AI for Children
Artificial Intelligence Curriculum for Elementary and Secondary Schools

How Robots Brushed Their Teeth

Algorithm & Machine Learning

03

npi | National Pedagogical Institute of the Czech Republic

We create methodologies in cooperation with the National Pedagogical Institute.

Teacher material for Elementary Schools–AI in Computer Science

Algorithm & Machine Learning – Robots Are Brushing Their Teeth

Concept

Robots would love to brush their metal teeth, but they're not quite sure how. Let's help them!
At first, we'll try explaining every step: pick up the brush, squeeze out the toothpaste… but uh-oh!
Hoo squeezed it onto the wrong end, and Ray put it straight on his teeth! That's not going to work.
So instead of telling the robots exactly what to do (that's called an algorithm), we'll just show them
lots of examples of how humans do it.

Robot Hoo

Hoo is programmed as a curious
and slightly unsure robot. He always
tries to understand others.
He also collects various human
artifacts he finds online–rare
memes or old internet trends.
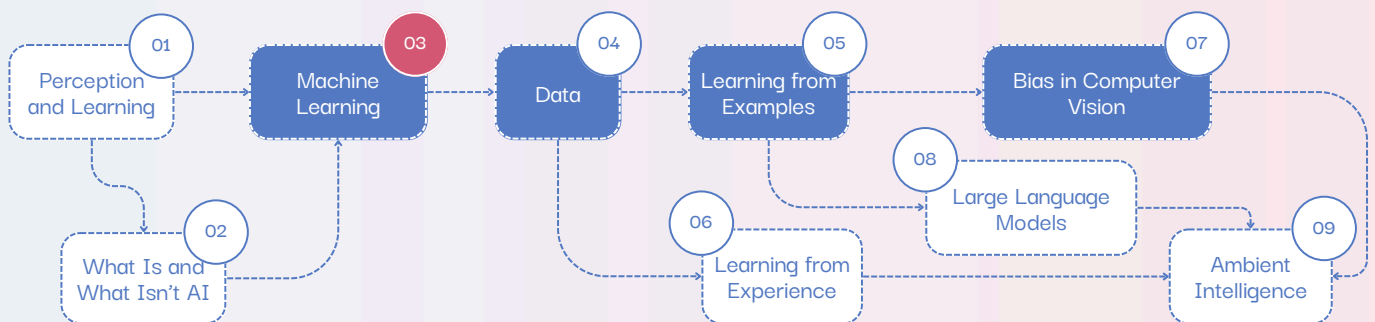He then shows them to Ray,
who sees no value in them.

Robot Ray

Ray is programmed for practicality.
He constantly looks for ways
to process data efficiently.
Human emotions don't interest him
–what matters are the numbers.
He always generates fast
and accurate responses, though
he often takes things too literally.
Ray spends his time building
complex mechanical models.
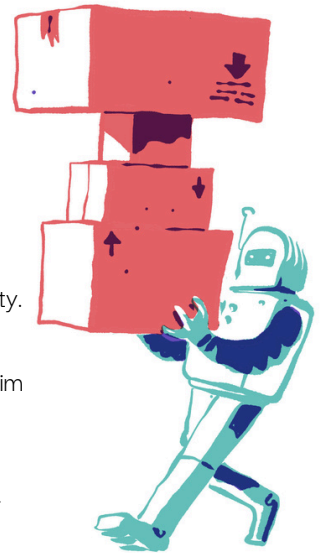
Learning progress map

The Learning Progress Map outlines the key concepts that children should understand during elementary school. The most
essential ones are marked in solid blue, while the recommended concepts are shown in white. Each concept is accompanied
by a teaching material and a presentation.

01 Perception and Learning
02 What Is and What Isn't AI
03 Machine Learning
04 Data
05 Learning from Examples
06 Learning from Experience
07 Bias in Computer Vision
08 Large Language Models
09 Ambient Intelligence

All materials can be found at kurikulum.aidetem.cz/en.

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Presentation   Editable template in Canva   Feedback form

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Glossary of terms

Artificial Intelligence (AI)
There is no single, universally accepted definition of artificial intelligence.
However, all definitions agree that it refers to a system that simulates human thinking and behavior.
AI usually takes the form of a computer program designed to solve tasks that once required significant human intelligence and were considered the domain of humans (or animals).
It is also a scientific field, with roots dating back to the first half of the 20th century, focused not only on understanding intelligent systems, but above all, on creating them.

Machine Learning (ML)
Just as humans can learn from examples and experiences, so can human-made machines.
Machines use a method called machine learning, which enables AI systems to go beyond simply following pre-programmed instructions and instead come up with new solutions on their own.

Algorithm
An algorithm is a detailed, step-by-step procedure for solving a specific problem or task, even when the input varies. It's a set of rules or instructions that describe how to reach a solution. An algorithm isn't tied to any particular programming language – it can be written in natural language, pseudocode, or other forms.
An algorithm is an abstract concept. Its main purpose is to clearly describe the logic of a solution, step by step.

Program
A program is a concrete implementation of one or more algorithms in a specific programming language. It's a set of instructions that tells a machine exactly what to do to carry out a task. So while an algorithm is a general method for solving a problem, a program is that method brought to life in code.

Lesson Overview

Recommended Age, Lesson Length
Children aged 8-11 (it helps if the kids have some experience with basic robot programming, but it's not a must), 45–90 minutes.

Building Blocks
Algorithm, machine learning.

What Are the Students Learning?
Instead of giving machines exact step-by-step instructions (an algorithm), we'll show them examples from which they can learn how to complete tasks on their own (machine learning).

Why Are They Learning This?
By understanding the difference between algorithmic and machine learning approaches, they can decide which method is better suited for a given task.

How Do We Know They Have Learned It?
They can explain the difference between the terms algorithm and machine learning.

Tools
Teacher: A presentation to project, cut-out images (can be folded) from the printable sheet (only one copy needed). You can also bring a real toothbrush and toothpaste instead of using paper models.
Students: Writing tools and worksheets.

Digital Competence
Communication and Collaboration.

Bloom's Taxonomy
Analysing: Students break down the task (tooth brushing) into individual steps, identify flaws in the algorithms, and suggest improvements.
Applying: Students apply their knowledge by assembling an algorithm for brushing teeth with a robot.
Creating: Students design their own algorithm and propose creative solutions based on the given challenge.

Five Big Ideas
3-A-I Nature of Learning (Humans vs. machines).

Note: Gender equality is key for AI for children, but for brevity we use masculine formulations in our methodologies.

Engage

min
00

Presentation slide 01

Read the beginning of the story aloud.

Hi there! It's us again – Hoo and Ray – the duo that never turns down an adventure or a chance to learn something new. So guess what? On our latest journey into the world of human creations, we decided to try something totally different – something that always brings a smile to people's faces. Yes, that's right: brushing teeth!
We know, we know… It might not sound like the most thrilling adventure. But we'll let you in on a secret – even something as ordinary as brushing teeth can turn into a blast for robots. Especially when it's your very first time. And since no one told us how to do it, we grabbed some toothbrushes and toothpaste (how many kinds do people even need?)… and just gave it a shot.

What do we need to do if we want to brush our teeth? How would we explain it to a robot so they get it right?
Suggested answer: First we need to take a toothbrush, put some toothpaste on it, then brush our teeth using small circular motions on each side of the mouth, rinse, and put the toothbrush away.
If we wanted the robot to do it, we'd have to describe these steps exactly – that's called an algorithm.
Note: Make sure to use the word "algorithm."

Have you ever heard the word "algorithm"? What do you think it means?
Suggested answer: An algorithm is an exact set of steps for doing something. Like when robots follow instructions or computers run programs – they use algorithms.

How do you think a robot could tell if teeth are clean or still need brushing?
Suggested answer: We could show the robot lots of pictures of clean and dirty teeth. Over time, it might learn to recognize the difference and figure out whether the teeth are already clean or still need brushing.

Understand

min
05

Presentation slide 02

Continue the story.

Robots Hoo and Ray found out that people brush their teeth. So, they decided to try it too. After all, it was part of their research – they were interested in morning routines and wanted to understand what makes them fun or worth repeating every day. The only problem? They weren't exactly sure how to do it. "Wait, what if we do it wrong?" asked Ray, a little worried. "Don't worry," said Hoo. "Look, the book in the bathroom says brushing is a big adventure. What could go wrong?" Ray just shook his head.

So they gave it a go. They decided to follow the book's instructions word for word. It said: Take a toothbrush, squeeze out the toothpaste… Hoo squeezed the toothpaste so hard it shot onto the ceiling. "Oh, maybe that's not how it works," he mumbled, watching the toothpaste slowly drip down. Meanwhile, Ray grabbed the second tube and managed to squeeze it everywhere except onto the toothbrush. "Looks like I've just discovered a fascinating new substance," Ray said with a proud grin. Next step in the book: Make circular motions to remove plaque from the teeth. So Hoo and Ray began spinning in circles. Hoo even grabbed a marker from the museum gift shop and began drawing big circles on the bathroom walls, creating a nice set of concentric rings. You know what? Tooth brushing is actually kind of fun," said Ray as he finished his last circle. The final step in the book was clear: Now rinse your mouth! Hoo and Ray looked at each other, shrugged, and began rinsing – the entire bathroom.

After a moment, Hoo announced: "Rinsing: successful. Bathroom: flooded. Teeth: still dirty." Ray stared at the disaster they had left behind in the bathroom after brushing their teeth. "And humans do this twice a day?" he asked in disbelief. "Maybe that's why some robots don't have teeth," Ray concluded, processing all the complications they'd just encountered.

First activity

Read to the children:
Imagine you're a teacher and your students are very unusual – they're robots! Your job is to teach them how to brush their teeth properly. But as you noticed in the story, these robots don't have much experience. They've never seen anyone brush their teeth and don't even really know what brushing teeth means. For robots, it's hard to do things based only on words. So let's help them out and create a clear algorithm for brushing teeth!

Presentation slides 03 and 04

min 10

Children fill in paper-based programming blocks from worksheet 1.

They can work in groups, pairs, or on their own.
Each programming block belongs to one object (toothpaste tube, cap, brush, etc.) from worksheet 2. The goal is to write an algorithm the robot can follow to brush its metal teeth properly. In each block, the children write the clearest possible instruction for what to do with that object.

You can also ask follow-up questions, like: Can you think of a simpler way to write that instruction? Would this work in all kinds of bathrooms? Is it too hard? Have someone else check the steps – is anything missing?

An example of what a detailed algorithm might look like:

	Start of algorithm: The robots have dirty teeth.
	Gently grip the toothpaste tube using the robot's hand.
	With the other hand, unscrew the cap. Turn it clockwise and not too forcefully. If that doesn't work, try turning it with more strength. Place the removed cap on the sink.
	Start squeezing the toothpaste from the end of the tube (the side opposite the opening), slowly and gently, until paste begins to come out.
	Carefully and slowly squeeze the toothpaste onto the bristles of the toothbrush until the entire top surface is covered.
	Open your mouth and touch the bottom teeth on the left side with the toothbrush. Clean the teeth using small circular motions, moving the brush to the right. Move slowly from left to right across the bottom teeth, then back again. Repeat 5×. Do the same for the top teeth.
	Turn on the cold water tap and wait until a suitable amount of water flows. Place an empty glass under the stream and fill it halfway.
	When the glass is half full, put down the toothbrush and turn off the cold water by turning the tap counterclockwise until the water stops flowing. Bring the glass to your mouth, take one sip, swish the water, and spit it out into the sink. Repeat once more. Then rinse the toothbrush and put it and the toothpaste back on the sink.
	End of algorithm: The robots now have clean teeth.

min
30

Second activity

Read to the children:
Now you've written an algorithm that we – Hoo and Ray – can finally use to clean our metal teeth! We're excited to see how it works and soon we'll know whether it really does the job. But since we can't be with you in the classroom, our creators have prepared everything you'll need – all nicely printed on paper. So let's get started!

Have the prepared cut-out images from worksheet 2 ready.

We recommend cutting them out ahead of time and ideally laminating them.

If you haven't prepared them, children can draw their own (about 5 minutes should be enough).

Each item only needs to be printed once.

Now it's time to try out the different algorithms the children have created.
Gather all the paper props you'll need. The children who want to test their algorithm will read their instructions one by one. Follow each step exactly as it's written – take it completely literally. Look out for mistakes or unclear parts in the instructions. For example, if it doesn't clearly say which end of the toothpaste tube to squeeze, try squeezing it from the wrong end. The goal of this activity is to understand that some things are hard – or even impossible – to describe precisely.

Read to the children:
Now imagine this: instead of explaining every single step to the robots about how to brush teeth properly (that's called an algorithm), we simply show them lots of videos or pictures of people brushing their teeth. And they learn it much better and faster that way! That's one of the ways machine learning works! It's a method that helps machines using artificial intelligence learn. But not all machines – just some robots (like Hoo and Ray) or computers can do this.

Play a video showing robots playing football (about 40 seconds is enough, mute the sound).
youtube.com/watch?v=RbyQcCT6890 (2:22)

Watch the video of robots playing football. Then let the children vote on the following question.

Do you think a robot could learn to play soccer just by following a set of precise instructions?

Explain to students: Some things are really hard—or even impossible—to explain using exact instructions. That's why it's often better to show machines examples, so they can learn on their own.
For example, robots that play football weren't given step-by-step instructions. Instead, they watched lots of videos (around the 35th second), and learned how to play by themselves. This is called machine learning—a different way for people to teach machines what to do, using examples instead of exact rules.

Reflect

min
40

Read to children:
So that's our story – the one where we discovered machine learning! It was actually pretty fun, even if we did have to clean up the bathroom in the end. We realized that understanding human habits isn't always easy, even when they look simple. But we figured it out with examples. You know what they say – a single good example can be worth more than a thousand words! Or in our case, a thousand code lines.

This adventure showed us that even something as ordinary as brushing teeth can be a real challenge for robots. But it also showed us that with a little patience – and a few good examples – we can learn just about anything.

We created an algorithm for the robots Hoo and Ray (a precise, step-by-step guide) to help them learn how to brush their teeth. How did it go? Were you able to describe all the steps? What was the hardest part?

How else could robots learn to brush their teeth if we didn't give them exact instructions? Can you think of what approach we used in the story?

What's the difference between an algorithm and machine learning?
Which approach do you think works better for complex tasks, like playing football or driving a car?

Explain: People have been making algorithms for robots and computers for a very long time. Thanks to these, a kettle can boil water or a calculator can solve a math problem. But with robots and computers, we often want them to do much more complicated things. Machine learning helps with that. Instead of giving robots detailed step-by-step instructions, we show it many examples of how people do it—and the robot learns on its own. Sometimes they learn just by watching what different things look like. And sometimes they try different ways themselves and learn from what works.

Can you think of other examples where it might be hard (or even impossible) to explain to a robot how to do something?
Possible answers: dancing, playing football, driving a car, caring for a baby, walking through a forest, climbing trees…

More to explore

min
45

Presentation slide 06

**Train the robots to recognize what doesn't belong in the ocean.**

You can find a great lesson on Code.org.

We highly recommend trying it with students – although it takes more time, it's not a quick 5-minute filler at the end of a lesson. It works best as a full 45-minute activity. In the game, children train a robot – teaching it what belongs in the ocean and what doesn't.
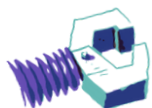
The lesson explores machine learning not only as a technological concept, but also from an ethical perspective.

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06

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≥ Curriculum

Yay! Let's teach the robots how to brush their teeth!

Dear children, for each item, write a short instruction for the robots – what to do with it so they can clean their teeth properly.
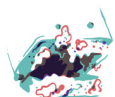
Start of algorithm: The robots have dirty teeth.

End of algorithm: The robots now have clean teeth.

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