

Regional Collaborations Supporting Cyberinfrastructure-Enabled Research During a Pandemic

The Structure and Support Plan of the SWEETER CyberTeam

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ABSTRACT

CyberInfrastructure enthusiasts in the South West United States collaborated to form the National Science Foundation CC* - funded SWEETER CyberTeam. SWEETER offers CI support to foster research collaborations at several minority serving institutions in Texas, New Mexico, and Arizona. Its training programs and student mentorship have supported participants, with several taking CI professional positions at research computing facilities. In this paper, we discuss the structure of the CyberTeam and the impact of the COVID 19 pandemic on its activities. The SWEETER CyberTeam has a hub-and-spoke structure that adopted a federated approach to ensure that each site maintained its own identity and was able to leverage local programs. It took a "boots on the ground" approach that ensured that services were up and running in a short period of time. To ensure adequate coverage of all fields of science, the project adopted an inclusive fractional service approach that leveraged expertise at the participating sites. The CyberTeam has organized several workshops, hackathons, and training events. Team members have participated in completions and several follow-on programs have been funded. We present the achievements and learnings from this effort and discuss efforts to make it sustainable.

CCS CONCEPTS

• cyberinfrastructure community; • CyberTeams; • academic needs;

KEYWORDS

cyberinfrastructure facilitation, hub and spoke model, community building, CI engagement, curricular developments.

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1 INTRODUCTION

Every day there is an accumulation of significant amounts of data and large-scale simulations. The obtained data and its interpretation can significantly advance our understanding of science and engineering; therefore, there is a need for enough computational support to guide any idea from its conception to the result. The South West Expertise in Expanding Training, Education and Research (SWEETER) CyberTeam was formed to address this growing need. The CyberTeam was funded under the National Science Foundation Campus Cyberinfrastructure (CC*) program in the Regional Facilitation award category (\$1.4 M, NSF award number # 1925764) [2, 7]. Since most smaller institutions do not hire a person in this capacity due to the scarcity of on-campus computationally-inclined researchers, SWEETER aims to fill this vacuum. Since the Fall of 2019, SWEETER has done so by providing computing expertise to help researchers in the region.

The SWEETER Cyber team is led by the High Performance Research Computing (HPRC) facility at Texas A&M University (TAMU), a Hispanic Serving Institution (HSI) at the forefront of engaging CI in research. Partnering with it are the Texas Advanced Computing Center (TACC) at the University of Texas at Austin (UTA), New Mexico State University (NMSU), Prairie View A&M University (PVAMU), West Texas A&M University, Texas A&M San Antonio, University of Texas San Antonio, and the University of Arizona (Figure 1).

This mix of research-intensive institutions, HSIs, emerging HSIs, and historically black colleges and Universities (HBCUs) represent several major public university systems across three southern states with communication flowing in a type of hub-and-spoke model. Other participating schools include Pima Community College in Tucson (Arizona, HSI), and Doña Anna Community College (HSI) & Santa Fe Community College (HSI) in Santa Fe, New Mexico.



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Figure 1: SWEETER encompasses partners located across Texas, New Mexico, and Arizona.

There are several areas of collaboration here. These universities are joined by several technology companies, the National Center for Genome Resources (NCGR) in New Mexico, and the Lonestar Education and Research Network (LEARN), a regional educational and research network provider in Texas.

A key strength of this partnership is our combined expertise in providing user support to enhance researcher-productivity. This level of expertise can be leveraged to support other institutions in the region, making it a mutually beneficial relationship in which schools of every size benefit from technology support, creating areas for growth and expertise with trainers and trainees for any computing topic. All of the participating universities are witnessing a significant rise in the number of Hispanic STEM students, in part, to the growing young Hispanic population across the states. As a result, all of these schools are actively working to provide access and support to this unique group of learners. In addition, the collaboration offers researchers at these schools to learn and collaborate with other CI-enabled research programs at other institutions. Projects like SWEETER will inform researchers and higher education across the nation as they experience similar growth. As a result, the Hispanic population will benefit in years to come, and higher education will have access to seek ways to recruit, retain, and graduate them in STEM fields.

2 METHODS

These partnerships aim for SWEETER to leverage existing programs at the local site to create the network. All participating institutions have existing CI research-based ties with each other. SWEETER was conceptualized with the practicality of deliverability and sustainability in mind. As such, we employ a "boots on the ground" approach that leverages existing facilitators rather than hiring new positions. As a result, we benefit from facilitators familiar with institutional knowledge and existing research networks in the region while avoiding the pitfall of employing and sustaining positions after the funding period is over. Also, we employ a federated model that guarantees each site a degree of autonomy. Prior research finds that researchers are more likely to gravitate toward a local

support structure than a remote structure [1]. Furthermore, such an approach allowed SWEETER to simultaneously cater to a diverse group of institutions with varying needs from their individual researchers' and student's academic needs. Co-PIs Hunt and Browning serve as the Deans of the College of Engineering at W-TAMU and UTSA, respectively. Together they brought a wealth of experience implementing such networks at the institutional level.

Our primary goal is to promote regional Cyber expertise by facilitating one-on-one interactions between researchers via virtual communities, meetings, workshops, and training programs. To address this, SWEETER had the following objectives: (i) Understand the research computing needs and requirements in the SWEETER research Community. Following the needs, we provided the training and education for researchers at campus institutions in research areas benefiting or relying on cyberinfrastructure (CI). (ii) Create opportunities for researchers across interdisciplinary platforms to have new connections. (iii) Create collaborations across departments at campuses and other SWEETER institutions to further expand the research community at campuses and improve the accessibility of resources. (iv) Host a series of virtual and in-person collaborative events at SWEETER campuses, supporting campus research, and sparking cross-campus collaborations. (v) Promote industry-led training and research events at participating campuses. This has been facilitated by our growing collaborations with companies such as NVIDIA, Intel, and Dell EMC.

3 RESULTS

The SWEETER Cyberteam aimed to form new relationships and collaborations to promote regional Cyber expertise through one-on-one interactions between researchers via virtual communities, meetings, workshops, and training programs. The SWEETER CyberTeam gained early momentum going into Fall 2019. The CyberTeam rapidly assembled and held a series of foundational meetings in 2019. Several members of the SWEETER team met in person at the PEARC 19 and SuperComputing19 conferences. An in-person two-day datathon at Texas A&M attracted 120 participants, with several participants from other SWEETER schools¹. An in-person student-researcher training workshop on using containers was organized at the University of Arizona by Senior Investigators (SIs) Joyce and Merchant². SI Perez from Texas A&M attended the workshop and brought the training materials for delivery to her campus. In Spring 2020, the team ran into headwinds in the form of imposed lockdown and other restrictions due to the COVID-19 pandemic. We simultaneously had to support an en masse adoption of CI by researchers who were new to this space, while facing uncertainties as our institutions, regions, states, and the nation adopted different health, work, social, and travel policies. We safely transitioned the hybrid management and governance framework to a virtual framework and built an online network using available tools for more accessible communication and resource sharing. Since then, the SWEETER group has remained a virtual organization that looks forward to leveraging meetings and conferences. We established a continuous reporting mechanism that routinely collected reports

¹<https://today.tamu.edu/2019/10/16/texas-am-to-host-worlds-first-datathon-october-19-20>

²<https://it.arizona.edu/workshops>

from each site. Most SWEETER activities are offered in a remote setting. Depending on prevailing state and local health and safety recommendations, some campus activities took place in person³ as well.

3.1 Schools

Leading into 2020, the CyberTeam had started assisting researchers, particularly at smaller schools and was actively engaged in implementing new cyberinfrastructure projects funded by local or federal awards. This community has actively assisted researchers in pursuing external funding for developing CI-driven research capabilities. These include assisting faculty and administrators at PVAMU to design and adapt their science DMZ and offering technical and administrative guidance to CI computing resource projects at Texas A&M University, NMSU, University of Texas Rio Grande Valley (UTRGV), TAMU SA and WTAMU⁴. In addition, SWEETER continues to host workshops and offer advice on mechanisms to improve CI adoption for schools in Alabama, Louisiana, New York, Maine, and North Carolina. As of today, the NSF has funded several of these CI projects. These include the NSF Major Research Infrastructure (MRI)-funded FASTER cluster (\$3.09 M) [5] and the NSF ACSS Track II ACES cluster (\$11 M)[4] on which SWEETER investigators Chakravorty, Cockerill and Perez serve as co-Principal Investigators. Support for these projects represents a tremendous return on investment for the NSF CC* program.

3.2 Student Engagement & Training

A second emerging highlight of the SWEETER effort is the success of the activities to build and sustain student engagement in CI and research computing. All SWEETER schools offer opportunities for students to learn CI practices. At Texas A&M, SWEETER has pioneered the development of two hybrid pedagogical approaches for CI-training. The first one, called “Primers,”⁵ uses a peer-moderated and peer-mentored approach to teach students introductory topics in computing. These Primers have been taken by hundreds of students, most of whom are undergraduates. The second approach, called “TechLabs”⁶, teaches students how to use common software applications on CI resources. The focus here has been on artificial intelligence / machine learning (AI/ML) techniques. These curricular materials are now being expanded on at the University of Arizona. PVAMU continues to invite students to its annual hybrid two-day IEEE workshops during which SWEETER team members from other institutions offer training sessions. SWEETER team members have participated as guest lecturers at other institutions.⁷ Students have participated in-person at regional conferences such as the Research Computing Symposium at Texas A&M⁸, TACCSTER at TACC⁹, and the Research Bazaar at the University of Arizona¹⁰. Participating students have presented posters online and in-person, and spoken

about their research at these conferences. Another highlight has been the participation of SWEETER student-teams in the hybrid international SuperComputing Student Cluster Competition¹¹ and Indy Cluster Competitions in 2020 and 2021 (SIs Perez, Bhatt and Cui)¹². These cluster competition teams included students from multiple SWEETER sites, introducing a novel element of “academic” diversity and letting the participating student’s network and build new relationships across institutions as well. SWEETER schools continue to host hybrid events that bring faculty, researchers, and students together. For example, lunch-and-learn sessions and joint workshops were organized at UTSA to stimulate student interest in CI. These projects have been guided by faculty advisory meetings and the development of curricular materials for the formal and informal (training) space.

For example, among others, SI Lisa Perez, taught students enrolled in CVEN 689 (Civil Engineering) and VIZA 681/689, how to use HPC architecture, parallelization, and software stacks. The annual Research Bazaar at the University of Arizona continued to engage students as well¹³. An interactive computing workshop at Texas A&M had ninety-nine participants, with 19 participants from SWEETER schools. Over 150 participants joined in the associated training sessions (RONIN, Intel FPGAs, Intel OneAPI) offered by the industry. Participants completing our last training session at Texas A&M in Spring 2022 earned an Intel-branded participation certificate. In 2021 and 2022, the WTAMU spoke organized student camps where over 70 community college students learned about data science and participated in hackathons. Our collaborations in this area led to the creation of the BRICCS¹⁴ (Building Research Innovation in Community Colleges, NSF CC* award number 2019136) group [3]. These are coupled by collaborative projects for curricular development that have been funded (\$300k and \$1.2M) by state-agencies like the Texas Higher Education Coordination Board. As perhaps one of its greatest achievements, the CyberTeam helped with the transition of four students to full-time CI professional positions at Texas A&M HPRC, with two women achieving system administrator roles.

3.3 Workshops

The CyberTeam has continued to organize hybrid workshops and supports research activities at participating schools. In the Fall of 2020, NMSU’s division of SWEETER collaborated with the High Performance Computing (HPC) team in educating the NMSU student body on how to use MATLAB 2020b on the HPC cluster, Discovery. In addition, NMSU produced highlight videos in the Fall of 2020 to showcase on-campus organizations and research. These videos aimed to promote New Mexican strides in research and outreach while maintaining the SWEETER initiative of professional networking.

A hybrid faculty workshop, organized at Texas A&M San Antonio and led by Prof. Smriti Bhatt, offered information to researchers at TAMUSA on CC* Team: SWEETER and also new HPC resources for faculty research. The university also had an open discussion with faculty where they shared their needs, expectations, recent

³<https://hprc.tamu.edu/sweeter/events.html>

⁴<https://hprc.tamu.edu/files/sweeter/Science-DMZ-NSF-CC-SWEETER-Workshop-Report-v2.pdf>

⁵https://hprc.tamu.edu/training/primers_popup.html

⁶<https://hprc.tamu.edu/training/techlab.html>

⁷<https://r5.ieee.org/houston/prairie-view-am-university-annual-ieee-ai-workshop-conference/>

⁸<https://hprc.tamu.edu/rcs/>

⁹<https://www.tacc.utexas.edu/taccster-2022>

¹⁰<https://researchbazaar.arizona.edu/>

¹¹<https://www.isc-hpc.com/student-cluster-competition.html>

¹²<https://sc21.supercomputing.org/program/studentssc/indyscc/>

¹³<https://researchbazaar.arizona.edu/>

¹⁴<https://hprc.tamu.edu/briccs/>

experiences, and challenges in accessing research computing resources from external options. At UTSA two online workshops were organized with the themes of Computational artificial intelligence / machine learning (AI/ML) and cloud computing. Another online workshop focusing on the use of AI/ML mechanisms was offered at UTSA [6].

The Texas A&M Institute for Data Sciences (TAMIDS, SIs Tao and Duffield) hosted a webinar to introduce data science fundamentals and some basic statistical concepts. We have since offered weekly in-person Bring-Your-Own-Data (BYOD)¹⁵ workshops to help researchers formulate approaches to Data Science projects and assist with code development to take advantage of the latest data analytics methods and high-performance computing facilities. Anirban Pal, a professor at WTAMU conducted a workshop on SPACK at the Research Bazaar at the University of Arizona in 2021 as part of our cross-campus collaborations.

3.4 Resources & Support

SWEETER continues in its mission to support research and science projects as well. We have continued to offer advanced CI-enabled support to our researcher community. This is a significant strength of SWEETER as it fills the void left by national CI resources. Examples include helping researchers run their code on HPC sites, debugging MPI code, porting Matlab applications to a parallel version, optimizing user code, supporting cryo-electron microscopy workflows and running R code that could use large-scale resources¹⁶. These include software development (Dhruva Chakravorty) and opportunities to leverage large-scale and cloud computing (Prof. Jeff Prevost, UTSA). Prof. Alsmadi, is studying ways to leverage data analytics and machine learning to filter spam posts from online social networks at TAMUSA. As part of its commitment to research, SWEETER supported three (2 females and 1 male) research experiences for undergraduate (REU) students who worked on projects ranging from cybersecurity frameworks, building network monitoring interfacing, and studying the migration of workflows from on-premise to cloud resources.

4 CONCLUSIONS AND FUTURE WORK

The SWEETER CyberTeam continues to facilitate CI-enabled research. Today, the SWEETER CyberTeam helps support several NSF CI infrastructure awards made in the region. A growing number of

community resources are available on our website. The CyberTeam faced a moment of reckoning during the pandemic, but successfully transitioned to using CI (research clusters) as the means to engage with researchers across campuses. With the growing need for computing services, it is natural that several team members moved to higher positions in other institutions. The fractional position “hiring” approach helped spread the responsibilities of these positions and ensured continuity when participants left their home institutions. With travel restarting in the region, the SWEETER CyberTeam is restarting campus visits and in-person engagements. A SWEETER wide event is planned for late May of 2022. Despite its many achievements in a virtual world, the members of the SWEETER team are yet to meet in person together.

¹⁵<https://coehpc.engr.tamu.edu/byod/>

¹⁶<https://hprc.tamu.edu/events/workshops/>

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