Pay to Teach and Learn

A proposal to making “research-teaching” *more* worth it

Description/Motivation

One of the key components involved in the HSF-Training mission plan is the creation of an “Essential HEP Core Curriculum” for computing. The creation of a full training involves both the development of a lesson webpage (e.g. CI/CD) as well as a set of standalone training videos (e.g. CI/CD videos). Over the past year, a number of tutorials have been developed by members of the community and they are at various stages of completion from being merely ideas, to being fully supported trainings (e.g. CI/CD above). This has happened on a *volunteer* basis and while this has been encouraging, it is not sustainable to solely rely on the good intentions of the community to drive progress. Moreover, the creation of a training amounts to a considerable time investment on the part of the instructors. It requires approximately 50 hours to create a lesson and between 20-30 hours to record the standalone videos. This amounts to a considerable time investment at the expense of taking time from their ongoing research activities.

On the other hand, teaching requires that there be an engaged audience who is invested in learning. Though at face value, it is commonly believed that providing educational resources for researchers is enough, the erroneous need to multi-task has been impressed by our community on our community, thereby creating educational audiences who try to check emails or perform analysis tasks during in person workshops and who, during virtual workshops, de-prioritize the work of learning. “It can always be done later,” is a common mentality for learning. In reality, by internalizing new skills, a student or researcher will become better equipped to be more efficient in the future. The challenge for educators lies in providing the appropriate motivation to engage and have the individual *commit* to learning in a focused way.

This is a proposal to IRIS-HEP to augment this model and offer *financial* rewards for the development of training content as well as their learning. We argue that this provides a more sustainable training model as it would create high-quality and distributable content that can be implemented in virtual training environments. This would also mitigate the issue of audience engagement, thereby making each training event more effective. Both of these features will lead to considerable financial savings by saving on travel expenses for instructors or participants of similar trainings and creating a more effective research workforce.

Pay to Develop

Developing the first iteration of a full set of content for the HSF Core Computing Curriculum is essential to the long-term success of the HSF-Training group. To help achieve this, we propose to implement a "marketplace"-like funding mechanism whereby we recruit "fellows" to produce singular Carpentry-style lessons. This will both accelerate the develop of content and serve to increase the size of the community.

Content Targets

The HSF Core Computing Curriculum was initially developed in the context of the February 2020 IRIS-HEP BluePrint Meeting. As you can see, lessons are at various stages of development and fully "complete" modules have both a lesson and a set of videos. These two stages of development can be undertaken by two different individuals and as such, awards can be provided incrementally and accommodate individuals who may not wish to actively teach but only develop web content. On the other hand, it also increases the pool of possible award recipients because many individuals enjoy teaching but are not expert enough to develop the initial lesson content. Completed lessons and videos are broadcast via the HSF-Training Curriculum page.

1. Version control/Git [From Carpentries]
2. Advanced Git
3. Python foundations [From Carpentries]
4. Building programs with python
5. Data analysis: numpy, pandas
6. Advanced data analysis
7. Advanced python and pyroot, uproot [Developed from HSF]
8. Build systems: from gcc to cmake [Developed from HSF]
9. Continuous Integration: Why and how? [Developed from HSF, Videos from HSF]
10. Docker and Containerization [Developed from HSF, Videos from HSF]
11. Unix (shell, bash, scripting, ...) [From Carpentries]
12. Advanced Unix/terminal
13. Jupyter notebooks and Binder/SWAN
14. ROOT
15. C++
16. Package managers and RPMs
17. Distributed file systems (mounting, access protocols, …)
18. Batch systems/schedulers
19. Distributed computing and "the grid"
20. Best practices from software engineering
21. Text editors and IDEs
22. Authentication (SSH/keys/tunneling)
23. Machine Learning
24. Debuggers (gdb, valgrind)
25. Parallel programming
26. Workflows & Reproducibility
27. Documentation (doxygen, sphinx, readthedocs…)
28. Event generation Monte Carlo (pythia, sherpa, madgraph, …)
29. GEANT and Material Simulation

Award Design

Awards will be competitively advertised and awarded as short term “Visiting Pedagogy Fellowship” with IRIS-HEP. These will be in a similar spirit as the existing IRIS-HEP Fellows program - https://iris-hep.org/fellows.html - but the topic of these will be considerably more constrained in scope. That is, the application will be tied to a specific project and deliverable. These will be for a limited duration of between three and six months. It is expected that the activities will not replace the ongoing research activities of the individual but that this appointment can augment their professional program and be carried out in parallel. In some sense, this can be thought of as an academic side-hustle.

Based on anecdotal experience during the past 1.5 years, it has been found that developing a new training module (i.e. a three hour lesson) takes approximately 40 hours of work time. The pre-tax hourly wage of a graduate student is estimated to be 12.5 USD/hour [25000 USD / (40 hrs/week * 50 weeks)] and that of a post-doctoral researcher is approximately 30 USD/hour [60000 USD / (40 hrs/week * 50 weeks)]. To make this a competitive fellowship and fulfill the mission of monetary incentivization, we propose to pay at a rate of 50 USD/hour of work. As such, bringing a module to completion and delivering a webpage (e.g. CICD Training) will be worth 2000 USD. This will come with no requirement to provide training videos but upon application, the option will be available to elect to provide training videos, which is an aspect of the Pay to Teach paradigm described here as well. During the fellowship period, the individual will be paid this fixed sum of money in two installments, one at the beginning of the fellowship and one at the end, upon successful delivery of the work. The degree of completion will be gauged by IRIS-HEP as well as the HSF-Training group.

Application Process

Lesson development targets will be advertised on a rolling basis with a “batch” of training materials which the group wishes to develop or revise. The desired goal for each development module will be laid out and applications will be solicited for a period of a month. The IRIS-HEP board and HSF-Training conveners will review all submissions and award the short-term fellowship

Pay to Teach

Teaching takes time. Even if the content exists, it must be effectively contextualized and communicated to students and made so as to allow those students to internalize it effectively. If this is not done well then students will not be able to apply it to their own research. Doing this well takes a non-negligible amount of time that detracts from efforts for research of those performing the teaching. As such, it should be compensated.

Award Design

This will function in a similar way as to the Pay to Develop awards. However, we will be granting individuals awards not for developing the content but for communicating the content to others. This can be done both as an Instructor and/or a Mentor as described by HSF-Training. In either case, the award will be granted as a "Short Term Educator" role.

In the virtual paradigm, instructors are those that create the training videos. Those who develop the original content will be given priority and asked upon their application if they wish to take this on. However, it is entirely possible that a different individual create the training videos. The creation of a set of training videos, because new novel intellectual material is not being created, is valued at half of the content development, being 1000 USD/lesson. If the awardee elects to not provide videos, a new fellowship opportunity can be opened to attract those with teaching experience to supplement the training materials with videos, still for an award of 1000 USD.

Finally, in the virtual paradigm, the role of Mentor is one that is low commitment, but requires energy and proactive engagement. As such, being a Mentor at a training session for a single module is valued at 100 USD. As such, if the workshop consists of three modules (i.e. February 2020 Analysis Preservation Bootcamp) then we would value participation of a mentor at 300 USD.

Application Process

The application process to become eligible to be an instructor or a mentor will occur on a rolling basis. Upon completion of a training course, all participants will be asked if they would like to join the training community, as is currently done in post-workshop surveys. There will be an application form that asks the potential educator to list their competency in a set of skills. If they are competent, as gauged by IRIS-HEP and the HSF-Training, then once a sufficiently large number of applicants has been found, we will hold a training course to describe the pedagogy of the training and how to go about teaching. The precise contents of this course will draw upon the training performed by Software Carpentries.

Once an individual has undergone this training, they can then begin to volunteer to be a paid mentor at any course in the curriculum.

It should be noted that only courses organized by HSF-Training or IRIS-HEP can qualify for this payment

Pay to Learn

Virtual environments for online learning provide the ability to potentially reach orders of magnitude more participants. However, the breadth of that reach is useless if those participants are not engaged in the lesson. Such has been the case at a number of events throughout the Covid-19 pandemic and it is common for there to be a 50% attrition rate between registration and attendance. Moreover, it has been found that the reward of “learning new skills” does not work because individuals often try to multi-task and continue their normal activities during the event, meaning that they simply do not learn. Here we outline a mechanism to incentivize engagement using money - i.e. pay people to attend educational events.

Award Design

As with the teaching award, the design will be given the context of a short term “Educational Award”. The ultimate goal is to reward students for being present and engaged during the educational event. However, the uniquely challenging aspect here is that unlike in Pay to Teach, the deliverable is considerably less well defined and very challenging to gauge. As such, it is necessary to design a mechanism to promote “buy in” by the students so that they stay engaged, but will reward them in a net positive way. As such, we propose the “Register and Return” system that operates as such :

[1] Registration : Students registering for the event pay a normal non-negligible registration fee of a hundred (100) USD. This means that the student has teeth in the game. They can do whatever they want but if they skip out on the event and don’t cancel with sufficient lead time, their money is lost.

[2] Event and Evaluate : The event proceeds as normal, and along the way, there are “attendance” checkpoints that the students must fulfill to ensure they are “present”. The evaluation will come in the form of the students in-person mentoring session which is intended to provide the one on one instruction.

[3] Return : If the student is found to have fulfilled the attendance checkpoints and the in-person session, then they are returned a sum of money which is greater than their registration fee. In this sense, they are incentivized to participate throughout the entire event. For example, they are returned 200 USD. There will be only one return amount so as to not have a conflict of interests and it will be almost entirely based on participation in [2].

In this system, there is buy in from the student and a period of evaluation so that the number of participants is more regulated, making the process of planning easier for any given event.

Application Process

The application process will be part of the normal registration process. All admitted students will be required to pay this fee and participate knowing this agreement. There will be no additional application beyond that which is already in place for a normal registration.

The only stipulation is that since participants are earning money, they can only participate in one workshop on a given topic. If in the future, a similar workshop is held and they would like to earn money, then they will be welcome to do so as an Instructor or Mentor.

Cost Analysis : A Case Study

Canonical Workshop

As an example, one of the early IRIS-HEP training events (https://indico.cern.ch/event/816946/) held at Berkeley catered to 30 students with 10 instructors. This was held at a total expense of approximately 27000 USD from various funding sources. This money was divided as such :

- Travel/Housing for Instructors : 4700
- Travel/Housing for Participants : 13000
- Food/Snacks : 4000
- Software Carpentry Trainers : 2000
- Additional IRIS-HEP Instructor : 1200
- Additional US-ATLAS Instructors : 1800

This should be added to the total amount of money spent by students which was approximately 700 USD/student, which supplemented the funding provided by the program listed above as “Travel/Housing for Participants”. This amounts to an additional 21000 USD. The total expenses for this training event are therefore approximately 48000 USD for which the material of four training modules was taught.

The primary benefit in this scenario is that the students are fully engaged during the training, presumably to their intellectual benefit.

New Paradigm

With the Pay to Develop/Teach/Learn paradigm, the expenses for this same workshop would amount to be 19000 USD and as follows :

- Content Development
    - Lesson Development : 2000 * 4 = 8000
    - Video Creation : 1000 * 4 = 4000
- Mentor Costs : 10 mentors * 4 modules * 100 USD/(mentor*module) = 4000
- Participant Costs : 30 participants * 100 USD net return/participant = 3000

This is less than half the cost of the canonical format!

Moreover, the primary cost in this new paradigm is in content development. However, because of the format of our training events which focus around pre-recorded lectures, this is a fixed cost which will not be incurred for future events using this same training module. As such, the real cost is that of the mentors and participants, which is less than half of that.