SUMMER CONFERENCES
FOR EDUCATORS

August 13 to August 15, 2024

UNIVERSITY OF
WATERLOO

The CENTRE for EDUCATION in
MATHEMATICS and COMPUTING

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Keynote Address

Artificial Intelligence: what's next?

Jesse Hoey   M3 1006

The aims of this presentation are to
(1) give a broad overview of the field of Artificial Intelligence or AI;
(2) to expose some of the philosophical and practical difficulties with modern AI; and
(3) to open a discussion about what is coming next with this exciting technology.
I will give a brief and sometimes personal history of Artificial Intelligence research, followed an examination of where the modern concept of "AI" falls far short of the capacities of humans. I will discuss some of my own research aimed at integrating emotions into AI, and open a discussion about where we AI is headed, including the deep and very challenging ethical and moral issues that come along with it.

Teaching About AI and With AI in Your CS Courses

Grant Hutchison   MC 4041

Philosophy of Teaching and Ethics

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Rob Ceccato   M3 3103

Practices for Orchestrating Productive Mathematics Discussions

7 & 8

Marcel te Bokkel   MC 2054

Integrating Problem Solving in Grades 9 and 10

9 to 12

Jason Van Rooyen   MC 2017

Teaching About AI and With AI in Your CS Courses

In this session we will start off with a discussion of types of AI applications. We will jointly explore how to create applications that use supervised learning AI methods using various online resources. We will also explore how to create applications that interface with generative AI models using the APIs provided. Finally, we will examine some of the benefits and limitations and concerns associated with the use of generative AI tools when designing, creating and testing applications. Many of the ideas from this session could be integrated into the new Grade 10 Computer Studies course or senior CS courses.

Philosophy of Teaching and Ethics

As teachers, we are bound by the Ontario College of Teachers Code of Ethics. In addition, teachers should develop their own Philosophy of Teaching either at the beginning of their teaching career or as an experienced teacher reflecting on their teaching practice. My presentation would discuss the importance of having a Philosophy of Teaching and how a teacher can develop their own. I will also share my own Philosophy of Teaching and how it can be best presented to their Learning Community.

OMG, I Have to Teach ICD20

OMG, I have to teach ICD2O, I could really use a completed unit plan. In this session, I want to help you figure out how to structure your ICD20 course, (units, assessment, lesson's, resources, final project, etc..) by sharing with you what I did, and how I set up my ICD2O course. This will start out as a presentation, with me showing you my units, lesson's, assessments, etc. However, I hope that after we cover my "vision" the rest of the session will be fluid and dynamic, so you can get the most help and understanding of why I set up my ICD2O course the way I did, and how you could do it for yourself.

Practices for Orchestrating Productive Mathematics Discussions

The 5 Practices are a framework for creating and implementing lessons that use student work as the focal point for engaging in mathematical discussions that leads to deeper understanding. By identifying and naming the practices, teachers can take control of a problem-solving session to ensure that student thinking builds towards the learning goal. Using VNPS/VRG model to get a class going, the 5 practices will enhance any mathematical discussion and provide opportunities for all students to think, discuss and learn.

Integrating Problem Solving in Grades 9 and 10

This session will examine the when, where and how of using problem solving in grades 9 and 10. A wide variety of problems will be examined and discussed, with varying levels of difficulty.

GitHub Pages *(Lab) - part 1*

Catherine Leung　　　　MC 2063

A Nesting Doll Approach

Mike Parchimowicz　　　　MC 4041

Arduino Programing – From Simple Circuits to Advanced Robotics and IoT *(Lab) - part 1*

John Rampelt　　　　MC 2062

Games in the 7/8 Math Classroom

Rebecca Channer　　　　MC 2054　　　　7 & 8

Using the Concrete-Diagrammatic-Symbolic Continuum in High School Math

Mike Jacobs　　　　MC 2017　　　　9 to 12

GitHub Pages

Github allows you to create websites based on files in your github repo with a tool called github pages. You can use it to publish your course website or use it with your students to host their web projects. Github pages are highly flexible, collaborative and can even be written without using html (though you can use html and all other client-side web tech you want). You can use one of Github's default themes or style it yourself. All this without running your own web server. You don't even need to know git!

This workshop will show you how to create a website using github pages. Topics include: How to Enable github pages

- Markdown
- Jekyll
- Docusaurus
- Actions
- Student management with classroom

Software Used: github pages

A Nesting Doll Approach

Careful selection of projects can assist with the acquisition of programming skills. The presenter proposes a 'layering in' approach to teaching computer science/programming, where each subsequent assignment is the previous assignment with some modifications to it that incorporate the latest concepts. Upon completion, each assignment looks strangely like the previous - like a Nesting Doll.

In this approach, programming concepts and skills are first modelled through seemingly disparate, but memorable exercises with colorful names, such as "My TV is broken" which is an exercise which covering rectangular collision detection, but presented in a context that is different from that which it will appear in the major project. These exercises can be thought of as the current outermost doll in a nesting doll and are used as a mental anchor for students when assisting with problem solving. A student may ask, "Why isn't my collision detection working?" to which I might simply reply "My TV is broken."

A significant challenge in mentoring and teaching programming to a broad array of student profiles is to know how much or how little support to provide. To this end, the teacher can help to appreciate the outermost doll, but the student is responsible for putting one doll inside of the next - "how does my last project 'turn into' this next one?"

Relatively sophisticated/self-reflective ideas (such as modularity, conventions, proper form) are learned by osmosis - students are compelled to make re-useable and modular code if they experience the conveniences first-hand.

A hypothetical concept map for a one semester, Grade 11 introductory programming course, with project ideas and resources, is presented and discussed to model a way this can be done. Java Processing is used, but the projects could be adapted to a number of different languages.
Software Used: Processing IDE (or the language of your choice)

Arduino Programming - From Simple Circuits to Advanced Robotics and IoT

Go beyond connecting Arduinos to simple breadboard circuits (and then trying to figure out how to turn these into viable robot projects at the end of the semester) using open circuits specifically designed for teaching introductory programming and for building simple robots! Both the open hardware ARPS and BEAPER Nano circuits have commonly used I/O devices such as pushbuttons, LEDs, a beeper, and a temperature sensor built in. Students can rapidly progress through learning fundamental programming skills in C or Python using these pre-wired components. When they're ready, the on-board motor driver, modular optical sensors, and integrated SONAR mount/expansion headers make it easy to convert these circuits into simple line-following, obstacle sensing, or classroom Sumo robots, as well as IoT (Internet of Things) hubs. We have a limited supply of Arduinos that participants may use during the session. However, participants may want to use their own Arduino Nano ESP32 (recommended) or an Arduino UNO R4 WiFi, Arduino UNO R4 Minima, or Arduino UNO R3 as they assemble and program their own simple classroom robot.
Software Used: Arduino IDE

Games in the 7/8 Math Classroom

Want to give students opportunities to use strategic thinking, practice mental math, build communication skills, and have a blast? Games are a great way to engage students in a low stake setting while deliberately practicing math. See why games are a high impact instructional practice that work in our intermediate classrooms and beyond. Everyone should come prepared to play and have fun!

Using the Concrete-Diagrammatic-Symbolic continuum in High School Math

Although arrays are first learned in the primary years, their power extends far into high school and beyond. Join me as we see how a concrete-diagrammatic-symbolic approach will help students learn about simple factoring in grade 9 and connect this to quadratic expressions in grade 10 (including perfect squares and difference of squares) and the factor theorem in grade 12.

GitHub Pages *(Lab) - part 2*

Catherine Leung   MC 2063

Online IDEs and Code Editors

Lisa Rubini-LaForest   MC 3003

Arduino Programing – From Simple Circuits to Advanced Robotics and IoT *(Lab) - part 2*

John Rampelt   MC 2062

Shifting Classroom Practices to put Student Thinking at the Centre

7 & 8

Carolyn Gingerich   MC 2054

Coding your way through Grade 9 Math

9 to 12

Sheri Hill and
Nathan Rowbottom   MC 4041

Online IDEs and Code Editors

As many school districts prioritize Chromebooks in student 1:1 programs, there is a need for an online code editor so that students may participate fully in their studies without an additional device available. In this session, we will look at the pros and cons on various online IDEs and code editors. Participants will be encouraged to use a personal email to join various online code editors and IDEs in a student role so they can judge the student experience of these websites for themselves.

Shifting Classroom Practices to put Student Thinking at the Centre

In this session, you will experience the routines and structures of a thinking classroom. We will unpack the ways in which these classroom practices can increase access to mathematical concepts for all students and the subtle teacher moves that make them most effective. Our focus will be on strategies that teachers can implement to build their students' capacity for thinking, problem solving, collaborating, and communicating in math class. This session will draw on the work of Peter Liljedahl, Zaretta Hammond, Ilana Horn and others. There will be something for everyone, both those who have experience with Thinking Classrooms and those for whom it is new!

Coding your way through Grade 9 Math

In Ontario, the Ministry has added the Coding Expectation to the Algebra Strand for the new grade 9 curriculum. However, coding should not be restricted to a single unit alone! Students should be able to view and interact with Math via coding in all aspects of the curriculum and beyond. In this session, we will provide pre-made activities that span the curriculum which non-coding teachers have used successfully in their classes. There will also be provided time for participants to play, tinker, and become comfortable to implement in their own classrooms. Note: No other coding experience is required.

ArenaBots *(Lab) - part 1*

Nathan Rowbottom   MC 3003

Using p5.js to Introduce Coding *(Lab) - part 1*

Sandy Graham   MC 2063

Design Your Own Circuit Boards Using KiCad *(Lab) - part 1*

John Rampelt   MC 2062

Out of this World: NASA/CSA Resources for Math Educators

Carly Ziniuk   MC 2054   7 & 8

Problem Solving

Shane Bauman   MC 2017   9 to 12

ArenaBots

Looking for a in interesting challenge for your 12 students? ArenaBots is an arena in which students submit code for Bot programs. Bot programs must process arrays of objects with the information of other bots and bullets in the arena and must weigh competing needs of dodging, tracking, firing and looting of ammo to decide what to do each frame. Abstract Bot classes are used to show what methods are required. There is active development of a server version which allows solo bots programmed in any coding language to compete via WebSocket libraries. In Java. there are two versions, one which features solo bots and another which is more group-based, which adds Roles like healers, support and tanks. Attendees will get access to simple bot examples and training scenarios, arena code. Server code will be demonstrated.

Software Used: Java IDE (may be possible to use other languages)

Using p5.js to Introduce Coding

Choosing a programming language to introduce coding can be difficult. Ideally the language syntax should be as simple as possible but also provide motivation for students to learn it. P5.js is a combination of JavaScript with a Processing library. JavaScript is the most popular language used on websites. Processing is a language designed to be easy to work with multimedia data and interact easily with the keyboard and mouse. This session will provide participants a taste of this language in action. This session will not assume any previous programming experience.

Software Used: Web-based IDE for p5.js

Design Your Own Circuit Boards Using KiCad

Learn how to use the open-source KiCad program to create schematic diagrams and design circuit boards for your computer technology program. Participants should download and install the appropriate version of KiCad (from https://www.kicad.org) for their operating system ahead of this session, and we will interactively design a simple circuit board and generate Gerber-format output files ready to be submitted to a printed circuit board manufacturer

Out of this World: NASA/CSA Resources for Math Educators

With our theme "Building an Inclusive Global Space Community," the NASA Space Apps Collective is using open data to spark innovations. As a Collective member and classroom teacher, I will share free, easily accessible NASA/CSA astronomy, space, and climate resources. Learn how to apply open datasets, use beautiful satellite images, stream video content, incorporate local "Astroindigenous" knowledge, download posters, find ready-to-use lesson plans with solutions, make Canadian connections, and illustrate math concepts with astronomy facts.

Problem Solving

In this session, we will have some fun solving some interesting problems. We'll look at different approaches to these problems and talk about some general problem-solving techniques.

ArenaBots *(Lab) - part 2*

Nathan Rowbottom   MC 3003

Using p5.js to Introduce Coding *(Lab) - part 2*

Sandy Graham   MC 2063

Design Your Own Circuit Boards Using KiCad *(Lab) - part 2*

John Rampelt   MC 2062

Situational Problems: Creating/Scaffolding/Marking Open-ended Real-World Problems

Kiera Pannell   MC 2054

7 & 8

Introducing Desmos Classroom for Secondary Math Classes

David Petro   MC 2017

9 to 12

Situational Problems: Creating/Scaffolding/Marking Open-ended Real-World Problems

Situational problems present students with obstacles and ask them to formulate a solution which meets the criteria of the problem. They require that students employ creativity when problem-solving and encourage resiliency, for a first idea might not be the best idea. This workshop will introduce the requirements for a situational problem, present examples of past problems, and identify key considerations for teachers who want to create their own problems. Participants will have the opportunity to solve problems themselves and/or correct examples of student work.

Introducing Desmos Classroom for Secondary Math Classes

Desmos Classroom (formerly Desmos Activity Builder) is a powerful and free tool that lets you run activities from all areas of math in such a way that fosters communication with and between students, allows you to see what they are doing on their computers from yours, and helps you probe student work for good and interesting thinking at the click of a mouse (among other things). In this session you will be introduced to several ready-made lessons for secondary math students, shown how to navigate the teacher dashboard, and more. Bring a laptop, Chromebook, or tablet to make the best of this session.

Screenfree Computational Thinking Activities
(Hands on) - part 1

Roma Uniat   MC 4042

KDTags and Bluetooth Communication (Lab) - part 1

Michael Chan   MC 2062

Using PCBs and PCB Creation in TEJ3M
& TEJ 4M Courses (Lab) - part 1

Stephen Emmell   M3 3103

Let's Solve Some Problems

Ashley Sorensen   MC 2054   7 & 8

Assessing Assessment - Is our Marking on Target?
When is Wrong more Right?

Rich Dlin   MC 2017   9 to 12

Screenfree Computational Thinking Activities

In this screen free lab, a variety of engaging activities that use computational thinking will be modelled and experienced. After each activity, we will discuss invisible barriers, adaptations for grade level, adaptations for materials and physical space limitations, and connections to computer science concepts. We will experience and discuss the importance of risk-taking, learning from mistakes, and collaboration in a classroom setting. These engaging activities can be used in a variety of grade levels and require no programming experience.

KDTags and Bluetooth Communication

Wireless Controls have become an essential and household part of our daily life. In particular, Bluetooth technology (BT) plays an important role in this area. Industries are quick to adopt and develop BT devices because the technology maintains universal standards and is easy to use. In fact, BT prototype is so simple to use that it could readily be applied in our CS classes. We could bring this state-of-art technology into our interfacing/control projects and enrich students their appreciation of programming. My presentation is composed of two parts. Part 1 introduces Bluetooth Technology, with a KDtag BT device illustrating its principles. Part 2 is a hands-on applications session. Teachers would have the chance to analyse the KDtag device in terms of communications, characteristics and control codes. At the end of the session, teachers should be comfortable to control interfacing devices (PC, Arduino...) via a KDtag using Python and C.
Software Used: Arduino IDE

Using PCBs and PCB Creating in TEJ3M & TEJ4M Courses

There is so much power in making real things! Want buy-in from your engineering students? Show them how easy it is to make a real printed circuit board (PCB) and use it in projects all semester.
Attendees will be shown
- A quick demo of KiCAD and what it takes to create a PCB
- What is involved in having a PCB actually manufactured and shipped to you
- Using a provided student-made PCB as an example, solder them together and do some simple programming examples to illustrate how they are used.

This is a terrific progression I have used where students use a provided PCB in TEJ3M (soldering, programming, wiring additional circuits onto) followed up by TEJ4M where they not only learn how to create their own PCBs, but have them manufactured, and then use that same original board from TEJ3M to program the ATTiny chips on their new PCBs.Key areas of focus:

- Illustrating the teaching of real industry software (KiCAD)
- Showcasing the viability of PCB fab use within a single semestered class
- Discussing additional uses of their project board that students receive in TEJ3M
- Basic programming pieces around using Arduino in the classroom, or the possibility of basing this idea on alternate microcontrollers (PICs, Pi Micro, Espressif, etc)

Let's Solve Some Problems

Let's take this opportunity to just solve some problems together. We'll work on a handful of
interesting problems that are harder, but still accessible. Along the way, we will talk about different approaches to solving these problems as well as some general problem-solving strategies.

Assessing Assessment - Is our Marking on Target? When is Wrong more Right?

In this session, we will explore times when there can be a significant disconnect between test scores and student ability in mathematics. Common assessment practices will be explored for inconsistencies and the mixed messages they can send to our students.

Screenfree Computational Thinking Activities
(Hands on) - part 2

Roma Uniat   MC 4042

KDTags and Bluetooth Communication *(Lab) - part 2*

Michael Chan   MC 2062

Using PCBs and PCB Creation in TEJ3M & TEJ 4M Courses *(Lab) - part 2*

Stephen Emmell   M3 3103

Introducing Desmos Classroom for Grade 7 and 8 Math Classes

7 & 8

David Petro   MC 4041

Out of this World: NASA/CSA Resources for Math Educators

9 to 12

Carly Ziniuk   MC 2017

Introducing Desmos Classroom for Grade 7 and 8 Math Classes

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Out of this World: NASA/CSA Resources for Math Educators

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Quantum Computing in the Classroom *(Hands on)*

John Donohue   MC 4042

Data Science with Data Dunkers *(Lab)*

Peter Beens   MC 3003

Raspberry Pi Pico Programming *(Lab) - part 1*

Grant Hutchison   M3 3103

Using Virtual Manipulatives to Visualize Student Thinking

7 & 8

Gerard Lewis   MC 2054

The Course Everyone Should Take

9 to 12

Lindsay Parchimowicz   MC 2017

Quantum Computing in the Classroom

Quantum mechanics describes the behaviour of atoms, electrons, photons, and more. If we encode bits of information in quantum systems, the rules of information processing also change, enabling an entirely new way of computing. In this workshop, we'll explore the behaviour of quantum systems and show how this changes the logical operations available to manipulate bits, introducing probability and superposition into our information processing toolbox. We'll explore a classroom-appropriate thought experiment that shows how certain problems can only be solved with quantum phenomenon and provide a big-picture overview of modern research in quantum computing.

Data Science with Data Dunkers

Embark on an exciting journey into data science with the Data Dunkers program, tailored to inspire educators to bring the world of numbers to life. This engaging workshop is designed to leverage the power of Jupyter Notebooks, Python, and Pandas to unravel the fascinating stories told by sport statistics. With a spotlight on NBA phenomenon Pascal Siakam and the Toronto Raptors, we reveal how the magic of math can be applied to real-world scenarios, making it both fun and accessible. This workshop is an excellent opportunity for math educators to enrich their teaching toolkit by integrating elements of coding and data analysis into their lessons. No previous knowledge of basketball is required to enjoy this exploration. Participants will leave equipped with the know-how to make data science an engaging part of their classroom experience. Note: Attendees are encouraged to have a Google account that has access to Google Colab (https://colab.research.google.com).
Software Used: Google Colab

Raspberry Pi Pico Programming

Hands on exploration of how to integrate Python programming and robotics into senior Computer Technology courses using Raspberry Pi Pico. We will provide Raspberry Pi and other materials to creating a line-following robot. We may need participants to work in pairs depending on the number that select this session.
We will be using the Thonny IDE and Python throughout the workshop so participants should bring their laptop with Thonny installed.
Software Used: Thonny https://thonny.org

Using Virtual Manipulatives to Visualize Student Thinking

In this hands-on session, participants will explore a variety of free virtual manipulatives connected to a variety of topics in the grade 7-8 classroom. We will take time to explore Amplify Polypad, Geogebra Geometry, and Pearson Interactive Tools. Some of the topics that we will look at include prime factorization, area of shapes, angle properties, nets, fraction operations, and algebraic expressions. Access to a computer would be essential for participation in this workshop.

The Course Everyone Should Take

Financial stress is a fact of our adult lives. Learn how you can run a course to help your students be equipped to deal with all the money issues that begin in post-secondary and continue for the rest of their lives. This is the math everyone needs to know for life! We've successfully run the course for 7 years with many students saying it was the most useful course they took in high school. Come out to get resources to run the full course and hear how we ran a Personal Finance course for our College and University bound students.

Node Based Programming Using Unreal Engine

Marc Dubeau   MC 3003

Interdepartmental Collaboration for Video Game Development in ICS4U

Andrew Seidel   MC 4041

Raspberry Pi Pico Programming *(Lab) - part 2*

Grant Hutchison   M3 3103

Algorithmic Adventures: Using Python Programming to Elevate Student Engagement

7 & 8

Kevin Watt   MC 2054

Integrate Coding in Mathematics using Python, Jupyter Notebooks, and Google Colab

9 to 12

Russell Gordon   MC 2017

Node Based Programming Using Unreal Engine

Join us for an insightful workshop where we delve into the journey of a high school Game Design class that successfully built and published two games on the STEAM Marketplace in 2023 and again in 2024. Discover how they used NODE based blueprints to publish their games on Steam.

In addition, explore the innovative cloud-based tool, InspireTech, which integrates Unreal Engine and other high-end software to run in the cloud. InspireTech and InspireStream are cutting-edge tools that provide equitable access to high-end software through virtual machines, ensuring all learners across North America can benefit from a robust STEM education.

Participants will gain valuable insights in how to take your classroom instruction to the next level. Join Marc Dubeau, winner of the STEM Prime Minister Award to learn first-hand what it takes to upgrade your game.

Here is the URL to download and play the game we published in 2023: The story of how my students and I published a game on the Steam marketplace.

Here is the URL to download and play the game we published in 2024: The story of how my students and I published a game on the Steam marketplace.

Link to the InspireTech and InspireStream: https://www.inspiretech.ca/

Software Used: InspireTech

Interdepartmental Collaboration for Video Game Development in ICS4U

Students learn the necessary skills to work with their peers in other classes as they develop their own video game. From the media arts department creating their characters, animations, backgrounds; drama students doing voice acting; incorporating music from the instrumental students; trailer creation with the communications technology students; writer's craft to create a script for the video game; working with the business marketing team to create marketing materials; and much more! Come to this collaborative session where we brainstorm together what might work in your classes, which courses you might collaborate with (and how), which other schools you might work with, and how we might do cross-curricular work in the other ICD/ICS courses.

Algorithmic Adventures: Using Python Programming to Elevate Student Engagement

In this session, we will explore the use of text-based coding to both hook the interest of middle school math students and explore ways to solve math problems using code. Get students excited by using conditional statements to make a "choose your own adventure" text-based adventure game! Energize your students' learning by using loops and random number generators to create games of chance. Interest your students in different aspects of the curriculum while learning core coding concepts such as: using conditionals to create a Pythagorean theorem calculator, building functions to make a provincial tax assessor, and exploring loops to calculate the mean, median and mode of their recent tests. We will use the Python programming language with the CodeHS online coding platform to build these programs and gain capacity to teach math through coding.

Integrate Coding in Mathematics using Python, Jupyter Notebooks, and Google Colab

In this hands-on lab session, try out resources that both introduce coding concepts as topics unto themselves, and use coding to advance our students' understanding of mathematics. In particular, understand how Google Colab, the Python programming language, and the Jupyter Notebooks format can be used to make student thinking visible. The goal is to not just "do coding" with our students but to make writing code another tool that students will naturally reach for when problem solving, exploring mathematical concepts, or when looking for meaning in data. You will have time in this session to experiment with authoring your own resources as well.

Glossary

Timing

Mathematics

Presenter

Grade 7 & 8 Mathematics

7 & 8

Venue

Grade 9 to 12 Mathematics

9 to 12

Computer Studies

This session includes the use of software. Read the session description for more information. You may find it useful to access the software on your own device with an operating system with which you are most comfortable. If the session is scheduled in one of the labs (MC2062, MC2063 or MC3003), then you can use one of the lab computers.

Participants are encouraged, as always, to follow best cybersecurity practices when deciding whether to download or use the software, among other things paying attention to the permissions that the app needs (e.g. access to GPS location, access to information about networks, open network sockets, write to external storage, etc.).

MC: Mathematics and Computing Building
M3: Mathematics 3 Building

Notes

The CENTRE for EDUCATION in MATHEMATICS and COMPUTING

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