AI for Children

Artificial Intelligence Curriculum for Elementary and Secondary Schools

Hoo and Ray in the Universe of Words

Language Model

08

Natural Language Processing

National Pedagogical Institute of the Czech Republic

We create methodologies in cooperation with the National Pedagogical Institute.

Teaching material for Elementary Schools–AI in Computer Science

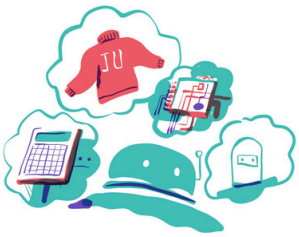
Language Model – Hoo and Ray in the Universe of Words

Concept

Hoo and Ray have found themselves in a vast and slightly mysterious universe of words. Every word here has its own place and is surrounded by many others that are somehow connected. But how does it all work? Even ordinary little words can cause quite a mix-up. What's their mission? With the help of the cat Kitty, who may seem grumpy at first, they'll figure things out – and maybe even make it smile. And along the way, they might discover that what matters most isn't just choosing the right words, but how and to whom we offer them.

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.

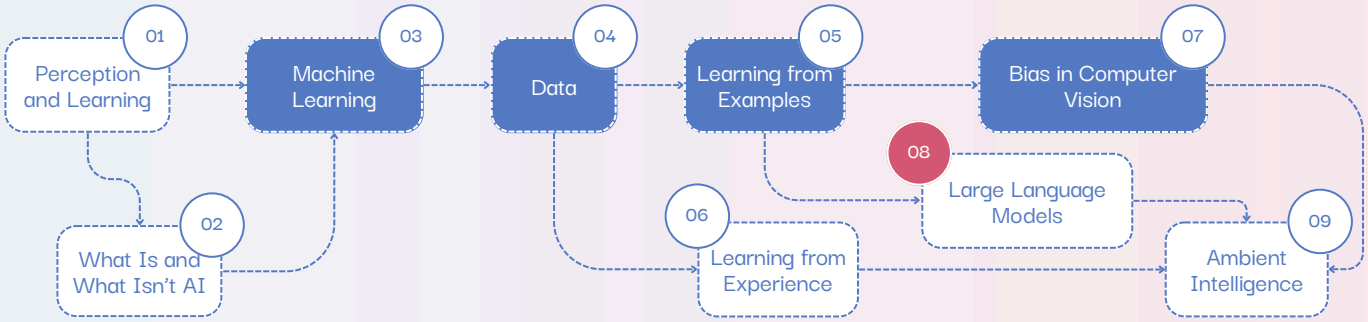


Robot Ray

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.



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

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These teaching materials were translated using ChatGPT.
Please note possible imperfections in the expressions or wording.

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.

Chatbot
A chatbot is a computer program designed to automatically engage in conversation with users. It uses artificial intelligence or predefined rules to answer questions, provide information, or perform various tasks such as booking a hotel or ordering food. Chatbots can operate within different apps, on websites, or in messaging platforms.

Generative Artificial Intelligence (GAI)
Generative AI is a type of artificial intelligence designed to create new content such as text, images, music, videos, and more, based on data it has been trained on. Unlike traditional AI systems that focus on analyzing or classifying information, generative AI uses algorithms like neural networks that "learn" from the structure and patterns in existing data in order to generate new, original content that often appears indistinguishable from content created by humans.

TAKE A LOOK!

Language model (LLM – Large Language Model)
A language model is a program (a neural network) that has been trained on massive amounts of text data (called a corpus). This can include digitized books, Wikipedia entries, online articles, and more. Based on this, a large language model can generate and process text in many ways (for example, in a chatbot).

Today, one of the best-known families of models is GPT by OpenAI, which you can use through apps like ChatGPT or Microsoft Copilot. Because of how large language models work, they can sometimes "hallucinate" – that means they might generate factually incorrect or otherwise inaccurate information. That's why it's important to always read their outputs critically and verify information when needed. In this activity, we aim to help children understand how large language models work and why it's so important to check their answers carefully.

Lesson Overview

Recommended Age, Lesson Length
Children aged 8-11, 45–90 minutes.

Building Blocks
Language model.

What Are the Students Learning?
A language model is a program trained on a large number of texts. It can produce texts that sound like they were written by people, but sometimes it generates incorrect content.

Why Are They Learning This?
By understanding how language models work, students can critically evaluate the outputs of generative AI.

How Do We Know They Have Learned It?
In their own words, students describe how a language model works and explain why it might generate incorrect information.

Tools
Teacher: Projecting device, presentation slides, account in an app that generates text.
Students: Writing supplies, glue, colored paper, printed worksheets.

Digital Competence
Facilitating Learners' Digital Competence.

Bloom's Taxonomy
Understanding: Students describe how a language model works and explain why it might generate incorrect information.
Creating: Build their own simplified model.

Five Big Ideas
4-B-I Commonsense Reasoning.

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

Engage

Presentation slide 02

min 00

Read the text to your students.

Hey there, space crew! Hoo and Ray here – your robot guides and fellow students. Today, we're taking you on a journey through the mysterious universe of words – a place where every word has its special place, and where you can discover how words connect and help us express just about anything. We'll explore how words form stories, how they connect with each other, and how they help us make sense of the world around us. So, are you ready?

Presentation slide 03

Show the presentation on slide 03 and let students fill in the missing words in the story. Encourage them to try out different word options. Language models generate so-called tokens – simplified words and sentence parts – based on texts mostly written by people. But not every word they suggest makes sense!

Do you know those stories with missing words where you fill in what fits best? Today we'll try it together! Fill in the missing words in Hoo and Ray's story so that it all makes sense.

Understand

min 08

Today we're going to play something called a language model! But before we jump in, let's take a moment to explain what a large language model actually is and where we can find it.

Have you ever heard of programs (or apps) that can create (generate) text?
These programs are called **chatbots**. Examples include ChatGPT, Microsoft Copilot, Google Gemini, or Claude. And of course, there are many others too!

Chatbots are simple programs you can talk or write to. But to act like people, they need to learn from examples how words relate to each other. That's what a **language model** is for.

Presentation slide 04

A language model is a computer program that sees language as a giant universe. But instead of planets, stars, moons, and other space objects, you'll find words. Some words tend to stick together or pull others closer – like "Hoo," "Ray," "cat," "knitting machine," and "Carl," for example.

But other words, like "furry" and "umbrella," are much farther apart, because people probably don't use the phrase "furry umbrella" very often. We'll look at the next image to see how close or far apart different word-planets are – and how strongly they pull toward each other. Ready to explore our galaxy of words?

Presentation slide 05

Show students the picture of robot Ray and explain that the words around it are placed based on how important or closely connected they are to Ray. Ask students why they think each word is there.

Just like filling in the missing words in Hoo and Ray's story, language models choose words based on what fits best. If we were describing the robot Ray, we might start by saying he's a robot and has a friend named Hoo – and then we'd probably add more details from there.

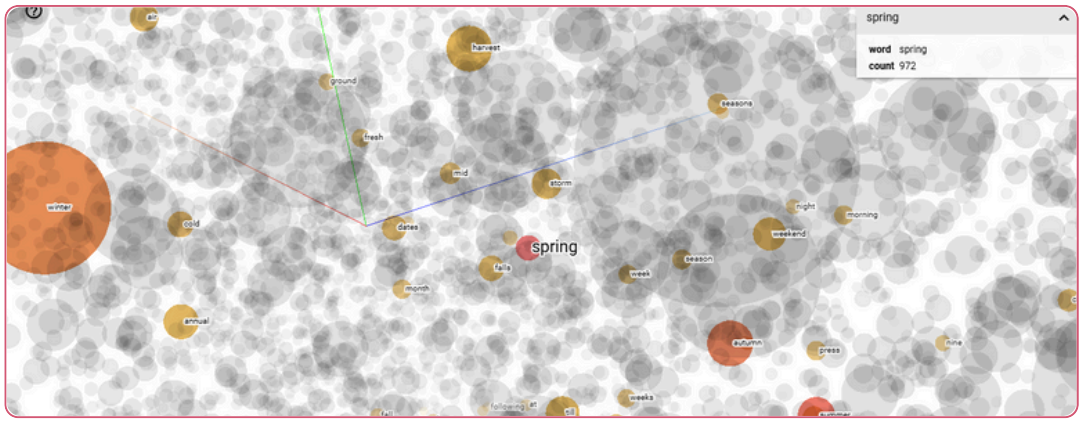
What kind of words did the students choose for robot Ray?

A language model works like a "clever detective" that reads loads of books and texts, looks for word patterns, and discovers how words relate to one another. Then it uses that to generate new text.

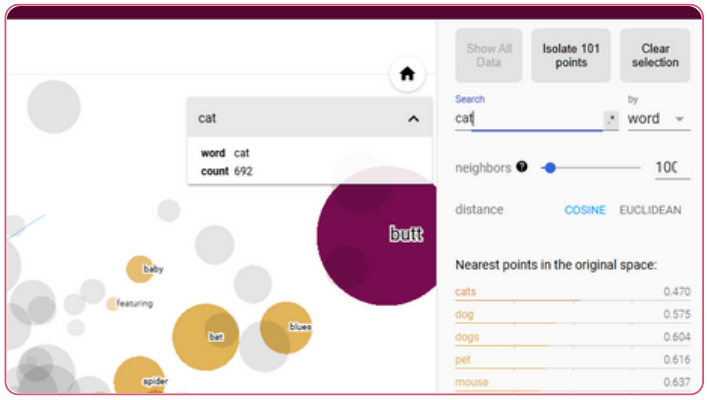
Presentation slide 06

min 12

Show the students a 3D space of semantically related words to help them understand how a language model represents our language: projector.tensorflow.org. You can zoom in and out with your mouse wheel and explore the connections between individual words. Words appear when you hover over the dots with your cursor. If you click on a dot, it will display words that are closely related in meaning to the selected one.



In the box on the right labeled "Search," you can also look up words. Try typing in the word "cat" and see what comes up!



What semantically similar words do you see near the word "cat"?
Can you think of any others that don't show up in the model?

Presentation slide 07

min 17

Show the students the presentation on slide 07. They'll see words that are likely to be related in meaning to the word "cat." The image also includes numbers – these show how strongly each word is connected to "cat." In this case, the closer the number is to 10, the more likely it is that the word really belongs with "cat." For example, a 9 next to "cat food" means it's very likely to be connected. These numbers are calculated based on how often certain words appear together across the huge number of texts the language model has "read." If a word has a score of 1 (like "broken vase"), it means the connection is weaker – but it might still make sense depending on the context.

Read the story.
One day, Hoo and Ray stumbled upon a mystery that really confused them. Their cat Kitty wasn't feeling well and nothing seemed to help. "What if we tried some wire around the edge?" suggested Hoo, pulling out a shiny copper coil. But Kitty just sighed.

"What if it needs some oil for the joints?" Ray added. Hoo agreed and brought some oil, but Kitty just looked annoyed and rolled out of sight. The robot friends felt lost. "Maybe we should try updating her program?" Ray offered.

What would you do in Hoo and Ray's place to cheer up the sad Kitty?
Do you have any ideas that might make her happy?

Hoo had an idea: "What if we asked the language model for help? Maybe we'll find the answer there!" Ray agreed, and Hoo dove into the universe of words inside the language model. After a while, he came back with a completely puzzled look. "Ray, Kitty needs... a giant bat to scratch behind her ears!" he said, just as surprised as Ray.

Ray stared at him. "That makes no sense! You got lost in the word connections. Instead of 'cat,' you ended up with 'bat' – probably through some weird mix-up!"

Hoo thought for a moment. "Maybe it's not that far off. Cats and bats do have something in common – they're both kind of soft and fuzzy... And they both have secret night missions!" Ray laughed. "That's true!" "But still, maybe we should get back to the right connection. Let's focus on what Kitty really needs."

So Ray asked the language model again, and this time they got it right. Eventually, they found something much closer in meaning: "cat – pet – comfort – human." Ray lit up. "Now I get it! A cat should be cared for by a person, not a robot!" Hoo agreed. "What if we gave Kitty to Carl? He loves cats!"

When the robots brought Kitty to Carl, he was thrilled. "For me? A cat? That's the nicest thing that could've happened!" Kitty curled up in his arms and began to purr. "See, Ray? The language model may have taken a few wrong turns, but it finally led us to the answer." Kitty was happy, Carl was overjoyed – and the team was free for their next adventure!

First activity

Presentation slide 08

min 22

Help the robots understand what cats need. Create a word universe around "cat."
Friends, we've got a worksheet (page 09) full of pictures all about cats. Help us understand everything that belongs to a cat's life and what things are connected to it.

Spread out and organize the pictures.
Start by laying out the pictures (e.g. ball, mouse, milk) and place them on a sheet of paper closer or farther from the cat, depending on how important or closely related you think they are. You can also stick them onto a bigger poster.

Add more drawings.
In the empty spaces, draw (or have the kids draw) more items that belong in the cat world – things they come up with, like claws or a ball of yarn.

Connect the pictures with lines and add numbers showing how closely they relate.
Draw lines between the items you think are connected. They don't all have to link directly to the cat – even a bowl and milk, for example, can be strongly related. For each connection, add a number between 1 and 10 to show how strongly you think the words are related. A 1 means barely related, a 10 means very closely connected. This way, you'll create a small "map" that Hoo and Ray can follow to understand how to care for Kitty.

Second activity

min 35

Do this activity with the kids if there's time left. Have the children pair up and explain their cat-word map to each other in their own words.
For example, if their map connects a faucet and a cat bed and they gave it a 10, they should explain why they think those belong together. If they rated the connection between a cat bed and a cat at 10, that counts too! They can even try to tell a story – maybe about feeding a cat or caring for it.

Reflect

min 35

Read the story.
Dear kids! Hoo and Ray want to thank you for helping them uncover the mysteries of the strange and magical universe of words! We hope you enjoyed the adventure as much as they did. Today, you got a glimpse of how a language model works. A real language model is actually much more complex! It contains billions of word combinations and patterns. And thanks to it, chatbots (robots) and other machines can talk to people!

Explain how you think language models generate answers. What do you think is key to how they work?
Language models work by "reading" huge amounts of text and learning which words often appear together. When you ask them a question or give them a prompt, they try to choose the most likely word that should come next to form a meaningful answer. Models don't actually understand meaning the way people do – they just follow patterns found in the text they've read. That's why their answers sometimes sound correct but actually don't make sense.

Do you think everything a language model generates can be trusted?
No, it can't. Language models create sentences based on what they've read, but that doesn't always mean it's true or accurate. Just because something sounds right doesn't mean it is. You should always double-check the information – either in another source, by asking someone, or by thinking it through yourself.

Why do some answers end up making no sense, like when Hoo found a giant bat instead of something to help Kitty?
Language models base their answers on data – but that data comes from huge amounts of text, some of which might include mistakes or confusing word relationships. Since they don't understand words like humans do, they can easily mix up things that sound or look related, like "cat" and "bat."
That's why experience and human judgment matter. Adults and experienced readers can usually spot when something feels of. That's also why it's so important to think critically, check connections, and always ask whether something really makes sense.

Presentation slide 09

Students complete one or more of the following sentences:

What surprised me most is that large language models _____.
Sample answers: What surprised me most is that large language models basically just combine words without actually knowing what they mean.
I was surprised that models don't choose answers based on what's right, but based on what they've seen most often in texts. That means they can sometimes get things wrong.

I think language models can be useful when _____.
Sample answers: I think language models can be useful when we need advice or are looking for ideas, because they give us lots of options. But we should be careful, because not all of their answers are correct. They can also be good helpers when we need something explained simply or when we want to find out what a word means. But we always need to double-check.

I was surprised that language models can sometimes _____.
Sample answers: I was surprised that they can make mistakes when they don't have enough information or haven't seen something in the texts they learned from. Large language models can't tell what's actually important – like whether a cat needs marmalade. They just connect words based on what seems likely.

If there's extra time

min 45

Chatbot

Try out how a real chatbot works with your children.
Children under 13 cannot use chatbots on their own. So instead, display a chatbot application on the board for the whole class. Most require registration in advance. Explain to the students that a chatbot works thanks to a language model inside it.

Students can ask the chatbot questions, for example, about how language models work. They can also ask the chatbot to explain things in a way they can understand.

Available tools:

ChatGPT
Chatbot by OpenAI. Limited use is available for free.

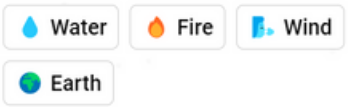
Microsoft Copilot
Chatbot by Microsoft. Limited use is available for free. No registration required. Age restrictions do not apply without signing in.

Claude AI
Chatbot by Anthropic. Requires login, offers a free version, and is available from age 18.

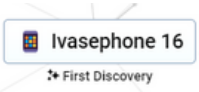
Google Gemini
Chatbot by Google. Free to use. Requires registration and is only available from age 18.

Infinite Craft

Try the Infinite Craft app with your students.
IPeople all over the world play Infinite Craft. The game starts the same way for everyone – each player gets access to 4 basic words:



From the right-hand column, the player drags one of the words onto the play area. Then they drag another word (the same or different) onto the first one. In some cases, this creates a new word, which then appears back in the right column. By combining and recombining words, players create new ones. Many words have already been discovered by other players, so it's rare to find one that hasn't been made yet. When you do, it's called a First Discovery – a brand-new word that no one has created before. These newly created words are saved in the Infinite Craft database. That means the player who discovered it will no longer see it marked as a First Discovery. At the moment, these first-time words are rare, and when they do appear, they sometimes don't make sense. The words are generated using generative artificial intelligence – specifically, a large language model, the same kind of system that powers ChatGPT.



Cut out the pictures and place them around the cat based on how closely they relate to it.
Don't forget to connect them with arrows and add numbers showing how strong the connection is.

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