AI4K12.org

AI for K-12 Initiative

Dave Touretzky
Fred Martin
Deborah Seehorn
Emily Reid
Miles Berry

#AI4K12

SIGCSE 2019 Special Session - Thursday, February 28, 2019

AI4K12.org

Presenters

Dave Touretzky
Carnegie Mellon
AI for K-12 Working Group Chair

Fred Martin
UMass Lowell
CSTA Chair of Board of Directors

Deborah Seehorn
Co-Chair of CSTA Standards Committee

Emily Reid
AI4ALL
VP, Open Learning Program

Miles Berry
Computing At School
University of Roehampton, UK

Overview

- Mission of the AI for K-12 Initiative
- Why is Need for AI in K-12? International Perspective
- What kind of impact can national K-12 AI education have? - US Perspective
- 5 Big Ideas in AI
- Guideline Development Process
- Needs of Teachers and Students
- Current AI Tools & Resources for K-12
- How to Contribute
- Discussion

AI for K-12 Initiative

Association for the Advancement of Artificial Intelligence

CSTEACHERS.ORG
COMPUTER SCIENCE TEACHERS ASSOCIATION

Carnegie Mellon University
School of Computer Science

AI4K12.org Mission

- Develop national guidelines for teaching AI in K-12
  - Modeled after the CSTA standards for computing education.
  - Four grade bands: K-2, 3-5, 6-8, and 9-12
  - What should students know?
  - What should students be able to do?

- Develop a curated AI resource directory for K-12 teachers
- Foster a community of K-12 AI resource developers

AI4K12.org Steering Committee

Dave Touretzky
Carnegie Mellon
AI for K-12 Working Group Chair

Christina Gardner-McCune
University of Florida
AI For K-12 Working Group Co-Chair

Fred Martin
UMass Lowell
CSTA Chair of Board of Directors

Deborah Seehorn
Co-Chair of CSTA Standards Committee

AI4K12.org

Academia/Industry Working Group Members

Hal Abelson
MIT

Cynthia Breazeal
MIT

Matt Dawson
Google

Emily Reid
AI4ALL

Matthijs Spaan
TU Delft
AAAI

K-12 Teacher Working Group Members

Grades K-2
Vicky Sedgwick (Lead)
Susan Amsler-Akacem
Dr. April DeGennaro
Charlotte Dungan

Grades 3-5
Kelly Powers (Lead)
Dr. Marlo Barnett
Dr. Phillip Eaglin
Brian Stamford

Grades 6-8
Padmaja Bandaru (Lead)
Minsoo Park
Juan Palomares
Sheena Vaidyanathan

Grades 9-12
Dianne O'Grady-Cunniff (Lead)
Jared Amalong
Dr. Smadar Bergman
Kate Lockwood

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Advisory Group

Miles Berry, Roehampton University, UK

Amy Eguchi, Bloomfield College, Bloomfield, NJ

Laura Hintzman Schmidt, Advancing AI Wisconsin

Irene Lee, MIT, Cambridge, MA

Dahua Lin, Chinese University of Hong Kong, China

Joseph South, ISTE, Portland, OR

Tom Vander Ark, Getting Smart, Federal Way, WA

Joyce D. Williams, Defense Acquisitions University, Ft. Belvoir, VA

AI4K12.org Timeline

May 2018 - AAAI & CSTA collaboration formed & press release

June 2018 - Interim Wiki launched - https://gitub.com/touretzkyds/ai4k12/wiki => http://AI4K12.org

June 2018 - Steering Committee formed

July 2018 - Interest Group formed - ai4k12-list@aaai.org

July 2018 - CSTA Breakfast -- 120 attendees!

August 2018 - Working Group formed

August 2018 - Working Group Kick-Off Meeting

September 2018 - 1st Monthly Working Group Meeting - Big Ideas Discussion

October 2018 - AI for K-12 Symposium (AAAI Fall Symposia) - 50 Invited Participants!!!

November - January 2019 - Big Idea #1 Development (Perception)

January - March 2019 - Big Idea #2 Development (Representation & Reasoning)

AI4K12.org Public Activities

#AI4K12

AI for K-12 Breakfast @ #csta2018

sponsored by Carnegie Mellon AI and The Robotics Hub

July 2018

AI for K-12 Symposium

@AAAI Fall Symposium, Washington, DC

October 20, 2018

AAAI 2019 Conference

AAAI Workshop K-12 Teacher Workshop

EAAI Panel

Senior Member - Blue Sky Talk)

Envisioning AI for K-12: What should every child know about AI?

SIGCSE 2019

- SIGCSE 2019 - *Special Session: AI For K-12 Initiative February 2019*

- SIGCSE 2019 - *Birds of a Feather*
  AI for K-12: Making Room for AI in the K-12 CS Curriculum

Upcoming events

- ISTE 2019 (June, Philadelphia)
  K-12 Guidelines for Artificial Intelligence: What Students & Teachers Should Know

- CSTA 2019 (July, Phoenix; two events)
  Workshop: K-12 AI Playground
  Special Session: How to teach AI across K-12

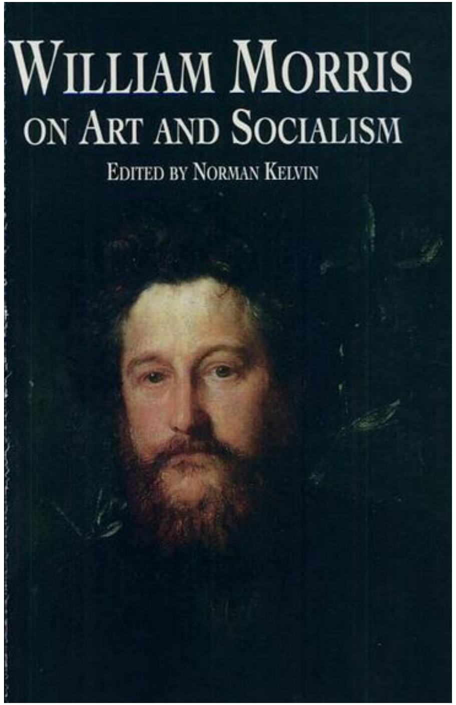
Why is AI for K-12 Needed?

International Perspective

Miles Berry

Beauty or utility?

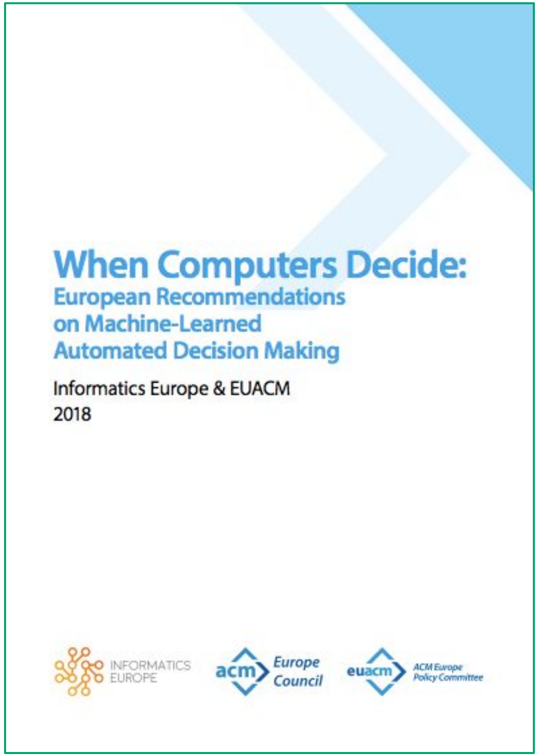
> If you want a golden rule that will fit everybody, this is it:
>
> Have nothing in your houses that you do not know to be useful, or believe to be beautiful.



Morris, 1880

A basic understanding

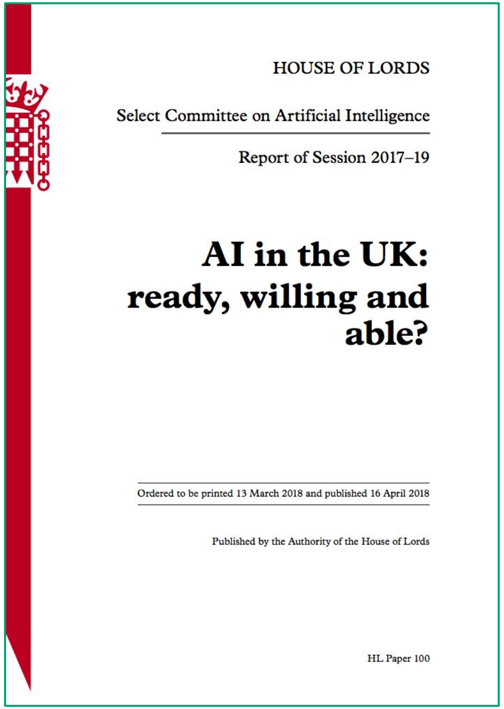
In the near future, perhaps sooner than we think, virtually everyone will need a basic understanding of the technologies that underpin machine learning and artificial intelligence.



ACM Europe / Informatics Europe

For some, or for all?

Children need to be adequately prepared for working with, and using, AI. **For a proportion**, this will mean a thorough education in AI-related subjects, requiring adequate resourcing of the computing curriculum and support for teachers. **For all children**, the basic knowledge and understanding necessary to navigate an AI driven world will be essential. In particular, we recommend that the ethical design and use of technology becomes an integral part of the curriculum.


HOUSE OF LORDS

Select Committee on Artificial Intelligence

Report of Session 2017–19

AI in the UK: ready, willing and able?

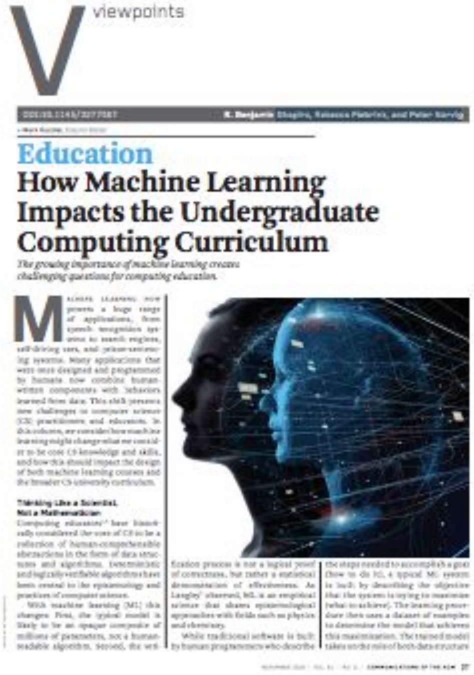
Ordered to be printed 13 March 2018 and published 16 April 2018

Published by the Authority of the House of Lords

HL Paper 100

Bringing ML into CS ed

To succeed with ML, many students will not concentrate on algorithm development, but rather on data collection, data cleaning, model choice, and statistical testing


viewpoints

Education

How Machine Learning Impacts the Undergraduate Computing Curriculum

The growing importance of machine learning creates challenging questions for computing education.

[Shapiro, Fiebrink and Norvig, 2018](#)

CS, IT, DL

Foundations

Applications

Implications

Computing in the English curriculum

Aims: **can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems**

5-7: recognise common uses of information technology beyond school

7-11: use and combine a variety of software (including internet services) to create, systems and content that accomplish given goals, including analysing and evaluating data and information

11-14: undertake creative projects that involve using, and combining multiple applications, to achieve challenging goals, including analysing data

14-16: develop and apply their analytic, problem-solving, design, and computational thinking skills

16-18 (AQA): project suggestions include an application of artificial intelligence; investigating an area of data science using, for example, Twitter feed data or online public data sets; and investigating machine learning algorithms.

Machine Learning

Create a problem solving prototype in 10-12 hours

Primary, Secondary and FE

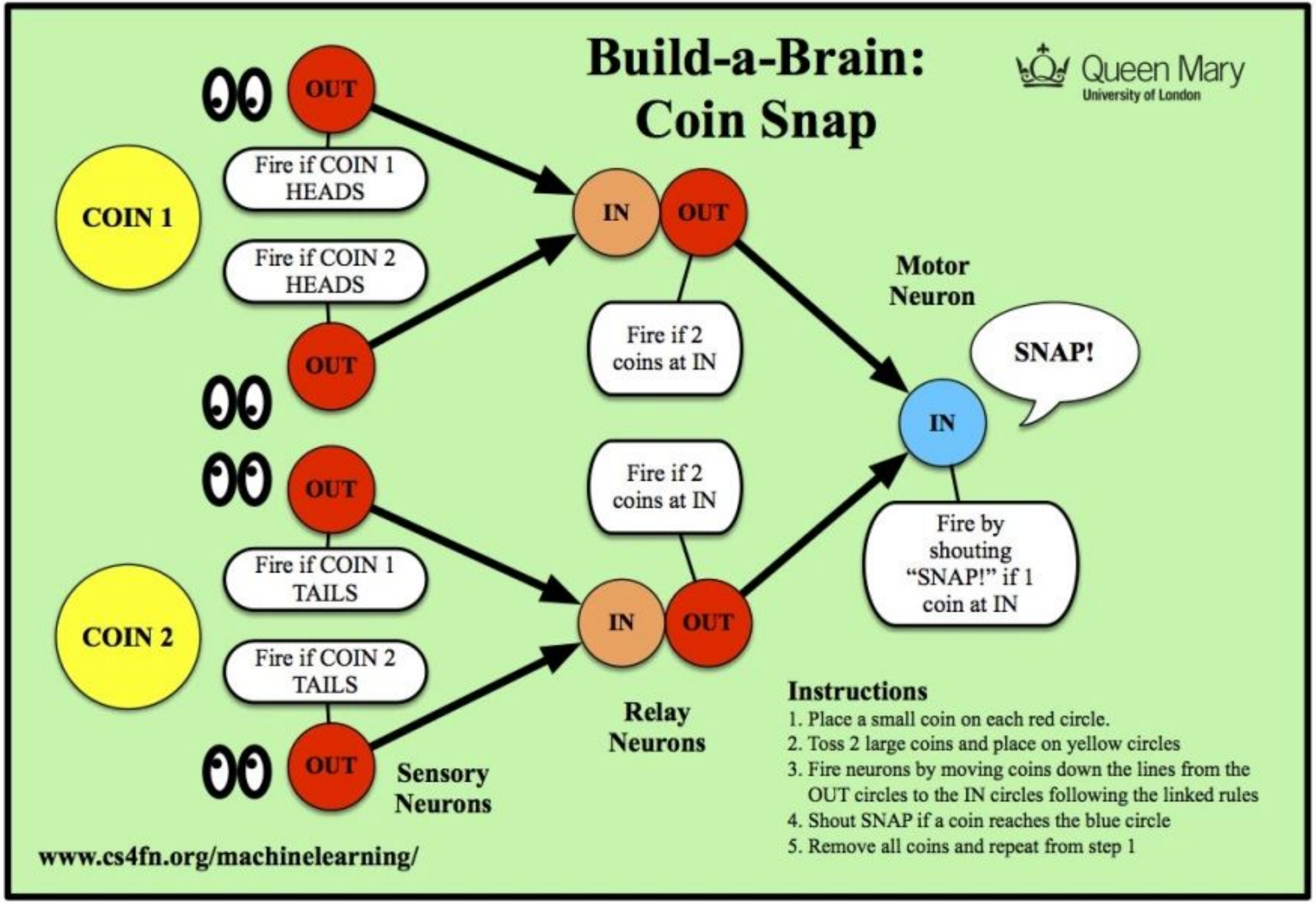
10 - 12 hours

In-class or extracurricular

Programming required

Course Summary

Explore machine learning with your students, including the ethics and benefits, and use machine learning algorithms to solve a real-world problem they care about.



Build-a-Brain:
Coin Snap
Queen Mary
University of London
COIN 1
COIN 2
OUT
Fire if COIN 1
HEADS
Fire if COIN 2
HEADS
OUT
OUT
Fire if COIN 1
TAILS
Fire if COIN 2
TAILS
OUT
Sensory
Neurons
IN
OUT
Fire if 2
coins at IN
Fire if 2
coins at IN
IN
OUT
Relay
Neurons
Motor
Neuron
SNAP!
IN
Fire by
shouting
"SNAP!" if 1
coin at IN
Instructions
1. Place a small coin on each red circle.
2. Toss 2 large coins and place on yellow circles
3. Fire neurons by moving coins down the lines from the
OUT circles to the IN circles following the linked rules
4. Shout SNAP if a coin reaches the blue circle
5. Remove all coins and repeat from step 1
www.cs4fn.org/machinelearning/

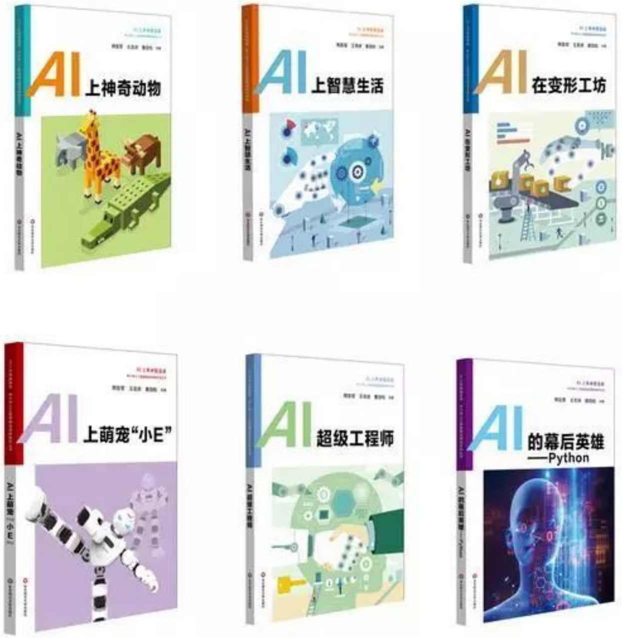
China

China has announced its intention to become the global leader in AI research by 2030.

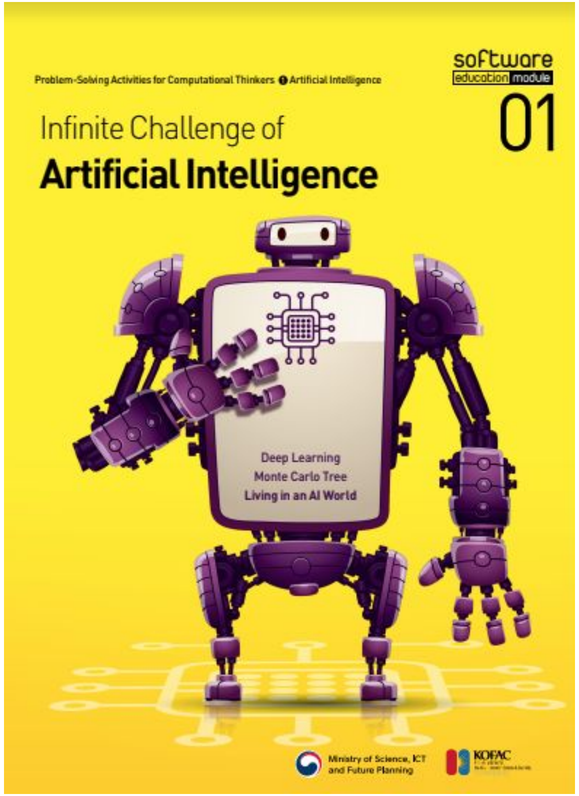
The Chinese government had mandated that all Chinese children should receive instruction in AI.

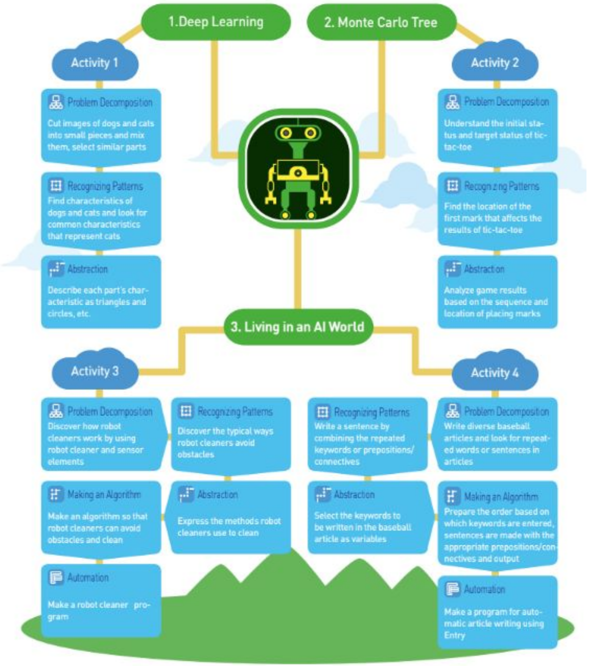
2018: the first AI textbook for high school students was published in China.

Great interest among parents in having their children learn about AI.



South Korea


Problem-Solving Activities for Computational Thinkers ❶ Artificial Intelligence
software education module
01
Infinite Challenge of
Artificial Intelligence
Deep Learning
Monte Carlo Tree
Living in an AI World
Ministry of Science, ICT and Future Planning
KOFAC


1.Deep Learning
2. Monte Carlo Tree
Activity 1
Problem Decomposition
Cut images of dogs and cats into small pieces and mix them, select similar parts
Recognizing Patterns
Find characteristics of dogs and cats and look for common characteristics that represent cats
Abstraction
Describe each part's characteristic as triangles and circles, etc.
Activity 2
Problem Decomposition
Understand the initial status and target status of tic-tac-toe
Recognizing Patterns
Find the location of the first mark that affects the results of tic-tac-toe
Abstraction
Analyze game results based on the sequence and location of placing marks
3. Living in an AI World
Activity 3
Problem Decomposition
Discover how robot cleaners work by using robot cleaner and sensor elements
Recognizing Patterns
Discover the typical ways robot cleaners avoid obstacles
Making an Algorithm
Make an algorithm so that robot cleaners can avoid obstacles and clean
Abstraction
Express the methods robot cleaners use to clean
Automation
Make a robot cleaner program
Activity 4
Recognizing Patterns
Write a sentence by combining the repeated keywords or prepositions/connectives
Problem Decomposition
Write diverse baseball articles and look for repeated words or sentences in articles
Abstraction
Select the keywords to be written in the baseball article as variables
Making an Algorithm
Prepare the order based on which keywords are entered, sentences are made with the appropriate prepositions/connectives and output
Automation
Make a program for automatic article writing using Entry

New Zealand

Curiosity: The real Turing test

Project: Run your own Turing test on a chatterbot

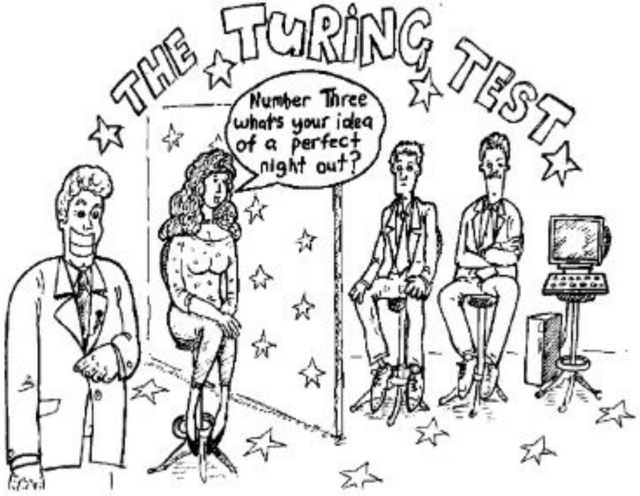


Table of Contents

Authors

Heidi Newton

What kind of impact can national K-12 AI education have?

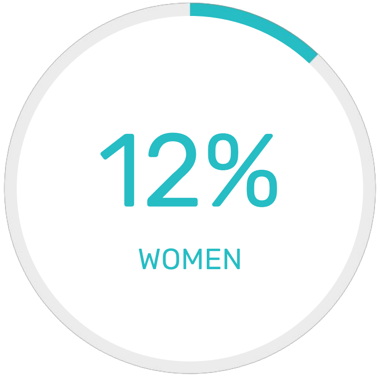
US Perspective

Emily Reid

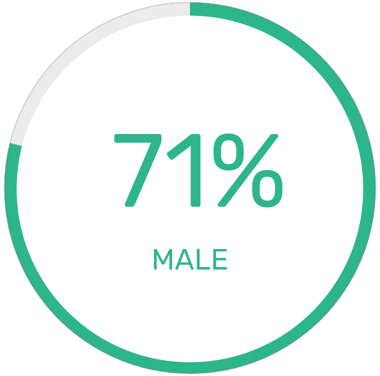
OUR MISSION:

Increase Diversity & Inclusion in AI Education, Development, Policy, & Research.

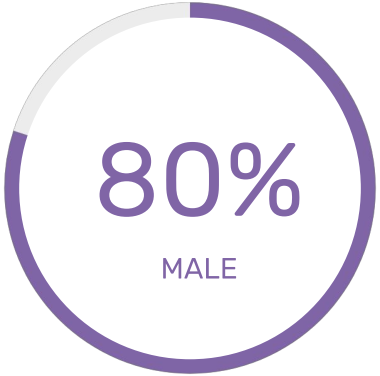
The Problem: Diversity Crisis



AI Researchers Around the World



Applicants for AI Jobs

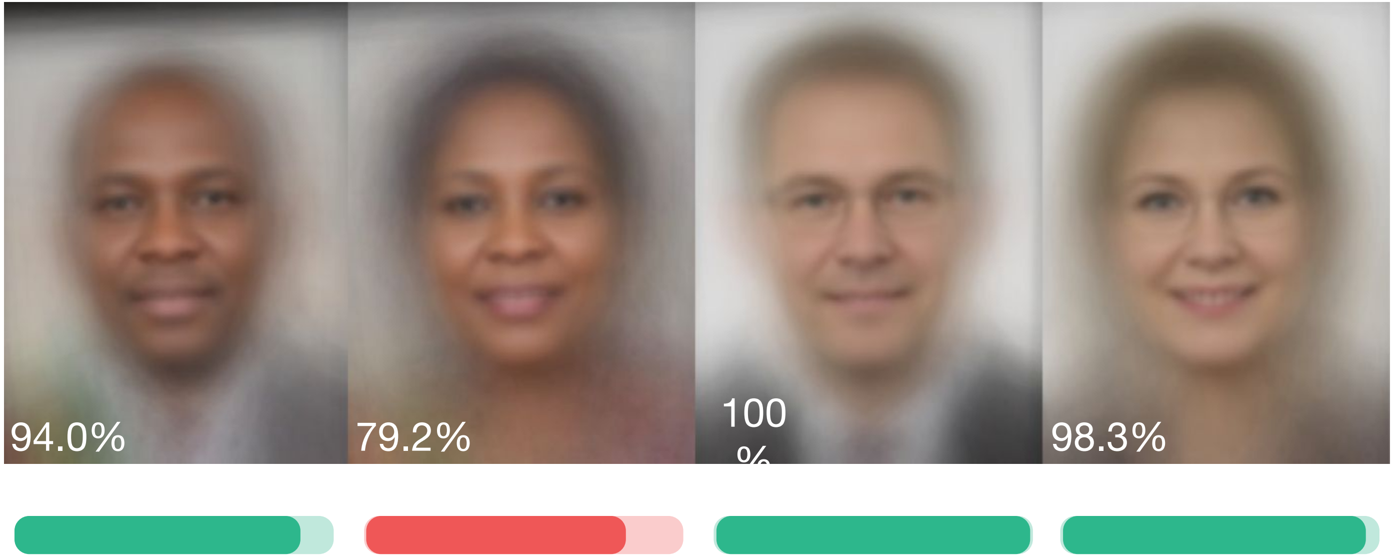


AI Professors

Element AI, 2018; AI Index, 2018

Bias: Facial Recognition

Darker-skinned Male | Darker-skinned Female | Lighter-skinned Male | Lighter-skinned Female



Gender Shades, Joy Buolamwini, Timnit Gebru, 2018

The AI4ALL Solution: 3 Core Initiatives

Summer Programs

Hosted at AI-focused Universities

University of Maryland · Stanford University · SFU Simon Fraser University · Princeton University · UCSF
Columbia University in the City of New York · Carnegie Mellon University · ASU Arizona State University · Boston University · Berkeley University of California

Changemakers in AI

Supporting careers for AI4ALL alumni

AI4ALL Open Learning

Enabling ethical AI projects

The Future of AI

Stephanie Tena
11TH GRADE

SALINAS, CA

STANFORD AI4ALL, 2017

Stephanie is researching AI solutions for predicting the flow of contaminated water.

The Future of AI

Amy Jin
COLLEGE FRESHMAN

SAN JOSE, CA
STANFORD AI4ALL, 2015

Amy won a Best Paper Award for her AI + healthcare research at the Machine Learning for Health Workshop at NeurIPS 2017.

The Future of AI

"Seeing the humanitarian applications in AI at Stanford AI4ALL, I realized that I didn't have to sacrifice fundamental aspects of my identity to pursue computer science."

Bekah Agwunobi
12TH GRADE

WALLINGFORD, CT
STANFORD AI4ALL, 2016

Alumni Annual Survey 2018

61%
Have started AI/CS projects

90%
Feel they are part of a community in AI/CS

100%
Feel that AI can improve the world and their community

87%
Feel the AI field could benefit from their perspective

77%
Are interested in a career in AI

88%
Feel they can succeed in AI

76%
Have participated in AI4ALL alumni events/programs

Open Learning: Students will learn to build AI for Social Good!

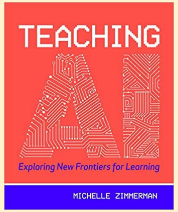
- Free, project-based AI education program
- Students can learn AI skills on the AI4ALL Open Learning platform (online)
- Then apply these skills to AI4ALL Open Learning group projects in a club format
- Curriculum Vision:
  - Overview, applications, and history of AI
  - Classification, Regression, Naive Bayes, Neural Nets, and other Machine Learning Concepts
  - Emphasis on the ethics and social impact of AI
- Curriculum is being built for high school students with a knowledge of basic algebra, statistics, and introductory text-based programming.
- Progress:
  - Pilot material was run in fall/winter 2018
  - Still in early stages of program & curriculum development
  - Will be releasing material in phases over the next few months

Sign up here to join our announcement list:

http://ai-4-all.org/open/

Snapshot: AI for K-12 Efforts in the US

ISTE: AI Professional Development course for teachers.



Teaching AI: Exploring New Frontiers for Learning, by Michelle Zimmerman.

Curiosity Machine AI Family Challenge (program of Iridescent)

At-home challenges for young children & parents

Google / Hal Abelson (MIT) ML Course

Machine learning for high school students.

ReadyAI.org: WAICY Competitions

5 Big Ideas in AI

Fred Martin

What is AI Fluency, Literacy & Thinking?

We are in the age of

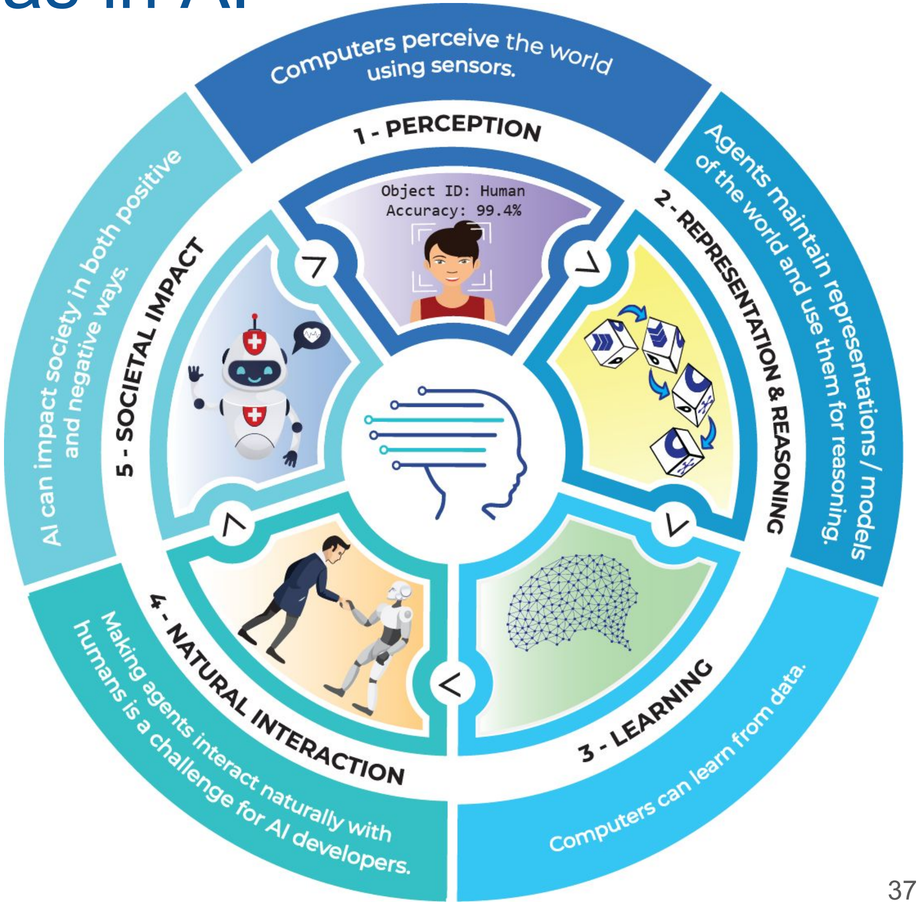
- AI consumers
- DIY makers, designers, and citizen scientists
- Bloggers and YouTubers

What **understandings**, **tools**, and **skills** do children need to competently engage with AI in their everyday lives?

What are the unique tools AI provides for people to **think about** and **solve problems** in the world?

AI4K12.org Five Big Ideas in AI

- Organizing framework for the K-12 guidelines.
- 5 big ideas are enough to cover the richness of the field, but small enough to be manageable by teachers
- CSTA experience shows 5 is a good number.
- Not necessarily the way AI practitioners view their field, but appropriate for the needs of the K-12 audience

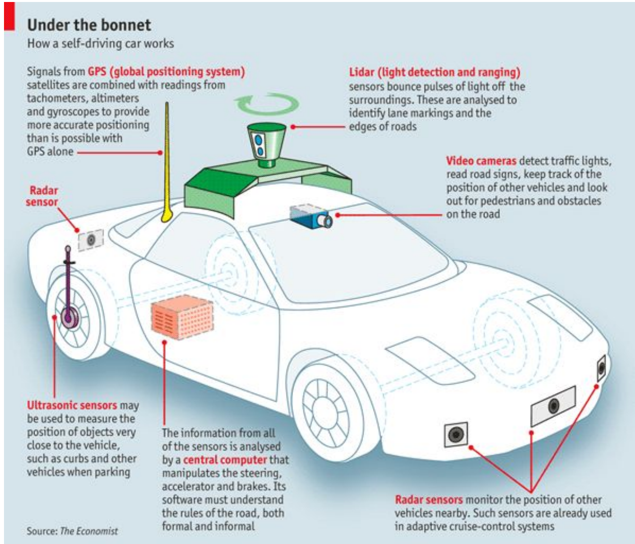


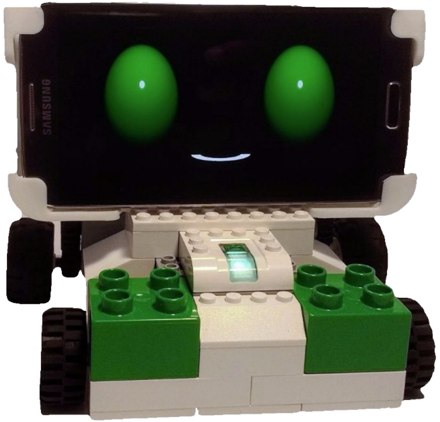
Big Idea #1: Perception

"Computers perceive the world using sensors."

- Speech recognition
- Computer vision, object recognition, scene understanding
- Face recognition
- Other forms of perception (e.g., sonar, LIDAR, music recognition)

Students should be able to identify types of sensors and their limitations.



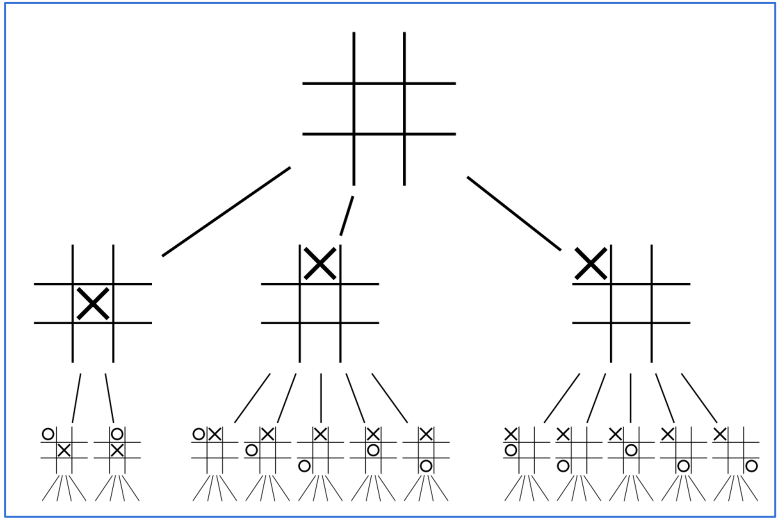


PopBots: robot perception for K-2

Big Idea #2: Representation and Reasoning

“Agents maintain representations (and models) of the world, and use them for reasoning.”

- Knowledge representation
- Semantic web
- Search (and heuristic search)
- Inference algorithms:
    - Theorem proving
    - Rule-based reasoning
    - Constraint satisfaction
    - Optimization
    - Etc.



Students in grades 6+ should be able to draw a search tree.

Big Idea #3: Learning

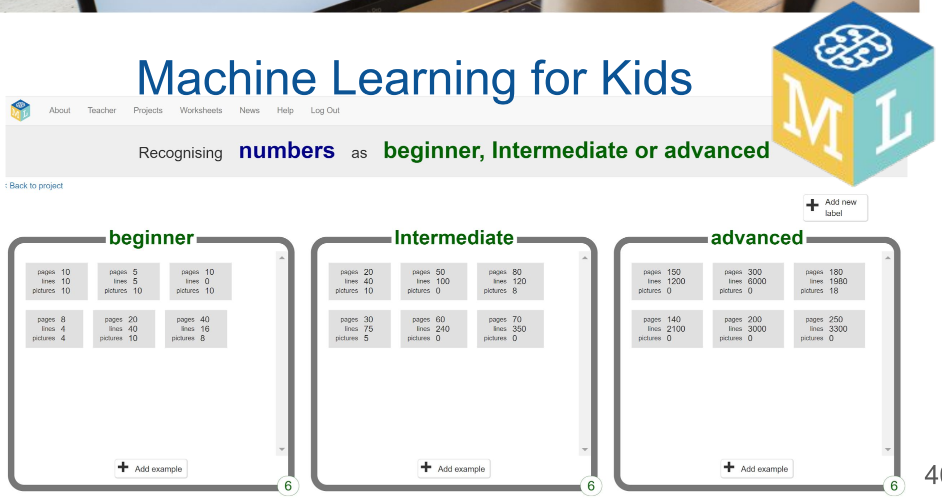
“Computers can learn from data.”

- Machine learning
  - Classifiers
  - Function approximators
  - Data science
  - Training sets and sources of bias
- Neural networks

Students should be able to train a classifier.:

Grades K-2: train a gesture discriminator..

Grades 6-8: define a feature set and train a a decision tree classifier.



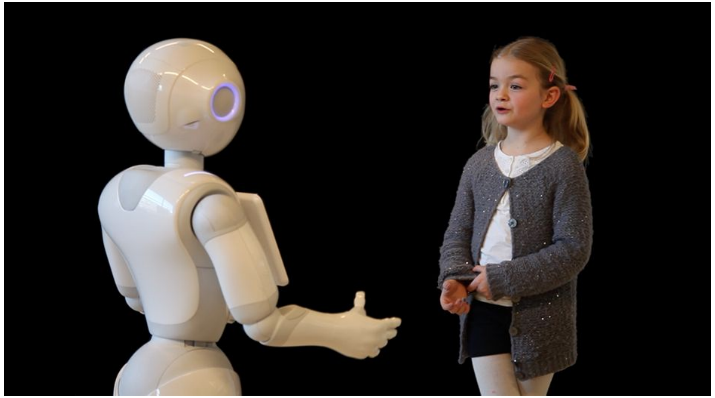
Big Idea #4: Natural Interaction

“AI developers strive to create agents that interact naturally with humans.”

- Natural language understanding
- Dialog management
- Affective computing
- Human-Robot Interaction
- Artificial general intelligence (AGI)

Grades K-2: students should be able to converse with an agent like Alexa.

Grades 6-8: students should be able to construct a simple chatbot.



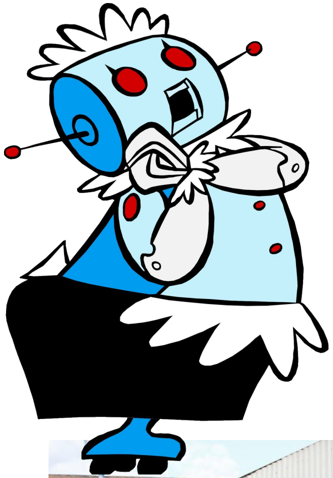
Big Idea #5: Societal Impact

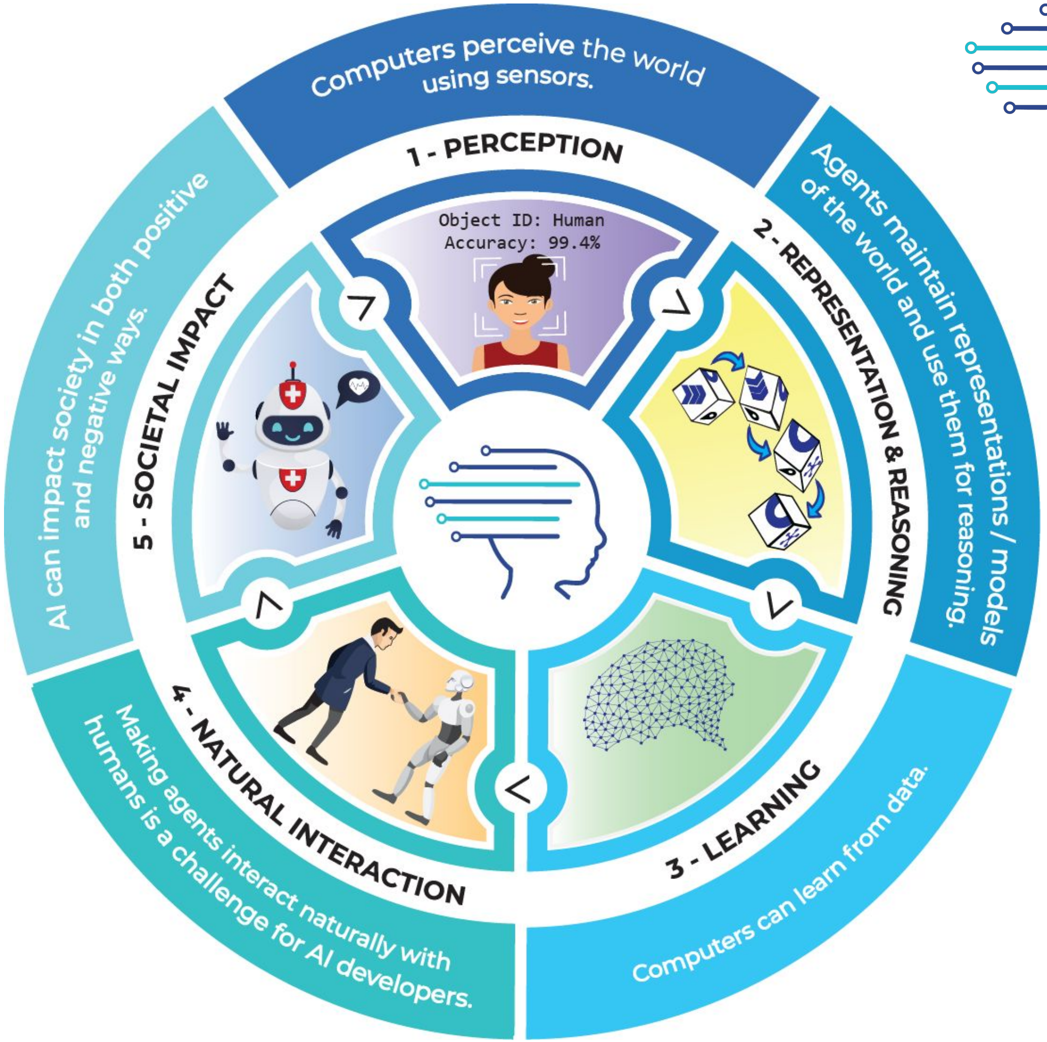
“Artificial Intelligence can impact society in both positive and negative ways.”

- Ethics: what sorts of applications are desirable/permissible?
  - Transparency and accountability of AI systems
  - Values tradeoffs, e.g., privacy vs. security; who should own your data?

- Effects: what are the likely impacts of AI technology on society?
  - Robot servants, rescuers, and companions
  - Economic disruption; changes in the nature of work
  - Effects of unintended biases

Grades 6+: Students should be able to identify ethical issues raised by AI applications.




Computers perceive the world using sensors.
1 - PERCEPTION
Object ID: Human
Accuracy: 99.4%
2 - REPRESENTATION & REASONING
Agents maintain representations / models of the world and use them for reasoning.
3 - LEARNING
Computers can learn from data.
4 - NATURAL INTERACTION
Making agents interact naturally with humans is a challenge for AI developers.
5 - SOCIETAL IMPACT
AI can impact society in both positive and negative ways.

AI4K12.org

Guideline Development Process

Deborah Seehorn

K-12 Teacher Working Group Members

Grades K-2
Vicky Sedgwick (Lead)
Susan Amsler-Akacem
Dr. April DeGennaro
Charlotte Dungan

Grades 3-5
Kelly Powers (Lead)
Dr. Marlo Barnett
Dr. Phillip Eaglin
Brian Stamford

Grades 6-8
Padmaja Bandaru (Lead)
Minsoo Park
Juan Palomares
Sheena Vaidyanathan

Grades 9-12
Dianne O'Grady-Cunniff (Lead)
Jared Amalong
Dr. Smadar Bergman
Kate Lockwood

<table>
<tr><th colspan="3">Working Group Members Areas of Expertise and Experience</th></tr>
<tr><th>AI & CS Expertise</th><th>AI & CS Teaching</th><th>Programming Languages & Tools</th></tr>
<tr>
<td>CS expertise/experience ranging from:
CS teacher PD, CS teacher certification, BS, MS, and PhD in Computer Science

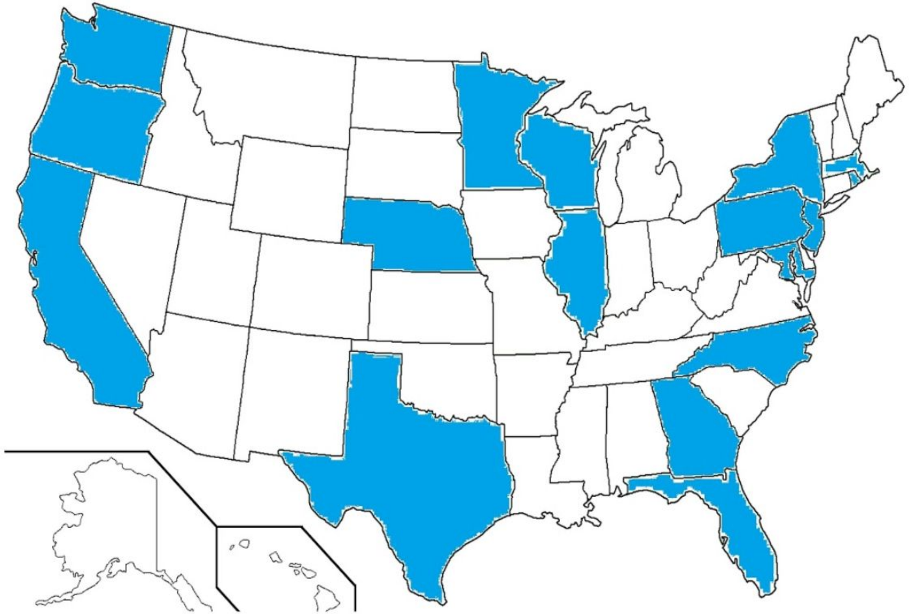
AI expertise: interested explorers (3), topical (2), CS PhD in AI areas (2), CS Industry (3)</td>
<td>CS Courses taught: programming fundamentals, Game Design & Animation,
Networking, software design,
AP CS A, AP CS Principles, ECS, Cybersecurity, Robotics, Web & App Development, Augmented Reality, Algorithms and Programming, Data Structures, and Physical Computing.

AI teaching: activities (1), units (4), courses (2)
- Intro to Machine Learning
- Intro to Data Science</td>
<td>Programming languages/environments: Scratch, Scratch Jr, Python, Snap!, Java, Javascript, App Inventor, and Processing.

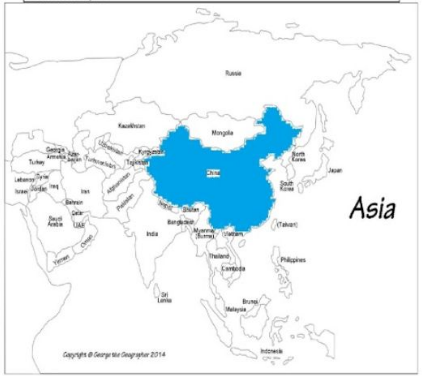
Physical Computing: Raspberry Pi, Arduino

Robotics Frameworks & teaching: Beebot, Dash, Ozobot & Sphero, Cubelets, Calypso for Cozmo, Lego EV3, Edison robot, Finch, and others</td>
</tr>
</table>

Across the three groups that make up the AI for K-12 Initiative, we have 33 individuals: 18 women and 15 men. We have representation from 17 US states, the UK, Europe, and Asia. Ethnic diversity: African American (5), Indian & Asian (5), Latino/a (2), and White (21).



AI For K-12 Geographic Distribution



Geographical Representation AI for K-12 WG

Geographically, we are distributed across the USA:

- 11 from New England, Northeast and Mid-Atlantic (RI, MA, NY, PA, MD)
- 7 from the West Coast (CA, OR, WA)
- 7 from the Midwest (IL, MN, NE, WI)
- 4 from the Southeast (NC, GA, FL)
- 1 from the Southwest (TX)

The K-12 working group members teach at diverse schools. Eleven teachers work in public schools, four work in private schools, and one at a charter school.

Our Challenge

We are working together and leveraging the strengths of the WG members to develop the guidelines.

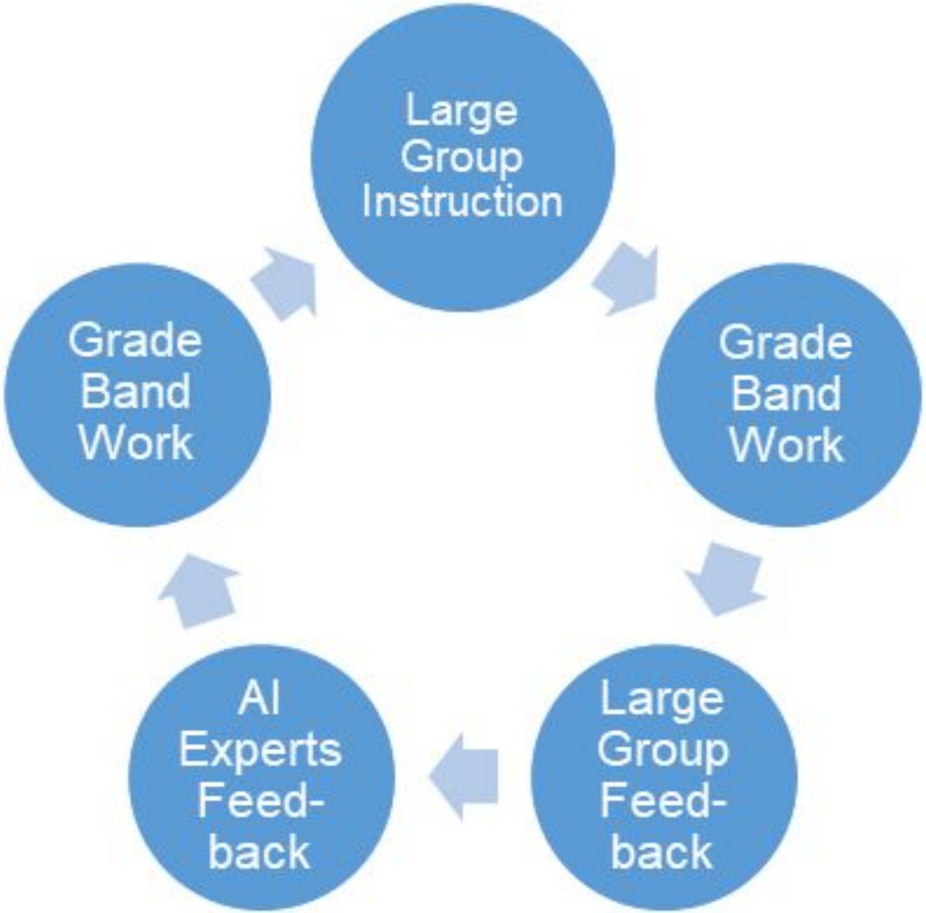
This process is a little different than previous standards writing efforts that working group members have been a part of for several reasons:

1. Most groups start out with existing standards or big ideas
2. Most groups have a clear idea of what they want students to learn by the end of 12th grade

3B-AP-08	11-12	**Describe how artificial intelligence drives many software and physical systems.**	Algorithms & Programming	Algorithms	Communicating
3B-AP-09	11-12	**Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem.**	Algorithms & Programming	Algorithms	Creating

Figure 1. CSTA 2017 AI Standards

Guideline Development Process



Ideas for the Guideline Format - K-12 CS Framework

The Concepts and Practices of the K–12 Computer Science Framework

Core Concepts

1. Computing Systems
2. Networks and the Internet
3. Data and Analysis
4. Algorithms and Programming
5. Impacts of Computing

Core Practices

1. Fostering an Inclusive Computing Culture
2. Collaborating Around Computing
3. Recognizing and Defining Computational Problems
4. Developing and Using Abstractions
5. Creating Computational Artifacts
6. Testing and Refining Computational Artifacts
7. Communicating About Computing

Practice 1. Fostering an Inclusive Computing Culture

Building an inclusive and diverse computing culture requires strategies for incorporating perspectives from people of different genders, ethnicities, and abilities. Incorporating these perspectives involves understanding the personal, ethical, social, economic, and cultural contexts in which people operate. Considering the needs of diverse users during the design process is essential to producing inclusive computational products.

By the end of Grade 12, students should be able to:

− 1. Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.

At all grade levels, students should recognize that the choices people make when they create artifacts are based on personal interests, experiences, and needs. Young learners should begin to differentiate their technology preferences from the technology preferences of others. Initially, students should be presented with perspectives from people with different backgrounds, ability levels, and points of view. As students progress, they should independently seek diverse perspectives throughout the design process for the purpose of improving their computational artifacts. Students who are well-versed in fostering an inclusive computing culture should be able to differentiate backgrounds and skillsets and know when to call upon others, such as to seek out knowledge about potential end users or intentionally seek input from people with diverse backgrounds.

+ 2. Address the needs of diverse end users during the design process to produce artifacts with broad accessibility and usability.

+ 3. Employ self- and peer-advocacy to address bias in interactions, product design, and development methods.

By the end of Grade 2

Impacts of Computing

Culture

Computing technology has positively and negatively changed the way people live and work. Computing devices can be used for entertainment and as productivity tools, and they can affect relationships and lifestyles.

− Description

Computing devices, such as fitness trackers, can motivate a more active lifestyle by monitoring physical activity. On the other hand, passively consuming media from computing devices may lead to a more sedentary lifestyle. In the past, the most popular form of communication was to send mail via the postal service. Now, more people send emails or text messages.

Crosscutting Concept: Human–Computer Interaction

Connection Within Framework: K–2.Data and Analysis.Inference and Models

Networks and the Internet

Network Communication and Organization

Computer networks can be used to connect people to other people, places, information, and ideas. The Internet enables people to connect with others worldwide through many different points of connection.

− Description

Small, wireless devices, such as cell phones, communicate with one another through a series of intermediary connection points, such as cellular towers. This coordination among many computing devices allows a person to voice call a friend or video chat with a family member. Details about the connection points are not expected at this level.

Crosscutting Concepts: Communication and Coordination; Human–Computer Interaction

Connections Within Framework: K–2.Impacts of Computing.Social Interactions;K–2.Data and Analysis.Collection; 3–5.Impacts of Computing.Social Interactions

Cybersecurity

Connecting devices to a network or the Internet provides great benefit, but care must be taken to use authentication measures, such as strong passwords, to protect devices and information from unauthorized access.

− Description

Authentication is the ability to verify the identity of a person or entity. Usernames and passwords, such as those on computing devices or Wi-Fi networks, provide a way of authenticating a user's identity. Because computers make guessing weak passwords easy, strong passwords have characteristics that make them more time-intensive to break.

Crosscutting Concepts: Privacy and Security; Communication and Coordination

Connection Within Framework: K–2.Impacts of Computing.Safety, Law, and Ethics

Ideas for the Guideline Format - CSTA K-12 CS Standards

CSTA K-12 Computer Science Standards, Revised 2017

Use the filters and search feature to configure the view. Click the arrow next to each standard to expand a clarification statement. Print any custom filter or view of the dynamic standards table by clicking the button at the bottom, or access a ***PDF version of all standards****.*

You can also view the standards in a ***progressions chart****.*

Level | Concept | Subconcept

Practice | Search

1 - 120 / 120

Identifier	Grades	Standard	Concept	Subconcept	Practice(s)
1A-CS-01	K-2	**Select and operate appropriate software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use.**	Computing Systems	Devices	Inclusion

By End of Grade 2, Students Should Know How to Identify Sensors on Robots, Phones, Tablets, etc.

Clarification

This ties in with CSTA Standard 1A-CS-02 which is related to identifying the external parts of computing devices and understanding of input and output.

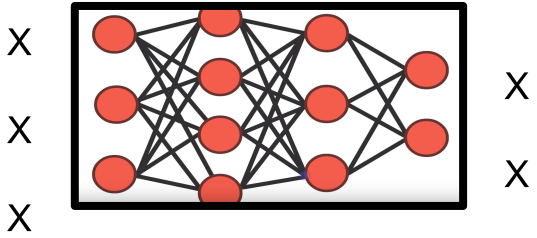
Be Able To Do

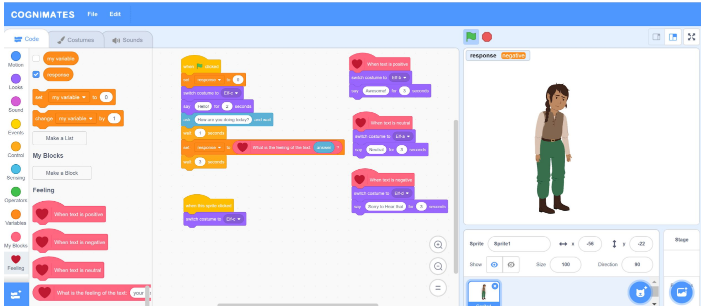
- Show where sensors are on robots, phones, tablets, etc. and explain what they do
- Explain what the output is from an AI agent

Supporting AI in K-12 Classrooms: What Teachers and Students Need

Guidelines for supporting K-12 students & teachers

1. **Transparency**
   help students see what is going on inside the black box and glass box
2. **Help students build models** of *what is happening under the hood of AI applications*
3. **Allow students to use AI services to develop AI applications**





Student Activity Considerations

- AI Experiments
  e.g., science experiments
- Hand simulations of AI algorithms
- Projects that allow students to build AI applications
- Case studies of ethical issues *that foster explore from multiple perspectives*

Projects and activities that promote understanding of

- how AI works
- limits of AI
- AI systems are built using smaller AI components
- sources of bias in AI
- results of AI systems

Types of Instructional Resources

Self-contained resource

Allows students to interact with AI concepts and run experiments

e.g.,Tensorflow playground - neural net

Plugin to existing frameworks

Allows Students to build AI Applications

a. Scratch
b. Snap!
c. Python libraries (with accompanying K-12 resource guide)

Demonstration (not a tool)

Provides insight into how AI works, e.g.,

Demos:

- speech recognition demo
- parser demonstrations that display the parse tree

Video Explanations:

- “How Snapchat’s filters work”
- “What neural networks see”
- AI Careers & Research
- Ethical issues

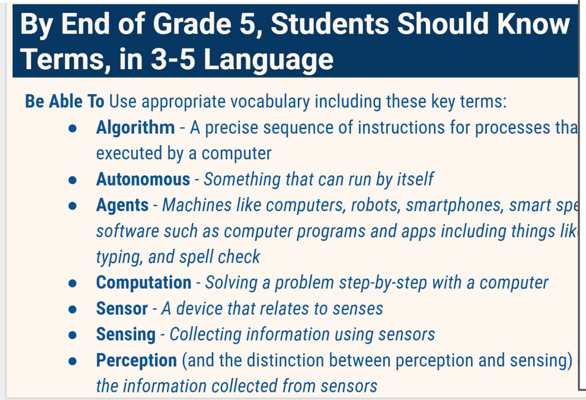
Classroom Support Considerations

Provide

- Terminology and definitions
- Sample projects
- Sample activities & experiments
- Troubleshooting guide
- Videos
- Student contests and competitions

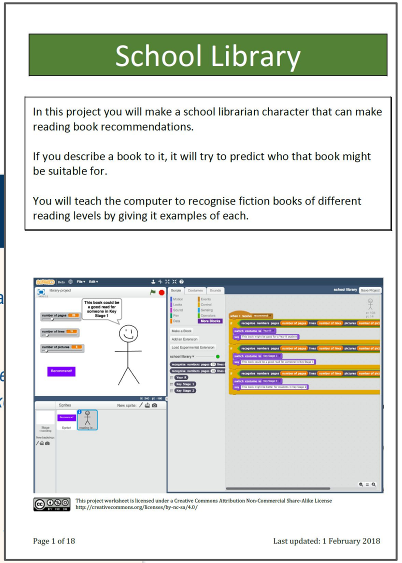
Design for

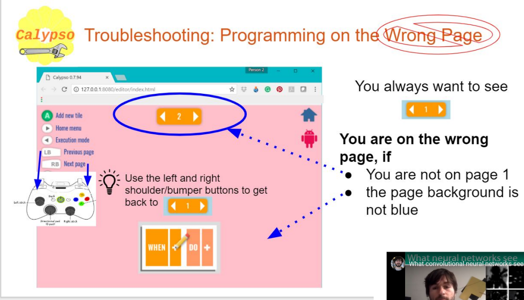
- Diverse learners
- Awareness, engagement, deep learning

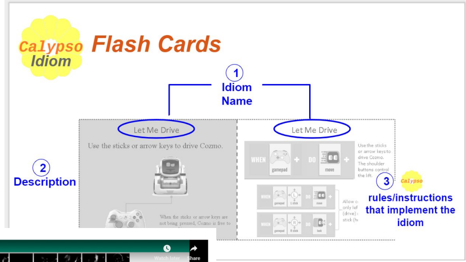

By End of Grade 5, Students Should Know Terms, in 3-5 Language

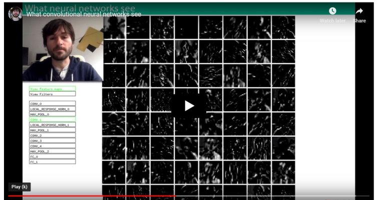
Be Able To Use appropriate vocabulary including these key terms:

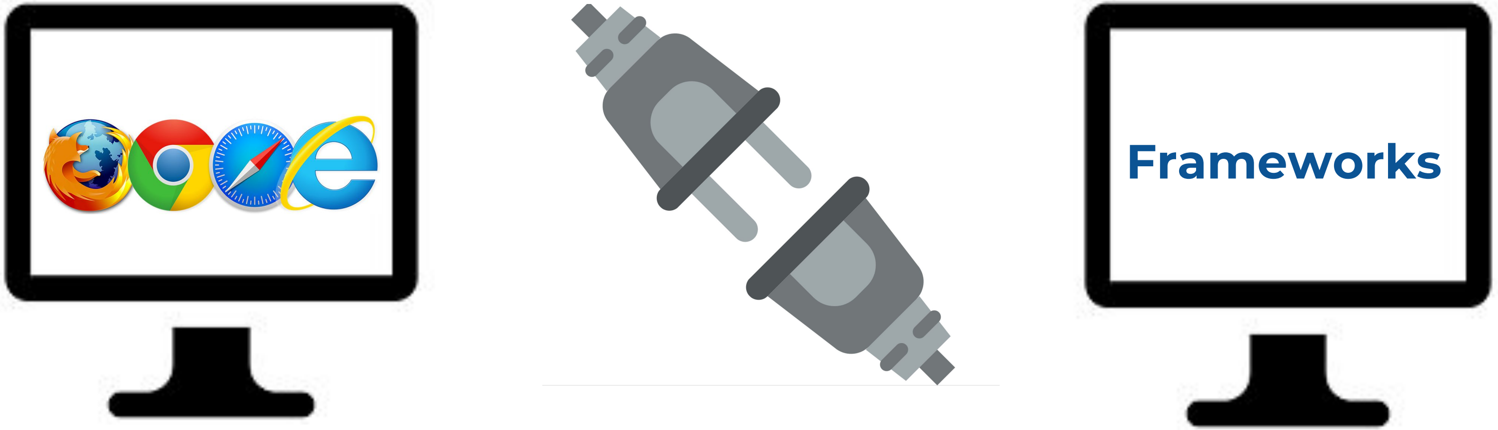
- **Algorithm** - A precise sequence of instructions for processes tha
executed by a computer
- **Autonomous** - *Something that can run by itself*
- **Agents** - *Machines like computers, robots, smartphones, smart spe software such as computer programs and apps including things lik typing, and spell check*
- **Computation** - *Solving a problem step-by-step with a computer*
- **Sensor** - *A device that relates to senses*
- **Sensing** - *Collecting information using sensors*
- **Perception** (and the distinction between perception and sensing) *the information collected from sensors*











Overview of the Resource Library:

AI Tools & Resources for K-12

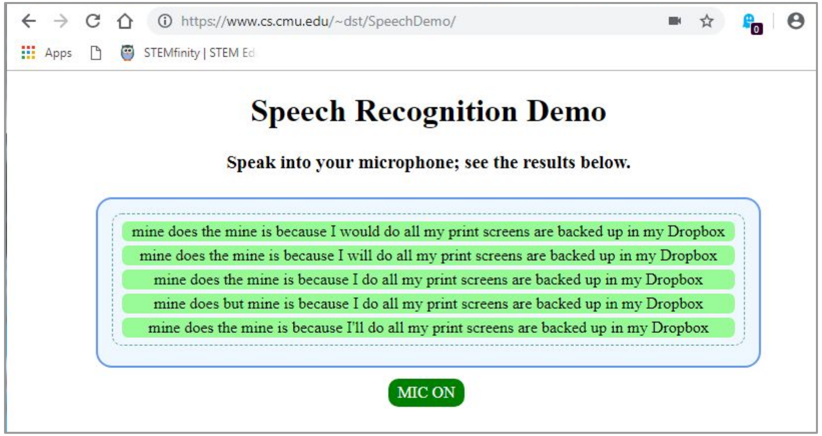
Dave Touretzky

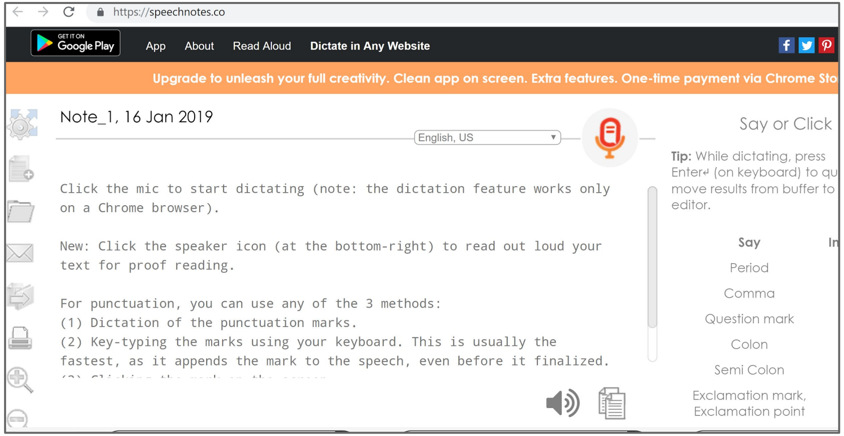
Free web-based AI demos

Speech Recognition: Speech to Text Demos

1. Demo shows alternative parses
https://www.cs.cmu.edu/~dst/SpeechDemo/

2. Demo speaks back what it heard
https://speechnotes.co/





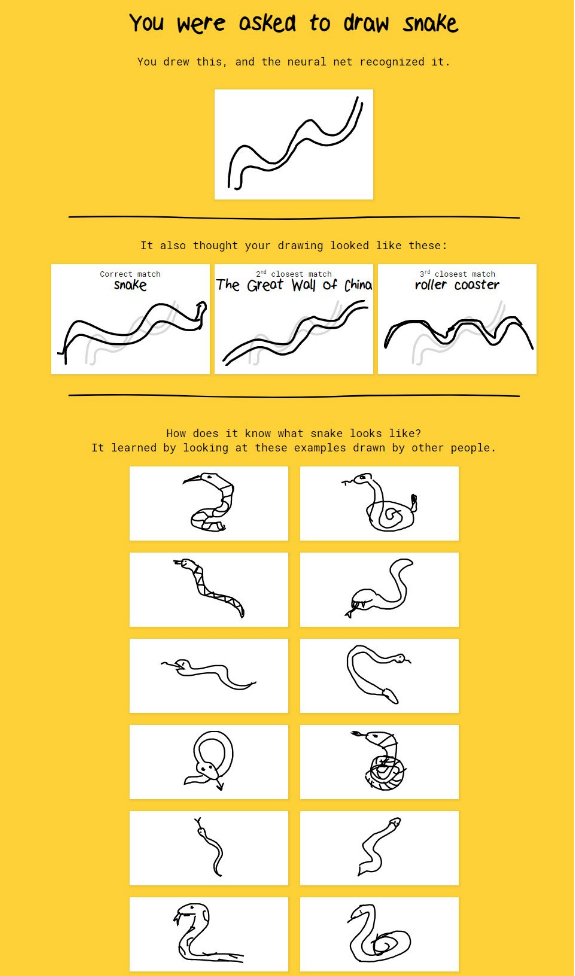
AI & Creativity

https://experiments.withgoogle.com/mixlab

Input & *Output*

Google's Quick, Draw!

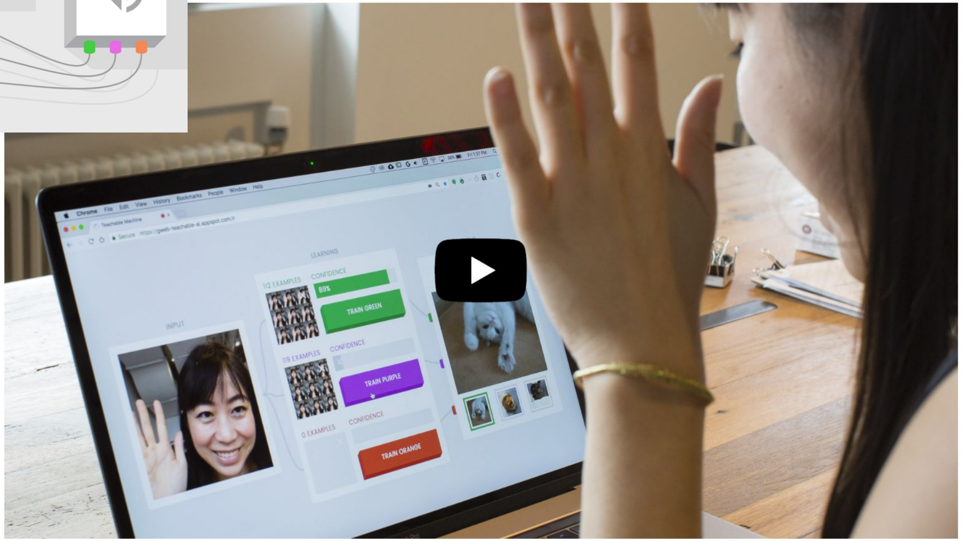
https://quickdraw.withgoogle.com/

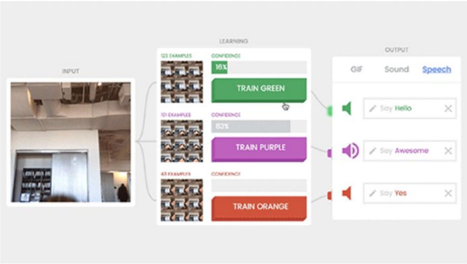


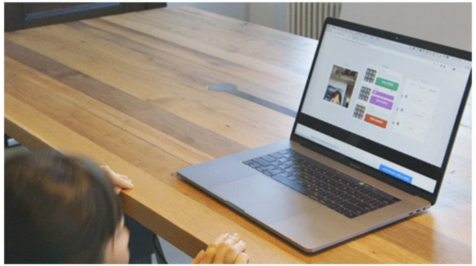
TEACHABLE MACHINE

Built with TensorFlow

- Teach a machine using your camera,
- live in the browser
- no coding required.



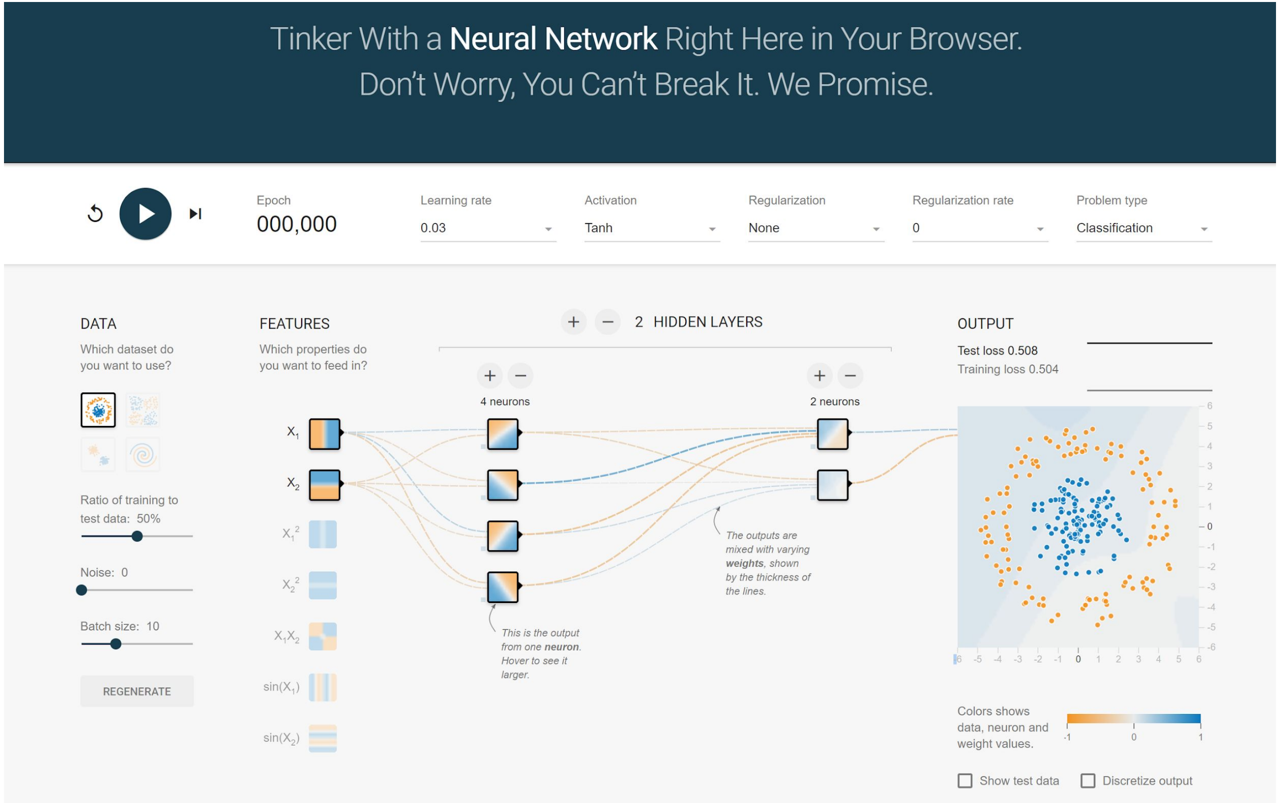




https://experiments.withgoogle.com/teachable-machine

TensorFlow Playground

https://playground.tensorflow.org



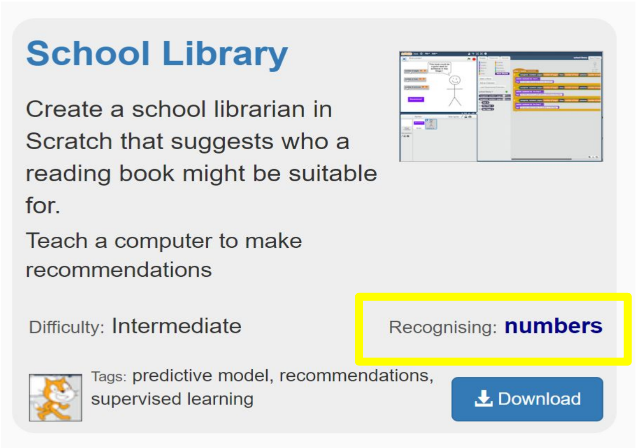
Tutorial: https://cloud.google.com/blog/products/gcp/understanding-neural-networks-with-tensorflow-playground

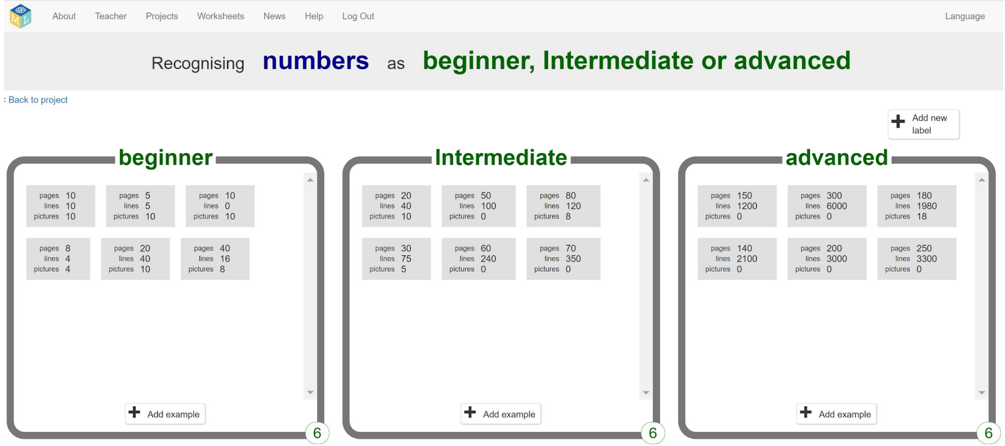
AI Programming Frameworks for Kids

Machine Learning for Kids

https://machinelearningforkids.co.uk

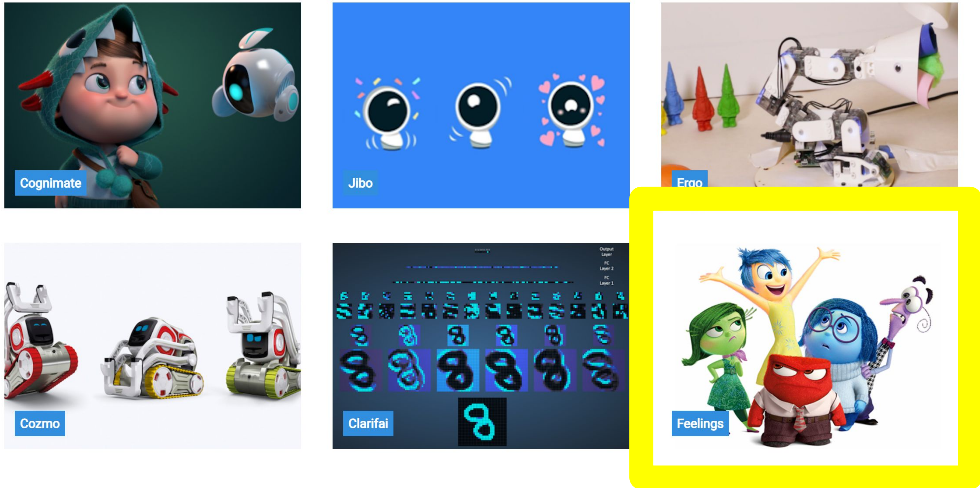
1. Collect examples of things you want to be able to recognise
2. Use the examples to train a computer to be able to recognise them
3. Make a game in Scratch that uses the computer's ability to recognise them





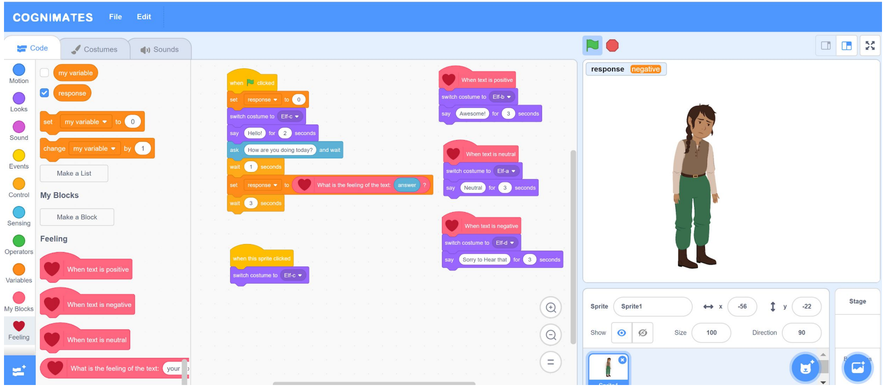
It is being built by Dale Lane using APIs from IBM Watson Developer Cloud.

http://cognimates.me



Project creator [Stefania Druga](#)

The project was supported by the [Personal Robots Group](#) at MIT Media Lab, directed by [Cynthia Breazeal](#), Associate Professor of Media Arts and Sciences.



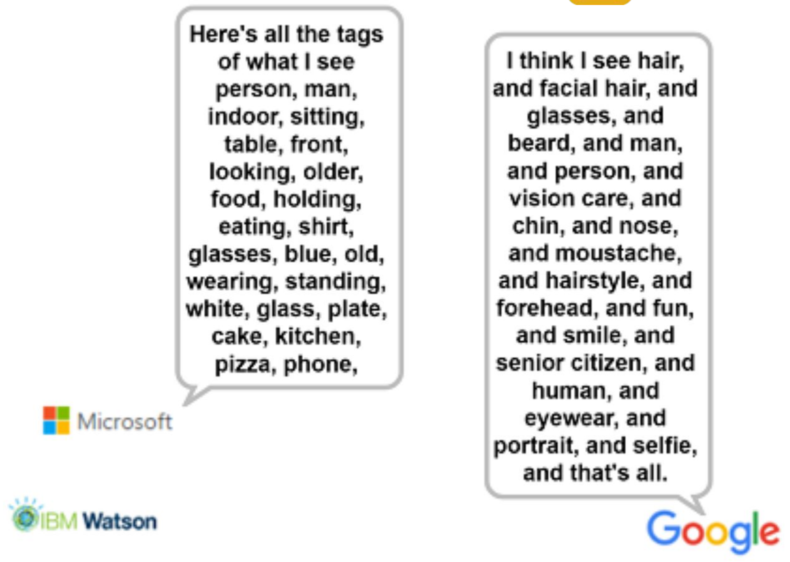
eCraft2Learn

https://ecraft2learn.github.io/ai/

Snapp!

AI services have become ubiquitous. But Designed for use by professional programmers.

The challenge - create child-friendly interfaces

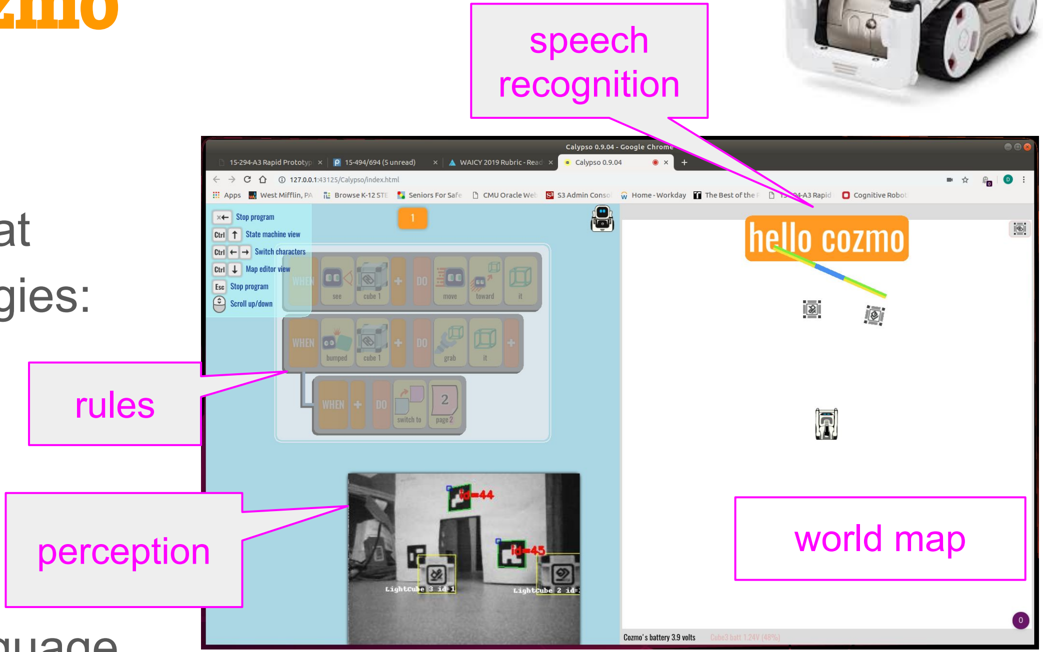


[Listen to a description of what is in front of the camera in response to you speaking](#)

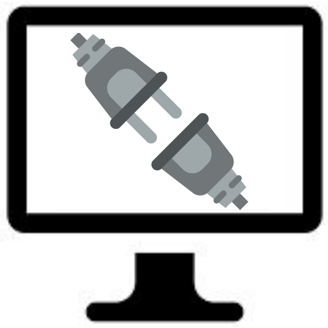
(requires microphone, speaker/headphones, webcam, and API key(s))

Calypso for Cozmo

- A robot intelligence framework that Incorporates multiple AI technologies:
  - Computer vision; face recognition
  - Speech recognition and generation
  - Landmark-based navigation
  - Path planning
  - Object manipulation



- Rule-based pattern matching language inspired by Microsoft's Kodu Game Lab
- Teaches computational thinking: "Laws of Calypso", idioms, etc.
- Web site: https://Calypso.software



AI Unplugged Activities

Create a Discrimination Net:
Guess the Animal

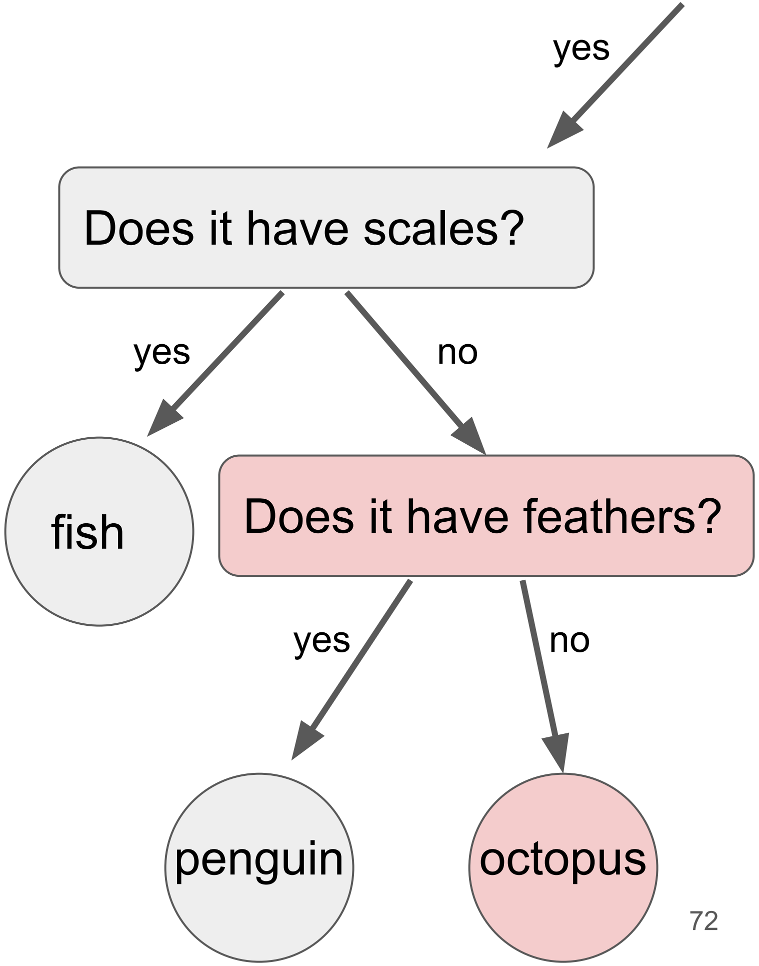
Computer: what question distinguishes between a penguin and an octopus?

Human: “Does it have feathers?”

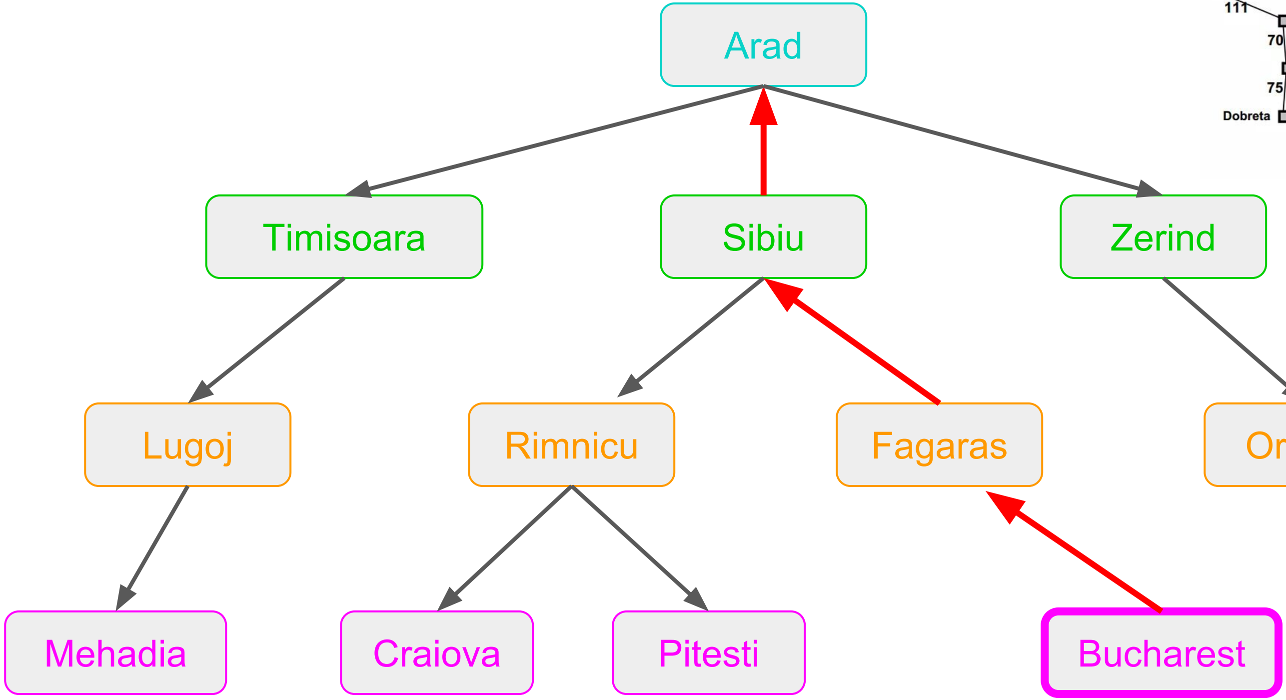
Computer: What is the answer for octopus?

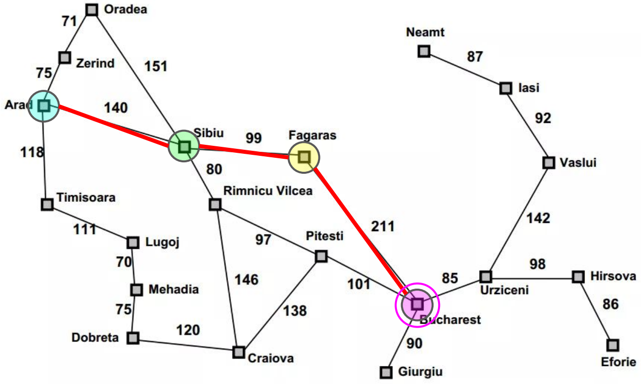
Human: “no”.

Computer: I’ll remember that.



Unplugged: Drawing Search Trees





AI Competitions for K-12

First WAICY - July 2018 at CMU

5 Time zones

200+ Students

50+ Teams

(**20+** remote participation)

"S.T.E.A.M.-Powered A.I."

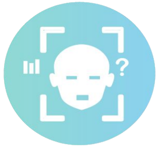
- 50/50 Rubric
- Winning Project

S.T.E.A.M-Powered A.I.

AI Criteria

Vision

Speech Recognition



Face Recognition

Landmark-based Navigation

Speech Generation

Object Manipulation

+

Multimedia Criteria

- Story line
- Visual Design
- Audio Design
- Theme/Message
- Preparation/Delivery
- . . .

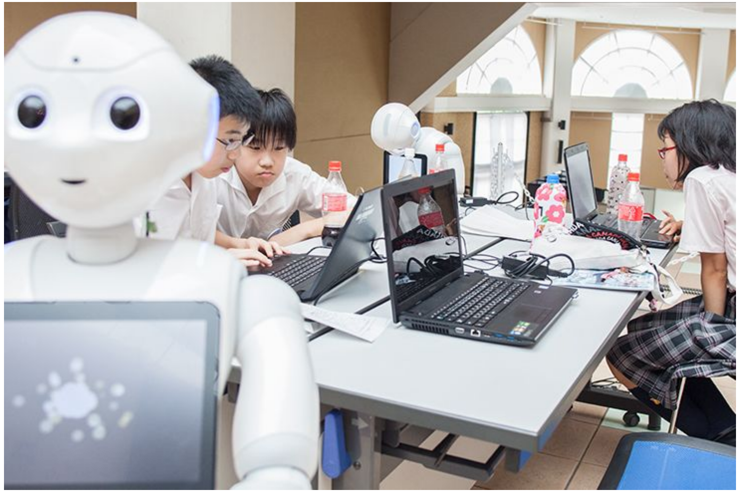
WRS World Robot Summit

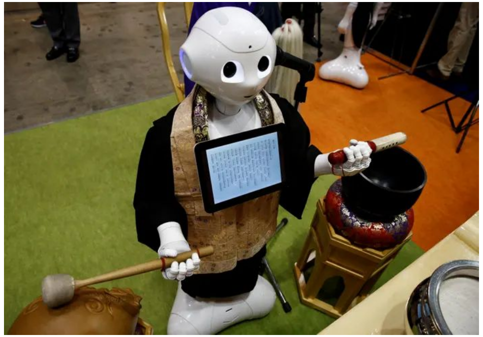
World Robot Challenge

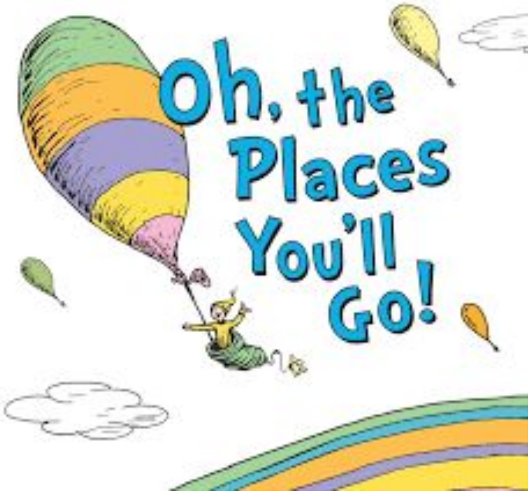
Robotics for Happiness

Towards achieving a society where humans and robots cooperate and coexist.

World Robot Challenge (WRC), a robot competition in which teams from all over the world compete in 4 categories where use of robots is highly expected: Industrial Robotics, Service Robotics, Disaster Robotics, and Junior.







How Can You Contribute???

How to Contribute

Develop
Assignments, Videos, Web-based Demos,
& Tool frameworks

- **Basic AI concepts**
- **How AI works** through the lens of everyday technologies
- **Advances in AI research**

Develop for all grade bands: k-2, 3-5, 6-8, and 9-12 & work with teachers & students

Start thinking of
Inspiring Assignments for AI
for K-12 classrooms
for
SIGCSE 2020

Begin incorporating AI into your plans for teaching CS in K-12

Provide Feedback on guidelines

Join the mailing list:
ai4k12@aaai.org

It’s time for all of us to think about AI in K-12.

Visit us

http://AI4K12.org

Join the mailing list:

Send mail to ai4k12@aaai.org

Let’s continue this conversation

in our **BOF @ 5:30pm**

(right after this session)

AI for K-12: Making Room for AI in K-12 CS Curricula

Location: Greenway J (2nd fl)

Discussion