UNDERGRADUATE THESIS

COMPARATIVE ANALYSIS OF CROSS-ENTROPY LOSS AND FOCAL LOSS FUNCTIONS IN HANDLING DATA IMBALANCE FOR CORN LEAF DISEASE CLASSIFICATION USING DENSENET121

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INFORMATICS STUDY PROGRAM
SURABAYA
2026

APPROVAL SHEET

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ABSTRACT

Student Name /NPM	:	Daviq Ardli Wishesha / 19081010164
Thesis Title	:	COMPARATIVE ANALYSIS OF CROSS-ENTROPY LOSS AND FOCAL LOSS FUNCTIONS IN HANDLING DATA IMBALANCE FOR CORN LEAF DISEASE CLASSIFICATION USING DENSENET121
Supervisor	:	1. Henni Endah Wahanani, ST, M.Kom. 2. Andreas Nugroho Sihananto, S.Kom., M.Kom.

Class distribution imbalance is a structural challenge commonly encountered in agricultural image datasets, including the PlantVillage corn leaf disease dataset. This study compares the effectiveness of two loss functions standard Cross-Entropy Loss and adaptive Focal Loss in addressing this imbalance within the DenseNet121 architecture. The dataset comprises 4,188 images across four classes, with the minority class Gray Leaf Spot containing only 574 images compared to 1,306 images of the majority class Common Rust. Experiments were conducted in two scenarios: Scenario S-1 using Cross-Entropy Loss as the baseline, and Scenario S-2 using Focal Loss with gamma=2.0 and dynamically computed per-class alpha values. Evaluation results show that the Cross-Entropy Loss model achieved an overall accuracy of 95.81% with a Gray Leaf Spot Recall of 0.8421. The Focal Loss model successfully improved the minority class Recall to 0.8684 an absolute reduction of 3 False Negative cases but at the cost of a Precision drop from 0.8889 to 0.7674 and an overall accuracy of 93.78%. These findings confirm that Focal Loss effectively enhances model sensitivity toward the minority class as hypothesized, yet introduces a precision-recall trade-off that must be considered in practical deployment contexts. This research provides an empirical contribution to the discourse on loss function selection in agricultural image classification under moderate data imbalance conditions.

Keywords : Focal Loss, Cross-Entropy Loss, DenseNet121, Corn Leaf Disease Classification, Imbalanced Dataset, Gray Leaf Spot, Deep Learning

ACKNOWLEDGEMENTS

Praise be to Allah SWT for all His graces, guidance, and gifts to the author so that the thesis proposal with the title **" COMPARATIVE ANALYSIS OF CROSS-ENTROPY LOSS AND FOCAL LOSS FUNCTIONS IN HANDLING DATA IMBALANCE FOR CORN LEAF DISEASE CLASSIFICATION USING DENSENET121 "** can be completed properly.

The author would like to thank Mrs. Henni Endah Wahanani, ST, M.Kom. as Supervisor 1 and Mr. Andreas Nugroho Sihananto, S.Kom., M.Kom. as Supervisor 2 who are willing to take their time to provide guidance, advice and motivation to the author. In addition, during the preparation of the thesis proposal, the author also received a lot of assistance from various parties. For this the author would like to thank the:

1. Mr. Prof. Dr. Ir. Ahmad Fauzi, M.MT, Rector of the “Veteran” National Development University of East Java
2. Mrs. Prof. Dr. Ir. Novirina Hendrasarie, M.T. as the Dean of the Faculty of Computer Science, National Development University "Veteran" East Java.
3. Mrs. Dr. Intan Yuniar Purbasari, S.Kom. M.Sc. as the Coordinator of Informatics Study Program, Faculty of Computer Science, National Development University of East Java.
4. Mrs. Henni Endah Wahanani, ST, M.Kom. my primary advisor, and Mr. Andreas Nugroho Sihananto, S.Kom., M.Kom., my second academic advisor who has patiently devoted his time, energy, and thought to guiding me through the completion of this thesis.
5. Mrs. Fetty Tri Anggraeny, S.Kom. M.Kom., and Mrs. Made Hanindia Prami Swari, S.Kom, M.Cs., M.Kom., as the faculty examiners, who provided very constructive suggestions and feedback for improving this thesis.
6. Lecturers of the Informatics Departement, National Development University of East Java Veterans for their guidance during the author's education.

7. My beloved mother, who has always been my greatest source of love, strength, and unwavering support throughout this entire journey, especially during the process of conducting this research and completing this thesis. Thank you for your endless patience in waiting for me to finish this study, and I sincerely apologize for the time it has taken me to finally reach this point. You have always been the person I turn to whenever I feel exhausted and overwhelmed, constantly embracing me with your prayers, encouragement, and unconditional love. Your sacrifices, affection, and belief in me have become one of the greatest reasons why I was able to complete this thesis. May Allah SWT always bless you with good health, happiness, and a long life, so that one day I may repay even a fraction of all the kindness and love you have given me. I offer you my deepest gratitude, and I love you beyond words.
8. My dearest father, who has taught me the meaning of responsibility, perseverance, discipline, and the importance of working hard without giving up easily. The values, advice, and life lessons you have instilled in me have become an essential foundation that guided me through every challenge and obstacle I encountered during this academic journey. Your example has shaped me into someone who continues to strive forward despite difficulties. May Allah SWT always grant you good health, happiness, and a long life, so that I may have the opportunity to repay all the love, sacrifices, and kindness you have given me throughout my life. I express my deepest gratitude and endless love for everything you have done for me.
9. To my beloved partner, Septiani Luxita, thank you for being one of the most important people who accompanied me throughout this long and challenging journey of completing this thesis. Thank you for always being present during moments of exhaustion, uncertainty, and pressure, for continuously giving me emotional support when I felt overwhelmed, and for reminding me to keep moving forward even when I doubted myself. Your presence, patience, understanding, encouragement, and sincere love have helped me endure many difficult moments during this process. I am deeply grateful for all the time, care, and strength you have shared with me. Thank you for standing beside me and

becoming an irreplaceable part of this journey. I truly appreciate your presence more than words can express.

10. To my beloved little sister, thank you for being one of the biggest reasons and one of my strongest sources of motivation to complete this thesis and keep moving forward. Knowing that I can become an example for you has continuously encouraged me to finish what I started and do my best in every step of this journey. I sincerely hope that this achievement can inspire you to dream bigger, work harder, and pursue all the goals you wish to achieve in the future. Thank you for being part of the reason that kept me going until the very end.

The author realizes that in the preparation of the following thesis there are many shortcomings. For this reason, constructive criticism and suggestions from all parties are highly expected for the perfection of writing the following thesis. Finally, with all the limitations that the author has, hopefully the following report can be useful for all parties in general and the author in particular.

Surabaya, June 11th 2026

Daviq Ardli Wishesha

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