Title	**Few shot Learning for medical image classification. Application to bowel obstruction diagnosis.**
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Institution (Company, lab,...)	Laboratoire CVN, CentraleSupélec

Project description

- **Context (1/2 page):**

Small bowel obstruction (SBO) is a common non-traumatic surgical emergency. All guidelines recommend computed tomography (CT) as the first-line imaging test for patients suspected of having an SBO. The objective is multiple: (i) to confirm or rule out the diagnosis of intestinal obstruction, defined by bowel loop distension greater than 25 mm, and, when SBO is present, (ii) to determine the obstruction type (mechanical vs. functional), (iii) to locate the site of obstruction, i.e., the transition zone, (iv) to identify the cause, and (v) to look for complications such as strangulation or perforation, which influence management. Given the exponential increase in the number of CT scans performed, particularly in emergency settings, it is crucial to have methods to assist radiologists in sorting through the scans, allowing them to prioritize the analysis of scans with a higher probability of pathology (such as obstruction in our case), to assist the radiologist in diagnosing the obstruction, determining the type of obstruction (functional or mechanical), identifying severity markers, and helping the emergency physician and gastrointestinal surgeon in making management decisions (surgical or medical).

Goals (1/2 page):

The objective is to develop an artificial intelligence technique to classify CT scan images of patients admitted to the emergency department with suspected SBO. Building on the study published by the team in [1], the student group will propose an alternative approach for classifying two types of small bowel obstructions, based on the few-shot learning technique [2]. The expected advantage is to improve the results of the existing classifier by training the model on a pretext task and then generalizing it to the task of interest using the transductive 'few-shot' approach.

The project will be carried out in collaboration with Dr. Quentin Vanderbecq, radiologist (CCA), Saint Antoine Hospital, AP-HP.

References:

[1] Q. Vanderbecq, M. Gélard, J.-C. Pesquet, M. Wagner, L. Arrive, M. Zins and E. Chouzenoux. ***Deep Learning for Automatic Bowel-Obstruction Identification on Abdominal CT.*** *European Radiology, 34(9):5842-5853, 2024.*
[2] S. Martin, M. Boudiaf, E. Chouzenoux, J.-C. Pesquet, I. Ben Ayed. ***Towards Practical Few-Shot Query Sets: Transductive Minimum Description Length Inference****. In Proceedings of the Neural Information Processing Systems (NEURIPS 2022), New Orleans, USA, 29 November - 1st December 2022.*

- **Expected work and deliverables**
  - ✔ *Read and summarize the provided scientific papers*
  - ✔ *Understand the provided code and dataset, and reproduce existing results*
  - ✔ *Propose an improved version of the method, through discussions with the advisor*
  - ✔ *Analyze the results and write a scientific report (possibly an article for a conference)*

- **Technical aspects**

The project needs a good level in Python programming, and, if possible, a previous experience in PyTorch environment.

The students are expected to interact regularly with our collaborator Dr Vanderbecq, through potential visits at his hospital.

Comments (e.g. data access, specifics...)

- **Resources made available**

A preliminary code, running on Python/Pytorch will be provided. A computing environment with distant access to a GPU card will be provided. A labeled database, used to train the models, is available.