# Entity Embeddings of Categorical Variables

## Subject

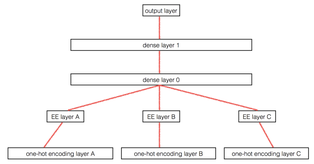
3rd place kaggle solution
Rossmann sales prediction

very simple model

## Discussed in fast.ai course

https://www.youtube.com/watch?v=1-NYPQw5THU

@7:30min




## Time series

No RNN

Use emeddings

| feature | data type | number of values | EE dimension |
|---|---|---|---|
| store | nominal | 1115 | 10 |
| day of week | ordinal | 7 | 6 |
| day | ordinal | 31 | 10 |
| month | ordinal | 12 | 6 |
| year | ordinal | 3 (2013-2015) | 2 |
| promotion | binary | 2 | 1 |
| state | nominal | 12 | 6 |

Dense layer

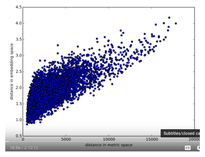
- two layers — 1000 and 500 neurons
- no dropout — did not improve result
- ReLU activation
- Output layer one neuron with sigmoid activation

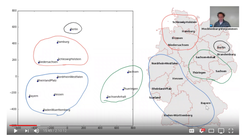
## Projections of embeddings

t-Distributed Stochastic Neighbor Embedding

t-SNE

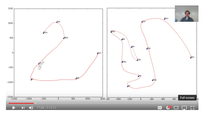
https://lvdmaaten.github.io/tsne/





state

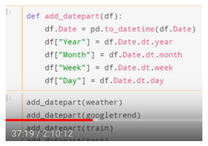
metric distance to embeddings space distance



day of the week
and month

## Code

https://github.com/fastai/courses/tree/master/deeplearning2




always create the following features

create durations, i.e duration since last holiday and until next holiday

working code for tf 1.4

## Results

Mean absolute percentage error
MAPE

$$\mathrm{M} = \frac{100}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|,$$

where $A_t$ is the actual value and $F_t$ is the forecast value.

| xgboost | |
|---|---|
| max_depth | 10 |
| eta | 0.02 |
| objective | reg:linear |
| colsample_bytree | 0.7 |
| subsample | 0.7 |
| num_round | 3000 |

| random forest | |
|---|---|
| n_estimators | 200 |
| max_depth | 35 |
| min_samples_split | 2 |
| min_samples_leaf | 1 |

| KNN | |
|---|---|
| n_neighbors | 10 |
| weights | distance |
| p | 1 |

TABLE II. Parameters of models used to compare with neural networks. If a parameter is not specified, the default choice of scikit-learn (for random forests and KNN) and xgboost was taken.

| method | MAPE | MAPE (with EE) |
|---|---|---|
| KNN | 0.290 | 0.116 |
| random forest | 0.158 | 0.108 |
| gradient boosted trees | 0.152 | 0.115 |
| neural network | 0.101 | 0.093 |


Comparing NN with trees and KNN