

ENGR 141

TA Manual

This manual is intended to help you in running a final project for ENGR 141. It should at least give some idea of the administrative tasks that need to be done and help you avoid past mistakes.

Contacts

ECE:

Darren Dawson ddarren@clemson.edu

General Engineering:

Beth Stephan bethste@clemson.edu

William Park parkw@clemson.edu

Steve Brandon brando4@clemson.edu

David Ewing ewing@clemson.edu

Jonathan Maier jmaier@clemson.edu

Tic-Tac-Toe

Spring 2012

Preparation

A few weeks before the project starts, you need to make check the RWTH website to see if they have made any updates to the toolbox that will require changing the toolbox setup instructions or the lab manual. Also, check for new versions of MotorControl.rxe from RWTH and new versions of the NXT firmware from Lego and keep the NXTs up to date.

The Mindstorms kits are located in the storeroom in the basement of Holtzendorff. You can get card access to that room (through B-03) from Dr. Brandon. The UTA key ring is also in that room, and can be used to unlock the project lab. Make sure enough robots are assembled. At a bare minimum, there should be enough so that every group in a section can have one. If more than one section meets at the same time, it will have to be taken into account. Because of the high demand during the evening UTA hours, it is best to go ahead and assembled as many robots as you have kits available. If more robots do need to be put together, talk to Dr. Stephan about having the general engineering undergraduate TAs do it. Check to see how many batteries are in the Holtzendorff storeroom and ask Gale Black (galew@clemsun.edu) to order more if necessary.

Students will be given time during their regular class time to work on their projects, and they will only have access to the robots during class time. At least one of the ECE TAs needs to be present for each section, so get the schedule from Dr. Stephan and arrange with the other TAs who will attend which sections. If more than one section meets at the same time, the professors will usually combine all the students working on the same project into one room, so one TA can cover multiple sections. Also, someone needs to attend the UTA hours from 7-9 PM Monday through Thursday. When you do attend one of the classes or UTA hours, make sure the students know that you are there and you can help them. Remember that these students have never seen you before and have no idea that you know anything about the project. Try to circulate around the room and occasionally check in on the teams. Also, on the first day, be sure to introduce yourself to the professor if you do not already know them, and they will probably introduce you to the class.

Getting Started

Part one of the project is all within MATLAB, so most of the questions during that part will just be explaining error messages and general debugging. The UTAs can help with this too. Also be prepared to answer questions about the game logic. In my experience, most groups choose to go with a program that attempts to: a) take a winning move, b) block an opponent's winning move, c) create fork, d) block an opponent's fork, and e) make any valid move. Very few actually attempt the game tree approach described in the project's background section.

Once part two starts and students get access to the robots, activity will pick up. On the first day they get the robots, you should just make a quick announcement to each class and tell them where to get started. A few things to cover:

- There is a link in the project description to the ECE project page (clemsun.edu/ces/departments/ece/academics/undergrad/mindstormslab.html). On that page is a PDF titled "RWTH Toolbox Setup Instructions" which contains step by step instructions for downloading and installing the RWTH toolbox and libusb.
 - After the libusb driver and RWTH toolbox are installed, the lab manual (also on the ECE project page) explains how to connect MATLAB to the NXT, how to control the motors, how to read from the sensors, etc. Refer students to that or the official RWTH documentation (mindstorms.rwth-aachen.de/trac/wiki/Documentation). The RWTH documentation is also linked to in the project description and on the ECE project page.
 - Controlling the motors with the RWTH toolbox depends on the MotorControl22.rxe program, which runs on the NXT itself. If this program is stopped for any reason, they will need to restart MotorControl for any motor commands to work.
 - Tell them to be careful when using the motor controlling the main arm on the robot. The board and the dropper motors can spin freely 360 degrees, but the arm motor has a limited range of motion. If they accidentally run a motor command that tries to move the arm where it cannot go and puts the robot in a bind, the orange button on the NXT will stop all motors.
 - Be sure to tell students to turn off the NXTs when they are done with them. The batteries drain fast if they are left on in the boxes.
- This information is covered in the lab manual, but that assumes students read it.

A note on MotorControl:

MotorControl should start automatically when they connect to the NXT. If it does not, MATLAB should display a warning. In this case, you will need to transfer MotorControl.rxe onto their NXT. Instructions for this are on the ECE project page, but this step is rare enough it is easier to do it yourself rather than trying to explain it to students.

Project

For the project, take a hands-off approach. Make it clear that this is a student driven project and they are going to basically be given the equipment to complete it and then set loose to work on it as they please. Of course, do be sure to emphasize that you will still be available to answer specific questions, help with debugging programs, etc. But as for general design questions, try to steer them toward coming up with their own ideas instead of just throwing out some of your own for them to use, and if they insist on asking overly broad questions about how to do the project, do not be afraid to respond with something to the effect of "that's your assignment." Encourage them to do their own research on the Internet to find ideas or check the RWTH toolbox documentation to find out all the capabilities of the robot that are available to them.

Student access to robots

All work on the robots must be done in the Holtzendorff project lab. Do not allow anyone to take a robot out of the room, not even to the hallway or B-03. About 5 minutes before a section starts, collect all of the robots and kick everyone out of the project lab (ask one of the professors to help with this if you need). Let the students in the current section come in and pick up robots first so that everyone is sure to get one at least during their section time. About 5 minutes after the section starts, start letting students from other sections in and giving them robots.

Any time someone picks up a robot, take his or her Tiger1 card in exchange for it. If you run out of robots, start a waiting list. Taking Tiger1 cards ensures that students have to bring robots back to you instead of giving them to their friends in another group. This helps ensure that the first groups on the waiting list get robots first. Priority must be given to students from the current section (each session of UTA hours also has specific sections that are given priority). If students from a priority section come in late, you may have to take robots away from groups in other sections. In this case, start from the bottom of the list so you do not punish students for being on time. The UTAs can handle checking out and returning robots while you answer questions.

If a student asks for another robot because theirs is not working, be sure to check it out before handing them another. Most of the time, there is nothing wrong with the robot and the problem is in their code. Occasionally though, you may get a robot that has motors/sensors plugged into the wrong ports (or unplugged entirely) or is put together incorrectly (the swivel points on the arm are where most mistakes are made). Even if there appears to be no problem with the robot, it may be easiest to just switch it out with another (assuming you have a spare). This just avoids any argument.

When students return a robot, make sure it is powered off. If MotorControl.rxe is left running, the NXT will not automatically power off and the batteries will drain between classes or overnight.

Grading

Within a week or so after the project starts, you need to decide how to split up grading among the ECE TAs. Each professor can provide you with the number of teams in each of their sections. It is probably best to split up grading along professor and section lines, since that way each professor has one person they can go to with requests or questions about grading. Also, each professor may have different expectations for how quickly grading is done, so each TA should contact the professors they are grading for and find out that information soon after part one of the project is submitted.

In order to keep grading as consistent as possible between TAs, each section of the rubric should be graded all or nothing, unless specified otherwise on the rubric. Leaving comments on the rubric will make it easier if students come to ask why they were docked points (and a few undoubtedly will).

Rubik's Cube Solver

Spring 2011

Spring 2011 was the first year ECE ran a project for ENGR 141, and the format was very different from what it is now. In Spring 2011, we were able to give every group their own Mindstorms kit and Rubik's cube, which they could take back to their dorms with them. We had the project lab in Holtzendorff open for a few hours Monday – Thursday evening when they could come in, work on their projects, and get help from the ECE TAs.

Preparation

This project only lasts 3 weeks, so you'll need to make sure everything is ready to go in advance because there is no room for delays once the project starts.

Get card access to the Holtzendorff storage room from Dr. Brandon. The UTA key ring is inside and you can use that to unlock the project lab.

Talk to Dr. Stephan to reserve times for the project lab. The times will have to be in the evening since that is the only time that a majority of the students will be available all at once. Keep in mind that some classes like Chemistry 101 or Math 106 will have evening tests that will occasionally conflict.

Also make sure the boxes in the Holtzendorff storage room are ready to go and that each one has a Mindstorms kit, set of batteries, and a Rubik's cube.

Finally, you will need to familiarize yourself with the project and the provided code in order to accurately answer questions about it. Although you will have access to a solution, you should go from only the code provided to the students and write your own solution. That way, you will probably encounter some of the same problems they will and already have answers.

Getting Started

The week before the project, you need to start getting the lists of students and teams from the ENGR 141 professors. You will probably also want to create an email list for easily sending messages to everyone doing the project. A text file with one email address per line works well for this as it can be copied and pasted into to the "to" field in your favorite email application.

Whenever you get the list of students, send out an email informing them of your project hours (when they can pick up their box with Mindstorms kit and Rubik's cube) and where they can download the project description and provided code. Both of those are available on the ECE project web page at <http://www.clemson.edu/ces/departments/ece/undergrad/mindstormslab.html>.

You will also need to explain what they need to setup to get the provided code working on their machines. They will need the RWTH Mindstorms for MATLAB Toolbox and depending a USB driver for the NXT (libusb for Windows, the official Lego Fantom driver for Mac). Instructions for installing these are on the ECE project web page under "RWTH Toolbox Setup Instructions".

Sample introductory email:

Hello everyone,

I'm _____, and I'll be one of your TAs for the ENGR 141 ECE project. First order of business, what is this project? For that, I'll refer you to the ECE project webpage at <http://www.clemson.edu/ces/departments/ece/academics/undergrad/mindstormslab.html>. In the "Downloads" section you can find the project description and a ZIP file containing the provided code and building instructions. If you're interested, there's also a video of what you'll be creating at <http://www.youtube.com/user/ECEatClemsonU#p/c/2/OtYtdC5eFj4>.

Each team will be given a Lego Mindstorms NXT 2.0 kit (to be returned at the end of the semester of course). For the course of the project, you'll be allowed to take this kit wherever you want so you can work on your project at home or in your ENGR 141 class. Also, the Holtzendorff project lab (room B-01) will be available at the following times: _____. At least one of the TAs will be there during those times to answer questions. Once you know your team, you can come to the project lab during those hours to pick up your Mindstorms kit.

Besides checking out the project description and the provided code, the other thing that you can go ahead and do is download and install the required software. Controlling the robot with MATLAB requires the RWTH Mindstorms for MATLAB Toolbox. You will also need a USB driver to allow your computer to communicate with the NXT brick. Instructions for installing both of these can be found under "RWTH Toolbox Setup Instructions" on the project webpage.

For reference material on the RWTH toolbox, the lab manual for the ECE section of ENGR 190 is available on the same webpage as the project description and contains more detailed instructions and examples than you will find in the documentation for the RWTH toolbox (which is available at <http://www.mindstorms.rwth-aachen.de/trac/wiki/Documentation>).

That's everything for now. Keep an eye out for more emails, and if you have questions, email me at _____@clemson.edu.

Project

For the project, take a very hands-off approach. Make it clear that this is a student driven project and they are going to basically be given the equipment to complete it and then set loose to work on it as they please. Of course, do be sure to emphasize that you will still be available to answer specific questions, help with debugging programs, etc. But as for general design questions, try to steer them toward coming up with their own ideas instead of just throwing out some of your own for them to use. Encourage them to do their own research on the Internet to find ideas or check the RWTH toolbox documentation to find out all the capabilities of the robot that are available to them.

Your main task will be to help everyone get the provided code running. Once they get to the point of writing their own code for the solution, they seem to be ok.