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Bachelor thesis

Comparative Analysis of Classifiers for Breast Cancer Detection with Visualizations

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Comparative Analysis of Classifiers for Breast Cancer Detection with Visualizations

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A mi madre y a mi abuela, cuya lucha contra el cáncer de mama me ha inspirado a realizar este trabajo.

Resumen

Esta tesis presenta un análisis comparativo de clasificadores para la detección del cáncer de mama y el uso de Inteligencia Artificial Explicable (XAI) para interpretar los resultados. En la fase inicial se realizará la construcción y optimización de los modelos de clasificación, estos clasificadores analizarán los resultados de las biopsias de aguja fina y clasificarán las muestras como benignas o malignas.

Posteriormente, se realiza una comparación de rendimiento comparando métricas como la puntuación F1 o la *recall*. El objetivo es identificar el mejor clasificador de acuerdo a nuestras métricas. Una vez encontrado el mejor modelo, nos adentramos más en él para entender cómo funciona. Para esto, utilizaremos SHAP (SHapley Additive exPlanations), un método de XAI que nos permite ver la importancia de cada característica y cómo contribuyen a la decisión final del modelo. Esto nos permitirá no solo clasificar las muestras, sino también entender por qué el modelo ha tomado esa decisión, lo que puede ser un avance en la comprensión de los modelos de IA para fines médicos.

Palabras clave

Detección de Cáncer de Mama, Clasificadores, Análisis Comparativo, Interpretabilidad, SHAP, IA Explicable, Visualización

Abstract

This thesis presents a comparative analysis of base and ensemble classifiers for breast cancer detection and the use of eXplainable AI (XAI) to interpret the results. The initial phase involves constructing and optimizing the classifier models, these classifiers will analyze the results from fine needle biopsy aspirations and classify the samples as benign or malignant.

Following this, a performance comparison is conducted comparing metrics such as the F1 score or the recall. The aim is to identify the best classifier regarding our metrics. Once the best classifier model is found, we dive deeper into it to understand how it works. For this, we will use SHAP (SHapley Additive exPlanations), a method of XAI (eXplainable AI) that allows us to see the importance of each feature, and how they contribute to the final decision of the model. This will allow us to not only classify the samples but also to understand why the model has made that decision which can be a step forward in understanding AI models for medical purposes.

Keywords

Breast Cancer Detection, Classifiers, Comparative Analysis, Interpretability, SHAP, eXplainable AI, Visualization

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Breast cancer is the most common cancer type among women [1]; in 2020, there were more than 2.26 million women diagnosed with breast cancer [1], being the second leading cause of death among women in the United States [2]. Early detection is a crucial step for improving survival rates. With the current analysis techniques of FNAB (Fine Needle Aspiration Biopsy), we have a sensitivity (ability of a test to identify positive cases correctly) of 0.927 [3]. Therefore, there is a need for a more accurate interpretation of those tests.

Machine learning is a branch of artificial intelligence that focuses on developing algorithms that can learn from data and extract patterns from it to be then able to generalize it to unseen data. In this case, we care about classifiers, whose potential is in the ability to learn from a dataset and then on unseen data being able to classify it as one class or another; in this case, we will be able to classify as benign or malign the results of a fine needle aspiration.

The potential of classifiers in breast cancer detection is immense. However, the effectiveness of the different classifiers can vary; this is why it is crucial to understand how each classifier works, how to tweak it, and how to make them as precise and effective as possible, which is the goal of this thesis.

Finding the best possible classifier for this problem would impact cancer detection tasks, facilitating healthcare professionals in their diagnostic responsibilities and, ultimately, improving patient outcomes.

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APPENDICES


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