RESET | DEEP LEARNING

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Exploring Artificial Intelligence with Scratch

TEACHER

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SUBJECT/GRADE LEVEL

Computer Science
High School 9-12

Materials

- Access to the internet with computer or chromebook
- Account registration with Scratch
- Paper or Spreadsheet

STANDARDS

AP Computer Science Principles (College Board)

- 1.B Determine and design an appropriate method or approach to achieve the purpose.
- 3.A Generalize data sources through variables.
- 3.B Use abstraction to manage complexity in a program.
- 3.C Explain how abstraction manages complexity.
- 5.B Explain how knowledge can be generated from data.
- 5.C Describe the impact of a computing innovation.

Next Generation Science Standards

- **HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

Mathematics Standards | Common Core State Standards

- CCSS.Math.Content.HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- CCSS.Math.Content.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- CCSS.Math.Content.HSS.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- CCSS.Math.Content.HSS.ID.B.6.a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

English Language Arts Standards | Common Core State

- CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- CCSS.ELA-Literacy.RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

LESSON OBJECTIVE(S)

Students will be able to create a basic neural net that will simulate personality for an artificial intelligence platform by using sequence, selection, and iteration in an algorithm.

CAREER CONNECTION(S)

Mentor Background: David Slayback is a Computer Engineer in the Synergistic Human-Machine Interface (SHMI) Branch at ARL's Human Research and Engineering Directorate (HRED). He has been involved with ARL in some capacity from 6th grade onward, via summer camps, internships, co-ops, during which he worked in materials science, neuroscience, psychology, brain-computer interfaces, and AI. David received his B.S. in Computer Science from University of Pittsburgh in 2016 and is currently in a Ph.D. program in AI at Northeastern University in Boston. His current work focuses on AI for multi-agent and/or dynamic environments, specifically developing new approaches in reinforcement learning to develop reusable skills with incomplete information. The end goal of this research is to develop effective, reliable robotic teammates for humans.

STEM Careers: Computer Systems Analyst, Software Developer, Web Developer

ENGAGEMENT

Teacher Actions:

Teacher introduces the concept of machine learning and artificial intelligence.

https://youtu.be/ALQ_RNSRE40

Crop or end video at 12:10

Alternative links:

https://edpuzzle.com/media/5f131271ad70c93f12fa7283

https://edpuzzle.com/media/5f18b00825a7593f16d79f62

Teacher guides discussion

Student Actions:

Students provide examples of artificial intelligence used in their own lives. Students discuss what they think are important considerations when designing an artificial intelligence application.

Alternative Guided discussion:

When choosing a best friend, what are some important characteristics of a best friend?

Rank the characteristics in order of importance.

Provide weights for the characteristics as a percentage (range 0.01 to 0.99).

Discuss whether a percentage weight is sufficient, or some other method would be best in determining whether someone is best friend material.

EXPLORATION

Teacher Actions:

Ask students to complete a turn and talk activity around these two questions:

1. How can you expose a chatterbot as a program or non-human?
2. What ways could you make the chatterbot seem more human-like?

After the turn and talk, ask students to converse with two chatterbots, Eliza and Cleverbot. Students will then reflect on their experiences with each chatterbot. How were they different? How were they similar?

Student Actions:

Turn and talk to a shoulder partner about the following questions:

1. How can you expose a chatterbot as a program or non-human?
2. What ways could you make the chatterbot seem more human-like?
3. After chatting with Eliza and Cleverbot, how were they different? What similarities did they have?

EXPLANATION

Teacher Actions:

Teacher will explain that AI personalities can respond to questions In this first practice, students will develop a "chatterbot"personality. Then, they will create questions that can fit into various buckets such as; memory-dependent language, questions about thought or feelings, computational questions, or questions that ask for reasoning (Why?)

Explain various types of artificial intelligence; strong AI and weak AI.

Strong AI - machines can think and carry out tasks on their own; similar to humans.

Weak AI - machines cannot work on their own and rely on human input; simulate human behavior

What are examples of both?

Student Actions:

Students are creating questions and sorting them into one of the four categories. This is best done in a table or spreadsheet.

Examples:

Reasoning: Why is the dog barking?

Computation: What is the product of 13 and 6?

Feelings/Thought: Are you happy when you exercise?

Memory-dependent: Have you traveled to Miami? Do you like to visit there?

Strong AI - Humanoids, R2D2 (All Science Fiction)

Weak AI - Siri, Self driving cars, Roomba

Quick Vocabulary Search:

Neural net

Convolutional Neural network

Feed Forward Structure

Algorithm

Abstraction

ELABORATION

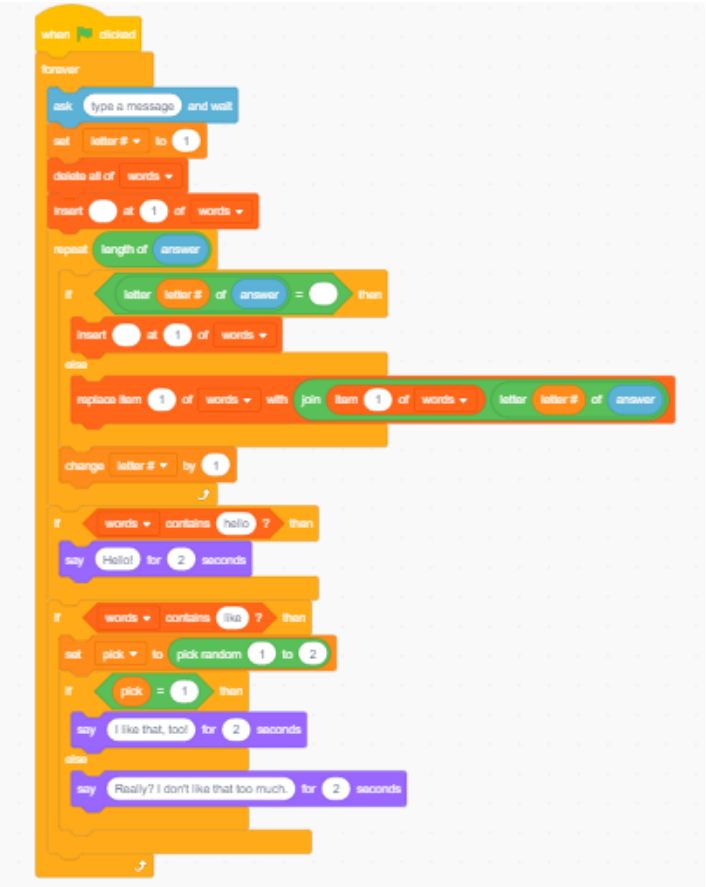
Teacher Actions:

A chatbot is a program that allows for communication with the computer. We are going to create a chatbot using Scratch. In scratch we will need to add many lists and operators. The most important block will be the "ask" block. The ask block must be used to enter a message. The program will then break the message into words, looking for specific words. If the message contains specific words, the chatbot can respond. To break the answer apart, the letters must be added to a list until the space is reached, then create a new item in the list and continue adding the letters, creating words.

The only list for this project is "words". The two variables for this project are "letter #" and "pick".

Student Actions:

1. Open a new scratch program.
2. Go to "create a variable" to create the variables "letter #" and "pick".
3. Go to "create a list" and create the list "words".
4. Replicate the example code below:



If a response with "like" is included the bot will respond I like that too! Or, Really? I don't like that too much. The pick variable is used to allow the bot to respond to more than one message. Test it out!

Extended Activity.

What other scripts can you include to allow the bot to respond to more questions? What lists do you need to include? What responses do you need to include?

EVALUATION

Teacher Actions:

Students are given an exit ticket/quiz based on this lesson. GooAI gle Form.

1. What are some common examples of deep learning currently available in the modern world? Provide at least three examples.
2. The architecture of a neural network is broken down into smaller and smaller components. The smallest decision making component is called a _____.
3. In a neural network, explain what is meant by a feed forward structure?
4. In a convolutional neural network(CNN), what is a convolution?
5. How does the chatbot in your scratch project respond to users? What variables did you include?
6. How much data do you need to accurately train a neural network? Explain your reasoning.
7. Which famous people and quotes did you select as test data for your trained project? How well were the famous people categorized based on the quotes? Explain. (You should have at least 5 test subjects)

Student Actions:

Students are taking the assessment.

REFERENCES

- Scratch - Creating a Chatbot
- Sample Scratch Lesson
- How Machine Learning is Fighting Cancer