Summary of BCS2006, 22-24 March 2006

Grand Challenges in Computing

This summary contains the following sections –

1. Introduction

BCS2006 took place 22-24 March 2006 in Glasgow, and was jointly organised by the UK Council of Computing Professors and Heads of Computing (CPHC) and the UK Computing Research Committee (UKCRC) under the auspices of the British Computer Society (BCS). Its objective was to consider the "*Grand Challenges in Computing*" and to act as a follow-on from the first conference on this theme in 2004. The two principal aspects to the grand challenges are Research and Teaching. The reports from the 2004 Conference are available at –
http://www.bcs.org/server.php?show=conWebDoc.1508

(The University of Bradford hosted this Conference in 2002, and the Vice-Chancellor gave a speech. Details of CPHC2002 and the papers presented are at –
http://www.inf.brad.ac.uk/intranet/Dean/cphc2002/)

The conference in 2006 reviewed the current issues facing computing in the UK in terms of curriculum, research, innovation, knowledge transfer, and the current perceptions of computing by pupils in high schools. A number of overseas academics were also present at the Conference and provided information on developments in their countries (Europe and the USA). The BCS2006 Conference programme is at -
http://www.bcs.org/server.php?show=ConWebDoc.2835

2. Declining interest in Computing and IT degrees

Applications to study Computing in UK Universities are down a further 10% this year – following on from a 20% drop last year, and a 15% the year before. In the USA, applications have dropped by 50% in the last 4 years. The UK is therefore following a similar trajectory.

3. Employability of Computing and IT graduates

Employability is defined as the number of graduates obtaining a job within 6 months of graduation and is derived from the national HESA statistics from all UK Universities. Employability in Computing and IT has dropped from 85% in 1998 to 65% in 2004 (Engineering has also dropped similar %, but over a 10-year time frame). This has generated the public view that there is only a 1 in 2 chance of a graduate getting a job, and has caused potential students and their parents to look at other areas (for example, Medicine has an employability of over 90%, as has Law). However, employability of those with an MSc in Computing has remained fairly constant at ~85% from 1998 to 2003. It has, however, dropped to ~70% in the last few years.

4. Perceptions of Computing and IT in high schools

Detailed surveys and analyses have been done by CPHC over the last year of pupils in high schools. Full reports are shortly to be made available on this. Pupils currently perceive computing and IT as too technical, boring, high workloads, and difficult to get good grades. Jobs in Computing/IT are perceived by pupils as not gaining as much respect and status as other areas (the nerd, geek, anti-social image tends to prevail). There is a perception that the computing is an office job and employees in the IT area will be stuck in front of a computer all day, rather than doing something interesting and different every day. Also there are no strong role models in the field to benefit from (e.g. compared to biosciences). They ask: *"Where is the 'thrill factor' in computing/IT?"*

5. Grand Challenge in Education - Computing and IT Curricula

Some of the issues discussed were as follows. Are computing degrees currently overly constrained by BCS Accreditation requirements? How can computing and IT courses optimally evolve and attract student interest? How are current courses preparing students for the global economy? How do they recognise the importance of creativity and innovation? How do they link in with competitiveness, capacity to lead, and economic productivity? Could early modules be based on new technologies and new developments to attract student interest and enthusiasm, rather than failing 20-30% of the student because they cannot pass the Java programming module? Do we have to teach students to write programs or is an understanding of software sufficient? Our IT courses address this point. Should computing courses move in this direction also? A BSc in Smart Systems?

"Computer science curricula have changed in the last 10 years to focus on languages (e.g. Java) and paradigms (e.g. object-oriented) that are difficult to teach and learn" (Prof E. Roberts, Stanford University). He said that the number of students in freshman (i.e. 1st year) computing classes at Stanford University has dropped to 50% of what it was 5 years' ago.

Prof Roberts cited the following reasons for the decline in interest in computing in the USA -

- No understanding of the opportunities in computing
- Negative image of work in computing fields
- Static curricula fail to attract today's students
- Growing complexity in introductory courses
- Concerns about job security in the wake of off-shoring (i.e. companies exporting work overseas)
- Belief that all jobs vanished with the dot-com collapse
- Students pursuing wealth over good salaries and secure jobs
- No jobs fear is widespread

Further information on studies done in the USA is available at http://www.cra.org/govaffairs/ http://www.cra.org/main/cra.pubs.html

"Interest in computer science (CS) or computer engineering (CE) as a major among incoming freshmen at all undergraduate institutions fell between 2004 and 2005 in the USA", according to the latest survey results from the Higher Education Research Institute http://www.gseis.ucla.edu/heri/freshman.html at the University of California at Los Angeles (HERI/UCLA). After peaking in 1999 and 2000, interest in CS as a major has fallen in each of the past five years.

Although production might not fall as much again, results from this year's Taulbee Survey http://www.cra.org/statistics/ of PhD-granting CS departments in the USA will show a double-digit drop in the number of CS bachelor's degrees granted in 2004/2005. (These numbers will be released later on in 2006). http://www.cra.org/wp/index.php?p=75

Chart only is at - http://www.cra.org/wp/wp-content/heriucla2005.gif

Prof Andrew McGettrick (University of Strathclyde) outlined what he felt were the key issues with regard to correcting the current perception of computing in high schools –

- Can we explain the essence of computing to 12-14 yr olds?

- Can we capture the imagination of 12-14 yr olds?
- Can they develop a level of excitement about the discipline and its future?

Role Models
How can the role model situation be improved? 12-14 yr olds are looking for these in their selection of University subjects to study. This choice of subject is now made at ~15 yrs old.

Outreach
We need to think about developing the following: increasing links to schools, expanding franchised courses overseas, developing E-learning courses, and expanding CPD.

Innovation
One of the greatest risks in top Universities in the USA is undergraduate students leaving to concentrate on their start-up (e.g. Stanford University and University of Washington) and not completing their degree.

6. Grand Challenges in Research
The current Grand Challenge areas are -
- GC1 Systems Biology
- GC2/4 Ubiquitous Computing
- GC3 Memories for Life
- GC 5 Architecture of Brain and Mind
- GC 6 Dependable Systems Evolution
- GC 7 Journeys in non-Classical Computation

http://www.ukcrc.org.uk/grand_challenges/index.cfm
http://www.ukcrc.org.uk/grand_challenges/current/index.cfm
http://www.ukcrc.org.uk/grand_challenges/about/criteria.cfm

There was also a proposal for a new GC – Bringing the past to Life for the Citizen.

GC1 – Systems Biology
We routinely use massively powerful computer simulations and visualisations to design aeroplanes, build bridges and to predict weather. With computer power and biological knowledge increasing daily *we can apply advanced computer simulation techniques to realise computer embodiments of living systems. We aim to realise fully detailed, accurate and predictive computer embodiments of plants, animals and unicellular organisms.*
http://www.cmp.uea.ac.uk/Research/ivis/index.jsp

GC2/4 – Ubiquitous Computing
By 2020 how many computers will you be using, wearing, have in your home, or even in your body? Computers are ubiquitous and will soon be globally connected. Shall we be in *control* of the complex emerging behaviour arising from their aggregation in a *"ubiquitous" global network*, or even *understand* it? As these devices become smaller, more numerous, more independent from users and more deeply embedded in the world around us, they raise formidable scientific and engineering challenges.
We propose to develop scientific theory and the design principles of *Global Ubiquitous Computing* together, in a tight experimental loop.
http://www-dse.doc.ic.ac.uk/Projects/UbiNet/GC/index.html

GC3 – Memories for Life
Memory – brain and computer. Storage and retrieval of our life information. Can we produce an understanding of what is common in memory systems, and use that understanding to improve efficiency, recall, and information management in an integrated way across various levels of human personal, social, and work domains?
http://www.memoriesforlife.org/

GC5 – Architecture of Brain and Mind
This will bring together work in neuroscience, cognitive science, various areas of AI, linguistics, and other relevant disciplines, so as to produce a new integrated theory of how a single functioning system can combine many human capabilities, including various kinds and levels of perception, different kinds of reasoning, planning, problem solving, wondering about, many varieties of learning (including grasping new abstract concepts and developing new fluent skills), many kinds of actions of varying complexity, different uses of language, varieties of affect including motivation and emotions, social interaction, and various forms of creativity.
http://www.cs.bham.ac.uk/research/cogaff/gc/

GC6 – Dependable Systems Evolution
Tony Hoare's *Grand Challenge* on the "verifying compiler", a vision of a world where programs would only be produced with machine-verified guarantees of adherence to specified behaviour.
Assurance/proofs
Specific code targets
Tools
http://www.fmnet.info/gc6/

GC7 – Journeys in Nonclassical Computation
To produce a fully mature science of all forms of computation, that unifies the classical and non-classical paradigms
http://www.cs.york.ac.uk/nature/gc7/

7. RAE2008
The criteria for RAE2008 were summarised by the chair of the Computer Science Panel, Prof Keith van Rijsbergen, and the time schedule for the evaluation process was given. This also included a summary of the recently published Science and Innovation information in the Chancellor's March Budget Speech. There will be no RAE beyond 2008 and research evaluation will be by appropriate metrics. The Treasury has already noticed that the current allocation of HEFCE QR has a 98% correlation with the allocation of research grants to institutions. In other words, the results of the RAE are already effectively known (to within 2%) before the long evaluation exercise starts - by the peer review process for grant applications*. Thus considerable expenditure could be saved on the current evaluation process by using metrics. The government has therefore offered the option of replacing the current evaluation for RAE2008 if the community could agree on appropriate metrics to be used to replace the current detailed peer review process.

8. Competition in the Sector
As the total volume of potential computing students decreases, there is increasing competition between Universities. There is also the RAE2008 and its possible bifurcation effects.

9. Institute of Computing
The community was urged to speak with one voice to government and the media. The leaders in the natural science communities had already learned this lesson. Even though there may be disagreements within the community, they are kept behind closed doors so that the leaders can speak clearly and unequivocally on behalf of the discipline. This had resulted in large amounts of funding being allocated to the natural sciences. Currently computing is fragmented within its community (teaching vs research vs industry) and in its organisation (BCS, IEE, CPHC, UKCRC, ACM, IEEE etc). Hopefully the Institute of Computing will reduce this fragmentation and disunity, and produce a pathway to integration.

** It is interesting to note that Prof John Midwinter, former Vice-Provost of UCL and former President of the IEE made this point following the RAE96 evaluation. At RAE96 the allocation of the scores on the EE Panel was based primarily upon grant income as its Chairman (Prof. J. Midwinter) asserted*

at the time that it was the only effective discriminator (reference - IEE Review, March 1997, pp.66-70). He also went much further and claimed that, for physical sciences and engineering, he had done a detailed audit of all the results and concluded that the difference between the actual RAE scores obtained and those corresponding to EPSRC income alone only differed by less than 0.1%. Thus the evaluation was already in the income - looking at the output in the papers and peer esteem factors made no difference to the overall results.
http://www.ee.ucl.ac.uk/~ong/people/midwinter.html

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