

Integrating multiple CT concepts and skills CT Escape room!


## Summary

This activity addresses several concepts related to Computational Thinking in the form of challenges in an Escape Room and culminates with exploring the relationship between algorithms and computer programming through giving a performance.

Target group: students in their final year of primary education, 10-12 years old

Duration: 120 minutes across two sessions. It also can be divided into smaller sessions addressing 1-2 challenges within each session.

Learning goals: The objective is to learn, in a practical and joyful way, several concepts related to Computational Thinking. Participants address five challenges and when they solve them, they are given a piece of a puzzle to use as part of the final challenge. The dynamic is structured as an Escape Room, and as well as CT-related concepts it also deals with soft skills such as logical thinking, teamwork, and time management. In the final challenge, participants explore the relationship between CT and the Arts by giving a performance.

Online/offline: offline

## Computational Thinking:

- General skills: teamwork, logical thinking, problem solving, time management.
- CT foundations: Algorithm, Decomposition, Abstraction, Pattern Recognition.
- CT concepts: binary code, programming, debugging, alternative sentence, repetitive sentence, sequences, coding and decoding


## Materials:

- Templates that include the activities. One activity is described on each sheet so that the challenges can be given one by one to the group. This is why it is provided for like this in the activity guide.
- Pencils and erasers
- Timer to show how long is left to solve the challenges


## Preparation

Divide the whole group into smaller groups comprising 4 to 8 participants.
Each group must play in a separate room along with a copy of all the materials needed for the session.

## Get the pieces of the puzzle...and discover the surprise!

## Introduction (5 min)

Explain to the students that they are in an Escape Room, and that they need to solve five challenges related to Computational Thinking to achieve the final surprise. They must think about strategies, teamwork, decision-making mechanisms and time management to get all of the pieces on time.

After solving each challenge, the students get one piece of the final puzzle. There are three puzzles that can be divided into three Escape Rooms. If the number of rooms is different to this, then the teacher can opt for a different distribution, whilst ensuring that at the end all of the pieces of the puzzle have been distributed amongst the participants.

Description of the lesson (45-60 min)
CHALLENGE 1 - PROGRAMMING TO CREATE A GRAPH
Using the arrows in the table, create the correct program to make this graph.


| Move a box to the right | Move a box to the left | Move a box up | Move a box down | Paint |
| :---: | :---: | :---: | :---: | :---: |
| $\rightarrow$ | $\leftarrow$ | $\uparrow$ | $\downarrow$ |  |

V
This symbol indicates the starting point and direction of the program.

Write below your program instructions in order (from left to right, and from top to bottom:)

|  |  |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Setting a time limit for each challenge and showing it to the participants on a timer increases the tension $\because$ Adjust the time to fit the number of participants in the group and their age and skills.

CHALLENGE 2 - COUNTING IN BINARY

This table shows how binary code works. Based on the values in the first examples, fill in the last rows:
$\left.\begin{array}{|c|c|c|c|c|c|c|}\hline \because: \% \\ \hdashline \because: 0\end{array}\right)$

CHALLENGE 3 －PROGRAMMING TO GET THE ASTRONAUT TO THE GOAL

Write the program that helps the astronaut to reach their target．We provide you with the beginning of the program．
$\left.\begin{array}{|c|c|c|c|}\hline \text { Starting position } & \text { Instructions available } & \text { First instructions } \\ \text { You can only use } 8 \text { blocks }\end{array}\right]$

You must decode the following message．There is one letter for each row．Follow the steps below：

1．Get the binary number and write it close to each row（e．g．00001）．
2．Find the corresponding decimal value（e．g．1）．
3．Find the letter in the table（e．g．A）．

Compose the message using all the letters．

Message：


Decoding table：

| 1 | 2 | 3 | 4 |  | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| a | b | C | ch |  | d | e | f | 9 | h | i | j | k | 1 | II |  |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |  |
| m | n | กี | 0 | P | 9 | r | S | t | U | V | w | X | $y$ | z |  |



## CHALLENGE 5 - CODING IMAGES

The $\mathbf{a}$ letter in a computer, if you zoom in on the pixels, can be seen as:


It can be coded using numbers as follows:

- The first number indicates the number of white boxes in a row.
- The following number indicates the number of black boxes in a row.
- Repeat the process until you reach the end of the sequence in each row.
- Exception: when a row begins with a black box, it starts with a zero (0); then, the number indicates how many zeros there are in a row.


Write a letter (i.e. R) and codify it with numbers:


Now, do the opposite exercise, which involves getting the image from the given sequence of numbers:


6, 5, 2, 3
$4,2,5,2,3,1$
3, 1,9,1,2,1
3.1.9.1, 1, 1

2, 1, 11, 1
$2,1,10,2$
2, 1, 9, 1, 1, 1
2, 1, $, 1,2,1$
2, 1, 7, 1, 3, 1
$1,1,1,1,4,2,3,1$
$0,1,2,1,2,2,5,1$
$0,1,3,2,5,2$
$1,3,2,5$

## Conclusion ( 10 min )

Within this activity numerous concepts related to Computational Thinking have been introduced in a playful way and related to the arts. Also, CT foundations and transversal skills have been applied to solve these challenges. At the end, the students can complete a choreography described via an algorithm.

We recommend that the teacher review with the students the CT concepts they have learned, the CT foundations they have applied, and the transversal skills required to deal with all the challenges in the activity.

To extend the activity, the teacher could also propose a new challenge to the class: design a small theatre play and design an algorithm for each profile (e.g., different characters, lighting, music, set designer, etc.).


Appendices

Appendix 1: worksheet - challenge 1

The challenge:


The potential instructions:

| Move a box to the right | Move a box to the left | Move a box up | Move a box down | Paint |
| :---: | :---: | :---: | :---: | :---: |
| $\rightarrow$ | $\leftarrow$ | $\uparrow$ | $\downarrow$ |  |

Write here your program (sequence of instructions in order), from left to right, and from top to bottom:

|  |  |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Worksheet - challenge 2
$\left.\begin{array}{|c|c|c|c|c|c|c|}\hline: \because:: \\ \because: \%\end{array}\right)$

Worksheet - challenge 3

| Starting position | Instructions available | First instructions <br> You can only use 8 blocks |
| :---: | :---: | :---: |
|  | move forward <br> turn left $\cup$ - <br> turn right $\circlearrowright$ <br> repeat until $P$ <br> do $\square$ | move forward <br> turn left S - |
|  | move forward <br> tum left $0^{\text {. }}$ <br> tum right 0 <br> repeat until $P$ <br> do $\square$ <br> if path to the left $\cup$. do $\square$ |  |

## Worksheet－challenge 4

The message：


Decoding table：

| 1 | 2 | 3 | 4 |  | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| a | b | c | ch |  | d | e | f | 9 | h | i | j | k | I | II |  |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |  |
| m | n | กี | $\bigcirc$ | p | 9 | r | $s$ | t | u | v | w | $\times$ | y | z |  |

## Worksheet - challenge 5

Write a letter (i.e., R) and codify it with numbers:

|  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

$\square$

Now, do the opposite exercise, which involves getting the image from the given sequence of numbers:

$6,5,2,3$
$4,2,5,2,3,1$
3, 1,9,1,2,1
3, 1,9.1,1,1
$2,1,11,1$
$2,1,10,2$
$2,1,9,1,1,1$
$2,1,6,1,2,1$
$2,1,7,1,3,1$
$1,1,1,1,4,2,3,1$
$0,1,2,1,2,2,5,1$
$0,1,3,2,5,2$
$1,3,2,5$

Appendix 2 - puzzle given to students after solving each challenge.

Clapping (each row is provided after solving one of the challenges in the Escape Room):

| 1 | $X$ | $X X$ | $X$ | $X X$ | $X$ | $X X$ | - |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $X X X$ | $X X$ | $X X X$ | $X$ | $X X X$ | $X X$ | $X$ |
| 3 | $X$ | $X X$ | $X X X$ | $X$ | $X X$ | $X X X$ | $X$ |
| 4 | $X X$ | $X$ | Rep 3 times: | $X$ | $X X$ | End-rep | $X$ |
| 5 | Rep 2 times: | $X$ | $X X$ | $X X X$ | End-rep | $X X$ | $X$ |

X-big clap
x-small clap

Movement (each row is provided after solving one of the challenges in the Escape Room):

| 1 | e) | $4$ |  |  | $4$ | $\square$ | $\square$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $4$ | e) | $4$ |  | (0) | $\square$ | $4$ |
| 3 | © |  |  |  |  | $4$ | (0) |
| 4 | (0) | $4$ | Rep 3 times: |  |  | End-rep |  |
| 5 | Rep 2 times: |  | U |  | End-rep |  |  |

Lighting (each row is provided after solving one of the challenges in the Escape Room):

| 1 |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 |  |  | - |  |  | -- |  |
| 3 |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |
| 5 | Rep 2 times: |  |  |  |  |  |  |

Appendix 3: solutions
CHALLENGE 1


| Move a box to <br> the right | Move a box to <br> the left | Move a box up | Move a box <br> down | Paint |
| :---: | :---: | :---: | :---: | :---: |
| $\rightarrow$ | $\leftarrow$ | $\uparrow$ | $\downarrow$ |  |

Write here your program instructions in order (from left to right, and from top to bottom). There are multiple solutions, including this one:

| $\rightarrow$ | $\rightarrow$ |  | $\rightarrow$ | $\rightarrow$ | $\downarrow$ |  | $\leftarrow$ |  | $\leftarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\downarrow$ | $\square$ | $\downarrow$ |  | $\downarrow$ |  | $\leftarrow$ |  | $\leftarrow$ |  |
| $\uparrow$ |  | $\uparrow$ |  |  |  |  |  |  |  |

CHALLENGE 2

| : $:: 7:$ | ! | - | $\square$ | $\bullet$ | Binary number | Decimal number |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0 | 0 | 0 | 1 | 1 | 00011 | 3 |
| 0 | 1 | 0 | 0 | 1 | 01001 | 9 |
| 1 | 1 | 0 | 1 | 0 | 11010 | 26 |
| 0 | 0 | 0 | 0 | 1 | 00001 | 1 |
| 0 | 0 | 1 | 0 | 1 | 00101 | 5 |
| 0 | 1 | 1 | 0 | 1 | 01101 | 13 |
| 0 | 1 | 0 | 1 | 1 | 01011 | 11 |


| 1 | 0 | 1 | 0 | 1 | 10101 | 21 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

CHALLENGE 3

| Starting position | Instructions available | First instructions You can only use 8 blocks |
| :---: | :---: | :---: |
|  | move forward <br> turn left $\cup$. <br> turn right $U$ <br> repeat until $\rho$ <br> do $\square$ |  |
|  | move forward <br> tum left U : <br> tum right $U$. <br> repeat until $\rho$ <br> do <br> if path to the left $\cup$ : do $\square$ |  |

## CHALLENGE 4

Message：


## CHALLENGE 5

Write a letter (i.e. R) and codify it with numbers:


| 042 |
| :--- |
| 01311 |
| 0141 |
| 01311 |
| 042 |
| 01113 |
| 01212 |
| 01311 |
| 0141 |

Now, do the opposite exercise, which involves getting the image from the given sequence of numbers:

$6,5,2,3$
$4,2,5,2,3,1$
3, 1,9,1,2,1
3.1.9.1,1.1
$2,1,11,1$
$2,1,10,2$
$2,1,9,1,1,1$
$2,1,6,1,2,1$
$2,1,7,1,3,1$
$1,1,1,1,4,2,3,1$
$0,1,2,1,2,2,5,1$
$0,1,3,2,5,2$
$1,3,2,5$


## Colophon

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