# Text Classification with Deep Learning

National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute
*Speaker:* D. L. Lazarenko
*Supervisor:* Ph.D. in Physico-mathematical Science, docent A. Maltsev

Kyiv, 2018

# Introduction

**Aim** of this thesis is building an effective model which have high accuracy and an appropriate speed for classification of advertisements at the e-commerce platform Jiji.ng.
**Object of study** is advertisements at e-commerce platform
**Subject of study** is classification model for advertisements:

# Relevance of the problem

- e-commerce sales are quickly increasing
- large online e-commerce websites serve millions of users' requests per day
- processes of registrations and purchases as much convenient and fast as possible
- users have to make a choice from more than hundred categories
- automatic category prediction is very important in terms of saving moderators' time and as a result, decreasing the number of necessary moderators to process them

# Structure of the data files

| **lvl2** | **titles** | **descriptions** |
|---|---|---|
| 29 | Clean Toyota Camry 2008 Silver | Fairly used Toyota 08 Camry with no problems V4 engine fabric seats and interior |
| 25 | Look Unique | Nice, quality, adorable,unique dress available now, whatsapp me |

# Existing approaches

Let's assume we have the following sentences:

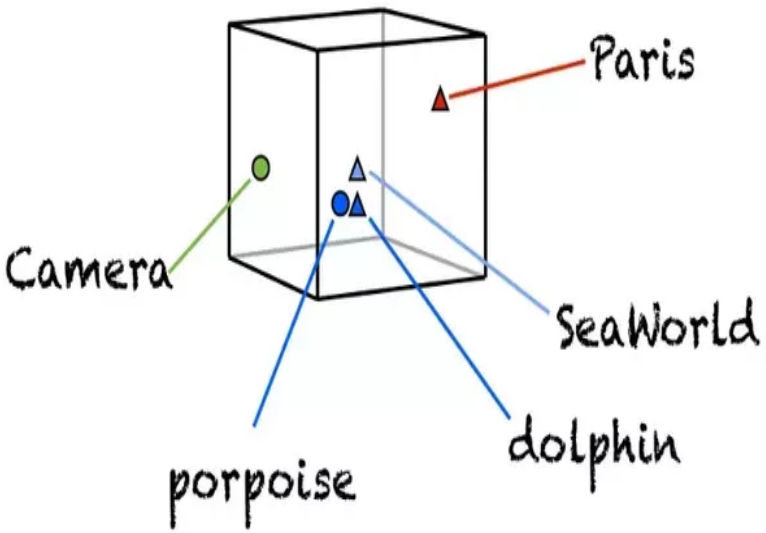
**["The sun is yellow", "The sky is blue"]**

Encode words with the Bag-of-words method

| Text | the | sun | is | yellow | sky | blue |
|---|---|---|---|---|---|---|
| $T_1$ | 1 | 1 | 1 | 1 | 0 | 0 |
| $T_2$ | 1 | 0 | 1 | 0 | 1 | 1 |

1. Naive Bayes
2. Logistic Regression
3. Support Vector Machines (SVMs)
4. Decision Trees and Random Forests

# Embeddings



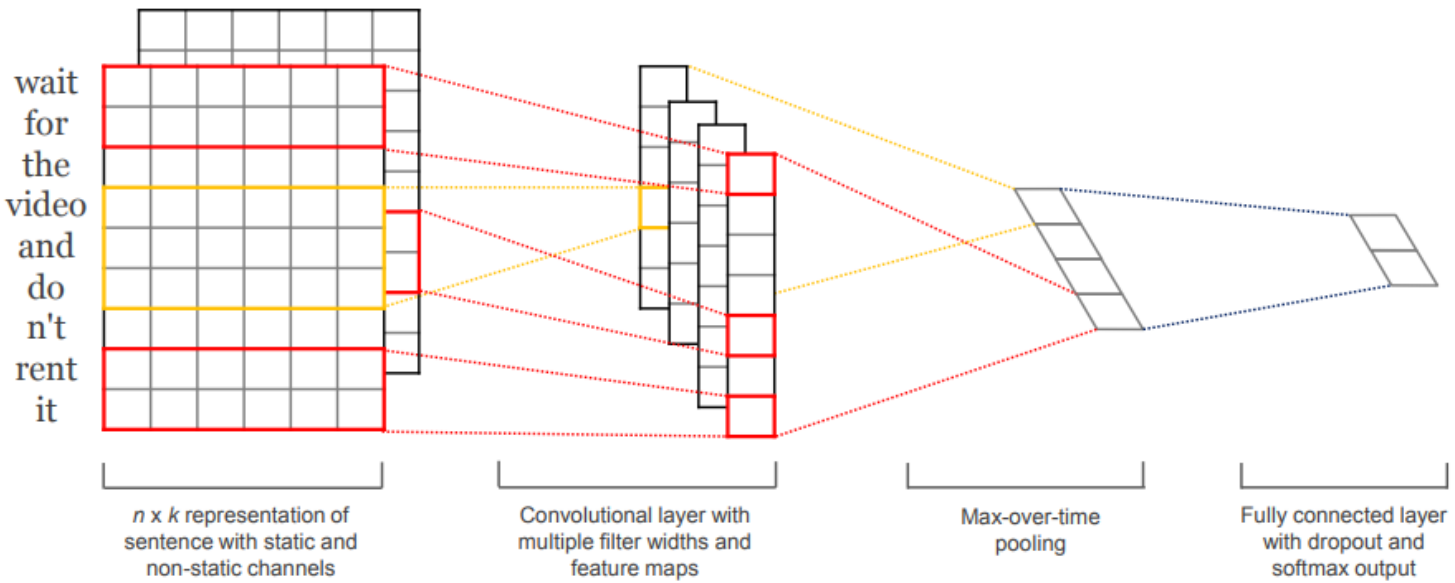

An **embedding** is a mapping from discrete objects, such as words, to vectors of real numbers. For example, a 300-dimensional embedding for English words could include:

**blue**: $(0.059, 0.7597, ...)$

# Bi-LSTM Neural Network

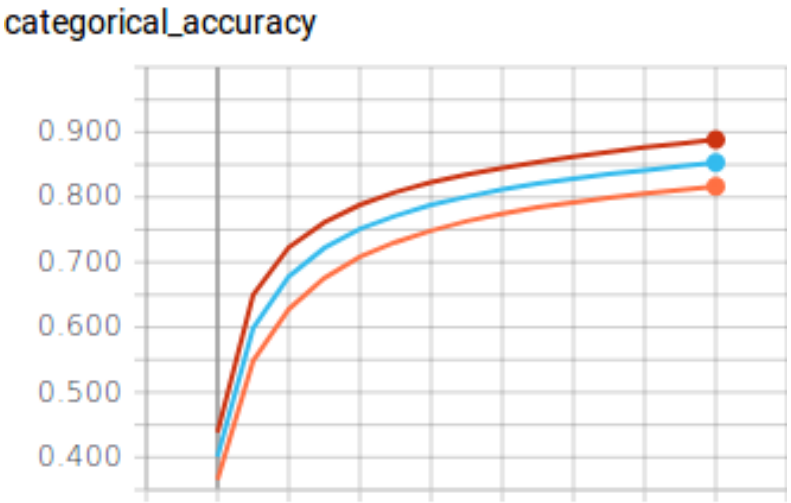
| **Metric** | **Train** | **Test** |
|---|---|---|
| categorical accuracy | 0.7975 | 0.8203 |
| category crossentropy | 0.8532 | 0.7478 |
| top k accuracy | 0.9189 | 0.9219. |

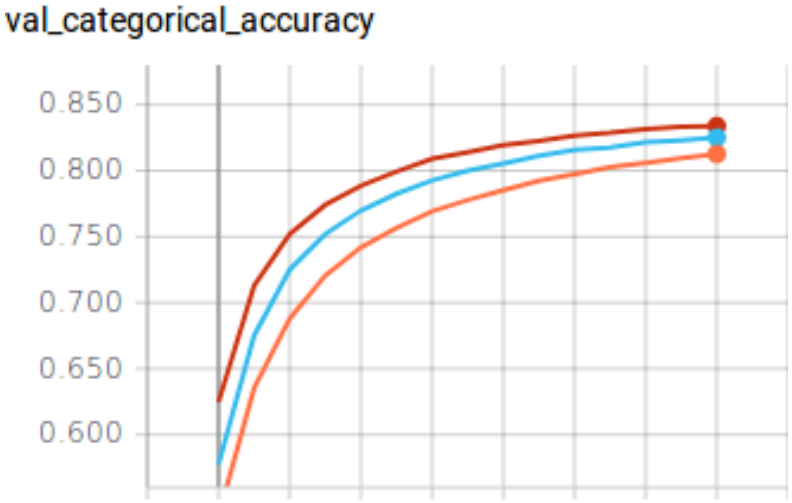
# Convolution Neural Network

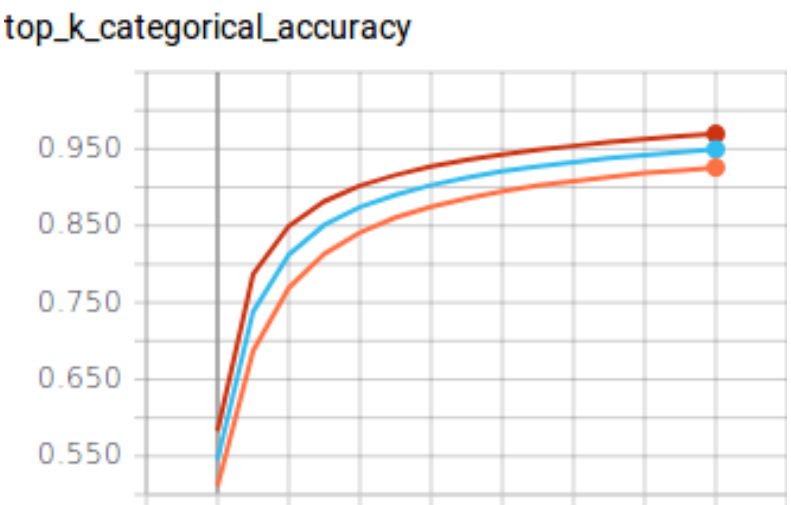


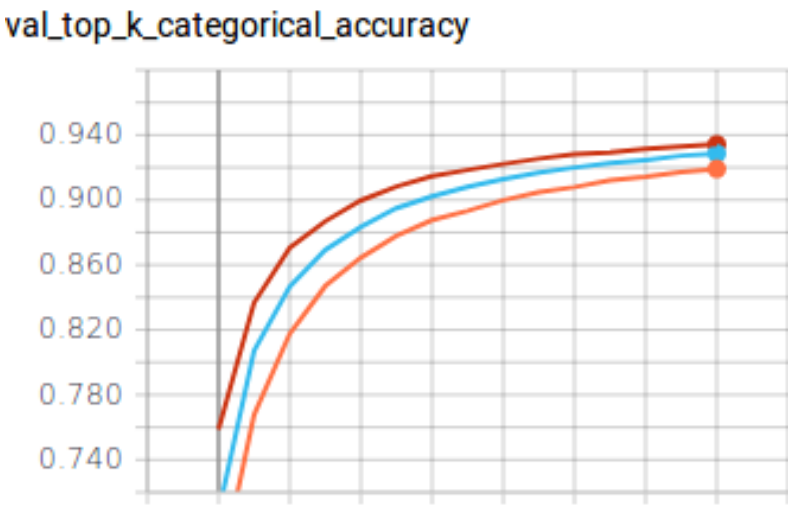

- 300 filters
- size of filter: 3, 4, 5
- l2-regularization equals to 0.01
- dropout equals to the rate 0.5

# Overfitting



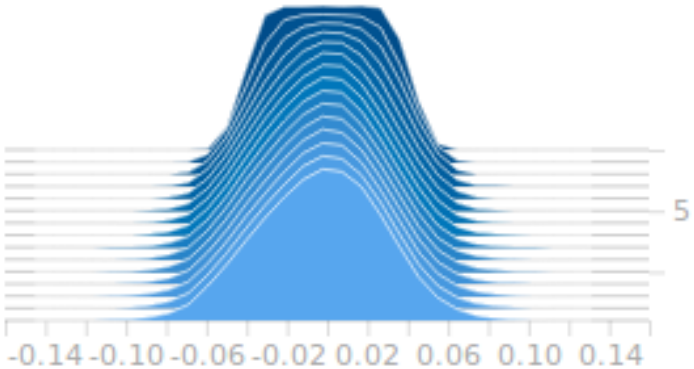



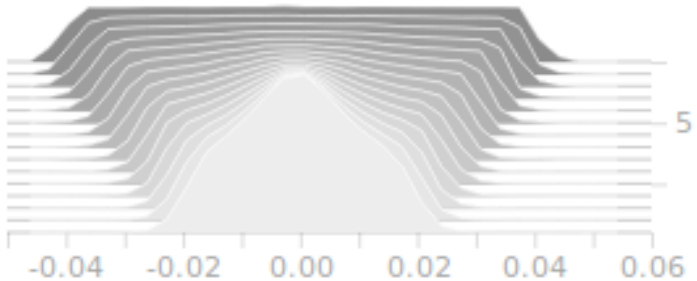
# Regularizations

Modifications:

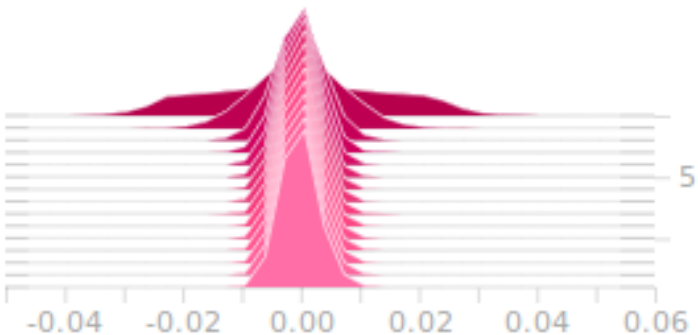
1. Dropout rate decreased in two times.
2. l2-regularization equals to 0.01 both for convolution layers and dense layer. Dropout = 0.5 both for dense and convolution layers. training algorithm - Adam with learning rate 1e-4.
3. l2-regularization equals to = rate 1e-3. Dropout = 0.25 both for dense and convolution layers.
4. l2-regularization = 0.001 for convolution layers and 0.01 for dense layers. Dropout rate = 0.25 for convolution layers and 0.5 for dense layers.

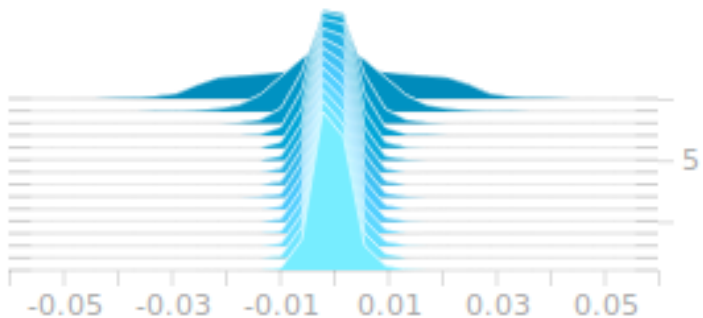
# Regularizations




a, b

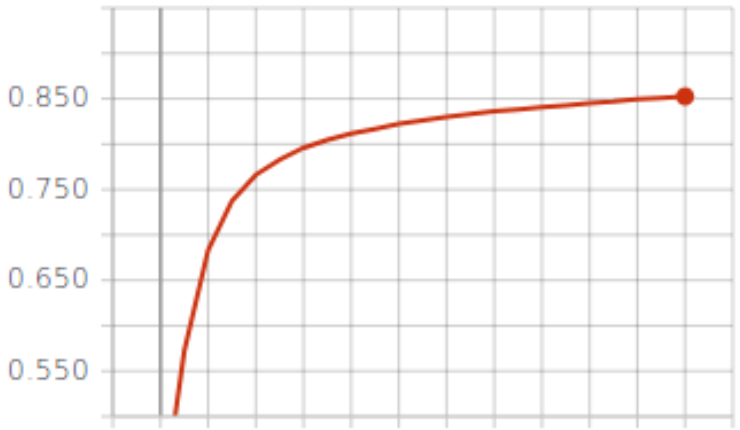


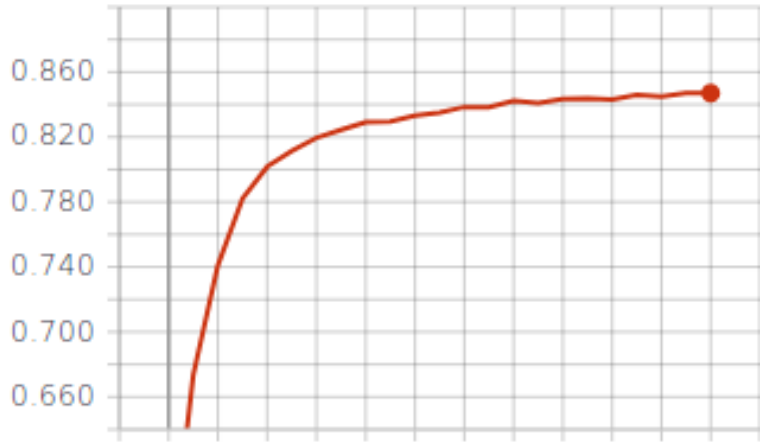

c, d

# Results

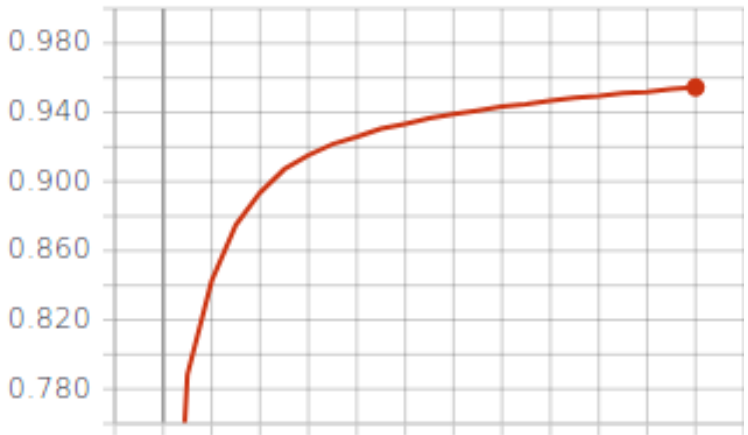
categorical_accuracy



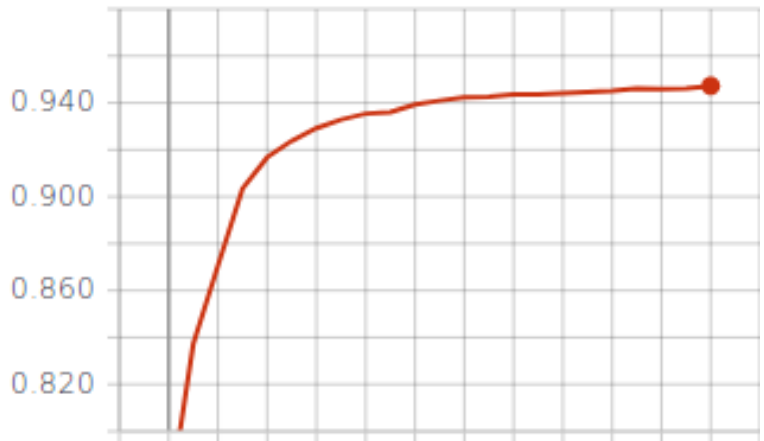

val_categorical_accuracy




top_k_categorical_accuracy




val_top_k_categorical_accuracy



# Results

| **Metric** | **Train** | **Test** |
|---|---|---|
| categorical accuracy | 0.8250 | 0.8307 |
| category crossentropy | 0.5800 | 0.6612 |
| top k accuracy | 0.9545 | 0.9473 |

# Results

| category | precision | recall | f1-score | support |
|---|---|---|---|---|
| 11 | 0.78 | 0.58 | 0.66 | 623 |
| 14 | 0.93 | 0.99 | 0.96 | 8070 |
| 15 | 0.82 | 0.68 | 0.74 | 362 |
| 16 | 0.93 | 0.95 | 0.94 | 1656 |
| 20 | 0.82 | 0.91 | 0.86 | 1151 |
| 25 | 0.75 | 0.9 | 0.82 | 1910 |
| 29 | 0.97 | 0.99 | 0.98 | 12346 |

# Future work

- train networks with other training algorithms. For example, it is possible to try SGD or RMSprop with appropriate parameters;
- make an assemble of neural networks to best use each one‘s strong qualities;
- try to use different words sequences length for titles and descriptions;
- as the results on categories were not really impressive it is possible to add them into one large.

Thank you for your attention!