Computational thinking

Cluster 3: STEM in a digital era

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Computational thinking

thinking or solving problems like computer scientists

a way of approaching and solving problems that draws upon principles from computer science and programming

Papert, 1980

thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent

Wing, 2006

emphasizing the importance of thinking and understanding in and for doing computation.

Li et al., 2020

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To think computationally means…

- to understand which aspects of the problem are machine-solvable,
- to evaluate the correspondence between the problem and the computational means,
- to understand the capabilities and limitations of computing resources,
- to apply computational means (technical means or abstract procedures and theoretical results) in a new way or in a new situation or adapt the means,
- to apply strategies of computer science in a different domain.

(Barr and Stephenson, 2011)

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Computational thinking skills

- Abstraction
- Representations
- Algorithmic thinking
- Problem decompostion
- Pattern recognition
- Generalisation
- Evaluation
- Debugging
- Iterative problem-solving
- Modelling and simulation
- Systematic reasoning and logical thinking

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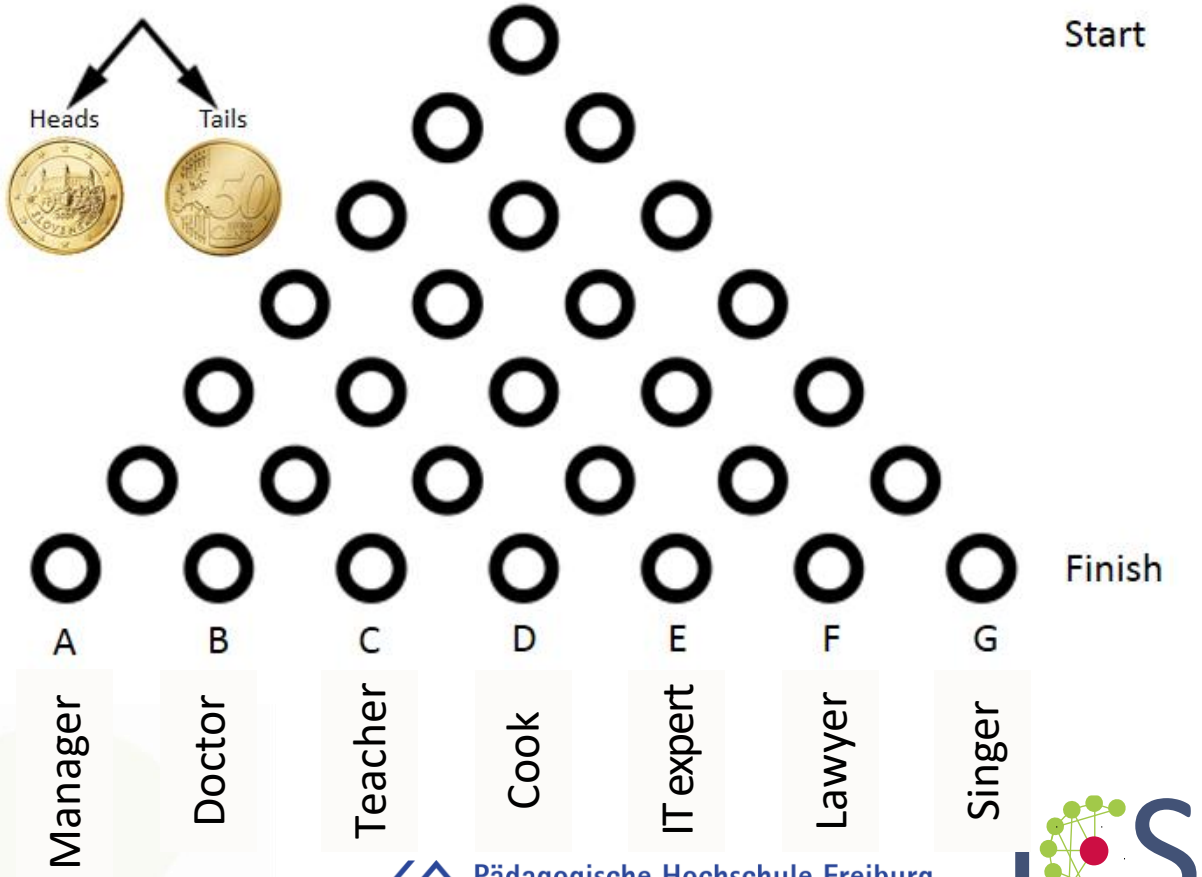
Toss a coin…

I suppose you have a coin in your wallet. You can use it to foretell your future career with the board below. Just start in the first line and toss the coin. When the head of the coin falls move in the left-down direction. When the tail with the value of the coin falls move in the right-down direction.

How many times do you need to toss the coin to reach the bottom line? I will reveal you your fated job according to the position at the bottom line.



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Try it again

- Are you not satisfied with the profession that the magic board foretold to you? Try it again.
  - Use the table below to record your result from the first tossing.
  - Repeat the coin-tossing three more times. Record both, the resulting occupation and the way to it.
  - Where would you put your dream-job? Why?

Foretold occupation	Your way to it

Which computational thinking skills can be addressed using this activity?

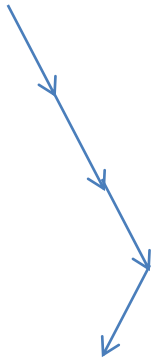
- Abstraction
- Representations
- Algorithmic thinking
- Problem decompostion
- Pattern recognition
- Generalisation
- Evaluation
- Debugging
- Iterative problem-solving
- Modelling and simulation
- Systematic reasoning and logical thinking

Representating the paths

Left, right, right, left, left, right, right

T tail >><<><
H head
T head ↙↘↘↘↙↘
T tail
H head L, R, R, L, L, L
T head

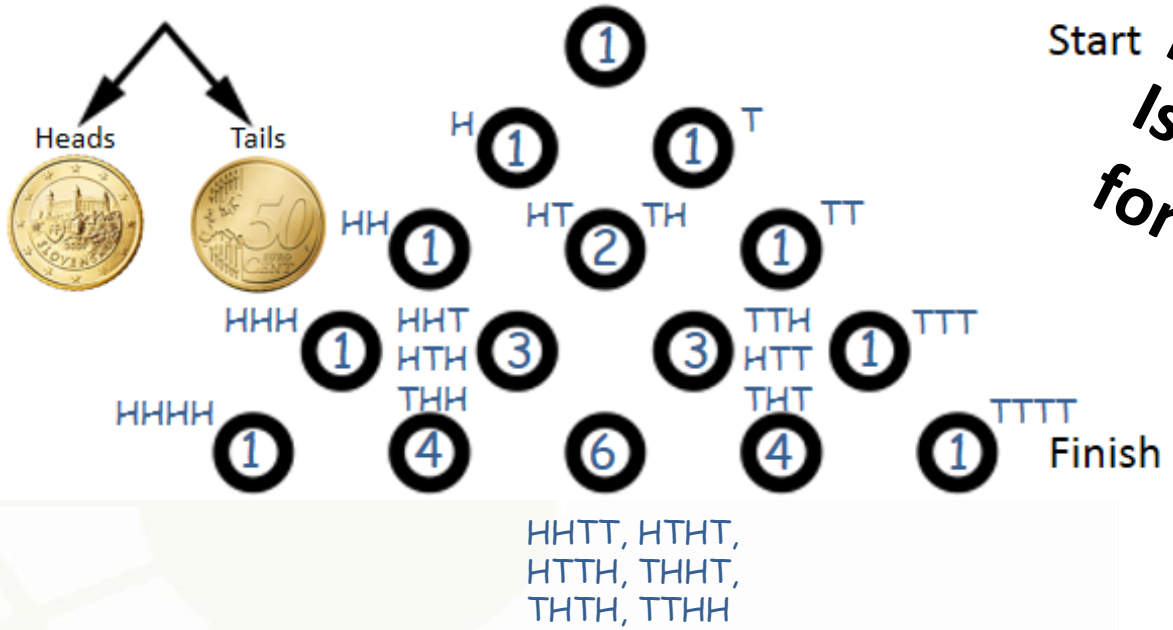
Which representation is suitable for the use of computer?



↙ $down$ ↘ $down$ ↘ $down$ ↘ $down$ ↙ $down$ ↘ $down$

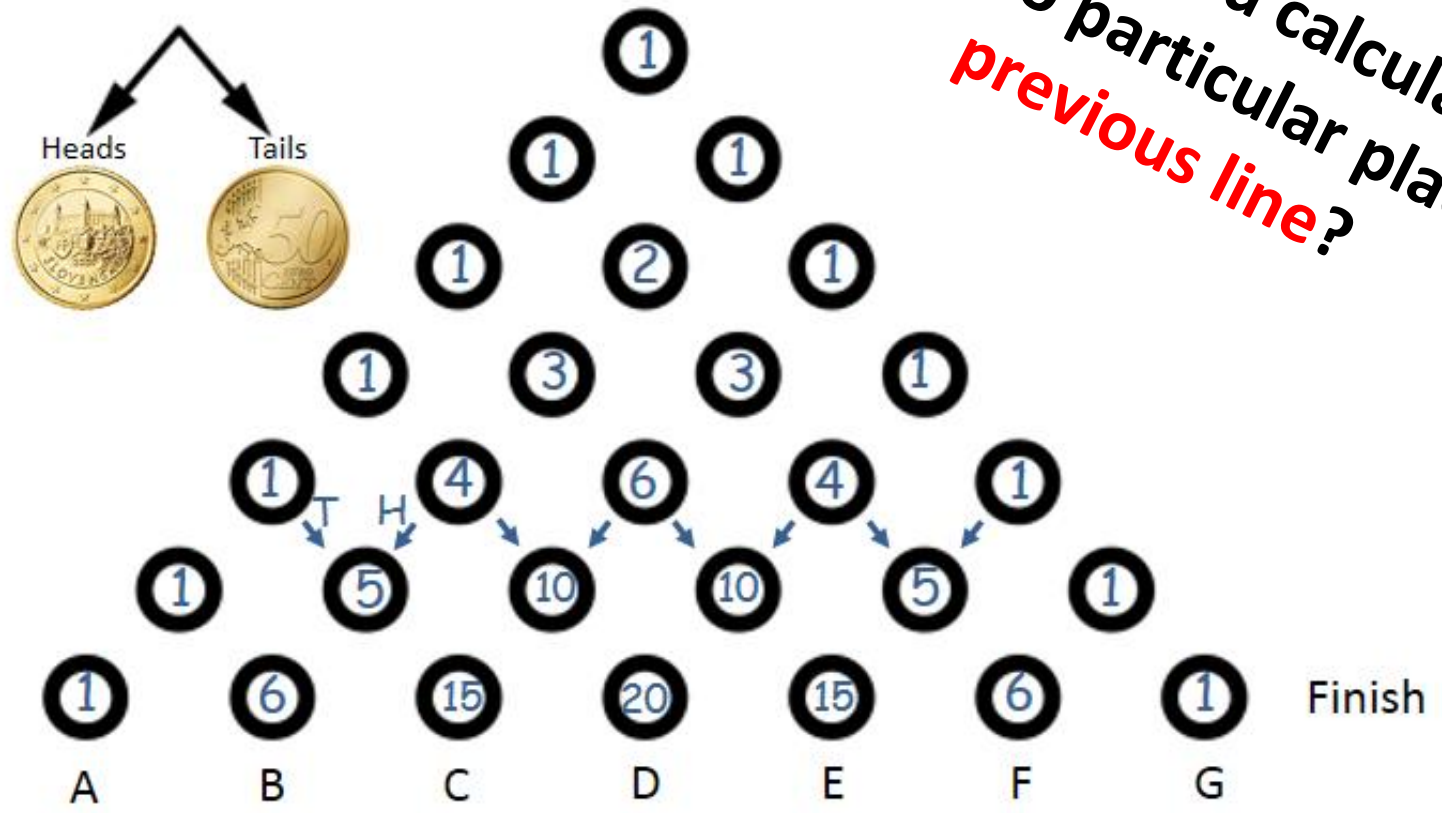
4T, 1H, 1T 3right, 1left, 2right

Describing procedures as algorithms



Describe the procedure to list all the possible ways to particular point.
Is it suitable for the use of computer?

Recognising patterns



Can you calculate the number of ways to particular place based on the previous line?

The <colette/> app

Introduction Workshop for Teachers

Computational Thinking Learning Environment for Teachers in Europe

Sylvia van Borkulo, Utrecht University, s.vanborkulo@uu.nl

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<colette/>

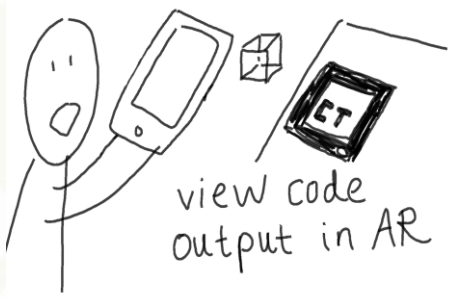
Computational Thinking Learning Environment for Teachers in Europe

<colette/> is co-founded by the European Union as part of the Erasmus+ Programme, Key Action 2 – Strategic Partnerships under the number: 2020-1-DE03-KA201-077363

Welcome!

‹colette/›

Computational Thinking Learning Environment for Teachers in Europe



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Our agenda today

Trying out the
<colette/> App

Homework:
Information
and Download

Background of <colette/>
Questions and Answers

Discussion

Aspects of <colette/>

- Web portal for teachers
- App for students
- Tasks that integrate CT into school mathematics
- Teacher trainings
- Handbook for educators and teachers

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Download App “colette-project”

App Store Link

Play Store Link

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Task Families

Building Cubes

Drone AR

Jumping

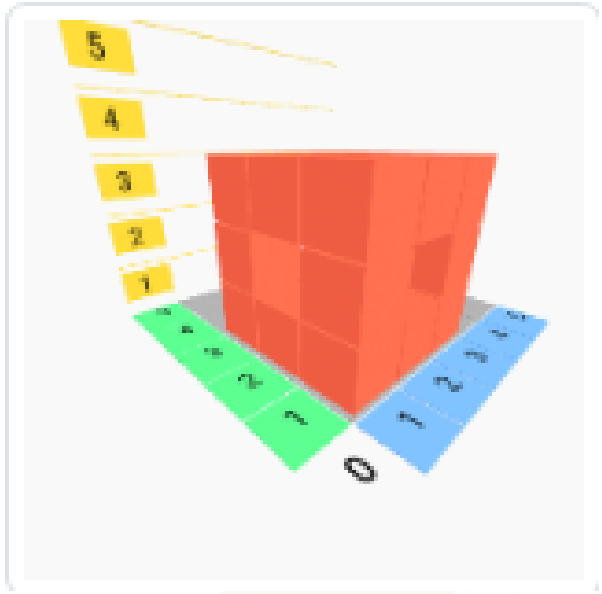
Truchet Explorer

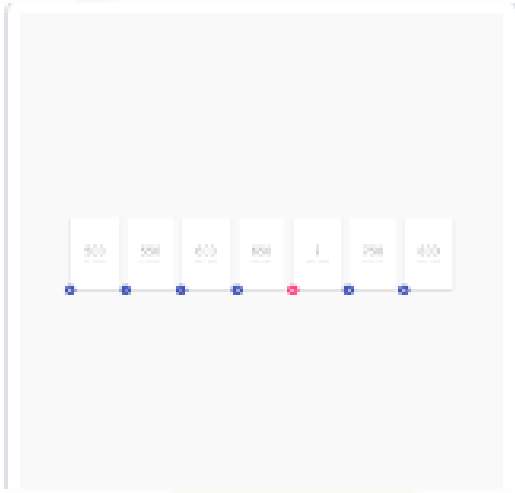
Process Diagram

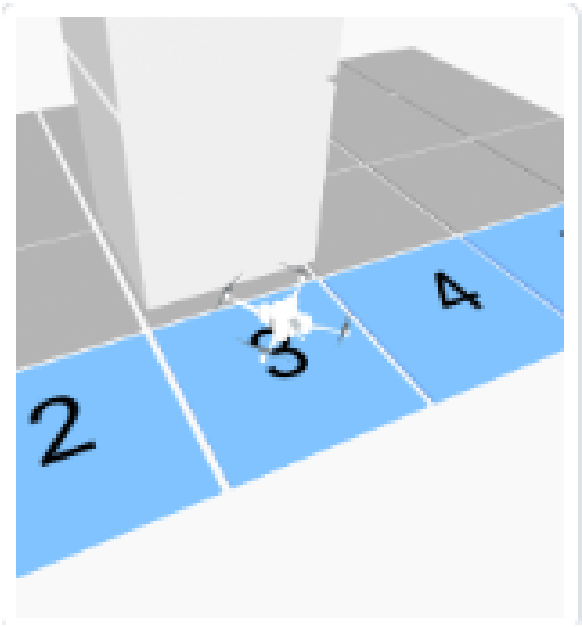
Draw o Bot

Graph Algorithms

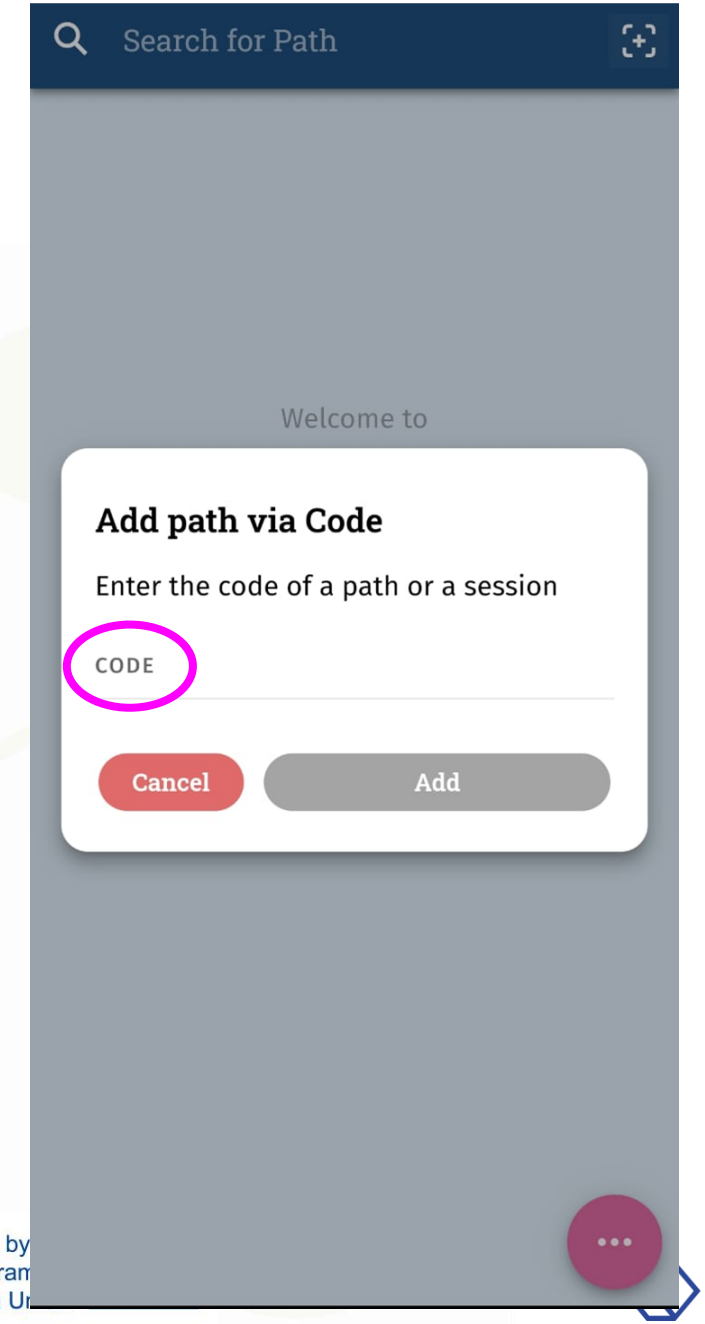
Linear Patterns

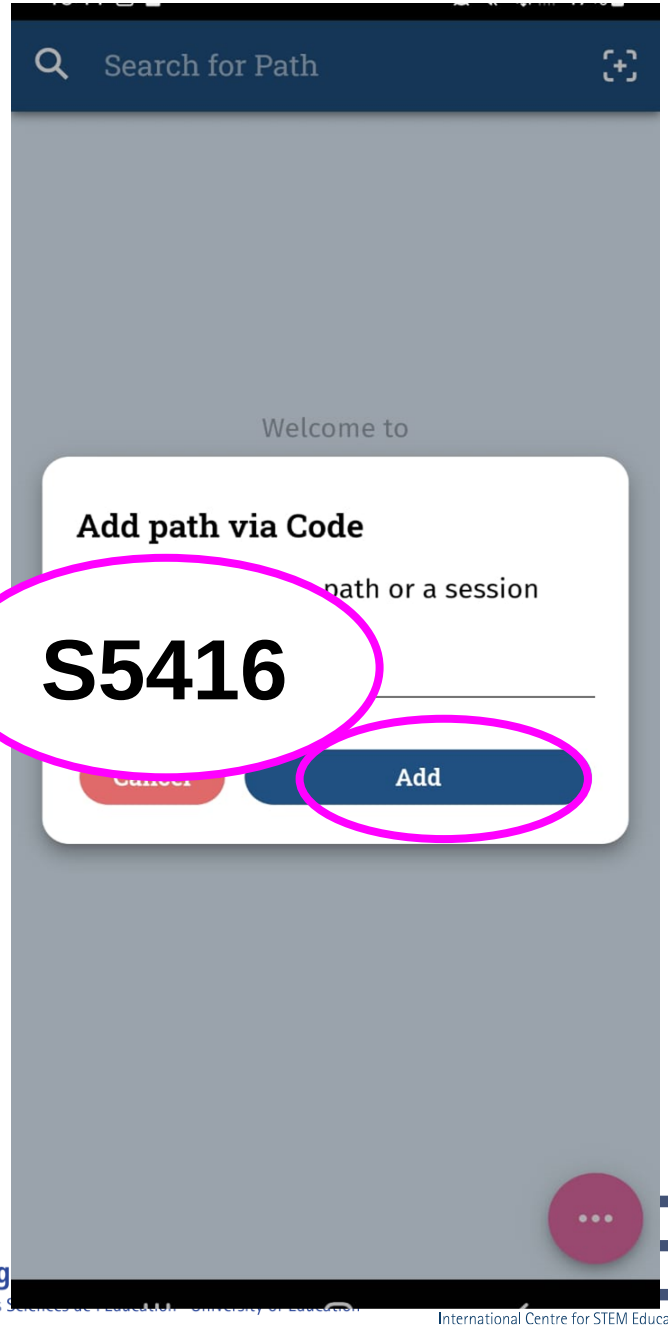


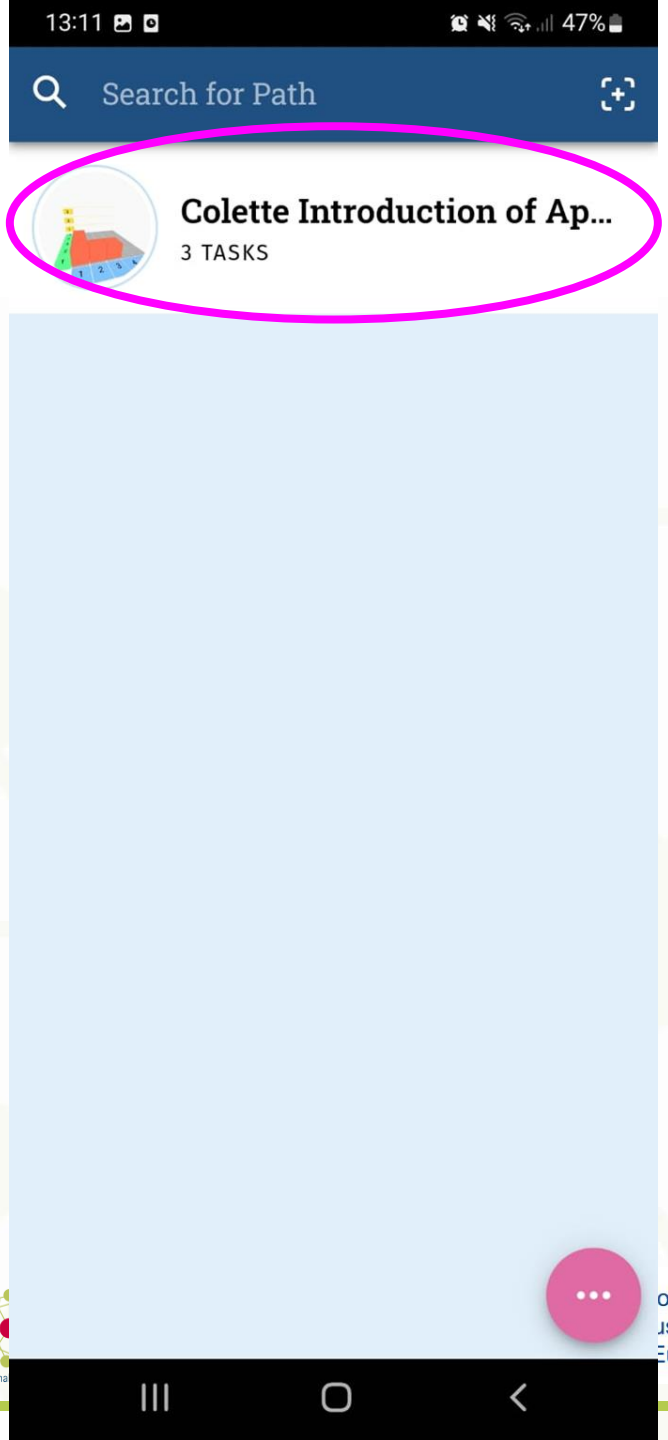


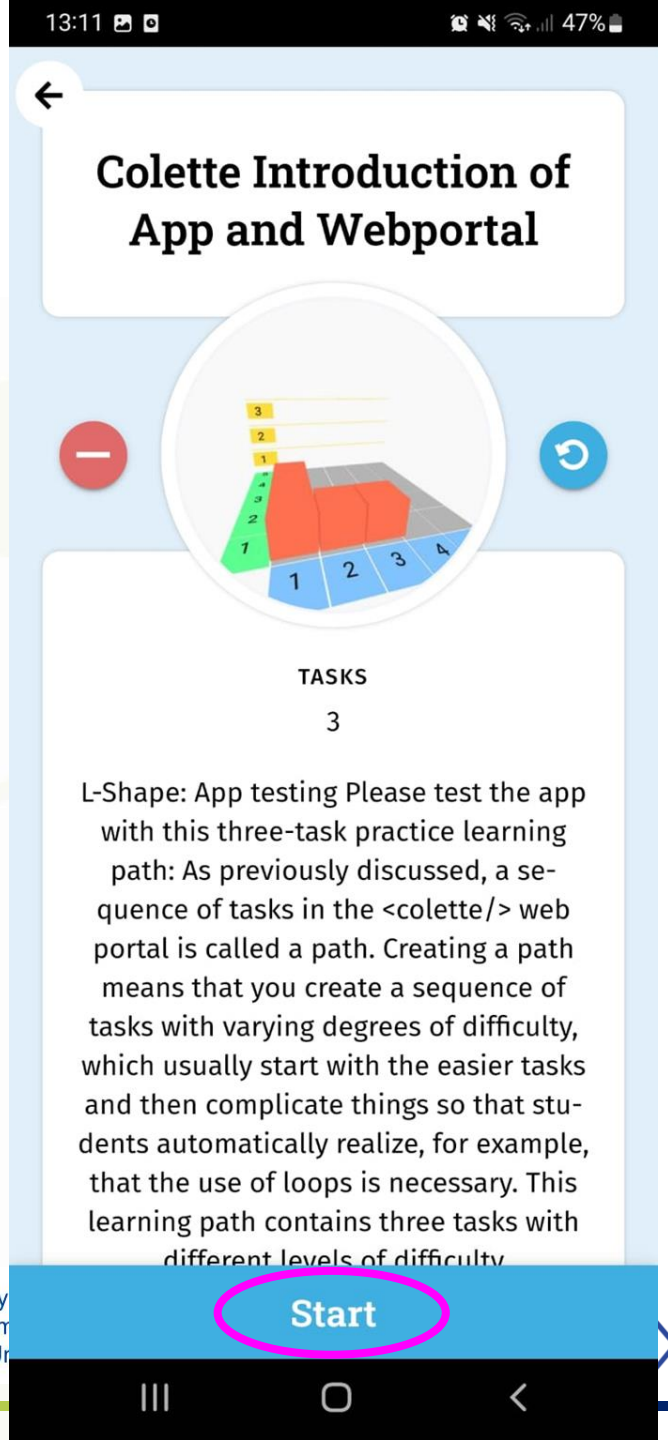


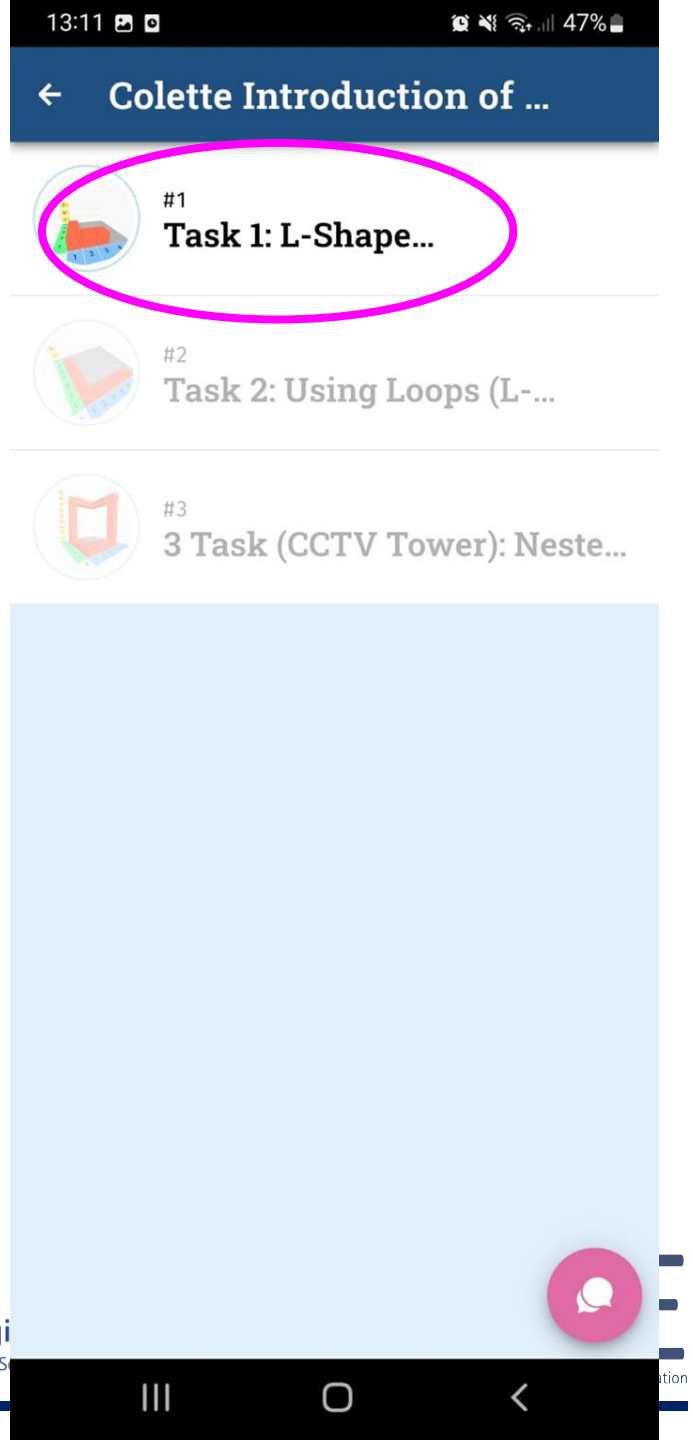

Search for Path
Welcome to
<colette/>
You don't seem to have added any paths yet.
To add a path just click on the "[+]" icon in the top-right corner!
You can find new Paths in the Webportal
Have fun.

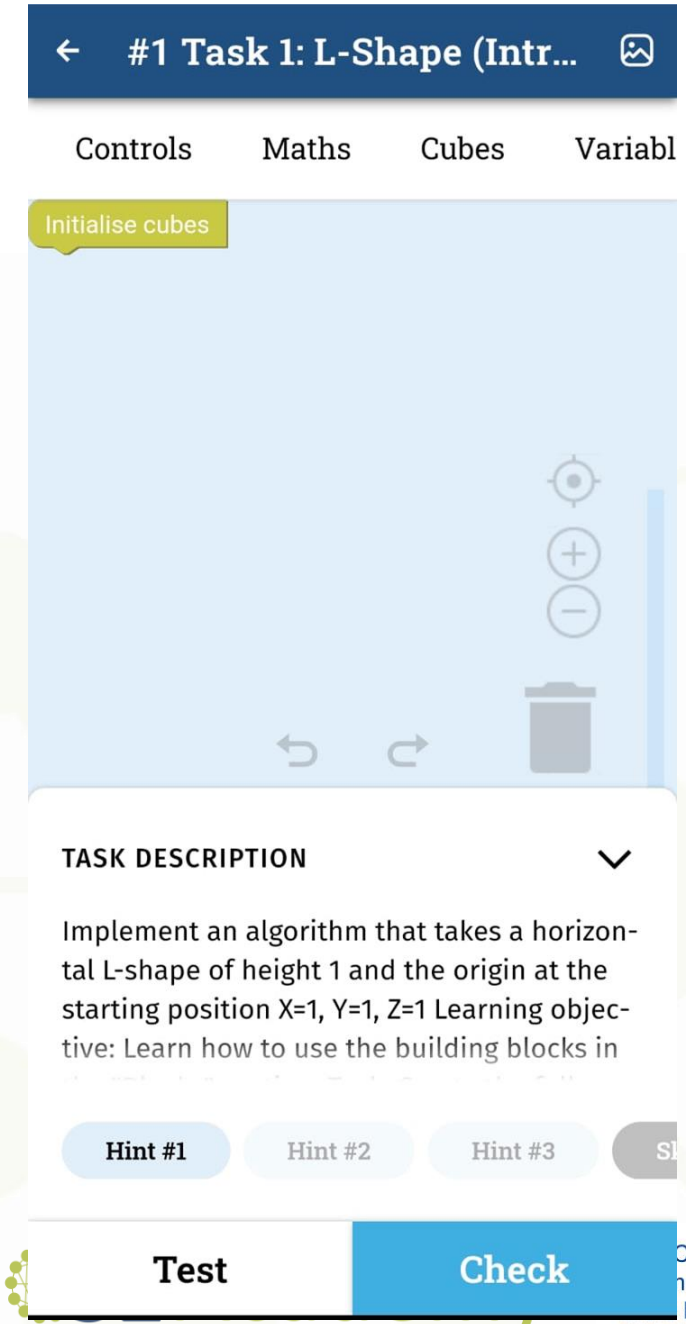

Search for Path
Welcome to
Add path via Code
Enter the code of a path or a session
CODE
Cancel
Add

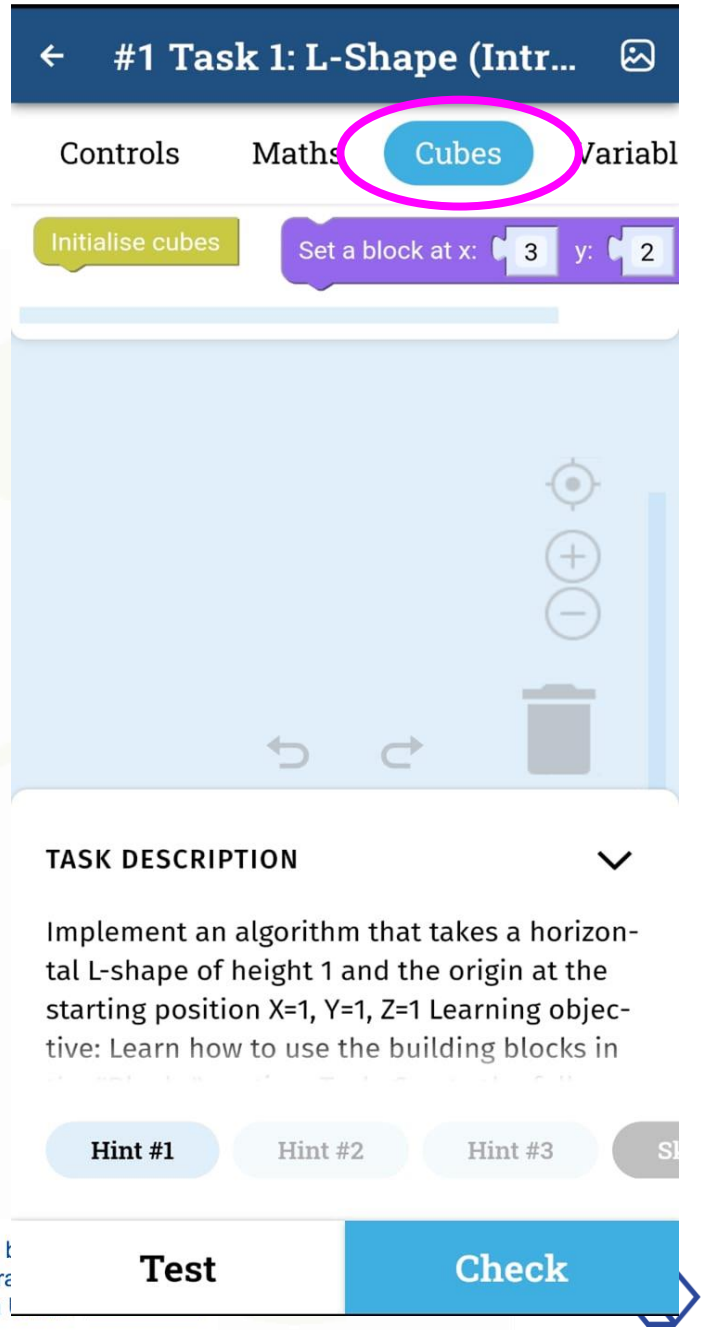

Search for Path
Welcome to
Add path via Code
path or a session
S5416
Add

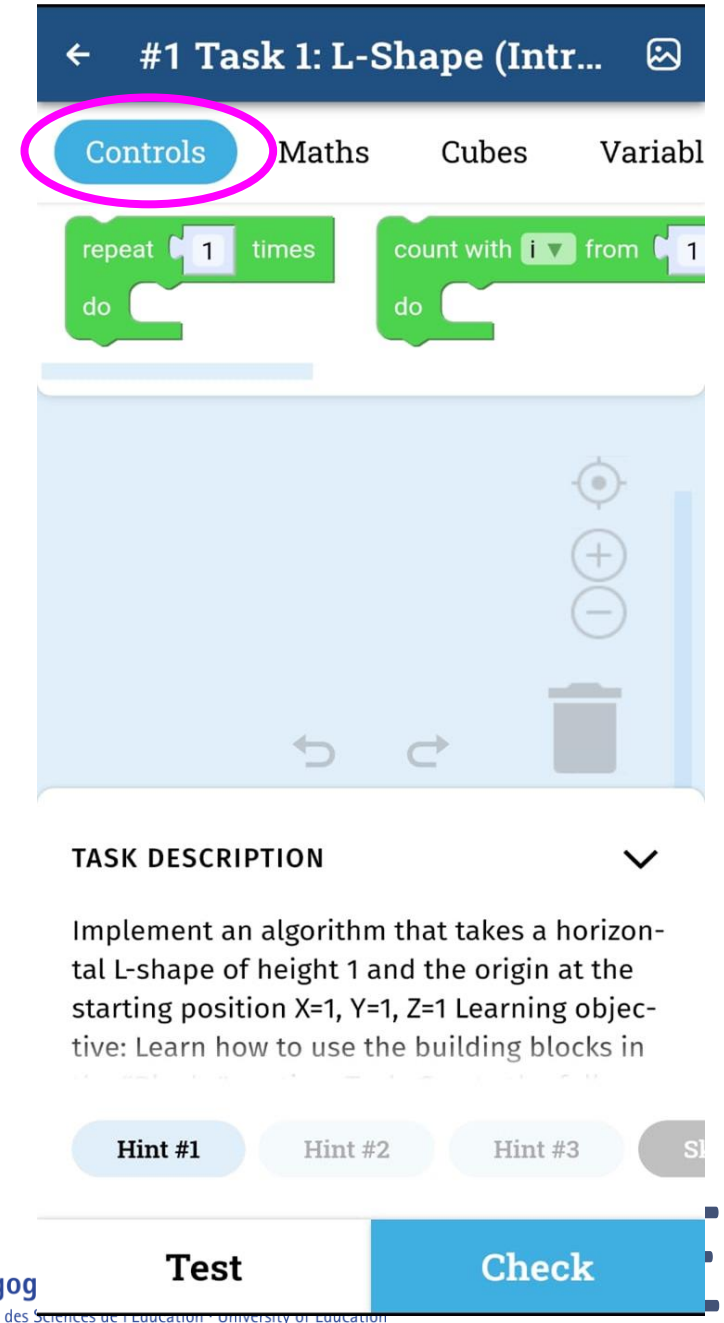

13:11
47%
Search for Path
Colette Introduction of Ap...
3 TASKS

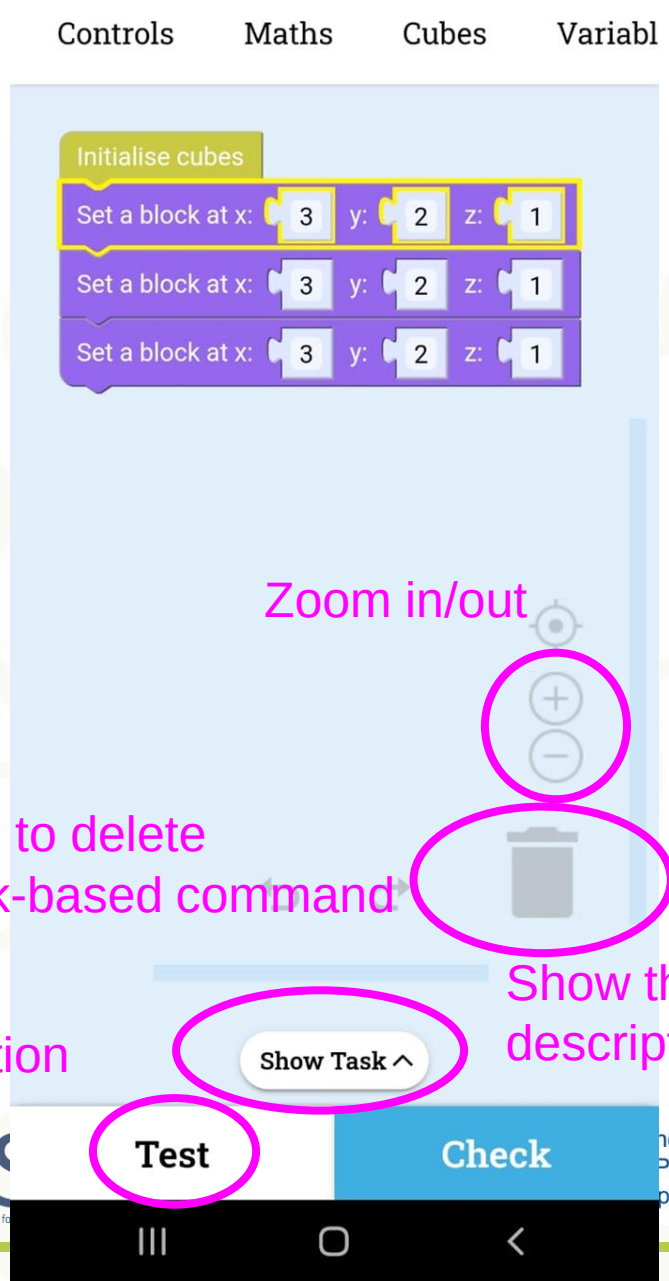

13:11
47%
Colette Introduction of App and Webportal
TASKS
3
L-Shape: App testing Please test the app with this three-task practice learning path: As previously discussed, a sequence of tasks in the <colette/> web portal is called a path. Creating a path means that you create a sequence of tasks with varying degrees of difficulty, which usually start with the easier tasks and then complicate things so that students automatically realize, for example, that the use of loops is necessary. This learning path contains three tasks with
Start


13:11
47%
Colette Introduction of ...
#1
Task 1: L-Shape...
#2
Task 2: Using Loops (L-...
#3
3 Task (CCTV Tower): Neste...


#1 Task 1: L-Shape (Intr...
Controls
Maths
Cubes
Variabl
Initialise cubes
TASK DESCRIPTION
Implement an algorithm that takes a horizontal L-shape of height 1 and the origin at the starting position X=1, Y=1, Z=1 Learning objective: Learn how to use the building blocks in
Hint #1
Hint #2
Hint #3
Test
Check


#1 Task 1: L-Shape (Intr...
Controls
Maths
Cubes
Variabl
Initialise cubes
Set a block at x: 3 y: 2
TASK DESCRIPTION
Implement an algorithm that takes a horizontal L-shape of height 1 and the origin at the starting position X=1, Y=1, Z=1 Learning objective: Learn how to use the building blocks in
Hint #1
Hint #2
Hint #3
Test
Check


#1 Task 1: L-Shape (Intr...
Controls
Maths
Cubes
Variabl
repeat 1 times
do
count with i from 1
do
TASK DESCRIPTION
Implement an algorithm that takes a horizontal L-shape of height 1 and the origin at the starting position X=1, Y=1, Z=1 Learning objective: Learn how to use the building blocks in
Hint #1
Hint #2
Hint #3
Test
Check

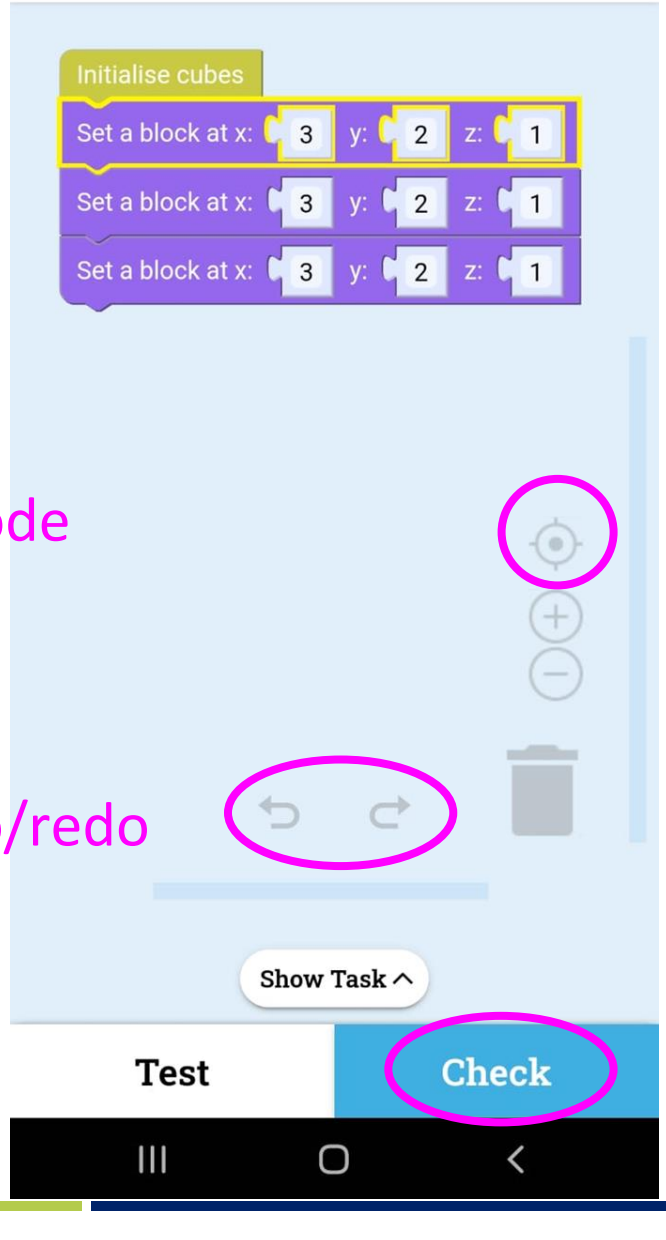


Zoom in/out

Drag to delete block-based command

Show the whole task description and hints

Test solution via AR

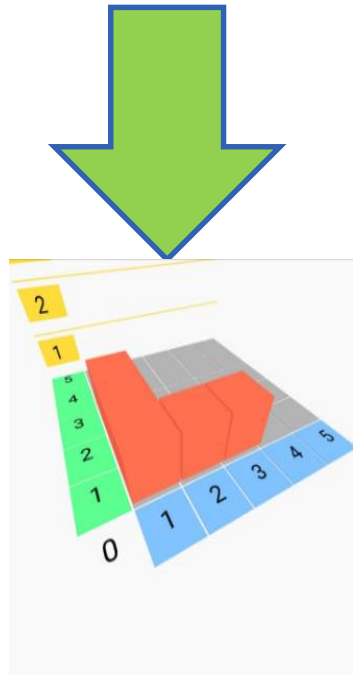


Center the code

Undo/redo

Check final solution

image again



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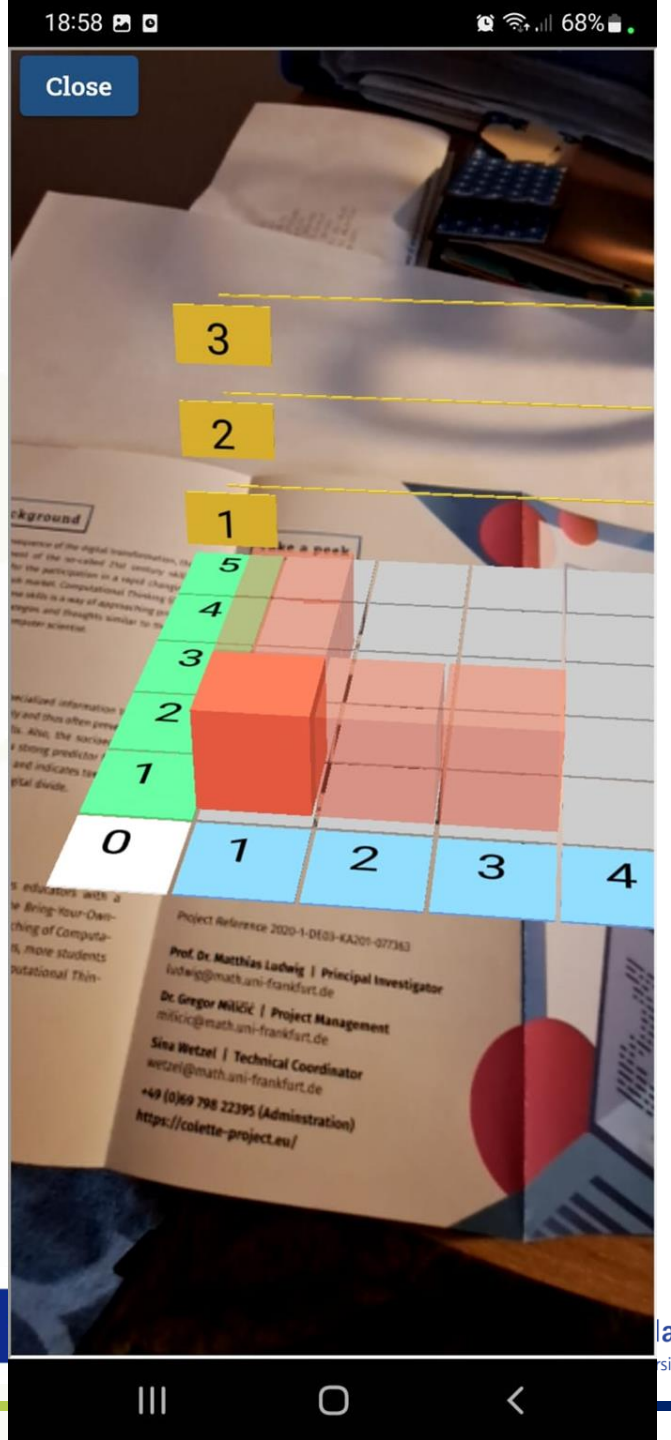
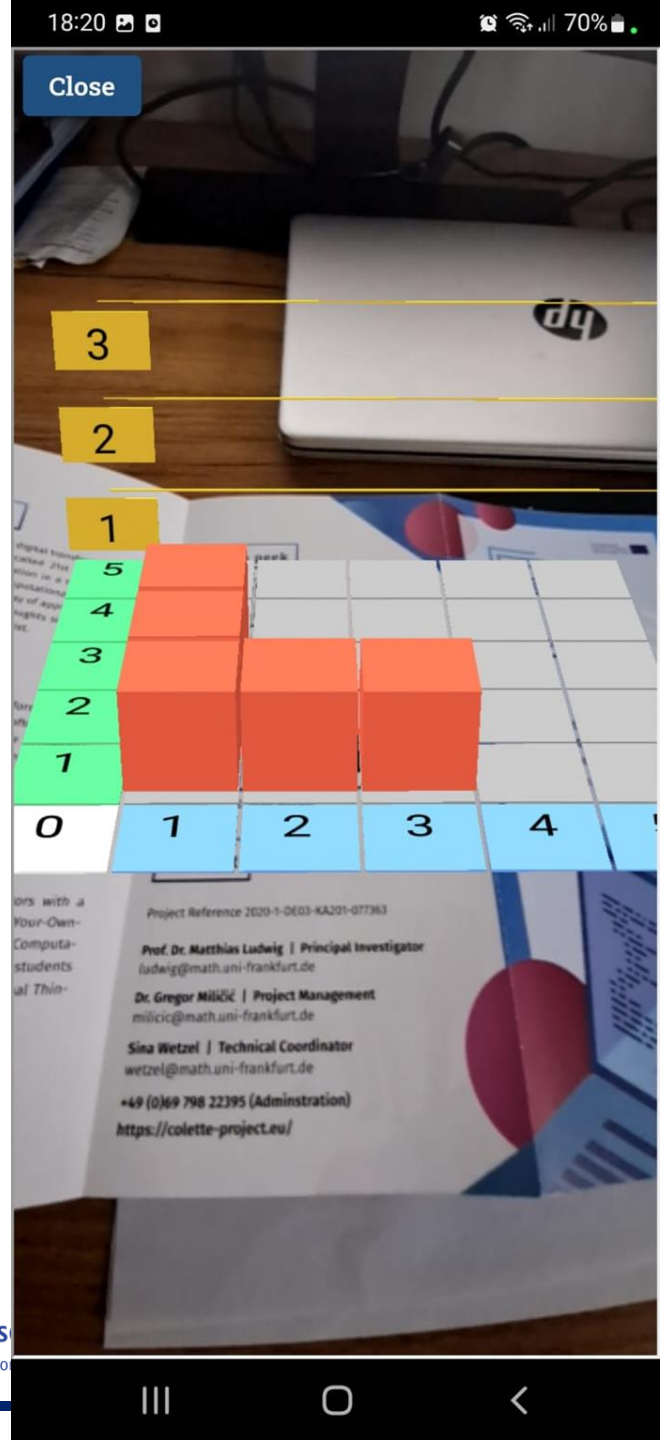
Testing the code with AR

AR marker

1. Get your printed AR marker
2. Click “Test”
3. Accept access to the camera
4. Point the camera at the CT marker
5. Check your solution in AR





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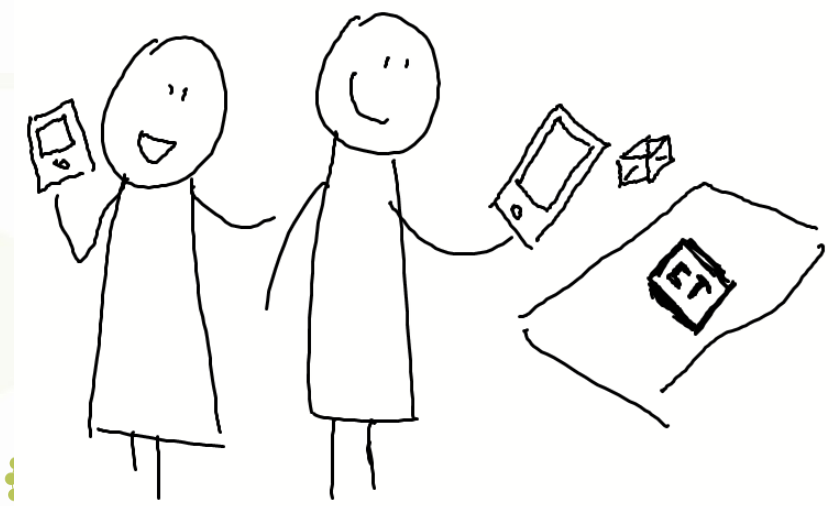
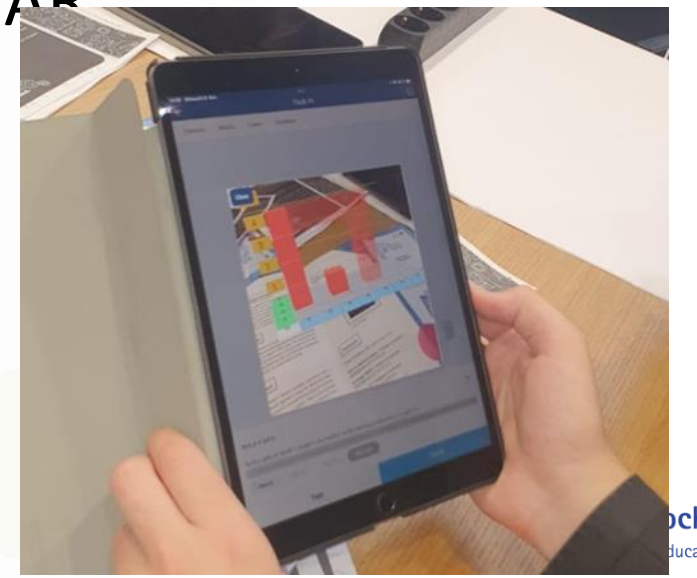
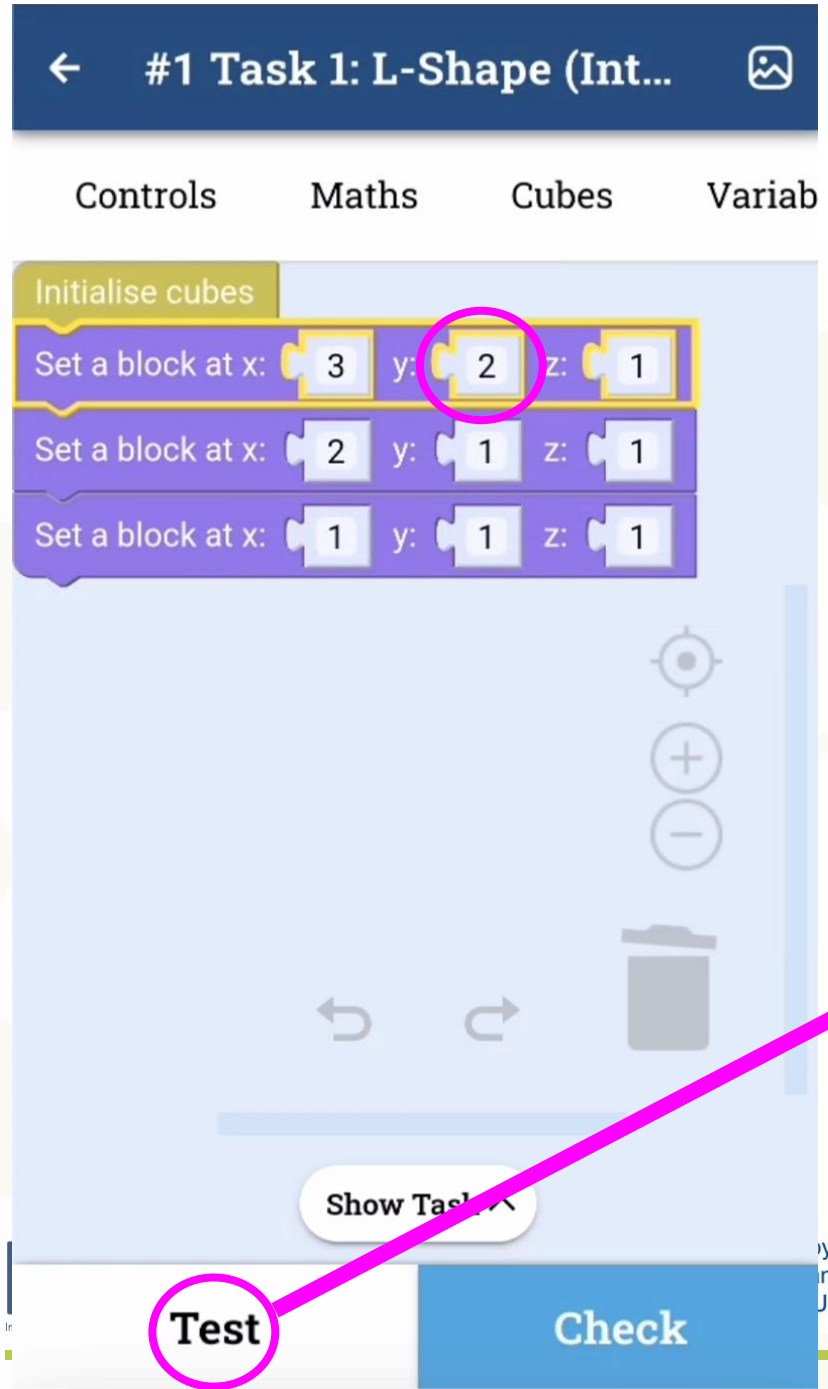
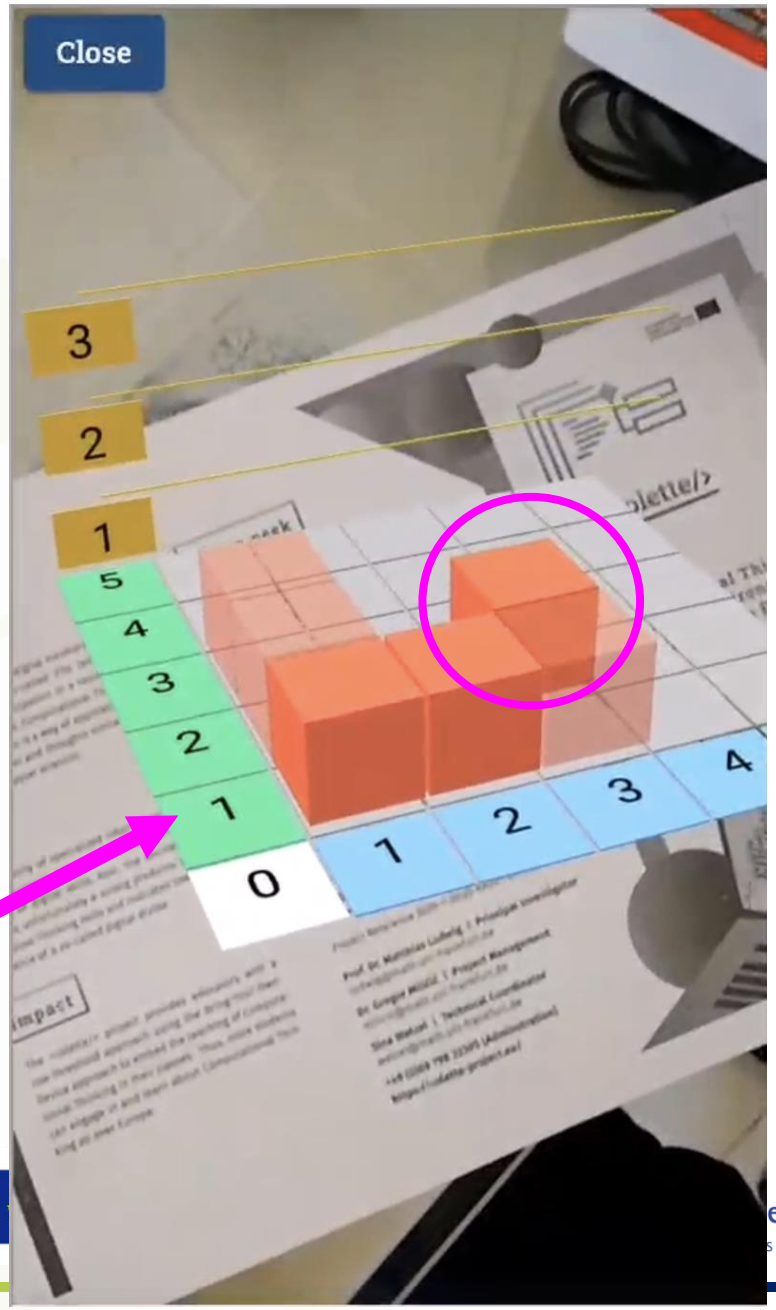
The AR function

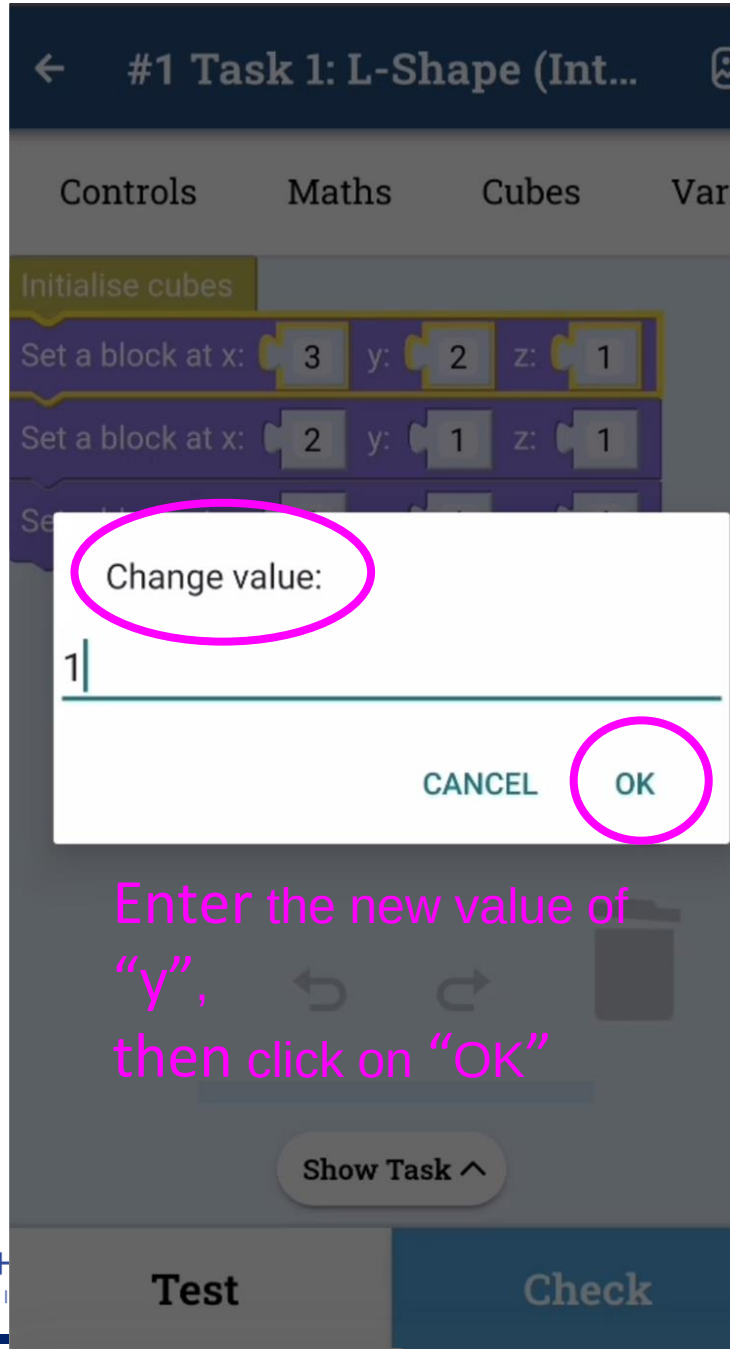
1. Get your printed version of the CT marker
2. Select to check/view your solution
3. Accept “Access to camera”
4. Point the camera to the CT marker
5. View the result of your code in AR

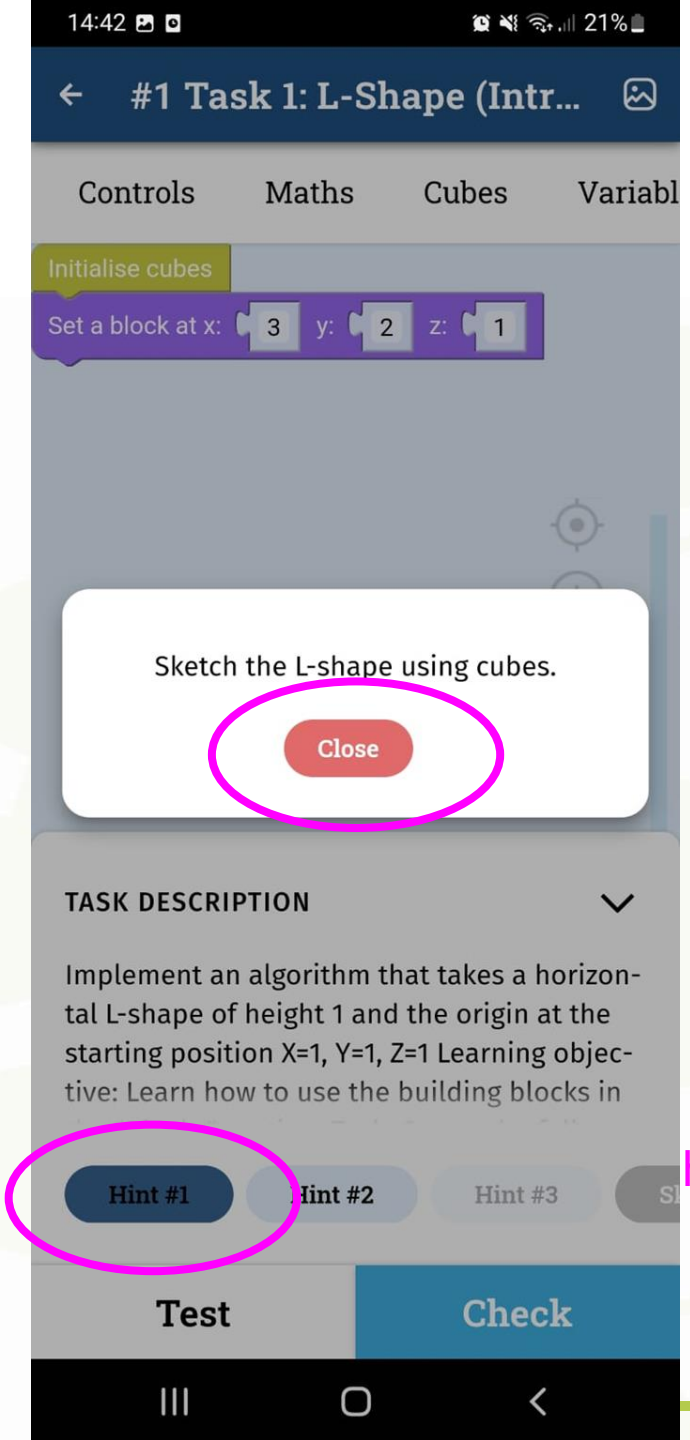





#1 Task 1: L-Shape (Int...
Controls
Maths
Cubes
Variab
Initialise cubes
Set a block at x: 3 y: 2 z: 1
Set a block at x: 2 y: 1 z: 1
Set a block at x: 1 y: 1 z: 1
Show Task
Test
Check

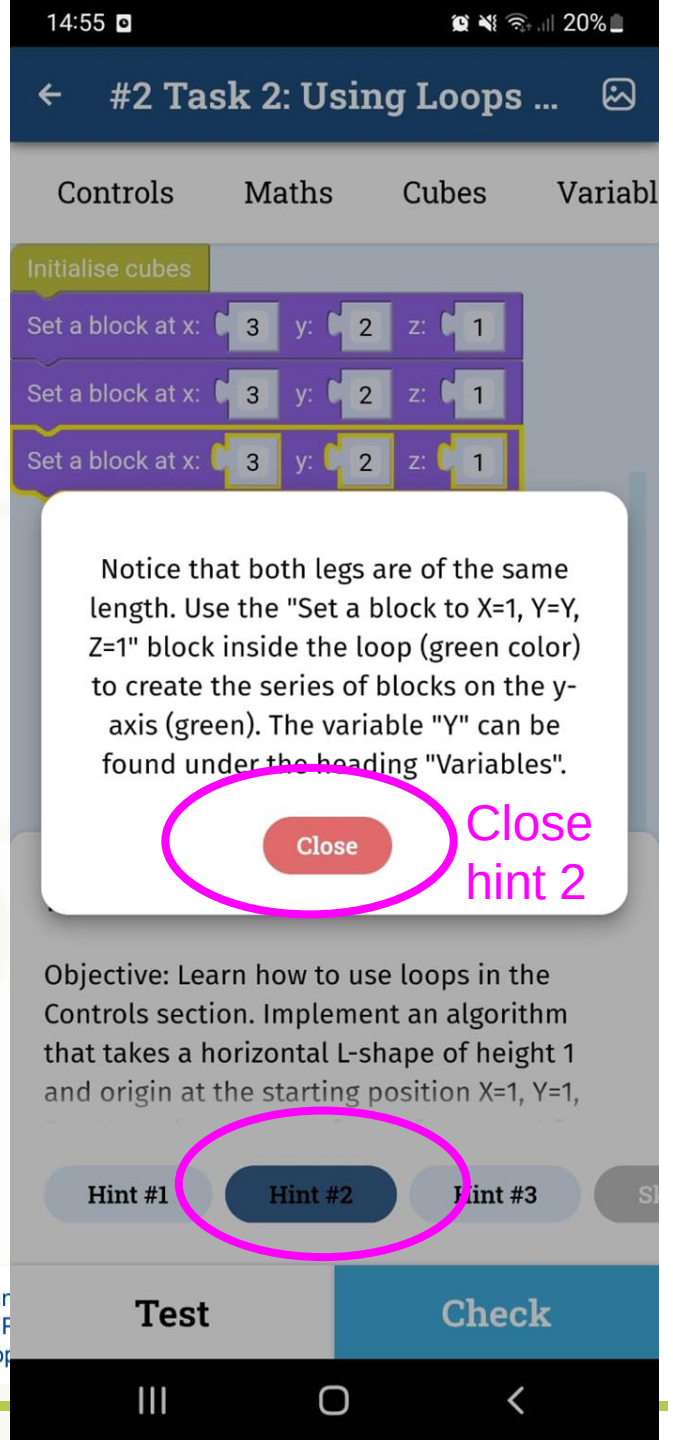

Close
3
2
1
5
4
3
2
1
0
1
2
3
4


#1 Task 1: L-Shape (Int...
Controls
Maths
Cubes
Initialise cubes
Set a block at x: 3 y: 2 z: 1
Set a block at x: 2 y: 1 z: 1
Change value:
1
CANCEL
OK
Enter the new value of "y", then click on "OK"
Show Task
Test
Check

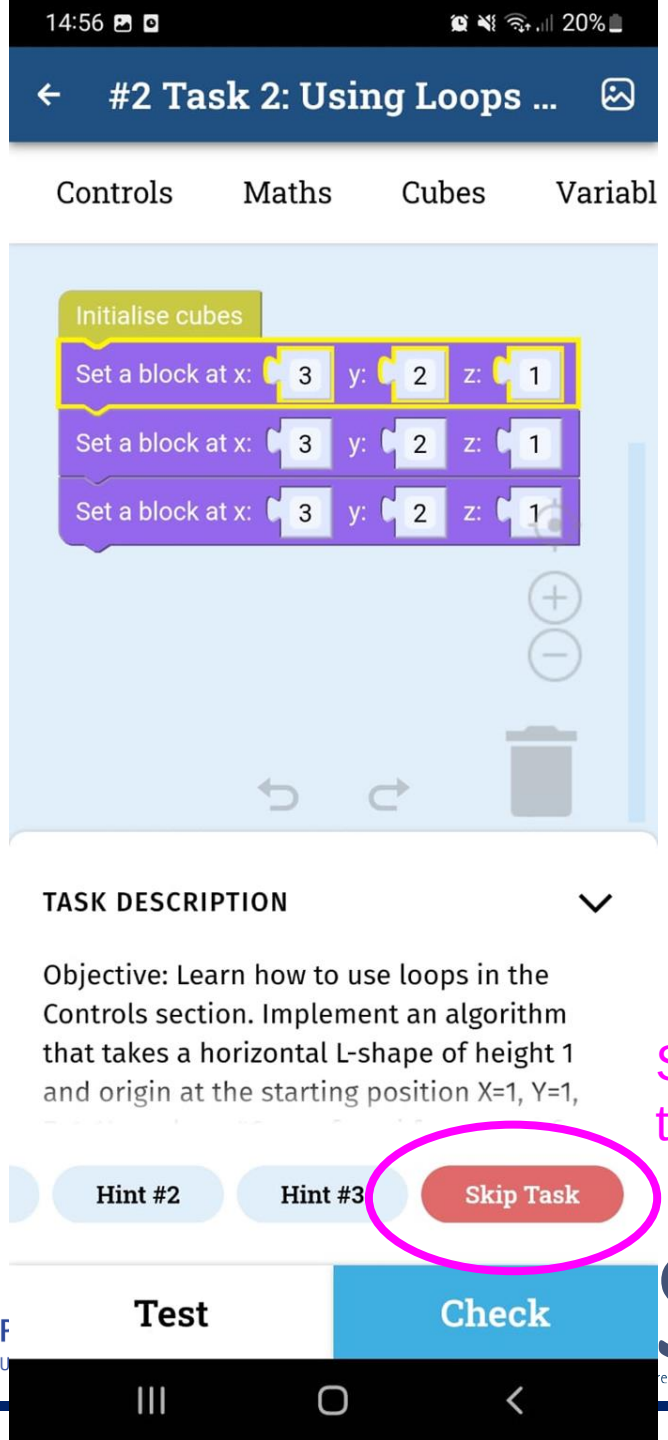


Close hint 1

hints

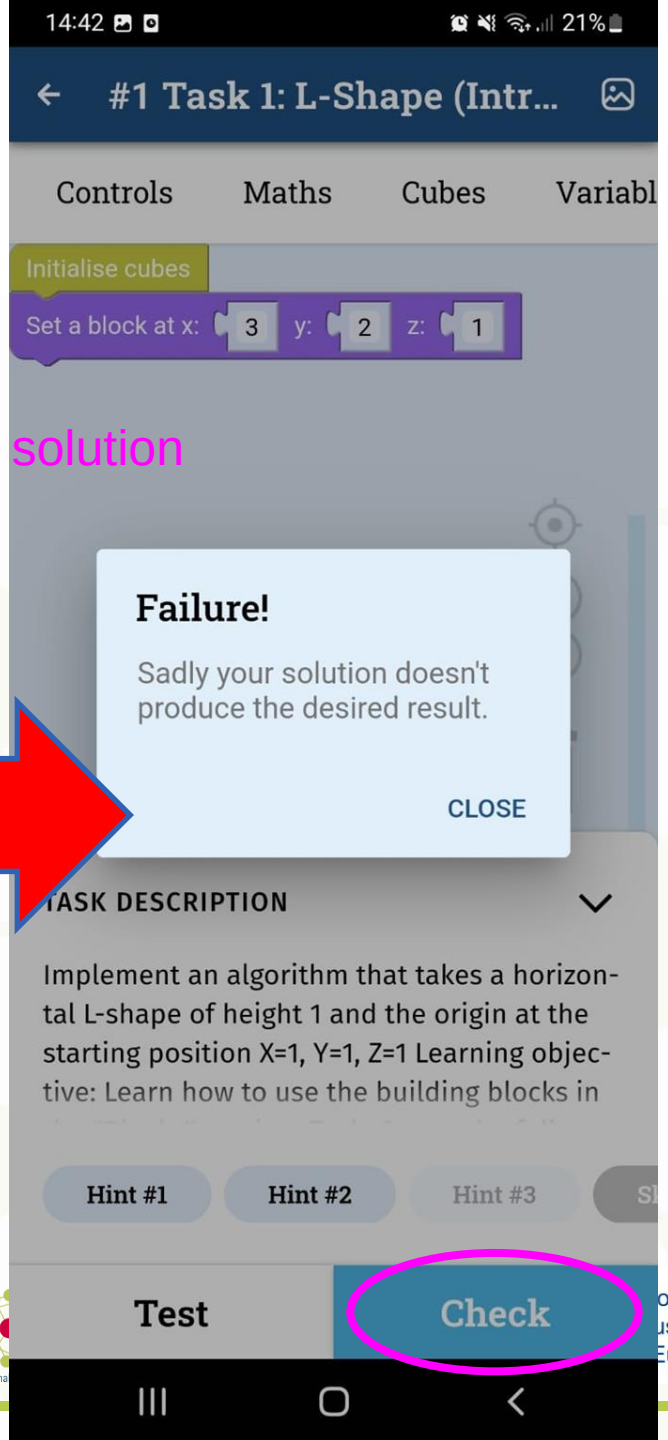


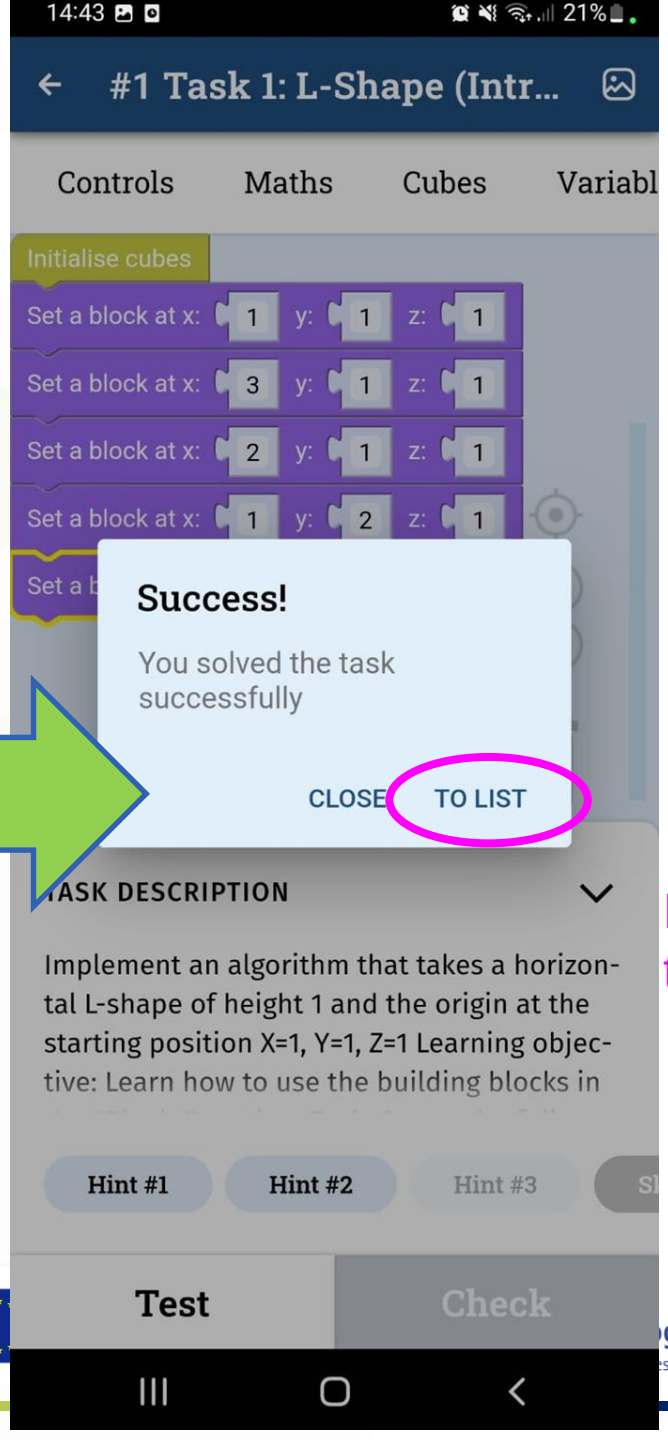
Close hint 2

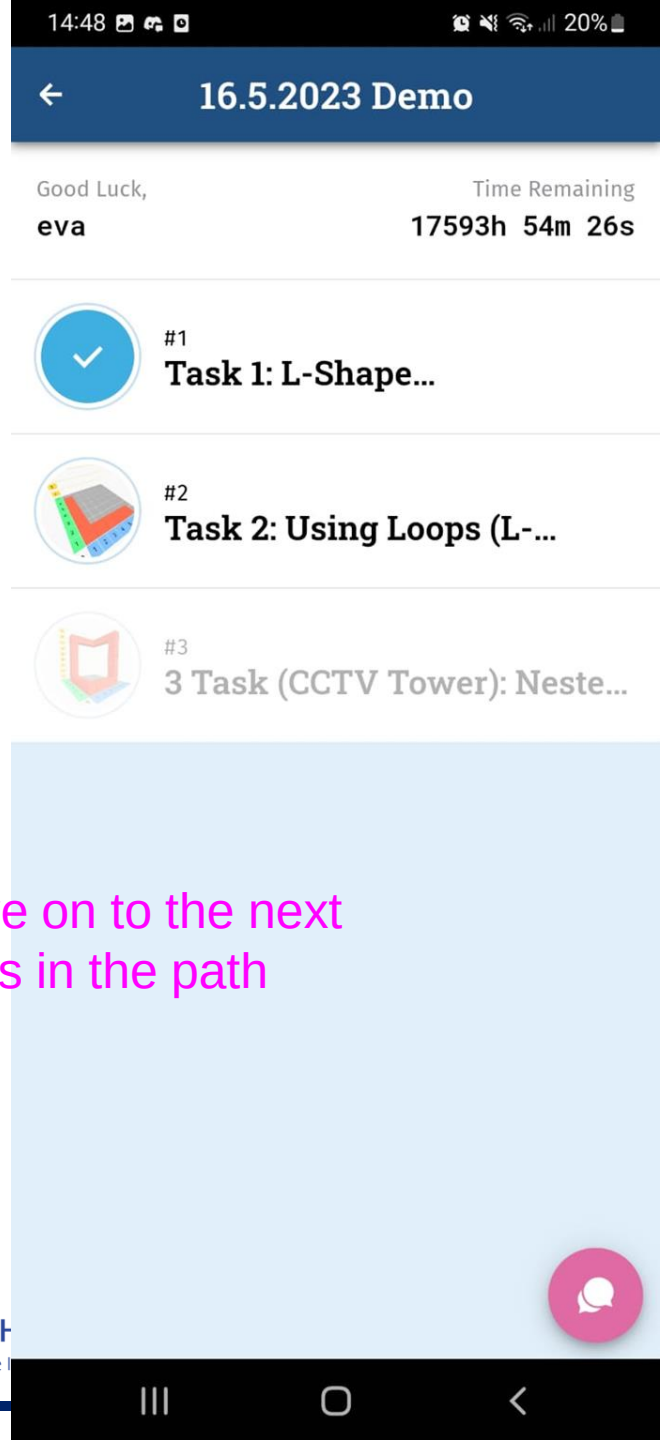


Skip the task

Wrong solution







Move on to the next tasks in the path

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Hands on!

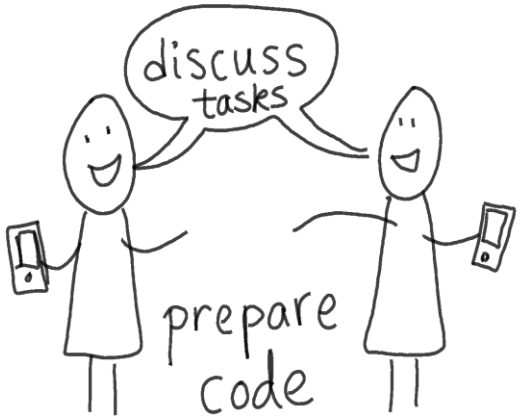
S5416 Architect in the virtual world

Go to breakout room until...

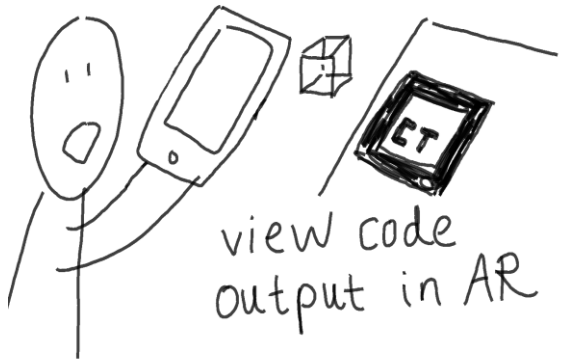
Discussion

What do you notice?
What do you wonder?
How could you use this in your class?

Comments, impressions, keywords, questions...



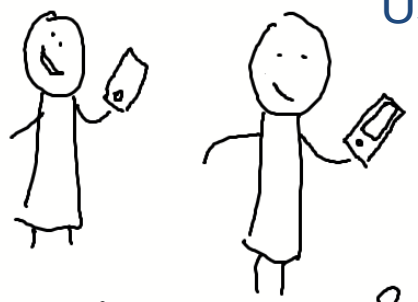
Connection to gaming - entertainment factor



Visualisation

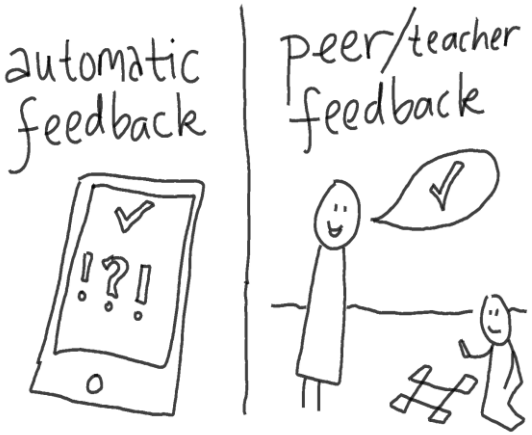
Advantages

Increase motivation and collaboration



collaborate & work individually

Use it anywhere



Time-saving

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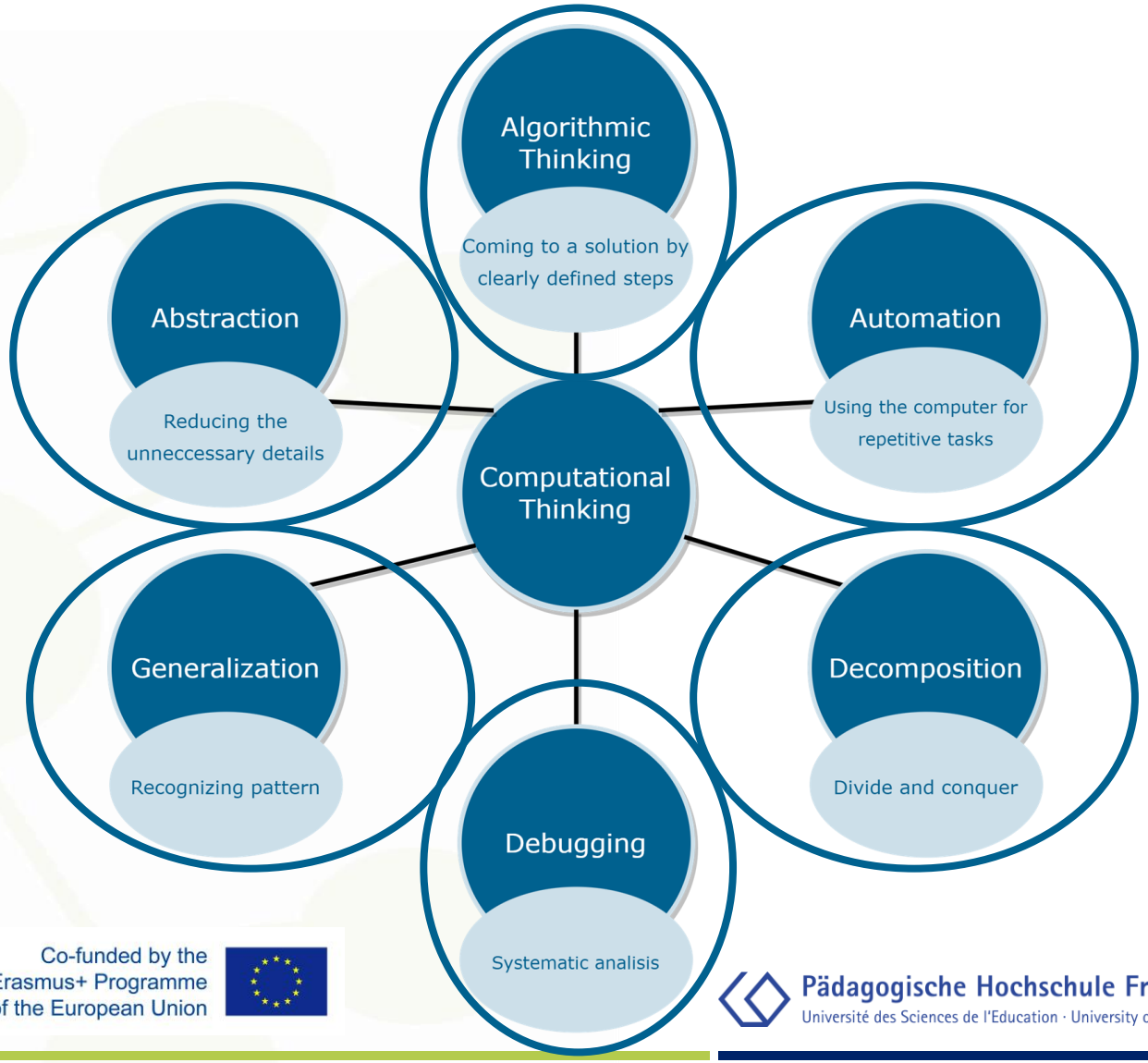
CT Background information



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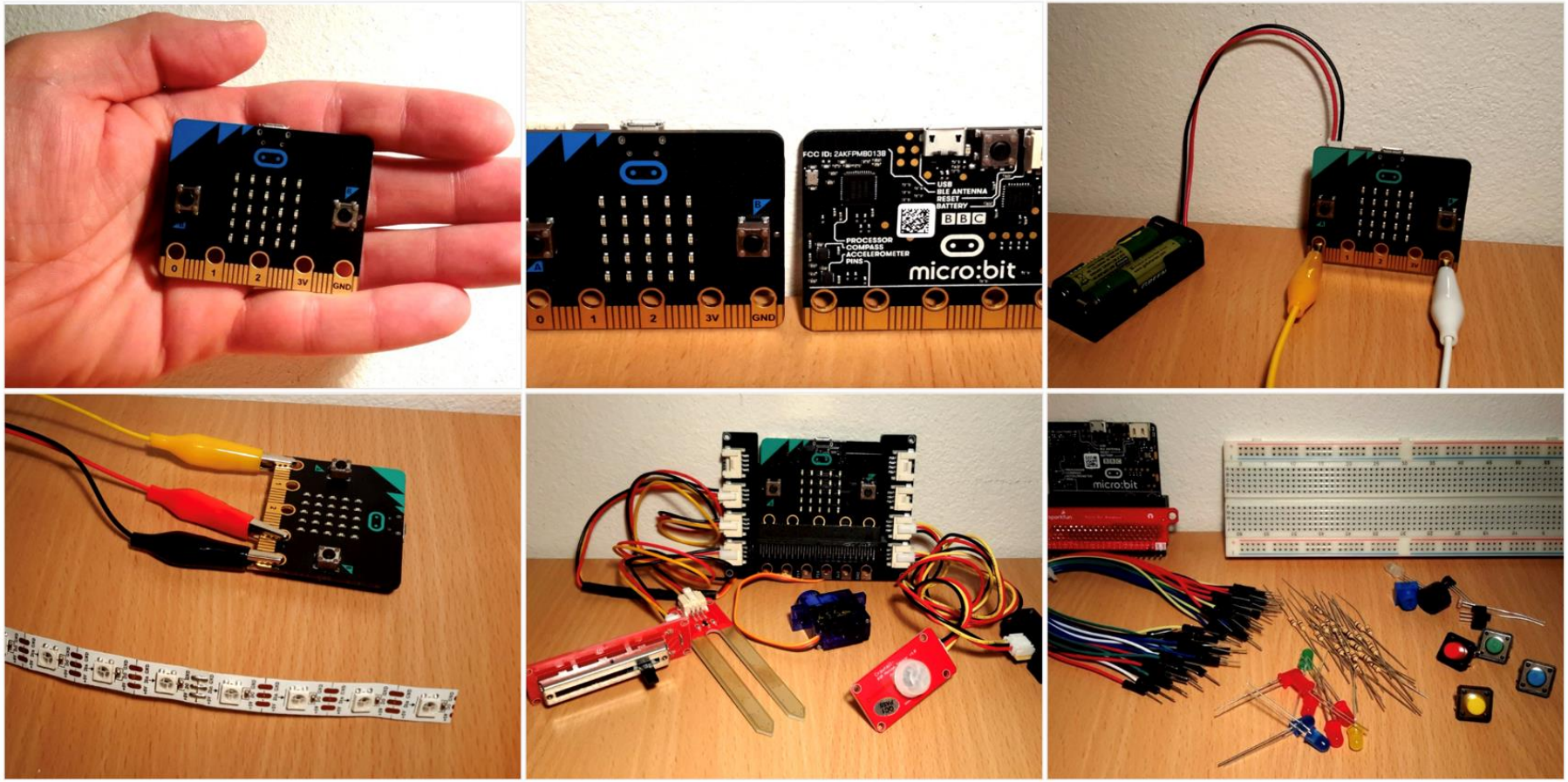
BBC micro:bit

„The micro:bit s a small uncased circuit board with a display made up of 25 LEDs, a couple of buttons, and some sensors. Crucially, it has a micro-USB socket that allows you to connect it to your computer both to power it and to send programs to it. The micro:bit can also be connected to a battery pack so that it can be used without your computer.“
(Programming the BBC micro, Simon Monk)

Levels of using BBC micro:bit



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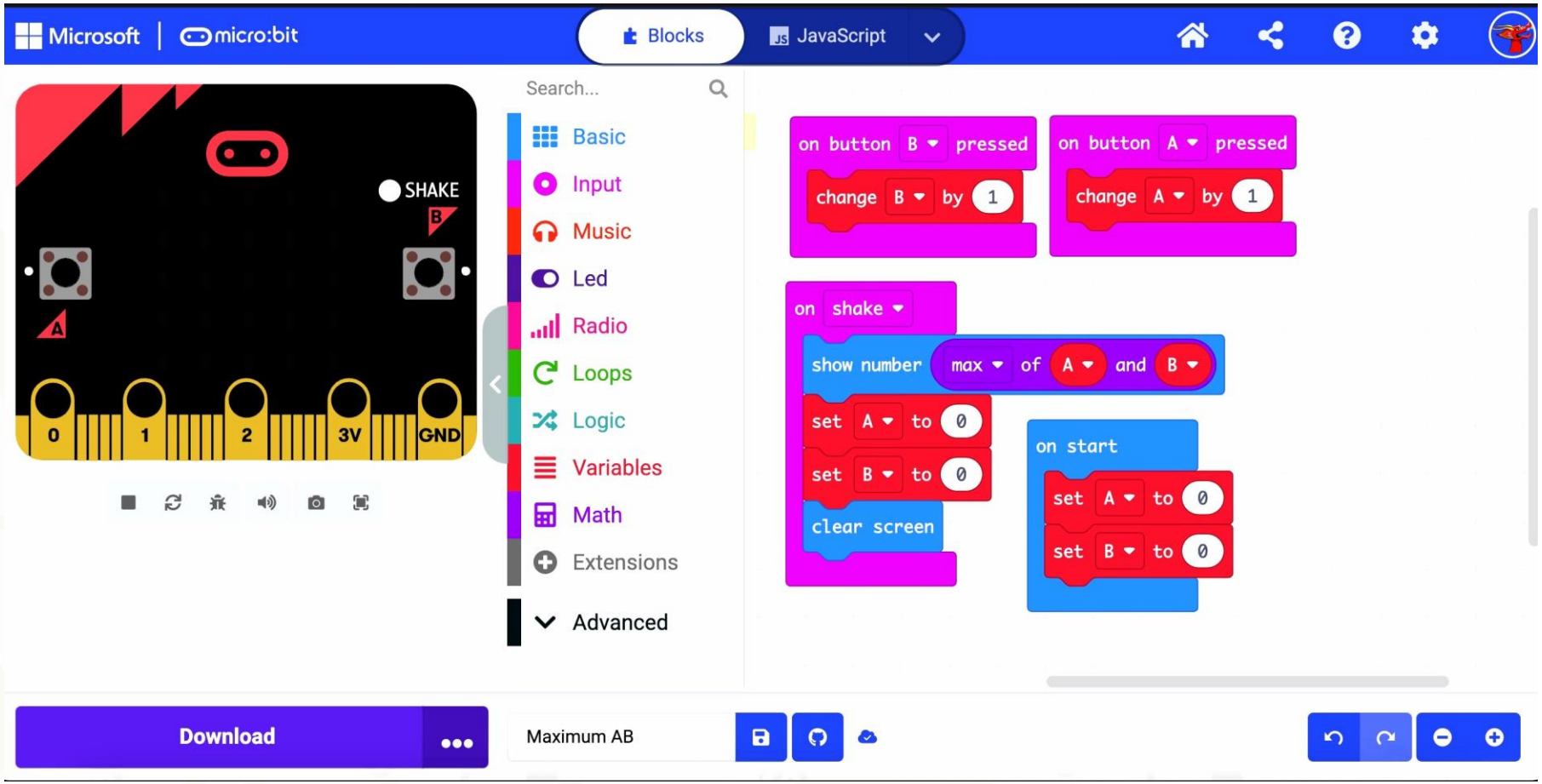
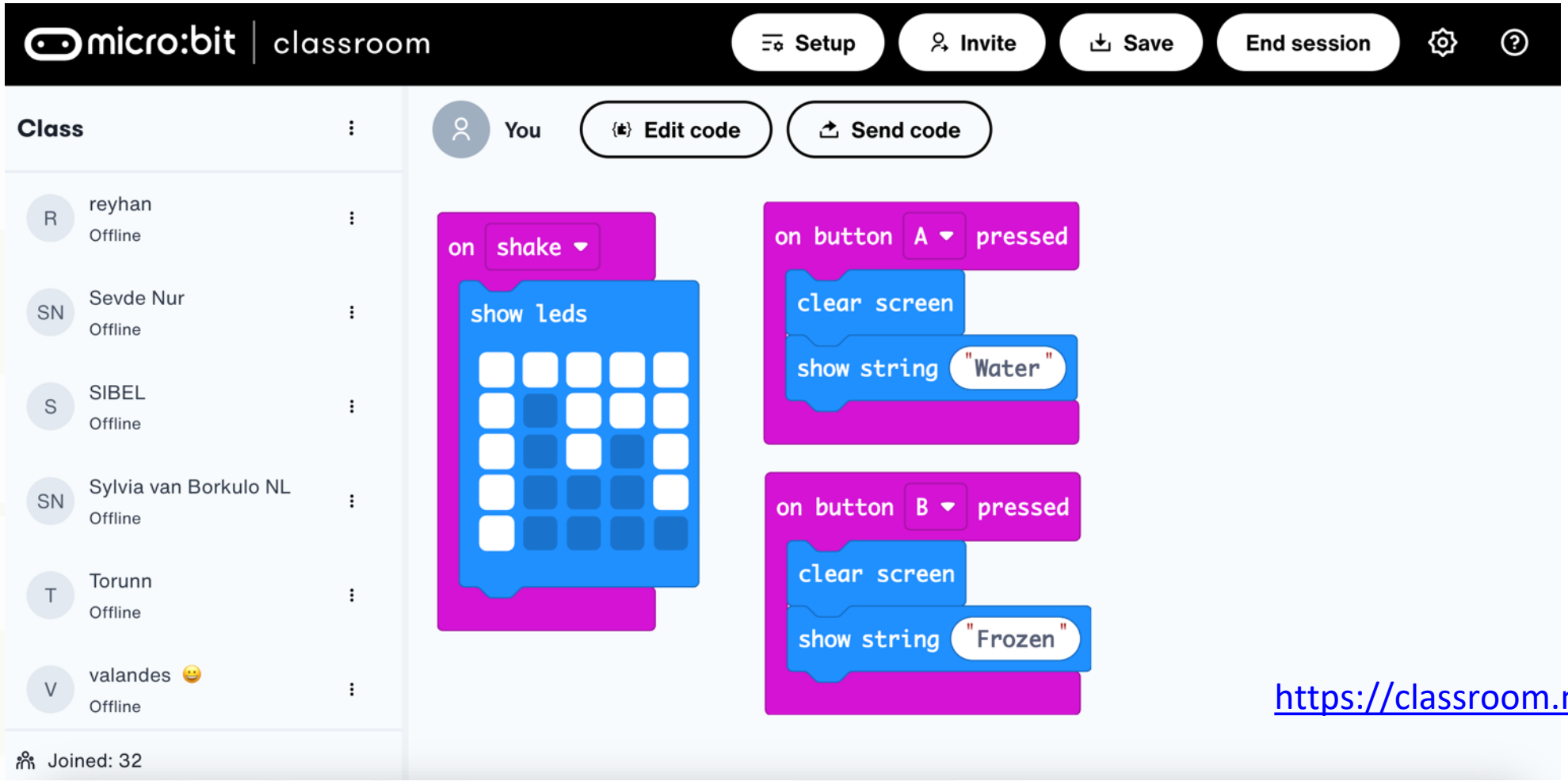
(Not only) Block Based Programming



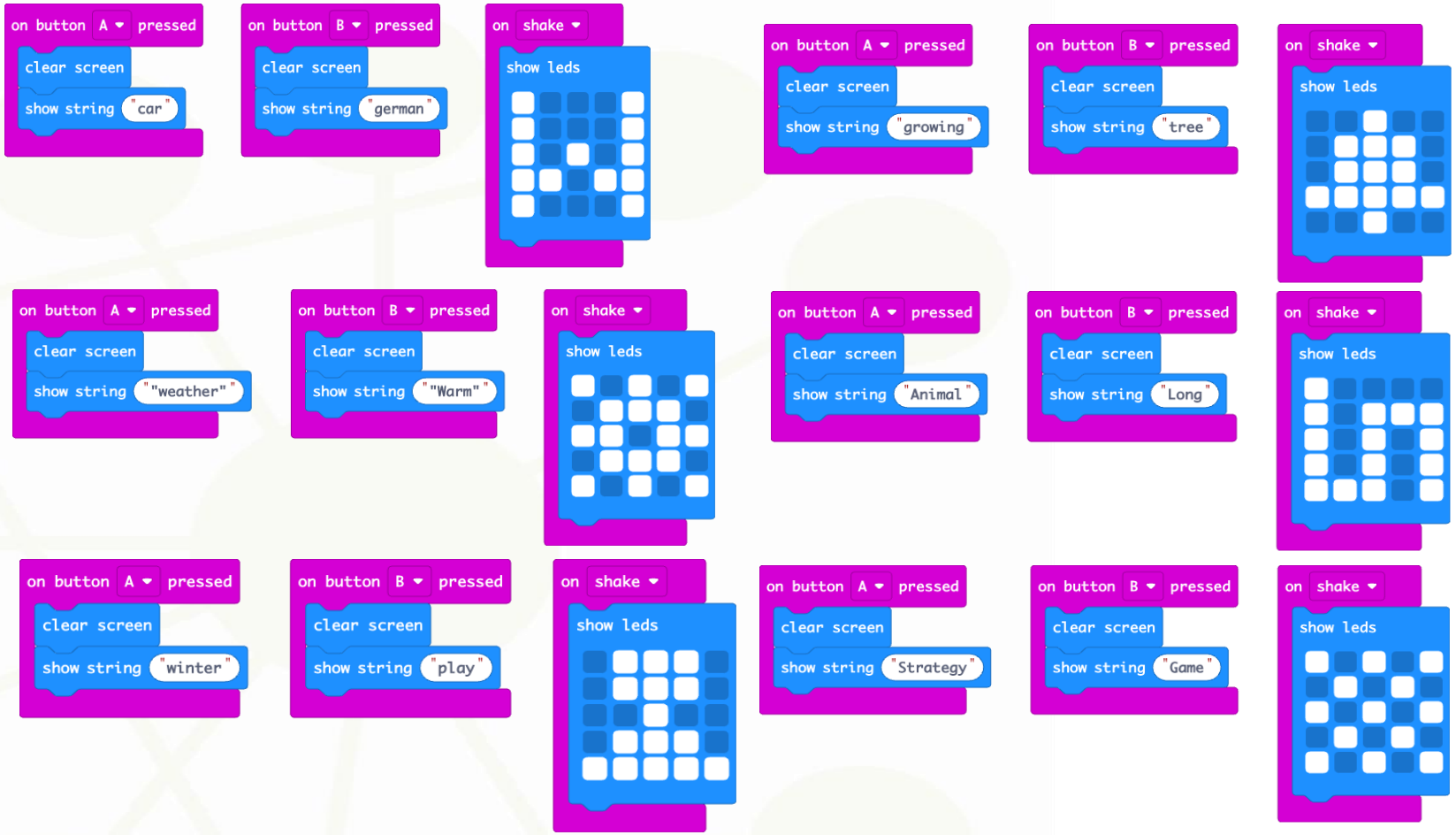
https://makecode.microbit.org/

Classroom Management System



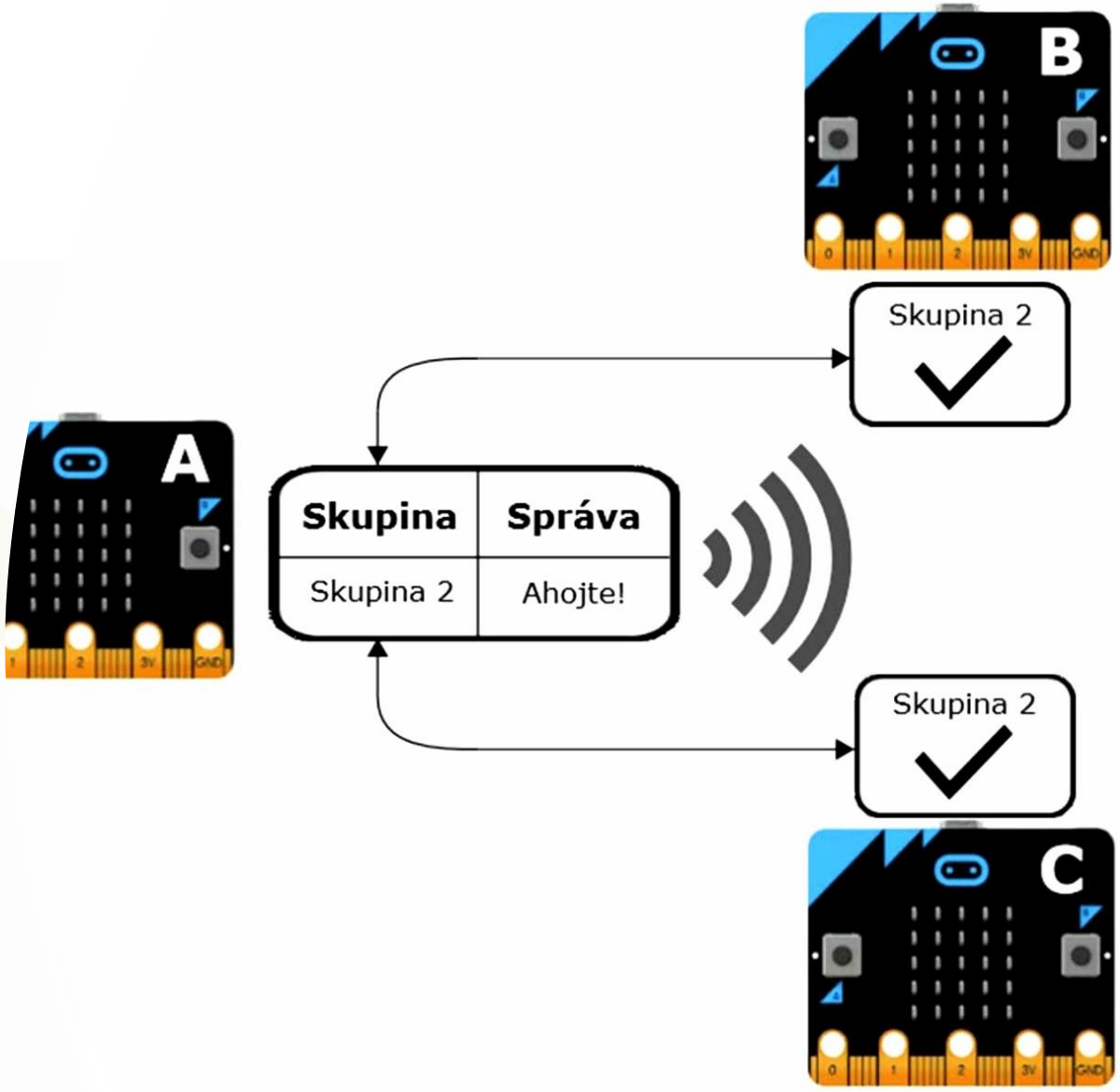
https://classroom.microbit.org/

Riddles from Attendees



Radio Communication

Micro:bits can communicate with each other. It works similarly to walkie-talkies. A microbit can be both a transmitter and a receiver at the same time. It can process the received message and so we can create many tasks based on the remote control principle.



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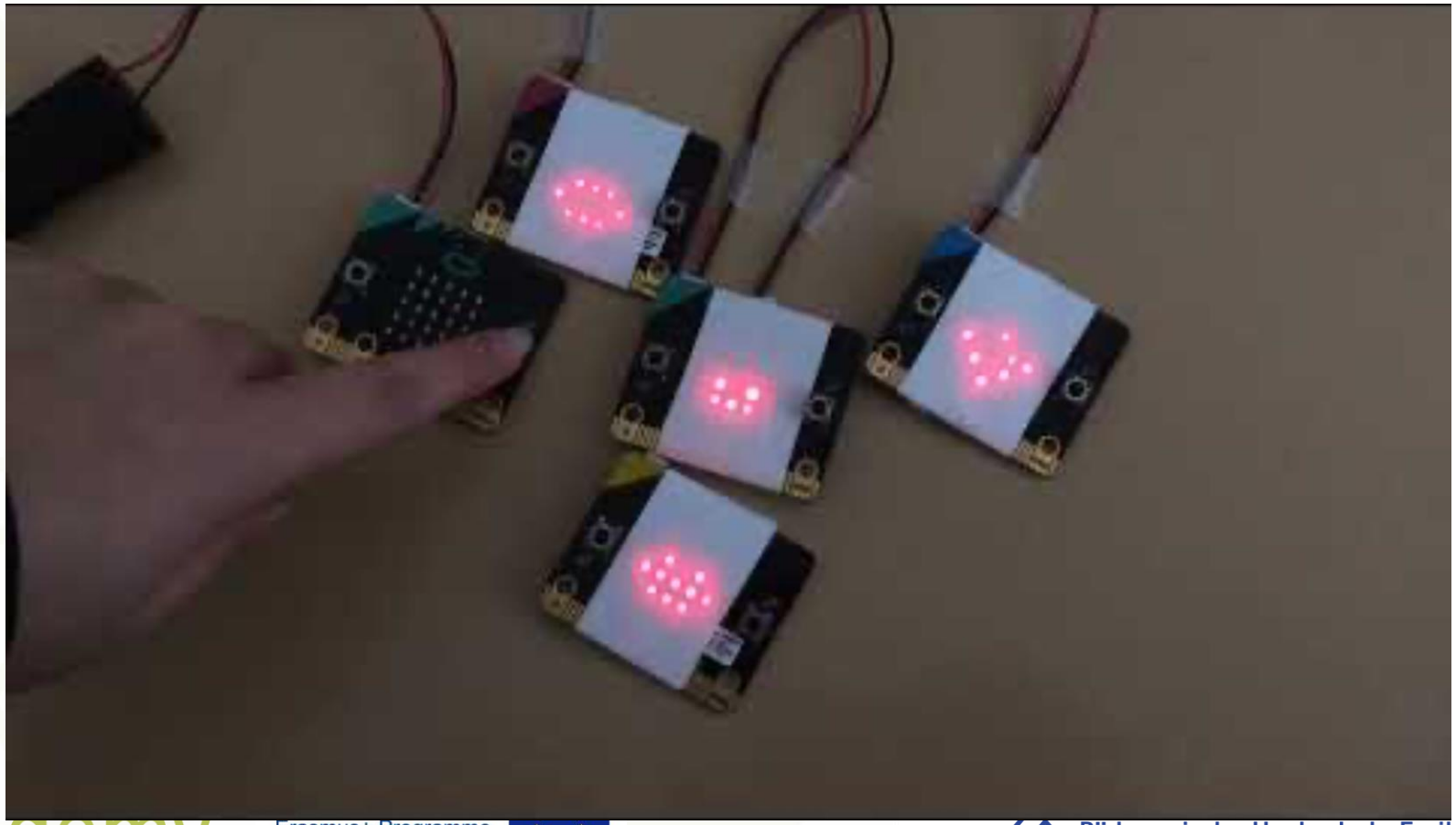
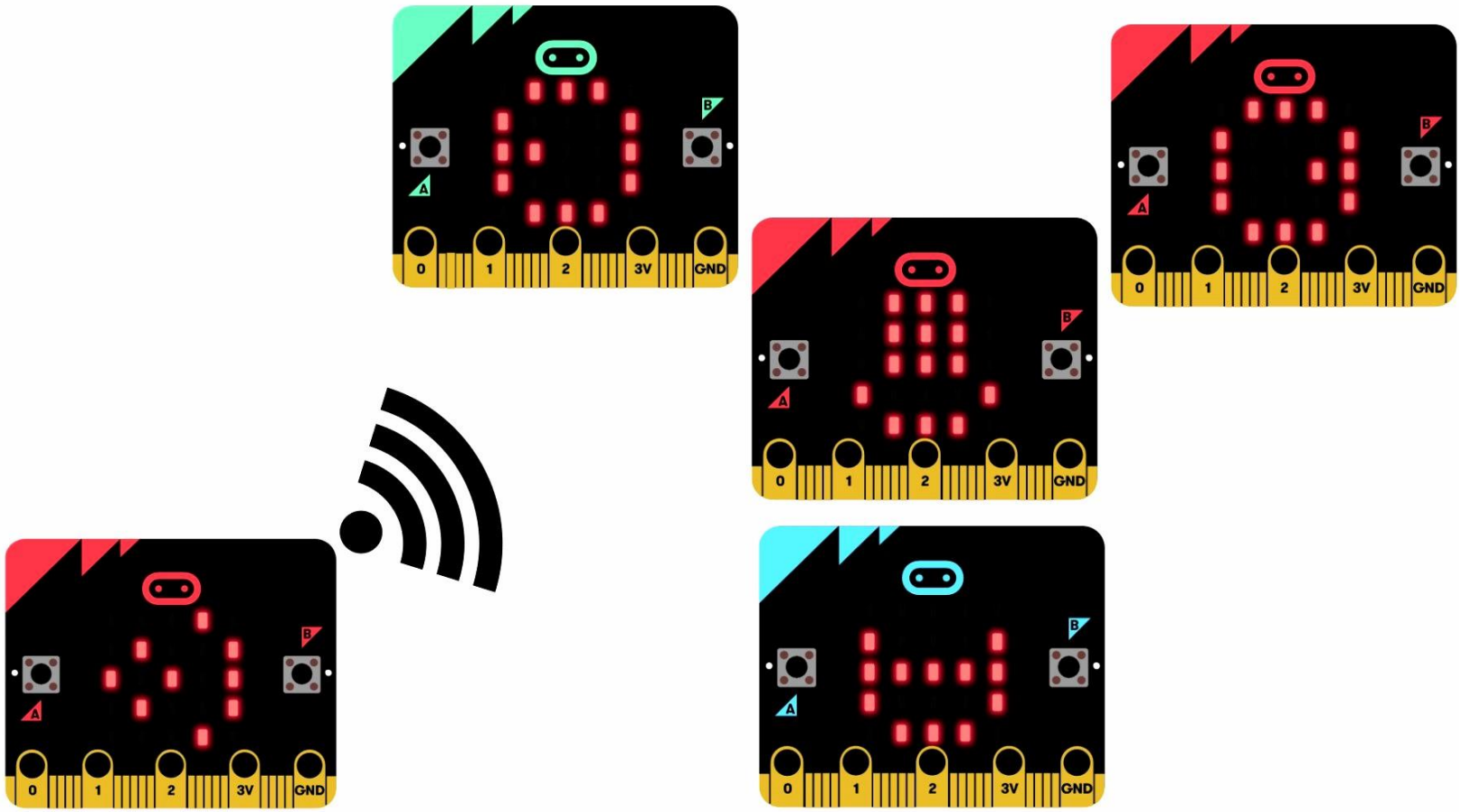
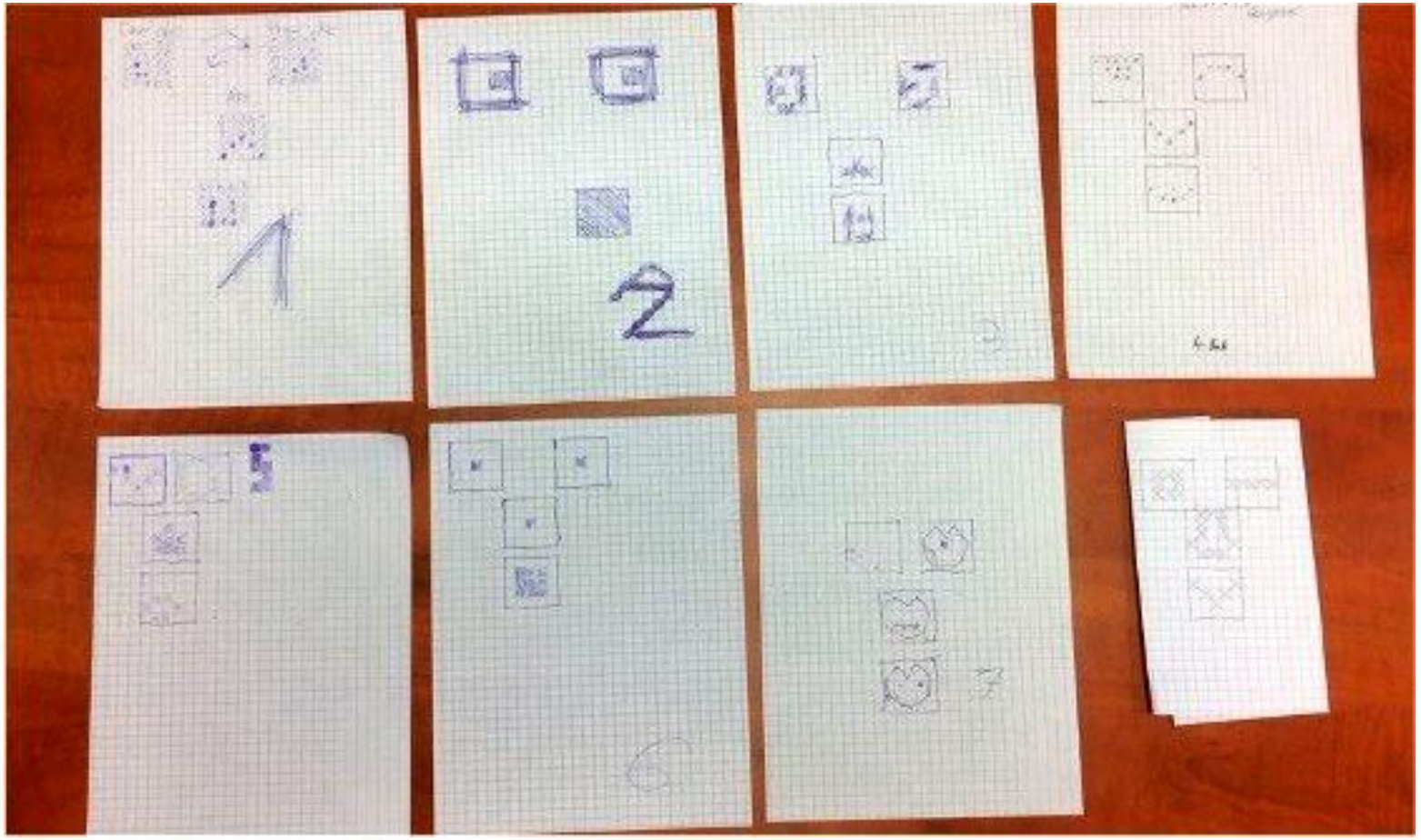
CT Project - Collaborative Smiley



Collaborative Smiley



Collaborative Smiley



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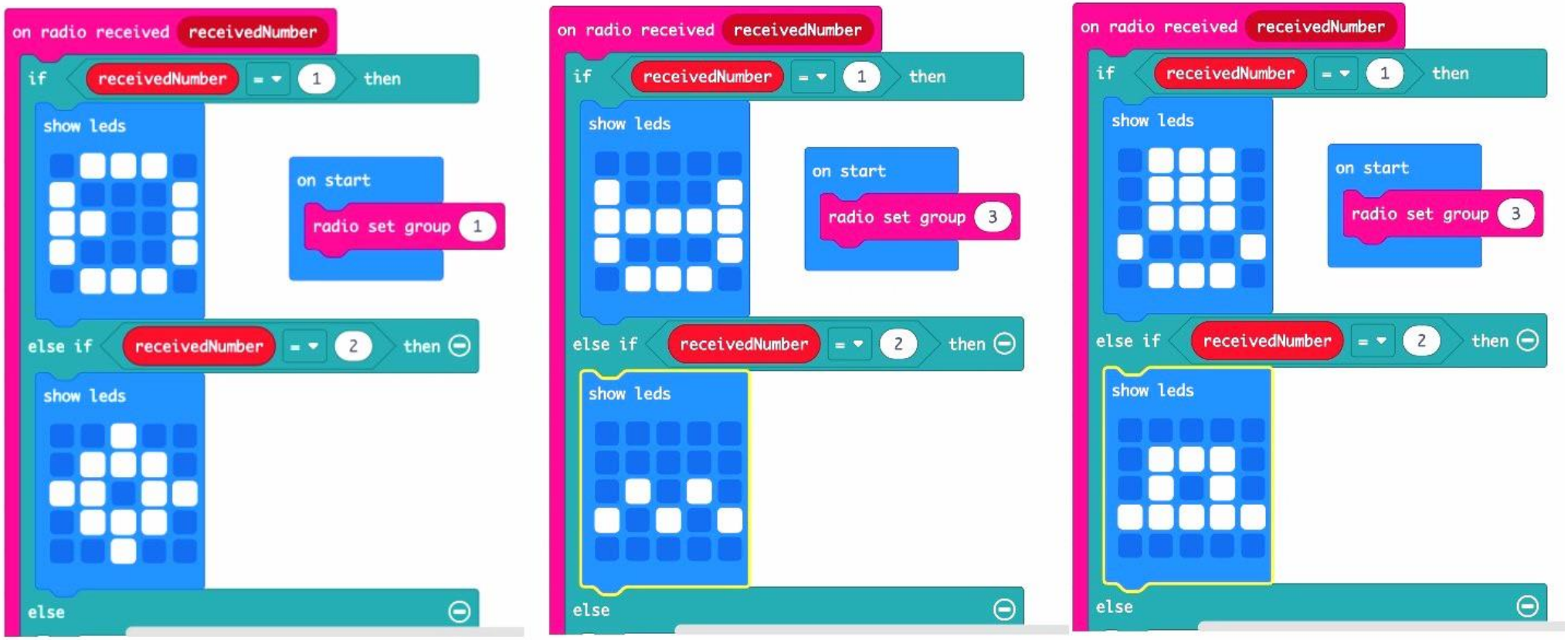
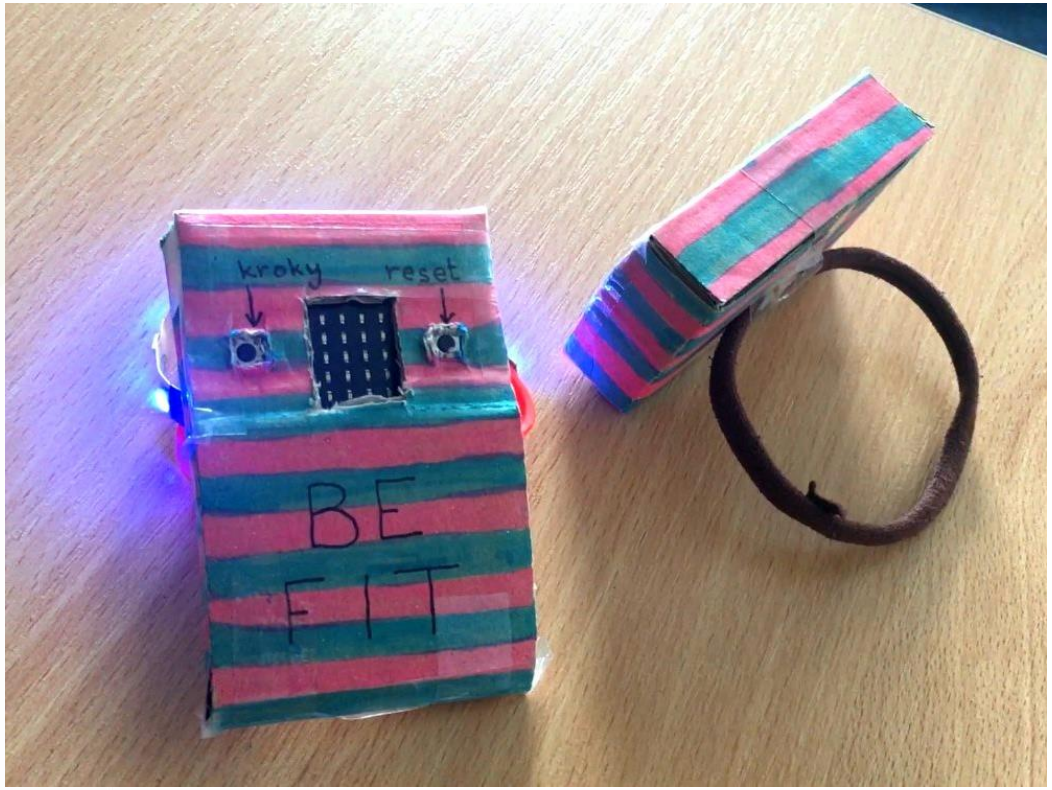
Collaborative Smiley



STE(A)M Projects

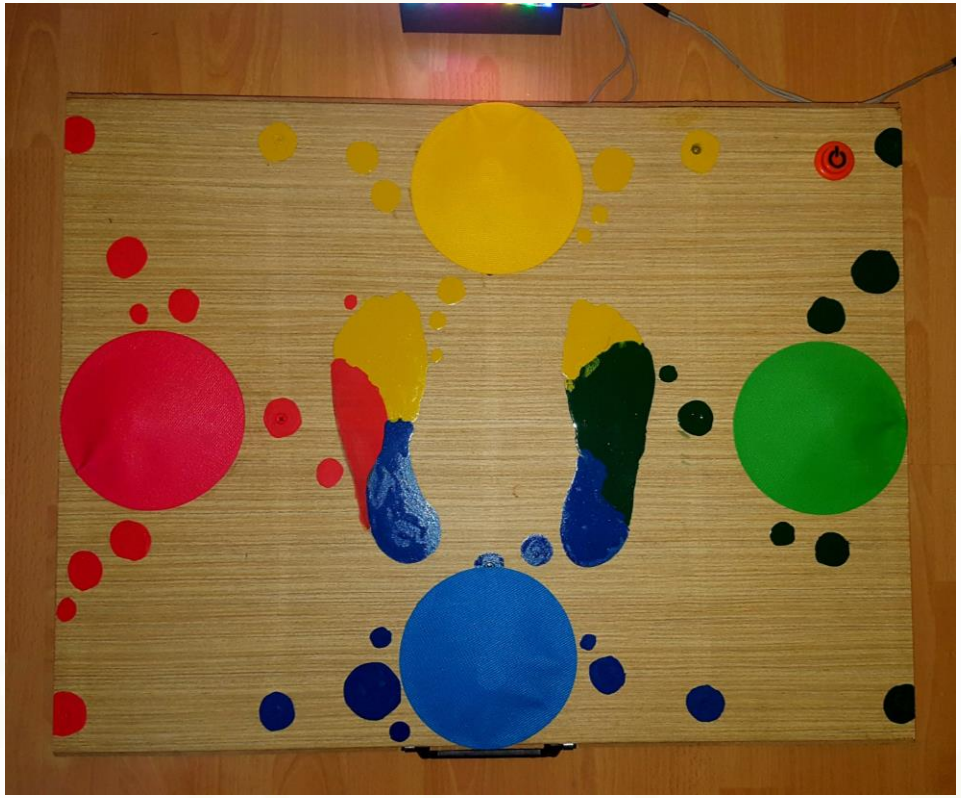
WaterBuddy

Be Fit

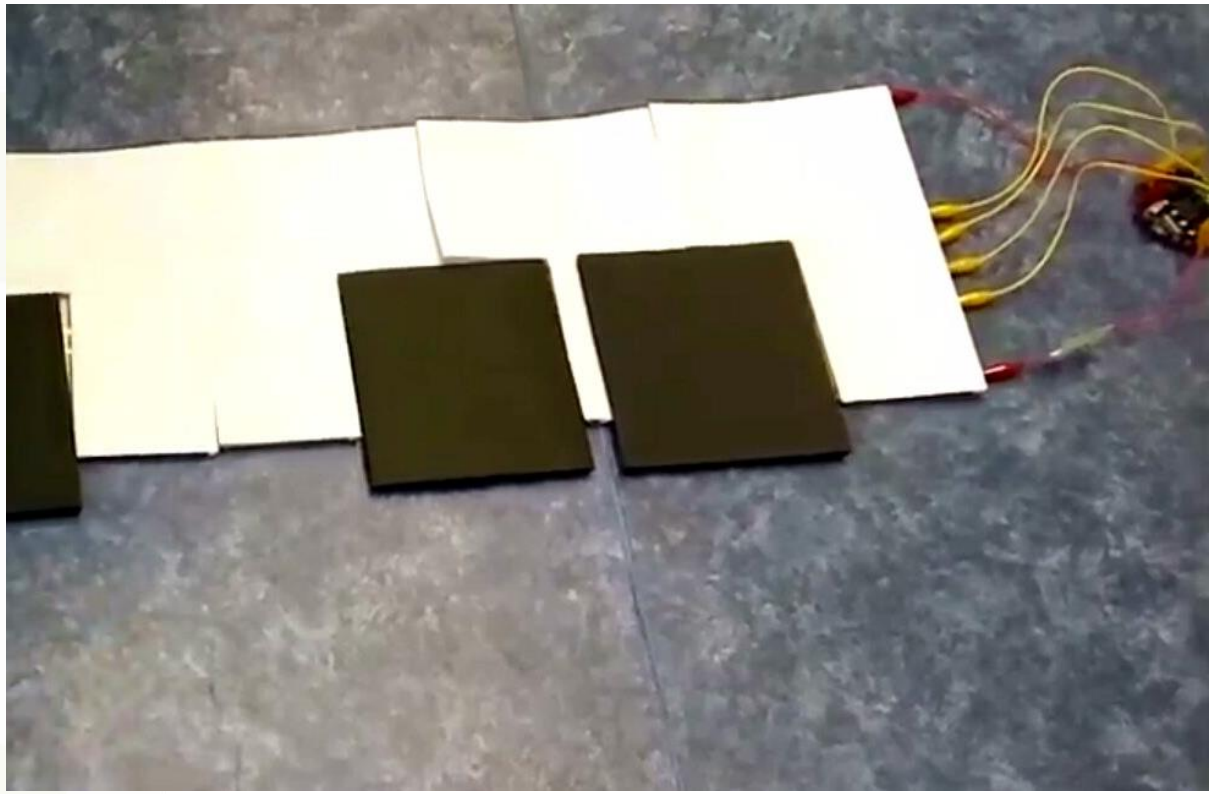


STE(A)M Projects

Color Jump

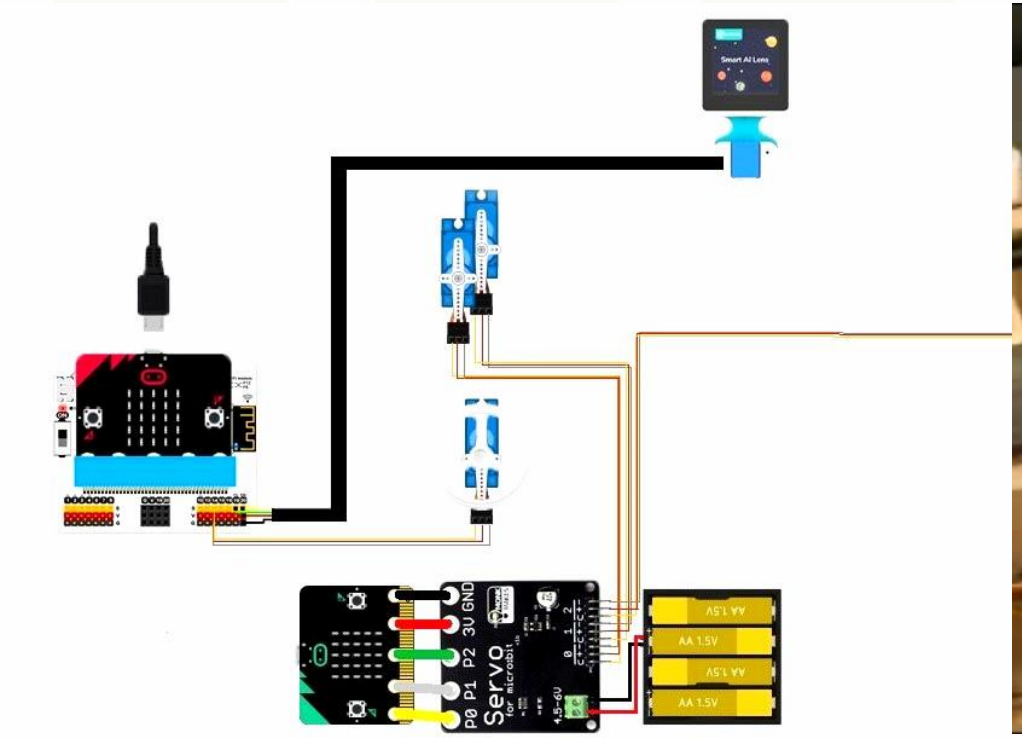


Piano



STE(A)M Projects

Sorting Machine



Thank you for your attention!

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