The CIRC User Community

I. Supporting Computational Literacy and Broadening Participation

Figure 1 illustrates the user distribution by college and department, where the diversity of users is apparent. Note however that many users are not affiliated with an investor or their resources. A large number of unaffiliated users avail themselves of this shared and open computational resource, where the "backfill queue" has been increasingly utilized over time where currently the average is 50-60%. By following such as condominium model, CIRC leverages the HPC facilities for the benefit of the entire WSU research community, both investors and the general research public alike.

Outreach and Engagement. A primary goal of CIRC is to engage, educate, and help facilitate high-performance computing research among the diverse academic community at WSU. A portion of this occurs via research seminars, computing workshops, and published newsletters that are organized by CIRC to promote connection between our university community, students, interns, and future employees. These activities help disseminate results of HPC based research that is ongoing at WSU, which will also help attract potential industrial and scientific partners as the computing community expands. Specific examples of resources and outreach provided by CIRC include:

Figure 1. User distribution by college and department.

- providing technical and organizational support for university-wide training.
- assisting and advising researchers about technical details for optimizing HPC resources and grant applications utilizing Kamiak (locally), as well as proposals seeking national computational resources on XSEDE and other leadership computing facilities (LCFs).
- workforce development via the CIRC internship program—which began in 2019. This program offers hands on HPC management opportunities, and plans are underway to expand this program with regional partners.
- creating computational literacy and awareness through outreach.

CIRC staff maintain the WSU HPC website that includes descriptions of these events and ongoing efforts are aimed at expanding and engaging with a more diverse community that includes HPC users from underrepresented disciplines such as Arts and Humanities, Social Sciences, Sports Management, etc. CIRC also supports regional activities that include regional computing conferences, student participation at annual hackathons, competitions and conferences.

While CIRC has effectively engaged many important communities throughout WSU, we are now at a stage where we can significantly amplify research productivity and competitiveness by a direct strategy that encompasses best practices for onboarding that is integrated with how other units support research for their faculty. Toward this end, we have identified three themes.
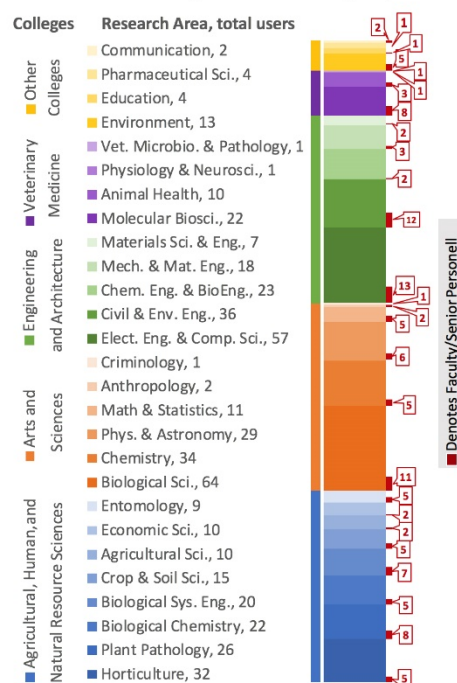
1. **Multifaceted onboarding and training opportunities across the WSU system.** To grow the use and accessibility of central research computing resources, CIRC must integrate with the communication and orientation processes of the Colleges to establish a pipeline by which faculty HPC need and readiness can be assessed. By coordinating communication efforts through existing pathways, CIRC can raise awareness of training opportunities, virtual and on-site, and alert faculty to the resources available to integrate HPC resources into their programs. Additionally, by creating a process to assess individual program's HPC needs and preparedness, CIRC can provide customized recommendations for how a program can proceed to better leverage research computing services.

2. **Diversification of infrastructure – a collaboration across units.** As the number of faculty using CIRC's services grows, so too will the demands for a more diverse set of infrastructure and capabilities, including demands of infrastructure outside the auspices of CIRC. As faculty at non-Pullman campuses begin to use central computing services, the networks between the campuses will become a limiting factor by constricting the transfer of data. CIRC can generate tangible use-cases to support investment in network connectivity between the campuses, and can create target performance benchmarks to support different types of research computing. Additionally, faculty need for a more diverse array of computing hardware will grow, as well as the need to develop integrations with other research groups and infrastructure. CIRC must balance the growth of supported hardware and integrations against the prevailing needs of the faculty and the finite resources at CIRC's disposal. However, by partnering and integrating with other service platforms, CIRC can provide a wider range of integrated services without having to meet every technology need manifest at WSU.

3. **Enhancing productivity.** A major barrier to the adoption of HPC is the design and implementation of workflows that enable researchers to collect, analyze, and store their data seamlessly. To fully actualize the potential of HPC at WSU, CIRC must raise awareness of the importance of proper workflow design, and also encourage faculty to include in their grants costs for developing these critical workflows. Additionally, CIRC can seek out funding to implement tools such as web-based portals and job launchers that can reduce the barriers for faculty in developing their workflows.

II. Workforce Development

Students and post-doctoral researchers form the backbone of research computing users at WSU, and broadly in academia. While it is true that engagement with faculty PI's helps to engage students as users of Kamiak, CIRC actively engages student researchers to inspire their ideas about the process and progress of research using high performance research computing. To enhance visibility, CIRC advertises regularly at campus events like Office of Research's "Research Week" and the WSU's Graduate School orientation. We also highlight CIRC services, events, and trainings on our website and Twitter. Once the word is out there is still one final barrier to getting students to run research on Kamiak, expertise. To use HPC resources for research, students need two practical skills, the ability to translate their research question into code and the ability to actually run that code on an HPC. Removing that barrier requires different levels of assistance and training depending on the student and their field.

The most basic level is promoting an understanding of what research can benefit from computing. CIRC offers periodic seminars and newsletters which highlight HPC opportunities both at WSU and off campus and provide concrete examples of the variety of research that benefits from research computing. CIRC also helps to foster and promote interdisciplinary student run groups with a focus in research computing, include in the R working group, Python Working Group, and HPC club. These student groups not only help by demonstrating the breadth of research that can benefit from research computing, but they also help with the next level of understanding needed to perform research on an HPC; translating research questions into code.

These student groups provide hands on assistance to students looking to use the R and/or Python programming languages for their research.

CIRC also provides more direct support for a broader range of languages in several ways. First, their Computational Scientists hold regular Drop-in Office Hours for 6 hours a week where researchers can get help with their code and with broader HPC related questions. CIRC also directly supports a number of workshops including Data Carpentry and Software Carpentry which aim to provide a basic understanding of processing data and programming for research. Once students are able to use computing in their research, the last step is to actually run those programs on an HPC like Kamiak. Here, CIRC offers support to the Kamiak High Performance Computing Club in the form of faculty/staff advisors and administrative support. This club includes both undergraduate and graduate students, and it was awarded funding to invest in a number of compute nodes that are available to its members. KHPC Club also runs its own periodic seminars and workshops. The club has a number of potential growth avenues, including additional nodes, increased undergraduate engagement with interns, and participation in central wiki management. CIRC also facilitates cross-pollination of the KHPC Club and student groups by offering planning and funding support for collaborative events such as the "Running R and Python on HPC" workshops.

CIRC also provides more direct support at this level by directly providing workshops and trainings in basic HPC topics including "Intro to Using the Kamiak HPC" and advanced HPC topics like Machine Learning and Parallel Computing. As CIRC continues to grow and establish a footprint at WSU, we hope to offer additional avenues to support student research on HPCs. This includes organizing and improving the quality of videos of CIRC HPC workshops to create mini tutorials that can be followed online at any time. CIRC also plans to extend in person trainings and direct assistance by sending its staff to additional campuses and creating a permanent video link into our Drop-in Office Hours for researchers outside of the Pullman campus. Additional online learning and training resources can also be made available to students including XSEDE trainings, HPC University Resources, and tutorials from Cyber Infrastructure Tutor. These trainings and CIRC resources can all be enhanced by having a centralized Wiki or Stack Overflow forum to help researchers with common HPC related issues.

To grow student involvement, CIRC could also sponsor students' competitive teams for external events such as the Student Cluster Competition at Supercomputing (http://www.studentclustercompetition.us/) and ISC (https://hpcadvisorycouncil.com/events/student-cluster-competition/). CIRC can also encourage students to apply for programs such as DOE Computational Science Graduate Fellowship (CSGF) program and NSF Graduate Research Fellowship Program (GRFP) and assist in developing HPC minor programs to provide students the necessary foundation for further HPC study and basis for employment in HPC focused fields.

Beyond support for student researchers, CIRC is also supporting workforce development in the field of HPC. This is very important, as new fields like HPC need to develop workers with the appropriate training and expertise in order to create a stable employment pipeline. CIRC has implemented a pilot internship program that can offer direct hand-on experience in systems administration and computational science to students. After one year of training our first intern in HPC Linux Systems Administration, we are preparing to expand the program to two CIRC supported interns each term starting in Spring 2020. One intern will focus on Systems Administration, while the other will focus on Computational Science, but cross training of each will be available and interns will have the option to rotate to the other internship to increase the breadth of their experience and give them an opportunity to test out both roles. Once both internships have bene tested, CIRC can support mentorship of additional interns if other colleges are interested in funding this experience to additional students.