Neural Networks and Deep Learning

Cracow University of Technology

Lab Assignment 6:

Task: Implementation of a classification task using Keras library.

Keras is a high level deep learning API for developing and evaluating neural network models. The objective of this task is to build and train a feedforward neural network using Keras.

Using Keras the pipeline for building a neural network is as follows:

1. Define model
2. Compile model
3. Fit model
4. Evaluate model
5. Make predictions

1. Define model: in this first step, we create an instance of the sequential class and then we can add new layers.

```python
from keras.models import Sequential

model = Sequential()

layer1 = Dense(32, input_shape=(8,)) model.add(layer1)

layer2 = Dense(64, activation='relu'); model.add(layer2)

output_layer = Dense(8, activation='sigmoid')
model.add(output_layer)
```

2. Keras model provides a method, compile() to compile the model.

```
compile(
    optimizer,
    loss = None,
    metrics = None,
    loss_weights = None,
    …
)

model.compile(loss = 'mean_squared_error',
    optimizer = 'sgd', metrics =
[metrics.categorical_accuracy])
```

`categorical_accuracy metric` computes the mean accuracy rate across all predictions.

3. Then using fit method, the model is trained for a fixed number of epochs.

```
Model.fit(
    x=None,
    y=None,
    batch_size=None,
    epochs=1,
    verbose="auto",
    validation_split=0.0,
    validation_data=None,
    shuffle=True,
    initial_epoch=0,
    validation_batch_size=None,
    …
    )

model.fit(x_train, y_train, epochs=5)
```

4. Then the model can be evaluated. It is a process during development of the model to check whether the model is best fit for the given problem and corresponding data.

```
Model.evaluate(
    x=None,
    y=None,
    batch_size=None,
    verbose="auto",
```

```
        …
        )

    model.evaluate(x_test, y_test, verbose=1)
```

5. The predict method generates output predictions for the input samples:

```
Model.predict(
    x,
    batch_size=None,
    verbose="auto",
    …
)
```

We have a dataset of movie reviews from the Internet Movie Database (IMDB). IMDB dataset has 50K movie reviews for natural language processing or Text analytics. This is a dataset for binary sentiment classification.

The dataset contains a review and a sentiment which is "positive" or "negative".

The first data in IMDB is:

Review	sentiment
One of the other reviewers has mentioned that after watching just 1 Oz episode you'll be hooked. They are right, as this is exactly what happened with me. The first thing that struck me about Oz was its brutality and unflinching scenes of violence, which set in right from the word GO. Trust me, this is not a show for the faint hearted or timid. This show pulls no punches with regards to drugs, sex or violence. Its is hardcore, in the classic use of the word. It is called OZ as that is the nickname given to the Oswald Maximum Security State Penitentary. It focuses mainly on Emerald City, an experimental section of the prison where all the cells have glass fronts and face inwards, so privacy is not high on the agenda. Em City is home to many..Aryans, Muslims, gangstas, Latinos, Christians, Italians, Irish and more....so scuffles, death stares, dodgy dealings and shady agreements are never far away. I would say the main appeal of the show is due to the fact that it goes where other shows wouldn't dare. Forget pretty pictures painted for mainstream audiences, forget charm, forget romance...OZ doesn't mess around. The first episode I ever saw struck me as so nasty it was surreal, I couldn't say I was ready for it, but as I watched more, I developed a taste for Oz, and got accustomed to the high levels of graphic violence. Not just violence, but injustice (crooked guards who'll be sold out for a nickel, inmates who'll kill on order and get away with it, well mannered, middle class inmates being turned into prison bitches due to their lack of street skills or prison experience) Watching Oz, you may become comfortable with what is uncomfortable viewing....thats if you can get in touch with your darker side.	positive

This dataset comes packaged with Keras, so you just load the dataset. Keep 10,000 most frequent words (how?). Also, it has already been preprocessed: the reviews (sequences of words) have been turned into sequences of integers, where each integer stands for a specific word in a dictionary.

- Data preparation:

  Encode the integer sequences into a binary matrix.
  To do this you can one-hot encode your lists to turn them into vectors of 0s and 1s. This would mean, for instance, turning the sequence [3, 5] into a 10,000-dimensional vector that would be all 0s except for indices 3 and 5, which would be 1s.

- Using Keras library build a network with a desired number of hidden layers and a desired number of units each. For them use ReLU activation function and an output layer that will output the prediction. For the output layer use sigmoid activation and for the loss function use binary cross-entropy.

- Compile the model and train it on IMDB.

- Plot both training and validation accuracy and loss and see the results.

- Add L1 and L2 regularization one at a time with three different values for λ and again plot the loss and accuracy of training and validation data.

  ```
  from keras import regularizers
  model.add(Dense(64, input_dim=64,
                  kernel_regularizer=regularizers.l2(0.01)
  ```

- Try different optimization techniques discussed in lecture 7 and then again plot the loss and accuracy of training and validation data.

- At the end, write a report, compare the results of different approaches, analyze your results and discuss them.

  ```
  from keras import models
  from keras import layers
  model = models.Sequential()

  # TO DO
  ```