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Heidelberg Anew

I have just returned from the fourth annual Heidelberg Laureate Forum and I want to emphasize how very important it has been for ACM Turing laureates to participate in

the program. Each year 200 math and computer science undergraduates participate in the program, approximately 100 each. Speeches by laureates are mixed with undergraduate workshops and plenary open sessions. There is ample opportunity for interaction among students and laureates and between students.

This year, Brian Schmidt gave the Lindau lecture (from the annual Nobel Prize winners meeting). Schmidt discovered that the universe is not only expanding, the expansion is accelerating. It would be difficult to imagine a more profound discovery. In the very long term, it appears the universe will expand to the point that only a certain amount of local gravity will hold a galaxy or small group of galaxies together. The rest will accelerate away and the universe will end in a cold whimper.

Fortunately, there was nothing but stimulating conversation at this year's Heidelberg Forum. More than ever we are seeing how mathematics and computer science are interacting, especially with the arrival of neural networks and quantum computers that have capabilities quite different from the conventional von Neumann designs that have dominated computing for over seven decades. Fundamental questions about what is computable, illuminated by Gödel, are getting attention in the light of these new computing engines.

Leslie Lamport delivered another extraordinary lecture reinforcing the value of thinking mathematically while considering the process of pro-

gramming. The value of abstraction to aid in reasoning about expected program function resonated very strongly with me and, I think, with others in attendance.

As always, the mathematics and computer science students were full of energy, ideas, and eagerness to interact with each other and with the laureates present. The organizers worked hard to maximize student opportunities to meet with laureates including a number of workshops where some in-depth discussion could be supported. Some of the laureates voiced a strong recommendation that every effort should be made to allow rich interaction between students of the two disciplines.

Looking at the available laureate attendee lists, I can't help but imagine that future Heidelberg events would benefit from a cohort of additional younger laureates so I look forward to the possibility

that other ACM awardees might be invited to attend the annual event.

Looking back on the Lindau event that I attended in late June at which Nobel Prize winners mingle with students, I was struck by the increasingly important role of computing in discovery science. Simulations of physical phenomena are revealing new insights into the nature of our universe. One of the dramatic examples I have seen shows an evolving universe from the big bang that takes into account dark matter and dark energy and produces a simulated universe with many of the large scale structures we actually see in the observable universe. We see huge reticular structures emerging that are largely the product of masses of dark matter that organize ordinary matter into a lacework of stars and gas. That these predictions can be tested through observation reinforces the importance of computing in our exploration of the natural world.

We are reaching an exciting period in scientific discovery in which computation is as important as laboratory experiment and observation. We can invent our own universes and test them for compatibility with the real one we can measure. Indeed, we may find that our predictions could draw our attention to phenomena we might never have looked for, were it not for the revelation of computation.

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