Photon

AI Teaching Kit

The AI Kit is a ready-to-use solution dedicated to educators who would like to introduce their students to artificial intelligence technology. The dedicated resources help educators learn how to talk about artificial intelligence and how to develop critical thinking skills in children so that they are conscious technology users.

What's in the Kit:

- 1 x Photon Robot
- 10x Lesson plans - Path A (Grades 1-3)
- 10x Lesson plans - Path B (Grades 4-5)
- 1x Smart City Educational mat
- 1x Tablet mount
- 19x Character / Traffic lights flashcards
- 9x Building models
- 54x Building signs
- 1x Roadblock
- 1x Refrigerator / Tic-tac-toe board
- 19x Food / tic-tac-toe cards
- 1x Set of flashcard stands

Why AI Teaching Kit?

The term artificial intelligence might seem like something straight out of a sci-fi movie. However, in the contemporary world it is not just a norm, but a necessity. Giants like Google, Facebook, Microsoft, or Amazon all use AI to remain competitive. As time passes, we are growing more closely attached to the immeasurable potential of this technology. Understanding AI will help students utilize it more efficiently and responsibly and will prepare them for the modern job market.

The kit is based on 10 classes that help to find out:

- What is artificial intelligence?
- How Does AI Work?
- What contributes to AI effectiveness?
- And put into practice selected AI solutions.

Older students have an additional opportunity to take a closer look at the importance of input data quality and learn about ethical issues related to AI use. The kit encourages students to explore AI-based solutions in their everyday lives.

The city model included in the kit helps students develop many AI-related competencies and put them into practice. Students receive an opportunity to build a city model from ready-made elements. By completing subsequent classes, students discover selected practical applications of artificial intelligence in everyday life scenarios.

Our **dedicated apps** assist students in training the artificial intelligence algorithm for the Photon Robot, which later could be turned into, among others, a smart cash register, smart refrigerator, autonomous vehicle, detective, or chatbot. Analysis of the Photon Robot's performance allows students to learn about the efficiency of training, understand the importance of the quantity and quality of the input data in the training model, and discuss AI technology use in everyday life.

Target groups:

The AI Kit is suitable for children aged 7-12. (Grades 1-5). The AI Kit offers a choice of two development paths based on the shared concept, each consisting of 10 classes.

Path 1: dedicated to younger students, aged 7-9 (Grades 1-3) which is based on the integrated learning system in classes. Each class lasts approximately 90 minutes. Additional selected off-line exercises help students to deepen their knowledge about the AI technology, and at the same time, enable to study other core curriculum subjects (e.g. maths, arts, language, natural sciences, etc).

Path 2: dedicated to older students, aged 10-12 (Grades 4-5) is a set of lesson plans conducted in computer science classes. Each class lasts approximately 45 minutes and focuses on technology solutions. In the Path 2 lesson scenarios, students pay more attention to analyzing the implications and consequences of AI technology use, the importance of the input model data quality, and ethical issues.

A detailed description of both paths is available here:
https://drive.google.com/file/d/1BZEc6u94toUMvTFYSYbI0c5mU_q3Fku7/view?usp=sharing

Teachers also receive a list of additional inspirations and resources, such as external tools based on artificial intelligence, which could be used as a starting point for in-class discussions on the use of AI technologies in everyday life.

Educators are free to combine exercises from both developmental paths and adapt them to their groups, students' abilities, and working environment.

Competencies and areas covered in the Kit:

Creativity & Real-Life Use

Students develop their creative skills by adding different buildings & places to the model of the city and developing their original AI systems. Furthermore, they learn about the uses of AI in real life, such as using AI in supporting the visually impaired.

Mathematical Skills

Students improve their understanding of spatial relationships, perform mathematical operations in memory, and try to outpace the AI at calculating.

Computer Science Skills

Students develop coding skills by programming the robot's actions and create their AI systems. In order to do that, they must first learn basic computer and programming skills.

Modern Job Market Skills

By learning how to program the robot and creating their own AI systems, students prepare for the modern job market in a fun, approachable manner.

Applying Acquired Knowledge in Real Life

Students learn about a multitude of uses of AI in real life, such as supporting the daily lives of the visually impaired.

Path 1

Title and Curriculum	Subject Area and Description
City - Road - Traffic - Students learn that technology to make vehicles move autonomously exists - Students learn examples of data required by such vehicles to operate	**Language education; Social Education; Technical Education; Arts** Students as a group design and build an urban space. They use a city base plan (a dedicated mat), put together model buildings, shop front signs, traffic signs, bus stops, CCTV systems, and urban green areas. The created city model should be treated as a concept space to analyze / find answers to the following question: Can a car drive itself (without a driver)? Students discuss whether this is possible and necessary. Together they watch and analyze an animation about self-driving vehicles. Students discuss all the information (road signs, traffic lights, road traffic volume, image recognition) that these vehicles/cars require to reach their destination safely.
Route - Robot - Programming - Students learn the definitions of programming and algorithm - Students learn the difference between a programmed machine and a machine equipped with artificial intelligence	**Arts, Computer Science** Using the previous class knowledge (moving around the city), students program the robot to reach a specific place in the built city model. Students discuss potential routes, the number of options, and what happens if the shop they wanted to visit changes its location. Students must come up with a list of vital things for the robot to solve this problem (they need to teach the robot to analyze information on the building/shop front signs).
Image - Robot - Data - Students learn that it is possible to teach machines to recognize images. - Students learn to indicate the data required to teach machines. - Students learn that the AI model does not “learn” on its own but learns on data provided by humans. - Students can explain the concept of artificial intelligence in their own words. - Students create and test a learning model.	**Computer Science, Biology, Maths** Students explain how the robot knows correct reactions/actions to take at crossroads with the traffic lights using previous class knowledge. Students try to find out where do they get the knowledge themselves to solve problems like this. How can a machine know this? How can we teach machines to solve such problems? Ask students to test their traffic lights recognition model on the built city model. Students learn the definition of artificial intelligence – the key feature that allows robots to analyze data/learn like humans.
Text - Robot - Data - Students learn that it is possible to teach machines to recognize text. - Students learn that the efficiency of the AI model depends on the amount and quality of information. - Students learn how to create and test a learning model.	**Computer Science, Language Education, Arts** While moving around the model city, the robot may come across more than just road signs. It could also be other information, such as shop front signs or external building signage with information on each building’s purpose. While the traffic lights presented in the previous example are quite universal, then signage can vary - after all, there are many different typefaces, languages, even handwriting styles. Students perform an experiment: they prepare a handwritten storefront sign to determine if the machine recognizes it without any problems. Students try to answer several questions about machine text/image recognition. Is it possible to teach a machine to recognize text? Is it more difficult for a machine to recognize text than images? When could this technology be useful? What happens if signs are in different languages?

Path 1

Title and Curriculum	Subject Area and Description
Store checkout - Shop - Photon - Students learn about the idea of a smart store (smart checkout) and how it works. - Students learn about the idea of machine learning. - Students learn how to teach a machine to recognize images. - Students learn how to create and test a learning model.	**Biology, Maths, Arts, Language Education** Students find a grocery store on their city model and must come up with several ways to turn a traditional cash register (a checkout) into a smart cash register. Students use the knowledge from previous classes - image recognition, text recognition. Students turn the Photon robot into an intelligent/smart cash register that quickly and efficiently analyzes the contents of a basket/shopping cart and calculates the products' total cash value. To make this possible, students train the robot to recognize products available in the shop and assign them prices according to a prepared price list.
Refrigerator - Shopping - Information - Students learn about the concept of the Internet of Things. - Students learn what other objects belong to the group of the Internet of Things, e.g., smartphones, smartwatches, and traffic lights - Students learn how to create and test a learning model.	**Biology, Arts, Computer Science** Refer to the previous class and ask students to analyze how we do the weekly shopping and how we could make it easier, i.e., grocery shopping. Students come up with ideas that help us shop (creating a shopping list), issues we have with shopping (we forget products, buy too much, too little). Students analyze the provided images of fridge contents and create shopping lists based on the contents. Students teach the robot to analyze fridge contents; the shopping list must be based on the analysis results.
Shopping List - Shopping - Route - Students learn about the idea of an autonomous vehicle and how it works. - Students learn that robots make mistakes.	**Biology, Arts, Computer Science** Using the shopping list from the previous class, students analyze possible routes for the robot to make sure the robot restocks the fridge quickly and efficiently; then, use the app to write an appropriate program. Students check if the route they choose is the same as the path automatically generated by the robot based on the shopping list. In reference to the first class, students learn what an autonomous vehicle is; they make a list of data sets required by the robot and ways to collect and analyze them in the most efficient way. In small groups, using available materials, students design and present their autonomous vehicle prototypes.
Camera - Robot - Trouble - Students learn that it is possible to teach machines to recognize faces. - Students create models and put them into practice. - Students learn that the efficiency of their model depends on the amount and quality of information.	**Language Education, Arts, Computer Science** Together with the Photon Robot, the students are on a mission to find a thief who robbed the city bank. Based on the information provided, students create a facial composite of a suspect, then analyze the CCTV footage to find the criminal's hiding place. Students consider competing with the robot - who will find the thief in less time. Students discuss the most optimal placement of the CCTV cameras to make the city safer.

Path 1

Title and Curriculum	Subject Area and Description
Game - Robot - Fun - Students use the image recognition model to create a robot-player (a play companion) - Students create models and put them into practice. - Students learn that the efficiency of their model depends on the amount and quality of information.	**Maths, Computer Science** While exploring the city, students arrive at a playground with a tic-tac-toe board. The students play several rounds to identify the game rules, as this is the basis for their attempt to teach these rules to the robot. The trained robot must be able to win the game. Later, students test the quality and effectiveness of their training by playing against the robot. Students discuss any other games where humans could play against a machine.
Conversation - Robot - Information - Students learn about the concept of a chatbot. - Students learn the pros and cons of using bots in everyday life.	**Language Education, Computer Science** In the last session, students attempt to have a conversation with a robot. Children pick a point at the city model base plan, and the robot's aim is to guess it. In this class, students learn about virtual assistants and how to design their own chatbots. Using previous class knowledge, students discuss the use of virtual assistants in vehicles, refrigerators, or shops.

Path 2

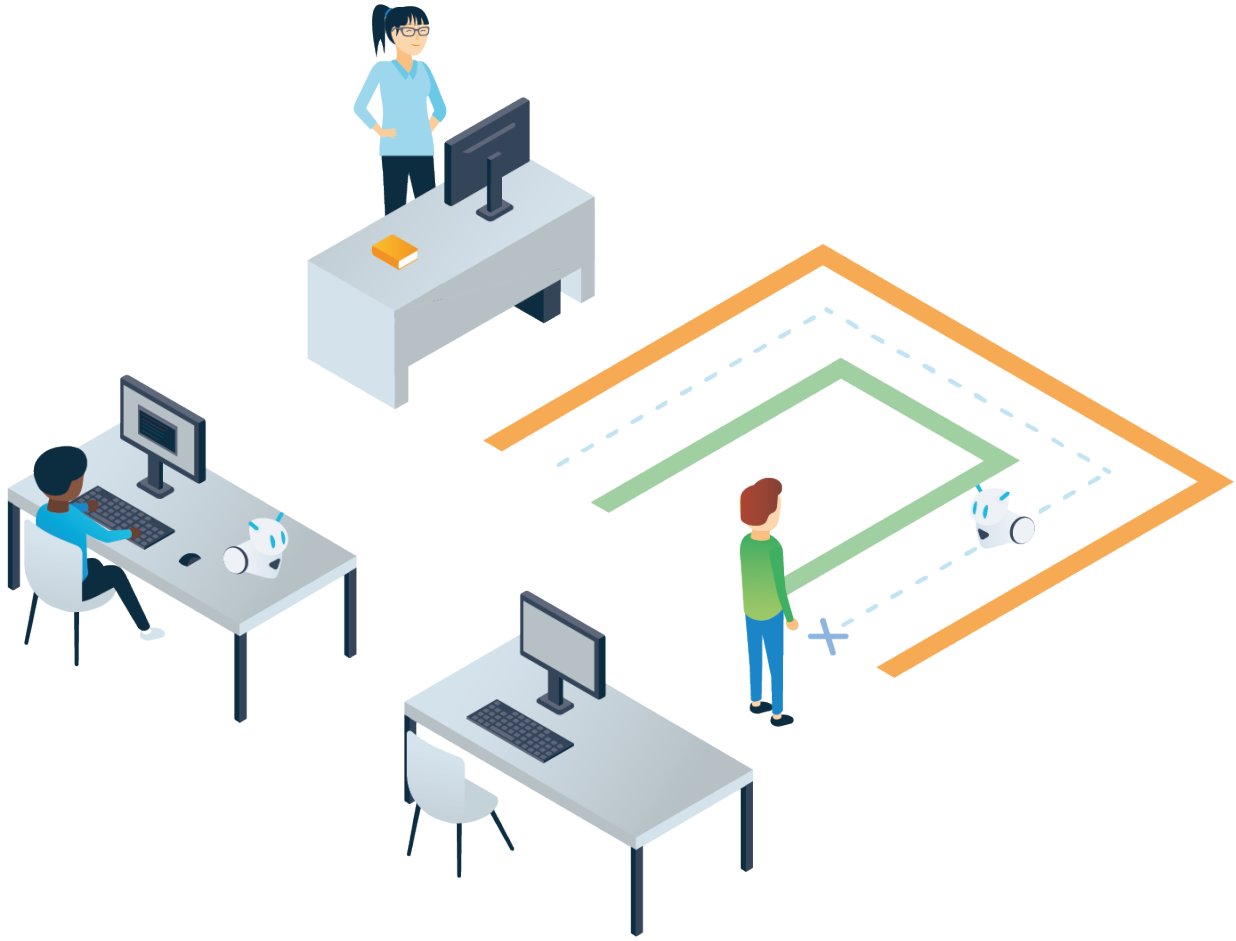
Title and Curriculum	Description
City - Road - Traffic - Students learn that technology to make vehicles move autonomously exists. - Students learn examples of data required by such vehicles to operate. - Students learn that autonomous vehicles (self-driving cars) already exist.	Students try to answer the following question during the class: Can a car drive itself (without a driver)? Students analyze and discuss the topic, try to answer whether it's possible, how it could be done, and if we need this kind of solution. Together they watch and analyze an animation about self-driving cars moving in city traffic. Students discuss all the information (road signs, traffic lights, road traffic volume, image recognition) that these vehicles/cars require to reach their destination safely.
Route - Robot - Programming - Students learn the definitions of programming and algorithm - Students learn the difference between a programmed machine and a machine equipped with artificial intelligence	Using the previous class knowledge (moving around the city), students program the robot to reach a specific place in the built city model. Students discuss potential routes, the number of options, and what happens if the shop they wanted to visit changes its location. Students must come up with a list of vital things for the robot to solve this problem (they need to teach the robot to analyze information on the building/shop front signs).

Path 2

Title and Curriculum	Description
Image - Robot - Data - Students learn that it is possible to teach machines to recognize images. - Students learn to indicate data required to teach machines. - Students learn that the AI model does not “learn” on its own, but learns on data provided by humans. - Students can explain the concept of artificial intelligence in their own words. - Students learn how to create and test a learning model.	Using the previous class knowledge, students try to explain how the robot knows correct reactions/actions to take at the crossroads with traffic lights, with a stop sign, or drive ahead only / turn left / turn right signs. Students try to find out where do they get the knowledge from themselves to solve problems like this. How can a machine know this? How can we teach machines to solve such problems? Using the available graphics, students train the robot and test the road sign recognition efficiency on the city model. Students learn the definition of artificial intelligence – the key feature that allows robots to analyze data/learn like humans. Students propose a list of every day/practical applications of the image recognition and analysis systems.
Text - Robot - Data - Students learn that it is possible to teach machines to recognize text. Students learn that any machine learning model's efficiency depends on the amount and quality of information. - Students learn how to create and test a learning model. - Students learn about OCR technology.	While moving around the model city, the robot may come across more than just road signs; it could also be other information, such as shop front signs or external building signage with information on each building’s purpose. While the traffic lights presented in the previous example are rather universal, then building signage can vary - after all, there are many typefaces, fonts, languages, even handwriting styles. Students try to answer several questions about machine text recognition possibilities. Is it more difficult for a machine to recognize text than humans? When could this technology be useful? What happens if signs are in different languages? Using the available graphics, students train the robot and test the automatic text recognition efficiency based on the shop front signs provided with the kit. Students learn about the OCR technology and test the Google Translate tool.
Store Checkout - Shop - Photon - Students learn about the idea of a smart store (smart checkout) and how it works. - Students learn of the pros and cons of using AI in sales/commerce. - Students get familiar with the idea of machine learning. - Students learn how to teach a machine to recognize images. - Students learn how to create a learning model.	Students think of several ways to turn a traditional cash register (check out) into a smart cash register. Students use the knowledge from previous classes - image recognition, text recognition. Students try to turn the Photon robot into an intelligent/smart cash register that quickly and efficiently analyzes the contents of a basket/shopping cart and calculates the total value of the products. To make this possible, students train the robot to recognize products available in the shop and assign them prices according to a prepared price list. Once the robot is trained, students move on to testing. Students come up with other technological solutions for sales/commerce that could be based on artificial intelligence.
Route - Vehicle - Obstacles - Students learn how an autonomous vehicle works - Students learn about the concept of the Internet of Things. - Students test implemented solutions - Students learn of the pros and cons of using AI in automotive solutions. - Students analyze how the training data used affects the AI model’s performance.	Using the first and following classes knowledge, students learn how an autonomous vehicle works. Students turn the Photon Robot into a shopping delivery man who will plan the route and set out to get all the required products. Students discuss several situations, incidents, issues a vehicle may encounter on the road. Students test how the Photon Robot uses sensors, among others, the distance sensor, how the Photon Robot reacts to traffic jams, road works, or other real-life situations on the road.

Path 2

Title and Curriculum	Description
Camera - Robot - Trouble - Students learn that it is possible to teach machines to recognize faces. - Students learn about the concept of artificial neural networks. - Students create AI models and put them into practice. - Students learn that the efficiency of their model depends on the amount and quality of information. - Students learn about potential machine errors, related ethical issues, and mistakes made by technologies based on artificial intelligence. - Students learn about the pros and cons of CCTV systems."	Together with the Photon Robot, the students are on a mission to find a thief who robbed the city bank. Based on the information provided, students create a facial composite of a suspect, then analyze the CCTV footage to find the criminal's hiding place. Students consider competing with the robot - who will find the thief in less time. Students discuss the most optimal placement of the CCTV cameras to make the city safer. During the class, we signal to students the issue of errors, ethics, mistakes made by technologies based on artificial intelligence.
Safety - Ethics - Application - Students learn about the concept of a BIAS - Students learn about the relationship between used data and AI developers and AI models performance/efficiency. - Students learn to identify risks associated with the use of AI in such areas as autonomous vehicles, commerce, security.	Using the previous class knowledge, students try to answer the following questions: is artificial intelligence a threat to our safety; how does training data affect the results; can artificial intelligence discriminate people; can the data provided be biased; can AI reproduce human errors? What happens if artificial intelligence gets it wrong when it comes to indicating the criminal? Students discuss different ways to solve these issues. Students pay attention to the quality and quantity of training data.
Conversation - Robot - Information Part 1 - Students learn the definition of a chatbot and virtual assistant. - Students learn the pros and cons of using bots in everyday life. - Students create a simple chatbot framework.	Students discuss various possibilities of having a conversation with a robot (how to communicate with a machine). Students learn about the history of chatbots and virtual assistants. Students test a bot provided during the class and discuss the potential use and benefits of that technology. Students learn how to prepare a simple bot of their choice.
Conversation - Robot - Information Part 2 - Students learn about the concept of a chatbot. - Students learn the pros and cons of using bots in everyday life. - Students learn how to test chatbot's efficiency - Students learn about the Turing test - Students create a simple chatbot framework.	Using previous class knowledge, students create a bot on their own computers - they prepare a simple database with questions and answers on the topic of their choice. In the end, students test each others bots. Students learn about the Turing test.



How to work with the Kit

Students develop competencies through practical activities by constructing a cityscape using ready-made elements, and then, by performing subsequent exercises. They discover various ways of using artificial intelligence in everyday life. Using a dedicated app, they will take part in developing the Photon Robot's AI.

Among other things, the robot can transform into an intelligent cash register, a refrigerator, an autonomous vehicle, a police detective, or a chatbot. By performing custom-designed experiments, they will have an opportunity to see the effects of their work in real life, examine the importance of quantity and quality of the training data, and explore the uses of the tested technology in everyday life.