

MATLAB EXPO

POLSKA 2024



Oprogramowanie
Naukowo-Techniczne
sp. z o.o.

MATLAB EXPO

Warsaw, 04.06.2024 r.

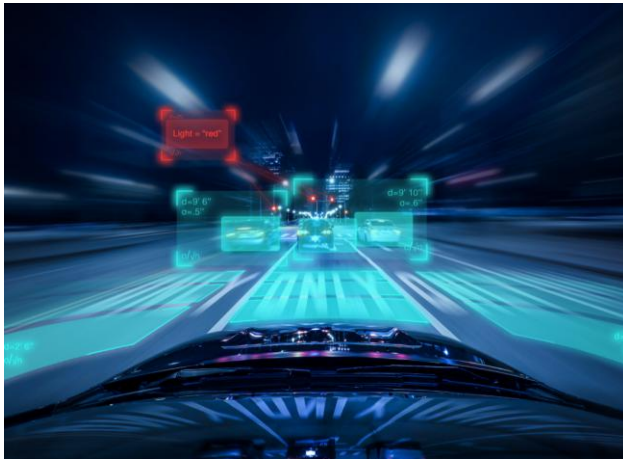
Interactive MATLAB tools for image processing and analysis

Paulina Kozakiewicz, Junior Application Engineer ONT

Agenda

1. Introduction
2. Using MATLAB interactive apps for pill segmentation
3. Deep Learning for image processing
4. App development and deployment

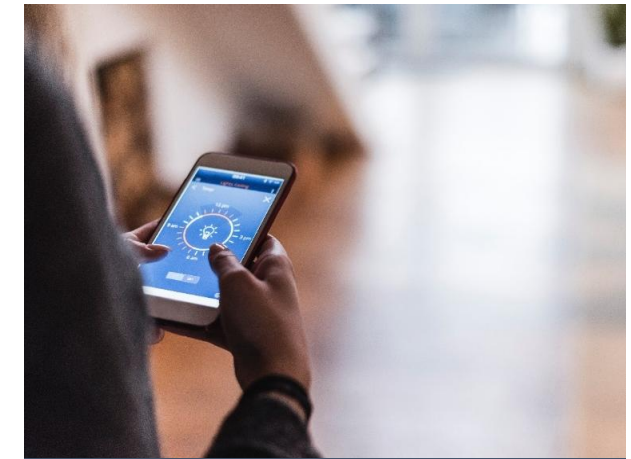
Image Processing and Computer Vision Applications



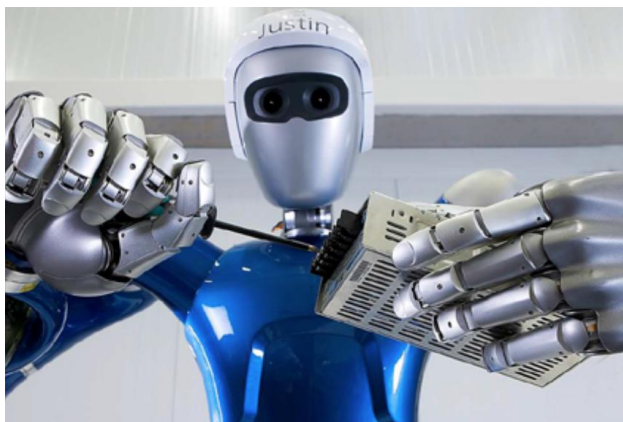
Automated Driving



Satellite Imagery



Consumer Electronics



Robotics

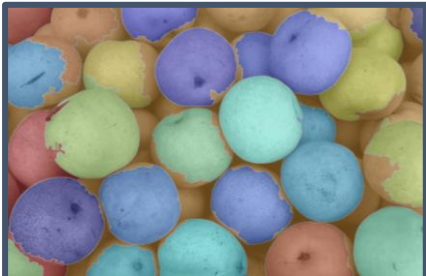


Machine Vision



Medical Imaging

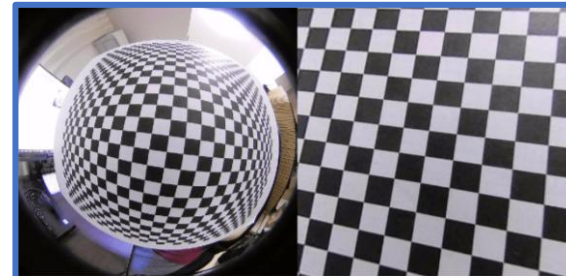
Image Processing and Computer Vision Techniques



Segmentation



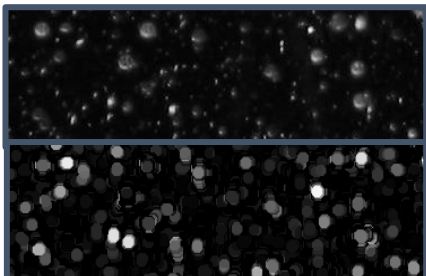
Edge Detection



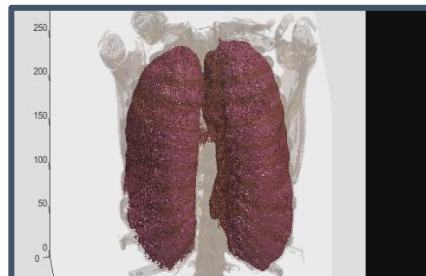
Camera Calibration



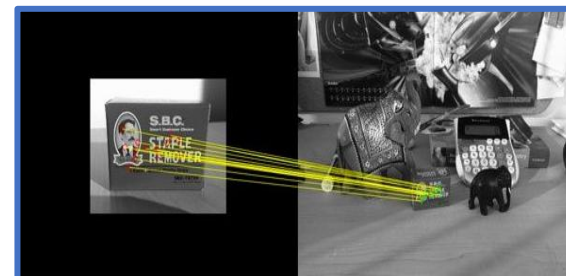
Labeling



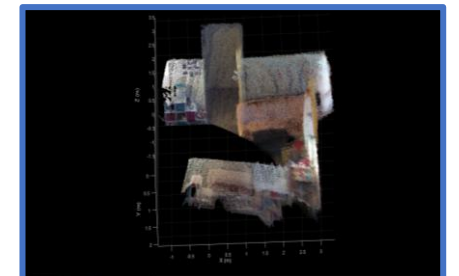
Morphology



3D Image Processing



Feature Detection



Point Cloud Processing



Image Registration

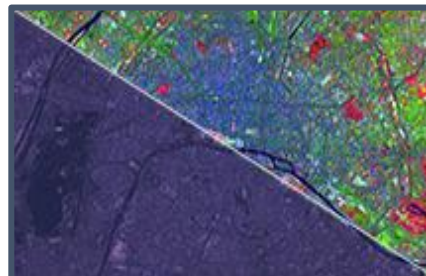
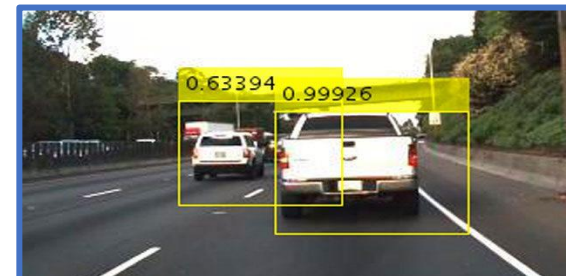


Image Enhancement

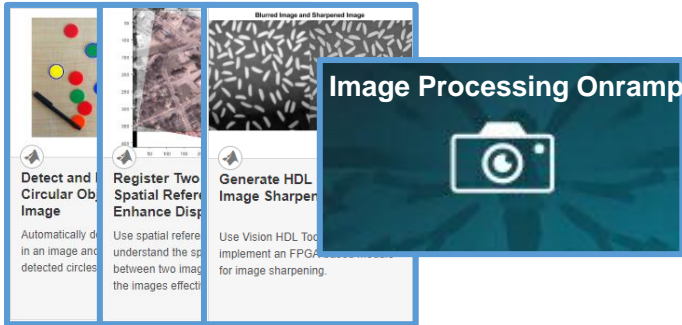


Object Detection

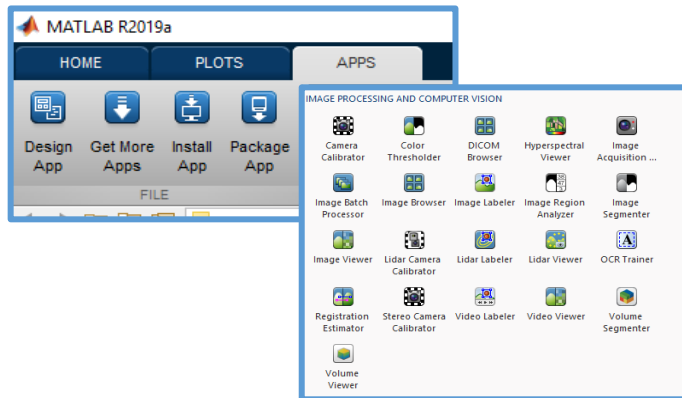


Tracking

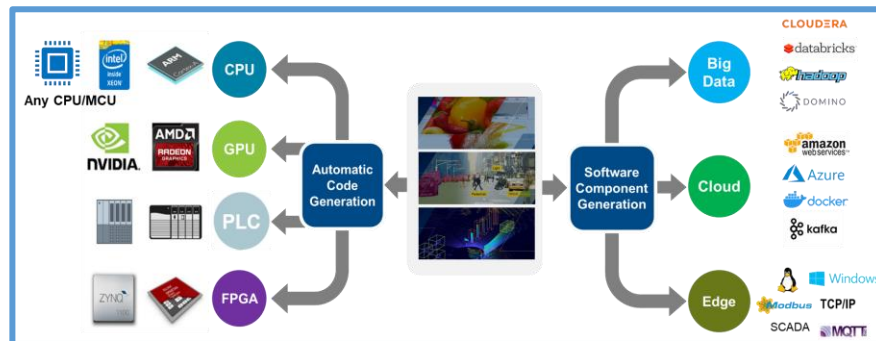
Why Use MATLAB?



MATLAB is easy to use, has thorough documentation and extensive support



MATLAB enables rapid prototyping and algorithm development



MATLAB enables Code Generation for Deployment

Image Processing Apps Accelerate Workflow

Apps provide interactive tools for tweaking parameters and visualizing results

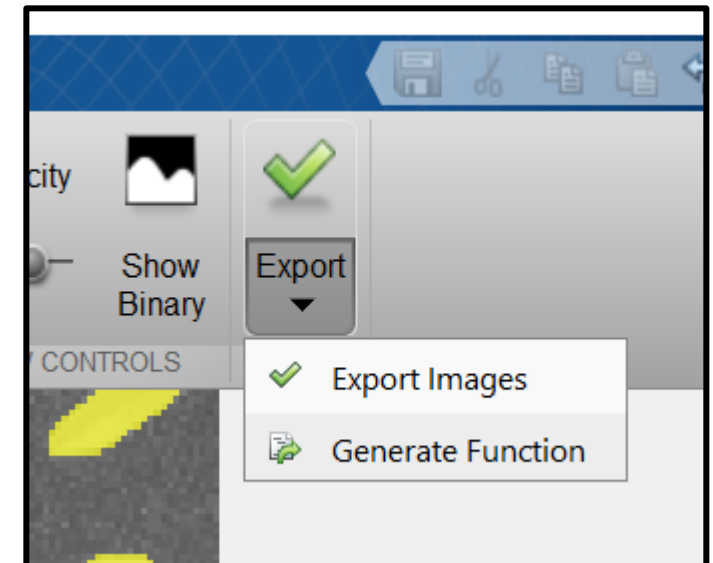
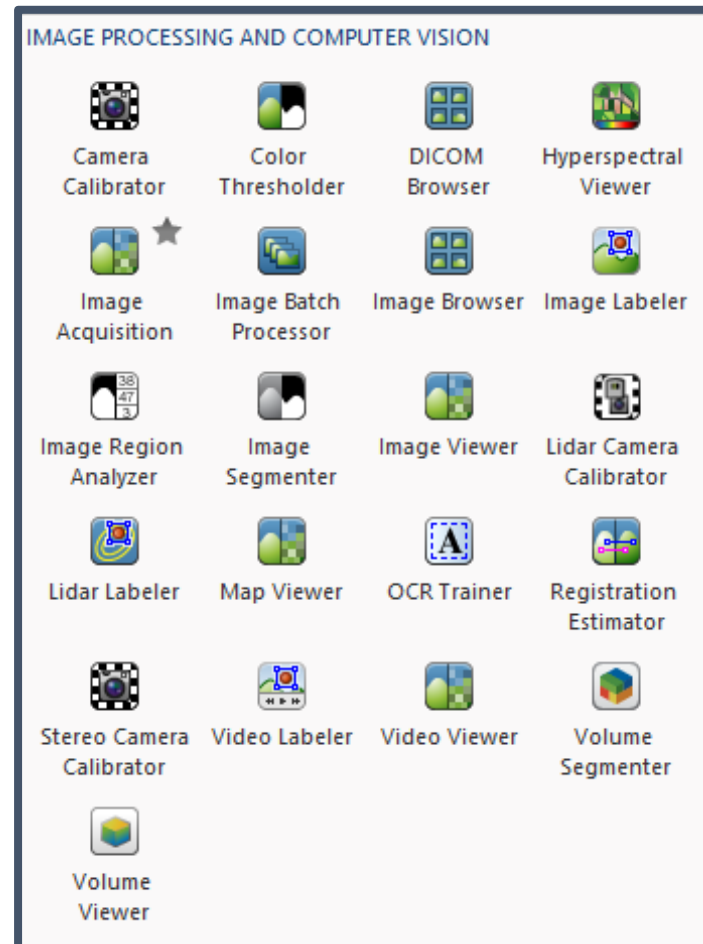
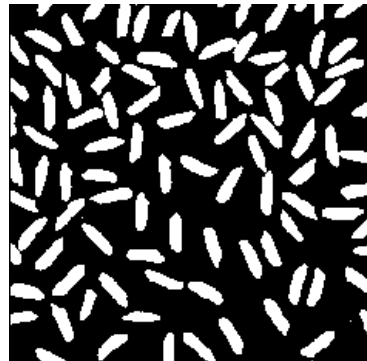
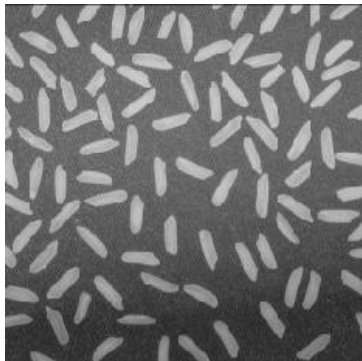


Image Segmentation

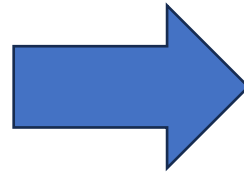
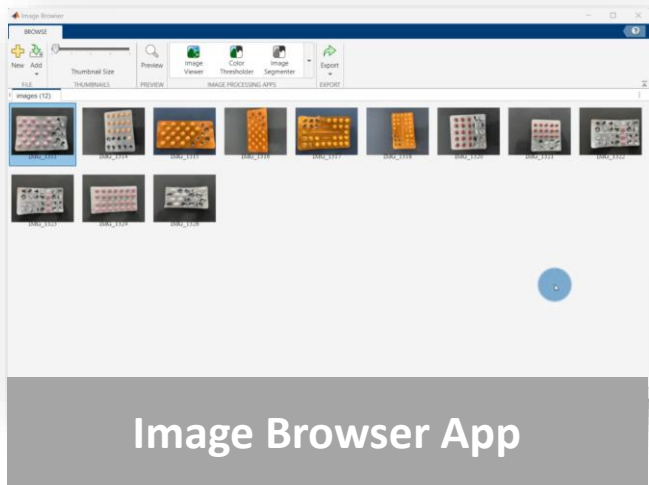
Creating masks where ROIs with similar traits are assigned the same value

Image Segmentation

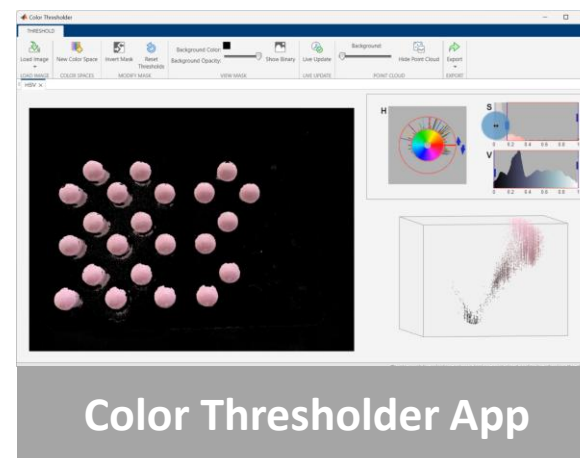


Example – pill segmentation

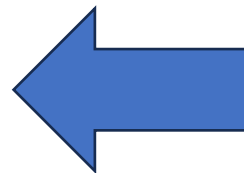
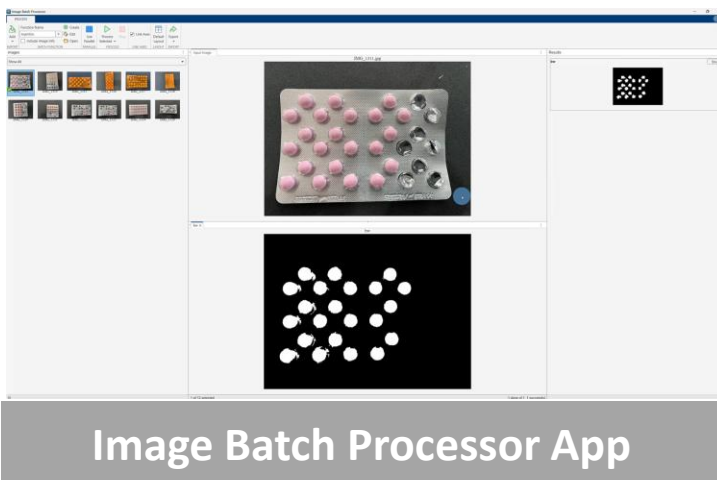
Import



Segmentation



Automation



Postprocessing

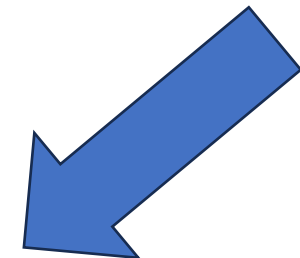
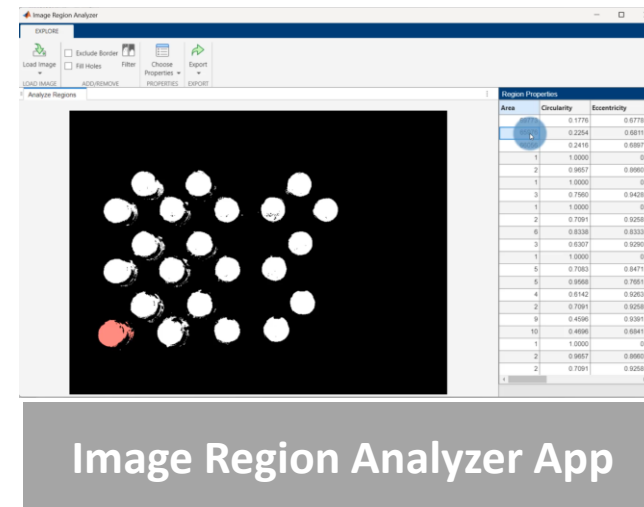
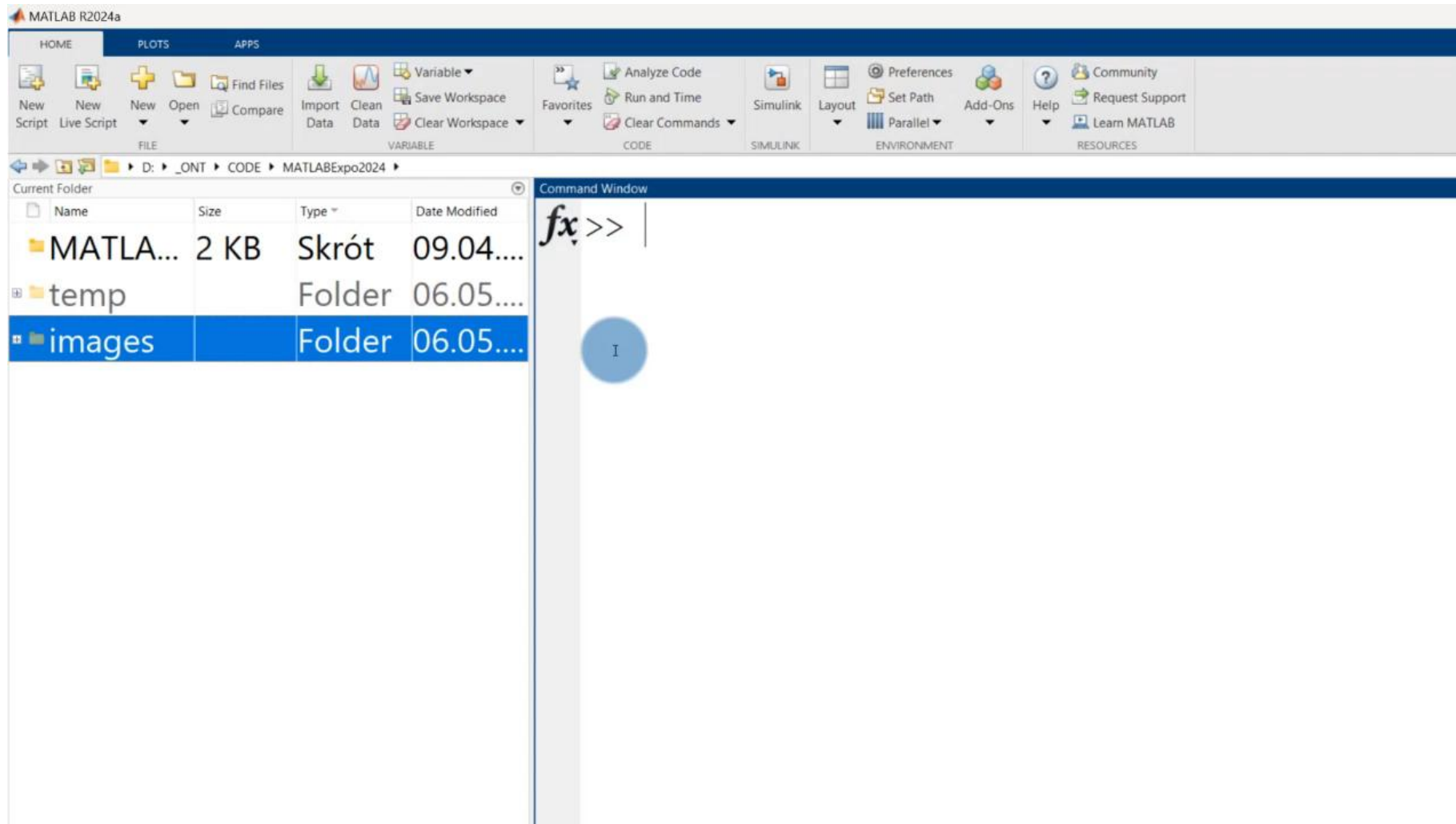


Image Browser App



Color Thresholder App

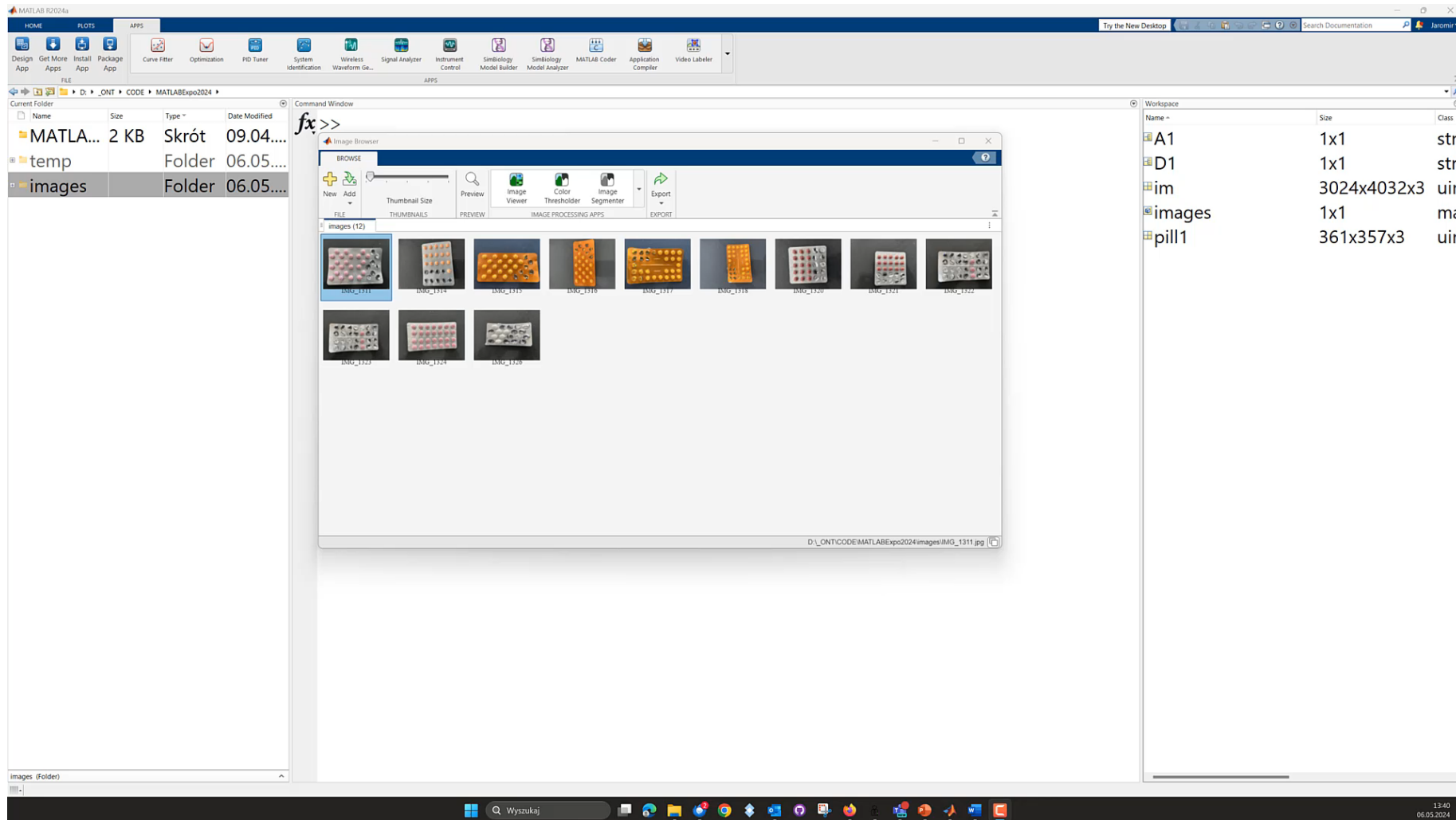


Image Segmenter App

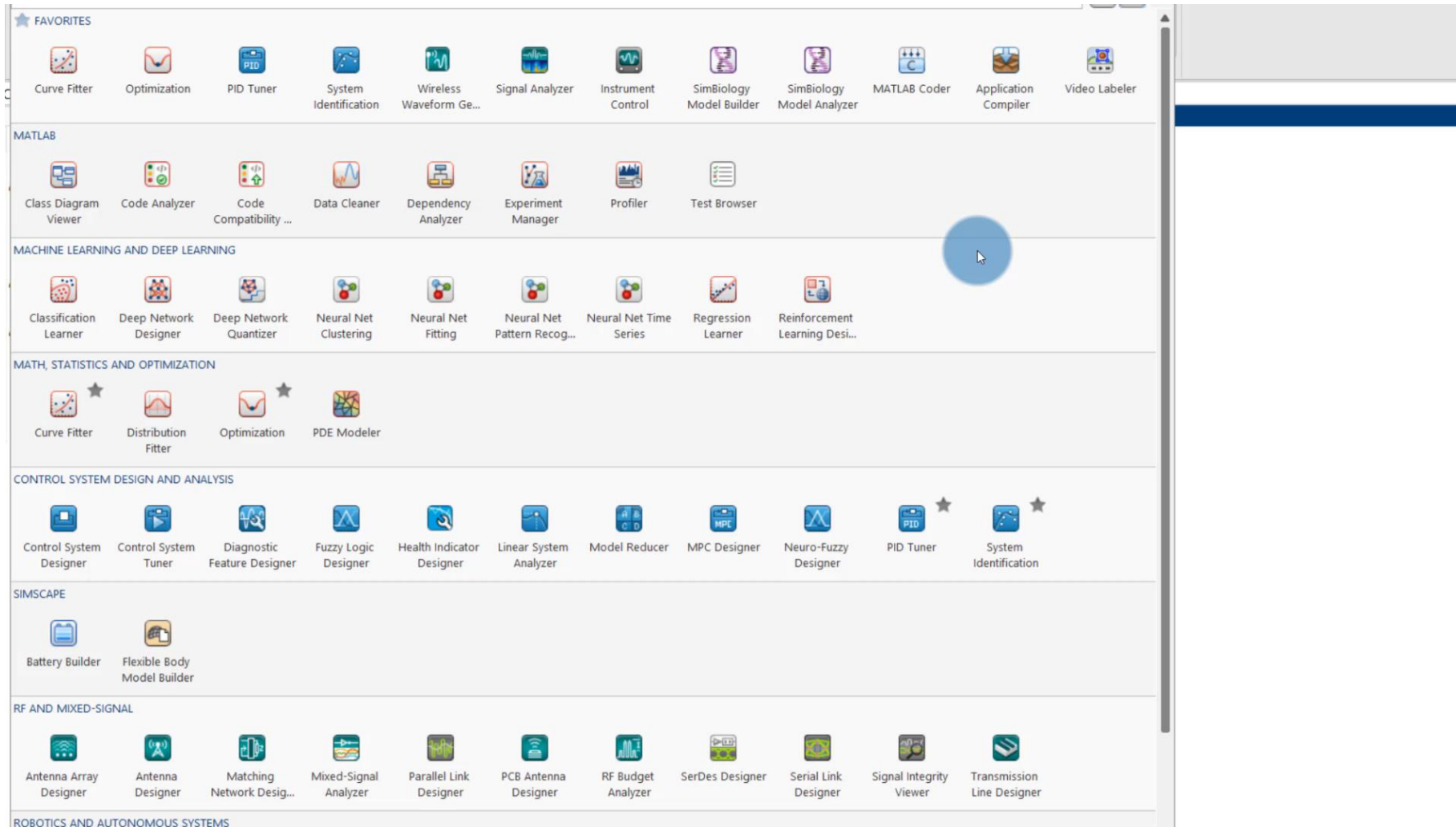


Image Region Analyzer App

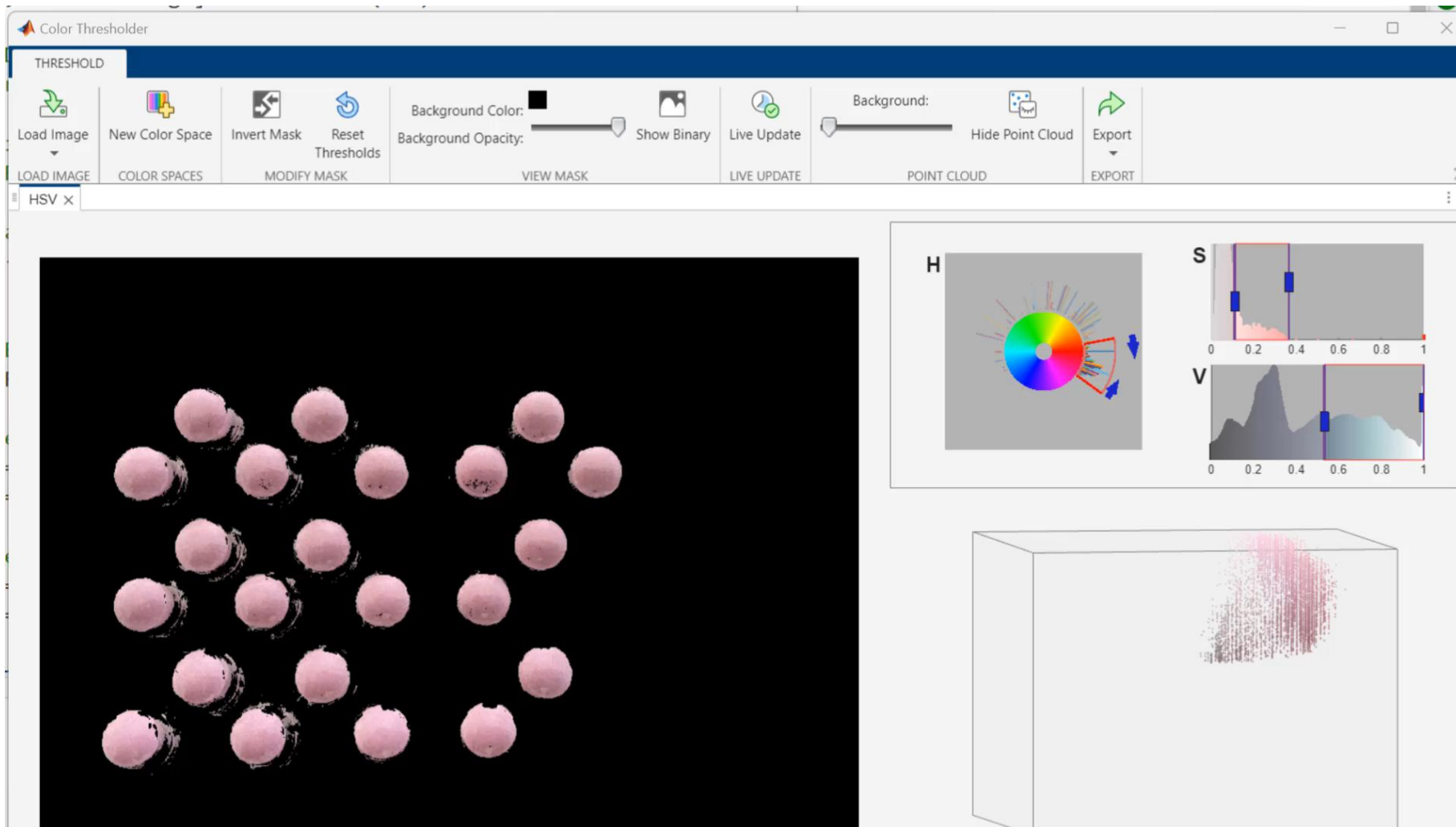
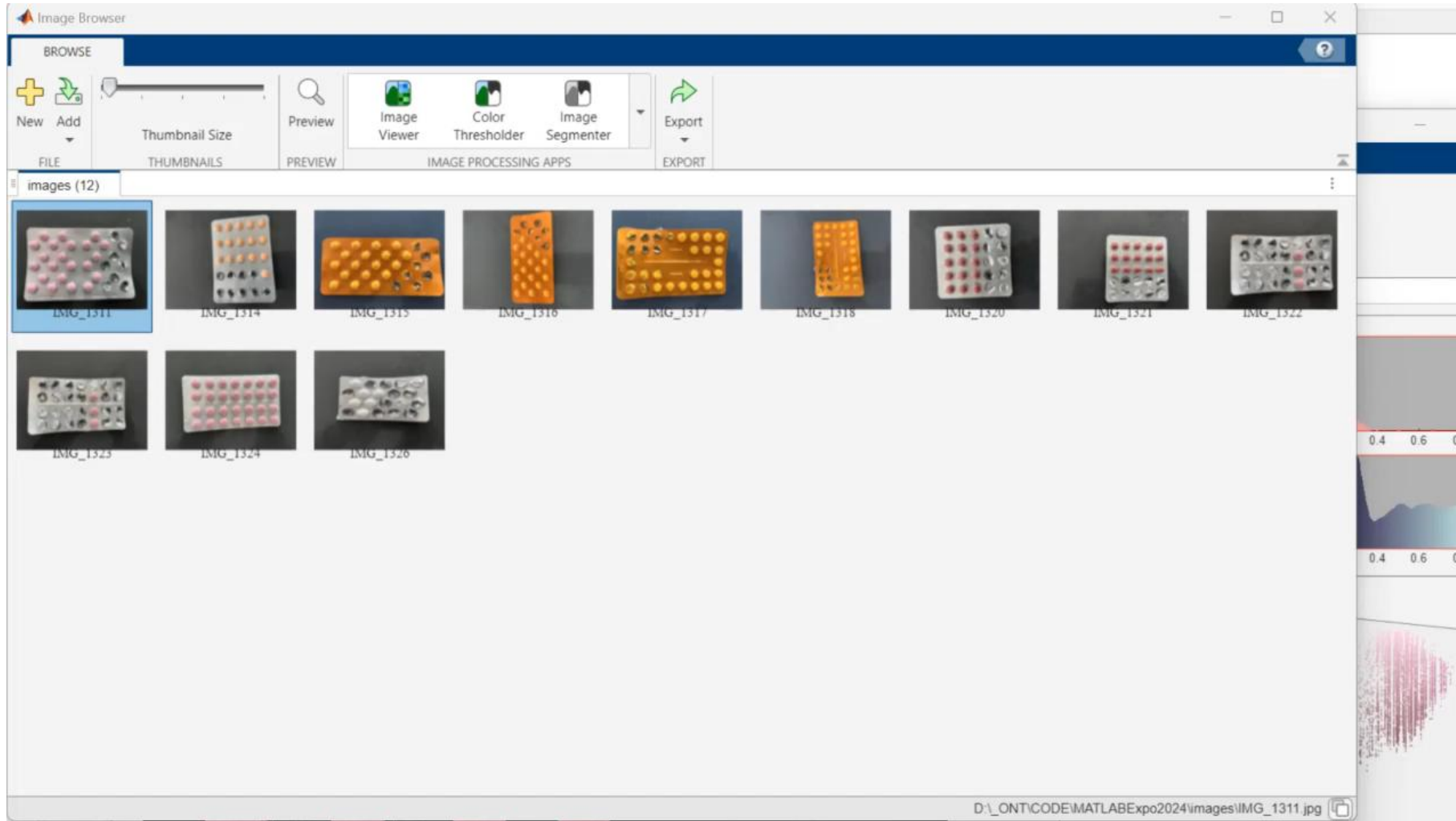


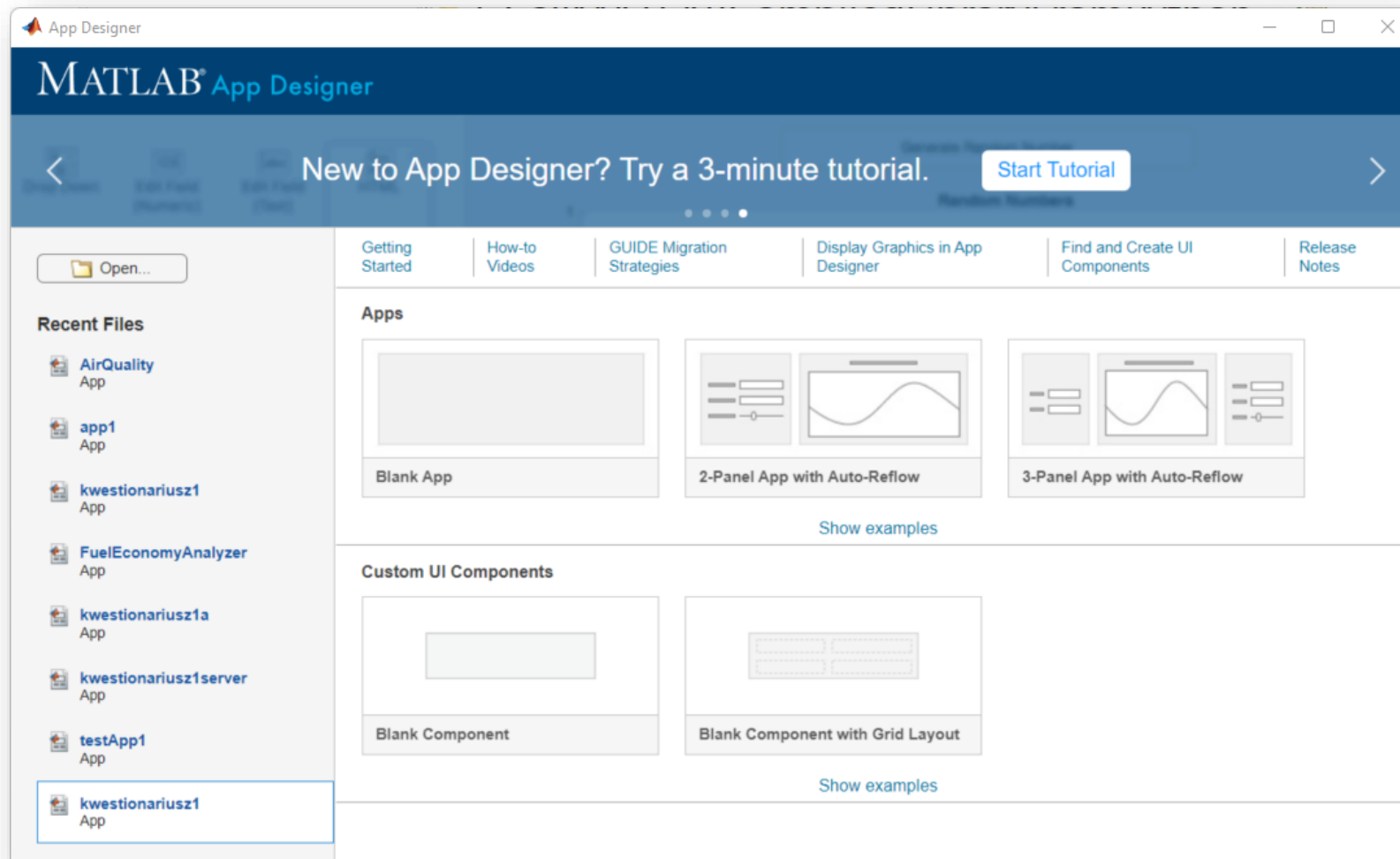
Image Batch Processor App





MATLAB App Designer

App development for Non-Programmers



Applications of deep learning for images and video



YOLO v2 (You Only Look Once)



Semantic Segmentation using SegNet

Spend Less Time Labeling Data

- Domain experts are best suited for accurately labeling data, but their time is valuable.
- Domain specific Apps for labeling **speed up and automate this process**

Image Labeler
Computer Vision Toolbox

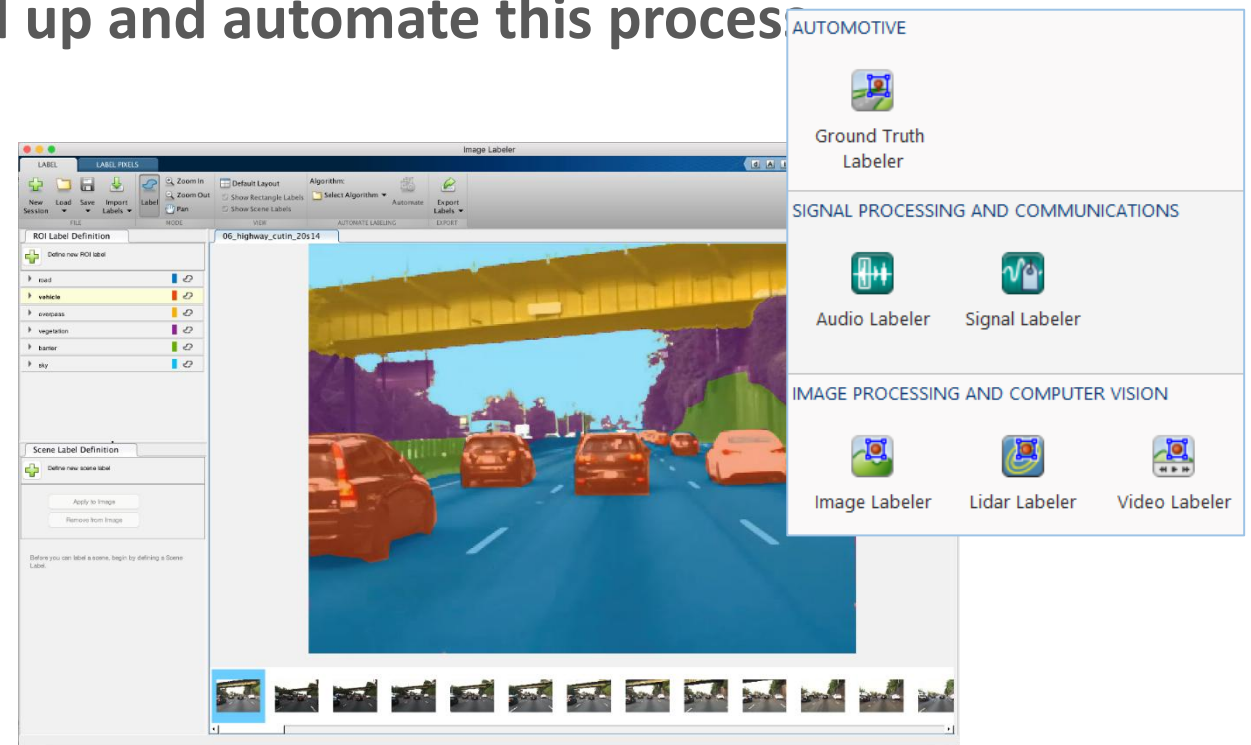
Video Labeler
Computer Vision Toolbox

Signal Labeler
Signal Processing Toolbox

Lidar Labeler
Lidar Toolbox

Image Labeler
Big Image support

Medical Image Labeler



Use labeling apps for deep learning workflows like semantic segmentation

Visually Creating Networks Enables Faster Design

Build, visualize, edit & train networks interactively with

An App that allows users to:

- Eliminate the need to manually code & test networks
- Edit networks and build new networks from scratch.
- Drag and drop to add new layers, create new connections.

Deep Network Designer



Deep Network Designer app to build, visualize, and edit deep learning networks

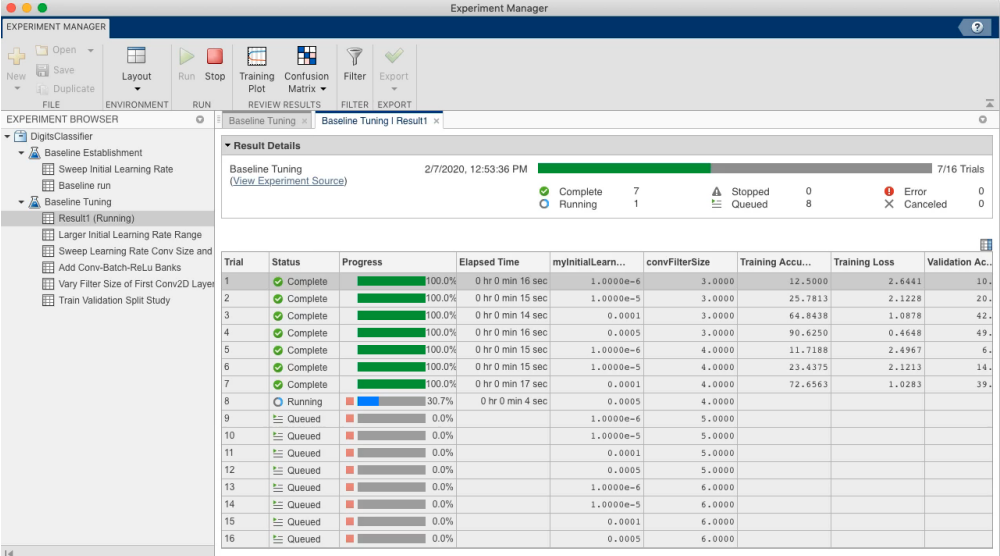
Find the Optimal Network Using Experiments

Run experiments to train networks under various initial conditions and compare the results.

Use deep learning experiments to:

- Sweep through a range of hyperparameter values
- Compare the results of using different data sets
- Test different deep network architectures

Experiment Manager App



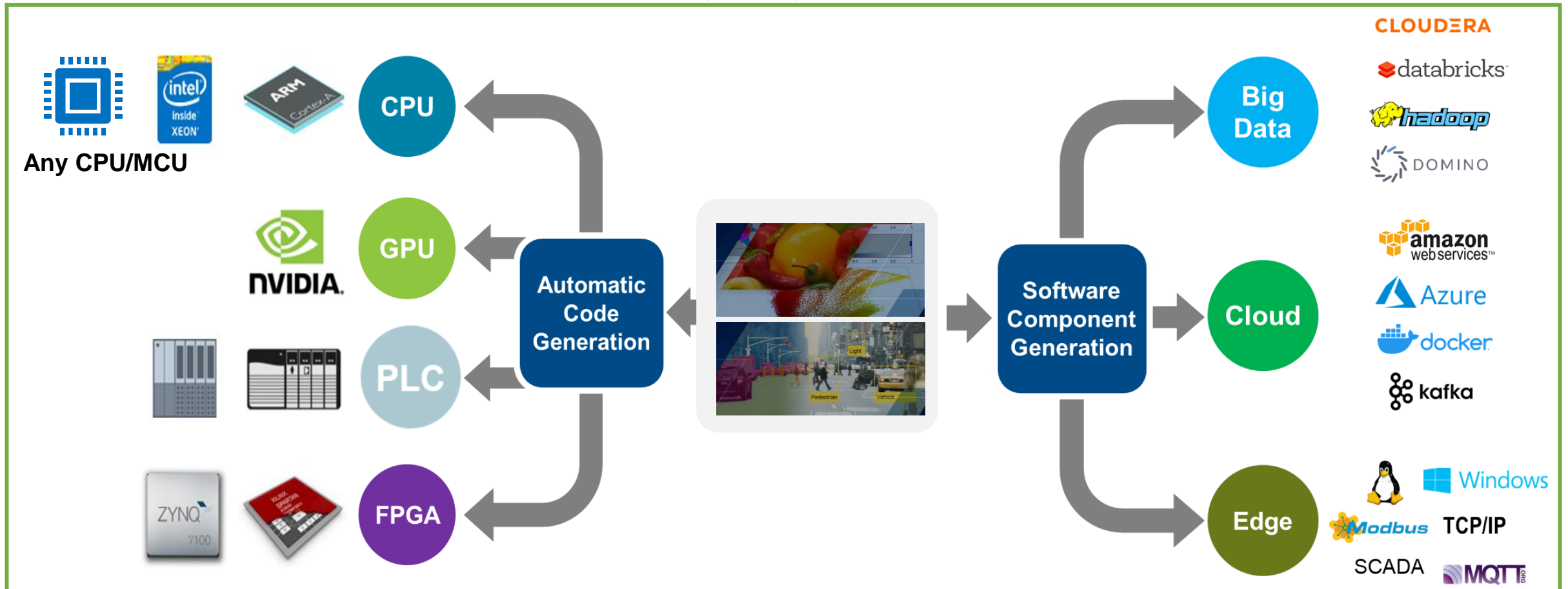
The screenshot shows the Experiment Manager app interface. The main window displays a list of trials for a 'Baseline Tuning' experiment. The trials are organized into a table with columns for Trial, Status, Progress, Elapsed Time, and various performance metrics. The first 7 trials are marked as 'Complete', while trials 8 through 16 are 'Queued'.

Trial	Status	Progress	Elapsed Time	myInitialLearn...	convFilterSize	Training Accu...	Training Loss	Validation Ac...
1	Complete	100.0%	0 hr 0 min 16 sec	1.0000e-6	3.0000	12.5000	2.6441	10.
2	Complete	100.0%	0 hr 0 min 15 sec	1.0000e-5	3.0000	25.7813	2.1228	20.
3	Complete	100.0%	0 hr 0 min 14 sec	0.0001	3.0000	64.8438	1.0878	42.
4	Complete	100.0%	0 hr 0 min 16 sec	0.0005	3.0000	90.6250	0.4648	49.
5	Complete	100.0%	0 hr 0 min 15 sec	1.0000e-6	4.0000	11.7188	2.4967	6.
6	Complete	100.0%	0 hr 0 min 15 sec	1.0000e-5	4.0000	23.4375	2.1213	14.
7	Complete	100.0%	0 hr 0 min 17 sec	0.0001	4.0000	72.6563	1.0283	39.
8	Running	30.7%	0 hr 0 min 4 sec	0.0005	4.0000			
9	Queued	0.0%		1.0000e-6	5.0000			
10	Queued	0.0%		1.0000e-5	5.0000			
11	Queued	0.0%		0.0001	5.0000			
12	Queued	0.0%		0.0005	5.0000			
13	Queued	0.0%		1.0000e-6	6.0000			
14	Queued	0.0%		1.0000e-5	6.0000			
15	Queued	0.0%		0.0001	6.0000			
16	Queued	0.0%		0.0005	6.0000			

Experiment Manager app to manage multiple deep learning experiments, analyze and compare results and code

Deploy to Embedded Systems or Enterprise Infrastructure

Code developed in MATLAB and Simulink can be deployed to embedded devices, enterprise systems or the cloud



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