

Why is this interesting?
Or:
What is Computational Thinking and
what is <colette/>?

Rebecca S. Stäter & Tim Läufer

Agenda

<colette/>

What is Computational
Thinking (CT)?

<ct/>

<colette/>



App



Web Portal



Didactic
Content



Teacher
Training

What is Computational Thinking?

„[Computational Thinking] represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use.”

(Wing, 2006)

Computational Thinking is a thought process used in formulating a given problem and its solution in a helpful way.

Solutions can be represented in a form that can be carried out by an information-processing agent.

This information-processing agent does not have to be a computer but can be a human as well.

(Cuny et al., 2010)

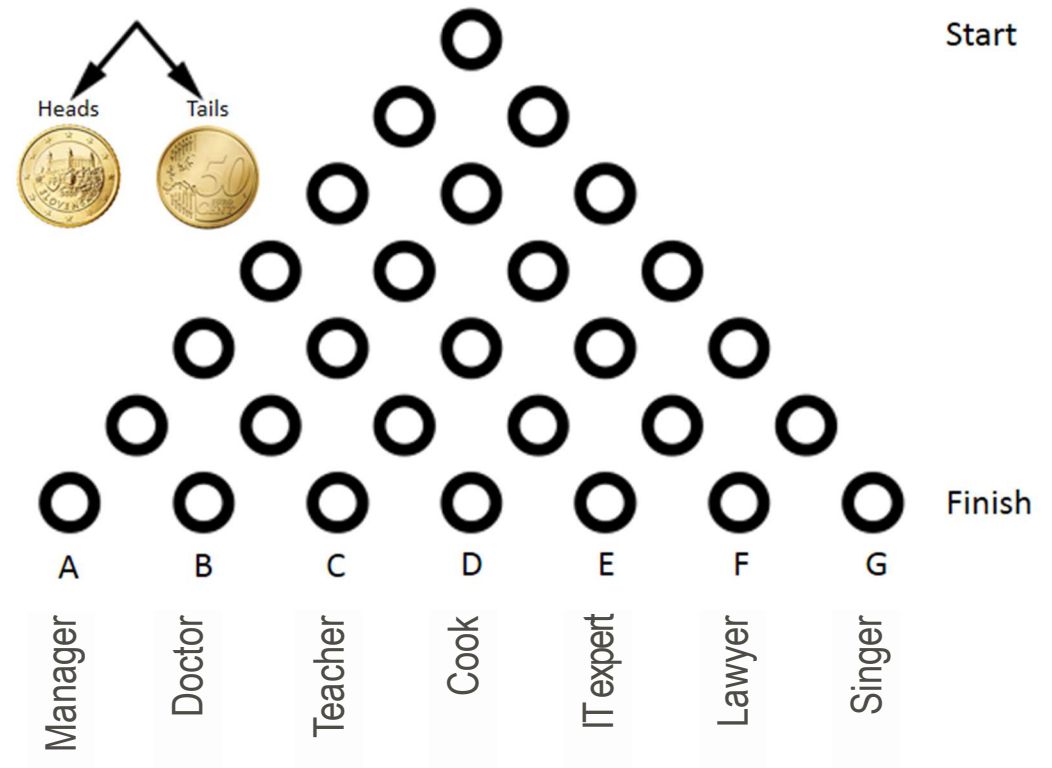
Toss a coin

I suppose you have a coin in your wallet. You can use it to foretell your future career with the board to the right.

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?

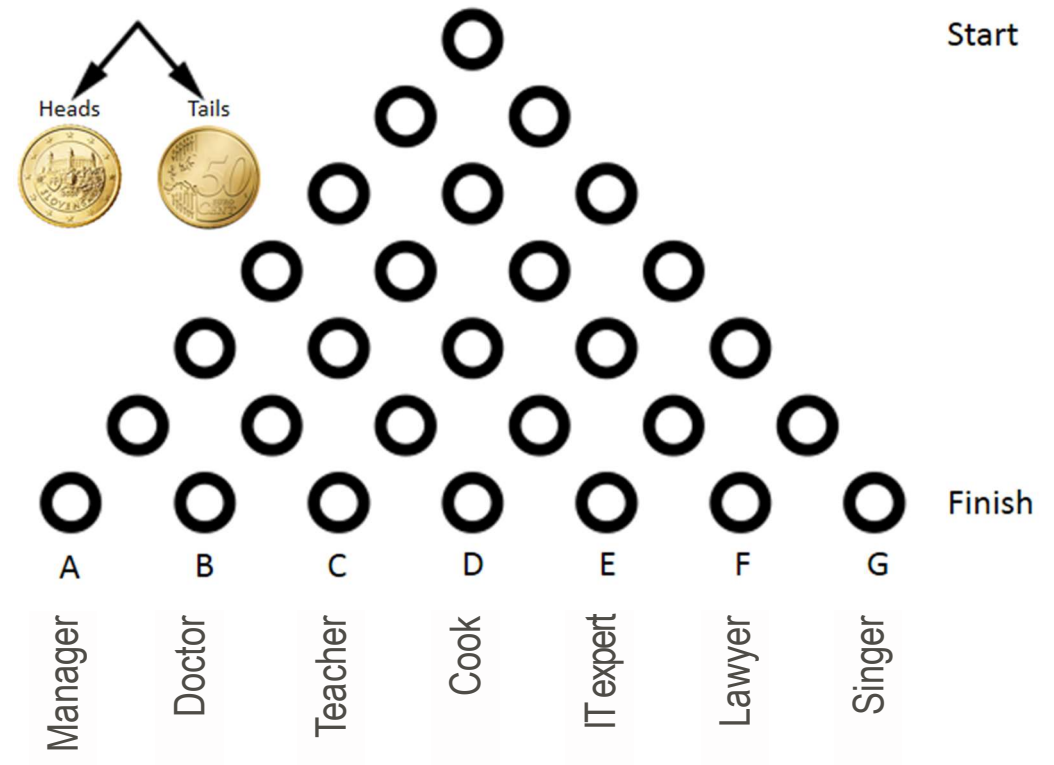


Try it again

Are you not satisfied with the profession that the magic board foretold to you?

Try it again:

- Use a table 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?



Representations

Which representation have you chosen? Why?

left, right, right, left, left, right, right

L, R, R, L, L, L

T H T T H T

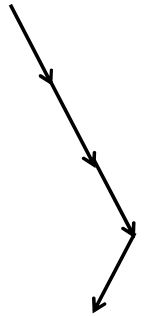
↙ ↘ ↘ ↘ ↙ ↘

>><<><

tail, head, head, tail, head, head

4T, 1H, 1T

3right, 1left, 2right

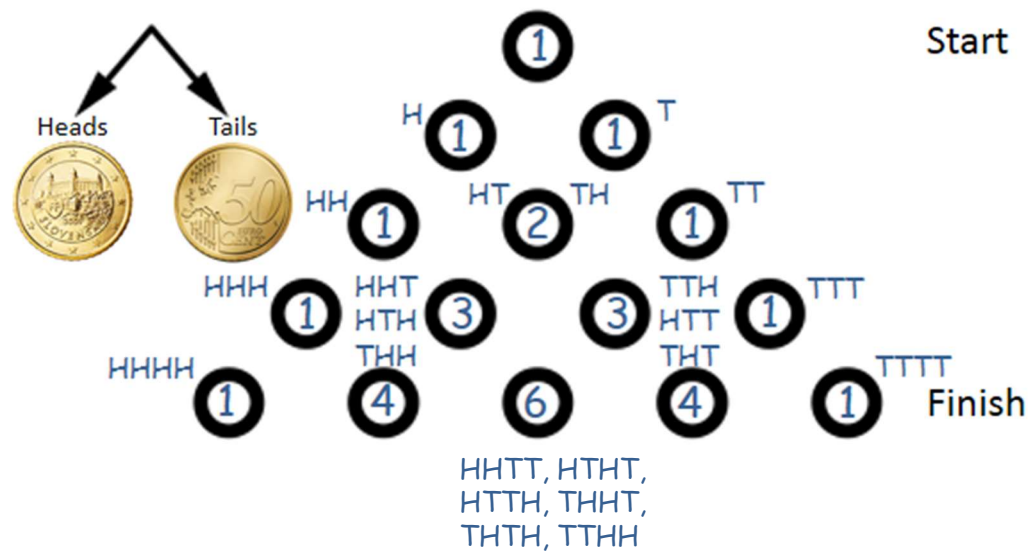


Which representation would you choose to explain your route to somebody else?

Which representation would you choose to work with a computer?

Describing procedures as algorithms

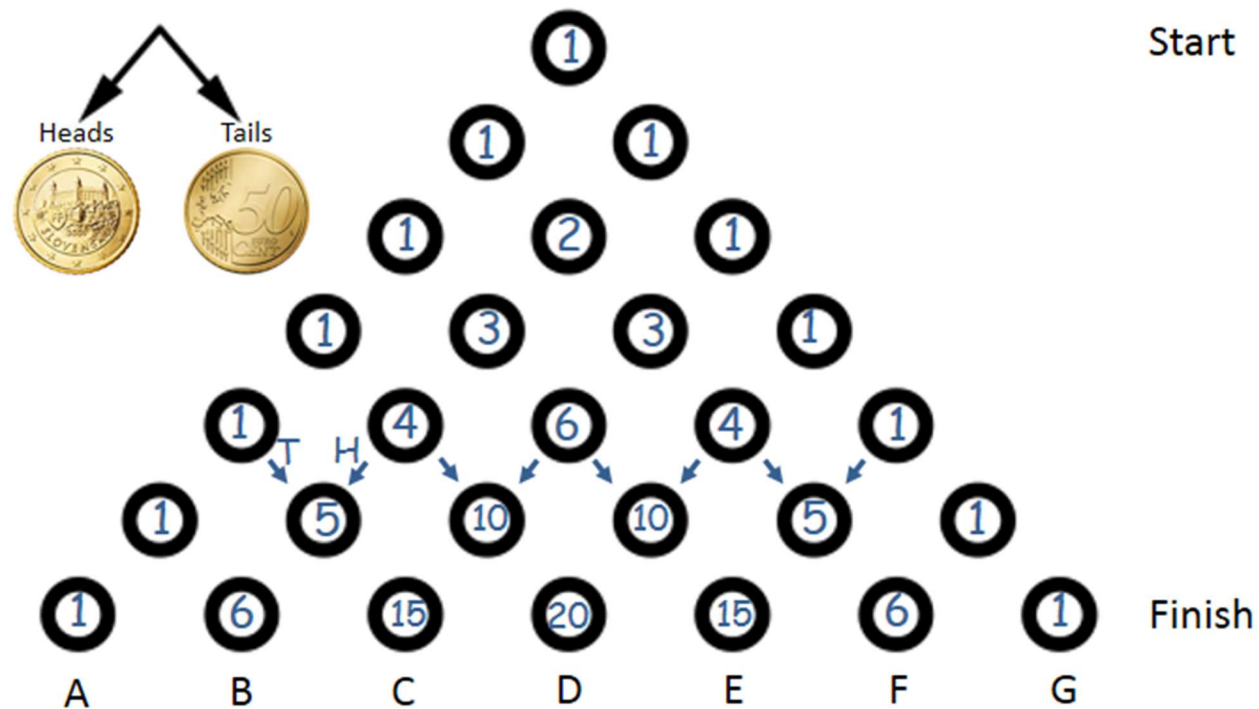
Describe the procedure to list all the possible ways to a particular point.



Is it suitable for the use of computer?

Recognising patterns

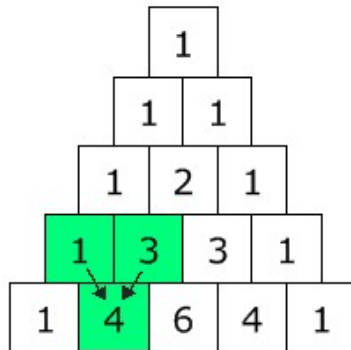
Can you calculate the number of ways to a particular place based on the previous line?



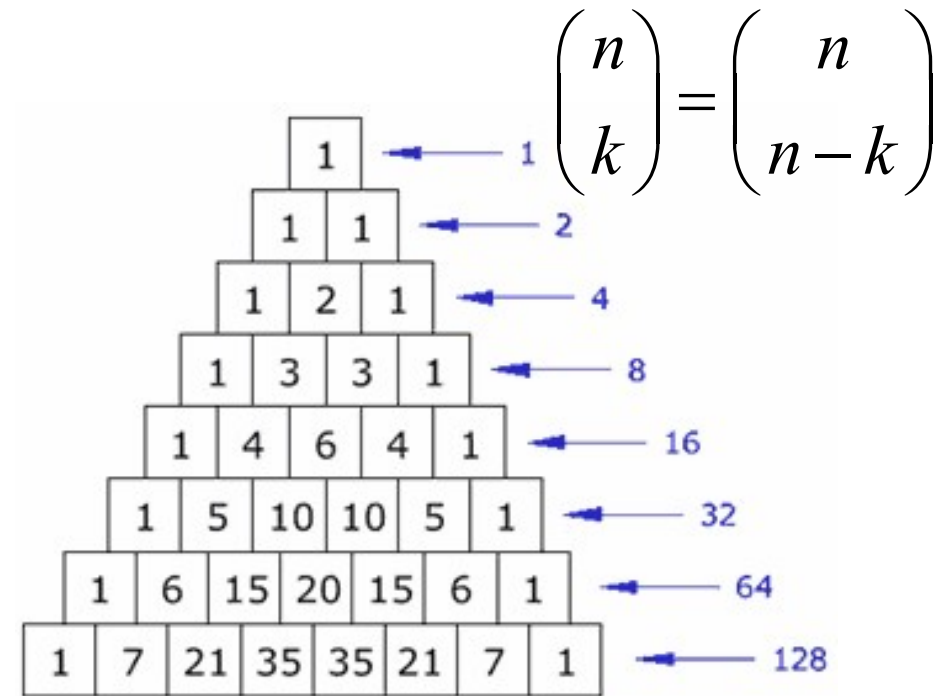
Some mathematical relations found

<colette/>

$$C_k(n) = \binom{n}{k} = \frac{n!}{k!(n-k)!}$$



$$\binom{n}{k} + \binom{n}{k+1} = \binom{n+1}{k+1}$$

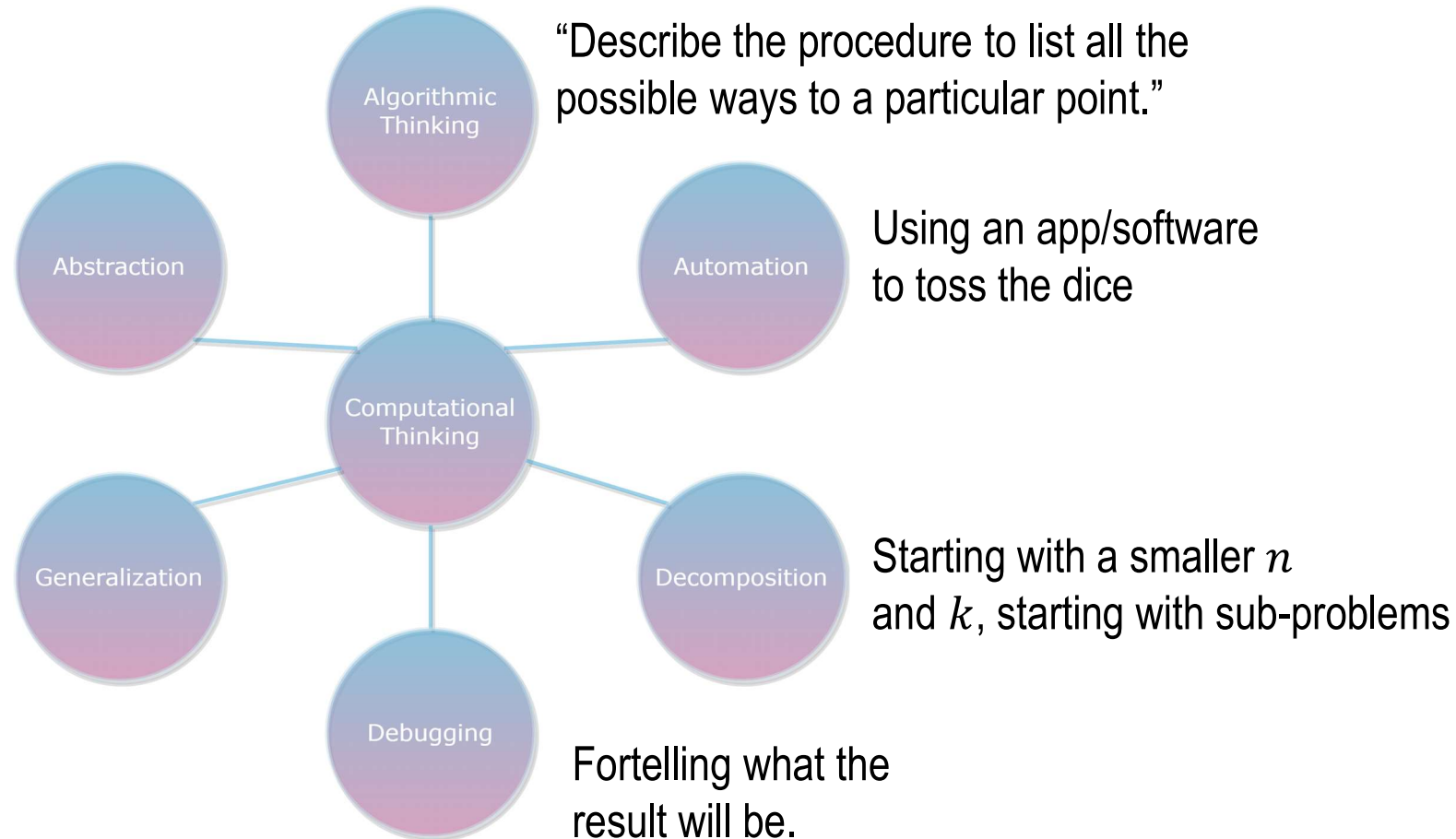


$$\binom{n}{0} + \binom{n}{1} + \dots + \binom{n}{n} = \sum_{k=0}^n \binom{n}{k} = 2^n$$



The Computational Thinking Skills

Working with
different representations



(Bocconi et al., 2016)

Computational Thinking is being taught

<colette/>

Computational Thinking (CT) is an essential skillset for participating and shaping our increasingly digital world.

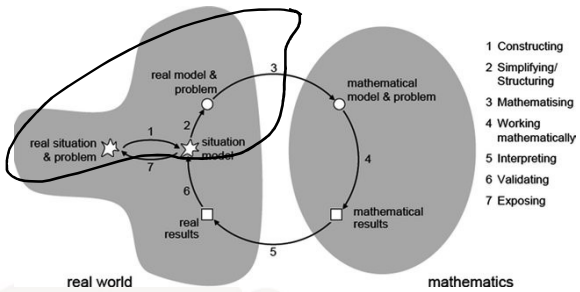
Hence, many countries have made teaching CT mandatory in one of the three ways (Bocconi et al., 2016, 2022):

1. As a cross-curricular theme
2. As part of a separate subject
3. Within other subjects

Teaching CT is often times integrated in teaching Computer Science (CS) but it should not only focus on enhancing CS skills. CT is at its core a skillset for generally solving problems.

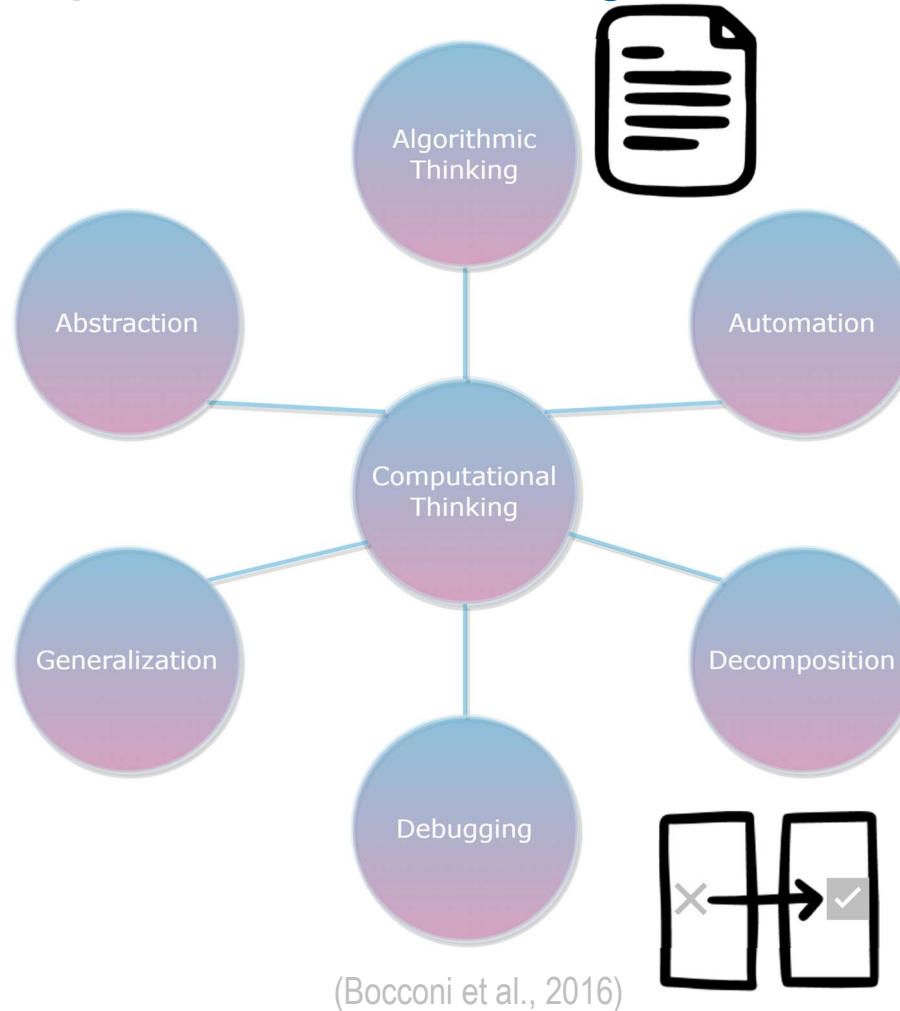
The Computational Thinking Skills & CS

<colette/>

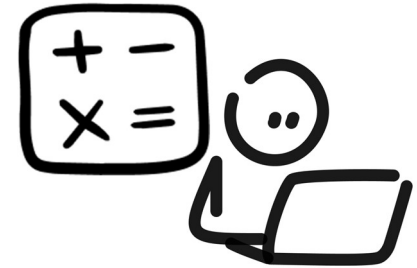


(Blum & Leiß, 2007)

$$x_{1;2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$



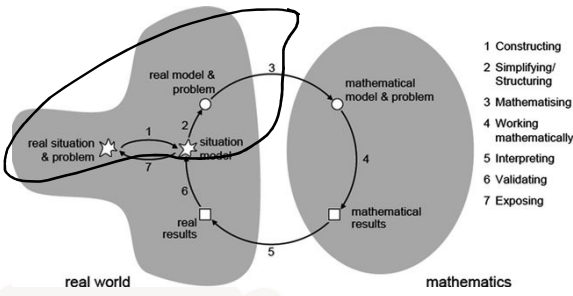
(Bocconi et al., 2016)



$$0 = xe^x - 2e^x - 2x + 4$$

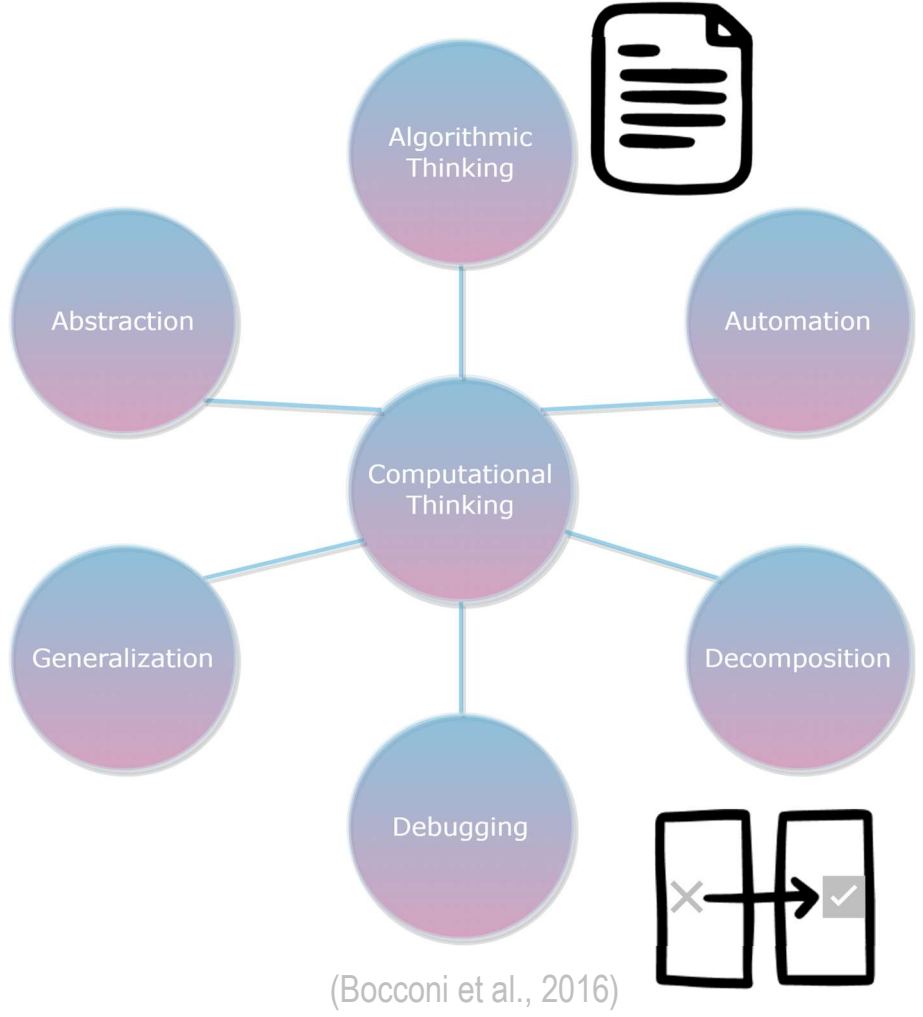
$$0 = (x - 2)(e^x - 2)$$

The Computational Thinking Skills & Maths <colette/>

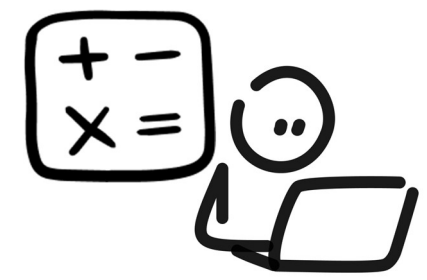


(Blum & Leiß, 2007)

$$x_{1;2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$

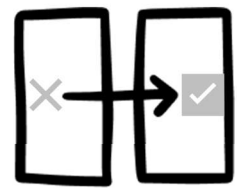


(Bocconi et al., 2016)



$$0 = xe^x - 2e^x - 2x + 4$$

$$0 = (x - 2)(e^x - 2)$$



Challenges Teaching CT

The four challenges presented were:

- competition with other curriculum priorities;
- **lack of adequately trained teachers;**
- **lack of tools and resources for teaching;**
- difficulties in assessing Computational Thinking / programming skills.

(Bocconi et al., 2022)

Agenda

<colette/>

What is Computational Thinking (CT)?

<ct/>

<colette/>

Computational Thinking Learning Environment for Teachers in Europe

App

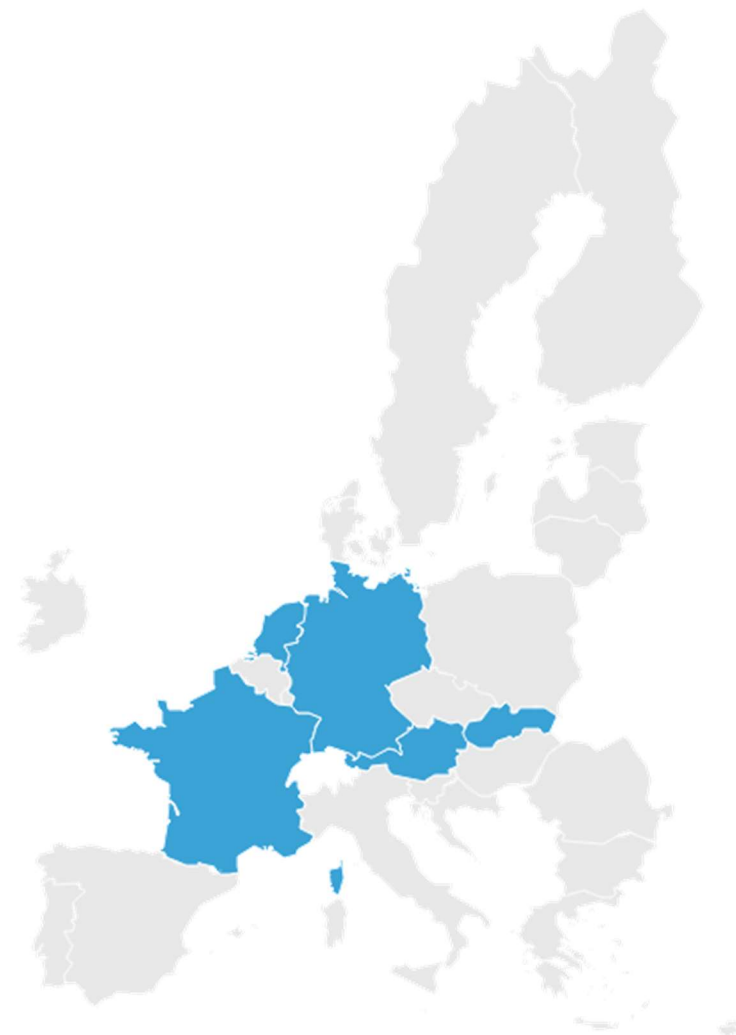
Web Portal

Didactic Content

Teacher Training

The Consortium

<colette/>



The project is (partially) funded by the Erasmus+ grant program of the European Union (2020-1-DE03-KA201-077363).

The Main Idea

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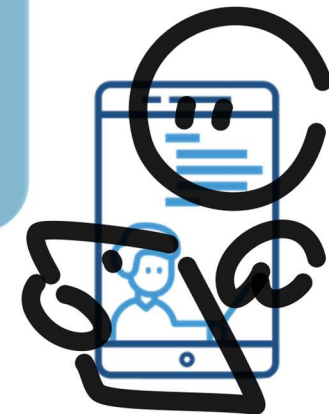
<colette/> is a twofold system: An app and a web portal.



The web portal acts as an authoring tool for the teachers to create tasks and learning paths for their students.

A learning path consists of different tasks. Students can retrieve geared hints and solutions will be given to students helping them validating their own solution.
(Roth, 2015)

The students will use the app to work on the assigned learning paths.



The Four Pillars of <colette/>

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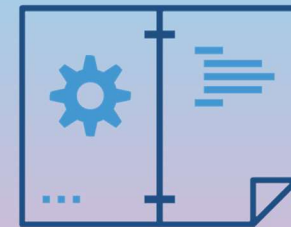
App



Web Portal



Didactic
Content



Teacher
Training

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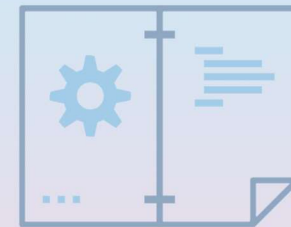
App



Web Portal



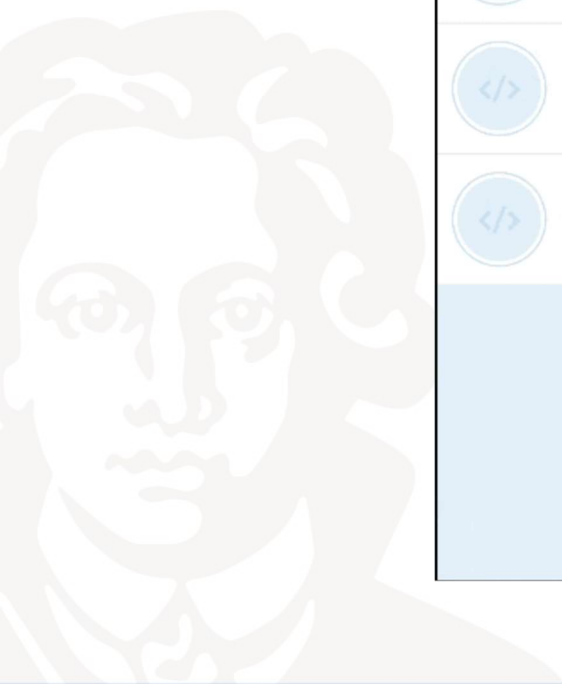
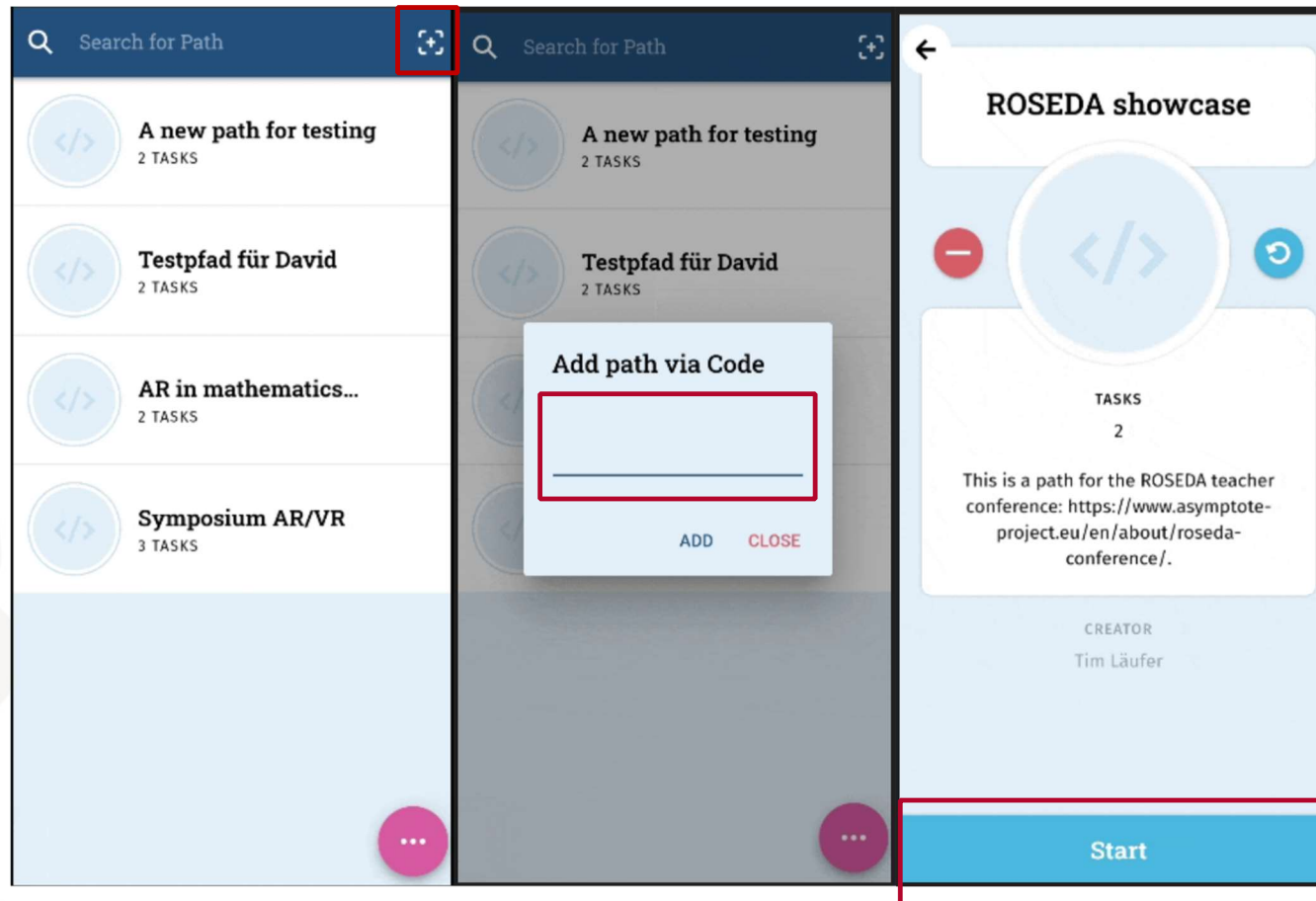
Didactic
Content



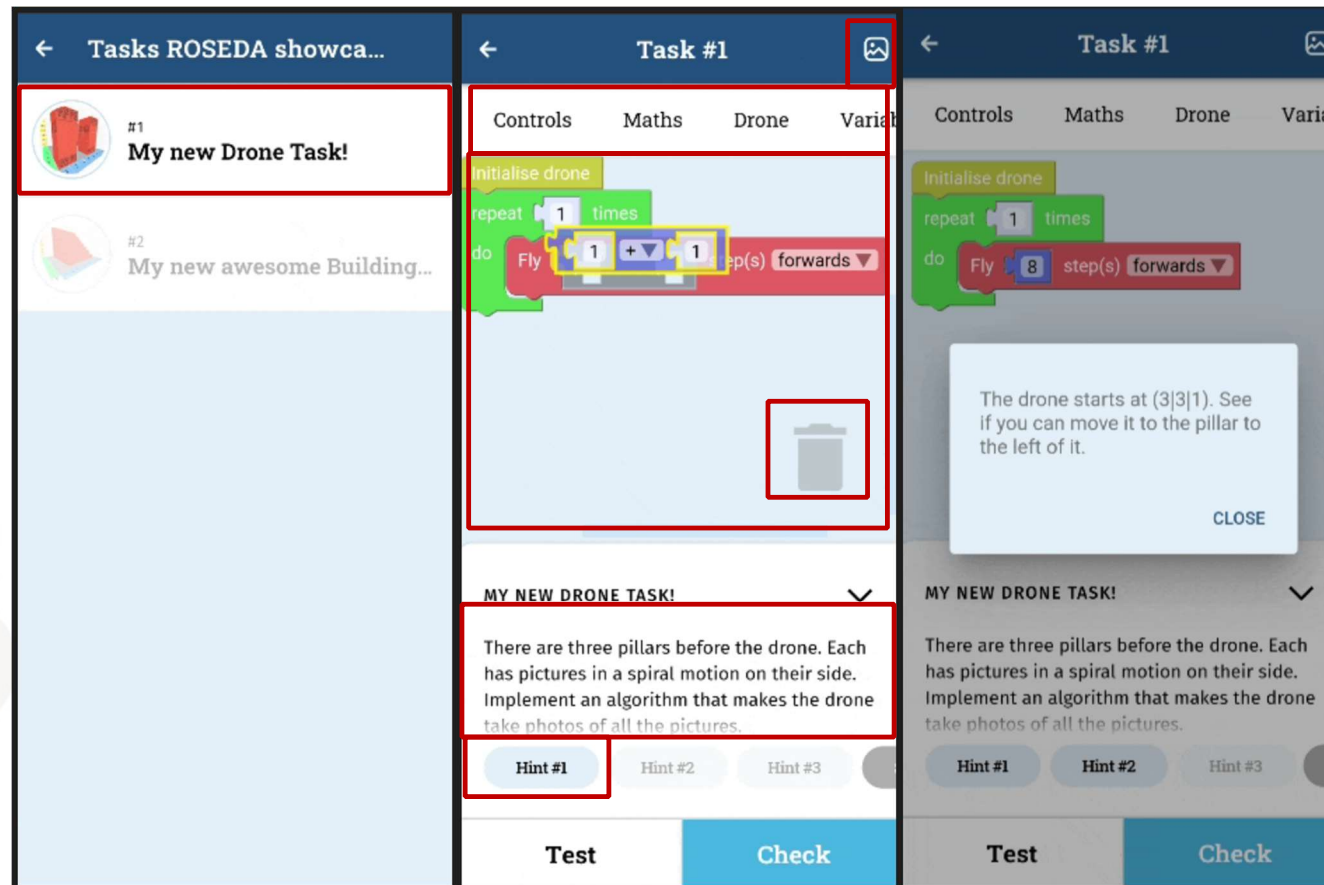
Teacher
Training

How the app works

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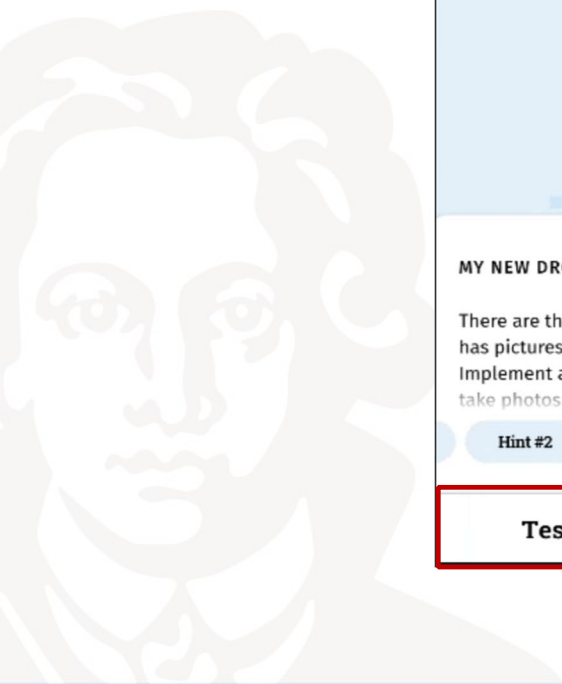
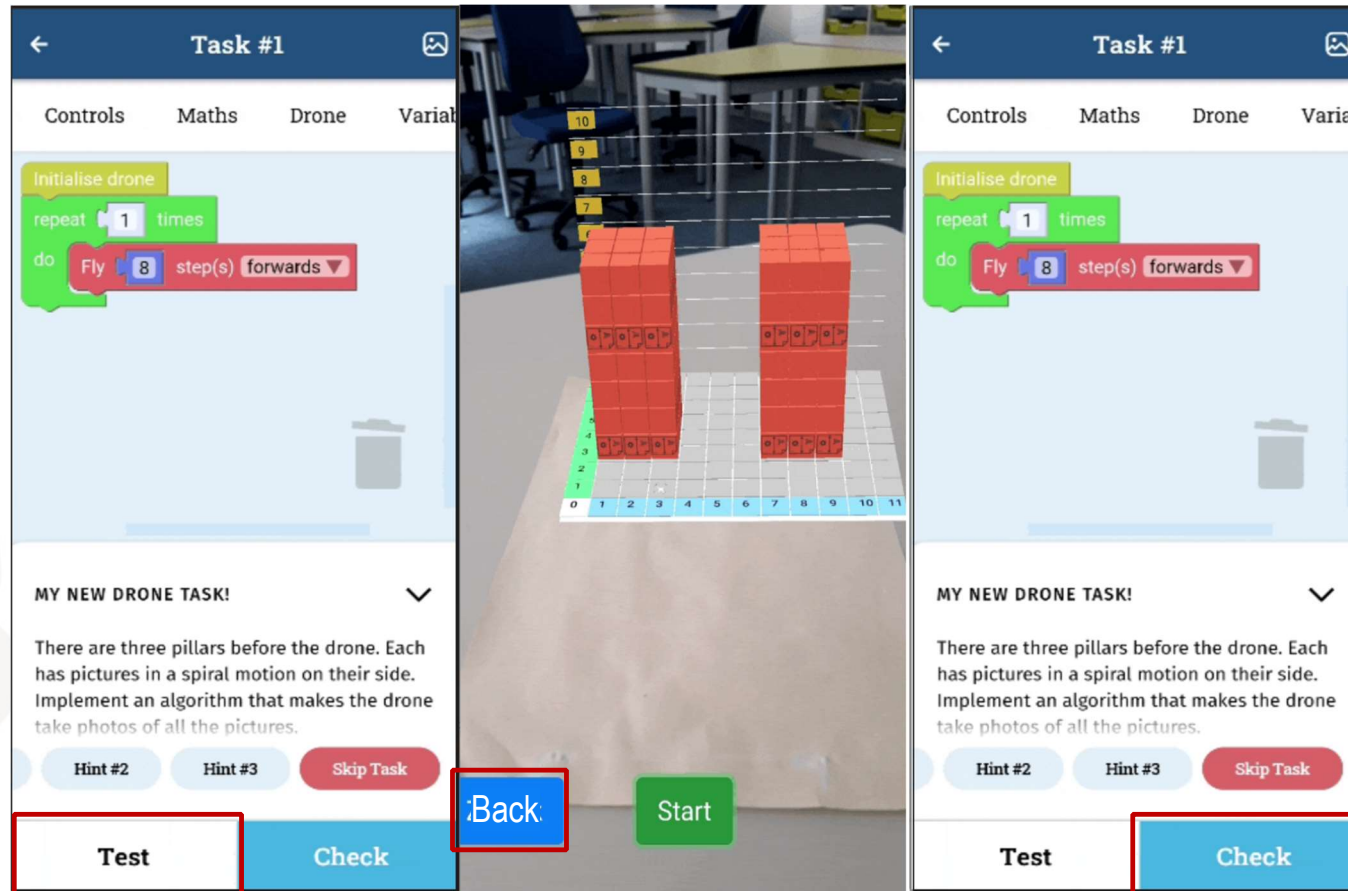


How the app works



How the app works

<colette/>



The Connection between Web Portal and App

The image displays two side-by-side screenshots illustrating the connection between a web portal and a mobile app. The left screenshot shows the web portal interface for a path titled "Symposium AR/VR". It features a 3D grid with orange blocks and a task list. A red box highlights the "Code to share with app" field containing "P9027" and a "Copy" button. A red arrow points from this code to the right screenshot. The right screenshot shows the mobile app interface. The top part displays a search for paths, listing "A new path for testing" and "Testpfad für David". A modal window titled "Add path via Code" is open, showing the code "P9027" entered into a text field, with "ADD" and "CLOSE" buttons below. The bottom part of the app shows the details of the selected path, including a "Start" button and a list of tasks: "#1 Marking the markings", "#2 The car can't stay there!", and "#3 A small step inbetween". A small icon of a smartphone is visible in the bottom right corner of the app interface.

(Läufer, et al. (to be published))

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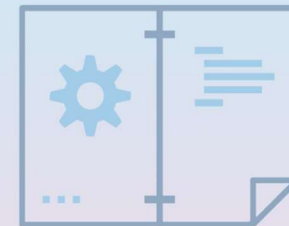
App



Web Portal



Didactic
Content



Teacher
Training



My Paths

Manage your Paths or create new ones.



My Tasks

Manage your tasks or create new ones.



Public Paths

Get inspired by Paths others have created.



Handbook

Find out more about Computational Thinking and the colette-project.



Data Protection

Inform yourself about our data protection measures.

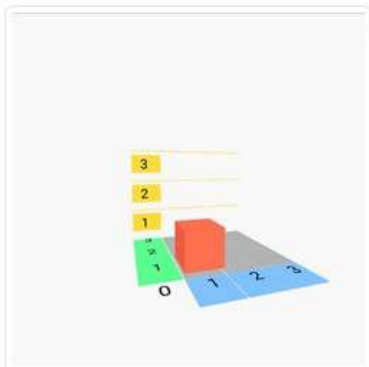


How to create a path in the web portal



Placing a cube!

Building Cubes Task



Algorithmic Thinking

Upper secondary grades

Augmented Reality

Choose what the student should do
Implementation

Show help

How to create a path in the web portal

Task Settings

Choose the scenario
Cuboid

Width *
1

Depth *
1

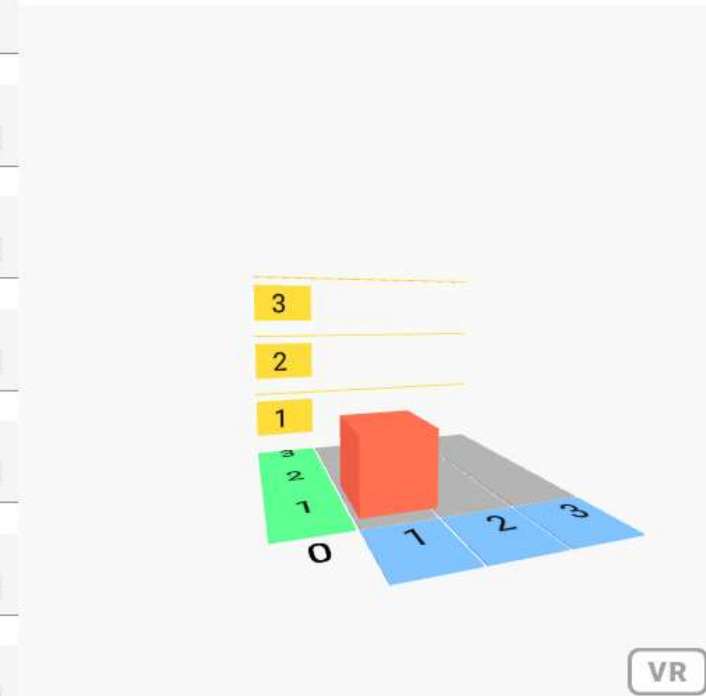
Height *
1

X Start Value *
1

Y Start Value *
1


Z Start Value *
1

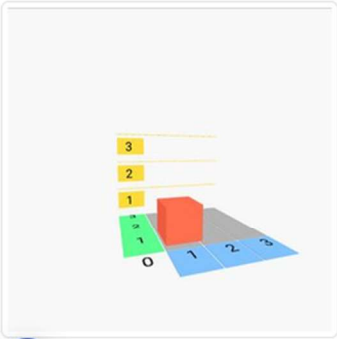
Preview




How to create a path in the web portal

Assignment Preview


Placing a cube! 



Place a cube at $X=1$, $Y=1$ and $Z=1$.


Take a Screenshot! 

Hint 1

 _____


Sketch the cuboid using cubes.

Hint 2

 _____





Think about the layers of the cuboid.

Hint 3

 _____


Three nested loops over the coordinates might be useful.

Keywords

 Algorithmic Thinking    Upper secondary grades    Augmented Reality 

Enter new keyword

Add keyword

Add to path 

Digital Classroom

<colette/>

The Digital Classroom is a tool that let's the teacher monitor the students' progress:

After joining the digital classroom the students work on an assigned path.

The teacher can

- See on what every student is working at every given moment
- See their produced code
- Give feedback through a chat

The student can

- Work on the assigned tasks
- Receive help and feedback from their teacher

Digital Classroom

← ● Currently Active

[s109] A new Digital classroom!

This is an example 3 day(s)

A	Anna Torphy	Progress	● — ● — ● — ●	TASK_SUBMIT	>
D	Dwight Rosenbaum	Progress	● — ● — ● — ●	No Event	>
E	Elvira Pacocha	Progress	● — ● — ● — ●	No Event	>
M	Marie Dach	Progress	● — ● — ● — ●	No Event	>
R	Randal Cole	Progress	● — ● — ● — ●	TASK_LEAVE	>

Anna Torphy

Event Filter TASK_SUBMIT

T TASK_SUBMIT
22.05.2023 09:28 Give Feedback



Task 1: Attempt: 2 ✓
Something with a building cubes problem

<> Show Blockly Code

```
When "Run" is clicked
set height to 5
set depth to 5
set width to 5
set startX to 3
set startY to 3
set startZ to 3

count with x from 0 to width - 1 by 1
do
  count with y from 0 to depth - 1 by 1
  do
    count with z from 0 to height - 1 by 1
    do
      if x = 0 or x = width - 1
      do
        Set red block at x: startX + x, y: startY + y, z: startZ + z
```

Chat

Message  

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App



Web Portal



Didactic
Content



Teacher
Training

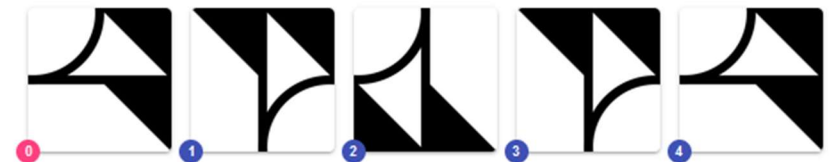
Building Cubes

CT skills: Pattern recognition, Generalization

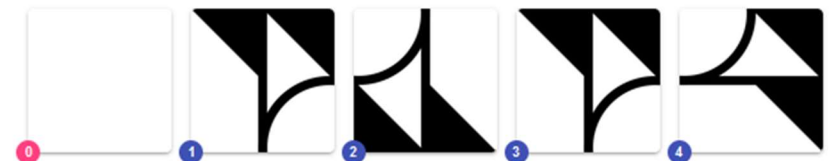
Possible scenarios:

- Geometric progression: $a_n = a \cdot q^{n-1}$
- Arithmetic progression: $a_n = a_1 + (n - 1) \cdot d$
- Tile patterns (Truchet tiling)

Solution



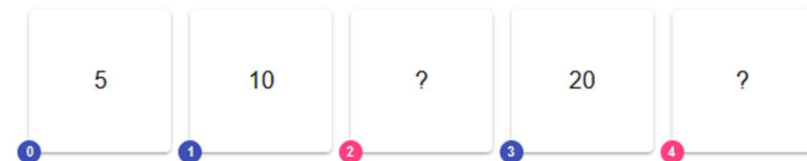
Problem



Problem



Problem



Drone

CT skills: Pattern recognition, Generalization

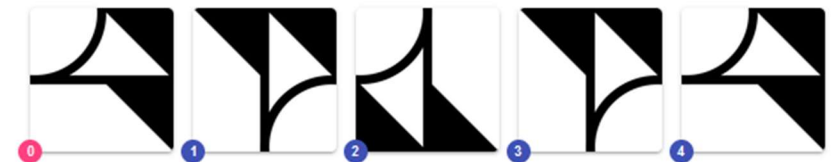
Possible scenarios:

- Geometric progression: $a_n = a \cdot q^{n-1}$
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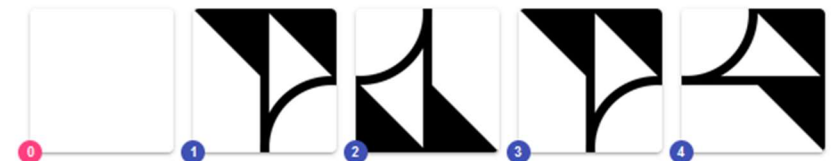
Problem



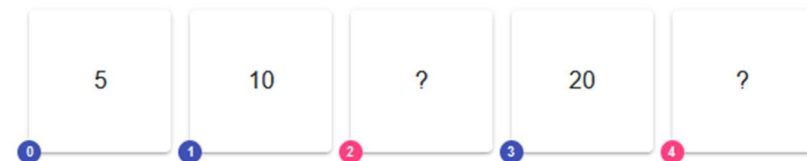
Solution



Problem



Problem



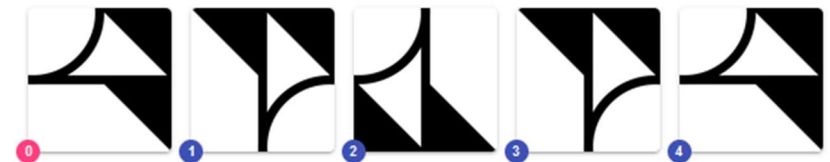
Patterns

CT skills: Pattern recognition, Generalization

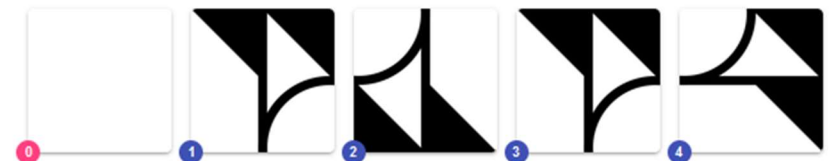
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Solution



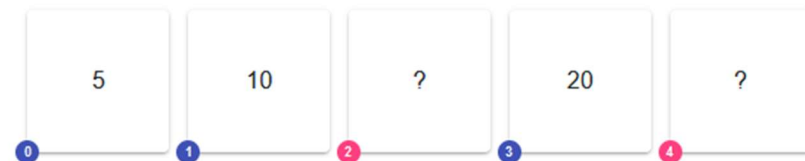
Problem



Problem



Problem



The Four Pillars of <colette/>

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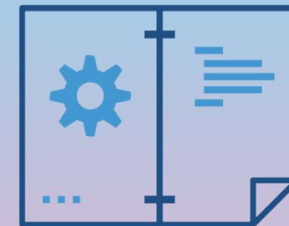
App



Web Portal



Didactic
Content



Teacher
Training

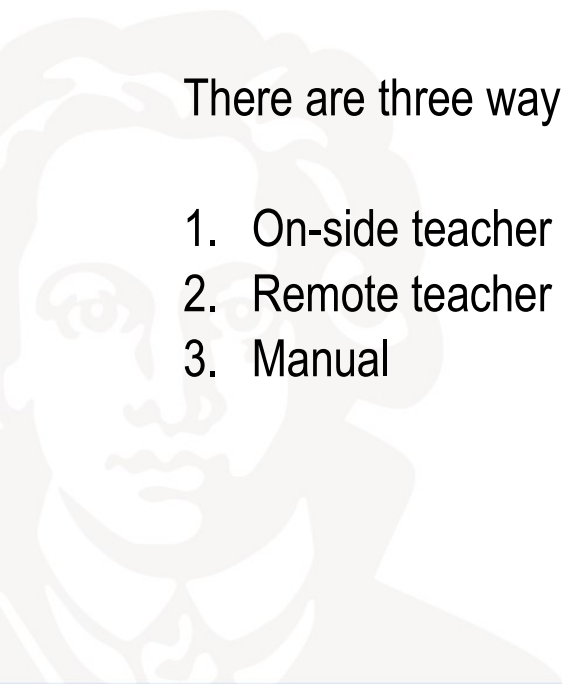
Short Term Curriculum – The Teacher Training <colette/>

For bringing the system into European Schools we need to have trained teachers.

One of the four challenges mentioned by Bocconi et al. (2022) was that teachers felt not adequately trained for teaching CT.

There are three ways we conduct teacher trainings:

1. On-side teacher trainings
2. Remote teacher trainings with video lessons
3. Manual



<colette/>



App

Downloadable for free

Block-based coding

Bring-Your-Own-Devide-
Approach

AR integration



Web Portal

No coding needed

Authoring Tool for CT
learning paths

Guidance through hints
and handbook

Best practice sharing



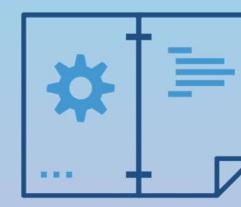
Didactic Content

All CT skills included

Great variety of tasks

Fits into many school
subjects

Unplugged and
"plugged" activities



Teacher Training

Introduction to CT

Familiarizing with
<colette/>

Digital Classroom

Digitally available also as
videos



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portal.colette-project.eu



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