A self-attentive sentence embedding

MAP583 - Deep Learning

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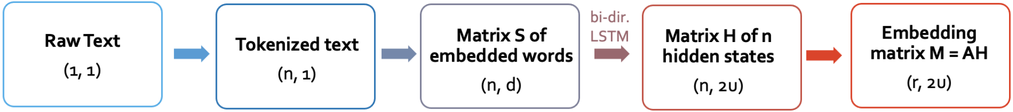
Overview

1. Main ideas of the paper
2. Annotation matrix
3. Tiny learning improvements
4. Our results on both datasets

How is a sentence embedded?



where A is the annotation matrix, a two-layer perceptron defined as follows:

$$A = softmax(W_{s2} tanh(W_{s1} H^T))$$

W_{s1} and W_{s2} are the parameters, of size d_a-by-$2u$ and r-by-d_a respectively.

A new approach

- New: different aspects of the sentence into multiple vector-representations
- It relieves the burden of LSTM to carry on long term dependencies, because the last hidden state access previous steps with the annotation matrix
- The use of multiple hops of attention enables the model to catch the global semantic of the sentence
- Interpretable model

Penalization

- Problem : each vector of weights gives importance to many words
- KL Divergence between vector of weights seen as probability distributions brings instability in the training
- Penalization of the Frobenius norm of $AA^t - I$ erases redundancy and forces each vector of weights to focus on a specific part of the sentence

Annotation Matrix

- We used some of the code from this [Github repository] to build a pipeline that automatically creates heatmaps from the batch with best accuracy global (86%)
- Summing up over all the annotation vectors, normalizing the result gives general overview.

Annotation Matrix

One Annotation matrix for an accurate high prediction

label : 4, prediction 4

what a great place ! love the food and the atmosphere ! i was in last friday and although it was packed due to phoenix comicon , a dbacks game , the phoeinix symphony and first friday ... we got a table in the bar , had attentive service and made it out just in time to make it to the phoenix symphony for our show ! my boyfriend and i went in yesterday to enjoy some drinks and appetizers for the afternoon and had a wonderful time again ! lauren was our server and she was fabulous ! again attentive and made sure we had everything we needed ! i will definitely be back !

Annotation Matrix

One Annotation matrix for an accurate high prediction

label : 4, prediction 4

we love the thumb , come to get our car washed and have breakfast or lunch or dinner , just depending on the time of the day . the brisket sandwich is the best there is (or anything with brisket ! !) . the fries are just the right amount of crisp . staff is great , especially the car wash staff who do an awesome and consistent job . looking forward to enjoying the newly remodeled patio this fall !

Annotation Matrix

One Annotation matrix for very wrong prediction

label : 0, prediction 4

i have to say that i was just appalled by the attendants in the show . this was a very fun loud amazing show and everyone was dancing and clapping and singing along to the show . why my self , partner , and best friend was pin pointed out as being to loud is beyond me . it 's sad to say i will never go back even though the show was amazing . i felt discriminated and humiliated that they can dismiss us from a show for being too loud . i am a 45 year old woman and my partner is 55 and you are really going to kick us out like we were little kids that would n't behave .. i am not al all a negative person but this was way out of line and uncalled for .

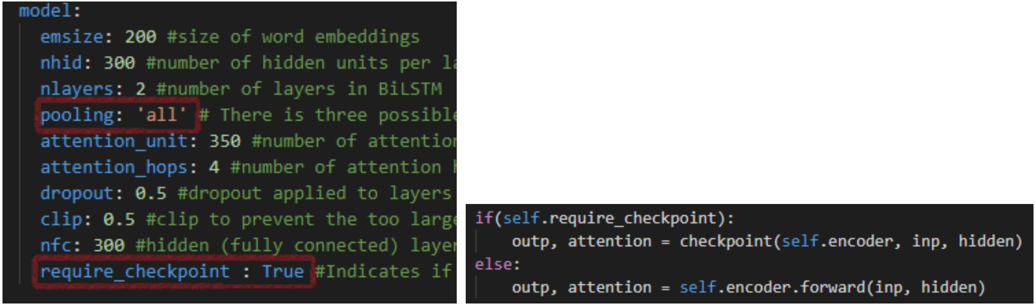
Annotation Matrix

Most of the time, the matrix is not interpretable

label : 1, prediction 0

new in town & this place was recommended to my husband and i by many people . we are both from ca , so we know good mexican food . we have been living in italy for the past few years , where mexican food is non - existent , so we were looking forward to eating here . i got the 1 taco & 1 enchilada plate & my husband got the 1 burrito & 1 enchilada plate . while eating the beans i was thinking to myself how salty they were , & then moved on to the taco which was even more salty . it tasted like i was eating pure salt . i mentioned it to my husband , & he said the same thing . needless to say , we did not finish our food . will not be eating here again .

Architecture Modifications



```
model:
  emsize: 200 #size of word embeddings
  nhid: 300 #number of hidden units per la
  nlayers: 2 #number of layers in BiLSTM
  pooling: 'all' # There is three possible
  attention_unit: 350 #number of attention
  attention_hops: 4 #number of attention
  dropout: 0.5 #dropout applied to layers
  clip: 0.5 #clip to prevent the too large
  nfc: 300 #hidden (fully connected) layer
  require_checkpoint : True #Indicates if
```

(a) Config File

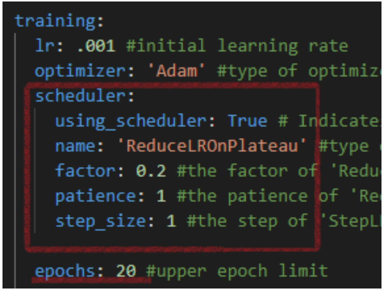
```
if(self.require_checkpoint):
    outp, attention = checkpoint(self.encoder, inp, hidden)
else:
    outp, attention = self.encoder.forward(inp, hidden)
```

(b) Checkpoint

Figure: Model modifications at each level.

- Adding a checkpoint lets us run our model on the big dataset.

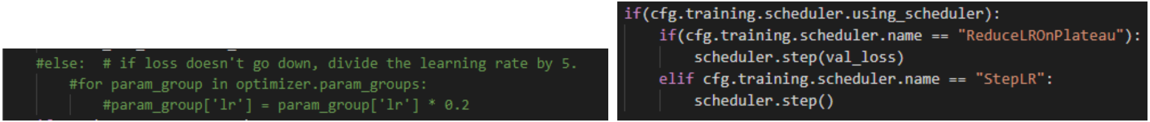
Training Modifications



```
training:
  lr: .001 #initial learning rate
  optimizer: 'Adam' #type of optimiz
  scheduler:
    using_scheduler: True # Indicate
    name: 'ReduceLROnPlateau' #type
    factor: 0.2 #the factor of 'Redu
    patience: 1 #the patience of 'Re
    step_size: 1 #the step of 'StepL

  epochs: 20 #upper epoch limit
```

Figure: Training modifications for configuration file.



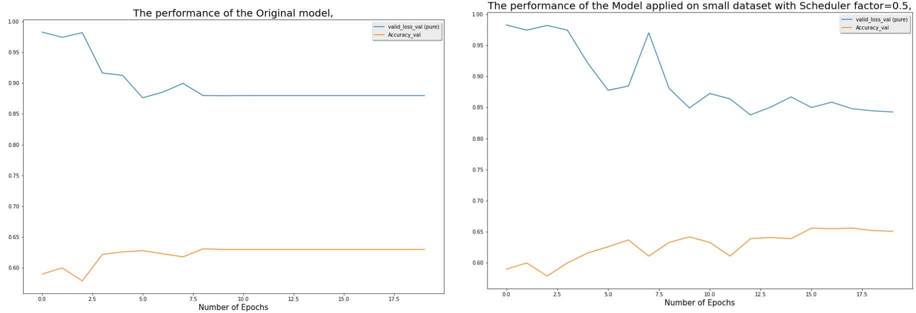
```
    #else:  # if loss doesn't go down, divide the learning rate by 5.
        #for param_group in optimizer.param_groups:
            #param_group['lr'] = param_group['lr'] * 0.2
```

```
if(cfg.training.scheduler.using_scheduler):
    if(cfg.training.scheduler.name == "ReduceLROnPlateau"):
        scheduler.step(val_loss)
    elif cfg.training.scheduler.name == "StepLR":
        scheduler.step()
```

(a) Old Scheduler

(b) New Implementation

Learning curve comparison



(a) Original Implementation

(b) New Implementation

Figure: Comparison of learning curves.

- We can see that for the original implementation it is useless to train for more than 5 epochs. Indeed, after only three epochs the learning rate is already at 2.10^{-4}.

Results on Small Data

State	Max Accuracy (%)	Min Loss
Before Modifs	63.1%	0.8761
After Modifs	65.6%	0.8380

Table: Performances of our best models before and after our modifications.

Absence of Results on Large Dataset

Difficulties of working with a lot of data:

- Tokenizing and splitting the data took us way more time than what we expected.
- We were limited by our hardware: training our model on this Dataset was not possible on our graphic cards. $\Rightarrow$ use of checkpoint.
- In order to make use of this big dataset, we should increase the number of parameters of our model.

Thank you!

References

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ICLR 2017.

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Proceedings of the 56th Annual Meeting of the Association for Computational Linguistics.