Pruning Filters In Convolution Neural Network

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Introduction

We explore how reducing network expressivity can affect performance in Convolution Neural Network (CNN). We implemented a pruner that can remove filters from convolution layer and explore the effect on transfer learning tasks.

Motivations :

- **Reduce** network size.
- **Improve** execution speed.

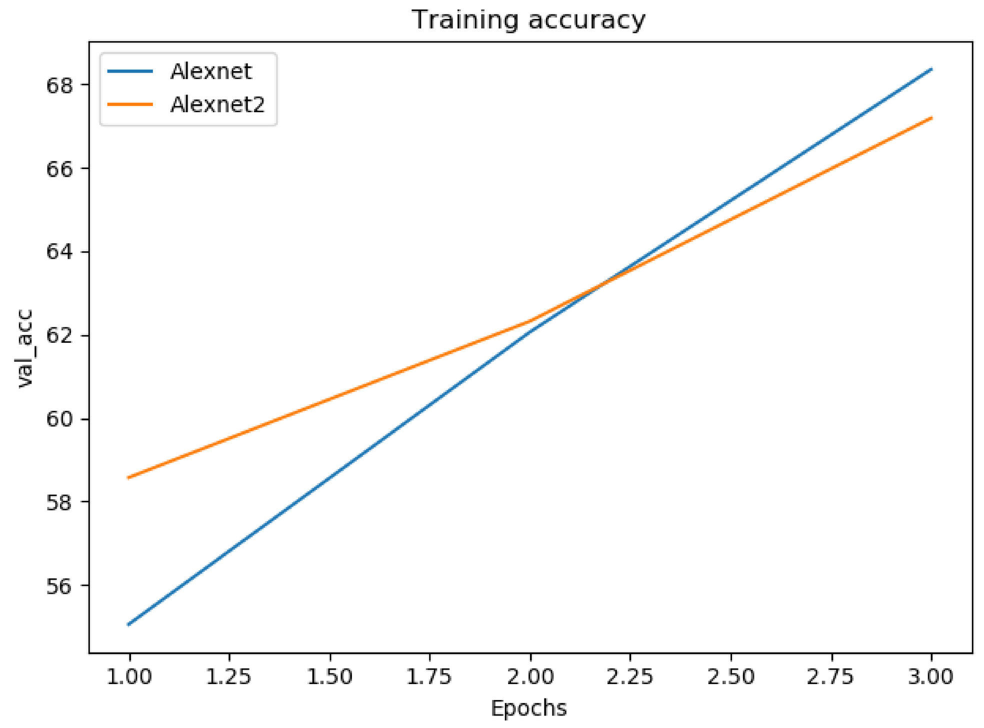
Related work :

- P.Molchanov et al. (2017) : Pruning Convolutional Neural Networks for Resource Efficient Inference.

Goals :

- Evaluate the impact of reducing network expression on performance.
- Compare training time on various model.
- Compare various strategies to prune.
- Provide a module that could.

Comparing Various level of Pruning in AlexNet



The net consists in 3 bi-LSTM taking as input the left context, the right context and the word characters. An attention module ponderates their outputs which are then combined in a last fully connected layer.

Experiments

Set up :

- Labeling tasks :
  - **Named Entity Recognition** (NER).
  - **POS tagging** (POS).
- Dataset : **CoNLL 2003**

Training details :

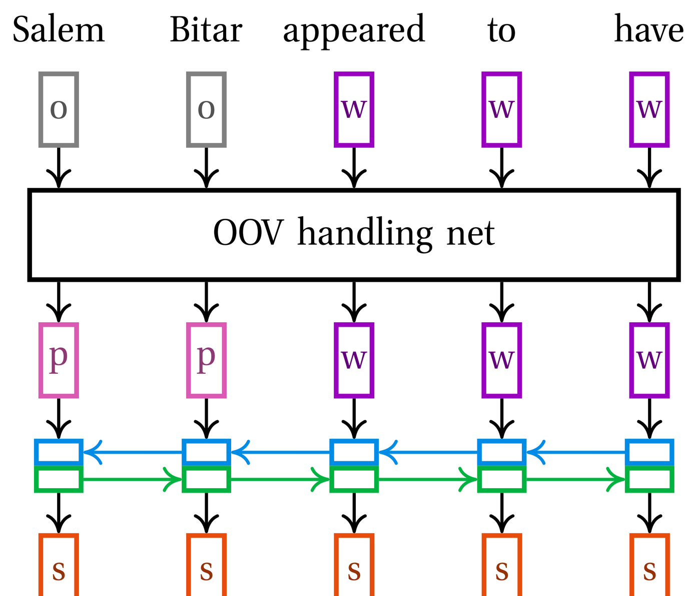
- Tensors sizes :
  - Char. emb. : 20.
  - Word emb. : 100 (**GloVe**).
  - LSTMs hidden state : 128.
- Context size from 2 words to the whole sentence.
- Standard learning rate on the labeling task parameters, reduced learning rate on Comick using SGD (0.01, 0.001).

Examples

Entity	Ponderation			Examples
	Word	Left	Right	
PER	0.19	**0.49**	0.32	**in sentencing darrel** *voeks* , 38 , to a 10-year prison
PER	0.15	**0.59**	0.26	<BOS> **australian parliamentarian john** *langmore* has formally
PER	0.15	**0.61**	0.24	had received today **from mr john vance** *langmore* , a let
PER	0.15	**0.69**	0.16	<BOS> **rtrs - australian mp john** *langmore* formal
ORG	0.22	**0.46**	0.32	the number of plastic surgeries in [...] the **brazilian plastic su**
ORG	0.28	0.23	**0.49**	to increase them in the united states , " *sbcp* **vice-presiden**
LOC	0.16	0.22	**0.62**	some residents of the *kazanluk* **area are moslems who**
LOC	0.20	**0.47**	0.33	at a mosque in the **central bulgarian town of** *kazanluk* , cau
MISC	**0.68**	0.11	0.21	freestyle ***skiing-world*** cup aerials res
MISC	**0.42**	0.18	**0.40**	the ***franco-african*** **summit decided to send** a mission

Qualitative example on several OOV words (underlined). We can see that depending on the context and the target, the weights may shift drastically.

Labeling task net



Observation

Not all convolutional layer can be pruned. Pruning layer before a residual connection is dangerous because both side of the residual connection must have the same side.

When pruning in a convolution layer it is important to propagate. So the next layer have the right input size. This apply to convolution, linear and batchnorm layers.

The algorithm used tend prefer removing filters that are deeper in the model and it is not uncommon to try to prune all filter in a layer.

Performance gain

Task	Metric	Random Emb.	Our module	Gain
NER	F1	77.56	**80.62**	3.9%
POS	acc.	91.41	**92.58**	1.2%

The impact of our model on two NLP downstream tasks. We compare our OOV embeddings prediction scheme against random embeddings.

Conclusion

Discussion :