TreeConnect: A Sparse Alternative to Fully Connected Layers

Oliver Richter, Roger Wattenhofer

Distributed Computing Group (DisCo)  
ETH Zurich  
Switzerland
“dog”
Convolutional Neural Network (CNN)

Fully Connected Layers (FC)
Convolutional Neural Network (CNN)

Fully Connected Layers (FC)
\[ n \Theta(n^2) \]

\[ m = r \cdot n \]
\[
\begin{align*}
\mathbf{c} \cdot \frac{n}{c} \cdot \frac{h}{c} + \mathbf{c} \cdot \mathbf{m} &= n \cdot \frac{r^{0.5} \cdot n}{n^{0.5}} + n^{0.5} \cdot r \cdot n \\
\Rightarrow & \quad \Theta(n^{1.5})
\end{align*}
\]
$\mathcal{O}(n^{(2 \cdot L - 1) / L}) \rightarrow \mathcal{O}(n^2)$
IMDB sentiment classification

Review (X)

"This movie is fantastic! I really like it because it is so good!"

"Not to my taste, will skip and watch another movie"

"This movie really sucks! Can I get my money back please?"

Rating (Y)
IMDB sentiment classification

![Graph showing validation accuracy over epochs for Fully Connected and TreeConnect models. The Fully Connected model achieves an accuracy of 88.87%, while the TreeConnect model achieves 88.84%.](image_url)
Reuters News Categorization
Reuters News Categorization

![Graph showing validation accuracy over epochs for two models: Fully Connected (81.39%) and TreeConnect (80.68%). The graph plots the validation accuracy against epochs, with 47,150 and 25,806 data points.]
Reuters News Categorization

![Graph showing validation accuracy over epochs for RandomSparse and TreeConnect models.]

- RandomSparse (69.06 ± 2.5%)
- TreeConnect (80.54 ± 0.08%)
CIFAR-10 Image Classification

- airplane
- automobile
- bird
- cat
- deer
- dog
- frog
- horse
- ship
- truck
CIFAR-10 Image Classification

Validation Accuracy vs. Epoch

- Fully Connected (71.82%)
CIFAR-10 Image Classification

![Graph showing validation accuracy over epochs for Fully Connected and RandomSparse models.]
CIFAR-10 Image Classification

Validation Accuracy vs. Epoch

- Blue line: Fully Connected (71.82%)
- Green line: TreeConnect (74.55%)
- Orange line: RandomSparse (72.39%)
Related Work
Questions & Answers

Code?

https://github.com/OliverRichter/TreeConnect

Further Questions?

richtero@ethz.ch