Crossing Chromosomes
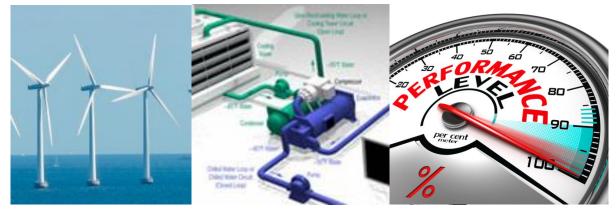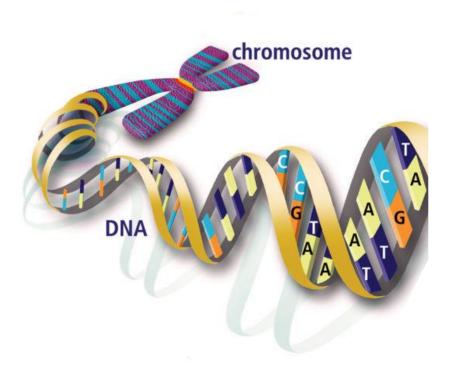## Image Segmentation on Overlapping Chromosomes

Lily Hu, PhD
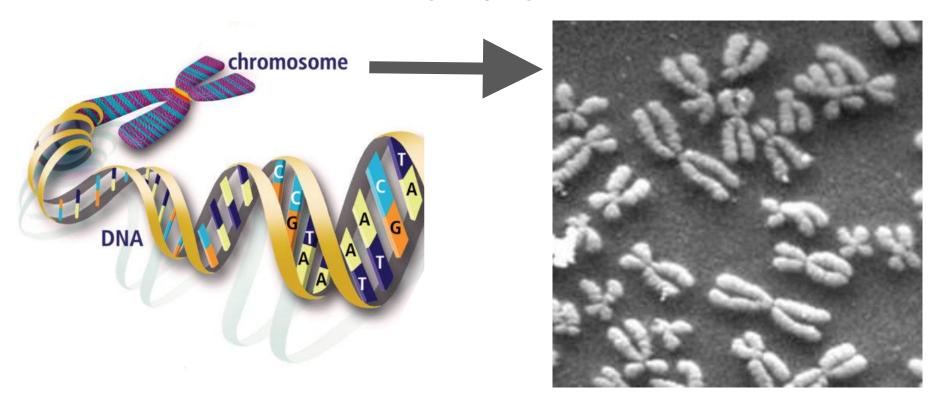
What Led Me to this Project

PhD Mechanical Engineering

Machine learning on sensor data for performance and health monitoring
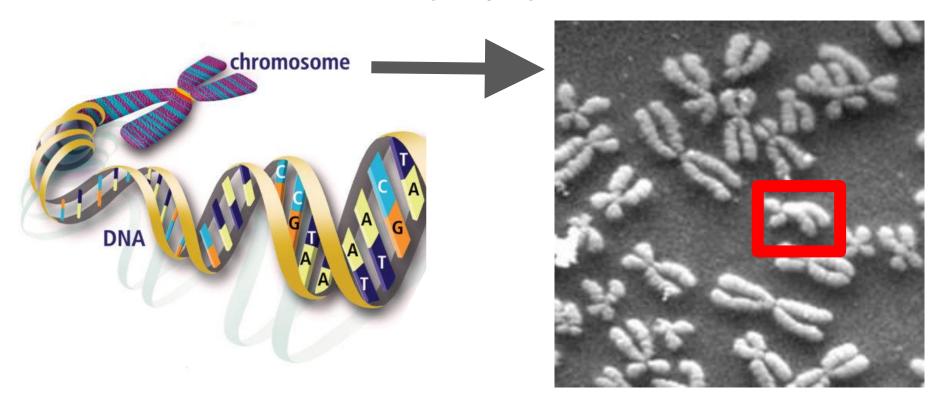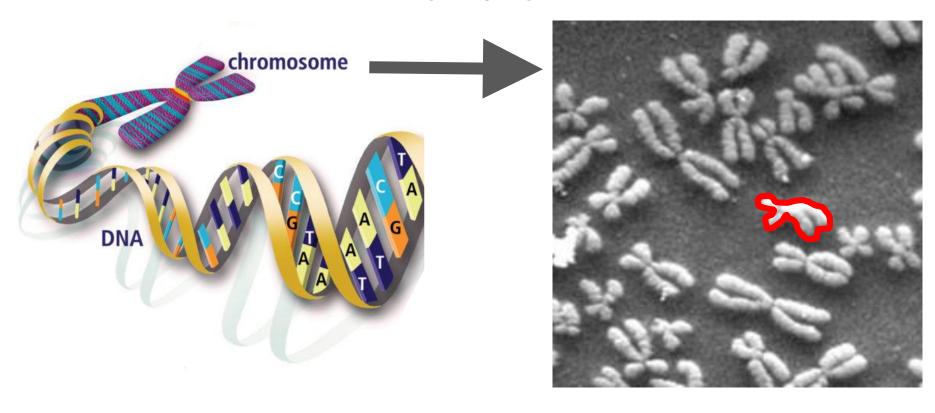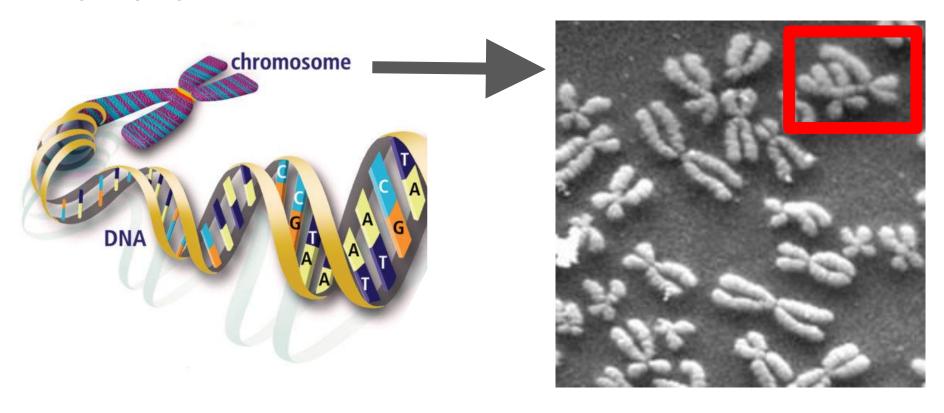
Motivation

Medical diagnostics

Drug development

Biomedical research

Motivation

Motivation

Motivation

Motivation

chromosome

DNA

Motivation

Images of Chromosomes ➤ Data Preprocessing ➤ Convolutional Neural Network ➤ Seperated Chromosomes

Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Images of Chromosomes → **Data Preprocessing** → Convolutional Neural Network → Seperated Chromosomes
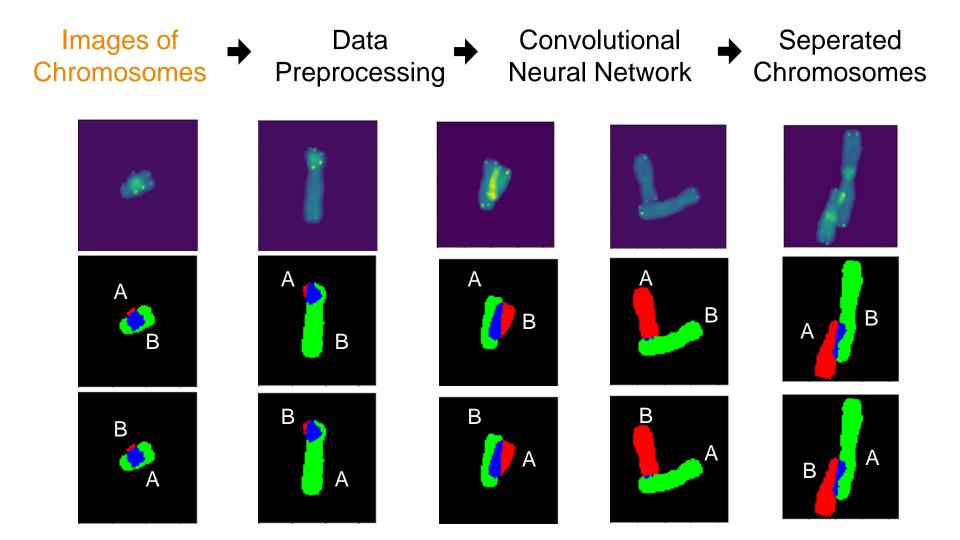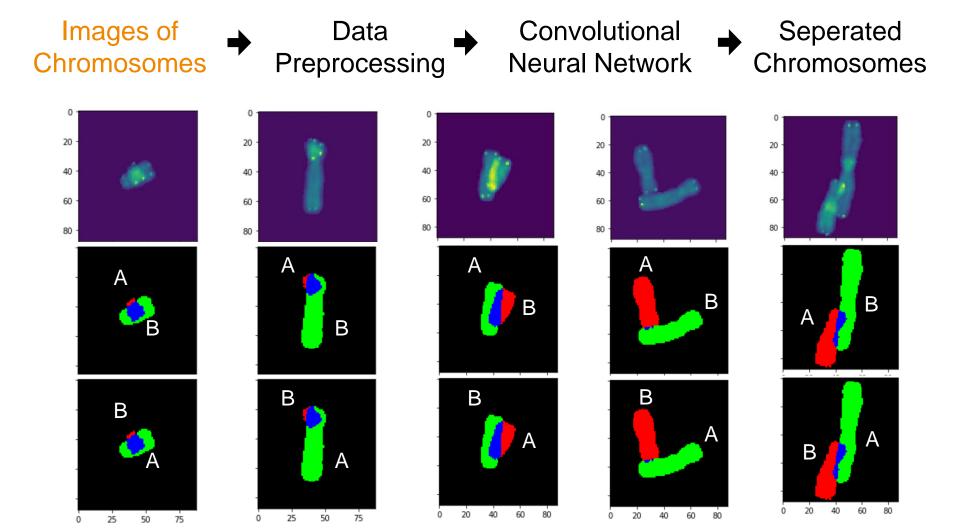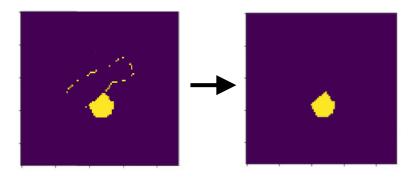
Clean labels

Crop images to factors/powers of 2
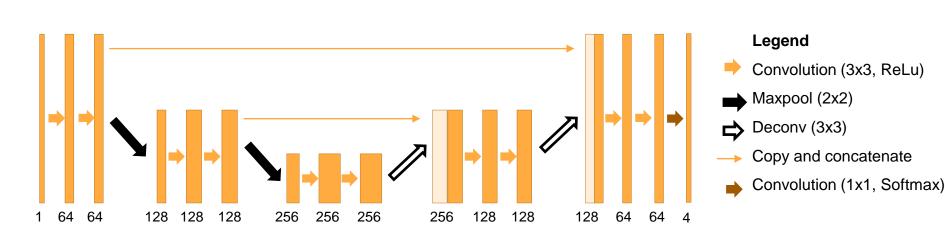
Process labels

Small image size (94x93 pixels)

Histograms of Single and Overlapping Chromosomes

Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Legend

→ Convolution (3x3, ReLu)

→ Maxpool (2x2)

⇨ Deconv (3x3)

→ Copy and concatenate

→ Convolution (1x1, Softmax)

1 64 64 128 128 128 256 256 256 256 128 128 128 64 64 4

Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Legend

→ Convolution (3x3, ReLu)

➡ Maxpool (2x2)

⇒ Deconv (3x3)

→ Copy and concatenate

→ Convolution (1x1, Softmax)

1 64 64 128 128 128 256 256 256 256 128 128 128 64 64 4

Model design driven by:

Inspired from image segmentation neural networks

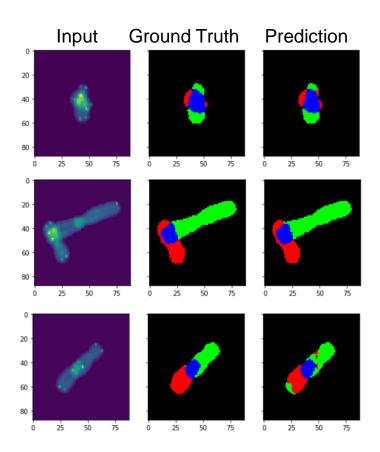Small input image dimension

Preserve dimensions of the output image

Reduce size of model

Segmentation classes: overlap only, integer encodings, etc.
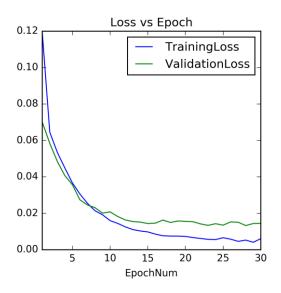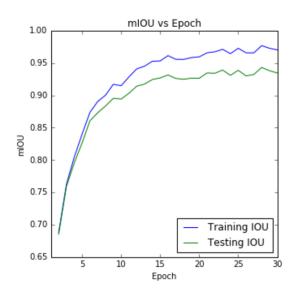
Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

97.6% Mean Intersection over Union on Training Set

94.3% Mean Intersection over Union on Test Set

Loss vs Epoch

- TrainingLoss
- ValidationLoss

mIOU vs Epoch

- Training IOU
- Testing IOU

Wrap-Up

Challenge posed by AI Open Networks

Delivered documentation

Pull request on Github

https://github.com/LilyHu

AI•ON
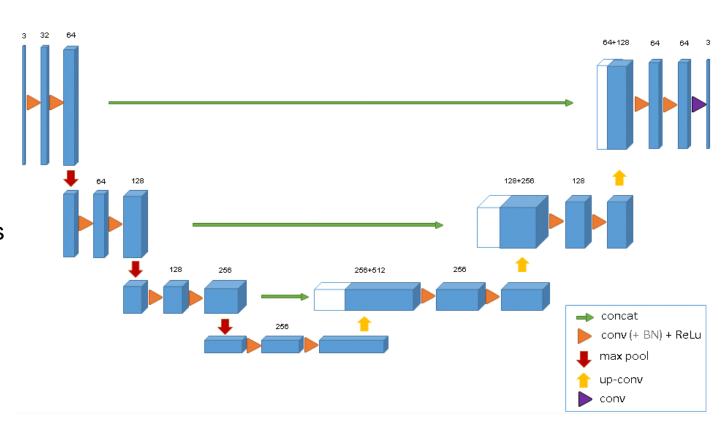Artificial Intelligence
Open Network

Thank you

Backup

Model – Modified U-Net

Previously used for medical image segmentation

Reduced number of layers

Crossing Chromosomes
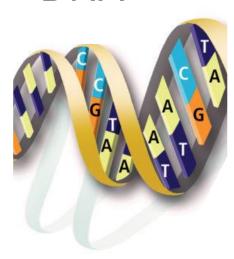## Image Segmentation on Overlapping Chromosomes

Lily Hu, PhD

Crossing Chromosomes
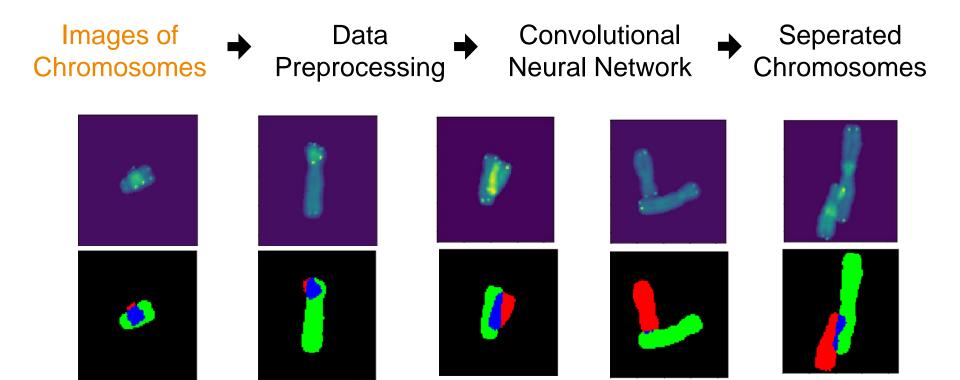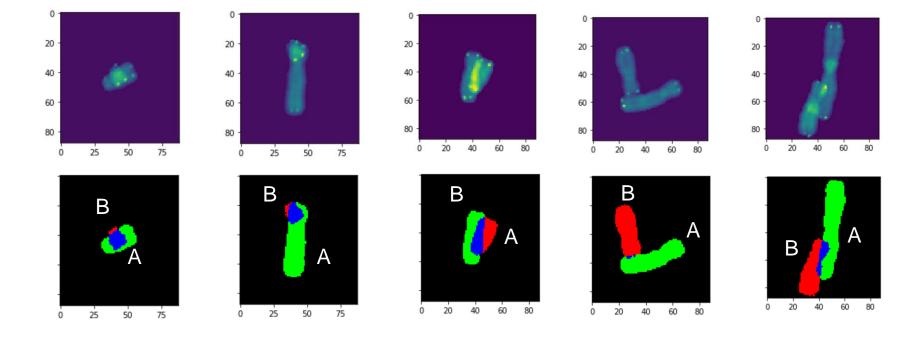## Image Segmentation on Overlapping Chromosomes
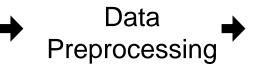
Lily Hu, PhD

Motivation

DNA

Medical diagnostics

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Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Images of
Chromosomes ➡ Data
Preprocessing ➡ New Convolutional
Neural Network ➡ Seperated
Chromosomes

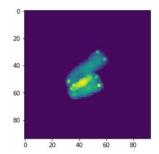Images of Chromosomes ➡ Data Preprocessing ➡ New Convolutional Neural Network ➡ Seperated Chromosomes

Images of
Chromosomes ➡ Data
Preprocessing ➡ New Convolutional
Neural Network ➡ Seperated
Chromosomes
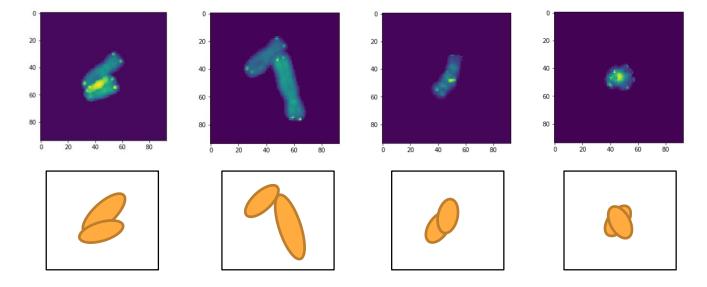
Images of Chromosomes → Data Preprocessing → New Convolutional Neural Network → Seperated Chromosomes
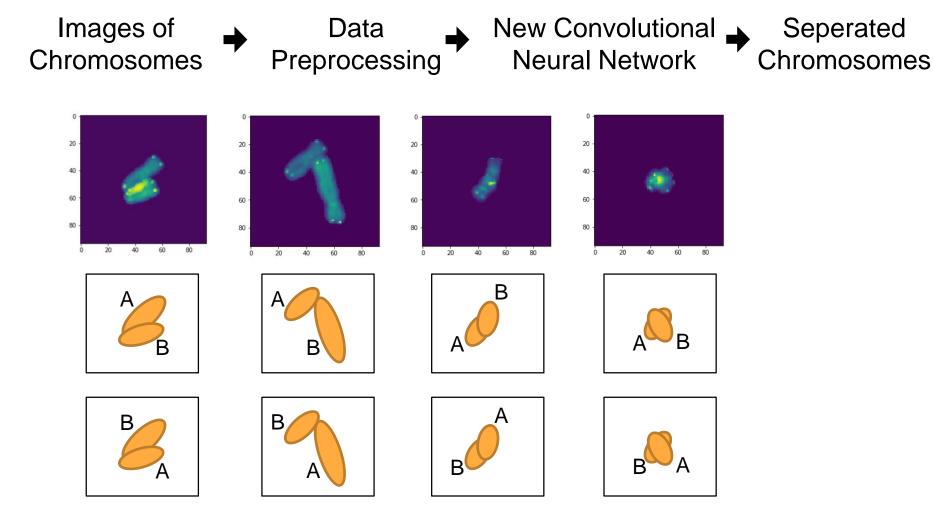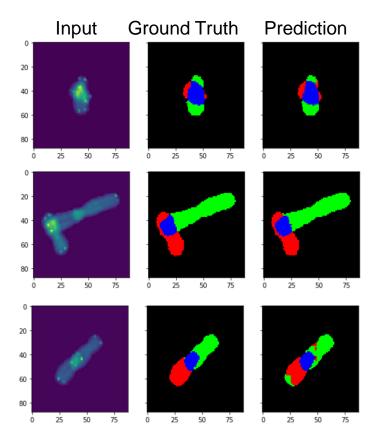
Images of Chromosomes → Data Preprocessing → Convolutional Neural Network → Seperated Chromosomes

Input | Ground Truth | Prediction

97.6% Mean Intersection over Union on Training Set

94.3% Mean Intersection over Union on Test Set

Loss vs Epoch
TrainingLoss
ValidationLoss
EpochNum