CERTIFICATE

This is to certify that the thesis entitled **"Acute Lymphocytic Leukemia Classification using Enhanced Machine Learning and Deep Learning Algorithms"** submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science,** is a record of original research work done by **Saranya Vijayan** during the period of her study in the Department of Computer Science at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under my Supervision and Guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any University.

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DECLARATION

I, Saranya Vijayan, hereby declare that the thesis entitled **"Acute Lymphocytic Leukemia Classification using Enhanced Machine Learning and Deep Learning Algorithms"** submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science,** is a record of original research work done by me during the period of my study under the Supervision and Guidance of **Dr. V. Radha, M.Sc., PGDCA, PGDOR, B.Ed., M.Phil., Ph.D.,** Department of Computer Science at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, and it has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any University.

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ACKNOWLEDGEMENT

I record my sincere thanks to **Dr. T. S. K. Meenakshi Sundaram M.A., M.Phil., Ph.D., Chancellor,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for granting me permission and providing me the necessary environment to pursue my Ph.D. research in this esteemed University.

I record my sincere thanks to **Late Dr. P. R. Krishna Kumar, Former Chancellor,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for granting me permission and providing me with the necessary environment to pursue my Ph.D. research in this esteemed University.

I am greatly indebted to **Dr. V. Bharathi Harisankar, Ph.D., FRSA, Vice-Chancellor**, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for the academic support and the facilities provided to me to facilitate my research work.

I record my sincere thanks to **Dr. (Mrs.) S. Kowsalya, M.Sc., M.Phil., Ph.D., Registrar**, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for extending invaluable help.

My sincere thanks go to **Dr. (Mrs.) K. Manimozhi, M.Sc., B.Ed., M.Phil., Ph. D., Controller of Examinations,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for her support, encouragement and cooperation rendered towards the completion of this research.

I express my sincere thanks to **Dr. (Mrs.) P. Lalitha, M.Sc., M.Phil., Ph.D., Director (Research and Consultancy),** Avinashilingam Institute for Home Science and Higher Education for women, Coimbatore for her spontaneous help and amenities provided for the successful completion of this research work

I extend a very special gratitude to **Dr. (Mrs.) Padmavathi M.Sc., M.Phil., Ph.D., Dean, School of Physical Science and Computational Sciences**, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for her timely help and encouragement in carrying out the research work.

My thanks are due to **Dr. (Mrs.) S. N. Geethalakshmi, MCA, M.Phil., Ph.D., Professor and Head, Department of Computer Science,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for her support, timely help, encouragement and cooperation rendered towards the completion of this research.

I am deeply indebted to my Supervisor **Dr. (Mrs.) V. Radha, M.Sc., PGDCA, PGDOR, B.Ed., M.Phil., Ph.D., Professor, Department of Computer Science,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. Her unstinting guidance, immense patience, insightful feedback, and relentless motivation contributed greatly towards the completion of my research work. I consider it a privileged opportunity to undergo my Doctoral Degree Programme under her able guidance. My heartfelt gratitude and thanks are to her for converting my dreams into reality.

I thank the Doctoral Committee Member **Dr. Kumudha Raimond, Professor, Department of Computer Science**, Karunya University, Coimbatore for having helped me in fine-tuning my research work through her valuable discussions, comments and suggestions as a Doctoral Committee Member.

I accord my warm thanks to all the **FACULTY MEMBERS, NON-TEACHING STAFF and RESEARCH SCHOLARS** of the Department of Computer Science, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for their encouragement and support.

Words fail to express my deepest indebtedness to my loving **PARENTS, MY SISTER**, **MY HUSBAND** and **MY DAUGHTER** for being the motivating forces by providing moral support and encouragement in carrying out my research work.

Above all, all praise and gratitude are due to **GOD ALMIGHTY** for showering His benevolent blessings on me. By His grace I had the strength, help and the ability to complete this Ph.D. Research Programme successfully.

Saranya Vijayan

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LIST OF ABBREVIATIONS

Abbreviation	Description
• AHE	Adaptive Histogram Equalization
• AI	Artificial Intelligence
• ALL	Acute Lymphoblastic Leukemia
• ALL-C	Acute Lymphocytic Leukemia Classification
• AML	Acute Myelogenous Leukemia
• ANN	Artificial Neural Networks
• BackGround	BG
• Bagging	Bootstrap Aggregating
• C	Color Feature
• CLAHE	Contrast Limited Adaptive Histogram Equalization
• CLL	Chronic Lymphoblastic Leukemia
• CML	Chronic Myelogenous Leukemia
• CNN	Convolutional Neural Network
• CNN-ESVM	Hybrid CNN and Ensemble SVM
• CNN-ESVM-DCS	Hybrid CNN and Ensemble SVM Using DCS
• CNN-ESVM-DES	Hybrid CNN and Ensemble SVM Using DES
• CNN-SVM	Hybrid CNN and SVM
• CSA-WBC	Combined Segmentation Algorithm for WBC Identification
• CSA-WBC	Combined Segmentation Algorithm for WBC Identification
• D4	Daubeschies Wavelet Transformation
• DL	Deep Learning
• DLC	Deep Learning Classifier / Deep Learning Classification
• DNN	Deep Neural Networks
• DT	Decision Tree
• DWT	Discrete Wavelet Transformation
• DWT-KSVD	Hybrid DWT and KSVD-Based Denoising Algorithm

Abbreviation	Description
• EC	Ensemble Classifier
• ECS	Ensemble Classification System
• EEE-SF	Enhanced Edge Enhancement Algorithm Using Sigmoid Function
• EE-SF	Edge Enhancement Algorithm Using Sigmoid Function
• ESVM	Ensemble System Based on SVM
• ESVM-DCS	ESVM using DSC
• ESVM-DES	ESVM using DES
• ESVM-EDCS	ESVM using Enhanced DCS
• ESVM-EDES	ESVM using Enhanced DES
• EWS-WBC	Enhanced Watershed Segmentation Algorithm to Identify WBC
• F	Optimal Feature Vector
• FN	False Negative
• FoM	Figure of Merit
• ForeGround	FG
• FP	False Positive
• GLCM	Gray-Level Co-occurrence Matrices
• HE	Histogram Equalization
• HH	High High wavelet subband
• HL	High Low wavelet subband
• HVS	Human Visual System
• I	Irregularity of the Nucleus Boundary Feature
• IR	Irrelevant features
• JPEG	Joint Photographic Experts Group
• KM-WBC	KMeans Clustering Algorithm to Identify WBC
• KNN	K-Nearest Neighbour
• K-SVD	K-Singular Value Decomposition
• LH	Low High wavelet subband
• LL	Low Low wavelet subband

Abbreviation	Description
• MF	Markov Filter
• ML	Machine Learning
• MLC	Machine Learning Classifier / Machine Learning Classification
• MLP	MultiLayer Perceptron
• MRMR	Minimum Redundant Maximum Relevant
• MSE	Mean-Squared Error
• MSSI	Mean Structural Similarity Index
• NN	Neural Networks
• NR	non-redundant features
• PFKM	Parameterless Fast K-Means Clustering
• PFKM-WBC	Parameterless Fast KMeans Clustering Algorithm to Identify WBC
• PSNR	Peak Signal to Noise Ratio
• R	Redundant features
• RBC	Red Blood Cells
• RBF	Radial Basis Function
• Re	Relevant features
• ReLu	REctified Linear Units
• RF	Random Forest
• RoC	Region of Competence
• ROI	Region of Interest
• S	Shape Feature
• SEM	Scanning Electron Microscopy
• SFV	Super Feature Vector
• SRe	Strongly Relevant features
• SVD	Singular Value Decomposition
• SVM	Support Vector Machine

Abbreviation	Description
• T	Texture Feature
• TN	True Negative
• TP	True Positive
• UCED	Unified Contrast adjustment, Edge enhancement and Denoising Algorithm
• WBC	White Blood Cells
• WM	Weight Matrix
• WRe	Weakly Relevant features
• WS-WBC	Watershed Segmentation Algorithm to Identify WBC