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Semantic Segmentation of Bioimages Using Convolutional Neural Networks

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Abstract
Convolutional neural networks have shown great promise in both general image segmentation problems as well as bioimage segmentation. In this paper, the application of different convolutional network architectures is explored on the C. elegans live/dead assay dataset from the Broad Bioimage Benchmark Collection. These architectures include a standard convolutional network which produces single pixel outputs, as well as Fully Convolutional Networks (FCN) for patch prediction. It was shown that the custom image processing pipeline, which achieved a worm segmentation accuracy of 94%, was outperformed by all of the architectures considered, with the best being 97.3% achieved by a FCN with a single downsampling layer. These results demonstrate the promise of employing convolutional neural network architectures as an alternative to ad-hoc image processing pipelines on optical microscopy images of C. elegans.