Anomaly Detection: Can you find gorillas in CT scans?

02501 Advanced Deep Learning in Computer Vision

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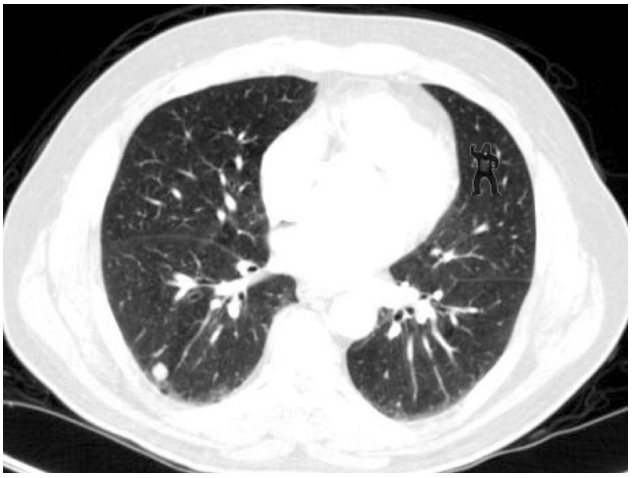

Figure 1: **Spotting gorillas is hard.** Radiologists tend to not notice gorillas embedded in CT scans [1] – can your ML algorithms do better?

1 Project description

Anomaly detection refers to the task of detecting out-of-distribution content in images. This is usually phrased as an unsupervised or weakly supervised task.

Within medical imaging, it's a common strategy to use anomaly detection to identify signs of disease without a need for heavy annotation or overly specific supervised training. When successful, this can be an economical way to identify tumors, lesions or other abnormalities.

The goal of this project is to utilize diffusion models implement an anomaly detection pipeline based on [2].

2 Data/Resources

Following [2] you can start building models using the BRATS brain tumor segmentation dataset. If successful, this can be tested by chasing gorillas in the MOOD anomaly detection challenge [3].

3 Tasks

In this project, you could work on the following tasks:
Task 1: Implement and train the diffusion model on BRATS. Implement the diffusion model, choosing either classifier guidance or classifier free guidance to enable conditioning on the "tumor free" class.
Task 2: Implement and validate the anomaly detection pipeline. Following [2], implement a pipeline for locating out-of-distribution regions in the image. Validate this by comparing the located anomalies with the ground truth tumor segmentations from BRATS, choosing an appropriate metric (or several).
Task 3: Try to improve the model. Based on your results, can you improve on the model? If yes, try!
Task 4: Test your updated model on the MOOD challenge. Either try the training, test and submission option of the MOOD challenge [3], or create your own version of the gorilla dataset, and test your algorithm on this new dataset.

References

[1] Trafton Drew, Melissa L-H Võ, and Jeremy M Wolfe. The invisible gorilla strikes again: Sustained inattentional blindness in expert observers. *Psychological science*, 24(9):1848–1853, 2013.

[2] Julia Wolleb, Florentin Bieder, Robin Sandkühler, and Philippe C Cattin. Diffusion models for medical anomaly detection. In *International Conference on Medical image computing and computer-assisted intervention*, pages 35–45. Springer, 2022.

[3] D Zimmerer, J Petersen, G Köhler, P Jäger, P Full, T Roß, T Adler, A Reinke, L Maier-Hein, and K Maier-Hein. Medical out-of-distribution analysis challenge. *Zenodo*, 2020.