weather-conditions-classification-using-fastai

July 21, 2025

[1]:
```
import os
import pandas as pd
from fastai.vision.all import *
from fastai.vision import models
from fastai.metrics import error_rate, accuracy

import warnings
warnings.filterwarnings('ignore')
set_seed(42)
```

1 Data Preprocessing

Read data and store it in dataframe

[2]:
```
#Generate data paths with labels
data_dir = '/kaggle/input/weather-dataset/dataset'
filepaths = []
labels = []

folds = os.listdir(data_dir)
for fold in folds:
    foldpath = os.path.join(data_dir, fold)
    filelist = os.listdir(foldpath)
    for file in filelist:
        fpath = os.path.join(foldpath, file)
        filepaths.append(fpath)
        labels.append(fold)

# Conatenate data paths with labels into one dataframe
Fseries = pd.Series(filepaths, name='filepaths')
Lseries = pd.Series(labels, name='labels')
df = pd.concat([Fseries,Lseries],axis=1)
```

[3]:
```
df
```

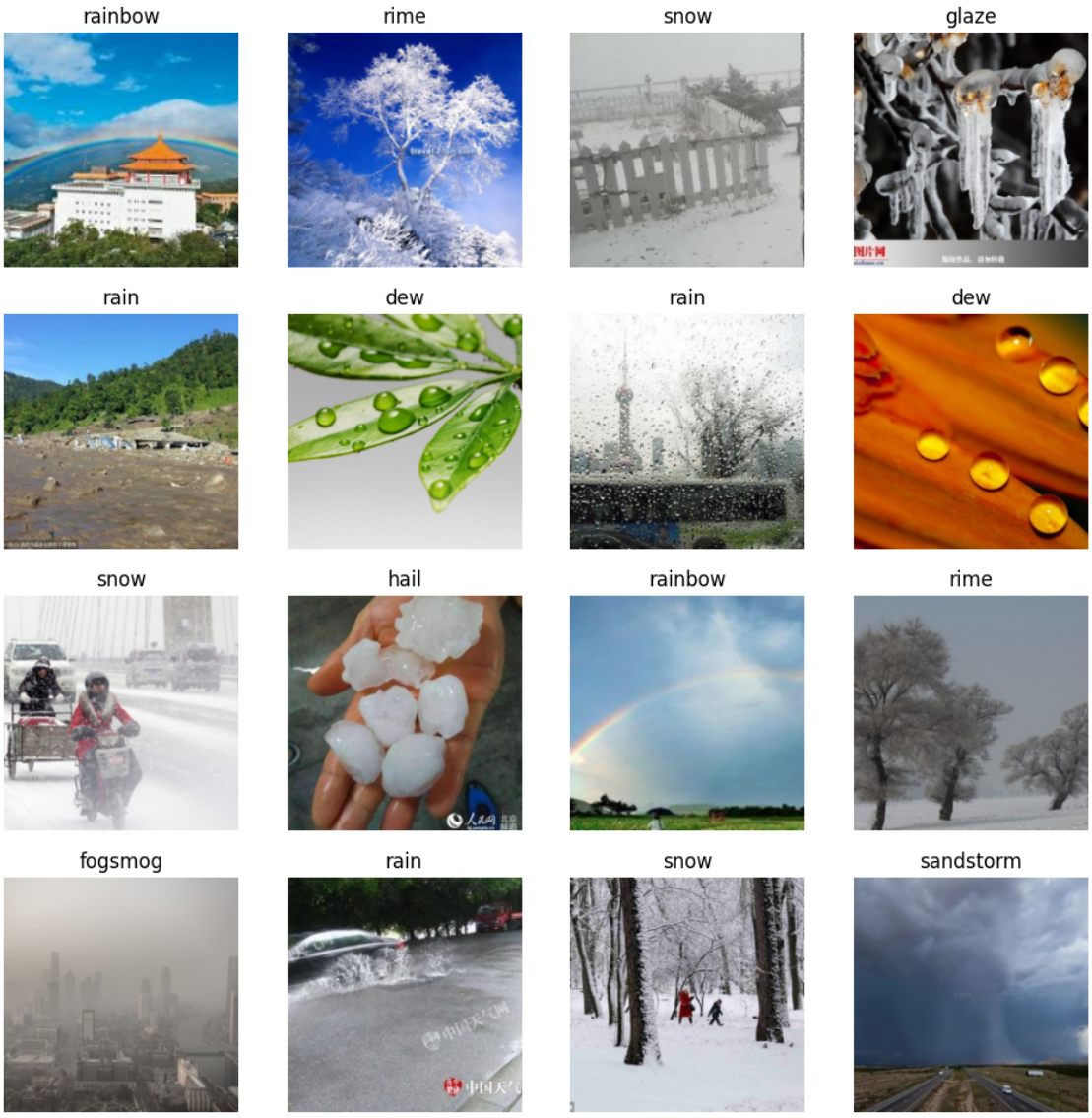
[3]:

	filepaths	labels
0	/kaggle/input/weather-dataset/dataset/hail/0106.jpg	hail
1	/kaggle/input/weather-dataset/dataset/hail/0375.jpg	hail

```
2     /kaggle/input/weather-dataset/dataset/hail/0285.jpg   hail
3     /kaggle/input/weather-dataset/dataset/hail/0074.jpg   hail
4     /kaggle/input/weather-dataset/dataset/hail/0077.jpg   hail
…                                                    …     …
6857   /kaggle/input/weather-dataset/dataset/dew/2689.jpg    dew
6858   /kaggle/input/weather-dataset/dataset/dew/2607.jpg    dew
6859   /kaggle/input/weather-dataset/dataset/dew/2691.jpg    dew
6860   /kaggle/input/weather-dataset/dataset/dew/2867.jpg    dew
6861   /kaggle/input/weather-dataset/dataset/dew/2599.jpg    dew

[6862 rows x 2 columns]
```

[4]:
```
dls = ImageDataLoaders.from_df(df,
                               fn_col=0, # filepaths
                               label_col=1, # labels
                               valid_pct=0.2,
                               folder='/',
                               item_tfms=Resize(224))
```

[5]:
```
dls.show_batch(max_n=16)
```



2 Model Structure

[6]:
```
model = vision_learner(dls, 'efficientnet_b3',
                       metrics=[accuracy,error_rate], path='.').to_fp16()
```

```
model.safetensors:   0%|          | 0.00/49.3M [00:00<?, ?B/s]
```

[7]:
```
model.summary()
```

```
<IPython.core.display.HTML object>
```

```
<IPython.core.display.HTML object>
```

[7]:
```
Sequential (Input shape: 64 x 3 x 224 x 224)
============================================================================
Layer (type)         Output Shape          Param #    Trainable
============================================================================
                     64 x 40 x 112 x 112
Conv2d                                     1080       False
Identity
SiLU
Conv2d                                     360        False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                     64 x 10 x 1 x 1
Conv2d                                     410        False
SiLU
----------------------------------------------------------------------------
                     64 x 40 x 1 x 1
Conv2d                                     440        False
Sigmoid
----------------------------------------------------------------------------
                     64 x 24 x 112 x 112
Conv2d                                     960        False
Identity
Identity
Conv2d                                     216        False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                     64 x 6 x 1 x 1
Conv2d                                     150        False
SiLU
----------------------------------------------------------------------------
                     64 x 24 x 1 x 1
Conv2d                                     168        False
Sigmoid
Conv2d                                     576        False
Identity
Identity
Identity
----------------------------------------------------------------------------
                     64 x 144 x 112 x 11
Conv2d                                     3456       False
Identity
SiLU
----------------------------------------------------------------------------
```

```
                    64 x 144 x 56 x 56
Conv2d                                  1296       False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 6 x 1 x 1
Conv2d                                  870        False
SiLU
----------------------------------------------------------------------------
                    64 x 144 x 1 x 1
Conv2d                                  1008       False
Sigmoid
----------------------------------------------------------------------------
                    64 x 32 x 56 x 56
Conv2d                                  4608       False
Identity
Identity
----------------------------------------------------------------------------
                    64 x 192 x 56 x 56
Conv2d                                  6144       False
Identity
SiLU
Conv2d                                  1728       False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 8 x 1 x 1
Conv2d                                  1544       False
SiLU
----------------------------------------------------------------------------
                    64 x 192 x 1 x 1
Conv2d                                  1728       False
Sigmoid
----------------------------------------------------------------------------
                    64 x 32 x 56 x 56
Conv2d                                  6144       False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 192 x 56 x 56
Conv2d                                  6144       False
Identity
SiLU
Conv2d                                  1728       False
```

```
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                     64 x 8 x 1 x 1
Conv2d                                1544       False
SiLU
--------------------------------------------------------------------------------
                     64 x 192 x 1 x 1
Conv2d                                1728       False
Sigmoid
--------------------------------------------------------------------------------
                     64 x 32 x 56 x 56
Conv2d                                6144       False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                     64 x 192 x 56 x 56
Conv2d                                6144       False
Identity
SiLU
--------------------------------------------------------------------------------
                     64 x 192 x 28 x 28
Conv2d                                4800       False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                     64 x 8 x 1 x 1
Conv2d                                1544       False
SiLU
--------------------------------------------------------------------------------
                     64 x 192 x 1 x 1
Conv2d                                1728       False
Sigmoid
--------------------------------------------------------------------------------
                     64 x 48 x 28 x 28
Conv2d                                9216       False
Identity
Identity
--------------------------------------------------------------------------------
                     64 x 288 x 28 x 28
Conv2d                                13824      False
Identity
SiLU
Conv2d                                7200       False
```

```
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 12 x 1 x 1
Conv2d                                  3468       False
SiLU
----------------------------------------------------------------------------
                    64 x 288 x 1 x 1
Conv2d                                  3744       False
Sigmoid
----------------------------------------------------------------------------
                    64 x 48 x 28 x 28
Conv2d                                  13824      False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 288 x 28 x 28
Conv2d                                  13824      False
Identity
SiLU
Conv2d                                  7200       False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 12 x 1 x 1
Conv2d                                  3468       False
SiLU
----------------------------------------------------------------------------
                    64 x 288 x 1 x 1
Conv2d                                  3744       False
Sigmoid
----------------------------------------------------------------------------
                    64 x 48 x 28 x 28
Conv2d                                  13824      False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 288 x 28 x 28
Conv2d                                  13824      False
Identity
SiLU
----------------------------------------------------------------------------
                    64 x 288 x 14 x 14
```

```
Conv2d                                  2592       False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 12 x 1 x 1
Conv2d                                  3468       False
SiLU
----------------------------------------------------------------------------
                    64 x 288 x 1 x 1
Conv2d                                  3744       False
Sigmoid
----------------------------------------------------------------------------
                    64 x 96 x 14 x 14
Conv2d                                  27648      False
Identity
Identity
----------------------------------------------------------------------------
                    64 x 576 x 14 x 14
Conv2d                                  55296      False
Identity
SiLU
Conv2d                                  5184       False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 24 x 1 x 1
Conv2d                                  13848      False
SiLU
----------------------------------------------------------------------------
                    64 x 576 x 1 x 1
Conv2d                                  14400      False
Sigmoid
----------------------------------------------------------------------------
                    64 x 96 x 14 x 14
Conv2d                                  55296      False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 576 x 14 x 14
Conv2d                                  55296      False
Identity
SiLU
Conv2d                                  5184       False
Identity
```

```
SiLU
Identity
--------------------------------------------------------------------------------
                    64 x 24 x 1 x 1
Conv2d                                13848      False
SiLU
--------------------------------------------------------------------------------
                    64 x 576 x 1 x 1
Conv2d                                14400      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 96 x 14 x 14
Conv2d                                55296      False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 576 x 14 x 14
Conv2d                                55296      False
Identity
SiLU
Conv2d                                5184       False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                    64 x 24 x 1 x 1
Conv2d                                13848      False
SiLU
--------------------------------------------------------------------------------
                    64 x 576 x 1 x 1
Conv2d                                14400      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 96 x 14 x 14
Conv2d                                55296      False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 576 x 14 x 14
Conv2d                                55296      False
Identity
SiLU
Conv2d                                5184       False
Identity
SiLU
```

```
Identity
----------------------------------------------------------------------------
                    64 x 24 x 1 x 1
Conv2d                                  13848      False
SiLU
----------------------------------------------------------------------------
                    64 x 576 x 1 x 1
Conv2d                                  14400      False
Sigmoid
----------------------------------------------------------------------------
                    64 x 96 x 14 x 14
Conv2d                                  55296      False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 576 x 14 x 14
Conv2d                                  55296      False
Identity
SiLU
Conv2d                                  14400      False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 24 x 1 x 1
Conv2d                                  13848      False
SiLU
----------------------------------------------------------------------------
                    64 x 576 x 1 x 1
Conv2d                                  14400      False
Sigmoid
----------------------------------------------------------------------------
                    64 x 136 x 14 x 14
Conv2d                                  78336      False
Identity
Identity
----------------------------------------------------------------------------
                    64 x 816 x 14 x 14
Conv2d                                  110976     False
Identity
SiLU
Conv2d                                  20400      False
Identity
SiLU
Identity
----------------------------------------------------------------------------
```

```
                    64 x 34 x 1 x 1
Conv2d                                27778      False
SiLU
--------------------------------------------------------------------------
                    64 x 816 x 1 x 1
Conv2d                                28560      False
Sigmoid
--------------------------------------------------------------------------
                    64 x 136 x 14 x 14
Conv2d                                110976     False
Identity
Identity
Identity
--------------------------------------------------------------------------
                    64 x 816 x 14 x 14
Conv2d                                110976     False
Identity
SiLU
Conv2d                                20400      False
Identity
SiLU
Identity
--------------------------------------------------------------------------
                    64 x 34 x 1 x 1
Conv2d                                27778      False
SiLU
--------------------------------------------------------------------------
                    64 x 816 x 1 x 1
Conv2d                                28560      False
Sigmoid
--------------------------------------------------------------------------
                    64 x 136 x 14 x 14
Conv2d                                110976     False
Identity
Identity
Identity
--------------------------------------------------------------------------
                    64 x 816 x 14 x 14
Conv2d                                110976     False
Identity
SiLU
Conv2d                                20400      False
Identity
SiLU
Identity
--------------------------------------------------------------------------
                    64 x 34 x 1 x 1
```

```
Conv2d                                  27778      False
SiLU
--------------------------------------------------------------------------------
                    64 x 816 x 1 x 1
Conv2d                                  28560      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 136 x 14 x 14
Conv2d                                  110976     False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 816 x 14 x 14
Conv2d                                  110976     False
Identity
SiLU
Conv2d                                  20400      False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                    64 x 34 x 1 x 1
Conv2d                                  27778      False
SiLU
--------------------------------------------------------------------------------
                    64 x 816 x 1 x 1
Conv2d                                  28560      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 136 x 14 x 14
Conv2d                                  110976     False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 816 x 14 x 14
Conv2d                                  110976     False
Identity
SiLU
--------------------------------------------------------------------------------
                    64 x 816 x 7 x 7
Conv2d                                  20400      False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
```

```
                    64 x 34 x 1 x 1
Conv2d                                27778      False
SiLU
--------------------------------------------------------------------------
                    64 x 816 x 1 x 1
Conv2d                                28560      False
Sigmoid
--------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                189312     False
Identity
Identity
--------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                322944     False
Identity
SiLU
Conv2d                                34800      False
Identity
SiLU
Identity
--------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                80794      False
SiLU
--------------------------------------------------------------------------
                    64 x 1392 x 1 x 1
Conv2d                                82128      False
Sigmoid
--------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                322944     False
Identity
Identity
Identity
--------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                322944     False
Identity
SiLU
Conv2d                                34800      False
Identity
SiLU
Identity
--------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                80794      False
```

```
SiLU
----------------------------------------------------------------------------
                    64 x 1392 x 1 x 1
Conv2d                                  82128      False
Sigmoid
----------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                  322944     False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                  322944     False
Identity
SiLU
Conv2d                                  34800      False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                  80794      False
SiLU
----------------------------------------------------------------------------
                    64 x 1392 x 1 x 1
Conv2d                                  82128      False
Sigmoid
----------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                  322944     False
Identity
Identity
Identity
----------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                  322944     False
Identity
SiLU
Conv2d                                  34800      False
Identity
SiLU
Identity
----------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                  80794      False
SiLU
```

```
--------------------------------------------------------------------------------
                    64 x 1392 x 1 x 1
Conv2d                                  82128      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                  322944     False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                  322944     False
Identity
SiLU
Conv2d                                  34800      False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                  80794      False
SiLU
--------------------------------------------------------------------------------
                    64 x 1392 x 1 x 1
Conv2d                                  82128      False
Sigmoid
--------------------------------------------------------------------------------
                    64 x 232 x 7 x 7
Conv2d                                  322944     False
Identity
Identity
Identity
--------------------------------------------------------------------------------
                    64 x 1392 x 7 x 7
Conv2d                                  322944     False
Identity
SiLU
Conv2d                                  12528      False
Identity
SiLU
Identity
--------------------------------------------------------------------------------
                    64 x 58 x 1 x 1
Conv2d                                  80794      False
SiLU
--------------------------------------------------------------------------------
```

```
                    64 x 1392 x 1 x 1
Conv2d                                  82128      False
Sigmoid
--------------------------------------------------------------------------
                    64 x 384 x 7 x 7
Conv2d                                  534528     False
Identity
Identity
--------------------------------------------------------------------------
                    64 x 2304 x 7 x 7
Conv2d                                  884736     False
Identity
SiLU
Conv2d                                  20736      False
Identity
SiLU
Identity
--------------------------------------------------------------------------
                    64 x 96 x 1 x 1
Conv2d                                  221280     False
SiLU
--------------------------------------------------------------------------
                    64 x 2304 x 1 x 1
Conv2d                                  223488     False
Sigmoid
--------------------------------------------------------------------------
                    64 x 384 x 7 x 7
Conv2d                                  884736     False
Identity
Identity
Identity
--------------------------------------------------------------------------
                    64 x 1536 x 7 x 7
Conv2d                                  589824     False
Identity
SiLU
--------------------------------------------------------------------------
                    64 x 1536 x 1 x 1
AdaptiveAvgPool2d
AdaptiveMaxPool2d
--------------------------------------------------------------------------
                    64 x 3072
Flatten
BatchNorm1d                             6144       True
Dropout
--------------------------------------------------------------------------
                    64 x 512
```

```
Linear                                   1572864    True
ReLU
BatchNorm1d                              1024       True
Dropout
------------------------------------------------------------------------------
                     64 x 11
Linear                                   5632       True
------------------------------------------------------------------------------

Total params: 12,194,600
Total trainable params: 1,585,664
Total non-trainable params: 10,608,936

Optimizer used: <function Adam at 0x7a7461d782c0>
Loss function: FlattenedLoss of CrossEntropyLoss()

Model frozen up to parameter group #1

Callbacks:
  - TrainEvalCallback
  - CastToTensor
  - MixedPrecision
  - Recorder
  - ProgressCallback
```

2.1 Training

[8]:
```
model.fit_one_cycle(20)
```

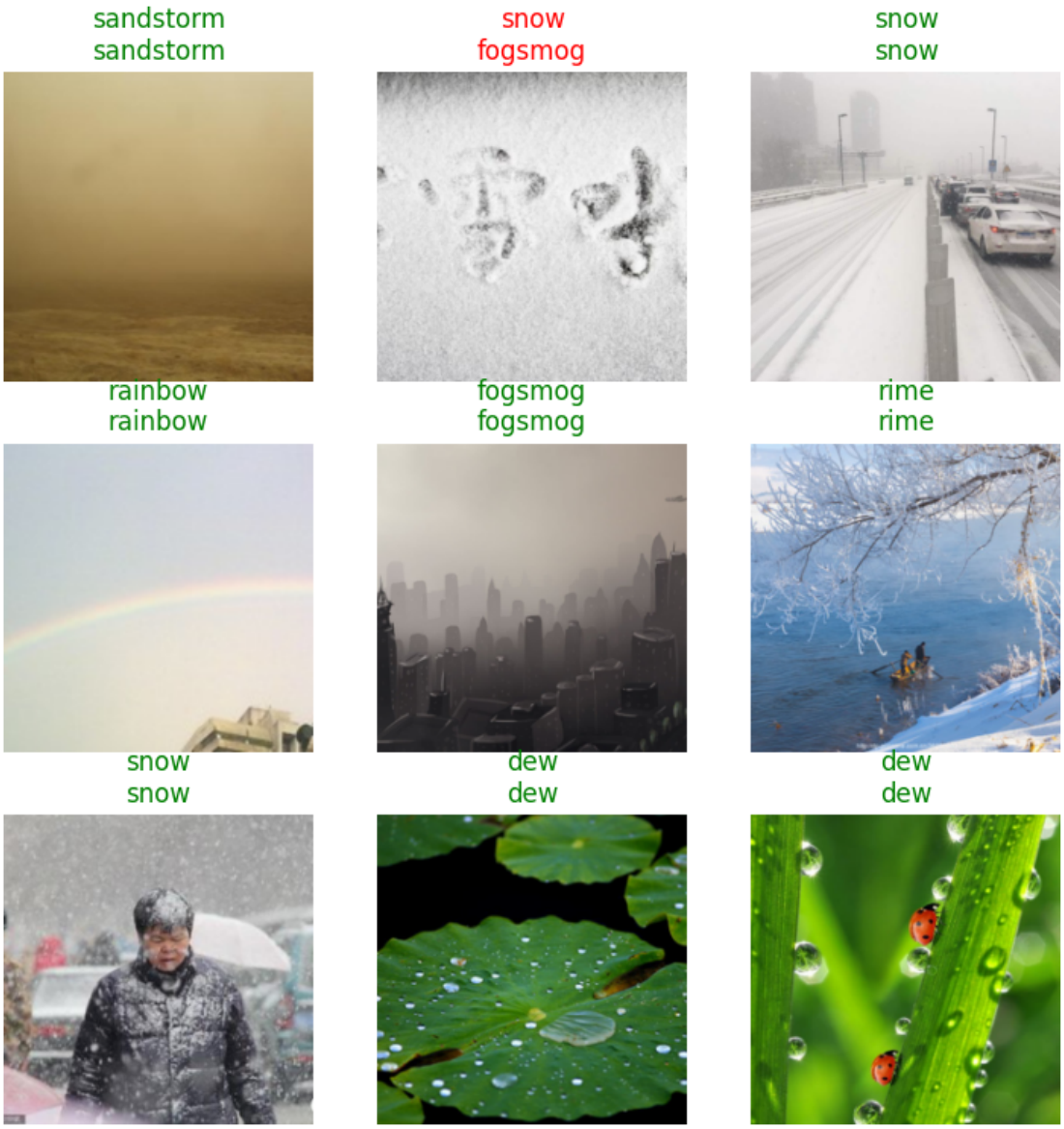
```
<IPython.core.display.HTML object>
```

```
<IPython.core.display.HTML object>
```

[9]:
```
model.show_results()
```

```
<IPython.core.display.HTML object>
```

```
<IPython.core.display.HTML object>
```



[13]:
```
val_loss, val_acc, val_err = model.validate()  # Unpack three values
print(f"Validation accuracy: {val_acc:.4f}")
print(f"Validation error rate: {val_err:.4f}")
```

```
Validation accuracy: 0.8921
Validation error rate: 0.1079
```

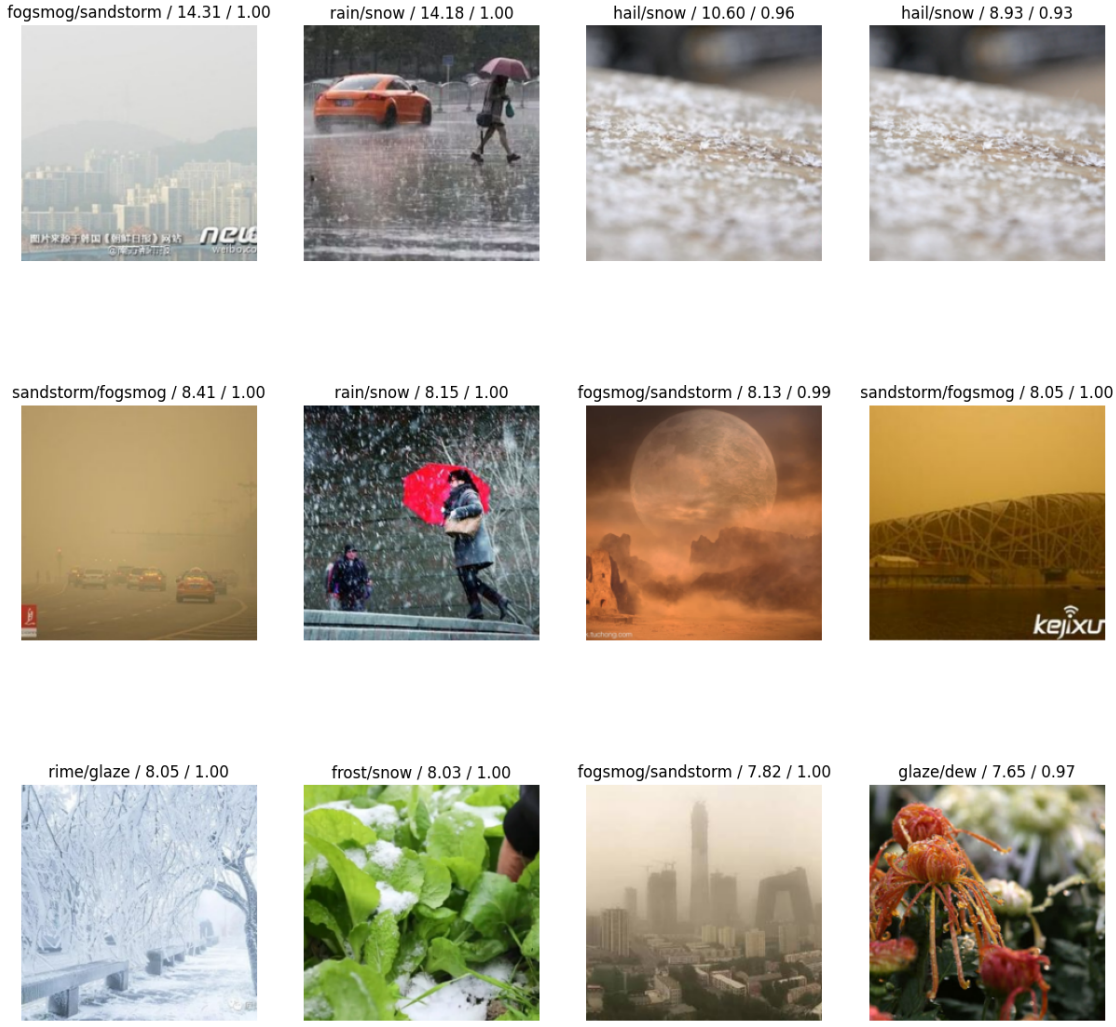
[16]:
```
# Build a Classification Interpretation object from our learn model
# it can show us where the model the worse predictions:
CI= ClassificationInterpretation.from_learner(model)
```

```
<IPython.core.display.HTML object>
```

```
<IPython.core.display.HTML object>
```

[17]:
```
# Plot the top 'n' classes where the classifier has least precision.
CI.plot_top_losses(12, figsize=(15,15))
```

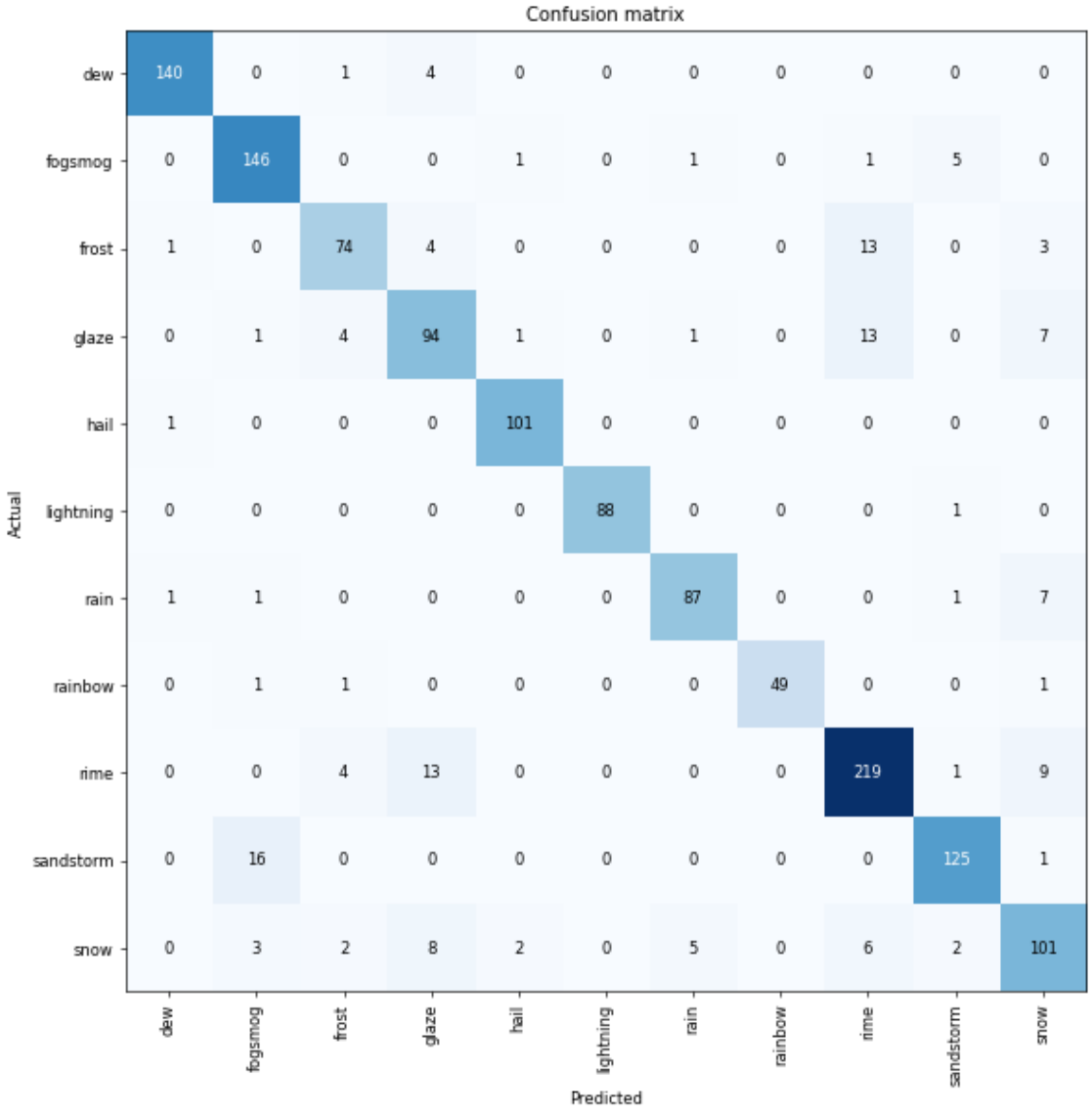
```
<IPython.core.display.HTML object>

<IPython.core.display.HTML object>
```



[18]:
```
CI.plot_confusion_matrix(figsize=(10,10),dpi=60)
```

```
<IPython.core.display.HTML object>
```

<IPython.core.display.HTML object>



[20]:
```
#To view the list of classes most misclassified as a list
CI.most_confused(min_val=2) #We are ignoring single image misclassification

#Sorted descending list of largest non-diagonal entries of confusion matrix,
#presented as actual, predicted, number of occurrences.
```

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

[20]:
```
[('sandstorm', 'fogsmog', 16),
 ('frost', 'rime', 13),
 ('glaze', 'rime', 13),
 ('rime', 'glaze', 13),
 ('rime', 'snow', 9),
 ('snow', 'glaze', 8),
 ('glaze', 'snow', 7),
 ('rain', 'snow', 7),
 ('snow', 'rime', 6),
 ('fogsmog', 'sandstorm', 5),
 ('snow', 'rain', 5),
 ('dew', 'glaze', 4),
 ('frost', 'glaze', 4),
 ('glaze', 'frost', 4),
 ('rime', 'frost', 4),
 ('frost', 'snow', 3),
 ('snow', 'fogsmog', 3),
 ('snow', 'frost', 2),
 ('snow', 'hail', 2),
 ('snow', 'sandstorm', 2)]
```

[ ]: