Invited Talk

Teaching Post-Classical Computation (extended abstract)

Susan Stepney
Department of Computer Science, University of York
Heslington, York, YO10 5DD, UK
susan@cs.york.ac.uk

1. INTRODUCTION

25 years after Christopher Strachey asked "Is Computing Science?" [1] and had to respond "no", how have things changed?

We do now have a subject with somewhat firmer academic credentials, but have we built our foundations in the wrong place? Will the current mathematico-logical underpinnings survive the onslaught of chaos, complexity, and interaction with the Real World? Are we teaching our CS undergraduates the wrong things for helping them survive amidst the 21st Century's novel computational paradigms?

2. POST-CLASSICAL COMPUTATION

Post-Classical Computation is that area of the computer science drawing heavy inspiration from the natural sciences, such as physics for quantum computation, or biology for bio-inspired algorithms, complexity and self-organisation. It recognizes that CS is not a purely mathematical discipline, but is deeply embodied in the physical world. What should we be teaching CS students in this new interdisciplinary area?

3. INTERDISCIPLINARITY

I was talking to a biologist who was working closely with a mathematician to build better biological models. The biologist was having to cope with some abstruse mathematical ideas, and was coping impressively well. I asked whether it was easier for a biologist to learn mathematics, or *vice versa*. They unhesitatingly replied that it was easier for mathematicians to learn biology, because biology was easier. I suspect, however, that the mathematician might have replied somewhat differently, because this particular area of biology, at least, is *amazingly* complicated: full of the kind of messy detail that mathematicians are born to abstract away from, yet doing so here would throw away many key properties. Different cultures, different mindsets, different kinds of research questions posed, all help to make interdisciplinarity so interesting.

So, what might be the best training for an interdisciplinary career? Given disciplines X and Y, what degrees should one do? (Let's not worry at this stage about adding in subject Z, too!)

The costliest approach would be to get an honours degree in X and then another in Y. I don't see anyone but the most dedicated perpetual student taking this approach.

The other extreme would be to take a joint honours in X/Y. For very new areas of interdisciplinarity, there might be no such option available, however. Even if there is, for it to be valuable, the course must be carefully structured. Too many joint honours just "cut and shut" existing courses. Modular degrees may simply result in a "pick'n'mix" hodgepodge with no underlying depth.

A more plausible approach would be to get a first degree in X, and then a conversion Masters in Y (if we are allowed to have conversion Masters any longer; but that is a different rant). This is my favoured approach, as one can get depth from the honours degree in X, plus breadth from the Masters in Y. (However, one does have to realize that the conversion Masters in Y will not tend to be linked with the subject matter of X in an interdisciplinary manner.) One does then have the task of deciding which subject to chose for each role.

I believe the optimal route to the interdisciplinarity of Post-Classical computation is to gain a first degree in a mature science with depth (biology, physics, mathematics) plus a tailored conversion masters in CS that can focus on the parts of our subject of critical importance to the interdisciplinary work. I believe it is not nearly as effective to try to take a CS major and add on a layer of science.

4. CLOSING RANT

One thing in particular that a three year honours degree should teach is what science *is*. We certainly don't do this in CS at the moment. The time is right to put the *science* into computer science.

Time for one more story, from a GECCO workshop I attended last year. GECCO is an international conference on Genetic and Evolutionary Computation, and this particular workshop was arranged to involve biologists. The paper I remember was presented by a biologist, describing experimenting with genetic algorithms to do some data analysis. And I mean *experimenting*. There were controls, there was changing one parameter only, there was statistical analysis, there was *science*. It puts most CS papers to shame. I hope never again to see a paper talking about a single data point, with no experimental hypothesis, no control, and no analysis – but I expect to be disappointed! We have been getting away with too much unscientific rubbish for years; maybe this closer connection with the Natural Sciences that comes from Post-Classical Computation will stop that being possible.

5. ACKNOWLEDGMENTS

I would like to thank Sam Valentine for bringing the Strachey paper to my attention.

6. REFERENCES

[1] Strachey, C. Is Computing Science? *I.M.A. Bull.* **6**(1) 1970.

ITICSE'04, June 28-30, 2004, Leeds, United Kingdom.
ACM 1-58113-836-9/04/0006.