

USING THE LEGO MINDSTORMS NXT ROBOT KIT IN AN INTRODUCTION TO C PROGRAMMING CLASS

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ABSTRACT

We all know that teaching an introductory programming class is hard, and that one of the most difficult parts is motivating freshmen to do the work in a timely manner. For the past 5 years, the C programming class at UNH has been using the Lego Mindstorms robot kit in a series of lab exercises that make programming more fun, and at the same time reinforce the basic concepts discussed in lecture. This is done using a variant of the C language, NXC, developed by John Hansen [1] for these robots. In this workshop, participants will be introduced to the robots and the NXC (Not eXactly C) programming language. An overview of a set of lab exercises will be given, and a hands-on activity using the robots will be included. Participants should have some background in C programming to best appreciate the workshop.

DETAILS OF SESSION

The workshop will begin with a lecture format section that will include the following topics:

1. The Lego Mindstorms NXT Kit – an introduction to the basic components
2. GUI Programming – the first robot lab in the course actually uses the graphical programming environment that comes with the kit. A demonstration of writing a simple program using this flowchart style of programming will show how this lab is useful.
3. NXC Language – an introduction to this language will be given, with web references to manuals and tutorials. Basic API functions to control motors, display values on the LCD and use sensors will be covered. Basic differences between C and NXC will be highlighted. The sample GUI program demonstrated in step 2 will be translated into NXC. Participants can follow along on their systems during this phase.
4. Sample lab exercises – the basic lab exercises used in our introductory course will be covered, emphasizing how each reinforces particular lecture concepts. Other examples of how the robots are used in other courses will also be given.

The workshop will conclude with a hands-on activity in which the participants will be asked to work individually or in pairs (our students typically work in pairs) on a programming project that is based on one of the lab exercises students do in the programming class. I will help the participants complete this activity by interacting with each team individually as they encounter difficulties.

MATERIALS NEEDED/PROVIDED

UNH has 20 Lego NXT kits that will be used for the hands-on activity. I will come with prebuilt robots similar to those used in our C programming class. A programming environment will be needed. The software that needs to be installed under Windows consists of a set of drivers from Lego, as well as an IDE for the NXC language called BricxCC [2], that has also been developed by John Hansen. Both are publicly downloadable and are not difficult to install. A room with a sufficient number of computers running Windows XP or Vista with this software installed will be available, or participants can bring laptops on which they have already installed this software (or it can be done fairly quickly during the workshop). Electronic copies of the presentation and lab exercises discussed will be made available.

PRESENTER BIOGRAPHY

David Eggert is an associate professor in the ECECS department at UNH and is currently in his 13th year there. He graduated with his Ph.D. in Computer Science & Engineering from the University of South Florida in 1991. Before coming to UNH he was a visiting professor at the University of Kentucky and a research associate at the University of Edinburgh in Scotland. His research areas include computer vision, object modeling, and mobile robotics. He teaches a wide variety of courses related to networking, O/S administration, computer security, AI, robotics, and all levels of C programming from the introductory course mentioned here to systems programming in a Unix environment. He is a co-author of the textbook *Applied C: An Introduction and More* [3] which is used in the introductory course.

REFERENCES

[1] Hansen, J., *Lego Mindstorms NXT Power Programming: Robotics In C*, Winnipeg, Manitoba: Variant Press, 2007.

[2] Hansen, J., Bricx Command Center 3.3, <http://bricxcc.sourceforge.net/>, 2008.

[3] Fischer, A.E., Eggert, D.W., Ross, S.M., *Applied C: An Introduction and More*, New York, NY: McGraw Hill Publishing, 2001.