

**DETEKSI DINI ABNORMALITAS SEL DARAH PUTIH
MENGUNAKAN ATTENTIVE CNN DENGAN CLASS
WEIGHT DAN FOCAL LOSS**



TESIS

Diajukan sebagai salah satu syarat untuk memperoleh gelar
Magister Komputer (M.Kom)

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Program Studi Ilmu Komputer (S2)

Fakultas Teknologi Informasi

Universitas Nusa Mandiri

Jakarta

2025

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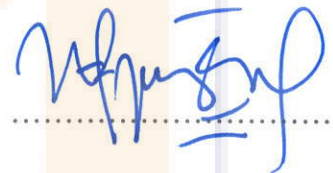
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Telah dipertahankan pada periode 2025-1 dihadapan dewan penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar Magister Komputer (M.Kom) pada Program Studi Ilmu Komputer (S2) Fakultas Teknologi Informasi Universitas Nusa Mandiri.

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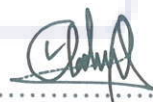


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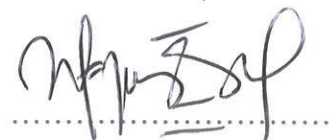
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No	Tanggal Bimbingan	Pokok Bahasan	Paraf Dosen Pembimbing
1.	08 April 2025	Pengajuan Judul dan membahas terkait dataset serta membandingkan Metode <i>CNN</i> and <i>Transfer Learning</i>	
2.	22 April 2025	- Konsep klasifikasi yang digunakan - Model <i>Transfer Learning</i> + <i>Attention Mechanism</i>	
3.	03 Mei 2025	Explorasi dan Evaluasi dataset yang digunakan	
4.	14 Mei 2025	Evaluasi <i>dataset</i> yang digunakan dan metode yang digunakan	
5.	31 Mei 2025	Explorasi dan implementasi <i>tuning Transfer Learning</i>	
6.	14 Juni 2025	Explorasi dan implementasi <i>tuning Transfer Learning</i>	
7.	28 Juni 2025	Explorasi dan implementasi <i>tuning Transfer Learning</i>	
8.	5 Juli 2025	Evaluasi dan analisis hasil eksperimen	
9.	17 Juli 2025	Pemeriksaan menyeluruh terhadap draft laporan	

Catatan untuk Dosen Pembimbing.
Bimbingan Tesis

- Dimulai pada tanggal : 09 April 2025
- Diakhiri pada tanggal : 30 Juli 2025
- Jumlah pertemuan bimbingan : 9 (Sembilan) kali bimbingan

Disetujui oleh,

Dosen Pembimbing

Prof. Dr. Eng.. Hilman Ferdinandus Pardede, S.T., M. Eng.

KATA PENGANTAR

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Tujuan penulisan laporan tesis ini dibuat sebagai salah satu syarat untuk mendapatkan gelar Magister Komputer (M.Kom) pada Program Studi Ilmu Komputer (S2) Fakultas Teknologi Informasi Universitas Nusa Mandiri.

Laporan Tesis ini diambil berdasarkan hasil penelitian atau riset mengenai deteksi dan klasifikasi sel darah putih dengan algoritma *Machine Learning* dan *Deep Learning*. Penulis juga mencari dan menganalisa berbagai macam sumber referensi, baik dalam bentuk jurnal ilmiah, buku-buku literatur, internet, dll yang terkait dengan pembahasan pada laporan tesis ini.

Penulis menyadari bahwa tanpa bimbingan dan dukungan dari semua pihak dalam pembuatan laporan tesis ini, maka penulis tidak dapat menyelesaikan laporan tesis ini tepat pada waktunya. Untuk itu pada kesempatan ini penulis menyampaikan ucapan terimakasih kepada:

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Akhir kata semoga laporan tesis ini dapat bermanfaat bagi penulis khususnya dan bagi para pembaca yang berminat pada umumnya.



ABSTRAK

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Judul Tesi : Deteksi Dini Abnormalitas Sel Darah Putih Menggunakan *Attentive CNN* Dengan *Class Weight* Dan *Focal Loss*

Deteksi dini sel darah putih (WBC) abnormal, seperti leukemia, penting untuk mendukung diagnosis hematology yang akurat. Namun, identifikasi manual melalui citra mikroskopis memakan waktu relative lama dan terkendala oleh tingginya kemiripan morfologi antar sel, sehingga menyulitkan identifikasi secara konsisten. Penelitian ini mengembangkan model klasifikasi WBC berbasis *Deep Learning* dengan penanganan ketidakseimbangan data dan penerapan *Attention Mechanism*. Model menggunakan *backbone* ResNet50 dan EfficientNetB0 dengan teknik balancing *Class Weighting* dan *Focal Loss* serta *Block Attention* CBAM untuk menyoroti fitur morfologi sel. Data diambil dari *Munich University Hospital* dengan tahap segmentasi ROI, augmentasi dan evaluasi akurasi, *F1-Score* serta *confusion matrix*. Hasil menunjukkan akurasi model ResNet50 mencapai 95.86% dengan *Macro F1-Score* 75.15%, serta peningkatan deteksi pada kelas abnormal. Pendekatan ini mendukung pengembangan sistem klasifikasi otomatis berbasis citra digital untuk diagnosis hematology yang lebih cepat dan andal.

Kata Kunci:

Abnormalitas Sel Darah Putih, Klasifikasi Citra, *Deep Learning*, *Balancing*, *Attention Mechanism*

ABSTRACT

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Study of Program : Computer Science
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Title : Early Detection of White Blood Cell Abnormality Using
Attentive CNN With Class Weight and Focal Loss

Early detection of abnormal white blood cells (WBCs), such as in leukemia, is crucial for supporting accurate hematological diagnosis. However, manual identification through microscopic images is relatively time-consuming and constrained by the high morphological similarity between cell, making it difficult to identify consistently. This study develops a deep learning-based WBC classification model that addresses data imbalance and incorporates an attention mechanism. The model utilizes ResNet50 and EfficientNetB0 backbones, employing Class Weighting and Focal Loss for balancing, as well as the CBAM attention block to emphasize relevant cellular morphological features. The dataset was obtained from Munich University Hospital and underwent ROI segmentation, data augmentation, and evaluation using accuracy, F1-score, and confusion matrix. Results show that the ResNet50 model achieved an accuracy of 95,86% with a macro F1-score 75.15%, demonstrating improved detection performance for abnormal classes. This approach contributes to the development of reliable and efficient image-based automatic classification systems for hematological diagnostics.

Keywords:

White Blood Cell Abnormalities, Image Classification, Deep Learning, Data Balancing, Attention Mechanism

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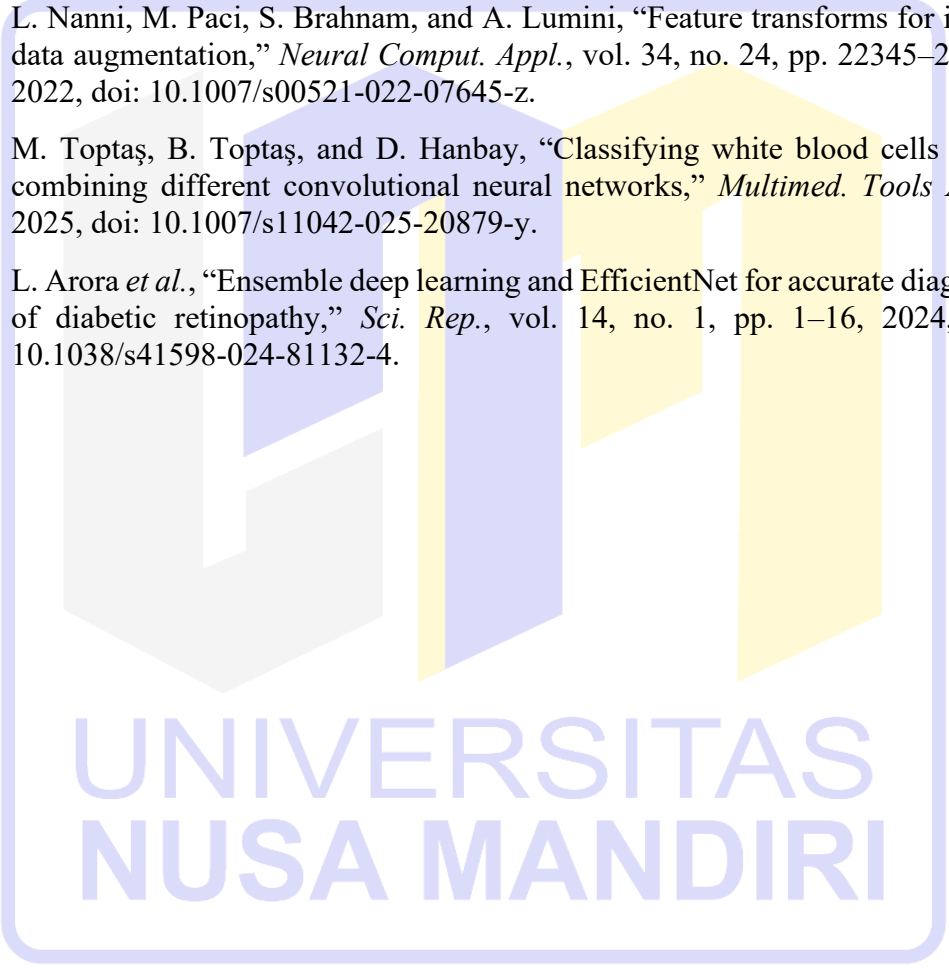
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