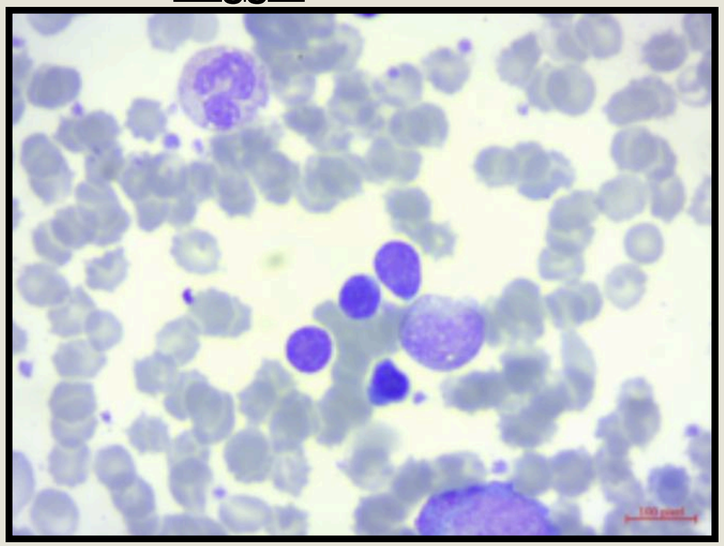
Leukemia Classification

A presentation by Zaky Ashari

Dataset Overview

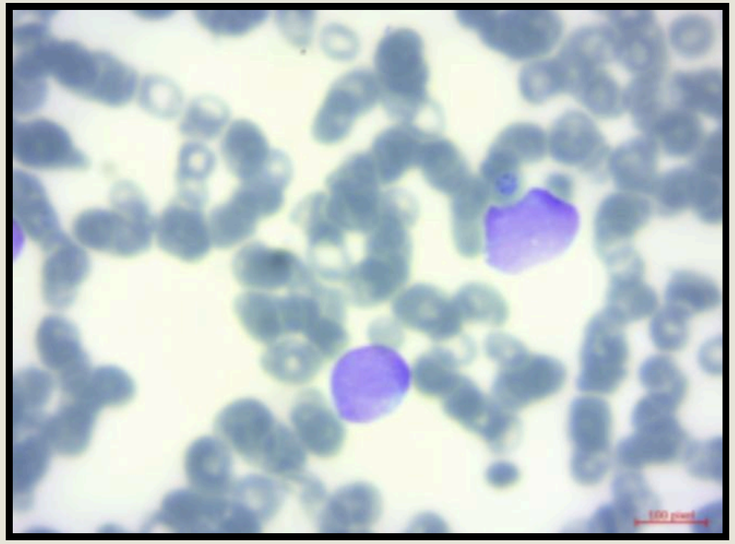
"Acute lymphoblastic leukemia (ALL) is a rare but aggressive cancer."
(www.medpagetoday.com)

Source: Kaggle



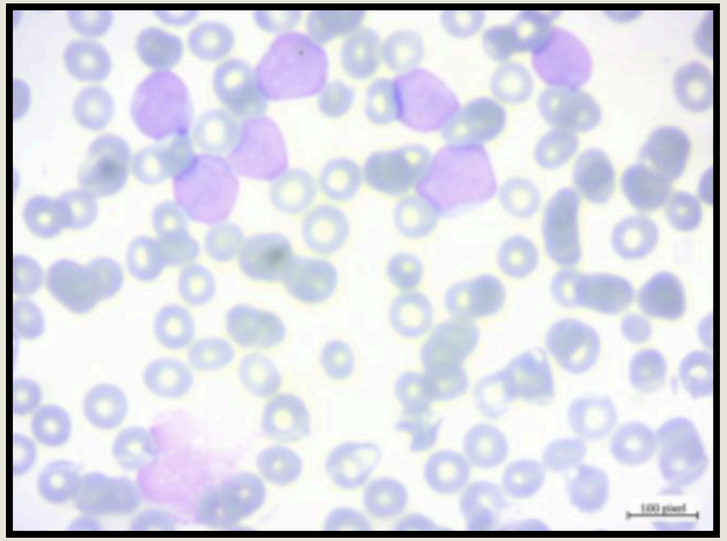
NORMAL - 512 images

- Normal distribution of mixed of RBC and WBC
- Darker WBC (dark purple) means it is a mature cells and has condensed DNA



PRE-B - 955 images

- Larger WBC
- Open Chromatin

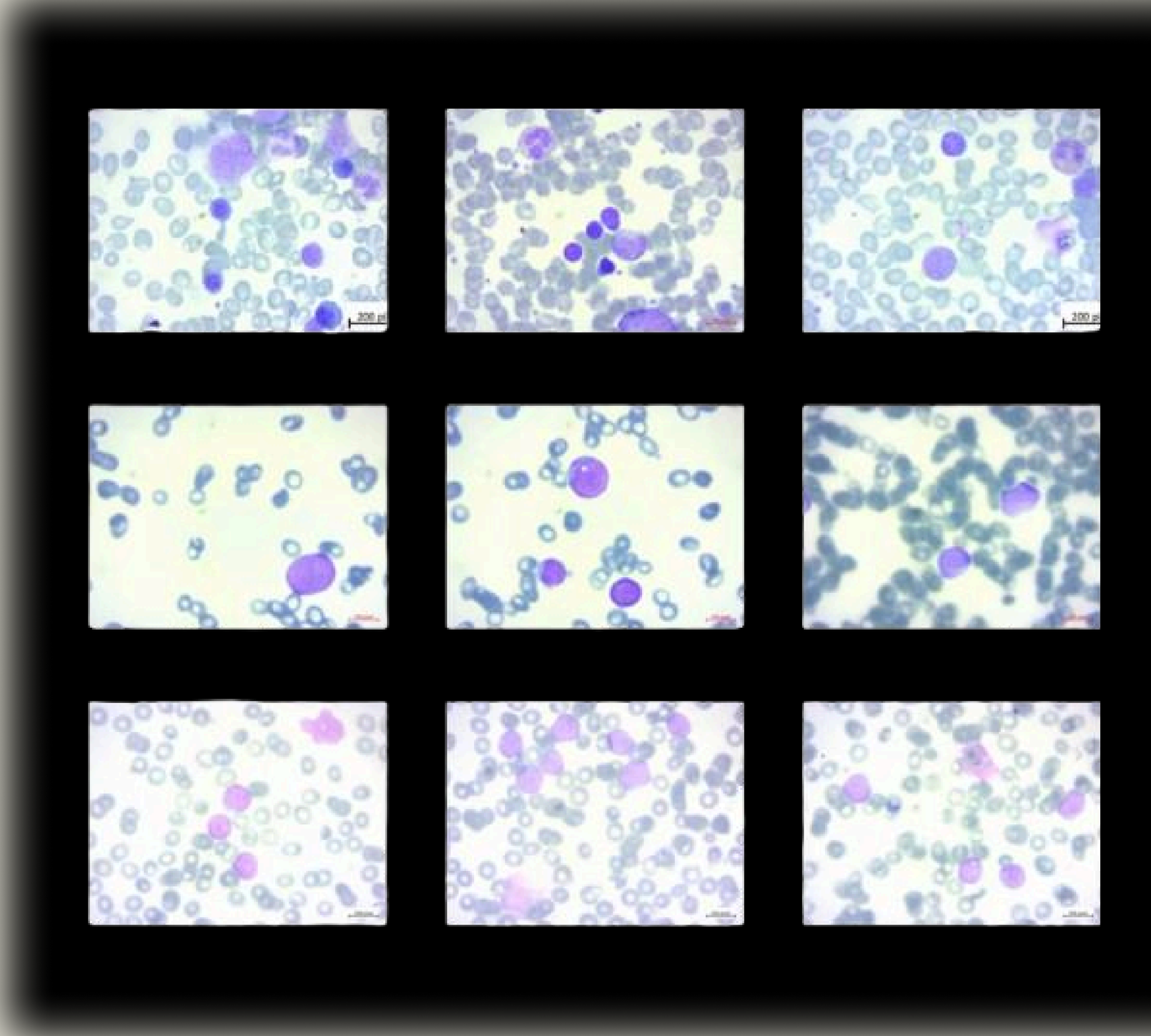


PRO-B - 796 images

- Less Condensed DNA (ligh purple), indicating Immature WBC
- Smaller than Pre-B WBC

Processing Pipeline

- blast-cell extraction
- Resize
- Rescale
- Ori-Mask Pairing
- Splitting
- Augmentation



Processing Pipeline

- **blast-cell extraction**
- Resize
- Rescale
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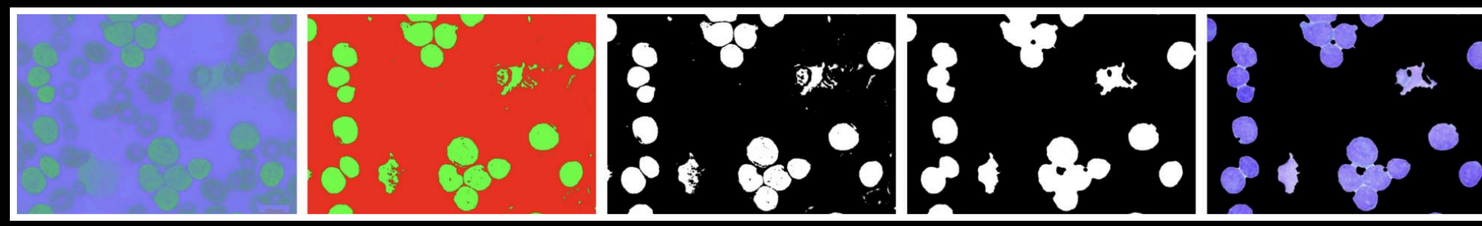
- Augmentation

1. **LAB Conversion**
   - Convert BGR→LAB to exploit perceptual color uniformity.
2. **K-Means Clustering**
   - Cluster the A channel (green–red axis) into 2 groups (K=2).
   - Color-visualize clusters as red/green overlay.
3. **Binary Thresholding**
   - Choose the cluster with higher mean A (more purple) as the blast mask
4. **Morphological Cleaning**
   - Open (3×3 ellipse) then Close (7×7 ellipse) to remove noise and fill holes
5. **Size Filtering & Imposition**
   - Drop connected components smaller than MIN_SIZE = 500 px.
   - Apply the cleaned mask back to the original image (bitwise AND).



Processing Pipeline

- blast-cell extraction
- **Resize**
- **Rescale**
- Ori-Mask Pairing
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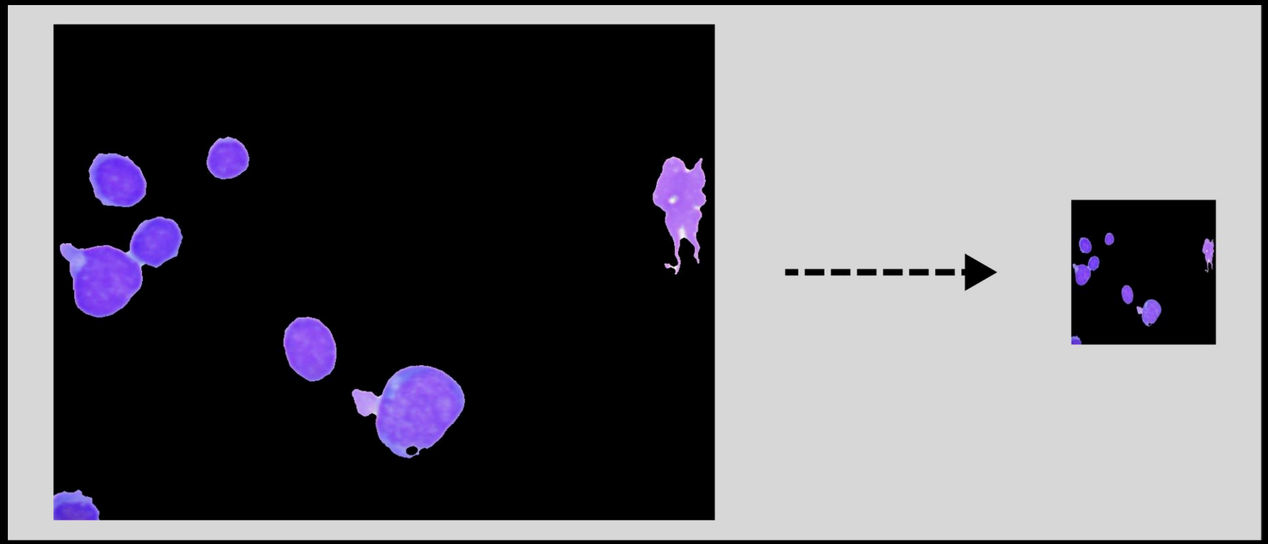
A. Resize to 224×224

- **Purpose:** Match CNN input size (EfficientNetB0, MobileNetV2, etc.).

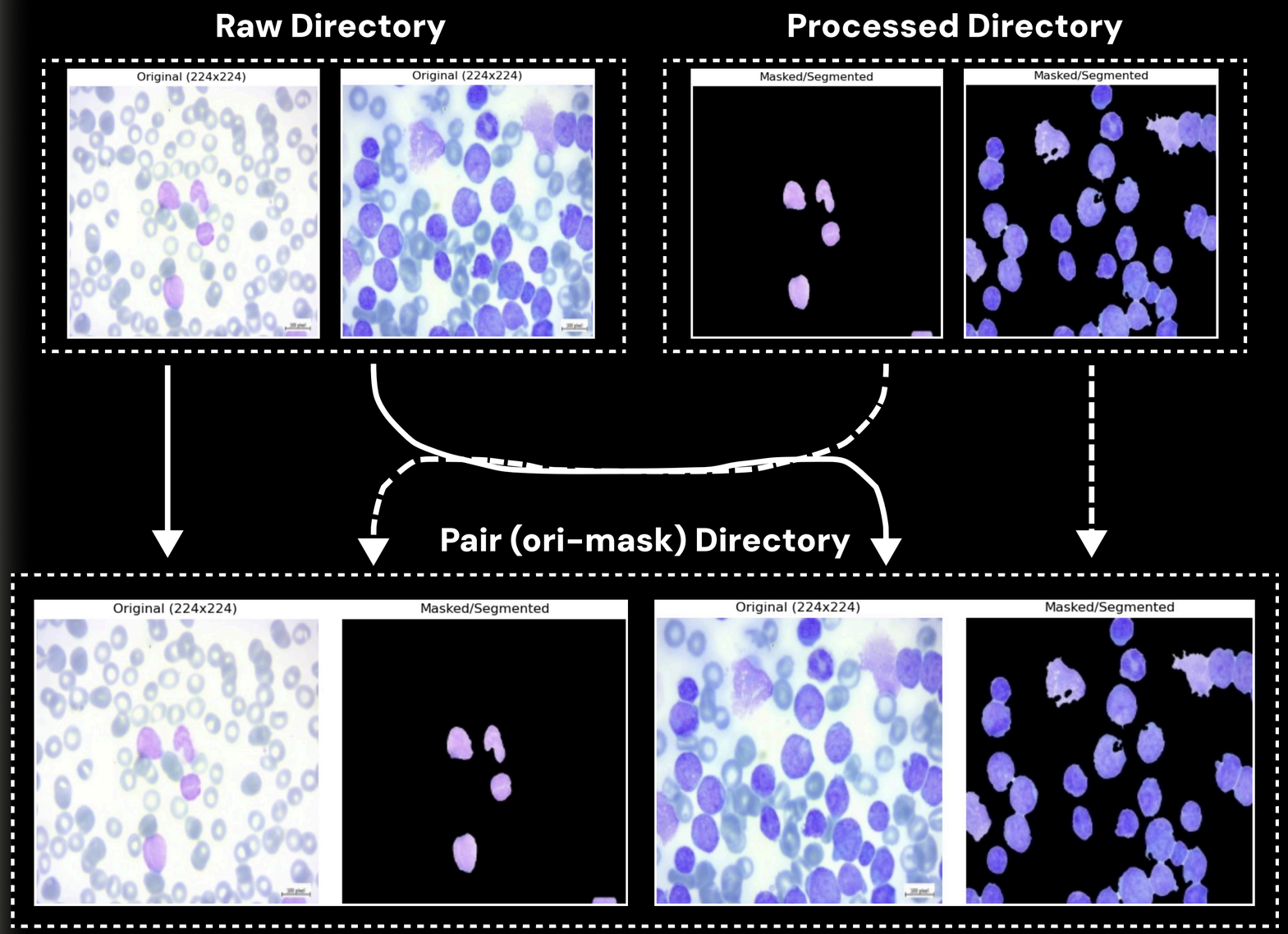
B. Rescale Pixel Values

- Converts [0–255] → [0–1] by dividing by 255.



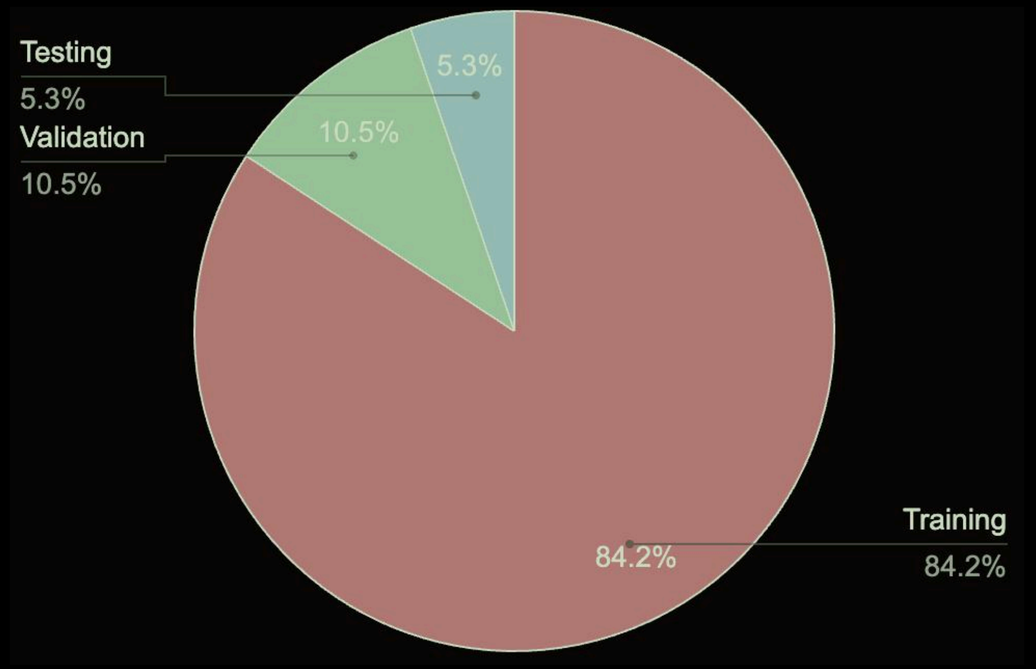
Processing Pipeline

- blast-cell extraction
- Resize
- Rescale
- **Ori-Mask Pairing**
- Splitting
- Augmentation



Processing Pipeline

- blast-cell extraction
- Resize
- Rescale
- Ori-Mask Pairing
- **Splitting**
- Augmentation

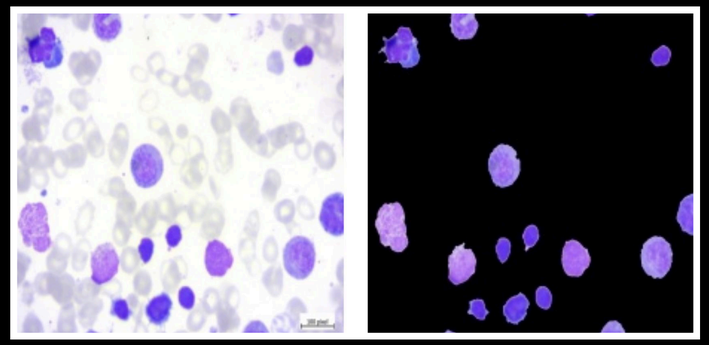


- **Ratios:** 85% train, 5% test, 10% validation on paired files.
- **Data Leakage Prevention:** Strips prefixes to get unique basenames, shuffles, floors split counts, then copies both ori_ and mask_ versions into each subset to prevent data leakage

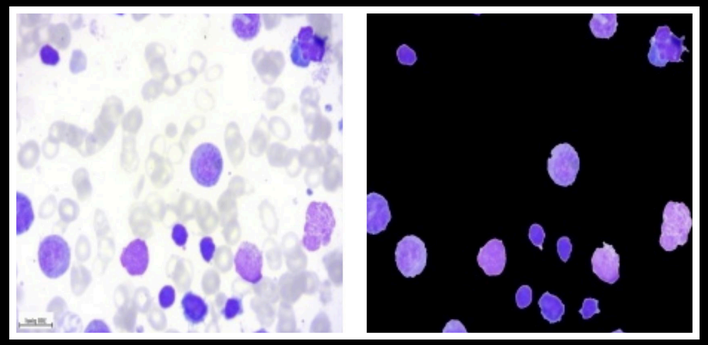
Processing Pipeline

- blast-cell extraction
- Resize
- Rescale
- Ori-Mask Pairing
- Splitting
- **Augmentation**

Original



Augmented



- **Target:** bring all training classes up to the size of the largest (811 pairs).
- **Method:** For each class with fewer than 811, performs random horizontal or vertical flips on randomly chosen existing train images—applying the same flip to both original and mask

Model Architectures

4 CNN

EfficientNet-B0
MobileNetV2
NASNet Mobile
Custom Dual Channel Model

3 YOLO

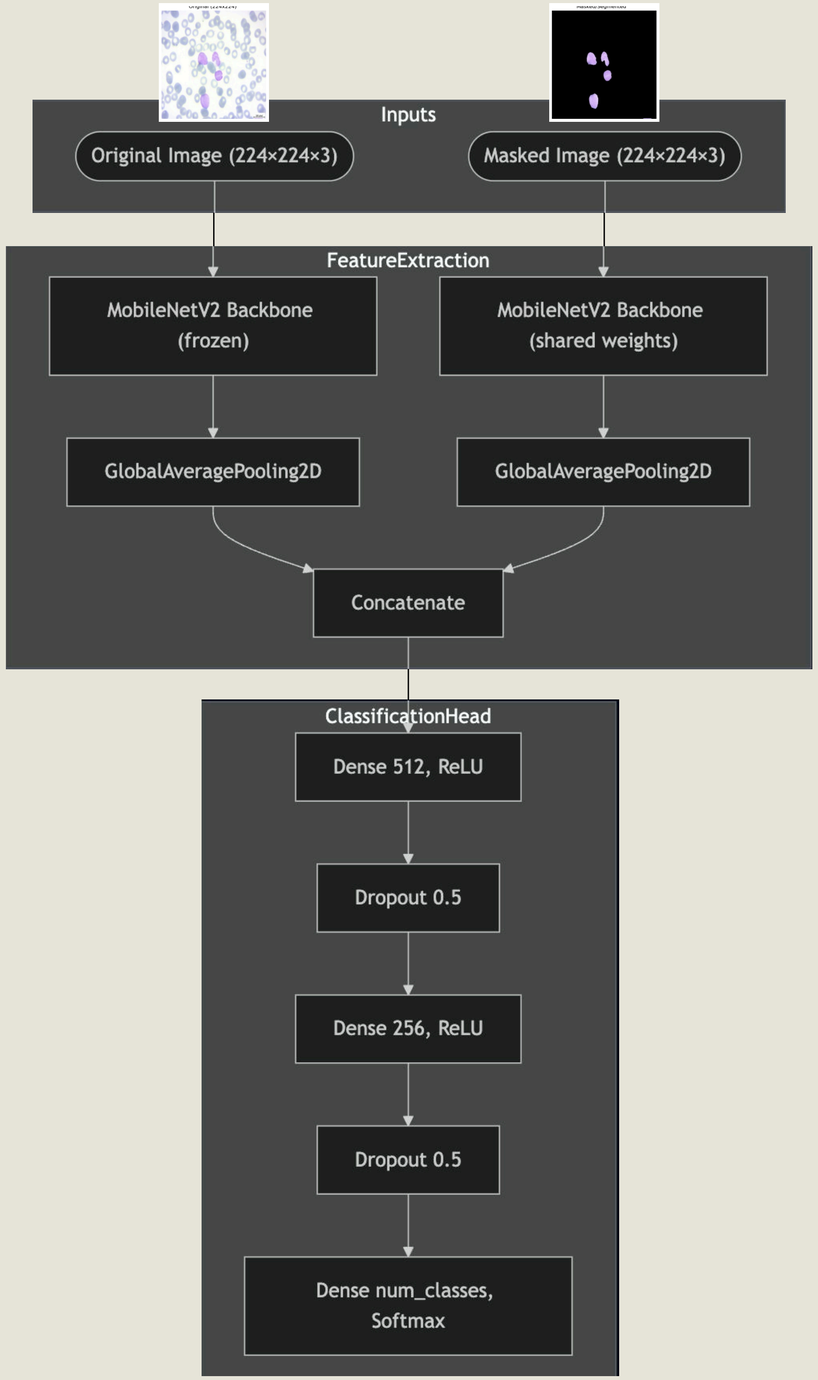
YOLOv8
YOLOv11
YOLOv12

Model Architectures

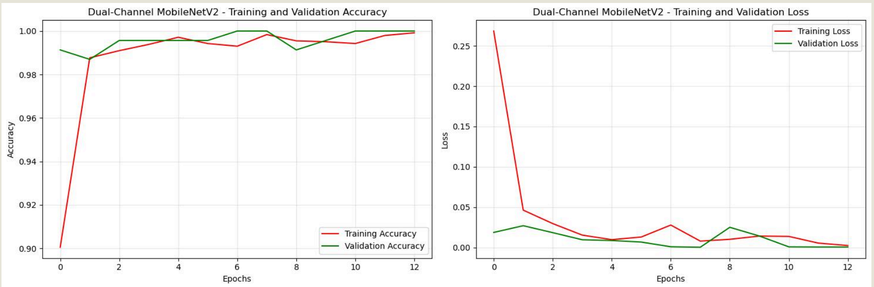
Custom Model

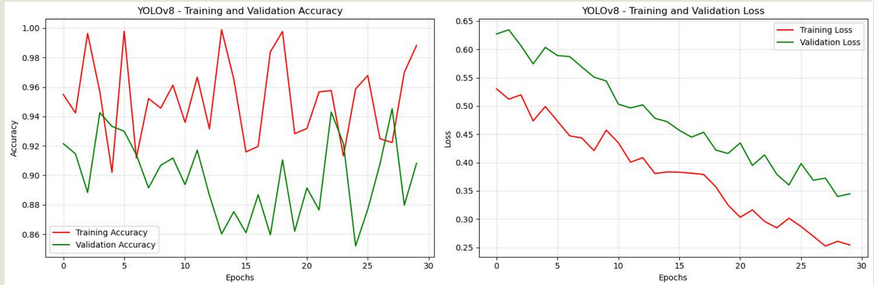
Three main parts:

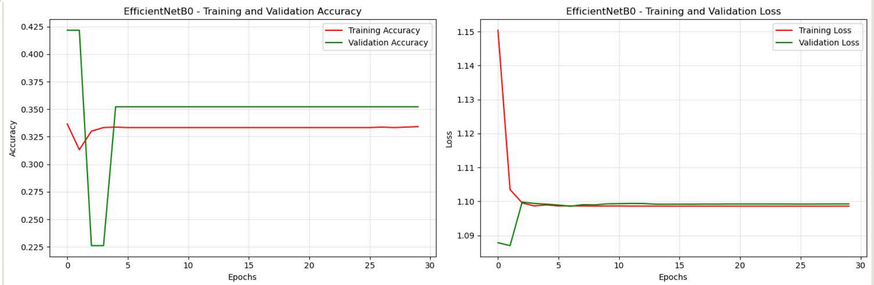
- **Dual-Input Stem**
  Two parallel inputs—an original RGB image and its segmented counterpart—each passed through the same frozen MobileNetV2 backbone (3×3 conv + 19 inverted residual blocks).
- **Body (Feature Extraction & Fusion)**
  Each branch produces a 1,280-dim feature vector via global average pooling; these two vectors are then concatenated into a single 2,560-dim representation.
- **Head (Classification)**
  The fused features flow through Dense(512→ReLU) → Dropout(0.5) → Dense(256→ReLU) → Dropout(0.5) → Dense(num_classes→Softmax), yielding the final class probabilities.

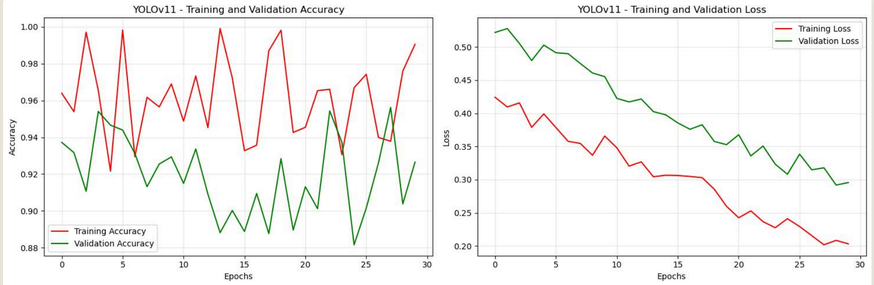


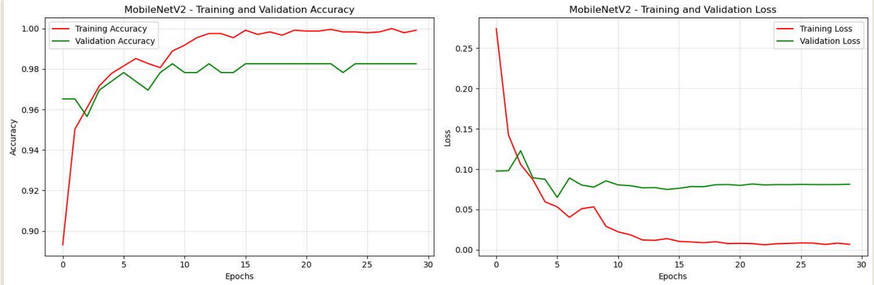
Training Model Performances

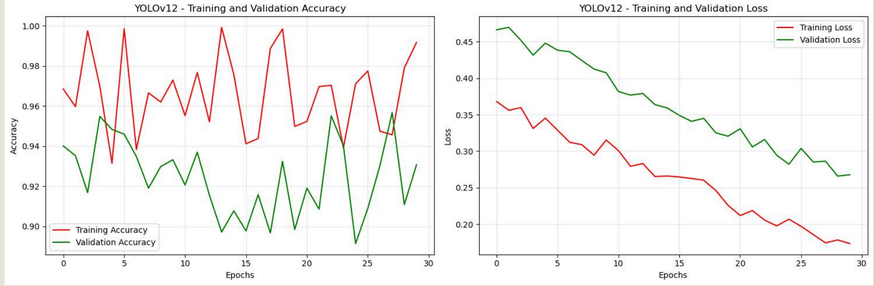


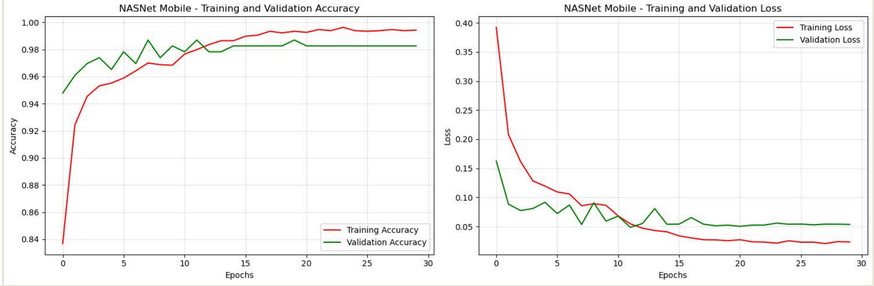




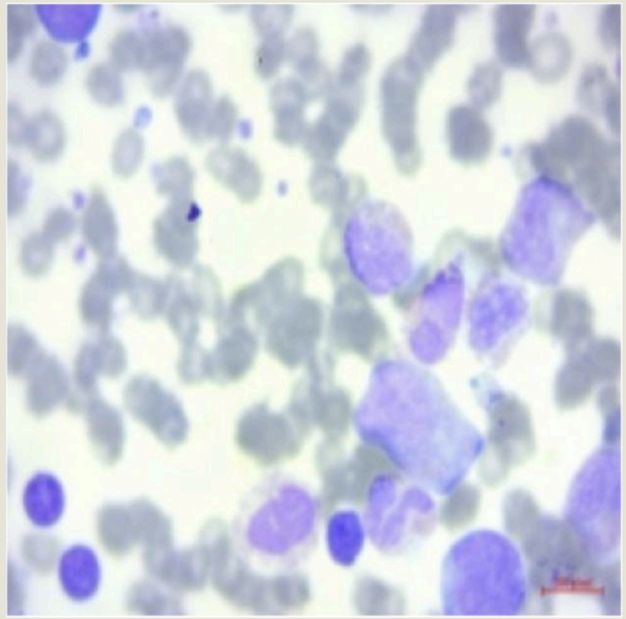






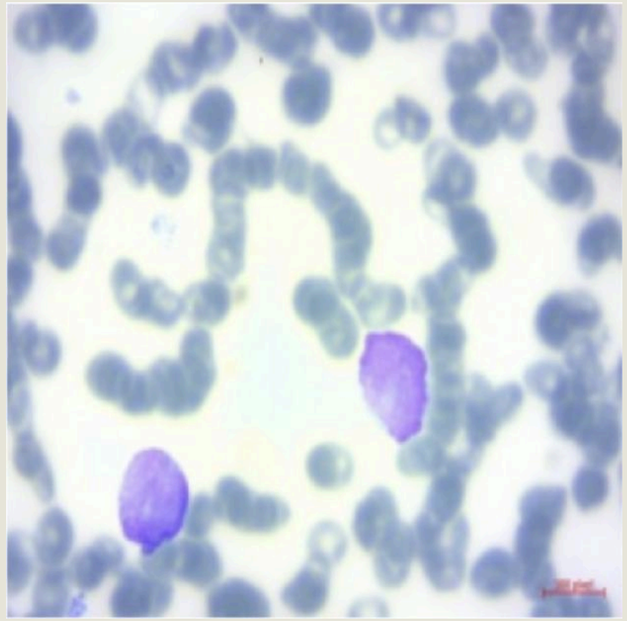


Model Performances – Unseen Data (New Data)



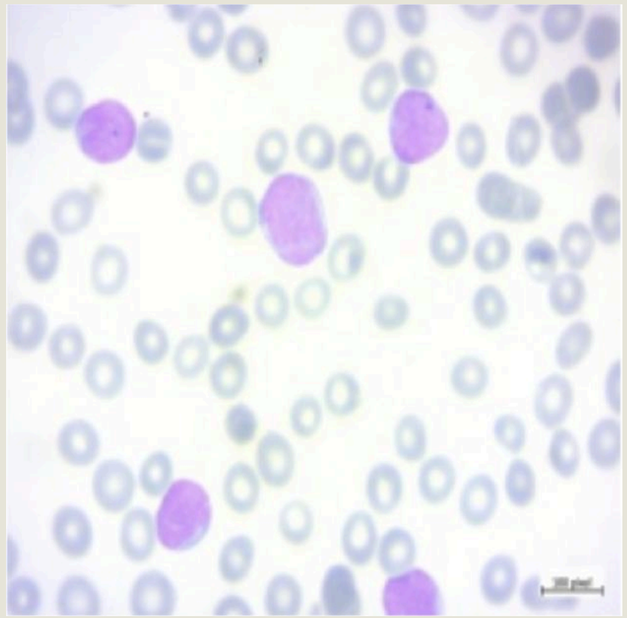
Models	True Label	Prediction	Confidence Score
EfficientNetB0	Normal	Pre-B	34.90%
MobileNetV2		Normal	68.10%
NASNet Mobile		Pre-B	99.61%
Dual-Channel		Normal	100.00%
YOLOv8		Normal	99.97%
YOLOv11		Normal	91.17%
YOLOv12		Normal	99.96%

Model Performances – Unseen Data (New Data)



Models	True Label	Prediction	Confidence Score
EfficientNetB0	Pre-B	Pre-B	34.87%
MobileNetV2		Pre-B	91.60%
NASNet Mobile		Pre-B	63.87%
Dual-Channel		Pre-B	96.49%
YOLOv8		Pre-B	94.29%
YOLOv11		Pre-B	86.10%
YOLOv12		Pre-B	96.95%

Model Performances – Unseen Data (New Data)



Models	True Label	Prediction	Confidence Score
EfficientNetB0	Pro-B	Pre-B	34.88%
MobileNetV2		Pro-B	100.00%
NASNet Mobile		Pro-B	99.95%
Dual-Channel		Pro-B	100.00%
YOLOv8		Pro-B	100.00%
YOLOv11		Pro-B	100.00%
YOLOv12		Pro-B	100.00%

Test Accuracy

Model	Test Accuracy
YOLOv8	1.000000
YOLOv11	1.000000
YOLOv12	1.000000
MobileNetV2	0.990991
Dual-Channel	0.990991
NASNet Mobile	0.963964
EfficientNetB0	0.351351

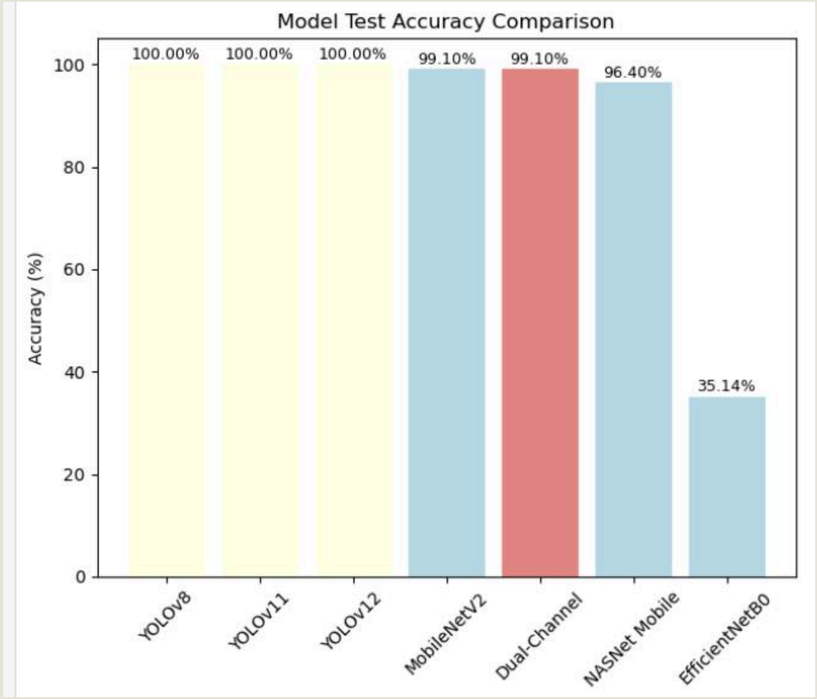
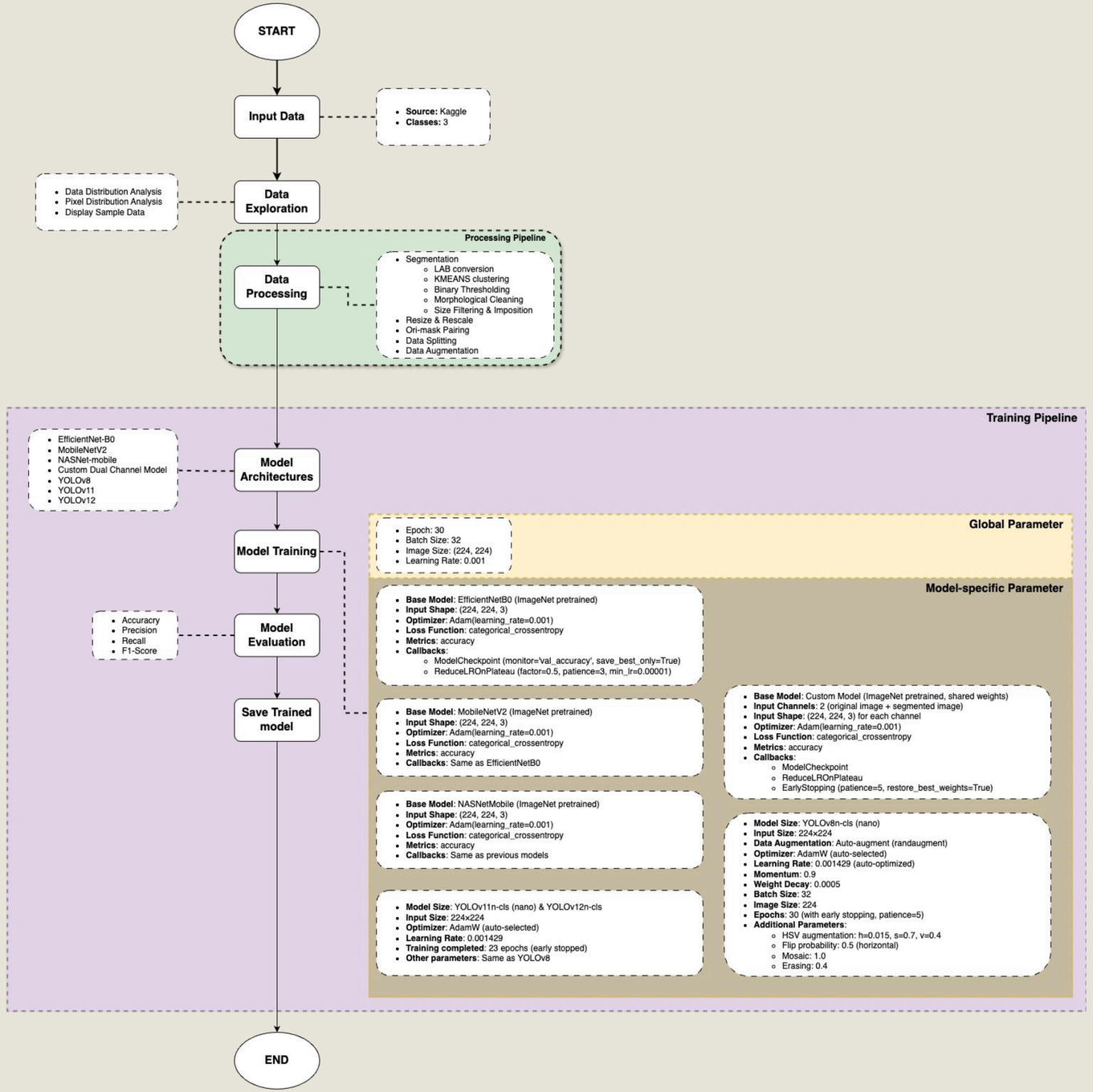


Diagram Flow



THANK YOU