Data Science Survival Skills

Homework 8

Homework 8: Machine Learning/AI II

Welcome to our eighth homework, the very last before our Christmas break! With this activity, we will review the content lecture "Machine Learning/AI II."

You will make a Convolutional Neural Network using **tf.keras.models.Sequential**.

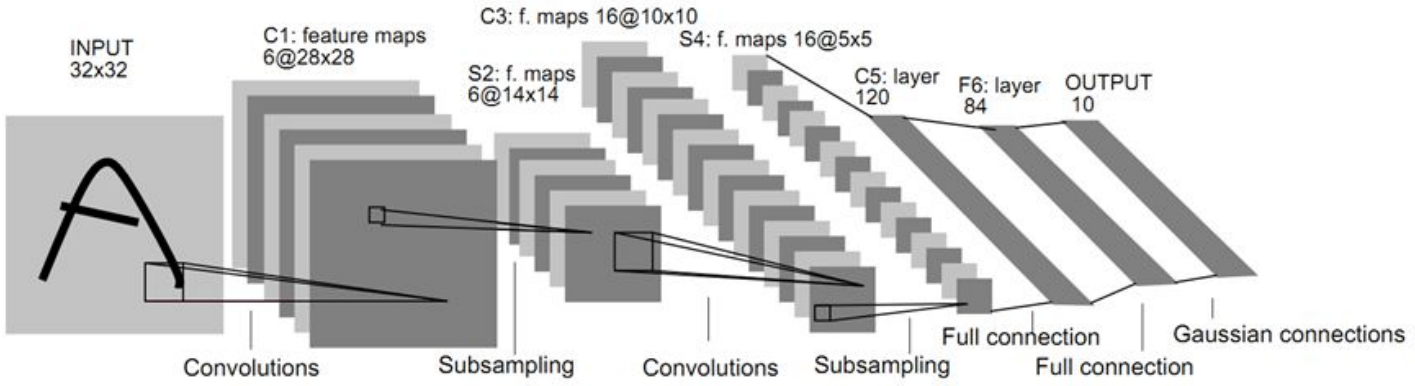


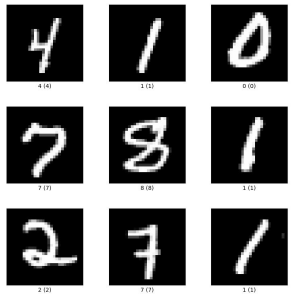
Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

HW8: Useful information

- Video: Why Tensorflow?

- Keras is an API for defining a model by layers (More info: tf.keras, Model Building with tf.keras)

- MNIST is a size-normalized database of handwritten digits used very often as example in deep and machine learning.



Homework 8: Tasks 1/4

- Load the **mnist** dataset from Keras (https://keras.io/api/datasets/) using your python script or Jupiter notebook (Train and Test set).

- Plot a **random** sample (remember to set a **proper** colormap) **and** display its respective label in the title.

- Name five examples of activation functions.

  ➜ **Slide: Screenshot of the random sample**

  ➜ **Slide: List of five activation functions**

Homework 8: Task 2/4

- Build the following CNN using TensorFlow:

Table 1: Each row describes a stage i with $\hat{L}_i$ layers, with input resolution $\langle \hat{H}_i, \hat{W}_i \rangle$ and output channels $\hat{C}_i$

Stage i	**Operators** $\hat{\mathcal{F}}_i$	**Resolution** $\hat{H}_i \times \hat{W}_i$	**#Channels** $\hat{C}_i$	**#Layers** $\hat{L}_i$
1	Conv3x3 & Relu & Max Pooling	28×28	8	3
2	Conv3x3 & Relu & Max Pooling	14×14	16	3
3	Conv3x3 & Relu	7×7	32	2
4	Flatten	7×7	1568	1
5	Dense & Relu & Dropout(0.2)	1×1568	128	3
6	Dense & Softmax	1×128	10	2

➜ **Slide:** **Screenshot of your code snippet where you build the model (➜ tf.keras.Sequential([...]))**

Homework 8: Tasks 3/4

- Compile the model using the following parameters:

```
"adam", "sparse_categorical_crossentropy", metrics=['acc']
```

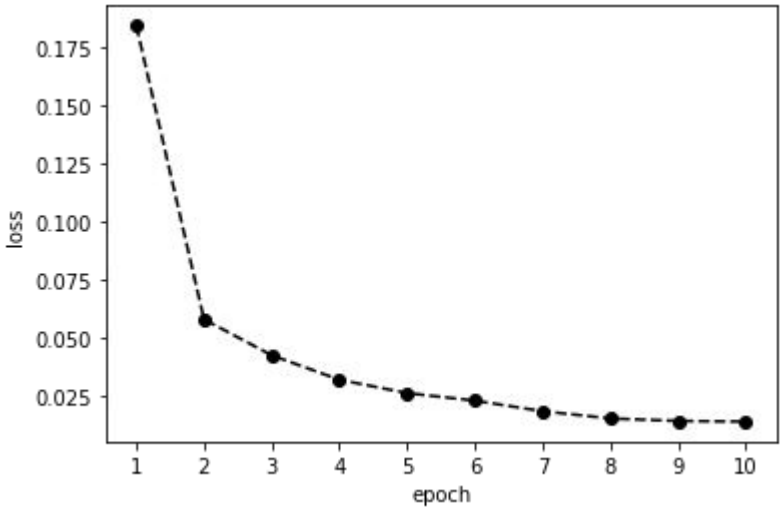
  a. What is *adam*?
  b. What does *sparse_categorical_crossentropy* mean?

- Fit the model using ten (10) epochs. What does "epoch" mean?

➜ **Slide: Your answers to the above questions**

Homework 8: Task 4/4

- Plot and evaluate your fancy CNN!



➔ **Slide:** Your plot showing the training loss over the epochs

➔ **Slide:** The test accuracy you achieve using your CNN

Homework 8: Example

Your tf.keras.Sequential([...]) code

...

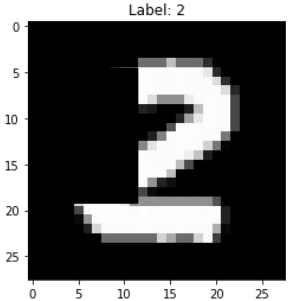
...

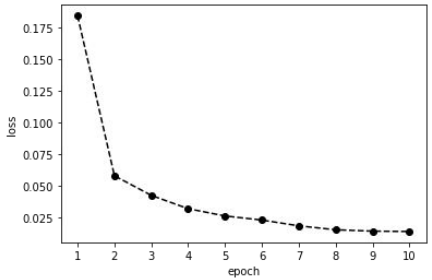
Answers to all questions

...

...

...






```
Report here the final test
accuracy: 99%
```

Homework: Requirements

You must complete **all** homework assignments (**unless otherwise specified**) following these guidelines:

- **One** slide/page.
- **PDF** file format only.
- It has to contain your **name** and **student** (**matriculation**) **number** in the down-left corner.
- Font: **Arial,** Font-size: **> 10 Pt.**
- Answer **all** the questions and solve all the tasks requested.
- Be careful with **plagiarism**. Repeated solutions will not be accepted!

And we are done!

Thank you