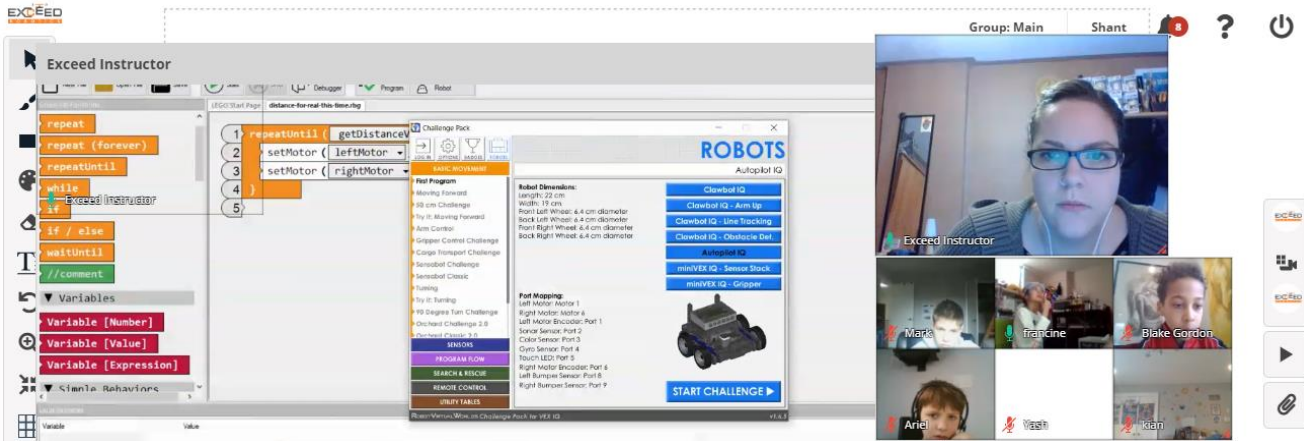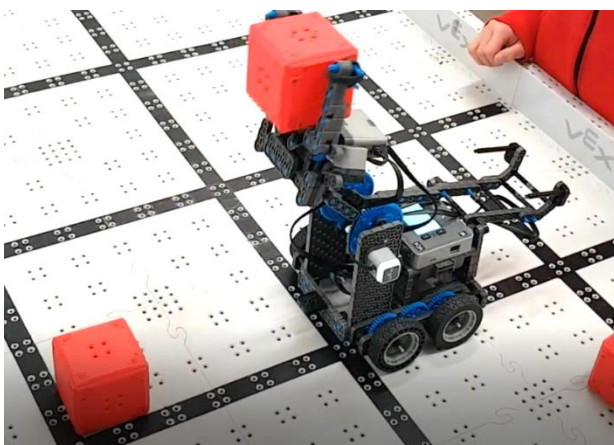# EXCEED
ROBOTICS

VIRTUAL ROBOTICS

AGES 9 - 11

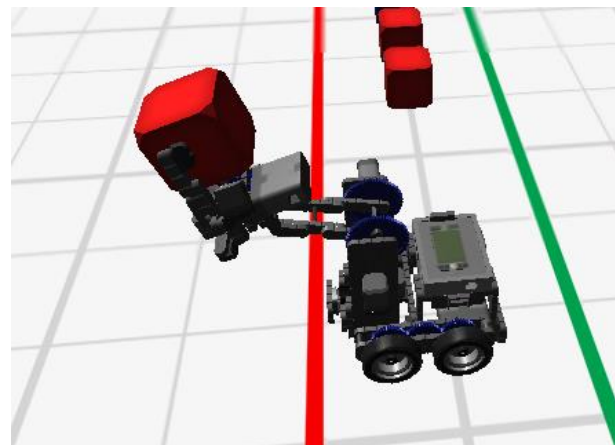# THE VIRTUAL CLASSROOM EXPERIENCE

All Exceed Robotics programs are offered on our Virtual Classroom for ages 9+ including Robotics, Python Game Development and Web Programming. Both virtual and in-centre courses are equivalent, allowing students to seamlessly transfer between in-person and online learning. The primary difference is the use of a robot simulator instead of a physical robot and a LIVE instructor to teach online.

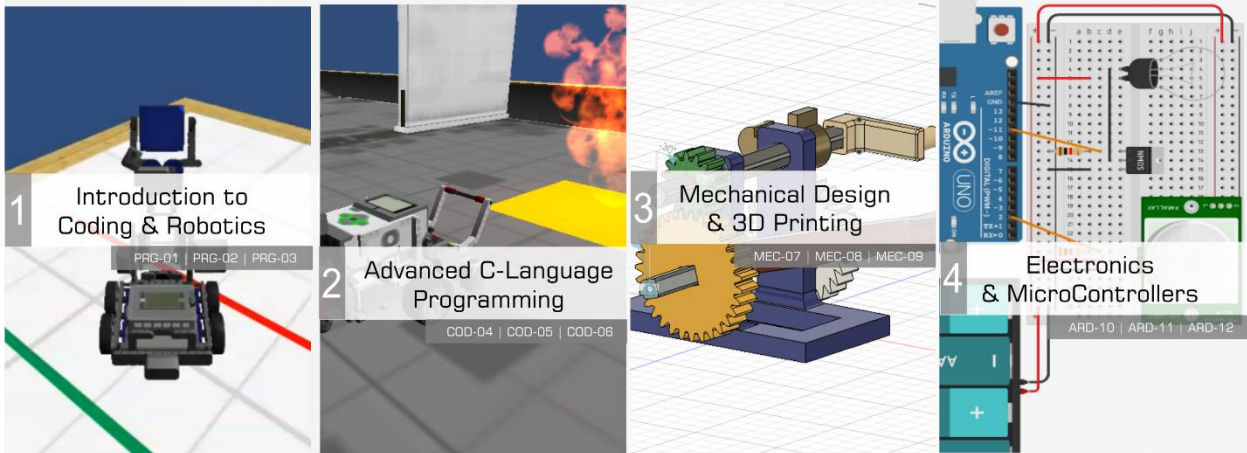| Virtual & In-Centre Courses	Unique to Virtual Courses
▪ same curriculum ▪ same learning objectives ▪ same lesson plans ▪ same coding & design software	▪ robot simulator (shown below) ▪ LIVE online instructor (above)

Physical Robot

Robot Simulator

VIRTUAL ROBOTICS CURRICULUM

1. Introduction to Coding & Robotics
   PRG-01 | PRG-02 | PRG-03

2. Advanced C-Language Programming
   COD-04 | COD-05 | COD-06

3. Mechanical Design & 3D Printing
   MEC-07 | MEC-08 | MEC-09

4. Electronics & MicroControllers
   ARD-10 | ARD-11 | ARD-12

The Virtual Robotics curriculum focuses on teaching students **Programming**, **Computer Design** and **Electronic Circuits** through real-world applications and a step-by-step approach.

All Robotics courses follow a structured curriculum with challenges each class designed to promote critical thinking and experiential learning. The end goal of the Robotics curriculum is to develop a skill set needed to independently create complete robots by designing mechanical parts, wiring electric circuits and programming microcontrollers.

PROGRAM DETAILS

2.5-year curriculum

Classes once per week

One-hour in duration

8 students max per class

Homework after each class

The Robotics curriculum was created by a team of mechatronics engineers with 25+ years of global industry experience with the aim of advancing STEM education amongst Canadian youth. The Robotics program's vision is to create a community of young innovators by developing computer science and engineering skills and directing them towards solving real-world problems.


Robotics Alumni Projects

PRG-01: LOGIC BUILDER

Prerequisite: ages 9+ (no experience required)

The first robotics course in the Exceed Robotics curriculum focuses on building programming logic using robots.

Sequential programming and conditional statements are introduced to program a robot to perform specific tasks, utilizing various sensors to make decisions.

STEM topics are integrated into each lesson by presenting the science behind a particular sensor or applying math for motor drive and control.
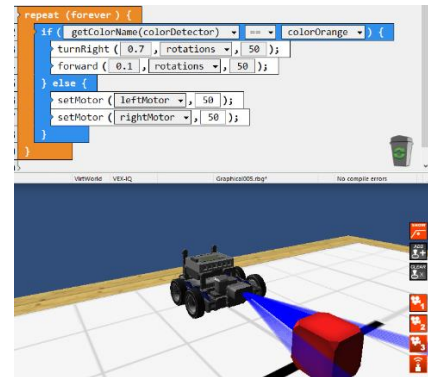

PRG-02: PROGRAMMING PROJECT

Prerequisite: PRG-01

To fully absorb the programming fundamentals taught in the first course, this project course provides the opportunity for students to apply recent coding concepts. Modular programming of a multi-motor, multi-sensor robot is used to perform a project based on real-world applications.

The project is designed to promote independence, build confidence and develop communication and problem-solving skills. Students present their work to their instructors and parents at the end of the course, where they are evaluated prior to moving on to the subsequent competition course.
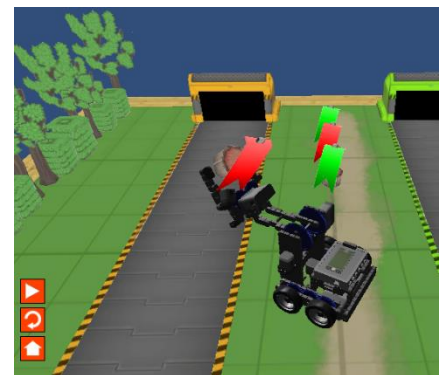
PRG-03: PROGRAMMING CHALLENGE

Prerequisite: PRG-02

An exciting course in modular programming using a complex robot to perform a Virtual World challenge. Students work on this programming challenge for the duration of the course and display their programs to the class on the last day.

Game objectives and milestones are presented at the start of the course and students continue working in programming, testing and refining their programs.

Students start learning about time management, strategy, and start gaining independence and experience in problem-solving.

COD-04: C-LANGUAGE FUNDAMENTALS

Prerequisite: PRG-03

After developing the logic of programming robots using modular programming, text-based programming with C-language is introduced. C-language is the most powerful and useful programming language which is used commonly used in industry.

The course begins teaching variables, datatypes, loops and conditional statements used to program robots. This course moves beyond graphical programming towards language-based coding which offers greater control for robot design and development.

A new robot platform is introduced to have students comfortable with transferring their knowledge to multiple types of robots.

```
void Grab()
{
  moveMotor(armMotor,-0.2,rotations,50);
  forward (3.41,rotations,50);
  moveMotor(armMotor,0.2,rotations,50);
  backward(10,rotations,50);
  moveMotor(armMotor,-0.15,rotations,50);
}

task main()
{
  int count;
  count = 0;

  while (count<2)
  {
    NextRoom();
    count = count
  }

  Grab();
}
```


COD-05: AUTONOMOUS STRUCTURE

Prerequisite: COD-04

This course focuses on programming structure for autonomous robot control. Learning about the structure for autonomous control is a critical step for students to start programming any robot to use any sensor to make decisions on its own. It has real world applications in self-driving cars, factory robots, etc.

Various sensors including ultrasonic, touch, colour and gyro are introduced and utilized to complete advanced programming challenges.
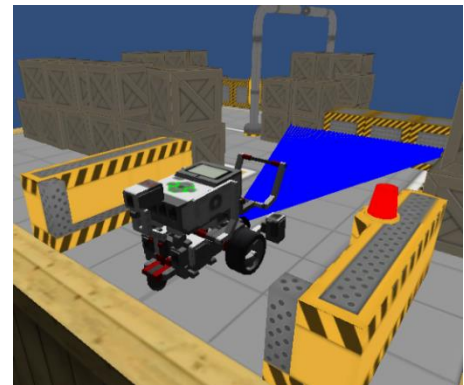

COD-06: SMART CITIES COMPETITION

Prerequisite: COD-05

This advanced programming competition course is based on Exceed's Smart Cities competition designed for Ryerson engineering students in 2019.

Students program their robots equipped with multiple sensors and motors to autonomously navigate through a virtual city. They will write code for line following, flag detecting, gyro turning and crash avoidance to complete the urban challenge in the least amount of time. The student with the most points will be virtually crowned.
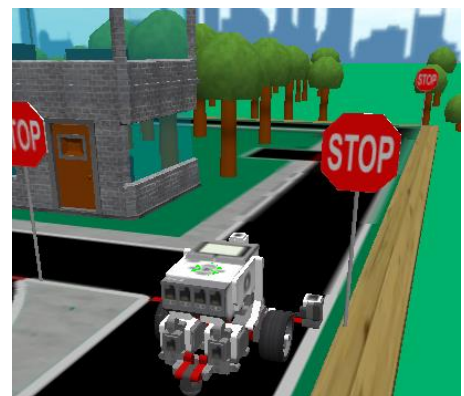
MEC-07: COMPUTER DESIGN FUNDAMENTALS
Prerequisite: COD-06

To first course in the Mechanics series relates to the design of 3D-printed mechanical parts. Students learn various design tools using Autodesk Fusion 360 to create their own designs.

Starting with sketching, students complete various design projects to practice using design tools and features. Through select projects, students will practice using fundamental tools in mechanical design. Design projects are assigned for students to independently apply their design skills and create functional mechanical components that could be 3D printed.


MEC-08: MACHINE DESIGN AND SIMULATION
Prerequisite: MEC-07

Building robots cannot be complete without learning how parts we design should fit together. This machine design course teaches students about the fundamentals of machine design including fits and clearances, structure design, levers, gears, and more.

Students will design each component of the machine and will assemble them together in the design software. By learning about joints and constraints, students will create a virtual simulation of their creations. In industry, design simulation is an essential tool used by engineers to predict functionality and performance before building a single prototype.
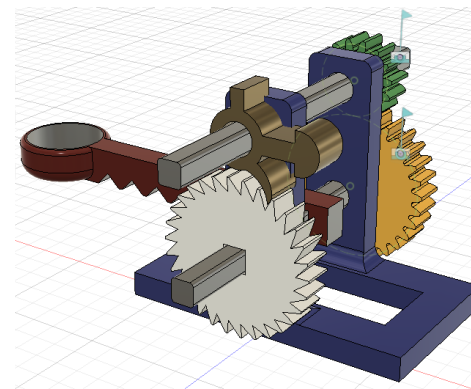

MEC-09: ELECTRONIC CIRCUITS
Prerequisite: MEC-08

The last course in this Mechatronics series is all about electronic circuits. After learning the fundamentals, students work on lab assignments by building and testing their own electronic circuits.

Students will learn about principles of electricity and Ohm's law relating to voltage, current and resistance. Using multimeters to measure voltage/current, students take measurements to better understand the effects of the different electronic components.

Electronic components including resistors, switches, motors and transistors will be covered in preparation for the next Microcontrollers series.

4   # MICROCONTROLLER PROGRAMMING
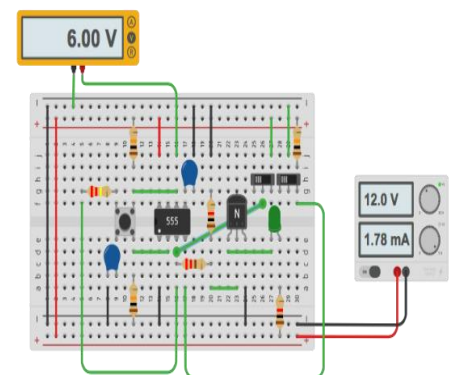
ARD-10: INTRODUCTION TO MICROCONTROLLERS
Prerequisite: MEC-09

The Arduino microcontroller is a widely used programmable development board that makers and hobbyists use to control custom robots.

Students will learn about digital and analog devices and be introduced to Arduino-controlled circuits to control devices such as LEDs, switches, buzzers, photoresistors and DC motors.
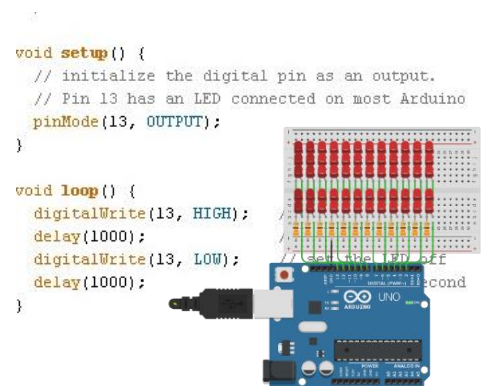
The programming of the Arduino is an extension of the Advanced Programming & Robotics courses (COD-04,-05,-06) as Arduino is based on the C programming language


```
void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```
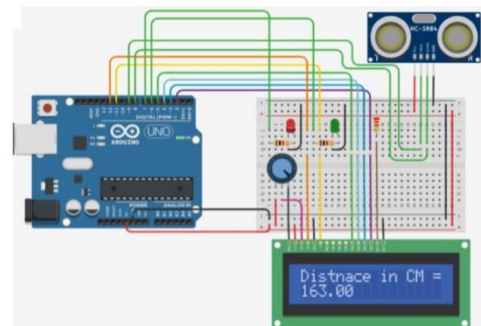
ARD-11: ADVANCED MICROCONTROLLERS I
Prerequisite: ARD-10

The second microcontrollers course moves onto wiring and programming circuits with advanced input devices including potentiometers and various analog sensors.

Students will practice wiring and programming circuits using various sensors throughout this course. At the end, the aim is to have students gain experience and feel comfortable using microcontrollers to make decisions using sensor data.


ARD-12: ADVANCED MICROCONTROLLERS II
Prerequisite: ARD-11

Building on our knowledge in creating circuits using analog sensors, this course teaches programming with complex sensors and servo motors, allowing students to create and program complex microcontroller circuits.

Combined with the previous Mechanical Design courses, learning how to build and program such advanced microcontroller circuits is the final step towards creating custom robots!
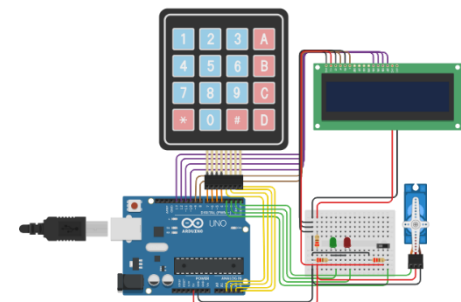
What's Next?

Our latest Web Development curriculum teaches **HTML, CSS and JavaScript** programming languages for front-end web development to students ages 11+. These courses were developed in partnership with a team of web developers from the University of Toronto

Python Game Programming available for students ages 12+ was created for students who want to continue to advance their programming skills through the fun application of game development.