White Blood Cell Differential Counting via Tiny YOLO

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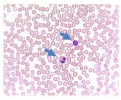
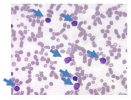
Motivation

- White blood cell (WBC) density and relative abundances are quantitative indications of our immune system state [1]



Healthy Patient[2]



Leukemic Patient[2]

- Current methods to count WBCs are done manually or via expensive flow cytometers[3]
- **Goal: Automate counting and differentiation of WBCs in microscopic blood smears**

Dataset

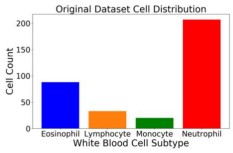
Eosinophil

Lymphocyte

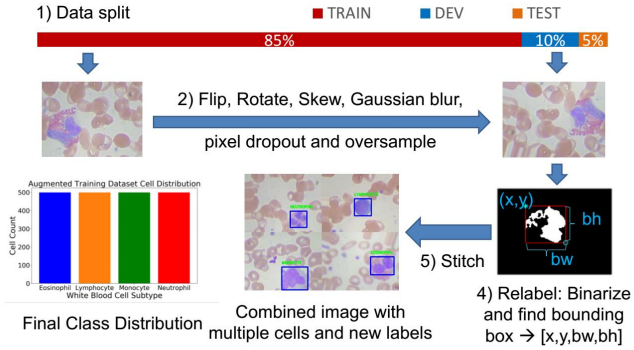
Monocyte

Neutrophil

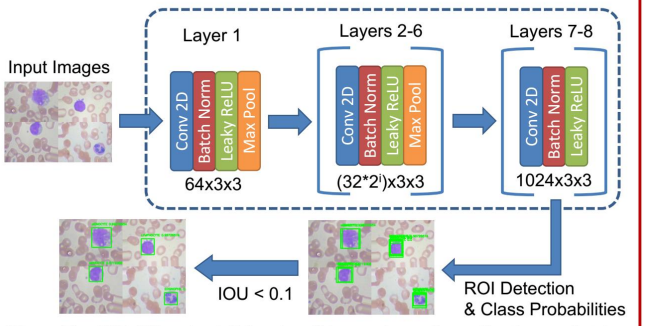
- There are 4 types of white blood cells that we classify and count (left)
- 348 Original 640 x 480 Images of single WBC surrounded by red blood cells[4]
- Skewed distribution of cells with many more neutrophils than others (bottom)
- Cell types pre-labeled by folder separation



Data Pre-Processing



Tiny YOLO Model

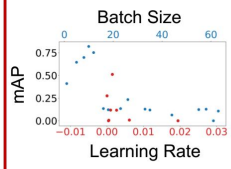


Chose Tiny YOLO[5] as best fit for classifying and counting cells of a small dataset

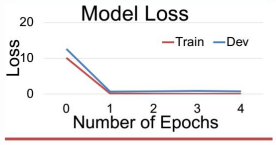
Results

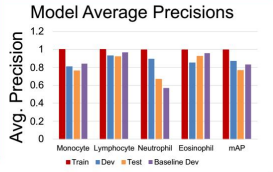
Hyperparameter Sweep

- Course grid search with 2000 training images and 200 validation images and fine random search with all train images
- Swept: Learning rate, batch size, momentum, etc.



	mAP	Multicell?
Baseline	0.835	No
Ours	0.871	Yes





Conclusion

- Made more useful WBC classification model to count cells
- Differentiated count of WBCs with 0.82 mAP on test set

Future Works

- Train the network with a bigger dataset
- Train on images of blood smears containing multiple cells
- Add regularization to reduce overfitting to training set

References

[1] Blumenreich. Clinical Methods.1990.
[2] Carleton. Hematology of Leukemia. 2017.
[3] Peng. Journal of Lab Hematology. 2007.
[4] Mooney. Kaggle. 2018.
[5] Redmon. CVPR. 2016.