CISC 1003 Exploring Robotics
3 hours, 3 credits

Introduction to programming through the use of project-based educational robotics activities. Small group work on a series of multi-week creative projects involving use of robots to address meaningful and socially important issues, such as urban search and rescue or elder care. Introduction to the fundamentals of robotics (including aspects of mechanical design) and elementary programming within a graphical environment. [Not open to students who are enrolled in or have completed CORC 3303]

Goals Addressed by Core Course:

1. To develop the ability to think critically and creatively, to reason logically, to reason quantitatively, and to express one's thoughts orally and in writing. (includes OARM goals 10, 11, 12, 13, 15, 16, 21)

2. To understand the development and workings of modern societies in an interdependent world. (includes OARM goals 6, 7)

3. To acquire the tools required to understand and respect the natural universe. (includes OARM goals 5, 18, 27)

4. To be capable of integrating knowledge from diverse sources. (includes OARM goal 28)

5. To produce informed and responsible citizens. (includes OARM goals 8)

6. To establish a foundation for lifelong learning and the potential for leadership. (includes OARM goals 29, 30)

Objectives of this Core Course:

1. Students will be able to address robotics performance questions through student-designed empirical studies. (OARM goal 10)

2. Students will be able to develop and test programs for real-world situations. (OARM goals 5 and 6)

3. Students will be able to form and test hypotheses by developing programs, observing results and modifying the programs to achieve desired results. (OARM goal 18)

4. Students will be able have their programs integrate knowledge from a variety of robot sensors to formulate a plan of action for the robot. (OARM goal 28)

5. Students will be able to analyze issues involving development and use of robots in modern society. (OARM goal 8)

6. Students will be able to demonstrate effective work on a team or in a working group. (OARM goal 29)

7. Students will be able to describe technical work orally and in writing. (OARM goals 11, 12)

Outcomes:

1. Students perform experiments to determine robot performance.

2. Students develop and test robotics programs.

3. Students debug and modify programs to achieve desired results.

4. Students write programs that integrate sensory data as input to the plan of action for a robot.

5. Students describe tasks for which robotic action is feasible and preferable to that of humans.

6. Students work in teams to construct and program robots.

7. Students describe their work both orally and in writing.

Course Outline:

Week 1.	Introduction to Robotics: technical and societal issues.
Weeks 2 & 3.	Project 1 – Simple Go-bot: motors and motion.
Weeks 4 & 5.	Project 2 – Dancing Go-bot: event-driven motion using one sensor.
Weeks 6, & 7.	Project 3 – Search-and-rescue Go-bot: complex motion using multiple sensors.
Weeks 8, 9 & 10.	Project 4 – Home-helper Go-bot: multiple activities in a complex environment.
Weeks 11 – 14.	Project 5 – Search-and-rescue Team: robots work together in a complex,
environment.	dynamic

These projects build in complexity in terms of the robot solution, the task environment and the task(s) to be accomplished. The first project introduces students to basic control ideas and the use of touch sensors. The second brings in the use of light sensors. The third project combines touch and light sensors, and makes more sophisticated use of the light sensors. The fourth project requires the students to deal with a more complex environment and multiple tasks, just as a real robot helper in the home might assist an elderly person. The final project brings all of the elements together while requiring cooperation of all the robots in the class to achieve the goal of locating and rescuing dummy victims from a mock collapsed building.

Method of Assessment:

1. Students will be asked to perform experiments on robot performance.

2. Students will be presented with problems for a robot to solve and will be asked to write a program for a robot to solve the problem. They will document their design and methodology.

3. Students will be asked to produce working programs. They will be given incorrect program segments to correct or abstract designs to implement.

4. Students will be given a problem involving sensory input and will be asked to create a program for a robot to detect and act on that input.

5. Students will be asked to present an example of a task for which robot action is feasible and preferable to human action, and explain why.

6. Students will be asked to participate in a team and will be assessed for performance by the other members of the team.

7. Students will be asked to make a short oral presentation and describe their work in writing.

Methods of evaluation: The five projects of the course (15% x 5) and the presentations and reports (5% x 5) will be used to assign grades.

Bibliography:

? Arkin, R.: *Behavior-Based Robotics*, MIT Press, 1998.

? Asimov, Isaac: *I, Robot*, Doubleday, 1950.

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? Baum, D., Gasperi, M., Hempel, R. and Villa, L.: *Extreme MINDSTORMS: An Advanced Guide to LEGO MINDSTORMS*, Apress, 2000.

? Bergin, Joseph, Mark Stehlik, Jim Roberts, Richard E. Pattis: *Karel++: A Gentle Introduction to the Art of Object-Oriented Programming*, Wiley: 1996.

? Braitenberg, V.: Vehicles: Experiments in Synthetic Psychology, MIT Press, 2000.

? Capek, Karel: *Rossum's Universal Robots*, Doubleday, Page, 1923.

? Knudsen, Jonathan: *The Unofficial Guide to LEGO MINDSTORMS Robots*, O'Reilly Publishing, 1999.

? Martin, Fred: *Robotic Explorations: A Hands-On Introduction to Engineering*, Prentice Hall, 2000.

? Mataric, Maja: *The Robotics Primer*, MIT Press, 2005.

? Pattis, Richard: *Karel The Robot: A Gentle Introduction to the Art of Programming, 2nd Edition*, Wiley: 1994.

? Eric L. Wang: *Engineering with LEGO Bricks and RoboLab, 2nd edition,* College House Books, 2004.

There is a growing research literature on the use of robotics in the classroom. The course proposers have published a recent journal paper on their past efforts and experiences:

? Elizabeth Sklar, Simon Parsons and Peter Stone (2004). *Using RoboCup in university-level computer science education*, In Journal on Educational Resources in Computing (JERIC), Volume 4, Issue 2 (June 2004) Special issue on robotics in undergraduate education. Part 1.