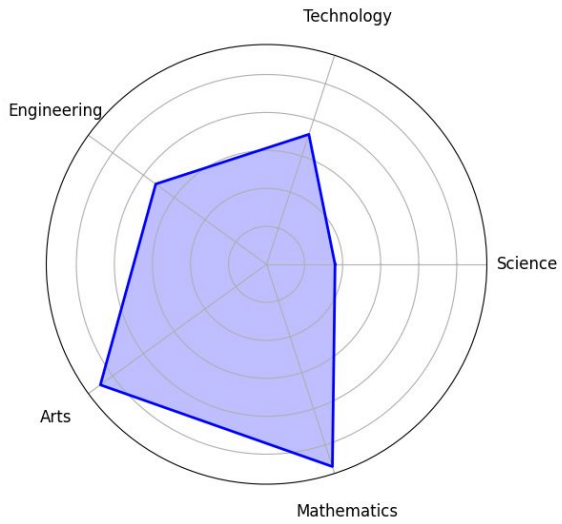
Curricular



ESCAPE ROOM ALGORITHMIC

Duration	Age	Difficulty
45-50 min	11-12	Easy
#MATH #ALGORITHM		

DESCRIPTION

Students will explore algorithms through a competitive Algorithmic Escape Room inspired by Ada Lovelace, the first programmer. In groups, they will decode punch cards to solve simple mathematical operations, find the correct solution card, and answer a question about Ada Lovelace.

Using a template to interpret the cards, students foster logical thinking, teamwork, and creativity, racing to complete the challenge first.

KEY COMPETENCES (EU)

- Numerical, scientific, and engineering skills.
- Digital and technology-based competencies.
- Interpersonal skills, and the ability to adopt new competencies.
- Entrepreneurship.
- Cultural awareness and expression.

ACTIVITY OBJECTIVES

- **Understand an algorithm as a sequence of steps to solve a problem.**
- **Explore Ada Lovelace's historical role and contributions to programming.**
- **Decode punch cards to solve mathematical operations in collaborative groups.**
- **Identify correct solution and answer cards using a provided template.**
- **Foster teamwork, equitable participation, and reflection on women in science.**
- **Apply logical thinking to interpret punch cards in a competitive challenge.**

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MATERIALS

Paper

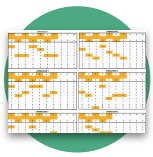
Pen

Biography of Ada Lovelace

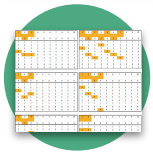
Excel file with all the answers and cards decrypted

How to read punched cards manual

Reference card for decoding



Punched cards (operations and questions)



Punched cards (encrypted answers for problems and questions)

- Provided by students
- Provided by the teacher/institution
- Downloadable Elements

PREVIOUS PREPARATION

- Form groups of 3–5 students, ensuring diversity and gender balance.
- Prepare materials: print the pre-made punch cards from the PDF, including cards for mathematical operations, solutions, Ada Lovelace questions, and answers, along with the decoding template for each group to interpret the punch cards.
- Explain how to read the holes on the punch cards using the decoding template and prepare a guided example before starting.
- Watch an introductory video on programming-algorithms.

CONTEXTUALIZATION AND ADAPTATION

The following questions are presented: “What is an algorithm in your daily life?”; “What would you do if you had to explain to a robot how to make a sandwich?”; “Did you know that Ada Lovelace wrote the first algorithm almost 200 years ago?”.

Algorithms are introduced as sequences of steps to solve problems, using everyday examples like a sandwich recipe (e.g., take bread, spread mayonnaise, add ham). Inspired by Ada Lovelace, the first programmer, students decode pre-made punch cards to solve simple math operations (e.g., 1/5 + 2/5) and answer questions about her work with the Analytical Engine in 1843. This competitive escape room, designed for 11-12-year-olds, aligns with the European math curriculum and fosters logical thinking, teamwork, and appreciation for women in science. Groups of 3-5 students, balanced for gender, use a provided decoding template, with minimal materials (printed PDF cards and template). Teachers guide with an example, and an video on algorithms enhance engagement.

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Watch video 📽️ - "BBC Learning What Is An Algorithm" or "What is Programming? What About Algorithms?"

Start the session with an introductory video for participants to learn about programming.

- ★ https://www.youtube.com/watch?v=r_Rsu6Av1Vk
- ★ https://www.youtube.com/watch?v=KJXd73u1g2c

Classroom activity 💡

In small groups, students discuss: "What daily tasks could be written as an algorithm?" Each group shares an example with the class.

Note for the teacher 📝

Ensure all students, especially girls, actively participate in technical and leadership roles to promote inclusion.

Biography of Ada Lovelace 📝

Meet Ada Lovelace, an woman who lived almost 200 years ago! Ada was born in 1815 in England, during a time called the Industrial Revolution, when new machines like trains and looms were being invented. Even though very few women studied science back then, Ada was different: she loved mathematics and dreamed big ideas!

When she was young, Ada met Charles Babbage, an inventor who designed a machine called the "**Analytical Engine**". This machine was like an ancient computer, capable of performing complex calculations. Ada not only understood how it worked, but she also wrote a set of instructions for the machine to solve a mathematical problem. That was the world's first algorithm, like a recipe for a computer to follow!

Ada also had a super modern idea: she said that machines could do more than just calculate numbers—they could create music or drawings if given the right instructions. That's why we call her **the first programmer** today. Her work inspired the computers we use now, from video games to phones.

How did the punch cards of the Analytical Engine work? Ada and Charles Babbage came up with a special way to give instructions to the Analytical Engine: using punch cards! These cards were pieces of cardboard with holes in specific places. The holes were like a secret code that the machine could understand.

- ➔ **What did the holes mean?** Each hole, or the absence of one, stood for something different, like a number, an operation (such as adding or subtracting), or even a bigger idea, like a musical note.

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- ➔ **How were they used?** The cards were placed in the machine, and it "read" them to know what to do, without a person having to give orders all the time. It was like programming the machine to work on its own!
- ➔ **What else were they used for?** The cards could also store the results of the calculations, creating new cards with the information the machine produced.

Ada imagined that with these cards, the machine could not only do math but also more creative things, like composing music or drawing. She saw the future of computers before anyone else!

These milestones will help you highlight the most important moments in Ada Lovelace's life and her contributions to science and technology:

- ❑ **1815 – Ada Lovelace is born in London, England:** Ada is the daughter of the poet Lord Byron and Annabella Milbanke. Her mother encouraged her education in mathematics and science to prevent her from following in her father's artistic footsteps.
- ❑ **1833 – Ada meets Charles Babbage, who is developing the Analytical Engine:** This meeting was pivotal because Babbage showed Ada his machine, and she was so enthusiastic that she began working on it. This would be the beginning of her relationship with computing.
- ❑ **1843 – Ada Lovelace writes the first algorithm for Babbage's Analytical Engine:** This algorithm is considered the first computer program in history, making Ada the first programmer. Her work predicted that machines could perform complex calculations and even follow instructions to perform other tasks, long before computers existed.
- ❑ **1843 – She publishes her famous article in the journal "Scientific Memoirs," in which she explains how Babbage's Analytical Engine works:** In this article, Ada not only describes the algorithm but also reflects on the future capabilities of machines to perform operations beyond numbers, anticipating the idea of modern computers.
- ❑ **1852 – Ada Lovelace dies at the age of 36, but her legacy remains almost forgotten for a long time:** Despite her short lifespan, her work on Babbage's Analytical Engine is fundamental to the history of computing. However, due to the era in which she lived, Ada did not receive the recognition she deserved.
- ❑ **1953 – A biography of Ada Lovelace is published, finally recognizing her as the first programmer in history:** It was only in the 20th century that Ada Lovelace's importance in the history of science and technology was officially recognized.

Watch video 📽️
The first storyteller in history:

- ★ ADA LOVELACE | Draw My Life | International Women's Day: https://www.youtube.com/watch?v=fEmKuJ8XL68

Other videos:

- ★ Ada Lovelace - History Who's who: https://www.youtube.com/watch?v=2vg-0mlSnSE

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Classroom activity 💡 Values/Ethics
Discuss the historical invisibility of women in science: What other figures do you know? How can this situation be changed?

The invisibility of women in science
Throughout history, many women have made important discoveries and breakthroughs in science, but they have not always received the recognition they deserve. Sometimes, their work was ignored or even credited to the men around them, even though women were truly responsible.

Why did this happen?
Few opportunities: In the past, girls weren't as encouraged to study science as boys. Many thought women couldn't be good at math or science.
Gender bias: People thought men were better at doing science and that women should stay at home. Because of this, many discoveries made by women went unrecognized.
They weren't given credit: Even when women discovered something important, they were sometimes not given credit. In many cases, a man's name was the one that appeared in the history books.

Some important women in science who were overlooked
Marie Curie: She was the first person to win two Nobel Prizes, in Physics and Chemistry, for her work on radioactivity. Although she is well-known today, she faced many difficulties in her time because she was a woman.
Rosalind Franklin: Her work was key to discovering the structure of DNA, but she did not receive the recognition she deserved. Other scientists (such as Watson and Crick) won the Nobel Prize for this discovery, although she also played a fundamental role.
Katherine Johnson: She was a mathematician who helped NASA send the first man to the moon. Her story was not known until much later, although it was fundamental to the success of space missions.
Hedy Lamarr: Inventor of the system that inspired Wi-Fi and Bluetooth, as well as being an actress.
Katherine Johnson: Mathematician who calculated trajectories for NASA, key to the Apollo missions.

How can we change this situation?
Learn about them: It's important that we learn about all these women and their discoveries. Not only should male scientists be remembered, but women too.
Give girls more opportunities: Girls can be scientists too. We should encourage them to study math, physics, biology, and other sciences, and show them examples of women who have done incredible things in science.

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Celebrate the achievements of women scientists today: There are many women working in science and technology today. It's important that their achievements be recognized and they be given the credit they deserve.
Talk about these stories: Teachers, the media, and families can help tell the stories of these women so everyone knows about them.

Conclusion
Throughout history, many women have accomplished incredible things in science, but for many reasons, they haven't always received the recognition they deserve. Now, it's more important than ever that we learn about their achievements and support girls so they too can dream of becoming scientists, engineers, or whatever they desire. We can all do great things, regardless of whether we're boys or girls!

Ideas for extension outside this session

- A mural could be created that combines the faces or silhouettes of these women, decorated with symbols of their achievements.
- Posters of female scientists, researchers and pioneers (casio): https://www.cientificascasio.com/media/postersCientificasCASIO-eng.zip

ACTIVITY

1. **Group division (5 minutes):**

What the teacher does:

- Divides students into groups of 3-5, depending on the total number of students (e.g., 20 students = 4-5 groups).
- Ensures groups are mixed (boys and girls) to promote equity. Encourages girls to take active roles, such as leading the interpretation of cards, by assigning equitable roles when forming groups (e.g., a girl as spokesperson).

2. **Introduction (10 minutes):**

What the teacher does:

- Presents a brief biography of Ada Lovelace (e.g., born in 1815, wrote the first algorithm for Babbage's Analytical Engine in 1843, predicted machines could create music or art). The teacher may even give each group a copy of Ada Lovelace's biography.
- Explains that an algorithm is a list of steps to solve a problem, like a recipe (e.g., "to make a sandwich: 1. Take bread, 2. Spread mayonnaise, 3. Add ham").
- Explains how a punch card works. For aid with this you also have the manual: How to read punched cards.
- Introduces the activity as a competition: "Each group will receive a 10 punched cards with a mathematical operation. You must decode it, solve it, find the card with the correct solution, and answer the questions about Ada Lovelace to win."

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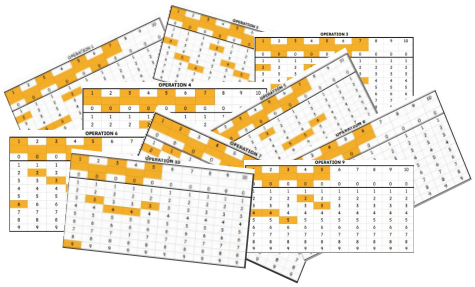
Note for the teacher: Monitor to ensure everyone participates and rotate roles if necessary (e.g., if one student dominates, ask another to speak; for example, request each member to explain part of the process).

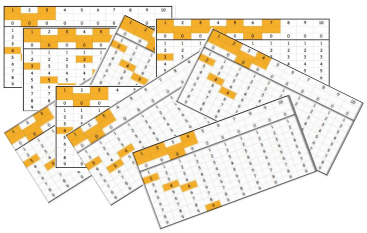
3. Decoding the Mathematical Operation (15 minutes):

First, **each group** of students receive 1**0 mathematical operations** from the document Punched cards operations and questions (They only receive the operations) **+ One reference card** for decoding the punched card (you may find them in the document Reference card for decoding) **+ the 10 punched cards with answers** for OPERATIONS (this is only the first page of the document Punched cards answers, the other pages have answers to things we will use later.

10 Operations cards



10 Answer cards (mixed very well)



1 Reference card for decoding

ZONE	12	11	0	12+11	11+0
1	A	J	R	0	9
2	B	K	S	1	+
3	C	L	T	2	-
4	D	M	U	3	*
5	E	N	V	4	/
6	F	Ñ	W	5	÷
7	G	O	X	6	´
8	H	P	Y	7	?
9	I	Q	Z	8	

This is what each group receives

GROUP

What students will have to do, is:

1. Decode each operation cards
2. Solve the posed mathematical problem
3. Decode the answers cards
4. Pair the **OPERATION CARD** with its corresponding **ANSWER CARD.**

Note for the teacher 📝 - Answers for operations

In this document: Punched cards templates with complete answers you will find every card decrypted with its corresponding answer card to the right. Each operation is divided in each "sheet" of the excel document.

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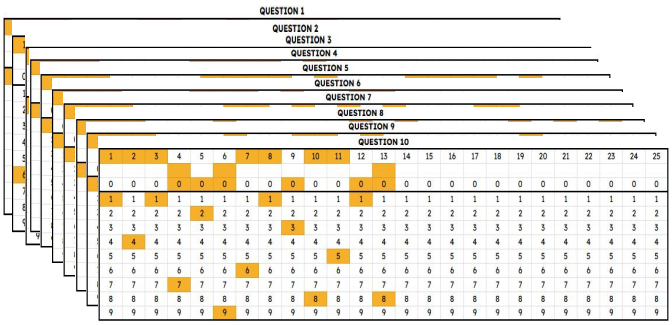
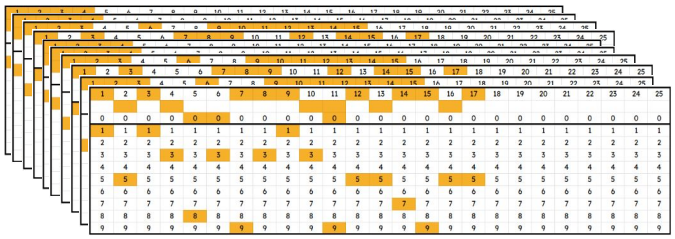
5. **Answering the Ada Lovelace's Questions (15 minutes):**

When students finish decoding the operations and pair them with their answers correctly. As soon the team finishes, the teacher (after checking the paring of the cards is correct) will give the team another set of cards but this time those are not mathematical operations but questions about Ada Lovelace's life, and another set of possible answers to those questions encrypted as well:

10 Question cards



10 Answer cards (mixed very well)



+

1 Reference card for decoding

ZONE	12	11	0	12+11	11+0
1	A	J	R	0	9
2	B	K	S	1	+
3	C	L	T	2	-
4	D	M	U	3	*
5	E	N	V	4	/
6	F	Ñ	W	5	÷
7	G	O	X	6	´
8	H	P	Y	7	?
9	I	Q	Z	8	

This is what each group receives

GROUP

What they have to do now is to decode the encrypted questions about Ada Lovelace's life and the possible answers and pair them. As well as the previous set of cards, at the end, the teacher should check if the paring of those cards (question - answer) is ok.

Finally they have to share their experience.

Note for the teacher: Praise teamwork and creativity, not just speed, to reinforce inclusion.

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6. Conclusion and Winner (5 minutes):

What the teacher does:

- Declares the winner as the first group to submit the correct Ada Lovelace answers cards.
- Facilitates a final discussion:
  - "How did they feel decoding the cards?"; "Why is it important to recognize Ada Lovelace?"; "Where do we use algorithms in daily life?"
  - **Optional**: Groups create a collective timeline of Ada Lovelace's milestones (e.g., "1843: Writes the first algorithm") on a whiteboard.

What the students do:

- Participate in the discussion and, if there is time, contribute to the timeline.

Note for the teacher: Punched cards 📝 Briefing of cards

Below are all of the mathematical operations and questions about Ada Lovelace. This are the questions and answers that correspond to the punched cards from the file Punched Cards Templates with Complete Answers.

1. Mathematical operation card + Solution card for the mathematical operation
2. Question card + Answer card for the question

****List of Mathematical Operations on Punched Card Templates****

1. 1/4 + 2/4 = 3/4
2. 2/5 + 3/5 = 5/5 = 1
3. 1/3 + 1/3 = 2/3
4. 3/8 + 5/4 = 13/8
5. 1/6 + 4/3 = 3/2
6. 5 + 2 × 3 = 11
7. 10 - 6 ÷ 2 = 7
8. 12 ÷ 4 + 3 = 6
9. 3 × 4 + 2 = 14
10. 8 - 3 × 2 = 2

****List of Ada Lovelace Questions on Punched Card Templates****

1. Year of Ada Lovelace's birth? 1815
2. Year of Ada's first algorithm? 1843
3. Who did Ada Lovelace work with? Charles Babbage
4. Machine used by Ada Lovelace? Analytical Engine
5. What did Ada predict for machines? Create music
6. Year of Ada Lovelace's death? 1852
7. Century of Ada's recognition? 20th century
8. Ada's method for instructions? Punched cards
9. Magazine of Ada's article? Scientific Memoirs
10. Who was Ada's father? Lord Byron

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Note for the teacher 📝
It is recommended to report an interactive app or website to create or visualize the algorithm digitally. For example:

1. **VisuAlgo**. This is an interactive platform that offers detailed animations of algorithms and data structures. It is ideal for visualizing how algorithms such as searching, sorting, and structures like trees and graphs work. You can enter your own data to see how they are processed step by step.
2. **Graph Online**. This is a tool that allows you to create custom graphs and apply various algorithms to them, such as finding shortest paths, minimum spanning trees, and more. It is especially useful for visualizing algorithms related to graphs and network structures.
3. **Algorithm Visualizer**. This is a platform that allows you to visualize how different algorithms are executed step by step. It is useful for understanding the execution flow and the logic behind various algorithms, from the simplest to the most complex.
4. **Flowgorithm**. This is a tool that allows you to create interactive flowcharts to represent algorithms. It is especially useful for students who are beginning to learn about programming logic and control structures. Wikipedia

Since this activity is aimed at students aged 11-12, **Graph Online** and **Flowgorithm** are particularly suitable options. These tools will allow students to experiment with creating and visualizing algorithms in a simple and understandable way.

CONCLUSION AND SHARING

Assessment: The teacher announces the winning group (the first to correctly submit the answer card about Ada Lovelace) and leads a brief discussion: How did they decode the punch cards? What did they learn about algorithms and Ada Lovelace? Each group shares a key idea (e.g., “Algorithms are step-by-step instructions” or “Ada was the first programmer”).

Teacher Feedback: Offer comments on teamwork, logical thinking during decoding, and inclusive participation, highlighting efforts to include everyone, especially girls. Relate the algorithms to everyday tasks.

Optional: If time allows, groups can:

- Diagram their “algorithmic path” (input → decoding → calculation → verification → output) on paper to show how they solved the problem.
- Respond in writing or orally: “What was the most difficult part of the escape room?” and “What surprised you about Ada Lovelace?”
- Decorate a collective Ada Lovelace timeline on the board, using drawings or mathematical symbols (e.g., 1843: First Algorithm).

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Final discussion 🗣️

How did it feel to work as a “human machine”?

Why is it important to recognize people like Ada Lovelace?

Where do we use algorithms in our daily lives?

You can share the project social media if any teachers want to share with us their results using the following sentence and template with the links:

Don’t forget to take a photo of your experience and share it with us!

LinkedIn Instagram X

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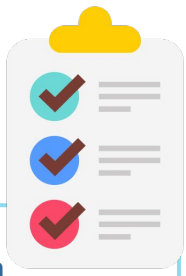
PROJECT EVALUATION



Activity Objectives	Key Competences (EU)	Evaluation Criteria
Understand an algorithm as a sequence of steps to solve a problem	Mathematical competence and basic competences in science and technology	The student correctly decodes the punch card and explains the steps to solve the mathematical operation.
Explore Ada Lovelace's historical role and contributions to programming	Cultural awareness and expression	The student identifies at least one milestone in Ada Lovelace's life (e.g., 1843: first algorithm) and reflects on her impact on science.
Decode punch cards to solve mathematical operations in collaborative groups	Digital competence, social and civic competences	The student actively collaborates in their group, respecting roles and contributing to decoding and solving the operation.
Identify correct solution and answer cards using a provided template	Sense of initiative and entrepreneurship	The student accurately selects the correct solution and answer cards, demonstrating precision in template interpretation.
Foster teamwork, equitable participation, and reflection on women in science	Social and civic competences	Girls and boys participate equitably in all tasks, including technical roles, and reflect on the importance of women like Ada Lovelace.
Apply logical thinking to interpret punch cards in a competitive challenge	Mathematical competence, digital competences	The student demonstrates logical thinking in decoding punch cards and, optionally, diagrams their "algorithmic path" or contributes to an artistic Ada Lovelace timeline.

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