

The background of the slide is a microscopic image of several chromosomes. The chromosomes are elongated, thread-like structures with a distinct blue outer boundary and a green internal core. Some chromosomes show internal banding patterns. They are scattered across the frame, with some appearing in the foreground and others in the background, creating a sense of depth. A large, solid black rectangular box is centered on the slide, containing the title and author information in orange text.

Crossing Chromosomes

Image Segmentation on Overlapping Chromosomes

Lily Hu, PhD

What Led Me to this Project

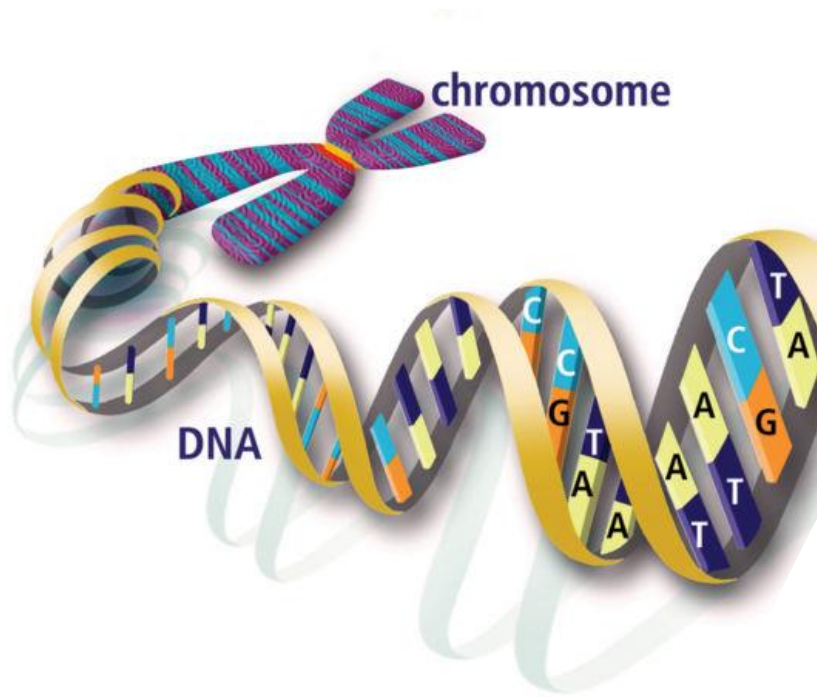


PhD Mechanical Engineering



Machine learning on sensor data for performance and health monitoring

Motivation

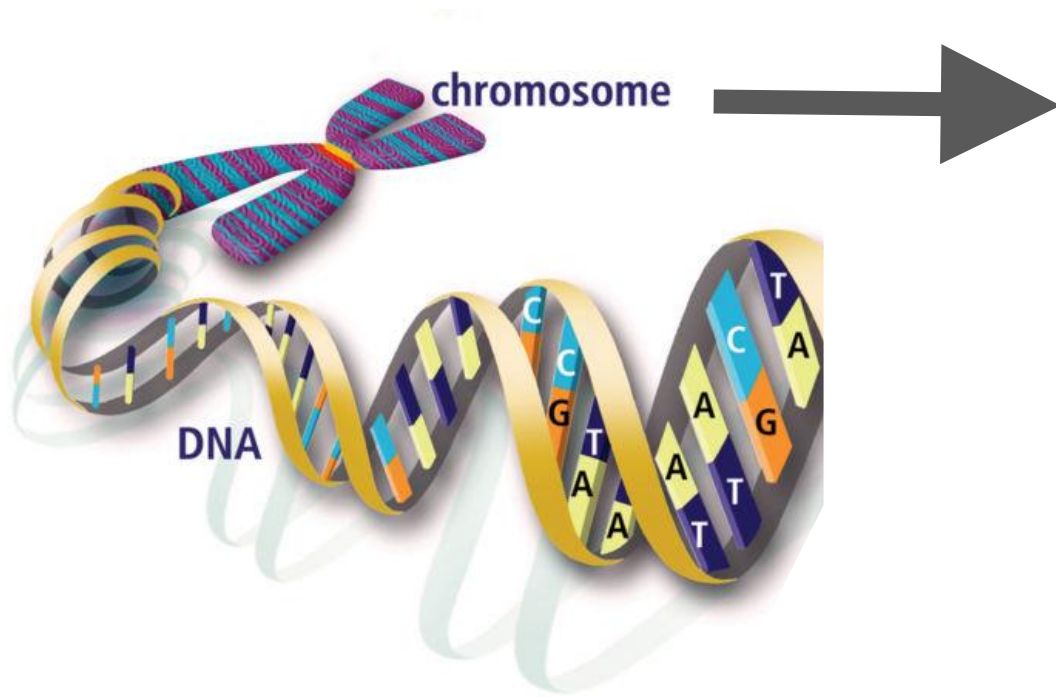


Medical diagnostics

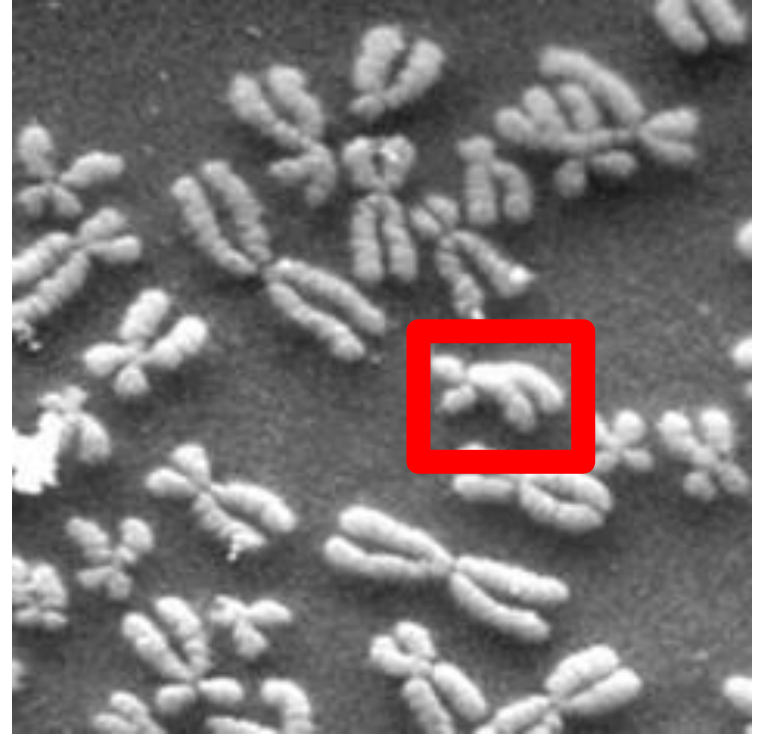
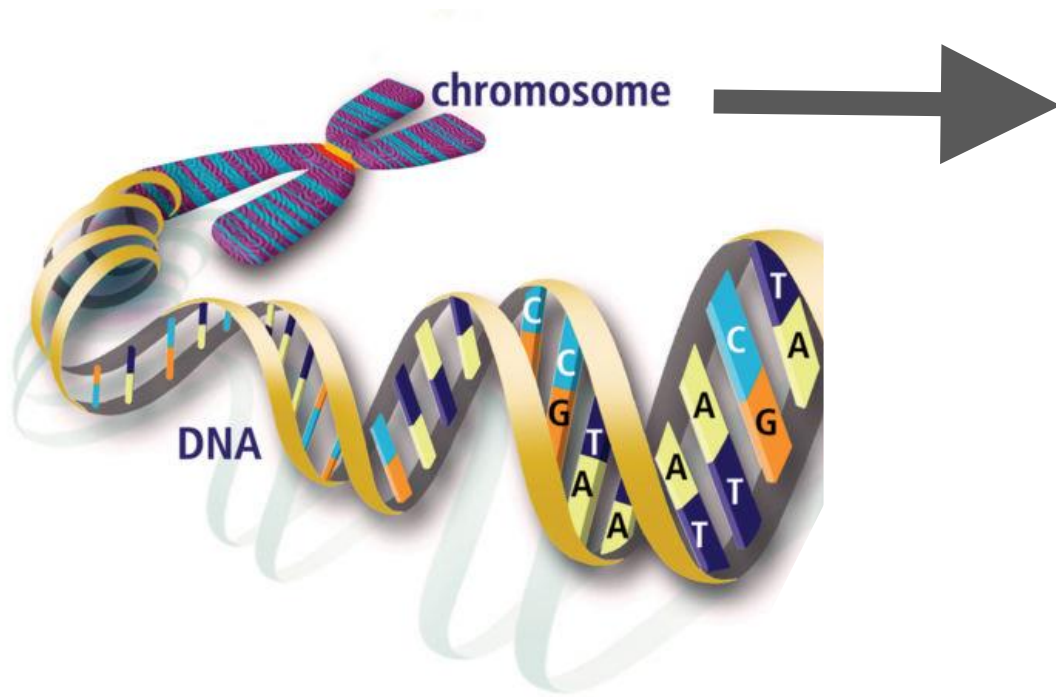
Drug development

Biomedical research

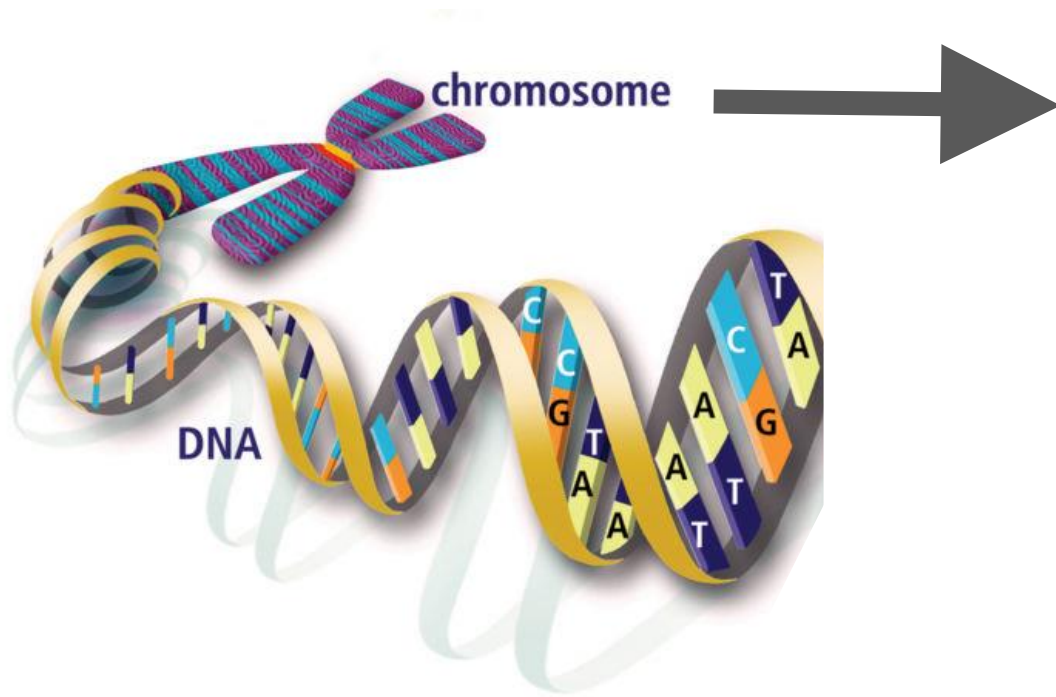
Motivation



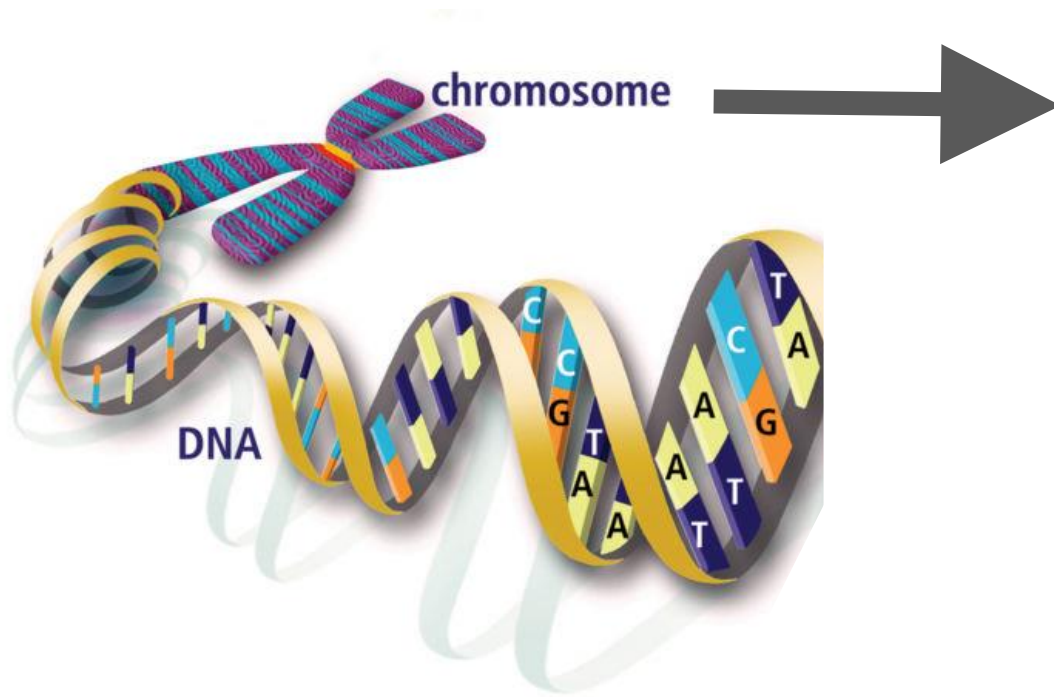
Motivation



Motivation



Motivation

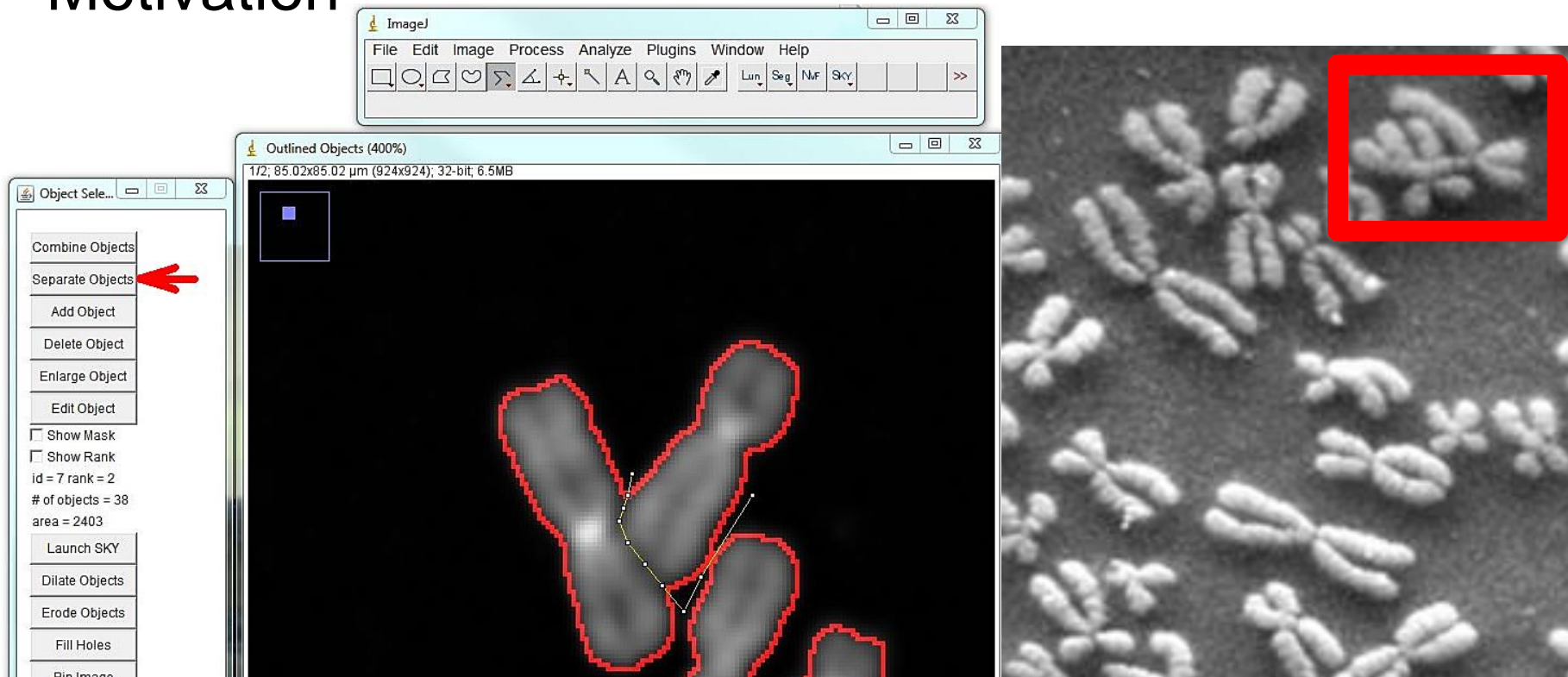


Problem: Overlap

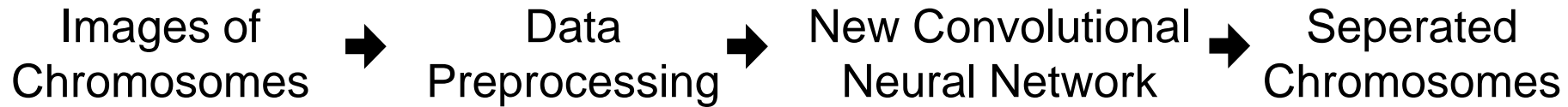


Motivation

Problem: Overlap



http://research.stowers.org/imagejplugins/KISS_analysis.html



Images of
Chromosomes



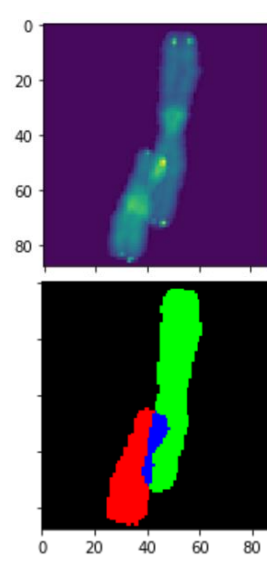
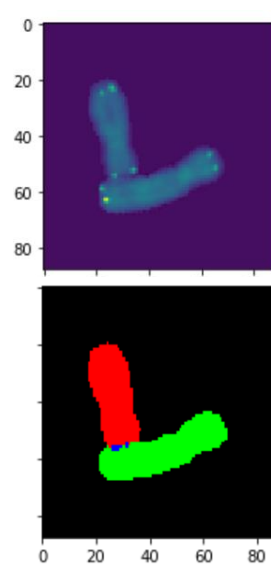
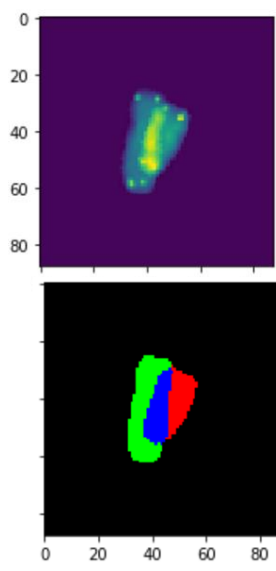
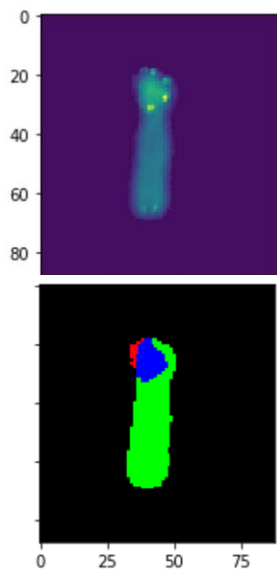
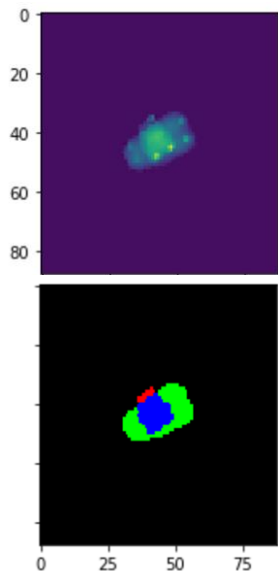
Data
Preprocessing



New Convolutional
Neural Network



Seperated
Chromosomes



Images of
Chromosomes



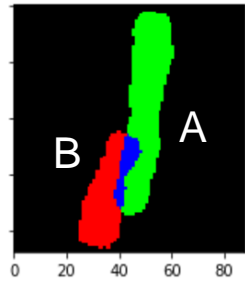
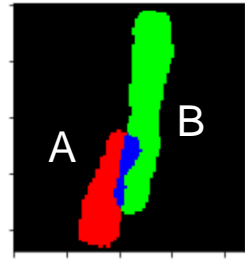
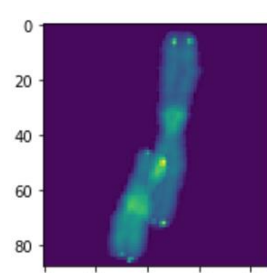
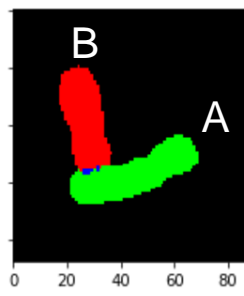
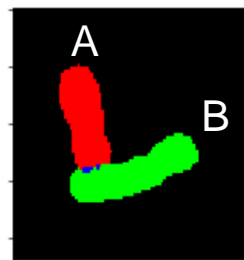
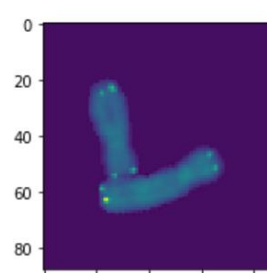
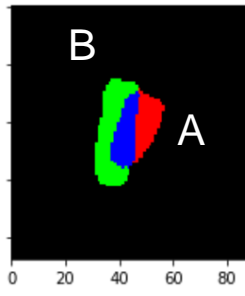
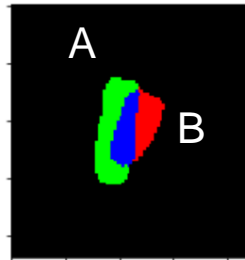
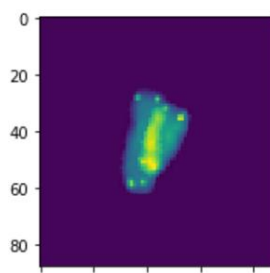
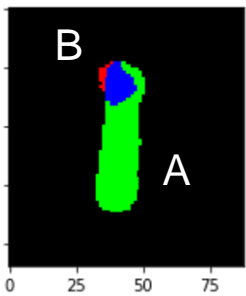
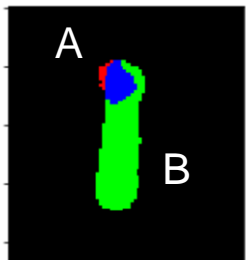
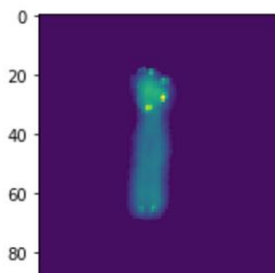
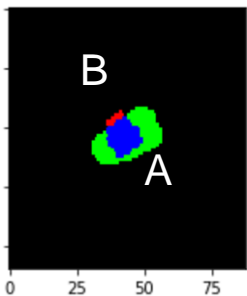
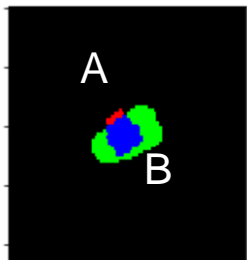
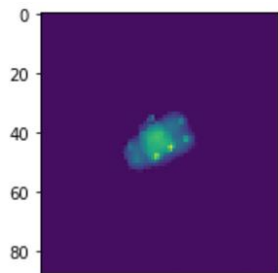
Data
Preprocessing

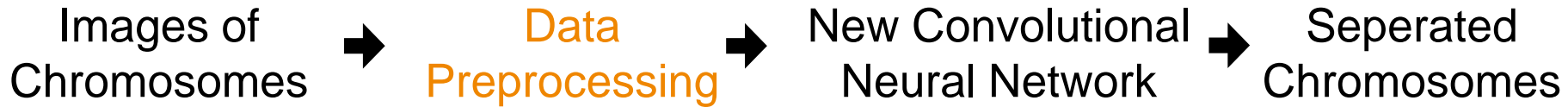


New Convolutional
Neural Network



Seperated
Chromosomes



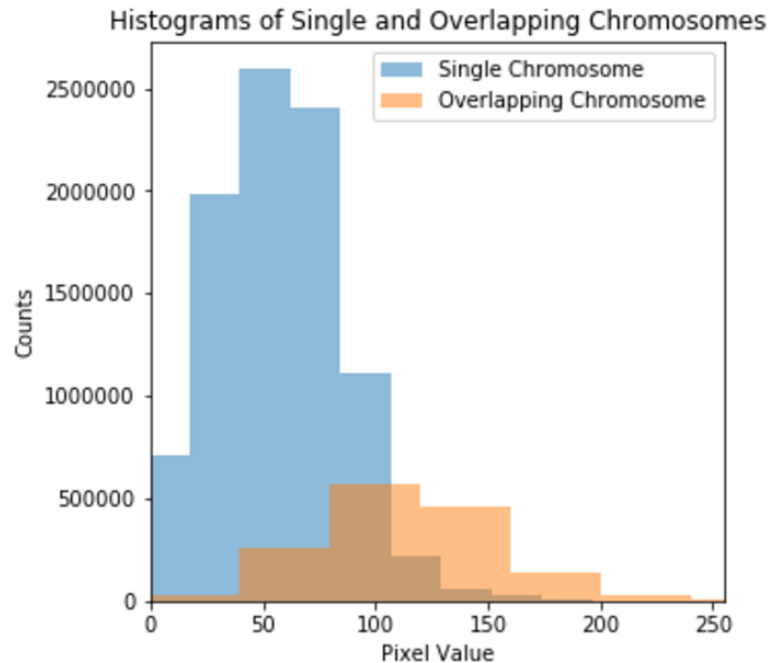
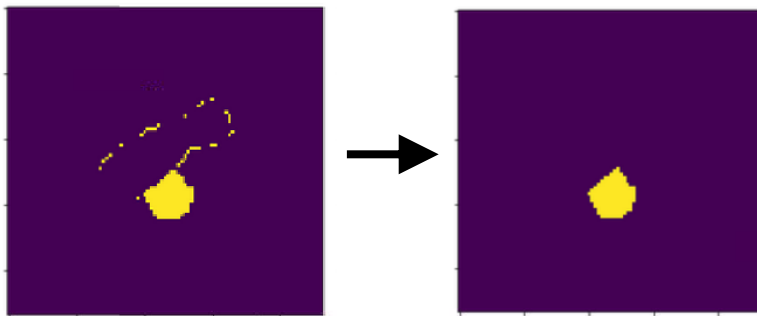


Clean labels

Crop images to factors/powers of 2

Process labels

Small image size (94x93 pixels)



Images of
Chromosomes



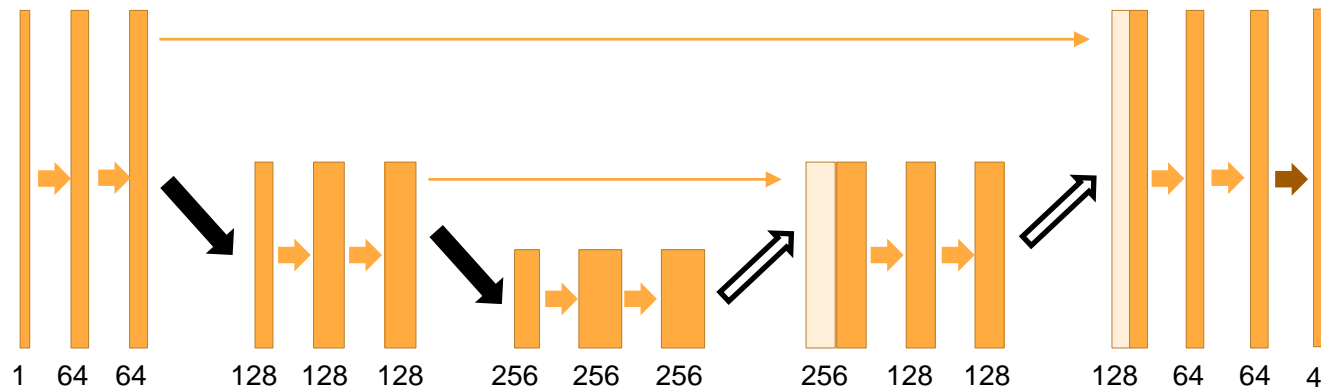
Data
Preprocessing



New Convolutional
Neural Network

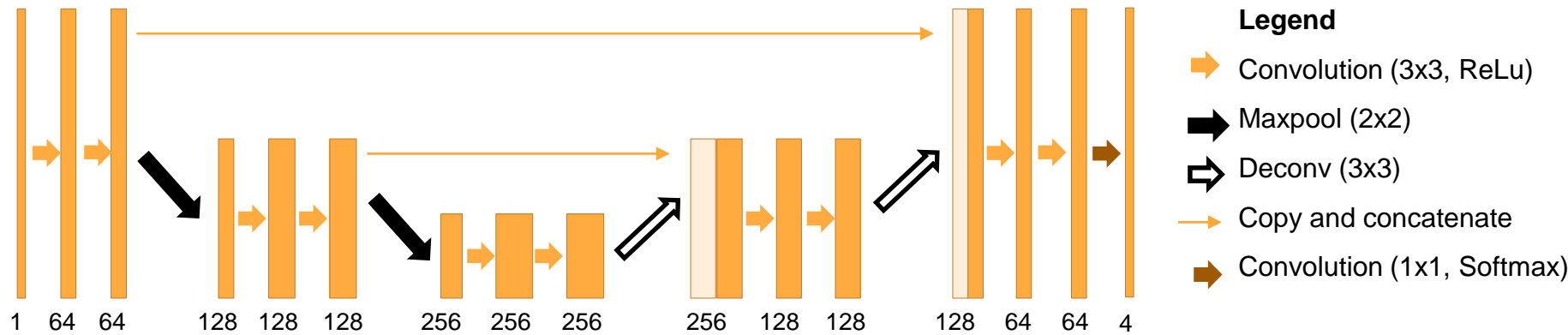
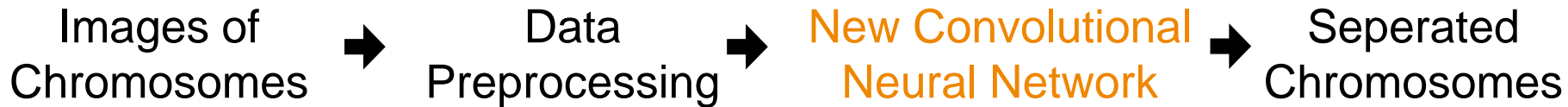


Seperated
Chromosomes



Legend

- Convolution (3x3, ReLu)
- Maxpool (2x2)
- Deconv (3x3)
- Copy and concatenate
- Convolution (1x1, Softmax)



Model design driven by:

Inspired from image segmentation neural networks

Small input image dimension

Preserve dimensions of the output image

Reduce size of model

Segmentation classes: overlap only, integer encodings, etc.

Images of
Chromosomes



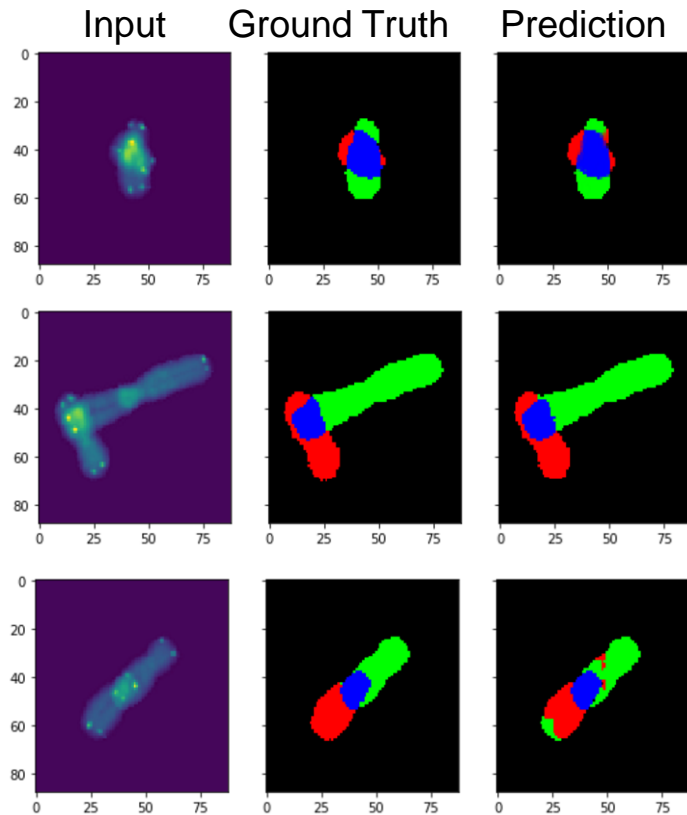
Data
Preprocessing



New Convolutional
Neural Network

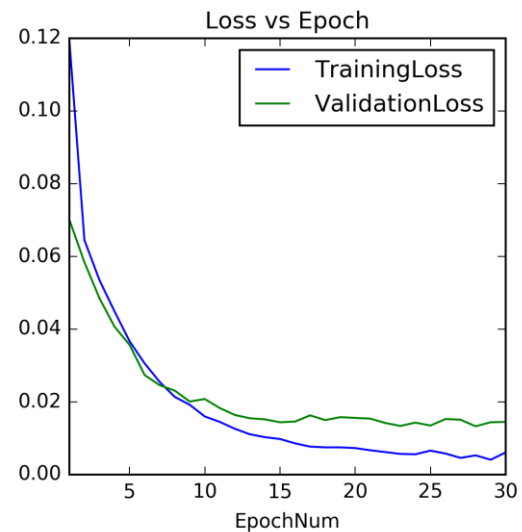


Seperated
Chromosomes



97.6% Mean Intersection over Union on Training Set

94.3% Mean Intersection over Union on Test Set



Wrap-Up

Challenge posed by AI Open Networks

Delivered documentation

Pull request on Github

<https://github.com/LilyHu>

AI•ON
Artificial Intelligence
Open Network

A microscopic view of several rod-shaped bacteria, likely E. coli, against a dark background. The bacteria are stained with a blue dye, and their internal DNA is highlighted with a bright green fluorescence. The DNA is visible as a double helix structure within the cells. The bacteria are arranged in various orientations, some showing binary fission.

Thank you

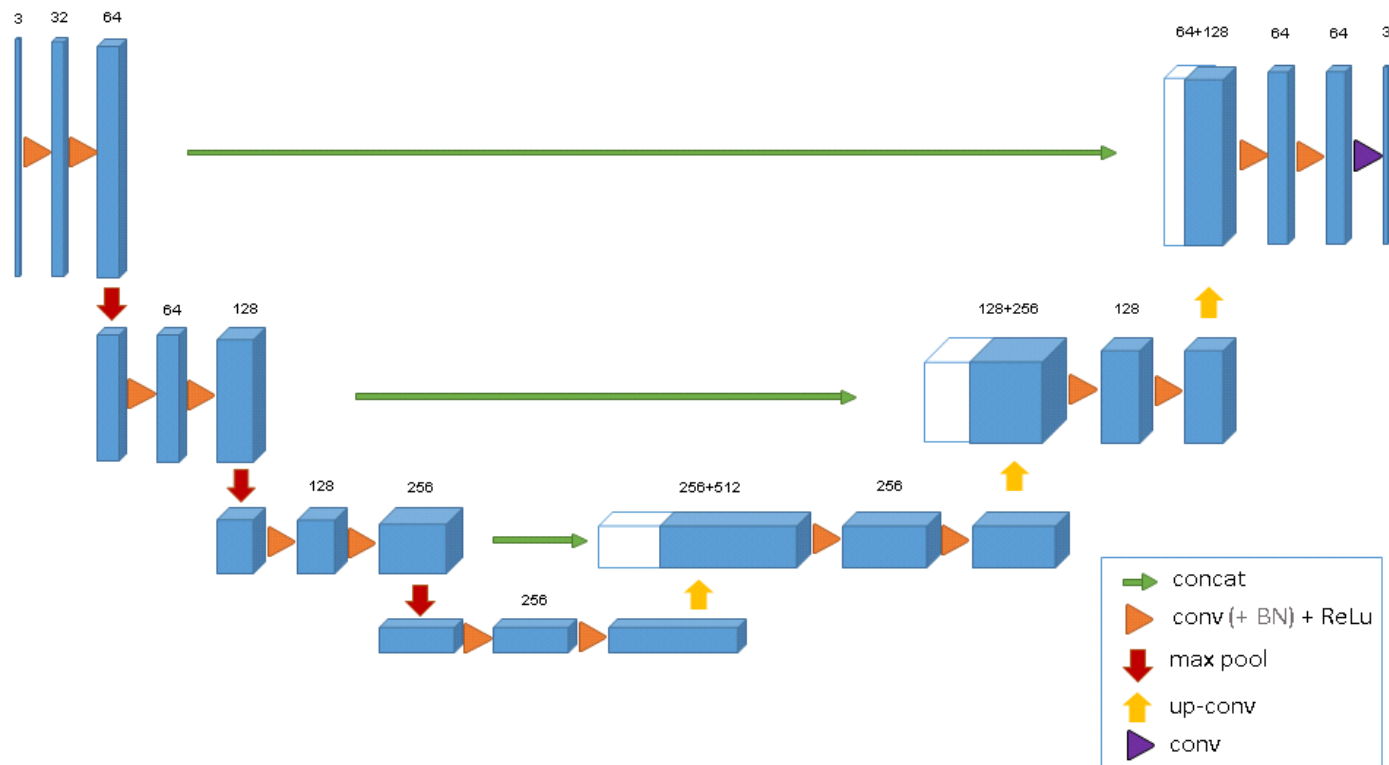
Thank you

Backup

Model – Modified U-Net

Previously used
for medical
image
segmentation

Reduced
number of layers



Crossing Chromosomes

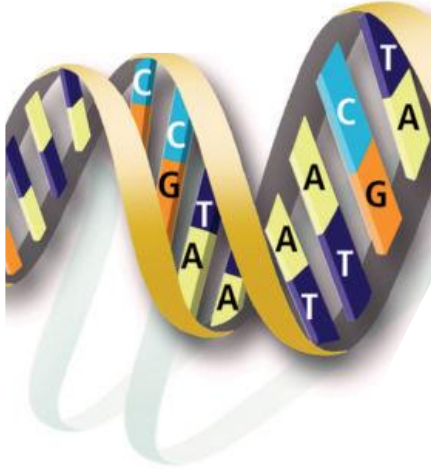
Image Segmentation on Overlapping Chromosomes

Lily Hu, PhD



Motivation

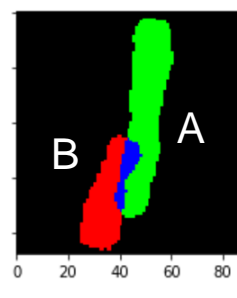
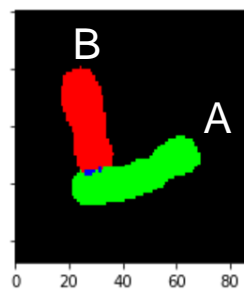
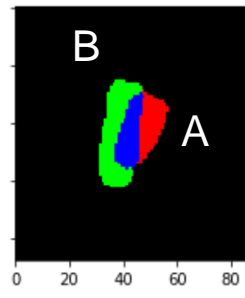
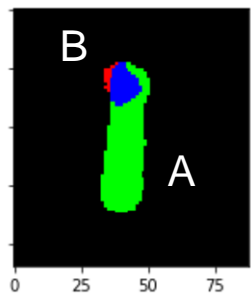
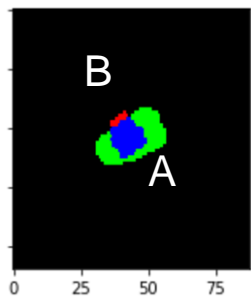
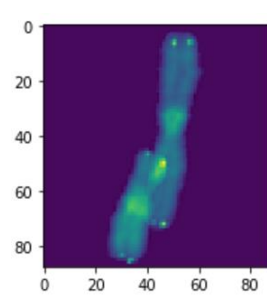
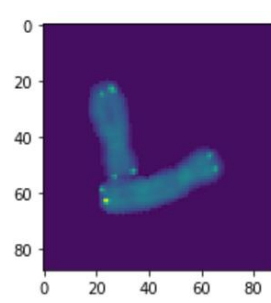
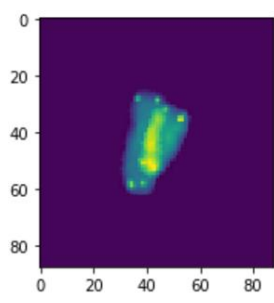
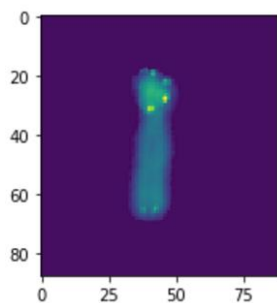
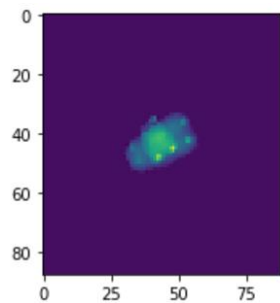
DNA



Medical diagnostics

Drug development

Biomedical research



Images of
Chromosomes



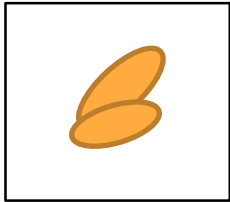
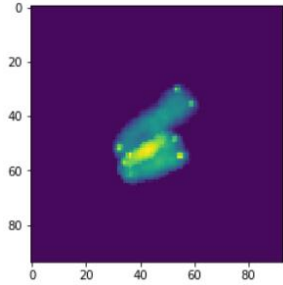
Data
Preprocessing



New Convolutional
Neural Network



Seperated
Chromosomes



Images of
Chromosomes



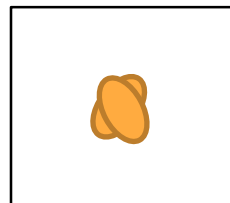
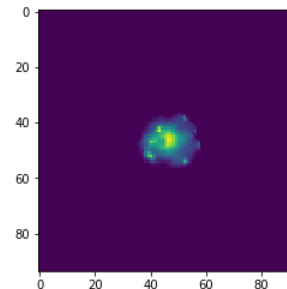
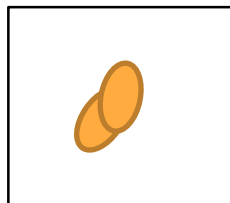
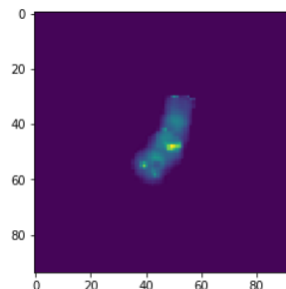
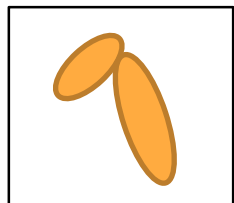
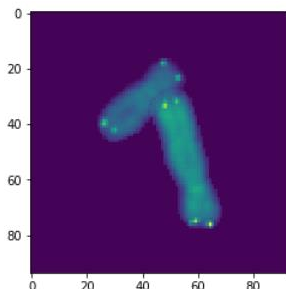
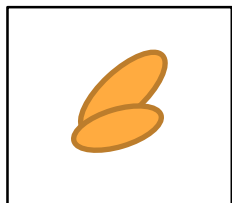
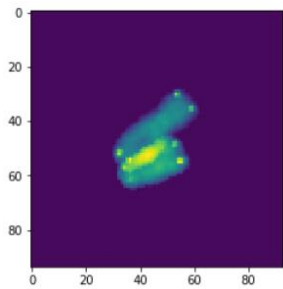
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New Convolutional
Neural Network



Seperated
Chromosomes



Images of
Chromosomes



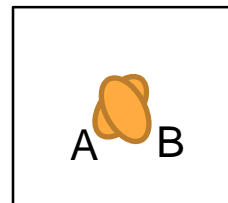
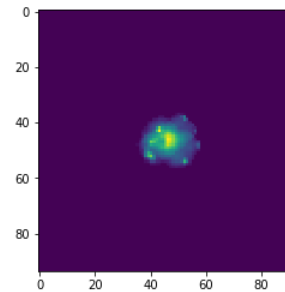
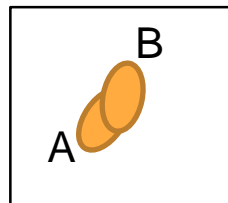
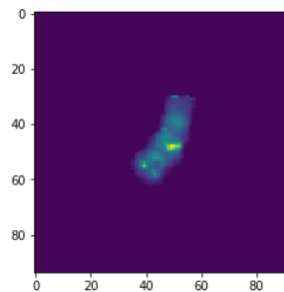
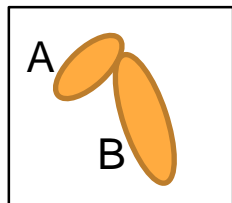
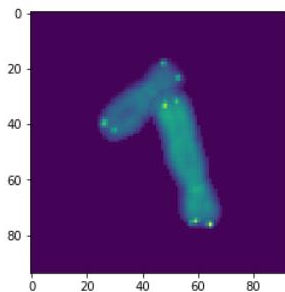
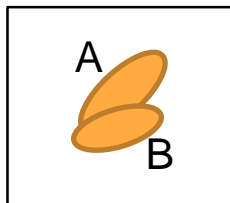
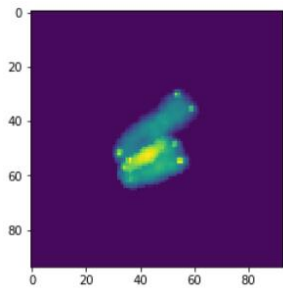
Data
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New Convolutional
Neural Network



Seperated
Chromosomes



Images of
Chromosomes



Data
Preprocessing



New Convolutional
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Seperated
Chromosomes

