Teaching AI Across K-12
What's New?

2020 CSTA Annual Conference
Monday, July 13, 2020
4:00-4:45 PM Central Time

bit.ly/csta2020ai4k12

Who Is Joining Us Today?

Vicky Sedgwick
K-2 Grade Level Lead

Sheena Vaidyanathan
6-8 Grade Level Lead

Kelly Powers
3-5 Grade Level Lead

Jared Amalong
9-12 Grade Level Lead

Deborah Seehorn
Steering Committee

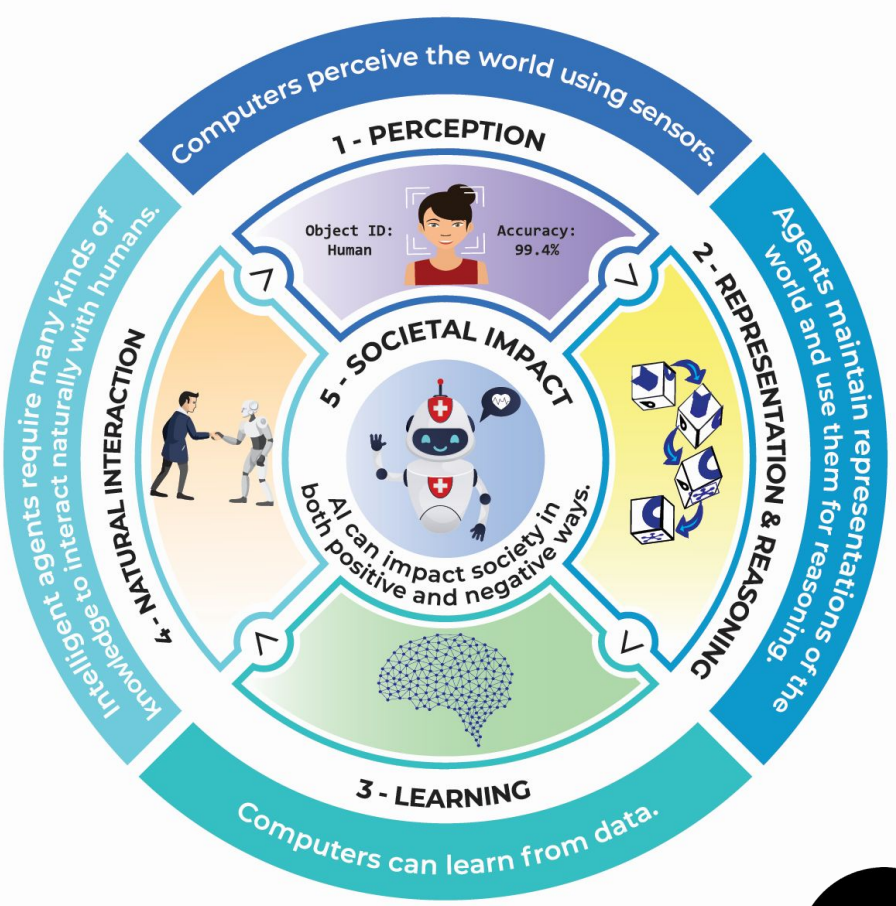
Please introduce yourself in the chat
Name, Location, and Job Role!

AI4K12.org

Five Big Ideas in AI

Download a free poster explaining the Five Big Ideas from our website:

AI4K12.org



Initiative 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 educators, researchers, and resource developers.

The AI4K12 Initiative, a joint project of:

AAAI (Association for the Advancement of Artificial Intelligence)

CSTA (Computer Science Teachers Association)

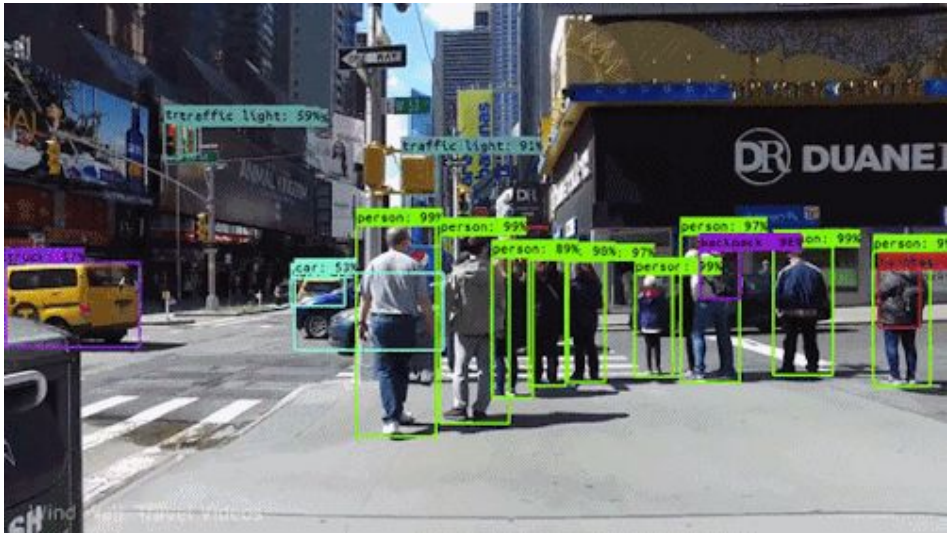
With funding from National Science Foundation ITEST Program (DRL-1846073)

Carnegie Mellon University
School of Computer Science

Big Idea #1: Perception

Computers perceive the world using sensors.

Key Understandings *(NEW!)*:

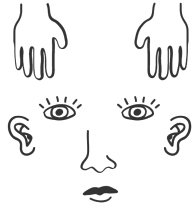


Perception is the extraction of *meaning* from sensory signals based on knowledge.

The transformation from signal to meaning takes place in stages, with increasingly abstract features and higher level knowledge applied at each stage.

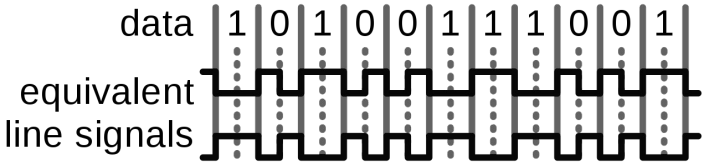
Big Idea #1: Perception 1-A Sensing

i. **Living Things**



ii. **Computer Sensors**

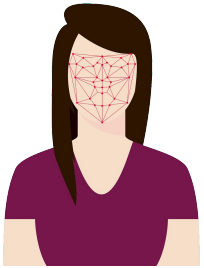
iii. **Digital Encoding**



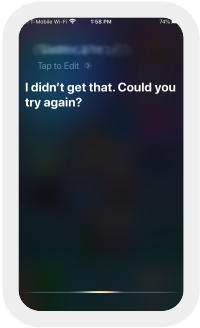
Big Idea #1: Perception 1-B Processing

i. Sensing vs Perception

ii. Feature Extraction



iii. Abstraction Pipeline: Language



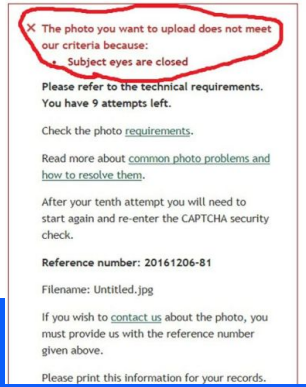
iv. Abstraction Pipeline: Vision

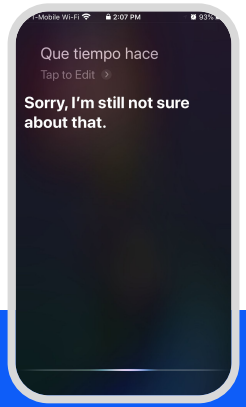
Big Idea #1: Perception 1-C Domain Knowledge

i. Types of Domain Knowledge

PLACE TAGS	PROBABILITY
japanese garden	16.22%
tree house	14.08%
chalet	5.99%
pond	5.06%
hunting lodge/outdoor	4.97%
cottage	4.83%
fishpond	4.15%

ii. Inclusivity





Big Idea #2: Representation and Reasoning

Agents maintain representations of the world, and use them for reasoning.

Key Understandings *(NEW!)*:

Representations drive reasoning.

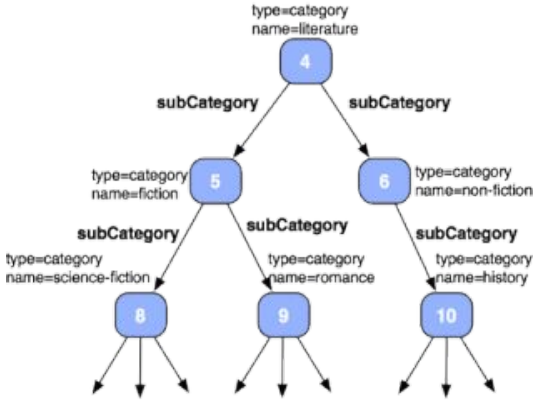
Reasoning algorithms manipulate representations.

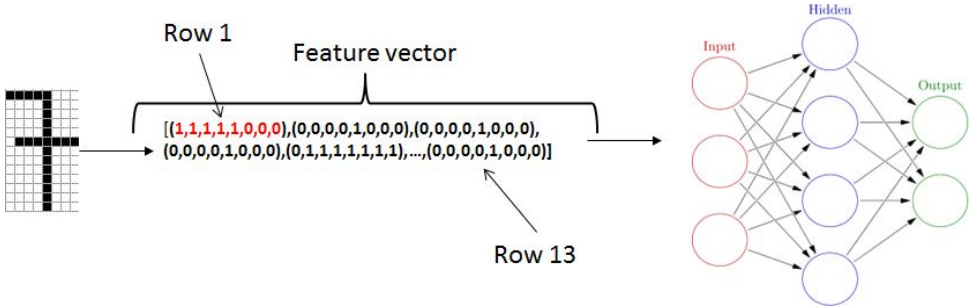
Big Idea #2: Types of Representation

i. Symbolic Representations

ii. Feature Vectors

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





Big Idea #2: Types of Reasoning

i. Classification

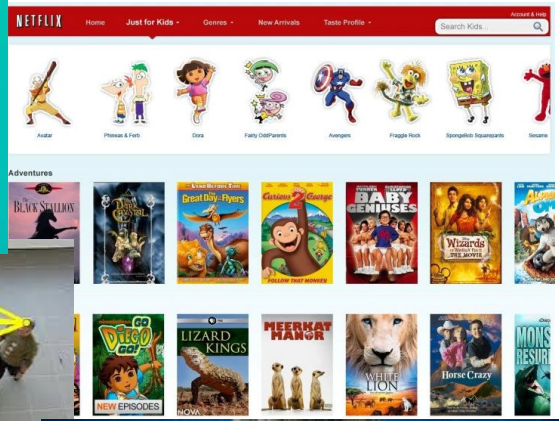
ii. Prediction

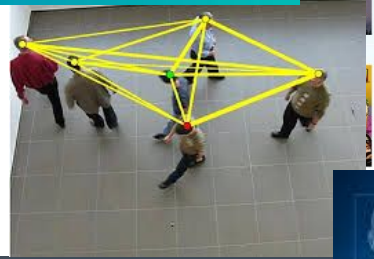
iii. Combinatorial Search

iv. Inference

v. Planning *(NEW)*

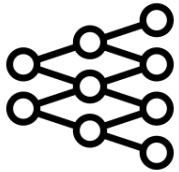
vi. Recognition



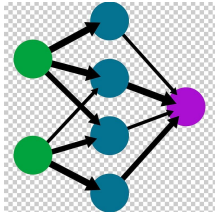


Big Idea #2: Families of Algorithms

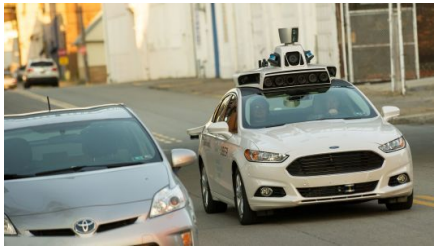
i. Decision Trees (Classification)

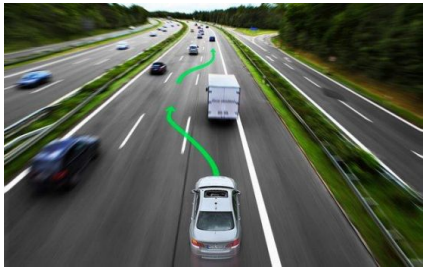


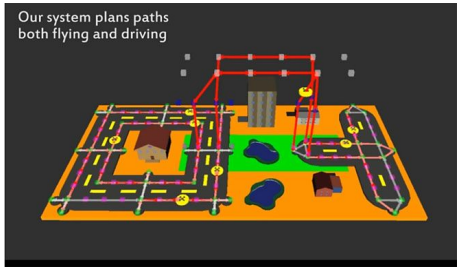
ii. Neural networks (Classification, Prediction, Recognition)



iii. Search (Planning, Combinatorial Search)







Big Idea #2: Representation and Reasoning

Example Guidelines

- Create/design a representation of an (animal) classification system using a tree structure.
- Draw a search tree for tic-tac-toe
- Describe how AI representations support reasoning to answer questions
- Describe the differences between types of search algorithms

Big Idea #3: Learning

Computers can learn from data.

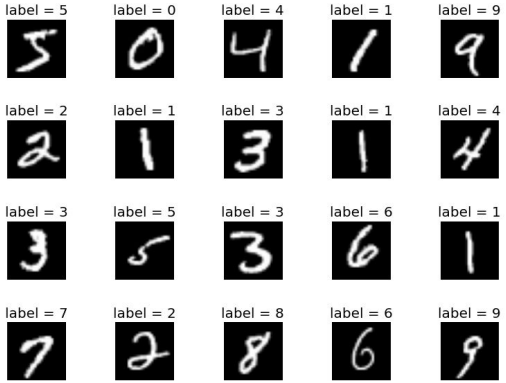
Key Understandings *(NEW!)*:

1. **Machine learning** :
   Computer acquire behaviors without being explicitly programmed

2. Learning of new behaviors is brought about by changes in internal **representation**.

Machine Learning in action : CLASSIFIER

Spam Filters:
Spam, or not-spam?



Handwriting recognition:
Read a check deposit

Movie recommendation
Romantic? Horror?

Big Idea #3 Concept A: Nature of Learning

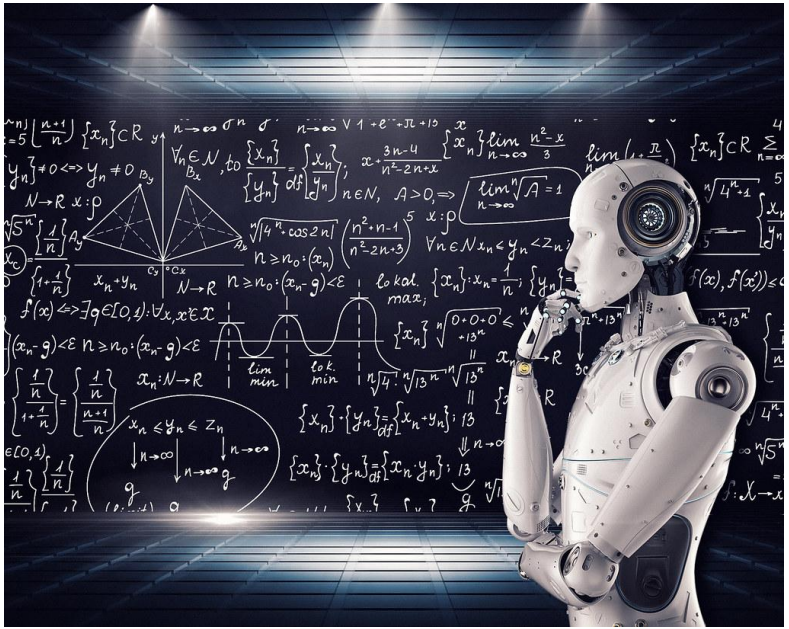
i. Human vs Machines

ii. Finding Patterns in Data (Supervised & Unsupervised)

iii. Training a Model

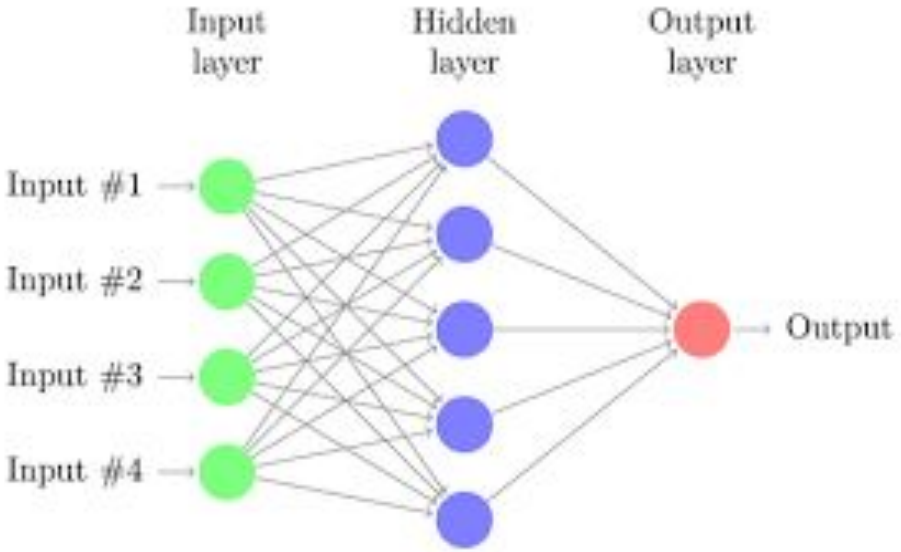
iv. Adjusting Parameters

v. Reinforcement learning



Big Idea #3 Concept B: Neural Networks

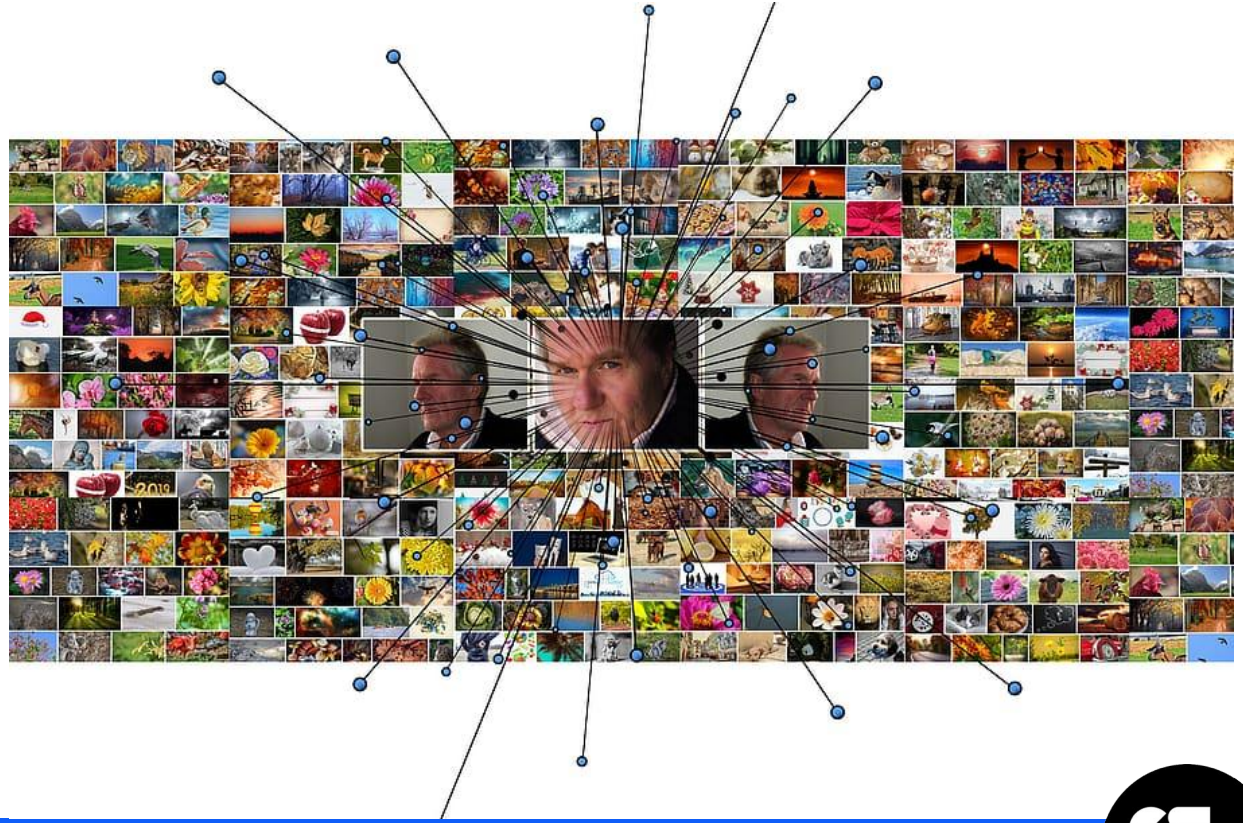
1. Structure of Neural Network
2. Weight Adjustment



Big Idea #3 Concept C: Datasets

Feature Sets

Large Datasets

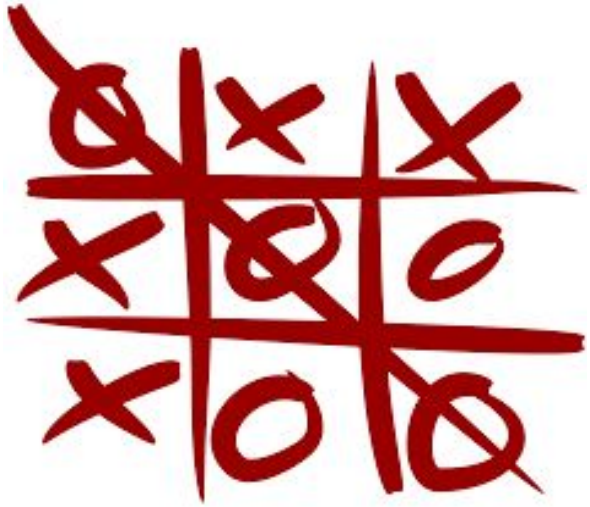


Learning - Sample guidelines by grade-band

K-2: How could we train a computers to tell dogs from cats?

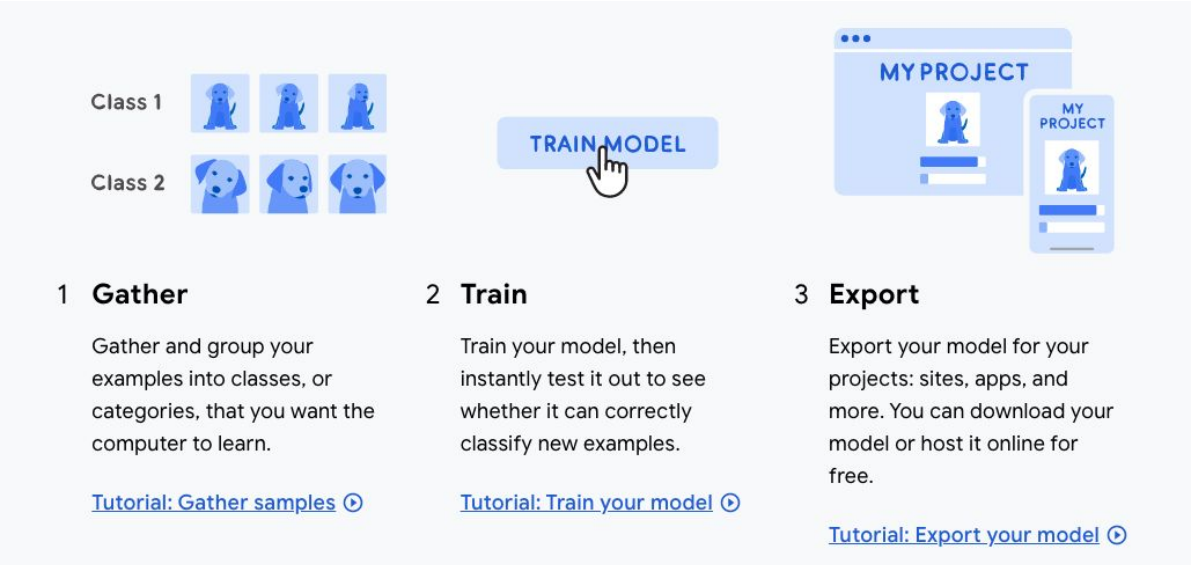
Learning - Sample guidelines by grade-band

3-5: Explain reinforcement learning - computer learns from experience (i.e., trial and error).



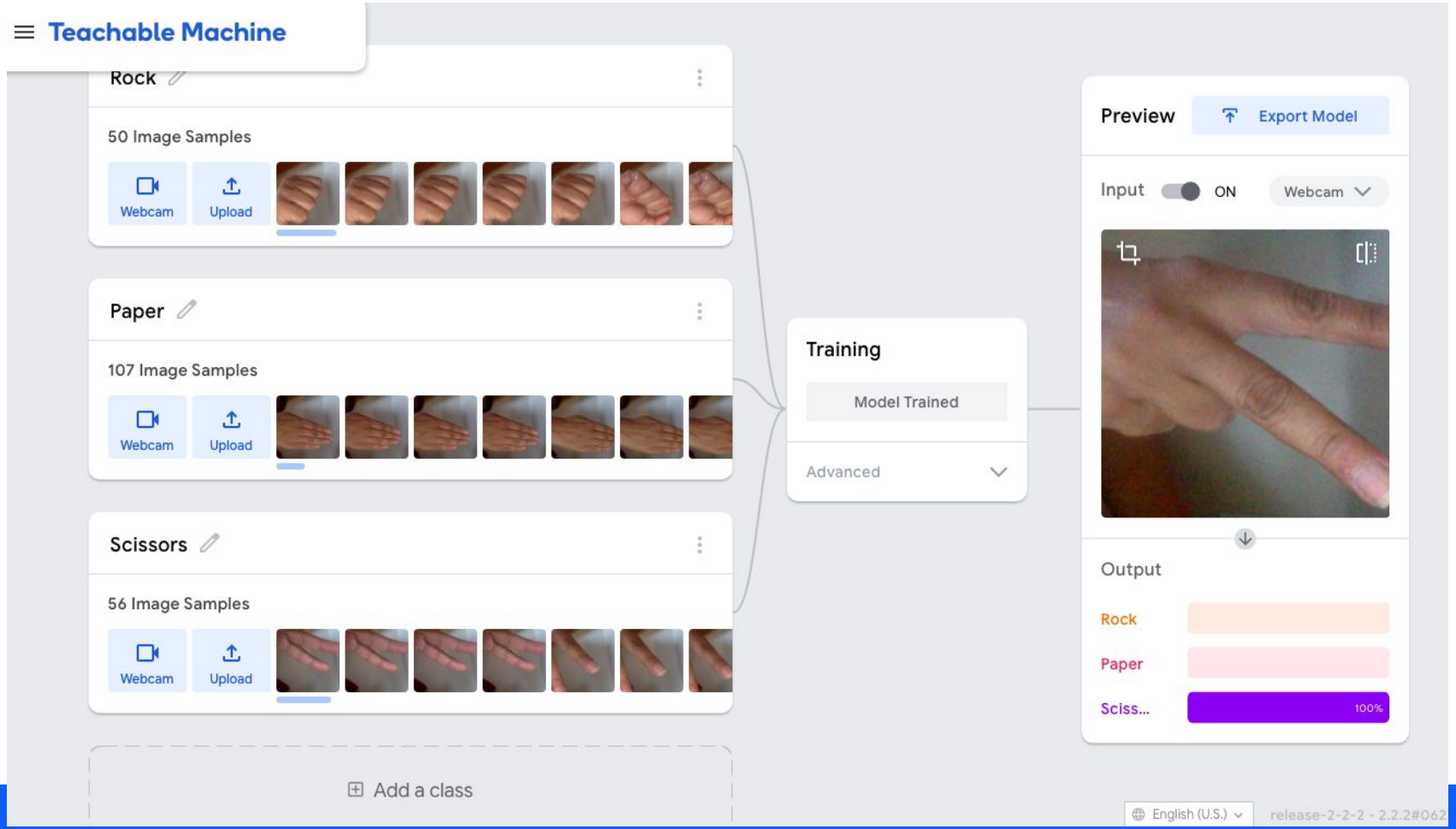
Learning - Sample guidelines by grade-band

6-8: Train a model and see how it classifies objects: discuss why it works or not and why size and quality of the training data



USE TOOLS LIKE

teachablemachine.withgoogle.com/


Teachable Machine
Rock
50 Image Samples
Webcam
Upload
Paper
107 Image Samples
Webcam
Upload
Scissors
56 Image Samples
Webcam
Upload
Add a class
Training
Model Trained
Advanced
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Export Model
Input
ON
Webcam
Output
Rock
Paper
Sciss...
100%
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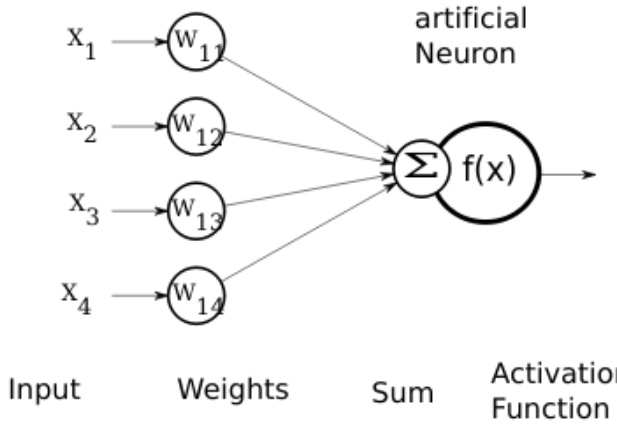
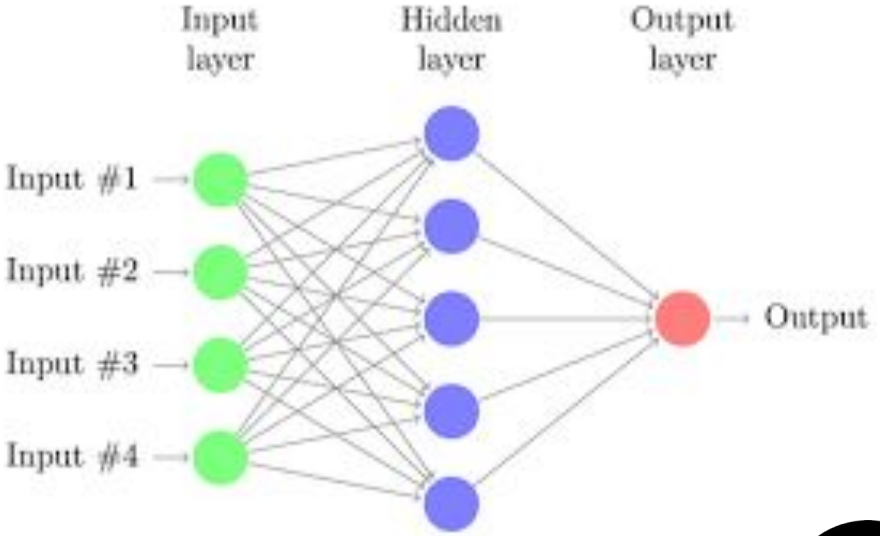
Learning - Sample guidelines by grade-band

9-12: Understand the structure of neural networks, and how the internal representation changes as the computer learns





Big Idea #4: Natural Interaction

Intelligent agents require many kinds of knowledge to interact naturally with humans.

Key Understandings :

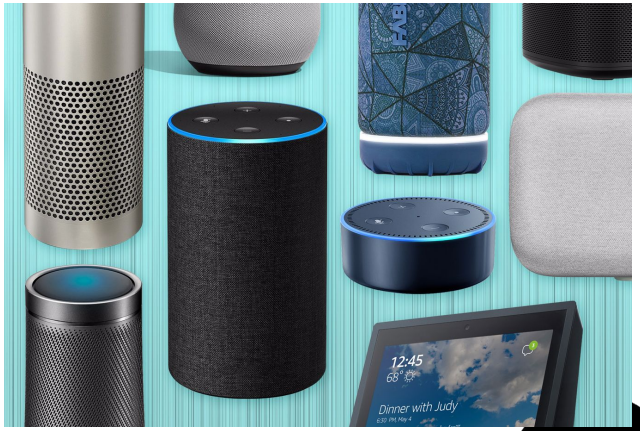
Big Idea #4
Concept A: **Natural language understanding**

The characteristics of human language

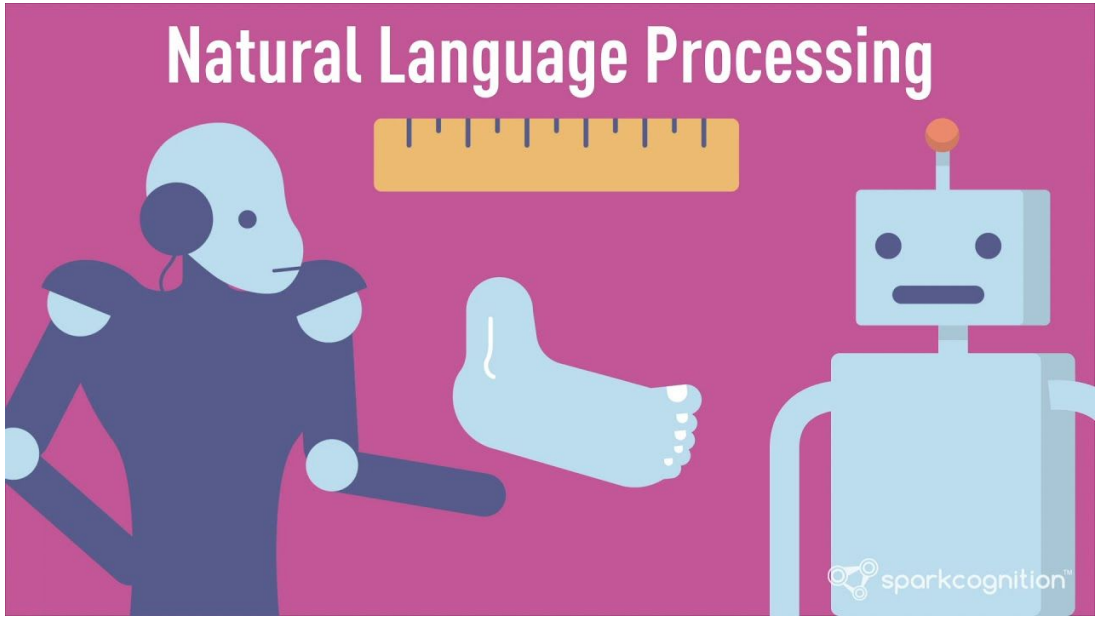
i. Types of linguistic knowledge (syntax, semantics, etc.)

ii. Question answering

iii. Machine translation



Concept B: Common Sense Reasoning



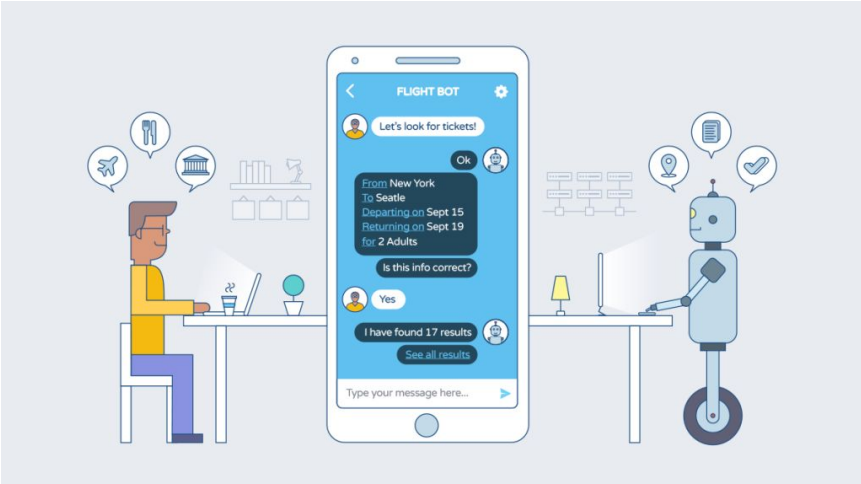
Concept C: Affective computing & interaction
(e.g. with robots, or speech agents)

i. Chatbots and conversational agents

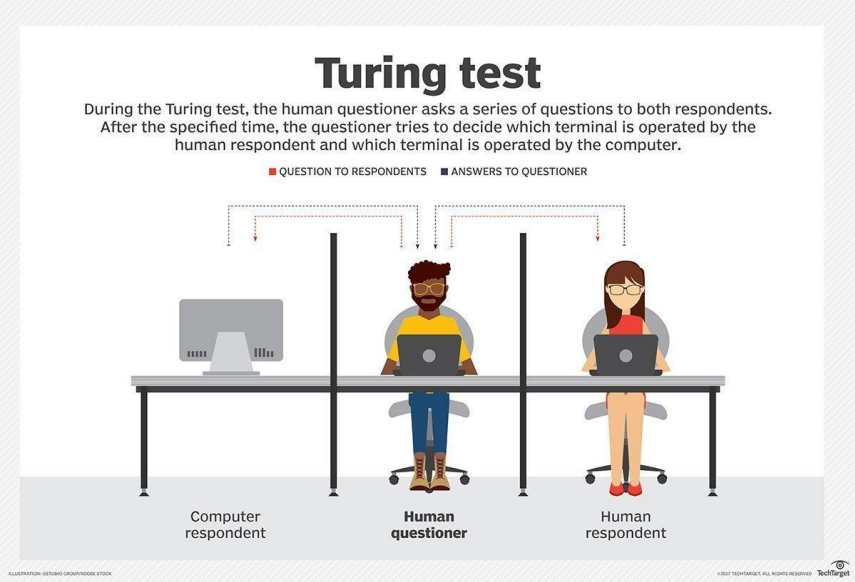
ii. Affective computing

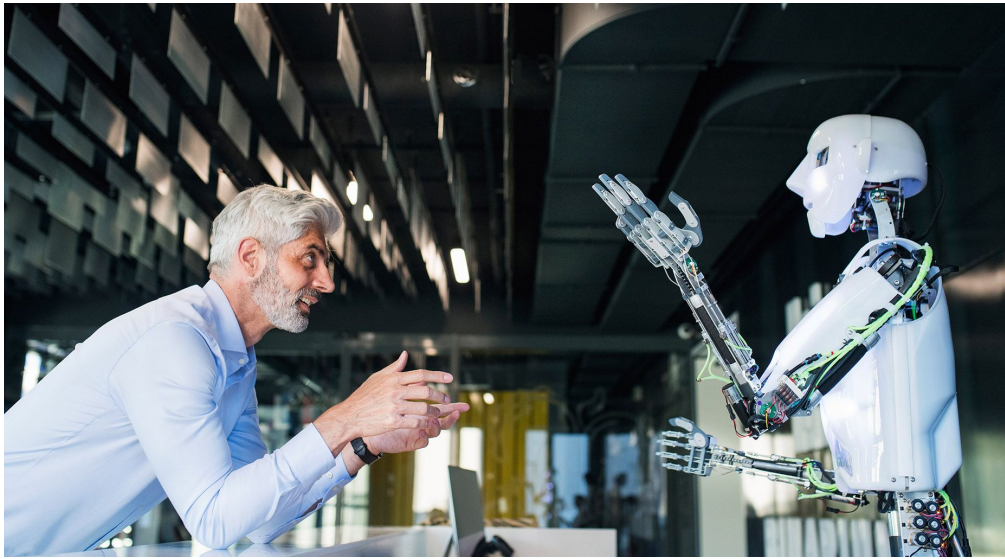
iii. Sentiment analysis

iv. Emotion recognition



Concept D: Consciousness and philosophy of mind





Natural Interaction - Sample guidelines

K-2 Explore an appropriate chatbot or a smart assistant, as a class, and discuss how it answers a question differently than a person answering a question.

Question 1: What does a horse say?

	Alexa	Google	Cortana	Siri
2 yrs. 6 mo.	✗	✗	✗	✗
2 yrs. 10 mo.	✗	✓	✓	✓
3 yrs. 7 mo.	✗	✗	✗	✗
3 yrs. 11 mo.	✓	✓	✓	✓
4 yrs. 2 mo.	✓	✓	✓	✗
4 yrs. 11 mo.	✓	✓	✓	✓
5 yrs. 1 mo.	✓	✓	✓	✓
5 yrs. 7 mo.	✓	✓	✓	✓

And who knew that a horse says, "Whinny."

K-2 Use a translation tool, with teacher guidance, to translate between languages.

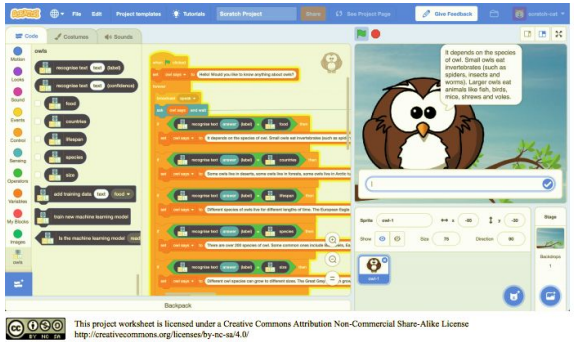
Natural Interaction - Sample guidelines

3-5 Use a speech recognizer to demonstrate and evaluate an NLP's ability to successfully interact and respond to human speech.

3-5 Design a basic sentiment analysis program (plugged or unplugged) using a set of texts (story).

Natural Interaction - Sample guidelines

6-8 - interact with chatbots to discover patterns/templates being used and discover the weakness of a rule based approach.



6-8 - Build a chatbot that uses trained data to understand other forms of the same sentence
https://machinelearningforkids.co.uk/

Natural Interaction - Sample guidelines

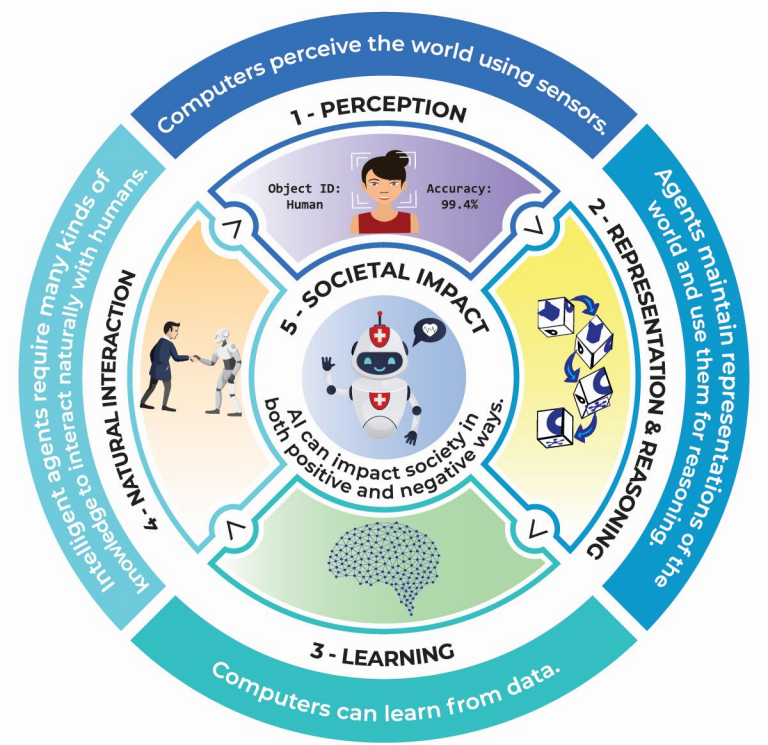
- **9-12** Reason about the nature of intelligence, and identify approaches to determining whether an agent is or is not intelligent.

- **9-12** Compare and contrast different methods for sentiment analysis (e.g. rule based/ NN based)

Big Idea #5: Societal Impact

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

Societal Impact == Core of AI Education



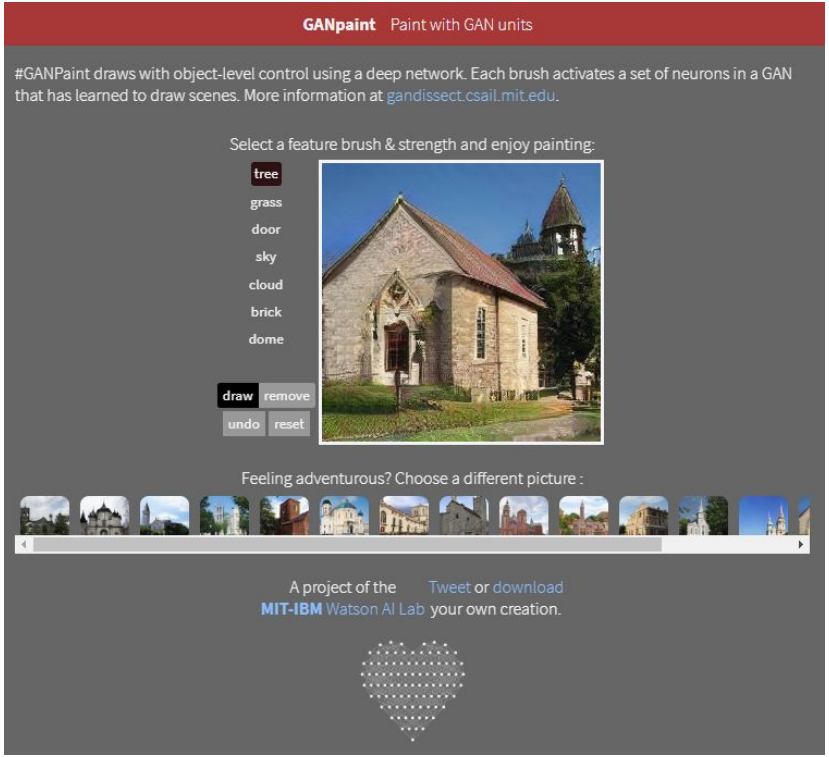
Concept A - Ethics of AI Making Decisions About People

"... an indifferent field serves the powerful."

"... racial capitalism, class inequality, and heteronormative patriarchy have roots in colonialism and that we need to recognize these power dynamics when designing AI systems to avoid perpetuating such harms."

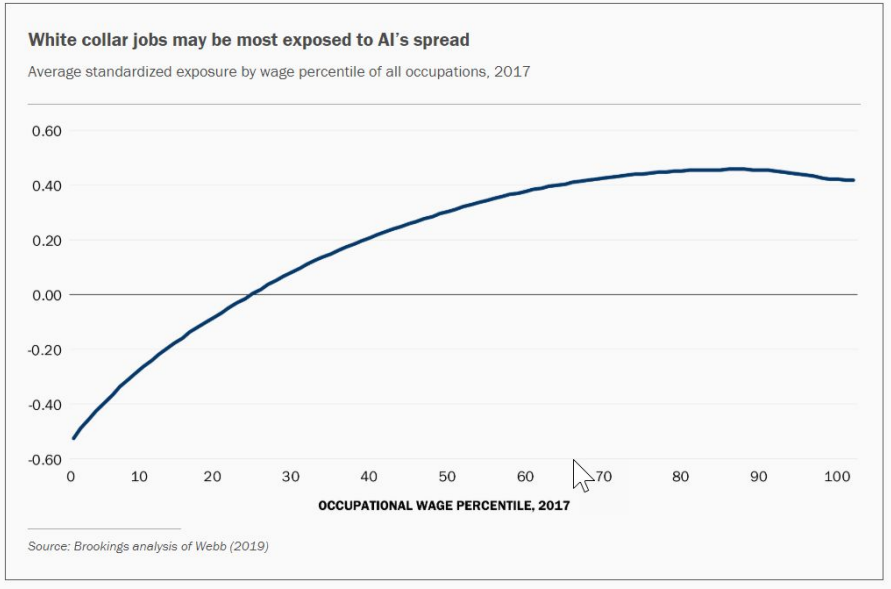
- Bias
- Fairness
- Transparency
- Explainability
- Accountability
- Values

Concept B - AI & Culture



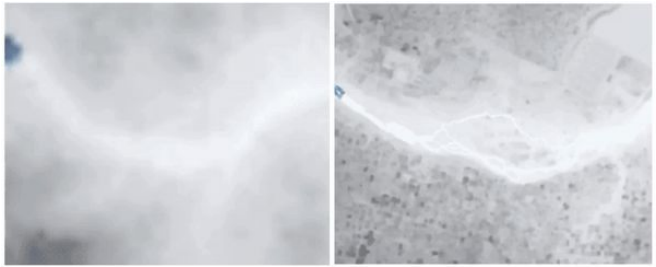
"Educators see AI as instrumental to their institution's competitiveness, yet most institutions still lack a formal data strategy to advance AI."

Concept C - Economic impact of AI on Sectors of Society



"White-collar jobs (better-paid professionals with bachelor's degrees) along with production workers may be most susceptible to AI's spread into the economy"

Concept D - AI for Social Good



Example Guidelines

- Critically explore the positive and negative impacts of an AI system
- Design and explain how an AI system can be used to address a social issue
- Describe ways that AI systems can be designed for inclusivity
- Understand tradeoffs in the design of AI systems and how decisions can have unintended consequences in the function of a system

We Need your Feedback on Big Idea 1

Please download and review the **Progression chart** prior to completing the **feedback form**.

The **feedback form** is designed to be used by either groups or individuals. We anticipate that it will take 35-45 mins to review the progression chart and complete the form. If you are short on time, you are able to save your progress and continue at a later time.

Progression Chart bit.ly/36InJgi

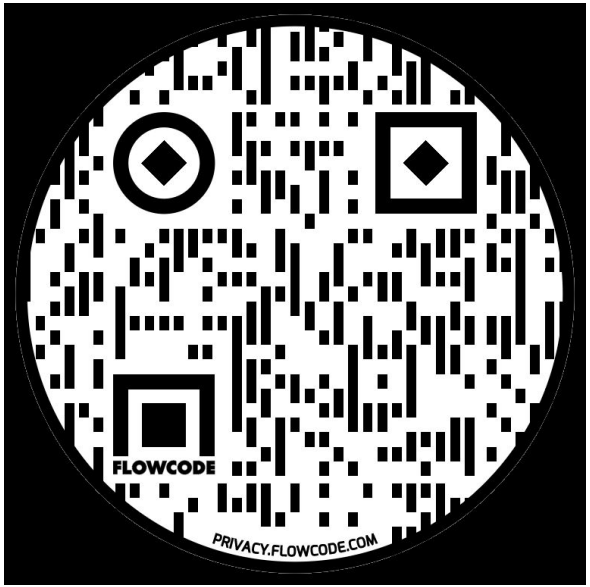
AI4K12.org

Draft Big Idea 1 - Progression Chart

Big Idea #1: Perception	*Computers perceive the world using sensors.*	**Perception is the extraction of meaning from sensory information using knowledge.**	**The transformation from signal to meaning takes place in stages, with increasingly abstract features and higher level knowledge applied at each stage.**
Concept	**K-2**	**3-5**	**6-8**
Sensing (Living Things) **1-A-i**	**LO:** Identify human senses and sensory organs. **EU:** People experience the world through sight, hearing, touch, taste, and smell.	**LO:** Compare human and animal perception. **EU:** Some animals experience the world differently than people do. **Unpacked:** Bats and dolphins use sonar. Bees can see ultraviolet. Rats are have no color vision; dogs are red-green colorblind. Dogs and rats can hear higher frequences than humans.	**LO:** Give examples of how humans combine information from muliple modalities. **EU:** People can exploit correlations between senses, such as sight and sound, to make sens of ambiguous signals. **Unpacked:** In a noisy environment, speech is more understandable when the speaker's mouth is visible. People learn the sounds associated with various actions (such as dropping an object and can recognize when the sound doesn't mat their expectation.
Sensing (Computer Sensors) **1-A-ii**	**LO:** Locate and identify sensors (camera, microphone) on computers, phones, robots, and other devices. **EU:** Computers "see" through video cameras and "hear" through microphones.	**LO:** Illustrate how computer sensing differs from human sensing. **EU:** Most computers have no sense of taste, smell, or touch, but they can sense some things that humans can't, such as infrared emissions, extremely low or high frequency sounds, or magnetism.	**LO:** Give examples of how intelligent agents combine information from multiple sensors. **EU:** Self driving cars combine computer vision with radar or lidar imaging. GPS measurement, and accelerometer data to form a detailed representation of the environment and their motion through it.

We Need your Feedback on Big Idea 1

Progression Chart



bit.ly/36InJgi

Feedback Form

bit.ly/Big_Idea_1_Feedback

Thank you!
Please visit our Website(s) for More information

Current wiki on GitHub

- Resource Directory
- Recent and Upcoming Events
- Announcements

Website *(NEW!)* **Coming in 2020:** www.ai4k12.org

- Searchable resources by grade level and concept
- Guidelines and progression charts
- Grade Band pages--helpful hints

github.com/touretzkyds/ai4k12/wiki