Slide 1:

Welcome! I'm Jan Cuny and I'm here to talk about a new solicitation called "Improving Undergraduate STEM Education: Computing in Undergraduate Education" of IUSE: CUE for short. It is officially NSF 19-536 and it is a joint solicitation from the Education and Human Resources and Computer and Information Science and Engineering Directorates.
We are particularly lucky today to have the Assistant Director for CISE here today to open the discussion in person.

Jim Kurose:
Thanks, Jan. Hi everybody. Jan and Allyson and I are so excited to be here for this webinar on CUE. This has been a long time coming and we think this is going to be a really important solicitation for the community.

As all of you folks know, our classes have been bursting at the seams. Certainly, we're seeing a huge number of students coming into our classes who really want to do the traditional computer science major. But increasingly, we're seeing other students now who want to look at the application of computing within a different domain, who think of computing as a way to creatively do what they want to do in a difference discipline, whether it's something disciplinary specific, maybe tackling a challenging problem that requires interdisciplinary approaches. We're seeing an increasing diversity of students in a lot of different dimensions, which we'll come back to shortly.

CUE is all about reimagining, rethinking the role of computing in undergraduate education, possibly restructuring curriculum, creating new programs or defining new degree pathways.

Some of you are on this road already. Jan and I and others have written about X+CS or CS+X, new degree pathways that apply computing in X, that is other disciplines or grand challenge problems. So, CUE grew out of these kinds of activities that are happening already on campuses around the country. But it aims to be more than that. We're not looking at just minor changes around the corners, but really thinking about re-envisioning the undergraduate computing curriculum. So, yes, we're going to continue working with our more traditional CS majors, but now, increasingly we have this other class of students who are our current major doesn't serve quite right. We're thinking about re-thinking curriculum, re-thinking pathways for these new kinds of students.

This isn't going to be achieved overnight, and it's also not going to be achieved in isolation, which brings us to a couple of things that are special about CUE. One is it requires that proposers work within a Network Improvement Community, otherwise known as a NIC. I want to say a couple words about NICS, and then a couple words about BPC, and ethics. Those three things are a little bit special for this solicitation. Then, I'm going to turn things over to Jan

So, what is a Network Improvement Community (NIC)? Some of you may have already heard of them, the Carnegie Foundation has been writing about them for a while. We're not looking for just change an individual institution.   We want change at scale, and that's going to happen best when folks are collaborating with each other. NICs are groups of like-minded institutions with similar goals who want to get together, who want to work together, can learn from each other, can understand dimensions of the problem that they might not have seen particularly on their individual campus. We hope to see a very strong notion of working together in these network improvement communities.

Another part of the solicitation that Jan will be talking about is Broadening Participation in Computing (BPC). And, here, I think, one of the things that is going to be different about students coming up from high school into these new pathways and new curricular frameworks that we're going to be working on as part of CUE is that that we are going to see a much more diverse set of students coming in. We're already seeing that in the students who are taking the new AP exam, AP Computer Science Principles. Many of these new students coming in are having a wider and broader diversity in demographics and interests, and we want to make sure that those students are well served by what happens in their undergraduate years. And so, BPC is another key component of all CUE proposals.

And then finally, just a word about ethics. Increasingly computing systems are being used throughout society, impacting people in almost every aspect of their daily lives. And, I think we all believe, that our students will need to understand ethics and the societal and social aspects of the computing. When you take a look at this solicitation, you'll see that ethics are also an important part.

So, in addition to this broad idea of rethinking the undergraduate education and restructuring curriculum and pathways and programs, be thinking again about these NICs and about ethics. And, with that, I'm going to turn it over to Jan.

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There are lots of reasons for this solicitation at this time. A 2017 National Academies report, for example, said "It is a time for institutions to consider their missions and the constituencies they serve, and to determine what role computing should play in the experience, knowledge, and skills of its graduates of 2025 and beyond."

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And if we look at the enrollment trends in CS departments, we see that the landscape is rapidly changing. Not only are we seeing a dramatic surge in enrollments across most departments but in many cases, there is also dramatic increase in non-major enrollment in CS courses.

Further non-major students who before might have taken a single, introductory course are now taking multiple, higher-level courses as you can see from this figure where the blue represents majors and the pink nonmajors. Each bar represents enrollment for a year (2005, 2010 or 2015). The graph shows the data for four different course levels: Intro Non-Majors, Intro Majors, Mid-Level and Upper-Level. These new students are not your typical CS students. They are not interested in becoming software engineers. Instead, they are interested in integrating advanced computation skills with domain-specific knowledge from non-CS majors.

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Here's another view of the growth, separating out just the nonmajors. You can see that over those 3 years, there's a 47% increase in nonmajors taking the Intro for Non-majors courses, 35% increase in the Intro for majors,68% in the Mid-Level courses and 65% in the Upper-Level courses.

These non-major students are often not well-served by the traditional CS curricula pathways. Yet they represent much of where CS is moving. Computation is ubiquitous, it underlies much of the work across all STEM disciplines and is increasingly integral to the interdisciplinary efforts needed to solve today's complex problems.

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As an aside, another characteristic of these non-majors is that they are often a more diverse group than we have traditionally seen in CS programs. Many of them come from biology or chemistry or mathematics – fields with much better stats on diversity.

Thus, these students offer the CS community a great opportunity to make our departments more inclusive, broadening participation by recruiting, welcoming and retaining a much more diverse group of students.

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Going back to The increasing need for CS education in interdisciplinary contexts …

- Special interdisciplinary programs, e.g. data science and AI;
- "CS+X" or "X+CS" where X is a discipline or set of disciplines that may include both STEM and non-STEM subjects, or X is a significant societal problem requiring interdisciplinary approaches and the Study of X is combined with relevant computing courses tailored to X;
- Elevating computing to a school or college.

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This all gives us incentives to re-envision the role of computer science in an undergraduate education. Perhaps the traditional course sequences and common silo-ing of CS off in its own department needs to be rethought.

We are proposing not merely the addition of computational elements to some courses but a comprehensive rethinking of computing as it cuts across undergraduate courses, a holistic restructuring of degree pathways.

The goal is to better prepare a wider, more diverse range of students to collaboratively use computation across a range of contexts and challenging problems.

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There are two key program elements:

1) Collaborations of 3 to 5 IHEs working together, structured and functioning (formally or informally) as a Networked Improvement Community (NIC);
2) All proposals must include specific BPC efforts.

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ELEMENT 1: the requirement of 3-5 IHEs working together as a Networked improvement community.

In the past NSF has funded efforts to reform various aspects of CS undergraduate education and those efforts have been successful at the institution that had the award, but they have not spread much beyond that. Too often they are seen as over-specialized to the particular context of the funded institution.

Our hope is that by requiring institutions to work in partnerships, and by providing venues for those partnerships together nationally, we will be able to build more robust solutions that have a greater potential for wide dissemination.

NICs are Design communities that have been successful in education reform efforts.

They generally involve a range of stakeholders as partners who

- Share a common goal;
- Have a common understanding of how to reach that goal;
- Employ common metrics;

- Meet often to discuss activities, successes, challenges & progress;
- Engage in rapid research cycles of Plan, Do, Study, Act (PDSA);
- "Learn fast, fail fast, and improve quickly";
- Develop, test, and refine interventions across a variety of educational contexts.

There are references in the solicitation itself to help you find out more about NICs and we hope to have another webinar soon to discuss them in more depth. Be on the lookout for that.

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Who is in a NIC?

- Faculty from different disciplines and departments;
- University administrators;
- Education researchers who answer questions generated by the participants and based on the common data collected;
- Evaluators who evaluate any implementations.

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ELEMENT 2: the requirement that all projects have a BPC component

What should you have in your proposal?

- Provide demographic information about the student populations served at each department/IHE;
- Identify relevant characteristics and needs of participants from the underrepresented or under-served groups you are addressing ;
- Include specific plans or strategies for addressing or accommodating those needs;
- Include metrics for measuring success.

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There are lots of resources for those wishing to know more about BP and some are listed here.

CISE has long supported a set of BPC Alliances: NCWIT, CAHSI, IAAMCS, AccessComputing, STARS, CRA-W, ECEP, and Into the Loop.

You could also look up some of the INCLUDES work at NSF.

And finally, you should take a look at BPCnet.org which is a collection of useful resources though it is still a work in progress. Featured at the BPCNet.org site is a White Paper on BPC

that was recently written by a number of experts in BPC who read 650 proposed BPC plans that were submitted to CISE. **You should read that White Paper for sure!!!**

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Ethics component encouraged!

There are many risks of technology: Erosion of privacy, Lack of fairness or accountability in algorithmic decision-making, and the Spread of misinformation.

Because of these risks, it is incumbent on us as educators to better prepare students in the ethical use of technology and to guard against misuse.

With this solicitation, NSF sees an opportunity to rethink the teaching of ethics in CS as well – not just as an isolated course but across the CS curricula and with the opportunity of this solicitation across the application domains as well.

That is, CISE encourages integration of ethics into curricula
- Within core CS courses;
- Across relevant interdisciplinary application areas.

This is perhaps complementary to the recently announced Responsible CS Challenge (Omidyar Network, Mozilla, Schmidt Futures, Craig Newmar Philanthropies)
 https://foundation.mozilla.org/en/initiatives/responsible-cs/

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The solicitation has the two normal review criteria:

1) Intellectual Merit:
   - Potential to advance knowledge.
2) Broader Impacts:
   - Potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

And it has two additional criteria are BPC – make sure not to miss those. They are somewhat hidden toward the end of the solicitation.

Additional Specific Review Criteria (BPC):
- Does the proposal identify the characteristics and needs of the identified underrepresented or underserved groups to be addressed?

- Does the proposal include specific plans or strategies for addressing or accommodating the particular needs of participants of the identified underrepresented groups?

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There are two constraints in the solicitations as well. The first we talked about already:

- Must be a multi-institutional partnership (functioning as a NIC) with a lead IHE + 2-4 additional IHE partners.

The second is because we want to build a community out of the NICs that we fund:

- Should budget for team members to attend two principal investigators' (PI) meetings over the 18-month award period.

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Speaking of budget, there are two size classes:

1) Without an ethics component
   o Maximum budget of $300,000 for up to 18 months;

2) With an ethics component
   o Maximum budget of $350,000 for up to 18 months.

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We expect to make:

- 12 to 15 awards ;
- Total program funding of $4,500,000;
- Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

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Contacts and Further information.