Detecting Political Bias in News Articles through Convolutional and Recurrent Neural Networks
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Abstract
The aim of this project is to determine effective deep learning models to detect political bias in news articles. We developed two different neural network models that attempt the same classification goal. The first neural network model takes a convolutional approach and the second is structured with a sequential LSTM (long short-term memory) recurrent neural network (RNN) architecture. For our LSTM RNNs, we design both bidirectional and single directional models. Each model takes in as input a series of GloVe vectors representing the article and returns an output whether the article is biased or unbiased (in the case of binary classification) or whether the article is conservative, neutral, or liberal (in the case of three-class classification).

<table>
<thead>
<tr>
<th># Articles</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York Times</td>
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<tr>
<td>Atlantic</td>
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<tr>
<td>Reuters</td>
<td>10000</td>
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<tr>
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<tr>
<td>Fox News</td>
<td>8000</td>
</tr>
<tr>
<td>Breitbart</td>
<td>7000</td>
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Data
We used a private dataset collected by our advisor, Frederic Billoux, which included thousands of articles labeled by publication with the text files included. For binary classification, we labeled these publications (and all their articles) as biased or unbiased, and for three-class classification, we labeled the publications liberal, neutral, or conservative.

Models
CNN: We trained four convolutional neural networks: one, two, three, and four layer convolutional networks. Each of these four CNNs was trained to perform both binary and three-class classification. Our first layer (after the initial embedding layer used to obtain GloVe vectors) in each CNN was a 1D convolution, followed by a 1D max-pooling layer. This convolution-pooling sequence was repeated for each layer in the CNNs with multiple layers. At the end of each CNN, there was a fully connected (or dense) layer with a ReLu activation, finally followed by a Sigmoid activation (in the case of binary classification) or Softmax (in the case of three-class classification).

LSTM RNN: We trained two sets of three RNNs. Each set contains one, two, and three layer recurrent networks; the first set contains bidirectional layers (which allow for the model to have both backward and forward information at every step) while the second set contains single directional layers. Each of these RNNs was trained to perform both binary and three-class classification. For each sequential layer in the RNN, we implemented dropout regularization. Each RNN ended with one fully connected layer, and then finally an activation function: either Sigmoid or Softmax.

Results
Data Split: Training set included 52282 articles, validation set included 13663 articles, and test set included 19106 articles.

Future
In the future, we hope to explore nuances beyond simple classification of conservative and liberal, instead performing regression to determine spectrums of economic left/right and political authoritarianism/libertarianism, plotting each article on a continuous 2D Cartesian plane.

References
François Chollet et al. Keras. https://keras.io, 2015.