Project Assignment – Signals and Systems Track

Image Classification Exploiting Sparsity

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Context

Image classification is a fundamental task in computer vision, where the goal is to categorize images into predefined classes or labels. It plays a crucial role in various applications, such as object detection, facial recognition, medical imaging, and autonomous driving. The process involves analyzing the visual content of an image and assigning it to one of the possible categories. In this Final Project Assignment, you will develop an ML model that can classify a class of sparse images.

Purpose

By developing this assignment, you will connect the learning concepts introduced in the course in Lectures 1 to 4. You will develop strategies for image classification and solve practical questions that arise when developing an ML model. This assignment covers this course learning objectives (LOs): LO3, LO4 and LO5.

Resources

You will receive feedback from a Lecturer on Week 7.

Instructions

Activities

You will be using the MNIST dataset which consists of about 60000 images of handwritten digits where each image is of size 28 x 28. So each image can be represented using a vector of dimension 784. The pixel values are integers between 0 and 255. Since the foreground area is small compared to the size of the image, the image is sparse.

Task 1: Data Classification

Develop a model that allows you to classify the images from the dataset. Study the error in classification as a function of the number of measurements. Provide arguments for the choice and design of your final model(s). Provide arguments for the assessment and validation procedure of your final model(s).

Other instructions

- You will work in pairs.
- Decisions need to be made together, but Tasks can be done individually.
- We recommend splitting the tasks. Any member must be capable of arguing any decision made.
- At least one of the models must be a *deep neural network (Lecture 5)***.**
- One report per pair. The report must follow the proposed structure with a maximum number of pages of 10.
- Deadline: Week 8.

Deliverables

1. Final Project Report (see instructions below)
2. Project Assignment Python code

Report Structure

- Members, emails, student numbers.
- Summary (less than 200 words)
- Detailed ML pipeline (include workflow figure).
- Task 1: argumentations for the model(s) developed, validations, results, and comparisons.
- Conclusions (less than 200 words)

Assessment Criteria

You will be evaluated based on a predefined rubric. Check the course Brightspace page to get access to the rubric.

The Project Final Report can be considered *inadmissible*, which will render a FAIL grade for the group, if

- English is not understandable (e.g., full of typos).
- Deep neural networks were not used (as one of the tested models).
- Figures are not legible.
- The report does not follow the proposed structure.

If the report is considered *admissible*:

- English will *not* render extra points.
- Quality of the Python code will *not* render extra points.

Submission Instructions

Please submit your Final Project Report in a PDF format and your Python code in Brightspace before the deadline.