

1) Definition Of Tabular Data we will analyze:

This data will help us to effectively predict lung cancer to know the risk of cancer, and it also helps people make the right decision based on their cancer risk status.

1. Gender: 0(male), 1(female)
2. Age: Age of the patient
3. Smoking: YES=2 , NO=1.
4. Alcohol: YES=2 , NO=1.
5. Shortness of Breath: YES=2 , NO=1.
6. Swallowing Difficulty: YES=2 , NO=1.
7. Chest pain: YES=2 , NO=1.
8. Lung Cancer: YES=1 , NO=0

9) Split age to 3 stages : (youth :21 To 39 ,
Adulthood : 40 To 60 , elderly :61 To 87)

```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import pandas as pd
from sklearn.preprocessing import LabelEncoder

data =pd.read_csv("/kaggle/input/lung-cancer-analysis-dataset/survey_lung_cancer.csv")
data.head()
```

	GENDER	AGE	SMOKING	YELLOW_FINGERS	ANXIETY	PEER_PRESSURE	\
0	M	69	1	2	2	1	
1	M	74	2	1	1	1	
2	F	59	1	1	1	2	
3	M	63	2	2	2	1	
4	F	63	1	2	1	1	
	CHRONIC DISEASE	FATIGUE	ALLERGY	WHEEZING	ALCOHOL	CONSUMING	
COUGHING \							
0		1	2	1	2		2
2							
1		2	2	2	1		1
1							
2		1	2	1	2		1
2							
3		1	1	1	1		2
1							
4		1	1	1	2		1
2							
	SHORTNESS OF BREATH	SWALLOWING DIFFICULTY	CHEST PAIN	LUNG_CANCER			
0		2		2	2		YES
1		2		2	2		YES
2		2		1	2		NO
3		1		2	2		NO
4		2		1	1		NO

```
LUNG_CANCER = data[['GENDER', 'AGE', 'SMOKING', 'ALCOHOL CONSUMING',
'LUNG_CANCER', 'SHORTNESS OF BREATH', 'CHEST PAIN', 'SWALLOWING
DIFFICULTY']]
```

```
LUNG_CANCER.to_csv('LUNG_CANCER.csv', index=False)
```

```
LUNG_CANCER
```

	GENDER	AGE	SMOKING	ALCOHOL CONSUMING	LUNG_CANCER	SHORTNESS OF BREATH \
0	M	69	1	2	YES	
2						
1	M	74	2	1	YES	
2						
2	F	59	1	1	NO	
2						
3	M	63	2	2	NO	
1						
4	F	63	1	1	NO	
2						
..	
...						
304	F	56	1	2	YES	
2						
305	M	70	2	2	YES	
2						
306	M	58	2	2	YES	
1						
307	M	67	2	2	YES	
2						
308	M	62	1	2	YES	
1						

	CHEST PAIN	SWALLOWING DIFFICULTY
0	2	2
1	2	2
2	2	1
3	2	2
4	1	1
..
304	1	2
305	2	1
306	2	1
307	2	1
308	1	2

```
[309 rows x 8 columns]
```

```
LUNG_CANCER.describe()
```

	AGE	SMOKING	ALCOHOL CONSUMING	SHORTNESS OF BREATH
\				

count	309.000000	309.000000	309.000000	309.000000
mean	62.673139	1.563107	1.556634	1.640777
std	8.210301	0.496806	0.497588	0.480551
min	21.000000	1.000000	1.000000	1.000000
25%	57.000000	1.000000	1.000000	1.000000
50%	62.000000	2.000000	2.000000	2.000000
75%	69.000000	2.000000	2.000000	2.000000
max	87.000000	2.000000	2.000000	2.000000

	CHEST PAIN	SWALLOWING DIFFICULTY
count	309.000000	309.000000
mean	1.556634	1.469256
std	0.497588	0.499863
min	1.000000	1.000000
25%	1.000000	1.000000
50%	2.000000	1.000000
75%	2.000000	2.000000
max	2.000000	2.000000

LUNG_CANCER.info()

<class 'pandas.core.frame.DataFrame'>

RangeIndex: 309 entries, 0 to 308

Data columns (total 8 columns):

#	Column	Non-Null Count	Dtype
0	GENDER	309 non-null	object
1	AGE	309 non-null	int64
2	SMOKING	309 non-null	int64
3	ALCOHOL CONSUMING	309 non-null	int64
4	LUNG_CANCER	309 non-null	object
5	SHORTNESS OF BREATH	309 non-null	int64
6	CHEST PAIN	309 non-null	int64
7	SWALLOWING DIFFICULTY	309 non-null	int64

dtypes: int64(6), object(2)

memory usage: 19.4+ KB

len(LUNG_CANCER.isnull().sum())

8

LUNG_CANCER.duplicated().sum()

55

```
len(LUNG_CANCER.isnull().sum())
```

8

```
LUNG_CANCER.dropna()
```

	GENDER	AGE	SMOKING	ALCOHOL CONSUMING	LUNG_CANCER	SHORTNESS OF BREATH \
--	--------	-----	---------	-------------------	-------------	-----------------------

0	M	69	1	2	YES
---	---	----	---	---	-----

2

1	M	74	2	1	YES
---	---	----	---	---	-----

2

2	F	59	1	1	NO
---	---	----	---	---	----

2

3	M	63	2	2	NO
---	---	----	---	---	----

1

4	F	63	1	1	NO
---	---	----	---	---	----

2

..
----	-----	-----	-----	-----	-----

...

304	F	56	1	2	YES
-----	---	----	---	---	-----

2

305	M	70	2	2	YES
-----	---	----	---	---	-----

2

306	M	58	2	2	YES
-----	---	----	---	---	-----

1

307	M	67	2	2	YES
-----	---	----	---	---	-----

2

308	M	62	1	2	YES
-----	---	----	---	---	-----

1

	CHEST PAIN	SWALLOWING DIFFICULTY
--	------------	-----------------------

0	2	2
---	---	---

1	2	2
---	---	---

2	2	1
---	---	---

3	2	2
---	---	---

4	1	1
---	---	---

..
----	-----	-----

304	1	2
-----	---	---

305	2	1
-----	---	---

306	2	1
-----	---	---

307	2	1
-----	---	---

308	1	2
-----	---	---

[309 rows x 8 columns]

```
LUNG_CANCER.drop_duplicates()
```

	GENDER	AGE	SMOKING	ALCOHOL CONSUMING	LUNG_CANCER	SHORTNESS OF BREATH \
0	M	69	1		2	YES
2						
1	M	74	2		1	YES
2						
2	F	59	1		1	NO
2						
3	M	63	2		2	NO
1						
4	F	63	1		1	NO
2						
..
...						
279	F	59	1		1	YES
1						
280	F	59	2		1	NO
2						
281	M	55	2		1	NO
2						
282	M	46	1		1	NO
1						
283	M	60	1		2	YES
2						
	CHEST PAIN		SWALLOWING DIFFICULTY			
0		2			2	
1		2			2	
2		2			1	
3		2			2	
4		1			1	
..		
279		1			2	
280		1			1	
281		2			1	
282		2			2	
283		2			2	

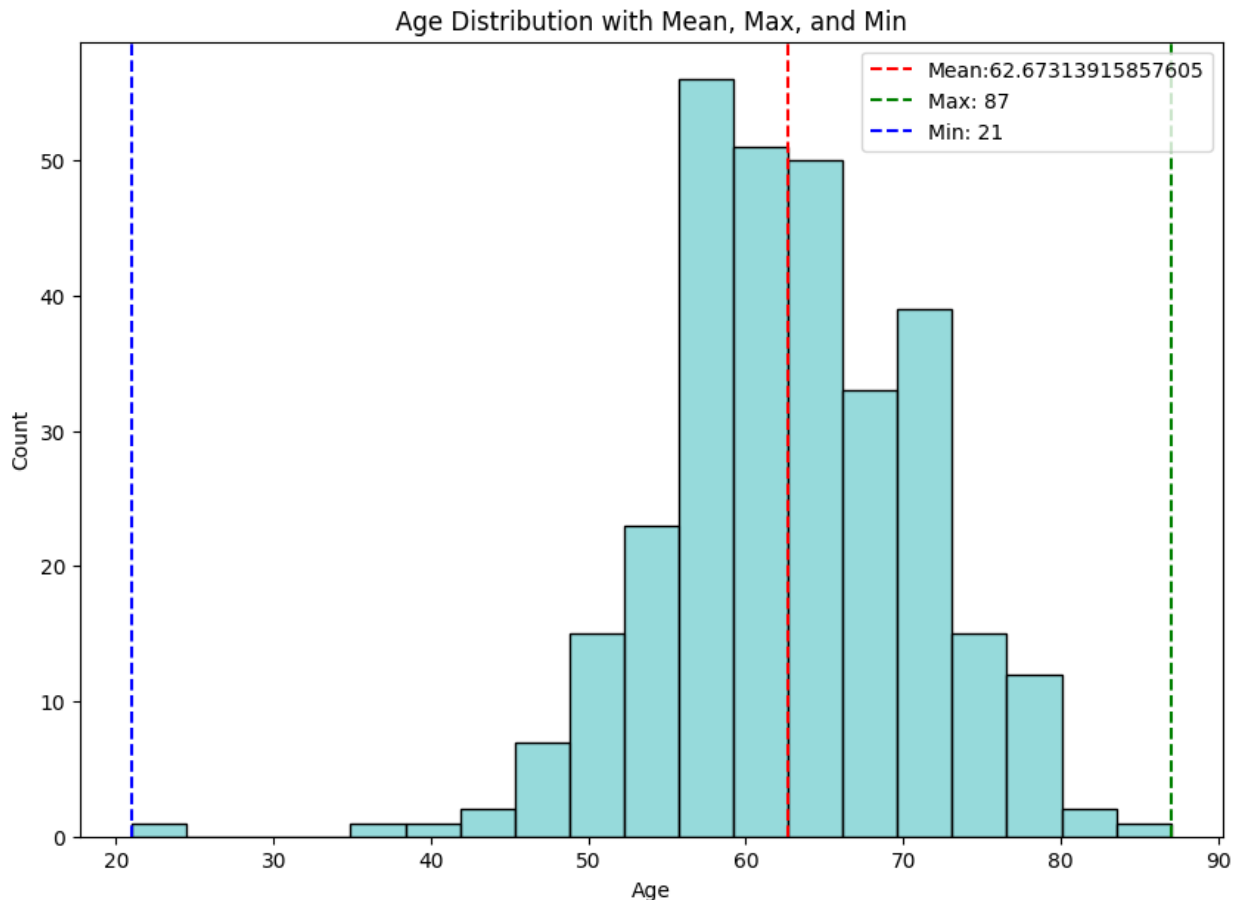
[254 rows x 8 columns]

```

mean_age = LUNG_CANCER['AGE'].mean()
max_age = LUNG_CANCER['AGE'].max()
min_age = LUNG_CANCER['AGE'].min()
plt.figure(figsize=(10,7))
sns.histplot(x=LUNG_CANCER['AGE'],color='#73ced0')
plt.title('Age Distribution with Mean, Max, and Min')
plt.xlabel('Age')
plt.axvline(mean_age, color='r', linestyle='--', label=f'Mean:
{mean_age}')
plt.axvline(max_age, color='g', linestyle='--', label=f'Max:

```

```
{max_age}')
plt.axvline(min_age, color='b', linestyle='--', label=f'Min:
{min_age}')
plt.legend()
plt.show()
```



From this 3 pie chart, we learned that males have little difference from females in lung cancer.

From this bar chart we knew the oldest age and the youngest age and the Mean Of age!

```
pd.options.mode.copy_on_write = True
label_encoder = LabelEncoder()
```

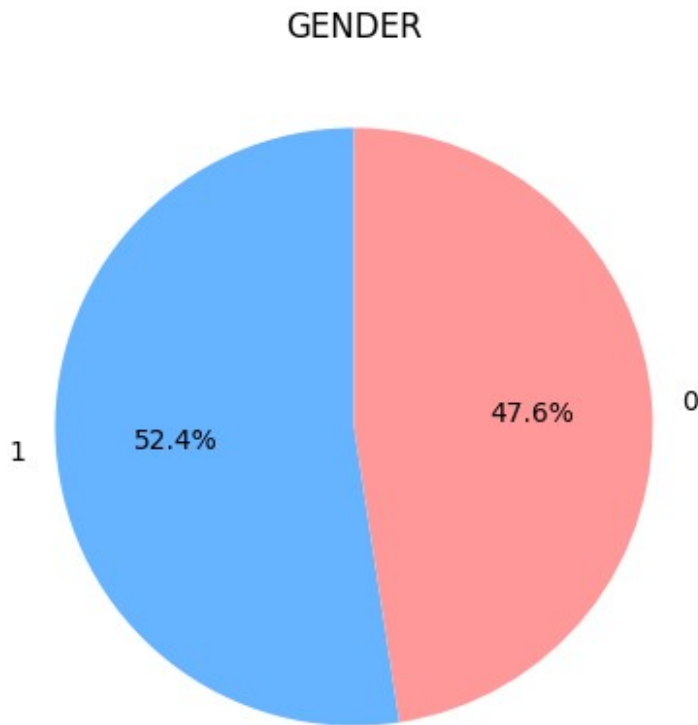
```

LUNG_CANCER['LUNG_CANCER'] =
label_encoder.fit_transform(LUNG_CANCER['LUNG_CANCER'])

pd.options.mode.copy_on_write = True
label_encoder = LabelEncoder()
LUNG_CANCER['GENDER'] =
label_encoder.fit_transform(LUNG_CANCER['GENDER'])

plt.figure(figsize=(5,5))
LUNG_CANCER['GENDER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#66b3ff','#ff9999'])
plt.title('GENDER')
plt.ylabel('')
plt.show()

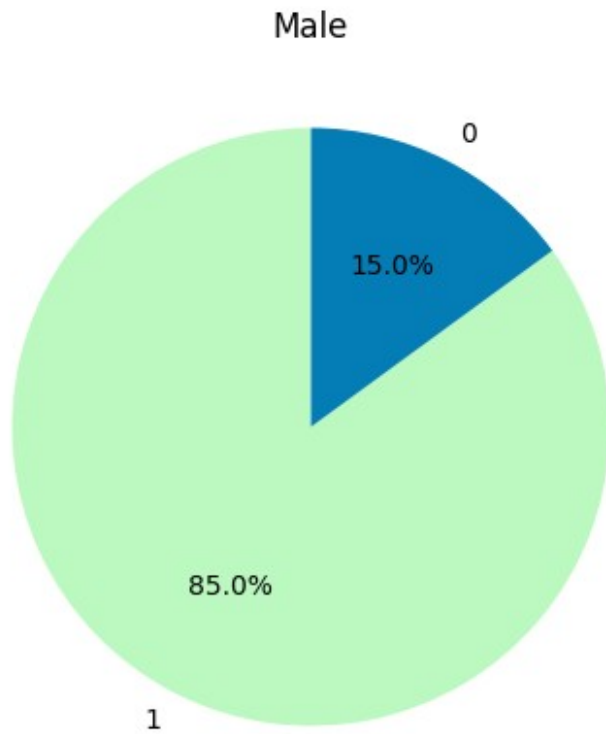
```



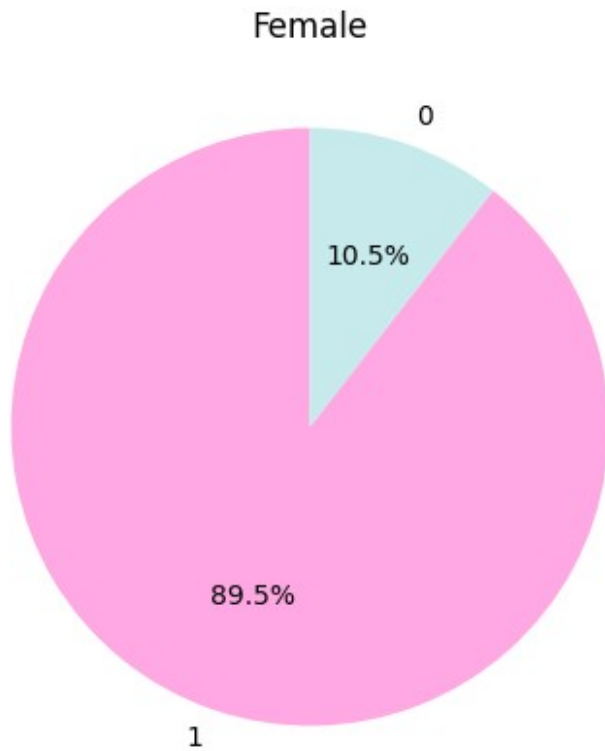
```

plt.figure(figsize=(5, 5))
LUNG_CANCER[LUNG_CANCER['GENDER'] == 0]
['LUNG_CANCER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#bbf9c0', '#047cb6'])
plt.title('Male')
plt.ylabel('')
plt.show()

```

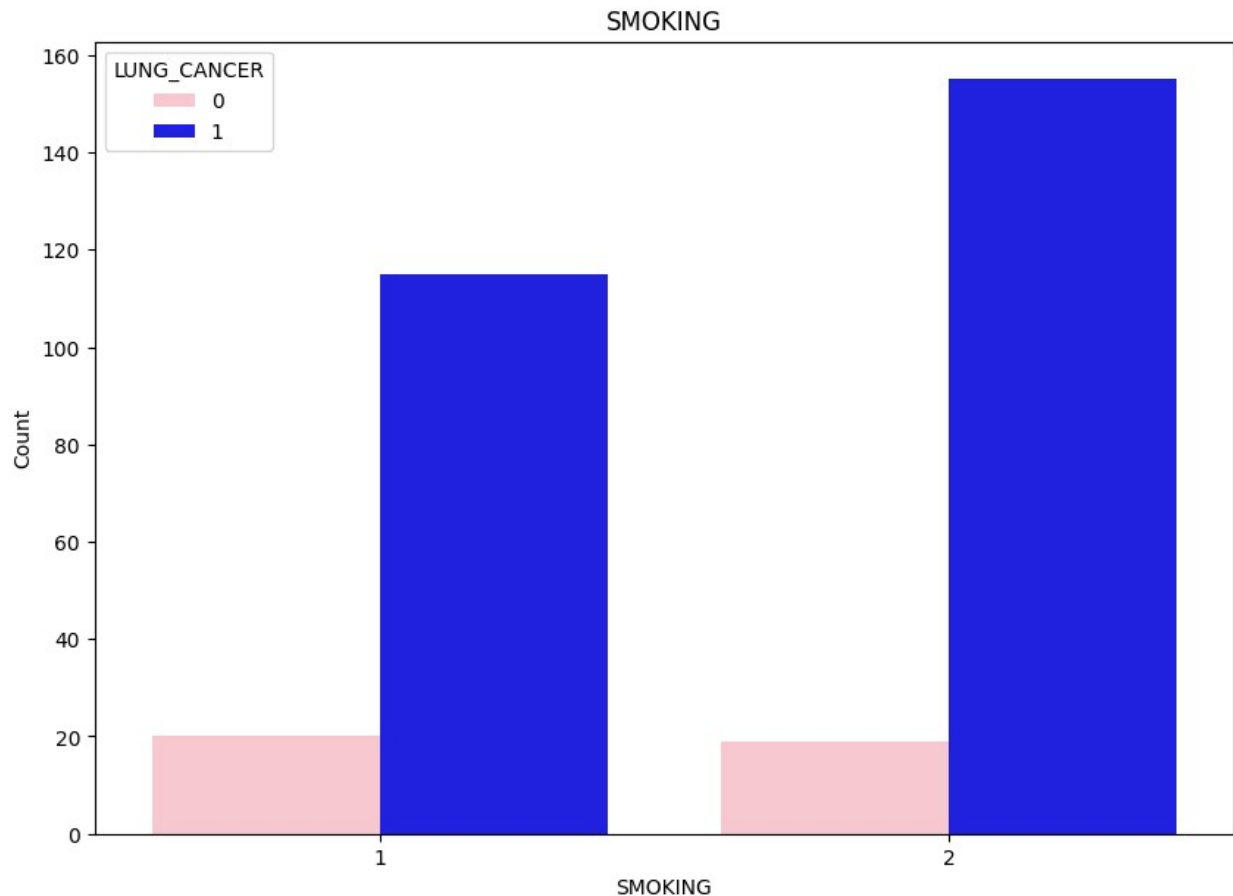



```
plt.figure(figsize=(5,5))
LUNG_CANCER[LUNG_CANCER['GENDER'] == 1]
['LUNG_CANCER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#ffa8e3','#c7ebec'])
plt.title('Female')
plt.ylabel('')
plt.show()
```



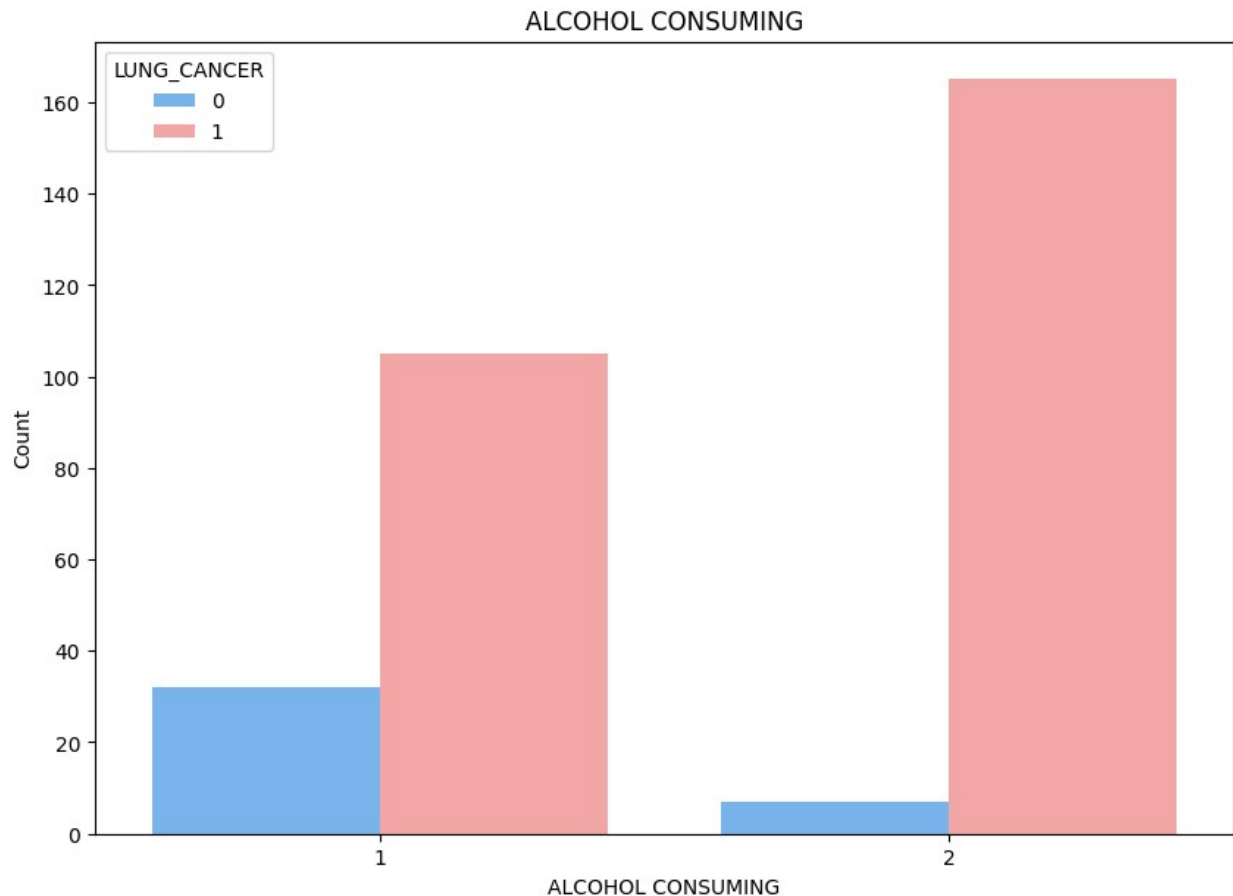
From this Graph we knew that smoking It has little cause of lung cancer where there is a bar chart

```
plt.figure(figsize=(10,7))
sns.countplot(x='SMOKING', hue='LUNG_CANCER', palette=['pink', 'b'],
data=LUNG_CANCER)
plt.xlabel('SMOKING')
plt.ylabel('Count')
plt.title('SMOKING')
plt.show()
```



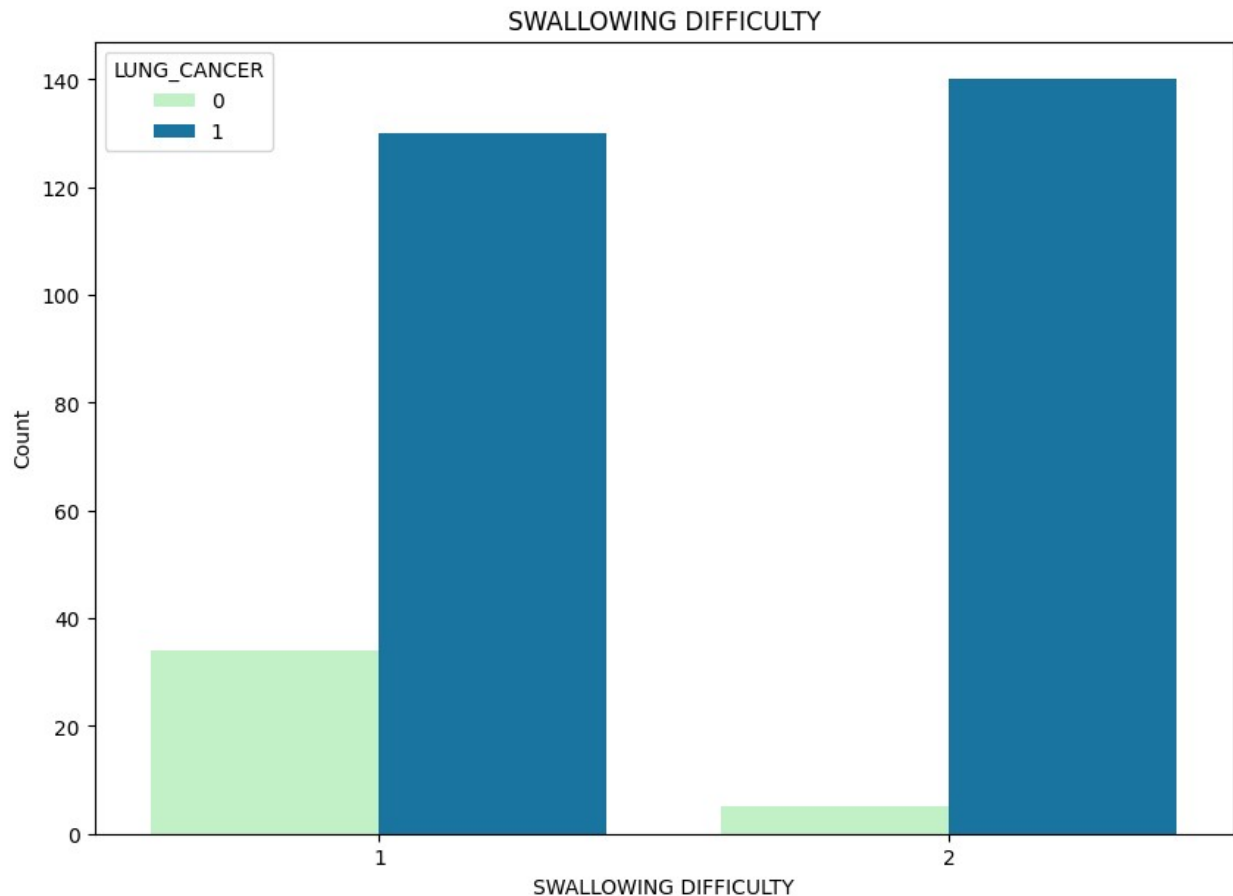
From this Graph we knew that alcohol can be a cause of lung cancer as there is bar chart

```
plt.figure(figsize=(10,7))
sns.countplot(x='ALCOHOL CONSUMING', hue='LUNG_CANCER',
palette=['#66b3ff', '#ff9999'], data=LUNG_CANCER)
plt.xlabel('ALCOHOL CONSUMING')
plt.ylabel('Count')
plt.title('ALCOHOL CONSUMING')
plt.show()
```



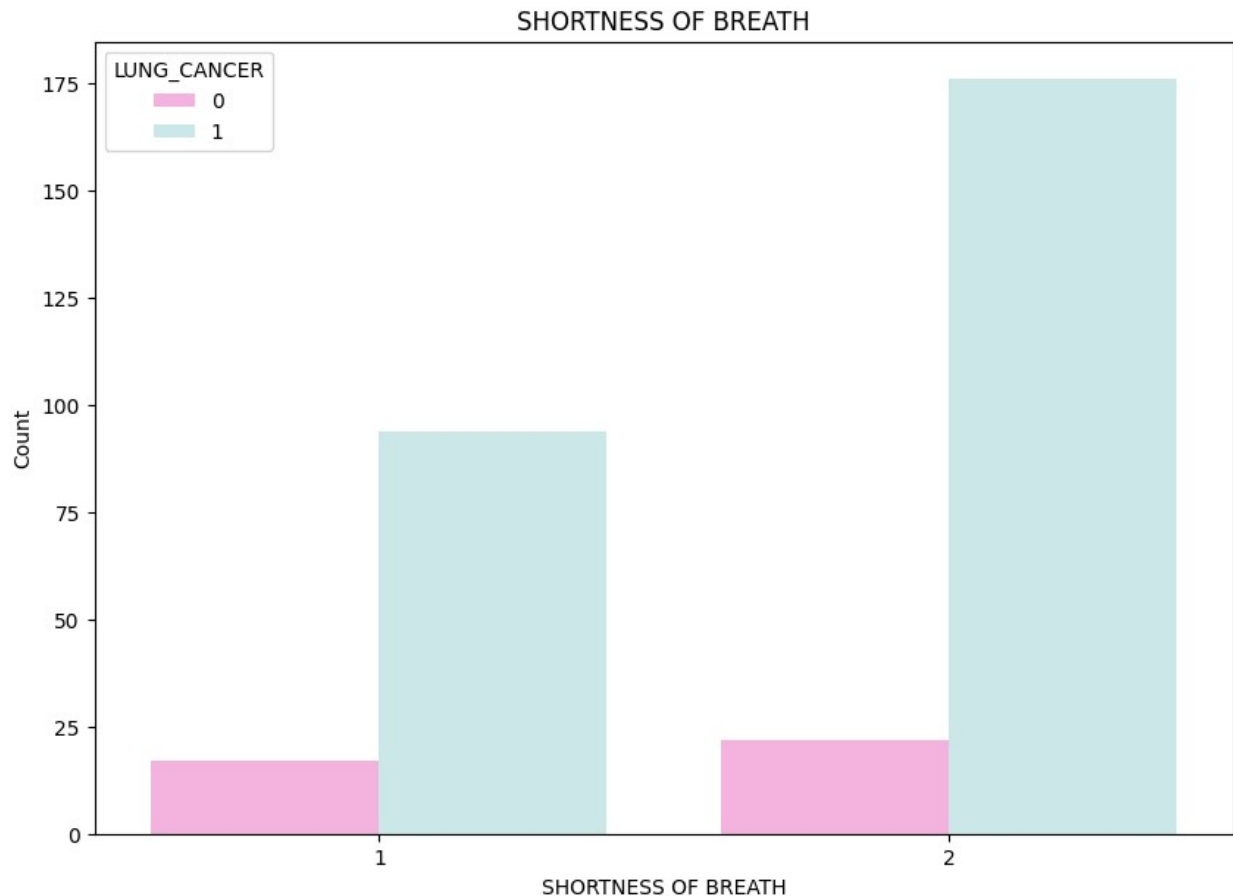
From this Graph we knew that difficulty swallowing indicates lung cancer, but not of the main reasons where there is a bar chart!

```
plt.figure(figsize=(10,7))
sns.countplot(x='SWALLOWING DIFFICULTY', hue='LUNG_CANCER',
palette=['#bbf9c0','#047cb6'], data=LUNG_CANCER)
plt.xlabel('SWALLOWING DIFFICULTY')
plt.ylabel('Count')
plt.title('SWALLOWING DIFFICULTY')
plt.show()
```



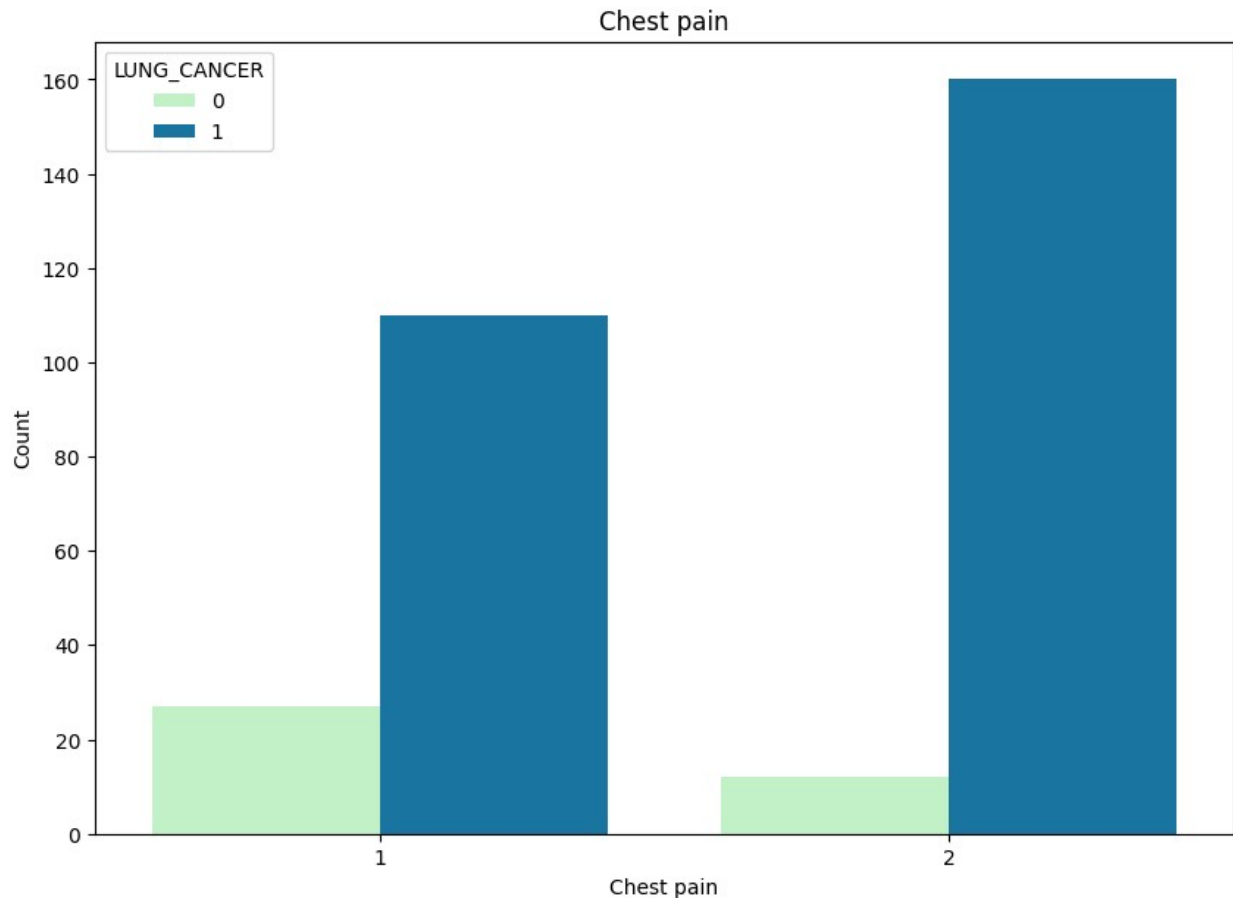
From this Graph we knew that Shortness of Breath has relation by lung cancer as there is bar chart

```
plt.figure(figsize=(10,7))
sns.countplot(x='SHORTNESS OF BREATH', hue='LUNG_CANCER',
palette=['#ffa8e3','#c7ebec'], data=LUNG_CANCER)
plt.xlabel('SHORTNESS OF BREATH')
plt.ylabel('Count')
plt.title('SHORTNESS OF BREATH')
plt.show()
```



From this Graph we knew that Chest pain has relation by lung cancer, as there is a bar chart

```
plt.figure(figsize=(10,7))
sns.countplot(x='CHEST PAIN', hue='LUNG_CANCER',
palette=['#bbf9c0', '#047cb6'], data=LUNG_CANCER)
plt.xlabel('Chest pain')
plt.ylabel('Count')
plt.title('Chest pain')
plt.show()
```



Split age to 3 stages : (youth :21 To 39 ,
Adulthood : 40 To 60 , elderly :61 To 87)

```
Youth= LUNG_CANCER[(LUNG_CANCER['AGE'] > 20) & (LUNG_CANCER['AGE'] < 39)]
```

```
Adulthood = LUNG_CANCER[(LUNG_CANCER['AGE'] > 39) & (LUNG_CANCER['AGE'] < 60)]
```

```
elderly = LUNG_CANCER[(LUNG_CANCER['AGE'] > 60) & (LUNG_CANCER['AGE'] <= 87)]
```

```
LUNG_CANCER_New = pd.read_csv('LUNG_CANCER.csv')  
LUNG_CANCER_New['Youth'] = Youth['AGE']  
LUNG_CANCER_New['Adulthood'] = Adulthood['AGE']  
LUNG_CANCER_New['elderly'] = elderly['AGE']  
LUNG_CANCER_New.to_csv('LUNG_CANCER.csv', index=False)  
LUNG_CANCER_New
```

	GENDER	AGE	SMOKING	ALCOHOL	CONSUMING	LUNG_CANCER	SHORTNESS OF BREATH \
0	M	69	1		2	YES	
2							
1	M	74	2		1	YES	
2							
2	F	59	1		1	NO	
2							
3	M	63	2		2	NO	
1							
4	F	63	1		1	NO	
2							
..	
...							
304	F	56	1		2	YES	
2							
305	M	70	2		2	YES	
2							
306	M	58	2		2	YES	
1							
307	M	67	2		2	YES	
2							
308	M	62	1		2	YES	
1							
	CHEST PAIN	SWALLOWING	DIFFICULTY	Youth	Adulthood	elderly	
0	2			2	NaN	NaN	69.0
1	2			2	NaN	NaN	74.0
2	2			1	NaN	59.0	NaN
3	2			2	NaN	NaN	63.0
4	1			1	NaN	NaN	63.0
..
304	1			2	NaN	56.0	NaN
305	2			1	NaN	NaN	70.0
306	2			1	NaN	58.0	NaN
307	2			1	NaN	NaN	67.0
308	1			2	NaN	NaN	62.0

[309 rows x 11 columns]

```

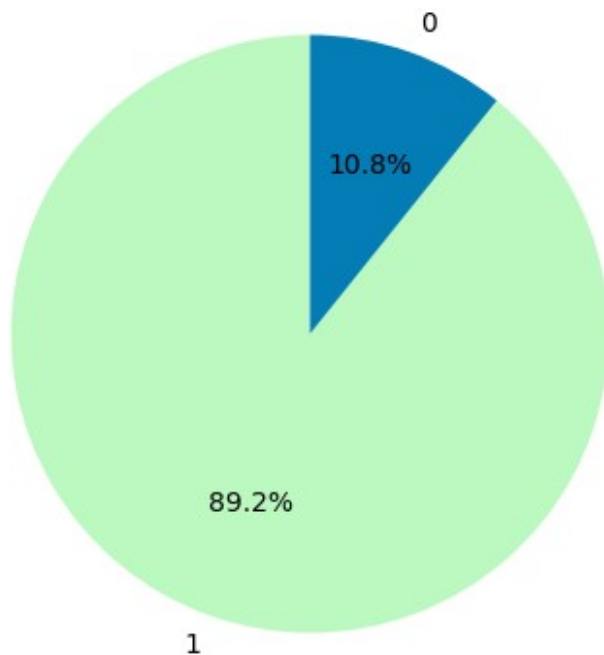
label_encoder = LabelEncoder()
LUNG_CANCER_New['LUNG_CANCER'] =
label_encoder.fit_transform(LUNG_CANCER_New['LUNG_CANCER'])

```


From this pie chart, we Knew The difference in Age stages of lung cancer

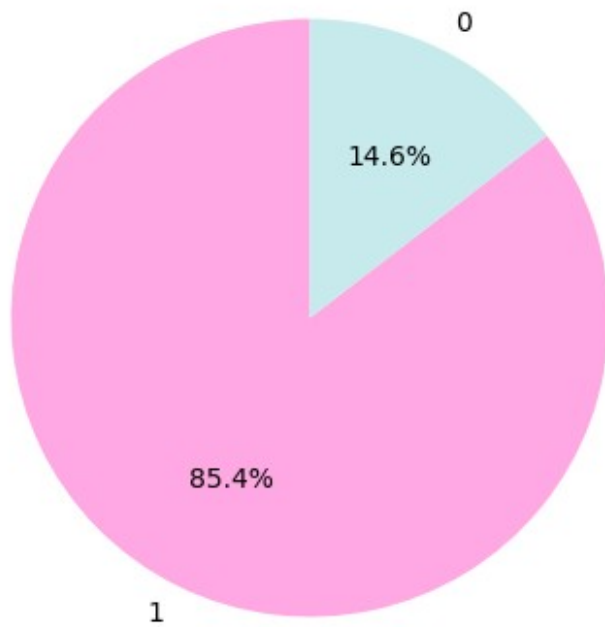
```
plt.figure(figsize=(5,5))
LUNG_CANCER_New[LUNG_CANCER['AGE'].isin(elderly['AGE'])]
['LUNG_CANCER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#bbf9c0','#047cb6'])
plt.title('LUNG_CANCER Distribution for elderly')
plt.ylabel('')
plt.show()
```

LUNG_CANCER Distribution for elderly



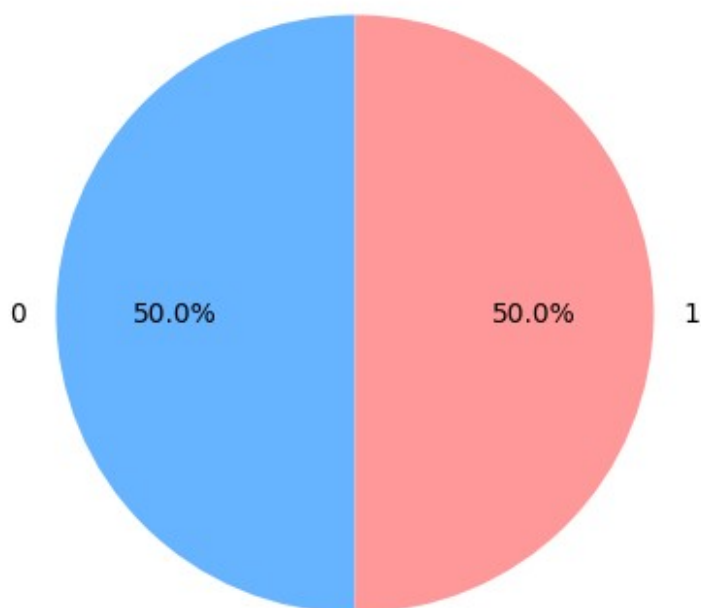
```
plt.figure(figsize=(5,5))
LUNG_CANCER_New[LUNG_CANCER['AGE'].isin(Adulthood['AGE'])]
['LUNG_CANCER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#ffa8e3','#c7ebec'])
plt.title('LUNG_CANCER Distribution for Adulthood')
plt.ylabel('')
plt.show()
```

LUNG_CANCER Distribution for Adulthood



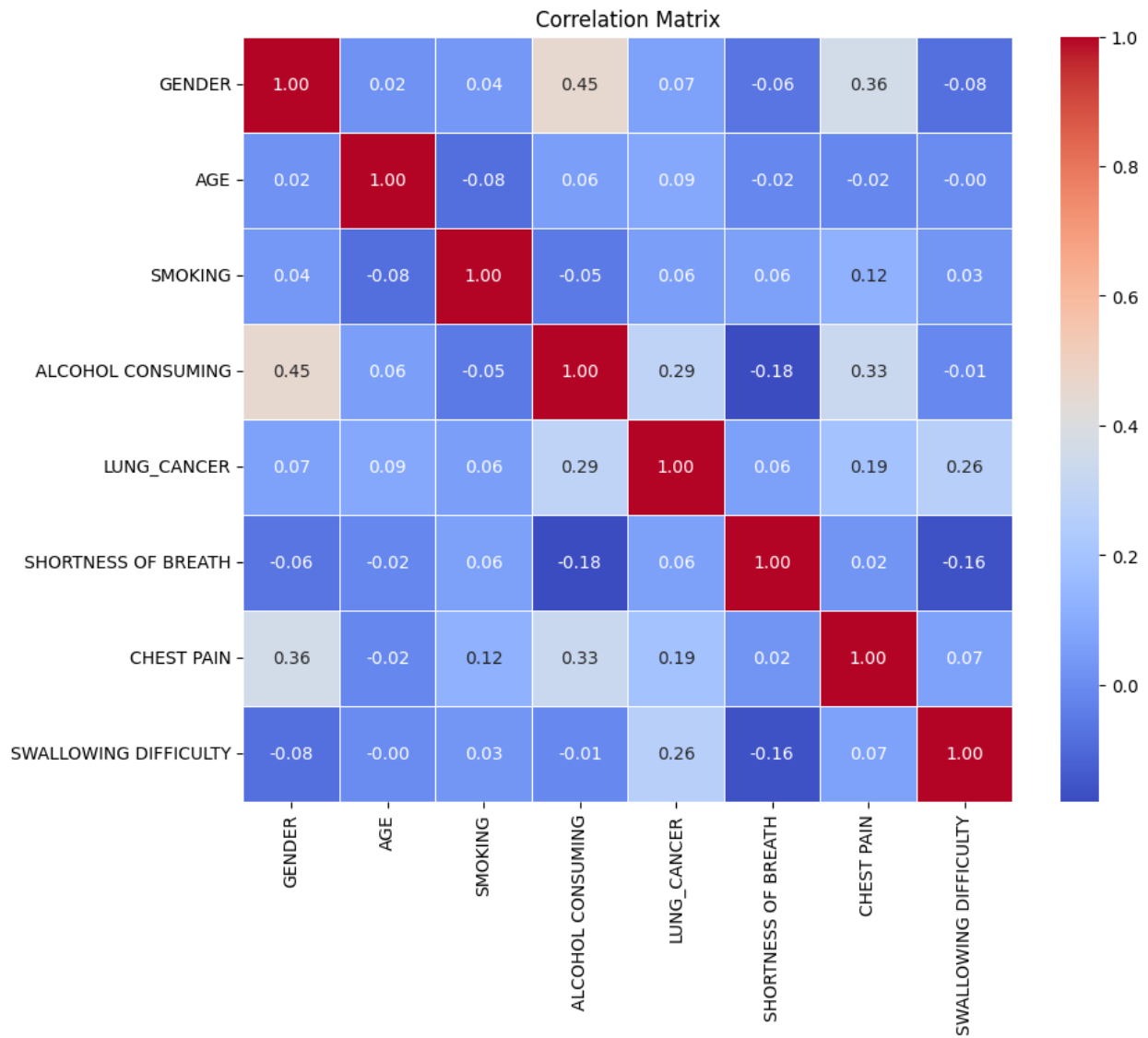
```
plt.figure(figsize=(5,5))
LUNG_CANCER_New[LUNG_CANCER['AGE'].isin(Youth['AGE'])]
['LUNG_CANCER'].value_counts().plot.pie(autopct='%1.1f%%',startangle=90,colors=['#66b3ff','#ff9999'])
plt.title('LUNG_CANCER Distribution for Youth')
plt.ylabel('')
plt.show()
```

LUNG_CANCER Distribution for Youth



```
label_encoder = LabelEncoder()
LUNG_CANCER_New['GENDER'] =
label_encoder.fit_transform(LUNG_CANCER_New['GENDER'])

corr_matrix = LUNG_CANCER.corr()
plt.figure(figsize=(10, 8))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt='.2f',
linewidths=0.5)
plt.title('Correlation Matrix')
plt.show()
```



```
import os
import tensorflow as tf

checkpoint_path = "training_1/cp.weights.h5"
checkpoint_dir = os.path.dirname(checkpoint_path)

cp_callback = tf.keras.callbacks.ModelCheckpoint(
    filepath=checkpoint_path,
    save_weights_only=True,
    verbose=1
)
```

```
WARNING: Logging before InitGoogle() is written to STDERR
E0000 00:00:1728936383.741288      13 common_lib.cc:798] Could not set
metric server port: INVALID_ARGUMENT: Could not find SliceBuilder port
8471 in any of the 0 ports provided in `tpu_process_addresses`="local"
```

=== Source Location Trace: ===

learning/45eac/tfrc/runtime/common_lib.cc:479

D1014 20:06:23.749461728 13 config.cc:196]

gRPC EXPERIMENT call_status_override_on_cancellation OFF
(default:OFF)

D1014 20:06:23.749476996 13 config.cc:196]

gRPC EXPERIMENT call_v3 OFF
(default:OFF)

D1014 20:06:23.749480610 13 config.cc:196]

gRPC EXPERIMENT canary_client_privacy ON
(default:ON)

D1014 20:06:23.749483008 13 config.cc:196]

gRPC EXPERIMENT capture_base_context ON
(default:ON)

D1014 20:06:23.749485431 13 config.cc:196]

gRPC EXPERIMENT client_idleness ON
(default:ON)

D1014 20:06:23.749487768 13 config.cc:196]

gRPC EXPERIMENT client_privacy ON
(default:ON)

D1014 20:06:23.749490018 13 config.cc:196]

gRPC EXPERIMENT dapper_request_wire_size OFF
(default:OFF)

D1014 20:06:23.749492221 13 config.cc:196]

gRPC EXPERIMENT empty_experiment OFF
(default:OFF)

D1014 20:06:23.749494391 13 config.cc:196]

gRPC EXPERIMENT event_engine_client OFF
(default:OFF)

D1014 20:06:23.749496549 13 config.cc:196]

gRPC EXPERIMENT event_engine_dns ON
(default:ON)

D1014 20:06:23.749498796 13 config.cc:196]

gRPC EXPERIMENT event_engine_listener ON
(default:ON)

D1014 20:06:23.749500979 13 config.cc:196]

gRPC EXPERIMENT free_large_allocator OFF
(default:OFF)

D1014 20:06:23.749503150 13 config.cc:196]

gRPC EXPERIMENT google_no_envelope_resolver OFF
(default:OFF)

D1014 20:06:23.749505313 13 config.cc:196]

gRPC EXPERIMENT http2_stats_fix OFF
(default:OFF)

D1014 20:06:23.749507556 13 config.cc:196]

gRPC EXPERIMENT keepalive_fix OFF
(default:OFF)

D1014 20:06:23.749509725 13 config.cc:196]

gRPC EXPERIMENT keepalive_server_fix ON

```

(default:ON)
D1014 20:06:23.749512048      13 config.cc:196]
gRPC EXPERIMENT loas_do_not_prefer_rekey_next_protocol OFF
(default:OFF)
D1014 20:06:23.749514378      13 config.cc:196]
gRPC EXPERIMENT loas_prod_to_cloud_prefer_pfs_ciphers  OFF
(default:OFF)
D1014 20:06:23.749516603      13 config.cc:196]
gRPC EXPERIMENT monitoring_experiment                  ON
(default:ON)
D1014 20:06:23.749518840      13 config.cc:196]
gRPC EXPERIMENT multiping                              OFF
(default:OFF)
D1014 20:06:23.749521004      13 config.cc:196]
gRPC EXPERIMENT peer_state_based_framing              OFF
(default:OFF)
D1014 20:06:23.749523171      13 config.cc:196]
gRPC EXPERIMENT pending_queue_cap                    ON
(default:ON)
D1014 20:06:23.749525411      13 config.cc:196]
gRPC EXPERIMENT pick_first_happy_eyeballs            ON
(default:ON)
D1014 20:06:23.749527583      13 config.cc:196]
gRPC EXPERIMENT promise_based_client_call            OFF
(default:OFF)
D1014 20:06:23.749529690      13 config.cc:196]
gRPC EXPERIMENT promise_based_inproc_transport       OFF
(default:OFF)
D1014 20:06:23.749531816      13 config.cc:196]
gRPC EXPERIMENT promise_based_server_call            OFF
(default:OFF)
D1014 20:06:23.749534080      13 config.cc:196]
gRPC EXPERIMENT registered_method_lookup_in_transport ON
(default:ON)
D1014 20:06:23.749536283      13 config.cc:196]
gRPC EXPERIMENT rfc_max_concurrent_streams           ON
(default:ON)
D1014 20:06:23.749538529      13 config.cc:196]
gRPC EXPERIMENT round_robin_delegate_to_pick_first  ON
(default:ON)
D1014 20:06:23.749541646      13 config.cc:196]
gRPC EXPERIMENT rstpit                                OFF
(default:OFF)
D1014 20:06:23.749543892      13 config.cc:196]
gRPC EXPERIMENT schedule_cancellation_over_write     OFF
(default:OFF)
D1014 20:06:23.749546221      13 config.cc:196]
gRPC EXPERIMENT server_privacy                       ON
(default:ON)

```

```

D1014 20:06:23.749548577      13 config.cc:196]
gRPC EXPERIMENT tcp_frame_size_tuning      OFF
(default:OFF)
D1014 20:06:23.749550875      13 config.cc:196]
gRPC EXPERIMENT tcp_rcv_lowat      OFF
(default:OFF)
D1014 20:06:23.749553055      13 config.cc:196]
gRPC EXPERIMENT trace_record_callops      OFF
(default:OFF)
D1014 20:06:23.749555266      13 config.cc:196]
gRPC EXPERIMENT unconstrained_max_quota_buffer_size      OFF
(default:OFF)
D1014 20:06:23.749557467      13 config.cc:196]
gRPC EXPERIMENT v3_backend_metric_filter      OFF
(default:OFF)
D1014 20:06:23.749559630      13 config.cc:196]
gRPC EXPERIMENT v3_channel_idle_filters      ON
(default:ON)
D1014 20:06:23.749561846      13 config.cc:196]
gRPC EXPERIMENT v3_compression_filter      ON
(default:ON)
D1014 20:06:23.749564011      13 config.cc:196]
gRPC EXPERIMENT v3_server_auth_filter      OFF
(default:OFF)
D1014 20:06:23.749566166      13 config.cc:196]
gRPC EXPERIMENT work_serializer_clears_time_cache      OFF
(default:OFF)
D1014 20:06:23.749568291      13 config.cc:196]
gRPC EXPERIMENT work_serializer_dispatch      OFF
(default:OFF)
D1014 20:06:23.749570484      13 config.cc:196]
gRPC EXPERIMENT write_size_cap      ON
(default:ON)
D1014 20:06:23.749572702      13 config.cc:196]
gRPC EXPERIMENT write_size_policy      ON
(default:ON)
D1014 20:06:23.749574912      13 config.cc:196]
gRPC EXPERIMENT wrr_delegate_to_pick_first      ON
(default:ON)
I1014 20:06:23.749740981      13 ev_epoll1_linux.cc:123]
grpc epoll fd: 68
D1014 20:06:23.749753228      13 ev_posix.cc:113]
Using polling engine: epoll1
D1014 20:06:23.760347231      13 lb_policy_registry.cc:46]
registering LB policy factory for "priority_experimental"
D1014 20:06:23.760357516      13 lb_policy_registry.cc:46]
registering LB policy factory for "outlier_detection_experimental"
D1014 20:06:23.760365479      13 lb_policy_registry.cc:46]
registering LB policy factory for "weighted_target_experimental"

```

```
D1014 20:06:23.760368479      13 lb_policy_registry.cc:46]
registering LB policy factory for "pick_first"
D1014 20:06:23.760371586      13 lb_policy_registry.cc:46]
registering LB policy factory for "round_robin"
D1014 20:06:23.760374296      13 lb_policy_registry.cc:46]
registering LB policy factory for "weighted_round_robin"
D1014 20:06:23.760406379      13 lb_policy_registry.cc:46]
registering LB policy factory for "grpclb"
D1014 20:06:23.760420711      13 dns_resolver_plugin.cc:43]
Using EventEngine dns resolver
D1014 20:06:23.760436057      13 lb_policy_registry.cc:46]
registering LB policy factory for "rls_experimental"
D1014 20:06:23.760455488      13 lb_policy_registry.cc:46]
registering LB policy factory for "xds_cluster_manager_experimental"
D1014 20:06:23.760462630      13 lb_policy_registry.cc:46]
registering LB policy factory for "xds_cluster_impl_experimental"
D1014 20:06:23.760465982      13 lb_policy_registry.cc:46]
registering LB policy factory for "cds_experimental"
D1014 20:06:23.760472203      13 lb_policy_registry.cc:46]
registering LB policy factory for "xds_override_host_experimental"
D1014 20:06:23.760475341      13 lb_policy_registry.cc:46]
registering LB policy factory for "xds_wrr_locality_experimental"
D1014 20:06:23.760478166      13 lb_policy_registry.cc:46]
registering LB policy factory for "ring_hash_experimental"
D1014 20:06:23.760481269      13 certificate_provider_registry.cc:33]
registering certificate provider factory for "file_watcher"
D1014 20:06:23.760511105      13 channel_init.cc:157]
Filter server-auth not registered, but is referenced in the after
clause of grpc-server-authz when building channel stack SERVER_CHANNEL
I1014 20:06:23.762170976      13 ev_epoll1_linux.cc:359]
grpc epoll fd: 70
I1014 20:06:23.763423851      13 tcp_socket_utils.cc:689]
Disabling AF_INET6 sockets because ::1 is not available.
I1014 20:06:23.767227334      176 socket_utils_common_posix.cc:452]
Disabling AF_INET6 sockets because ::1 is not available.
I1014 20:06:23.767289789      176 socket_utils_common_posix.cc:379]
TCP_USER_TIMEOUT is available. TCP_USER_TIMEOUT will be used
thereafter
E1014 20:06:23.773644905      170 oauth2_credentials.cc:238]
oauth_fetch: UNKNOWN:C-ares status is not ARES_SUCCESS qtype=A
name=metadata.google.internal. is_balancer=0: Domain name not found
{grpc_status:2, created_time:"2024-10-14T20:06:23.773629878+00:00"}
```


2)DataOF IMAGES

Data has 15000 Images

Testing The Model By CNN

The CNN Architecture

used vision learner fast ai

```
import os
import itertools
# Data handling tools
# pd.options.mode.copy_on_write = True
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
# Deep learning libraries
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator

!pip install torch==2.0.0+cpu torchvision==0.15.2+cpu --extra-index-
url https://download.pytorch.org/whl/cpu
!pip install fastai==2.7.12 fastcore==1.5.29 numpy==1.24.4
tensorflow==2.16.1 torchtext==0.18.0 transformers==4.42.3
```

```
Looking in indexes: https://pypi.org/simple,
https://download.pytorch.org/whl/cpu
Collecting torch==2.0.0+cpu
  Downloading https://download.pytorch.org/whl/cpu/torch-2.0.0%2Bcpu-
cp310-cp310-linux_x86_64.whl (195.4 MB)
195.4/195.4 MB 2.4 MB/s eta
0:00:0000:0100:01
1.5/1.5 MB 45.9 MB/s eta
0:00:00
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/site-
packages (from torch==2.0.0+cpu) (3.1.4)
Requirement already satisfied: filelock in
/usr/local/lib/python3.10/site-packages (from torch==2.0.0+cpu)
```

```
(3.15.4)
Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/site-packages (from torch==2.0.0+cpu)
(4.12.2)
Requirement already satisfied: networkx in
/usr/local/lib/python3.10/site-packages (from torch==2.0.0+cpu) (3.3)
Requirement already satisfied: sympy in
/usr/local/lib/python3.10/site-packages (from torch==2.0.0+cpu)
(1.13.0)
Requirement already satisfied: requests in
/usr/local/lib/python3.10/site-packages (from torchvision==0.15.2+cpu)
(2.32.3)
Requirement already satisfied: pillow!=8.3.*,>=5.3.0 in
/usr/local/lib/python3.10/site-packages (from torchvision==0.15.2+cpu)
(10.4.0)
Requirement already satisfied: numpy in
/usr/local/lib/python3.10/site-packages (from torchvision==0.15.2+cpu)
(1.26.4)
INFO: pip is looking at multiple versions of <Python from Requires-
Python> to determine which version is compatible with other
requirements. This could take a while.
INFO: pip is looking at multiple versions of torch to determine which
version is compatible with other requirements. This could take a
while.
ERROR: Cannot install torch==2.0.0+cpu and torchvision==0.15.2+cpu
because these package versions have conflicting dependencies.
```

```
The conflict is caused by:
  The user requested torch==2.0.0+cpu
  torchvision 0.15.2+cpu depends on torch==2.0.1
```

```
To fix this you could try to:
1. loosen the range of package versions you've specified
2. remove package versions to allow pip attempt to solve the
dependency conflict
```

```
ERROR: ResolutionImpossible: for help visit
https://pip.pypa.io/en/latest/topics/dependency-resolution/#dealing-
with-dependency-conflicts
```

```
[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
Collecting fastai==2.7.12
  Downloading fastai-2.7.12-py3-none-any.whl (233 kB)
  233.1/233.1 kB 5.2 MB/s eta
0:00:00a 0:00:01
  67.6/67.6 kB 5.0 MB/s eta
0:00:00
py==1.24.4
  Downloading numpy-1.24.4-cp310-cp310-
```

```
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (17.3 MB)
----- 17.3/17.3 MB 57.7 MB/s eta
0:00:0000:0100:01
Requirement already satisfied: tensorflow==2.16.1 in
/usr/local/lib/python3.10/site-packages (2.16.1)
Requirement already satisfied: torchtext==0.18.0 in
/usr/local/lib/python3.10/site-packages (0.18.0)
Requirement already satisfied: transformers==4.42.3 in
/usr/local/lib/python3.10/site-packages (4.42.3)
Collecting torch<2.1,>=1.7
  Downloading torch-2.0.1-cp310-cp310-manylinux1_x86_64.whl (619.9 MB)
----- 619.9/619.9 MB 871.3 kB/s eta
0:00:0000:0100:01
Requirement already satisfied: packaging in /usr/local/lib/python3.10/site-
packages (from fastai==2.7.12) (24.1)
Collecting spacy<4
  Downloading spacy-3.8.2-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (29.1 MB)
----- 29.1/29.1 MB 21.8 MB/s eta
0:00:0000:0100:01
Requirement already satisfied: pandas in /usr/local/lib/python3.10/site-
packages (from fastai==2.7.12) (2.2.2)
Collecting fastdownload<2,>=0.0.5
  Downloading fastdownload-0.0.7-py3-none-any.whl (12 kB)
Requirement already satisfied: scikit-learn in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (1.5.1)
Requirement already satisfied: requests in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (2.32.3)
Requirement already satisfied: pip in /usr/local/lib/python3.10/site-
packages (from fastai==2.7.12) (23.0.1)
Requirement already satisfied: torchvision>=0.8.2 in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (0.18.0)
Requirement already satisfied: pillow>6.0.0 in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (10.4.0)
Requirement already satisfied: scipy in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (1.14.0)
Requirement already satisfied: pyyaml in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (6.0.1)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (3.9.1)
Requirement already satisfied: tensorboard<2.17,>=2.16 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(2.16.2)
Requirement already satisfied: google-pasta>=0.1.1 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(0.2.0)
Requirement already satisfied: astunparse>=1.6.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(1.6.3)
```

Requirement already satisfied: h5py>=3.10.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(3.11.0)

Requirement already satisfied: flatbuffers>=23.5.26 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(24.3.25)

Requirement already satisfied: typing-extensions>=3.6.6 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(4.12.2)

Requirement already satisfied: opt-einsum>=2.3.2 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(3.3.0)

Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(3.20.3)

Requirement already satisfied: ml-dtypes~=0.3.1 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(0.3.2)

Requirement already satisfied: setuptools in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(65.5.1)

Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(0.37.1)

Requirement already satisfied: six>=1.12.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(1.16.0)

Requirement already satisfied: wrapt>=1.11.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(1.16.0)

Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1
in /usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(0.6.0)

Requirement already satisfied: libclang>=13.0.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(18.1.1)

Requirement already satisfied: termcolor>=1.1.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(2.4.0)

Requirement already satisfied: keras>=3.0.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(3.4.1)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(1.64.1)

Requirement already satisfied: absl-py>=1.0.0 in
/usr/local/lib/python3.10/site-packages (from tensorflow==2.16.1)
(2.1.0)

INFO: pip is looking at multiple versions of tensorflow to determine which version is compatible with other requirements. This could take a while.

Collecting tensorflow==2.16.1

Downloading tensorflow-2.16.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (589.8 MB)
589.8/589.8 MB 1.3 MB/s eta

0:00:0000:0100:01

multiple versions of numpy to determine which version is compatible with other requirements. This could take a while.

INFO: pip is looking at multiple versions of fastcore to determine which version is compatible with other requirements. This could take a while.

INFO: pip is looking at multiple versions of <Python from Requires-Python> to determine which version is compatible with other requirements. This could take a while.

INFO: pip is looking at multiple versions of fastai to determine which version is compatible with other requirements. This could take a while.

ERROR: Cannot install fastai==2.7.12 and torchtext==0.18.0 because these package versions have conflicting dependencies.

The conflict is caused by:

fastai 2.7.12 depends on torch<2.1 and >=1.7

torchtext 0.18.0 depends on torch>=2.3.0

To fix this you could try to:

1. loosen the range of package versions you've specified
2. remove package versions to allow pip attempt to solve the dependency conflict

ERROR: ResolutionImpossible: for help visit
<https://pip.pypa.io/en/latest/topics/dependency-resolution/#dealing-with-dependency-conflicts>

[notice] A new release of pip is available: 23.0.1 -> 24.2

[notice] To update, run: pip install --upgrade pip

!pip install torch==1.13.1+cpu torchvision==0.14.1+cpu --extra-index-url https://download.pytorch.org/whl/cpu

!pip install fastai==2.7.12

!pip install fastcore==1.5.29

import torch

import torchvision

print(torch.__version__)

print(torchvision.__version__)

Looking in indexes: https://pypi.org/simple,

https://download.pytorch.org/whl/cpu

Collecting torch==1.13.1+cpu

Downloading https://download.pytorch.org/whl/cpu/torch-1.13.1%2Bcpu-cp310-cp310-linux_x86_64.whl (199.1 MB)

199.1/199.1 MB 3.8 MB/s eta

0:00:0000:0100:01

16.8/16.8 MB 61.8 MB/s eta

0:00:0000:0100:01

Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/site-packages (from torch==1.13.1+cpu)
(4.12.2)

Requirement already satisfied: numpy in
/usr/local/lib/python3.10/site-packages (from torchvision==0.14.1+cpu)
(1.26.4)

Requirement already satisfied: pillow!=8.3.*,>=5.3.0 in
/usr/local/lib/python3.10/site-packages (from torchvision==0.14.1+cpu)
(10.4.0)

Requirement already satisfied: requests in
/usr/local/lib/python3.10/site-packages (from torchvision==0.14.1+cpu)
(2.32.3)

Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/site-packages (from requests-
>torchvision==0.14.1+cpu) (3.3.2)

Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/site-packages (from requests-
>torchvision==0.14.1+cpu) (2.2.2)

Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/site-packages (from requests-
>torchvision==0.14.1+cpu) (2024.7.4)

Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/site-packages (from requests-
>torchvision==0.14.1+cpu) (3.7)

Installing collected packages: torch, torchvision

Attempting uninstall: torch

Found existing installation: torch 2.3.0

Uninstalling torch-2.3.0:

Successfully uninstalled torch-2.3.0

Attempting uninstall: torchvision

Found existing installation: torchvision 0.18.0

Uninstalling torchvision-0.18.0:

Successfully uninstalled torchvision-0.18.0

ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.

torchtext 0.18.0 requires torch>=2.3.0, but you have torch 1.13.1+cpu
which is incompatible.

torchaudio 2.3.0 requires torch==2.3.0, but you have torch 1.13.1+cpu
which is incompatible.

Successfully installed torch-1.13.1+cpu torchvision-0.14.1+cpu

WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.

It is recommended to use a virtual environment instead:
<https://pip.pypa.io/warnings/venv>

```
[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
Collecting fastai==2.7.12
  Using cached fastai-2.7.12-py3-none-any.whl (233 kB)
Requirement already satisfied: torchvision>=0.8.2 in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12)
(0.14.1+cpu)
Requirement already satisfied: scipy in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (1.14.0)
Requirement already satisfied: pillow>6.0.0 in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (10.4.0)
Requirement already satisfied: pandas in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (2.2.2)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (3.9.1)
Collecting spacy<4
  Using cached spacy-3.8.2-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (29.1 MB)
Collecting fastcore<1.6,>=1.5.29
  Downloading fastcore-1.5.55-py3-none-any.whl (77 kB)
 77.2/77.2 kB 2.5 MB/s eta
0:00:00
Requirement already satisfied: requests in /usr/local/lib/python3.10/site-
packages (from fastai==2.7.12) (2.32.3)
Collecting fastprogress>=0.2.4
  Using cached fastprogress-1.0.3-py3-none-any.whl (12 kB)
Collecting fastdownload<2,>=0.0.5
  Using cached fastdownload-0.0.7-py3-none-any.whl (12 kB)
Requirement already satisfied: scikit-learn in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (1.5.1)
Requirement already satisfied: pyyaml in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (6.0.1)
Requirement already satisfied: pip in /usr/local/lib/python3.10/site-
packages (from fastai==2.7.12) (23.0.1)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12) (24.1)
Requirement already satisfied: torch<2.1,>=1.7 in
/usr/local/lib/python3.10/site-packages (from fastai==2.7.12)
(1.13.1+cpu)
Requirement already satisfied: numpy>=1.19.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai==2.7.12)
(1.26.4)
Requirement already satisfied: jinja2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai==2.7.12)
(3.1.4)
Collecting spacy-loggers<2.0.0,>=1.0.0
```

```

    Downloading spacy_loggers-1.0.5-py3-none-any.whl (22 kB)
Collecting catalogue<2.1.0,>=2.0.6
    Downloading catalogue-2.0.10-py3-none-any.whl (17 kB)
Collecting preshed<3.1.0,>=3.0.2
    Downloading preshed-3.0.9-cp310-cp310-
manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_17_x86_64.manylinux
2014_x86_64.whl (156 kB)
_____ 156.9/156.9 kB 7.0 MB/s eta
0:00:00
Requirement already satisfied: tqdm<5.0.0,>=4.38.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai==2.7.12)
(4.66.4)
Requirement already satisfied: pydantic!=1.8,!1.8.1,<3.0.0,>=1.7.4 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai==2.7.12)
(2.8.2)
Collecting murmurhash<1.1.0,>=0.28.0
    Downloading murmurhash-1.0.10-cp310-cp310-
manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_17_x86_64.manylinux
2014_x86_64.whl (29 kB)
Collecting srsly<3.0.0,>=2.4.3
    Downloading srsly-2.4.8-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (493 kB)
_____ 493.0/493.0 kB 20.3 MB/s eta
0:00:00
_____ 47.3/47.3 kB 4.4 MB/s eta
0:00:00
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (3.7 MB)
_____ 3.7/3.7 MB 67.3 MB/s eta
0:00:00:00:01
_____ 182.4/182.4 kB 15.1 MB/s eta
0:00:00
Requirement already satisfied: em<2.1.0,>=2.0.2
    Downloading cymem-2.0.8-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (46 kB)
_____ 46.1/46.1 kB 3.4 MB/s eta
0:00:00
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/site-
packages (from spacy<4->fastai==2.7.12) (65.5.1)
Collecting weasel<0.5.0,>=0.1.0
    Downloading weasel-0.4.1-py3-none-any.whl (50 kB)
_____ 50.3/50.3 kB 4.3 MB/s eta
0:00:00
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/site-
packages (from requests->fastai==2.7.12) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/site-packages (from requests-
>fastai==2.7.12) (2.2.2)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/site-packages (from requests-

```



```

>fastai==2.7.12) (3.3.2)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/site-packages (from requests-
>fastai==2.7.12) (2024.7.4)
Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/site-packages (from torch<2.1,>=1.7-
>fastai==2.7.12) (4.12.2)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (1.2.1)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (4.53.1)
Requirement already satisfied: cycler>=0.10 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (0.12.1)
Requirement already satisfied: kiwisolver>=1.3.1 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (1.4.5)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (3.1.2)
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.10/site-packages (from matplotlib-
>fastai==2.7.12) (2.9.0.post0)
Requirement already satisfied: tzdata>=2022.7 in
/usr/local/lib/python3.10/site-packages (from pandas->fastai==2.7.12)
(2024.1)
Requirement already satisfied: pytz>=2020.1 in
/usr/local/lib/python3.10/site-packages (from pandas->fastai==2.7.12)
(2024.1)
Requirement already satisfied: threadpoolctl>=3.1.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn-
>fastai==2.7.12) (3.5.0)
Requirement already satisfied: joblib>=1.2.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn-
>fastai==2.7.12) (1.4.2)
Collecting language-data>=1.2
  Downloading language_data-1.2.0-py3-none-any.whl (5.4 MB)
  5.4/5.4 MB 78.4 MB/s eta
0:00:00:00:01
Requirement already satisfied: pydantic-core==2.20.1 in
/usr/local/lib/python3.10/site-packages (from pydantic!=1.8,!
=1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai==2.7.12) (2.20.1)
Requirement already satisfied: annotated-types>=0.4.0 in
/usr/local/lib/python3.10/site-packages (from pydantic!=1.8,!
=1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai==2.7.12) (0.7.0)
Requirement already satisfied: six>=1.5 in
/usr/local/lib/python3.10/site-packages (from python-dateutil>=2.7-

```

```

>matplotlib->fastai==2.7.12) (1.16.0)
Collecting blis<1.1.0,>=1.0.0
  Downloading blis-1.0.1-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (9.2 MB)
----- 9.2/9.2 MB 86.8 MB/s eta
0:00:00:00:0100:01
py>=1.19.0
  Downloading numpy-2.0.2-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (19.5 MB)
----- 19.5/19.5 MB 65.8 MB/s eta
0:00:0000:0100:01
>=1.3.0
  Downloading shellingham-1.5.4-py2.py3-none-any.whl (9.8 kB)
Requirement already satisfied: rich>=10.11.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai==2.7.12) (13.7.1)
Requirement already satisfied: click>=8.0.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai==2.7.12) (8.1.7)
Collecting smart-open<8.0.0,>=5.2.1
  Downloading smart_open-7.0.5-py3-none-any.whl (61 kB)
----- 61.4/61.4 kB 486.2 kB/s eta
0:00:00a 0:00:01
----- 49.4/49.4 kB 3.9 MB/s eta
0:00:00
ent already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.10/site-packages (from jinja2->spacy<4-
>fastai==2.7.12) (2.1.5)
Collecting marisa-trie>=0.7.7
  Downloading marisa_trie-1.2.1-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.3 MB)
----- 1.3/1.3 MB 52.7 MB/s eta
0:00:00
ent already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai==2.7.12) (2.18.0)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai==2.7.12) (3.0.0)
Requirement already satisfied: wrapt in
/usr/local/lib/python3.10/site-packages (from smart-
open<8.0.0,>=5.2.1->weasel<0.5.0,>=0.1.0->spacy<4->fastai==2.7.12)
(1.16.0)
Requirement already satisfied: mdurl~=0.1 in
/usr/local/lib/python3.10/site-packages (from markdown-it-py>=2.2.0-
>rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy<4->fastai==2.7.12) (0.1.2)
Installing collected packages: cymem, wasabi, spacy-loggers, spacy-
legacy, smart-open, shellingham, numpy, murmurhash, marisa-trie,
fastprogress, fastcore, cloudpathlib, catalogue, srsly, preshed,

```

```
language-data, fastdownload, blis, typer, langcodes, confection,
weasel, thinc, spacy, fastai
  Attempting uninstall: numpy
    Found existing installation: numpy 1.26.4
    Uninstalling numpy-1.26.4:
      Successfully uninstalled numpy-1.26.4
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.
transformers 4.42.3 requires numpy<2.0,>=1.17, but you have numpy
2.0.2 which is incompatible.
torchtext 0.18.0 requires torch>=2.3.0, but you have torch 1.13.1+cpu
which is incompatible.
tensorflow 2.16.1 requires numpy<2.0.0,>=1.23.5; python_version <=
"3.11", but you have numpy 2.0.2 which is incompatible.
albucore 0.0.12 requires numpy<2,>=1.24.4, but you have numpy 2.0.2
which is incompatible.
accelerate 0.32.1 requires numpy<2.0.0,>=1.17, but you have numpy
2.0.2 which is incompatible.
Successfully installed blis-1.0.1 catalogue-2.0.10 cloudpathlib-0.19.0
confection-0.1.5 cymem-2.0.8 fastai-2.7.12 fastcore-1.5.55
fastdownload-0.0.7 fastprogress-1.0.3 langcodes-3.4.1 language-data-
1.2.0 marisa-trie-1.2.1 murmurhash-1.0.10 numpy-2.0.2 preshed-3.0.9
shellingham-1.5.4 smart-open-7.0.5 spacy-3.8.2 spacy-legacy-3.0.12
spacy-loggers-1.0.5 srsly-2.4.8 thinc-8.3.2 typer-0.12.5 wasabi-1.1.3
weasel-0.4.1
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv

[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
Collecting fastcore==1.5.29
  Using cached fastcore-1.5.29-py3-none-any.whl (67 kB)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/site-packages (from fastcore==1.5.29) (24.1)
Requirement already satisfied: pip in /usr/local/lib/python3.10/site-
packages (from fastcore==1.5.29) (23.0.1)
Installing collected packages: fastcore
  Attempting uninstall: fastcore
    Found existing installation: fastcore 1.5.55
    Uninstalling fastcore-1.5.55:
      Successfully uninstalled fastcore-1.5.55
Successfully installed fastcore-1.5.29
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv
```

```
[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
```

```
/usr/local/lib/python3.10/site-packages/tqdm/auto.py:21: TqdmWarning:
IPProgress not found. Please update jupyter and ipywidgets. See
https://ipywidgets.readthedocs.io/en/stable/user\_install.html
  from .autonotebook import tqdm as notebook_tqdm
```

```
1.13.1+cpu
0.14.1+cpu
```

```
from fastai.vision import *
from fastai.metrics import error_rate, accuracy, top_k_accuracy
from fastai.vision.all import *
```

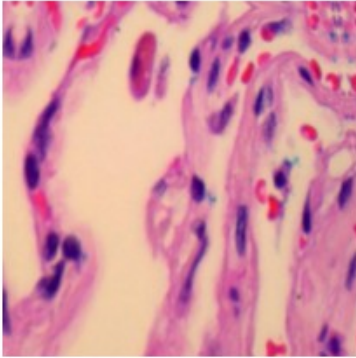
```
image_directory="/kaggle/input/lung-and-colon-cancer-
histopathological-images/lung_colon_image_set/lung_image_sets"
```

```
tfms=aug_transforms(do_flip=True,max_rotate=10.0,max_lighting=0.1,
max_zoom=1.1, max_warp=0.2)
```

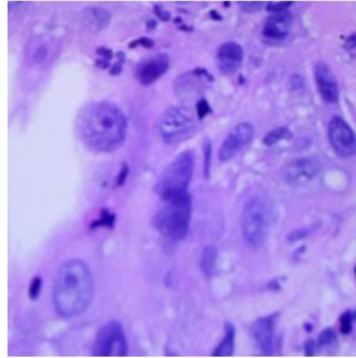
```
data=ImageDataLoaders.from_folder(image_directory,train="train",val="v
al",bs=64,item_tfms=Resize(224),batch_tfms=tfms,valid_pct=0.2,num_work
ers=8,n_job=-1)
```

```
data.show_batch()
```

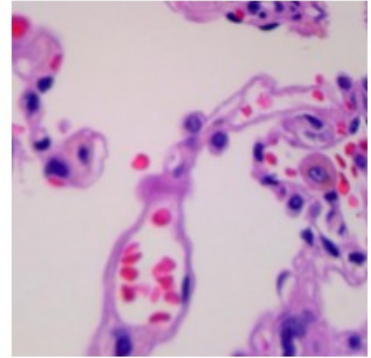
lung_n



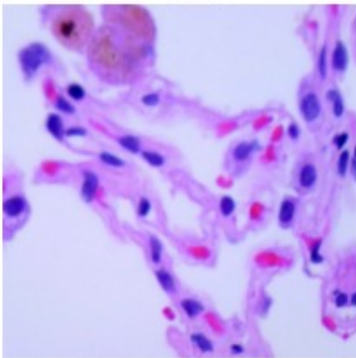
lung_scc



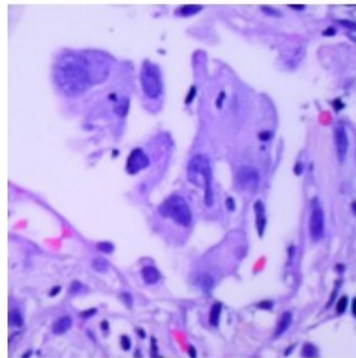
lung_n



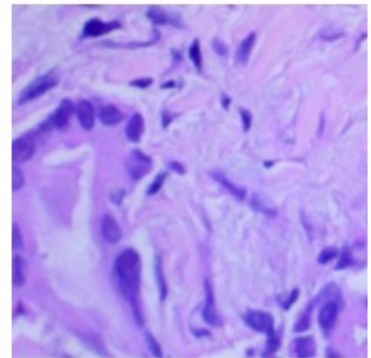
lung_n



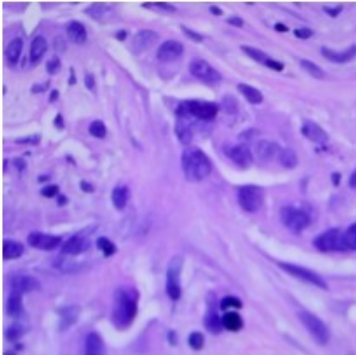
lung_aca



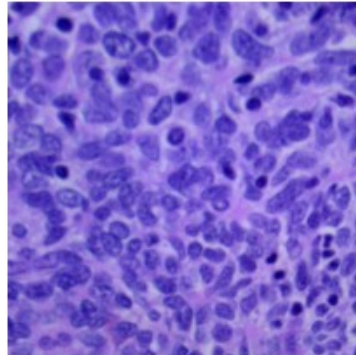
lung_aca



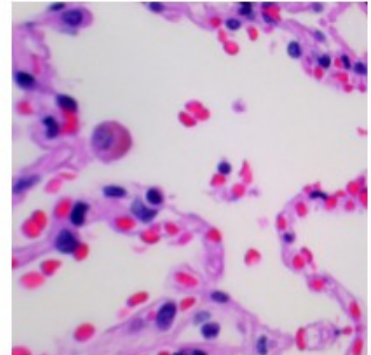
lung_aca



lung_scc



lung_n



```
print(len(data.train_ds),len(data.valid_ds))
# Access the classes through the vocab attribute
print(data.vocab) # Print the vocab to understand its structure
print(data.train_ds.vocab) # Print the vocab for the training dataset
```

```
12000 3000
['lung_aca', 'lung_n', 'lung_scc']
['lung_aca', 'lung_n', 'lung_scc']
```

```
import os
import tensorflow as tf
```

```
checkpoint_path = "training_2/cp.weights.h5"
checkpoint_dir = os.path.dirname(checkpoint_path)

cp_callback = tf.keras.callbacks.ModelCheckpoint(
    filepath=checkpoint_path,
    save_weights_only=True,
    verbose=1
)
```

```
print(data.vocab)
dir(models)
```

```
['lung_aca', 'lung_n', 'lung_scc']
```

```
['AlexNet',
 'AlexNet_Weights',
 'ConvNeXt',
 'ConvNeXt_Base_Weights',
 'ConvNeXt_Large_Weights',
 'ConvNeXt_Small_Weights',
 'ConvNeXt_Tiny_Weights',
 'DenseNet',
 'DenseNet121_Weights',
 'DenseNet161_Weights',
 'DenseNet169_Weights',
 'DenseNet201_Weights',
 'EfficientNet',
 'EfficientNet_B0_Weights',
 'EfficientNet_B1_Weights',
 'EfficientNet_B2_Weights',
 'EfficientNet_B3_Weights',
 'EfficientNet_B4_Weights',
 'EfficientNet_B5_Weights',
 'EfficientNet_B6_Weights',
 'EfficientNet_B7_Weights',
 'EfficientNet_V2_L_Weights',
 'EfficientNet_V2_M_Weights',
 'EfficientNet_V2_S_Weights',
 'GoogLeNet',
 'GoogLeNetOutputs',
 'GoogLeNet_Weights',
 'Inception3',
 'InceptionOutputs',
 'Inception_V3_Weights',
 'MNASNet',
 'MNASNet0_5_Weights',
 'MNASNet0_75_Weights',
 'MNASNet1_0_Weights',
 'MNASNet1_3_Weights',
 'MaxVit',
```

'MaxVit_T_Weights',
'MobileNetV2',
'MobileNetV3',
'MobileNet_V2_Weights',
'MobileNet_V3_Large_Weights',
'MobileNet_V3_Small_Weights',
'RegNet',
'RegNet_X_16GF_Weights',
'RegNet_X_1_6GF_Weights',
'RegNet_X_32GF_Weights',
'RegNet_X_3_2GF_Weights',
'RegNet_X_400MF_Weights',
'RegNet_X_800MF_Weights',
'RegNet_X_8GF_Weights',
'RegNet_Y_128GF_Weights',
'RegNet_Y_16GF_Weights',
'RegNet_Y_1_6GF_Weights',
'RegNet_Y_32GF_Weights',
'RegNet_Y_3_2GF_Weights',
'RegNet_Y_400MF_Weights',
'RegNet_Y_800MF_Weights',
'RegNet_Y_8GF_Weights',
'ResNeXt101_32X8D_Weights',
'ResNeXt101_64X4D_Weights',
'ResNeXt50_32X4D_Weights',
'ResNet',
'ResNet101_Weights',
'ResNet152_Weights',
'ResNet18_Weights',
'ResNet34_Weights',
'ResNet50_Weights',
'ShuffleNetV2',
'ShuffleNet_V2_X0_5_Weights',
'ShuffleNet_V2_X1_0_Weights',
'ShuffleNet_V2_X1_5_Weights',
'ShuffleNet_V2_X2_0_Weights',
'SqueezeNet',
'SqueezeNet1_0_Weights',
'SqueezeNet1_1_Weights',
'SwinTransformer',
'Swin_B_Weights',
'Swin_S_Weights',
'Swin_T_Weights',
'Swin_V2_B_Weights',
'Swin_V2_S_Weights',
'Swin_V2_T_Weights',
'VGG',
'VGG11_BN_Weights',
'VGG11_Weights',

```
'VGG13_BN_Weights',
'VGG13_Weights',
'VGG16_BN_Weights',
'VGG16_Weights',
'VGG19_BN_Weights',
'VGG19_Weights',
'ViT_B_16_Weights',
'ViT_B_32_Weights',
'ViT_H_14_Weights',
'ViT_L_16_Weights',
'ViT_L_32_Weights',
'VisionTransformer',
'Wide_ResNet101_2_Weights',
'Wide_ResNet50_2_Weights',
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'all',
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'convnext_large',
'convnext_small',
'convnext_tiny',
'densenet121',
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'densenet169',
'densenet201',
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'efficientnet_b2',
'efficientnet_b3',
'efficientnet_b4',
'efficientnet_b5',
'efficientnet_b6',
'efficientnet_b7',
'efficientnet_v2_l',
'efficientnet_v2_m',
'efficientnet_v2_s',
'googlenet',
'inception_v3',
'maxvit_t',
'mnasnet0_5',
'mnasnet0_75',
```



```
'mnasnet1_0',  
'mnasnet1_3',  
'mobilenet_v2',  
'mobilenet_v3_large',  
'mobilenet_v3_small',  
'regnet_x_16gf',  
'regnet_x_1_6gf',  
'regnet_x_32gf',  
'regnet_x_3_2gf',  
'regnet_x_400mf',  
'regnet_x_800mf',  
'regnet_x_8gf',  
'regnet_y_128gf',  
'regnet_y_16gf',  
'regnet_y_1_6gf',  
'regnet_y_32gf',  
'regnet_y_3_2gf',  
'regnet_y_400mf',  
'regnet_y_800mf',  
'regnet_y_8gf',  
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'resnet152',  
'resnet18',  
'resnet34',  
'resnet50',  
'resnext101_32x8d',  
'resnext101_64x4d',  
'resnext50_32x4d',  
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'squeezenet1_1',  
'swin_b',  
'swin_s',  
'swin_t',  
'swin_v2_b',  
'swin_v2_s',  
'swin_v2_t',  
'tvm',  
'unet',  
'vgg11',  
'vgg11_bn',  
'vgg13',  
'vgg13_bn',  
'vgg16',  
'vgg16_bn',  
'vgg19',
```

```
'vgg19_bn',  
'vit_b_16',  
'vit_b_32',  
'vit_h_14',  
'vit_l_16',  
'vit_l_32',  
'wide_resnet101_2',  
'wide_resnet50_2',  
'xresnet']
```

```
learn=vision_learner(data,models.convnext_base,opt_func=Adam,metrics=[  
accuracy,error_rate])
```

```
/usr/local/lib/python3.10/site-packages/torchvision/models/  
_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated  
since 0.13 and may be removed in the future, please use 'weights'  
instead.
```

```
warnings.warn(  
/usr/local/lib/python3.10/site-packages/torchvision/models/_utils.py:2  
23: UserWarning: Arguments other than a weight enum or `None` for  
'weights' are deprecated since 0.13 and may be removed in the future.  
The current behavior is equivalent to passing  
'weights=ConvNeXt_Base_Weights.IMAGENET1K_V1'. You can also use  
'weights=ConvNeXt_Base_Weights.DEFAULT' to get the most up-to-date  
weights.
```

```
warnings.warn(msg)  
Downloading: "https://download.pytorch.org/models/convnext_base-  
6075fbad.pth" to /root/.cache/torch/hub/checkpoints/convnext_base-  
6075fbad.pth  
100%|██████████| 338M/338M [00:01<00:00, 261MB/s]
```

```
learn.summary()
```

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

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

```
Sequential (Input shape: 64 x 3 x 224 x 224)
```

=====			
=====			
Layer (type)	Output Shape	Param #	Trainable
=====			
=====			
	64 x 128 x 56 x 56		
Conv2d		6272	False
LayerNorm2d		256	True
Conv2d		6400	False
<hr/>			
	64 x 56 x 56 x 128		
Permute			

LayerNorm	256	True
64 x 56 x 56 x 512		
Linear GELU	66048	False
64 x 56 x 56 x 128		
Linear	65664	False
64 x 128 x 56 x 56		
Permute StochasticDepth Conv2d	6400	False
64 x 56 x 56 x 128		
Permute LayerNorm	256	True
64 x 56 x 56 x 512		
Linear GELU	66048	False
64 x 56 x 56 x 128		
Linear	65664	False
64 x 128 x 56 x 56		
Permute StochasticDepth Conv2d	6400	False
64 x 56 x 56 x 128		
Permute LayerNorm	256	True
64 x 56 x 56 x 512		
Linear GELU	66048	False
64 x 56 x 56 x 128		

Linear	65664	False
64 x 128 x 56 x 56		
Permute StochasticDepth LayerNorm2d	256	True
64 x 256 x 28 x 28		
Conv2d	131328	False
Conv2d	12800	False
64 x 28 x 28 x 256		
Permute LayerNorm	512	True
64 x 28 x 28 x 1024		
Linear GELU	263168	False
64 x 28 x 28 x 256		
Linear	262400	False
64 x 256 x 28 x 28		
Permute StochasticDepth Conv2d	12800	False
64 x 28 x 28 x 256		
Permute LayerNorm	512	True
64 x 28 x 28 x 1024		
Linear GELU	263168	False
64 x 28 x 28 x 256		
Linear	262400	False
64 x 256 x 28 x 28		

Permute			
StochasticDepth			
Conv2d	64 x 28 x 28 x 256	12800	False
Permute			
LayerNorm		512	True
Linear	64 x 28 x 28 x 1024	263168	False
GELU			
Linear	64 x 28 x 28 x 256	262400	False
Permute			
StochasticDepth	64 x 256 x 28 x 28		
LayerNorm2d		512	True
Conv2d	64 x 512 x 14 x 14	524800	False
Conv2d		25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute			
StochasticDepth	64 x 512 x 14 x 14		
Conv2d		25600	False

	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			

	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth			

Conv2d	25600	False
64 x 14 x 14 x 512		
Permute LayerNorm	1024	True
64 x 14 x 14 x 2048		
Linear GELU	1050624	False
64 x 14 x 14 x 512		
Linear	1049088	False
64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d	25600	False
64 x 14 x 14 x 512		
Permute LayerNorm	1024	True
64 x 14 x 14 x 2048		
Linear GELU	1050624	False
64 x 14 x 14 x 512		
Linear	1049088	False
64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d	25600	False
64 x 14 x 14 x 512		
Permute LayerNorm	1024	True
64 x 14 x 14 x 2048		

Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		

Permute			
StochasticDepth			
Conv2d	64 x 14 x 14 x 512	25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute			
StochasticDepth	64 x 512 x 14 x 14		
Conv2d	64 x 14 x 14 x 512	25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute			
StochasticDepth	64 x 512 x 14 x 14		
Conv2d	64 x 14 x 14 x 512	25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True

	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False

	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True

	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False
	64 x 512 x 14 x 14		
Permute StochasticDepth Conv2d		25600	False
	64 x 14 x 14 x 512		
Permute LayerNorm		1024	True
	64 x 14 x 14 x 2048		
Linear GELU		1050624	False
	64 x 14 x 14 x 512		
Linear		1049088	False

	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False

	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True

	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			

	64 x 14 x 14 x 512		
Linear		1049088	False

	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False

	64 x 14 x 14 x 512		
Permute			
LayerNorm		1024	True

	64 x 14 x 14 x 2048		
Linear		1050624	False
GELU			

	64 x 14 x 14 x 512		
Linear		1049088	False

	64 x 512 x 14 x 14		
Permute			
StochasticDepth			
Conv2d		25600	False

	64 x 14 x 14 x 512		
--	--------------------	--	--

Permute			
LayerNorm	64 x 14 x 14 x 2048	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute	64 x 512 x 14 x 14		
StochasticDepth			
Conv2d	64 x 14 x 14 x 512	25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute	64 x 512 x 14 x 14		
StochasticDepth			
Conv2d	64 x 14 x 14 x 512	25600	False
Permute			
LayerNorm	64 x 14 x 14 x 512	1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			

Linear	64 x 14 x 14 x 512	1049088	False
Permute	64 x 512 x 14 x 14		
StochasticDepth			
Conv2d		25600	False
Permute	64 x 14 x 14 x 512		
LayerNorm		1024	True
Linear	64 x 14 x 14 x 2048	1050624	False
GELU			
Linear	64 x 14 x 14 x 512	1049088	False
Permute	64 x 512 x 14 x 14		
StochasticDepth			
LayerNorm2d		1024	True
Conv2d	64 x 1024 x 7 x 7	2098176	False
Conv2d		51200	False
Permute	64 x 7 x 7 x 1024		
LayerNorm		2048	True
Linear	64 x 7 x 7 x 4096	4198400	False
GELU			
Linear	64 x 7 x 7 x 1024	4195328	False

	64 x 1024 x 7 x 7		
Permute			
StochasticDepth			
Conv2d		51200	False
	64 x 7 x 7 x 1024		
Permute			
LayerNorm		2048	True
	64 x 7 x 7 x 4096		
Linear		4198400	False
GELU			
	64 x 7 x 7 x 1024		
Linear		4195328	False
	64 x 1024 x 7 x 7		
Permute			
StochasticDepth			
Conv2d		51200	False
	64 x 7 x 7 x 1024		
Permute			
LayerNorm		2048	True
	64 x 7 x 7 x 4096		
Linear		4198400	False
GELU			
	64 x 7 x 7 x 1024		
Linear		4195328	False
	64 x 1024 x 7 x 7		
Permute			
StochasticDepth			
	64 x 1024 x 1 x 1		
AdaptiveAvgPool2d			
AdaptiveMaxPool2d			

	64 x 2048	
Flatten		
BatchNorm1d	4096	True
Dropout		

	64 x 512	
Linear	1048576	True
ReLU		
BatchNorm1d	1024	True
Dropout		

	64 x 3	
Linear	1536	True

Total params: 88,601,600
Total trainable params: 1,093,376
Total non-trainable params: 87,508,224

Optimizer used: <function Adam at 0x7ecfe3f875b0>
Loss function: FlattenedLoss of CrossEntropyLoss()

Model frozen up to parameter group #1

Callbacks:

- TrainEvalCallback
- CastToTensor
- Recorder
- ProgressCallback

```
import os
import tensorflow as tf

checkpoint_path = "training_3/cp.weights.h5"
checkpoint_dir = os.path.dirname(checkpoint_path)

cp_callback = tf.keras.callbacks.ModelCheckpoint(
    filepath=checkpoint_path,
    save_weights_only=True,
    verbose=1
)

# Install Graphviz
import multiprocessing as mp
mp.set_start_method('spawn', force=True)
!apt-get install -y graphviz
```

```
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  fonts-liberation2 libabsl20220623 libann0 libavif15 libcdt5
  libcgraph6
  libgavl-1 libgd3 libgts-0.7-5 libgts-bin libgvc6 libgvpr2 liblab-
  gamut1
  libpathplan4 libxaw7 libxmu6 libxpm4 libyuv0
Suggested packages:
  gsfonts graphviz-doc libgd-tools
The following NEW packages will be installed:
  fonts-liberation2 graphviz libabsl20220623 libann0 libavif15 libcdt5
  libcgraph6 libgavl-1 libgd3 libgts-0.7-5 libgts-bin libgvc6 libgvpr2
  liblab-gamut1 libpathplan4 libxaw7 libxmu6 libxpm4 libyuv0
0 upgraded, 19 newly installed, 0 to remove and 10 not upgraded.
Need to get 4954 kB of archives.
After this operation, 18.7 MB of additional disk space will be used.
Get:1 http://deb.debian.org/debian bookworm/main amd64 fonts-
liberation2 all 2.1.5-1 [1479 kB]
Get:2 http://deb.debian.org/debian bookworm/main amd64 libann0 amd64
1.1.2+doc-9+b1 [25.1 kB]
Err:3 http://deb.debian.org/debian bookworm/main amd64 libcdt5 amd64
2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Err:4 http://deb.debian.org/debian bookworm/main amd64 libcgraph6
amd64 2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Get:5 http://deb.debian.org/debian bookworm/main amd64 libabsl20220623
amd64 20220623.1-1 [391 kB]
Get:6 http://deb.debian.org/debian bookworm/main amd64 libgavl-1 amd64
0.18.0-1+b1 [332 kB]
Get:7 http://deb.debian.org/debian bookworm/main amd64 libyuv0 amd64
0.0~git20230123.b2528b0-1 [168 kB]
Get:8 http://deb.debian.org/debian bookworm/main amd64 libavif15 amd64
0.11.1-1 [93.8 kB]
Get:9 http://deb.debian.org/debian bookworm/main amd64 libxpm4 amd64
1:3.5.12-1.1+deb12u1 [48.6 kB]
Get:10 http://deb.debian.org/debian bookworm/main amd64 libgd3 amd64
2.3.3-9 [124 kB]
Get:11 http://deb.debian.org/debian bookworm/main amd64 libgts-0.7-5
amd64 0.7.6+darcs121130-5+b1 [160 kB]
Err:12 http://deb.debian.org/debian bookworm/main amd64 libpathplan4
amd64 2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Err:13 http://deb.debian.org/debian bookworm/main amd64 libgvc6 amd64
2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Err:14 http://deb.debian.org/debian bookworm/main amd64 libgvpr2 amd64
2.42.2-7+b3
```

```
404 Not Found [IP: 151.101.66.132 80]
Err:15 http://deb.debian.org/debian bookworm/main amd64 liblab-gamut1
amd64 2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Get:16 http://deb.debian.org/debian bookworm/main amd64 libxmu6 amd64
2:1.1.3-3 [60.1 kB]
Get:17 http://deb.debian.org/debian bookworm/main amd64 libxaw7 amd64
2:1.0.14-1 [201 kB]
Err:18 http://deb.debian.org/debian bookworm/main amd64 graphviz amd64
2.42.2-7+b3
404 Not Found [IP: 151.101.66.132 80]
Get:19 http://deb.debian.org/debian bookworm/main amd64 libgts-bin
amd64 0.7.6+darcs121130-5+b1 [50.3 kB]
Fetched 3133 kB in 1s (2290 kB/s)
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/libcdt5_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/libcgraph6_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/libpathplan4_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/libgvc6_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/libgvpr2_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/liblab-
gamut1_2.42.2-7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Failed to fetch
http://deb.debian.org/debian/pool/main/g/graphviz/graphviz_2.42.2-
7%2bb3_amd64.deb 404 Not Found [IP: 151.101.66.132 80]
E: Unable to fetch some archives, maybe run apt-get update or try with
--fix-missing?
```

```
!pip install numpy<2
!pip install fastai --upgrade # Ensure your fastai library is updated
!pip install --upgrade torchvision
```

```
from fastai.interpret import Interpretation
from fastai.data.all import *
from fastai.vision.all import *
```

```
# Assuming 'learn' is your fastai Learner object
interp = Interpretation.from_learner(learn)
```

```
# You can now use various plotting functions from the Interpretation
```

object

like plot_top_losses to visualize your model's performance:

```
interp.plot_top_losses(k=9)
```

```
/usr/bin/sh: 1: cannot open 2: No such file
```

```
Requirement already satisfied: fastai in
```

```
/usr/local/lib/python3.10/site-packages (2.7.12)
```

```
Collecting fastai
```

```
  Downloading fastai-2.7.17-py3-none-any.whl (234 kB)
```

```
234.5/234.5 kB 5.5 MB/s eta
```

```
0:00:00a 0:00:01
```

```
Requirement already satisfied: spacy<4 in /usr/local/lib/python3.10/site-packages (from fastai) (3.8.2)
```

```
Requirement already satisfied: pip in /usr/local/lib/python3.10/site-packages (from fastai) (23.0.1)
```

```
Requirement already satisfied: matplotlib in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (3.9.1)
```

```
Requirement already satisfied: pyyaml in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (6.0.1)
```

```
Requirement already satisfied: requests in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (2.32.3)
```

```
Requirement already satisfied: fastcore<1.8,>=1.5.29 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (1.5.29)
```

```
Requirement already satisfied: fastprogress>=0.2.4 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (1.0.3)
```

```
Requirement already satisfied: scikit-learn in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (1.5.1)
```

```
Requirement already satisfied: scipy in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (1.14.0)
```

```
Requirement already satisfied: pillow>=9.0.0 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (10.4.0)
```

```
Requirement already satisfied: torch<2.5,>=1.10 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (1.13.1+cpu)
```

```
Requirement already satisfied: packaging in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (24.1)
```

```
Requirement already satisfied: torchvision>=0.11 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (0.14.1+cpu)
```

```
Requirement already satisfied: pandas in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (2.2.2)
```

```
Requirement already satisfied: fastdownload<2,>=0.0.5 in
```

```
/usr/local/lib/python3.10/site-packages (from fastai) (0.0.7)
```

```
Requirement already satisfied: thinc<8.4.0,>=8.3.0 in
```

```
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (8.3.2)
```

```
Requirement already satisfied: numpy>=1.19.0 in
```

```
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.0.2)
```

```
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in
```

```
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.0.8)
```

```
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.11 in
```

```
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
```

```
(3.0.12)
```

Requirement already satisfied: srsly<3.0.0,>=2.4.3 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.4.8)

Requirement already satisfied: tqdm<5.0.0,>=4.38.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(4.66.4)

Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (1.0.5)

Requirement already satisfied: wasabi<1.2.0,>=0.9.1 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (1.1.3)

Requirement already satisfied: typer<1.0.0,>=0.3.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(0.12.5)

Requirement already satisfied: pydantic!=1.8,!1.8.1,<3.0.0,>=1.7.4 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.8.2)

Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(1.0.10)

Requirement already satisfied: weasel<0.5.0,>=0.1.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (0.4.1)

Requirement already satisfied: preshed<3.1.0,>=3.0.2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.0.9)

Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(2.0.10)

Requirement already satisfied: langcodes<4.0.0,>=3.2.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.4.1)

Requirement already satisfied: jinja2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.1.4)

Requirement already satisfied: setuptools in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(65.5.1)

Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)
(3.3.2)

Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/site-packages (from requests->fastai) (3.7)

Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)
(2.2.2)

Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)
(2024.7.4)

Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10->fastai) (4.12.2)

Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(4.53.1)

Requirement already satisfied: kiwisolver>=1.3.1 in

/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(1.4.5)
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(2.9.0.post0)
Requirement already satisfied: cycycler>=0.10 in
/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(0.12.1)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(1.2.1)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.10/site-packages (from matplotlib->fastai)
(3.1.2)
Requirement already satisfied: pytz>=2020.1 in
/usr/local/lib/python3.10/site-packages (from pandas->fastai) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in
/usr/local/lib/python3.10/site-packages (from pandas->fastai) (2024.1)
Requirement already satisfied: threadpoolctl>=3.1.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn->fastai)
(3.5.0)
Requirement already satisfied: joblib>=1.2.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn->fastai)
(1.4.2)
Requirement already satisfied: language-data>=1.2 in
/usr/local/lib/python3.10/site-packages (from langcodes<4.0.0,>=3.2.0-
>spacy<4->fastai) (1.2.0)
Requirement already satisfied: pydantic-core==2.20.1 in
/usr/local/lib/python3.10/site-packages (from pydantic!=1.8,!
=1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai) (2.20.1)
Requirement already satisfied: annotated-types>=0.4.0 in
/usr/local/lib/python3.10/site-packages (from pydantic!=1.8,!
=1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai) (0.7.0)
Requirement already satisfied: six>=1.5 in
/usr/local/lib/python3.10/site-packages (from python-dateutil>=2.7-
>matplotlib->fastai) (1.16.0)
Requirement already satisfied: confection<1.0.0,>=0.0.1 in
/usr/local/lib/python3.10/site-packages (from thinc<8.4.0,>=8.3.0-
>spacy<4->fastai) (0.1.5)
Requirement already satisfied: blis<1.1.0,>=1.0.0 in
/usr/local/lib/python3.10/site-packages (from thinc<8.4.0,>=8.3.0-
>spacy<4->fastai) (1.0.1)
Requirement already satisfied: click>=8.0.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (8.1.7)
Requirement already satisfied: rich>=10.11.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (13.7.1)
Requirement already satisfied: shellingham>=1.3.0 in

```

/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (1.5.4)
Requirement already satisfied: cloudpathlib<1.0.0,>=0.7.0 in
/usr/local/lib/python3.10/site-packages (from weasel<0.5.0,>=0.1.0-
>spacy<4->fastai) (0.19.0)
Requirement already satisfied: smart-open<8.0.0,>=5.2.1 in
/usr/local/lib/python3.10/site-packages (from weasel<0.5.0,>=0.1.0-
>spacy<4->fastai) (7.0.5)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.10/site-packages (from jinja2->spacy<4->fastai)
(2.1.5)
Requirement already satisfied: marisa-trie>=0.7.7 in
/usr/local/lib/python3.10/site-packages (from language-data>=1.2-
>langcodes<4.0.0,>=3.2.0->spacy<4->fastai) (1.2.1)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai) (2.18.0)
Requirement already satisfied: wrapt in
/usr/local/lib/python3.10/site-packages (from smart-
open<8.0.0,>=5.2.1->weasel<0.5.0,>=0.1.0->spacy<4->fastai) (1.16.0)
Requirement already satisfied: mdurl~=0.1 in
/usr/local/lib/python3.10/site-packages (from markdown-it-py>=2.2.0-
>rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy<4->fastai) (0.1.2)
Installing collected packages: fastai
  Attempting uninstall: fastai
    Found existing installation: fastai 2.7.12
    Uninstalling fastai-2.7.12:
      Successfully uninstalled fastai-2.7.12
  Successfully installed fastai-2.7.17
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv

[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
Requirement already satisfied: torchvision in
/usr/local/lib/python3.10/site-packages (0.14.1+cpu)
Collecting torchvision
  Downloading torchvision-0.19.1-cp310-cp310-manylinux1_x86_64.whl
(7.0 MB)
----- 7.0/7.0 MB 46.9 MB/s eta
0:00:0000:0100:01
ent already satisfied: pillow!=8.3.*,>=5.3.0 in
/usr/local/lib/python3.10/site-packages (from torchvision) (10.4.0)
Collecting torch==2.4.1

```


Downloading torch-2.4.1-cp310-cp310-manylinux1_x86_64.whl (797.1 MB)

797.1/797.1 MB 463.5 kB/s eta

0:00:0000:0100:01

Requirement already satisfied: numpy in /usr/local/lib/python3.10/site-packages (from torchvision) (2.0.2)

Requirement already satisfied: jinja2 in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (3.1.4)

Requirement already satisfied: filelock in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (3.15.4)

Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (10.3.2.106)

Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (12.1.105)

Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (12.1.105)

Collecting nvidia-cudnn-cu12==9.1.0.70

Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-manylinux2014_x86_64.whl (664.8 MB)

664.8/664.8 MB 648.6 kB/s eta

0:00:0000:0100:01

Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (12.1.3.1)

Collecting triton==3.0.0

Downloading triton-3.0.0-1-cp310-cp310-

manylinux2014_x86_64.manylinux_2_17_x86_64.whl (209.4 MB)

209.4/209.4 MB 4.0 MB/s eta

0:00:0000:0100:01

Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (12.1.105)

Requirement already satisfied: nvidia-nccl-cu12==2.20.5 in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (2.20.5)

Requirement already satisfied: sympy in

/usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (1.13.0)

Requirement already satisfied: nvidia-cusparse-cu12==12.1.0.106 in /usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (12.1.0.106)

Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/python3.10/site-packages (from torch==2.4.1->torchvision) (4.12.2)

Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in

```
/usr/local/lib/python3.10/site-packages (from torch==2.4.1-
>torchvision) (11.0.2.54)
Requirement already satisfied: networkx in
/usr/local/lib/python3.10/site-packages (from torch==2.4.1-
>torchvision) (3.3)
Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in
/usr/local/lib/python3.10/site-packages (from torch==2.4.1-
>torchvision) (11.4.5.107)
Requirement already satisfied: fsspec in
/usr/local/lib/python3.10/site-packages (from torch==2.4.1-
>torchvision) (2024.6.1)
Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105
in /usr/local/lib/python3.10/site-packages (from torch==2.4.1-
>torchvision) (12.1.105)
Requirement already satisfied: nvidia-nvjitlink-cu12 in
/usr/local/lib/python3.10/site-packages (from nvidia-cusolver-
cu12==11.4.5.107->torch==2.4.1->torchvision) (12.5.82)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.10/site-packages (from jinja2->torch==2.4.1-
>torchvision) (2.1.5)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in
/usr/local/lib/python3.10/site-packages (from sympy->torch==2.4.1-
>torchvision) (1.3.0)
Installing collected packages: triton, nvidia-cudnn-cu12, torch,
torchvision
  Attempting uninstall: triton
    Found existing installation: triton 2.3.0
    Uninstalling triton-2.3.0:
      Successfully uninstalled triton-2.3.0
  Attempting uninstall: nvidia-cudnn-cu12
    Found existing installation: nvidia-cudnn-cu12 8.9.2.26
    Uninstalling nvidia-cudnn-cu12-8.9.2.26:
      Successfully uninstalled nvidia-cudnn-cu12-8.9.2.26
  Attempting uninstall: torch
    Found existing installation: torch 1.13.1+cpu
    Uninstalling torch-1.13.1+cpu:
      Successfully uninstalled torch-1.13.1+cpu
  Attempting uninstall: torchvision
    Found existing installation: torchvision 0.14.1+cpu
    Uninstalling torchvision-0.14.1+cpu:
      Successfully uninstalled torchvision-0.14.1+cpu
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.
torchaudio 2.3.0 requires torch==2.3.0, but you have torch 2.4.1 which
is incompatible.
accelerate 0.32.1 requires numpy<2.0.0,>=1.17, but you have numpy
2.0.2 which is incompatible.
Successfully installed nvidia-cudnn-cu12-9.1.0.70 torch-2.4.1
```

```
torchvision-0.19.1 triton-3.0.0
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv
```

```
[notice] A new release of pip is available: 23.0.1 -> 24.2
[notice] To update, run: pip install --upgrade pip
```

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

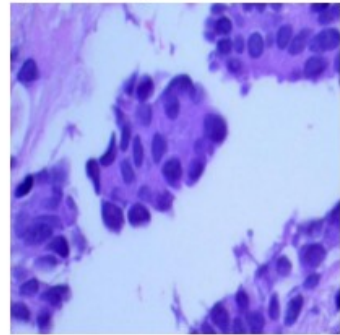
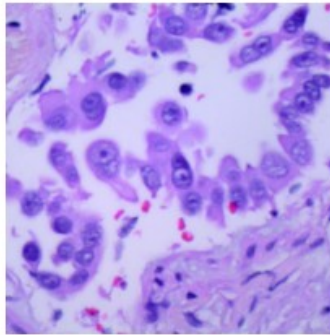
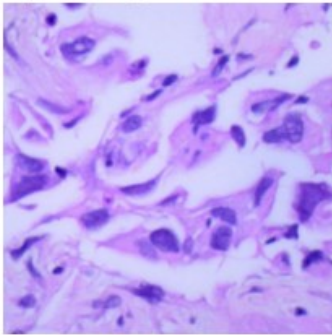
```
<IPython.core.display.HTML object>
```

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

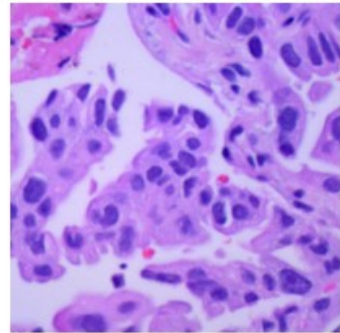
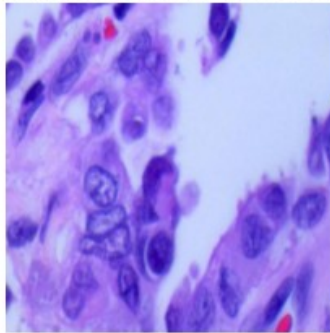
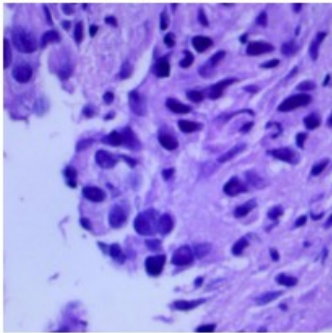
```
<IPython.core.display.HTML object>
```

Prediction/Actual/Loss/Probability

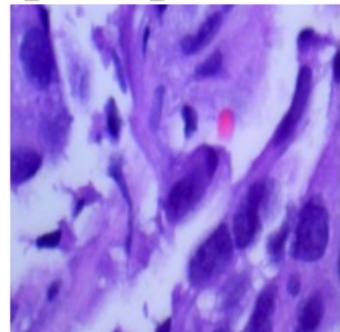
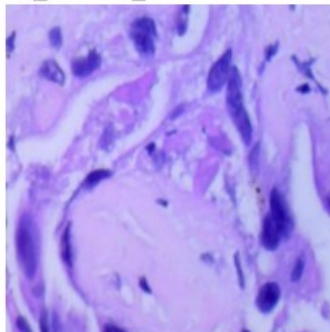
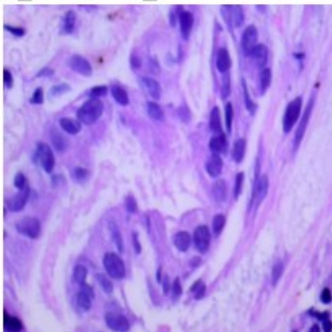
lung_n/lung_aca / 4.31 / 0.89 lung_n/lung_aca / 4.25 / 0.68 lung_scc/lung_aca / 4.19 / 0.58



lung_scc/lung_aca / 4.09 / 0.60 lung_n/lung_aca / 4.08 / 0.90 lung_n/lung_aca / 4.05 / 0.70



lung_scc/lung_aca / 4.02 / 0.85 lung_n/lung_aca / 3.90 / 0.69 lung_scc/lung_aca / 3.90 / 0.53



```
from fastai.vision.all import *  
  
# Assuming you have your data and model defined  
# Example of creating a vision learner (make sure your model is defined)  
learn = vision_learner(data, convnext_tiny,  
                        metrics=[accuracy], # Include accuracy as a  
metric  
                        model_dir='/kaggle/working/models')  
  
# Training the model
```

```

learn.fit_one_cycle(5) # Train for 5 epochs

# Plot losses including the suggestion for learning rate
learn.recorder.plot_losses(suggestion=True)

# Plot accuracy over the epochs
learn.recorder.plot_metrics() # This will plot the metrics including
accuracy

/usr/local/lib/python3.10/site-packages/torchvision/models/
_utils.py:223: UserWarning: Arguments other than a weight enum or
`None` for 'weights' are deprecated since 0.13 and may be removed in
the future. The current behavior is equivalent to passing
`weights=ConvNeXt_Tiny_Weights.IMAGENET1K_V1`. You can also use
`weights=ConvNeXt_Tiny_Weights.DEFAULT` to get the most up-to-date
weights.
  warnings.warn(msg)
Downloading: "https://download.pytorch.org/models/convnext_tiny-
983f1562.pth" to /root/.cache/torch/hub/checkpoints/convnext_tiny-
983f1562.pth
100%|██████████| 109M/109M [00:00<00:00, 225MB/s]

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

Exception ignored in: <function _MultiProcessingDataLoaderIter.__del__
at 0x7ecff21820e0>
Traceback (most recent call last):
  File
"/usr/local/lib/python3.10/site-packages/torch/utils/data/dataloader.p
y", line 1466, in __del__

  File
"/usr/local/lib/python3.10/site-packages/torch/utils/data/dataloader.p
y", line 1424, in _shutdown_workers
    self._worker_result_queue.cancel_join_thread()
AttributeError: '_MultiProcessingDataLoaderIter' object has no
attribute '_workers_status'

-----
-----
AttributeError                                Traceback (most recent call
last)
Cell In[60], line 13
     10 learn.fit_one_cycle(5) # Train for 5 epochs
     12 # Plot losses including the suggestion for learning rate
--> 13 learn.recorder.plot_losses(suggestion=True)
     15 # Plot accuracy over the epochs
     16 learn.recorder.plot_metrics() # This will plot the metrics
including accuracy

```

```
File /usr/local/lib/python3.10/site-packages/fastcore/basics.py:496,
in GetAttr.__getattr__(self, k)
    494 if self._component_attr_filter(k):
    495     attr = getattr(self,self._default,None)
--> 496     if attr is not None: return getattr(attr,k)
    497 raise AttributeError(k)
```

```
File /usr/local/lib/python3.10/site-packages/fastcore/basics.py:496,
in GetAttr.__getattr__(self, k)
    494 if self._component_attr_filter(k):
    495     attr = getattr(self,self._default,None)
--> 496     if attr is not None: return getattr(attr,k)
    497 raise AttributeError(k)
```

```
File
/usr/local/lib/python3.10/site-packages/torch/nn/modules/module.py:126
9, in __getattr__(self, name)
    1249 def register_full_backward_hook(
    1250     self,
    1251     hook: Callable[["Module", _grad_t, _grad_t], Union[None,
_grad_t]],
    1252     prepend: bool = False,
    1253 ) -> RemovableHandle:
    1254     r"""Register a backward hook on the module.
    1255
    1256     The hook will be called every time the gradients with
respect to a module
    1257     are computed, i.e. the hook will execute if and only if
the gradients with
    1258     respect to module outputs are computed. The hook should
have the following
    1259     signature::
    1260
    1261         hook(module, grad_input, grad_output) -> tuple(Tensor)
or None
    1262
    1263     The :attr:`grad_input` and :attr:`grad_output` are tuples
that contain the gradients
    1264     with respect to the inputs and outputs respectively. The
hook should
    1265     not modify its arguments, but it can optionally return a
new gradient with
    1266     respect to the input that will be used in place
of :attr:`grad_input` in
    1267     subsequent computations. :attr:`grad_input` will only
correspond to the inputs given
    1268     as positional arguments and all kwarg arguments are
ignored. Entries
-> 1269     in :attr:`grad_input` and :attr:`grad_output` will be
```

```

1270     ``None`` for all non-Tensor
1271         arguments.
1272     For technical reasons, when this hook is applied to a
Module, its forward function will
1273     receive a view of each Tensor passed to the Module.
Similarly the caller will receive a view
1274     of each Tensor returned by the Module's forward function.
1275
1276     .. warning ::
1277         Modifying inputs or outputs inplace is not allowed
when using backward hooks and
1278         will raise an error.
1279
1280     Args:
1281         hook (Callable): The user-defined hook to be
registered.
1282         prepend (bool): If true, the provided ``hook`` will be
fired before
1283             all existing ``backward`` hooks on this
1284             :class:`torch.nn.modules.Module`. Otherwise, the
provided
1285             ``hook`` will be fired after all existing
``backward`` hooks on
1286             this :class:`torch.nn.modules.Module`. Note that
global
1287             ``backward`` hooks registered with
1288             :func:`register_module_full_backward_hook` will
fire before
1289             all hooks registered by this method.
1290
1291     Returns:
1292         :class:`torch.utils.hooks.RemovableHandle`:
1293         a handle that can be used to remove the added hook
by calling
1294         ``handle.remove()``
1295
1296     """
1297     if self._is_full_backward_hook is False:
1298         raise RuntimeError("Cannot use both regular backward
hooks and full backward hooks on a "
1299                             "single Module. Please use only one
of them.")
AttributeError: 'Sequential' object has no attribute 'plot_losses'
from fastcore.all import *
learn.recorder.plot_metrics()

```

```

-----
-----
AttributeError                                Traceback (most recent call
last)
Cell In[61], line 2
      1 from fastcore.all import *
----> 2 learn.recorder.plot_metrics()

File /usr/local/lib/python3.10/site-packages/fastcore/basics.py:496,
in GetAttr.__getattr__(self, k)
    494 if self._component_attr_filter(k):
    495     attr = getattr(self,self._default,None)
--> 496     if attr is not None: return getattr(attr,k)
    497 raise AttributeError(k)

File /usr/local/lib/python3.10/site-packages/fastcore/basics.py:496,
in GetAttr.__getattr__(self, k)
    494 if self._component_attr_filter(k):
    495     attr = getattr(self,self._default,None)
--> 496     if attr is not None: return getattr(attr,k)
    497 raise AttributeError(k)

File
/usr/local/lib/python3.10/site-packages/torch/nn/modules/module.py:126
9, in __getattr__(self, name)
    1249 def register_full_backward_hook(
    1250     self,
    1251     hook: Callable[["Module", _grad_t, _grad_t], Union[None,
_grad_t]],
    1252     prepend: bool = False,
    1253 ) -> RemovableHandle:
    1254     r"""Register a backward hook on the module.
    1255
    1256     The hook will be called every time the gradients with
respect to a module
    1257     are computed, i.e. the hook will execute if and only if
the gradients with
    1258     respect to module outputs are computed. The hook should
have the following
    1259     signature::
    1260
    1261         hook(module, grad_input, grad_output) -> tuple(Tensor)
or None
    1262
    1263     The :attr:`grad_input` and :attr:`grad_output` are tuples
that contain the gradients
    1264     with respect to the inputs and outputs respectively. The
hook should
    1265     not modify its arguments, but it can optionally return a
new gradient with

```



```

1266     respect to the input that will be used in place
of :attr:`grad_input` in
1267     subsequent computations. :attr:`grad_input` will only
correspond to the inputs given
1268     as positional arguments and all kwarg arguments are
ignored. Entries
-> 1269     in :attr:`grad_input` and :attr:`grad_output` will be
``None`` for all non-Tensor
1270     arguments.
1271
1272     For technical reasons, when this hook is applied to a
Module, its forward function will
1273     receive a view of each Tensor passed to the Module.
Similarly the caller will receive a view
1274     of each Tensor returned by the Module's forward function.
1275
1276     .. warning ::
1277         Modifying inputs or outputs inplace is not allowed
when using backward hooks and
1278         will raise an error.
1279
1280     Args:
1281         hook (Callable): The user-defined hook to be
registered.
1282         prepend (bool): If true, the provided ``hook`` will be
fired before
1283             all existing ``backward`` hooks on this
1284             :class:`torch.nn.modules.Module`. Otherwise, the
provided
1285             ``hook`` will be fired after all existing
``backward`` hooks on
1286             this :class:`torch.nn.modules.Module`. Note that
global
1287             ``backward`` hooks registered with
1288             :func:`register_module_full_backward_hook` will
fire before
1289             all hooks registered by this method.
1290
1291     Returns:
1292         :class:`torch.utils.hooks.RemovableHandle`:
1293         a handle that can be used to remove the added hook
by calling
1294         ``handle.remove()``
1295
1296     """
1297     if self._is_full_backward_hook is False:
1298         raise RuntimeError("Cannot use both regular backward
hooks and full backward hooks on a "
1299                             "single Module. Please use only one
of them.")

```

AttributeError: 'Sequential' object has no attribute 'plot_metrics'

```
import fastai
print(fastai.__version__)
print(dir(learn.recorder))
```

2.7.12

```
['__destination__', '__call__', '__class__', '__delattr__', '__dict__',
 '__dir__', '__doc__', '__eq__', '__format__', '__ge__', '__getattr__',
 '__getattribute__', '__getstate__', '__gt__', '__hash__', '__init__',
 '__init_subclass__', '__le__', '__lt__', '__module__', '__ne__',
 '__new__', '__reduce__', '__reduce_ex__', '__repr__', '__setattr__',
 '__setstate__', '__sizeof__', '__stored_args__', '__str__',
 '__subclasshook__', '__weakref__', 'apply', 'backward',
 'backward_hooks', 'bn_bias_state', 'buffers', 'call_impl',
 'call_one', 'component_attr_filter', 'component_attr_filter',
 'default', 'default', 'dir', 'dir', 'do_epoch',
 'do_epoch_train', 'do_epoch_validate', 'do_fit', 'do_grad_opt',
 'do_one_batch', 'end_cleanup', 'forward_hooks',
 'forward_pre_hooks', 'get_backward_hooks', 'get_item_by_idx',
 'get_name', 'grab_cbs', 'init_state', 'is_full_backward_hook',
 'load_from_state_dict', 'load_state_dict_post_hooks',
 'load_state_dict_pre_hooks', 'maybe_warn_non_full_backward_hook',
 'methods', 'metrics', 'modules', 'named_members',
 'non_persistent_buffers_set', 'parameters',
 'register_load_state_dict_pre_hook', 'register_state_dict_hook',
 'replicate_for_data_parallel', 'save_to_state_dict', 'set_device',
 'slow_forward', 'split', 'state_dict_hooks', 'stateattrs',
 'step', 'train_mets', 'valid_mets', 'version', 'with_events',
 'add_cb', 'add_cbs', 'add_module', 'add_time', 'added_cbs',
 'after_batch', 'after_cancel_train', 'after_cancel_validate',
 'after_epoch', 'after_train', 'after_validate', 'all_batches',
 'append', 'apply', 'arch', 'before_epoch', 'before_fit',
 'before_train', 'before_validate', 'bfloat16', 'buffers',
 'cancel_train', 'cancel_valid', 'cast_to_tensor', 'cbs', 'children',
 'cpu', 'create_mbar', 'create_opt', 'cuda', 'default_cbs', 'dl',
 'dls', 'double', 'dump_patches', 'epoch', 'eval', 'export', 'extend',
 'extra_repr', 'final_record', 'fine_tune', 'fit', 'fit_flat_cos',
 'fit_one_cycle', 'fit_sgdr', 'float', 'forward', 'freeze',
 'freeze_to', 'get_buffer', 'get_extra_state', 'get_parameter',
 'get_preds', 'get_submodule', 'half', 'hps', 'insert', 'ipu', 'iter',
 'iters', 'learn', 'load', 'load_state_dict', 'lock', 'log', 'logger',
 'loss', 'loss', 'loss_func', 'loss_grad', 'loss_not_reduced',
 'losses', 'lr', 'lr_find', 'lrs', 'metric_names', 'metrics', 'model',
 'model_dir', 'modules', 'moms', 'n_epoch', 'n_iter', 'n_out', 'name',
 'named_buffers', 'named_children', 'named_modules',
 'named_parameters', 'no_bar', 'no_logging', 'no_mbar', 'normalize',
 'one_batch', 'opt', 'opt_func', 'order', 'ordered_cbs', 'parameters',
 'path', 'pct_train', 'plot_loss', 'plot_lr_find', 'plot_sched', 'pop',
```

```
'pred', 'predict', 'pretrained', 'progress', 'recorder',
'register_backward_hook', 'register_buffer', 'register_forward_hook',
'register_forward_pre_hook', 'register_full_backward_hook',
'register_load_state_dict_post_hook', 'register_module',
'register_parameter', 'remove_cb', 'remove_cbs', 'remove_on_fetch',
'removed_cbs', 'requires_grad_', 'run', 'run_train', 'run_valid',
'save', 'set_extra_state', 'share_memory', 'show_results',
'show_training_loop', 'smooth_loss', 'smooth_loss', 'splitter',
'start_epoch', 'state_dict', 'summary', 'to', 'to_channelslast',
'to_contiguous', 'to_detach', 'to_empty', 'to_fp16', 'to_fp32',
'to_non_native_fp16', 'to_non_native_fp32', 'train', 'train_bn',
'train_eval', 'train_iter', 'train_metrics', 'training', 'training',
'tta', 'type', 'unfreeze', 'valid_metrics', 'validate',
'validation_context', 'values', 'wd', 'wd_bn_bias', 'x', 'xb', 'xpu',
'y', 'yb', 'zero_grad']
```

```
learn.recorder.plot_loss()
!pip install --upgrade fastai
```

```
Requirement already satisfied: fastai in
/usr/local/lib/python3.10/site-packages (2.7.17)
Requirement already satisfied: fastcore<1.8,>=1.5.29 in
/usr/local/lib/python3.10/site-packages (from fastai) (1.5.29)
Requirement already satisfied: pandas in
/usr/local/lib/python3.10/site-packages (from fastai) (2.2.2)
Requirement already satisfied: pyyaml in
/usr/local/lib/python3.10/site-packages (from fastai) (6.0.1)
Requirement already satisfied: fastprogress>=0.2.4 in
/usr/local/lib/python3.10/site-packages (from fastai) (1.0.3)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.10/site-packages (from fastai) (3.9.1)
Requirement already satisfied: scikit-learn in
/usr/local/lib/python3.10/site-packages (from fastai) (1.5.1)
Requirement already satisfied: spacy<4 in
/usr/local/lib/python3.10/site-packages (from fastai) (3.8.2)
Requirement already satisfied: fastdownload<2,>=0.0.5 in
/usr/local/lib/python3.10/site-packages (from fastai) (0.0.7)
Requirement already satisfied: torchvision>=0.11 in
/usr/local/lib/python3.10/site-packages (from fastai) (0.19.1)
Requirement already satisfied: torch<2.5,>=1.10 in
/usr/local/lib/python3.10/site-packages (from fastai) (2.4.1)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/site-packages (from fastai) (24.1)
Requirement already satisfied: requests in
/usr/local/lib/python3.10/site-packages (from fastai) (2.32.3)
Requirement already satisfied: scipy in
/usr/local/lib/python3.10/site-packages (from fastai) (1.14.0)
Requirement already satisfied: pillow>=9.0.0 in
/usr/local/lib/python3.10/site-packages (from fastai) (10.4.0)
Requirement already satisfied: pip in /usr/local/lib/python3.10/site-
```

packages (from fastai) (23.0.1)
Requirement already satisfied: numpy>=1.19.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.0.2)
Requirement already satisfied: weasel<0.5.0,>=0.1.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (0.4.1)
Requirement already satisfied: langcodes<4.0.0,>=3.2.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.4.1)
Requirement already satisfied: tqdm<5.0.0,>=4.38.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(4.66.4)
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.0.8)
Requirement already satisfied: wasabi<1.2.0,>=0.9.1 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (1.1.3)
Requirement already satisfied: srsly<3.0.0,>=2.4.3 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.4.8)
Requirement already satisfied: thinc<8.4.0,>=8.3.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (8.3.2)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.0.9)
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(1.0.10)
Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(2.0.10)
Requirement already satisfied: typer<1.0.0,>=0.3.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(0.12.5)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.11 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(3.0.12)
Requirement already satisfied: pydantic!=1.8,!1.8.1,<3.0.0,>=1.7.4 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (2.8.2)
Requirement already satisfied: setuptools in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai)
(65.5.1)
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (1.0.5)
Requirement already satisfied: jinja2 in
/usr/local/lib/python3.10/site-packages (from spacy<4->fastai) (3.1.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)
(2.2.2)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)
(2024.7.4)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/site-packages (from requests->fastai)

(3.3.2)

Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/site-packages (from requests->fastai) (3.7)

Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105
in /usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (12.1.105)

Requirement already satisfied: networkx in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (3.3)

Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (12.1.105)

Requirement already satisfied: typing-extensions>=4.8.0 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (4.12.2)

Requirement already satisfied: nvidia-nccl-cu12==2.20.5 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (2.20.5)

Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (10.3.2.106)

Requirement already satisfied: filelock in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (3.15.4)

Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (12.1.105)

Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (11.4.5.107)

Requirement already satisfied: triton==3.0.0 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (3.0.0)

Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (12.1.3.1)

Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (11.0.2.54)

Requirement already satisfied: fsspec in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (2024.6.1)

Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (12.1.105)

Requirement already satisfied: sympy in
/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10-
>fastai) (1.13.0)

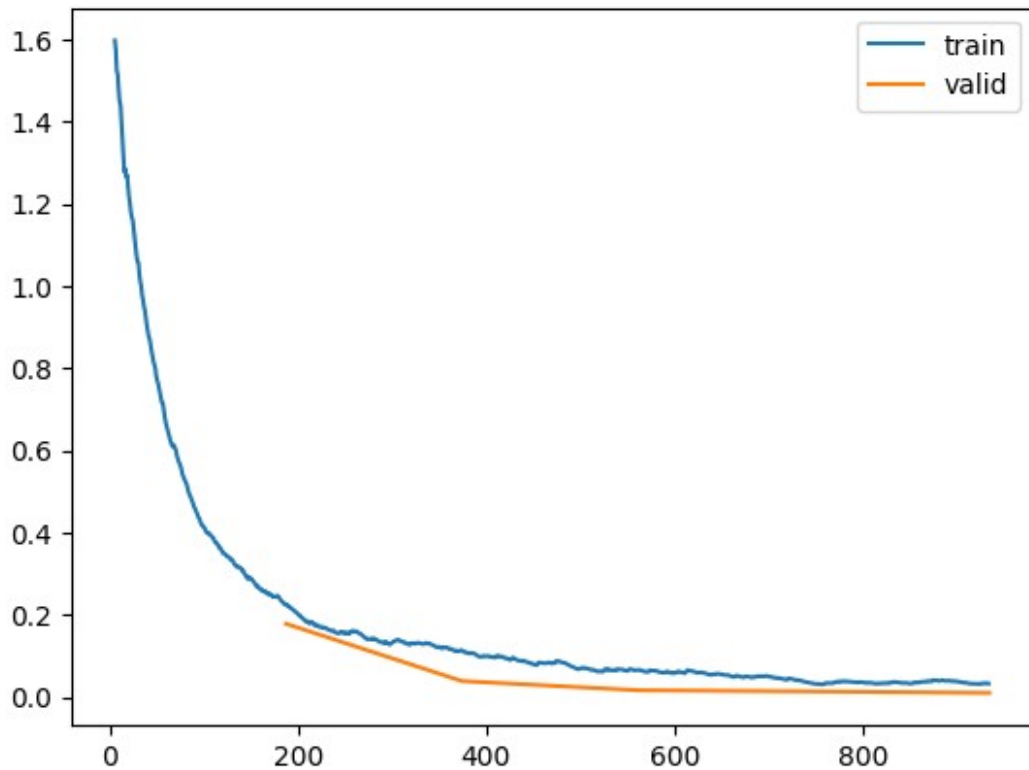
Requirement already satisfied: nvidia-cuspars-cu12==12.1.0.106 in

/usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10->fastai) (12.1.0.106)
Requirement already satisfied: nvidia-cudnn-cu12==9.1.0.70 in /usr/local/lib/python3.10/site-packages (from torch<2.5,>=1.10->fastai) (9.1.0.70)
Requirement already satisfied: nvidia-nvjitlink-cu12 in /usr/local/lib/python3.10/site-packages (from nvidia-cusolver-cu12==11.4.5.107->torch<2.5,>=1.10->fastai) (12.5.82)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (3.1.2)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (4.53.1)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (1.4.5)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (1.2.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (0.12.1)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/site-packages (from matplotlib->fastai) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/site-packages (from pandas->fastai) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/site-packages (from pandas->fastai) (2024.1)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.10/site-packages (from scikit-learn->fastai) (3.5.0)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.10/site-packages (from scikit-learn->fastai) (1.4.2)
Requirement already satisfied: language-data>=1.2 in /usr/local/lib/python3.10/site-packages (from langcodes<4.0.0,>=3.2.0->spacy<4->fastai) (1.2.0)
Requirement already satisfied: pydantic-core==2.20.1 in /usr/local/lib/python3.10/site-packages (from pydantic!=1.8,! =1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai) (2.20.1)
Requirement already satisfied: annotated-types>=0.4.0 in /usr/local/lib/python3.10/site-packages (from pydantic!=1.8,! =1.8.1,<3.0.0,>=1.7.4->spacy<4->fastai) (0.7.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/site-packages (from python-dateutil>=2.7->matplotlib->fastai) (1.16.0)
Requirement already satisfied: blis<1.1.0,>=1.0.0 in

```
/usr/local/lib/python3.10/site-packages (from thinc<8.4.0,>=8.3.0-
>spacy<4->fastai) (1.0.1)
Requirement already satisfied: confection<1.0.0,>=0.0.1 in
/usr/local/lib/python3.10/site-packages (from thinc<8.4.0,>=8.3.0-
>spacy<4->fastai) (0.1.5)
Requirement already satisfied: shellingham>=1.3.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (1.5.4)
Requirement already satisfied: click>=8.0.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (8.1.7)
Requirement already satisfied: rich>=10.11.0 in
/usr/local/lib/python3.10/site-packages (from typer<1.0.0,>=0.3.0-
>spacy<4->fastai) (13.7.1)
Requirement already satisfied: smart-open<8.0.0,>=5.2.1 in
/usr/local/lib/python3.10/site-packages (from weasel<0.5.0,>=0.1.0-
>spacy<4->fastai) (7.0.5)
Requirement already satisfied: cloudpathlib<1.0.0,>=0.7.0 in
/usr/local/lib/python3.10/site-packages (from weasel<0.5.0,>=0.1.0-
>spacy<4->fastai) (0.19.0)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.10/site-packages (from jinja2->spacy<4->fastai)
(2.1.5)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in
/usr/local/lib/python3.10/site-packages (from sympy->torch<2.5,>=1.10-
>fastai) (1.3.0)
Requirement already satisfied: marisa-trie>=0.7.7 in
/usr/local/lib/python3.10/site-packages (from language-data>=1.2-
>langcodes<4.0.0,>=3.2.0->spacy<4->fastai) (1.2.1)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai) (2.18.0)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.10/site-packages (from rich>=10.11.0-
>typer<1.0.0,>=0.3.0->spacy<4->fastai) (3.0.0)
Requirement already satisfied: wrapt in
/usr/local/lib/python3.10/site-packages (from smart-
open<8.0.0,>=5.2.1->weasel<0.5.0,>=0.1.0->spacy<4->fastai) (1.16.0)
Requirement already satisfied: mdurl~=0.1 in
/usr/local/lib/python3.10/site-packages (from markdown-it-py>=2.2.0-
>rich>=10.11.0->typer<1.0.0,>=0.3.0->spacy<4->fastai) (0.1.2)
WARNING: Running pip as the 'root' user can result in broken
permissions and conflicting behaviour with the system package manager.
It is recommended to use a virtual environment instead:
https://pip.pypa.io/warnings/venv
```

[notice] A new release of pip is available: 23.0.1 -> 24.2

[notice] To update, run: pip install --upgrade pip



```
def calculate_train_metric():  
    # Replace this with your actual metric calculation logic  
    # Example: return the mean of some loss values  
    return np.random.rand() # Placeholder for actual metric  
    calculation  
  
import numpy as np # Make sure to import numpy if you're using it  
  
# Initialize a list to store training metrics  
training_metrics = []  
  
def calculate_train_metric():  
    # Replace this with your actual metric calculation logic  
    # Example: return the mean of some loss values  
    return np.random.rand() # Placeholder for actual metric  
    calculation  
  
for epoch in range(5):  
    # Your training loop here  
    train_metric = calculate_train_metric() # Call the function to  
    get the metric  
    training_metrics.append(train_metric) # Append the metric to the  
    list  
  
print(training_metrics) # Print the collected metrics
```



```
[0.06960452785777205, 0.8378583699550395, 0.7626845642302271,  
0.8479715913437157, 0.48330040130034657]
```

```
import os  
import tensorflow as tf  
  
checkpoint_path = "training_4/cp.weights.h5"  
checkpoint_dir = os.path.dirname(checkpoint_path)  
  
cp_callback = tf.keras.callbacks.ModelCheckpoint(  
    filepath=checkpoint_path,  
    save_weights_only=True,  
    verbose=1  
)
```

```
import fastai  
print(fastai.__version__)
```

```
2.7.12
```

```
from fastai.interpret import Interpretation  
  
# Create an interpretation object  
interp = Interpretation.from_learner(learn)  
  
# Plot the top losses  
interp.plot_top_losses(k=9, figsize=(15, 10), nrows=3)  
  
# If you want to plot the confusion matrix  
interp.plot_confusion_matrix(figsize=(8, 8), dpi=60)
```

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

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

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

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

```
-----  
-----
```

```
AttributeError                                Traceback (most recent call  
last)
```

```
Cell In[72], line 10
```

```
      7 interp.plot_top_losses(k=9, figsize=(15, 10), nrows=3)
```

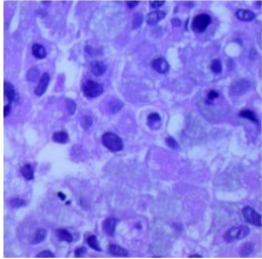
```
      9 # If you want to plot the confusion matrix
```

```
--> 10 interp.plot_confusion_matrix(figsize=(8, 8), dpi=60)
```

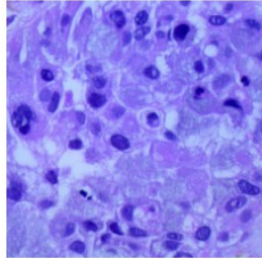
```
AttributeError: 'Interpretation' object has no attribute  
'plot_confusion_matrix'
```

Prediction/Actual/Loss/Probability

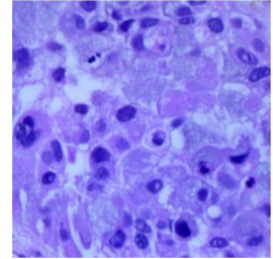
lung_scc/lung_aca / 2.61 / 0.93



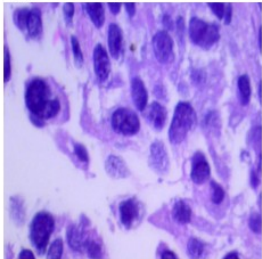
lung_scc/lung_aca / 2.28 / 0.90



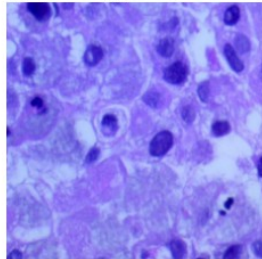
lung_scc/lung_aca / 1.71 / 0.82



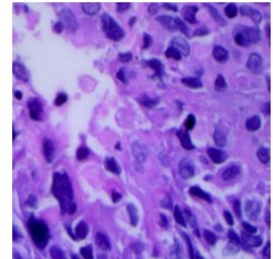
lung_scc/lung_aca / 1.31 / 0.73



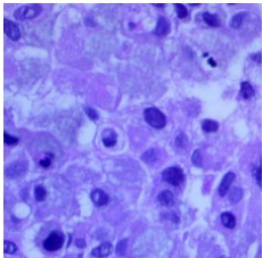
lung_scc/lung_aca / 1.20 / 0.70



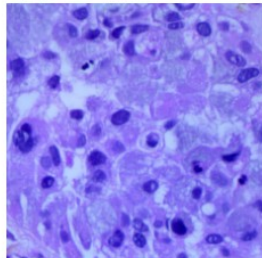
lung_aca/lung_scc / 1.10 / 0.67



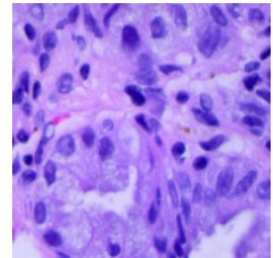
lung_scc/lung_aca / 1.09 / 0.66



lung_scc/lung_aca / 1.05 / 0.65



lung_scc/lung_aca / 0.95 / 0.61



```
from keras.utils import plot_model
# plot_model(learn.model, to_file='model.png', show_shapes=True,
# show_layer_names=True)
# Print the model architecture
print(learn.model)

Sequential(
  (0): Sequential(
    (0): Sequential(
      (0): Conv2dNormActivation(
        (0): Conv2d(3, 96, kernel_size=(4, 4), stride=(4, 4))
        (1): LayerNorm2d((96,), eps=1e-06, elementwise_affine=True)
      )
      (1): Sequential(
        (0): CNBlock(
          (block): Sequential(
            (0): Conv2d(96, 96, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=96)
            (1): Permute()
```

```

        (2): LayerNorm((96,), eps=1e-06, elementwise_affine=True)
        (3): Linear(in_features=96, out_features=384, bias=True)
        (4): GELU(approximate='none')
        (5): Linear(in_features=384, out_features=96, bias=True)
        (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.0, mode=row)
)
(1): CNBlock(
  (block): Sequential(
    (0): Conv2d(96, 96, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=96)
    (1): Permute()
    (2): LayerNorm((96,), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=96, out_features=384, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=384, out_features=96, bias=True)
    (6): Permute()
  )
  (stochastic_depth): StochasticDepth(p=0.0058823529411764705,
mode=row)
)
(2): CNBlock(
  (block): Sequential(
    (0): Conv2d(96, 96, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=96)
    (1): Permute()
    (2): LayerNorm((96,), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=96, out_features=384, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=384, out_features=96, bias=True)
    (6): Permute()
  )
  (stochastic_depth): StochasticDepth(p=0.011764705882352941,
mode=row)
)
)
(2): Sequential(
  (0): LayerNorm2d((96,), eps=1e-06, elementwise_affine=True)
  (1): Conv2d(96, 192, kernel_size=(2, 2), stride=(2, 2))
)
(3): Sequential(
  (0): CNBlock(
    (block): Sequential(
      (0): Conv2d(192, 192, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=192)
      (1): Permute()
      (2): LayerNorm((192,), eps=1e-06, elementwise_affine=True)
      (3): Linear(in_features=192, out_features=768, bias=True)

```

```

        (4): GELU(approximate='none')
        (5): Linear(in_features=768, out_features=192, bias=True)
        (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.017647058823529415,
mode=row)
    )
    (1): CNBlock(
        (block): Sequential(
            (0): Conv2d(192, 192, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=192)
            (1): Permute()
            (2): LayerNorm((192,)), eps=1e-06, elementwise_affine=True)
            (3): Linear(in_features=192, out_features=768, bias=True)
            (4): GELU(approximate='none')
            (5): Linear(in_features=768, out_features=192, bias=True)
            (6): Permute()
        )
        (stochastic_depth): StochasticDepth(p=0.023529411764705882,
mode=row)
    )
    (2): CNBlock(
        (block): Sequential(
            (0): Conv2d(192, 192, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=192)
            (1): Permute()
            (2): LayerNorm((192,)), eps=1e-06, elementwise_affine=True)
            (3): Linear(in_features=192, out_features=768, bias=True)
            (4): GELU(approximate='none')
            (5): Linear(in_features=768, out_features=192, bias=True)
            (6): Permute()
        )
        (stochastic_depth): StochasticDepth(p=0.029411764705882353,
mode=row)
    )
    )
    (4): Sequential(
        (0): LayerNorm2d((192,)), eps=1e-06, elementwise_affine=True)
        (1): Conv2d(192, 384, kernel_size=(2, 2), stride=(2, 2))
    )
    (5): Sequential(
        (0): CNBlock(
            (block): Sequential(
                (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
                (1): Permute()
                (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
                (3): Linear(in_features=384, out_features=1536, bias=True)
                (4): GELU(approximate='none')
            )
        )
    )

```

```

        (5): Linear(in_features=1536, out_features=384, bias=True)
        (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.03529411764705883,
mode=row)
    )
    (1): CNBlock(
        (block): Sequential(
            (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
            (1): Permute()
            (2): LayerNorm((384,), eps=1e-06, elementwise_affine=True)
            (3): Linear(in_features=384, out_features=1536, bias=True)
            (4): GELU(approximate='none')
            (5): Linear(in_features=1536, out_features=384, bias=True)
            (6): Permute()
        )
        (stochastic_depth): StochasticDepth(p=0.0411764705882353,
mode=row)
    )
    (2): CNBlock(
        (block): Sequential(
            (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
            (1): Permute()
            (2): LayerNorm((384,), eps=1e-06, elementwise_affine=True)
            (3): Linear(in_features=384, out_features=1536, bias=True)
            (4): GELU(approximate='none')
            (5): Linear(in_features=1536, out_features=384, bias=True)
            (6): Permute()
        )
        (stochastic_depth): StochasticDepth(p=0.047058823529411764,
mode=row)
    )
    (3): CNBlock(
        (block): Sequential(
            (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
            (1): Permute()
            (2): LayerNorm((384,), eps=1e-06, elementwise_affine=True)
            (3): Linear(in_features=384, out_features=1536, bias=True)
            (4): GELU(approximate='none')
            (5): Linear(in_features=1536, out_features=384, bias=True)
            (6): Permute()
        )
        (stochastic_depth): StochasticDepth(p=0.052941176470588235,
mode=row)
    )
    (4): CNBlock(

```

```

        (block): Sequential(
          (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
          (1): Permute()
          (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
          (3): Linear(in_features=384, out_features=1536, bias=True)
          (4): GELU(approximate='none')
          (5): Linear(in_features=1536, out_features=384, bias=True)
          (6): Permute()
        )
      (stochastic_depth): StochasticDepth(p=0.058823529411764705,
mode=row)
    )
    (5): CNBlock(
      (block): Sequential(
        (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
        (1): Permute()
        (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
        (3): Linear(in_features=384, out_features=1536, bias=True)
        (4): GELU(approximate='none')
        (5): Linear(in_features=1536, out_features=384, bias=True)
        (6): Permute()
      )
      (stochastic_depth): StochasticDepth(p=0.06470588235294118,
mode=row)
    )
    (6): CNBlock(
      (block): Sequential(
        (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
        (1): Permute()
        (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
        (3): Linear(in_features=384, out_features=1536, bias=True)
        (4): GELU(approximate='none')
        (5): Linear(in_features=1536, out_features=384, bias=True)
        (6): Permute()
      )
      (stochastic_depth): StochasticDepth(p=0.07058823529411766,
mode=row)
    )
    (7): CNBlock(
      (block): Sequential(
        (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
        (1): Permute()
        (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
        (3): Linear(in_features=384, out_features=1536, bias=True)
        (4): GELU(approximate='none')

```

```

        (5): Linear(in_features=1536, out_features=384, bias=True)
        (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.07647058823529412,
mode=row)
    )
    (8): CNBlock(
    (block): Sequential(
    (0): Conv2d(384, 384, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=384)
    (1): Permute()
    (2): LayerNorm((384,)), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=384, out_features=1536, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=1536, out_features=384, bias=True)
    (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.0823529411764706,
mode=row)
    )
    )
    (6): Sequential(
    (0): LayerNorm2d((384,)), eps=1e-06, elementwise_affine=True)
    (1): Conv2d(384, 768, kernel_size=(2, 2), stride=(2, 2))
    )
    (7): Sequential(
    (0): CNBlock(
    (block): Sequential(
    (0): Conv2d(768, 768, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=768)
    (1): Permute()
    (2): LayerNorm((768,)), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=768, out_features=3072, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=3072, out_features=768, bias=True)
    (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.08823529411764706,
mode=row)
    )
    (1): CNBlock(
    (block): Sequential(
    (0): Conv2d(768, 768, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=768)
    (1): Permute()
    (2): LayerNorm((768,)), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=768, out_features=3072, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=3072, out_features=768, bias=True)

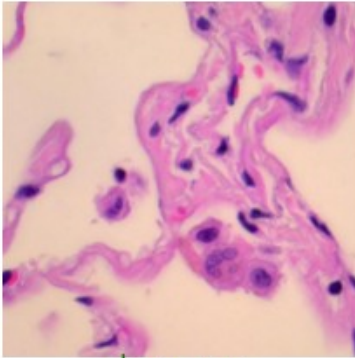
```

```

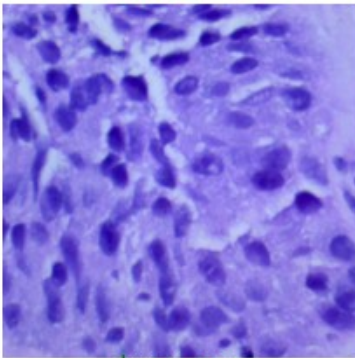
        (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.09411764705882353,
mode=row)
    )
    (2): CNBlock(
    (block): Sequential(
    (0): Conv2d(768, 768, kernel_size=(7, 7), stride=(1, 1),
padding=(3, 3), groups=768)
    (1): Permute()
    (2): LayerNorm((768,)), eps=1e-06, elementwise_affine=True)
    (3): Linear(in_features=768, out_features=3072, bias=True)
    (4): GELU(approximate='none')
    (5): Linear(in_features=3072, out_features=768, bias=True)
    (6): Permute()
    )
    (stochastic_depth): StochasticDepth(p=0.1, mode=row)
    )
    )
    )
    (1): Sequential(
    (0): AdaptiveConcatPool2d(
    (ap): AdaptiveAvgPool2d(output_size=1)
    (mp): AdaptiveMaxPool2d(output_size=1)
    )
    (1): fastai.layers.Flatten(full=False)
    (2): BatchNorm1d(1536, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
    (3): Dropout(p=0.25, inplace=False)
    (4): Linear(in_features=1536, out_features=512, bias=False)
    (5): ReLU(inplace=True)
    (6): BatchNorm1d(512, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
    (7): Dropout(p=0.5, inplace=False)
    (8): Linear(in_features=512, out_features=3, bias=False)
    )
    )
learn.unfreeze()
learn.show_results()
<IPython.core.display.HTML object>
<IPython.core.display.HTML object>

```

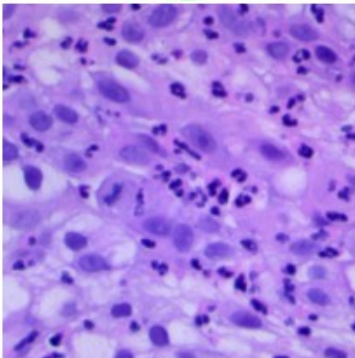

lung_n
lung_n



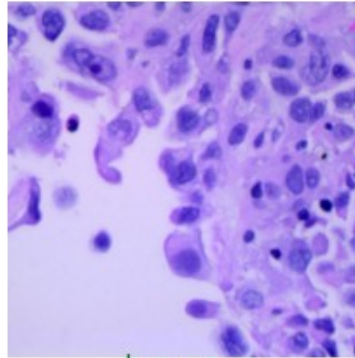
lung_scc
lung_scc



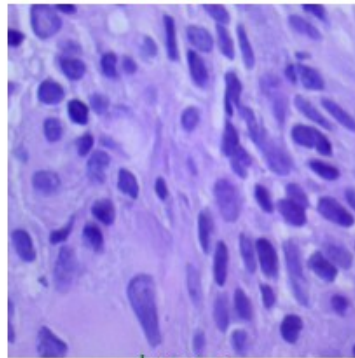
lung_scc
lung_scc



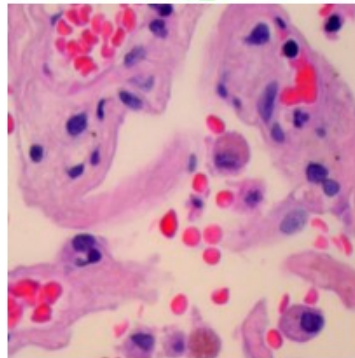
lung_aca
lung_aca



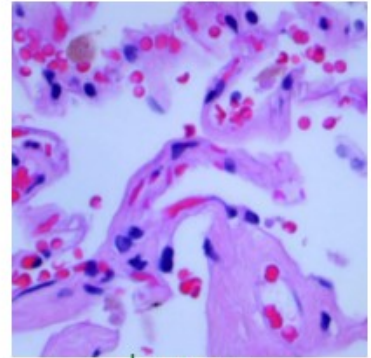
lung_scc
lung_scc



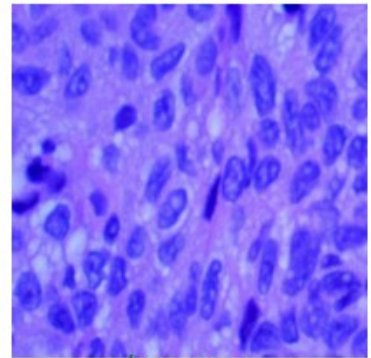
lung_n
lung_n



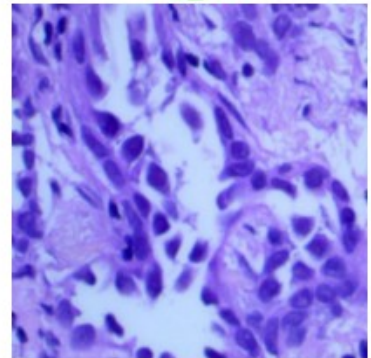
lung_n
lung_n



lung_scc
lung_scc



lung_aca
lung_aca



```
import os
import tensorflow as tf

checkpoint_path = "training_5/cp.weights.h5"
checkpoint_dir = os.path.dirname(checkpoint_path)

cp_callback = tf.keras.callbacks.ModelCheckpoint(
    filepath=checkpoint_path,
```

```

    save_weights_only=True,
    verbose=1
)

from fastai.vision.all import *
learn = vision_learner(data, convnext_tiny, metrics=[accuracy,
error_rate], model_dir='/kaggle/working/models')

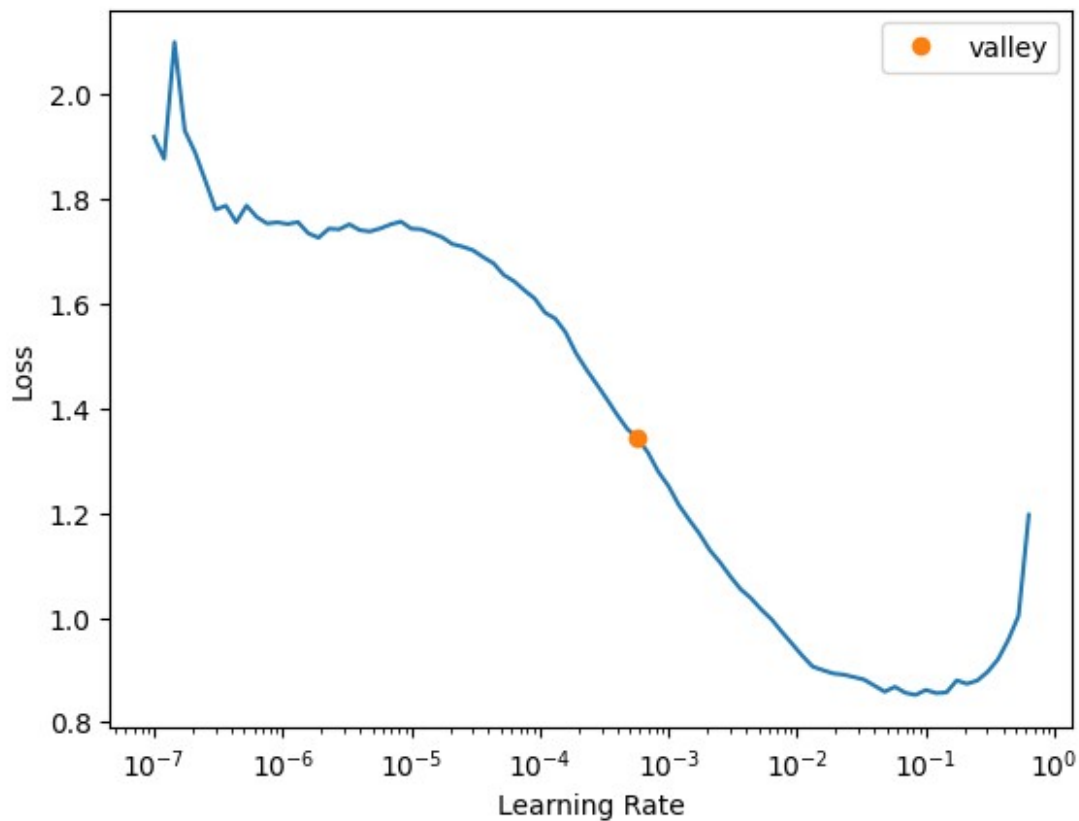
# Find the learning rate
learn.lr_find()

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

SuggestedLRs(valley=0.0005754399462603033)

```



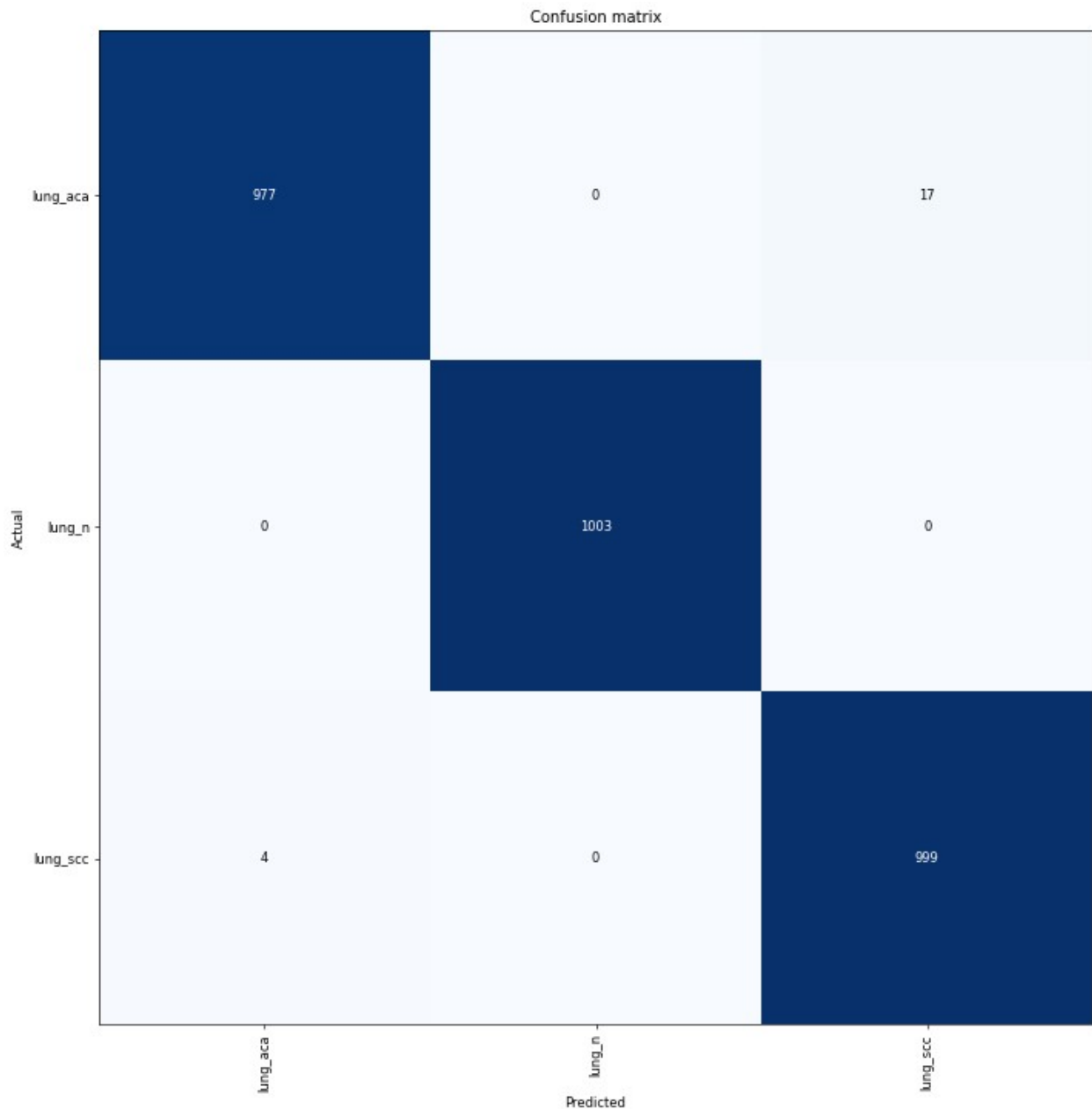
```

interp=ClassificationInterpretation.from_learner(learn)
interp.plot_confusion_matrix(figsize=(12,12), dpi=60)

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

```



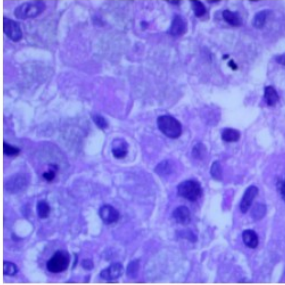
```
# pip install --upgrade fastai matplotlib
interp.plot_top_losses(9, figsize=(15, 11))
```

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

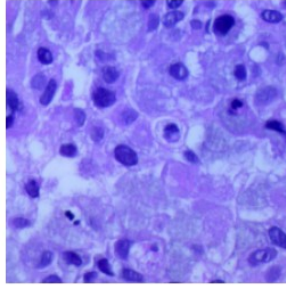
```
<IPython.core.display.HTML object>
```

Prediction/Actual/Loss/Probability

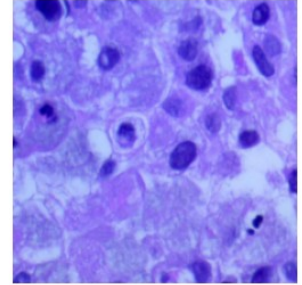
lung_scc/lung_aca / 3.59 / 0.97



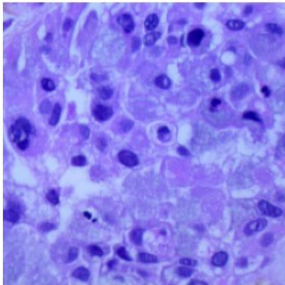
lung_scc/lung_aca / 3.36 / 0.97



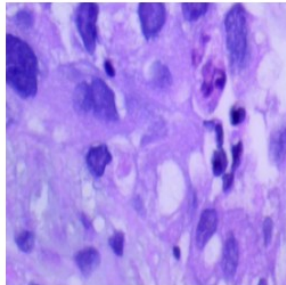
lung_scc/lung_aca / 2.57 / 0.92



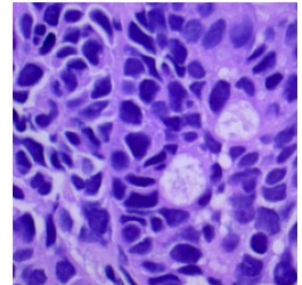
lung_scc/lung_aca / 2.31 / 0.90



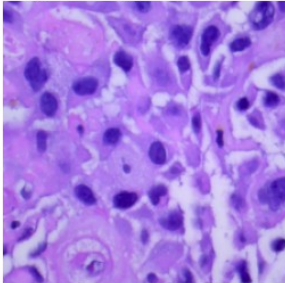
lung_scc/lung_aca / 2.08 / 0.88



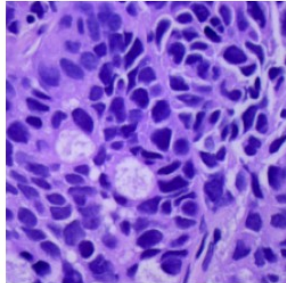
lung_scc/lung_aca / 1.97 / 0.86



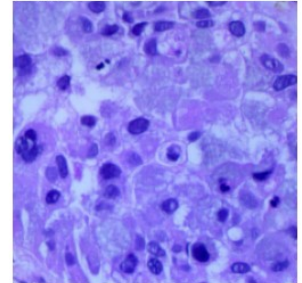
lung_aca/lung_scc / 1.78 / 0.83



lung_scc/lung_aca / 1.71 / 0.82



lung_scc/lung_aca / 1.69 / 0.81



```
interp.most_confused(min_val=2)
<IPython.core.display.HTML object>
<IPython.core.display.HTML object>
[('lung_aca', 'lung_scc', 17), ('lung_scc', 'lung_aca', 4)]
learn.save("convnext")
Path('/kaggle/working/models/convnext.pth')
learn.load("convnext")
<fastai.learner.Learner at 0x7ecda8530070>
```

3) Deployment By Streamlit app

```
from IPython.display import Video

# Replace 'path_to_your_video.mp4' with the path to the uploaded video
Video('/kaggle/input/video-l/Untitled video - Made with
Clipchamp.mp4', embed=True, width=600, height=400)

<IPython.core.display.Video object>

import os
import tensorflow as tf

checkpoint_path = "training_6/cp.weights.h5"
checkpoint_dir = os.path.dirname(checkpoint_path)

cp_callback = tf.keras.callbacks.ModelCheckpoint(
    filepath=checkpoint_path,
    save_weights_only=True,
    verbose=1
)
```