Title: Information Science & Technology Institute

Author(s): Turcotte, Melissa

Intended for: Briefing

Issued: 2020-03-17

ISTI Information Science & Technology Institute

The Information Science & Technology Institute (ISTI), as part of the National Security Education Center, enables the execution of LANL's institutional IS&T pillar strategy through revitalization of technical IS&T areas, recruiting, and retention of IS&T staff.

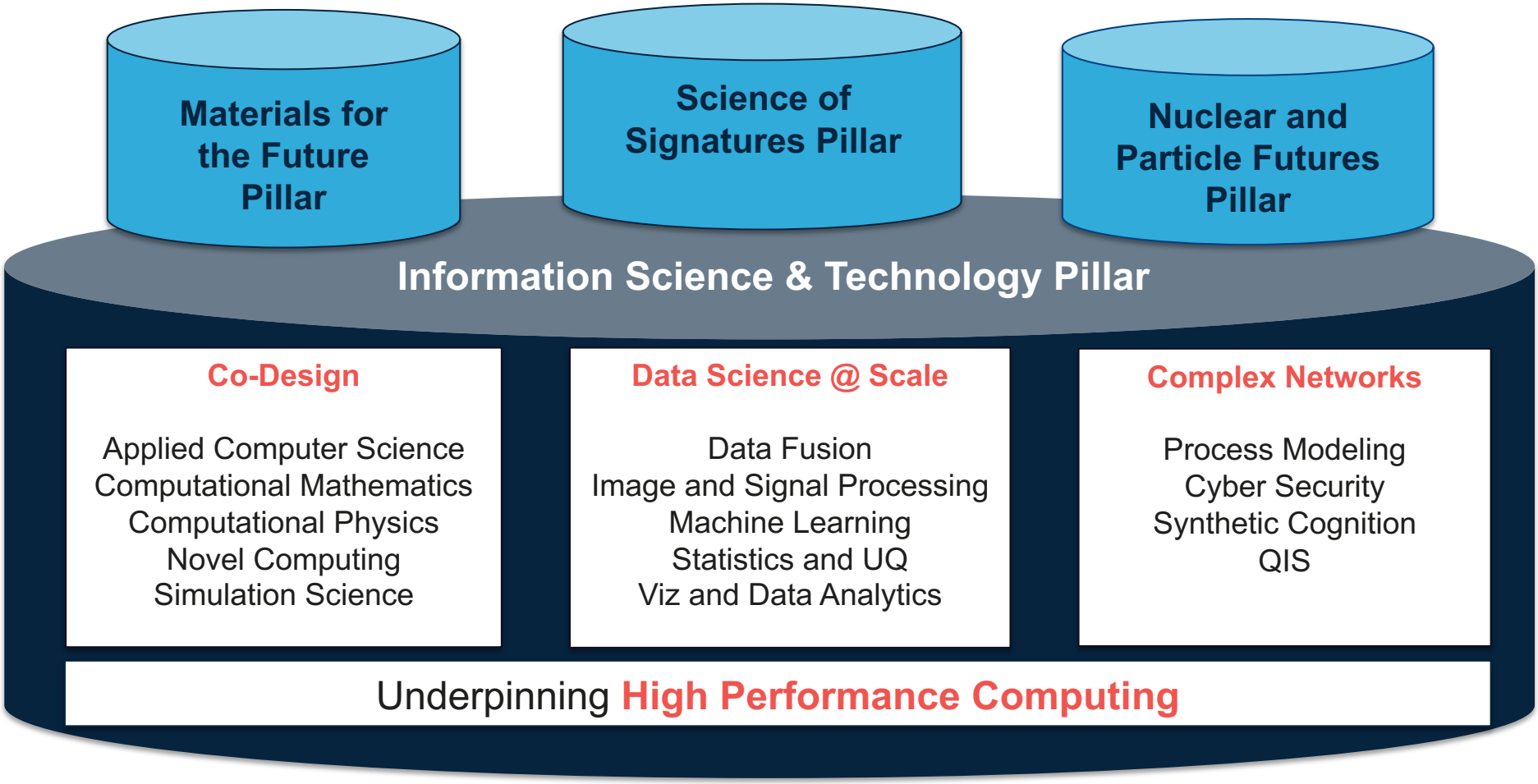
Los Alamos NATIONAL LABORATORY EST. 1943

Melissa Turcotte
Center Lead

https://isti.lanl.gov

NNSA National Nuclear Security Administration
Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

The Information Science & Technology Pillar is a key enabler of the LANL mission



ISTI activities support the IS&T Pillar with recruiting pipelines, revitalization of staff, expertise development, and bottom-up strategy input.

Main Activities

ISTI activities support the IS&T Pillar with recruiting pipelines, revitalization of staff, expertise development, and bottom-up strategy input.

Rapid Response

- D-Wave Quantum Annealer
- Quantum Programming IBM
- Hands-On Quantum Computing
- Novel Computing
- Data challenges (cyber, accelerator ops, HPC ops, resilient ML)
- Cloud Computing

Seminar Series

- 30+ talks each year by external IS&T speakers
- ISTI funds one week for external visitors
- Sub-series
  - In-situ inference (N. Urban, E. Lawrence)
  - Quantum Computing (D. O'Malley)
  - Resilient Machine Learning (J. Moore)

Summer School Program

- 3rd Quantum Computing
- 4th Applied Machine Learning
- 4th Cyber Security
- 5th Parallel Computing
- 10th Co-Design
- 10th Data Science at Scale
- 14th Supercomputer Institute

University Partnerships

- CMU: Reliable High Performance Computing
- Auburn University: Cyber Security Science

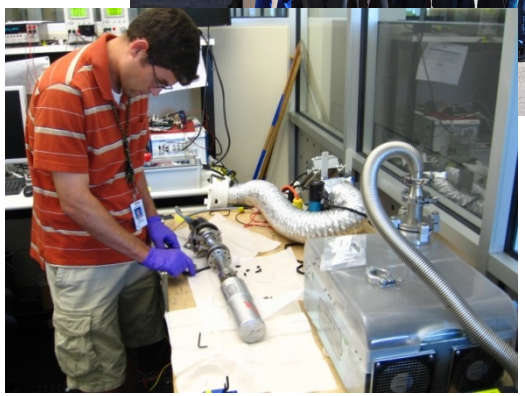
Workshops

- Conference on Data Analysis (CODA)
- Physics Informed Machine Learning
- Software Carpentry

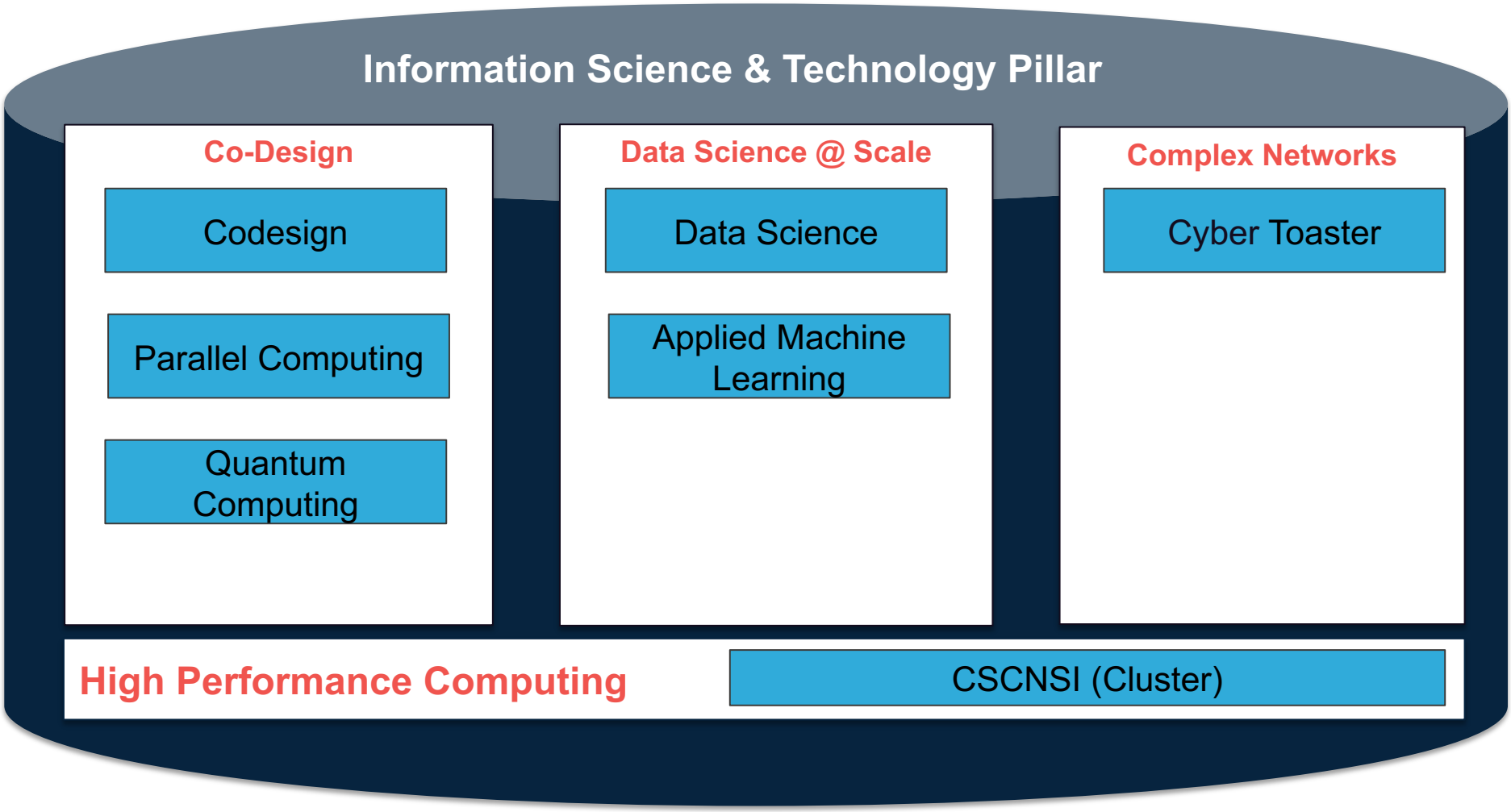
Summer Schools: What and Why?

Hands-On Lectures	Research Projects	Presentations Poster, Papers
Week1	Week 3- 4	Week 10-12

- "A summer school exhibits most or some of the following characteristics":
  - Student presence at LANL 10 – 12 weeks (in summer)
  - Structured environment (lectures, presentations)
  - Unifying technical topic relevant to IS&T strategy
  - Led by rotating school lead(s) who assemble a dedicated mentor team
  - Physical colocation of students
- Rationale:
  - Recruiting pipeline
    - School structure increases chances that students return to LANL
    - Exposing students to LANL National Security challenge overcomes recruiting disadvantages
  - In some LANL-unique technical areas, externally-offered courses simply do not exist or are not common

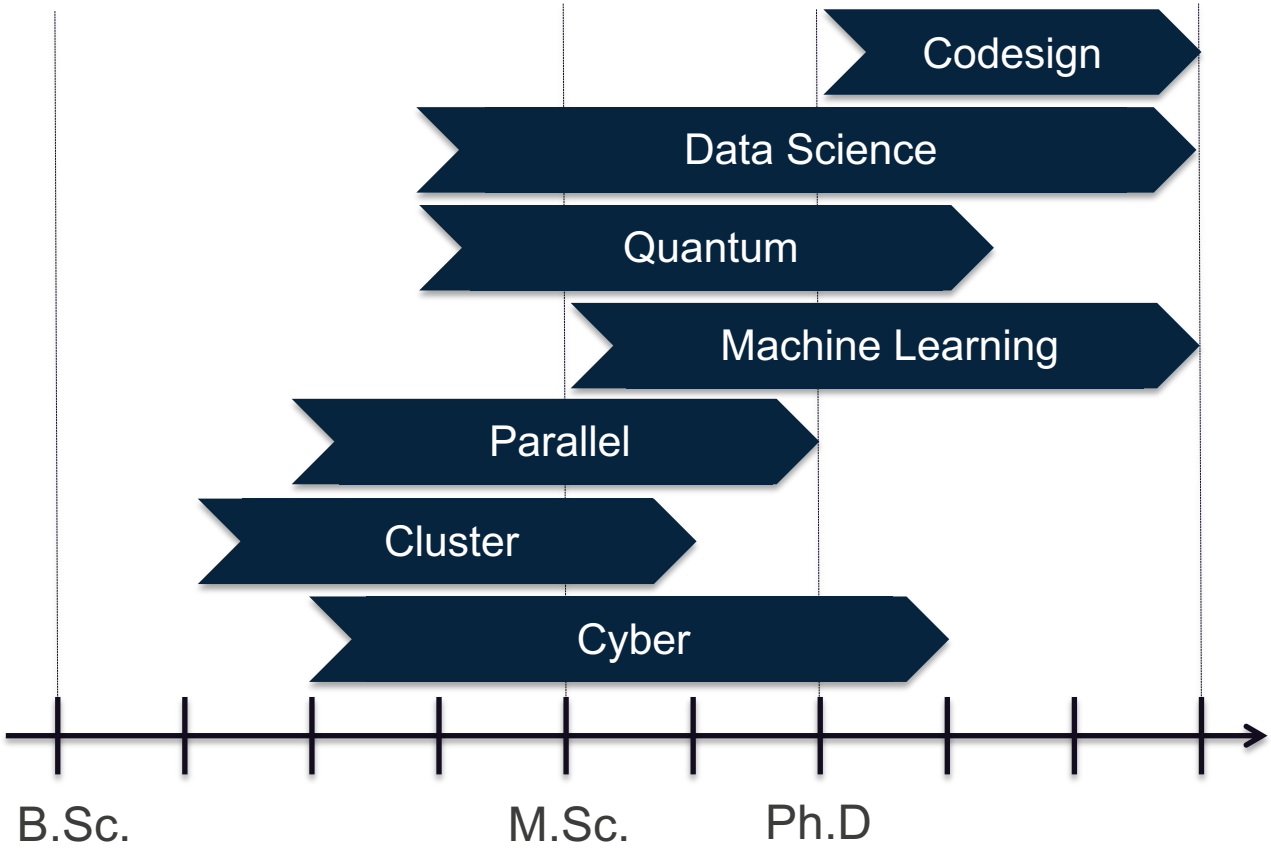


ISTI Summer Schools address strategic areas within the IS&T Pillar and fill recruiting pipelines



Advertising and Target Student

Target Student by School

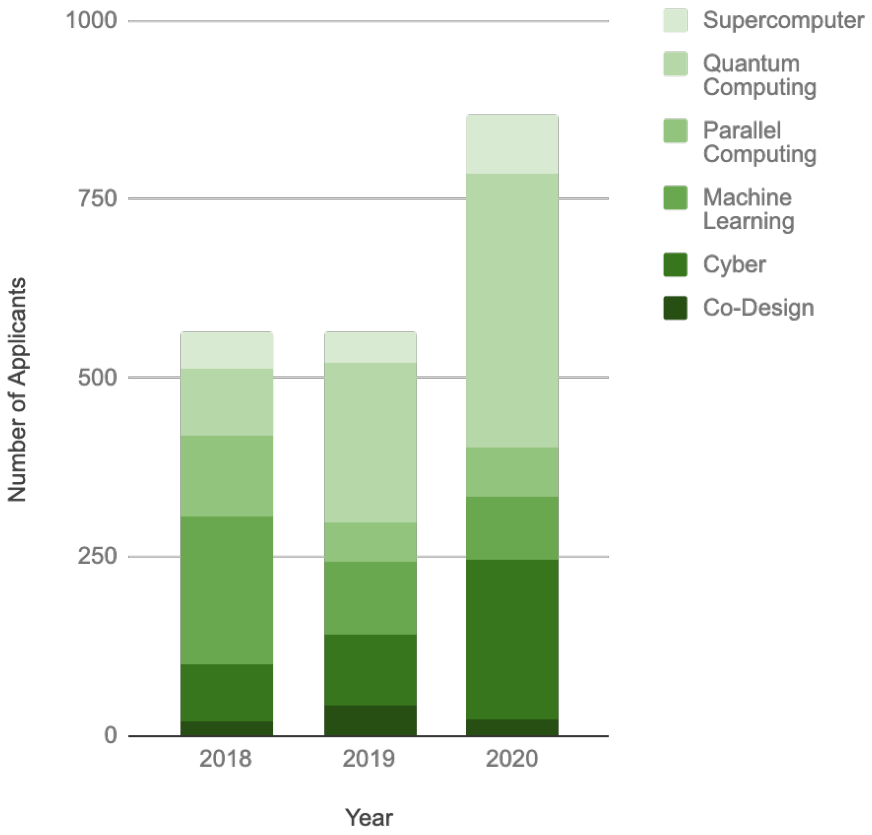


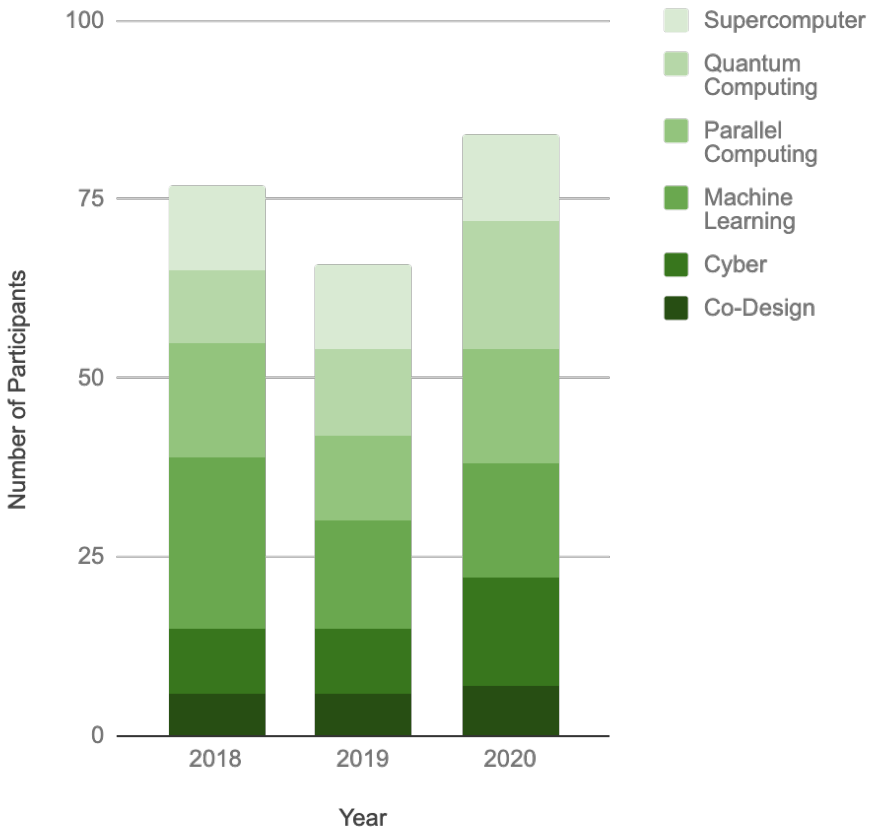
Advertising

- Careers fairs at colleges/universities
- Staff Alumni
- Word of Mouth
- Website
- Social Media
- Conferences
  - Super Computing
  - TAPIA – Diversity in Computing
  - Grace Hopper

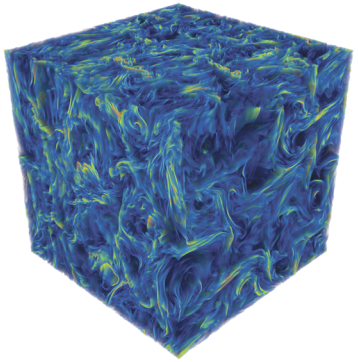
Many students return to individual mentors as students, become postdocs, or directly staff in many divisions

Applicants + Participants





Parallel Computing Summer Research Internship (PCRSI)



How do turbulent plasmas behave in star formation?

The Parallel Computing Summer Research Internship is an intense 10 week program aimed at providing students with a solid foundation in modern high performance computing (HPC) topics integrated with research on real problems encountered in large-scale scientific codes. Students will collaborate in teams to identify and investigate different computational problems and implement solutions with guidance from mentors with scientific and computational expertise.

Application Deadline: late January

Statistics

Started	2016
#Students per year	12-16
#Applicants per year	50-100+
#Students total	57
#Universities (FY19)	10
#Mentor Groups (FY19)	8
#Returnees to LANL	~30%

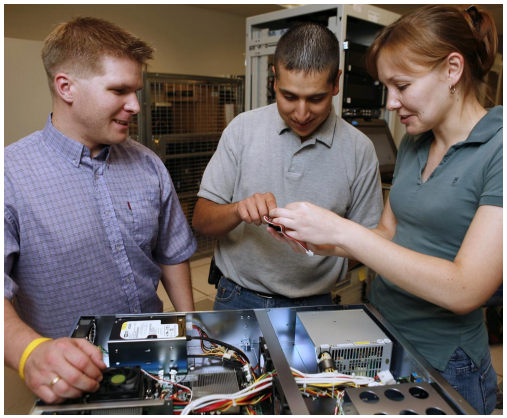
Example Projects

- Quantifying Uncertainties in Vector Particle-In-Cell
- Statistical Estimation via Variational Inference using MPI and GPUs
- Benchmarking sparse matrix solvers on CPUs and GPUs for nuclear reaction networks
- Enabling Performance Portable Exascale Atmospheric Simulations

Highlights

Conference posters: SuperComputing, SIAM
LANL Student Symposium Poster Winner 2017, 2018

Supercomputer Institute



Supercomputer Institute is a 11 week technical summer school program offering hands-on experience building and operating state-of-the-art and next-generation computer clusters, high-speed networks, extreme-scale filesystems, containers, security, and more. Students work in small project teams to execute real-world projects on computer clusters that they have assembled and configured.

Application Deadline: early December

Statistics

Started	2007
#Students per year	9-12
#Applicants per year	40-50
#Students total	151
#Universities (FY19)	11
#Returnees to LANL	~50%

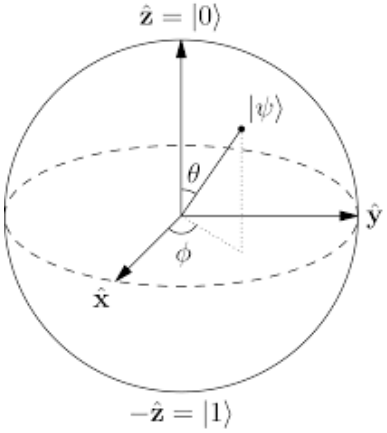
Example Projects

- Exploring Computational System Health Monitoring and Reporting Solutions
- sFlow Monitoring for Security and Reliability
- LayerCake Workflow: Incorporating Containers into an HPC Environment
- An Analysis of the Effects of the Spectre and Meltdown Patches on the Lustre Parallel File System

Highlights

- Recruitment to HPC, NIE, XIT
- Strong record of SuperComputing posters

Quantum Computing Summer School



The Quantum Computing School is an immersive 10-week curriculum focused on the theory, applications, and hands-on programming of quantum computers. In the first 2 weeks, students will attend lectures given by world-leading experts, from both academia and industry. In the following 8 weeks, each student will be paired with a mentor to work on a cutting-edge research project in quantum computing.

Application Deadline: late January

Statistics

Started	2018
#Students per year	10-18
#Applicants per year	150-350
#Students total	22
#Universities (FY19)	11
#Mentor Groups (FY19)	6
#Returnees to LANL	~15%

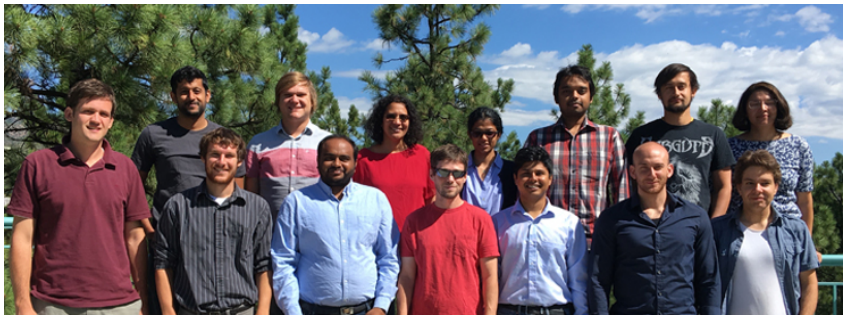
Example Projects

- Quantum Algorithms for Lattice Gauge Theories
- Efficient Quantum Algorithms for Computing Renyi Entropies
- The Neutrino Many-body Problem on a Quantum Computer
- Variational Quantum Linear Solver
- Noise Resilience of Variational Quantum Compiling

Highlights

- Many research papers (3-4 per year)
- Distinguished lecture series world renowned speakers such as John Martinis, Peter Shor and many more.

Applied Machine Learning (AML) Research Internship



The Applied Machine Learning Research Internship is an intense 10-week program is aimed at providing students with a solid foundation in modern machine learning (ML) topics combined with research on real problems encountered in national laboratory missions.

Application Deadline: late January

Statistics

Started	2017
#Students per year	12-16
#Applicants per year	80-100+
#Students total	53
#Universities (FY19)	13
#Mentor Groups (FY19)	4
#Returnees to LANL	~25%

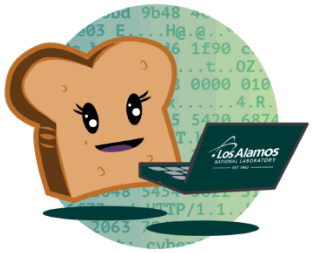
Example Projects

- Machine Learning for Analyzing Scientific Images
- Scientific Machine Learning for Subsurface Imaging
- Molecules and Materials: Atomistic Machine Learning
- Nonnegative Tensor Factorization for Machine Learning

Highlights

- Many research papers: ICCV, AGU, plus others
- LANL Student Symposium Poster Winner 2020
- Co-sponsored by CSES, CNLS + LDRD

Cyber Security Summer School



<cyber.toaster>

The Cyber Summer School ("Cyber Toaster") prepares students for careers in cyber security. The school has two tracks: incident response to learn the necessary concepts and skills to investigate cyber security incidents, or research to develop innovative solutions to help address national cyber threats.

Application Deadline: early December – late January, rolling acceptances

Statistics

Started	2017
#Students per year	9-16
#Applicants per year	80-200
#Students total	27
#Universities (FY19)	7
#Mentor Groups (FY19)	2
#Returnees to LANL	~40%

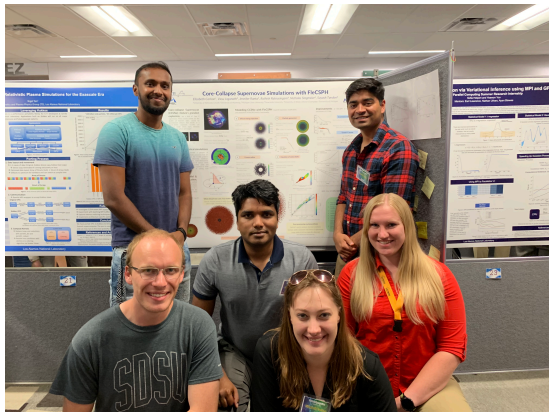
Example Projects

- Multi-modal Generative Models for Resilient Detection of Fake Data
- Secure & Assured Systems Research using Post-Quantum Cryptography & Zero-Knowledge Proofs
- Learning Critical Infrastructure in the Presence of Adversaries and Data Corruption
- Coordinating Incident Response to Advanced Threat

Highlights

- LANL Student Symposium Poster Winner 2020
- Co-sponsored by OCIO and Cyber Fire Program

Codesign Summer School



The Codesign School recruits 6-8 graduate students from varying backgrounds (usually computer science, computational physics, and mathematics) to work on a computational codesign topic on a specific application, such as kinetic theory, molecular dynamics, hydrodynamics, and astrophysics. Participants work together to solve a focused problem that is designed to build the skills needed to tackle the grand challenges of the future.

Application Deadline: mid February

Statistics

Started	2011
#Students per year	6-8
#Applicants per year	40-50
#Students total	56
#Universities (FY19)	6
#Returnees to LANL	~25%

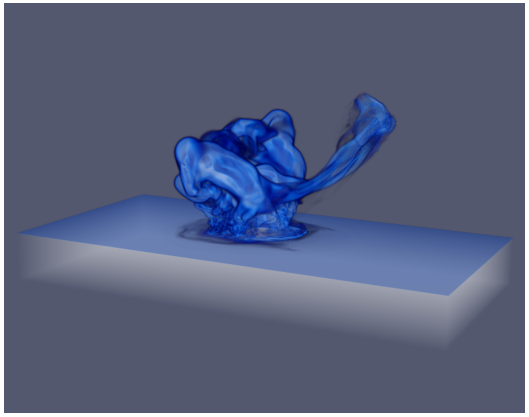
Example Projects

- 2017: Accelerated Molecular Dynamics
- 2018: Equation of State: Caching and Balancing Tables
- 2019: Performance and Stack Portability of FleCSPH- Core Collapse Supernovae
- 2020: Exploring Performance Portability of a Multi-physics Framework for Flow and Reactive Transport Modelling

Highlights

- Co-sponsored by ASC since 2014
- Many research papers and posters

Data Science at Scale Summer School



Students work together with computer and application scientists to produce prototypes that solve data intensive scientific problems relevant to LANL's mission. A key focus is placed on using big data technologies to gain insights from science data.

Application Deadline: late February, rolling

Statistics

Started	2013
#Students per year	10-25
#Applicants per year	50-65
#Universities (FY19)	3
#Mentor Groups (FY19)	2

Example Projects

- Extending Visualization Task Taxonomies for Scientific Users
- In-Situ-Dashboard: Enable Scientific Simulation and Data Visualization of HPC Data
- Finite-time Saddles from Particle Origin and Destination

Highlights

- Co-sponsored by ASC and many other programs
- Many research papers and posters
- Year-round students