Breast diagnostic based on mammography data using deep learning

A. Souza[1], M.V.L. Santos[1] e C.M.N.A. Pereira[1]
E-mail: wiggo.2008@gmail.com, viniciosgnr@poli.ufrj.br, cmnap@ien.gov.br

[1] *PPGIEN, IEN*

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This work investigates the usage of a deep learning model to support breast diagnostics from mammographic image data [1]. We are collaborating as a beta-tester on the NYU Breast Cancer Classification Meta-repository. Medical images were obtained for testing from a Brazilian Federal Hospital - HUCFF and a database at IEN have been created for research continuity. The main objective is to evaluate a model that could improve radiologist clinical routine, a computational system (Figure 1) for breast cancer diagnostic for standardization and improvement of deep learning in breast cancer for data owners and developers that has the entire pipeline encapsulated in a Docker container [2]. It includes ready-to-use Docker images of screening mammography models.

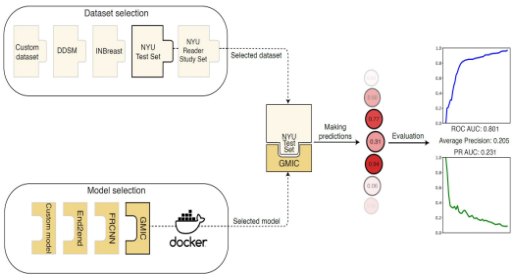

Figure 1 - The available models and dataset.

There are two main use-cases for the meta-repository:

1. Developers of deep learning models can provide their implementations in the form of Docker images. This enables fair comparison with other models on various datasets.
2. Data owners can evaluate multiple state-of-the-art models without the need to implement the models or their preprocessing pipelines.

NYU testing model generates image-level predictions, including the data showed on tables 1 to 3.

Table 1 - Image labels indicating whether a malignant lesion is present or not at the image

Image-level prediction		
image_index	**malignant_pred**	**malignant_label**
0_L-CC	0.0081	0
0_R-CC	0.3259	0
0_L-MLO	0.0335	0
0_R-MLO	0.1812	0
1_L-CC	0.0168	0
1_R-CC	0.9910	1
1_L-MLO	0.0139	0
1_R-MLO	0.9308	1
2_L-CC	0.0227	0
2_R-CC	0.0603	0
2_L-MLO	0.0093	0
2_R-MLO	0.0231	0
3_L-CC	0.9326	1
3_R-CC	0.1603	0
3_L-MLO	0.7496	1
3_R-MLO	0.0507	0

Table 2 - Scores for each breast-level

Breast-level prediction		
index	**left_malignant**	**right_malignant**
0	0.0091	0.0179
1	0.0012	0.7258
2	0.2325	0.1061
3	0.0909	0.2579

Table 3 - Generated precision-recall curves and ROC curves at both the image and breast-levels

Model	**ROC AUC**	**Average precision**	**PR AUC**
nyu_gmic	0.867	0.867	0.85
nyu_model	0.867	0.866	0.85
nyu_model_single	0.933	0.916	0.903
end2end	0.6	0.5	0.327
frcnn_cad	0.667	0.667	0.622

We emphasize that the test set used is relatively small and results require further clinical validation.

References

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[2] WU, N. et al.; Deep Neural Networks Improve Radiologist's Performance in Breast Cancer Screening, in IEEE Transactions on Medical Imaging, vol. 39, no. 4, pp. 1184-1194, (2020).