NM EPSCoR INTERDISCIPLINARY INNOVATION WORKING GROUP (I-IWG):
NEW MEXICO COMPUTATIONAL SCIENCE PATHWAY: AN INTEGRAL PART OF NEW MEXICO'S
CYBERINFRASTRUCTURE FOR RESEARCH AND EDUCATION

SEPTEMBER 28 - 30, 2017
UNM SEVILLETA FIELD STATION, NEW MEXICO

FINAL REPORT

I. KEY OBJECTIVES

This NM EPSCoR Interdisciplinary Innovation Working Group (I-IWG), New Mexico Computational Science Pathway: an Integral Part of NM's Cyberinfrastructure for Research and Education, brought together computer scientists, educators, and policy advocates from eight institutions for two and half days to address two questions: 1) *How can the existing CS resources in NM be most effectively leveraged and connected to promote computing and computational literacy and skill-building from K-12 through careers?* 2) *What are the policies and institutional barriers that must be addressed to enable a coherent, productive pathway for student success in CS?*

II. SUMMARY OF KEY IDEAS DISCUSSED

A. Vision for CS in New Mexico - Ten years from now, CS education in New Mexico will be different in myriad ways. It will be accessible to all students (in and out of school), flexible and adaptable at all levels, integrated across the curriculum (social sciences, math, engineering, art, etc.), with seamless transitions and smooth pathways within K-20, enabling students to succeed by the time they enroll in their first college level course. Moreover, students will be prepared for graduate programs and the growing CS/computational thinking (CT) job market and workforce by the time they complete their undergraduate studies. K-12 teaching will also be different vis-à-vis new educational and science standards that will include computational thinking, more effective teacher professional development, enhanced training through college-prep programs that will impart CS/CT knowledge skills and aptitudes, and better K-12 teacher recruitment through learning service stipends and pathways for retraining. Teachers will also have greater support from a united stakeholder community, including from New Mexico technology industry retirees, funders, national labs, and state and federal legislators that will invest in computer science teaching infrastructure (internet, computers,

computer labs, etc.). Through all of this, New Mexico students will be able to focus on computational modeling, complex systems, and scientific computing, among other computer science applications, early in their education, which will prepare them for a computational workforce.

B. Landscape of CS in NM - New Mexico's advantages in CS education include its history of leadership in CS education, the large number of existing in and out of K-20 classroom programs, the high per capita number of research and teaching universities, national laboratories and Ph.D. educated individuals involved in CS/CT education and research, and the state's overall exceptional computational capability that will ensure that residents are well-prepared for the growing CS/CT job market in New Mexico. In addition, New Mexico's large underrepresented populations have the capacity to greatly diversify the CS workforce.

C. Gaps/Barriers to Achieving Vision - New Mexico can improve its standing in CS education by enhancing CS educational pathways, developing more K-12 course opportunities, greatly increasing teacher professional development opportunities, including teacher training and creating more connections with industry and mentors, and strengthening the currently fragmented pipeline. In addition, New Mexico students can greatly benefit from expanding current CS programs at the K-12 level, including CS4All, CS4HS, GUTS and Mesa, and others that have met with success. However, in order to generate greater progress in the future, New Mexico must create CS standards, provide more CS/CT educational programming, particularly in rural schools, enhance its CS education infrastructure through greater funding, and build greater inroads to the state and federal government, families and the broader community. Finally, New Mexico must strengthen the CS pipeline in order to retain successful students within the New Mexico job market. This can be enabled through greater industry mentorship collaborations and strengthening connections with New Mexico industry partners.

III. OUTCOMES (WHO IS DOING WHAT)

A. University/National Laboratory Collaboration to Refine Graduate Computer Science Courses to Promote New Mexico Resident Recruitment, Retention, Retraining, and Increased Diversity: Alliance for Graduate Education and the Professorate

Patrick Bridges, Bob Robey: New Mexico universities and national laboratories will collaborate to create specialized mid-level computational science courses using Los Alamos National Laboratories (LANL) and Sandia National Laboratories staff and retirees. Courses would include computational fluid dynamics courses with Eulerian, Lagrangian and multi-physics content,, exa-scale programming courses, and computational science courses. Course materials and assessment standards for these specialized courses must be developed, and teaching assistants will need to be hired to create and grade exams, and mange all of the university internal grading processes. In addition, professional engineering software applications must be brought in. These courses, either hosted at LANL, Sandia and/or online, will help to recruit undergraduate students to graduate programs and better prepare all students for LANL and Sandia Labs CS/CT jobs. Strong recruitment programs must also be developed to ensure that sufficient New Mexico university and national lab students, including current staff seeking re-training, enroll. Shared undergraduate/graduate credit will be enabled.

Funding through the National Science Foundation (NSF) Research Traineeship (NRT) program is one mechanism to consider to fund critical elements of this program. In addition, a white paper outlining programmatic mechanisms will be developed and distributed to the Department of Energy, congressional leaders for incorporation into their budgets, and to the national labs (LANL and Sandia) for potential seed funding.

More work must be completed vis-à-vis mentorship for students; identifying who at Sandia Labs and NMSU to reach out to; policy items; creating a scholarship pool at the national labs; and setting up mechanisms for upcoming retirees at national labs to become faculty.

B. Articulation Agreement between CNMs CS courses with UNM and NMSU

Hye Clark, Rebecca Galves, Patrick Bridges – Central New Mexico Community College (CNM) will work with New Mexico State University (NMSU) and University of New Mexico (UNM) to develop two-year to four-year articulation agreements for CNMs Computer Information Technology (CIT) courses to ensure shared placement/entrance collaboration.


C. Create CS

Melanie Moses, Steve Cox, Enrico Pontelli, Hye Clark - In an effort to continue providing high school teachers professional development and training in CS/CT, a multi-institutional (UNM, NMSU, Northern New Mexico Community College (NNMC) and CNM) group of CS faculty will repurpose the UNM CS4All proposal submitted to NSF in 2016 to create a new NSF DRK-12 proposal. The proposal will include high school teacher professional devleopment, undergraduate classes, and high school dual credit courses that will be re-vamped and expanded from the current CS4All program. The current one-semester course for high school students will be turned into a two-semester course that is aligned with Next Generation Science Standards and include a science fair component (e.g., Swarmathon, Robo Rave, hackathons or traditional science fairs). The two-semester high school course will also have to be aligned with the one-semester college course, and colleges and university admissions will have to recognize CS courses that satisfy math and science credits in high school. Steve Cox will take the lead in creating a Teaching Assistant development/training course.

D. Advocacy for CS

Selena Connealy, Paige Prescott, Irene Lee: A one-page policy brief is being prepared for New Mexico gubernatorial candidates and other policy-makers that will help enable all high schools to offer at least one rigorous CS course; fund professional learning opportunities for teachers to prepare them for teaching these courses; and create a set of high quality K-12 standards to guide local implementation.
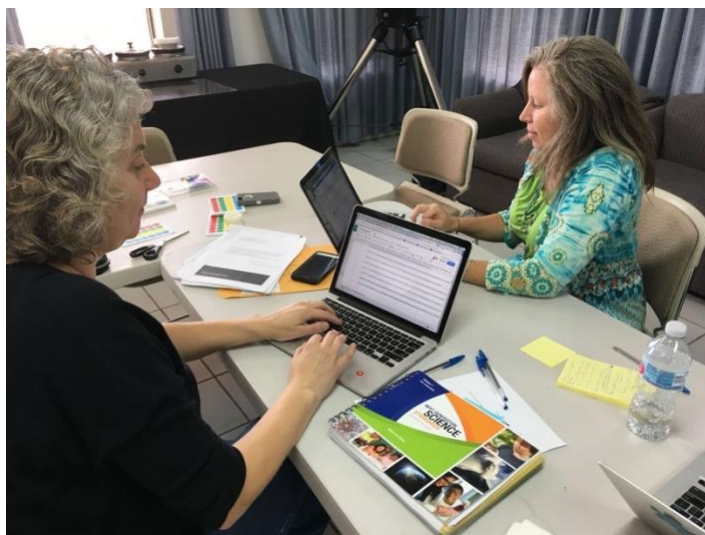
The group must still include a section for engaging New Mexico industry and high tech business partners; and break the statement up into a vision statement and a detailed plan. They will consult with the NM Tech Council and others with connections to industry, and those who have worked on similar successful platforms.

E. Outreach for CS/CT

Allison Brody, Raena Cota, Rebecca Galves - This group will focus on professional development for K-12 teachers that will introduce them to basic computational thinking concepts, with examples of CT integration across the curriculum. The group will produce a one-hour webinar on CT and the New Mexico science standards as part of the professional development opportunity for K-12 teachers. This will be done in collaboration with the NM EPSCoR, who will provide the webinar software.

In addition, the partnership that includes NMSU, the Museum of Nature & Science (MoNaS) in Las Cruces, and Explora in Albuquerque will work together to generate a proposal for an Institute of Museum and Library Sciences (IMLS) competition. There are two upcoming, potentiated opportunities: Museums Empowered: Professional Development and Capacity Building Opportunities for Museums due March 01, 2018; or the National Leadership Grants for Museums due December 01, 2017.

The group must map out the webinar component pieces; generate the IMSL grant proposal; plan for expanding CS-related teacher training programs; and create a plan for bringing in K-12 administrators for the training, as well as teachers.

F. Professional Development for K-12 teachers in CS
Paige Prescott, Enrico Pontelli, Hye Clark, Steve Cox, Allison Brody, Melanie Moses, Irene Lee

A proposal for creating a first annual NM CS Professional Development Week to be held in June 2018 became more formalized and commitments from various partners were made more tangible. This week of CS professional development will involve many organizations committing funds, facilitators, organizational support and classrooms. Recruitment for teachers will be statewide and is meant to bring the teachers to a central location for the whole week in order to get high quality professional development as well as create community around CS education. This group will continue to find ways to recruit teachers as well as commit facilitators and resources needed to bring over 100 educators together around CS education in K-12.

IV. WORKSHOP PARTICIPANTS AND AFFILIATED INSTITUTIONS

Patrick Bridges, University of New Mexico
Melanie Moses, University of New Mexico
Paige Prescott, University of New Mexico
Bob Robey, Los Alamos National Laboratory
Steve Cox, Northern New Mexico College
Enrico Pontelli, New Mexico State University
Selena Connealy, New Mexico EPSCoR
Irene Lee, Massachusetts Institute of Technology
Hyekyung Clark, Central New Mexico Community College
Bobbi Eichhorst, New Mexico Public Education Department
Allison Brody, Explora Children's Museum Science Center
Raena Cota, New Mexico State University
Rebecca Galves, New Mexico State University
Mary Jo Daniel, Facilitator, University of New Mexico
Carman Melendrez, Facilitator, University of New Mexico