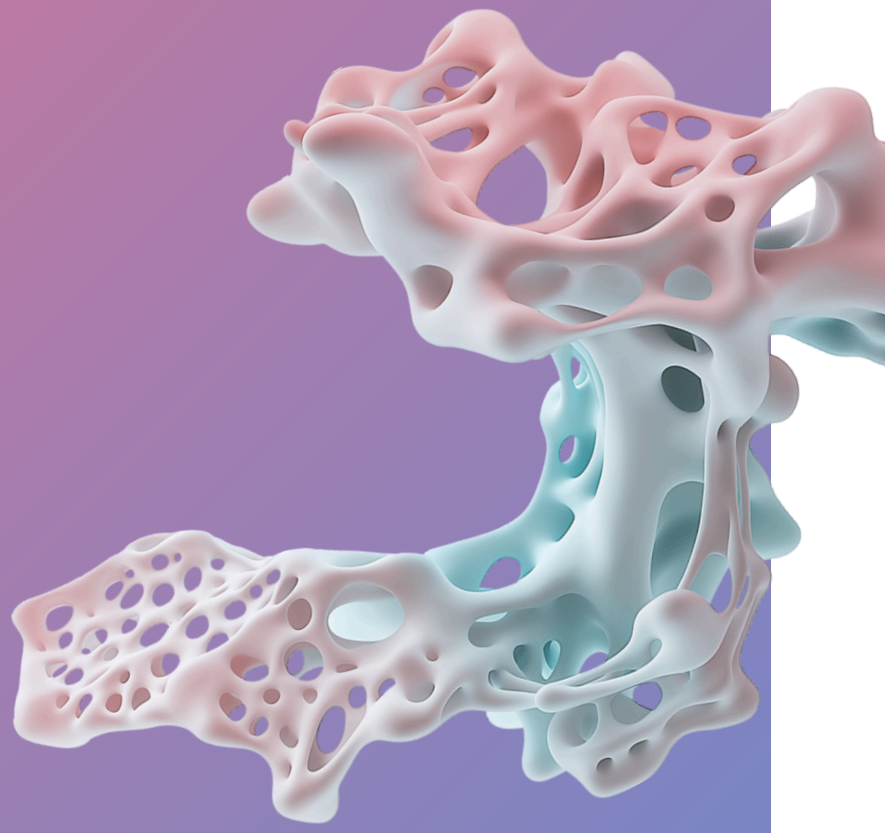
AI for Children

Artificial Intelligence Curriculum for Elementary and Secondary Schools

Art Education II

Algorithmically Invisible



kurikulum.aidetem.cz/en

Created by: Eva Nečasová
Expert guarantors: Pavel Kordík, Tomáš Mlynář
Proofreading: not yet done
Last update: 01/2025
Version: 04

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

Form for comments

Art Education II – Algorithmically Invisible

A few words to begin

Dear Teacher,

You are receiving a teacher material developed to support the teaching of artificial intelligence at the elementary and secondary school levels. In this lesson, we deal with computer vision technology, thanks to which computers can "see" in a similar way to humans. Like any technology, it can be used for good but also for bad purposes. In the lesson, students will learn how computer vision works and evaluate its impacts using an activity inspired by the artist Adam Harvey. Thank you for your desire, energy and courage to introduce children to this topic.

– AI for Children team

This lesson deals with so-called computer vision systems. In an active form, students will understand how they work and at the same time think about the impact they have/can have on society or individuals.

Lesson presentation

Editable presentation in Canva

Lesson Overview

Recommended Age, Lesson Length
Children aged 13–20, 45 minutes.

Building Blocks
Computer vision.

What Are the Students Learning?
Computer vision systems can recognize objects in images or video.
Computer vision systems can serve not only good purposes, but also be misused.

Why Are They Learning This?
Based on an understanding of how computer vision systems work, they critically assess the benefits and reflect on their risks.

How Do We Know They Have Learned It?
They will explain how computer vision systems work and outline their benefits and risks for individuals and society.

Tools
Teacher: Projection equipment, presentation.
Students: Computer with camera, face paint, fabric, paper, colored tape... anything students can use to decorate their face or style their hair – hairspray, spray...

Digital Competence
Facilitating Learners' Digital Competence.

Bloom's Taxonomy
Applying: Students apply facial recognition theory and design their own functional camouflage.
Analyzing: They examine how their designs affect the functionality of computer vision systems and identify key factors for success or failure.
Creating: Creates Computer Vision Dazzle camouflage.

Five Big Ideas
5-A-II Ethical AI (Ethical Design Criteria).

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

Glossary of terms

Artificial Intelligence (AI)
None of the definitions of the term artificial intelligence are actually fixed, but they all agree that it is a system that simulates human thinking and actions.
Artificial intelligence usually takes the form of a computer program and is used to solve tasks that previously required considerable human intellect and were therefore the domain of humans.
It is also, among other things, a scientific field with origins dating back to the first half of the 20th century. It seeks not only to understand intelligent systems, but especially to create them.

Machine Learning (ML)
Just as humans can learn from examples and experience, so too can man-made machines.
Machines use a method called machine learning to learn, which allows artificial intelligence systems to be more than just a set of pre-programmed actions, but to come up with new solutions on their own.
The goal of machine learning methods is to discover patterns occurring in large amounts of data.

Computer Vision (CV)
A field that was developed before the advent of artificial intelligence – mainly for the purpose of recognizing patterns in images. However, after the advent of artificial neural networks, it has moved significantly and now computers "see" similarly to humans. If we provide image recognition systems with data, they can learn to recognize anything, from people to familiar landmarks to pets.
With computer vision, we can now log into our mobile phones by showing our face (Face ID), measure distances and search for information about objects that we can't even name (Google Lens), or take AI into the forest (BirdNET).
Thanks to the accurate recognition of traffic signs, lanes and obstacles on the road, self-driving car technology is also maturing.

Dazzle Camouflage
Dazzle Camouflage is a form of camouflage used primarily during World War I and World War II on warships. Ships were painted with complex patterns of stripes, geometric shapes, and contrasting colors. This visually broke up the outline of the ship and made it difficult for enemy vessels to identify it, estimate its direction of travel, and estimate its speed. This type of camouflage was designed to confuse the enemy, making it difficult to successfully target and attack the ship. Dazzle Camouflage was first used by the British Navy and was later adopted by other national navies. Dazzle camouflage designs were usually very bold and imaginative, with each ship having a unique pattern to prevent easy identification.

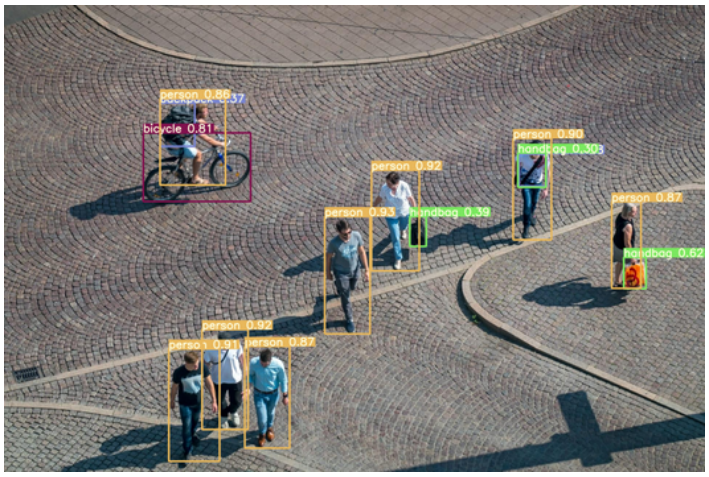
CV Dazzle make-up
In the context of computer vision, "Dazzle" makeup refers to a specific style of camouflage that is designed to make it difficult for computer vision (facial recognition) algorithms to identify a face.
CV Dazzle combines camouflage warfare techniques with modern design and fashion aesthetics to create a look that intentionally confuses computer vision algorithms. This approach typically involves the use of asymmetrical patterns, contrasting colors, and geometric shapes that cover important facial features such as the eyes, nose, and mouth, making it impossible for algorithms to successfully identify a face or interpret its expressions.
The concept was first introduced by artist and researcher Adam Harvey as a way for people to defend themselves against surveillance without having to hide or use masks, which could be illegal or socially unacceptable in some contexts. CV Dazzle thus represents a form of "software" camouflage that uses visual tricks to protect an individual's privacy in the digital age.

Biometric data
In general, a biometric is a unique physical or physiological characteristic that allows identification. For example:
Fingerprint: One of the most commonly used methods that analyzes the patterns on an individual's fingertips.
Facial Recognition: The Technology That Scans and recognizes the facial features of an individual.
Iris scanning: Recognizes unique patterns in the iris of the eye.
Voice Recognition: Analyzes an individual's voice patterns and intonation for identification or verification.
Gait and movement: Recognizes and analyzes the way an individual walks or moves.

Preparation for teachers

CV Dazzle (Computer Vision Dazzle)

CV Dazzle is a form of confusion for computer vision systems. These are systems that have been trained on a large amount of data (images and videos) and are able to recognize objects in other images or videos. When the system recognizes something, it is visualized by a bounding box.

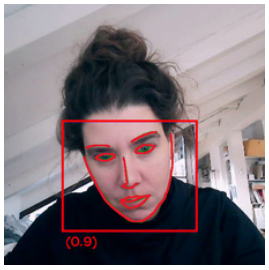


YOLOv7 algorithm
Image source: viso.ai

These systems are trained on different data sets depending on their intended use.
For example, face recognition systems are trained on many photos of human faces.
Or a system that recognizes defective products on a production line might have been trained on photos of defective products. So let's narrow our introduction to face recognition systems.

Artist Adam Harvey's work seeks ways to confuse these systems so that they don't recognize human faces. You can read more about the project to which we dedicate this methodology directly on his website. The project represents the first documented camouflage technique that successfully defies some computer vision algorithms and focuses on disrupting facial detection using distinctive patterns and hair and makeup adjustments.

The idea is to disrupt the key facial features that computer vision algorithms use to detect them. These are the symmetry and typical layout of the eyebrows, eyes, nose and mouth. The technique uses irregular patterns, contrasting makeup and stylized hair styles to "break up" or mask these features, making it difficult or impossible for the algorithms to recognize the face. The approach is inspired by the military's Dazzle camouflage, which was used during World War I and II to make it harder to estimate the distance and direction of ships.



Key facial features and a bounding box indicating the probability that the recognized object is a human face.

Adam Harvey's CV Dazzle project highlights the increasing effectiveness and proliferation of computer vision-based systems, pointing out the potential dangers and ethical dilemmas associated with ubiquitous surveillance, while also emphasizing the possibility of individual defenses against it.

Engage

10 min

5–10 min

Think about it.

Presentation slide 02

What is meant by the term camouflage?
Camouflage is a method of concealment that allows an object to blend in with its surroundings or otherwise makes it difficult to find or recognize.

When and where can camouflage be used?
Animals camouflage themselves for survival, humans use camouflage, for example, in the military.

Camouflage is often used in the military. An interesting use of camouflage is called "Dazzle Camouflage". It is a form of camouflage used mainly during the First and Second World Wars on warships. The ships were painted with complex patterns of stripes, geometric shapes and contrasting colors. This method of camouflage inspired the work of, for example, Pablo Picasso. How do you think this camouflage worked?
It optically broke up the ship's outline and made it difficult for enemy vessels to identify it, estimate its direction of travel, and estimate its speed.

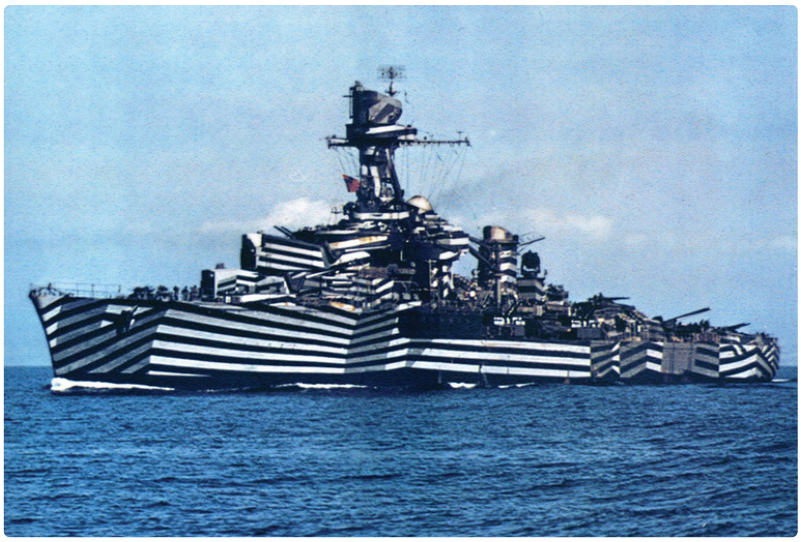


Image source: warfarehistorynetwork.com

You can show the image to the students from the attached presentation on slide 02.

Share

Camouflage has also been used in art. Shortly before his death, the artist Andy Warhol created a series of "Camouflage Self-Portraits." The portrait of the artist looks directly at the viewer. The black, solid background forces the viewer to focus directly on his face. This contrasts with the camouflage pattern. Although Warhol was fascinated by celebrities and became one himself, he remained a person who shared very little of his privacy throughout his life.

Some people want to attract attention – for example, by taking selfies and posting them on social media. Others are very protective of their privacy. What is your stance on this and why?

In what cases do you think people don't want to be seen online?
Possible answers: They want to protect their privacy, they are worried about their safety, they are afraid of corporate surveillance, etc.

Discuss

Even when we don't share our photos – for example, on social media – we are being recorded. Can you think of where?
Possible answers: In public and private spaces using cameras. When we log in to the phone using biometrics (see glossary, entry Biometric data).
In phone calls (voice recording), etc.

Understand

30 min

10 min
Videos & discussions

Presentation slide 03

Show the students a three-minute video.
youtube.com/watch?v=6tI5EY4hLv4

Discuss with the students.

What is Adam Harvey's Computer Vision Dazzle project about?
Artist Adam Harvey's project seeks ways to confuse facial recognition systems so that they don't recognize them.

Thanks to the development of artificial intelligence technologies, it is relatively easy to recognize specific people in a photo or video these days. This is made possible by so-called computer vision systems. Adam talks about them in the video. What do you imagine by that?
Possible answer: These are systems that have been trained on a large amount of data (images, videos), and thanks to this, they can recognize objects in other images or in video (for example, footage from a camera in a public area).

Example: If we wanted to create a program (model) that recognizes cats and dogs, we would first have to show it a large number of pictures of cats and dogs divided into cat and dog categories. The application would identify common similarities in cats and dogs (for example, ears, nose, etc.). If we then showed the application a picture of a dog or cat that it had not "seen" before, based on the similarities found, it would lean towards one or the other variant.

Source Data
Images, text, numbers, or sounds, for example

Data Annotation
Data is manually categorized into classes, creating a dataset

Training the Machine Learning Model

Using the Model
The model is presented with images it has never seen before

How can these systems be fooled?
The CV Dazzle technique that Adam is talking about is a technique that disrupts key facial features that computer vision algorithms use to detect them. These are the symmetries and typical layouts of the eyebrows, eyes, nose and mouth. The technique uses irregular patterns, contrasting makeup and stylized hair styles to "break up" or mask these features, making it difficult or impossible for algorithms to recognize the face. The approach is inspired by the military camouflage Dazzle, which was used during both World Wars I and II to make it harder to estimate the distance and direction of ships.

20 min
Activity

Presentation slides 04–08

Students will try to create their own CV Dazzle makeup design.
Inspire your students with demonstrations of different forms of makeup.

Presentation slide 09

Show students this video in which influencer Martymoment describes how she created her own makeup designs. She also explains which ones didn't work and why.
Link to the video (the video is on Instagram, if it has been disabled by your administrator, it will not be displayed).

Based on trial and error, Martymoment came to these conclusions:
1. Technology is getting harder and harder to fool every day.
2. Computer vision systems only need to see a fraction of ONE of the following parts of the face: eyes, nose, and mouth to identify a face.
3. Jewelry seems to work best because it reflects light.

Key findings:
1. The systems recognized her with makeup and an eye patch.
2. Masks that cover the nose or mouth do not work because the eyes are visible.
3. Dark-skinned people are easier to fool computer vision systems because these systems tend to be racially biased (i.e., dark-skinned people are less represented in the data on which these systems
4. are trained, and therefore these systems are less able to recognize them).

Presentation slides 10–11

It is important that students continuously test during the creation process whether they are still recognizable using computer vision systems.

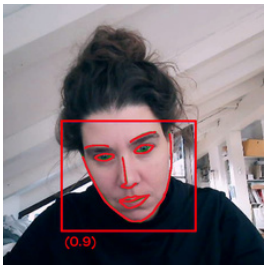
For example, the Webcam Face Tracking tool can be used for this (you will need a computer with a camera, and you must enable the use of the camera in your browser).

If a bounding box appears around the face, the system has recognized the face. The number below the box indicates the probability. However, this system is not that difficult to fool.

The real challenge is to trick Snapchat's facial recognition, for example. If students use it, they can test it.

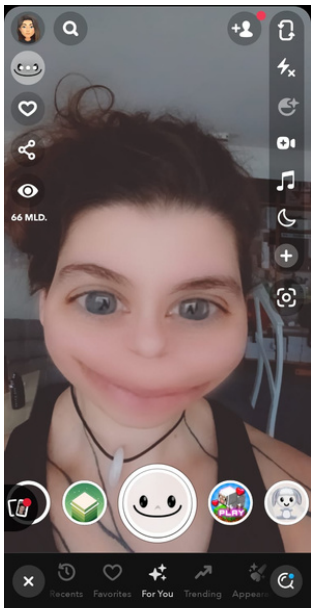
Snapchat offers many filters that modify the face in various ways when a face is detected by computer vision. Simply select one of the filters. If it is not activated, the face was not recognized.

Facial detection can also be tried if students have smartphones that unlock based on facial biometrics.



Bounding box in Webcam Face tracking application

Filters in Snapchat



Reflect

5 min

Share

Could your makeup fool a computer vision system?
What did you notice that worked?
What, on the other hand, had no (or very little) effect on detection?

Think, pair, share

Think: Students first think about the topic independently.
Pair: They form pairs to discuss the topic and write down the results.
Share: After time has passed, the selected pairs share their findings with the whole class.

Camouflage has been used many times in history. We gave some examples at the beginning of the lesson. Now we thought about camouflage in the context of surveillance (of the state, corporations). Why do some people tend to be algorithmically invisible – undetectable by computer vision systems?
The trend towards algorithmically invisible computer vision systems is linked to the increasing use of surveillance technologies by the state and corporations. These technologies, including facial recognition, tracking and behavioral analysis, have enormous potential for intrusion into individual privacy and freedom.

Therefore, some people try to become "invisible" to these systems for several reasons:
In the digital age, it is increasingly difficult to maintain privacy. Computer vision systems can be used to constantly monitor and analyze people's behavior without their knowledge or consent. Becoming unrecognizable to these systems may be a way to maintain at least some privacy.
In authoritarian regimes or situations where governments or corporations abuse surveillance technologies, the ability to remain invisible to algorithms can be crucial to the safety of participants in protests, political rallies, or even freedom of expression in general.

What do you perceive as the benefits of computer vision systems?
Computer vision systems bring a number of benefits and innovations across various fields and industrial sectors.

Here are three key benefits:

1. Increased security: Computer vision systems can significantly improve the security of public spaces, workplaces, and homes through the ability to quickly identify potential threats or unusual behavior.
2. In transportation, they can help reduce the number of accidents by monitoring driver behavior and alerting them to potential collisions.
1. In industry, for example, CV systems can easily identify defective products on production lines.
2. They can help doctors make more accurate diagnoses by analyzing imaging data, such as X-rays.
3. They open up new possibilities in areas such as autonomous driving, smart agriculture and many others.