Photon

Artificial Intelligence

Get to know your teaching kit

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Congratulations

on choosing the Artificial Intelligence Teaching Kit!

Let's begin our adventure with artificial intelligence! While the term Artificial Intelligence may still sound unfamiliar to many, learning the concept behind it is a must in our technologically advanced world. We are becoming increasingly attached to new technological solutions that make our lives easier on so many levels.

The tech giants, such as Google, Facebook and Microsoft, use artificial intelligence to increase their competitiveness and effectiveness. The latest technology allows us to open up to new opportunities and prepare students for the demands of the modern-day job market. Let's explore the fascinating world of artificial intelligence!

Your kit and the U.S. teaching standards

Like the rest of our technology-driven solutions, the AI Teaching Kit aligns seamlessly with the ISTE Standards for Students and forms a teaching ecosystem where educators can design meaningful and cutting-edge learning experiences that are both inclusive and cost-effective.

Our products conform to selected Common Core State Standards: Literacy (writing, reading, speaking, and listening) and basic math (operations and algebraic thinking, measurement and data).

The Photon AI Teaching Kit is the most innovative teaching product we have ever created. When creating the Kit, we ensured to incorporate the latest approaches currently being developed by AI4K12.org (an NGO developing national guidelines for AI education for K-12).

Get to know your teaching kit

With the Photon Artificial Intelligence Teaching Kit, you can introduce your students to the fascinating world of artificial intelligence (AI for short). This advanced technology is already widely used in our everyday lives.

The AI Kit is a complete out-of-the-box teaching aid. The resources and our application are designed to help you and provide you with the necessary knowledge. Dedicated lesson scenarios guide you step-by-step through prepared activities and show you how to explain artificial intelligence and how to develop critical thinking skills in children, so they become informed users of this technology. You will learn domain-specific terms, as well as the basic principles of artificial intelligence to make sure you explain it in an attractive way to your students.
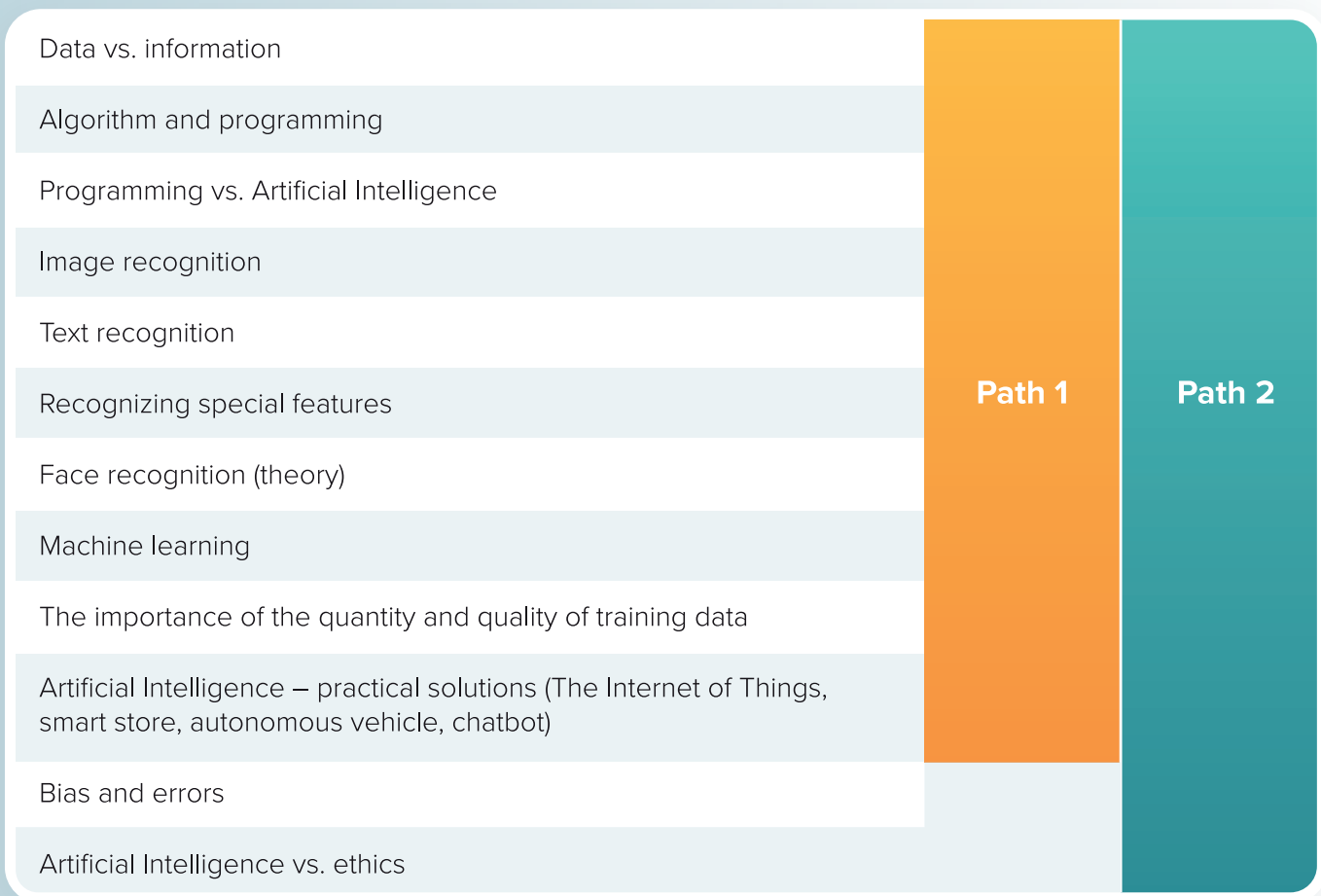
The target group – two learning paths

The AI Kit is suitable for children aged 7–12. In order to best adapt your classes and the resources to the age groups of your students, we have prepared two learning paths – for younger children (7–9 year olds) and older children (10–12 year olds). We have also made sure that the teaching paths fit into the core curriculum in your education system. Therefore, you can now conduct a series of classes introducing artificial intelligence during regular classes, not just extracurricular activities.

Each path consists of a series of 10 activities that, by progressive knowledge sharing, introduce students to the world of artificial intelligence. During this series of classes, your students will learn:

- What is artificial intelligence?
- How does AI work?
- What contributes to AI efficiency?
- How to put AI solutions into practice?

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

	Path 1	Path 2
Data vs. information	●	●
Algorithm and programming	●	●
Programming vs. Artificial Intelligence	●	●
Image recognition	●	●
Text recognition	●	●
Recognizing special features	●	●
Face recognition (theory)	●	●
Machine learning	●	●
The importance of the quantity and quality of training data	●	●
Artificial Intelligence – practical solutions (The Internet of Things, smart store, autonomous vehicle, chatbot)	●	●
Bias and errors		●
Artificial Intelligence vs. ethics		●

Path 1 – 10x90 minutes   **Path 2** – 10x45 minutes

Path 1

This path is dedicated to students aged **7–9**. The classes are based on the Integrated Learning System. Each lesson scenario includes a detailed description of the task at hand, with classes lasting 90 minutes.

Activities developing competencies in artificial intelligence are an integral part of each lesson scenario supported with many engaging activities. They enable the implementation of the core curriculum objectives set for other education domains, such as art, math, English, and science.

The entire series of activities from the AI Kit require using a tablet or an interactive whiteboard. You do not need access to a computer lab.

Classes conducted in this Path help to improve social competencies as well – students work in groups in almost every class. Each scenario assumes students' active participation in discussions on specific lesson topics, which helps students develop the ability to justify their opinions.

If you work as a teacher in the first grades of primary school, this path is the best choice for you and your students.

Path 2

This path is dedicated to students aged **10–12**. Classes in Path 2 are set to last 45 minutes and mainly focus on Artificial Intelligence, its everyday life use, and the ethics of AI-based solutions.

These have been prepared specifically for computer science classes conducted in a computer lab. In addition to lab computers, you also need a tablet or smartphone to control the robot.

Apart from learning about artificial intelligence, students improve other vital competencies related to computer science. In the classes, they need to take a task-oriented approach and work on improving their programming skills. They will learn the difference between data and information, how to improve their Internet research skills, and critical evaluation of information sources. Each lesson is an opportunity to improve students' justification skills, stimulate creativity, and promote teamwork.

If you work as an IT teacher in grades 4–6– this path is ideal for you and your students.

Based on Path 1 and Path 2, you are welcome to prepare your own set of activities focusing on specific needs and your own ideas. This way, you can create the ideal series of lesson scenarios that perfectly suit the needs of your students and their abilities.

What does the AI kit contain?

The Photon Artificial Intelligence Teaching Kit contains three types of teaching aids: lesson scenarios, hardware & software, and the smart city mat. When used together, you can conduct all of the planned AI Kit activities.
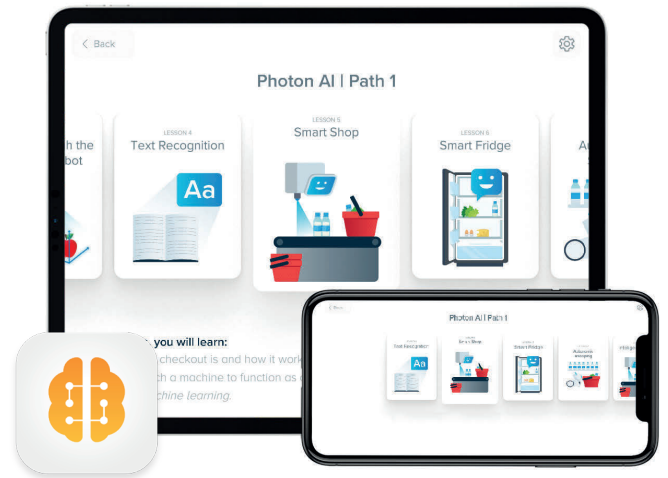
Teaching resources

- **Path 1** – A series of 10 lesson scenarios along with worksheets,
- **Path 2** – A series of 10 lesson scenarios with an attachment titled *Additional Inspirations – a collection of external resources.*

The above lesson scenarios are the starting point when working with the kit and are an integral part of the remaining components and accessories. They define how you organize and conduct activities and show you how and when to use the AI app and additional accessories. The lesson scenarios also contain tips and suggestions on external tools that you might find helpful when discussing specific topics.

Hardware and Software

- The *Photon AI* app,
- Tablet or smartphone **(not included in the Kit)** – to install the app,
- The Photon Robot
- A tablet holder – allows a tablet or smartphone with a camera to be attached to the robot.

These devices allow you to implement a hands-on AI teaching process and then test and verify its effectiveness by observing the robot's reaction. With a mobile device, you will be able to conduct all artificial intelligence training and experiments.

Accessories

- The smart city mat,
- Boards with a graphical representation of buildings to build a city (x9),
- External building signage in 6 languages (x9 in each kit),
- Flashcards and activity boards (traffic lights, road works sign, mock-up fridge board and tic-tac-toe game board, characters, magnetic flashcards of items to put in a fridge, tic-tac-toe flashcards to play with the robot),
- A set of stands to insert flashcards that are placed on the city mat.

Accessories to help you conduct the prepared activities – off-line, as well as those within the *Photon AI* app connecting with the robot. These elements are an integral part of the smart city model you first need to build and then expand in the following classes. There are tic-tac-toe game flashcards to play with the Photon Robot or things that help you turn the robot into a policeman looking for a bank robber in the city crowd.

Teaching resources

Lesson scenarios

For your convenience, we have prepared two independent publications with a collection of hand-picked lesson scenarios complementing the Path 1 and Path 2 scenarios. A table with a brief summary of the class activities is found at the beginning of each one.

Lesson scenarios structure

All the lesson scenarios share the same template. The first page contains a brief summary of a class, as well as basic instructions and information to help you prepare for the class – key objectives and a list of required resources.

Theoretical introduction

Each class begins with an introduction to the lesson topic, during which you will brainstorm and perform a variety of off-line activities. This section provides the necessary theoretical background for students. At this stage, you will frequently use the *Photon AI* app and the *Knowledge* module to learn interesting facts related to the main lesson topic.

Training AI

After the introduction, you can proceed to work with the application. At first, you can train the artificial intelligence by teaching it to recognize traffic lights colors, groceries, and places where you buy them. Depending on the scenario, you will be presented with one or two activities.

If there is anything you need to do for the first time (for example connecting to the robot), the lesson scenarios contain additional tips and screenshots from the app that will guide you step-by-step through the planned activities.

Experiments

In order to see how effective your AI learning algorithm is, you can run a set of experiments based on the training data you provided to the robot in the previous stage, for example, you can verify whether the robot correctly recognizes and reacts to the signboards placed on the mat, or whether it correctly recognizes food items and shops where you buy them.

Depending on the lesson scenario, you can conduct one, two, or three experiments at this stage. To carry them out, you need specific accessories. Information on which ones and how to use them is in the scenario and the application.

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Working with the app

Each time you need to use the app (*Knowledge*, *Training AI*, or *Experiments* modules), detailed information on how to find a specific activity is provided in the lesson scenario.

Time to teach the robot

- Introduce the children to their new task – teaching the robot to identify traffic light colors correctly. Refer them to the third lesson in the *Photon AI* app and the AI training section **(Path 1, Lesson 3, AI Training)**.

Featured content

Lesson scenarios often have additional text boxes with key information and tips. They can be found very easily in the scenario content.

Definitions

In the course of AI classes, you will introduce your students to several new terms. All of them are highlighted in the *Definition* text boxes

Tip

Anything that might help organize your classes, extra information and hints on adding new activities to proposed classes is available in the *Tip* text boxes.

Note

Technical requirements important from the app functionality point of view are listed in the *Note* text boxes.

See also...

Each scenario in the Path 2 set of lesson scenarios also features *See also...* text boxes. They refer you to the *External resources* table where you can find links to additional videos or apps related to the main discussion topic.

Worksheets for Path 1

To conduct Path 1 activities there are two additional worksheets (*Traffic signs observation sheet* – Class #3 and *Postcard template* – Class #10). Worksheet templates are on last pages in each scenario. Prepare the necessary number of photocopies according to the number of students in your class.

Additional inspirations – a collection of external resources for Path 2

This Path 2 dedicated resource focuses on already functioning artificial intelligence solutions implemented in our everyday lives. This collection contains links to external sources – videos on the already introduced content or applications based on the technologies being discussed. Due to the dynamic nature in this domain and for your convenience, this table is available online at:

https://photon.education/en/ai-discovery-inspirations/

About the *Photon AI* app

The AI app is the main tool to use in every class. It helps you train and test your artificial intelligence. The difference between the two learning paths is also reflected in the app. Depending on the path you choose, there are slightly different lesson plans and activities available. The application supports both paths. The decision on the path you want to follow is made on the very first screen.


There are 10 lessons for each path available in the app. Each lesson corresponds to a specific lesson scenario in the AI Kit. Selecting a lesson results in displaying a *In this class, you will learn* list in the lower part of the screen. This is a list of key objectives for each lesson.

Classes with the application – types of modules

- There are three types of modules in the app – *Knowledge*, *Training AI* and *Experiments*.
- Depending on the lesson scenario, there may be more than one *Training AI* and *Experiments* module. They are numbered separately to make them easier to find in the body of the text.
- The *Knowledge* and *Training AI* modules are always available in the app regardless of the connection to the robot. To carry out exercises from these modules, you can use additional tablets or computers (if you want your students to work in smaller groups).
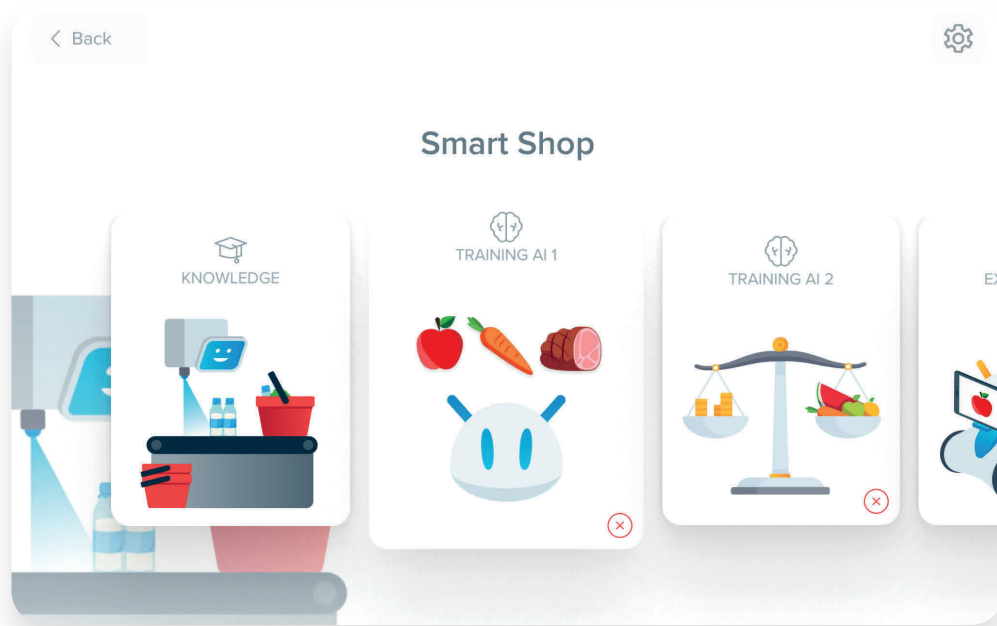
Knowledge

This is the most static part of the application. It is a collection of interesting facts related to the main topic of the class. In each lesson scenario, you have references to information from this module. The facts section is divided into three categories: concept, person, and date.
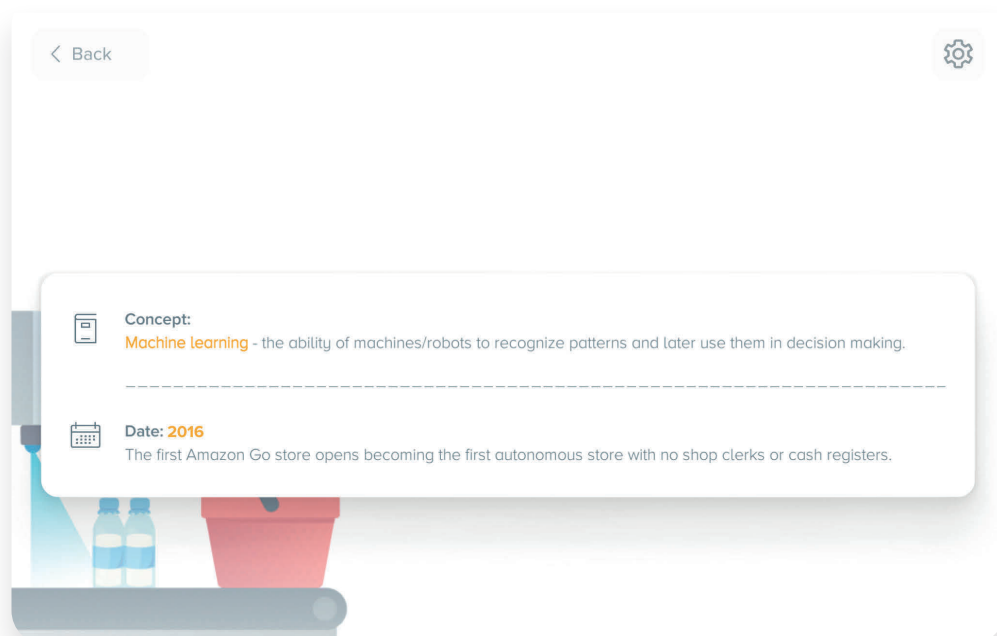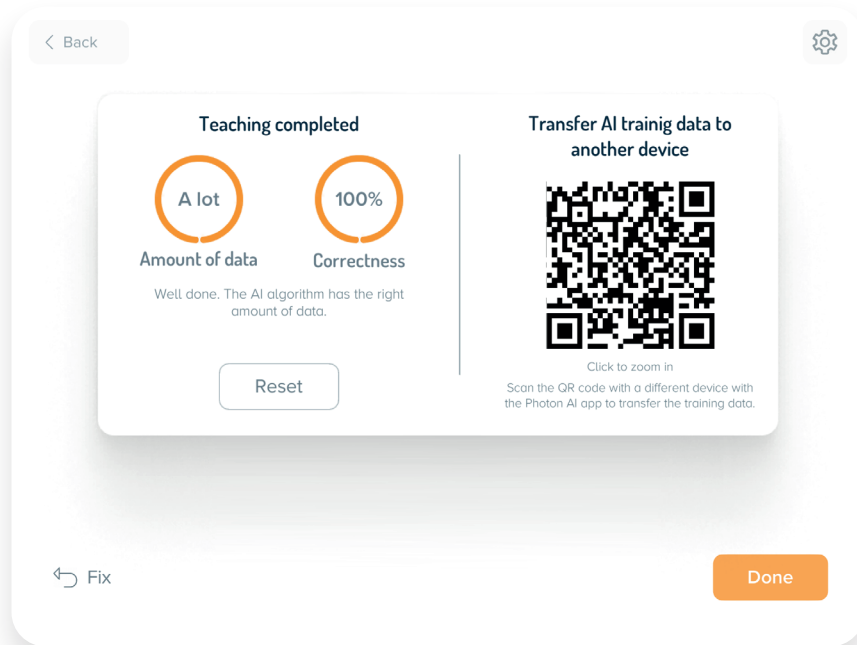
Training AI

In this module, your students will train the AI by providing it with relevant data. Depending on the scenario, the AI teaching process is slightly different. Most often, however, students are asked to choose correct answers based on the images shown.
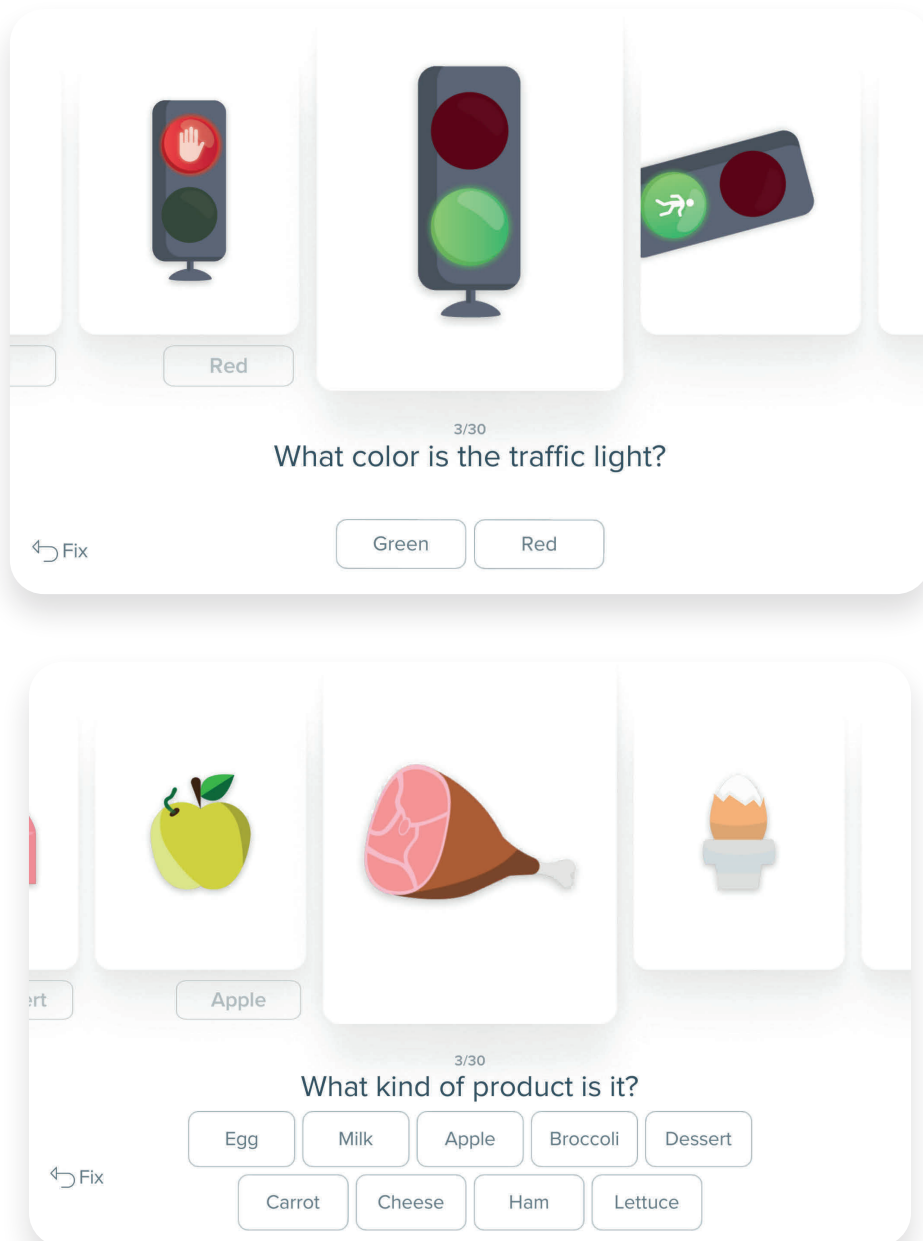

- There are usually 30 images to be analyzed in the *Training AI* module. You can correct any previously given answer at any time by clicking the *Fix* button. The application deletes the previous answer and allows you to provide a new one.
- After every ten (10) answers, a summary screen appears informing you of the AI training progress – the amount and quality of the provided data. If you are not satisfied with the data quality, click *Reset* to start the AI teaching process over. You can correct errors manually by using the *Fix* button and going back to your previous answers.
- Even if there is very little data (after the first 10 analyzed images), you can proceed with other experiments – in this case click the *Done* button.

- Please remember that the amount of collected data is of great importance in the AI module. The less data, the more unexpected mistakes the artificial intelligence can make during the experiment. Therefore, continuing the training of your AI algorithm till the end – by clicking *Keep teaching AI* is recommended.
- Given the above, you should see the *training AI summary* screen three times over the course of the module. These screens are significant because they also contain a QR Code allowing you to transfer the training data to another device. That feature helps to verify the training efficiency in a separate experiment (more information on data import, see the *Experiments* section in this guide).

- When you exit the *Training AI* module, by clicking the *Return* button, a green check mark appears on this module's tile – this means that the training part (or at least the first part of it) is complete, and you can move on to the experiment part. You can check your trained artificial intelligence "knowledge level" at any time. Just click the tile to display the summary screen.
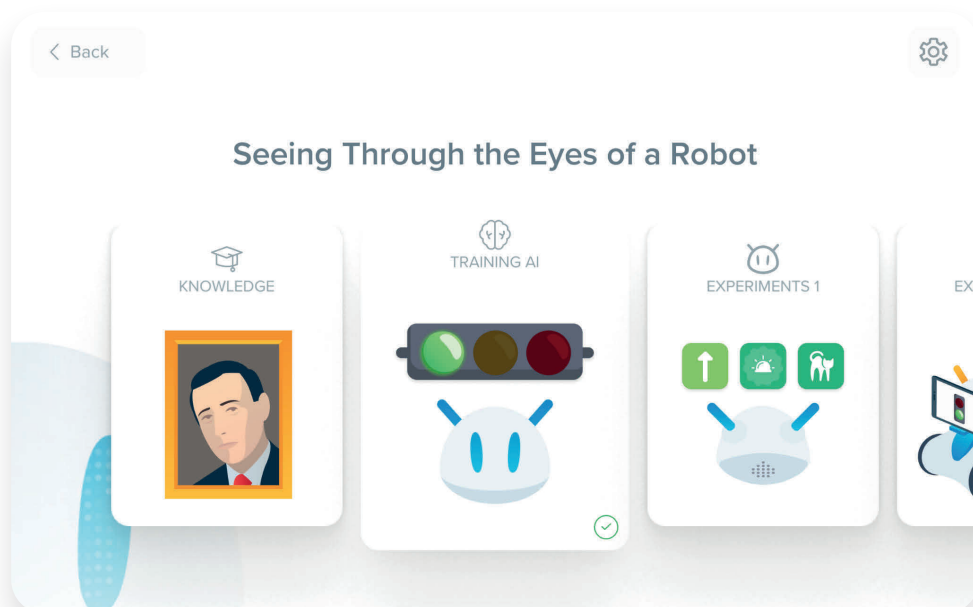
Class preparation – data export

Data from the *Training AI* module is used in experiments. To conduct experiment, you need a tablet or smartphone connected to the Photon Robot. However, this does not mean that the training and the experiment must take place on the same device.

To help you split your class into smaller groups working on the AI training using the equipment available in the school, we made it possible to share and import the data output from the completed training sessions. Thanks to this feature, regardless of whether the students trained artificial intelligence using computers, interactive whiteboards, or tablets not connected to the robot, you can test the efficiency of the AI training completed to date.

In order to do this, displaying the summary screen of a selected *Training AI* module that contains a corresponding QR Code is required. You need to use this code to load the data in the appropriate section in the *Experiments* module. To display the summary screen, click on the selected *Training AI* tile with a green check mark (on the device from which you want to download data).

The AI training method depends on you and your classroom or computer lab facilities. You can conduct artificial intelligence training:

- engage everyone using an interactive whiteboard, computer or tablet
- in small groups on tablets
- in small groups on desktop computers.

Experiments

Children are the most excited when working with this module of the application. Students have a real opportunity to see if their robot has learned anything, and how effective the artificial intelligence training was. Does it behave in the desired way? For example, will the robot stop when it detects a red light or which route it will take to the store to buy carrots missing in the fridge. Analysis of the Photon Robot's performance allows students to learn about the efficiency of training, understand the importance of quantity and quality of the input data in AI training process, and discuss the use of AI technology in everyday life.

In order to conduct experiments, you need a mobile device – a tablet or smartphone with a camera and the installed AI application, as well as an active connection to the Photon Robot.

During the experiments, the robot moves around the mat and reacts to surrounding objects. The Robot needs a camera to recognize images and signs. You need to attach a tablet/smartphone to the robot. This device also allows you to launch the experiment.
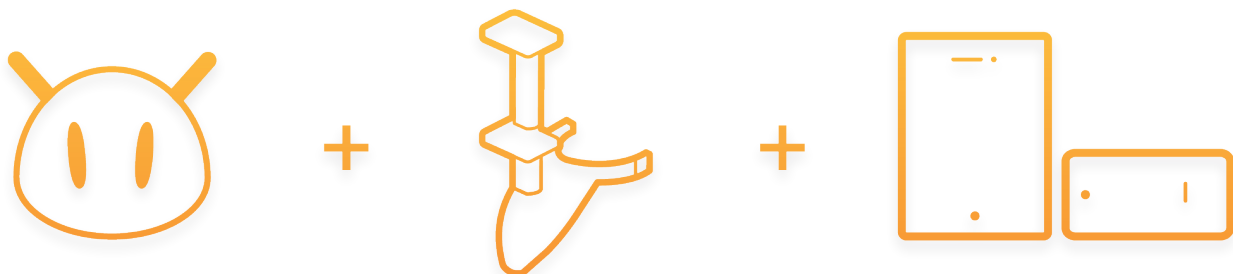
To do this, use our dedicated mobile device holder included in the kit. Attach the holder on the back of the robot and then place your tablet in it Important! In order for the application to recognize objects appearing on the robot's path, the camera needs to be on the right side of the robot (in the lower right corner).

If the Photon Robot is required to conduct AI experiments, you will see a notification on the screen. In specific cases, e.g. classes about chatbots, you do not need an active connection with the robot to conduct experiments in the application.
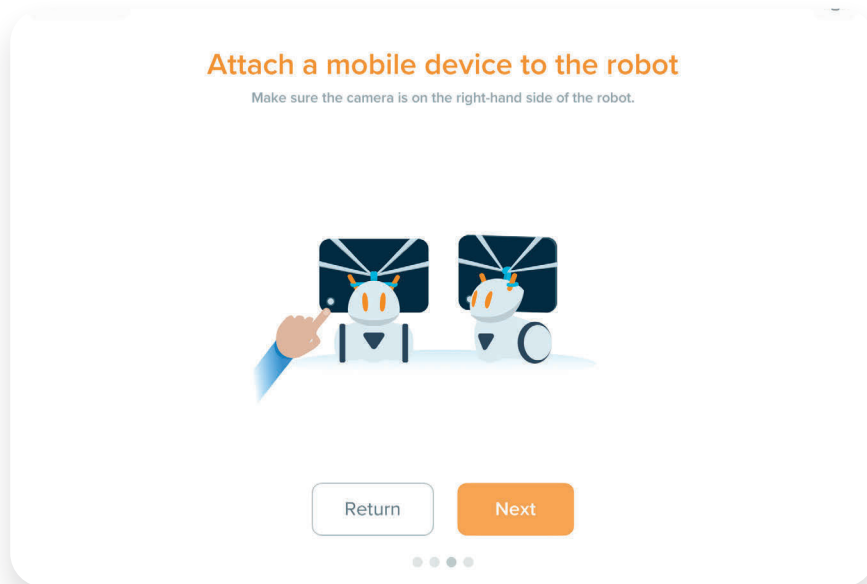

Connecting with the Photon Robot

- If an active connection to the Photon Robot is required to conduct an AI experiment, the app displays a specific message on the first screen.
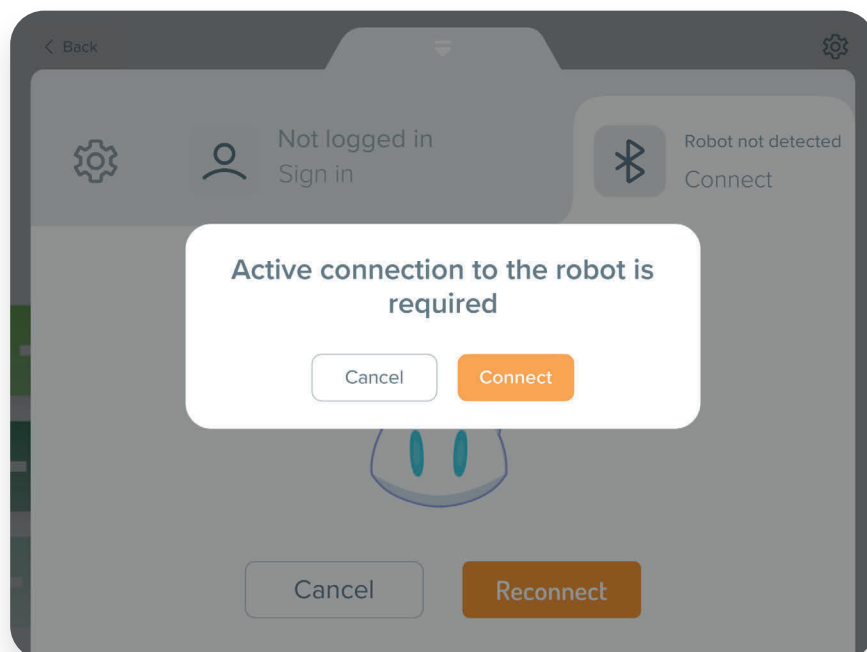
- At this point, you need to turn the robot on (press and hold down the button on its head). Then click *Connect*.
- The first time you launch the application, you will see a pop–up requesting access to your device's GPS location. Please click *Allow* or *OK* – this is mandatory, otherwise, our application won't find any robots in its surroundings.
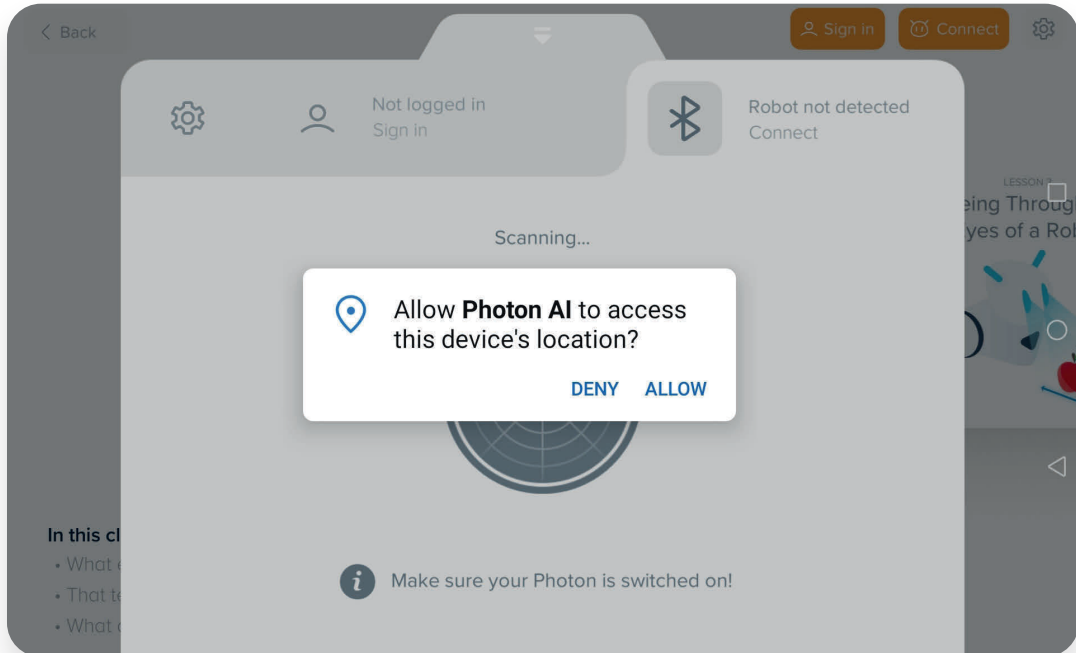

- If your device's Bluetooth is turned off, the application will ask for permission to turn it on. Click *Allow* for this action as well.
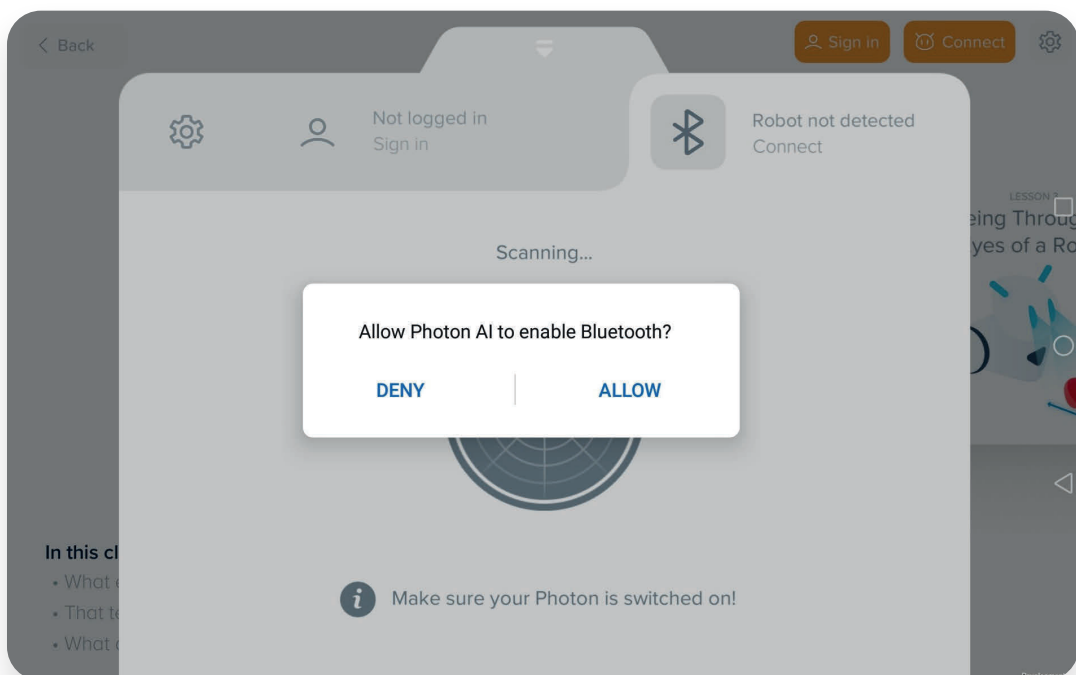
- Once done, the application starts scanning your immediate area for robots. At first, your Photon Robot's serial number appears on the screen (you can compare it with the serial number at the robot's chassis bottom).
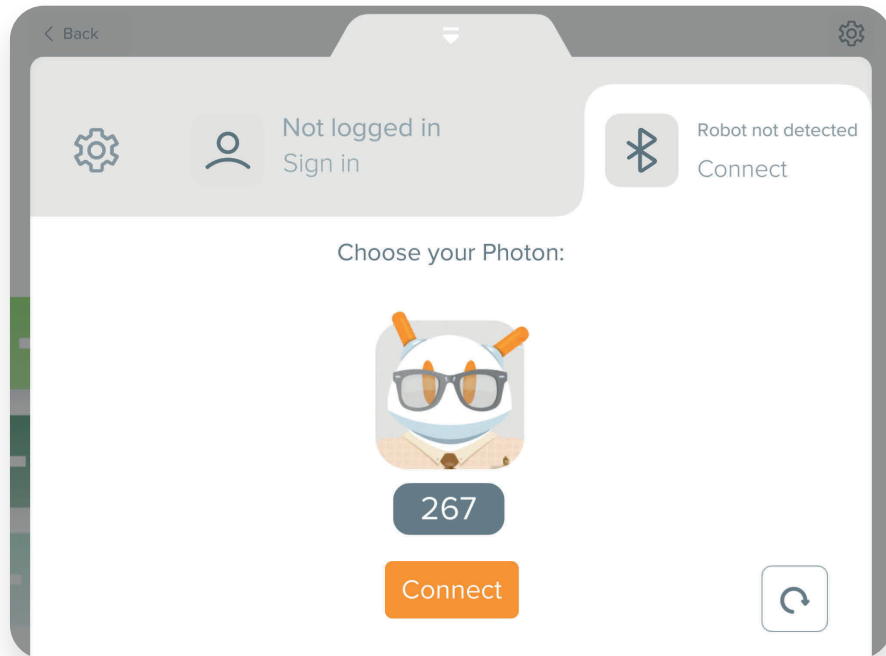
- If there are more robots, choose the one you need from the list then click *Connect* – that's it! Your Photon Robot is now ready for action!
- Successful connections are always confirmed on the tablet screen. Click anywhere on the robot image window to close it and proceed with the experiment.
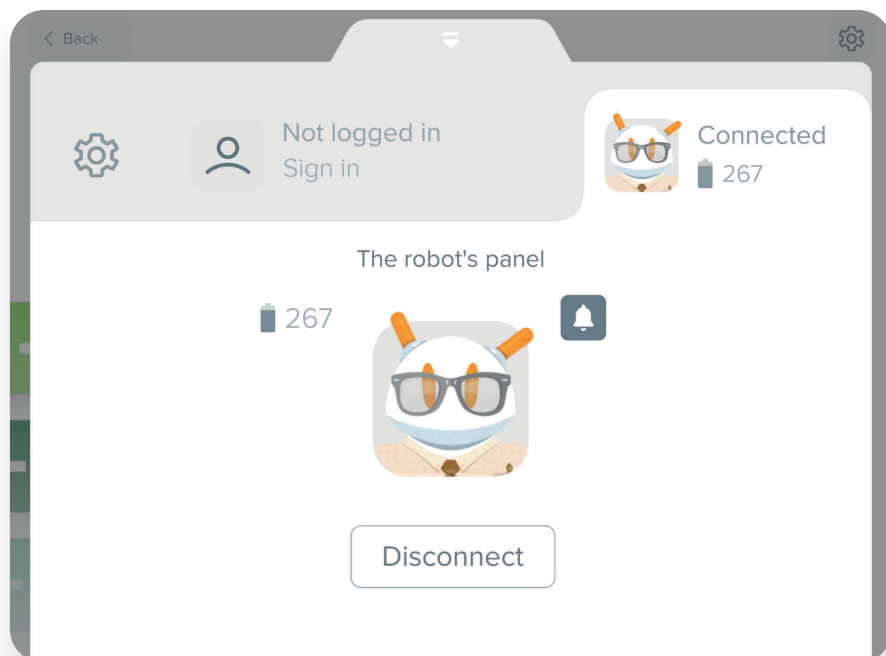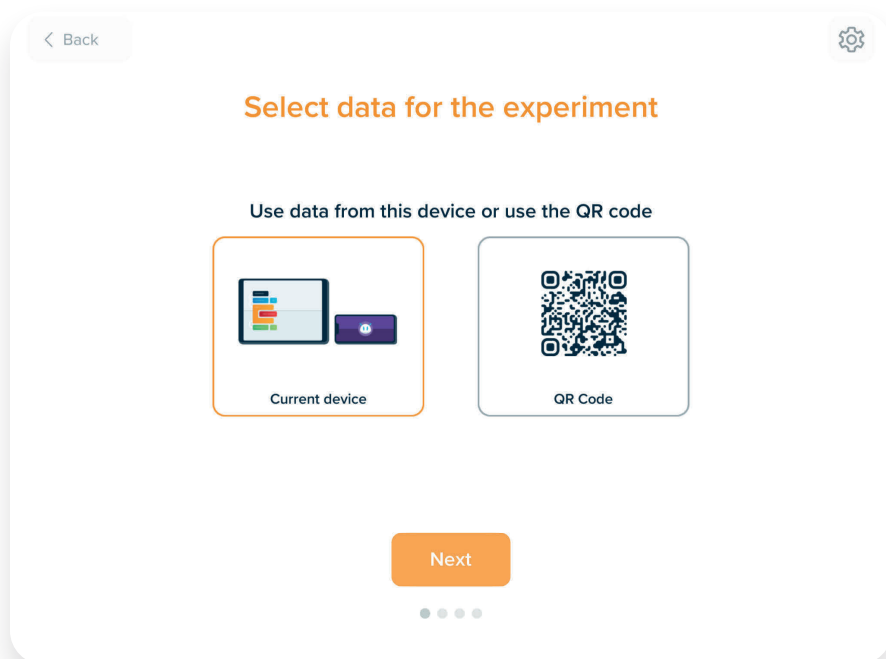
- You can also connect to the robot at any time from the settings menu.

Importing data from the *Training AI* module

To conduct the experiments, you need training data output – the effects of the completed learning process. Once you are in the *Experiments* module, you will be prompted to select data to use in testing.

- You will always have the option to use data from your current device – choose this option if you have trained AI together with the students on this tablet or if you want to test the AI learning progress of a group that has worked on this device.

- There is also a second option – import data from another device where AI training took place. Use this option if students worked in small groups on tablets or computers or if you trained AI together on another device.
- When you select the *QR Code* tile, a code scanner appears on the screen. Scan the code from the *Training AI* summary screen generated on another device, then click *Next*. From now on, the tablet attached to the robot uses the data you provided specifically for this experiment.
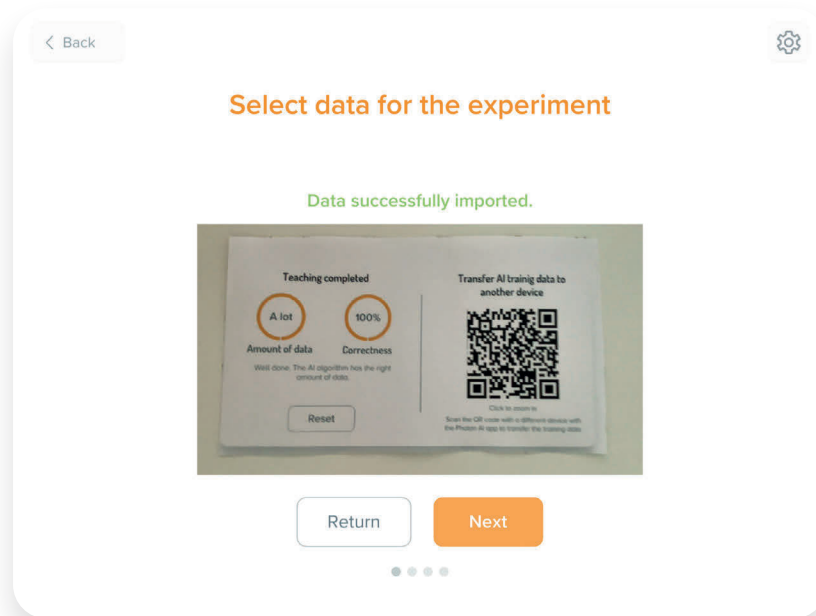
How to download the AI application?

The application is available for mobile devices (Google Play and App Store) and for computers (Windows and macOS). You can download it to as many devices as you need.

Application for mobile devices

- The app comes with full access to all modules (including the *Experiments* module).
- To download the *Photon AI* application, visit the app store of your choice according to your device's operating system. Then look up the *Photon AI* app and follow the instructions on the screen to install it.

Desktop application (for computers)

- The desktop app comes with full access to the *Knowledge* and *Training AI* modules and all related lesson scenarios.
- Provides access to the *Experiments* module in Lesson 10 for both learning paths (these experiments are conducted entirely in the app).
- Our dedicated application is also available as an embedded module in the Photon Magic Bridge app for desktop computers. To download the Photon Magic Bridge to your computer, please visit **https://photon.education/en/magic-bridge-download/**
- The AI module in the Magic Bridge app appears in the list of available programs - see the bar on the left-hand side.

Accessories

The AI Teaching Kit includes many accessories – a mat, boards, and flashcards to build a smart city model. All of them help you conduct AI-related activities, explore the technology and learn about artificial intelligence.

The smart city mat

The mat depicts a city – streets and green spaces. It consists of 24 fields (4x6), measuring 30x30 cm (1x1 ft) each. Four cardinal points are marked on the mat and coordinate pairs for each field – you can use them when instructing students where to place selected objects.

There are additional markings on the mat as well – traffic signals and people, as well as building outlines (gray lines). These markings indicate spaces for selected items to be placed on the mat in your next classes. It is crucial to place all the different AI Kit accessories in the designated spaces. This way, you have a guarantee that the AI app is working as intended.
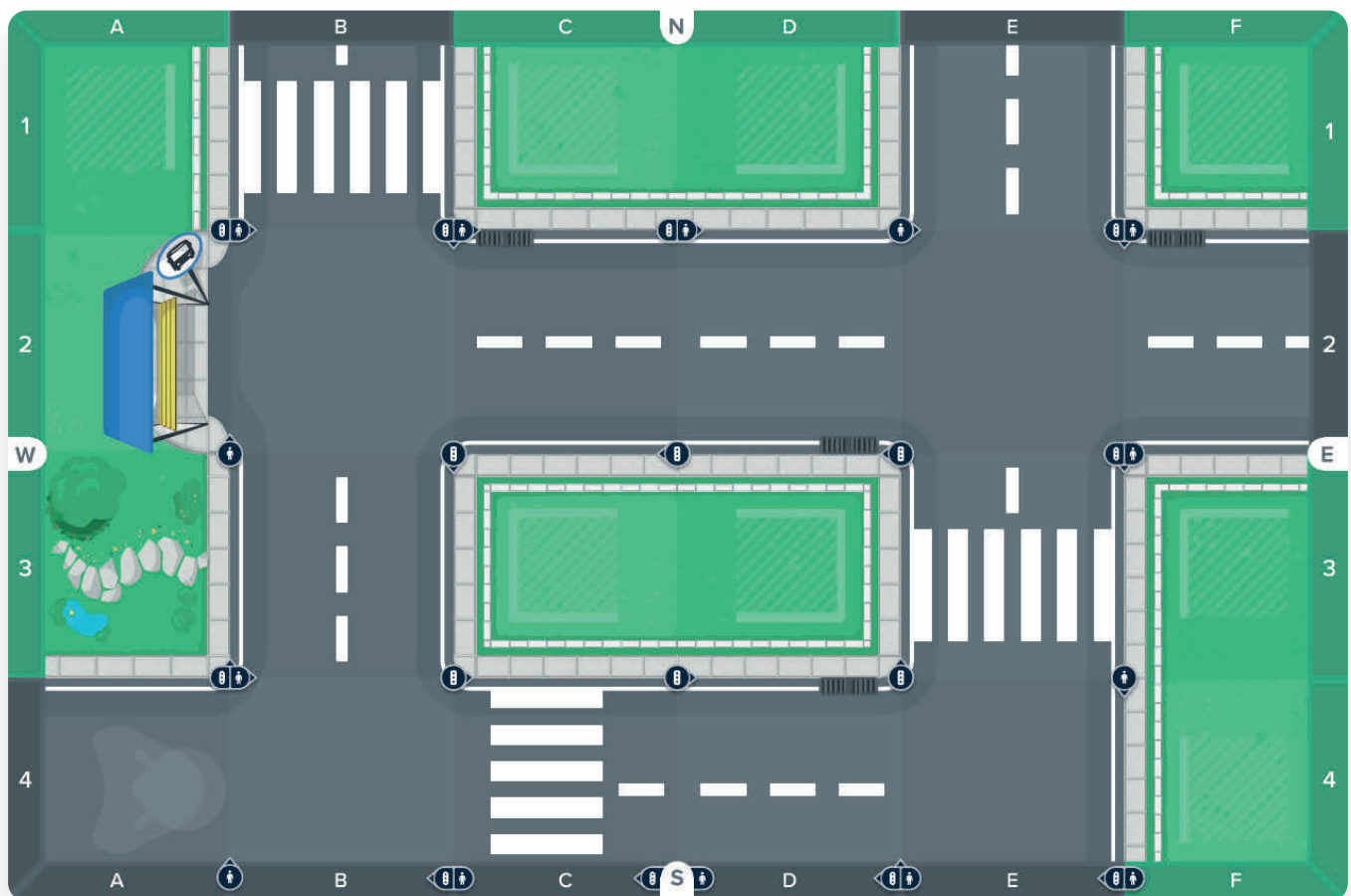
Buildings and shop front signs

To turn the mat into a smart city model, you need to set up nine (9) buildings, complete with correct signage, in the very first class. The kit includes three types of buildings: a commercial building, a public office building, and a dedicated organic food store.

Assign one of the available signs for each building:

- Library
- City Hall Office
- Post Office
- Police
- Bank

- Grocery store
- Butcher store
- Organic food store
- Bakery

Buildings and shop front signs use a magnetic strip. You always attach these magnetic signs to the top part of the building board.

The signs in the Kit come in 6 languages – you will use the foreign language versions in a class dedicated to text recognition. You can also set up your city with building signs already in a foreign language, as if they were abroad, and use such a mat as a part of your foreign language classes.

Buildings with front signs should additionally be attached to dedicated stands and only then placed on the mat. Each building board (and any other flashcard you place on the mat) has special indents at the bottom. Carefully attach the cards to the stands and make sure they stay firmly on the mat.
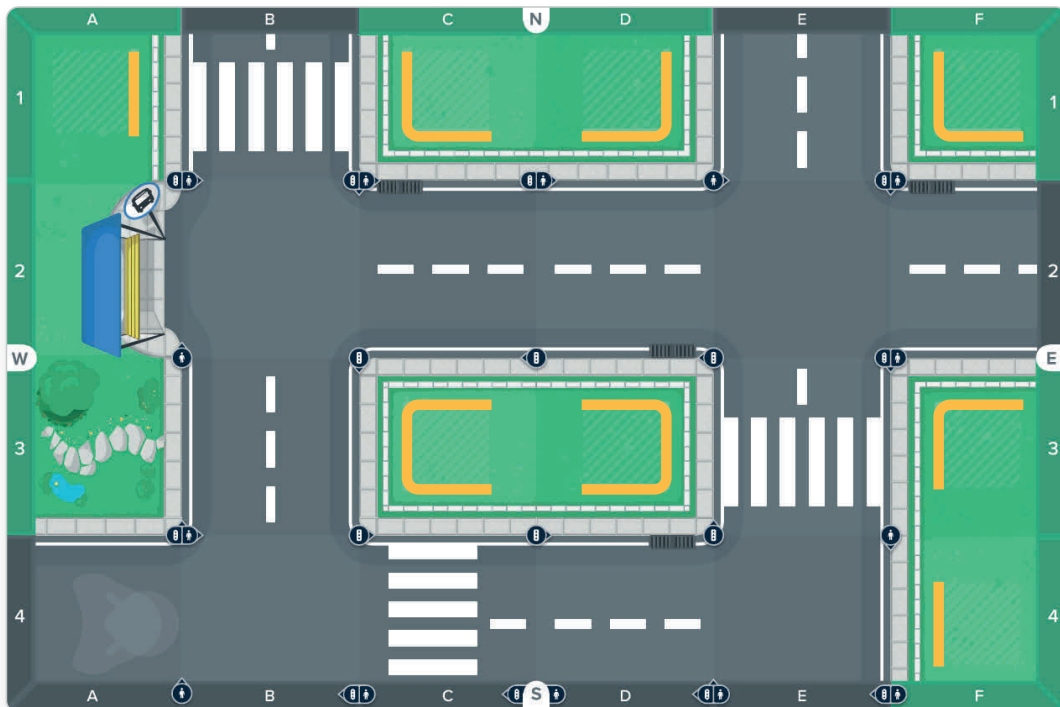
The completion of the Path 1 activities requires you to use the model city in each class. Since the city model is an integral part of the course, decide on a place for it in your classroom that will be accessible at all times. The city model is necessary, but not limited to, artificial intelligence related classes. While moving around the city, you have an opportunity to take a closer look at your immediate surroundings – talk about transportation in the city, traffic safety, shopping, police patrols or visits to the city hall office or library.

The city model is also used in most of the Path 2 classes. If you don't have any spare space for it in your classroom or activity room, take a picture of it once its ready, so you can put it away. Photos will help you quickly recreate your setup for the next class.

Other flashcards and boards

In future classes, you will have a chance to use all the remaining accessories not mentioned here, to conduct other experiments.

You have to place the building boards and flashcards in designated spaces on the city model mat.
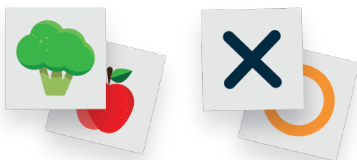
Double-sided traffic light flashcards and a set of images of 14 people.

As with building boards, you must attach these flashcards to stands before placing them on the mat.
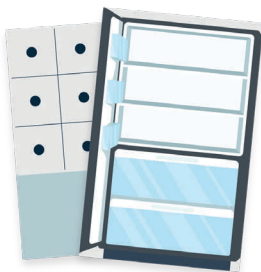
Mock-up fridge and tic-tac-toe boards with magnets

You attach the smaller magnetic flashcards to them. You can also place them (if using stands) anywhere on or off the mat.

Small magnetic flashcards

Small magnetic flashcards with images of food to put on the mock-up fridge board (broccoli, apple, lettuce, carrots, ham, cheese, egg, milk, cake) and circle and cross symbols – to play tic-tac-toe with the robot in Path 1 activities.

Integrated magnets allow you to attach them on the fridge and tic-tac-toe boards.

Road works sings

In Path 2 activities, you can use flashcards representing traffic obstacles – road works. You also need to attach a stand to it and place it on the street, directly on the robot's travel path.

Lesson scenarios contain instructions that will help you prepare required accessories and use them. Moreover, the app makes sure that all items required in each given activity are in the right place.
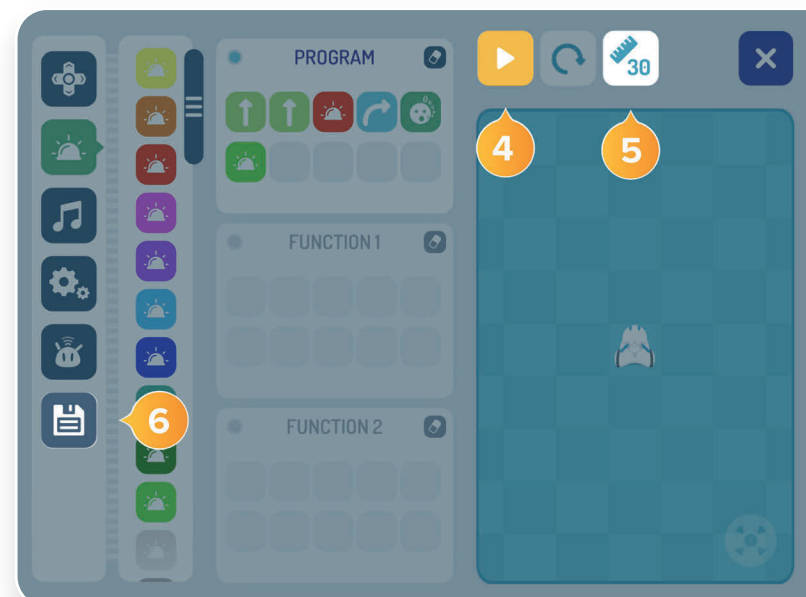
Programming interfaces

The lesson scenarios provide you with an opportunity to program the Photon Robot - you have two visual programming interfaces to choose from. Below you will find an overview of both of them.

Photon Badge – Path 1

This is a programming interface based on arranging symbols into a logical sequence – directional arrows, colors, sounds, and sensors.

1. Use the *Program* box to plan (code) the robot's actions. The Photon Robot performs arranged actions always in the same order. There is a space for 10 actions.

2. When you click on an action category on the side menu (e.g., movement – directional arrow symbol), a list of available actions (instructions) appears. If you want to add an instruction to your program click and drag it to the *Program* box.

3. If you want to remove an action from your program – just click on it. If you want to delete the entire program, and start over, click the eraser icon (top right corner of the *Program* box) or hold down the arrow button.

4. To run your program (make the robot perform arranged actions), click the orange *Play* button.

5. You can also decide how long is a single robot's "step", i.e., how far the robot travels in one move. The default value is 30 cm (one foot) – this is the length of one field on all our educational mats.

6. Whenever you create a program, you can save it for later use (for example, in your next class). This is also where you can load a previously saved program.

Photon Blocks – Path 2

This programming interface allows for programming a robot's actions by arranging blocks with instructions into sequences. This interface is much more advanced than Photon Badge. Among other things, it allows for the use of an unlimited number of blocks and greater customization of actions (e.g., you can program the robot's eyes and ears colors separately or set a precise rotation angle for robot turns).

1. To start programming, place instruction blocks under the top *Start* instruction. The Photon Robot runs your program instructions in a top-to-bottom order.

2. When you click on an action category in the side menu (e.g., movement – directional arrows symbol), a list of available actions (instructions) appears. If you want to add a block to the program, click on it or drag it to the desired location in the program. You can change the order of instructions at any time by dragging and dropping them in the desired position.

3. If you want to remove a block from the program, drag it to the right side of the screen. A *Recycle Bin* appears. If you want to delete the entire program, hold down the arrow button.
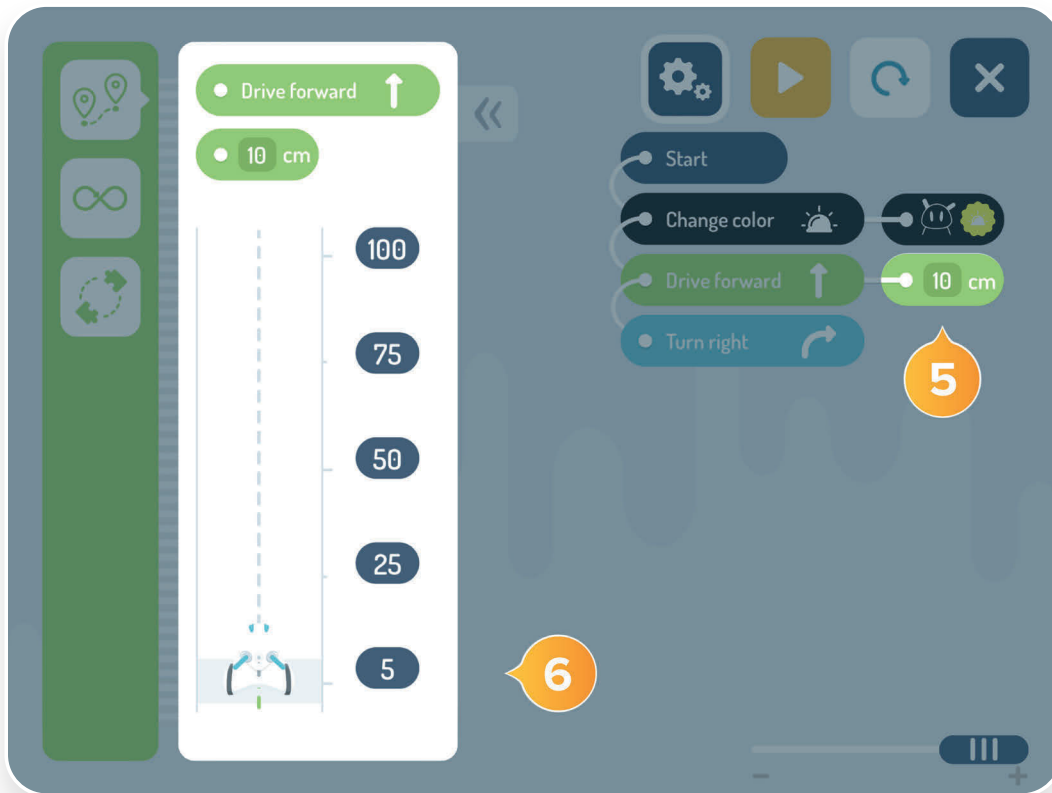
4. To run and test your newly created program, click the *Play* button.

5. If a block consists of two elements connected by a line, you can customize this instruction further. Click on the element "attached" to the block (e.g., 10 cm) to open an additional menu.

6. If you use the *Go forward* block, you can customize the travel distance for that move (the *Go forward* block can take different distance values, e.g., the robot can move forward indefinitely or until a specific trigger action makes it stop – use the infinity "figure of eight" icon) or, as in previous interfaces, move by a specific number of fields (you can specify each step's length).

7. Whenever you create a program, you can save it for later use (for example, in your next class). This is also where you can load a previously saved program.

Photon Robot – a comprehensive teaching aid

If your students like the Photon Robot activities, feel free to make the most of it in other classes too. The Photon Robot has many superpowers! We encourage teachers to explore them with their students. This section focused on the robot's features required for you to work with the Photon Artificial Intelligence Teaching Kit. You will also have an opportunity to explore and become familiar with two programming interfaces (independent in the Photon EDU app). This is just a preview of the robot's full capabilities. If you want to learn more, please download the Photon EDU app and explore, test, and make your classes even better!

If you have any questions, visit our Help Center

https://help.photon.education/

Join our global community of educators

https://www.facebook.com/groups/photonglobalcommunity

For inspirations on how to use the Photon Robot in your classes visit:

https://portal.photon.education/en