Goal : Build a Hybrid ML architecture for medical image classification(endoscopy images) that can be embedded later
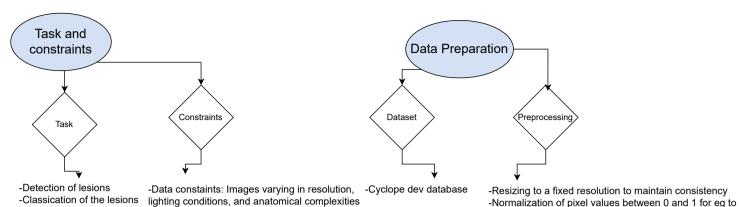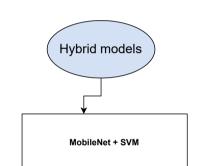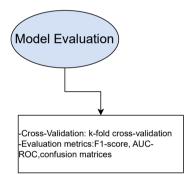
Task and constraints

Task

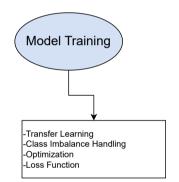-Detection of lesions
-Classication of the lesions
 into polyps/nonpolyps

Constraints

-Data constaints: Images varying in resolution, lighting conditions, and anatomical complexities
-Hardware constraints: processing power (CPU,GPU),memory(RAM, storage), battery life

Data Preparation

Dataset

-Cyclope dev database

Preprocessing

-Resizing to a fixed resolution to maintain consistency
-Normalization of pixel values between 0 and 1 for eg to ensure stable training
Augmentation:rotation,zoom,brightness adjustments to make the model robust to variations in real world

Model selection

Balance accuracy and efficiency

Light weight DL

-MobileNetV2
-MobileNetV3
-EfficientNet-Lite
-SqueezeNet

Light weight ML

-SVM
-TinyML

Quantization and model optimization

-Quantizationon 16bit/8bit
-Pruning
-Knowledge Distillation

Hybrid models

MobileNet + SVM

Used in medical image analysis research, less common in endoscopy

Model Evaluation

-Cross-Validation: k-fold cross-validation
-Evaluation metrics:F1-score, AUC-ROC,confusion matrices

Model Training

-Transfer Learning
-Class Imbalance Handling
-Optimization
-Loss Function

Model Architecture

Given the constraint of an embedded system, the model architecture should prioritize efficiency while mainting accuracy

-Input layer: Accepts preprocessed endoscopic images
-Feature extraction layer: lightweight CNN
-Global Average pooling: to reduce the number of parameters and prevent overfitting, instead of fully connected layers
-Classification Head : Add a few dense layers followed by a softmax layer to classify the extracted features
-Output : the predicted class label