Robots for Beginners

Instructor's Guide

Hints, tips and tricks

This document contains useful information for leaders of the S2 Workshop. You are encouraged to read through (and if possible, do) all of the projects, and be ready to provide guidance and materials as required.

Required Materials:

1. Adequate printed copies of each of the workshop projects.
2. S2 Robots, one robot per one or two participants, with USB-Serial adapter and cables.
3. PCs running Windows XP, 2K, Vista or 7, one per robot plus one for you. Laptops are fine. It's up to YOU to load the S2 Program Maker and USB drivers on each PC, you are urged to put the installation files on a USB stick to make it possible without an internet connection.
4. A teacher's computer with a projector, this makes it MUCH easier to show participants how to do stuff.
5. Dry erase markers that will fit through the hole in the S2 Robot. Make sure they're fresh. One per robot.
6. Several 12" rulers and a few tape measures.
7. Dry erase boards that can be lain horizontally, such on tabletops. A good source of this material is the white shiny wallboard (often used as shower walls), available from Home Depot and Lowes. It's essentially 4'x8' ¼" thick Masonite boards with a shiny white surface on one side. You can request that the store cut it into pieces 2' by 4', a good size for this workshop.
8. Erasers for use on the dry erase boards.
9. Black masking tape, ¾" wide. NOT black electrical/vinyl tape, duct tape or any other tape. ONLY BLACK MASKING TAPE can be reliably seen by the S2 Line sensors. Also bring scissors to cut the tape; it's a bit tricky to form into segmented curves. Plan on using two rolls, 60' long. This can be bought on-line from a variety of sources, mostly art material suppliers. Amazon has it.
10. Adequate table areas for participants to test run their robots.
11. Spare AA alkaline batteries as a precaution.
12. Treats (candy?) for Competition 2.
13. The upper portion of disposable plastic wine/champagne glasses, also for Competition 2.

You should encourage your participants to read the S2 Robot Startup guide before coming to the workshop. It is available for download from the Parallax web site. Also be prepared for variations in completion speed for the different participants. It's doubtful anyone can finish this whole thing in one day!

Note: Finished and tested code for each project is provided in a separate zip file for you to use, show and modify. Feel free to share this with your students, but only after they have tried on their own.

Project 1: Light those LEDs, "Your first program, get going with the GUI and your S2"

An easy project, but first-timers may be confused by the non-drag-and-drop interface of the S2 program maker. A short demo on the teacher's PC (with projector) will go a long way in helping here.

You will likely get questions about the demo programs Tell them that the demos were written in "Spin", a more advanced language, and that the GUI can't do everything that it does.

Make sure your participants see how and where to save their worksheets.

Project 2: Sound OFF (and ON), "Your Learn about steps in a program, make some music"

The primary purpose of this project is to gain a better feel for the GUI, cutting, copying, pasting. It also emphasizes how program steps (blocks) are executed sequentially, from top to bottom.

Project 3: Straight on till Dawn, "Your Baby's first steps out into the real world"

The robots finally begin moving in this project. Since it's pretty limited travel, it's feasible (if you have the room) for each student/team to run the robot around immediately adjacent to their computer. Otherwise, get ready for some back-and-forth foot traffic as they go to the tables and return.

Participants will need the 12" rulers for this project, have them handy.

Project 4: A"maze"ing Turns. Sometimes the only way to get ahead is by going sideways

Quite a bit more motion here, ending with a maze that you provide. See the diagram in the project printout, make something like it on a white board. Since this is not line following, you can use vinyl tape (easier to make curves) but make SURE your participants realize the Line sensor can't see it. The curved regions need to be as nearly circular as possible, otherwise they will be tough to follow.

This project is "dead reckoning", the robot can't tell where it is. Participants use the dry erase markers, keep them handy, plus an eraser.

Project 5: Subroutines. How to keep your programs small and simple

A bit of programming style and substance. Even though the final program looks a bit "chunky", the subroutines start to really pay dividends when they're used more often within a program. You should point out to the participants that if this was a larger program, with lots of letters and long messages, the program would be huge if it was just one long string of steps.

Also point out that if an error is found in a subroutine, it's much easier to fix just once (within the subroutine), rather than multiple times.

Project 6: Simple Figures, Loops. Using your growing collection of subroutines.

This project begins to point out the importance of modularity, that each figure drawing routine starts and ends at the same relative place, allowing a "string of pearls" to be created of the different components. It also further demonstrates the power of subroutines.

This project uses more space, be ready with some larger (longer actually) open areas for drawing.

Project 7: Write your initials. More, bigger, better.

Participants are largely on their own in this one, it shouldn't take too long given the extensive experience they've already had drawing shapes. Encourage them to use a three letter initial, keeps it interesting.

This is a good time to allow some quality "failure" time, let people stew a bit if they're hung up. They'll learn more and feel better when they resolve it themselves.

Competition 1: Drawing trials.

The number of students and robots will drive how you split them up into "alliances". Two per alliance is best, working together at one station. Your judgement will tell you which of the three challenges to use, they are approximately in order of difficulty.

If you're running short on time, or the participants are edgy to get on with more projects, you can bypass the competition altogether.

Certificates (awards) are provided in the zip file, one each for Speed, Quality and Programming Star. These go a long way in making folks feel proud.

Project 8: The Monitor (no Merrimack). Let's see…really!

An easy intro to the sensors on the S2. Nothing too difficult, but do make sure each participant understands the purpose and limitations of each sensor. FYI downloading the monitor program will over-write any user program that may have been present. Also, it will only work if the cable is connected.

You may want to do a demo of this at the teacher's station (assuming your group is at the same point together).

Project 9: Stop at the Line. First "exposure" to using line sensors in your programs.

This is the first closed-loop exercise and may be confusing to some. Emphasize the real-time nature of programming; the program constantly checks and adapts to the environment. As simple as it is, this is a really exciting (and important) concept. Good time to describe the difference between open and closed loop systems.

It's also the first contact with the Test blocks, you may want to walk them through an example slowly, describing how it works, why it exits one way or the other based on the result. Also emphasize that the path NOT chosen is not executed.

Project 10: Running Ragged (some call it "Suicide"). A bit more structure to your program as you navigate from line to line

The name "suicide" is derived from soccer or football practice, they run similar patterns on a large field. Pretty tiring! This project is an extension of the prior one, brings more logic and flow into the program, and, if done right, really nails home the concept of subroutines.

It's also (in a hidden way) the start of algorithm development. Let's save that discussion for later.

This project is quite self-driven, there's little hand holding provided. Let them stumble for a while; if necessary, ask leading questions that might suggest a useful direction.

Project 11: Follow the Black Brick Road (sorry Dorothy). Intro to line following

Again building on prior skills, this project starts to show how the robot can do some pretty complex navigating on its own with a very small program. You will need to provide a variety of lines and curves to follow, make sure there are simple and more complex ones, some with gentle turns, some quite sharp.

Expect this project to take a while, the participants will want to fine-tune their numbers and try again and again.

Project 12: Get better at Following. How to bullet-proof your algorithm (my "algo" what?)

Participants are encouraged to fine-tune their programs from Project 11 to handle more difficult situations, such as sharp turns and losing the line altogether. Flags are introduced.

Project 13: Feeling your way. First experience with front-mounted sensors

Be prepared for a lot of robots underfoot as participants attempt to avoid objects, walls and each other. This project introduces the obstacle sensors, with a very simple algorithm.

Project 14: Obstacle avoidance. Roomba's got nothing on us, baby.

The final project, participants are encouraged to improve their "touring" code in whatever way they want. Again be ready for a lot of robots on the floor.

Competition 2: The Candy Run. First one home…YUM!

The number of students and robots will drive how you split them up into "alliances". Two per alliance is best, working together at one station. Depending on whether the participants have all finished through project 14, you may change the challenge to include or omit the obstacle at the end of the run. Hopefully everyone will have finished project 12.

If you are working with a non-candy group, use healthy snacks (raisins, nuts).

One thing NOT mentioned in the description is to use the top portion of cheap two-part plastic wine glasses, with the stem inserted into the hole in the robot to act as a carrying container for the treats.

Be prepared with a special treat for the champion, your call.

Note: It's up to the instructor to create a path that is suitably difficult and interesting for the two tracks. If the group has generally completed through project 14, place a block or other obstacle at the end of the tracks for the obstacle detector to see. If not, just let the line end, and when robots get there, manually stop them, give the winner a treat, and turn them around to send them back.