

**The new CTS Computer Science curriculum,  
Its status as a University entrance subject,  
and Implications for High and Junior-High Schools**

Briefing Note  
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In the Spring of 2009 the University of Alberta made the first major change in entrance requirements in over 30 years by adding CTS Computer Science (CSE) to the list of science admission subjects. Starting in the 2010-2011 academic year it becomes part of the Group C list (with Biology 30, Chemistry 30, Pure Math 30, Math 31, Physics 30, and Science 30).

To enter the Faculty of Science students can now select as their required subjects any two of Biology 30; Chemistry 30; Mathematics 31; Physics 30; Computer Science (CSE) Advanced Level, Career and Technology Studies (CTS) (5 Credits).

The U of A was closely followed by the University of Calgary, and the University of Lethbridge. Grant MacEwan University and other post-secondary Alberta schools are planning to follow. From the very beginning, there was enthusiastic buy-in among the post secondary institutions.

This is the result of five years of work, that began with the simple grass roots question we asked a group of Edmonton-area high school Computer Science teachers:

*Computer Science is not dead by any means. It is crucial to virtually every aspect of modern society.*

*There are more computing jobs now than at the height of the dot com bubble!*

*So what is causing the decline in CS enrollment, and what can we do about it?*

At the undergraduate level, we addressed the increasingly interdisciplinary nature of CS by introducing a very flexible Computing Science program, our so-called Computing and X that enables student to combine computing with another subject area of interest. But that doesn't address enrollment, that starts earlier.

We began regular high school teachers symposia, so that we could talk directly with teachers of CS. This exposed all kinds of structural issues that we didn't know about. The biggest was that since Computer Science was not a university entrance subject, students simply could not take it if they wanted to keep their university entrance options open. The other 30-level subjects filled up their option slots.

Another issue was the placement of Computer Science within the CTS (Career Technology Studies) curriculum. It was lost among the broad range of other CTS subjects. Serendipitously, an Alberta Education review of the CTS curriculum was in progress, and we all had input into the design of the new CSE courses. The advantage of the CTS format is that it gives flexibility in structure that reflects the broad nature of CS, and enables the content of the CS courses to evolve at the same rapid pace as the discipline.

All the pieces fell into place.

### **What does this mean for high schools?**

A change in entrance subject has major impact on high schools. The obvious one is budget. But there are subtle effects in the political economy of a school, such as the increased prestige associated with teaching a university entrance subject.

- *CS 10, 20, 30 curriculum design.* The new CSE courses provide for a core of CS, with many possible variations to build around the core. This enables individual high schools to tailor their CS offerings to play to the interests of the students and the strength of their teachers. To provide a 3 course 5-credits per course sequence would require
  - CS 10 to have CSE 1010, 1110, 1120;
  - CS 20 to have CSE 2010, 2110, 2120;
  - CS 30 to select among number of courses to provide various themes. For example Computer Science Pathways for University or College Entrance see [http://www.education.alberta.ca/media/1106111/bit\\_path.pdf](http://www.education.alberta.ca/media/1106111/bit_path.pdf)

Here are links to the main CSE documents:

- Overview <http://www.education.alberta.ca/teachers/program/cts/programs-of-study.aspx>
- CSE Summary [http://www.education.alberta.ca/media/1074890/cse\\_sum.pdf](http://www.education.alberta.ca/media/1074890/cse_sum.pdf)
- CSE Intro Courses [http://www.education.alberta.ca/media/947185/cse\\_intro.pdf](http://www.education.alberta.ca/media/947185/cse_intro.pdf)
- CSE Intermediate Courses [http://www.education.alberta.ca/media/947189/cse\\_inter.pdf](http://www.education.alberta.ca/media/947189/cse_inter.pdf)
- CSE Advanced Courses [http://www.education.alberta.ca/media/947189/cse\\_inter.pdf](http://www.education.alberta.ca/media/947189/cse_inter.pdf)
- *Grade 9 recruiting.* Science 10 is the route to Biology, Chemistry, and Physics 20 and 30. If students are interested in Computer Science, they need to be made aware of it at the Grade 9 open houses and registration literature so that they can consider CS 10 for a Grade 10 option. It is possible to do CS 10-30 in 2 years, but it depends on the school. CIPS WIT (Women in IT) has 370 Grade 9 girls come through every year, and we turn students away.
- *University Recruiting.* Many students have no idea what Computer Science is about. WISEST and Choices help. But we wanted to capture the attention of students who show an aptitude for computing in high school, and show them the breadth of our discipline. So the Computing Science Department introduced a High School Internship program, where we take a select group of 15-20 students, and hire them for 6 weeks to work in our research labs. We have recruited a number of our top students this way.
- *But I have no more space or budget for computer labs.* Teaching CS is no longer an expensive lab issue. With the advent of low cost netbooks, wireless connections, and open source software, CS can be taught in the regular classroom. A typical netbook is only twice the cost of a graphing calculator!
- *Where do my CS teachers come from?* There is now a BEd CS minor, and the CS major is winding its way through the Alberta Quality Council process. Once the major is in place, there will be a combined BSc BEd degree in CS. Some of our CS graduates have become teachers. Some current CS teachers have taken leaves to study more CS. But how to develop more CS teachers is a major issue. It will require close collaboration between teachers, schools, Computing Science, and Faculty of Education. Our liaison person for CS in the Faculty of Education is

Prof. Catherine Adams, Secondary Education, 780-492-5769, catherine.adams@ualberta.ca.

## All the various pieces you need to consider

1. Look at your own program and ask if it reflects the broad presence of computing in society. Can a student study CS as a means rather than an end. We describe CS as an "intellectual amplifier" for other disciplines.
2. Find a retired, or almost retired teacher that has been doing CS since the dark ages. They know how the system works, how to get curriculum changes through, and all of the unintended effects of change. Use them as your outreach agent.
3. Engage the high school CS teachers and develop a community. The teachers are our best defense against ill-informed guidance counselors and parents. Hold regular meeting with all the teachers you can get. They develop connections among each other, and connect with the university. Consider forming a CSTA (Computer Science Teachers Association). The CSTA Alberta chapter was just recently formed. <http://csta.acm.org>
4. Don't worry too much about the content of the K-12 CS curriculum. We still have no clue about what CS is or how to teach it. Placing CS into the CTS curriculum rather than the traditional core (English, Math, Physics, Biology etc.) means that the curriculum can be defined more flexibly and leave room for teachers to take different approaches.
5. Develop outreach activities that get students on campus. Trips to schools get lost in the general recruiting festival. Day long events like the Iverson Computing Contest can handle a large number of students (circa 100). More intensive activities like the High School Internship engage students and they pass it on, especially the students from Grade 10 and 11.
6. Engage the other faculties and departments on campus. We took our plans up to the main academic governing body (Academic Standards Committee) to get buy-in from the various faculties. This is where we realized the broad support for computing, and the recognition that it was key to every discipline on campus.
7. Work with the other post-secondary institutions to present a single voice. Through our regular meetings of ACAT (Alberta Council on Accreditation and Transfers) we kept each other informed of our challenges and efforts. When we discussed making CS an entrance subject, we got consensus that U of A should take the first step and be the main point of contact with Alberta Education. The other institutions would then adopt the same entrance rules. Governments like their universities to work together.
8. Keep aware of unintended consequences. For example, students in Grade 9 need to know about CS before they begin to think about registering for their Grade 10 courses. High Schools need to arrange their courses so that students who discover CS in grade 10 can complete the CS requirement. Principals need to worry about finding CS teachers.