UNITS OF INQUIRY

(7-9)

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Lesson Plans

Standards and Guidelines Cited

ISTE Standards

The International Society for Technology in Education (ISTE) produces a series of standards for those involved in education. The lessons in the following curriculum utilize the seven ISTE Student Standards.

- The ISTE Student Standards can be found at https://www.iste.org/standards/iste-standards-for-students

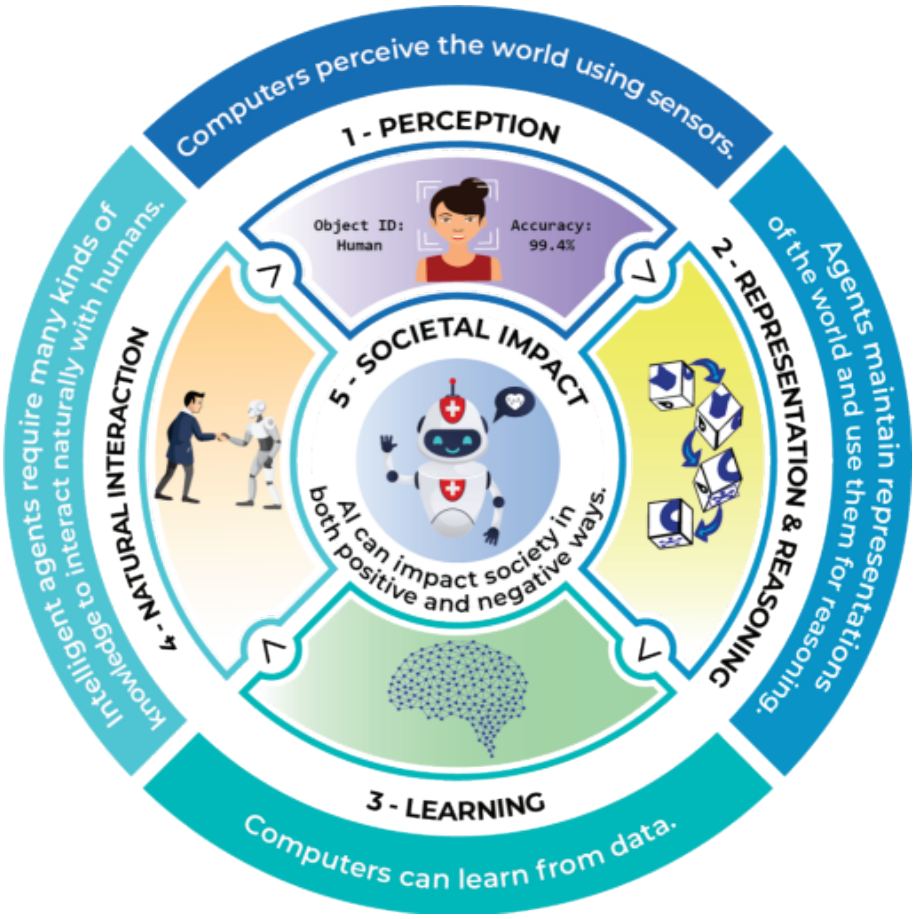
AI4K12 Guidelines

AI4K12.org has released a list of “Five Big Ideas in AI” along with draft grade band progression charts for each of these ideas.

- The five big ideas are summarized on a poster that can be found at

  https://ai4k12.org/resources/big-ideas-poster/.

- The grade band progression charts are available at https://ai4k12.org/gradeband-progression-charts/



Big Idea 1 - Perception: Computers perceive the world using sensors.

Big Idea 2 - Representation and Reasoning: Agents maintain representations of the world and use them for reasoning.

Big Idea 3 - Learning: Computers can learn from data.

Big Idea 4 - Natural Interaction: Intelligent agents require many kinds of knowledge to interact naturally with humans.

Big Idea 5 - Societal Impact: AI can impact society in both positive and negative ways.

Curriculum Map - G7

Subject: Computer Science **Time Frame:** 2022-2023 School Year

Grade: Seventh Grade

Essential Question:
- How can I use Python programming to create art?
- Can a robotic arm be created with robotics?
- What ethical considerations do programmers need to consider when programming autonomous cars?
- Can I simulate the heart using a robotics kit and what benefits might this lead to in biomedical engineering?

Objectives:
- Students will design a vinyl cutout for their laptop computers and program the design using Python programming and Turtle Art
- Students will create a mini drum kit using Makey Makey and experiment with musical sounds
- Students will explore the heart and use a robotics kit to simulate a beating heart
- Students will discover how robotic arms are used in society both for manufacturing purposes and prosthetics

Standards:
- **ISTE 1.2 Digital Citizen:** Students recognize the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, and they act in ways that are safe, legal, and ethical
- **ISTE 1.6 Creative Communicator:** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, format, and digital media appropriate to the goals
- **ISTE 1.4 Innovative Designer:** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
- **Five Big Ideas of AI: Idea #5:** Societal Impact - AI can impact society in both positive and negative ways

Skills:
- Biomedical engineering with robotic arms
- Machine learning in autonomous vehicles
- Art and coding with vinyl designs
- Connecting LEDs and motors to robotic kits

Coding Programs:
- Python with AutoAuto
- LEGO Sprike Coding
- iRobot Coding
- Turtle Art
- Makecode
- AutoAuto Python

Materials:
- Chromebooks/ iPads
- Root Robot
- Makey Makey
- AutoAuto Cars
- Hummingbird Kits
- Hydraulic Kits
- LEGO Spike Prime

Activities:
- Use Turtle Art to create patterns on vinyl for laptop
- Use AutoAuto cars to avoid humans & pets
- Create a heart with a
- Hummingbird Kit
- LEGO Spike robotic arm with coding
- Makey Makey drum kit creation

Resources:
- Brainbird Technologies teaching unit
- LEGO Spike Prime App
- iRobot education learning guide
- Moxie robot app and tutorials
- Common Sense Media: Digital Skills

Assessment:
- Rubric for Turtle Art coding and design
- LEGO Spike robotic arm goals
- AutoAuto online Python assessments
- Hummingbird Kit project completion

Computer Science

SCOPE & SEQUENCE

Seventh Grade | 2023

UNIT 1 | UNIT 2 | UNIT 3 | UNIT 4

INTRO TO CLASS	
WEEK 1:	**Title: Robotics and Tools Guidelines** 1. Review new equipment and projects that the 7th graders will use 2. Have students practice using the machines and equipment in class
WEEK 2:	**Title: Create a Story on Scratch to Represent Your Break** 1. Using Scratch, create a sprite and background to tell about break 2. Add movement and sound effects to your Scratch story and share
UNIT 1: Autonomous Vehicles	
WEEK 3:	**Title: AutoAuto Car Maze** 1. Program the cars to complete a maze in the virtual world 2. Create a maze using the mats and race the cars in the maze
WEEK 4:	**Title: AutoAuto Python** 1. Create a course with two obstacles, a cat and a tree 2. Discuss the decision making that programmers make for self driving cars, as well as the impact on society
WEEK 5:	**Title: Code Monkey Chatbot** 1. Complete the Code Monkey Activity to code a chatbot 2. Discuss multiple ways that chatbots are used in today's society
WEEK 6:	**Title: Hydraulic Crane** 1. Learn about how hydraulics are used by machines and robots 2. Create a crane using hydraulics, specifically syringes and tubes
WEEK 7:	**Title: Hydraulic Press** 1. Examine how a hydraulic press works and the strength of the press 2. Create a miniature hydraulic press in class

UNIT 2: Beating Heart Hummingbird Kit	
WEEK 8:	**Title: Hummingbird Makecode** 1. Use Makecode to add coding blocks that control the Hummingbird 2. Practice plugging in the white, red, and black wires into the Servo port
WEEK 9:	**Title: Hummingbird LEDs & Sensors** 1. Program the light sensor to control a single LED when it is dark or light 2. Write a program that makes an LED turn on and off with another sensor
WEEK 10:	**Title: Hummingbird Heart** 1. Using cardboard, create a heart attached to a Hummingbird kit 2. Have the heart light up like a heart beat and try out different rhythms
WEEK 11:	**Title: Common Sense Media Ad Detective** 1. Discuss how companies target their ads towards certain individuals 2. Discuss privacy settings and complete the media ad detective activity
WEEK 12:	**Title: Create an Online Appropriate and Inappropriate Post** 1. Practice writing posts with photos that are appropriate to post online 2. Discuss information that is important to keep private and not share on social media for security or privacy reasons
UNIT 3: Robotic Arms	
WEEK 13:	**Title: LEGO Spike Robotic Arm** 1. Use the LEGO Spike app to complete the robotic arm design 2. Discuss how the motors and servos work to make the arm move
WEEK 14:	**Title: LEGO Spike Code** 1. Program the robotic arm to pick up LEGO pieces 2. Add functionality so that the arm could be used in more situations
WEEK 15:	**Title: Talk to a Biomedical Engineer** 1. Write questions to ask a biomedical engineer who utilizes AI 2. Interview the engineer to learn about the engineering design process
WEEK 16:	**Title: Root Robot & Fireplace** 1. Discuss how a fireplace robot might change colors to imitate fire 2. Use the root robot to flicker different colors in a mini fireplace
WEEK 17:	**Title: Root Robot** 1. Discuss how iRobot makes Root Robot and Roomba 2. Discuss how Root Robot could be used for cutting the grass, etc.

UNIT 4: Turtle Art & Vinyl Cutouts	
WEEK 18:	**Title: Turtle Art & Python Coding** 1. Use the turtle art tutorial to learn about drawing shapes with Python 2. Write a program to draw different sized spirals
WEEK 19:	**Title: Turtle Art & Vinyl Cutting** 1. Create an new, original design to display on a laptop 2. Using Python, program the Turtle Art design and use the vinyl cutter to attach to the students' laptop
WEEK 20:	**Title: Explore Chrome Music Lab & Blob Opera** 1. Experiment with Blob Opera and explore how the app uses AI 2. Compose a simple melody using Chrome Music Lab
WEEK 21:	**Title: Makey Makey Controller** 1. Connect Makey Makey to the Pinball game on the app 2. Control the game using tinfoil cutouts attached to pool noodles
WEEK 22:	**Title: Makey Makey Drum Kit** 1. Students create their own drum kits with partners 2. Connect a Makey Makey and play the drums to create a new beat
WEEK 23:	**Title: ToxiCode** 1. Complete the ToxiCode Compute It Hour of Code 2. Discuss strategies for following the code and completing the activity
END OF CLASS	
WEEK 24:	**Title: Create a slideshow for a student in the future** 1. Each student creates one slide to prepare a future student for CS 2. Use Generative AI to add an image to the slideshow
WEEK 25:	**Title: Robot Playground** 1. Using pool noodles for barriers, control Dash Robot and Root Robot 2. See who can most successfully dash to the other side of the room

Curriculum Map - G8

Subject: Computer Science **Time Frame:** 2022-2023 School Year

Grade: Eighth Grade

Essential Question:
- As AI translation tools develop rapidly, how can the travel industry utilize these translation tools?
- How can drones be used to assist with delivery in the real world?
- In what ways can ChatGPT be used to apply for a job?
- Are there AI tools to help those with special needs and can we create more?
- Who is the artist when AI assists in creating music?

Objectives:
- Students will research the physical challenges of a person with cerebral palsy and design an invention to make a daily task easier
- Students will investigate the pros and cons of delivery drones and create a delivery course for a drone
- Students will examine language translation tools and create a multilingual travel agent bot
- Students will program a Choose Your Own Adventure type game in Python
- Students will create music using an AI-generative music tool

Standards:
- **ISTE1.3 Knowledge Constructor:** Students evaluate the accuracy, perspective, credibility, and relevance of information, media,
- data or other resources.
- **ISTE 1.5 Computational Thinker:** Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
- **ISTE 1.6 Creative Communicator:** Students create original works or responsibly repurpose or remix digital resources into new creations.
- **Five Big Ideas of AI: Idea #3:** Computers can learn from data.

Skills:
- Programming a drone to land in a specific location
- Applying for jobs using Large Language Models
- Writing music with AI-assisted online tools
- Develop an invention for a person with cerebral palsy

Coding Programs:
- Tello Drone
- MakeCode Arcade
- ChatGPT
- Python Coding
- AutoAuto Python

Materials:
- Chromebooks/ iPads
- Language Translation Bot
- Tello Drones
- Moxie Robot
- AIVA
- ChatGPT
- LEGO Spike Prime
- AutoAuto Cars

Activities:
- Program Tello Drone to deliver a small package
- Create an instrument using a Makey Makey or Arduino
- Program a Choose Your Own Adventure game
- Build and program a multilingual travel bot

Resources:
- AutoAuto AI Python App
- Tello Drone Education
- LEGO Spike Prime App and Tutorials
- Raspberry Pi Bird Watch Website 1.0
- Common Sense Media: Digital Skills

Assessment:
- Tello Drone Landing Location assessment
- LEGO Spike Prime project completion
- AutoAuto online Python assessment
- Language Translation Bot grading rubric
- Musical Instrument checklist

Computer Science

SCOPE & SEQUENCE

Eighth Grade | 2023

UNIT 1 | UNIT 2 | UNIT 3 | UNIT 4

INTRO TO CLASS	
WEEK 1:	**Title: Write your name in binary** 1. Explain binary code and have students write their names in binary 2. Display names around the room and have the other students decode
WEEK 2:	**Title: Write your first class blog** 1. Explain how HTML works for creating websites and have students explore multiple websites viewing the HTML 2. Set up a class website for students to add blog posts about projects
UNIT 1: ChatGPT & Job Applications	
WEEK 3:	**Title: ChatGPT Capabilities** 1. Test out new ways to use ChatGPT, like creating blog posts and ads 2. Select a food blog and rewrite the blog in class using ChatGPT
WEEK 4:	**Title: ChatGPT & Job Applications** 1. Explore resume writing, cover letters, interview questions, and job searching using ChatGPT 2. Discuss the ethical issues of using large language models for jobs
WEEK 5:	**Title: Makecode Arcade** 1. Using Makecode Arcade, create a sprite and background 2. Add a challenge that includes a scoreboard and at least two levels
WEEK 6:	**Title: Invention for Cerebral Palsy** 1. Research cerebral palsy and discover daily challenges 2. Use the engineering design process to create an invention to help
WEEK 7:	**Title: Invention presentation** 1. Create a small cardboard prototype of the invention 2. Present to classmates and a doctor specializing in cerebral palsy

UNIT 2: Computer Vision	
WEEK 8:	**Title: Title: AutoAuto Python** 1. Complete the computer vision unit in AutoAuto Python 2. Using the virtual tool, have cars recognize different signs like stop signs
WEEK 9:	**Title: AutoAuto Cars with Road Signs** 1. Set up a course with stop signs, yield signs, and stop lights 2. Program the physical cars to run the course and recognize the signs
WEEK 10:	**Title: Raspberry Pi Bird Watch Website 1.0** 1. Review how HTML works in website design and explain CSS 2. Compete the Bird Watch Website 1.0 activity to create a bird website
WEEK 11:	**Title: AIVA Music Tool** 1. Research how AI is used for movie scores and TV commercials 2. Use AIVA to create a short melody utilizing multiple tracks
WEEK 12:	**Title: AIVA Music Creation** 1. Rewrite the melody you have created using the AIVA editor 2. Dicuss the ethics of using AI music creation sites and legal concerns
UNIT 3: Natural Language Processing	
WEEK 13:	**Title: Language Translation and NLP** 1. Explore the terms Natural Language Processing, classification, sentiment, and modeling 2. Use Google Translate to see how NLP works with translation
WEEK 14:	**Title: Travel Chat Bots & NLP** 1. Program a travel bot to help someone travel to Barcelona 2. Describe famous locations, food, and entertainment in the location
WEEK 15:	**Title: Interview with a Machine Learning Scientist** 1. Discuss how algorithms are used in machine learning 2. Ask questions about how automation in AI and predictive models
WEEK 16:	**Title: LEGO Spike Prime & Wind Turbine** 1. Build a wind turbine following the instructions on LEGO Spike app 2. Program the robot to move to the Wind Turbine and press to move it
WEEK 17:	**Title: LEGO Spike Prime & Solar Panels** 1. Build a small house with a flat roof and large windows 2. Program the robot to add solar panels to the house

UNIT 4: Delivery Drones	
WEEK 18:	**Title: Tello Drones Landing** 1. Practice flying the drones through various obstacles like hoops & rings 2. Code the drone to fly in a basic square shape
WEEK 19:	**Title: Delivery with Tello Drones** 1. Research how delivery drones are used by companies like Amazon 2. Practice flying the drones and landing on the landing pads to “deliver” a specific package to a location
WEEK 20:	**Title: Python Choose Your Own Adventure** 1. Begin programming a Choose Your Own Adventure activity in Python 2. Select three different situations and have two options for each
WEEK 21:	**Title: Python Choose Your Own Adventure** 1. Add details to the story to make it more interesting and believable 2. Have other students in class play your game and provide feedback
WEEK 22:	**Title: Moxie Robot** 1. Teach Moxie to say your name and greet you in another language 2. Ask Moxie to tell you a story and write down feedback about the story
WEEK 23:	**Title: Moxie Robot** 1. Discuss how Moxie could be useful in a hospital or a nursing home 2. Explore the benefits of facial recognition in robots like Moxie
END OF CLASS	
WEEK 24:	**Title: ChatGPT Yearbook** 1. Use ChatGPT to write articles for a yearbook with made up stories 2. Read the stories and the generative AI photos of people and reflect on how made up information and photos effect society
WEEK 25:	**Title: Robot Playground** 1. Draw a picture of your favorite robot from the year 2. Share with the class the capabilities and the reason for your selection

01

AI & Facial Recognition (7-9)

TEACHING GUIDE

Lesson Overview:
In this lesson, students will learn about AI and facial recognition. To engage all learners, students will create a Scratch based program that utilizes facial recognition. Finally, students will test the limits of the AI facial recognition tools through experimentation.

Lesson Objectives:
By the end of this lesson, students will be able to
- Explain in age appropriate terms how facial recognition works
- Test the limits of industry AI apps
- Posit causes for the limitations they discovered

Alignment with Big Ideas:
Big Idea #1: Computers perceive the world using sensors.

ISTE Standards for Students:
1.1 Empowered Learner
- 1.1d - Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

1.3 Knowledge Constructor
- 1.3d - Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

ISTE Computational Thinking Competencies:
5.1 Computational Thinking (Learner)
- Recognize how computing and society interact to create opportunities, inequities, responsibilities and threats for individuals and organizations.

Equipment

Student iPads, computer connected to a projector. Paper large enough to cover students faces, rubber bands, paper clips, drawing and art utensils.
- AI & Facial Recognition PPT Grades 7-9[1]
- AI & Facial Recognition - Face Templates PDF[2]

Preperation

Ensure the following websites are accessible:
- https://calypso-robotics.com/
- https://www.visagetechnologies.com/HTML5/latest/Samples/ShowcaseDemo/ShowcaseDemo.html

1 https://docs.google.com/presentation/d/12TL7RTVw-htOPEDL2cFeedZfBm4dgkFW/edit?usp=sharing&ouid=101810545102982502092&rtpof=true&sd=true
2 https://drive.google.com/file/d/1pFbWytn1FgZVYj6ogspAxNdGbyVUeaU8/view?usp=sharing

- https://lab.scratch.mit.edu/face
- How Snapchat's filters work[3]

Ensure student iPads are properly charged.

3 https://www.youtube.com/watch?v=Pc2aJxnmzh0

Lesson Orientation

Warm-Up Open Cloud Calypso on iPads. Students may do this by going to https://calypso-robotics.com/ Alternatively, students may be trained to use a QR code on the screen to open the Cloud Calypso website. Demonstrate the facial emotion recognition feature of Cloud Calypso. Ask students what emotions the teacher is demonstrating. Then, ask students if the Cloud Calypso software is accurately identifying the emotion. Allow students a moment to play with the facial recognition feature themselves. To close this portion of the work, ask students where they have seen facial recognition in their lives. Some answers may include: • Entry to Neom • Unlocking phones or other devices	5 minutes
Presentation Tell students that AI can do more than just recognize a face and identify it. Explain that AI can identify emotions as well. Present the video, "How Snapchat filters work[1]." Allow students to share their impressions. Ask students how this technology works.Solicit responses. After allowing students to share what they learned, present the following: We can tell by looking at someone's face whether they are happy, sad, surprised, scared, or angry. We show these emotions mainly with our mouth, eyes, eyebrows, and nose. If someone is smiling they are probably happy. If someone is angry their eyes may be partly closed and their nostrils flared, while if they're surprised their eyes might be wide open and their eyebrows raised. Computers recognize emotion the same way. First they look at the image and measure the shapes of the mouth, eyes, eyebrows, and nose. Then, they choose which emotion most closely matches those shapes. Present the slide deck[2] that reviews how computers have this ability. Ask for student involvement using the questions prepared in the slide deck.	15 minutes

1 https://www.youtube.com/watch?v=Pc2aJxnmzh0

2 https://docs.google.com/presentation/d/12TL7RTVw-htOPEDL2cFeedZfBm4dgkFW/edit?usp=sharing&ouid=111724821344470190729&rtpof=true&sd=true

Practice Introduce students to the Visage Technologies demo[3]. Explain that this is a more powerful facial recognition tool and that students are now going to test its capacity.	5 minutes
To test the technology, however, students will play with facial features printed out for them. Students can cut out the eyebrows, eyes, noses, and mouths and glue them to a paper face. Students should then show their created faces to the AI system. What emotion does the system attribute to the face? Students can experiment with changing out the mouth with a different mouth shape and/or changing the eyebrow positioning to see how this affects the emotion the AI program detects. For example, an open mouth and wide eyes are indications of surprise, while a smiling mouth is an indication of happiness. Pursed lips might indicate anger, but the eyebrow positions and eye shape might also be important in discriminating anger vs. fear or sadness. Allow students time to practice with the app. Explain that the computer *generally* knows where the eyes, nose, mouth, and so forth should be on a normal human being. Explain that students will now test the limits of the AI system. For instance, what happens if only part of the face is showing? Students should cover half the face and see if the AI still recognizes the face. Ask students to share what happened. Students can test the system in other ways. Have students test different experiments with Visage: • Put the eyeballs vertically instead of horizontally • Show the camera the picture upside down or sideways • Scribble over one part of the face • Put non-matching eyes/eyebrows on the face • Leave out pieces of the face when they create a face using the PDF.	
Production Ask students how they might be able to create their own app that allows them to manipulate facial recognition and AI. In this way, they will create their own version of a Snapchat filter. Explain to students that now they will use AI and code a basic program in Scratch. Go to Face Sensing - Scratch Lab[4] and ask students to begin a program. Some sample coding is found in the Appendix to this lesson.	20 minutes

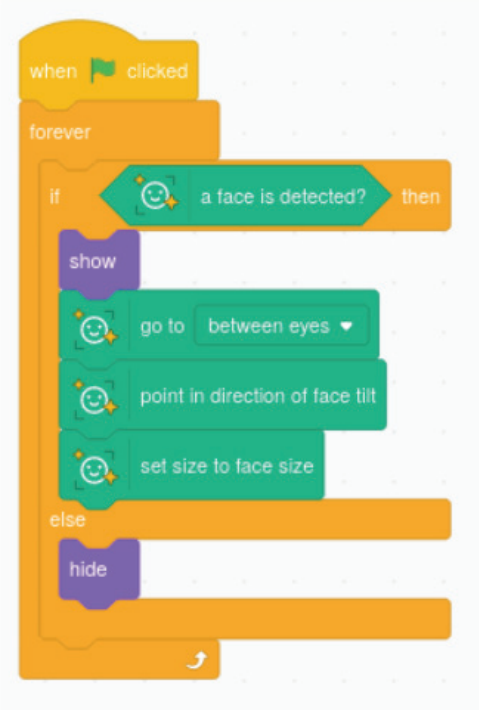
3 https://www.visagetechnologies.com/HTML5/latest/Samples/ShowcaseDemo/ShowcaseDemo.html
4 https://lab.scratch.mit.edu/face

The reason the Scratch demo works is because of its ability to locate facial features. We don't know precisely how the Scratch demo is doing it as we cannot see what's happening behind the program. However, we have proof that it works because it is accurately placing the glasses on the face, the tie below the neck, etc. Ask students to share what they are learning and offer possibilities for why the AI facial recognition software fails some tests and passes others.	
Extension Ask students to think about what *practical* features face filters might have beyond just entertainment.	

Appendix

Snapchat Filter in Scratch

1. Go to https://lab.scratch.mit.edu/face
2. Click the blue "Try it out" button.
3. Delete the Scratch Cat sprite.
4. Click on the button to choose a new sprite.
5. Click on "Fashion" and select "Glasses".
6. Enter the following code for the Glasses sprite:



7. Run the program. (Click on the green check mark.) Verify that the user now is wearing glasses.

8. Click on the button to choose another sprite.
9. Click on “Fashion” and select “Winter Hat”
10. Enter the following code for the Winter Hat sprite:

11. Click on the green start flag and try moving your head around to see the effects:
    a. Moving closer or farther should change the size of the glasses and hat.
    b. Tilting your head to the side should cause the glasses and hate to rotate.
12. Select the Glasses sprite, go to the Costumes tab, and select the glasses-c costume (pink heart-shaped glasses).
13. Try holding up a picture from a magazine and see if the computer can recognize that face.
14. Now, try creating your own filter. Students may swap out the bowtie, hat, etc. Or, students may use the drawing tools in Scratch to introduce new characters. For instance, students can draw a third eye, bunny ears, cat whiskers, a dog tongue, a necklace, and so forth. Then, they can code the placement of this drawing on the face.