CORE Institute Curriculum

Fellows Virtual Bootcamp 2023: Sessions Descriptions

Week 1: Kick-Off (March 6-10, 2023)

March 7- The Power of Convergence Research - Douglas Maughan, Ilkay Altintas & Larry Smarr.

Broad introduction to the importance of Convergence Research with examples of the impact of projects that take this approach.

March 8- AI & Climate-Induced Challenges - Tapio Schneider & Jennifer Burney

While climate change is certain, precisely how climate will change is less clear. Markets and societies are beginning to demand fine-grained climate risk assessments that current climate models do not provide. The plethora of Earth observations available from space and from the ground, exponentially increasing computer power, and new AI tools promise to deliver breakthroughs in climate modeling. But questions remain how to combine these ingredients effectively and efficiently: Should computing power be invested in increasing the resolution of models as much as possible, or is it better invested in being able to run models many times, for example, for calibration and uncertainty quantification? How can we use AI tools, broadly understood, to learn about uncertain processes in climate models from noisy and diverse Earth observations? The panel will highlight the way in which progress in climate prediction can be achieved, for us to be able to proactively address climate change.

March 9- Responsible AI, Data Ecosystems & Climate Action - David Danks & Brad Voytek

The limited perspective of the long-term benefits of data sharing makes the costs of sharing data appear higher than they actually are. Panelists will discuss the relevance of creating ethical and responsible data ecosystems for scientific progress. The session will also emphasize the importance of developing transparent and explainable AI systems to ensure that we understand the ways in which new technologies advance (or not) our values and interests.

March 10- The CORE Fellows- Zaira Razu and John Bwarie

Fellows will meet each other and learn about their areas of interest and expertise through a "speed networking" guided session in breakout rooms.

Week 2: Foundations of Convergence Research (March 13-17, 2023)

March 14- Use-inspired Research- Michael Pozmantier and Shalini Vajjhala

Use-inspired research is motivated by the desire to solve real-world problems and meet practical needs. It is characterized by a strong focus on the application of scientific discoveries and an emphasis on collaboration between researchers and practitioners from different fields. Panelists will discuss how to identify use-inspired research problems that can generate new knowledge and technologies to improve people's lives and address societal challenges.

March 15- Scientific discovery and Innovation - Chaitan Baru and Beatriz Martinez

Convergence research requires making a compelling case for how the project will catalyze scientific discovery and innovation in the context of addressing a specific scientific and/or societal challenge. The panelists will discuss how to approach research projects with reference to an existing scientific body of knowledge and will describe their experience integrating this knowledge, methods, and expertise across disciplines to achieve societally relevant outcomes.

March 16- Team Science- Judith Olson

Team science is a research approach that emphasizes the interdisciplinary and collaborative nature of scientific inquiry. Effective teams require the integration of diverse perspectives and skills, as well as the creation of a supportive and inclusive environment that encourages open communication and collaboration. The panelists will highlight the importance of social and interpersonal factors in team science, such as communication, trust, and shared goals. The fellows will learn about effective collaboration and interdisciplinary teamwork as a way to tackle complex and multifaceted scientific problems that cannot be solved by individuals working in isolation.

March 17- Project Sustainability - Dan Atkins and Melissa Floca

The urgency of climate-induced challenges requires accelerating the pace at which we develop science-based solutions. Convergence research involves designing pathways for projects to be integrated into the real world. But many convergence research projects that offer innovative solutions to important use-inspired problems stumble when it comes to project sustainability. The skills to scale solutions outside of the research setting go far beyond traditional academic approaches and include a focus on financial viability at scale, integration into existing structures/systems, and user adoption. This requires an entrepreneurial mindset and the flexibility to adapt and pivot.

Week 3: Fighting Wildfires with AI (March 20-25, 2023)

March 21- Fire Science and Fire Management- Max Moritz and Kevin Hiers

A century of wildfire suppression has created an overabundance of fuels and unnatural ecosystem states. Now when wildfires occur, they are often much harder to suppress, leading to an increase in frequency of devastating fires that risk human life and property, and destroy ecosystems. The past decade has demonstrated the fact that today's predominantly reactive approach is not working. The practitioner and science community agree on the need for a new proactive approach to wildland fire, including accelerating the reintroduction of "good fires" to the landscape through prescribed fire in order to reduce incidence of severe "bad fires".

March 22- 3D Fire models- Rod Linn and Scott Pokswinski

In recent years, fire scientists have created high-resolution, 3-D models to predict how a fire will evolve based on ignition patterns, weather and wind conditions, topography, and types and amount of vegetation. These models have the potential to be a game changer for burn managers, but using them often requires sophisticated technical knowledge and a significant investment in bringing together the necessary data. The BurnPro3D platform was envisioned from inception as a tool to help burn managers use next-generation data and models to understand risks and tradeoffs quickly and accurately to plan and conduct prescribed burns more effectively.

March 23- Cyberinfrastructure and AI for Wildfire Mitigation - Ilkay Altintas & Yolanda Gil

Currently, wildfire related data, models and interfaces exist in silos. BurnPro3D uses a WIFIRE Commons framework for open data and model sharing on top of the WIFIRE CI, maintained by continuous curation through an AI Gateway using innovative AI methods. Cataloging, curating, sharing and discovering data and optimizing the integration of data sets for application-optimized modeling tools are potentially the biggest enablers for progress in data-driven wildland fire science.

March 24- Fellows Discussion and Workshop II- Zaira Razu and John Bwarie

Week 4: AI for Hydrologic Forecasting (March 27-31, 2023)

March 28- Software Challenges Developing Community Hydrologic Modeling Platforms- Nirav Merchant & Laura Condon

Simulations of rapidly changing ecosystems require high computational resources. An advanced cyberinfrastructure is key to building sophisticated and comprehensive hydrological models over a national scale. This infrastructure must be able to handle the large amounts of data and provide a platform for users to access and analyze the data. The team is working to build (1) a front end user interface that requires no training or experience programming or data handling (2) back end workflows for machine learning model training and testing. They are also constantly balancing the demands on their small software team and looking for pragmatic solutions. This panel will discuss the team's approach to platform development and how they have worked closely with the Cyverse project at UA. We welcome discussion on FAIR data and software challenges at the interface between research and operations.

March 29- User Centered Design to Advanced Hydrologic Models and Water Management – Lindsay Bearup & Laura Condon

Panelists will discuss Hydrologic Scenario Generation (HydroGEN) and how machine learning can be used to model rapidly changing ecosystems. HydroGEN can be used to predict streamflow, soil moisture and groundwater quantity and location. This session will focus on HydroGEN's team approach to user centered design. There are many open scientific questions in hydrologic forecasting. The panelists will discuss how they worked with potential users to determine the scope of the project. They will also explore the potential for collaborative partnerships between government, industry and academic institutions and welcome discussion on the value and pitfalls of applied science.

March 30- Interdisciplinary machine learning research to push hydrologic science forward- Peter Melchior & Laura Condon

Watersheds are complex non-linear systems that have long been a challenge to predict. Challenges are further amplified in a warming climate where historical observations are no-longer a reliable guide for the future. HydroGEN's team includes domain experts in hydrology and hydrologic modeling as well as experts in machine learning that are not hydrologists. Panelists will discuss the research progress of their team as well as how they are able to work together. We welcome discussion on the challenges and opportunities of interdisciplinary research.

March 31- Fellows Discussion and Workshop III - Zaira Razu and John Bwarie

Week 5: Proposal Ideation (April 3-7, 2023)

April 4- Webinar: Online Collaboration- John Porten

In this session, fellows will receive an overview of the challenges attendant to managing teamwork in online and hybrid environments. Fellows will learn the most important strategies for cultivating creativity, trust, and accountability among team members, and get a sense of the resources the CORE Institute staff (particularly John Porten) can provide as you move forward with your team proposals.

April 5 and 6- Fellows 1 min. Presentations-

April 7- Webinar: Pitch preparation

Topics covered: Timeline, format, evaluation committee and criteria, elements of a good pitch

Week 6: Pitch Preparation (April 10-15, 2023)

April 10 and 11- Office hours for team formation/pitch preparation-

April 12- Webinar

Goal: Discuss challenges of working with researchers to incorporate new scientific advances into solutions to real world problems. Practitioners from different sectors, including local and federal governments, nonprofits, and the private sector, will discuss the challenges they have faced and the strategies they have developed to overcome these.

Moderator**:** *Lydia McClure*- Program Director for the Innovation-Corps (I-Corps) program at the National Science Foundation (NSF)
Participants **:**

- Federal Government: *Russ Parsons*- Research Ecologist, US Forest Service
- Local Government: *Andrell Bower*- Chief Data Officer, City of San Diego
- Private Sector: *Ethan Jackson*- Senior Director and Principal Researcher, Microsoft Healthcare
- Nonprofit Sector: *Melisa Leñero*- Senior Design Strategist & Manager- International Development Enterprises

April 13 and 14- Hands-on team breakout sessions
The CORE team will be available for questions and general feedback at noon, PT, on our usual zoom link. We will also facilitate presentations for fellows still looking for a team.