Building Expertise, Connections, and Communities for Computational AI and HPC Training and Education: NAIRR Pilot User Experience Group Initiatives

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ABSTRACT

Given the rapidly changing computing landscape propelled with innovations and convergence of new cutting-edge technologies such as high-performance computing (HPC), AI, Cybersecurity, Quantum computing and more, the accelerated need for upskilling/reskilling the workforce to mitigate skills gaps is becoming increasingly important. Whether you are student, researcher, faculty, staff, or other stakeholder of academia/industry who is part of this evolving digital ecosystem, the continuous learning and adaptation of HPC along with AI best practices, research and technology is a key to remain competitive. Furthermore, a triumvirate of user expertise, connections, and communities is required to enable efficient integration of (HPC) and AI ecosystem to offer key technologies for meeting performance requirements that pushes innovations to their limits in science, engineering and other domains. To address the challenges involved in leveraging Artificial Intelligence (AI) along with computational, data, software, training, and educational resources for the U.S. research and education communities, the National Artificial Intelligence Research Resource (NAIRR) Pilot was launched in 2024. As part of this effort, the NAIRR Pilot User Experience Working Group (UEWG) have conducted various engagement initiates, such as researcher showcases, pilot industry partner showcases, webinar series, regional workshops and one national workshop on AI Training. This paper presents a reproducible roadmap based on the observations and results of the above-mentioned training and education efforts that can be used to efficiently train the next generation workforce in AI and HPC at all levels. Thus, bridging the talent gap and advancing secure and trustworthy AI in research and society.

KEYWORDS

Computational Research Tools, Artificial Intelligence, Workforce Development

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1 INTRODUCTION

HPC is central for empowering progress in diverse scientific and non-scientific domains. A myriad of technologies in the post petascale computing demand a significantly greater degree of parallelism than we currently observe. The rapid advancement of new HPC technologies has facilitated the convergence of Artificial Intelligence (AI), Big Data Analytics, and the HPC platforms to solve complex, large-scale, real-time analytics and applications for scientific and non-scientific fields. AI and High-Performance Computing (HPC) are complementary technologies, with HPC providing the powerful infrastructure and processing capabilities needed to run large-scale AI models, while AI enhances HPC systems by enabling intelligent data processing, pattern recognition, and optimization of complex simulations and workflows [3, 4] This synergy allows for greater efficiency, deeper data-driven insights, and the ability to tackle more complex problems than either technology could on its own, driving significant advancements across various industries from scientific research to cybersecurity. As we start the process of getting your own AI-accelerated HPC initiative running, it's important to understand common challenges:

- For AI and HPC configurations, traditionally there is a trade-off between AI and HPC requirements within the CPU architecture. AI-heavy workloads typically exchange core count for speed, while HPC workloads often prefer greater compute performance with a high core count and more core-to-core bandwidth.
- Increasingly data-intensive workloads, such as modeling, simulation, and AI, create performance bottlenecks that require solutions with high-bandwidth memory that's architected to unlock and accelerate them.
- The high level of complexity of AI in HPC is a major source of friction for adoption. The skill sets for AI and HPC are very domain specific, and finding talent skilled in both areas is difficult. However, without this talent, AI-accelerated HPC initiatives might not move forward.

Thus, as we move towards exascale, the convergent computing platforms along with a paradigm shift in the programming applications provide both challenges and opportunities, for cyberinfrastructure facilitators and educators to prepare and support a diverse community of professionals to utilize evolving HPC, equipping them to solve complex scientific, engineering, and technological

problems [1, 2, 5]. In 2024, the National Artificial Intelligence Research Resource (NAIRR) Pilot was launched as a U.S. government-led public-private initiative that provides American researchers and educators with broad access to advanced AI tools, data, and computational resources. Led by the National Science Foundation (NSF), the pilot program is a stepping stone toward a permanent, full-scale NAIRR program. The pilot program is designed to democratize access to AI resources and spur innovation by addressing the following goals such as 1) Spur innovation to facilitate AI-driven research and discovery across all scientific fields. 2) Advance responsible AI to promote the development of AI that is safe, secure, trustworthy, and protects privacy and civil liberties. 3) Build talent to provide resources and training to educate the next generation of the AI workforce. 4) Expand capacity to improve the nation's overall capacity for AI research and development. As part of NAIRR pilot, the NAIRR pilot User Experience Working Group (UEWG) is involved in assessing the needs of researchers and educators using the National Artificial Intelligence Research Resource (NAIRR) Pilot. The group's findings help shape the future of the NAIRR program. The UEWG group aids in:

- Assessing user needs: The UEWG works to identify challenges and priorities for the research and education communities as they engage with AI. They use methods such as surveys and workshops to gather information.
- Informing NAIRR development: Insights from the UEWG are used to refine the pilot program and contribute to the design of the full-scale, long-term NAIRR program.
- Promoting trustworthy AI: By identifying common challenges and sharing solutions, the group fosters the development of responsible AI.
- Supporting user engagement: The group helps facilitate community engagement and support, including efforts like the Researcher Showcases, Workshops such as "AI Unlocked " workshop held in April 2025.

This paper will highlight the key findings by the UEWG summarizing key insights gathered from surveys and outreach efforts. Moreover, the paper presents a reproducible roadmap that details the mechanisms used and recommendations to address the following challenges [5]:

- Gaps in expertise: need for more high-performance computing (HPC) knowledge among users.
- Training framework: users require structured AI education, hands-on training, and workshops.
- Key training areas: such as large language models (LLMs) and general AI research applications.
- Community connections: users are highly interested in knowledge sharing and networking opportunities

This paper is coordinated by NAIRR Pilot UEWG and fosters collaborations among practitioners to explore strategies enhancing computational, data-enabled, AI and HPC educational needs. The article will discuss approaches for developing and deploying AI and HPC education and training and keeping pace with rapid technological advances: collaborative online learning tools, technology solutions supporting HPC, Accelerated Analytics, and AI applications. The paper will highlight methods for conducting effective AI and HPC education and training for emerging technologies; promote HPC and AI educators' community; disseminate best practices.

2 BACKGROUND

2.1 User Experience Working Group

The National Artificial Intelligence Research Resource (NAIRR) pilot was launched in Jan 2024 to spur innovation around AI workflows and tools and support research endeavors. Federal agencies are collaborating with government-supported and non-governmental partners to implement the Pilot as a preparatory step toward eventual full NAIRR implementation. The NAIRR User Experience Working Group, the second working group, convened as part of the NAIRR pilot works with the researchers or educators who have been selected to participate in the current open call for access to resources as part of NAIRR. Individuals selected as part of the open call are given access to resources to achieve success in their projects. These resources include not only physical hardware but also user support. The NAIRR User Experience Working Group focuses on understanding how to best facilitate the successful completion of these pilot projects. Moreover, this working group also identify the best methods to achieve these goals, pain point resolution, services or support that are needed, and other issues as they arise to formulate a successful NAIRR project after the pilot phase. The Group facilitates recommendations on good user support that enables NAIRR Pilot users to complete their work effectively and efficiently and have positive experience in the Pilot.

3 NAIRR USER EXPERIENCE GROUP INITIATIVES ROADMAP

Since the inception of NAIRR pilot, the User Experience Working Group (UEWG) has been helping to overcome the intimidation factors and barriers for current NAIRR Pilot users and potential users and to overcome issues with underutilized resources for improving the reward process. To improve the success rate for projects at the end of the pilot, the UEWG laid down an Initiatives Roadmap that involved high-level mapping out the NAIRR users' landscape and analyzing user experiences and AI/HPC programs implementations for identifying common practices and barriers resulting in framing informed recommendations to achieve the set UEWG and NAIRR pilot goals.

3.1 Map NAIRR User Landscape

To aid the NAIRR pilot current and potential users, it became of paramount importance to map the NAIRR user landscape. To map NAIRR stakeholders the first step was to identify the users, their goals, and services required to improve user experiences. However, this was not easy due to the diverse and rapidly expanding NAIRR user landscape and dynamically changing trends in user landscape. The NAIRR user landscape encompasses users who are determined by need for the massive computational power to process large datasets and to train complex AI models, for generative AI and deep learning applications and for classroom education. Moreover, the user landscape involves stakeholders ranging from hyperscale data center operators to researchers, engineers and staff from national research laboratories, universities, and government

and private sector enterprises. The users of NAIRR are involved in research and innovations utilizing AI HPC systems for complex scientific workloads, accelerating discovery in various fields like genomics, molecular modeling, climate modeling, high-energy physics, autonomous driving, robotics, and manufacturing, national security, defense applications and more. Many applications and advanced users employ AI software and leverage HPC resources for tasks like data analytics, model validation, and developing new AI applications. Furthermore, with private sector dominating development of AI models in comparison to academia along with the need for AI-optimized GPUs and AI-coupled workflows for enhancing speed and performance of traditional HPC simulations, the need for better training and workforce development to ensure NAIRR users can effectively leverage these complex, highly experimental AI-HPC resources became imperative.

NAIRR pilot UEWG took many initiatives to efficiently map the landscape of NAIRR users' experience including their goals, AI tools, computing resources, and experiences to identify and gather gaps, opportunities, and interactions. The first initiative taken by NAIRR UEWG was launching the National Artificial Intelligence Research Resource (NAIRR) Pilot Project Researcher Showcases in October 2024 with an aim to share insights into cutting-edge AI projects, motivations, challenges, and engagement with the NAIRR community. In these showcases researchers were invited to present various projects involving work on digital agriculture, colorectal cancer diagnosis, neuroimage modeling for Alzheimer's risk, large foundation model pre-training, teaching AI for quality engineering, and more.

These showcases provided a unique opportunity for all users to connect with leaders in the field of AI research and education and were ideal for individuals of all skill levels who are interested in AI advancements. We had huge success with the showcases as we received more than 100 registrations for each showcase with max 187 registrations for some showcases. Furthermore, in summer 2025, UEWG launched the National Artificial Intelligence Research Resource (NAIRR) Pilot Partner Series with an aim to inform U.S. researchers and educators about the specific AI resources and services available to them at no cost through the NAIRR Pilot program's application process. The series featured in-depth presentations by the many governmental and non-governmental organizations that contribute resources to the NAIRR Pilot, such as, Databricks, Groq, Lexset, MLCommons/Croissant, Neocortex, SambaNova. Moreover, the partner series also highlighted a specific partner's resources, availability, accessibility of computing cloud platforms, tools/specialized hardware, and potential research applications.

3.2 Analyze User Experiences and AI/HPC programs Implementations

Rapid changing landscape and convergence of AI, HPC and other technologies is not only empowering innovations but also increasing gaps in specialized skills and talent pipelines. Thus, as part of the roadmap, UEWG tried to identify the training and upskilling needs of the current and potential NAIRR pilot users by identifying user experiences with respect to the different technologies present and with respect to what kind of training and skill is required to cope up with such dynamic computing environments. The group tried to analyze the experiences of users with various HPC programs implementations by trying to address various questions such as: 1) What is the NAIRR pilot user experience like? ; 2) what would potential users need to join the NAIRR pilot?; 3)What services or tool can we provide to enable the user's success?: 4) What are the needs of the current NAIRR pilot users?; 5) What are the needs of the potential users?; 6) what recommendation did the UEWG provide to best meet the needs of the users and to tailor the new user experiences?

The UEWG group took many initiatives to identify the obstacles by gathering the user input, understanding the user priorities and assessing the training needs with respect to NAIRR pilot resources. One of the most important initiatives taken by the UEWG was gathering data by administering NAIRR user experience surveys which aimed at identifying the needs and challenges faced by the AI research and education communities to aid the pilot program and inform an eventual full-scale national AI infrastructure. The survey questionnaire gathered information on various topics of interest such as the overview of AI tools, overview of research process using AI, how to get involved with NAIRR?, specialized help in certain domain sciences, preparing datasets to use AI, available computational resources, LLMs, providing participants with tangible tools to work on after workshop and walking people through the NAIRR pilot reward process.

The surveys were conducted via various mailing lists such as ACCESS mailing and NAIRR pilot user mailing lists and there were more than 402 responses recorded to the initial survey administered in Fall 2024. One of the most important findings of the survey results was the answer to the important question on the survey which was: What is your biggest challenge with AI? More than 40% of the users mentioned that their biggest challenge is: "There are too many tools, and I need help understanding what is most applicable to my domain" and almost 30% of the users mentioned that: "I am using it in my research and use some 1:1 help with specific issues."

Moreover, to compare the responses from more regional and national scales along with different levels of HPC expertise we also compared the responses of the survey respondents from the HPC community and the Rocky Mountain Advanced Computing Consortium (RMACC) community. The comparison illustrated that there is immense interest in learning about AI among communities. The members from RMACC feel more "beginner" level (only 33% of the surveys responders us AI in their research and/or projects) and members from HPC community as a whole feel more "intermediate" level (almost 62% of the surveys responders us AI in their research and/or projects). However, all community members want to learn more about tools and are interested in workforce development. Moreover, UEWG learned that AI introduces a different subset of people to the HPC community and many of them are not sure where to start. Furthermore, when asked about the most important topic of interest, more than 70% of the survey respondents voted for AI tools and their application to various domains as the topic of interest if there was an in-person training workshop organized by UEWG.

3.3 Identify Common Practices and Barriers

The NAIRR pilot encompasses many operations teams including UEWG, allocations working group, coordination group, portal and website, newsletter and metrics. After gathering the users' experience data, UEWG planned many initiatives to identify common practices and barriers. As part of the next step of the roadmap, the UEWG team worked closely together with the NAIRR Pilot Working Groups and Teams that are operating on other aspects of the NAIRR pilot process to share knowledge and insights. The goal here was to identify requirements of other working groups and resource providers who have team of user support that provides the first line of service and meet with the user support staff bi-weekly. As part of identifying pain points and solutions, the UEWG group also worked on office hours, consultations, and ticketing which aimed at in-depth support with accessing resources for AI research and advanced computing, proposal submissions and eligibility requirements, and active NAIRR Pilot awards and ACCESS resource usage. The office hours and consultations provided live, one-on-one support and guidance available for researchers and educators to access the NAIRR Pilot's AI resources. Moreover, the SCIPE awardees provide in-depth support outside of office hours or for specific issues that need tracking, users can submit a ticket.

The UEWG group also initiated the National AI Workshop in April 2025, called AI Unlocked workshop, where 768 community members applied for registration, and 304 members were invited, with 292 in attendance at the workshop event. The second series of such National AI workshop is planned in Denver again in June 2026 and will be a day and a half-long event, sponsored by ACCESS and NAIRR Pilot and University of Colorado, Boulder. In addition to the National Workshop, the UEWG group also planned and organized regional AI workshops in University of Colorado, Boulder, University of Kentucky, and University of California, Los Angeles, where more than 100 regional community members attended these regional workshops.

The goal of these AI workshops is to provide a collaborative environment and community building for existing and new AI users to discuss challenges, share experiences, and work through solutions in real-time. The workshop structure comprises two-day sessions of reproducible modules for beginners, intermediate and advanced users. The workshop includes parallel sessions providing comprehensive overview of AI fundamentals and hands-on practical experience with customizable AI tools and processes on computing resources for beginners along with providing experienced participants help in identifying and deconstructing specific challenges in their AI projects. The workshops aid in identifying common practices and barriers, uncovering skill gaps, highlighting practical barriers, addressing fears and resistance, thus promoting cross-functional collaboration and facilitating best practice sharing and a foundation for future training.

In addition to the workshops, UEWG group also submitted series of BOF's and Panels at various conferences such as SC, PEARC and EDUCAUSE that provided provides a unique opportunity to learn about the NAIRR Pilot offerings, current activities, and to discuss key hurdles for users at the intersection of HPC and AI, such as computational integration, user expectations, and effective onboarding strategies.

3.4 Develop Informed Recommendations

To overcome the identified barriers the UEWG encourages NAIRR stakeholders to incorporate informed recommendations for ensuring a more seamless, transparent, and effective experience for all users engaging with the NAIRR Pilot. As part of the roadmap, the UEWG focuses on overcoming barriers for incoming and potential users with respect to allocations, training, intimidation factors and onboarding process by providing informed recommendations, some of which are: 1) Engaging more with cutting-edge technologies for building expertise, connections, and communities; 2) Enhancing instructional design and supporting additional regional workshops that mimic the "AI Unlocked" workshop for addressing skills gap; 3) Rotating times and formats along with usability tests accommodating varying participants for AI/HPC education and training fostering redesign for usability and reproducibility; 4) Planning recurring webinars, showcases, town halls, and additional national workshops and training opportunities on topics of interest including high performance computing, PyTorch, TensorFlow, industry tools, Large Language Models, classroom and education use cases, and ethics for promoting AI/HPC awareness and gathering user feedback and pain points; and 5) Developing step-by-step guides for improving documentation accessibility and clarity for current and potential NAIRR pilot users.

The set of recommendations developed by the National Artificial Intelligence Research Resource (NAIRR) Pilot UEWG is not only intended to enhance the overall user experience of the NAIRR Pilot but also intended for the various operations teams involved in implementing several aspects of the NAIRR Pilot, particularly those with a direct connection to user experience, as well as for the federal funding agencies supporting the effort.

4 CONCLUSION

The roadmap described in this paper enabled UEWG to make a meaningful impact on user experiences by increasing access to cutting-edge infrastructure, building interdisciplinary connections, and reinforcing NAIRR's commitment to support AI research. Moreover, the roadmap outlined is an iterative, flexible, and evolving plan that aligns learning initiatives with NAIRR Pilot goals through continuous feedback and improvement in understanding of user experiences. The UEWG continues to assess and analyze user landscape and identify user needs to make recommendations for enhancing the NAIRR Pilot's operations.

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