Topic Modeling Using Natural Language Processing

Johnny McGregor
General Assembly

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Objective

- Build a model that can help a science website identify whether posts to their website is relevant.
- Collect posts from the science and comedy subreddits.
- Use Natural Language Processing to make the text compatible with the model.
  - Represent the words as numbers
- Evaluate how accurate the model is at distinguishing between the two topics.

Data

- Collected using the Reddit API
    - Collected as a JSON file (Java Script Object Notation)
    - Using Python we can convert into a Pandas Dataframe

- 2868 total posts
    - 1344 science
    - 1524 comedy

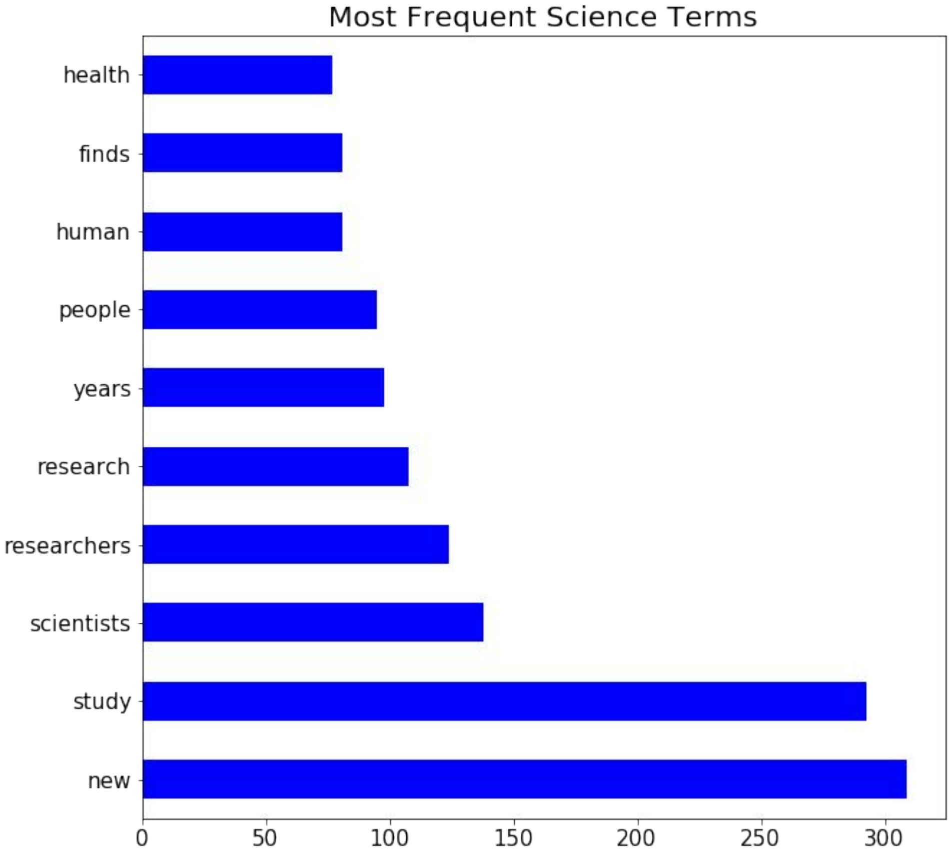
Natural Language Processing

- “Hello, how are you?”
  - hello
  - how
  - are
  - you
- Filter out everything except the letters
  - Comma, questions mark, and quotes are removed above.
  - Each word can become a feature in the model

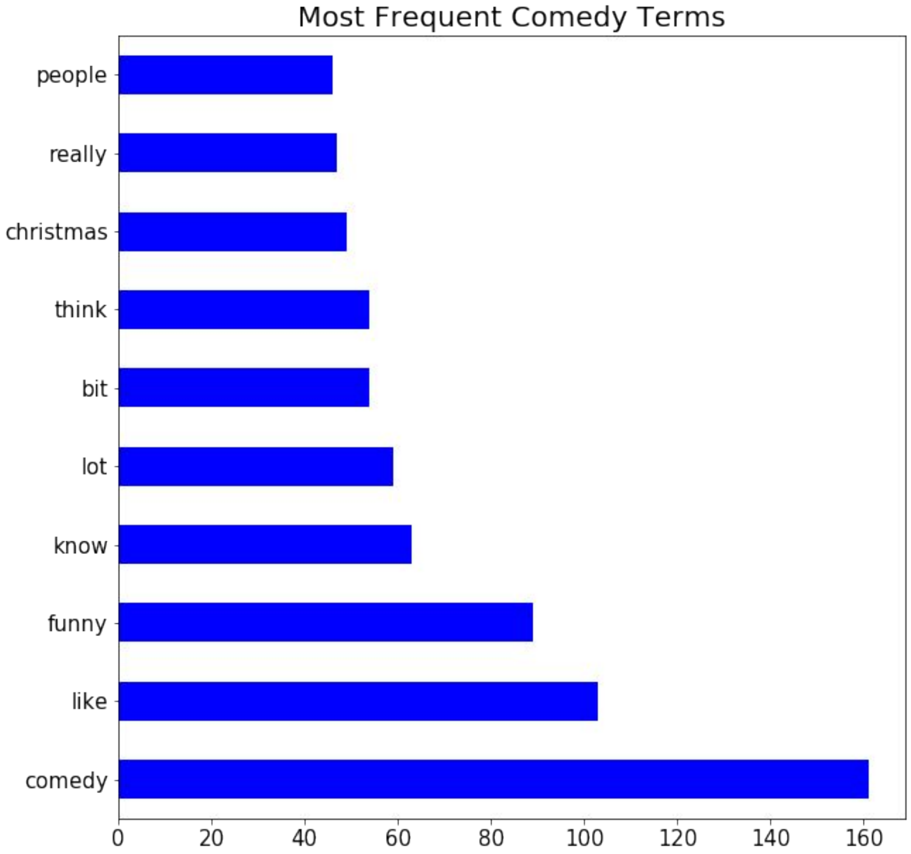
Natural Language Processing

- Word Count
  - Tracks the amount of times a word occurs.
  - Ignores grammar, structure, order
- Frequency
  - Number of times a word is in a document (post) / Total words in document
  - Number of total documents (2868 in this case) / Number of documents that contain the word
- Often a good idea to discard “stop words”
  - Due to high frequency they are usually not meaningful in distinguishing between categories
  - I, by, me, my, of, we you
- Feature Engineering
  - Shortening words to their roots
  - Combining words into pairs/trios

Most Common Words



Most Frequent Science Terms



Most Frequent Comedy Terms

Modeling

- Split up our data
  - 2151 posts used for training data set
  - 717 posts used for test data set
- Fit Training data to the model
  - Set certain parameters like maximum features, maximum document frequency
- Predict whether each post in the test data came from science or comedy subreddit

How Do We Measure Success?

- Of the 717 posts in the test data set how many were correctly identified?
  - Accuracy
- Of the posts that were about science how many were correctly identified?
  - True Positive Rate
- Of the posts that weren’t about science how many were correctly identified?
  - True Negative Rate
- Of all science predictions how many were correct?
  - Precision

How Do We Measure Success?

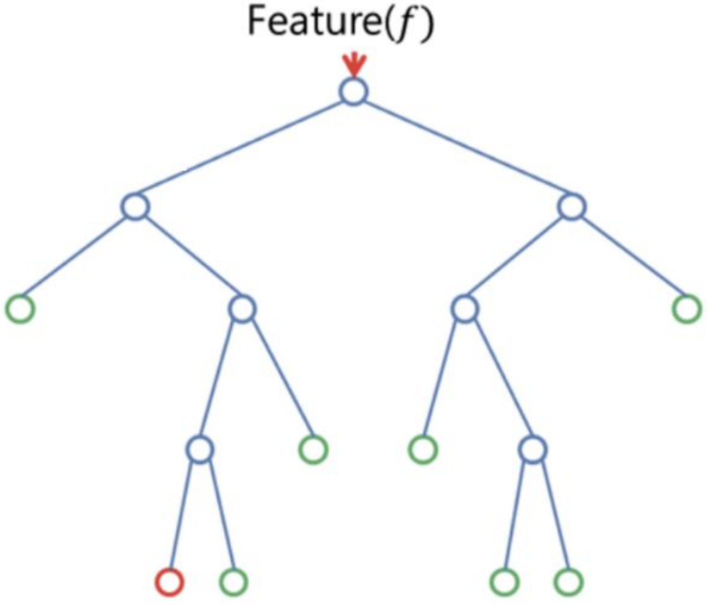
- Accuracy
- Low False Positives Rate (1 - True Positive Rate)
- Baseline Score
  - 1524 comedy posts/ 1344 science posts
  - If we predicted every post to be comedy (or not science) we would be right 53.1% of the time

Logistic Regression

- Makes predictions based on the probability of a post being in either science or not science. 1 or 0.
- Can quantify the likelihood of a 1 or a zero based on each feature. The word study in a post makes it *x* times more likely to be a science post.
    - Three and half times more likely to be classified science If “study” is in the post
    - Probability .78

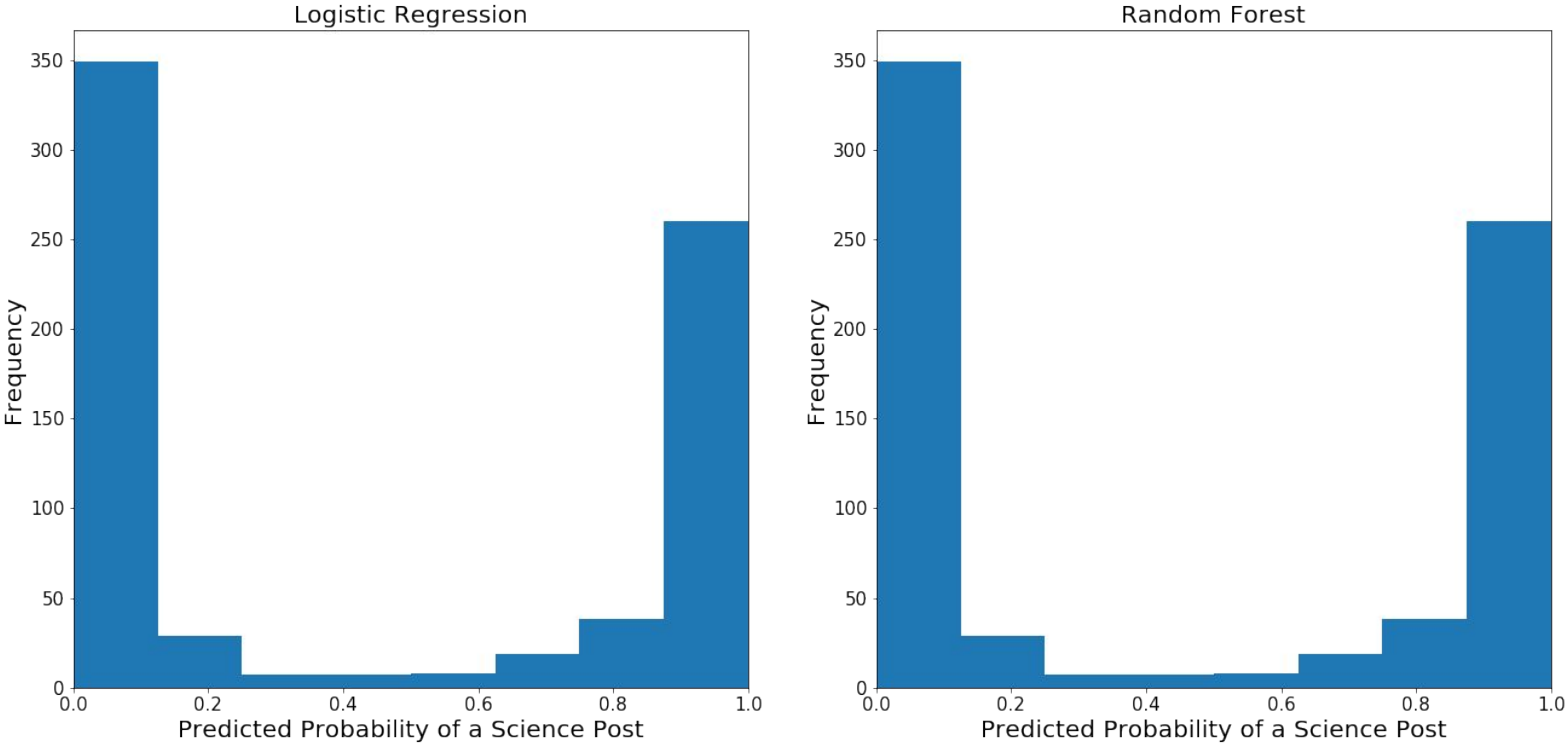
Random Forest

- Splits the data up based on random subset of features
- Can set the depth of the “trees”, maximum amount of features,
- The goal is to separate the two classes as much as possible and this is done many times over with a many Decision Tree Classifier



Decision Tree

Model Comparison



Model Comparison (717 Possible Outcomes)

Logistic Regression:

Accuracy - 97.6

True Negatives - 378 (Rate = 99.2)

True Positives - 322 (Rate = 95.8)

False Negatives - 14

False Positives - 3

Precision = 99.0

Random Forest:

Accuracy - 96.9

True Negatives - 378 (Rate = 99.2)

True Positives - 317   (Rate = 94.3)

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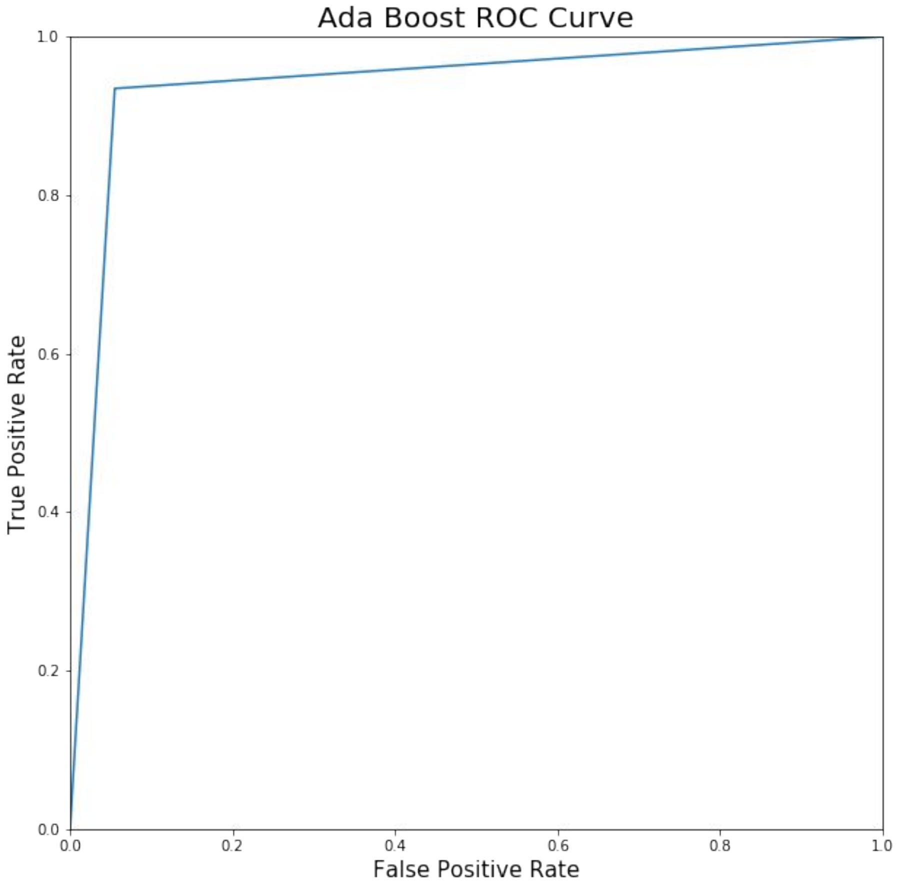
Ada Boost ROC Curve



True Negatives: 363

False Positives: 18

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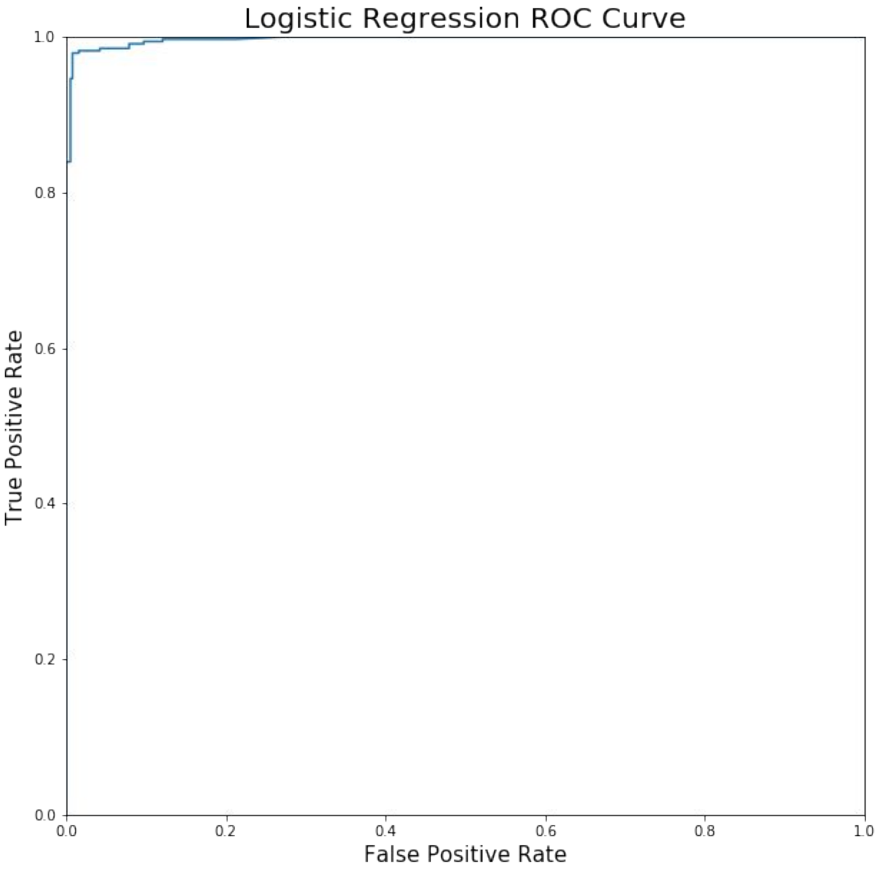
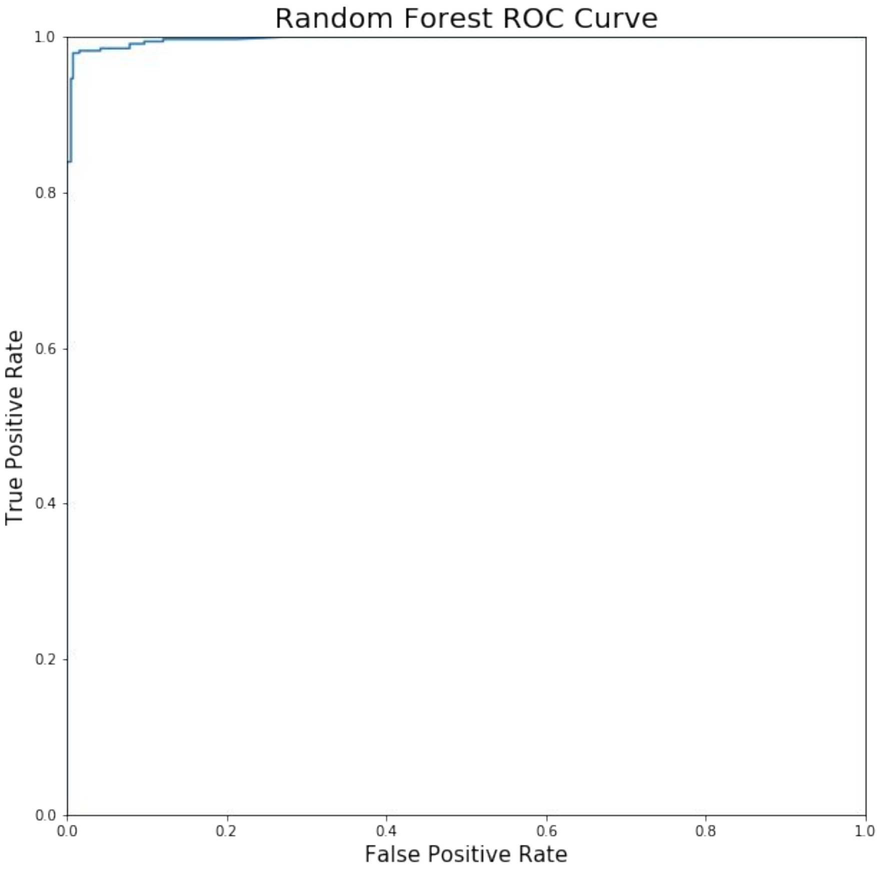
True Positives: 314

Adjust Probability threshold lower to lessen false positives, adjust higher for false negatives

ROC Curves

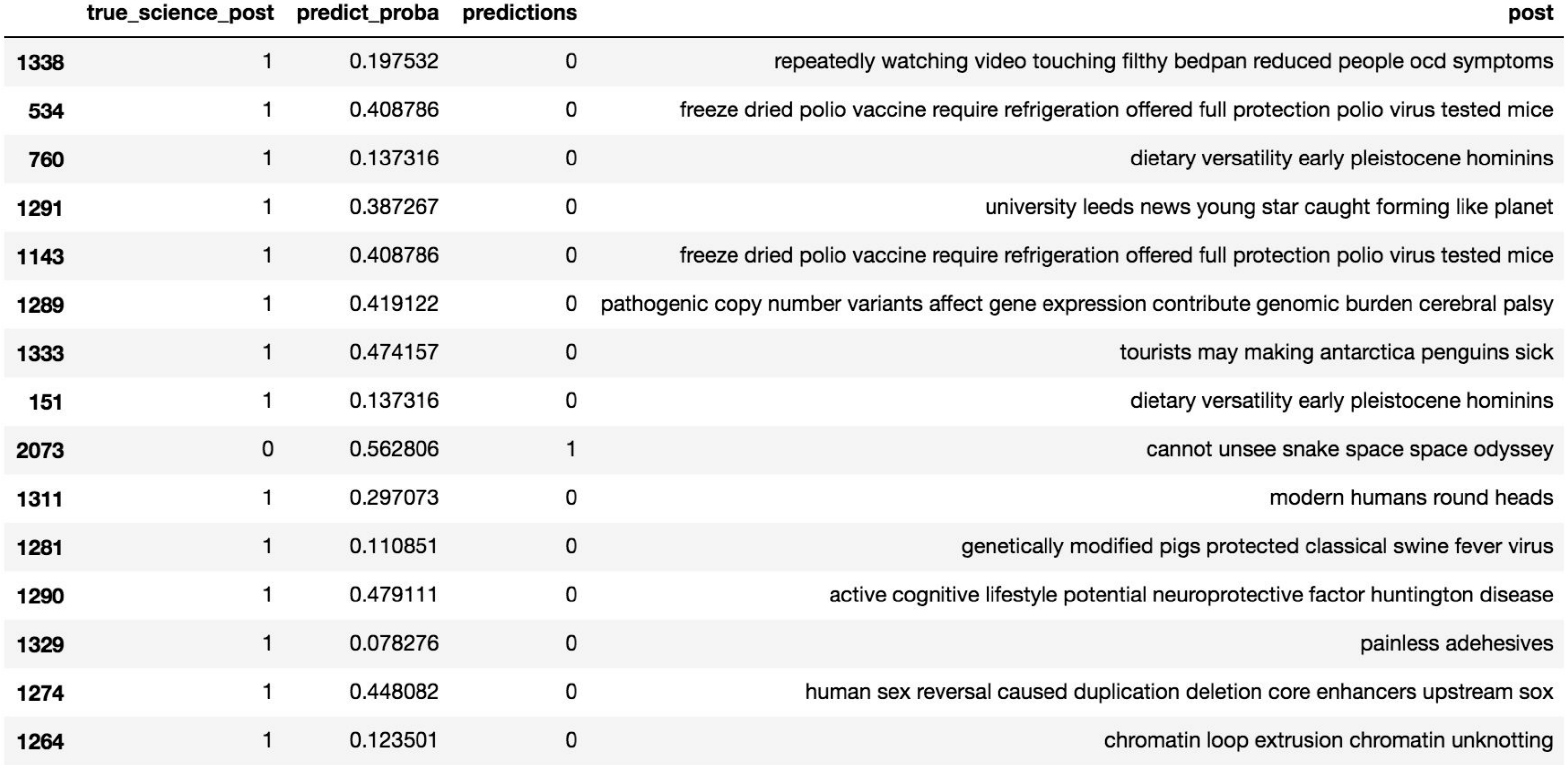


Logistic Regression ROC Curve



Random Forest ROC Curve

Misclassifications



	true_science_post	predict_proba	predictions	post
1338	1	0.197532	0	repeatedly watching video touching filthy bedpan reduced people ocd symptoms
534	1	0.408786	0	freeze dried polio vaccine require refrigeration offered full protection polio virus tested mice
760	1	0.137316	0	dietary versatility early pleistocene hominins
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Recommendations

- If you want to eliminate posts incorrectly being classified as science, increase the threshold higher than .5
- Random Forest over Logistic Regression
- Look at some common words from misclassified posts to better train the model, and possibly flag inappropriate posts

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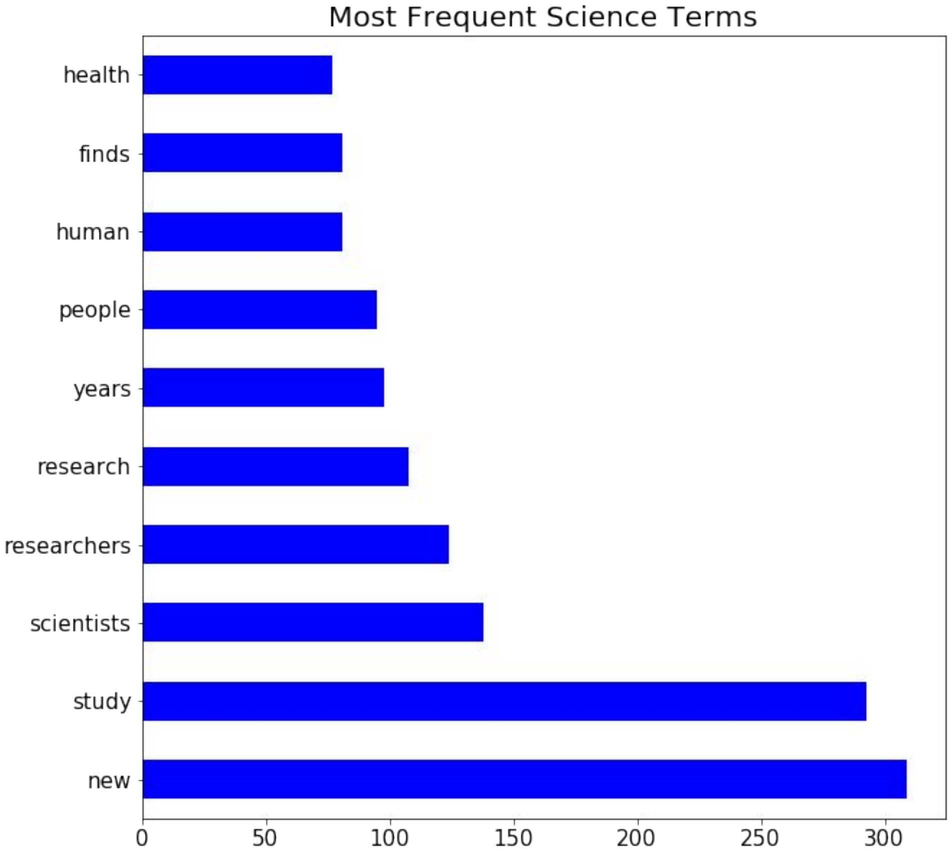

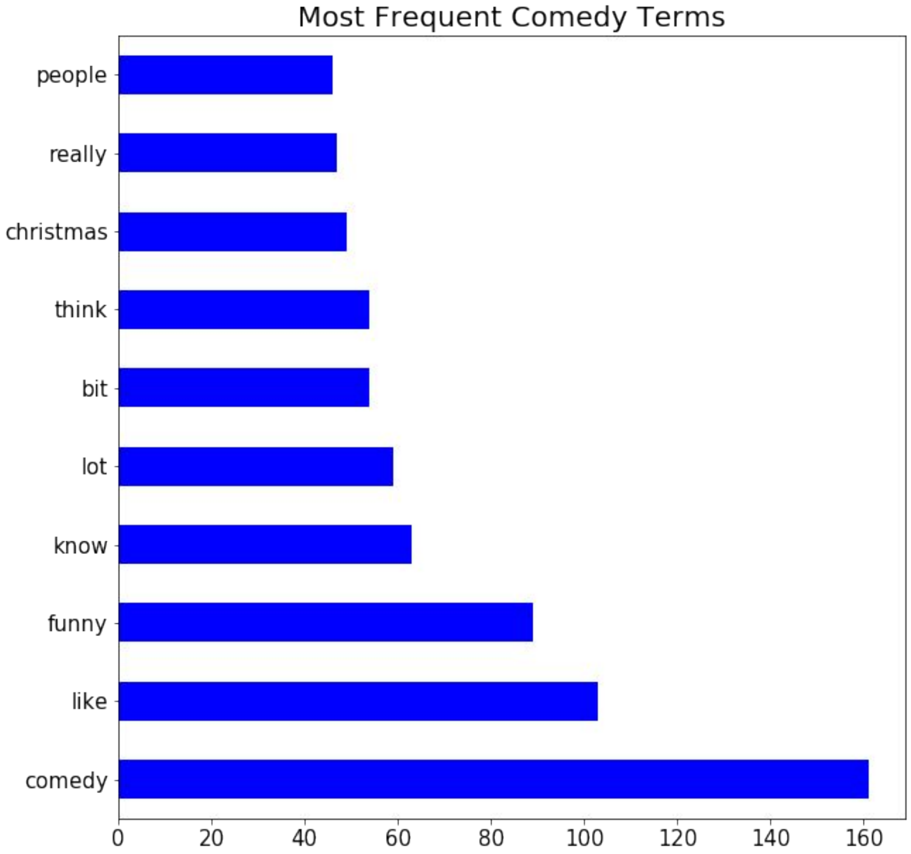

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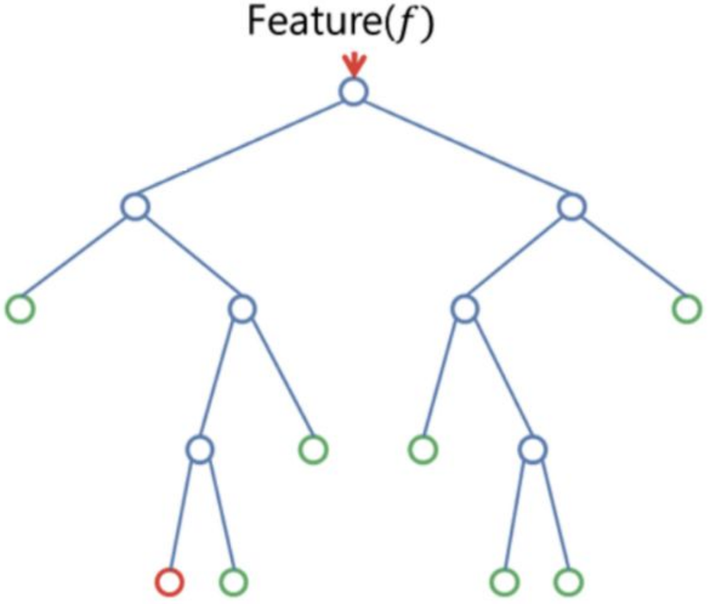

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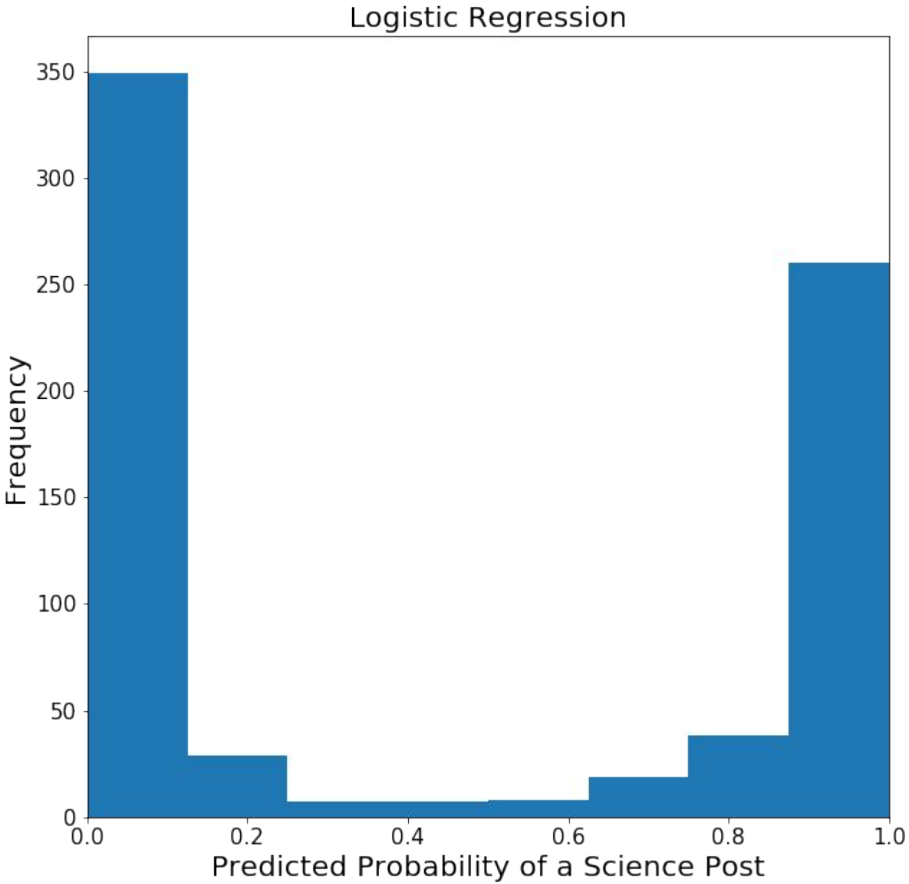

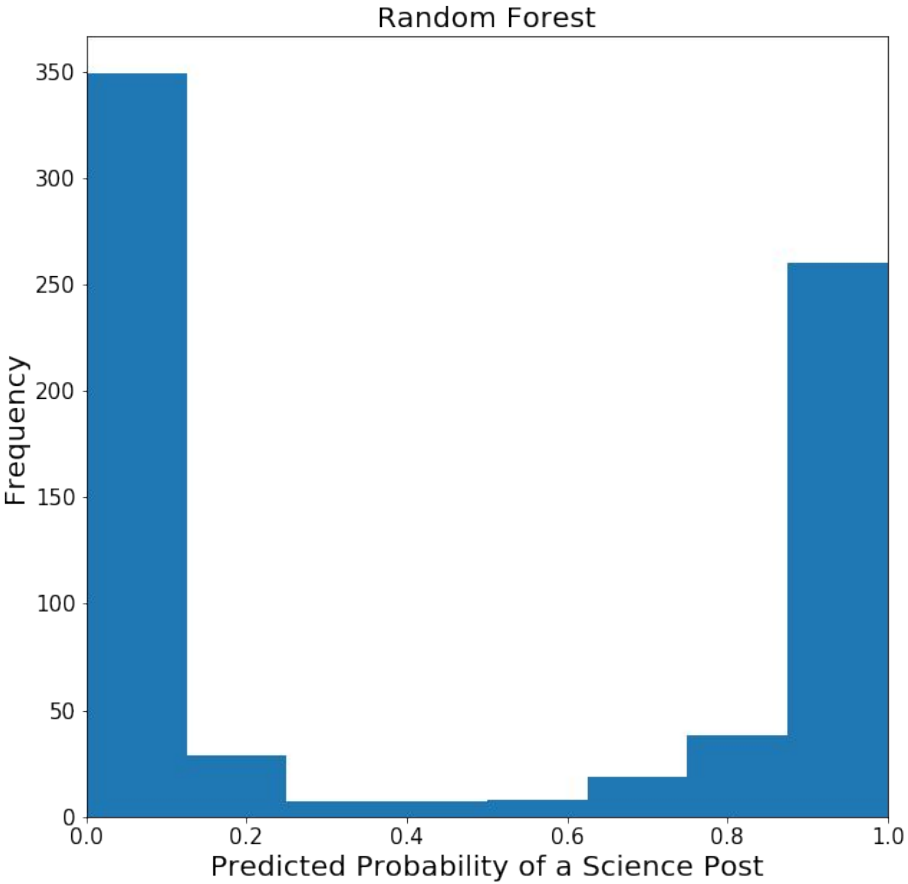

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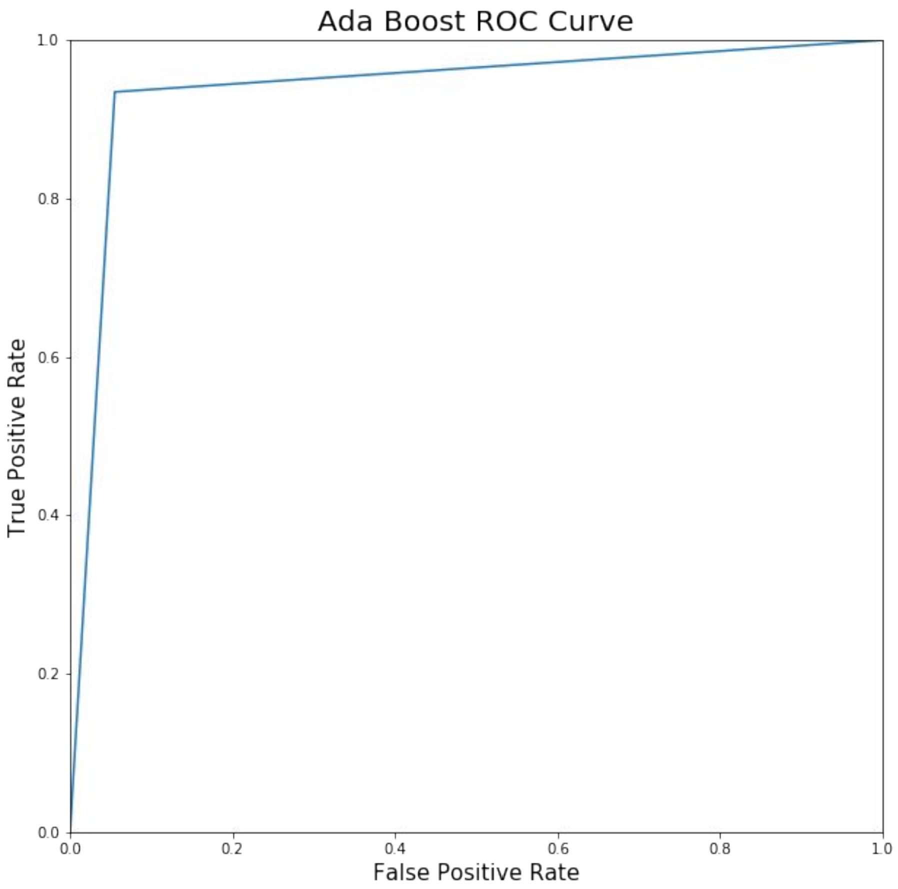

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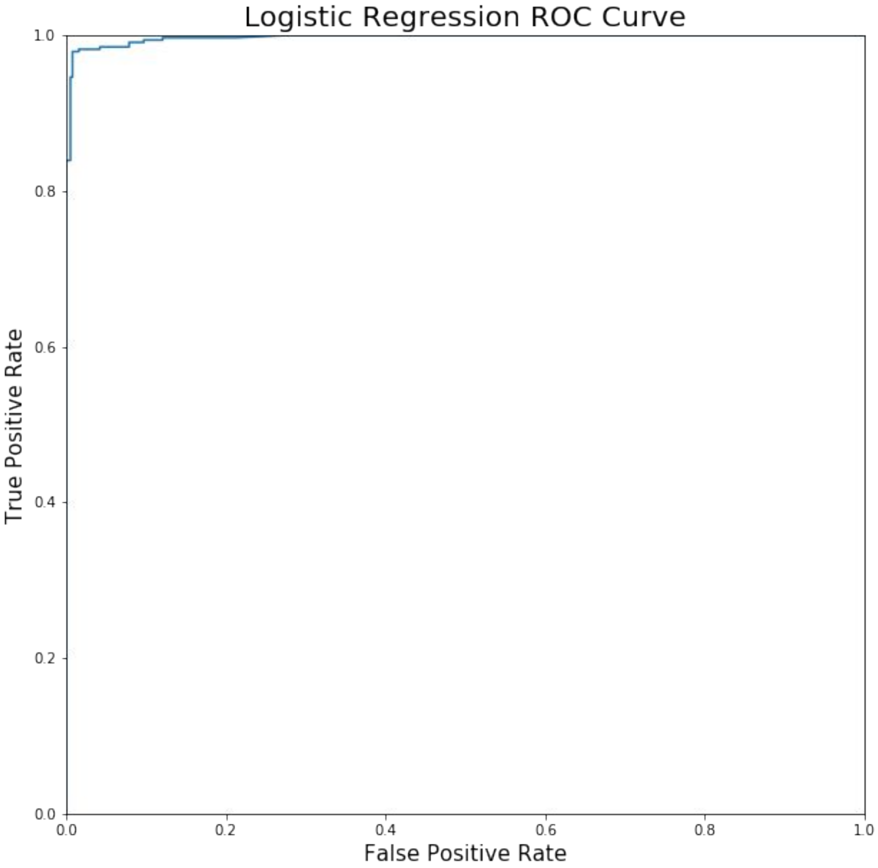
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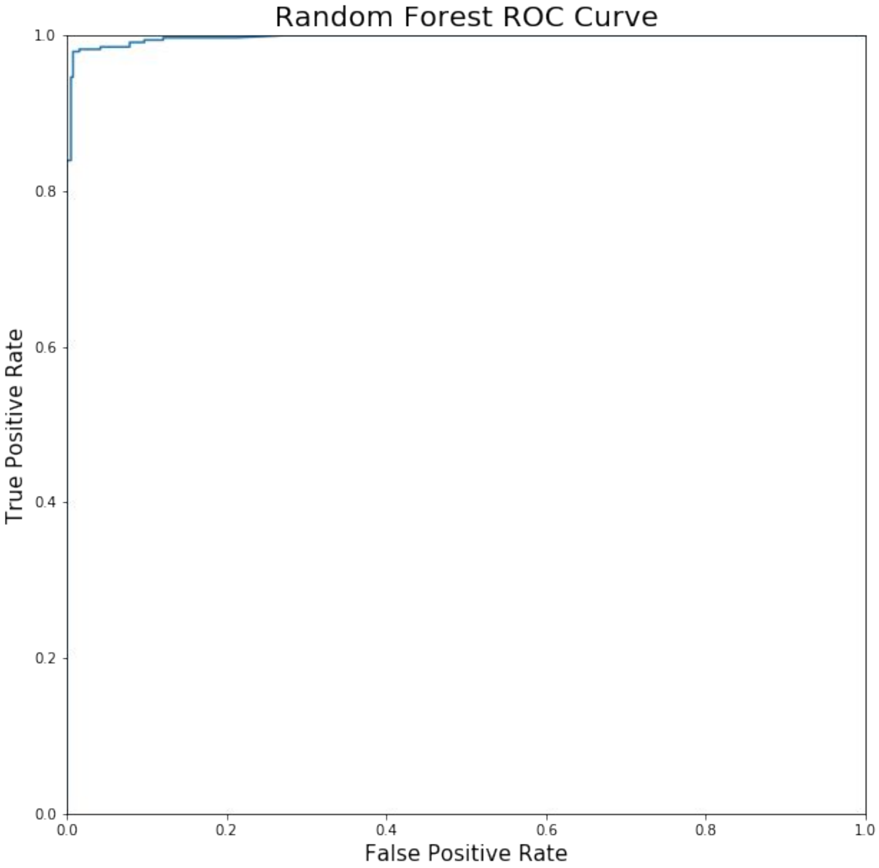
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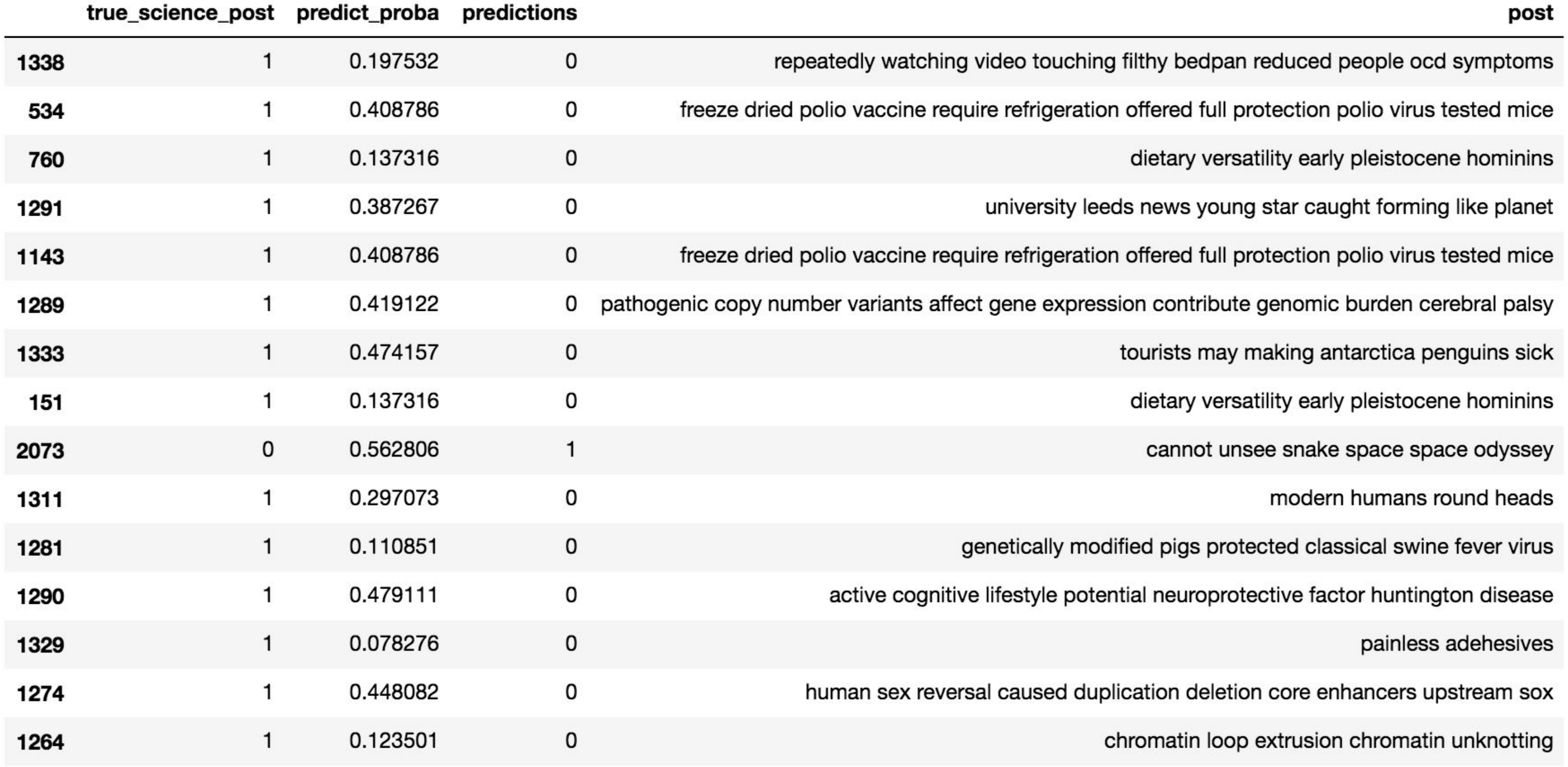

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