

Computer Science Education Week 2010 ***A Canadian Plan***

Computer Science Education Week will be celebrated December 6-10, 2010. Last year, computing organizations and universities held outreach and educational events to encourage interest in computer science as a course of study and career. This year, we encourage universities across Canada to contribute by organizing an outreach event for grade 9 and 10 students during this week. The goal is to encourage these students to enrol in introductory computer science when they select courses for the following year.

Motivation

We see a need to support our high school CS teacher colleagues who are struggling to attract students to their courses. A few of our Canadian CS departments have been directly approached by teachers or school boards specifically asking for help with recruitment to senior high school CS courses. The idea is not to promote our individual universities but inspire students to consider the field overall.

We encourage departments to hold a new event during CS Education Week and where possible to hold it on Thursday, December 9th. Simultaneous events will attract more media attention and can be promoted on a shared CS Education Week web-page. The CACS Outreach committee will facilitate communication among departments and distribute some shared resources such as media releases.

Example Full-Day Events

Each department should determine what scale and style of event will work best in their context. Universities with a small number of local high schools might consider sending an ambassador to each school. In departments where the number of local schools is large, an on-campus activity may make more sense. Below are two examples of such events that are available for modification and use. The first, from the University of Alberta, has been run for several years but is slightly different in design; it is targeted only at young women.¹ The second is planned for December 9, 2010 at the University of Toronto at Mississauga. The large-group activity has been pilot-tested in a grade 9 classroom but the breakout sessions have not yet been run.

University of Alberta WIT Day

CIPS has run a Women in IT day (<http://www.cipswitedmonton.ca/>) in Edmonton for several years. For the past two years, over 340 grade 9 girls have come to the U of A campus during February. The objectives for this one-day conference are similar to our own. They are to (a) inform young women about the variety of fun and creative careers that exist in information technology; (b) encourage the young women to keep their future options open by taking math and science courses throughout High School; and (c) motivate the young women to consider a future in Information Technology. The main activities during the event revolve around delivering this message to 300 young women from grade nine while they have fun exploring technology. The following descriptions are for the 6 (from a total of 20) sessions hosted by the computer science department. There were other types of sessions such as matching your personality to your job. Each girl was assigned to three sessions in groups that forced the mixing of girls from different schools and ensured that each student would have at least one hands-on session such as those run by the CS department.

¹For 2010/11, Alberta is considering running some variation of these successful workshops during the December Education week in addition to their February girls-only event.

Session Descriptions

1. Build Your Own Avatar

Developing appealing graphics and animations has become a requirement in many industrial applications like advertising, movies, games and TV. Virtual characters or avatars have also been integrated into many social web applications such as Second Life, GOOGLE and so on. This WIT session is intended to inspire the interest of high school students to learn Graphics and Animation through the use of the 3D Studio Max package.

2. Scratch Ping Pong

The objective of this session is for participants to build a 1-player ping-pong game using Scratch. (<http://scratch.mit.edu>) Students who complete this task can modify the game for two players. The handout is available from the WIT pages from <http://launch.cs.ualberta.ca>.

3. Alice: Programming as Story Telling²

This activity will introduce participants to basic programming concepts using Alice (www.alice.org), a popular object-orientated programming environment. Specific programming concepts include events, variables, methods, loops (e.g., Do Together), and If/Else statements. Estimated Length: 30 minutes teaching, 15+ minutes free-time

You are the commander of a spaceship that was sent to earth. Your mission is to invade earth, capture as many cows as possible, and bring them back to your home planet. You flew around many different farms in the Edmonton area and found the perfect herd of cows to bring home but due to the warm temperatures on Earth, none of the controls on your spaceship work. You must repair your space ship's controls so that you will be able to fly around the farm, determine when you are close enough to a cow to *beam* it up to your ship, and then fly home.

4. Cryptography

The objectives of this session are to (a) understand the purpose of data encryption and (b) understand a simple algorithm for data encryption. The particular encryption and decryption algorithms used in this exercise are fairly simple. They employ a data structure called an encryption matrix which is a two-dimensional grid of characters.

Data encryption plays a major role in computer applications, ranging from simple logins for system accounts to secure transmission of information over a network. The purpose of data encryption is to transform data into a secure form so that it can only be accessed by those who are authorized to do so.

5. Robotics Session (Lego Mindstorms)

The goal of the WIT Robotics session was to have the girls engaged in the engineering side of robotics as well as the computing science side, through building and programming, respectively. The girls used the robots they helped to build and programmed to make it through a giant maze, by guiding them through by light, sound and/or motion. The session was a success and gave the girls a fun look into the world of robotics (there was much laughing and celebrating involved!) and an experience they may look back on when deciding upon a career path.

²Developed by Michelle Annett, Ph.D. Candidate, CS, UofAlberta.

6. Algorithmics: City Planners for a Day

An algorithm is a step-by-step "recipe" for solving a problem. In this activity, you will design algorithms for solving two city-planning problems: (a) paving a muddy city with streets so that people can get from anywhere in the city to anywhere else, using the minimum number of paving stones, and (b) placing critical facilities in a city so that anyone can reach one by walking to the end of their street and then, at most, one block further. These are examples of well-known graph-theory problems with a multitude of real-life applications.

Exploring CS with Grade 9 Math students

The University of Toronto at Mississauga is inviting 150 grade 9 enhanced math students and their teachers to come to campus for a conference-like field trip from 9:30 to 2 for for a range of CS-related activities:

1. Introduction. A large group session in a lecture hall featuring the active learning exercise described below. (45 mins)
2. Parallel Workshops. Individuals register for break-out sessions with enrollment in a session capped at 20 or 30. The exact sessions offered will depend on availability of workshop leaders, but some ideas are listed below. (60 mins)
 - *Storytelling with Alice*. An Alice tutorial. This hands-on session will be held in a computer lab where students will write a short animated story using Alice.
 - *Get the Most from Web Searches*. A behind-the-scenes look at how web searches work, combined with guidelines for finding and evaluating web content.
 - *Defense Against the Dark Arts*. Demonstrations of common attacks against desktops and how firewalls, anti-virus software, and common sense can protect against them.
 - *CS Unplugged*. This active session will teach some basic computer science concepts through interactive activities. If you like to be on your feet and moving around the room while thinking about mathematical ideas, this session is for you.
 - *Secret Codes*. How does encryption really work? Can we be sure that someone can't break our secret codes? What does it mean to sign something with a public key and how can it be part of a secret code if it is public? Explore the mathematical explanations behind these questions and others about cryptography.
 - *A Taste Of Programming*. A hands-on pair programming tutorial. This hands-on session will be held in a computer lab where students will explore code that runs a basic text adventure game and will add new features. *This workshop fills both the morning and afternoon slots.*
3. Lunch and student poster session. The poster session will showcase top projects from Grade 11 and 12 computer science classes as well as a selection of projects by university students. The poster presenters will be selected by their instructors and will have a chance to meet faculty and other top students during the parallel workshop time. (60 minutes)
4. Workshops. Repeat of pre-lunch activities so that students can attend two events. Some activities fill both workshop periods. (60 mins)

5. Conclusion. A second large group session in a lecture call featuring highlights from the workshops and a presentation. The presentation could be either something from an alumni about CS careers and employment prospects or an exciting talk about research directions in CS. It should also include a specific pitch for students to enroll in grade 11 computer science for the following year. (45 mins)

Large Group Session: More Details

The large group session is designed to connect to the Ontario grade 9 curriculum. It is hoped that this will be comparable in other provinces. The idea uses weighted averages to demonstrate that computer scientists can harness community intelligence to answer questions that any single individual in the community cannot accurately answer. As part of the registration process, we will ask that participants complete a survey consisting of questions that use life knowledge or instinct. (For example, "What will the high temperature be on December 1?" or "What is the average height of a woman in Grade 9?") Using the survey answers, we will show how individual responses can be wildly inaccurate but that the distribution of answers matches the correct distribution.

At the session, we ask small groups to estimate the volume of simple containers (cubic boxes and spheres) and track which groups answer the questions correctly. Then, we ask the groups to estimate the volume of more complex shapes (cones and then compound objects) and will show how accurate the estimates are. We discuss how to increase accuracy by valuing (weighting) answers from groups that were more accurate on the simple shapes and show how the predictions become more accurate after weighting.

Finally, we relate these techniques to procedures for predicting preferences. We have students rate recent movies and show how to predict a student's movie preferences based on their previously-rated movies and their similarity to other student ratings. This again involves weighted averages of the ratings from other students. This ties into a discussion of the recent Netflix contest.

Canadian Participation

In order to maximize collective impact, consider holding your event on December 9th, 2010 and let the CACS/AIC outreach committee know your plans by contacting Michelle Craig (mcraig@cs.toronto.edu). Consider working together with your local school board and with other university CS departments in your geographic area to offer a joint event and present a united front. ACM and CSTA resources are available at <http://csedweek.org> and you are welcome to copy and modify ideas from the sessions described above.