# Evaluating neural network explanation methods using hybrid documents and morphosyntactic agreement (supplementary material) 

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## 1 Corpora and data preprocessing

The 20 newsgroups corpus (Lang, 1995) was downloaded using the Python sklearn package (Pedregosa et al., 2011), removing all headers, footers and quotes. The corpus contains 18,846 posts and comes with a training and test set. We randomly split the latter into a heldout and a test set.

For sentiment analysis we use the Pennsylvania subset of the 10th yelp dataset challenge ${ }^{1}$. It contains 206,338 reviews with 1 to 5 star ratings. 1 or 2 stars are mapped to "negative", 4 or 5 stars to "positive", 3 star reviews are discarded. We randomly split the data into training, heldout and test sets $(90 \% / 5 \% / 5 \%)$. On both corpora, we use NLTK (Bird et al., 2009) for word and sentence tokenization. Words with a frequency rank above 50000 are mapped to oov. To create hybrid documents, we sentence-tokenize the test sets, shuffle, and then concatenate ten sentences at a time.

The manually annotated 20 newsgroups documents were obtained from Mohseni and Ragan (2018) ${ }^{2}$. The relevance ground truth consists of one list of lowercased word types per document. There are a number of mismatches between the ground truth and the documents (e.g., one list contains rays but its document only contains $x$-rays). This made some reverse engineering necessary: Given $\mathbf{X}$ and its list, we add $t$ to $\operatorname{gt}(\mathbf{X})$ if lower-cased $x_{t}$ is a prefix or suffix of at least one word type in the list.

For the morphosyntactic agreement experiment, we use Linzen et al. (2016)'s corpus of 1,577,211 English Wikipedia sentences with automatic morphosyntactic annotation ${ }^{3}$. We replicate the original dataset sizes ( $9 \%$ train, $1 \%$ heldout, $90 \%$ test). Like in the original corpus, words with a frequency rank above 10,000 are replaced by their part-of-speech tag.

## 2 Neural networks

Every neural network used in our paper is made up of a word embedding matrix, followed by a core layer, followed by a fully-connected layer with softmax activation.

In the hybrid document experiment, the $|V| \times 300$ embedding matrix is initialized with GloVe embeddings (Pennington et al., 2014) ${ }^{4}$, which are fine-tuned during training. The core layer is a bidirectional Gated Recurrent Unit (GRU, Cho et al. (2014)), bidirectional Long-Short Term Memory Network (LSTM, Hochreiter and Schmidhuber (1997)), bidirectional Quasi-GRU or Quasi-LSTM (Bradbury et al., 2017), or a 1D Convolutional Neural Network (CNN) with global max

[^0]pooling (Collobert et al., 2011). In all cases, the core layer has a hidden size of 150 (bidirectional architectures: 75 per direction), for QRNNs and CNN, we use a kernel width of 5 . For regularization, we use $50 \%$ dropout between layers and on hidden-to-hidden connections (GRU/LSTM only).

We minimize categorical crossentropy using Adam (Kingma and $\mathrm{Ba}, 2015$ ), with learning rate $0.001, \beta_{1}=0.9$, $\beta_{2}=0.999$ and batch size 8 . Heldout accuracy is monitored; after two stagnant epochs, the learning rate is halved, and after 5 (yelp), resp. 25 ( 20 newsgroups), stagnant epochs, training is stopped and the model from the best epoch is stored. Final test set accuracies are .964/.954/.965/.959/.957 on yelp and $.727 / .716 / .730 / .735 / .705$ on 20 newsgroups (GRU/QGRU/LSTM/QLSTM/CNN).

In the morphosyntactic agreement experiment, the $|V| \times$ 50 embedding matrix is randomly initialized. All (Q)RNNs are unidirectional and have a hidden size of 50. QRNN kernel width is 5 . The core layer is followed by a fully connected $50 \times 2$ layer with softmax activation. We minimize categorical crossentropy using Adam (see above), with early stopping after 20 epochs based on heldout accuracy, and a batch size of 16. Final test set accuracies are .991/.985/.990/.986 (GRU/QGRU/LSTM/QLSTM). Contrary to Linzen et al. (2016), we do not train an ensemble.

### 2.1 GRU

$$
\begin{aligned}
\vec{h}_{0} & =0 \\
\vec{z}_{t} & =\sigma\left(\mathbf{V}_{\mathbf{z}} \vec{e}_{t}+\mathbf{U}_{\mathbf{z}} \vec{h}_{t-1}+\vec{b}_{z}\right) \\
\vec{r}_{t} & =\sigma\left(\mathbf{V}_{\mathbf{r}} \vec{e}_{t}+\mathbf{U}_{\mathbf{r}} \vec{h}_{t-1}+\vec{b}_{r}\right) \\
\vec{g}^{\prime}{ }_{t} & =\mathbf{V} \vec{e}_{t}+\mathbf{U}\left(\vec{r}_{t} \odot \vec{h}_{t-1}\right)+\vec{b} \\
\vec{g}_{t} & =\tanh \left({\overrightarrow{g^{\prime}}}_{t}\right) \\
\vec{h}_{t} & =\vec{z}_{t} \odot \vec{h}_{t-1}+\left(\overrightarrow{1}-\vec{z}_{t}\right) \odot \vec{g}_{t}
\end{aligned}
$$

### 2.2 QGRU

$$
\begin{aligned}
\mathbf{Z} & =\sigma\left(\mathbf{V}_{\mathbf{z}} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b}_{z}\right) \\
\mathbf{G}^{\prime} & =\mathbf{V} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b} \\
\mathbf{G} & =\tanh \left(\mathbf{G}^{\prime}\right) \\
\vec{h}_{0} & =0 \\
\vec{h}_{t} & =\vec{z}_{t} \odot \vec{h}_{t-1}+\left(1-\vec{z}_{t}\right) \odot \vec{g}_{t}
\end{aligned}
$$

### 2.3 LSTM

$$
\begin{aligned}
\vec{c}_{0} & =\vec{h}_{0}=0 \\
\vec{i}_{t} & =\sigma\left(\mathbf{V}_{\mathbf{i}} \vec{e}_{t}+\mathbf{U}_{\mathbf{i}} \vec{h}_{t-1}+\vec{b}_{i}\right) \\
\vec{f}_{t} & =\sigma\left(\mathbf{V}_{\mathbf{f}} \vec{e}_{t}+\mathbf{U}_{\mathbf{f}} \vec{h}_{t-1}+\vec{b}_{f}\right) \\
\vec{o}_{t} & =\sigma\left(\mathbf{V}_{\mathbf{o}} \vec{e}_{t}+\mathbf{U}_{\mathbf{o}} \vec{h}_{t-1}+\vec{b}_{o}\right) \\
{\overrightarrow{g^{\prime}}}_{t} & =\mathbf{V} \vec{e}_{t}+\mathbf{U} \vec{h}_{t-1}+\vec{b} \\
\vec{g}_{t} & =\tanh \left({\overrightarrow{g^{\prime}}}_{t}\right) \\
\vec{c}_{t} & =\vec{f}_{t} \odot \vec{c}_{t-1}+\vec{i}_{t} \odot \vec{g}_{t} \\
\vec{h}_{t} & =\vec{o}_{t} \odot \tanh \left(\vec{c}_{t}\right)
\end{aligned}
$$

### 2.4 QLSTM

$$
\begin{aligned}
\mathbf{I} & =\sigma\left(\mathbf{V}_{\mathbf{i}} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b}_{i}\right) \\
\mathbf{F} & =\sigma\left(\mathbf{V}_{\mathbf{f}} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b}_{f}\right) \\
\mathbf{O} & =\sigma\left(\mathbf{V}_{\mathbf{o}} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b}_{o}\right) \\
\mathbf{G}^{\prime} & =\mathbf{V} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T}\right]+\vec{b} \\
\mathbf{G} & =\tanh \left(\mathbf{G}^{\prime}\right) \\
\vec{h}_{0} & =\vec{c}_{0}=0 \\
\vec{c}_{t} & =\vec{f}_{t} \odot \vec{c}_{t-1}+\vec{i}_{t} \odot \vec{g}_{t} \\
\vec{h}_{t} & =\vec{o}_{t} \odot \tanh \left(\vec{c}_{t}\right)
\end{aligned}
$$

### 2.5 CNN

$$
\begin{aligned}
\mathbf{G}^{\prime} & =\mathbf{V} \star\left[0 \ldots \vec{e}_{1} \ldots \vec{e}_{T} \ldots 0\right]+\vec{b} \\
\mathbf{G} & =\operatorname{relu}\left(\mathbf{G}^{\prime}\right) \\
h_{d} & =\max _{t}\left(g_{t, d}\right)
\end{aligned}
$$

## 3 RGB coding in examples

$$
\begin{aligned}
\phi^{\prime}(t, k, \mathbf{X}) & =\frac{\phi(t, k, \mathbf{X})}{\max _{t^{\prime}}\left(1.1\left|\phi\left(t^{\prime}, k, \mathbf{X}\right)\right|\right)} \\
R(t, k, \mathbf{X}) & =\phi^{\prime}(t, k, \mathbf{X}) \mathbb{I}[\phi(t, k, \mathbf{X})<0] \\
G(t, k, \mathbf{X}) & =\phi^{\prime}(t, k, \mathbf{X}) \mathbb{I}[\phi(t, k, \mathbf{X})>0] \\
B(t, k, \mathbf{X}) & =0
\end{aligned}
$$

## 4 Epsilon LRP and DeepLIFT

In the following, we assume that the hidden layer relevance vector $R(\vec{h})$ (resp. $R\left(\vec{h}_{T}\right)$ ) has been backpropagated by the upstream fully connected layer using equations from Sections 3.2 and 3.3 (main paper). DeepLIFT can be derived by replacing $h, g, g^{\prime}, e, c$ with $h-\bar{h}, g-\bar{g}, g^{\prime}-\bar{g}^{\prime}, e-\bar{e}, c-\bar{c}$. F is CNN / QRNN kernel width.

### 4.1 GRU

$$
\begin{aligned}
R\left(g_{t, d}\right) & =R\left(h_{t, d}\right) \frac{g_{t, d} \cdot\left(1-z_{t, d}\right)}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
R\left(e_{t, d}\right) & =\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} R\left(g_{t, j}\right) \frac{e_{t, d} \cdot v_{d, j}}{g_{t, j}^{\prime}+\operatorname{esign}\left(g_{t, j}^{\prime}\right)} \\
R\left(h_{t-1, d}\right) & =R\left(h_{t, d}\right) \frac{h_{t-1, d} \cdot z_{t, d}}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
& +\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} R\left(g_{t, j}\right) \frac{h_{t-1, d} \cdot r_{t, d} \cdot u_{d, j}}{g_{t, j}^{\prime}+\operatorname{esign}\left(g_{t, j}^{\prime}\right)}
\end{aligned}
$$

### 4.2 QGRU

$$
\begin{aligned}
R\left(g_{t, d}\right) & =R\left(h_{t, d}\right) \frac{g_{t, d} \cdot\left(1-z_{t, d}\right)}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
R\left(h_{t-1, d}\right) & =R\left(h_{t, d}\right) \frac{h_{t-1, d} \cdot z_{t, d}}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
R\left(e_{t, d}\right) & =\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} \sum_{k=0}^{F-1} R\left(g_{t+k, j}\right) \frac{e_{t, d} \cdot v_{k, d, j}}{g_{t+k, j}^{\prime}+\operatorname{esign}\left(g_{t+k, j}^{\prime}\right)}
\end{aligned}
$$

### 4.3 LSTM

$$
\begin{aligned}
R\left(c_{T+1, d}\right) & =0 \\
R\left(c_{t, d}\right) & =R\left(h_{t, d}\right) \frac{\tanh \left(c_{t, d}\right) \cdot o_{t, d}}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
& +R\left(c_{t+1, d}\right) \frac{c_{t, d} \cdot f_{t+1, d}}{c_{t+1, d}+\operatorname{esign}\left(c_{t+1, d}\right)} \\
R\left(g_{t, d}\right) & =R\left(c_{t, d}\right) \frac{g_{t, d} \cdot i_{t, d}}{c_{t, d}+\operatorname{esign}\left(c_{t, d}\right)} \\
R\left(e_{t, d}\right) & =\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} R\left(g_{t, j}\right) \frac{e_{t, d} \cdot v_{d, j}}{g_{t, j}^{\prime}+\operatorname{esign}\left(g_{t, j}^{\prime}\right)} \\
R\left(h_{t-1, d}\right) & =\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} R\left(g_{t, j}\right) \frac{h_{t-1, d} \cdot u_{d, j}}{g_{t, j}^{\prime}+\operatorname{esign}\left(g_{t, j}^{\prime}\right)}
\end{aligned}
$$

### 4.4 QLSTM

$$
\begin{aligned}
R\left(c_{T+1, d}\right) & =0 \\
R\left(c_{t, d}\right) & =R\left(h_{t, d}\right) \frac{\tanh \left(c_{t, d}\right) \cdot o_{t, d}}{h_{t, d}+\operatorname{esign}\left(h_{t, d}\right)} \\
& +R\left(c_{t+1, d}\right) \frac{c_{t, d} \cdot f_{t+1, d}}{c_{t+1, d}+\operatorname{esign}\left(c_{t+1, d}\right)} \\
R\left(g_{t, d}\right) & =R\left(c_{t, d}\right) \frac{g_{t, d} \cdot i_{t, d}}{c_{t, d}+\operatorname{esign}\left(c_{t, d}\right)} \\
R\left(e_{t, d}\right) & =\sum_{j=1}^{\operatorname{dim}\left(\vec{g}_{t}\right)} \sum_{k=0}^{F-1} R\left(g_{t+k, j}\right) \frac{e_{t, d} \cdot v_{k, d, j}}{g_{t+k, j}^{\prime}+\operatorname{esign}\left(g_{t+k, j}^{\prime}\right)}
\end{aligned}
$$

### 4.5 CNN

$$
\begin{aligned}
F^{\prime} & =\frac{F-1}{2} \\
R\left(g_{t, d}\right) & =R\left(h_{d}\right) \cdot \mathbb{I}\left[\operatorname{argmax}_{t^{\prime}}\left(g_{t^{\prime}, d}\right)=t\right] \\
R\left(e_{t, d}\right) & =\sum_{j=1}^{\operatorname{dim}(\vec{g})} \sum_{k=-F^{\prime}}^{F^{\prime}} R\left(g_{t+k, j}\right) \frac{e_{t, d} \cdot v_{k, d, j}}{g_{t+k, j}^{\prime}+\operatorname{esign}\left(g_{t+k, j}^{\prime}\right)}
\end{aligned}
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| $\mathrm{occ}_{3}$ | few if any events in history [are ...] |  | occ $_{3}$ | the link provided by the editor above [gives ...] |
| $\mathrm{occ}_{7}$ | few if any events in history [are ...] |  | $\mathrm{occ}_{7}$ | the link provided by the editor above [gives ...] |
| decomp | few if any events in history [are ...] |  | decomp | the link provided by the editor above [gives ...] |
| $\operatorname{lrp}$ | few if any events in history [are ...] |  | $\operatorname{lrp}$ | the link provided by the editor above [gives ...] |
| deeplift | few if any events in history [are ...] |  | deeplift | the link provided by the editor above [gives ...] |
| limsse ${ }^{\text {bb }}$ | few if any events in history [are ...] |  | limsse ${ }^{\text {bb }}$ | the link provided by the editor above [gives ...] |
| limsse ${ }_{\text {ms }}$ | few if any events in history [are ...] |  | limsse ${ }_{\text {ms }}$ | the link provided by the editor above [gives ...] |
| limsse ${ }_{p}^{\text {ms }}$ | few if any events in history [are ...] |  | limsse ${ }_{p}^{\text {ms }}$ | the link provided by the editor above [gives ...] |

Figure 1: Verb context classified plural. Green (resp. red): evidence for (resp. against) the prediction. Underlined: subject. Bold: rmax position.

Figure 2: Verb context classified singular. Green (resp. red): evidence for (resp. against) the prediction. Underlined: subject. Bold: rmax position.

| $\operatorname{grad}_{1 s}^{\mathrm{L} 2}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| :---: | :---: |
| $\operatorname{grad}_{1 p}^{\mathrm{L} 2}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{f_{s}^{\mathrm{L}} 2}^{1 p}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int}^{\mathrm{L} 2} p$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{1 s}^{\text {dot }}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{1 p}^{\text {dot }}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int}^{\text {dot }}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int p}^{\text {dot }}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| omit $_{1}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{omit}_{3}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| omit $_{7}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{1}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{3}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{7}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| decomp | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{lr} p$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| deeplift | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| limsse ${ }^{\text {bb }}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| limsse ${ }_{s}^{\text {ms }}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| limsse ${ }_{p}^{\mathrm{ms}}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{1 s}^{\mathrm{LL}}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{1 p}^{\mathrm{L} 2}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int s}^{\mathrm{L} 2}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int}^{\mathrm{L} 2} p$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{grad}_{1 s}^{\text {dot }}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{1 p}^{\text {dot }}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int s}^{\mathrm{dot}}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{grad}_{\int p}^{\mathrm{dot}}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| omit $_{1}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| omit $_{3}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| omit $_{7}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{1}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{3}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\mathrm{occ}_{7}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| decomp | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{lr} p$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| deeplift | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| limsse ${ }^{\text {bb }}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| $\operatorname{limsse}_{s}^{\mathrm{ms}}$ | $i$ like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |
| limsse ${ }_{p}^{\mathrm{ms}}$ | i like the fact that there is n't an editor making news decisions, that nearly any news story published [has ...] |

Figure 3: Verb context classified singular by GRU and plural by QLSTM. Green (resp. red): evidence for (resp. against) the prediction. Underlined: subject. Bold: rmax position.

| From : kolstad @ cae.wisc.edu ( Joel Kolstad ) Subject : Re : Can Radio Freq. Be Used To Measure Distance ? Organization : U of Wisconsin-Madison |  |
| :--- | :--- |
|  | College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tge @ otter.hpl.hp.com ( Tom Gardner ) writes : > What is the difference |
| between vertical and horizontal ? Gravity ? Does n't gravity pull down the photons and cause a doppler shift or something ? ( Just kidding ! ) |  |

Figure 4: sci.electronics post (not hybrid). Underlined: Manual relevance ground truth. Green (resp. red): evidence for (resp. against) sci.electronics. Task method: CNN. Italics: OOV. Bold: rmax position.

| （en | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary． |
| :---: | :---: |
| No | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion ，and my existence ，if necessary ． |
|  | From ：chorley＠vms．ocom．okstate．edu Subject：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
| 近 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary ． |
| 第 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
|  | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
| 烒 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
| 㑕 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary ． |
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| $\stackrel{\text { m }}{\substack{\text { and }}}$ | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
| N | From ：chorley＠vms．ocom．okstate．edu Subject：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organization ：OSU College of Osteopathic Medicine This question derives from the Waco incident：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children ．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
| Ü | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary ． |
| ¢000 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence，if necessary ． |
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| $\stackrel{\square}{\square}$ | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary ． |
| 出 | From ：chorley＠vms．ocom．okstate．edu Subject ：CS＂gas＂and allergic response－Ques ．Lines ： 6 Nntp－Posting－Host ：vms．ocom．okstate．edu Organi－ zation ：OSU College of Osteopathic Medicine This question derives from the Waco incident ：Could CS（＂gas＂）particles create an allergic response which would result in laryngospasm and asphyxiation ？－especially in children．DNC in Ok．OSU－COM will disavow my opinion，and my existence ，if necessary ． |
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Figure 5：sci．med post（not hybrid）．Underlined：Manual relevance ground truth．Green（resp．red）： evidence for（resp．against）sci．med．Task method：GRU．Italics：OOV．Bold：rmax position．
If you find faith to be honest, show me how . David The whole denominational mindset only causes more problems, sadly . (See section 7 for details ) Thank you. 'The Armenians just shot and shot . Maybe coz they 're 'quality' cars ; - ) 200 posts/day . can you explain this or is it that they usually talk to stars more than regular players which explains the hight percentage of results after. It was produced in collaboration with the American College of Surgeons Commission on Cancer .
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Figure 6: Hybrid newsgroup post, classified talk.politics.mideast. Green (resp. red): evidence for (resp. against) talk.politics.mideast. Underlined: talk.politics.mideast fragment. Italics: OOV. Task method:
QGRU. Bold: rmax position.

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Figure 7: Hybrid newsgroup post, classified comp.windows.x. Green (resp. red): evidence for (resp. against) comp.windows.x. Underlined: comp.windows.x fragment. Italics: OOV. Task method: LSTM. Bold: rmax position. The telephone numbers in the last sentence appear in 3 comp.windows.x posts but nowhere else in the corpus.
Sorry for any confusion I may have created. Jon Mandaville, Professor of History , Portland State University (Oregon ). Trying to mix up the lines is a dead end . matter of proving the track record of the \# scientific method. - I know that I will have to pay tax when I go to register the car. It sounds like he has had another set back in his come back. Oh, and a prediction : Milt Cuyler. The Xaw support was missing from OW2.0 but added in 3.0 . This slant permeates the text.
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Figure 8: Hybrid newsgroup post, classified comp.windows.x. Green (resp. red): evidence for (resp. against) comp.windows.x. Underlined: comp.windows.x fragment. Italics: OOV. Task method: QLSTM. Bold: rmax position.

| 0 | That should have been a flag for me for when I came in. Service was excellent and food very good. This was a disaster, and Penn Avenue Fish Company was responsible. Very clean = Did n't see that coming. Always a pleasure : I really felt like I had wasted $\$ 25$. Will always go back Check them out on Beer Advocate. Friendly staff : |
| :---: | :---: |
| N1\% | That should have been a flag for me for when I came in. Service was excellent and food very good. This was a disaster, and Penn Avenue Fish Company was responsible. Very clean : Did n't see that coming. Always a pleasure : I really felt like I had wasted $\$ 25$. Will always go back Check them out on Beer Advocate : Friendly staff . |
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Figure 9: Hybrid yelp review, classified positive. Green (resp. red): evidence for (resp. against) positive. Underlined: positive fragments. Italics: OOV. Task method: GRU. Bold: rmax position.
When we went to pay we handing the guy the card and our payment , he checked us out and handed back our payment $\underline{\text { after we got our food our waitress }}$, went M.I.A. The room was good size $:!$ ) The waitresses need to work on their skills a little more. This place is terrible $:!$ We will not be back : Luckily I do eat salmon, so I headed to the smoked salmon station. One of the few places where you can find good Italian food.
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Figure 10: Hybrid yelp review, classified negative. Green (resp. red): evidence for (resp. against) negative. Underlined: negative fragments. Italics: OOV. Task method: LSTM. Bold: rmax position.

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[^0]:    ${ }^{1}$ www.yelp.com/dataset_challenge
    ${ }^{2}$ http://github.com/SinaMohseni/ ML-Interpretability-Evaluation-Benchmark
    ${ }^{3}$ www.tallinzen.net/media/rnn_ agreement/agr_50_mostcommon_10K.tsv.gz
    ${ }^{4}$ http://nlp.stanford.edu/data/glove. 840B.300d.zip

