Load Pickle Data

In [1]:
```
import numpy as np
import pickle
from sklearn.utils import shuffle
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import tensorflow as tf
import cv2

# Import necessary items from Keras
from tensorflow.keras.models import Sequential
from tensorflow.keras import datasets, layers, models
from tensorflow.keras.layers import Activation, Dropout, UpSampling2D
from tensorflow.keras.layers import Conv2DTranspose, Conv2D, MaxPooling2D, BatchNormalization
# from tensorflow.keras.layers.BatchNormalization
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras import regularizers
```

In [2]:
```
# from PIL import Image
# img = plt.imread(r"/scratch1/pswaroo/data/bdd100k/labels/drivable/colormaps/val/b1c66a42-6f7d68ca.png")
# plt.imshow(img[:,:,])
# print(img.shape)
# Load training images
path = '/scratch1/pswaroo/data/curated_data/'
```

In [3]:
```
train_images = np.load(path+'images/rainy.npy')
```

In [4]:
```
i = 0

scale_percent = 60 # percent of original size
width = int(train_images[0].shape[1] * scale_percent / 100)
height = int(train_images[0].shape[0] * scale_percent / 100)
dim = (width, height)
# print(height)
# X_train = np.array((train_images.shape))
X_train = np.zeros((train_images.shape[0],height,width,train_images.shape[3]))

for image in train_images:
    resize = cv2.resize(image, dim, interpolation = cv2.INTER_AREA)
    X_train[i] = resize / 255
    i +=1

train_images = np.asarray(X_train)
print(train_images.shape)
plt.imshow(train_images[0])
```

Out[4]:
```
(5070, 432, 768, 3)
<matplotlib.image.AxesImage at 0x153fa4163e48>
```

In [5]:
```
# np.save("/scratch1/pswaroo/data/rainy_normalized",train_images)
```

In [6]:
```
train_labels = np.load(path+'final_data/archives/Labels/rainy_labels.npy')
y_train = np.zeros((train_labels.shape[0],height,width))
i = 0
for label in train_labels:
    label = label / 94
    y_train[i] = cv2.resize(label, dim, interpolation = cv2.INTER_NEAREST)
    i += 1

train_labels = np.asarray(y_train)
print(train_labels.shape)
```

```
(5070, 432, 768)
```

In [7]:
```
# np.unique(train_labels[86])
```

In [8]:
```
import tensorflow as tf
print("Num GPUs Available: ", len(tf.config.list_physical_devices('GPU')))
```

```
Num GPUs Available:  1
```

In [ ]:

In [9]:
```
## filter_size = (5, 5)
# activation_type = 'relu'
pool_size = (2,2)

model = tf.keras.Sequential()
# model = Sequential()
# Normalizes incoming inputs. First layer needs the input shape to work
# model.add(BatchNormalization(input_shape=(720,1280,3)))
# Below layers were re-named for easier reading of model summary; this not necessary
# Conv Layer 1
model.add(layers.Conv2D(8, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv1', input_s

# Conv Layer 2
model.add(layers.Conv2D(16, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv2'))

# Pooling 1
model.add(layers.MaxPooling2D(pool_size=pool_size))

# Conv Layer 3
model.add(layers.Conv2D(16, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv3'))
model.add(layers.Dropout(0.2))

# Conv Layer 4
model.add(layers.Conv2D(32, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv4'))
model.add(layers.Dropout(0.2))

# Conv Layer 5
model.add(layers.Conv2D(32, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv5'))
model.add(layers.Dropout(0.2))

# Pooling 2
model.add(layers.MaxPooling2D(pool_size=pool_size))

# Conv Layer 6
model.add(layers.Conv2D(64, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv6'))
model.add(layers.Dropout(0.2))

# Conv Layer 7
model.add(layers.Conv2D(64, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Conv7'))
model.add(layers.Dropout(0.2))

# Pooling 3
model.add(layers.MaxPooling2D(pool_size=pool_size))

# Upsample 1
model.add(layers.UpSampling2D(size=pool_size))

# Deconv 1
model.add(layers.Conv2DTranspose(64, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon
model.add(layers.Dropout(0.2))

# Deconv 2
model.add(layers.Conv2DTranspose(64, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon
model.add(layers.Dropout(0.2))

# Upsample 2
model.add(layers.UpSampling2D(size=pool_size))

# Deconv 3
model.add(layers.Conv2DTranspose(32, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon
model.add(layers.Dropout(0.2))

# Deconv 4
model.add(layers.Conv2DTranspose(32, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon
model.add(layers.Dropout(0.2))

# Deconv 5
model.add(layers.Conv2DTranspose(16, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon
model.add(layers.Dropout(0.2))

# Upsample 3
model.add(layers.UpSampling2D(size=pool_size))

# Deconv 6
model.add(layers.Conv2DTranspose(16, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Decon

# Final layer - only including one channel so 1 filter
model.add(layers.Conv2DTranspose(1, (3, 3), padding='valid', strides=(1,1), activation = 'relu', name = 'Final'
```

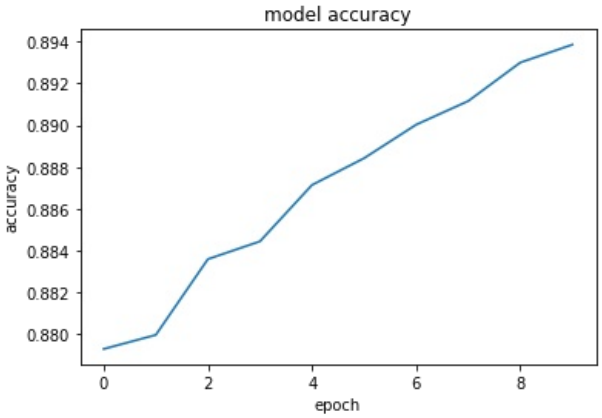
In [10]:
```
batch_size = 16
epochs = 10
# datagen = ImageDataGenerator(channel_shift_range=0.2)
X_train = train_images
```

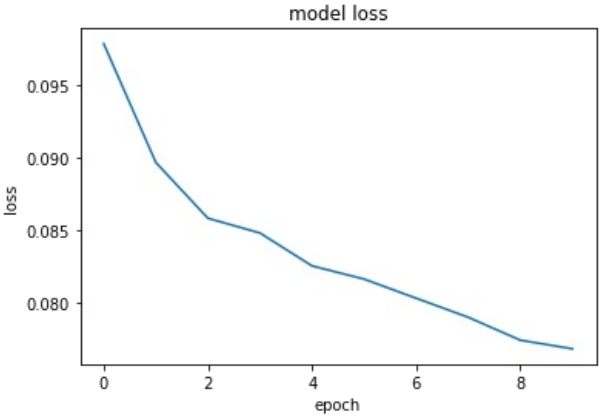
```
y_train = train_labels
# datagen.fit(X_train)

model.compile(optimizer='Adam', loss='mean_squared_error', metrics=['accuracy'])
history = model.fit(train_images, train_labels, batch_size=batch_size, steps_per_epoch=len(train_images)/batch_
model.save("DL_10EPOCH_RAINY_ACCURACY_NOCHANGE")
# # Freeze layers since training is done
# model.trainable = False
# model.compile(optimizer='Adam', loss='mean_squared_error')
```

```
Epoch 1/10
316/316 [==============================] - 91s 260ms/step - loss: 0.1021 - accuracy: 0.8804
Epoch 2/10
316/316 [==============================] - 78s 245ms/step - loss: 0.0899 - accuracy: 0.8807
Epoch 3/10
316/316 [==============================] - 78s 246ms/step - loss: 0.0871 - accuracy: 0.8822
Epoch 4/10
316/316 [==============================] - 78s 245ms/step - loss: 0.0856 - accuracy: 0.8842
Epoch 5/10
316/316 [==============================] - 77s 244ms/step - loss: 0.0844 - accuracy: 0.8842
Epoch 6/10
316/316 [==============================] - 78s 245ms/step - loss: 0.0819 - accuracy: 0.8878
Epoch 7/10
316/316 [==============================] - 77s 243ms/step - loss: 0.0806 - accuracy: 0.8900
Epoch 8/10
316/316 [==============================] - 78s 245ms/step - loss: 0.0793 - accuracy: 0.8907
Epoch 9/10
316/316 [==============================] - 78s 246ms/step - loss: 0.0777 - accuracy: 0.8926
Epoch 10/10
316/316 [==============================] - 77s 243ms/step - loss: 0.0761 - accuracy: 0.8953
INFO:tensorflow:Assets written to: DL_10EPOCH_RAINY_ACCURACY_NOCHANGE/assets
```

In [11]:

```
plt.plot(history.history['accuracy'])
# plt.plot(history.history['val_accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
# plt.legend(['train', 'test'], loc='upper left')
plt.show()
plt.savefig("DL_10EPOCH_RAINY_ACCURACY_NOCHANGE")
# summarize history for loss
plt.plot(history.history['loss'])
# plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
# plt.legend(['train', 'test'], loc='upper left')
plt.show()
plt.savefig("DL_10EPOCH_RAINY_LOSS_NOCHANGE")
```






```
<matplotlib.figure.Figure at 0x154c51a93c18>
```

In [1]:

```
from sklearn.metrics import confusion_matrix
```

```
import numpy as np
import pickle
from sklearn.utils import shuffle
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import tensorflow as tf
import cv2

# Import necessary items from Keras
from tensorflow.keras.models import Sequential
from tensorflow.keras import datasets, layers, models
from tensorflow.keras.layers import Activation, Dropout, UpSampling2D
from tensorflow.keras.layers import Conv2DTranspose, Conv2D, MaxPooling2D, BatchNormalization
# from tensorflow.keras.layers.BatchNormalization
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras import regularizers
```

In [2]:
```
def compute_iou(y_pred, y_true):
    # ytrue, ypred is a flatten vector
    y_pred = y_pred.flatten()
    y_true = y_true.flatten()
    current = confusion_matrix(y_true, y_pred, labels = [0, 1])
    # compute mean iou
    intersection = np.diag(current)
    ground_truth_set = current.sum(axis=1)
    predicted_set = current.sum(axis=0)
    union = ground_truth_set + predicted_set - intersection
    IoU = intersection / union.astype(np.float32)
    return np.mean(IoU)
```

In [3]:
```
path = '/scratch1/pswaroo/data/curated_data/'

test_images = np.load(path+'images/foggy.npy')

scale_percent = 60 # percent of original size
width = int(test_images[0].shape[1] * scale_percent / 100)
height = int(test_images[0].shape[0] * scale_percent / 100)
dim = (width, height)


X_test = np.zeros((test_images.shape[0],height,width,test_images.shape[3]))

i=0
for image in test_images:
    image = image / 255
    X_test[i] = cv2.resize(image, dim, interpolation = cv2.INTER_NEAREST)
    i +=1

model = tf.keras.models.load_model('DL_10EPOCH_RAINY_ACCURACY_NOCHANGE/')
y_pred = model.predict(X_test)
```

In [4]:
```
y_pred[y_pred <= 0.6] = 0
y_pred[y_pred > 0.6] = 1
```

In [5]:
```
path = '/scratch1/pswaroo/data/curated_data/'

test_labels = np.load(path+'final_data/archives/Labels/foggy_labels.npy')

scale_percent = 60 # percent of original size
width = int(test_labels[0].shape[1] * scale_percent / 100)
height = int(test_labels[0].shape[0] * scale_percent / 100)
dim = (width, height)


Y_test = np.zeros((test_labels.shape[0],height,width))

i=0
for image in test_labels:
    image = image / 94
    Y_test[i] = cv2.resize(image, dim, interpolation = cv2.INTER_NEAREST)
    i +=1
```

In [6]:
```
y_true=Y_test
# test_labels = np.load(path+'final_data/archives/Labels/foggy_labels.npy')
print(np.unique(y_pred[29]))
```

```
[0. 1.]
```

In [7]:
```
# print(compute_iou(y_pred[1], y_true[1]))
# # train_labels.shape
m_iou = []
for i in range(130):
    m_iou.append(compute_iou(y_pred[i], y_true[i]))
    print(i)
```

```
/software/spackages/linux-centos8-x86_64/gcc-8.3.1/anaconda3-5.1.0-c3p5et4cpo7jaiahacqa3pqwhop7tiik/lib/python3
.6/site-packages/ipykernel_launcher.py:11: RuntimeWarning: invalid value encountered in true_divide
  # This is added back by InteractiveShellApp.init_path()
```

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/software/spackages/linux-centos8-x86_64/gcc-8.3.1/anaconda3-5.1.0-c3p5et4cpo7jaiahacqa3pqwhop7tiik/lib/python3
.6/site-packages/ipykernel_launcher.py:11: RuntimeWarning: invalid value encountered in true_divide
  # This is added back by InteractiveShellApp.init_path()
```

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```

In [15]:
```
print(np.nanmean(m_iou))
```

```
0.4840061407290205
```

In [ ]:

```
import
path = '/scratch1/pswaroo/data/curated_data/'

test_labels = np.load(path+'final_data/archives/Labels/foggy_labels.npy')
```