Qualifying Event for Robot Olympics
Line Hurdles

Just like humans, robots have their version of the Olympics, known as the "Robot Olympics", and they should be qualified for the Robot Olympics. Our Robot Olympics will take place in the final meeting of this course and will consist of different events.

Your goal is to implement a program for an event. Your program will participate in the event in the competition and your grade will depend on the program's performance.

Once the competition begins, you will not be able to modify your programs. Your robot will also earn points based on its performance in the competition. The winner of the competition will be the robot with the greatest number of points. First six robots are qualified for the Olympics events!

This project description is divided into three parts. The first section describes the general rules of the competition and provides some general hints. The next section describes the event, its rules, grading scheme, and hints for building the program. The last two sections describes the lab/project report requirements and the deliverables.

1 General Rules

For the event in the competition the top three robots will be awarded gold, silver, and bronze medals. Before the event, a robot must contain the program. Once an event begins, no reprogramming of robots is allowed. Rule violation will result in disqualification from the event. Robot batteries should be fully charged prior to the start of the competition.

Robots will be started in an event by pressing their **Forward Button**. The starter will say "Ready!", "Set!", "Go!", and will start the clock while one of your team members presses the **Forward Button**. It is recommended that the **Backward Button** be used to stop the robot, in the event of a false start or some other irregularity.

Once a robot begins an event it cannot be touched or interfered with in any way. If the robot is touched or interfered with in any way then the robot's attempt is disqualified.

2 The Event: Line Hurdles

The hurdles is a traditional track and field event. In hurdles, runners must leap over barriers as they run a race. In Line Hurdles, a robot must race a long black winding line, avoiding barriers that have been placed in its way.

2.0.1 Rules

1. This event will take place in a $1.8m \times 0.9m$ table (one of the large tables in the lab).

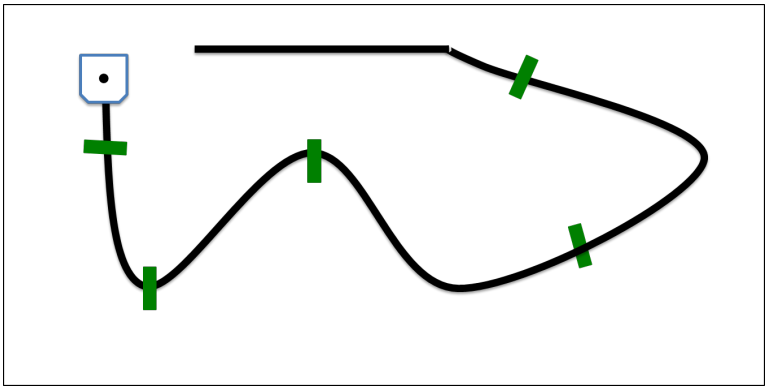

Figure 1: An example of a Line Hurdles course.

2. There will be a winding black line of electrical tape on the table, approximately, 1.5-2cm thick with no sharp corners.
3. There will be a number of blocks placed on the line such that they are at least 20cm away from each other.
4. Each object will be centered on the black line and will be a green Duplo wall, 10cm wide, 3cm deep, and 6cm high. (Four 6 x 2 blocks stacked together.)
5. When your program encounters an object it must move the robot around it, reacquire the line, and continue along the line.
6. The robot will be placed on the "start" end of the black line such that the end of the line is visible through the hole in the middle of the robot, and the black line is between the two ground proximity sensors.
7. The program is allowed three 1-minute attempts to race along the black line to the other end.
8. The robot completes the attempt when its front end passes over the end of the line.
9. If a block is pushed completely off the line, the attempt is terminated.
10. Each attempt will be timed from when the robot starts the attempt to when it ends.
11. The best attempt will be graded.
12. The program will be graded based on race completion and the time to complete the race.

2.0.2 Grading Scheme

Your robot will be graded using the following general grading scheme:

F	No show or robot does no complete more than half the course.
D	robot completes more than half the course.
C	robot completes course.
C+	robot completes course, rarely loses the line or dislodges at most four hurdles.
B-	robot completes course, rarely loses the line or dislodges at most three hurdles.
B	robot completes course,rarely loses the line or dislodges at most two hurdles.
B+	robot completes course, rarely loses the line or dislodges at most one hurdle.
A-	robot completes course, never loses the line or touches blocks, and has the 3rd fastest time.
A	robot completes course, never loses the line or touches blocks, and has the 2nd fastest time.
A+	robot completes course, never loses the line or touches blocks, and has the fastest time.

2.0.3 Hints and Suggestions

If the robot is traveling at full speed, it will likely go off-course, so you may need to put in failure detection and recovery. If you do, you will need to disable it while going around obstacles. You can use the horizontal proximity sensors to detect the obstacles and the ground proximity sensors to detect the line. You can start with the line following program we developed during the tutorials and extend it.

3 Lab Period Questions

For the two lab reports that you will need to fill out while working on your project please answer the corresponding questions.

Period 1 :

1. Describe in detail your strategy and tactics for the event—you can reuse this in the final report.
2. Provide a Gantt chart describing your project plan. It should include all your group members as resources. Your time-line should be in terms of hours or project periods. Note, some work may need to be done outside of lab time.
3. Describe what has been accomplished so far and what remains to be done.

Period 2 :

1. What changes did you have to make to your strategies and tactics as you built and tested your programs?
2. Describe what has been accomplished so far and what remains to be done.
3. Did you manage to complete most of your programs? Why or why not?
4. Is your progress in-line with your project plan? If not, provide a plan update.
5. Did you test your program on the Line Hurdles course? If so, what was the score and why?

4 Report Guidelines

You must submit a technical report as one of the deliverables. The purpose of this report is to describe the program that your group implemented for the robotics competition. The report should describe the program's design, the reasons for the design, and the strengths and weaknesses of the design.

The audience for your report are your class peers, the teaching assistants for the course, and the course instructor. Consequently, your report must contain a sufficiently detailed description of your project, but must not be overly long because we will need to read many of them in order to perform the evaluations. Put another way, another student in the course should be able to reproduce your project from the description you provide. Your report should comprise the following sections:

Title and Author Information is the first part of the report containing:

- the report title,
- the authors' (your) names, and
- the authors' affiliation (Faculty of Computer Science, Dalhousie University, Canada).

The title itself should be a meaningful phrase giving the reader a succinct description of what the report is about. "Our Project" is *not* a good title.

Abstract is a brief summary of the entire report, briefly stating the purpose of the project, what was done during the project and what the results were. The abstract is limited to 100 words.

Introduction sets the stage for the report. It should introduce the topic(s) and problem(s) at hand, state the purpose of the project (what is being solved), outline what was done in greater detail than the abstract, and possibly discuss the results of the project. A student, having read the introduction, should have a clear picture of the problem(s) and what was done.

For example, your introduction should briefly describe the area of robotics, then give an overview of your project, including: the robot system that was used, the event in the robotics competition, the major problems encountered during the project and the resulting solutions.

Background sets the context for the report. It describes previous work and concepts that were used in the project and discusses common assumptions made in the course of the project. This section will typically have quite a few citations because it discusses work, ideas, and concepts that preceded your project report.

For example, your background section should thoroughly describe the robot platform that was used, including its basic structures, the sensor capabilities, its mobility, and also the platform's limitations. This section should also describe features that are common to the event. Lastly, you should discuss (and cite) any related work that you encountered while working on the project.

The content in this section typically comprises material compiled from other sources. Be sure to properly cite all material that you reference in your report.

Program description explains how the problem was solved and why was this solution chosen. Thus, the report must describe the event and the particular challenges that it entails.

The report must then describe your solution to the problem including state transition diagram(s). It should describe the basic strategy of your solution and the tactics used to achieve it. For example, a slow and steady strategy, using the ground proximity sensors to follow the line and horizontal proximity sensors to detect the hurdles.

Lastly, and most important, your solution must be justified. You need to justify both your strategy and your tactics. I.e., Why did you decide on a particular strategy to solve the problem and why did you use the tactics your report describes. Your justification should also describe the strengths and weaknesses of your solution.

Results describes and analyzes the quality of your solutions. This section will be based on the competition that will take place in the presentation day and should describe how well your program performed, why the program performed as well or as poorly as they did, and how well your program performed relative to other programs. For example, your Line Hurdles program may have taken 90 seconds to complete the race, but this does not mean anything until you mention that only two programs managed to complete the race with a faster time, indicating that your program was one of the better ones.

Conclusion and Future Work After a final synopsis, you should describe what else you would have liked to do with your project, how the project could be improved or extended, etc. Important ideas that were part of the solutions should be recapped here. Lastly, this section describes what should be done if more time to improve the programs was available.

References contains a complete citation listing of any other works that you referred to or used for preparing this includes Wikipedia. Citations in computer science are typically done using

end-notes[4]. However, using other styles such as the APA [1], Chicago Manual of Style [3], ACM [2], etc, are all acceptable as long as they are used consistently.

The project report should use 11-point font and be no more than five (5) pages in length, except for the program code. This means that the title, all figures, and references must all fit within the eight page limit.

Standard conventions for grammar, word use, spelling, citations, headings, paragraphs, figures, and tables are expected. A template is provided on the course website so you know how they should be formatted. The report will be marked using the rubric in Table 1.

	Exceptional: A	Acceptable: B	Substandard: C-D	Unacceptable: F
Content and Structure (50%)	Contains all required information. Ideas well organized and logically laid out always or almost always.	Contains most of the required information. Ideas well organized and logically laid out with competence.	Contains some of the required information. Minimal organization and logical progression of ideas.	Is missing most of the required information. Little or no organization or logical flow of ideas.
Analysis and Depth (30%)	Identifies and explains all issues and design decisions. Considers the issues from multiple points of view. Shows superior understanding of subject.	Identifies and explains most of the issues and design decisions. Shows commonplace understanding of subject.	Identifies and explains some of the issues and design decisions. Shows partial or limited understanding of the subject.	Identifies and explains few of the issues and design decisions. Shows a great deal of misunderstanding about the subject.
Presentation, Style & Tone (20%) Standard conventions for grammar, word use, spelling, citations, headings, paragraphs, figures, and tables. Word choices set appropriate style and tone.	Always uses standard conventions. The document looks professional. Shows exceptional use of tone and style. Speaks to the reader with precise, concise, appropriate language, and choice of words.	Mostly uses standard conventions. The document could use some editing. Shows competent use of tone and style. Makes good word choices.	Does not consistently use standard conventions. The document requires significant editing. Shows minimal attention to tone and style. Shows poor usage or ineffective word variation.	Standard conventions are flouted. Document is unreadable. Shows little or no understanding of appropriate tone. Uses inappropriate language and word choice.

Table 1: Technical Report Rubric, based on Fleming, "Grading Rubric for Written Assignments", CSCI 2100, 2011.

5 Deliverables

The deliverables for this project are:

One program loaded on your robot to compete in the Qualifying event for the Robot Olympics.
Technical report in PDF or Word format.
Code for the program provided in appendices in your report.

The *program* should be ready to go for the competition at the start of the presentation period for this module. The technical report is due at the start of the next Lab following the presentation period (October 13/14,2016). Students must provide printouts of their programs as part of their reports. These can be generated by copying and pasting the programs into an appendix at the end of your report. Be sure to format this nicely. The reports must be submitted electronically, via `csci1108@gmail.com` and in hard-copy to the TAs as well.

References

[1] American Psychological Association. *Publication Manual of the American Psychological Association*. American Psychological Association, Washington, DC, USA, 6th edition, 2009.

[2] Association for Computing Machinery. `http://www.acm.org/publications/submissions`. Accessed August 17, 2012.

[3] University of Chicago Press Staff, editor. *The Chicago Manual of Style*. University of Chicago Press, 15th edition, 2003.

[4] Mary-Claire van Leunen. *A Handbook for Scholars*. Oxford University Press, New York, revised edition, 1992.