IDEAS³

Integrated Data-Driven Discovery in Earth and Astrophysical Sciences

Northwestern CIERA

Center for Interdisciplinary Exploration and Research in Astrophysics

got bigdata?

Researchers in academia and industry are struggling to keep up with complex data sets – "BigData". The IDEAS program trains graduate students in interdisciplinary data-science techniques, bringing together courses in Earth & Planetary Science, Physics & Astronomy, and Electrical Engineering & Computer Science. Students earn a certificate in Integrated Data Science, have the opportunity to take communications workshops and summer programming & visualization workshops, participate in citizen science projects, and engage in a summer internship experience.

Traineeship Goals

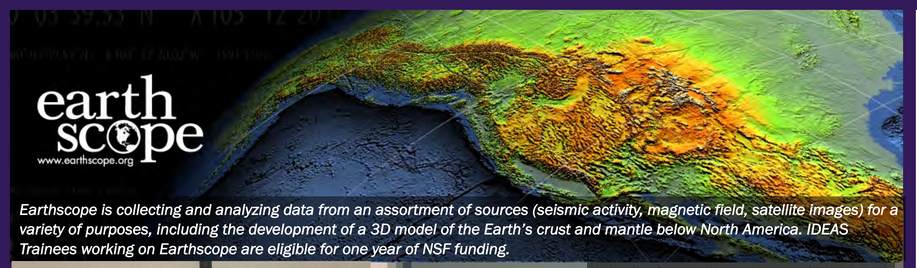
- Develop and implement interdisciplinary graduate training to advance the NSF's Large Synoptic Survey Telescope (LSST), Laser Interferometer Gravitational-wave Observatory (LIGO), and Earthscope projects, enabling students to become innovative researchers and to pursue successful, wide-ranging careers as data scientists.
- Prepare students to work in a collaborative, global scientific community by improving their leadership, communication, teamwork, mentoring, and management skills.
- Increase the number of students, including those from underrepresented groups, who pursue Data-Enabled Science and Engineering (DESE) research projects and enter DESE-related professional sectors.
- Help strengthen DESE-related training by expanding the availability of interdisciplinary course offerings and training activities. Create, refine, and broadly disseminate scalable, innovative models for STEM graduate education.

IDS Certificate

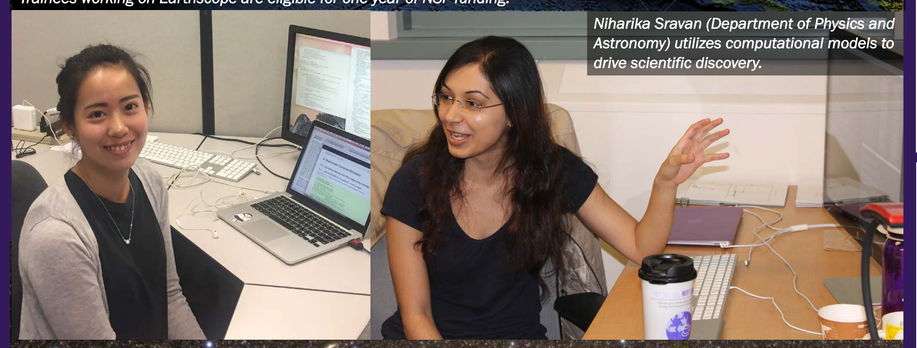
IDEAS Traineeship (MS/PhD Students)

IDEAS Fellowship Traineeship with Funding (PhD students)

- Citizen Science Project
- Weekly Meetings
- Summer Internship
- Communication Workshops
- Focus Summer Schools
- DATA_SCI 401 Data-Driven Research
- DATA_SCI 421 Statistical Methods
- DATA_SCI 422 Inverse Methods
- DATA_SCI 423 Machine Learning
- One elective from ~15 options



Earthscope is collecting and analyzing data from an assortment of sources (seismic activity, magnetic field, satellite images) for a variety of purposes, including the development of a 3D model of the Earth's crust and mantle below North America. IDEAS Trainees working on Earthscope are eligible for one year of NSF funding.



Niharika Sravan (Department of Physics and Astronomy) utilizes computational models to drive scientific discovery.

The Laser Interferometer Gravitational-wave Observatory (LIGO) project uses laser interferometry to detect extremely small ripples in space & time that are created when, for instance, black holes merge (above). Those ripples are known as gravitational waves; their direct detection opens up a "new window" on the universe. IDEAS Trainees working on LIGO are eligible for one year of NSF funding.

The Large Synoptic Survey Telescope (LSST) will transform astronomy by conducting a ten-year survey of the dynamic universe. The telescope will map the visible sky twice per week, mapping tens of billions of stars and galaxies, over its lifetime. LSST will, in essence, create an extraordinary movie of the sky; IDEAS Trainees working on LSST are eligible for one year of NSF funding.

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"Industry is looking for a magical mix of talent when they hire data scientists. They want quantitative expertise mixed with computational wizardry, a creative mind that can not only answer questions but infer the questions no one has yet thought to ask. Someone who will present those findings in impressive, visual ways to a non-technical audience, demonstrating what they know and how that information can best be utilized for the benefit of the company."

IDEAS *prepares students for these opportunities.*

Graduate Certificate in Integrated Data Science

Domain Data Science Course	Core Data Science Courses	Elective Data Science Courses (1 required)
DATA_SCI - 401 Data Driven Research in Physics, Geophysics and Astronomy (Earthscope - LIGO - LSST)	**DATA_SCI - 421** Integrated Data Analytics 1 (Statistical Methods for Physicists & Astronomers) **DATA_SCI - 422** Integrated Data Analytics 2 (Mathematical Inverse Methods in Earth and Environmental Sciences) **DATA_SCI - 423** Integrated Data Analytics 3 (Machine Learning: Foundations, Applications and Algorithms)	*Data Management and Information Processing* *Digital Image Processing* *Nonlinear Optimization* *Social Media Mining* *Numerical Methods for Random Processes* *Time Series Analysis* *Applied Bayesian Inference* *Statistical Methods for Data Mining* *Geospatial Vision and Visualization* *and more!*

Focus Summer Schools

Programming
- 1 – 3 weeks, on-line, self-paced

Visualizations
- 2 weeks
- principles of visualization design, user interaction
- basics of data access / organization

python, Ps, plotly, Bokeh, ParaView Parallel Visualization Application, matplotlib, GMT The Generic Mapping Tools, D3

Communication

RSG *Research Communication Training Program*
Turning Great Researchers into Great Communicators

Summer Internships

Argonne National Laboratory, CHASE, airbnb, the IRIS Consortium, NUIT Northwestern University Information Technology, LSST Large Synoptic Survey Telescope, LIGO

Citizen-Science Projects

IDEAS Fellows join in our collaboration with Adler Planetarium to create Citizen-Science projects. These projects allow members of the public to help analyze large data sets, contributing to scientific discoveries.

ZOONIVERSE