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 challenge¹. 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 **X** and its list, we add *t* to gt(**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 annotation³. 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 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 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 50×2 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

$$\vec{h}_0 = 0$$

$$\vec{z}_t = \sigma(\mathbf{V}_{\mathbf{z}}\vec{e}_t + \mathbf{U}_{\mathbf{z}}\vec{h}_{t-1} + \vec{b}_z)$$

$$\vec{r}_t = \sigma(\mathbf{V}_{\mathbf{r}}\vec{e}_t + \mathbf{U}_{\mathbf{r}}\vec{h}_{t-1} + \vec{b}_r)$$

$$\vec{g'}_t = \mathbf{V}\vec{e}_t + \mathbf{U}(\vec{r}_t \odot \vec{h}_{t-1}) + \vec{b}$$

$$\vec{g}_t = \tanh(\vec{g'}_t)$$

$$\vec{h}_t = \vec{z}_t \odot \vec{h}_{t-1} + (\vec{1} - \vec{z}_t) \odot \vec{g}_t$$

2.2 QGRU

$$\mathbf{Z} = \sigma(\mathbf{V}_{\mathbf{z}} \star [0 \dots \vec{e}_1 \dots \vec{e}_T] + \vec{b}_z)$$
$$\mathbf{G}' = \mathbf{V} \star [0 \dots \vec{e}_1 \dots \vec{e}_T] + \vec{b}$$
$$\mathbf{G} = \tanh(\mathbf{G}')$$
$$\vec{h}_0 = 0$$
$$\vec{h}_t = \vec{z}_t \odot \vec{h}_{t-1} + (1 - \vec{z}_t) \odot \vec{q}_t$$

¹www.yelp.com/dataset_challenge

²http://github.com/SinaMohseni/

ML-Interpretability-Evaluation-Benchmark ³www.tallinzen.net/media/rnn_

agreement/agr_50_mostcommon_10K.tsv.gz
 ⁴http://nlp.stanford.edu/data/glove.
840B.300d.zip

2.3 LSTM

$$\begin{aligned} \vec{c}_0 &= \vec{h}_0 = 0\\ \vec{i}_t &= \sigma(\mathbf{V}_i \vec{e}_t + \mathbf{U}_i \vec{h}_{t-1} + \vec{b}_i)\\ \vec{f}_t &= \sigma(\mathbf{V}_f \vec{e}_t + \mathbf{U}_f \vec{h}_{t-1} + \vec{b}_f)\\ \vec{o}_t &= \sigma(\mathbf{V}_o \vec{e}_t + \mathbf{U}_o \vec{h}_{t-1} + \vec{b}_o)\\ \vec{g'}_t &= \mathbf{V} \vec{e}_t + \mathbf{U} \vec{h}_{t-1} + \vec{b}\\ \vec{g}_t &= \tanh(\vec{g'}_t)\\ \vec{c}_t &= \vec{f}_t \odot \vec{c}_{t-1} + \vec{i}_t \odot \vec{g}_t\\ \vec{h}_t &= \vec{o}_t \odot \tanh(\vec{c}_t) \end{aligned}$$

2.4 QLSTM

$$\mathbf{I} = \sigma(\mathbf{V}_{i} \star [0 \dots \vec{e}_{1} \dots \vec{e}_{T}] + \vec{b}_{i})$$
$$\mathbf{F} = \sigma(\mathbf{V}_{f} \star [0 \dots \vec{e}_{1} \dots \vec{e}_{T}] + \vec{b}_{f})$$
$$\mathbf{O} = \sigma(\mathbf{V}_{o} \star [0 \dots \vec{e}_{1} \dots \vec{e}_{T}] + \vec{b}_{o})$$
$$\mathbf{G}' = \mathbf{V} \star [0 \dots \vec{e}_{1} \dots \vec{e}_{T}] + \vec{b}$$
$$\mathbf{G} = \tanh(\mathbf{G}')$$
$$\vec{h}_{0} = \vec{c}_{0} = 0$$
$$\vec{c}_{t} = \vec{f}_{t} \odot \vec{c}_{t-1} + \vec{i}_{t} \odot \vec{g}_{t}$$
$$\vec{h}_{t} = \vec{o}_{t} \odot \tanh(\vec{c}_{t})$$

2.5 CNN

$$\mathbf{G}' = \mathbf{V} \star [0 \dots \vec{e_1} \dots \vec{e_T} \dots 0] + \vec{b}$$
$$\mathbf{G} = \operatorname{relu}(\mathbf{G}')$$
$$h_d = \max_t(g_{t,d})$$

3 RGB coding in examples

$$\phi'(t, k, \mathbf{X}) = \frac{\phi(t, k, \mathbf{X})}{\max_{t'}(1.1|\phi(t', k, \mathbf{X})|)}$$
$$R(t, k, \mathbf{X}) = \phi'(t, k, \mathbf{X})\mathbb{I}[\phi(t, k, \mathbf{X}) < 0]$$
$$G(t, k, \mathbf{X}) = \phi'(t, k, \mathbf{X})\mathbb{I}[\phi(t, k, \mathbf{X}) > 0]$$
$$B(t, k, \mathbf{X}) = 0$$

4 Epsilon LRP and DeepLIFT

In the following, we assume that the hidden layer relevance vector $R(\vec{h})$ (resp. $R(\vec{h}_T)$) 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', e, c with $h - \bar{h}, g - \bar{g}, g' - \bar{g}', e - \bar{e}, c - \bar{c}$. F is CNN / QRNN kernel width.

4.1 GRU

$$R(g_{t,d}) = R(h_{t,d}) \frac{g_{t,d} \cdot (1 - z_{t,d})}{h_{t,d} + \operatorname{esign}(h_{t,d})}$$
$$R(e_{t,d}) = \sum_{j=1}^{\dim(\vec{g}_t)} R(g_{t,j}) \frac{e_{t,d} \cdot v_{d,j}}{g'_{t,j} + \operatorname{esign}(g'_{t,j})}$$
$$R(h_{t-1,d}) = R(h_{t,d}) \frac{h_{t-1,d} \cdot z_{t,d}}{h_{t,d} + \operatorname{esign}(h_{t,d})}$$
$$+ \sum_{j=1}^{\dim(\vec{g}_t)} R(g_{t,j}) \frac{h_{t-1,d} \cdot r_{t,d} \cdot u_{d,j}}{g'_{t,j} + \operatorname{esign}(g'_{t,j})}$$

4.2 **QGRU**

$$R(g_{t,d}) = R(h_{t,d}) \frac{g_{t,d} \cdot (1 - z_{t,d})}{h_{t,d} + \operatorname{esign}(h_{t,d})}$$
$$R(h_{t-1,d}) = R(h_{t,d}) \frac{h_{t-1,d} \cdot z_{t,d}}{h_{t,d} + \operatorname{esign}(h_{t,d})}$$
$$R(e_{t,d}) = \sum_{j=1}^{\dim(\vec{g}_t)} \sum_{k=0}^{F-1} R(g_{t+k,j}) \frac{e_{t,d} \cdot v_{k,d,j}}{g'_{t+k,j} + \operatorname{esign}(g'_{t+k,j})}$$

4.3 LSTM

$$R(c_{t+1,d}) = 0$$

$$R(c_{t,d}) = R(h_{t,d}) \frac{\tanh(c_{t,d}) \cdot o_{t,d}}{h_{t,d} + \operatorname{esign}(h_{t,d})}$$

$$+ R(c_{t+1,d}) \frac{c_{t,d} \cdot f_{t+1,d}}{c_{t+1,d} + \operatorname{esign}(c_{t+1,d})}$$

$$R(g_{t,d}) = R(c_{t,d}) \frac{g_{t,d} \cdot i_{t,d}}{c_{t,d} + \operatorname{esign}(c_{t,d})}$$

$$R(e_{t,d}) = \sum_{j=1}^{\dim(\tilde{g}_t)} R(g_{t,j}) \frac{e_{t,d} \cdot v_{d,j}}{g'_{t,j} + \operatorname{esign}(g'_{t,j})}$$

$$R(h_{t-1,d}) = \sum_{j=1}^{\dim(\tilde{g}_t)} R(g_{t,j}) \frac{h_{t-1,d} \cdot u_{d,j}}{g'_{t,j} + \operatorname{esign}(g'_{t,j})}$$

4.4 QLSTM

$$\begin{aligned} R(c_{t+1,d}) &= 0\\ R(c_{t,d}) &= R(h_{t,d}) \frac{\tanh(c_{t,d}) \cdot o_{t,d}}{h_{t,d} + \operatorname{esign}(h_{t,d})} \\ &+ R(c_{t+1,d}) \frac{c_{t,d} \cdot f_{t+1,d}}{c_{t+1,d} + \operatorname{esign}(c_{t+1,d})}\\ R(g_{t,d}) &= R(c_{t,d}) \frac{g_{t,d} \cdot i_{t,d}}{c_{t,d} + \operatorname{esign}(c_{t,d})}\\ R(e_{t,d}) &= \sum_{j=1}^{\dim(\vec{g}_t)} \sum_{k=0}^{F-1} R(g_{t+k,j}) \frac{e_{t,d} \cdot v_{k,d,j}}{g'_{t+k,j} + \operatorname{esign}(g'_{t+k,j})} \end{aligned}$$

4.5 CNN

$$\begin{split} F' &= \frac{F-1}{2} \\ R(g_{t,d}) &= R(h_d) \cdot \mathbb{I}[\operatorname{argmax}_{t'}(g_{t',d}) = t] \\ R(e_{t,d}) &= \sum_{j=1}^{\dim(\vec{g})} \sum_{k=-F'}^{F'} R(g_{t+k,j}) \frac{e_{t,d} \cdot v_{k,d,j}}{g'_{t+k,j} + \operatorname{esign}(g'_{t+k,j})} \end{split}$$

$\operatorname{grad}_{1s}^{L2}$	few if any events in history [are]	
$\operatorname{grad}_{1p}^{L2}$ $\operatorname{grad}_{\int s}^{L2}$	few if any events in history [are]	
$\operatorname{grad}_{\int s}^{L_2}$	few if any events in history [are]	
$\operatorname{grad}_{\int p}^{L_2}$	few if any events in history [are]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$	few if any events in history [are]	
$\operatorname{grad}_{\int p}^{L2}$ $\operatorname{grad}_{1s}^{\operatorname{dot}}$ $\operatorname{grad}_{1p}^{\operatorname{dot}}$	few if any events in history [are]	
grad	few if any events in history [are]	
$\operatorname{grad}_{\int p}^{\operatorname{dot}}$	few if any events in history [are]	iRU
omit_1	few if any events in history [are]	9
omit ₃ omit ₇	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
occ1	few if any events in history [are]	
occ3	few if any events in history [are]	
occ7 decomp	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
lrp	few if any events in history [are]	
deeplift	few if any events in history [are]	
$limsse^{bb}$ $limsse^{ms}_{s}$	few if any events in history [are]	
limeso ^{ms}	few if any events in history [are] few if any events in history [are]	
and L2	few if any events in history [are]	
	few if any events in history [are]	
$\operatorname{grad}_{1p}^{1p}$ $\operatorname{grad}_{\int s}^{L2}$	few if any events in history [are]	
grad ¹	few if any events in history [are]	
$\operatorname{grad}_{1s}^{f} p$ $\operatorname{grad}_{1s}^{dot}$ $\operatorname{grad}_{1p}^{dot}$	few if any events in history [are]	
$\operatorname{grad}_{1n}^{\operatorname{dot}}$	few if any events in history [are]	
grad	few if any events in history [are]	
$\operatorname{grad}_{\int p}^{\int s}$	few if any events in history [are]	RU
mit_1	few if any events in history [are]	QG
omit ₃	few if any events in history [are]	
omit ₇	few if any events in history [are]	
occ ₁ occ ₃	few if any events in history [are] few if any events in history [are]	
occ7	few if any events in history [are]	
decomp	few if any events in history [are]	
lrp deeplift	few if any events in history [are] few if any events in history [are]	
limsse ^{bb}	few if any events in history [are]	
$limsse_{s}^{ms}$	few if any events in history [are]	
$\frac{\text{limsse}_{p}^{s}}{\text{grad}_{1s}^{L2}}$	few if any events in history [are]	
$\operatorname{grad}_{1s}^{L2}$ $\operatorname{grad}_{1p}^{L2}$ $\operatorname{grad}_{\int s}^{L2}$	few if any events in history [are]	
grad _{1p} grad ^{L2}	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
$\operatorname{grad}_{\int s}^{\int s}$	few if any events in history [are]	
$\int p$		
$\operatorname{grad}_{1s}^{\operatorname{dot}}$ $\operatorname{grad}_{1p}^{\operatorname{dot}}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
	few if any events in history [are]	
$\operatorname{grad}_{\int s}^{\operatorname{dot}}$ $\operatorname{grad}_{\int p}^{\operatorname{dot}}$		Σ
$\inf_{\substack{grad}{p}} p$	few if any events in history [are]	
	few if any events in history [are]	LST
omit ₃	few if any events in history [are] few if any events in history [are]	LST
$_{\text{omit}_{7}}$	few if any events in history [are] few if any events in history [are]	LST
$ \text{omit}_7 $ $ \text{occ}_1 $	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	LST
$ \begin{array}{c} \operatorname{omit}_{7} \\ \operatorname{occ}_{1} \\ \operatorname{occ}_{3} \end{array} $	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are] few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	TST
$\begin{array}{c} \operatorname{omit}_7\\ \operatorname{occ}_1\\ \operatorname{occ}_3\\ \operatorname{occ}_7\\ \operatorname{decomp} \end{array}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	TST
$\begin{array}{c} \operatorname{omit}_7\\ \operatorname{occ}_1\\ \operatorname{occ}_3\\ \operatorname{occ}_7\\ \operatorname{decomp}\\ \operatorname{lrp} \end{array}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	LST
$\begin{array}{c} \operatorname{omit}_7\\ \operatorname{occ}_1\\ \operatorname{occ}_3\\ \operatorname{occ}_7\\ \operatorname{decomp}\\ \operatorname{lrp}\\ \operatorname{deeplift}\\ \operatorname{limsse}_{\operatorname{bb}} \end{array}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{leeplift} \\ \operatorname{limsse}^{\operatorname{bb}} \\ \operatorname{limsse}^{\operatorname{ms}} \end{array}$	few if any events in history [are] few if any events in history [are]	LST
$\begin{array}{c} \operatorname{omit}_7\\ \operatorname{occ}_1\\ \operatorname{occ}_3\\ \operatorname{occ}_7\\ \operatorname{decomp}\\ \operatorname{lrp}\\ \operatorname{decplift}\\ \operatorname{limsse}^{\mathrm{bb}}\\ \operatorname{limsse}^{\mathrm{ms}}\\ \operatorname{limss} \operatorname{lims} \\ \operatorname{limss} \operatorname{lims} \\ \operatorname{limss} \operatorname{lims} \\ \operatorname{limss} \operatorname{lims} \\ \operatorname{limss} \\ \operatorname$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limse}^{\mathrm{ls}} \\ \operatorname{grad}_{1s}^{\mathrm{L2}} \end{array}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	TST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limsse}^{\mathrm{ms}} \\ \operatorname{limse}^{\mathrm{ls}} \\ \operatorname{grad}_{1s}^{\mathrm{L2}} \end{array}$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	LST
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$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{12} \\ grad$	few if any events in history [are] few if any events in history [are]	
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{12} \\ grad$	few if any <u>events</u> in history [are] few if any <u>events</u> in history [are]	
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}^{bb} \\ \operatorname{limsse}^{bb} \\ \operatorname{limsse}^{bb} \\ \operatorname{limsse}^{bb} \\ \operatorname{grad}_{1p}^{L2} \\ \operatorname{grad}_{1p}^{L2} \\ \operatorname{grad}_{1p}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s$	few if any events in history [are] few if any events in history [are]	
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{ss}^{bb} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{dot} \\ \operatorname{grad}_{1p}^{dot} \\ \operatorname{grad}_{1p}^{$	few if any events in history [are] few if any events in history [are]	ILST W
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}$	few if any events in history [are] few if any events in history [are]	LST LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{p} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{1s} \\ \operatorname{grad}$	few if any events in history [are] few if any events in history [are]	QLSTM LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{p} \\ \operatorname{grad}_{1p} \\ gr$	few if any events in history [are] few if any events in history [are]	QLSTM QLSTM
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bc} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ g$	few if any events in history [are] few if any events in history [are]	QLSTM QLSTM
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{ss}^{bb} \\ \operatorname{limsse}_{ss}^{bb} \\ \operatorname{limsse}_{ss}^{bb} \\ \operatorname{limsse}_{ss}^{bb} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1s}^{L2} \\ \operatorname{grad}_{1p}^{L2} \\ \operatorname{grad}_{1p$	few if any events in history [are] few if any events in history [are]	QLSTM LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bc} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ g$	few if any events in history [are] few if any events in history [are]	QLSTM LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_p^{\operatorname{bb}} \\ \operatorname{limsse}_p^{\operatorname{bb}} \\ \operatorname{limsse}_p^{\operatorname{lrg}} \\ \operatorname{grad}_{1s}^{\operatorname{L2}} \\ \operatorname{grad}_{1s}^{\operatorname{L2}} \\ \operatorname{grad}_{1s}^{\operatorname{fg}} \\ \operatorname{grad}_{1p}^{\operatorname{fg}} \\ \operatorname{grad}_{1p}^{\operatorname{fg}} \\ \operatorname{grad}_{1p}^{\operatorname{dot}} \\ \operatorname{grad}_{1p}^{\operatorname{fg}} \\ \operatorname{grad}_{1p}^{\operatorname{dot}} \\ \operatorname{grad}_{1p}^{\operatorname{fg}} \\ \operatorname{grad}_{1p}^{\operatorname{dot}} \\ \operatorname{grad}_{1p}^{\operatorname{grad}} \\ \operatorname{grad}_{1p}^{$	few if any events in history [are] few if any events in history [are]	Drstm Crstm Crstm
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bc} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ g$	few if any events in history [are] few if any events in history [are]	OLSTM LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}^{\mathrm{hs}} \\ \operatorname{limsse}^{\mathrm{hs}} \\ \operatorname{limsse}^{\mathrm{hs}} \\ \operatorname{grad}_{1s}^{L2} \\$	few if any events in history [are] few if any events in history [are]	QLSTM LST
$\begin{array}{c} \operatorname{omit}_7 \\ \operatorname{occ}_1 \\ \operatorname{occ}_3 \\ \operatorname{occ}_7 \\ \operatorname{decomp} \\ \operatorname{lrp} \\ \operatorname{deeplift} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bb} \\ \operatorname{limsse}_{bc} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1p} \\ \operatorname{grad}_{1s} \\ g$	few if any events in history [are] few if any events in history [are]	QLSTM LST

$\operatorname{grad}_{1s}^{L2}$	the \underline{link} provided by the editor above [gives]	
$\operatorname{grad}_{1p}^{L_2}$	the link provided by the editor above [gives]	
$\operatorname{grad}_{\int s}^{L2}$	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{\int p}^{L_2^2}$	the link provided by the editor above [gives]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$	the link provided by the editor above [gives]	
$\operatorname{grad}_{1s}^{\int p}$ $\operatorname{grad}_{1s}^{\operatorname{dot}}$ $\operatorname{grad}_{1p}^{\operatorname{dot}}$	the link provided by the editor above [gives]	
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$\operatorname{grad}_{\int p}^{\operatorname{dot}}$	the link provided by the editor above [gives]	GRU
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occ7	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
decomp lrp	the link provided by the editor above [gives]	
deeplift	the link provided by the editor above [gives]	
limssebb	the <u>link</u> provided by the editor above [gives]	
$limsse_{\tilde{ms}}^{ms}$ $limsse_{p}^{\tilde{ms}}$	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
ann dL2	the link provided by the editor above [gives]	
grad ¹⁵ grad ¹² _{1p}	the link provided by the editor above [gives]	
grad ^{L2}	the link provided by the editor above [gives]	
$\operatorname{grad}_{\left(n\right) }^{rs}$	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$	the link provided by the editor above [gives]	
$\operatorname{grad}_{1p}^{\operatorname{dot}}$	the link provided by the editor above [gives]	
aradaot	the link provided by the editor above [gives]	
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	the link provided by the editor above [gives]	QGRI
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omit ₇	the link provided by the editor above [gives]	
occ1	the link provided by the editor above [gives]	
occ3 occ7	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
decomp	the link provided by the editor above [gives]	
lrp	the link provided by the editor above [gives]	
deeplift limsse ^{bb}	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
limsse	the link provided by the editor above [gives]	
$limsse_s^{ms}$ $limsse_p^{ms}$	the link provided by the editor above [gives]	
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$\operatorname{grad}_{1s}^{L2}$ $\operatorname{grad}_{1p}^{L2}$ $\operatorname{grad}_{\int s}^{L2}$	the <u>link</u> provided by the editor above [gives]	
grad f s	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{\int p}^{L2}$	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$ $\operatorname{grad}_{1p}^{\operatorname{dot}}$	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{1p}^{\operatorname{dot}}$	the <u>link</u> provided by the editor above [gives]	
$\operatorname{grad}_{\int s}^{\operatorname{dot}}$	the <u>link</u> provided by the editor above [gives]	ų
$\operatorname{grad}_{\int p}^{\operatorname{dot}}$	the <u>link</u> provided by the editor above [gives]	STN
$omit_1$	the <u>link</u> provided by the editor above [gives]	1
omit ₃ omit ₇	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
occ1	the link provided by the editor above [gives]	
occ3	the <u>link</u> provided by the editor above [gives]	
occ ₇ decomp	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
lrp	the link provided by the editor above [gives]	
deeplift	the <u>link</u> provided by the editor above [gives]	
$limsse^{bb}$ $limsse^{ms}$	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
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$\operatorname{grad}_{1s}^{L2}$ $\operatorname{grad}_{1p}^{L2}$	the link provided by the editor above [gives]	
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	the link provided by the editor above [gives]	
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$\operatorname{grad}_{1p}^{\operatorname{dot}}$	the link provided by the editor above [gives]	
grad	the link provided by the editor above [gives]	_
graddot	the link provided by the editor above [gives]	QLSTM
mit_1	the link provided by the editor above [gives]	QLS
omit ₃	the link provided by the editor above [gives]	
omit ₇ occ ₁	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
occ3	the <u>link</u> provided by the editor above [gives]	
occ7	the link provided by the editor above [gives]	
decomp	the link provided by the editor above [gives]	
decomp lrp deeplift		
decomp lrp deeplift limsse ^{bb}	the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives] the <u>link</u> provided by the editor above [gives]	
decomp lrp deeplift	the link provided by the editor above [gives] the link provided by the editor above [gives] 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.

$\operatorname{grad}_{1s}^{L2}$	i like the fact that there is n't an editor making news decisions , that nearly any news story published [has]	
$\operatorname{grad}_{1p}^{L2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int s}^{L^2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int p}^{L^2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1p}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int s}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int \mathcal{P}}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	5
omit_1^p	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	GRU
$omit_3$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	Ŭ
omit ₇	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	1
occ_1	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
occ3	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
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]	
lrp	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]	
$limsse^{bb}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$limsse_s^{ms}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$limsse_{n}^{ms}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1s}^{L^2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1p}^{L2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int s}^{\hat{L^2}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int p}^{L_2}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1s}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{1n}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{ls}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$\operatorname{grad}_{\int p}^{\operatorname{dot}}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	ΓM
$\operatorname{omit}_1^{j_r}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	QLSTM
$omit_3$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	Ø
$omit_7$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
occ_1	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
occ3	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
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]	
lrp	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]	
$limsse^{bb}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$limsse_s^{ms}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
$limsse_p^{ms}$	i like the fact that there is n't an editor making news decisions, that nearly any news story published [has]	
P		4

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.

$\operatorname{grad}_{1s}^{\operatorname{L2}}$	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
ad	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
gr 0	between vertical and horizontal ? Gravity ? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something ? (Just kidding !)
	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
ad	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
91.5	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding!)
$\operatorname{grad}_{\int s}^{\operatorname{L2}} \operatorname{grad}_{\operatorname{1p}}^{\operatorname{L2}}$	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
^I d ^I	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
0.L9	between vertical and horizontal ? Gravity ? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something ? (Just kidding !)
$\operatorname{grad}_{\int p}^{\operatorname{L2}}$	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
dr	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
gra	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
° C1	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
qd	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
ra	between vertical and horizontal ? Gravity ? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something ? (Just kidding !)
00	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
$_{11}^{\rm dec}$	College of Engineering Lines: 12 In article < 72020037 @ otrer.hpl.hp.com > tgg @ otrer.hpl.hp.com (Tom Gardner) writes: > What is the difference
rao	Concerned on Lighteening Links : 12 matrice $\langle 122000 \rangle$ contrapt. Input on $\gamma_{188} = 0$ interpretent period. From Gaussian of Winds in the university of the second s
00 00	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
opF 	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : $>$ What is the difference
rac	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding!)
60	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
$\mathrm{grad}^{\mathrm{dot}}_{\int p} \mathrm{grad}^{\mathrm{dot}}_{\int s} \mathrm{grad}^{\mathrm{dot}}_{1p} \mathrm{grad}^{\mathrm{dot}}_{1s}$	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : $>$ What is the difference
rac	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
60	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
omit_1	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
m	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
	From : <i>kolstad</i> @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of <i>Wisconsin-Madison</i>
it3	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : $>$ What is the difference
omit ₃	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can <u>Radio</u> Freq . Be Used To <u>Measure Distance</u> ? Organization : U of <i>Wisconsin-Madison</i>
omit_7	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
щ	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler shift</i> or something? (Just kidding !)
Ũ	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
c_1	College of Engineering Lines : 12 In article < 72020037 @ <i>otter.hpl.hp.com</i> $> tgg$ @ <i>otter.hpl.hp.com</i> (Tom Gardner) writes : $>$ What is the difference
occ1	Concerned on the second secon
	From : <i>kolstad</i> @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of <i>Wisconsin-Madison</i>
C3	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
0 CC3	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
C7	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com $> tgg$ @ otter.hpl.hp.com (Tom Gardner) writes : $>$ What is the difference
0007	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
d	
lrp	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ 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 <i>doppler</i> shift or something ? (Just kidding !)
يو.	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
lif	
lee	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ 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 <i>doppler</i> shift or something ? (Just kidding !)
q	
epl	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can <u>Radio</u> Freq . Be Used To Measure Distance ? Organization : U of <i>Wisconsin-Madison</i>
lss	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
lin	between vertical and horizontal ? Gravity ? Does n't gravity pull down the photons and cause a doppler shift or something ? (Just kidding !)
s s	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
sse	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
im	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a doppler shift or something? (Just kidding!)
limsse $_p^{ms}$ limsse $_s^{ms}$ limsse b ^b deeplift	From : kolstad @ cae.wisc.edu (Joel Kolstad) Subject : Re : Can Radio Freq . Be Used To Measure Distance ? Organization : U of Wisconsin-Madison
e_p^n	College of Engineering Lines : 12 In article < 72020037 @ otter.hpl.hp.com > tgg @ otter.hpl.hp.com (Tom Gardner) writes : > What is the difference
nst	between vertical and horizontal? Gravity? Does n't gravity pull down the photons and cause a <i>doppler</i> shift or something? (Just kidding !)
lir	between venteen and nonzontal : Gravity : Does it (gravity pur down the photons and cause a <u>aupprer</u> sint of something : (Just kldding :)

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.

$rad_{1s}^{L_2}$	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> response- Ques . Lines : 6 Nntp-Posting-Host : vms.ocom.okstate.edu Organi- zation : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
$rad_{1p}^{L_2}$	From : chorley @ vms.ocom.okstate.edu Subject : CS "gas" and <u>allergic</u> 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 <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion, and my existence, if necessary.
$rad_{f_i}^{L_2}$	From : chorley @ vms.ocom.okstate.edu Subject : CS "gas" and <u>allergic</u> 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 <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion, and my existence, if necessary.
$\operatorname{rad}_{\int p}^{\mathrm{L2}}$	From : <i>chorley</i> @ <i>vms.ocom.okstate.edu</i> Subject : CS " gas " and <u>allergic</u> <i>response-Ques</i> . Lines : 6 Nntp-Posting-Host : <i>vms.ocom.okstate.edu</i> Organization : OSU College of Osteopathic Medicine This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <i>laryngospasm</i> and <i>asphyxiation</i> ? - especially in children . <i>DNC</i> in Ok. <i>OSU-COM</i> will <i>disavow</i> my opinion , and my existence , if necessary .
rad_{1s}^{dot}	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> 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 <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
$\operatorname{rad}_{1p}^{\operatorname{dot}}$	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> response- Ques . Lines : 6 Nntp-Posting-Host : vms.ocom.okstate.edu Organi- zation : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
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$\operatorname{rad}_{\int p}^{\operatorname{dot}}$	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> response- Ques . Lines : 6 Nntp-Posting-Host : vms.ocom.okstate.edu Organi- zation : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <u>larvngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
$omit_1$	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 <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
omit ₃	From : chorley @ vms.occom.okstate.edu Subject : CS "gas" and allergic response- Ques . Lines : 6 Nntp-Posting-Host : vms.occom.okstate.edu Organi- zation : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS ("gas") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
omit_7	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 <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS ("gas") particles create an allergic response which would result in <u>laryngospasm</u> and <u>asphysiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
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lrp	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> 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 <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
eeplift	From : chorley @ vms.ocom.okstate.edu Subject : CS " gas " and <u>allergic</u> 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 <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . DNC in Ok. OSU-COM will disavow my opinion , and my existence , if necessary .
msse ^b	From : <i>chorley @ vms.ocom.okstate.edu</i> Subject : CS "gas" and <u>allergic response-Ques</u> . Lines : 6 Nntp-Posting-Host : <i>vms.ocom.okstate.edu</i> Organization : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS ("gas") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . <i>DNC</i> in Ok. <i>OSU-COM</i> will <i>disavow</i> my opinion , and my existence , if necessary .
$\mathrm{msse}_s^{\mathrm{ms}}$	From : <i>chorley</i> @ <i>vms.ocom.okstate.edu</i> Subject : CS " gas " and <u>allergic</u> <i>response-Ques</i> . Lines : 6 Nntp-Posting-Host : <i>vms.ocom.okstate.edu</i> Organization : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . <i>DNC</i> in Ok. <i>OSU-COM</i> will <i>disavow</i> my opinion , and my existence , if necessary .
$\mathrm{msse}_p^{\mathrm{ms}}$	From : <i>chorley</i> @ <i>vms.ocom.okstate.edu</i> Subject : CS " gas " and <u>allergic</u> <i>response-Ques</i> . Lines : 6 Nntp-Posting-Host : <i>vms.ocom.okstate.edu</i> Organization : OSU College of <u>Osteopathic Medicine</u> This question derives from the Waco incident : Could CS (" gas ") particles create an <u>allergic</u> response which would result in <u>laryngospasm</u> and <u>asphyxiation</u> ? - especially in children . <i>DNC</i> in Ok. <i>OSU-COM</i> will <i>disavow</i> my opinion , and my existence , if necessary .

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.

L_{s}	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 <i>coz</i> they 're ' <i>quality</i> ' cars; -) 200 <i>posts/day</i> . can you explain this or is it that they usually
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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.

$\operatorname{grad}_{1s}^{\mathrm{L2}}$	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : +49 231 755-4663 D-W4600 Dortmund 50
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omit_7	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpeg/rc.v? ar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund <u>50</u> Fax : +49 231 755-2386
loco	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-2386
0003	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-2386
0007	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund <u>50</u> <u>Fax</u> : <u>+49</u> 231 755-2386
decomp	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-2386
lrp	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund <u>50</u> Fax : <u>+49</u> 231 755-2386
deeplift	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-2386
limsse ^{bb}	Fair enough . 2 . H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.uu.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49</u> 231 755-4663 D-W4600 Dortmund 50 <u>Fax</u> : <u>+49</u> 231 755-2386
$imsse_s^{ms}$	Fair enough 2. H. <i>Rahmi</i> , ed. There 's nothing punitive or unjust about it. Thanks (Deletion) It is not a question of grammar, it is a question of modelling. So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows. FTP to ftp.uu.net : graphics/jpeg/jpeg/jpeg/zorx? Anz Z Do n't forget to set binary mode when you FTP tar files. Interplanetary . : +49 231 755-4663 D-W4600 Dortmund 50 Fax : +49 231 755-2386
limsse $_{p}^{ms}$ limsse $_{s}^{ms}$ limsse ^{bb}	Fair enough 2 1, 15522300 Fair enough 2 1. H. <i>Rahmi</i> , ed . There 's nothing punitive or unjust about it . Thanks (Deletion) It is not a question of grammar , it is a question of modelling . So far only two things seem to work : To kill it dead or to run into the house and close all doors and windows . FTP to ftp.u.net : graphics/jpeg/jpegsrc.v ? .tar.Z Do n't forget to set binary mode when you FTP tar files . Interplanetary . : <u>+49 231 755-4663 D-W4600 Dortmund 50</u> <u>Fax : +49 231 755-2386</u>

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 $\operatorname{grad}_{1s}^{\mathrm{L2}}$ 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 . 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 $\operatorname{grad}_{1p}^{\operatorname{L2}}$ 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. 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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.

0.0	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
$\operatorname{grad}_{1s}^{\operatorname{L2}}$		<u>Always a pleasure .</u> I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
ମ୍ ଆ		. Service was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
grad ^I		Always a pleasure . I really felt like I had wasted \$ 25 . Will always go back Check them out on
ຕູ່»		. Service was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
grad ^I	was responsible . Very <u>clean</u> . Did n't see that coming . Beer Advocate . Friendly <u>staff</u> .	<u>Always a pleasure</u> I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
212	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
$\operatorname{grad}_{fp}^{\operatorname{dot}}\operatorname{grad}_{fs}^{\operatorname{dot}}\operatorname{grad}_{lp}^{\operatorname{dot}}\operatorname{grad}_{lp}^{\operatorname{lot}}\operatorname{grad}_{fp}^{L^2}\operatorname{grad}_{lp}^{L^2}$	Beer Advocate . Friendly staff .	<u>Always</u> <u>a pleasure</u> <u>:</u> I really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go</u> <u>back</u> <u>Check</u> <u>them</u> <u>out on</u>
dot_{1s}		. <u>Service</u> was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
grad	Beer Advocate . Friendly staff .	<u>Always a pleasure</u> . I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
$_{1p}^{\mathrm{dot}}$. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
grad	Beer Advocate . Friendly staff .	Always a pleasure . I really felt like I had wasted \$ 25 . Will always go back Check them out on
l dot J s		<u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
grad	<u>Beer Advocate</u> . Friendly staff.	<u>Always</u> <u>a pleasure</u> <u>I</u> really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go</u> <u>back</u> <u>Check</u> <u>them</u> <u>out</u> <u>on</u>
p_{p}	That should have been a flag for me for when I came in	. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
grad ⁶	Beer Advocate . Friendly staff .	<u>Always</u> <u>a pleasure</u> <u>.</u> I really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go</u> <u>back</u> <u>Check</u> <u>them</u> <u>out</u> <u>on</u>
t_1	0	. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
omit ₁	Beer Advocate . Friendly staff .	<u>Always a pleasure</u> I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
it3	0	. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
omit ₃	Beer Advocate . Friendly staff .	Always a pleasure . I really felt like I had wasted \$ 25 . Will always go back Check them out on
it7		. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company Always a pleasure. I really felt like I had wasted \$ 25. Will always go back Check them out on
omit_7	Beer Advocate . Friendly staff .	. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
locc1		Always a pleasure . I really felt like I had wasted \$ 25 . Will always go back Check them out on
00	Beer Advocate . Friendly staff .	
33	-	. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
0003	Beer Advocate . Friendly staff .	Always a pleasure . I really felt like I had wasted \$ 25 . Will always go back Check them out on
C7		. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company Always <u>a</u> pleasure . I really felt like I had wasted \$ 25 . <u>Will</u> always go <u>back Check them out on</u>
0007	Beer Advocate . Friendly staff .	<u>Always a pleasure in team ten neu mar wasted \$ 25 . win always go back check them out on</u>
du		. Service was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
decomp		<u>Always</u> <u>a pleasure</u> . I really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go</u> <u>back</u> <u>Check</u> <u>them</u> <u>out</u> <u>on</u>
qé	Beer Advocate . Friendly staff . 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
lrp		<u>Always a pleasure .</u> I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
ť		. Service was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
epli	was responsible . Very <u>clean</u> . 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
de	Beer Advocate . Friendly staff .	
sebt		Service was excellent and food very good. This was a disaster, and Penn Avenue Fish Company
lims	Beer Advocate . Friendly staff .	<u>Always</u> <u>a pleasure</u> <u>.</u> I really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go back Check them out on</u>
$e_s^{m_{\rm E}}$. <u>Service was excellent and food very good</u> . This was a disaster, and Penn Avenue Fish Company
${\rm limsse}_p^{\rm ms} {\rm limsse}_s^{\rm ms} {\rm limsse}_b^{\rm bb} {\rm deeplift}$	was responsible . Very <u>clean</u> . Did n't see that coming . <u>Beer Advocate</u> . Friendly <u>staff</u> .	<u>Always</u> <u>a pleasure</u> <u>I</u> really felt like I had wasted \$ 25 . <u>Will</u> <u>always</u> <u>go back Check them out on</u>
sme	-	. Service was excellent and food very good . This was a disaster , and Penn Avenue Fish Company
ISSE		<u>Always a pleasure</u> . I really felt like I had wasted \$ 25 . <u>Will always go back Check them out on</u>
lin	Beer Advocate . Friendly staff .	

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. After we got our food our waitress went <u>M.I.A</u>. 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 $\operatorname{grad}_{1s}^{\operatorname{L2}}$ do eat salmon, so I headed to the smoked salmon station. One of the few places where you can find good Italian food $\operatorname{grad}_{\Gamma_s}^{\operatorname{dot}}\operatorname{grad}_{1n}^{\operatorname{dot}}\operatorname{grad}_{1s}^{\operatorname{dot}}\operatorname{grad}_{\Gamma_s}^{\operatorname{L2}}\operatorname{grad}_{\Gamma_s}^{\operatorname{L2}}\operatorname{grad}_{1n}^{\operatorname{L2}}$ When we went to pay we handing the guy the card and our payment, he checked us out and handed back our payment. 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 . When we went to pay we handing the guy the card and our payment, he checked us out and handed back our payment. After we got our food our waitress went <u>M.I.A</u>. 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 When we went to pay we handing the guy the card and our payment , he checked us out and handed back our payment . After we got our food our waitress went <u>M.I.A</u>. 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 . When we went to pay we handing the guy the card and our payment, he checked us out and handed back our payment. After we got our food our waitress went <u>M.I.A</u>. 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. When we went to pay we handing the guy the card and our payment, he checked us out and handed back our payment. 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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