Text Classification for AI Education

Tejal Reddy, Randi Williams, Cynthia Breazeal | Media Lab | Massachusetts Institute of Technology

Problem and Motivation

In recent years, Artificial Intelligence (AI) has become increasingly prevalent in our lives. Because of this, it is important for individuals of all ages to be aware of how AI impacts them.

To help middle school students learn more about AI, we created the How to Train Your Robot curriculum to teach students about AI, how it's used, and ethical issues with the technology.

Presentation slide from the first day of the curriculum. Students were asked to define the words 'artificial' and 'intelligence'.

Students worked together to categorize various items as 'AI or Not'. They then provided justification by answering the five key questions at the top of the worksheet. These questions are derived from the five big ideas of AI.

One key topic of the curriculum is Text Classification. To teach students this topic, we provided them with a hands-on opportunity to experiment with text classification and apply it to their own projects. To enable this exploration, we created our own model-making application embedded within a block-based programming platform.

Background and Related Work

As AI has become more prevalent, there has a rapid increase in work geared towards teaching students about AI [11]. Many AI platforms use block-based programming languages catered towards students unfamiliar with programming. These platforms include [2][6][8][13]:

COGNIMATES · ML · λSnap! · MIT APP INVENTOR

However, few tools allow students to create and use their own natural language processing algorithms.

Our extension is most similar to the Machine Learning for Kids [8] text classifier. However, their model is not directly built into a programming platform and requires students to generate their own API keys, which have limited free use.

Machine Learning for Kids' text extension training interface

We provided students with a more streamlined platform that allows them to create models without limitations. Furthermore we created activities, similar to those used in other middle school AI curricula [9], to help students understand more about AI and its impacts.

Benefits of AI

Drawbacks of AI

Approach and Uniqueness

Curriculum Design

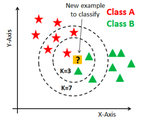
We wanted to ensure that students thoroughly understood all the steps of text classification. To do this, we emphasized the concepts of **word embeddings**, the **K-Nearest Neighbors (KNN) algorithm [4]**, and **classification bias**. Students then demonstrated their understanding in a **programming activity** and their **final projects**.

1. **Word Embeddings:**

	King	Queen	Woman	Princess
Royalty	0.99	0.99	0.02	0.98
Masculinity	0.99	0.05	0.01	0.02
Femininity	0.05	0.93	0.99	0.94
Age	0.7	0.6	0.5	0.1
...	...	...	...	...

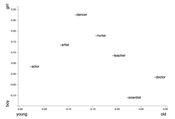
Students were introduced to the concept of how words can be numerically represented with word vectors. We went through examples of creating a word vector with the word 'princess' and deciding whether the numbers in its vector corresponding to 'royalty', 'masculinity', 'femininity', and 'age' should be high or low.

2. **KNN Algorithm:**



To better understand the KNN algorithm, students used a visual of words plotted on a 2-D graph [14]. They learned how the selection of the K parameter can impact the output of the algorithm.

3. **Classification Bias:**



To illustrate classification bias, students used a word analogies website [15] to plot jobs such as 'nurse', 'doctor', 'scientist', 'dancer', 'teacher', 'actor', and 'artist'. From there, they were able to observe gender biases in how word vectors represent some of these words.

4. **Programming Activity:** Students put their new knowledge into practice by using a Text Classification model-making extension we built into a block-based programming interface. They started with a short tutorial that showed them how to make a robot respond to three commands: Drive, Dance, and Speak.

Interface

The text classifier was designed to maximize ease-of-use and understanding for middle school students. The three main components of the text classifier are the **translator**, **sentence encoder [3]**, and **classifier [10]**. The classifier is built into a block-based programming interface developed on top of the open-source Scratch Blocks repository [7].

The initial process of inserting training data into the classifier. The user can dynamically change the training data by adding, deleting, or changing the various labels and their corresponding examples. After training, the user can then classify any word.

Two of the programming blocks users can use to predict labels for inputted words. The left block is suited to being used in conditionals and outputs either 'true' or 'false'. The right block outputs the predicted label for the inputted text.

Experiment Setup

Student Understanding

We tested the classifier with students in the Summer of 2020 during an online class with 29 students. In their daily reflections, students demonstrated their excitement about the concept of text classification and the multitude of ways it could be used.

"The coolest thing was the text classification"
Brant, age 13

"Today I got to create my own command for my robot! That was amazing"
Cacey, age 12

In their final projects, students used their knowledge about text classification to implement their own projects. There were a total of eight final projects that used text classification. Projects tended to align with the theme of helping others and included a snake identifier, a TV show suggester, a dog food detector, an addition robot, a chat robot, a concussion tester, an animal classifier, and a healthcare robot.

Healthcare robot final project

Task - What will your project accomplish?

Our project will help Someone who is sick (who) with The possibility to address the symptoms of the common cold or the flu or covid-19 (goal)

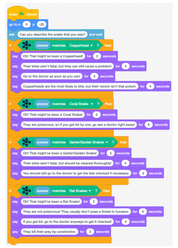
Our project will accomplish not (goal) by Helping a person know if they are very sick or not

First Asking how they are doing and ask what is going on

Then Act as a doctor and ask if they are coughing or sneezing act act

And finally Finally it will identify the symptoms and address the person and say "you have been infected with covid-19", or if not just say "you have a common cold do not worry."

Snake Identifier final project



Task - What will your project accomplish?

Our project will help anyone who sees a snake (who) with identifying the snake (goal)

Our project will accomplish identifying snakes (goal) by

First the user describes the snake (its color, markings, etc.), or shows the robot a picture of the snake.

Then the robot uses that information to identify what type of snake it could be.

And finally the robot tells the user whether the snake could be poisonous or not.

Comparison between Classifiers

To determine the effectiveness of our text classifier, we compared it against two similar text classifiers for children: the Machine Learning for Kids text classifier and UClassify's [12] text classifier. We generated two test datasets, one which contained phrases that could be classified as click-bait and not click-bait [1] and the other which did sentiment analysis on movie reviews [5].

Benchmark Test #1 Trial 2		
Clickbait	Non-Clickbait	Test Inputs
Ed Sheeran Has Revealed His Very Good Reason For Becoming A	Madoff jailed after pleading guilty to $50 billion fraud scheme	We Need To Talk About Joseph Gordon-Levitt
19 Beautiful Ways To Use Sampaguita Flowers In Your Wedding	Over 400 attend Scottish singer-songwriter Gerry Rafferty's funeral	Wikimania 2008: MediaWiki use in the U.S. Department of State
Match The Celebrity Baby Name From 2015 To Their Famous Parer	Four miners trapped in Ecuador mine	A New Dad Proposed To His Girlfriend Right After The Birth Of Their Baby
We Know Your Hogwarts House Based On The Things You Hate	Court finds random bag searches in NYC subway constitutional	France Rejects Plan to Curb Internet Piracy
This Little Girl Reacting To The Reveal Of Luke Skywalker's Father I Over a dozen killed in suicide bombing in Iran		

Correct answer	PRG	ML4kids	uclassify
Clickbait	Correct	Correct	Correct
Non-clickbait	Correct	Incorrect	Incorrect
Clickbait	Correct	Correct	Correct
Non-clickbait	Correct	Correct	Incorrect

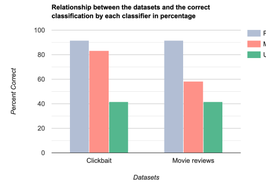
We conducted three rounds of testing with each dataset, training on ten randomly selected inputs. We only used five random inputs for each label to imitate how children used these tools. We then tested the effectiveness of the classifiers by testing them on four random phrases (two of each label).

Results and Conclusions

Student Understanding

Through the use of final projects, we saw that the text classifier and related activities were effective in helping students understand how it worked as well as its uses. Many of the students used the classifier in their final projects to help others, and by doing this, were able to reinforce the concepts taught in class. In the future, we hope to improve this understanding by adding a KNN plot so that students can visualize the reasons behind their classifiers' decisions.

Comparison between Classifiers



From the results of the experiment, it can be seen that our classifier is comparable to the numerous text classifiers already in existence.

Acknowledgements

We would like to thank the teachers and students who participated as well as Amazon Future Engineer for supporting the program.

References

[1] Abhijnan Chakraborty, Bhargavi Paranjape, Sourya Kakarla, and Niloy Ganguly. 2016. Stop Clickbait: Detecting and preventing clickbaits in online news media. In Advances in Social Networks Analysis and Mining (ASONAM), 2016 IEEE/ACM International Conference on. IEEE, 9–16.
[2] Stefania Druga. 2018. Cognimates. http://cognimates.me/home/
[3] Google. [n.d.]. https://tfhub.dev/google/universal-sentence-encoder/4
[4] Italo José. [n.d.]. https://towardsdatascience.com/knn-k-nearest-neighbors-1-a4707b24bd1d
[5] Kaggle. [n.d.]. https://www.kaggle.com/lakshmi25npathi/sentiment-analysisof-imdb-movie-reviews/data
[6] Ken Kahn, Rani Megasari, Erna Piantari, and Enjun Junaeti. 2018. AI Programming by Children using Snap! Block Programming in a Developing Country. In EC-TEL Practitioner Proceedings 2018: 13th European Conference On Technology Enhanced Learning, Leeds, UK, September 3-6, 2018. http://ceur-ws.org/Vol-2193/paper1.pdf
[7] Lifelong Kindergarten. [n.d.]. https://github.com/LLK/scratch-blocks
[8] Machine Learning for Kids. [n.d.]. https://machinelearningforkids.co.uk/
[9] Personal Robots Group and I2 Learning. [n.d.]. https://aieducation.mit.edu/documents/i2educatorguide2019.pdf
[10] TensorFlow. [n.d.]. https://github.com/tensorflow/tfjs-models/tree/master/knnclassifier
[11] David Touretzky, Christina Gardner-McCune, Fred Martin, and Deborah Seehorn. 2019. Envisioning AI for K-12: What should every child know about AI?. In AAAI.
[12] Uclassify. [n.d.]. https://uclassify.com/
[13] Jessica Raquelle Van Brummelen. 2019. Tools to create and democratize conversational artificial intelligence.
[14] Avinash Navlani. 2018. https://www.datacamp.com/community/tutorials/k-nearest-neighbor-classification-scikit-learn
[15] Julia Bazińska. 2017. https://lamyiowce.github.io/word2viz/