Neural Network Deployment with DIGITS and TensorRT

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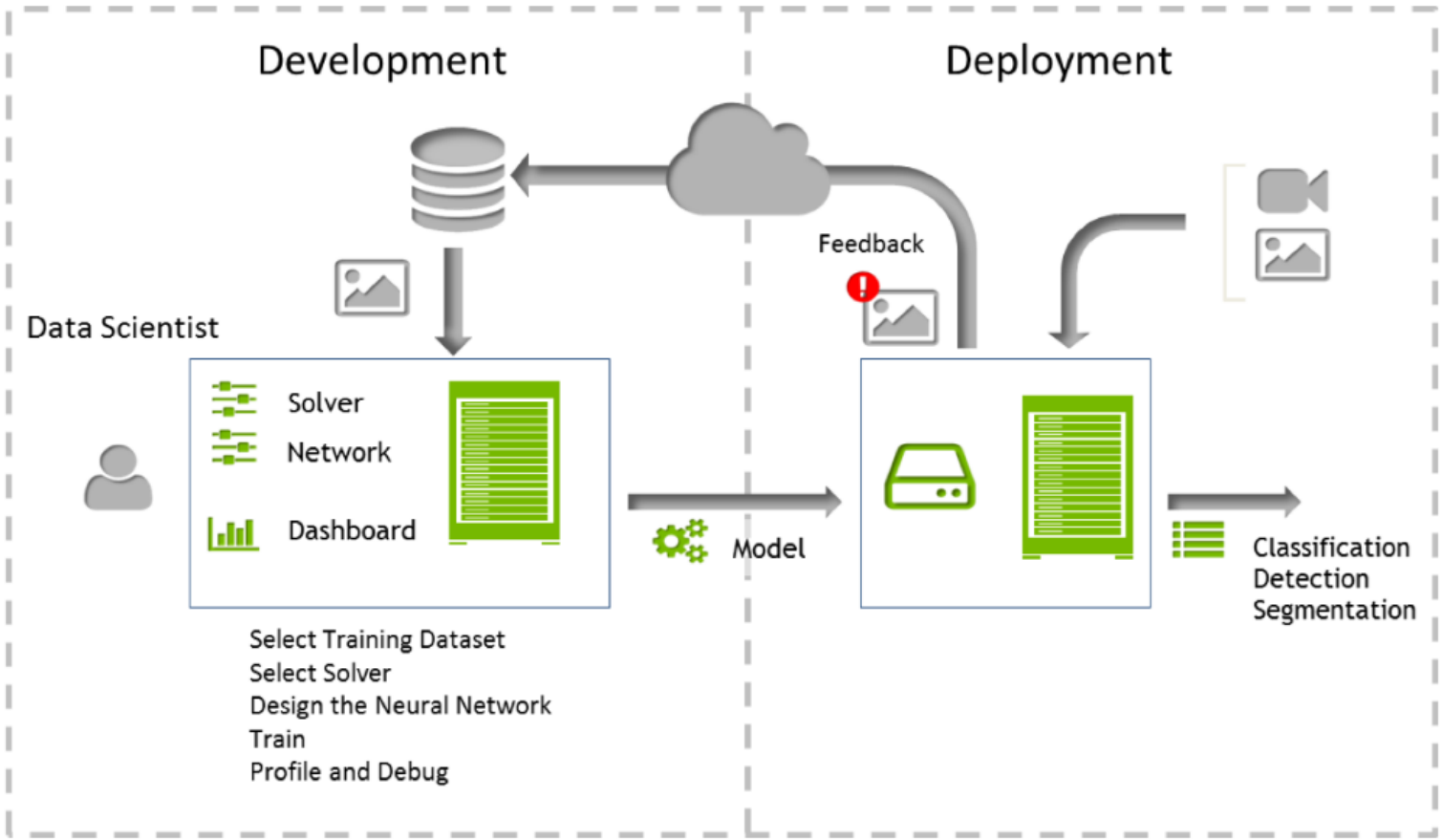
8 January 2018

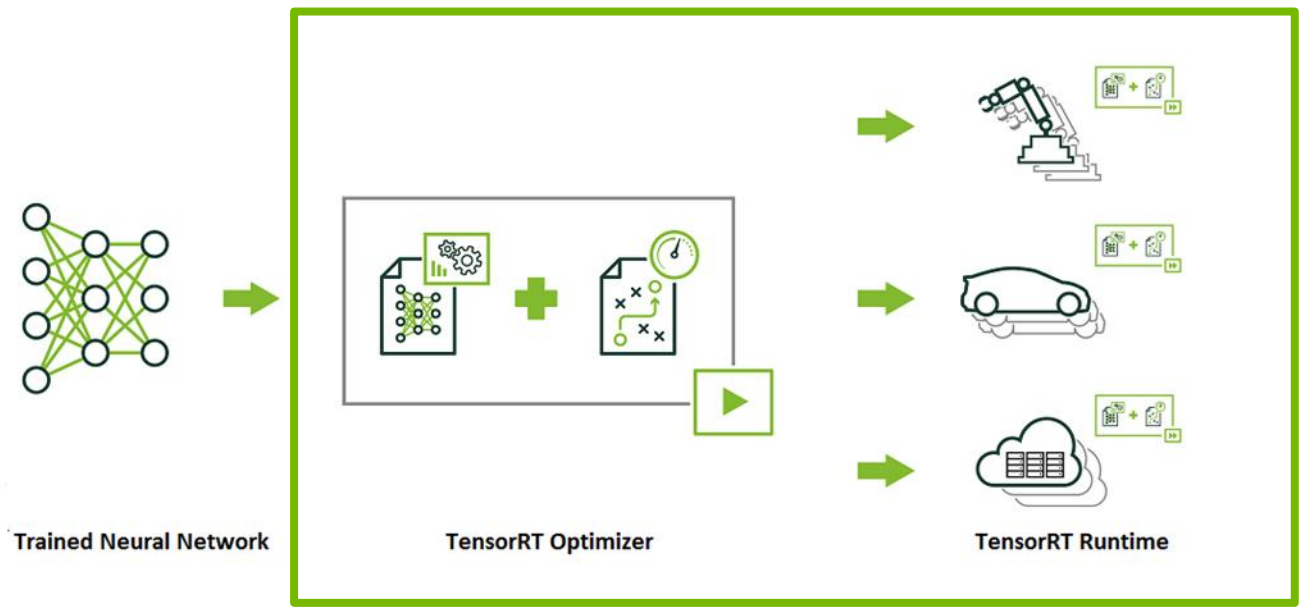
Deep Learning Approach

Neural network training and inference



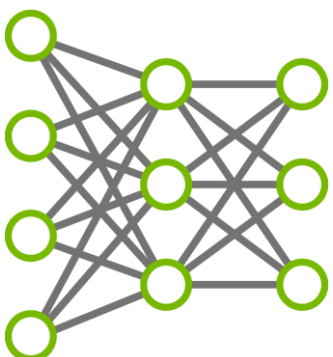
TensorRT

- Inference engine for production deployment of deep learning applications



- Allows developers to focus on developing AI powered applications
  - TensorRT ensures optimal inference performance

TensorRT Optimizer



TRAINED
NEURAL
NETWORK

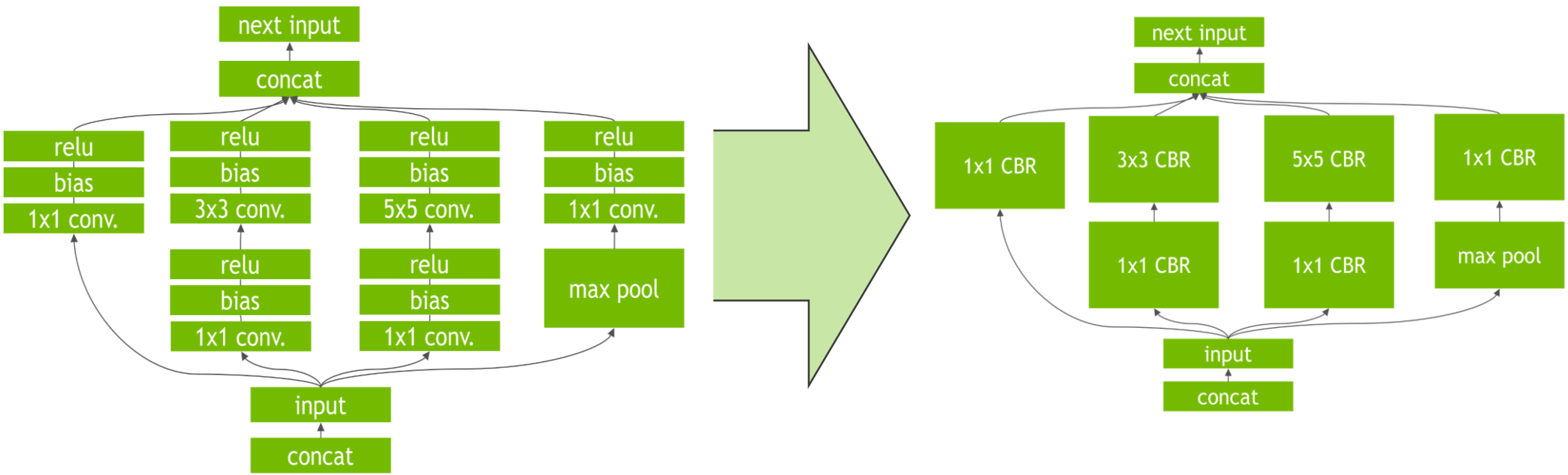
- **Fuse network layers**
- **Eliminate concatenation layers**
- **Kernel specialization**
- **Auto-tuning for target platform**
- **Select optimal tensor layout**
- **Batch size tuning**

OPTIMIZED
INFERENCE
RUNTIME

developer.nvidia.com/tensorrt

TensorRT Optimizer

Vertical Layer Fusion



CBR = Convolution, Bias and ReLU

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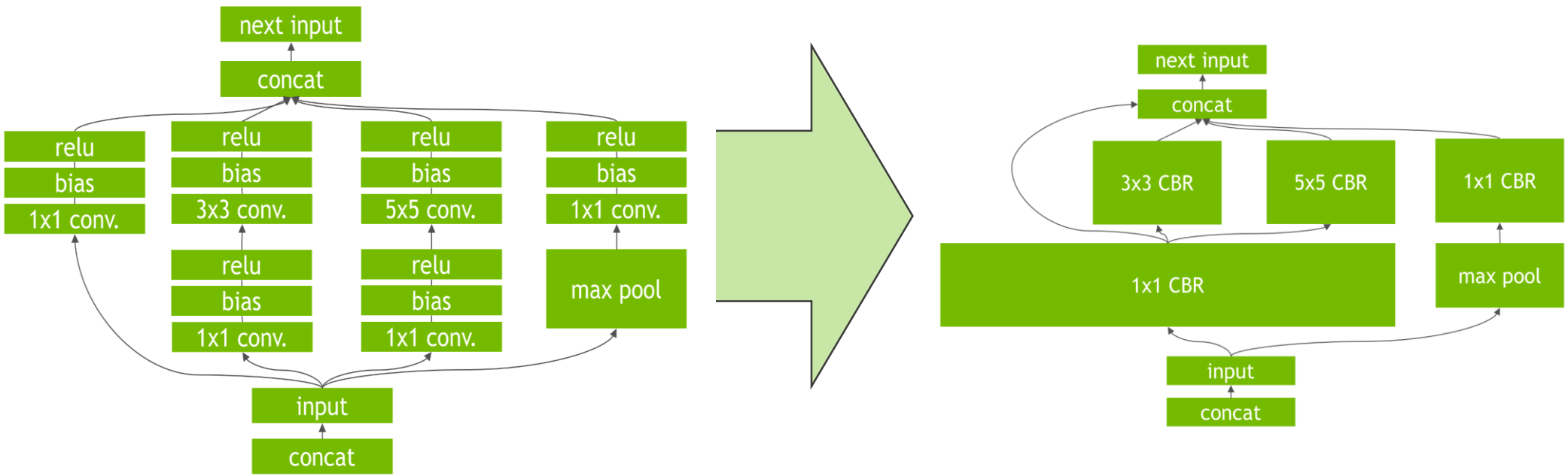
TensorRT Optimizer

Horizontal Layer Fusion (Layer Aggregation)



CBR = Convolution, Bias and ReLU

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TensorRT Optimizer

Supported layers

- Convolution: 2D
- Activation: ReLU, tanh and sigmoid
- Pooling: max and average
- ElementWise: sum, product or max of two tensors
- LRN: cross-channel only
- Fully-connected: with or without bias
- SoftMax: cross-channel only
- Deconvolution

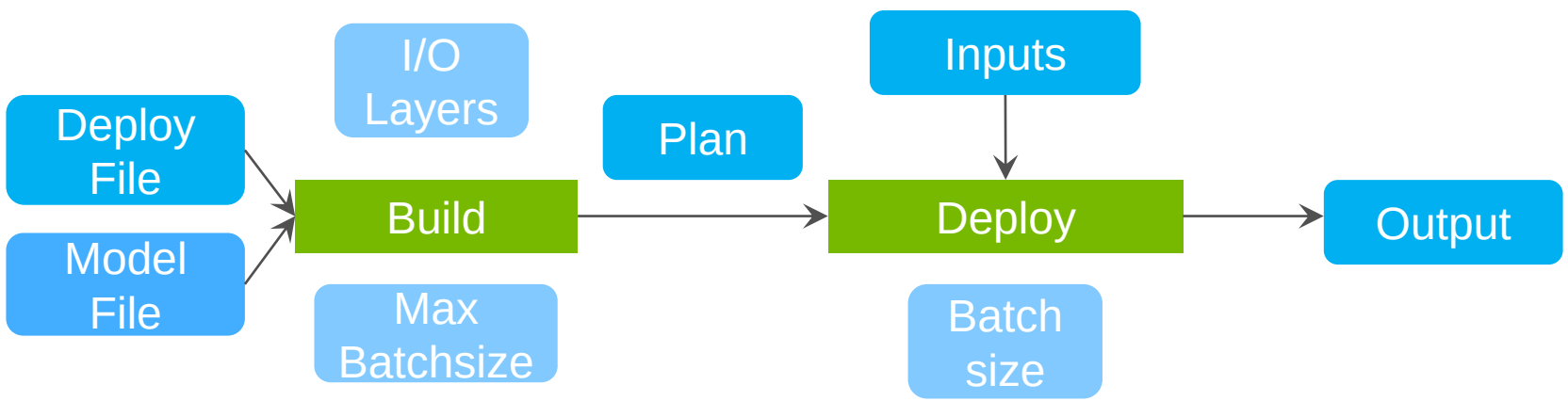
TensorRT Optimizer

- Scalability:
  - Output/Input Layers can connect with other deep learning framework directly
    - Caffe, Theano, Torch, TensorFlow
- Reduced Latency:
  - INT8 or FP16
    - INT8 delivers 3X more throughput compared to FP32
    - INT8 uses 61% less memory compared to FP32

TensorRT Runtime

Two Phases

- **Build:** optimizations on the network configuration and generates an optimized plan for computing the forward pass
- **Deploy:** Forward and output the inference result



TensorRT Runtime

- No need to install and run a deep learning framework on the deployment hardware
- **Plan** is a runtime (serialized) object
  - smaller than the combination of model and weights
  - Ready for immediate use. Alternatively, state can be serialized and saved to disk or to an object store for distribution.
- Three files needed to deploy a classification neural network:
  - Network architecture file (deploy.prototxt)
  - Trained weights (net.caffemodel)
  - Label file to provide a name for each output class

LAB DETAILS

Lab Architectures / Datasets

- *GoogleNet*
  - CNN architecture trained for image classification using the ilsvrc12 Imagenet dataset
  - 1000 class labels to an entire image based on the dominant object present
- *pedestrian_detectNet*
  - CNN architecture able to assign a global classification to an image and detect multiple objects within the image and draw bounding boxes around them
  - Trained for the task of pedestrian detection using a large dataset of pedestrians in a variety of indoor and outdoor scenes

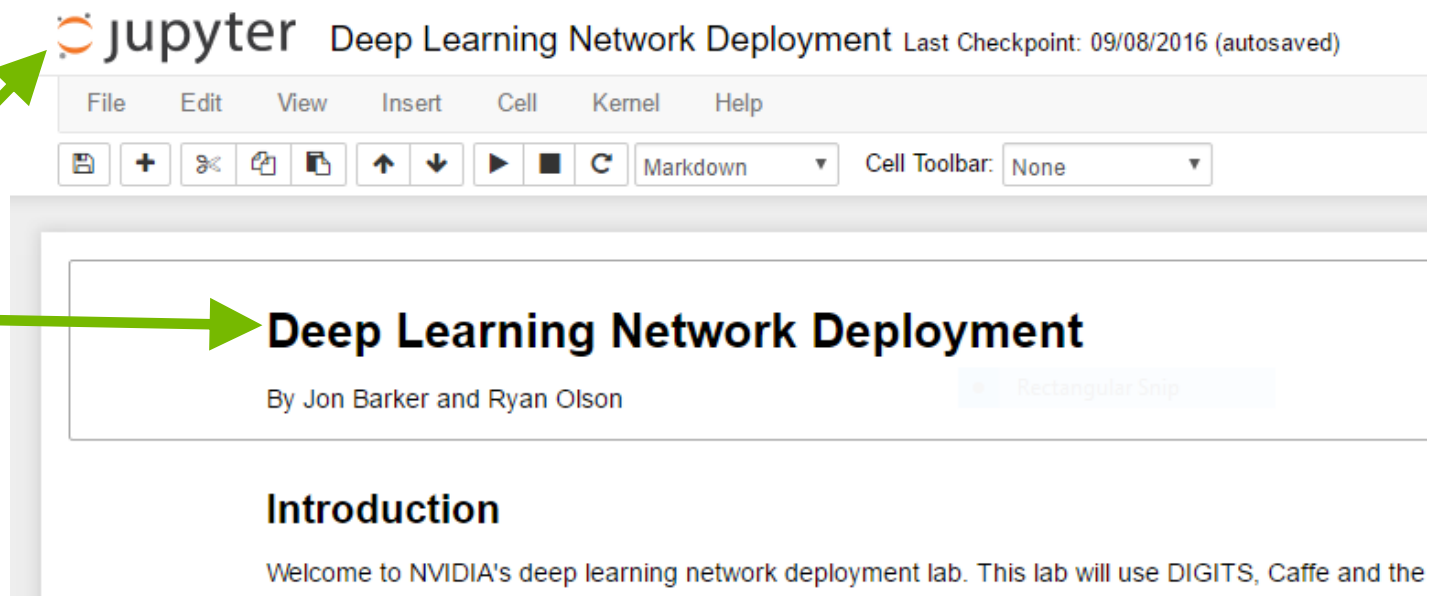
Lab Tasks

- GPU Inference Engine (GIE) = TensorRT
- Part 1: Inference using DIGITS
  - Will use existing model in DIGITS to perform inference on a single image
- Part 2: Inference using Pycaffe
  - Programming production-like deployable inference code
- Part 3: NVIDIA TensorRT
  - Will run TensorRT Optimizer to build a plan
  - Deploy the plan using TensorRT Runtime

LAUNCHING THE LAB ENVIRONMENT

CONNECTING TO THE LAB ENVIRONMENT

You should see your "Deep Learning Network Deployment" Jupyter notebook



REVIEW / NEXT STEPS

WHAT'S NEXT

- Use / practice what you learned
- Discuss with peers practical applications of DNN
- Reach out to NVIDIA and the Deep Learning Institute
- Look for local meetups
- Follow people like Andrej Karpathy and Andrew Ng

WHAT'S NEXT

TAKE SURVEY

…for the chance to win an NVIDIA SHIELD TV.

Check your email for a link.

ACCESS ONLINE LABS

Check your email for details to access more DLI training online.

ATTEND WORKSHOP

Visit www.nvidia.com/dli for workshops in your area.

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APPENDIX

Lab Debug

Can’t display Ipython Notebook?

IPython Notebook

- Chrome/Firefox/Safari recommended. IE will work but not as well
- Websockets are required - you can test at websocketstest.com
  - Look for this result:

- Execute cells with ctrl+enter or pressing play button

Lab Debug

Don’t know if cell is running??

You should see In[*] and not In[ ] or In[<some number>].

Solid grey circle in the top-right of the browser window

If you only see #1 and not #2, then you need to try the following in order:

Press the stop button on the toolbar. Try again.

Click Kernel -> Restart. Try again.

Save the Notebook and refresh the page. Try again.

End the lab from the qwikLABS page and start a new instance. All work will be lost.
(Please let me know before you do this)

Lab Debug

Revert to some checkpoint