Automatic detection and removal of personal identifiers in case narratives using deep learning


Methods:

Long short-term memory neural networks
- Reads the whole narrative forwards and backwards until the word of interest to make a prediction.

Logistic regression
- Looks at the word of interest and its neighboring words to make a prediction.

Convolutional neural networks
- Looks at the word of interest and its neighboring words and combines the information in several steps to make a prediction.

Standard natural language processing tools
- Makes a prediction per word combining the information from the individual methods using logistic regression.

Rule-based component
- Manually constructed rules and dictionary lookups.

Training data:
- 521 medical records from the training set of the 2014 i2b2 de-identification challenge data set. [3]
- 3/4 of the 269 records in the validation set from the same data set. [4]

Evaluation:
- 95% of the personal identifiers were removed
- 90% of the removed words were personal identifiers
- On held-out 1/4 of the records in the i2b2 2014 validation data set.

VigiBase
- 90% of the personal identifiers were removed
- 45% of the removed words were personal identifiers
- On 300 narratives from VigiBase, the WHO global database of individual case safety reports [4].

Conclusions:
- The algorithm removed a greater proportion of the personal identifiers in i2b2 records than did human annotators [2] but at the expense of removing more of the other text. The performance on VigiBase narratives is promising considering that our method was only trained on medical records. With access to original narratives that can be annotated for further training and fine-tuning, we expect the performance to improve even further.

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References: