Experimental collaborations
- Bigger, spread over continents
- CMS and ATLAS ~ 8000 users, DUNE - 1200 users

Big, distributed computing resources, manpower
- Detectors building, instrumentation and detector operations require expertise takes years of experience and involvement
- Large data set volumes to process
- Emerging technologies, novel techniques, disruptive changes (COVID, architecture, ideas)
- Investment in organised training (hands-on)
  - Mitigate some of the above challenges
  - Build future workforce
  - Careers in HEP or other STEM areas
- Organised Software Training is essential
Workforce Pipeline

Training is integral to the success of HEP
Training Efforts

Several synergistic players and drivers
Paradigm

- No standard curricula for HEP students exists
- Not all HEP students can attend university-offered software courses
- HEP students in many cases don’t receive any programming training
- Students trained as physicists but asked to be data analysts

We need a **unified, scalable, and sustainable** software training framework powered by the entire community

Experiments need Cyberinfrastructure professionals and lifelong learners

**Democratize science** by making software prerequisites accessible to everyone

HSF/IRIS-HEP is leading training efforts
Software Training

- **Software training** hub for new researchers in
  - High Energy Physics
  - Related communities - Nuclear, Neutrino, Astro, Theory

- **Skills are essential**
  - To produce high-quality and sustainable software needed to do the research, solve future challenges

- **Thousands of users in the community**
  - Sustainability (challenging) is the centerpiece of its approach

- **The training modules are**
  - Open source - GitHub, Slack, Websites, Indico, youtube videos
  - Enable technical continuity, collaboration and nurture the sense to develop software that is reproducible and reusable

- Made huge input impact to Snowmass 2021 process on Community Engagement Efforts

- Training Scientists, Postdocs, Graduate Students, Undergrads
- Broader Impacts - Training High School Teachers, diversity
- Pivotal Role in making training integral of HEP future
Scalability and Sustainability

Most training modules are website built from easy-to-read source files

< Complete video walkthroughs!

^ Lessons build on each other

^ Enough verbosity for self-study

Weekly meetings
Community pages
Monthly hackathons
Slack
Recognition

Modules build on each other
# Publications and Visibility

## Training Talks & Papers

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Title</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022-10-12</td>
<td>talk</td>
<td>HSF / IRIS-HEP Training Activities (Coordinated Ecosystems Workshop)</td>
<td></td>
</tr>
<tr>
<td>2022-09-12</td>
<td>talk</td>
<td>Training Challenge (IRIS-HEP retreat)</td>
<td></td>
</tr>
<tr>
<td>2022-09-05</td>
<td>talk</td>
<td>Teaching Python the Sustainable Way: Lessons Learned at HSF Training (pyHEP 22)</td>
<td></td>
</tr>
<tr>
<td>2021-02-28</td>
<td>paper</td>
<td>Software Training in HEP</td>
<td>Published in CSBS</td>
</tr>
<tr>
<td>2021-06-29</td>
<td>talk</td>
<td>Software Training and Sustainable HEP</td>
<td>Video available</td>
</tr>
<tr>
<td>2021-05-21</td>
<td>talk</td>
<td>Software Training in HEP</td>
<td>Video available</td>
</tr>
<tr>
<td>2020-11-19</td>
<td>talk</td>
<td>Community building</td>
<td>Video available</td>
</tr>
<tr>
<td>2020-11-19</td>
<td>talk</td>
<td>HSF Training: Making &quot;that thing my postdoc taught me once&quot; available for everyone</td>
<td>Video available</td>
</tr>
<tr>
<td>2018-07-08</td>
<td>paper</td>
<td>HEP Software Foundation Community White Paper Working Group - Training, Staffing and Careers</td>
<td></td>
</tr>
</tbody>
</table>
Broader Impacts

- Software awareness and skill development among high school students via teachers
- Developed Software module
- Coding Camps
- Relation with community of teachers to expand and sustain our efforts
- Access to wider community of teachers to get software training
- Breaks barriers and enables diversity
USCMS Internship Program

- Gives minoritized, MSI and HBU students opportunity for HEP tools
- Software Training Curriculum provided by HSF/IRIS-HEP

US CMS Undergraduate Internship

Program Description

The US CMS Summer Undergraduate Research Internship Program seeks to address the under-representation of women and minoritized students in STEM fields, in particular Physics. It is a 10-week paid internship program, which offers female and minority undergraduate students an opportunity to perform a project under the mentorship of scientists working at the frontier of Physics at one of the 50+ institutions in the US.

The internship program is open to students pursuing physics, engineering, computer science, math, chemistry, or related majors. We aim to strengthen our research by increasing diversity.

The research internships will be structured to encourage students to persist in a STEM major through college and to train them in skills needed for a future career in the STEM workforce, in order to sustain a diverse and inclusive talent pool in research and innovation.

This immersive research internship opportunity will cover areas in instrumentation, technology, and computing projects. Students will use computational tools and data-science methods to learn about fundamental particles and their interactions, by analyzing data obtained from the CMS experiment at the Large Hadron Collider (LHC) located at CERN, Switzerland. The pool of mentors are physicists from US institutes affiliated with the CMS experiment at the LHC and at the rank of university faculty, scientists from national labs, postdoctoral fellows, and advanced graduate students.

The program is funded by U.S. Department of Energy RENEW-HEP: U.S. CMS SPRINT award at Tougaloo College, Brown University, University of Puerto Rico (Mayaguez), and University of Wisconsin; and the U.S. CMS Operations program at Fermilab and the University of Nebraska-Lincoln.

Questions about the US CMS internship program can be directed to Sudhir Malik

Key Dates

- Application Period
  - Dec 12, 2022 – Jan 31, 2023
- Program Dates
  - June 5, 2023 – Aug 11, 2023
- Acceptance Date
  - March 31, 2023

Application is Closed

Fill out the online application and be prepared to present any other application requirements.

Contact Information

Email
<table>
<thead>
<tr>
<th>Training and on-boarding initiatives in HEP</th>
<th>Allison Reinsvold Hall (US Naval Academy)</th>
<th>8 May 2023, 11:45 15m Marriott Ballroom I (Norfolk Waterside Marriott) Oral Track 8 - Collaboration, Reinterpretation, Outreach and Education Track 8 - Collaboration, Reinterpretation, Outreach and Education</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Train to Sustain</strong> (This Talk)</td>
<td>Sudhir Malik (University of Puerto Rico Mayaguez)</td>
<td>8 May 2023, 12:15 Chesapeake Meeting Room (Norfolk Waterside Marriott) Oral Track 5 - Sustainable and Collaborative Software Engineering Track 5 - Sustainable and Collaborative Software Engineering</td>
</tr>
<tr>
<td>Building a Global HEP Software Training Community</td>
<td>Kilian Lieret (Princeton University)</td>
<td>9 May 2023, 17:30 Marriott Ballroom I (Norfolk Waterside Marriott) Oral Track 8 - Collaboration, Reinterpretation, Outreach and Education Track 8 - Collaboration, Reinterpretation, Outreach and Education</td>
</tr>
<tr>
<td>Software Training Outreach In HEP</td>
<td>Cordero, Danelix (CROEM High School, Mayaguez, PR)</td>
<td>11 May 2023, 11:45 Marriott Ballroom I (Norfolk Waterside Marriott) Oral Track 8 - Collaboration, Reinterpretation, Outreach and Education Track 8 - Collaboration, Reinterpretation, Outreach and Education</td>
</tr>
</tbody>
</table>
Thank you to the organisers for the opportunity to give this talk

Thank you to all contributors to HSF/IRIS-HEP Training

https://hepsoftwarefoundation.org/training/community.html