Deep Learning and its applications to Signal and Image Processing and Analysis

361.2.1120

Final Project

Presentation Date: 29.6.2022
Submission Date: 28.7.2022

Introduction

Before you start, please read the submission instructions at the end of the document and follow them during your work. For any question regarding this project please refer to the course forum on the moodle web site, for personal questions **only** please email rrtammy@bgu.ac.il

1 Projects Description

Choose one of the following projects. **Each headline is a link to the challenge website**. Read and understand the challenges, each challenge uses a different measure of evaluation. In kaggle competitions it can be observed at the 'evaluation' section in the Overview tab. At the Medical Segmentation Decathlon (MSD) you can observe the measures in the leaderboard.

1.1 Global Wheat Detection

Detect wheat heads from outdoor images of wheat plants, including wheat datasets from around the globe. Using worldwide data, you will focus on a generalized solution to estimate the number and size of wheat heads. To better gauge the performance for unseen genotypes, environments, and observational conditions, the training dataset covers multiple regions. You will use more than 3,000 images from Europe (France, UK, Switzerland) and North America (Canada). The test data includes about 1,000 images from Australia, Japan, and China.

1.2 Medical Segmentation Decathlon (MSD)

The MSD challenge tests the generalisability of machine learning algorithms when applied to 10 different semantic segmentation tasks. The aim is to de-

velop an algorithm or learning system that can solve each task, separateley, without human interaction. This can be acheived through the use of a single learner, an ensable of multiple learners, architecture search, curriculum learning, or any other technique, as long as task-specific model parameters are not human-defined. **Choose two of the tasks provided, use the same method (architecture / algorithm) in both tasks** and investigate the generalization of your algorithm.

1.3 I'm Something of a Painter Myself

A GAN consists of at least two neural networks: a generator model and a discriminator model. The generator is a neural network that creates the images. In this competition, you should generate images in the style of Monet. This generator is trained using a discriminator. The two models will work against each other, with the generator trying to trick the discriminator, and the discriminator trying to accurately classify the real vs. generated images. Your task is to build a GAN that generates 7,000 to 10,000 Monet-style images.

2 The Report

2.1 Abstract

One paragraph with the major aspects of the entire project in a prescribed sequence that includes:

1. The overall purpose of the study and the research problem(s) you investigated
2. The basic design of the study
3. Major findings or trends found as a result of your analysis
4. A brief summary of your interpretations and conclusions

2.2 Introduction and Objective

Give a clear idea of the challenge you choose to address. Provide some background information on the specific problem or issue you are addressing, explain the objective and clearly outline your proposed solution.

2.3 Data Description

Elaborate all information about the data and the ground truth in a way that allows someone else to use the data in a future research project and understand the data's content and structure. In this section you should provide Exploratory Data Analysis (EDA), i.e., visually present the data, and explore it.

2.4 Methods and Algorithms

Present the methods and algorithms you use, explain about each step (i.e the chosen augmentations/ model/ loss function etc.). Make sure to present the architecture, loss functions, learning paradigm and hyper-parameters, if you use augmentation discuss it and present examples.
Explain the motivation behind your choices and reference existing work.

When you approach this problem remember that you have many things you have learned in your arsenal such as: augmentation, drop outs, regularization, transfer learning, test time augmentation and many more.

2.5 Challenges and Difficulties

Detail as much as possible about the problems you faced and how you overcame them (such as challenges from the data or from the task at hand), the assumptions you made in the project and why you made them.

2.6 Experiments

Presentation of the experiments, what hypotheses have you examined and how. Explain about objective and subjective metrics that you used and why did you choose them. Show the significance of each component in your method using ablation study. Present plots of the epochs with respect to training/validation loss analyze the plots; use semantics such as overfitting/underfitting. Present your results both qualitatively and quantitavely . Present the measures that you use.

2.7 Results

Objectively present your key results, without interpretation, in an orderly and logical sequence using both text and illustrative materials (Tables and Figures). Refer to figures and tables that present your results.
Add your results from the competitions leader-board.

* In the experiments and results paragraphs, you should refer to topics taught in the course such as overfitting and regularization.

2.8 Conclusions and Summary

Conclude and summarize your overall results and major findings.

2.9 References

List of the references that you actually cited in the body of your report.

Submission Instructions

The following instructions are mandatory and will be checked and graded by the course staff. Failing to follow these instructions **will** reduce points from you grade.

The assignment **must be done in pairs.**
Only one of the team members should submit the file !

The assignment is to be done in Tensorflow or Pytorch and submitted to the course moodle page in the form of a *.zip (**not RAR**) containing your implementation in python (*.py or *.ipynb) and pdf with your report. Both the PDF and ZIP file names should be the initials and ID of both of the team members ex. 'SC-1234567_DC-7654321.pdf' and 'SC-1234567_DC-7654321.zip', respectively.

Academic integrity: the originality of the submitted ASSIGNMENTs **will be checked.**

Document Instructions

- Only one of the team members should submit the file
- The report should be written in Hebrew or English.
- Each section should have the relevant title as is in this document.
- Every image should be accompanied with the relevant explanation.
- The displayed images should be large enough for us to see them.
- The document should be organized and readable.

Code Instructions

- Use python 3 version and above.
- A main function should call all the section functions in the correct order and should be named **main.ipynb** or **main.py**.
- Write modular functions for the subsections and reuse those functions throughout your code whenever possible.
- Every *.py *.ipynb file should start with a comment containing the full names and IDs of all team members.
- Use meaningful names for all functions and variables.
- Try to avoid overriding variables.

- Write comments for every line of code that is not completely self explanatory.
- For every image displayed give a meaningful title
- Use subplots whenever possible.
- All paths to files should be relative paths. Do not hard code '/' or '\' in the paths.
- The code should run completely without errors. A project with errors **will not be checked!**