COSC433 Computer Science Education
Course Outline

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Semester 1, 2011

Lecturers: Tim Bell (CSSE), with guest lecturers

Enquiries to tim.bell@canterbury.ac.nz (027-433-1998)

Course goal

The goal of the course is to produce students who are well-informed about the wide-ranging issues surrounding Computer Science education, are able to provide balanced and sound advice to computing teachers who have a weak background in Computer Science, and are able to develop and use effective resources themselves.

Course outline

Computer Science Education has received a lot of attention recently, as governments seek to boost the competitiveness of their country in the face of falling rolls in universities. A lot of innovation and research over the last few years has changed the kind of resources that are available, and there are a rich range of materials available (e.g. alice.org, cs4fn.org, csta.acm.org, and our own csunplugged.org). There has also been a lot of debate about related issues such as which programming languages are best for beginners, and how to get more women involved in CS.

In New Zealand, the computing topics taught in schools were revised in 2009, with the major changes appearing in NCEA from 2011. This has raised many new research questions about which topics can and should be taught at high school, the best way to deliver them, and provides a chance to evaluate the effect of the changes.

In this course we will look at the many issues surrounding CS education. There will be a major project where students will develop new educational materials and/or evaluate them.

The course is aimed at people who may be interested in being CS educators (teachers or lecturers), as well as participating in outreach programs (such as industry-sponsored events and school visits), and those who may get involved in educational research and policy. It will also give you a new view of your own education. It will assume that you have a broad 3-year background in Computer Science, but no previous background in education is required.

Lecture topics

There will be two hours of lectures per week. Lectures are expected to cover the following topics:

- Curricula (school and university, NZ and international, CSTA/ACM guidelines, ISTE NETS, AP exams)
- Pedagogy
    - learning models e.g. instructional design, high-order thinking (Bloom, mind mapping etc.), learning styles (visual, aural, kinesthetic)
    - socio-cultural theory e.g. Vygotsky/constructivist approach, Piaget
    - teaching and learning tools – CMS (Moodle etc.), Distance Learning, e-learning, ITSs etc.
- K-12 computer science education and outreach (curricula, programming languages, robotics, kinesthetics, camps, clubs and events)
- First programming languages and environments (Alice, Scratch, Pascal, BlueJay, Greenfoot, Kodu, rurple…), OO-first, functional-first, first courses (CS1)
- Non-major computer science courses (CS0)
- Visualisation and algorithm animation
- Gender, diversity, disability and equity issues
- Competitions and challenges (e.g. ACM, IOI, Science fairs)
- Educational games for CS
- Grading computer science work (automatic marking, test-driven programming, style)

Learning outcomes

- Have an understanding of key pedagogical ideas, learning theories and teaching tools
- Have an understanding of standard CS curricula that have been used or proposed in NZ and overseas
- Understand approaches for K-12 education and outreach in CS
- Be aware of issues surrounding the choice of first programming languages and introductory CS courses
- Understand techniques for visualisation and algorithm animation
- Be able to discuss gender, diversity, disability and equity issues in CS education
- Be aware of the ideas and issues surrounding programming competitions and challenges
- Understand issues surrounding grading computer science work, especially programming assignments
- Be able to develop new resources to convey topics from CS to students

Assessment

Project (worth 60%)

- The goal of the project will be to develop an educational resource that could be used in schools; ideally this would be for the new NCEA topics. There will be regular discussions of the projects in class and in meetings with relevant lecturers or teachers.

Final test (worth 40%)

Other important information

There are several important documents available online about departmental regulations, policies and guidelines at the following site. We expect all students to be familiar with these.

http://www.cosc.canterbury.ac.nz/regulations/

Notices about this class will be posted to the class forum in the Learn system (learn.canterbury.ac.nz). COSC students will also be made members of a class called "CSSE Notices", where general notices will be posted that apply to all classes (such as information about building access or job opportunities).

Reading

Readings will be selected from the following books and papers. Additional material will be referenced during the course, mainly from the SIGCSE and ITiCSE conferences.

The New Zealand Curriculum, Ministry of Education, NZ. (http://nzcurriculum.tki.org.nz/)

The TKI Secondary Education portal (http://secondary.tki.org.nz/)

ACM K-12 Computer Science model curriculum. http://www.csta.acm.org/Curriculum/sub/ACMK12CSModel.html

CS Unplugged: Text written for Chinese High School students (in English). Bell, Arpaci-Dusseau, Witten and Fellows, 2009.

The future of Computer Science and Digital Technologies in NZ secondary schools. Position paper by Tim Carrell, Vilna Gough-Jones and Karen Fahy. Available from http://dtg.tki.org.nz/other_resources ("Digital Technologies discussion paper")

How People Learn: Brain, Mind, Experience, and School. Committee on Developments in the Science of Learning with additional material from the Committee on Learning Research and Educational Practice, National Research Council, 2000

Education and Technology. An encyclopedia. Kovalchick A. & Dawson, K. (Eds.) (2004). Two volumes. Santa Barbara, CA: ABC-CLIO Inc.