CIML

Overview: MNIST w/noise, and tensorboard

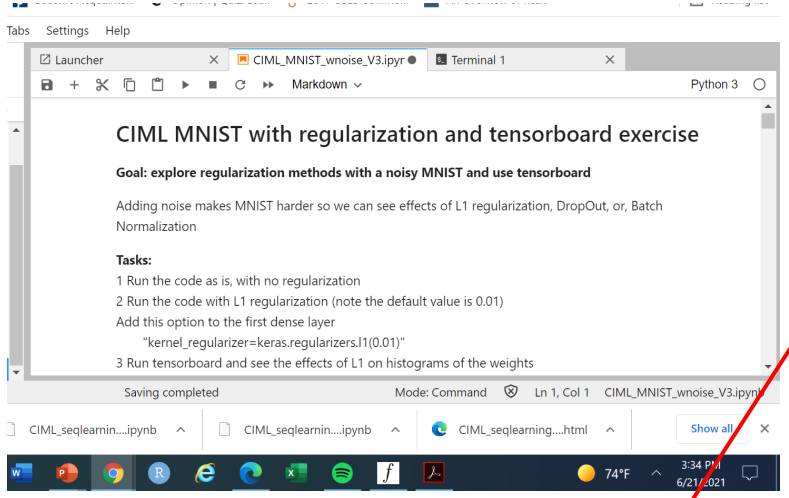
MNIST is too easy, so switch labels to make learning harder

Try an L1 regularization (a penalty $\boldsymbol{\lambda}^{*}\boldsymbol{\Sigma}\,|W|$ is added to Loss) on the classification layer

View results in tensorboard.dev (you will need a google id)

Optional: dropout layer (drop % of activations of a layer)

batchNormalization (center and scale activations of a layer)



Read the instructions and glance at the code sections

Notice there is a log directory name set up for tensorflow

Notice there is a new callback function to log information

Next cell sets up directory for tensorboard logs

[1]:
```
#Set up the location for tensorflow logs
import datetime, os
logdir  = os.path.join("logs",
                datetime.datetime.now().strftime("%Y%m%d-%H%M%S")+'_'+ \
                       'test')   #<<<<<----- you can add a comment to describe the test
print('using',logdir,' for logs')
```

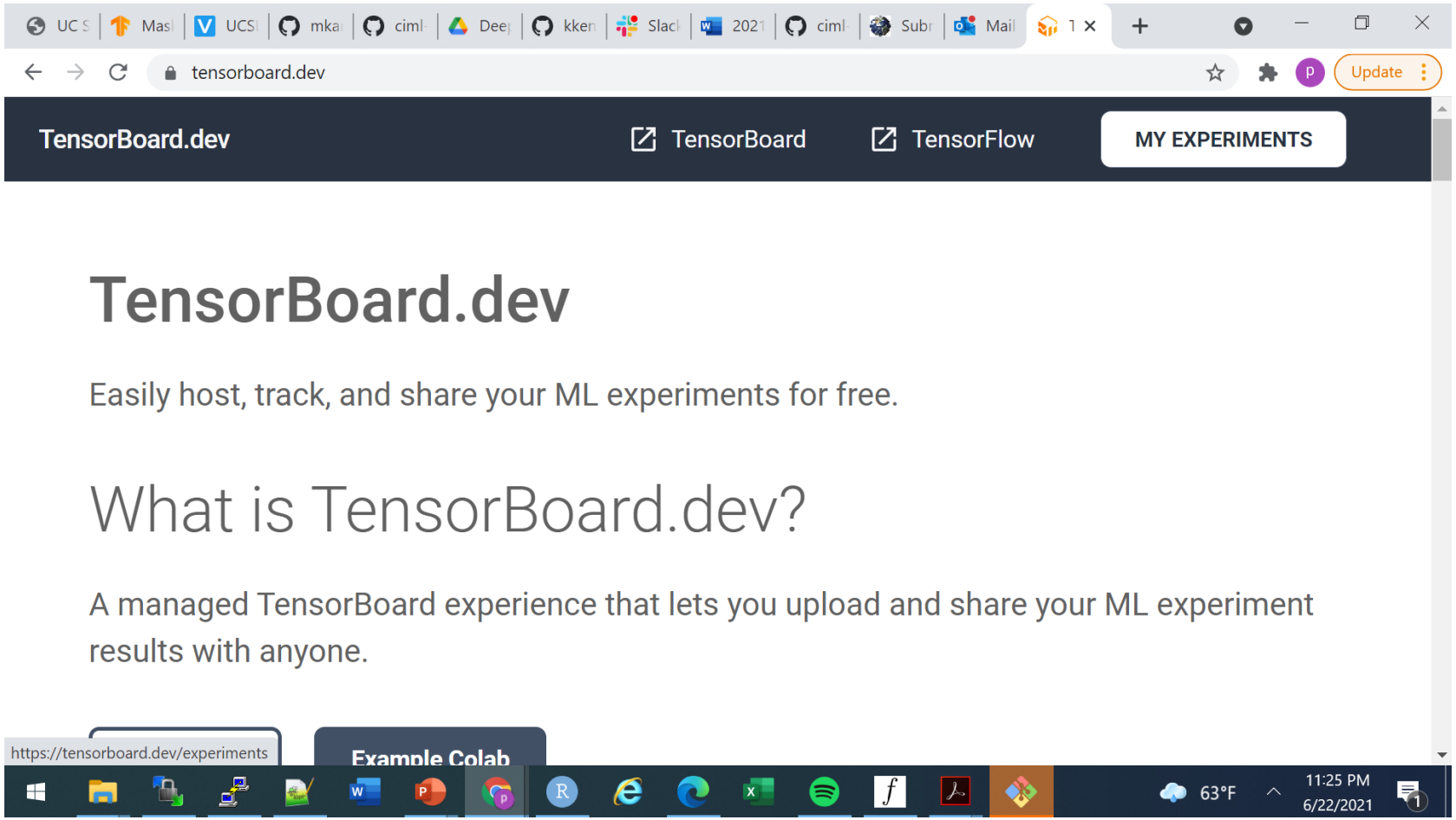
5]:
```
from tensorflow.keras.callbacks import EarlyStopping
ES_function = EarlyStopping(monitor='val_loss', mode='min',  patience=20)
                  #or try: monitor='val_accuracy', mode='max', patience=1)

tensorboard_callback = tf.keras.callbacks.TensorBoard(logdir, histogram_freq=1)
       #Use this to get performance info, like memory usage:  profile_batch = '5,20')

fit_history=mymodel.fit(X_train, Y_train, #validation_split=0.20,
          validation_data=(X_test,Y_test),
          batch_size=64, epochs=100, verbose=1,callbacks=[ES_function,tensorboard_callback])
```

Tensorboard has no reverse-proxy on Expanse, so we can use public tensorboard

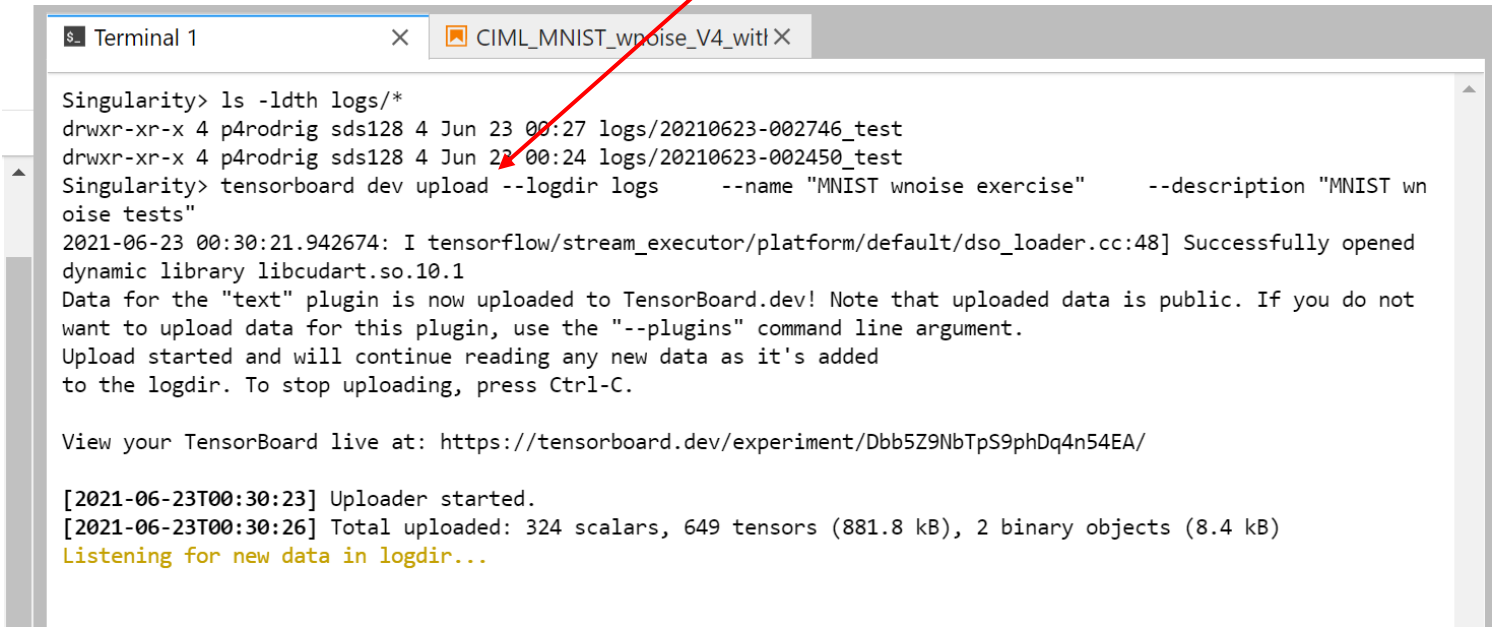
(In future, we will get a more secure set up on Expanse)



From a terminal window (inside the notebook) , upload log files to tensorboard.dev

```
$ tensorboard dev upload --logdir logs \
   --name "(optional) My latest experiment" \
   --description "(optional) Simple comparison of several hyperparameters"
```

go to folder with log directory and enter this command



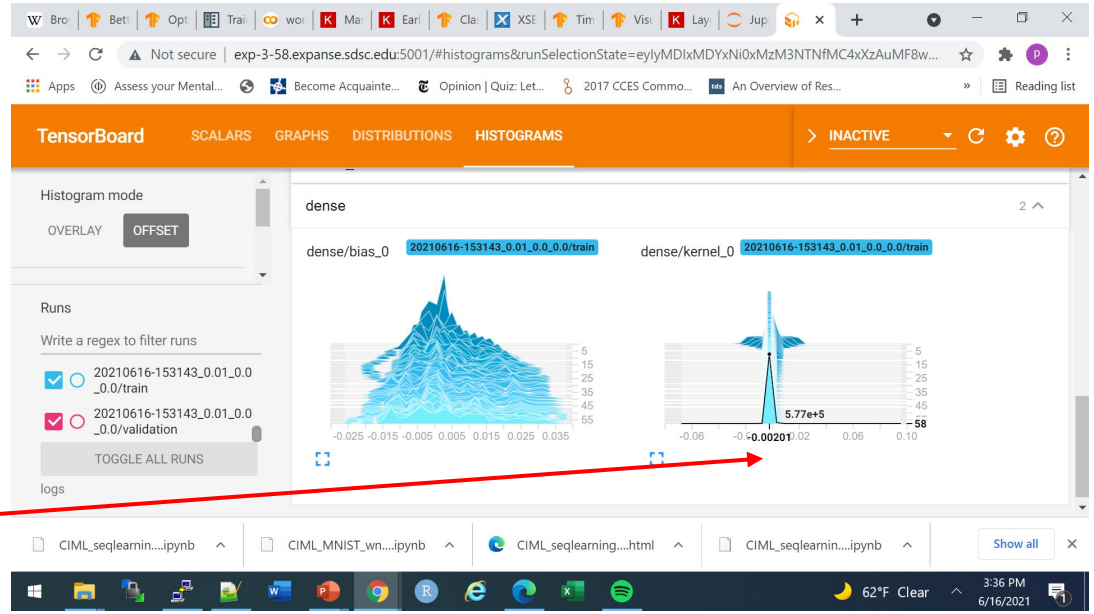
Also use these to clean up uploaded experiments:

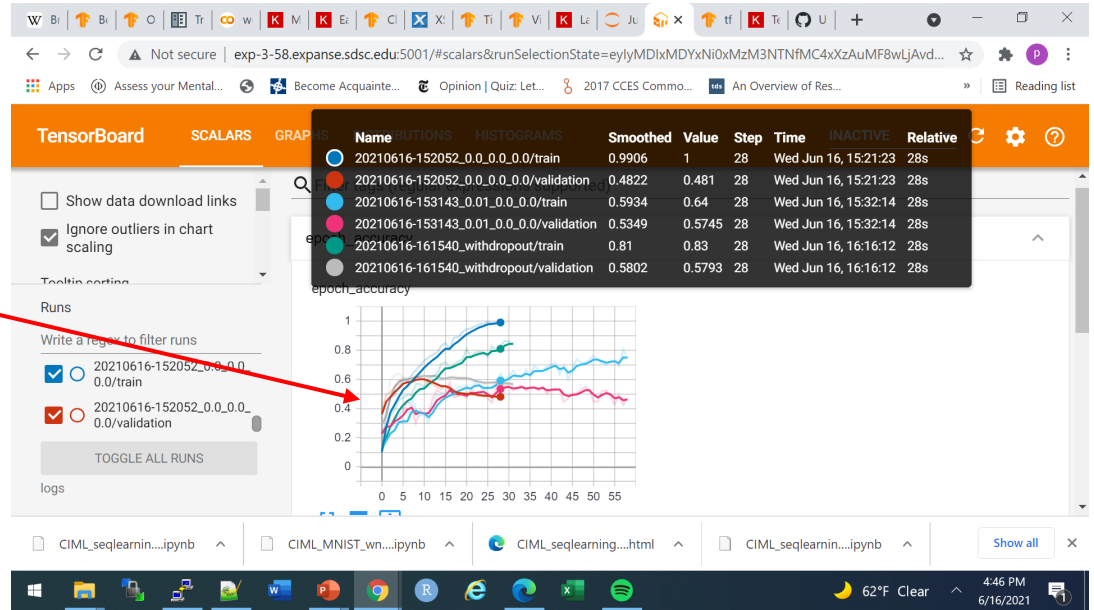
```
$tensorboard dev list
$tensorboard dev delete --experiment_id GdEEZ0NBQaGdOjqXeijwLw
```

Run the notebook;
Find the <<<< ---- comments to change/add regularization

In tensorboard, for L1 regularization logs the weight histogram will be mostly 0s – right?
(try toggling runs on/off, look for dense layer)

If you run several times you can get all the performances plotted together (depending on what log data you toggle)





NOTE on extra tasks:

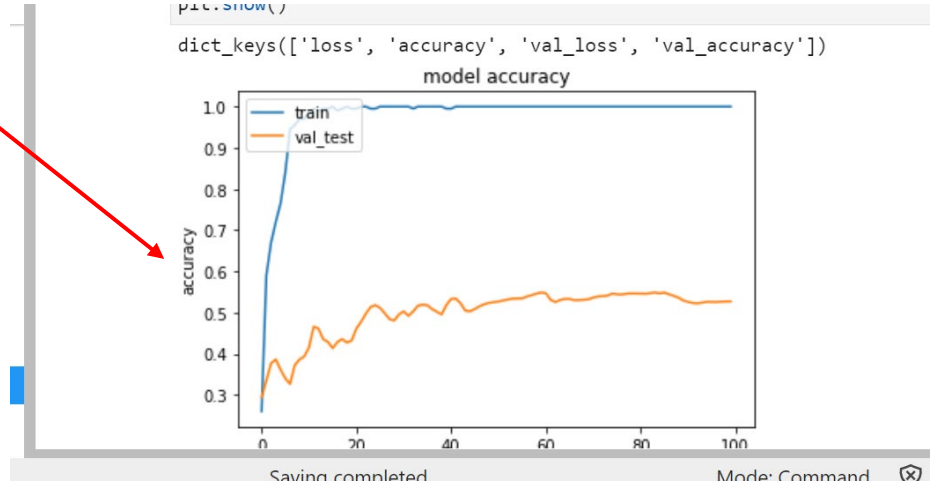
BatchNormaliztion seems to learn the training set very fast and avoid the inverted U for accuracy

```
numfilters = 64
mymodel.add(Convolution2D(numfilters, (3,3), strides=1,  data_format="channels_last", activation='relu'
mymodel.add(Convolution2D(numfilters, (3,3), strides=1,  data_format="channels_last", activation='relu'
mymodel.add(MaxPooling2D(pool_size=(2,2),strides=2,data_format="channels_last"))
mymodel.add(Flatten())

#----- add final classification layers
mymodel.add(Dense(64, activation='relu'))   #<<<<---- Add the L1 reglzer option here
#mymodel.add(Dropout(0.50))
mymodel.add(BatchNormalization(axis=-1))

mymodel.add(Dense(10, activation='softmax'))

print('added layers to model')
```



EXTRA NOTE:

Tensorboard has a ‘profiler’ plugin

The profile option has performance information for some part of the training iterations

On Expanse it does not run in the container – yet.