

Canon vs Fanon?

Distinguishing Fanfiction from Canonical Writing

Using a Neural Network



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2016-2017

8TH GRADE

MASSACHUSETTS STATE SCIENCE
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ABSTRACT

This project analyzed how a convolutional neural network can differentiate between fanfiction and J.K Rowling's original writing. Fanfiction is writing created by fans based of the original, which in this case is Harry Potter. The algorithm was directed towards telling apart different types of writing using the Keras library. Using a tokenizer and GloVe alongside the Keras library, my model was able to distinguish between fanfiction and canonical writing with an accuracy of up to 98% by converting text into numbers and inputting that into a convolutional neural network. The neural network was trained on part of a database of Harry Potter fanfiction and the original Harry Potter corpus. The other part of the database was used to create a validation set to use to obtain the accuracy of the machine after it has been trained. In contrast to the results of the algorithm, the human accuracy score was approximately 68%.

BACKGROUND

After reading several research papers on the significance of natural language processing, I decided to base my project around it. As I primarily work in Python, I decided to learn about Keras, a open source neural network library written in Python, originally released in March 2015. As well studying the ins and out of using Keras, I researched how to map words to numbers, an essential part of the word vectorization often used in natural language processing. An unsupervised learning algorithm used by many for word vectorization called GloVe (Global Vectors for Word Representation) is what I eventually used. In addition, I have had prior experience with applying neural networks to images with the MNIST data set for handwriting recognition.

QUESTION

Can a convolutional neural network distinguish between original writing and fanfiction?

HYPOTHESIS

Using the Keras library, I hope to make a performant neural network that can distinguish between the Harry Potter series and fan-made writing based off of it.

MATERIALS

1. Computer
2. Internet connection
3. Java, Eclipse, Python, Keras
4. GPU server
5. Spreadsheet program
6. Survey: <http://www.surveygizmo.com/s3/3521782/Canon-vs-Fanon>

PROCEDURE

I collected my data set from Fanfiction.net and used the Harry Potter corpus, and then set up this data by separating the text from the html source code off of Fanfiction.net, along with other important identifiers.

Then, I set up each piece of information into one big array, and did the same with the full corpus, but by segmenting each page into one big line, so that the lengths of the excerpts would be similar. All my data was compiled into an organized file, and then called on in the program that trains my model.

After tokenizing to get rid of repeated word vectors, I can convert the words to numbers. To further use this data, I have to import it in, and use a word vectorization function called GloVe alongside it, mapping the words to an array of numbers that represent various semantic relationships of the words. I also made sure to set up and complete padding, so that each excerpt is the same length, with padding of zeros at the end to do so.

I split my data into a training set and a validation set. The training set can have thousands of training excerpts, but the machine is only trained on these so that it can be ready to predict when it comes to the validation set and also so you know to trust the validation set's accuracy. I then train the algorithm by preparing the embedding matrix, and setting up a neural network. After that is optimized to lower losses, I can run the model.

I ran into several problems, but my biggest one was that my neural network was overfitting, performing too well. It turned out it was taking any testing excerpts I put in and simply classifying them by length. After analyzing my training set, I found that most fanfiction excerpts were approximately between two hundred and four hundred words, whilst excerpts from the Harry Potter series were either under two hundred or between four hundred words and one thousand words.

To solve this, I truncated all my excerpts to less than four hundred words and greater than one hundred words to ensure that the algorithm would not overfit based on length. Afterwards, I decided to survey several people to compare their accuracy with the algorithm. I set up a survey using excerpts from my validation set, and had participants mark whether it was JK Rowling's writing, "Canon," or fanfiction, "Fanon." Although people scored above fifty percent, beating guessing, my algorithm was still more

performant than those surveyed.

DATA

How people performed in my survey:

Consent	Read HP	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F	C or F
	CORRECT >>>	F	C	C	C	F	F	F	F	F	F	F	F	C	F	C	C	C
I give consent.	No.	F	F	F	C	F	C	C	F	C	C	F	F	F	F	F	F	F
I give consent.	No.	C	F	C	F	C	C	C	C	F	F	F	F	F	F	F	C	C
I give consent.	Yes, all of it.	F	C	C	F	F	C	F	C	F	C	C	F	C	F	C	C	C
I give consent.	Yes, all of it.	F	F	C	F	F	F	F	F	F	C	F	C	C	C	F	F	F
I give consent.	Yes, all of it.	F	F	C	F	F	F	C	F	F	C	F	C	F	C	C	F	F
I give consent.	Yes, all of it.	F	C	C	F	C	F	F	F	F	C	F	C	C	C	C	C	C
I give consent.	No.	F	C	C	F	C	F	F	C	C	F	C	C	C	C	C	F	C
I give consent.	No.	F	C	C	C	F	F	F	F	F	F	F	C	F	C	C	C	F
I give consent.	Yes, all of it.	F	C	C	F	F	C	C	F	F	C	C	C	C	C	C	C	C
I give consent.	Yes, all of it.	F	C	F	F	F	F	C	F	F	C	F	C	C	C	F	C	C
I give consent.	Yes, all of it.	F	C	F	F	F	F	C	F	F	C	F	C	C	C	C	C	C
I give consent.	Yes, all of it.	F	C	C	F	F	F	C	F	F	F	C	F	C	C	C	C	C
I give consent.	Yes, all of it.	F	C	C	F	F	F	C	F	F	C	F	C	C	C	C	C	C
I give consent.	Yes, but not all of it.	F	C	C	F	F	F	C	C	C	C	F	C	C	F	C	F	C
I give consent.	Yes, all of it.	F	C	C	C	F	C	F	C	C	C	C	C	C	C	C	C	C
I give consent.	Yes, all of it.	F	C	C	F	F	F	F	F	F	C	F	C	C	C	C	C	C
I give consent.	No.	F	C	C	F	F	C	C	F	F	F	F	C	C	F	C	F	F
I give consent.	Yes, all of it.	F	C	C	F	F	F	F	F	F	C	F	C	C	C	C	C	C
I give consent.	Yes, all of it.	F	C	C	F	F	F	C	F	F	C	F	C	C	C	C	C	C
I give consent.	No.	F	C	C	F	F	F	C	F	F	C	F	C	C	C	C	C	C
I give consent.	No.	F	C	C	C	F	F	C	F	F	F	F	C	F	C	F	C	C
I give consent.	Yes, but not all of it.	F	C	C	F	C	F	C	F	F	C	F	C	F	C	F	C	F
I give consent.	Yes, all of it.	F	C	C	F	F	F	C	F	F	C	F	C	C	C	C	C	C
I give consent.	No.	C	F	C	C	F	C	F	C	C	C	C	F	F	F	C	C	C
I give consent.	No.	C	C	F	C	F	F	C	C	F	C	C	C	F	F	F	C	C

R	W	W	R	R	W	W	R	W	W	W	R	W	W	W	W	Percentage
R	W	W	R	R	W	W	R	W	W	W	R	W	W	W	W	31.25
W	R	W	W	W	R	W	W	W	W	R	R	R	R	W	W	37.5
W	W	R	R	W	R	R	R	R	W	W	R	W	R	R	R	62.5
R	W	R	R	R	W	R	W	R	R	W	W	R	R	W	W	56.25
R	R	R	R	R	R	W	R	R	R	R	R	R	R	R	R	93.75
R	W	R	R	W	R	W	R	R	R	R	R	R	W	W	W	62.5
R	R	R	R	R	R	R	W	W	W	W	R	R	R	W	R	68.75
R	R	R	W	W	R	R	W	W	W	W	R	R	R	R	R	62.5
R	R	R	W	R	W	W	R	R	R	W	R	R	R	W	R	68.75
R	R	W	R	R	W	R	R	R	R	W	R	R	W	R	R	75
R	R	R	R	R	R	R	R	R	R	R	R	R	W	R	R	93.75
R	R	W	R	R	R	R	R	R	R	R	R	R	R	R	R	93.75
R	R	R	R	R	R	W	W	W	R	R	R	W	R	R	R	75
R	R	R	W	W	R	R	R	R	W	R	R	R	R	W	R	75
R	R	R	W	R	W	R	W	W	R	W	R	R	R	R	R	68.75
R	R	R	R	R	W	W	R	R	W	W	R	W	R	W	W	56.25
R	R	R	R	R	W	W	R	R	W	W	R	W	R	W	W	56.25
R	R	R	R	R	R	W	R	R	R	R	R	R	R	R	R	93.75
R	R	R	R	R	R	W	R	R	W	R	R	W	R	R	R	75
R	R	R	W	W	R	R	R	R	W	R	R	R	R	W	R	75
R	R	R	R	W	R	R	R	R	R	R	R	W	R	W	R	81.25
W	W	R	W	R	W	W	W	W	R	R	W	W	R	R	R	43.75
R	W	W	R	R	W	W	R	W	R	W	W	R	W	R	R	50
																68.22916667
																17.95569981

Samples of what the Neural Network was trained on:

\$ cat shortsamples.txt | head

fanon | <https://www.fanfiction.net/f/10000109/f/Of-Dead-Puppies-and-Dropped-Pianos> | eThe words left Hannahs mouth before she could stop them She almost wanted to reach out and grab them and stuff them back inside but it would not be fair for her to let Nott continue his mistreatment of poor Luna Hannah was all about fairplay Whats it to you Abbott Nott sneered twirling Lunas wand between his fingers Hannah straightened her robes and jabbed a finger at her prefect badge Aside from the obvious she said with a sniff looking the sandyhaired boy in the eye I dont think Miss Lovegood is having as good a time as you are Lunas face showed no sign that she was even putout by the boys actions but Hannah soldiered on And Id just hate for Slytherin to lose points all because one person cant understand that we mustnt touch what isnt ours Nott straightened his spine then standing to his full height He was now a good foot taller than she was the top of her head barely reaching his shoulders and Hannah felt the knot of worry in her stomach twist And who says whats hers isnt mine Hannahs eyebrows raised involuntarily confusion settling over her This little blood traitor doesnt deserve to have a wand he continued eyes flashing as he advanced on her Anymore that you deserve to set foot in this school halfbreed Hannahs head snapped back like hed delivered a sound slap to her face Venom dripped from every syllable especially the last two which still hung in the air like a bad odor Fifty points from Slytherin she snapped reaching out and snatching the wand from him with surprising speed and handing it back to the blonde behind her For bullying theft derogatory remarks and backsassing a prefect Take it up with

fanon | <https://www.fanfiction.net/f/10038989/f/The-Great-Bubble-War-of-1979> | Mmm That was good Guess its time for you to do the dishes love James said cheekily as he pushed his plate away from him Oh are you serious Lily exclaimed exaperatedly No Remember you married me instead of Sirius hon He said with a wink Starting to regret that she grumbled I doubt hed be as sexist as you Just because Im your wife does not mean that I have to do the dishes But I did them last time dear and I cooked dinner Fine Lily agreed grumpily as she roughly grabbed his plate and utensils She hated that smirk that now graced his features Okayhate was a strong wordmaybe something closer to dislikedslightly leaning towards enjoyedor perhaps hated to admit how much she absolutely loved it was more accurate Lily brought the dishes over and turned on the water She added soap and soon a thick layer of bubbles floated lazily on the surface James sat casually on the counter next to her still smirking Make yourself useful she said as she threw a sponge at his face Damn She thought as he skillfully caught it Curse those chaser reflexes James cheerfully went off to clean the table and counters Lily continued to wash the plates and soon moved onto the utensils She was just washing a rather large knife when James snuck up behind her leaned around and planted a quick kiss on her cheek You do realize Im washing a knife correct She asked gesturing with said knife Ah yes dear but Im armed with a sponge He brandished his weapon dramatically as though it were a sword She raised an eyebrow skeptically and he flourished it some more Lily tried to keep a straight face but when James yelled En Garde She knew laughter

canon | 3975 | Ginny kissed Albus goodbye See you at Christmas Bye Al said Harry as his son hugged him Dont forget Hagrids invited you to tea next Friday Dont mess with Peeves Dont duel anyone till youve learned how And dont let James wind you up What if Im in Slytherin The whisper was for his father alone and Harry knew that only the moment of departure could have forced Albus to reveal how great and sincere that fear was Harry crouched down so that Albuss face was slightly above his own Alone of Harrys three children Albus had inherited Lilys eyes Albus Severus Harry said quietly so that nobody but Ginny could hear and she was tactful enough

to pretend to be waving to Rose who was now on the train you were named for two headmasters of Hogwarts One of them was a Slytherin and he was probably the bravest man I ever knew But just say then Slytherin House will have gained an excellent student wont it It doesnt matter to us Al But if it matters to you youll be able to choose Gryffindor over Slytherin The Sorting Hat takes your choice into account Really It did for me said Harry He had never told any of his children that before and he saw the wonder in Albus face when he said it But now the doors were slamming all along the scarlet train and the blurred outlines of parents were swarming forward for final kisses lastminute reminders

canon | 1493 | over and thats not until June And dont forget if youre talking about me among yourselves call me Snuffles okay He handed Harry the empty napkin and flask and went to pat Buckbeak goodbye Ill walk to the edge of the village with you said Sirius see if I can scrounge another paper He transformed into the great black dog before they left the cave and they walked back down the mountainside with him across the boulderstrewn ground and back to the stile Here he allowed each of them to pat him on the head before turning and setting off at a run around the outskirts of the village Harry Ron and Hermione made their way back into Hogsmeade and up toward Hogwarts Wonder if Percy knows all that stuff about Crouch Ron said as they walked up the drive to the castle But maybe he doesnt care itd probably just make him admire Crouch even more Yeah Percy loves rules Hed just say Crouch was refusing to break them for his own son Percy would never throw any of his family to the dementors said Hermione severely I dont know said Ron If he thought we were standing in the way of his career Percys really ambitious you know They walked up the stone steps into the entrance hall where the delicious smells of dinner wafted toward them from the Great Hall Poor old Snuffles said Ron breathing deeply He must really like you Harry Imagine having to live off rats

canon | 1285 | Four fully grown enormous viciouslooking dragons were rearing onto their hind legs inside an enclosure fenced with thick planks of wood roaring and snorting torrents of fire were shooting into the dark sky from their open fanged mouths fifty feet above the ground on their outstretched necks There was a silveryblue one with long pointed horns snapping and snarling at the wizards on the ground a smoothscaled green one which was writhing and stamping with all its might a red one with an odd fringe of fine gold spikes around its face which was shooting mushroomshaped fire clouds into the air and a gigantic black one more lizardlike than the others which was nearest to them At least thirty wizards seven or eight to each dragon were attempting to control them pulling on the chains connected to heavy leather straps around their necks and legs Mesmerized Harry looked up high above him and saw the eyes of the black dragon with vertical pupils like a cats bulging with either fear or rage he couldnt tell which It was making a horrible noise a yowling screeching scream Keep back there Hagrid yelled a wizard near the fence straining on the chain he was holding They can shoot fire at a range of twenty feet you know Ive seen this Horntail do forty Isn it beautiful said Hagrid softly Its no good yelled another wizard Stunning Spells on the count of three Harry saw each of the dragon keepers pull out his wand Stupefy they shouted in unison and the Stunning Spells shot into the darkness like fiery rockets bursting in showers of stars on the dragons scaly hides

ANALYSIS

I wanted to see how the human accuracy score stacks up against my algorithm's validation accuracy. I chose to use the validation accuracy over the training accuracy because I ensured that my validation set used excerpts that were not in the training set, so that when it ran, it wouldn't have to analyze sets it had already been trained on.

To see how people would perform in comparison to the algorithm, I created an anonymous survey that asked them to identify pieces of writing as either canonical writing or fanfiction. I had around fifteen questions that consisted of excerpts from the validation set and options to mark the pieces of text as: "Canon" or "Fanon."

After having twenty-five participants complete my survey, I had enough data to gather that the accuracy of humans was approximately sixty-eight percent. I exported the results of the survey into a spreadsheet and compiled the data surveygizmo provided. My survey took in their results, but not whether or not they were right. To find each person's accuracy, I had to compare the answer key of the survey, and the participant's results, which were written as "Canon" or "Fanon," and had to be converted into "Right" or "Wrong." Using the equation $\text{IF}(\text{participantresult} = \text{correctresult}, "R", "W")$, I was able to map out the participant's "grades" for my survey. I was then able to find the average of the scores by using the equation $\text{AVERAGE}(\text{firstscore} : \text{lastscore})$, which was 68.23%. I also used $\text{STDEV}(\text{firstscore} : \text{lastscore})$ to find a standard deviation of almost 19%.

FUTURE APPLICATIONS

Possible further applications for my algorithm include maturity rating excerpts of text, classifying which author out of several is most likely to have written the given work, distinguishing between fanfiction and canonical writing with authors other than J.K Rowling, and even be used to possibly counteract plagiarism.

CONCLUSION

I conclude that after my algorithm was trained on an many fanfiction excerpts and the entire Harry Potter corpus, it was able to distinguish between fan-made writing and canonical writing up to an accuracy of 97%, scoring better than the average humans in my study.

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