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Changes at the NSF and Computing in the Physics Curriculum

When I last wrote this column,[1] the subject was the future of advanced computing at the US National Science Foundation (NSF). At the risk of sounding like I have a one-track mind or perhaps a Track 1 mind (sorry, I couldn't resist the pun), I want to revisit that topic and also talk about a recent experience with the Partnership for Integration of Computation into Undergraduate Physics (PICUP) program.

In 2013, the Office of Advanced Cyberinfrastructure (OCI) was moved from the Office of the Director at the NSF to the Computer & Information Science & Engineering (CISE) Directorate and renamed the Division of Advanced Cyberinfrastructure (ACI). Many people were concerned about this because the OCI funds the supercomputing centers that are so essential for many of the foundation's directorates. The move into CISE could have set up funding competition between internal CISE needs and external requests from those who rely on supercomputers for their research. My last column mentioned the review that was undertaken by the NSF regarding the ACI's placement. In November 2016, at the National Science Board meeting, NSF Director France Córdova announced the findings of the review and decisions about the ACI's future (http://tiny.cc/n64ajy).

The upshot is that the ACI is to remain within CISE; however, it will revert to its old name, the Office of Advanced Cyberinfrastructure, and be endowed with a new acronym, the OAC. Adding "Office" to the title is seen as acknowledgment that the OAC will be serving all of the NSF, not just CISE. The OAC budget will be set as in the past, that is, through discussions with leadership of the OAC, CISE, and the Office of the Director. What would seem to be a very positive step is that the Director of the OAC will "actively participate in the NSF's senior management meetings, providing an OAC voice and visibility in key agency decisions." Another change is that there will be a national search when a future Director of the OAC is to be selected. Such searches are typically done for senior leadership positions such as assistant directors. The current leader, Irene Qualters, has been doing an excellent job, and I hope she continues for a long time. However, it's good to hear that future searches will be so thorough. Also of note, the Advisory Committee for Cyberinfrastructure, which provides outside advice, will continue.

In addition, the NSF has requested input on "Future Needs for Advanced Cyberinfrastructure to Support Science and Engineering Research (NSF CI 2030)." The deadline for input, 5 April, will occur before this column appears, so I'll be brief. My last column also reported on the National Research Council report from the Committee, *Future Directions for NSF Advanced Computing Infrastructure to Support US Science in 2017–2020*. The committee, chaired by William Gropp (University of Illinois) and Robert Harrison (Stony Brook University), found that a lot more community input and planning would be needed to optimize NSF investments. Thus, it's very good to see that such activities have started. I hope that the NSF will get much useful input from current and potential users of its infrastructure.

On Friday, 27 January, I attended a half-day workshop organized by PICUP. The workshop was led by Larry Engelhardt (Francis Marion University) and Kelly Roos (Bradley University). Norman Chonacky, former editor in chief of *CiSE*, and David Winch, a long-time member of the editorial board who died in 2013, found-

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ed PICUP. I've been aware of the project for some time and have visited the PICUP repository that's part of the Compadre digital library. (In the interest of full disclosure, the last time I saw Norman, he asked me if I might be interested in joining the board of a nonprofit PICUP, which he's contemplating incorporating.) One of my motivations in attending the workshop was to learn more about the current state of PICUP, both from pedagogical and practical viewpoints. I came away motivated to try more of the examples and get more involved.

The idea behind PICUP is that most physicists still teach the classic courses the way they were taught, and most textbooks don't have examples or homework that involve computation. This is highly divergent from the practice of physics, in which computation is essential. Introducing computation can also help students think about physics in new ways. However, faculty might be concerned about what they need to remove from their courses to introduce computation, and developing new computational examples can be time-consuming.

The PICUP website (gopicup.org) lets educators view a library of peer-reviewed exercise sets (currently 35) for various undergraduate physics classes. You can browse by course, level, or programming language. I suggested that it would be nice to be able to browse by author as well. One especially nice feature of the material, is that there are often implementations in pseudocode and multiple languages, including C, C++, Fortran, Mathematica, Python, iPython/Jupyter, VPython, Octave/Matlab, and spreadsheet (the choice of implementations varies, so don't expect all of these to be available for each exercise). Readers are encouraged to contribute variations to existing exercise sets and implementations in additional languages. Each exercise has an introduction, indication of which courses it might be included in, available implementations, learning objectives, and time to completion. After the introductory material, there are tabs for the instructor's guide, theory, the exercises, code, solutions, references, and comments.

At the workshop, we got an introduction to the website and then worked through an exercise on a falling body with a drag force. The worksheet distributed would have worked very nicely in a first-year introductory physics course or sophomore mechanics. This worksheet wasn't on the PICUP site, so I encouraged Kelly and Larry to add it. Instructors can download materials from PICUP and modify them under the Creative Commons Attribution-Noncommercial-ShareAlike 4.0 license. PICUP is a great resource, and I'll make sure that more people in my department are aware of it. The current website has been enhanced by the efforts of the American Association of Physics Teachers (AAPT), and we should be very grateful for that contribution. A red banner at the upper left of the page indicates the site is in beta mode and feedback is welcome. A few workshop participants made suggestions.

Under the events tab on the PICUP site, you can see a list of recent and upcoming workshops, including the summer faculty development workshop in River Falls, Wisconsin, 10–14 July. This would be a great opportunity to both learn about what's available and get experience on what needs to be done to develop new content. There are also monthly community meetings the first or second Tuesday of each month conducted using Zoom.

I hope some of the readers of this column will consider getting more involved with PICUP and NSF planning. You won't regret it in the long run! ■

Reference

1. S. Gottlieb, "The Future of NSF Advanced Computing Infrastructure Revisited," *Computing in Science & Eng.*, vol. 8, no. 5, 2016, pp. 4–7.

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