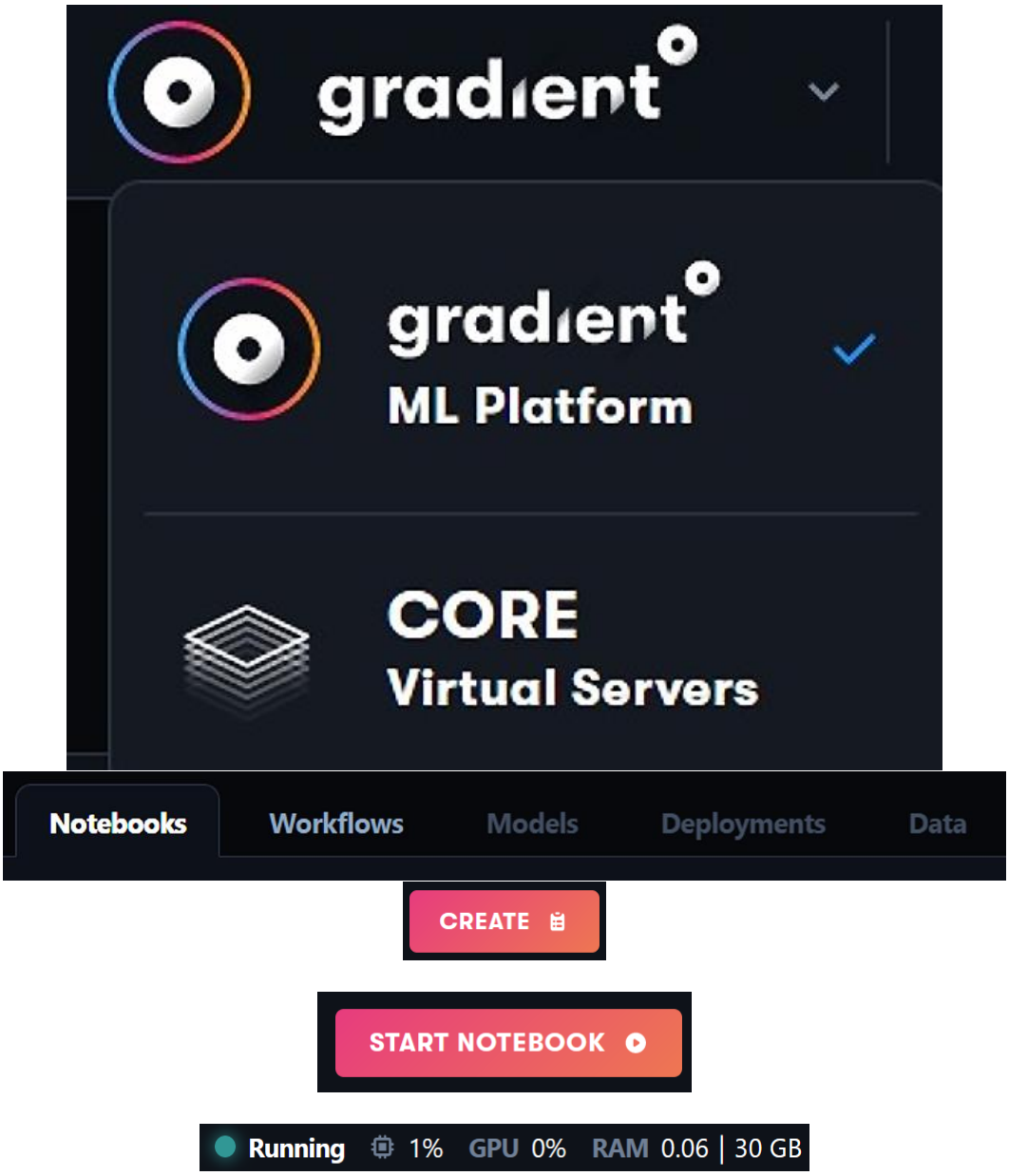
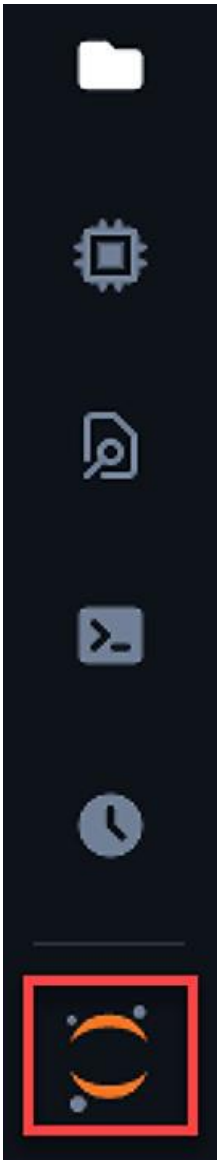
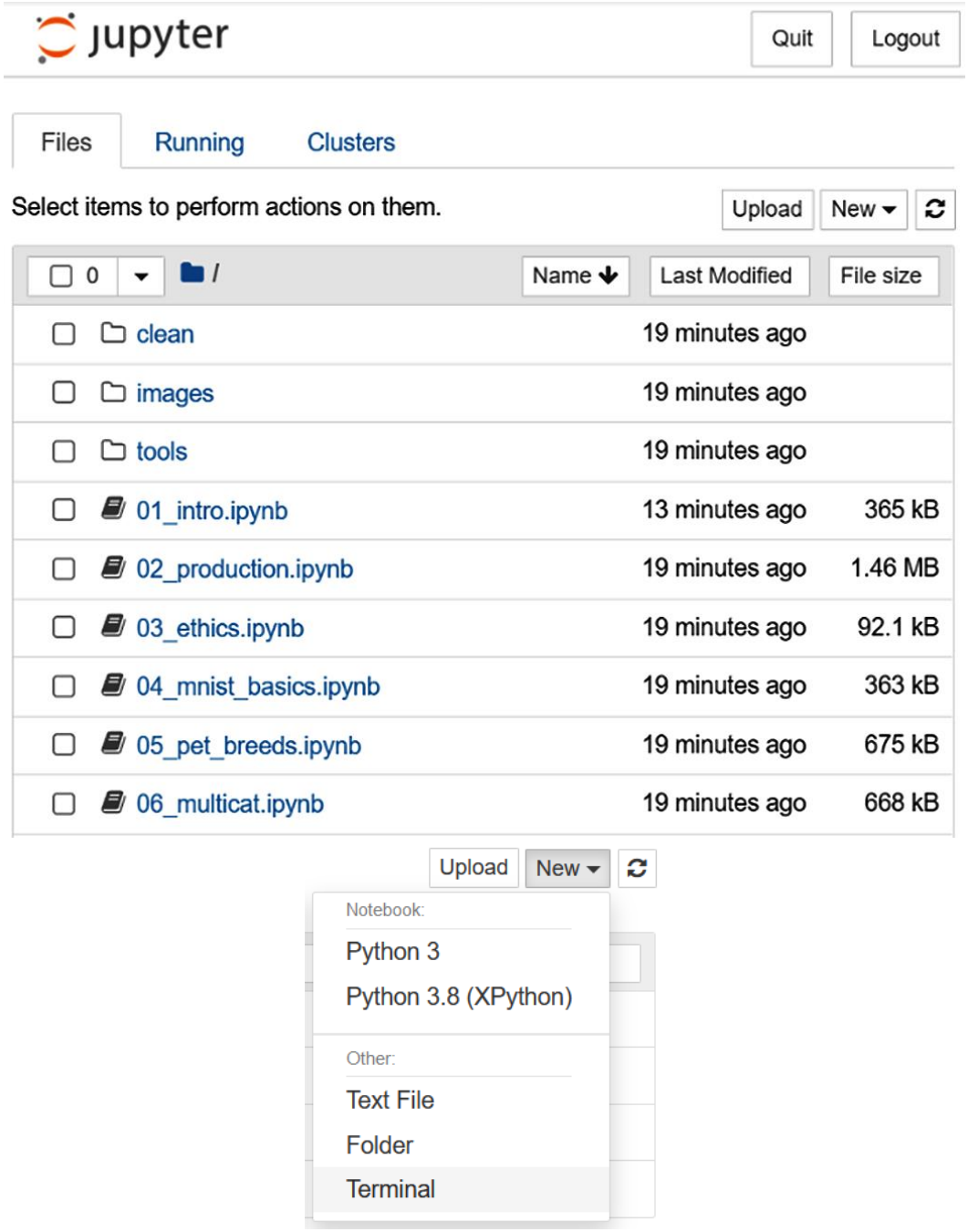
Chapter 1: Getting Started with fastai






jupyter
Quit
Logout
Files
Running
Clusters
Select items to perform actions on them.
Upload
New
0
/
Name
Last Modified
File size
clean 19 minutes ago
images 19 minutes ago
tools 19 minutes ago
01_intro.ipynb 13 minutes ago 365 kB
02_production.ipynb 19 minutes ago 1.46 MB
03_ethics.ipynb 19 minutes ago 92.1 kB
04_mnist_basics.ipynb 19 minutes ago 363 kB
05_pet_breeds.ipynb 19 minutes ago 675 kB
06_multicat.ipynb 19 minutes ago 668 kB
Upload
New
Notebook:
Python 3
Python 3.8 (XPython)
Other:
Text File
Folder
Terminal


```
# validate the version of fast.ai
import fastai
fastai.__version__
```

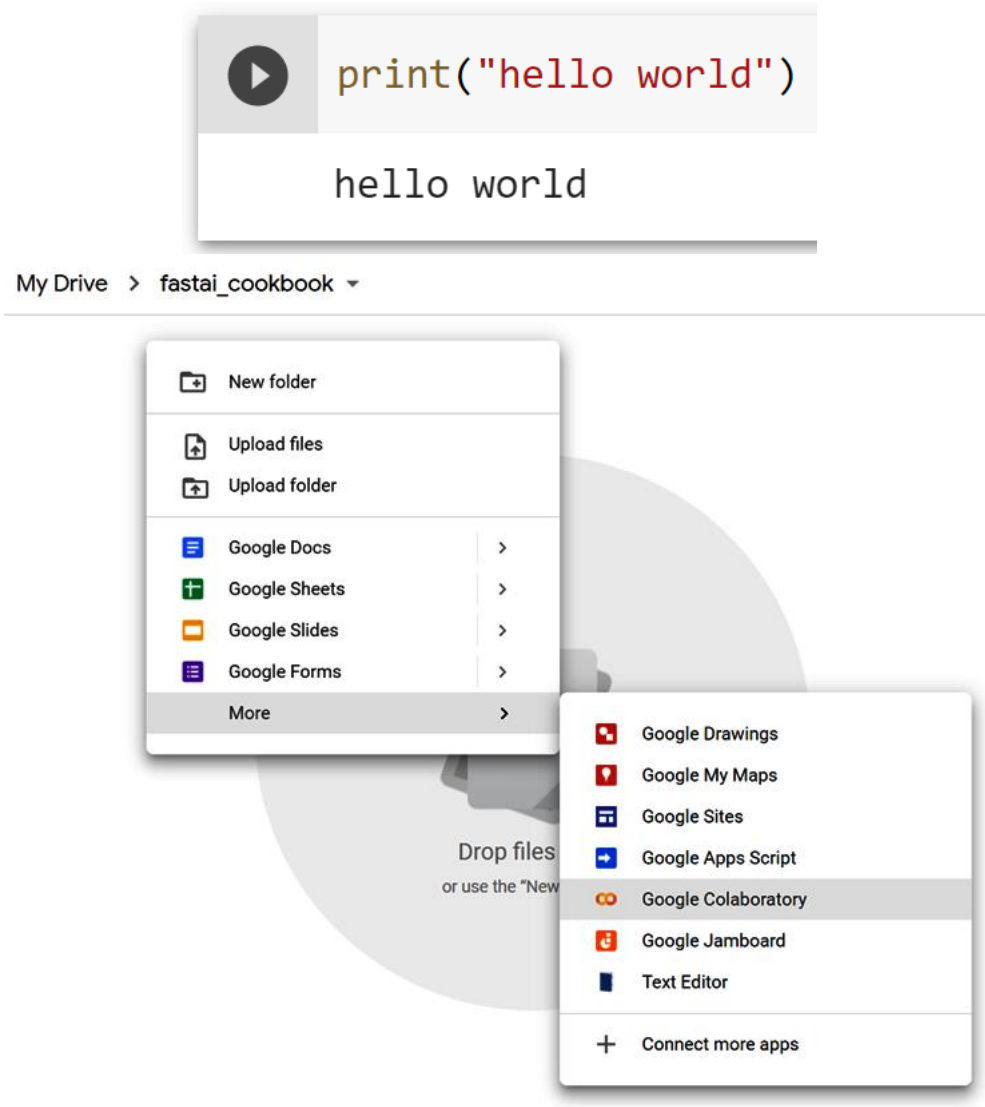
```
'2.1.5'
```

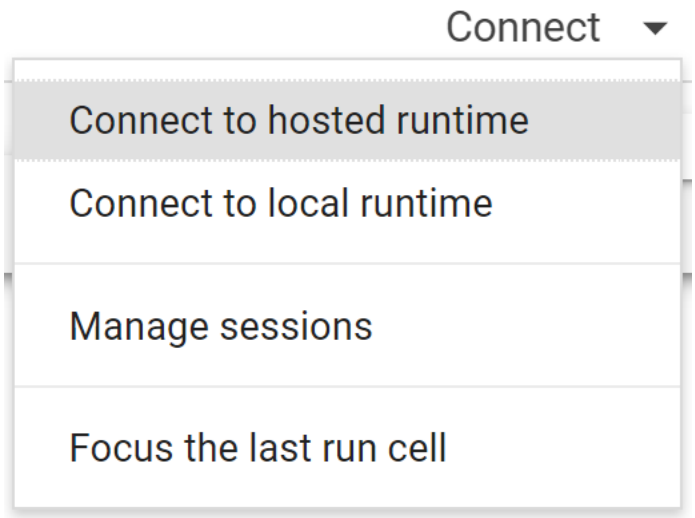
```
# validate access to GPUs
!nvidia-smi
```

```
Sun Dec 27 18:12:30 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 450.36.06    Driver Version: 450.36.06    CUDA Version: 11.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Quadro P5000        On   | 00000000:00:05.0 Off |                  Off |
| 26%   20C    P8     6W / 180W |      1MiB / 16278MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

```
!nvidia-smi
```

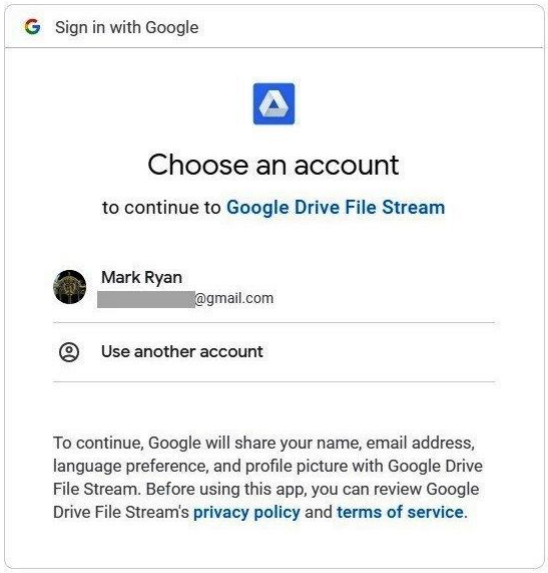
```
NVIDIA-SMI has failed because it couldn't communicate with the NVIDIA driver.
```

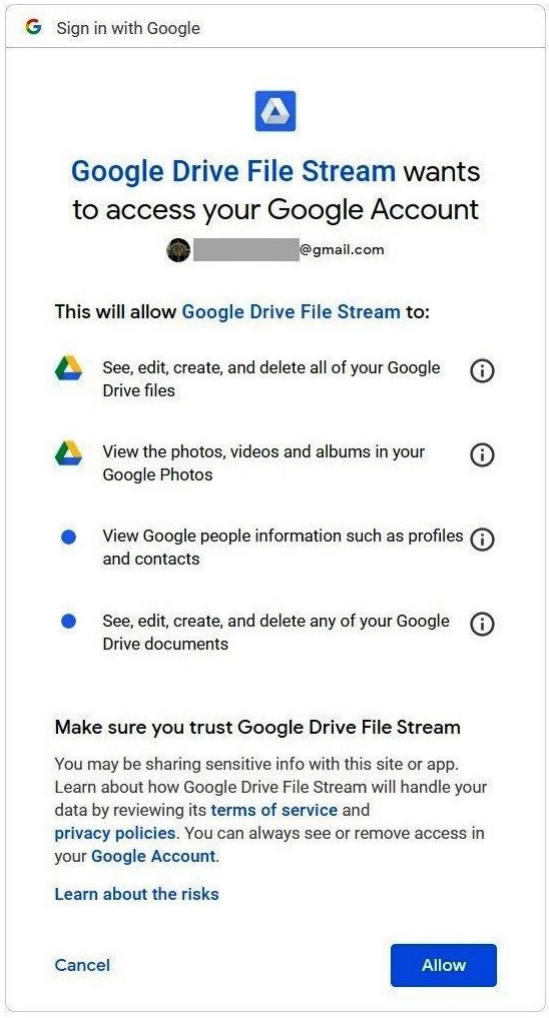

print("hello world")
hello world
My Drive
fastai_cookbook
New folder
Upload files
Upload folder
Google Docs
Google Sheets
Google Slides
Google Forms
More
Drop files
or use the "New
Google Drawings
Google My Maps
Google Sites
Google Apps Script
Google Colaboratory
Google Jamboard
Text Editor
Connect more apps

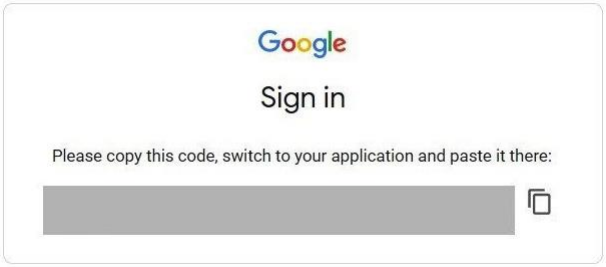



```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i

Enter your authorization code:
```




Sign in with Google
Google Drive File Stream wants to access your Google Account
[redacted]@gmail.com
This will allow Google Drive File Stream to:
See, edit, create, and delete all of your Google Drive files
View the photos, videos and albums in your Google Photos
View Google people information such as profiles and contacts
See, edit, create, and delete any of your Google Drive documents
Make sure you trust Google Drive File Stream
You may be sharing sensitive info with this site or app. Learn about how Google Drive File Stream will handle your data by reviewing its terms of service and privacy policies. You can always see or remove access in your Google Account.
Learn about the risks
Cancel
Allow


Google
Sign in
Please copy this code, switch to your application and paste it there:
[redacted]

```
from google.colab import drive
drive.mount('/content/drive')
```

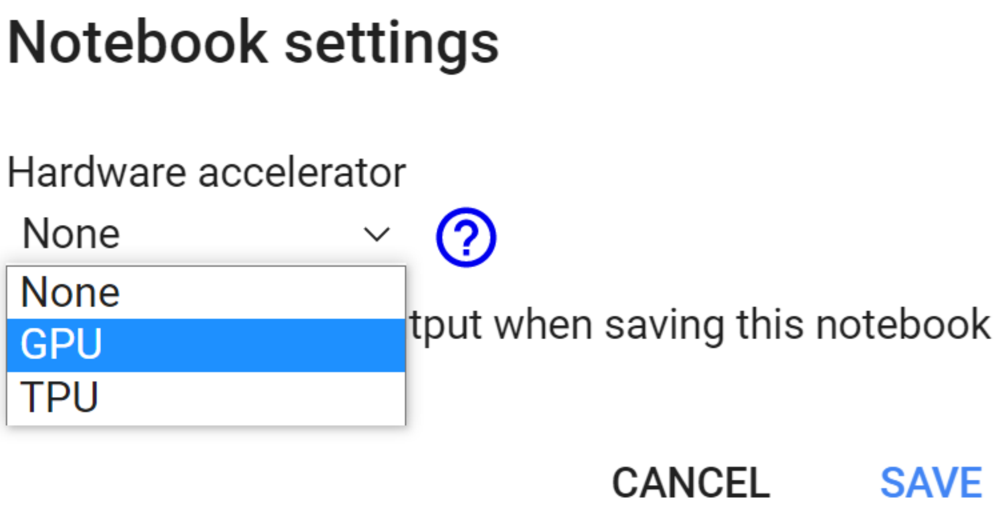
```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i

Enter your authorization code:
·····················································
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i

Enter your authorization code:
··········
Mounted at /content/drive
```

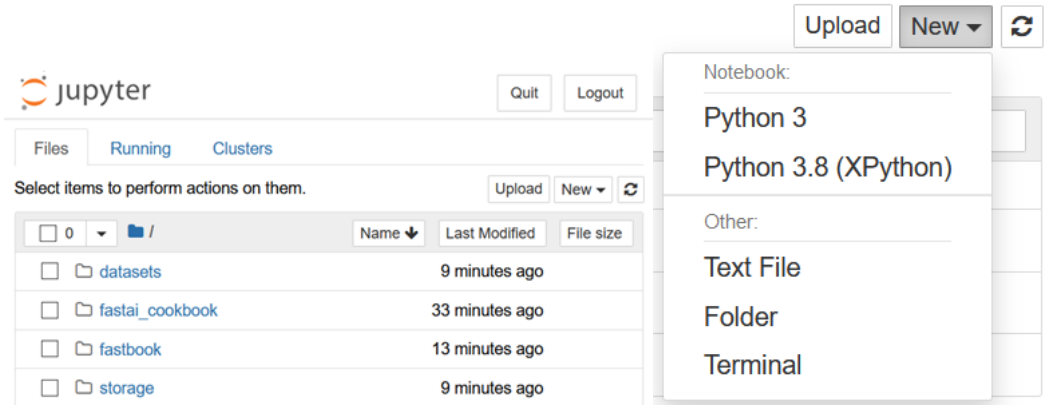


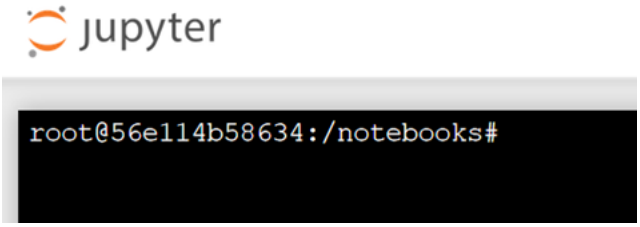

```
# validate the version of fast.ai
import fastai
fastai.__version__
```

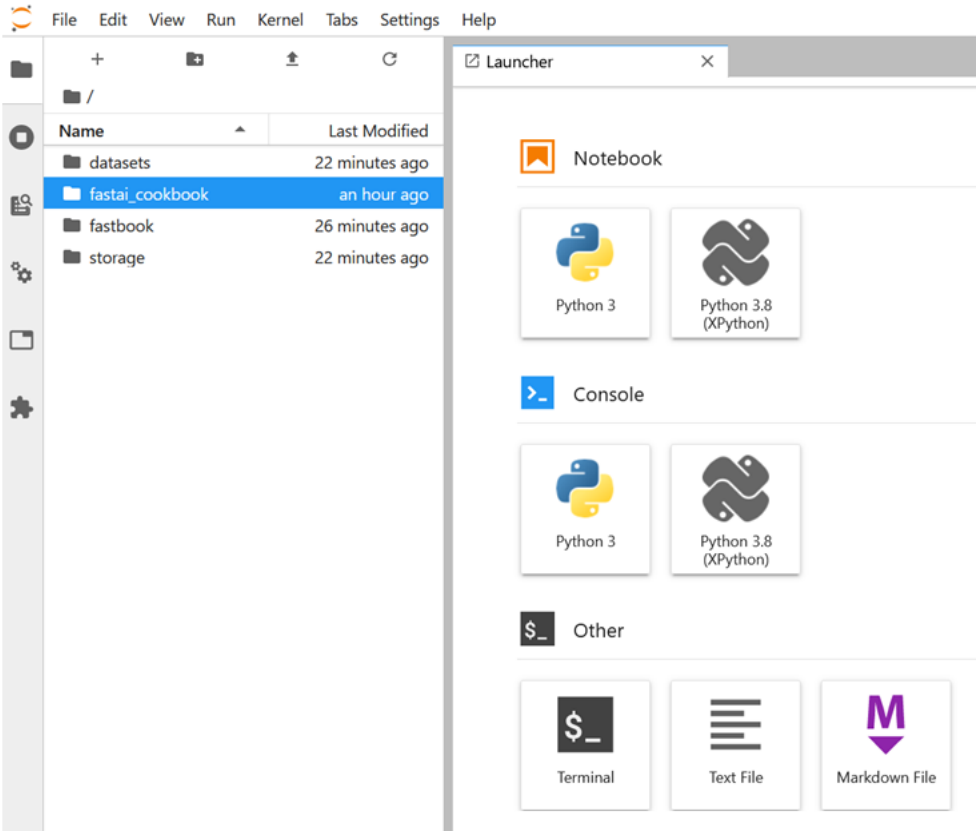
```
'1.0.61'
```

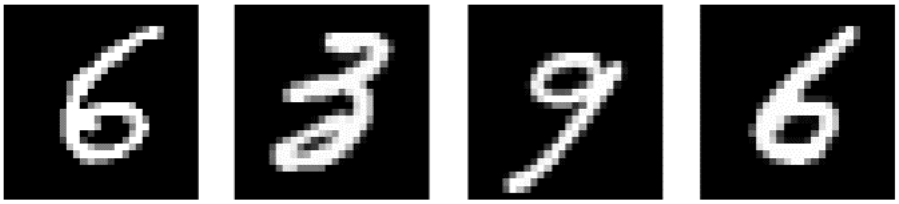
```
# validate access to GPUs
!nvidia-smi
```

```
Mon Dec 28 03:36:32 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.27.04    Driver Version: 418.67       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0 |
| N/A   39C    P8    10W /  70W |      0MiB / 15079MiB |      0%      Default |
|                               |                      |                 ERR! |
+-------------------------------+----------------------+----------------------+
```






File Edit View Run Kernel Tabs Settings Help
/
Name
Last Modified
datasets
22 minutes ago
fastai_cookbook
an hour ago
fastbook
26 minutes ago
storage
22 minutes ago
Launcher
Notebook
Python 3
Python 3.8 (XPython)
Console
Python 3
Python 3.8 (XPython)
Other
Terminal
Text File
Markdown File



```
# select a different image and apply the model to it to get a prediction
img = PILImage.create(img_files[5800])
img
```

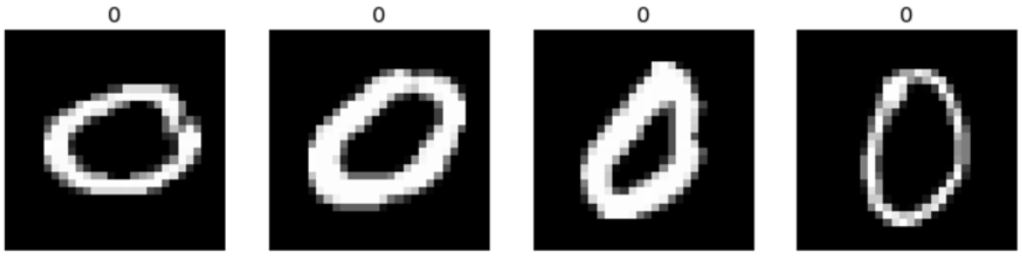
```
learn.predict(img)
```

```
('1',
 TensorImage(1),
 TensorImage([0.0092, 0.9091, 0.0106, 0.0121, 0.0087, 0.0121, 0.0098, 0.0091, 0.0115,
0.0078]))
```

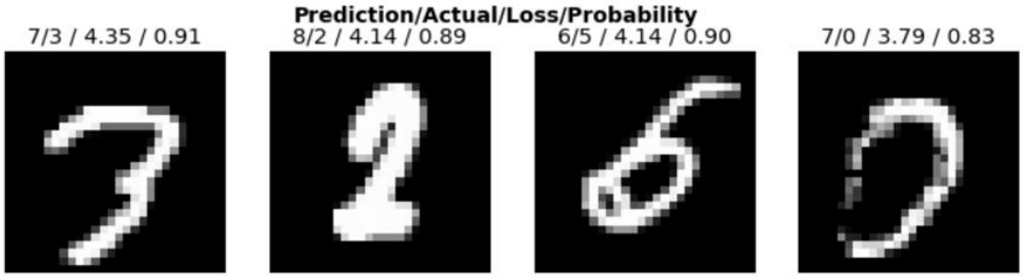
epoch	train_loss	valid_loss	accuracy	time
0	0.567086	0.524767	0.991400	00:50

```
# show a batch of training data
dls.train.show_batch(max_n=4, nrows=1)
```


```
# show a batch of validation data
dls.valid.show_batch(max_n=4, nrows=1)
```



```
# show the images with the highest loss
interp = ClassificationInterpretation.from_learner(learn)
interp.plot_top_losses(4, nrows=1)
```




```
# select an image from the test set
img = PILImage.create(img_files[0])
img
```

```
# apply the trained model to the image
learn.predict(img)
```

```
('0',
 TensorImage(0),
 TensorImage([0.9018, 0.0085, 0.0073, 0.0085, 0.0100, 0.0090, 0.0146, 0.0104, 0.0114, 0.0184]))
```

```
a = torch.ones(5, 7, dtype=torch.float)
a
```

```
tensor([[1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.]])
```

```
b = torch.eye(5,7)
b
```

```
tensor([[1., 0., 0., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0., 0., 0.],
        [0., 0., 1., 0., 0., 0., 0.],
        [0., 0., 0., 1., 0., 0., 0.],
        [0., 0., 0., 0., 1., 0., 0.]])
```

```
c = torch.eye(5,5)
c
```

```
tensor([[1., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0.],
        [0., 0., 1., 0., 0.],
        [0., 0., 0., 1., 0.],
        [0., 0., 0., 0., 1.]])
```

```
b[0]
```

```
tensor([1., 0., 0., 0., 0., 0., 0.])
```

```
b[0,0]
```

```
tensor(1.)
```

```
b[2:]
```

```
tensor([[0., 0., 1., 0., 0., 0., 0.],
        [0., 0., 0., 1., 0., 0., 0.],
        [0., 0., 0., 0., 1., 0., 0.]])
```

```
a_plus_b = a + b
a_plus_b
```

```
tensor([[2., 1., 1., 1., 1., 1., 1.],
        [1., 2., 1., 1., 1., 1., 1.],
        [1., 1., 2., 1., 1., 1., 1.],
        [1., 1., 1., 2., 1., 1., 1.],
        [1., 1., 1., 1., 2., 1., 1.]])
```

```
a_mult_c = a@c
a_mult_c
```

```
---------------------------------------------------------------------------
RuntimeError                              Traceback (most recent call last)
<ipython-input-27-a25dfb8b9002> in <module>
      1 # multiply two tensors
----> 2 a_mult_c = a@c
      3 a_mult_c

RuntimeError: mat1 and mat2 shapes cannot be multiplied (5x7 and 5x5)
```

```
d = torch.eye(7,7)
d
```

```
tensor([[1., 0., 0., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0., 0., 0.],
        [0., 0., 1., 0., 0., 0., 0.],
        [0., 0., 0., 1., 0., 0., 0.],
        [0., 0., 0., 0., 1., 0., 0.],
        [0., 0., 0., 0., 0., 1., 0.],
        [0., 0., 0., 0., 0., 0., 1.]])
```

```
a_mult_d = a@d
a_mult_d
```

```
tensor([[1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1., 1., 1.]])
```

```
a_trans = torch.transpose(a,0,1)
a_trans
```

```
tensor([[1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.]])
```

```
a_trans_mult_c = a_trans @ c
a_trans_mult_c
```

```
tensor([[1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.],
        [1., 1., 1., 1., 1.]])
```

Chapter 2: Exploring and Cleaning Up Data with fastai

```
# imports for notebook boilerplate
!pip install -Uqq fastbook
import fastbook
from fastbook import *
from fastai.vision.all import *
```

```
# set up the notebook for fast.ai
fastbook.setup_book()
```

```
# In Gradient, datasets get saved in /storage/data when untar_data is called
# if the dataset has not been copied there already
path = untar_data(URLs.MNIST)
```

```
path.ls()
```

```
(#2) [Path('/storage/data/mnist_png/training'),Path('/storage/data/mnist_png/testing')]
```

```
# get the structure of one of the training subdirectory
(path/'training').ls()
```

```
(#10) [Path('/storage/data/mnist_png/training/0'),Path('/storage/data/mnist_png/training/2'),Path('/storage/data/mnist_png/training/9'),Path('/storage/data/mnist_png/training/8'),Path('/storage/data/mnist_png/training/7'),Path('/storage/data/mnist_png/training/1'),Path('/storage/data/mnist_png/training/5'),Path('/storage/data/mnist_png/training/4'),Path('/storage/data/mnist_png/training/6'),Path('/storage/data/mnist_png/training/3')]
```

```
(path/'training').ls()
```

```
(#10) [Path('/storage/data/mnist_png/training/0'),Path('/storage/data/mnist_png/training/2'),Path('/storage/data/mnist_png/training/9'),Path('/storage/data/mnist_png/training/8'),Path('/storage/data/mnist_png/training/7'),Path('/storage/data/mnist_png/training/1'),Path('/storage/data/mnist_png/training/5'),Path('/storage/data/mnist_png/training/4'),Path('/storage/data/mnist_png/training/6'),Path('/storage/data/mnist_png/training/3')]
```

```
??URLs
```

```
Init signature: URLs()
Source:
class URLs():
    "Global constants for dataset and model URLs."
    LOCAL_PATH = Path.cwd()
    MDL = 'http://files.fast.ai/models/'
    S3  = 'https://s3.amazonaws.com/fast-ai-'
    URL = f'{S3}sample/'

    S3_IMAGE    = f'{S3}imageclas/'
    S3_IMAGELOC = f'{S3}imagelocal/'
    S3_AUDI     = f'{S3}audio/'
    S3_NLP      = f'{S3}nlp/'
    S3_COCO     = f'{S3}coco/'
    S3_MODEL    = f'{S3}modelzoo/'

                  •
                  •
                  •
    # image classification datasets
    CALTECH_101  = f'{S3_IMAGE}caltech_101.tgz'
    CARS         = f'{S3_IMAGE}stanford-cars.tgz'
    CIFAR_100    = f'{S3_IMAGE}cifar100.tgz'
    CUB_200_2011 = f'{S3_IMAGE}CUB_200_2011.tgz'
    FLOWERS      = f'{S3_IMAGE}oxford-102-flowers.tgz'
    FOOD         = f'{S3_IMAGE}food-101.tgz'
    MNIST        = f'{S3_IMAGE}mnist_png.tgz'
```

```
?Path.ls
```

```
Signature: Path.ls(self: pathlib.Path, n_max=None, file_type=None, file_exts=None)
Source:
@patch
def ls(self:Path, n_max=None, file_type=None, file_exts=None):
    "Contents of path as a list"
    extns=L(file_exts)
    if file_type: extns += L(k for k,v in mimetypes.types_map.items() if v.startswith(fil
e_type+'/'))
    has_extns = len(extns)==0
    res = (o for o in self.iterdir() if has_extns or o.suffix in extns)
    if n_max is not None: res = itertools.islice(res, n_max)
    return L(res)
File:      /opt/conda/envs/fastai/lib/python3.8/site-packages/fastcore/xtras.py
Type:      function
```

```
doc(Path.ls)
```

`Path.ls` [source]

> `Path.ls(n_max=None, file_type=None, file_exts=None)`

Contents of path as a list

Show in docs

```
path.ls()
```

```
(#3) [Path('/storage/data/adult_sample/adult.csv'),Path('/storage/data/adult_sample/export.pkl'),Path('/storage/data/adult_sample/models')]
```

```
df.head()
```

	age	workclass	fnlwgt	education	education-num	marital-status	occupation	relationship	race	sex	capital-gain	capital-loss	hours-per-week	native-country	
0	49	Private	101320	Assoc-acdm	12.0	Married-civ-spouse	NaN	Wife	White	Female	0	1902	40	United-States	>=
1	44	Private	236746	Masters	14.0	Divorced	Exec-managerial	Not-in-family	White	Male	10520	0	45	United-States	>=
2	38	Private	96185	HS-grad	NaN	Divorced	NaN	Unmarried	Black	Female	0	0	32	United-States	<
3	38	Self-emp-inc	112847	Prof-school	15.0	Married-civ-spouse	Prof-specialty	Husband	Asian-Pac-Islander	Male	0	0	40	United-States	>=
4	42	Self-emp-not-inc	82297	7th-8th	NaN	Married-civ-spouse	Other-service	Wife	Black	Female	0	0	50	United-States	<

```
# main datasets
ADULT_SAMPLE         = f'{URL}adult_sample.tgz'
BIWI_SAMPLE          = f'{URL}biwi_sample.tgz'
CIFAR                = f'{URL}cifar10.tgz'
COCO_SAMPLE          = f'{S3_COCO}coco_sample.tgz'
COCO_TINY            = f'{S3_COCO}coco_tiny.tgz'
HUMAN_NUMBERS        = f'{URL}human_numbers.tgz'
IMDB                 = f'{S3_NLP}imdb.tgz'
IMDB_SAMPLE          = f'{URL}imdb_sample.tgz'
ML_SAMPLE            = f'{URL}movie_lens_sample.tgz'
ML_100k              = 'http://files.grouplens.org/datasets/movielens/ml-100k.zip'
MNIST_SAMPLE         = f'{URL}mnist_sample.tgz'
MNIST_TINY           = f'{URL}mnist_tiny.tgz'
MNIST_VAR_SIZE_TINY  = f'{S3_IMAGE}mnist_var_size_tiny.tgz'
PLANET_SAMPLE        = f'{URL}planet_sample.tgz'
PLANET_TINY          = f'{URL}planet_tiny.tgz'
IMAGENETTE           = f'{S3_IMAGE}imagenette2.tgz'
IMAGENETTE_160       = f'{S3_IMAGE}imagenette2-160.tgz'
IMAGENETTE_320       = f'{S3_IMAGE}imagenette2-320.tgz'
IMAGEWOOF            = f'{S3_IMAGE}imagewoof2.tgz'
IMAGEWOOF_160        = f'{S3_IMAGE}imagewoof2-160.tgz'
IMAGEWOOF_320        = f'{S3_IMAGE}imagewoof2-320.tgz'
IMAGEWANG            = f'{S3_IMAGE}imagewang.tgz'
IMAGEWANG_160        = f'{S3_IMAGE}imagewang-160.tgz'
IMAGEWANG_320        = f'{S3_IMAGE}imagewang-320.tgz'
```

```
path.ls()
```

```
(#2) [Path('/storage/data/wikitext-2/train.csv'),Path('/storage/data/wikitext-2/test.csv')]
```

```
df_train.head(2)
```

	\n = 2013 – 14 York City F.C. season = \n \n The 2013 – 14 season was the <unk> season of competitive association football and 77th season in the Football League played by York City Football Club , a professional football club based in York , North Yorkshire , England . Their 17th @-@ place finish in 2012 – 13 meant it was their second consecutive season in League Two . The season ran from 1 July 2013 to 30 June 2014 . \n Nigel Worthington , starting his first full season as York manager , made eight permanent summer signings . By the turn of the year York were only above the relegation zone on goal difference , before a 17 @-@ match

```
df_train.head(2)
```

	0
0	\n = 2013 – 14 York City F.C. season = \n \n The 2013 – 14 season was the <unk> season of competitive association football and 77th season in the Football League played by York City Football Club , a professional football club based in York , North Yorkshire , England . Their 17th @-@ place finish in 2012 – 13 meant it was their second consecutive season in League Two . The season ran from 1 July 2013 to 30 June 2014 . \n Nigel Worthington , starting his first full season as York manager , made eight permanent summer signings . By the turn of the year York were only above the

```
df_tok.head(3)
```

	text	text_length
0	[xxbos, =, 2013, –, 14, xxmaj, york, xxmaj, city, xxup, f.c, ., season, =, \n__\n__, xxmaj, the, 2013, –, 14, season, was, the, xxunk, season, of, competitive, association, football, and, 77th, season, in, the, xxmaj, football, xxmaj, league, played, by, xxmaj, york, xxmaj, city, xxmaj, football, xxmaj, club, ,, a, professional, football, club, based, in, xxmaj, york, ,, xxmaj, north, xxmaj, yorkshire, ,, xxmaj, england, ., xxmaj, their, 17th, -, place, finish, in, 2012, –, 13, meant, it, was, their, second, consecutive, season, in, xxmaj, league, xxmaj, two, ., xxmaj, the, season, ran, from...	4405
1	[xxbos, =, xxmaj, big, xxmaj, boy, (, song,), =, \n__\n__, ", xxmaj, big, xxmaj, boy, ", xxunk, ", i, ', m, a, xxmaj, big, xxmaj, boy, xxmaj, now, ", was, the, first, single, ever, recorded, by, the, xxmaj, jackson, 5, ,, which, was, released, by, xxmaj, steeltown, xxmaj, records, in, xxmaj, january, 1968, ., xxmaj, the, group, played, instruments, on, many, of, their, xxmaj, steeltown, compositions, ,, including, ", xxmaj, big, xxmaj, boy, ", ., xxmaj, the, song, was, neither, a, critical, nor, commercial, success, ,, but, the, xxmaj, jackson, family, were, delighted, with, the, outcome, n...	976

```
# NLP datasets
AG_NEWS                  = f'{S3_NLP}ag_news_csv.tgz'
AMAZON_REVIEWS           = f'{S3_NLP}amazon_review_full_csv.tgz'
AMAZON_REVIEWS_POLARITY  = f'{S3_NLP}amazon_review_polarity_csv.tgz'
DBPEDIA                  = f'{S3_NLP}dbpedia_csv.tgz'
MT_ENG_FRA               = f'{S3_NLP}giga-fren.tgz'
SOGOU_NEWS               = f'{S3_NLP}sogou_news_csv.tgz'
WIKITEXT                 = f'{S3_NLP}wikitext-103.tgz'
WIKITEXT_TINY            = f'{S3_NLP}wikitext-2.tgz'
YAHOO_ANSWERS            = f'{S3_NLP}yahoo_answers_csv.tgz'
YELP_REVIEWS             = f'{S3_NLP}yelp_review_full_csv.tgz'
YELP_REVIEWS_POLARITY    = f'{S3_NLP}yelp_review_polarity_csv.tgz'
```

```
df_pose = pd.read_csv(path/'05/frame_00191_pose.txt', header=None)
df_pose.head()
```

	0
0	0.860993 0.162766 -0.481869
1	0.00729371 0.943363 0.331682
2	0.508564 -0.289091 0.811042
3	116.403 12.1671 871.544

```
df_no_missing.show(3)
```

	workclass	education	marital-status	occupation	relationship	race	sex	native-country	education-num_na	age
0	Private	Assoc-acdm	Married-civ-spouse	#na#	Wife	White	Female	United-States	False	49
1	Private	Masters	Divorced	Exec-managerial	Not-in-family	White	Male	United-States	False	44
2	Private	HS-grad	Divorced	#na#	Unmarried	Black	Female	United-States	True	38

```
df_no_missing.items.head(3)
```

	age	workclass	fnlwgt	education	education-num	marital-status	occupation	relationship	race	sex	capital-gain
0	49	5	101320	8	12.0	3	0	6	5	1	0
1	44	5	236746	13	14.0	1	5	2	5	2	10520
2	38	5	96185	12	10.0	1	0	5	3	1	0

```
df_no_missing.items.isnull().sum()
```

```
age                0
workclass          0
fnlwgt             0
education          0
education-num      0
marital-status     0
occupation         0
relationship       0
race               0
sex                0
capital-gain       0
capital-loss       0
hours-per-week     0
native-country     0
salary             0
education-num_na    0
dtype: int64
```

```
path.ls()
```

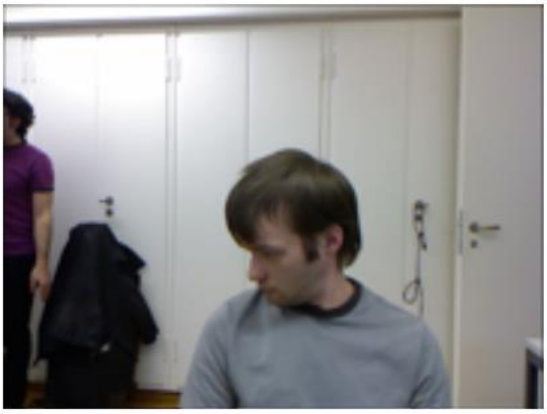
```
(#3) [Path('/storage/data/oxford-102-flowers/valid.txt'),Path('/storage/data/oxford-102-flowers/jpg'),Path('/storage/data/oxford-102-flowers/test.txt')]
```

```
df_valid = pd.read_csv(path/'valid.txt', header=None)
df_valid.head()
```

	0
0	jpg/image_04467.jpg 89
1	jpg/image_07129.jpg 44
2	jpg/image_05166.jpg 4
3	jpg/image_07002.jpg 34
4	jpg/image_02007.jpg 79

```
img.to_thumb(180)
```

```
img_files = get_image_files(path/'10')
img = PILImage.create(img_files[8])
img.to_thumb(180)
```



Chapter 3: Training Models with Tabular Data

epoch	train_loss	valid_loss	accuracy	time
0	0.328067	0.376390	0.830508	00:09
1	0.324054	0.356516	0.830508	00:09
2	0.300545	0.340962	0.838983	00:09

```
# show sample result, including transformed x, y and predicted transformed y
learn.show_results()
```

	workclass	education	marital-status	occupation	relationship	race	sex	native-country	education-num_na	age	fnlwgt	education-num	capital-gain	capital-loss	hours-per-week	salary	salary_pred
0	7.0	12.0	3.0	13.0	1.0	5.0	2.0	40.0	1.0	58.0	248841.0	9.0	15024.0	0.0	40.0	1.0	1.0
1	8.0	11.0	3.0	11.0	1.0	5.0	2.0	40.0	1.0	41.0	309056.0	16.0	0.0	0.0	50.0	1.0	1.0
2	5.0	5.0	7.0	9.0	3.0	2.0	1.0	31.0	1.0	63.0	106910.0	3.0	0.0	0.0	19.0	0.0	0.0
3	1.0	11.0	3.0	1.0	1.0	5.0	2.0	40.0	1.0	72.0	118902.0	16.0	0.0	2392.0	6.0	1.0	1.0
4	5.0	2.0	5.0	7.0	3.0	3.0	1.0	40.0	1.0	41.0	155657.0	7.0	0.0	0.0	40.0	0.0	0.0
5	5.0	2.0	1.0	8.0	2.0	5.0	2.0	40.0	1.0	38.0	252250.0	7.0	0.0	0.0	65.0	0.0	0.0
6	5.0	16.0	5.0	15.0	5.0	5.0	2.0	40.0	1.0	29.0	277342.0	10.0	0.0	0.0	40.0	0.0	0.0
7	5.0	12.0	3.0	7.0	1.0	5.0	2.0	40.0	1.0	25.0	218667.0	9.0	0.0	0.0	40.0	0.0	0.0
8	7.0	10.0	1.0	5.0	2.0	5.0	2.0	40.0	1.0	54.0	154785.0	13.0	0.0	0.0	50.0	0.0	0.0

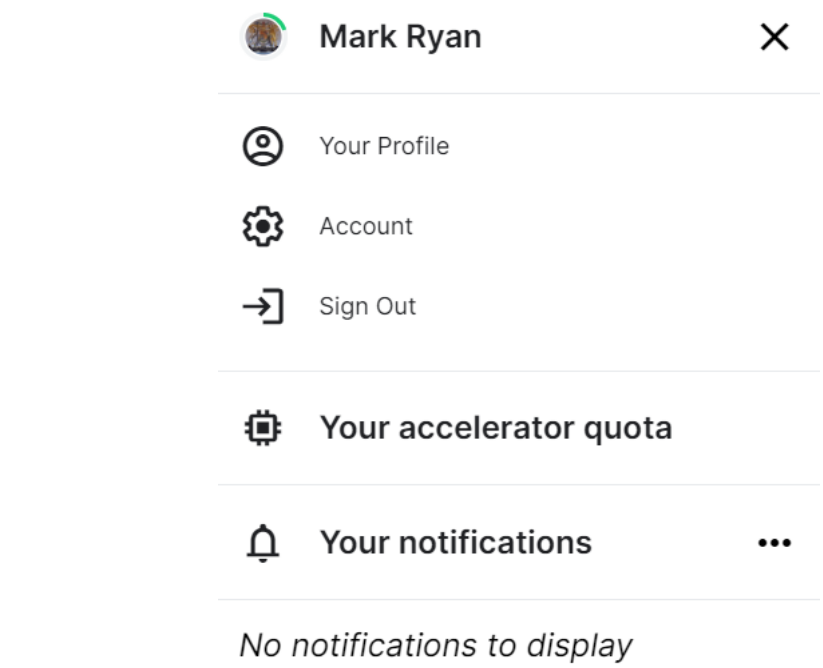
```
TabularModel (Input shape: ['64 x 9', '64 x 6'])
================================================================
Layer (type)         Output Shape         Param #    Trainable
================================================================
Embedding            64 x 6               60         True
_____________________________________________________________
Embedding            64 x 8               136        True
_____________________________________________________________
Embedding            64 x 5               40         True
_____________________________________________________________
Embedding            64 x 8               128        True
_____________________________________________________________
```

```
Total params: 33,936
Total trainable params: 33,936
Total non-trainable params: 0

Optimizer used: <function Adam at 0x7f1377973820>
Loss function: FlattenedLoss of CrossEntropyLoss()

Model unfrozen

Callbacks:
  - TrainEvalCallback
  - Recorder
  - ProgressCallback
```



API

Using Kaggle's beta API, you can interact with Competitions and Datasets to download data, make submissions, and more via the command line. Read the docs

Create New API Token | Expire API Token

MoSold	YrSold	SaleType	SaleCondition	SalePrice
2	2008	WD	Normal	1
5	2007	WD	Normal	1
9	2008	WD	Normal	1
2	2006	WD	Abnorml	0
12	2008	WD	Normal	1

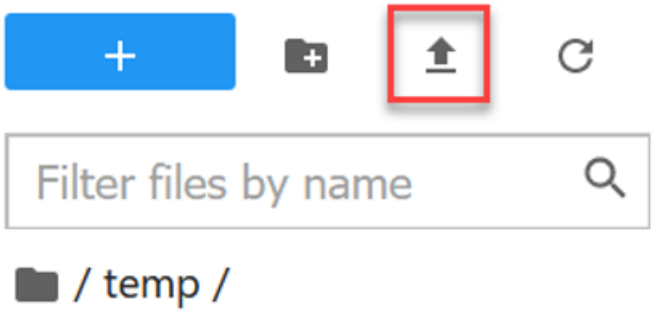
	missing_count	missing_ratio
LotFrontage	259	0.177397
Alley	1369	0.937671
MasVnrType	8	0.005479
MasVnrArea	8	0.005479
BsmtQual	37	0.025342

```
df_train_missing
```

	missing_count	missing_ratio

epoch	train_loss	valid_loss	accuracy	time
0	0.524770	0.579092	0.820000	00:00
1	0.348470	0.325142	0.870000	00:00
2	0.248136	0.216792	0.920000	00:00
3	0.194248	0.159855	0.920000	00:00
4	0.156570	0.166303	0.920000	00:00

Porch	3SsnPorch	ScreenPorch	PoolArea	MiscVal	MoSold	YrSold	SalePrice	SalePrice_pred
52508	-0.117549	-0.271653	-0.06042	-0.085622	-0.117503	0.146225	1.0	1.0
52508	-0.117549	-0.271653	-0.06042	-0.085622	0.622329	-0.607057	0.0	0.0
31317	-0.117549	-0.271653	-0.06042	-0.085622	-0.487419	-0.607057	0.0	0.0
52508	-0.117549	-0.271653	-0.06042	-0.085622	1.362161	-1.360339	1.0	1.0
52508	-0.117549	-0.271653	-0.06042	-0.085622	0.622329	-1.360339	0.0	0.0
75433	-0.117549	-0.271653	-0.06042	-0.085622	-0.117503	1.652790	0.0	0.0



	Location	Price	Rooms	Bathrooms	Car Parks	Property Type	Size	Furnishing
0	KLCC, Kuala Lumpur	RM 1,250,000	2+1	3.0	2.0	Serviced Residence	Built-up : 1,335 sq. ft.	Fully Furnished
1	Damansara Heights, Kuala Lumpur	RM 6,800,000	6	7.0	NaN	Bungalow	Land area : 6900 sq. ft.	Partly Furnished
2	Dutamas, Kuala Lumpur	RM 1,030,000	3	4.0	2.0	Condominium (Corner)	Built-up : 1,875 sq. ft.	Partly Furnished
3	Cheras, Kuala Lumpur	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	Bukit Jalil, Kuala Lumpur	RM 900,000	4+1	3.0	2.0	Condominium (Corner)	Built-up : 1,513 sq. ft.	Partly Furnished

```
df_train.shape
```

```
(53635, 8)
```

```
df_train['Size'].head(10)
```

```
0        Built-up : 1,335 sq. ft.
1        Land area : 6900 sq. ft.
2        Built-up : 1,875 sq. ft.
4        Built-up : 1,513 sq. ft.
5        Land area : 7200 sq. ft.
7        Land area : 3600 sq. ft.
8       Land area : 25x75 sq. ft.
9          Built-up : 904 sq. ft.
11    Land area : 22 x 80 sq. ft.
12       Land area : 1900 sq. ft.
Name: Size, dtype: object
```

```
# get the record count after the Size column has been cleaned up
df_train.shape
```

```
(52309, 9)
```

```
df_train.head()
```

	Location	Price	Rooms	Bathrooms	Car Parks	Property Type	Size	Furnishing	Size_type
0	KLCC, Kuala Lumpur	1250000	2+1	3.0	2.0	Serviced Residence	1335.0	Fully Furnished	built-up
1	Damansara Heights, Kuala Lumpur	6800000	6	7.0	NaN	Bungalow	6900.0	Partly Furnished	land area
2	Dutamas, Kuala Lumpur	1030000	3	4.0	2.0	Condominium (Corner)	1875.0	Partly Furnished	built-up
4	Bukit Jalil, Kuala Lumpur	900000	4+1	3.0	2.0	Condominium (Corner)	1513.0	Partly Furnished	built-up
5	Taman Tun Dr Ismail, Kuala Lumpur	5350000	4+2	5.0	4.0	Bungalow	7200.0	Partly Furnished	land area

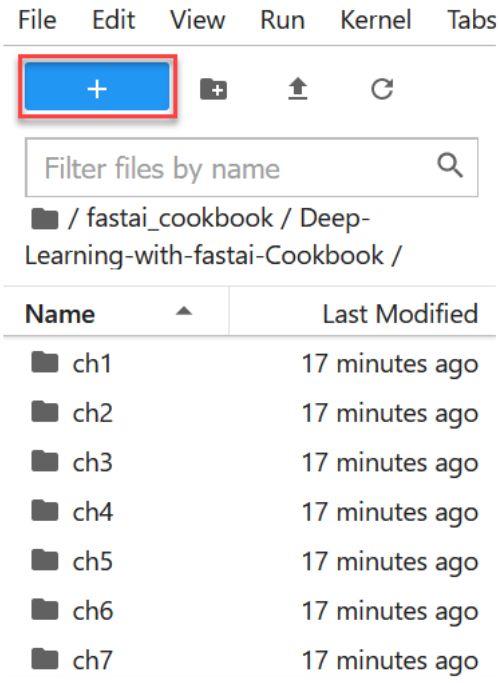
	Location	Price	Rooms	Bathrooms	Car Parks	Property Type	Size	Furnishing	Size_type
0	KLCC, Kuala Lumpur	0	2+1	3.0	2.0	Serviced Residence	1335.0	Fully Furnished	built-up
1	Damansara Heights, Kuala Lumpur	1	6	7.0	NaN	Bungalow	6900.0	Partly Furnished	land area
2	Dutamas, Kuala Lumpur	0	3	4.0	2.0	Condominium (Corner)	1875.0	Partly Furnished	built-up
4	Bukit Jalil, Kuala Lumpur	0	4+1	3.0	2.0	Condominium (Corner)	1513.0	Partly Furnished	built-up
5	Taman Tun Dr Ismail, Kuala Lumpur	1	4+2	5.0	4.0	Bungalow	7200.0	Partly Furnished	land area

```
# define and fit the model
learn = tabular_learner(dls, metrics=accuracy)
learn.fit_one_cycle(3)
```

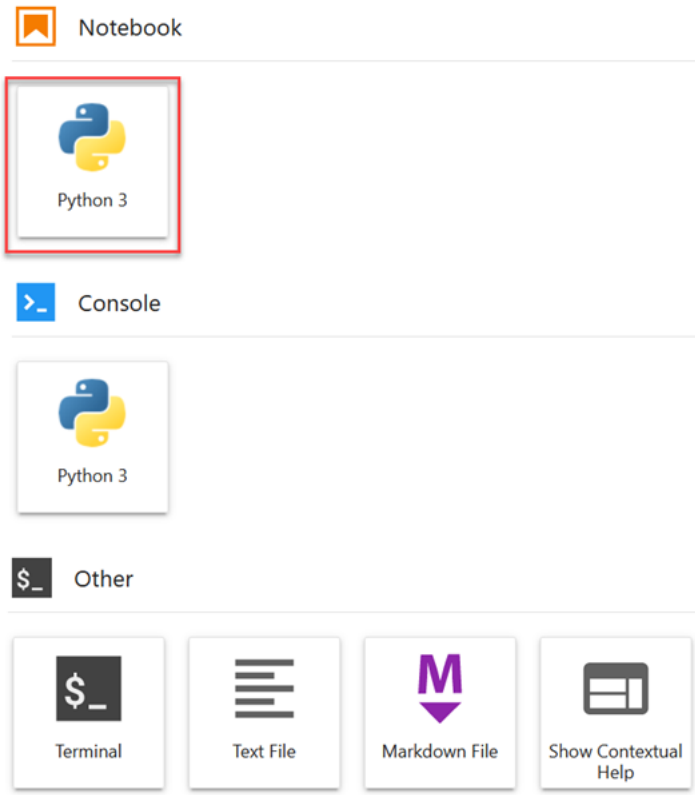
epoch	train_loss	valid_loss	accuracy	time
0	0.175031	0.174658	0.929600	00:10
1	0.143417	0.147668	0.936000	00:09
2	0.128981	0.146698	0.938600	00:10

```
# show a set of results from the model
learn.show_results()
```

	Location	Rooms	Property Type	Furnishing	Size_type	Bathrooms_na	Car Parks_na	Bathrooms	Car Parks	Size	Price	Price_pred
0	3.0	0.0	56.0	4.0	2.0	2.0	2.0	-0.053581	-0.010860	0.245799	1.0	1.0
1	14.0	1.0	88.0	2.0	1.0	1.0	1.0	-1.299513	-0.931626	-0.042105	0.0	0.0
2	56.0	2.0	88.0	2.0	1.0	1.0	1.0	-1.299513	-0.931626	-0.027924	0.0	0.0
3	89.0	27.0	76.0	0.0	2.0	2.0	2.0	-0.053581	-0.010860	0.947749	1.0	1.0
4	25.0	0.0	74.0	0.0	2.0	2.0	2.0	-0.053581	-0.010860	0.150699	1.0	1.0
5	19.0	24.0	51.0	2.0	2.0	1.0	2.0	0.569386	-0.010860	0.525406	1.0	1.0
6	14.0	18.0	85.0	1.0	1.0	1.0	2.0	-0.053581	-0.010860	-0.026419	1.0	1.0
7	45.0	18.0	84.0	1.0	1.0	1.0	1.0	-0.676547	-0.931626	-0.035274	0.0	0.0
8	56.0	1.0	84.0	0.0	1.0	1.0	1.0	-0.676547	-0.931626	-0.039847	0.0	0.0


File
Edit
View
Run
Kernel
Tabs
+
Filter files by name
/ fastai_cookbook / Deep-Learning-with-fastai-Cookbook /
Name
Last Modified
ch1
17 minutes ago
ch2
17 minutes ago
ch3
17 minutes ago
ch4
17 minutes ago
ch5
17 minutes ago
ch6
17 minutes ago
ch7
17 minutes ago

fastai_cookbook/Deep-Learning-with-fastai-Cookbook




```
# imports for notebook boilerplate
!pip install -Uqq fastbook
import fastbook
from fastbook import *
from fastai.tabular.all import *
```

```
# set up the notebook for fast.ai
fastbook.setup_book()
```

	Open	High	Low	Close	Volume
Date					
2021-07-09	59.12	59.910	59.070	59.63	6173577
2021-07-08	59.45	59.670	58.830	59.26	6894951
2021-07-07	59.76	59.820	59.295	59.76	6434879
2021-07-06	60.41	60.555	59.870	59.90	6893637
2021-07-02	60.26	60.875	60.065	60.79	5198428

```
df.shape
```

```
(1258, 5)
```

```
# check for missing values
df_missing
```

missing_count	missing_ratio

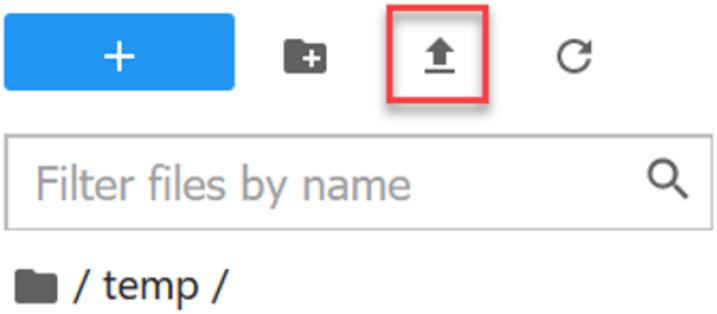
epoch	train_loss	valid_loss	accuracy	time
0	1562.704834	698.903931	0.000000	00:00
1	1393.395386	487.360260	0.000000	00:00
2	1241.338989	416.841797	0.000000	00:00

epoch	train_loss	valid_loss	accuracy	time
0	0.645138	0.602366	0.980000	00:00
1	0.520773	0.289147	1.000000	00:00
2	0.383414	0.065214	1.000000	00:00

```
(   workclass  education  marital-status  occupation  relationship  race  sex  \
 0        5.0        8.0             3.0         0.0           6.0   5.0  1.0

    native-country  education-num_na   age    fnlwgt  education-num  \
 0            40.0              1.0  49.0  101320.0           12.0

    capital-gain  capital-loss  hours-per-week  salary
 0           0.0        1902.0            40.0     1.0  ,
tensor(1),
tensor([0.2312, 0.7688]))
```




```
df_train.head()
```

	date	date_block_num	shop_id	item_id	item_price	item_cnt_day
0	02.01.2013	0	59	22154	999.00	1.0
1	03.01.2013	0	25	2552	899.00	1.0
2	05.01.2013	0	25	2552	899.00	-1.0
3	06.01.2013	0	25	2554	1709.05	1.0
4	15.01.2013	0	25	2555	1099.00	1.0

Chapter 4: Training Models with Text Data

UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment
3799	48751	London	16-03-2020	@MeNyrbie @Phil_Gahan @Chrisitv https://t.co/iFz9FAn2Pa and htt	Neutral
3800	48752	UK	16-03-2020	advice Talk to your neighbours family to exchange phone numbers ci	Positive
3801	48753	Vagabonds	16-03-2020	Coronavirus Australia: Woolworths to give elderly, disabled dedicate	Positive
3802	48754		16-03-2020	My food stock is not the only one which is empty...	Positive

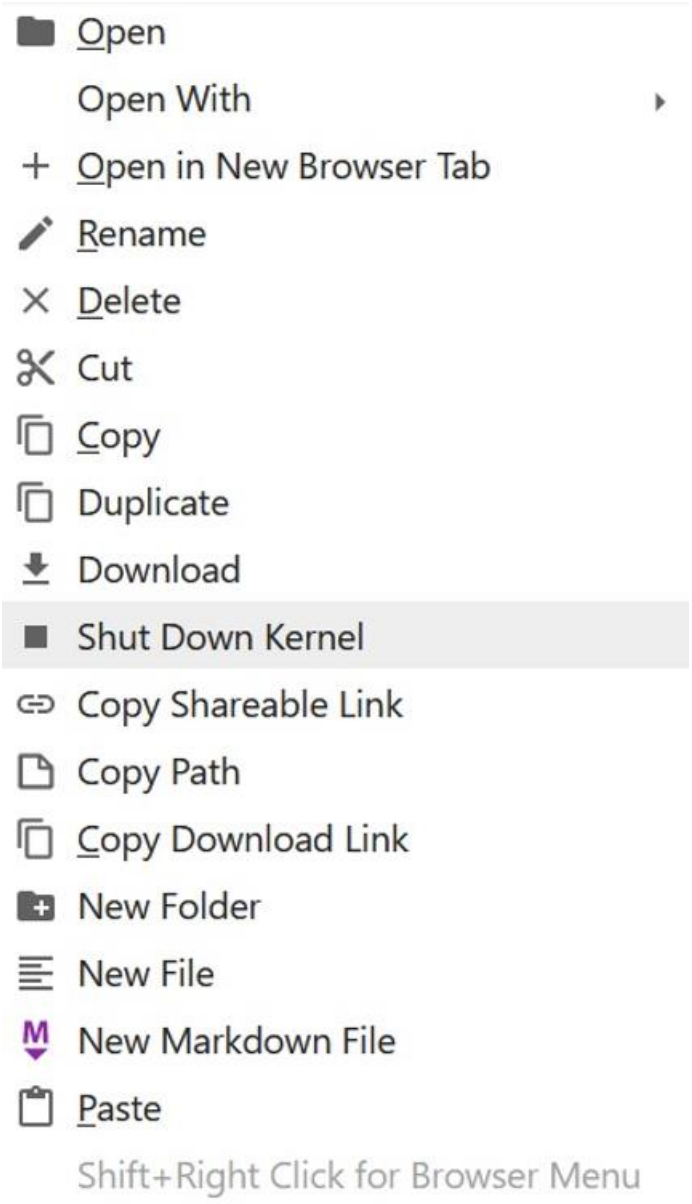
	text	text_
0	xxbos 50 years old , this musical comedy fantasy might look its age , but it wears it with dignity . \n\n xxmaj this film is still great fun . xxmaj crosby was never really romantic lead material , but he delivers the material with the lightly humorous edge it needs . xxmaj bendix plays broad and is huge fun in a part which calls upon his strengths . xxmaj hardwicke -	50 years old , this musical comedy fantasy might look its age , but it wears it with dignity . \n\n xxmaj this film is still great fun . xxmaj crosby was never really romantic lead material , but he delivers the material with the lightly humorous edge it needs . xxmaj bendix plays broad and is huge fun in a part which calls upon his strengths . xxmaj hardwicke - how
1	something despite stating that he wants to escape so he can see his daughter again , and xxmaj kate becomes emotionally tough seconds after going to pieces over someone that ripped her off for a xxunk . xxmaj yeah . \n\n xxmaj after starting out as a " this could happen to anyone " movie , it quickly falls apart as it introduces ideas that make it more and more unrealistic .	despite stating that he wants to escape so he can see his daughter again , and xxmaj kate becomes emotionally tough seconds after going to pieces over someone that ripped her off for a xxunk . xxmaj yeah . \n\n xxmaj after starting out as a " this could happen to anyone " movie , it quickly falls apart as it introduces ideas that make it more and more unrealistic . a

epoch	train_loss	valid_loss	accuracy	time
0	4.741510	4.345975	0.266929	34:07

epoch	train_loss	valid_loss	accuracy	time
0	4.238236	4.044060	0.296340	35:18

```
CPU times: user 50min 5s, sys: 12min 56s, total: 1h 3min 2s
Wall time: 1h 9min 32s
```

```
'what comes next is a same repugnantly western trash animation , badly written and watched TV comedy , largely written by'
```


Open
Open With
Open in New Browser Tab
Rename
Delete
Cut
Copy
Duplicate
Download
Shut Down Kernel
Copy Shareable Link
Copy Path
Copy Download Link
New Folder
New File
New Markdown File
Paste
Shift+Right Click for Browser Menu

	text	category
0	xxbos xxmaj match 1 : xxmaj tag xxmaj team xxmaj table xxmaj match xxmaj bubba xxmaj ray and xxmaj spike xxmaj dudley vs xxmaj eddie xxmaj guerrero and xxmaj chris xxmaj benoit xxmaj bubba xxmaj ray and xxmaj spike xxmaj dudley started things off with a xxmaj tag xxmaj team xxmaj table xxmaj match against xxmaj eddie xxmaj guerrero and xxmaj chris xxmaj benoit . xxmaj according to the rules of the match , both opponents have to go through tables in order to get the win . xxmaj benoit and xxmaj guerrero heated up early on by taking turns hammering first xxmaj spike and then xxmaj bubba xxmaj ray . a xxmaj german xxunk by xxmaj benoit to xxmaj bubba took the wind out of the xxmaj dudley brother . xxmaj spike tried to help his brother , but the referee restrained him while xxmaj benoit and xxmaj guerrero	pos
1	xxbos xxmaj by now you 've probably heard a bit about the new xxmaj disney dub of xxmaj miyazaki 's classic film , xxmaj laputa : xxmaj castle xxmaj in xxmaj the xxmaj sky . xxmaj during late summer of 1998 , xxmaj disney released " kiki 's xxmaj delivery xxmaj service " on video which included a preview of the xxmaj laputa dub saying it was due out in " 1 xxrep 3 9 " . xxmaj it 's obviously way past that year now , but the dub has been finally completed . xxmaj and it 's not " laputa : xxmaj castle xxmaj in xxmaj the xxmaj sky " , just " castle xxmaj in xxmaj the xxmaj sky " for the dub , since xxmaj laputa is not such a nice word in xxmaj spanish (even though they use the word xxmaj laputa many times	pos
2	xxbos xxmaj this movie was recently released on xxup dvd in the xxup us and i finally got the chance to see this hard - to - find gem . xxmaj it even came with original theatrical previews of other xxmaj italian horror classics like " xxunk " and " beyond xxup the xxup darkness " . xxmaj unfortunately , the previews were the best thing about this movie . \n\n " zombi 3 " in a bizarre way is actually linked to the infamous xxmaj lucio xxmaj fulci " zombie " franchise which began in 1979 . xxmaj similarly compared to " zombie " , " zombi 3 " consists of a threadbare plot and a handful of extremely bad actors that keeps this ' horror ' trash barely afloat . xxmaj the gore is nearly non - existent (unless one is frightened of people running around with	neg

epoch	train_loss	valid_loss	accuracy	time
0	0.432951	0.299519	0.874200	03:46
1	0.411521	0.291931	0.878600	03:29
2	0.395382	0.275534	0.887120	03:28
3	0.409314	0.263998	0.890040	03:28
4	0.379574	0.264123	0.891080	03:28

```
# get a prediction on a negative phrase
preds = learn.predict("this film shows incredibly bad writing and is a complete disaster")
```

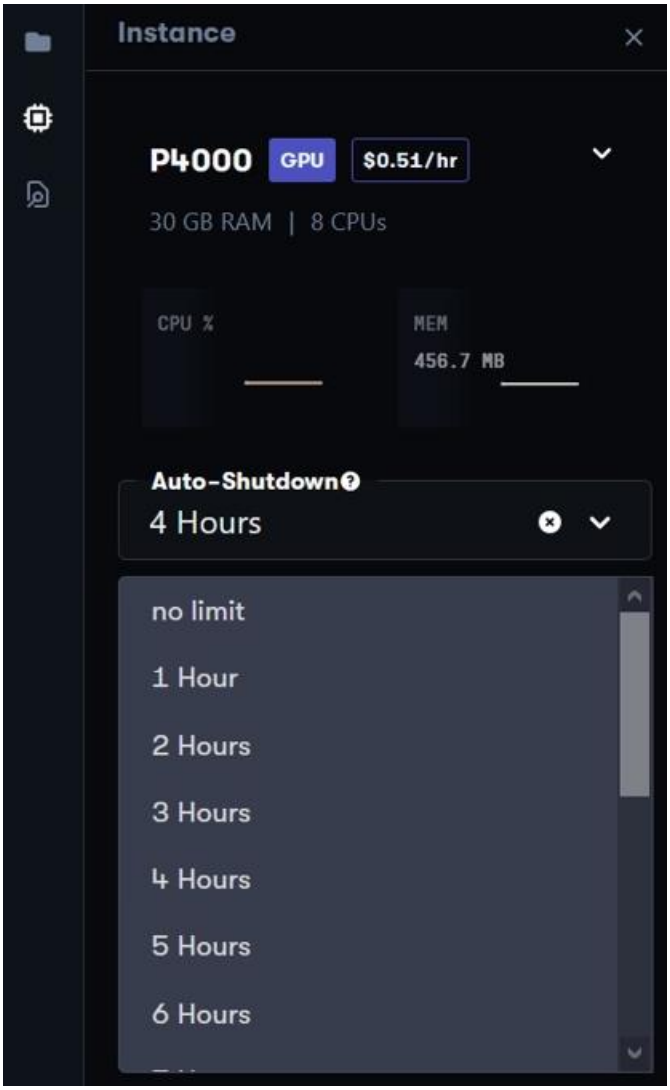
```
preds
```

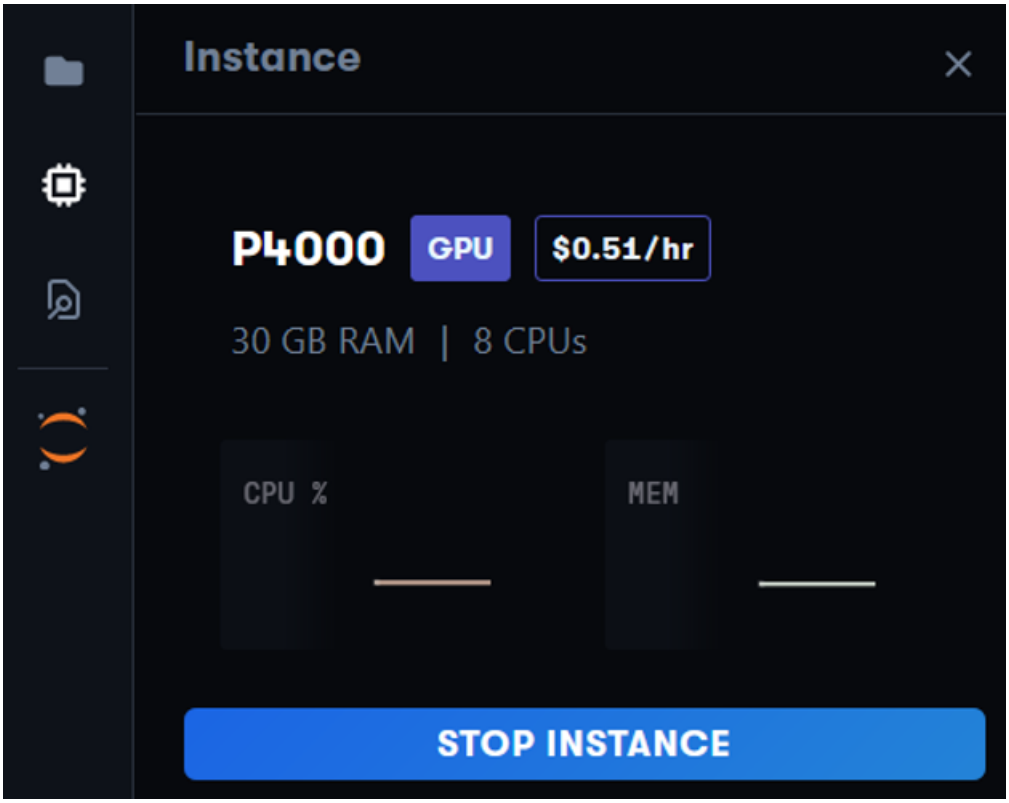
```
('negative', TensorText(0), TensorText([0.7244, 0.2756]))
```

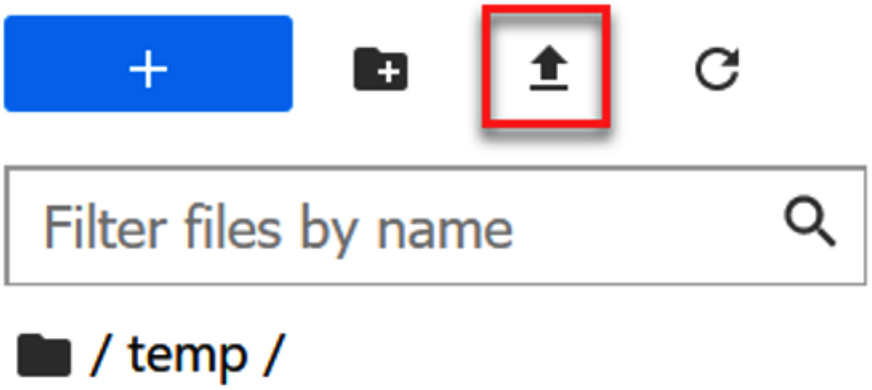
```
# get a prediction on a positive phrase
preds = learn.predict("this film shows incredible talent and is a complete triumph")
```

```
preds
```

```
('positive', TensorText(1), TensorText([0.0962, 0.9038]))
```


Instance
P4000
GPU
$0.51/hr
30 GB RAM | 8 CPUs
CPU %
MEM
456.7 MB
Auto-Shutdown
4 Hours
no limit
1 Hour
2 Hours
3 Hours
4 Hours
5 Hours
6 Hours


Instance
P4000
GPU
$0.51/hr
30 GB RAM | 8 CPUs
CPU %
MEM
STOP INSTANCE


Filter files by name
/ temp /

epoch	train_loss	valid_loss	accuracy	time
0	4.440168	3.958502	0.321858	01:56

epoch	train_loss	valid_loss	accuracy	time
0	3.998470	3.737445	0.343541	02:14

```
'what comes next to the message of panic for customers , who at this time constantly more hardship for bu
sinesses , they must'
```

	text	category
0	xxbos xxrep 5 ? ? ? xxrep 7 ? ? ? xxrep 7 ? xxrep 4 ? xxrep 4 ? xxrep 11 ? ? ? xxrep 6 ? xxrep 4 ? , xxrep 3 ? xxrep 3 ? ? ? xxrep 3 ? xxrep 4 ? xxrep 3 ? ? ? ? ? xxrep 4 ? ? ? xxrep 3 ? , xxrep 4 ? ? ? ? ? xxrep 6 ? xxrep 3 ? xxrep 3 ? xxrep 3 ? ? ? xxrep 3 ? \r\r\n__ xxrep 5 ? xxrep 6 ? ? ? xxrep 3 ? xxrep 4 ? xxrep 4 ? ? ? xxrep 4 ? xxrep 6 ? xxrep 4 ? xxrep 8 ? ? ? xxrep 6 ? ? ? xxrep 5 ? ? ? xxrep 3 ? xxrep 4 ? ? ? xxrep 7 ? xxrep 5 ? - xxrep 8 ? xxrep 5	Neutral
1	xxbos xxmaj fun xxmaj riding 4 xxmaj xxunk , xxmaj shield xxmaj bash # xxmaj cod # callofduty # xxmaj practice # xxmaj xxunk # xxmaj xxunk # xxmaj recreation # xxmaj fun # xxmaj bored # todo # xxmaj coronavirus # xxmaj quarantine # xxmaj isolation # toiletpaper # xxmaj lockdown # xxmaj art # xxmaj milk # xxmaj water # xxmaj xxunk # xxmaj weather # xxmaj cleveland # xxmaj ohio # xxmaj browns # xxup nfl # xxmaj xxunk # xxmaj poetry \r\r\n https : / / t.co / xxunk via @youtube	Positive
2	xxbos xxmaj friends ! xxmaj it 's xxmaj march 25 , 2020 at 03:00pm- time to xxup stop xxup renting & & buy a # home from # realtor xxmaj kally (khoelcher (at) gmail (dot) com) of # xxmaj goodyear # xxmaj arizona # coldwellbanker (269)240 - 8824 . # xxup n95 masks , # gloves , & & hand # sanitizer provided to xxup prevent # coronavirus . # xxmaj avondale # xxmaj buckeye # â __ https : / / t.co / xxunk	Extremely Positive

epoch	train_loss	valid_loss	accuracy	time
0	1.461614	1.281477	0.453286	00:37

```
preds = learn_clas.predict("the government's approach to the pandemic has been a complete disaster")
```

```
preds
```

```
('Negative',
 TensorText(2),
 TensorText([0.3328, 0.0545, 0.3551, 0.1026, 0.1551]))
```

```
preds = learn_clas.predict("the new vaccines hold the promise of a quick return to economic growth")
```

```
preds
```

```
('Extremely Positive',
 TensorText(1),
 TensorText([0.0565, 0.3758, 0.1528, 0.0699, 0.3450]))
```

Chapter 5: Training Recommender Systems

```
(#1) [Path('/storage/data/movie_lens_sample/ratings.csv')]
```

	userId	movieId	rating	timestamp
0	73	1097	4.0	1255504951
1	561	924	3.5	1172695223
2	157	260	3.5	1291598691
3	358	1210	5.0	957481884
4	130	316	2.0	1138999234

	userId	movieId	rating
0	461	150	3.0
1	285	3793	4.0
2	15	377	4.0
3	468	47	3.5
4	587	318	4.5
5	285	1291	3.0
6	268	500	3.0
7	380	590	4.0
8	128	364	5.0
9	574	780	3.5

epoch	train_loss	valid_loss	time
0	2.568535	2.594522	00:00
1	2.278521	2.051913	00:00
2	1.661850	1.358955	00:00
3	1.235316	1.137351	00:00
4	1.060143	1.107881	00:00

	userId	movieId
0	388	153
1	607	1210

```
(tensor([2.4156, 3.6090]), None)
```

```
'what comes next to the message of panic for customers , who at this time constantly more hardship for bu
sinesses , they must'
```

	userId	movieId
0	388	153
1	607	1210

```
(#23) [Path('/storage/data/ml-100k/ua.base'),Path('/storage/data/ml-100k/README'),Path('/storage/data/ml-100k/u4.test'),Pat
h('/storage/data/ml-100k/u.genre'),Path('/storage/data/ml-100k/u.item'),Path('/storage/data/ml-100k/u2.test'),Path('/storag
e/data/ml-100k/u.user'),Path('/storage/data/ml-100k/u5.test'),Path('/storage/data/ml-100k/u.occupation'),Path('/storage/dat
a/ml-100k/u5.base')...]
```

	userId	movieId	rating	timestamp
0	196	242	3	881250949
1	186	302	3	891717742
2	22	377	1	878887116
3	244	51	2	880606923
4	166	346	1	886397596

(100000, 4)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0	1	Toy Story (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Toy%20Story%20(1995)	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	GoldenEye (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?GoldenEye%20(1995)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2	3	Four Rooms (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Four%20Rooms%20(1995)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
3	4	Get Shorty (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Get%20Shorty%20(1995)	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
4	5	Copycat (1995)	01-Jan-1995	NaN	http://us.imdb.com/M/title-exact?Copycat%20(1995)	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0

(1682, 24)

	movieId	movieName
0	1	Toy Story (1995)
1	2	GoldenEye (1995)
2	3	Four Rooms (1995)
3	4	Get Shorty (1995)
4	5	Copycat (1995)

	userId	movieId	rating	timestamp	movieName
0	196	242	3	881250949	Kolya (1996)
1	186	302	3	891717742	L.A. Confidential (1997)
2	22	377	1	878887116	Heavyweights (1994)
3	244	51	2	880606923	Legends of the Fall (1994)
4	166	346	1	886397596	Jackie Brown (1997)

```
(100000, 5)
```

```
userId         943
movieId       1682
rating           5
timestamp    49282
movieName     1664
dtype: int64
```

```
userId       0
movieId      0
rating       0
timestamp    0
movieName    0
dtype: int64
```

	userId	movieName	rating
0	459	Bogus (1996)	3
1	332	Time to Kill, A (1996)	5
2	458	Independence Day (ID4) (1996)	1
3	932	Bananas (1971)	4
4	130	Jerry Maguire (1996)	5
5	717	Executive Decision (1996)	4
6	776	Terminator, The (1984)	3
7	25	North by Northwest (1959)	4
8	116	Ulee's Gold (1997)	3
9	466	Jackie Chan's First Strike (1996)	3

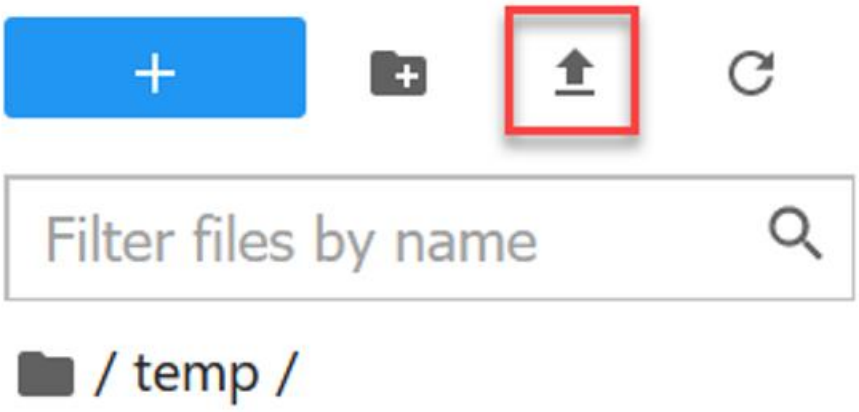
epoch	train_loss	valid_loss	time
0	1.259702	1.244677	00:10
1	0.916582	0.937143	00:10
2	0.831102	0.894830	00:10
3	0.804616	0.880501	00:10
4	0.755278	0.878830	00:10

	userId	movieId	rating	timestamp	movieName
979	233	375	4	876374419	Showgirls (1995)
3969	201	375	3	884287140	Showgirls (1995)
6158	343	375	2	876406978	Showgirls (1995)
11568	291	375	1	874868791	Showgirls (1995)
31108	346	375	1	875266176	Showgirls (1995)

```
1.9565217391304348
```

	userId	movieId	movieName
0	607	242	Kolya (1996)
1	607	302	L.A. Confidential (1997)
2	607	375	Showgirls (1995)

```
(tensor([4.2557, 4.3637, 2.2996]), None)
```




```
(#1) [Path('/storage/archive/amazon_reviews/ratings_Electronics.csv')]
```

	userID	productID	rating	timestamp
0	AKM1MP6P0OYPR	0132793040	5.0	1365811200
1	A2CX7LUOHB2NDG	0321732944	5.0	1341100800
2	A2NWSAGRHCP8N5	0439886341	1.0	1367193600
3	A2WNBOD3WNDNKT	0439886341	3.0	1374451200
4	A1GI0U4ZRJA8WN	0439886341	1.0	1334707200

```
(7824482, 4)
```

	userID	productID	rating
0	APSVFXSVU0P6C	B008ABOJKS	4.0
1	A2C2TQICKW8W8	B00BQ4SBSM	2.0
2	A1I2HYPP41PIAF	B000BKJZ9Q	2.0
3	A6XLG77BC9R8R	B003A4H4VQ	5.0
4	A2NYK9KWFMJV4Y	B002JDVBYU	5.0
5	A1H9OR8UASFIR6	B000BMAQAQ	4.0
6	A1E7USO8M79M7A	B0018JV6X2	1.0
7	A1N6RWK9XBXG3T	B007B31IYQ	5.0
8	A5NBOXDPQ75RJ	B006202R44	5.0
9	A29ZTEO6EKSRDV	B004S4XNKI	3.0

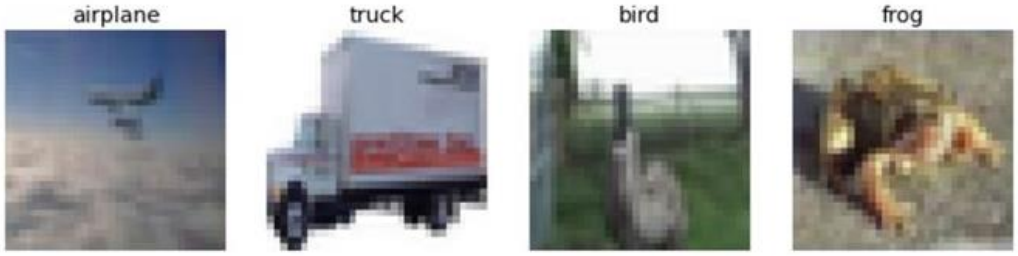
epoch	train_loss	valid_loss	time
0	2.829242	2.826828	3:36:08

	userID	productID
0	A2NYK9KWFMJV4Y	B008ABOJKS
1	A29ZTEO6EKSRDV	B006202R44

```
(tensor([4.4364, 2.5531]), None)
```

Chapter 6: Training Models with Visual Data

```
(#3) [Path('/storage/data/cifar10/test'),Path('/storage/data/cifar10/train'),Path('/storage/data/cifar1
0/labels.txt')]
```




```
(#10) [Path('/storage/data/cifar10/train/dog'),Path('/storage/data/cifar10/train/automobile'),Path('/st
orage/data/cifar10/train/frog'),Path('/storage/data/cifar10/train/airplane'),Path('/storage/data/cifar1
0/train/deer'),Path('/storage/data/cifar10/train/horse'),Path('/storage/data/cifar10/train/cat'),Path
('/storage/data/cifar10/train/truck'),Path('/storage/data/cifar10/train/bird'),Path('/storage/data/cifa
r10/train/ship')]
```

```
(#5000) [Path('/storage/data/cifar10/train/dog/15233_dog.png'),Path('/storage/data/cifar10/train/dog/15
19_dog.png'),Path('/storage/data/cifar10/train/dog/13990_dog.png'),Path('/storage/data/cifar10/train/do
g/16280_dog.png'),Path('/storage/data/cifar10/train/dog/42635_dog.png'),Path('/storage/data/cifar10/tra
in/dog/37152_dog.png'),Path('/storage/data/cifar10/train/dog/16540_dog.png'),Path('/storage/data/cifar1
0/train/dog/2182_dog.png'),Path('/storage/data/cifar10/train/dog/48048_dog.png'),Path('/storage/data/ci
far10/train/dog/17186_dog.png')...]
```


epoch	train_loss	valid_loss	accuracy	time
0	1.834696	1.698438	0.467800	00:56

epoch	train_loss	valid_loss	accuracy	time
0	1.312279	1.225815	0.677300	01:05
1	1.111695	1.048064	0.760600	01:06
2	0.947037	0.991742	0.785300	01:05
3	0.810161	0.987946	0.791500	01:05
4	0.745295	0.995719	0.793400	01:05

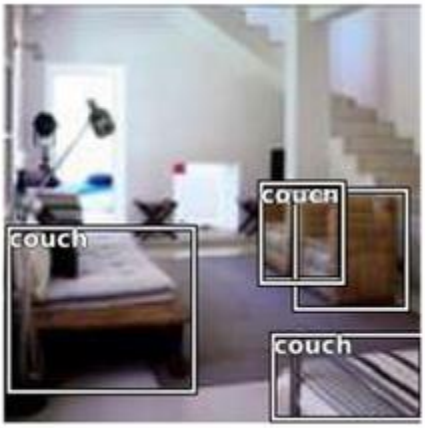

```
('dog',
 TensorImage(5),
 TensorImage([0.0167, 0.0154, 0.1496, 0.0879, 0.0338, 0.4890, 0.1772, 0.0096, 0.0082, 0.0125]))

('bird',
 TensorImage(2),
 TensorImage([0.0153, 0.0173, 0.7091, 0.0153, 0.1924, 0.0120, 0.0116, 0.0098, 0.0067, 0.0105]))

(#5000) [Path('/storage/data/cifar10/train/dog/15233_dog.png'),Path('/storage/data/cifar10/train/dog/15
19_dog.png'),Path('/storage/data/cifar10/train/dog/13990_dog.png'),Path('/storage/data/cifar10/train/do
g/16280_dog.png'),Path('/storage/data/cifar10/train/dog/42635_dog.png'),Path('/storage/data/cifar10/tra
in/dog/37152_dog.png'),Path('/storage/data/cifar10/train/dog/16540_dog.png'),Path('/storage/data/cifar1
0/train/dog/2182_dog.png'),Path('/storage/data/cifar10/train/dog/48048_dog.png'),Path('/storage/data/ci
far10/train/dog/17186_dog.png')...]
```

```
(#5000) [Path('/storage/data/cifar10/train/cat/42930_cat.png'),Path('/storage/data/cifar10/train/cat/21
351_cat.png'),Path('/storage/data/cifar10/train/cat/4151_cat.png'),Path('/storage/data/cifar10/train/ca
t/34987_cat.png'),Path('/storage/data/cifar10/train/cat/2197_cat.png'),Path('/storage/data/cifar10/trai
n/cat/15181_cat.png'),Path('/storage/data/cifar10/train/cat/26462_cat.png'),Path('/storage/data/cifar10
/train/cat/38932_cat.png'),Path('/storage/data/cifar10/train/cat/19061_cat.png'),Path('/storage/data/ci
far10/train/cat/23239_cat.png')...]
```

```
Downloading: "https://download.pytorch.org/models/resnet18-5c106cde.pth" to /root/.cache/torch/hub/checkpoints/resnet
18-5c106cde.pth
```




```
(#2) [Path('/storage/data/coco_tiny/train'),Path('/storage/data/coco_tiny/train.json')]
```

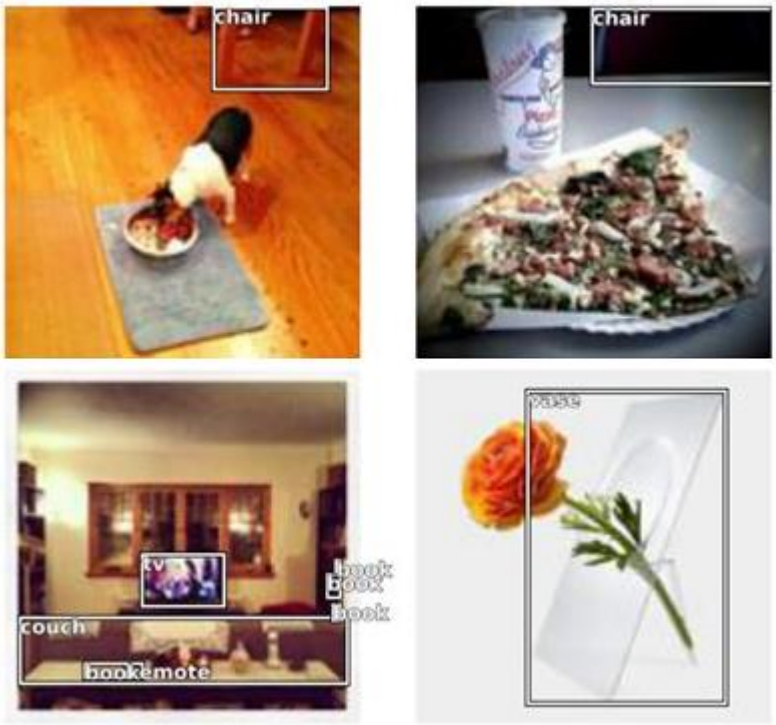
```
categories  [{'id': 62, 'name': 'chair'}, {'id': 63, 'name': 'couch'}, {'id': 72, 'name': 'tv'}, {'id':
75, 'name': 'remote'}, {'id': 84, 'name': 'book'}, {'id': 86, 'name': 'vase'}]
```

```
subset of images [{'id': 542959, 'file_name': '000000542959.jpg'}, {'id': 129739, 'file_name': '0000001
29739.jpg'}, {'id': 153607, 'file_name': '000000153607.jpg'}, {'id': 329258, 'file_name': '00000032925
8.jpg'}, {'id': 452866, 'file_name': '000000452866.jpg'}]
```

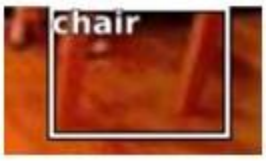
```
subset of annotations [{'image_id': 542959, 'bbox': [32.52, 86.34, 8.53, 9.41], 'category_id': 62}, {'i
mage_id': 542959, 'bbox': [98.12, 110.52, 1.95, 4.07], 'category_id': 86}, {'image_id': 542959, 'bbox':
[91.28, 51.62, 3.95, 5.72], 'category_id': 86}, {'image_id': 542959, 'bbox': [110.48, 110.82, 14.55, 1
5.22], 'category_id': 62}, {'image_id': 542959, 'bbox': [96.63, 50.18, 18.67, 13.46], 'category_id': 6
2}]
```

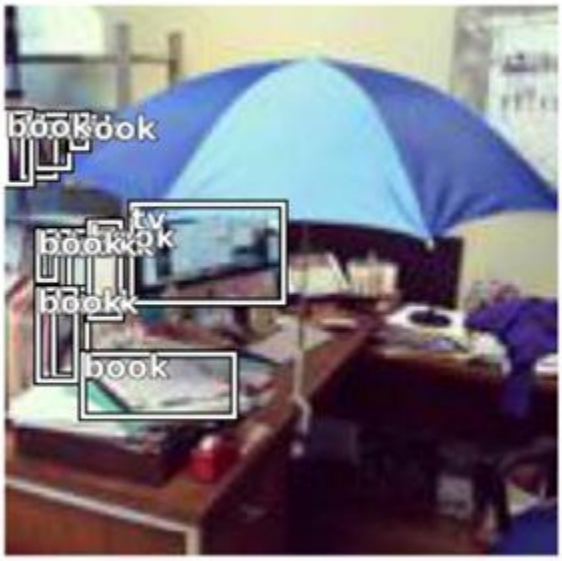
```
([[103.73, 49.63, 125.98, 91.81],
  [18.25, 78.44, 36.980000000000004, 89.50999999999999]],
 ['tv', 'chair'])
```


chair
couch
couch
vase
vase
vase
vase



categories [{'id': 62, 'name': 'chair'}, {'id': 63, 'name': 'couch'}, {'id': 72, 'name': 'tv'}, {'id': 75, 'name': 'remote'}, {'id': 84, 'name': 'book'}, {'id': 86, 'name': 'vase'}]





subset of annotations [{'image_id': 542959, 'bbox': [32.52, 86.34, 8.53, 9.41], 'category_id': 62}, {'image_id': 542959, 'bbox': [98.12, 110.52, 1.95, 4.07], 'category_id': 86}, {'image_id': 542959, 'bbox': [91.28, 51.62, 3.95, 5.72], 'category_id': 86}, {'image_id': 542959, 'bbox': [110.48, 110.82, 14.55, 15.22], 'category_id': 62}, {'image_id': 542959, 'bbox': [96.63, 50.18, 18.67, 13.46], 'category_id': 62}]

array([[13.52, 19.59, 44. , 56.46]])

LICENSE Test Training papers readme.md test-multiple_fruits

(#6) [Path('/storage/archive/fruits-360/Test'),Path('/storage/archive/fruits-360/papers'),Path('/storage/archive/fruits-360/LICENSE'),Path('/storage/archive/fruits-360/test-multiple_fruits'),Path('/storage/archive/fruits-360/Training'),Path('/storage/archive/fruits-360/readme.md')]

(#131) [Path('/storage/archive/fruits-360/Training/Pomegranate'),Path('/storage/archive/fruits-360/Training/Pepper Green'),Path('/storage/archive/fruits-360/Training/Apple Golden 2'),Path('/storage/archive/fruits-360/Training/Strawberry Wedge'),Path('/storage/archive/fruits-360/Training/Apple Crimson Snow'),Path('/storage/archive/fruits-360/Training/Granadilla'),Path('/storage/archive/fruits-360/Training/Quince'),Path('/storage/archive/fruits-360/Training/Tomato not Ripened'),Path('/storage/archive/fruits-360/Training/Peach'),Path('/storage/archive/fruits-360/Training/Apricot')...]

epoch	train_loss	valid_loss	accuracy	time
0	1.077759	1.049447	0.963946	01:31

epoch	train_loss	valid_loss	accuracy	time
0	0.913377	0.902737	0.991978	01:58
1	0.863309	0.864238	0.995769	01:58
2	0.841727	0.836321	0.997796	01:58
3	0.831393	0.830771	0.997444	01:58
4	0.829582	0.828693	0.997884	01:58

```
('Strawberry Wedge',
 TensorImage(117),
 TensorImage([5.5287e-04, 5.8729e-04, 4.3915e-04, 7.1637e-04, 4.6952e-04, 5.7983e-04, 4.7180e-04, 5.961
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         7.2990e-04, 8.4665e-04, 3.6720e-04, 7.0212e-04, 8.6347e-04, 6.0037e-04, 7.3940e-04, 7.6813e-0
4, 6.0635e-04, 7.5843e-04, 7.1088e-04, 6.3793e-04, 7.8211e-04, 5.6861e-04, 6.8963e-04, 6.6847e-04,
         6.0576e-04, 6.2287e-04, 7.5428e-04, 9.0836e-04, 6.8213e-04, 7.9148e-04, 5.5145e-04, 5.9907e-0
4, 5.0626e-04, 5.7467e-04, 6.3718e-04, 6.5144e-04, 5.0754e-04, 8.1586e-04, 5.3653e-04, 6.4462e-04,
         6.2153e-04, 6.6965e-04, 7.3855e-04, 7.9604e-04, 5.8874e-04, 5.4711e-04, 5.7097e-04, 6.0761e-0
4, 5.8197e-04, 7.9834e-04, 7.2468e-04, 6.7074e-04, 4.2638e-04, 6.4700e-04, 7.2001e-04, 4.7989e-04,
         6.2428e-04, 5.0561e-04, 8.9213e-04, 6.2297e-04, 6.2638e-04, 6.8443e-04, 6.0546e-04, 7.3738e-0
4, 5.9545e-04, 5.4710e-04, 5.5876e-04, 5.5428e-04, 7.0495e-04, 5.9575e-04, 6.4429e-04, 6.2548e-04,
         5.3481e-04, 7.3763e-04, 8.1653e-04, 6.7845e-04, 5.5469e-04, 5.8693e-04, 7.6158e-04, 5.2563e-0
4, 5.5775e-04, 8.9908e-04, 5.8551e-04, 7.3647e-04, 7.4814e-04, 6.9160e-04, 6.0768e-04, 6.0972e-04,
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4, 8.1783e-04, 6.8215e-04, 5.9703e-04, 6.2589e-04, 6.8557e-04, 7.1313e-04, 7.0622e-04, 5.2479e-04,
         9.2585e-04, 6.6376e-04, 8.6684e-04, 1.4500e-03, 5.9743e-04, 9.1559e-01, 6.1752e-04, 5.8028e-0
4, 6.2902e-04, 6.2443e-04, 6.4723e-04, 5.7449e-04, 5.8301e-04, 6.6725e-04, 5.9484e-04, 6.9533e-04,
         5.5896e-04, 6.6607e-04, 5.7679e-04]))
```

```
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 TensorImage(125),
 TensorImage([5.6110e-04, 7.4122e-04, 6.6106e-04, 7.0526e-04, 8.3456e-04, 7.1830e-04, 4.7857e-04, 8.251
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         4.8520e-04, 6.9078e-04, 6.8147e-04, 6.5862e-04, 6.2541e-04, 6.0323e-04, 5.7093e-04, 6.2094e-0
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         1.0332e-03, 7.8081e-04, 6.2899e-04, 6.0411e-04, 9.1333e-04, 5.1715e-04, 7.8582e-04, 5.9428e-0
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         6.4336e-04, 5.6270e-04, 6.3225e-04, 4.6516e-04, 8.3983e-04, 9.1788e-04, 7.0737e-04, 5.5703e-0
4, 1.0298e-03, 7.0811e-04, 1.0442e-03, 5.1234e-04, 7.6787e-04, 9.0879e-01, 6.5822e-04, 5.9174e-04,
         6.9979e-04, 7.3096e-04, 7.3068e-04]))
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        4.9715e-04, 9.2339e-01, 5.6719e-04]))
```

```
Path('/storage/archive/fruits-360/models/fruits_modelmay3.pth')
```

```
(#8) [Path('/storage/data/pascal_2007/train'),Path('/storage/data/pascal_2007/test.json'),Path('/storage/data/pascal_2007/se
gmentation'),Path('/storage/data/pascal_2007/train.json'),Path('/storage/data/pascal_2007/valid.json'),Path('/storage/data/p
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subset of annotations [{'segmentation': [[155, 96, 155, 270, 351, 270, 351, 96]], 'area': 34104, 'iscrowd': 0,
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crowd': 0, 'image_id': 17, 'bbox': [89, 77, 314, 259], 'category_id': 13, 'id': 3, 'ignore': 0}, {'segmentatio
n': [[8, 229, 8, 500, 245, 500, 245, 229]], 'area': 64227, 'iscrowd': 0, 'image_id': 23, 'bbox': [8, 229, 237, 2
71], 'category_id': 2, 'id': 4, 'ignore': 0}, {'segmentation': [[229, 219, 229, 500, 334, 500, 334, 219]], 'are
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```

```
([[8, 106, 499, 263], [420, 199, 482, 226], [324, 187, 411, 223]],
 ['aeroplane', 'aeroplane', 'aeroplane'])
```

```
([[8, 106, 499, 263], [420, 199, 482, 226], [324, 187, 411, 223]],
 ['aeroplane', 'aeroplane', 'aeroplane'])
```


```
array(['motorbike', 'person', 'person', 'person', 'person', 'person', 'person', 'person', 'person', 'person', 'person', 'per
son', 'person', 'person'], dtype=object)
```


```
number of training images:  5011
number of testing images:  4952

                              len(return_list):  2501
number of categories is:  20  len(empty_list):  2510
```

tvmonitor

dog;person;sheep

bird

dog;person

epoch	train_loss	valid_loss	time
0	0.877005	0.559717	00:07

epoch	train_loss	valid_loss	time
0	0.642405	0.471323	00:09
1	0.523728	0.292567	00:09
2	0.340163	0.150779	00:09
3	0.216213	0.119942	00:09
4	0.158638	0.109708	00:09
5	0.129925	0.107407	00:09
6	0.112691	0.105818	00:09
7	0.102112	0.103462	00:09
8	0.094495	0.103746	00:09
9	0.091821	0.103420	00:09

```
((#2) ['horse','person'],
 TensorImage([False, False, False, False, False, False, False, False, False, False, False, False,  True, F
alse,  True, False, False, False, False, False]),
 TensorImage([0.0020, 0.0067, 0.0016, 0.0090, 0.0063, 0.0034, 0.0185, 0.0066, 0.0041, 0.0366, 0.0059, 0.16
36, 0.7742, 0.0050, 0.9009, 0.0044, 0.0075, 0.0075, 0.0099, 0.0031]))
```

```
((#1) ['cat'],
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alse, False, False, False, False, False, False, False]),
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74, 0.0098, 0.0033, 0.0026, 0.0027, 0.0050, 0.0075, 0.0026, 0.0045]))
```

```
number of training images:  5011
number of testing images:  4952
```

```
len(return_list):  2501
len(empty_list):  2510
```

```
root@nyyka0v6hr:/storage/archive/fruits-360# find /storage/archive/fruits-360/Training -type f | wc -l
67692
```

```
Total params: 11,714,112
Total trainable params: 547,200
Total non-trainable params: 11,166,912
```

epoch	train_loss	valid_loss	time
0	0.883540	0.556862	00:08

epoch	train_loss	valid_loss	time
0	0.640981	0.464962	00:10
1	0.563007	0.366122	00:10
2	0.442997	0.236964	00:10
3	0.308103	0.149992	00:10
4	0.212907	0.120228	00:10
5	0.163879	0.111883	00:10
6	0.135566	0.107638	00:11
7	0.115231	0.109443	00:10
8	0.100900	0.104464	00:10
9	0.089603	0.103160	00:10
10	0.082206	0.105580	00:10
11	0.074104	0.105146	00:10
12	0.065566	0.103051	00:10
13	0.058820	0.106906	00:10
14	0.055226	0.104793	00:10
15	0.050850	0.106087	00:10
16	0.047641	0.105736	00:10
17	0.044487	0.106318	00:10
18	0.043247	0.105515	00:10
19	0.042669	0.105577	00:10

```
Total params: 11,714,112
Total trainable params: 11,714,112
Total non-trainable params: 0
```

epoch	train_loss	valid_loss	time
0	0.877005	0.559717	00:07

epoch	train_loss	valid_loss	time
0	0.642405	0.471323	00:09
1	0.523728	0.292567	00:09
2	0.340163	0.150779	00:09
3	0.216213	0.119942	00:09
4	0.158638	0.109708	00:09
5	0.129925	0.107407	00:09
6	0.112691	0.105818	00:09
7	0.102112	0.103462	00:09
8	0.094495	0.103746	00:09
9	0.091821	0.103420	00:09

```
root@nyyka0v6hr:/storage/archive/fruits-360# find /storage/archive/fruits-360/Training -type f | wc -l
67692
```

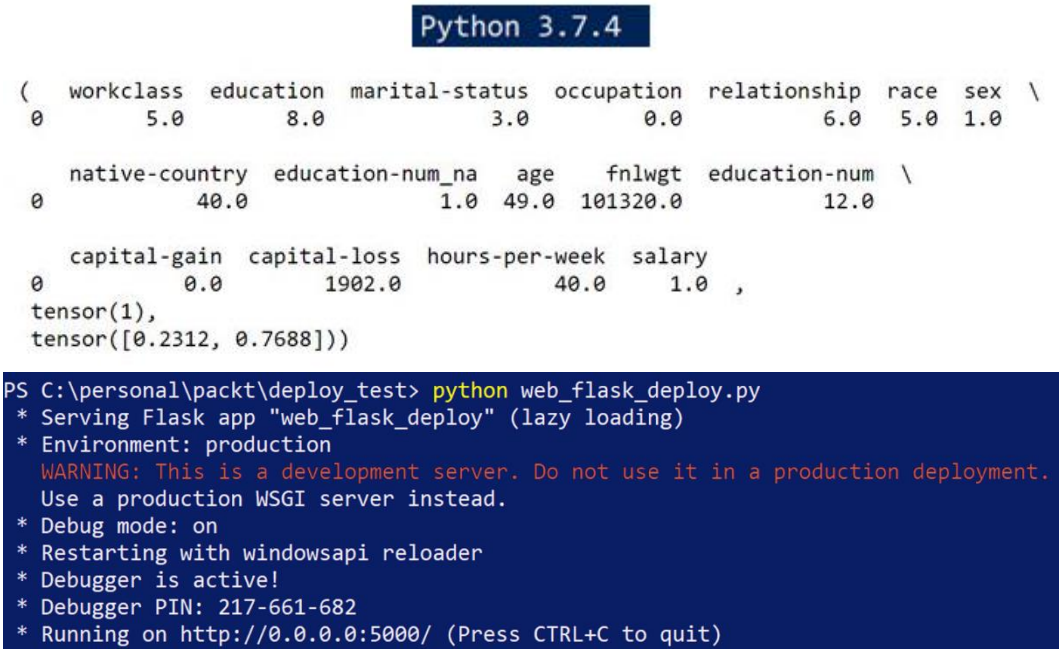
```
Total params: 11,714,112
Total trainable params: 547,200
Total non-trainable params: 11,166,912
```

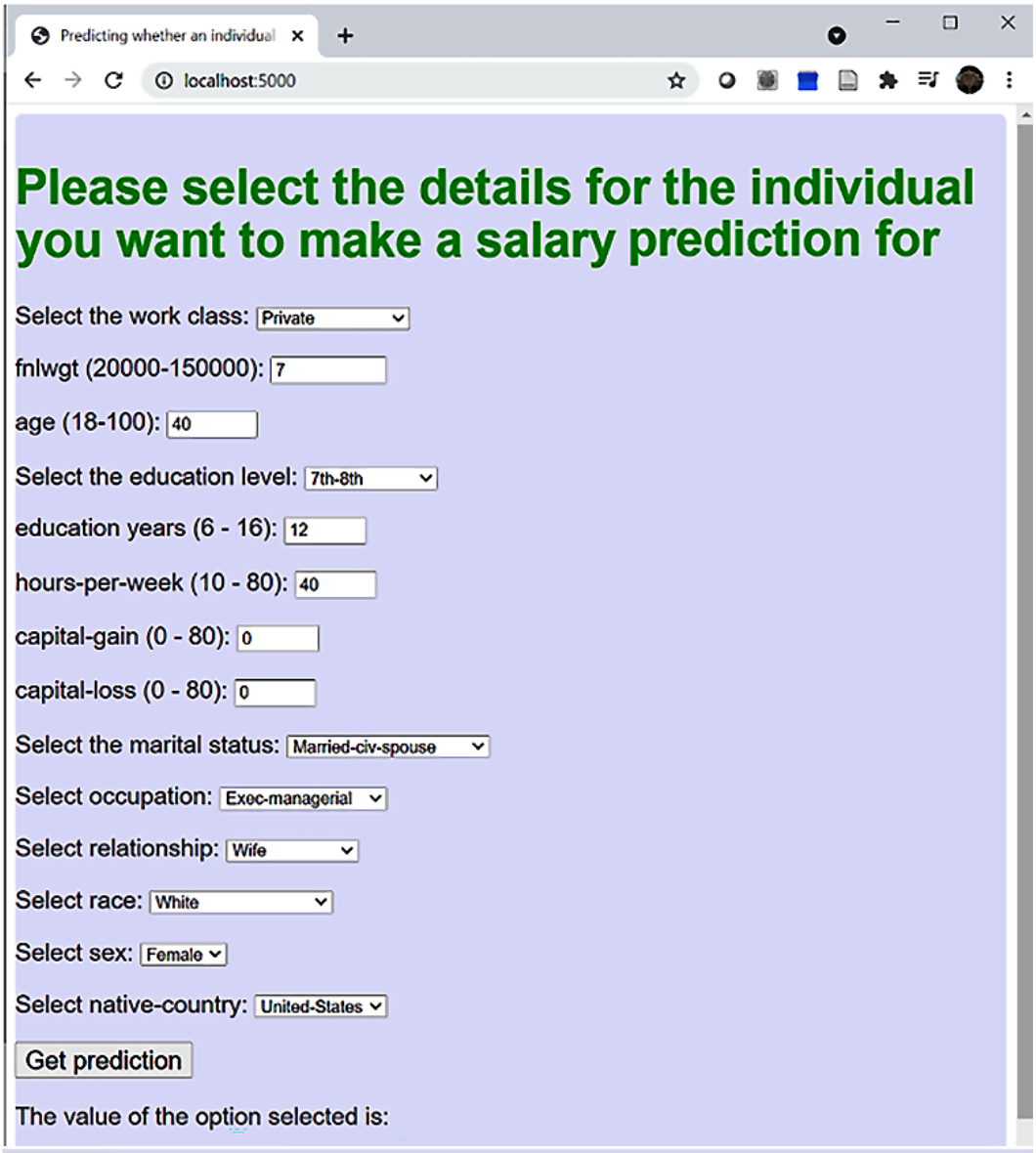
epoch	train_loss	valid_loss	time
0	0.883540	0.556862	00:08

epoch	train_loss	valid_loss	time
0	0.640981	0.464962	00:10
1	0.563007	0.366122	00:10
2	0.442997	0.236964	00:10
3	0.308103	0.149992	00:10
4	0.212907	0.120228	00:10
5	0.163879	0.111883	00:10
6	0.135566	0.107638	00:11
7	0.115231	0.109443	00:10
8	0.100900	0.104464	00:10
9	0.089603	0.103160	00:10
10	0.082206	0.105580	00:10
11	0.074104	0.105146	00:10
12	0.065566	0.103051	00:10
13	0.058820	0.106906	00:10
14	0.055226	0.104793	00:10
15	0.050850	0.106087	00:10
16	0.047641	0.105736	00:10
17	0.044487	0.106318	00:10
18	0.043247	0.105515	00:10
19	0.042669	0.105577	00:10

```
Total params: 11,714,112
Total trainable params: 11,714,112
Total non-trainable params: 0
```

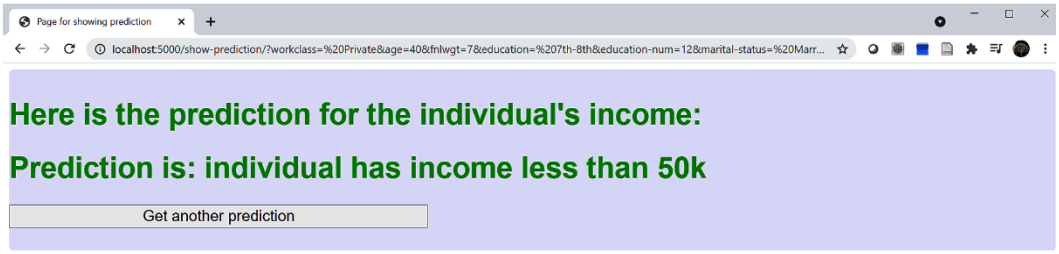
Chapter 7: Deployment and Model Maintenance

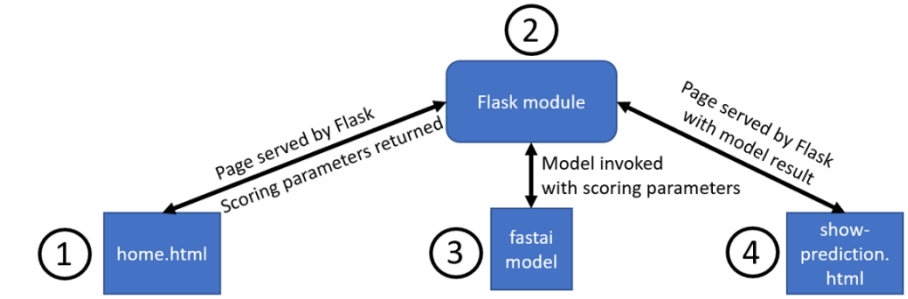


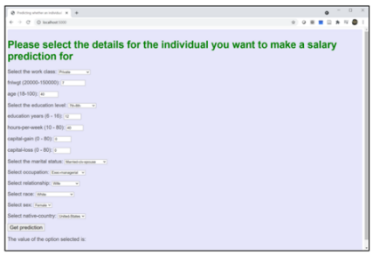


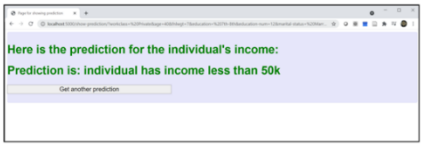
Get prediction

The value of the option selected is: /show-prediction/?workclass= Private&age=40&fnlwgt=7&education= 7th-8th&education-num=12&marital-status= Married-civ-spouse&occupation= Exec-managerial&relationship= Wife&race= White&sex= Female&capital-gain=0&capital-loss=0&hours-per-week=40&native-country=United-States







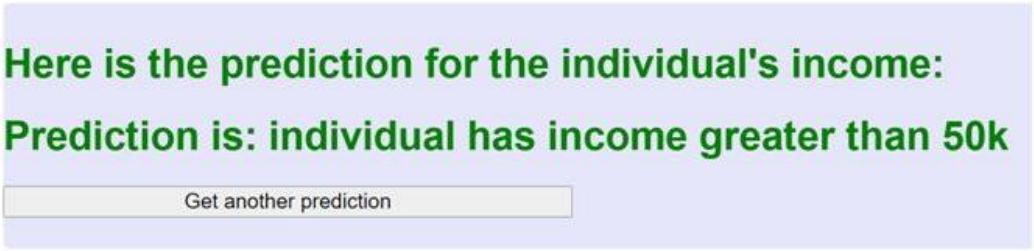



```
(   workclass  education  marital-status  occupation  relationship  race  sex  \
 0        5.0        8.0             3.0         0.0           6.0   5.0  1.0

    native-country  education-num_na   age    fnlwgt  education-num  \
 0            40.0               1.0  49.0  101320.0           12.0

    capital-gain  capital-loss  hours-per-week  salary
 0           0.0        1902.0            40.0     1.0  ,
 tensor(1),
 tensor([0.2312, 0.7688]))
```

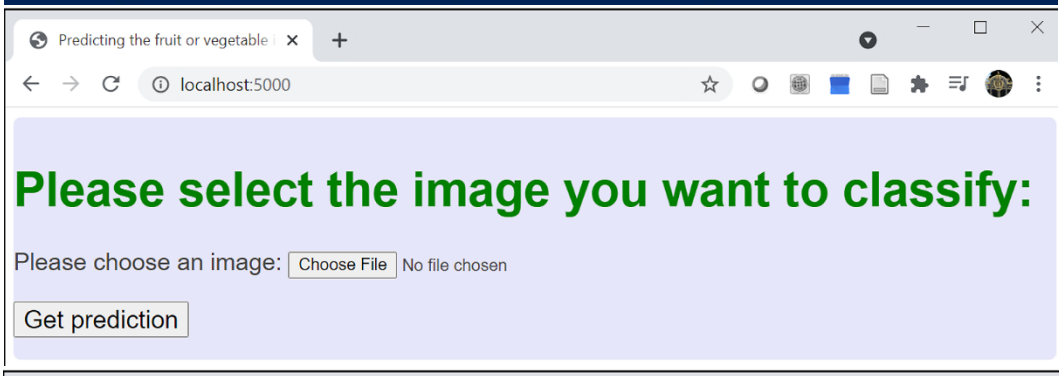
⟵ pred_class

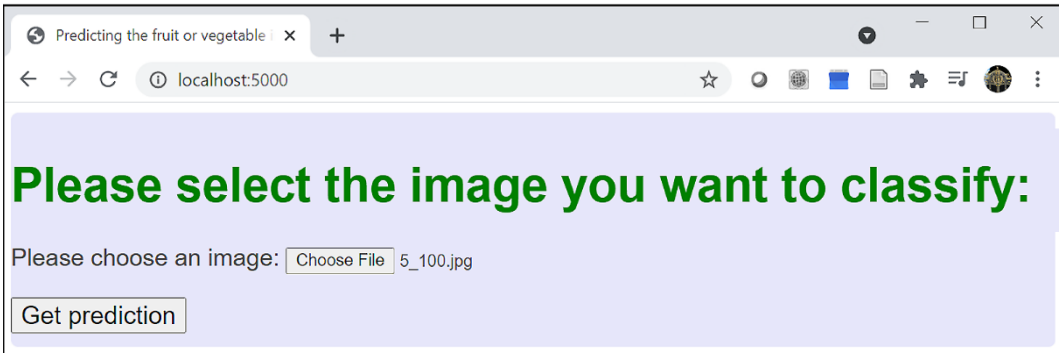
⟵ pred_idx

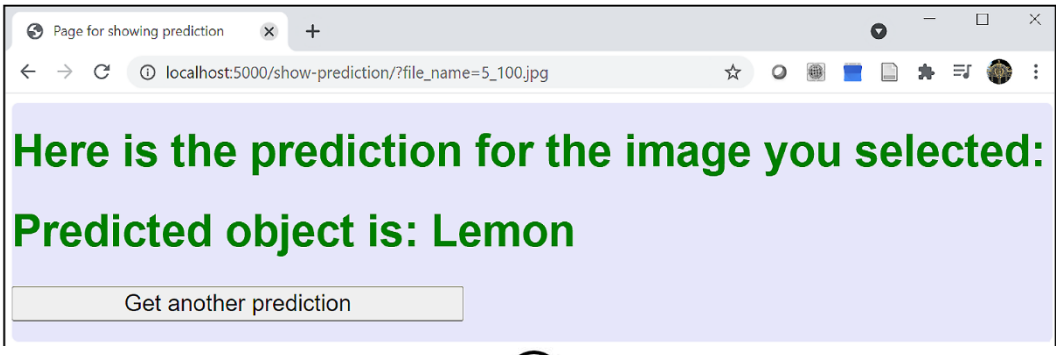
⟵ outputs

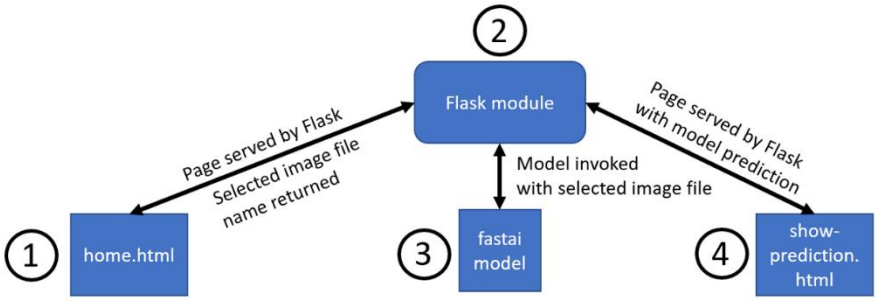


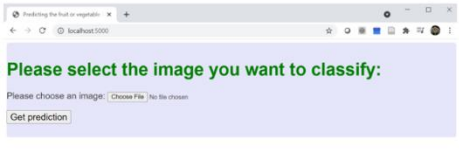
```
PS C:\personal\packt\deploy_image> python web_flask_deploy_image_model.py
path is: C:\personal\packt\deploy_image
full_path is:  C:\personal\packt\deploy_image\fruits_360may3.pkl
 * Serving Flask app "web_flask_deploy_image_model" (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production deployment.
   Use a production WSGI server instead.
 * Debug mode: on
 * Restarting with windowsapi reloader
path is: C:\personal\packt\deploy_image
full_path is:  C:\personal\packt\deploy_image\fruits_360may3.pkl
 * Debugger is active!
 * Debugger PIN: 217-661-682
 * Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
```

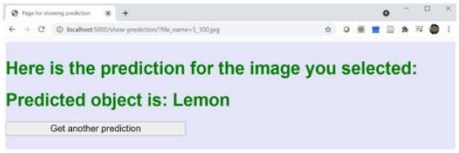




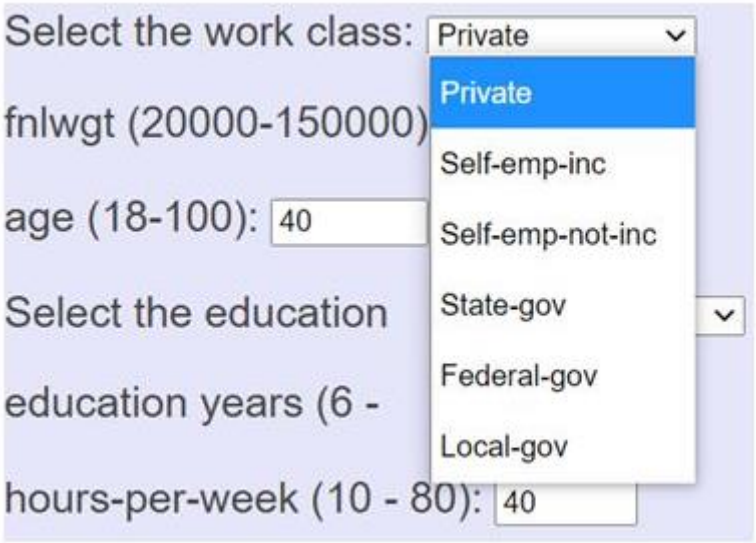








	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	age	workclass	fnlwgt	education	education-	marital-sta	occupatio	relationshi	race	sex	capital-gai	capital-los	hours-per-	native-cou	salary
2	49	Private	101320	Assoc-acd	12	Married-civ-spouse		Wife	White	Female	0	1902	40	United-St	>=50k
3	44	Private	236746	Masters	14	Divorced	Exec-man	Not-in-fa	White	Male	10520	0	45	United-St	>=50k
4	38	Private	96185	HS-grad		Divorced		Unmarrie	Black	Female	0	0	32	United-St	<50k
5	38	Self-emp	112847	Prof-scho	15	Married-c	Prof-speci	Husband	Asian-Pac-	Male	0	0	40	United-St	>=50k
6	42	Self-emp	82297	7th-8th		Married-c	Other-ser	Wife	Black	Female	0	0	50	United-St	<50k
7	20	Private	63210	HS-grad	9	Never-ma	Handlers-	Own-child	White	Male	0	0	15	United-St	<50k
8	49	Private	44434	Some-coll	10	Divorced		Other-rel	White	Male	0	0	35	United-St	<50k
9	37	Private	138940	11th	7	Married-civ-spouse		Husband	White	Male	0	0	40	United-St	<50k
10	46	Private	328216	HS-grad	9	Married-c	Craft-repa	Husband	White	Male	0	0	40	United-St	>=50k
11	36	Self-emp	216711	HS-grad		Married-civ-spouse		Husband	White	Male	99999	0	50	?	>=50k
12	23	Private	529223	Bachelors	13	Never-married		Own-child	Black	Male	0	0	10	United-St	<50k
13	18	Private	216284	11th		Never-ma	Adm-cleri	Own-child	White	Female	0	0	20	United-St	<50k
14	30	Private	151989	Assoc-voc		Married-civ-spouse		Wife	White	Female	0	0	40	United-St	<50k



Please select the images you want to classify:

Please choose images: Choose Files 3 files

Get prediction

Here are the predictions for the images you selected:

Apricot, Lemon, Beetroot

Get another prediction

Chapter 8: Extended fastai and Deployment Features

epoch	train_loss	valid_loss	accuracy	recall_score	precision_score	time
0	0.337531	0.354399	0.830508	0.609375	0.722222	00:07
1	0.325458	0.356652	0.826271	0.562500	0.734694	00:07
2	0.317219	0.344203	0.838983	0.578125	0.770833	00:07

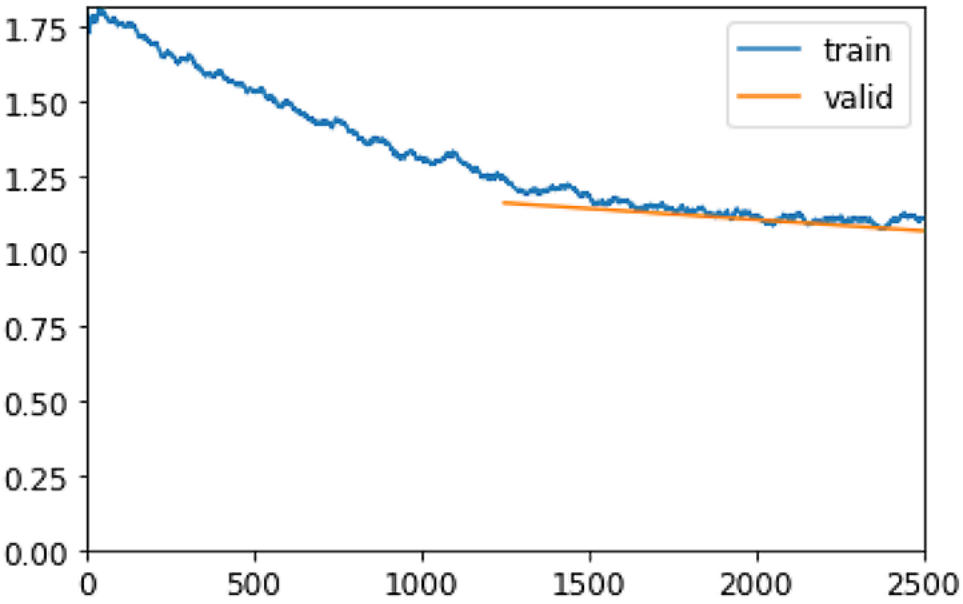
```
CPU times: user 21.2 s, sys: 112 ms, total: 21.3 s
Wall time: 21.3 s
```

```
Setting-up type transforms pipelines
Collecting items from /storage/data/cifar10/train
Found 50000 items
2 datasets of sizes 40000,10000
```

```
Building one sample
  Pipeline: PILBase.create
    starting from
      /storage/data/cifar10/train/truck/3702_truck.png
    applying PILBase.create gives
      PILImage mode=RGB size=32x32
  Pipeline: parent_label -> Categorize -- {'vocab': None, 'sort': True, 'add_na': False}
    starting from
      /storage/data/cifar10/train/truck/3702_truck.png
    applying parent_label gives
      truck
    applying Categorize -- {'vocab': None, 'sort': True, 'add_na': False} gives
      TensorCategory(9)
```

```
Building one batch
Applying item_tfms to the first sample:
  Pipeline: ToTensor
    starting from
      (PILImage mode=RGB size=32x32, TensorCategory(9))
    applying ToTensor gives
      (TensorImage of size 3x32x32, TensorCategory(9))
```

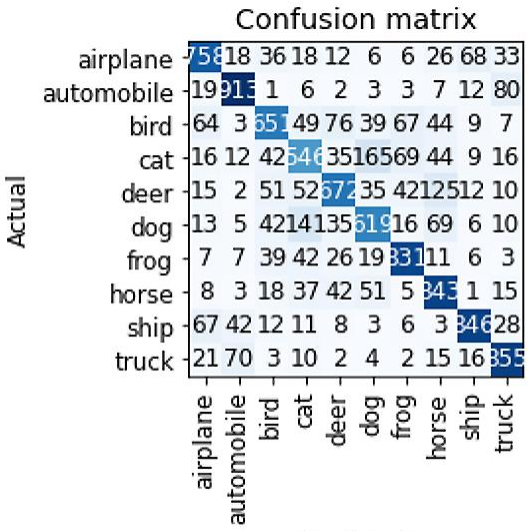
```
Applying batch_tfms to the batch built
  Pipeline: IntToFloatTensor -- {'div': 255.0, 'div_mask': 1}
    starting from
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
```



epoch	train_loss	valid_loss	accuracy	time
0	1.248233	1.160732	0.714300	01:50
1	1.109203	1.067518	0.752600	01:49

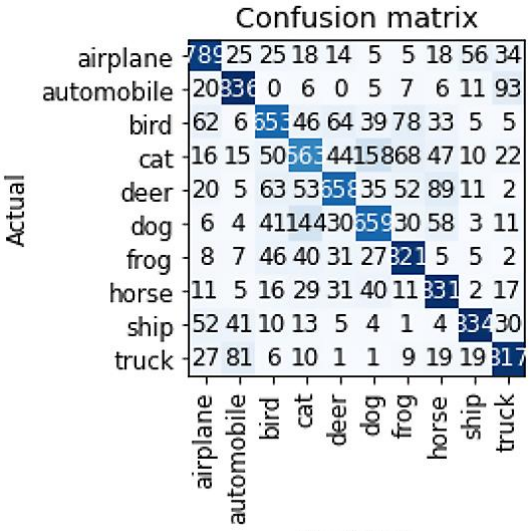
```
(#2) [1.0675183534622192,0.7526000142097473]
```

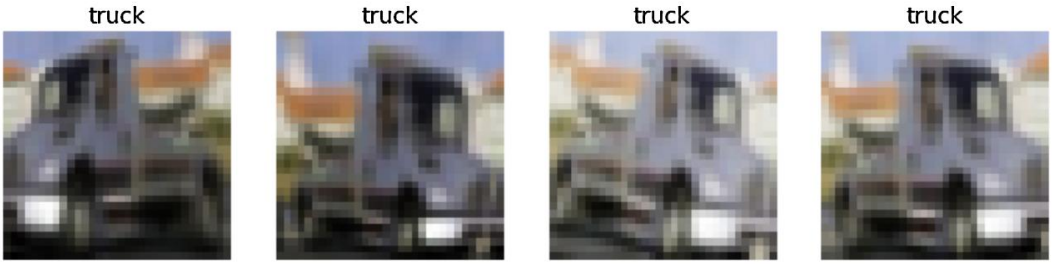
Prediction/Actual/Loss/Probability



(#2) [1.0432653427124023,0.7565000057220459]

Prediction/Actual/Loss/Probability

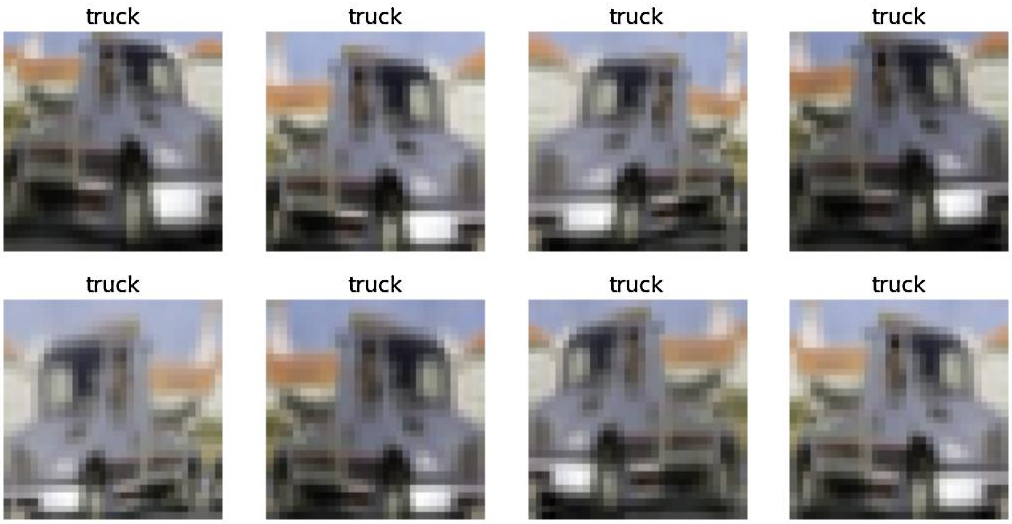





```
Setting-up type transforms pipelines
Collecting items from /storage/data/cifar10/train
Found 50000 items
2 datasets of sizes 40000,10000
Building one sample
  Pipeline: PILBase.create
    starting from
      /storage/data/cifar10/train/truck/3702_truck.png
    applying PILBase.create gives
      PILImage mode=RGB size=32x32
  Pipeline: parent_label -> Categorize -- {'vocab': None, 'sort': True, 'add_na': False}
    starting from
      /storage/data/cifar10/train/truck/3702_truck.png
    applying parent_label gives
      truck
    applying Categorize -- {'vocab': None, 'sort': True, 'add_na': False} gives
      TensorCategory(9)
```

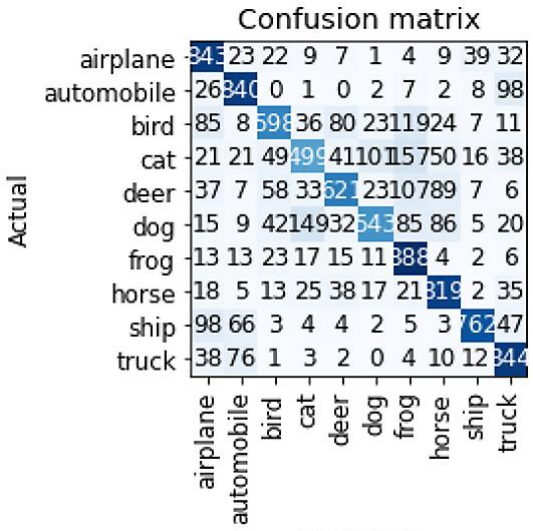
```
Building one batch
Applying item_tfms to the first sample:
  Pipeline: ToTensor
    starting from
      (PILImage mode=RGB size=32x32, TensorCategory(9))
    applying ToTensor gives
      (TensorImage of size 3x32x32, TensorCategory(9))
```

```
Applying batch_tfms to the batch built
  Pipeline: IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} -> Flip -- {'size': None, 'mode': 'bilinear', 'pad_mode': 'refl
ection', 'mode_mask': 'nearest', 'align_corners': True, 'p': 0.5} -> Brightness -- {'max_lighting': 0.2, 'p': 1.0, 'draw': No
ne, 'batch': False}
    starting from
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying Flip -- {'size': None, 'mode': 'bilinear', 'pad_mode': 'reflection', 'mode_mask': 'nearest', 'align_corners': Tr
ue, 'p': 0.5} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying Brightness -- {'max_lighting': 0.2, 'p': 1.0, 'draw': None, 'batch': False} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
```



epoch	train_loss	valid_loss	accuracy	time
0	1.356869	1.199771	0.695700	02:26
1	1.197363	1.099920	0.736000	02:29

```
(#2) [1.1021363735198975,0.7366666793823242]
```



Training results with non-augmented dataset

epoch	train_loss	valid_loss	accuracy	time
0	1.248233	1.160732	0.714300	02:07
1	1.109203	1.067518	0.752600	02:05

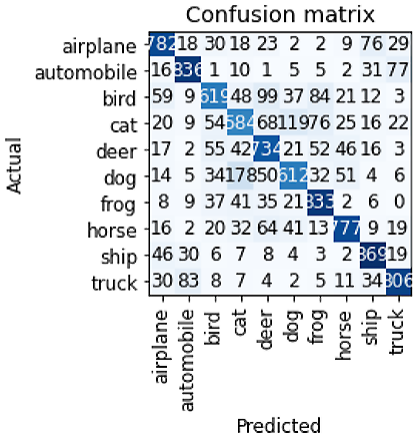
Training results with augmented dataset

epoch	train_loss	valid_loss	accuracy	time
0	1.356869	1.199771	0.695700	02:26
1	1.197363	1.099920	0.736000	02:29

Validating on test set (non-augmented training dataset)

(#2) [1.0601791143417358,0.7543434500694275]

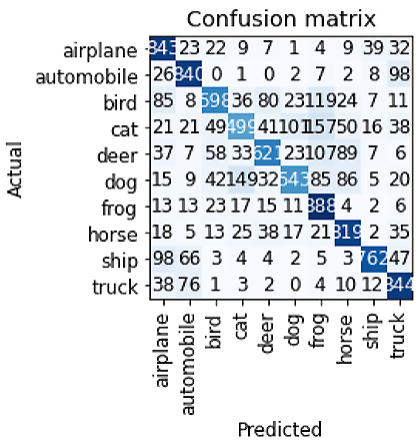
Confusion matrix on test set (non-augmented training dataset)



Validating on test set (augmented training dataset)

(#2) [1.1021363735198975,0.7366666793823242]

Confusion matrix on test set (augmented training dataset)




```
Applying batch_tfms to the batch built
  Pipeline: IntToFloatTensor -- {'div': 255.0, 'div_mask': 1}
    starting from
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
```


```
Applying batch_tfms to the batch built
  Pipeline: IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} -> Flip -- {'size': None, 'mode': 'bilinear', 'pad_mode':
'reflection', 'mode_mask': 'nearest', 'align_corners': True, 'p': 0.5} -> Brightness -- {'max_lighting': 0.2, 'p': 1.0,
'draw': None, 'batch': False}
    starting from
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying Flip -- {'size': None, 'mode': 'bilinear', 'pad_mode': 'reflection', 'mode_mask': 'nearest', 'align_corner
s': True, 'p': 0.5} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
    applying Brightness -- {'max_lighting': 0.2, 'p': 1.0, 'draw': None, 'batch': False} gives
      (TensorImage of size 4x3x32x32, TensorCategory([9, 7, 9, 0], device='cuda:0'))
  Pipeline: IntToFloatTensor -- {'div': 255.0, 'div_mask': 1} -> Flip -- {'size': None, 'mode': 'bilinear', 'pad_mode':
'reflection', 'mode_mask': 'nearest', 'align_corners': True, 'p': 0.5} -> Brightness -- {'max_lighting': 0.2, 'p': 1.0,
'draw': None, 'batch': False}
```

epoch	train_loss	valid_loss	accuracy	time
0	0.341347	0.360610	0.822034	00:10
1	0.334492	0.369722	0.809322	00:10
2	0.331509	0.331108	0.838983	00:10
3	0.312824	0.337519	0.838983	00:10
4	0.312502	0.347008	0.843220	00:10
5	0.303788	0.319890	0.851695	00:10
6	0.300724	0.315468	0.851695	00:10
7	0.305295	0.322067	0.838983	00:10
8	0.295115	0.318580	0.843220	00:10
9	0.294310	0.314723	0.847458	00:10

```
CPU times: user 1min 42s, sys: 626 ms, total: 1min 43s
Wall time: 1min 43s
    (#2) [0.3147226572036743,0.8474576473236084]
```

epoch	train_loss	valid_loss	accuracy	time
0	0.339484	0.361489	0.822034	00:08
1	0.339429	0.366499	0.826271	00:07
2	0.323125	0.321370	0.864407	00:06
3	0.325409	0.342183	0.838983	00:06
4	0.326003	0.335209	0.843220	00:06
5	0.317508	0.336868	0.830508	00:06
6	0.310379	0.330359	0.830508	00:06
7	0.297920	0.334773	0.843220	00:06
8	0.297238	0.333442	0.843220	00:06
9	0.282386	0.332747	0.843220	00:06

```
CPU times: user 1min 6s, sys: 499 ms, total: 1min 7s
Wall time: 1min 8s
```

(#2) [0.3327472507953644,0.8432203531265259]

epoch	train_loss	valid_loss	accuracy	time
0	0.339484	0.361489	0.822034	00:07
1	0.339429	0.366499	0.826271	00:09
2	0.323125	0.321370	0.864407	00:07
3	0.325409	0.342183	0.838983	00:08
4	0.326003	0.335209	0.843220	00:08
5	0.317508	0.336868	0.830508	00:08

```
No improvement since epoch 2: early stopping
CPU times: user 50.1 s, sys: 326 ms, total: 50.4 s
Wall time: 50.5 s
```

(#2) [0.33686837553977966,0.8305084705352783]

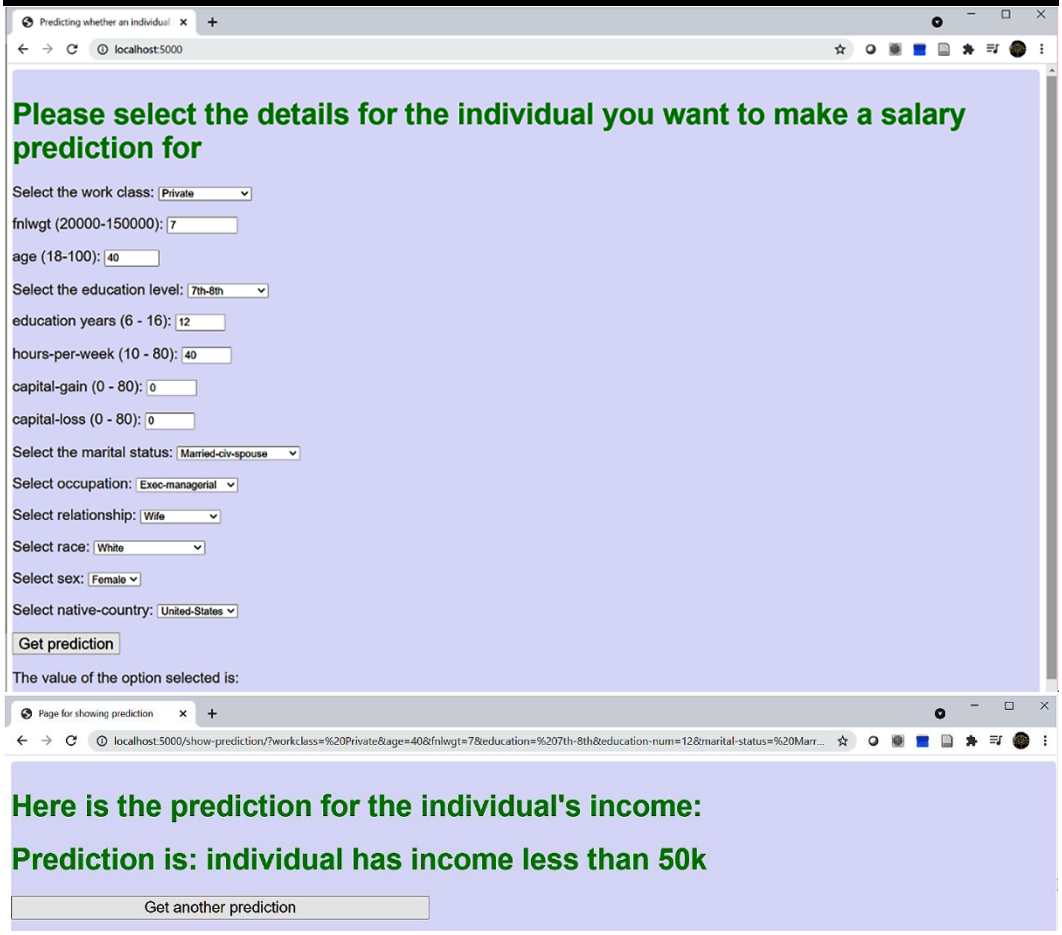
epoch	train_loss	valid_loss	accuracy	time
0	0.339484	0.361489	0.822034	00:08
1	0.339429	0.366499	0.826271	00:09
2	0.323125	0.321370	0.864407	00:09
3	0.325409	0.342183	0.838983	00:09
4	0.326003	0.335209	0.843220	00:09
5	0.317508	0.336868	0.830508	00:09

```
Better model found at epoch 0 with accuracy value: 0.8220338821411133.
Better model found at epoch 2 with accuracy value: 0.8644067645072937.
No improvement since epoch 2: early stopping
CPU times: user 54.6 s, sys: 300 ms, total: 54.9 s
Wall time: 55 s
```

(#2) [0.32137033343315125,0.8644067645072937]

```
Callbacks:
  - TrainEvalCallback
  - Recorder
  - ProgressCallback
```

```
ngrok by @inconshreveable

Session Status                online
Account                       Mark Ryan (Plan: Free)
Update                        update available (version 2.3.40, Ctrl-U to update)
Version                       2.3.34
Region                        United States (us)
Web Interface                 http://127.0.0.1:4040
Forwarding                    http://aefa693e9059.ngrok.io -> http://localhost:5000
Forwarding                    https://aefa693e9059.ngrok.io -> http://localhost:5000

Connections                   ttl     opn     rt1     rt5     p50     p90
                              0       0       0.00    0.00    0.00    0.00
```



Please select the image you want to classify:

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Get prediction

Please select the image you want to classify:

Please choose images: Choose File No file chosen

Get prediction image to display here

Please select the images you want to classify:

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Get prediction