	0,35	0,13	0,67	0,06	0,8	0,07	0,01	0	0,01	0,06	0,37	0,53
2019	0,71	0,29	0,55	0,22	0,38	0,13	0,66	0,08	0,76	0,07	0,01	0	0	0,07	0,41	0,54
2020	0,71	0,29	0,55	0,14	0,42	0,13	0,66	0,08	0,74	0,08	0,01	0	0,01	0,08	0,44	0,55
2021	0,69	0,31	0,57	0,08	0,25	0,1	0,55	0,09	0,74	0,06	0,01	0	0	0,09	0,45	0,52
2022	0,69	0,31	0,56	0,13	0,44	0,14	0,64	0,07	0,75	0,06	0,02	0	0	0,09	0,44	0,55
2023	0,71	0,29	0,55	0,15	0,48	0,15	0,63	0,07	0,77	0,07	0,01	0	0,01	0,07	0,41	0,53
Average	0,74	0,26	0,52	0,21	0,27	0,19	0,70	0,06	0,78	0,07	0,02	0,00	0,01	0,06	0,39	0,54
Standard deviation	0,04	0,04	0,04	0,08	0,13	0,07	0,07	0,02	0,03	0,01	0,01	0,00	0,01	0,02	0,04	0,02

Source: Own elaboration.

Table 8. Most relevant data for NeurIPS including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,86	0,14	0,37	0,55	0,01	0,15	0,51	0,06	0,75	0,08	0,01	0	0,02	0,07	0,44	0,44
2008	0,89	0,11	0,32	0,54	0,02	0,15	0,55	0,09	0,73	0,07	0,01	0,01	0,01	0,09	0,47	0,45
2009	0,85	0,15	0,39	0,55	0,03	0,17	0,55	0,09	0,74	0,07	0,02	0	0,01	0,07	0,45	0,46
2010	0,83	0,17	0,41	0,59	0,03	0,16	0,5	0,06	0,79	0,07	0,02	0,01	0,01	0,04	0,41	0,44
2011	0,87	0,13	0,34	0,54	0,02	0,19	0,55	0,04	0,8	0,06	0,02	0,01	0,01	0,06	0,38	0,42
2012	0,84	0,16	0,4	0,52	0,04	0,18	0,59	0,06	0,79	0,05	0,02	0	0	0,08	0,39	0,46
2013	0,85	0,15	0,39	0,54	0,03	0,17	0,56	0,07	0,79	0,06	0,01	0	0,01	0,06	0,39	0,45
2014	0,82	0,18	0,43	0,57	0,04	0,14	0,53	0,08	0,79	0,05	0,02	0	0	0,05	0,39	0,45
2015	0,85	0,15	0,39	0,59	0,03	0,13	0,52	0,11	0,74	0,05	0,01	0	0,02	0,07	0,45	0,45
2016	0,84	0,16	0,41	0,6	0,05	0,13	0,52	0,12	0,74	0,04	0,01	0	0,01	0,08	0,43	0,45
2017	0,82	0,18	0,43	0,59	0,06	0,11	0,53	0,1	0,7	0,05	0,01	0	0,01	0,13	0,49	0,48
2018	0,81	0,19	0,45	0,55	0,09	0,1	0,55	0,08	0,7	0,05	0,01	0	0,01	0,15	0,47	0,49
2019	0,79	0,21	0,47	0,39	0,08	0,11	0,64	0,09	0,67	0,05	0,02	0	0,01	0,17	0,5	0,54
2020	0,79	0,21	0,46	0,34	0,09	0,1	0,65	0,11	0,68	0,04	0,01	0	0,01	0,16	0,49	0,53
2021	0,78	0,22	0,48	0,41	0,15	0,11	0,66	0,11	0,71	0,04	0,01	0	0,01	0,13	0,46	0,53
2022	0,77	0,23	0,5	0,34	0,21	0,1	0,67	0,13	0,68	0,04	0,01	0	0,01	0,13	0,48	0,55
2023	0,73	0,25	0,62	0,35	0,22	0,09	0,65	0,12	0,7	0,05	0,01	0	0,01	0,11	0,48	0,58
Average	0,82	0,18	0,43	0,50	0,07	0,13	0,57	0,09	0,74	0,05	0,01	0,00	0,01	0,10	0,45	0,48
Standard deviation	0,04	0,04	0,07	0,09	0,06	0,03	0,06	0,02	0,04	0,01	0,00	0,00	0,00	0,04	0,04	0,05

Source: Own elaboration.

Table 9. Most relevant data for Recsys including proportions for relevant classes and diversity indicators.

Year	Male	Female	**GDI**	US	China	EU	**GeoDI**	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	**BDI**	**CDI**
2007	0,77	0,23	0,5	0,28	0	0,32	0,7	0,15	0,79	0,05	0	0	0	0,01	0,32	0,51
2008	0,81	0,19	0,44	0,32	0,11	0,38	0,68	0,08	0,8	0,1	0	0	0	0,02	0,33	0,48
2009	0,78	0,22	0,48	0,3	0	0,38	0,69	0,14	0,73	0,1	0	0	0,02	0,02	0,42	0,53
2010	0,77	0,23	0,49	0,21	0,05	0,5	0,79	0,13	0,59	0,16	0,01	0	0,01	0,1	0,57	0,62
2011	0,83	0,17	0,42	0,26	0,11	0,34	0,73	0,16	0,72	0,04	0	0	0,01	0,05	0,43	0,53
2012	0,81	0,2	0,45	0,28	0,12	0,43	0,72	0,19	0,71	0,07	0	0	0,01	0,03	0,42	0,53
2013	0,82	0,18	0,43	0,24	0,09	0,29	0,79	0,17	0,72	0,04	0,01	0	0,01	0,03	0,44	0,55
2014	0,81	0,19	0,44	0,47	0,04	0,29	0,62	0,26	0,57	0,1	0,01	0,01	0	0,04	0,55	0,54
2015	0,8	0,2	0,46	0,28	0,03	0,33	0,83	0,11	0,7	0,09	0,01	0	0,01	0,08	0,48	0,59
2016	0,81	0,18	0,45	0,34	0,05	0,38	0,76	0,17	0,66	0,04	0,01	0	0	0,11	0,48	0,56
2017	0,81	0,19	0,44	0,28	0,03	0,42	0,79	0,18	0,67	0,1	0,01	0	0	0,05	0,48	0,57
2018	0,73	0,27	0,53	0,35	0,04	0,38	0,72	0,16	0,66	0,05	0	0	0	0,13	0,48	0,58
2019	0,76	0,24	0,5	0,21	0,07	0,35	0,81	0,33	0,51	0,04	0,01	0	0	0,12	0,54	0,62
2020	0,74	0,26	0,53	0,33	0,11	0,25	0,77	0,27	0,58	0,02	0,01	0	0	0,12	0,5	0,6
2021	0,78	0,22	0,48	0,33	0,07	0,38	0,78	0,29	0,53	0,04	0,01	0	0	0,13	0,55	0,6
2022	0,73	0,27	0,56	0,37	0,13	0,27	0,72	0,38	0,43	0,02	0	0	0,01	0,17	0,55	0,61
2023	0,71	0,29	0,55	0,27	0,27	0,27	0,72	0,27	0,49	0,01	0,01	0	0,01	0,21	0,56	0,61
Average	0,78	0,22	0,48	0,30	0,08	0,35	0,74	0,20	0,64	0,06	0,01	0,00	0,01	0,08	0,48	0,57
Standard deviation	0,04	0,04	0,04	0,06	0,06	0,06	0,05	0,08	0,10	0,04	0,00	0,00	0,01	0,06	0,07	0,04

Source: Own elaboration.

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