

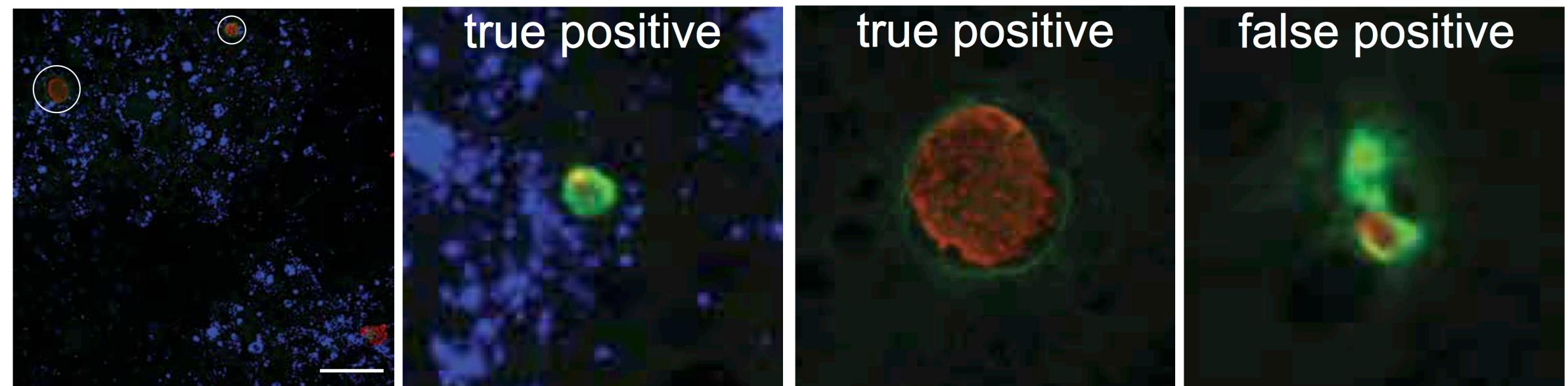
Ava P. Soleimany^{1,2}, Harini Suresh¹, Jose Javier Gonzalez Ortiz¹, Divya Shanmugam¹, Nil Gural¹, John Guttag¹, Sangeeta N. Bhatia^{1,3}

¹ MIT; ² Harvard University; ³Howard Hughes Medical Institute

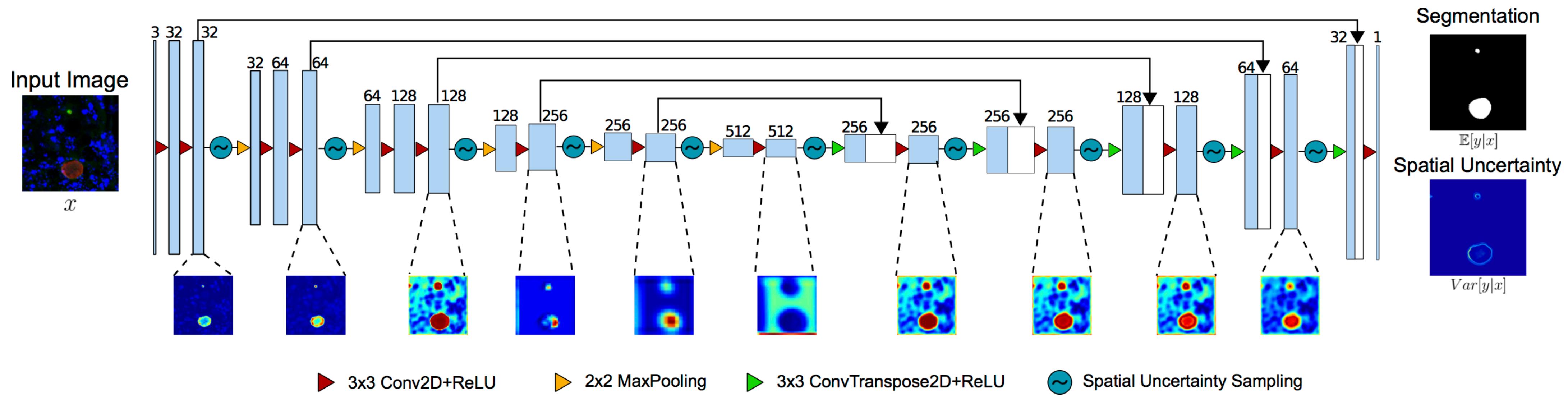
Overview & Dataset

Background: Malaria eradication necessitates drugs effective against liver stage disease. Imaging parasites in *in vitro* culture remains standard, but analysis is a bottleneck.

Objective: high-precision parasite segmentation and uncertainty estimation.



Convolutional Architecture



A convolutional U-Net successively compresses and decompresses the input image to output a pixelwise classification. Spatial uncertainty sampling via dropout is applied between successive convolutional blocks to estimate model uncertainty.

Uncertainty Estimation

- Input image data \mathbf{X} and segmentation \mathbf{Y}
- Dropout-based approximation of the posterior
- Estimate likelihood of a segmentation given an input image and weights \mathbf{W} :

$$q(\mathbf{Y}|\mathbf{X}) = \int P(\mathbf{Y}|\mathbf{X}, \mathbf{W}) q(\mathbf{W}) d\mathbf{W}$$

- Evaluate T stochastic forward passes through the network $\{\mathbf{W}_t\}_{t=1}^T$
- Predictive mean: $\mathbb{E}(\mathbf{Y}|\mathbf{X}) = \frac{1}{T} \sum_{t=1}^T f(\mathbf{X}|\mathbf{W}_t)$
- Predictive variance:

$$\text{Var}(\mathbf{Y}|\mathbf{X}) = \frac{1}{T} \sum_{t=1}^T f(\mathbf{X})^2 - \mathbb{E}(\mathbf{Y}|\mathbf{X})^2$$

Results

