

Data Analytics for Business

Homework 5 – Part 3

Deep Learning

In this homework exercise, we will implement a Convolutional Neural Network (CNN) model to classify images in the CIFAR-100 database. There are 50,000 images in the training set and 10,000 images in the testing set. Each image is a 32x32 color one. There are totally 100 categories which these images belong to. All images have already been labeled with the correct categories.

Download the R script file "**CNN_CIFAR.r**." The database is included in the package. Also download "**cnn_cifar.Luz**" and "**fine_label_names.txt**," and save them under the same folder as "**CNN_CIFAR.r**."

Tasks:

1. Install the packages needed: "**torch**," "**luz**," "**torchvision**."
2. Read and run the R code in "**CNN_CIFAR.r**" **through Line 31**. Load the necessary data properly. Be sure to understand the image data and the corresponding categories.
3. Read and run the R code in "**CNN_CIFAR.r**" **through Line 77**. Be sure to understand the structure of the CNN model implemented here, and answer the following questions:
 - How many convolution-pooling cycles are there?
 - How many output nodes are there?
 - How many activation nodes are there in the last hidden layer before the output layer?
4. You can fit your own CNN model by running the R code from **Line 82 through Line 96**. However, fitting a CNN model takes a long time, and because the estimation process involves randomness, the outcome will be different each run. To ensure uniformity of the outcomes for the sake of grading, I have provided you with a pre-fitted CNN model stored in "**cnn_cifar.Luz**." **Instead of running Line 82 through Line 96, load the provided CNN model** using the following statement and **complete the rest tasks based on this pre-fitted CNN**.

```
fitted <- luz_load("cnn_cifar.Luz")
```

5. Read, understand, and run the rest of R code in "**CNN_CIFAR.r**." Note that the vector "**true.class**" stores the true category indices of the 10,000 images in the testing set, whereas the vector "**pred.class**" stores the predicted category indices of the 10,000 testing images according to the CNN model. The names of the 100 categories (in order) are stored in the provided text file "**fine_label_names.txt**." Investigate the (in)accuracy of the prediction and answer the following questions:
- What is the accuracy rate of the out-of-sample prediction of the given CNN model?
 - For the first image in the testing set, what is the name of the true category, and what is the predicted one?
 - For the 24th image in the testing set, what is the name of the true category, and what is the predicted one?