National Centre for Computing Education

Raspberry Pi

Lesson 5: Algorithm design

Introduction

Learners will design an algorithm to move their robot around the mat that they designed in Lesson 4. As part of the design process, learners will outline what their task is by identifying the starting and finishing points of a route. This outlining will ensure that learners clearly understand what they want their program to achieve.

Learning objectives

To design an algorithm

- I can explain what my algorithm should achieve
- I can create an algorithm to meet my goal
- I can use my algorithm to create a program

Key vocabulary

Algorithm

Preparation

Subject knowledge:

- You should have a good understanding of the term 'algorithm'. An algorithm is a precise set of ordered instructions, which can be turned into code. In this lesson, learners will create algorithms by drawing symbols (arrows pointing forwards, left, right, and backwards). When learners press the corresponding buttons on the robot, this will create a program that the robot will follow.
- In Activity 1, learners will think through the task that they want their program to address. Identifying and fully understanding the task is a key step in program design.

You will need:

- L5 Slides
- Floor robots
- Mats and obstacles from Lesson 4
- Dry wipe boards, pens, and erasers, or paper and pens

Assessment opportunities

Activity 1: You can assess whether learners can select a 'start' and 'end' square and plan a route between the two.
Activity 2: You can assess whether learners can draw an algorithm for the route that they have identified.
Activity 3: You can assess whether learners can test their algorithm as a program on the floor robot.

Outline plan

Please note that the slide deck labels the activities in the top right-hand corner to help you navigate the lesson.

Note: For the activities in this lesson, learners should ideally work in pairs, or if necessary, groups of three.

**Timings are rough guides*

Introduction (Slides 2–3) 5 mins	**This way and that way** Display slide 2 and introduce the lesson objectives. Move on to slide 3 and remind learners of Lesson 4, in which they produced mats that had places to visit and obstacles to avoid. Tell learners that in this lesson, they will create algorithms and programs for different routes.
Activity 1 (Slide 4) 5 mins	**Algorithm decisions** In this activity, learners will think about the task in their program design. Display slide 4 and explain the instructions, clicking through the animations on the slide to illustrate your explanation: 1. First, learners should choose a square at each end of their mat. 2. Then, learners should decide which way their robot should face at the start. 3. Then, learners should determine the route that they want to program the robot to follow. 4. Finally, learners should describe the route to a partner. **Note:** The aim of asking learners to verbalise their intention is to encourage them to commit to a specific task.
Activity 2 (Slide 5) 15 mins	**Algorithm design** Display slide 5. Tell learners that they now need to draw the algorithm that will make the robot follow the route that they have selected and explained to their partner. Ask learners to draw arrow symbols showing the steps for

	the robot on a dry wipe board or piece of paper. Explain that these symbols indicate the commands that will need to be used in a program later. Once learners have drawn their route, ask them to carefully follow it to check it, either by pointing or using a paper-bot (as they did in Lesson 3). **Note:** If learners find it more difficult to relate the arrows to the orientation of the floor robot, encourage them to use the paper-bot, as this will support them. Finally, ask learners to talk through their algorithm with a partner.
Activity 3 (Slide 6) 15 mins	**Programming** Display slide 6. Tell learners that they now need to try their algorithms as programs on the floor robot. Tell them that they should take it in turns to try their algorithms. Before they start, remind learners that it is really important to start the robot on the square that they chose in Activity 1. It is also crucial that the robot face in the direction that they selected. Also, remind learners that before they enter their program, they need to clear any previous programs that the robot had by pressing X. Tell learners to work together to ensure that programs are entered as accurately as possible: one learner should press the buttons on the robot, while the other learner keeps track of the algorithm. Explain that to keep track, learners can tick under the commands or cover the commands, but they should not cross out or erase the commands. Tell learners that when they run a program, they should follow the robot's movement and point at the corresponding command in their algorithm. Tell learners that if the robot does not move to the square that they expected, they should first try clearing the robot's memory and re-entering the program. If the robot still does not get to the expected destination, learners should try to identify where their algorithm may be incorrect. If learners can identify the issue, they should try to correct it. If their program did not work the first time, ask learners if and how they managed to fix it.
Plenary (Slide 7) 5 mins	**Debugging** Ask learners to reflect on the activities that they have completed in the lesson, and whether they found anything that did not go as expected. Display slide 7 and introduce the term 'debugging'. Explain that programmers very rarely get things right the first time, and when a programmer finds a problem in their program or algorithm, they work to

	fix it.
Summary (Slides 8–9) 5 mins	Display slide 8. Ask learners to reflect on the lesson and indicate how confident they feel about what they have learnt. Move on to slide 9. Summarise what learners did in this lesson, and introduce what they will do in the next lesson.