

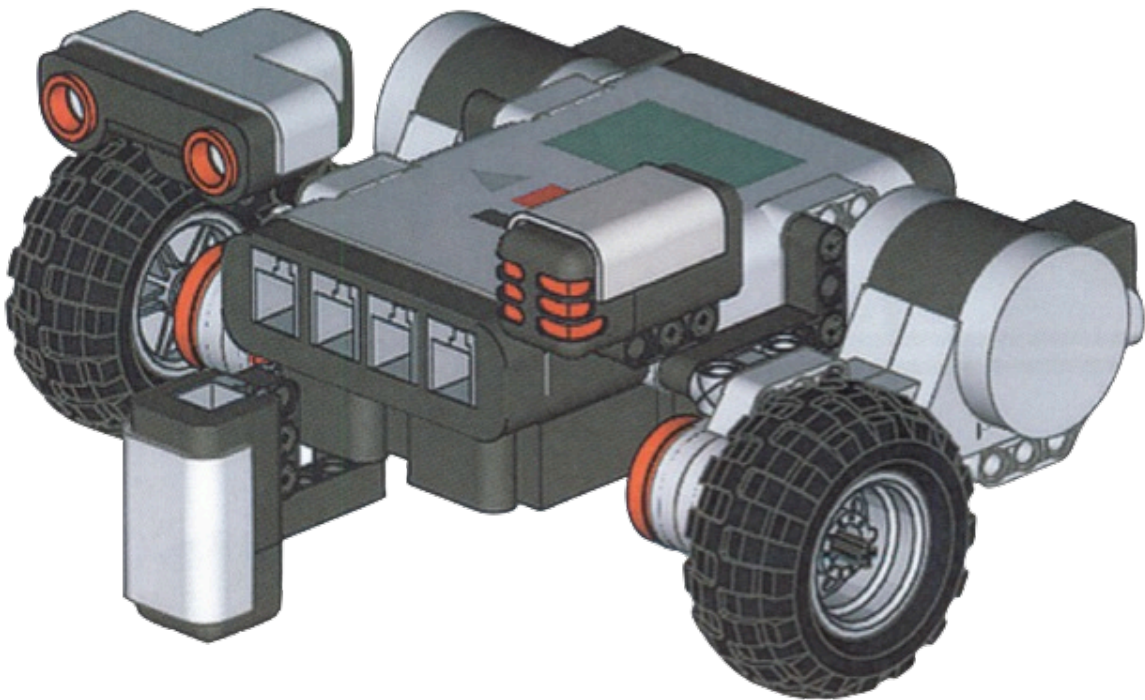
# technocamps

Inspiring | Creative | Fun

Ysbrydoledig | Creadigol | Hwyl



## LEGO Mindstorm Workshop Session Plan



# Workshop Schedule

“By failing to prepare, you are preparing to fail.”



Event Set Up	30 minutes
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## Introduction

Welcome/Pre-day Forms	5 minutes
Introduction	5 minutes

(Slides 1-2)

(Slides 3-6)

## Robotic Hardware

Introduction	15 minutes
The Mindstorms Robot	10 minutes
Building the Robot	45 minutes

(Slides 7-10)

(Slides 11-13)

(Slides 14-17)

## Robotic Programming

Introduction	5 minutes
Cargo-Bot	45 minutes
NXT Programming	90 minutes

(Slide 18)

(Slide 19)

(Slides 20-28)

## Conclusion

Dismantle Robots	20 minutes
Q&A/Post-day Forms	5 minutes

(Slide 29)

(Slide 30)

Event Clean Up	30 minutes
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Total: 4 hours and 30 minutes for attendees

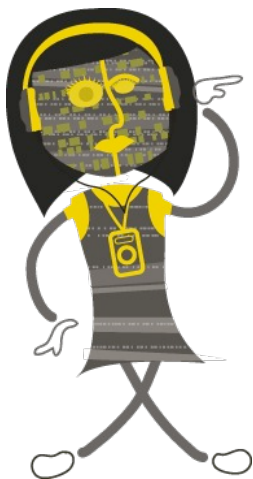
Total: 5 hours and 30 minutes for staff involved

# Hardware and Software Requirements

1. 8 x LEGO Mindstorms Kits (See Kit List).
2. MacBook or PC per participant.
3. LEGO Mindstorms NXT Software.
4. iPad per participant.
5. Clicker per participant.



## Attendee Prerequisites



1. No previous programming experience required.
2. Some basic knowledge of programming constructs (although it is taught with the assumption of no prior knowledge).
3. Complete consent forms.

## Learning Outcomes

1. The ability to construct a LEGO Mindstorms robot.
2. Acquire the skills to program a LEGO Mindstorms robot to complete a specific task.
3. The ability to reason about given problems and develop a design of a possible solution.
4. An insight into basic programming constructs such as loops, conditional statements and basic instructions.



# Event Set Up and Clean Up

## Event Set Up

1. Prepare any pre and post-day questionnaire forms as required. Remember spare pens / pencils.
2. Ensure tables and chairs are arranged to naturally encourage people to sit in groups; ensure no one is sitting with their back to the podium.
3. Test display equipment (e.g. projector) and ensure that presentation and internet connection are working and ready for use.
4. Set up the iPads on to the Cargo-Bot application. It is advised that you also lock the iPads into “Guided Access” mode so that participants only have access to one application. (See guide below.)
5. Prepare the LEGO kits by checking that each box contains a Kit List, Workbook and the hardware required as specified on the Kit List.



## Event Clean Up

1. Ensure all pre-day and post-day questionnaire forms have been collected if required.
2. Unlock all of the iPads from “Guided Access”, close all open applications and ensure that they are replaced into their storage container.
3. Ensure that the participants have dismantled their robots and have put them back into the container in the same way they were issued.
4. Clear up litter and refuse. Remember to recycle where facilities exist. Remember to switch off lights, computers, and projectors!



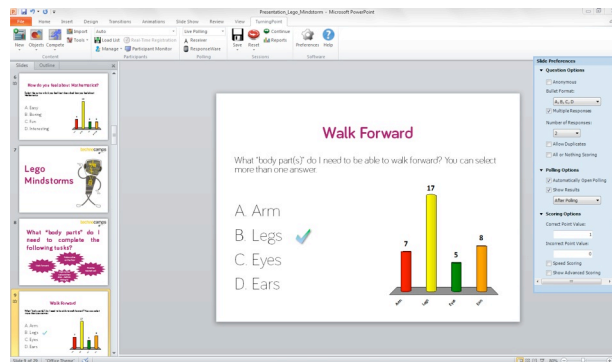
# Using Clickers and iPad Set Up

## Using Clickers



When using Clickers in the workshop, you need to ensure that they have been set-up prior to the start of the workshop and that they are correctly connected to the presentation laptop.

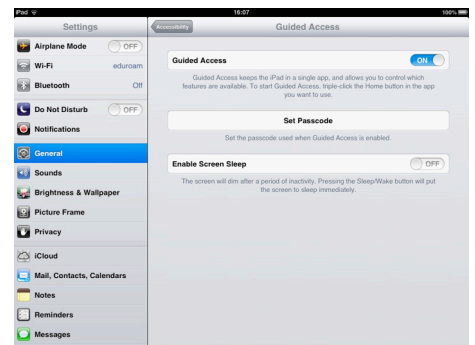
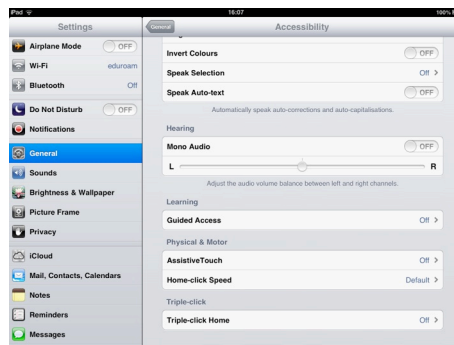
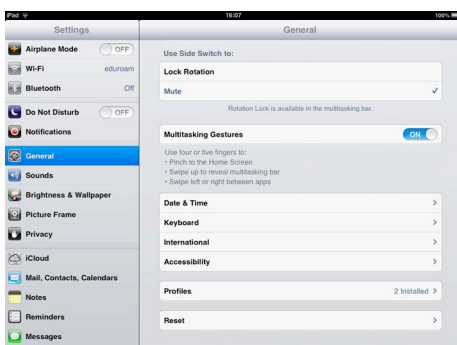
At this point in time there does not exist a built in client for Microsoft PowerPoint for Mac OS X therefore it is suggested that you use Microsoft PowerPoint with the built in TurningPoint client. You must open the presentation through the TurningPoint application by clicking on PowerPoint polling. You can then open the presentation through PowerPoint and will have the TurningPoint tool bar as shown below.



## iPad Set up

“Guided Access” will already be set-up on the Technocamps iPads and therefore to lock the iPads you need to open Cargo-bot, triple click the home button and then click start. These iPads will now be locked (to unlock the iPads triple click the home button and type in the password). To set-up guided access follow these instructions.

General > Accessibility > Guided Access > On & Set Passcode. You can then follow the instructions above to enable “Guided Access”.





# Introduction

## Welcome and Pre-day Forms

The first 5 minutes is very much about welcoming and encouraging people to complete any pre-day forms before the workshop begins. Also ensure you read through the pre-day forms with the participants to confirm they have been filled in correctly.

Ensure that you welcome the attendees as they enter the room; this helps to create a positive connection.

## Introduction

The introduction gives you time to introduce everyone involved with hosting the workshop.

The main aim is to have everyone settled, focused, and filling required forms, e.g. pre- and post-day questionnaires.

### (Slide 1: Title)

“Good XXX, I’m XXX and I work for an pan-Wales organisation called Technocamps.

Has anybody heard of Technocamps before or been to one of our workshops?

We are a £6 million government funded organisation getting young adults and children aged between 11 and 19 to become excited about Computer Science and what it has to offer, in both their education and future careers.”

### (Slides 2-6: Introduction)

Today we are going to be looking at programming robots, in particular building and programming LEGO Mindstorms robot. In the workshop today we are going to be using Clickers. A Clicker is a small device which looks very much like a remote control. (Hold up a Clicker.) You can use the Clickers to provide answers to the questions asked throughout the workshop. On the Clickers there are 10 buttons labelled A to J. When a question is presented I will asked you to choose from a set of choices using these buttons.

Before we start the workshop today we are going to do a short quiz using the Clickers.

(Follow through the questions on the slides and ensure that all attendees answer them by checking the number of responses on the top of the slides)

# Robotic Hardware

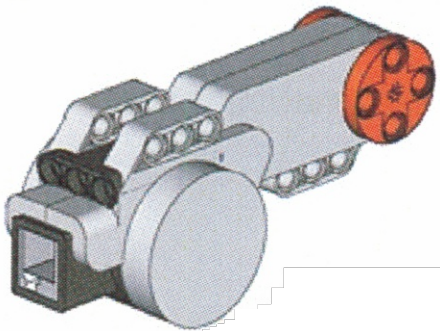
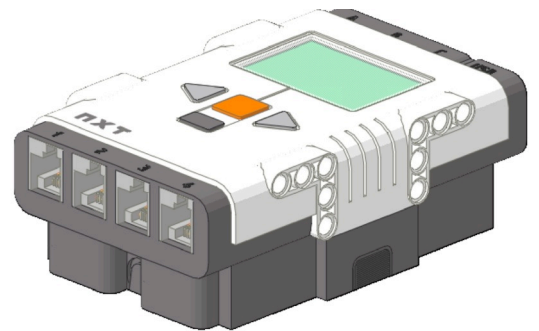
(Slides 7-10 : Robots and body parts)

“Next we are going to be looking at what makes a robot and how the different parts relate to human body parts. So what body parts do I need to complete the following tasks?

(Describe the tasks and move onto the next slide and follow through the questions using the Clickers)

(Slides 11-13 : The Mindstorms Robot)

We are now going to have a look at the LEGO Mindstorms NXT robot. The robot is made up of three main components: the NXT, servo motors and sensors. The NXT can be thought of as the “brain” of the robot, the servo motors give your robot the ability to move and there is a range of sensors which the robot can use to learn about the world around it.



(Next Slide) Being the “brain” of the robot, the NXT comes with several ports to connect the other components to. The ports labeled with A, B and C are used to connect the servo motors. The ports labeled with 1, 2, 3 and 4 are used to connect the sensors. There is also a micro-USB port to connect the NXT to a computer.

(Next Slide) The servo motors can be attached to a variety of different parts of the Mindstorms kit to create wheels (to move the robot), an arm (to grab objects), and so on. Servo motors can also provide feedback to the NXT (similar to a sensor) of how many rotations they have made. There are various sensors available for the Mindstorm robot and you will look at these in more detail with the participants later.



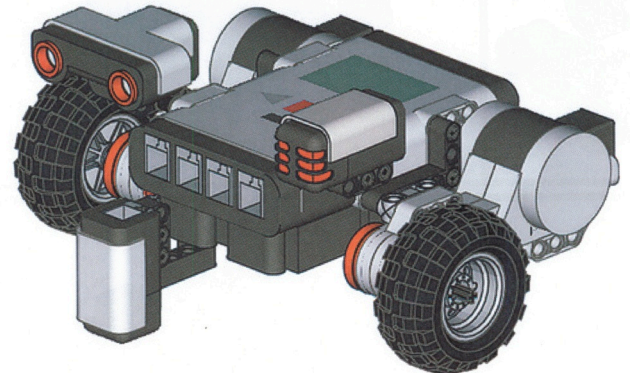
There are various sensors available for the Mindstorms robot and we will look at these in more detail later.”

# Robotic Hardware

(Slides 14 - 17 : Building Your First Mindstorms Robot!)

“Now it is your chance to get hands on with the Mindstorms robot and start building your first robot. We are going to begin by creating a simple robot which will allow you to add additional motors or sensors to complete certain tasks.

The base design consists of two servo motors attached to wheels to allow movement and a rotating back wheel which is used to help the robot turn.”



(Follow through the slides on how to create the robot with the participants. Most groups will take between 30 to 45 minutes to complete the build. Brief the students to connect the motors to ports B and C)

1 4x		2 2x 2x		3 1x 1x 1x	
4 Turn over		5 4x		6 2x 1x	
7 1x		8 1x 2x 1x 1x		9 2x 1x	
10 Turn over		11 2x 2x		12 2x 2x	
13 2x		14 1x 1x			



# Robotic Programming

(Slide 18 : If I was a robot, how would you instruct me to ...)

This snippet of the workshop requires imagination and programming knowledge from deliverer. The idea is that you become the robot and the participants need to instruct you to complete the task presented on the presentation. However you do not provide them with information about what you understand / your basic instructions.

For example, for the “Walk Forward” task you may get one participant who says “walk forward” and you would respond with “I don’t understand what walk forward means.” Once the participants start to break down the instructions i.e. move right leg forward, then bring in the idea of looping instructions and conditions for instructions.

(Slide 19 : Cargo-Bot)

“Cargo-Bot is an iPad application where you program a robotic arm to move around boxes from an initial set-up to a given final set-up.”

The aim of this part of the session is get the the pupils thinking about the three main programming constructs namely: basic instructions, conditional statements and iteration. It is a good idea to write these on a whiteboard as you are discussing them and demoing the application.

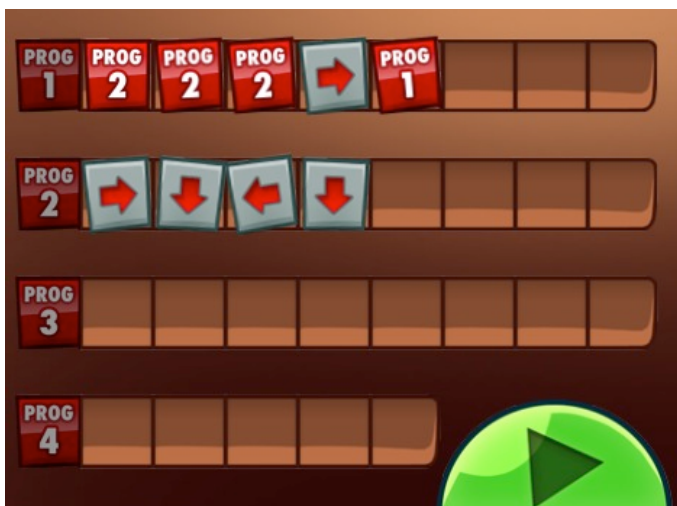


**(Demonstrate the tutorials on the projector and then instruct the participants to complete the tutorials on their iPads)**

Once they have completed the tutorials set the participants a challenge to find a three star solution to the following problems:

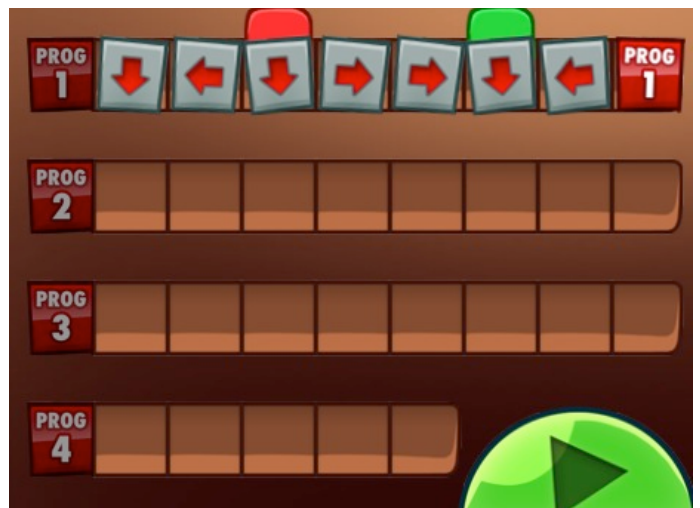
## Go Left

To solve this problem you need to move one box to the left, repeat these instructions for each box in the pile, move to the right and repeat for each pile.



## Colour Sort

To solve this problem you need to pick up a block, move left, if the block is red drop it, move far right, if the block is green drop, move to the middle and repeat.

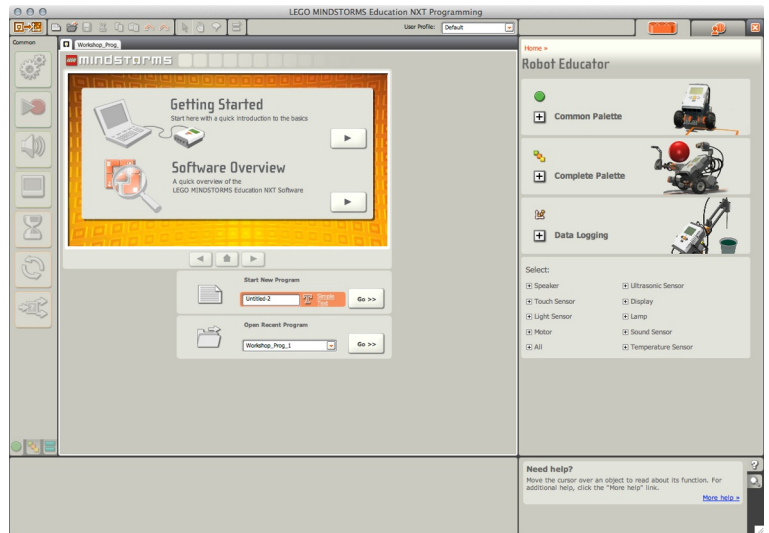


# Robotic Programming

(Slides 20-21 : NXT Programming)

“We are now going to start looking at programming the LEGO Mindstorms robots.

(Next Slide) The LEGO Mindstorms NXT programming software is an all in one tool which allows you to write programs to control the LEGO Mindstorms robot. On opening the program, you should see a screen similar to the one on this slide.



(Guide the participants through opening the software and connecting their robots to the machines)

“Now you have all opened the software I am going to demonstrate the move block available to control your robot. There is also a list of some of the other blocks in the back of the workbook.”

(Indicate to the pupil how a move block works, go through the different options and download the program to an NXT and show the robot moving)

(Slides 23-24 : Tasks 1 & 2)

## Task 1

Program your robot to move to the end of the table and stop at the edge!

To complete this tasks the pupils will need to roughly decide how far their robot moves per rotation or second and then use this measure to move the robot to the end of the table.

## Task 2

Program your robot to navigate its way through the maze.

To complete this task the participants will need to use a series of move blocks to manoeuvre the robot through the maze.

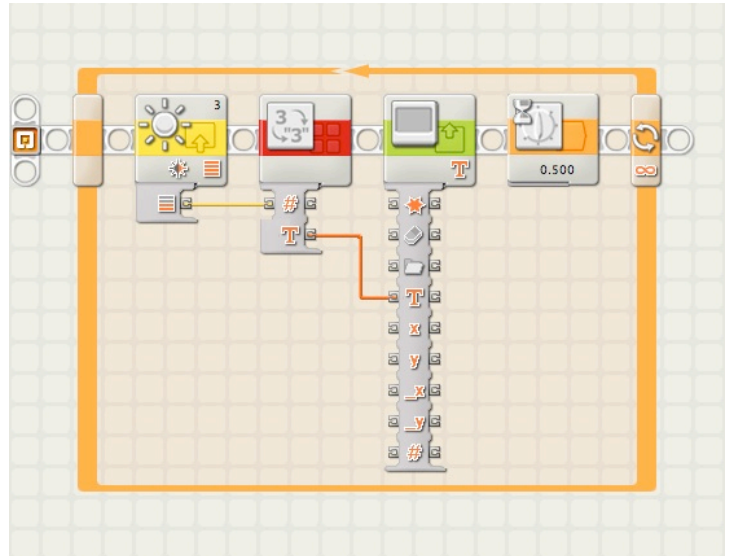
Hint: Remember each turn will require its own move block!

# Robotic Programming

(Slides 25-26 : Using Sensors)

For tasks 1.5 and 2.5 the students will need to use a light sensor to complete them. To be able to do this they need a way of testing the values from their light sensors in different positions. They can do this by creating a program as discussed on slide 26.

(Follow the program through with the participants and show a demonstration of the program running)



They will also require different types of controlled loops. You will have discussed the forever loop for use within the sensor program however it may also be worth demonstrating the use of a loop controlled by a light sensor.

## Task 1.5

Program your robot to move to the end of the table and stop at the edge using a light sensor.

To complete this task the pupils will need to create a loop controlled by a light sensor. When the light sensor has a value relative to being on the table, move forward, else break the loop.

Once all groups think they have a solution to this problem, test their robots by putting two tables together! (This will reveal if anyone is still using their program from Task 1!)

## Task 2.5

Program your robot to navigate its way through the maze using a light sensor.

This is a rather complex task however with time, the higher ability participants will be able to solve it.

A solution to this problem would be to make the robot move forward until it reaches the first line and do a right turn, then continue forward until it hits another line ...

To solve a maze of this shape would require a right turn, followed by 2 left turns followed by 2 right turns, and so on.

# Q&A Session & Closure

(Take several questions from the attendees)

(If no questions are asked by attendees, begin summarising topics covered)

Once an appropriate number of questions has been taken, you can then begin to close the workshop. Be sure to have any post-day questionnaire forms filled in by attendees as required. Some audiences may require more prompting to fill in such forms.

## Closure and Post-day Forms

The last 5 minutes of closure must be used to, if required, ensure that post-day questionnaires are filled in by the attendees and talk them through the information they have filled in. Ensure that you collect all of the post-day form in before attendees depart, and be sure to thank each person for taking the time to fill in the forms.



