This Notebook

In this notebook, we'll train a basic Fully Connected CNN as a baseline. While it is not obvious from the notebook, I used errors from my Bash logger output to install the necessary requirements for getting my CNNs to train on my GPU instead of my CPU, including installing cudnn7.6 and the CUDA 10.1 toolkit from NVIDIA and verifying files were on system paths. The experiment is also not evident in this notebook, but you can use os.environ["CUDA_VISIBLE_DEVICES"] = "-1" to hide the GPU and force training on the CPU, and in doing so I evaluated the training time difference. For a training run on a small number of images, the ETA using the CPU was 1.5 h, while on my GPU, the expected runtime was 8 min. Thus all CNNs were trained using my GPU, a NVIDIA RTX 2070 Super.

Importing Images

Let's set up some generators, since we won't be able to load all the images into memory, accessing the file structure built in the preprocessing notebook.

In [1]:

```
import datetime
import os
import gc
import numpy as np
import tensorflow as tf
from keras.preprocessing.image import ImageDataGenerator
from keras import layers
from keras import models
from keras import optimizers
from keras import backend as K
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:

```
image_root_dir = 'E:\LargeDatasets\SAR-Ocean-Images\GeoTIFF\OrganisationForModel'
train_dir = f'{image_root_dir}\\train'
val_dir = f'{image_root_dir}\\val'
test_dir = f'{image_root_dir}\\test'
```

Setting up generators..

In [3]:

```
batch_size = 10

test_generator = ImageDataGenerator(rescale=1./255).flow_from_directory(
        test_dir, class_mode = 'categorical',
        target_size=(540, 490), batch_size = batch_size)

val_generator = ImageDataGenerator(rescale=1./255).flow_from_directory(
        val_dir, class_mode = 'categorical',
        target_size=(540, 490), batch_size = batch_size)

train_generator = ImageDataGenerator(rescale=1./255).flow_from_directory(
        train_dir, class_mode = 'categorical',
        target_size=(540, 490), batch_size= batch_size)
```

```
C:\Users\mattl\anaconda3\envs\learn-env\lib\site-packages\keras_preprocessing\i
mage\utils.py:179: UserWarning: Using ".tiff" files with multiple bands will ca
use distortion. Please verify your output.
  warnings.warn('Using ".tiff" files with multiple bands '

Found 3756 images belonging to 10 classes.
Found 3756 images belonging to 10 classes.
Found 30041 images belonging to 10 classes.
```

Intializing a small CNN for a baseline.. NOTE: I ran this baseline before recognizing, in the CNN_iters notebook, that the files weren't being processed properly. Thus, these results and use as a baseline are kind of nonsensical, nevertheless, it demonstrates the process.

Building Model

In [4]:

```
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu',
                        input_shape=(540, 490, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(128, activation='relu'))
model.add(layers.Dense(256, activation='relu'))
model.add(layers.Dense(512, activation='relu'))
model.add(layers.Dense(10, activation='softmax'))
```

In [5]:

```
model.compile(loss='categorical_crossentropy',
              optimizer=optimizers.RMSprop(lr=.001),
              metrics=['acc'])
```

In [6]:

```
history = model.fit(train_generator,
                        steps_per_epoch=30041//batch_size,
                        epochs=5,
                        validation_data=val_generator,
                        validation_steps=3756//batch_size)
```

```
Epoch 1/5
   2/3004 [..............................] - ETA: 1:19 - loss: 17.8426 - acc:
0.1000 WARNING:tensorflow:Callbacks method `on_train_batch_end` is slow compare
d to the batch time (batch time: 0.0210s vs `on_train_batch_end` time: 0.0319
s). Check your callbacks.
3004/3004 [==============================] - 650s 216ms/step - loss: 2.2544 - a
cc: 0.1446 - val_loss: 2.1746 - val_acc: 0.1509
Epoch 2/5
3004/3004 [==============================] - 649s 216ms/step - loss: 2.2245 - a
cc: 0.1474 - val_loss: 2.1725 - val_acc: 0.1491
Epoch 3/5
3004/3004 [==============================] - 610s 203ms/step - loss: 2.2422 - a
cc: 0.1363 - val_loss: 2.2296 - val_acc: 0.1275
Epoch 4/5
3004/3004 [==============================] - 563s 187ms/step - loss: 2.2299 - a
cc: 0.1277 - val_loss: 2.2300 - val_acc: 0.1277
Epoch 5/5
3004/3004 [==============================] - 571s 190ms/step - loss: 2.2301 - a
cc: 0.1281 - val_loss: 2.2298 - val_acc: 0.1307
```

In [7]:

```
model.evaluate(test_generator)
```

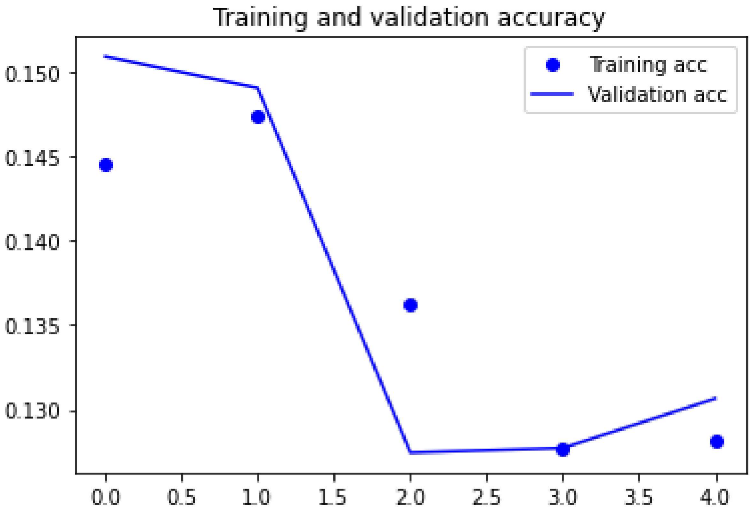
```
376/376 [==============================] - 87s 232ms/step - loss: 2.2297 - acc:
0.1305
```

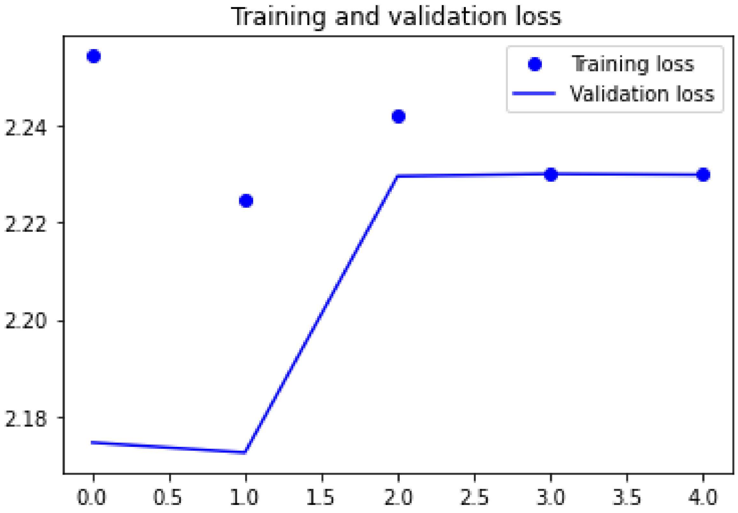
Out[7]:

```
[2.229677200317383, 0.13045793771743774]
```

In [10]:

```
acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(len(acc))
plt.plot(epochs, acc, 'bo', label='Training acc')
plt.plot(epochs, val_acc, 'b', label='Validation acc')
plt.title('Training and validation accuracy')
plt.legend()
plt.figure()
plt.plot(epochs, loss, 'bo', label='Training loss')
plt.plot(epochs, val_loss, 'b', label='Validation loss')
plt.title('Training and validation loss')
plt.legend()
plt.show()
```





In [12]:

```
model.save('.\SavedModels\BaselineCNN', overwrite = True)
```

```
INFO:tensorflow:Assets written to: .\SavedModels\BaselineCNN\assets
```

In [ ]: