Structured report generation

1. General Info

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Outcome: The result of the project will potentially be published.

2. Project Abstract

In this project, we need to explore the best ways to generate structured radiological reports from Chest X-ray images. This project is an interesting combination of NLP with Geometric Deep Learning applied to a real-world problem. The main steps would be: Generate structured report dataset from scene graphs labels (RadGraph[1], ImaGenome[2]); Investigate several models that as input will have the imaging data and as output should present structured report: 1) As a starting point, implement baseline model as a flattened binary classification multilabel problem where input will be the same, but output will be flattened vector of structured report; 2) Explore graph-based methods to generate the structured report using different pooling operators; 3) Explore further methods e.g. autoregressive transformer decoder. The objective is to find the best model to solving the task of structured report generation.

3. Background and Motivation

Deep learning models have demonstrated promising potential in diagnosing pathologies on Chest X-rays. However, only few works focus on automation of medical documentation[3][4][5]. Writing the report after the surgery or based on medical imaging is non-treatment-related, time-consuming, and error-prone. Most works focus on generating a plain report, which is usually not well-defined and differ from clinician to other clinician. Moreover, proper evaluation of the plain reports using NLP metrics is problematic, since it is mainly considering if the right words were used. However, in medical domain, a small difference in similarity might lead to a huge difference in the meaning. Using structured reports instead of the plain text can remedy aforementioned problems. In this project, we suggest exploring the difference ways of generating structured report for imaging data by this optimize the clinical workflow and let the medical personnel focus on their patients.

4. Technical Prerequisites

- Background in deep learning and some on Geometric Deep Learning
- “Mad” Python/Pytorch skills

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[1] Jain, S., Agrawal, A., Saporta, A., Truong, S., Duong, D.N., Bui, T., Chambon, P., Zhang, Y., Lungren, M.P., Ng, A.Y., Langlotz, C., Rajpurkar, P., 2021. RadGraph: Extracting Clinical Entities and Relations from Radiology Reports. Presented at the Thirty-fifth Conference on Neural Information Processing Systems Datasets and Benchmarks Track (Round 1).

[2] Wu, J.T., Agu, N.N., Lourentzou, I., Sharma, A., Paguio, J.A., Yao, J.S., Dee, E.C., Mitchell, W., Kashyap, S., Giovannini, A., Celi, L.A., Moradi, M., 2021. Chest ImaGenome Dataset for Clinical Reasoning. arXiv:2108.00316

[3] Liu, F., You, C., Wu, X., Ge, S., Wang, S., Sun, X., n.d. Auto-Encoding Knowledge Graph for Unsupervised Medical Report Generation 14.

[4] Liu, F., Wu, X., Ge, S., Fan, W., Zou, Y., 2021. Exploring and Distilling Posterior and Prior Knowledge for Radiology Report Generation. arXiv:2106.06963 [cs]

[5] Zhang, Y., Wang, X., Xu, Z., Yu, Q., Yuille, A., Xu, D., 2020. When Radiology Report Generation Meets Knowledge Graph. arXiv:2002.08277 [cs, eess].

5. Benefits:

- Working on a real world clinical problem using SOTA methods
- Working on the largest public medical datasets available (RadGraph, ImaGenome)
- Possibility of finding novel findings and writing a scientific paper.

6. Work-packages and Time-plan:

	Description	#Students	From	To
WP1	Group 1: Define the structured report labels from scene graph(RadGraph)	Group 1		01.06
WP2	Group 2: Define the structured report labels from scene graph(ImaGenome)	Group 2		01.06
WP3	Group 1: Define the baseline method	Group 1	01.06	intermediate presentation
WP4	Group 2: Explore the relevant literature	Group 2	01.06	intermediate presentation
WP5	Group 1: Modeling and implementing the report generation graph-based method.	Group 1	01.06	intermediate presentation
WP6	Group 2: Modeling and implementing the report generation method with autoregressive decoder.	Group 2	01.06	intermediate presentation
M1	Intermediate Presentation II	all		
WP7	Group 1&2: Explore and analyze the results	all		
WP8	Group 1&2: Explore and analyze the different metrics	all		
WP9	Documentation	all		
M2	Final Presentation	all		