

Piximi: an in-browser "Images to Discovery" tool for easy deep learning

B.A. Cimini¹

¹ Imaging Platform, Broad Institute.

Abstract

Creation of machine learning networks for biological imaging tasks often suffers from a crucial gap: the subject matter experts who understand the images well are not typically computationally comfortable training neural networks, and lack simple ways getting started to do so. We therefore present here Piximi (piximi.app), a free, open-source "Images To Discovery" web app designed to make it easy to train and deploy neural networks directly in the web browser, meaning users face no installation hurdles and can access web accessibility features such as in-browser translation. Piximi allows users to upload 8-bit or 16-bit images that use common image formats such as png and tiff; it supports arbitrary channel numbers as well as arbitrary numbers of Z planes. Uploaded images can be saved to a h5-backed project file, allowing for multi-session use and encouraging reproducibility/sharing. All images uploaded stay local on the user's machine, and training happens inside the browser; no data is transmitted to a central server. Due to this architecture, Piximi can even be run offline from a locally hosted Docker container.

Once loaded into Piximi, images can be classified into any number of categories the user wants; Piximi additionally allows users to train based on a small subset of their data and then predict on a larger number of unclassified images, simplifying the identification of difficult-to-classify images and allowing their subsequent addition to the training set for future training runs. Hyperparameters can be tuned in a simple interface but are hidden by default, making it easy for less computationally comfortable users to get started using Piximi. Piximi classification can be run on any device with a web browser, including mobile devices often unsupported by scientific software. Models trained by Piximi can then be exported and run on any other device/context that uses Tensorflow, meaning networks trained in-browser on smaller subsets of data can then be applied to arbitrarily large data sets that would not be appropriate for the browser.

Piximi allows users to segment object(s) of their choosing using the app's built-in segmentation neural networks or by uploading a Tensorflow model from elsewhere. Users can also fine-tune segmentation networks in the browser, and Piximi supports common specifications such as COCO for uploading image annotations. If users want to create new annotations and/or fine-tune uploaded annotations, Piximi contains an in-app annotation tool which supports both arbitrary channels and Z planes - lookup tables and brightness can be easily adjusted and the settings transferred from one image to the rest of the image set. Piximi contains 9 annotation tools, from simple bounding boxes to sophisticated color annotation. Annotations can then be used in Piximi to train segmentation networks or exported in one of several common formats for training in other applications, meaning Piximi can also serve as a stand-alone annotation tool. Identified objects can be subsequently classified using Piximi's classifier functionality.

In summary, we believe this tool will thus help close the gap between scientists who want to use neural networks, and those who can, accelerating bioimage-based science in many domains.