



# Malignant Lymphoma Classification

Graduation Project (2021/2022)

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# Main topics

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# Problem Definition

- Lymphoma is a cancer that begins in infection-fighting cells of the immune system, called lymphocytes.
- Only the most expert pathologists specializing in these types of lymphomas are able to consistently and accurately classify its subtypes.
- There are two main types of lymphoma: Non-Hodgkin and Hodgkin.

# Objective

- Classify the Non-Hodgkin subtypes of Lymphoma in order to determine the most suitable diagnoses.
- Find the best accuracy for the classification.

# Motivation

- Cancer diseases diverse in many body organs.
- Things will be easier by classifying the sample images.
- Trying to use new techniques to help the medical field.
- Using the benefit of the advanced machine learning techniques.
- Trying to help find a cure for Cancer.

# Non-Hodgkin's Lymphoma

- A type of cancer that develops in the lymphatic system.
- The exact cause of non-Hodgkin lymphoma is unknown.
- The most common symptom of it, is a painless swelling in a lymph node.
- The only way to confirm a diagnosis of it, is by carrying out a biopsy.
- The main treatments used for non-Hodgkin lymphoma are:
  - Chemotherapy
  - Radiotherapy

# Types

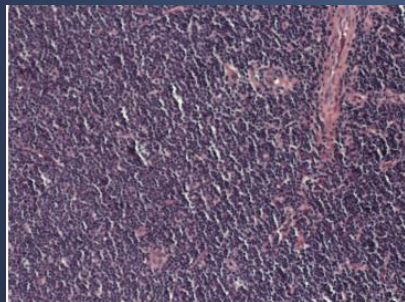
- Focusing on classifying the Non-Hodgkin lymphoma's three types based on CT scans of patients
  1. CLL (Chronic Lymphocytic Leukemia)
  2. FL (Follicular Lymphoma)
  3. MCL (Mantle Cell Lymphoma)



1

## CLL (Chronic Lymphocytic Leukemia)

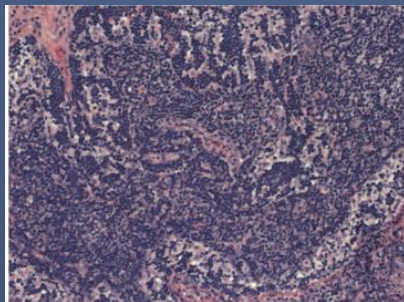
Blood and bone Marrow cancer



2

## FL (Follicular Lymphoma)

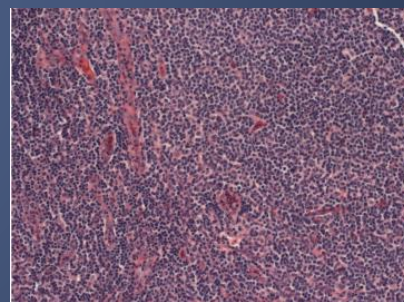
Derived from white blood cells



3

## MCL (Mantle Cell Lymphoma)

B-cell lymphoma that develops from malignant B-lymphocytes



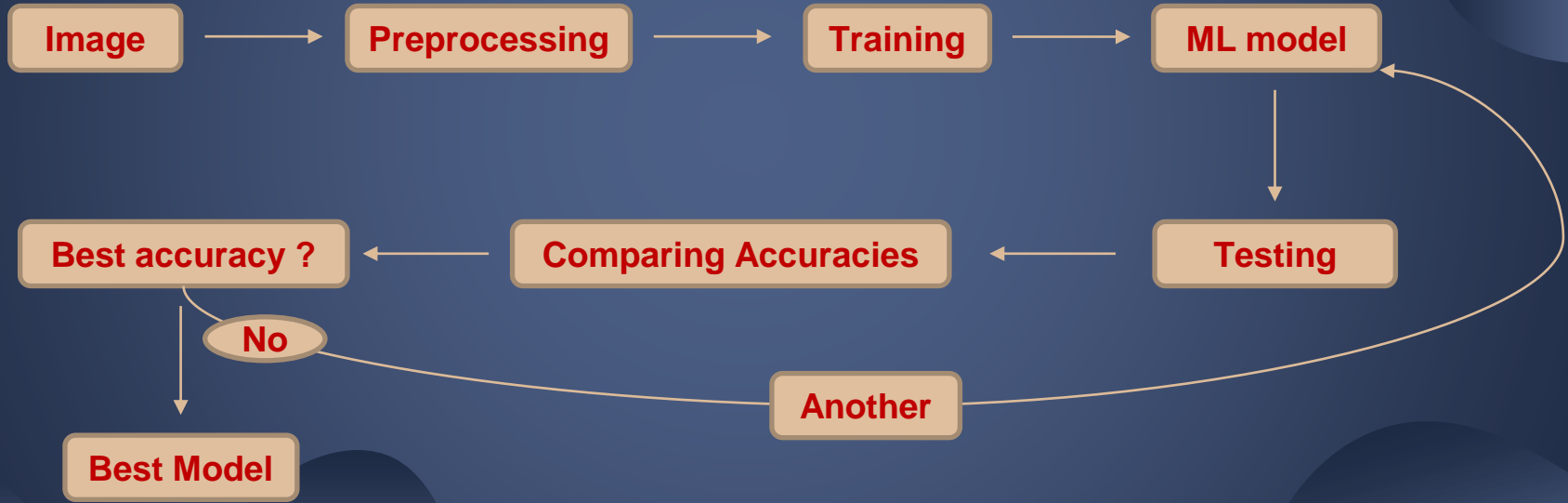
# Data Preprocessing

- Acquiring good dataset to work on.
- Import all the crucial libraries.
- Data Cleaning to ignore noisy images.
- Data normalization ( Feature Scaling)
- Splitting the data into training set 80% and testing set 20%.
- Resizing images to 224x224 to be able to process them in our machine learning classifiers.

# Dataset

- The used dataset is provided by National Institute of Ageing (NIA).
- It includes images of three types of lymphoma: FL, CLL and MCL.
- The data was collected from various sites to introduce a high variation to the dataset.
- This dataset is 374 images.
- Resolution: 1388 X 1040 px.
- 112 images belong to CLL, 140 to FL and remaining 124 to MCL.

# Project stages (Phase 1)



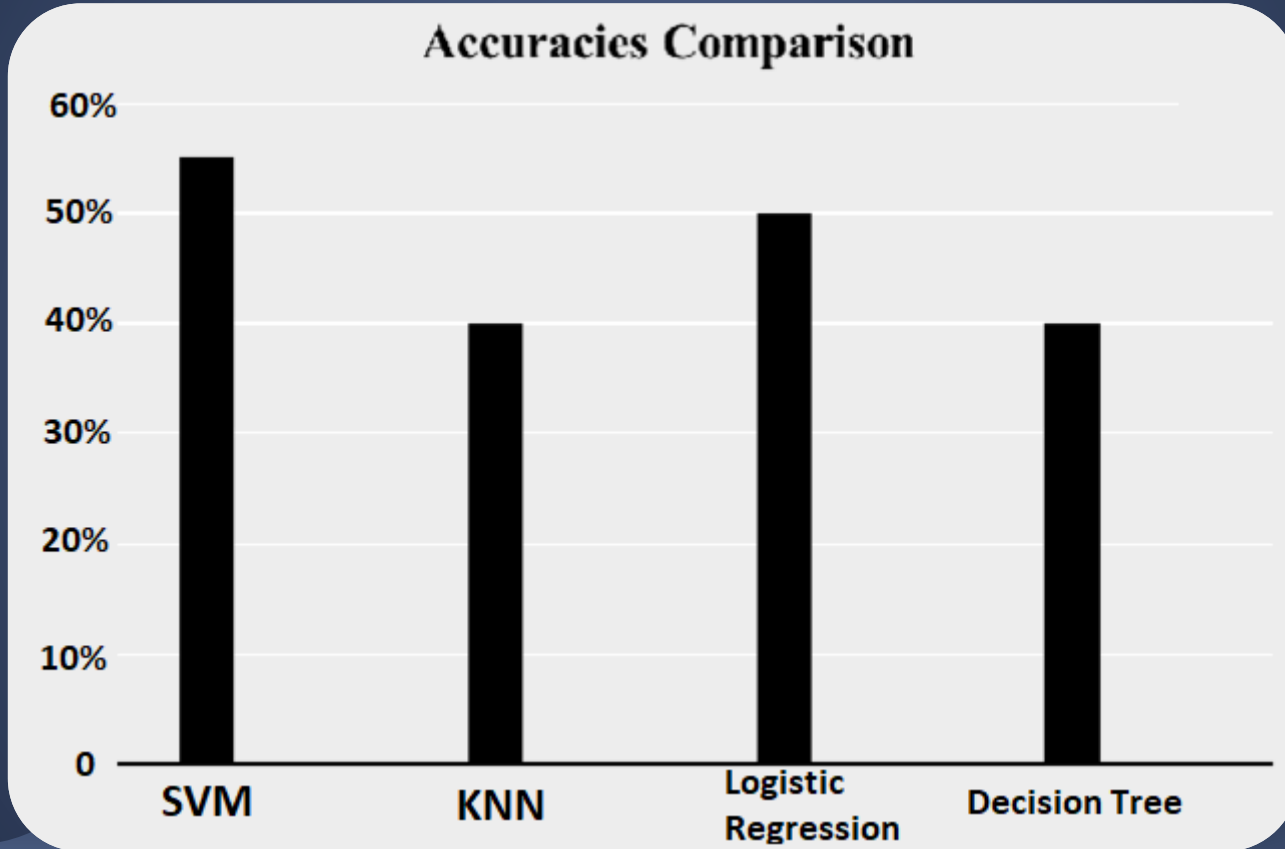
# Time Plan

[illegible]

# Classifiers Accuracies

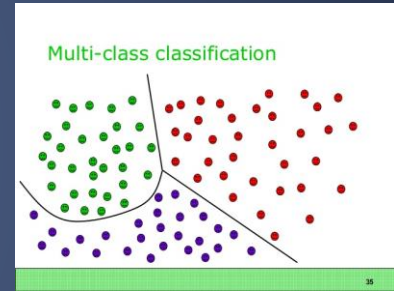
ML Classifier	Accuracy
SVM	55%
Decision Tree	40%
Logistic Regression	50%
KNN	40%

# Classifiers Accuracies



# SVM

- SVM is a very helpful method that we use when we don't have much idea about the data or it's not regularly distributed and have unknown distribution.
- SVM has a nature of Convex Optimization.
- Kernel's trick can solve any complex problem.
- Space of the decision boundary separating the three classes.





# Observations

- The number of images is insufficient.
- Some methods gave low accuracies we can't depend on.
- SVM gives the best accuracy among the different methods (KNN, Logistic Regression, Decision Tree)
- Among different accuracies we got **55%** before Augmentation.

# Conclusion

- Classifying with traditional machine learning techniques isn't good enough
- We decided some decisions which are :
  1. Using data augmentation to increase the number of images.
  2. We are excluding these traditional methods.
  3. Using deep learning instead for better accuracy.
  4. Making our project easy to use by publishing a web App.
- Start working on phase two.

# References

- Malignant Lymphoma Classification | Kaggle
- NHL Pathological Image Classification Based on Hierarchical Local Information and GoogLeNet-Based Representations (nih.gov)
- [https://mdpi-res.com/d\\_attachment/cancers/cancers-13-02419/article\\_deploy/cancers-13-02419.pdf](https://mdpi-res.com/d_attachment/cancers/cancers-13-02419/article_deploy/cancers-13-02419.pdf)
- Deep Learning for the Classification of Non-Hodgkin Lymphoma on Histopathological Images (nih.gov)
- Deep Learning for the Classification of Non-Hodgkin Lymphoma on Histopathological Images - PubMed (nih.gov)

Thank You!