```
train, test, id2label, label2id = VisionDataset.fromImageFolder(
    "./hirise-map-proj-v3/data/",
    test_ratio   = 0.15,
    balanced     = False,
    augmentation = True,
);
```

```
C:\Anaconda\envs\CEML\lib\site-packages\tqdm\auto.py:22: TqdmWarning: IProgress
not found. Please update jupyter and ipywidgets. See
https://ipywidgets.readthedocs.io/en/stable/user_install.html
  from .autonotebook import tqdm as notebook_tqdm
C:\Anaconda\envs\CEML\lib\site-
packages\torchvision\transforms\transforms.py:333: UserWarning: Argument
interpolation should be of type InterpolationMode instead of int. Please, use
InterpolationMode enum.
  "Argument interpolation should be of type InterpolationMode instead of int. "
C:\Anaconda\envs\CEML\lib\site-
packages\torchvision\transforms\transforms.py:333: UserWarning: Argument
interpolation should be of type InterpolationMode instead of int. Please, use
InterpolationMode enum.
  "Argument interpolation should be of type InterpolationMode instead of int. "
```

```
Split Datasets…
train_ds:  8886
+---------+-------------+--------+-----------+---------------+-------+----------
----+--------+--------------+-------+
| Dataset | bright_dune | crater | dark_dune | impact_ejecta | other |
slope_streak | spider | swiss_cheese | Total |
+---------+-------------+--------+-----------+---------------+-------+----------
----+--------+--------------+-------+
|  Train  |     299     |  755   |    445    |      16       | 7005  |     218
|   42    |     106     | 8886  |
|  Test   |     55      |  115   |    87     |       4       | 1240  |      42
|   10    |      16     | 1569  |
+---------+-------------+--------+-----------+---------------+-------+----------
----+--------+--------------+-------+
```

[2]:
```
huggingface_model = 'google/vit-base-patch16-224-in21k'
```

[3]:
```
from hugsvision.nnet.VisionClassifierTrainer import VisionClassifierTrainer
from transformers import ViTFeatureExtractor, ViTForImageClassification

model_name = "HIRISE_5EPOCH_BATCH16"

trainer = VisionClassifierTrainer(
    model_name   = model_name,
    train        = train,
    test         = test,
```

```
    output_dir   = "hirise-map-proj-v3/out/",
    max_epochs   = 5,
    batch_size   = 16, # On RTX 2080 Ti
    lr           = 2e-5,
    model = ViTForImageClassification.from_pretrained(
        huggingface_model,
        num_labels = len(label2id),
        label2id   = label2id,
        id2label   = id2label
    ),
    feature_extractor = ViTFeatureExtractor.from_pretrained(
        huggingface_model,
    ),
)
```

```
Some weights of the model checkpoint at google/vit-base-patch16-224-in21k were
not used when initializing ViTForImageClassification: ['pooler.dense.bias',
'pooler.dense.weight']
- This IS expected if you are initializing ViTForImageClassification from the
checkpoint of a model trained on another task or with another architecture (e.g.
initializing a BertForSequenceClassification model from a BertForPreTraining
model).
- This IS NOT expected if you are initializing ViTForImageClassification from
the checkpoint of a model that you expect to be exactly identical (initializing
a BertForSequenceClassification model from a BertForSequenceClassification
model).
Some weights of ViTForImageClassification were not initialized from the model
checkpoint at google/vit-base-patch16-224-in21k and are newly initialized:
['classifier.bias', 'classifier.weight']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
C:\Anaconda\envs\CEML\lib\site-packages\transformers\optimization.py:309:
FutureWarning: This implementation of AdamW is deprecated and will be removed in
a future version. Use the PyTorch implementation torch.optim.AdamW instead, or
set `no_deprecation_warning=True` to disable this warning
  FutureWarning,
***** Running training *****
  Num examples = 8886
  Num Epochs = 5
  Instantaneous batch size per device = 16
  Total train batch size (w. parallel, distributed & accumulation) = 16
  Gradient Accumulation steps = 1
  Total optimization steps = 2780
```

```
{'0': 'bright_dune', '1': 'crater', '2': 'dark_dune', '3': 'impact_ejecta', '4':
'other', '5': 'slope_streak', '6': 'spider', '7': 'swiss_cheese'}
{'bright_dune': '0', 'crater': '1', 'dark_dune': '2', 'impact_ejecta': '3',
'other': '4', 'slope_streak': '5', 'spider': '6', 'swiss_cheese': '7'}
```

```
Trainer builded!
Start Training!
```

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

```
***** Running Evaluation *****
  Num examples = 1569
  Batch size = 16
***** Running Evaluation *****
  Num examples = 1569
  Batch size = 16
***** Running Evaluation *****
  Num examples = 1569
  Batch size = 16
***** Running Evaluation *****
  Num examples = 1569
  Batch size = 16
***** Running Evaluation *****
  Num examples = 1569
  Batch size = 16
```

```
Training completed. Do not forget to share your model on huggingface.co/models
=)
```

```
Saving model checkpoint to hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21/trainer/
Configuration saved in hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21/trainer/config.json
Model weights saved in hirise-map-proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09
-11-27-21/trainer/pytorch_model.bin
Configuration saved in hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21/model/config.json
Model weights saved in hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21/model/pytorch_model.bin
Feature extractor saved in hirise-map-proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-0
5-09-11-27-21/feature_extractor/preprocessor_config.json
```

```
Model saved at: hirise-map-
```

```
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21
```

[5]:
```
import pandas as pd
import seaborn as sn
import matplotlib.pyplot as plt
from sklearn.metrics import confusion_matrix

cm = confusion_matrix(ref, hyp)
```

```
labels = list(label2id.keys())
df_cm = pd.DataFrame(cm, index = labels, columns = labels)

plt.figure(figsize = (10,7))
sn.heatmap(df_cm, annot=True, annot_kws={"size": 8}, fmt="")
plt.savefig("./hirise-map-proj-v3/out/"+model_name+"/conf_matrix_1.jpg")

print("Confusion Matrix saved to ./hirise-map-proj-v3/out/"+model_name+"/
 ↪conf_matrix_1.jpg")
```

```
Confusion Matrix saved to ./hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/conf_matrix_1.jpg
```

1.5 4. Evaluate CNN vs ViT - WIP

[ ]:
```
# Evaluating the CNN - BEST IS 81% AFTER 5 EPOCHS
test_loss, test_accuracy = model.evaluate(test_images, test_labels)
print("Final loss was {}.\nAccuracy of model was {}".format(test_loss,␣
 ↪test_accuracy))
```

[4]:
```
# Evaluate the ViT
ref, hyp = trainer.evaluate_f1_score()
```

```
100%|      | 1569/1569 [08:03<00:00,  3.25it/s]
```

	precision	recall	f1-score	support
bright_dune	0.9123	0.9455	0.9286	55
crater	0.8814	0.9043	0.8927	115
dark_dune	0.9535	0.9425	0.9480	87
impact_ejecta	0.0000	0.0000	0.0000	4
other	0.9839	0.9847	0.9843	1240
slope_streak	0.8837	0.9048	0.8941	42
spider	0.8889	0.8000	0.8421	10
swiss_cheese	1.0000	0.9375	0.9677	16
accuracy			0.9688	1569
macro avg	0.8130	0.8024	0.8072	1569
weighted avg	0.9665	0.9688	0.9676	1569

```
Logs saved at: hirise-map-
proj-v3/out/HIRISE_5EPOCH_BATCH16/5_2022-05-09-11-27-21
```