

Подготовка к обучению

Для обучения модели YOLOv8n мы воспользовались библиотекой *ultralytics*, которая предоставляет удобный интерфейс и больше количество возможностей

```
!pip install ultralytics
```

```
Collecting ultralytics
```

```
  Downloading ultralytics-8.1.19-py3-none-any.whl.metadata (40 kB)  
----- 40.4/40.4 kB 2.1 MB/s eta
```

```
0:00:00
```

```
Requirement already satisfied: matplotlib>=3.3.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (3.7.4)  
Requirement already satisfied: opencv-python>=4.6.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (4.9.0.80)  
Requirement already satisfied: pillow>=7.1.2 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (9.5.0)  
Requirement already satisfied: pyyaml>=5.3.1 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (6.0.1)  
Requirement already satisfied: requests>=2.23.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (2.31.0)  
Requirement already satisfied: scipy>=1.4.1 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (1.11.4)  
Requirement already satisfied: torch>=1.8.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (2.1.2)  
Requirement already satisfied: torchvision>=0.9.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (0.16.2)  
Requirement already satisfied: tqdm>=4.64.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (4.66.1)  
Requirement already satisfied: psutil in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (5.9.3)  
Requirement already satisfied: py-cpuinfo in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (9.0.0)  
Collecting thop>=0.1.1 (from ultralytics)  
  Downloading thop-0.1.1.post2209072238-py3-none-any.whl.metadata (2.7  
kB)  
Requirement already satisfied: pandas>=1.1.4 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (2.1.4)  
Requirement already satisfied: seaborn>=0.11.0 in  
/opt/conda/lib/python3.10/site-packages (from ultralytics) (0.12.2)  
Requirement already satisfied: contourpy>=1.0.1 in  
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0-  
>ultralytics) (1.2.0)  
Requirement already satisfied: cycler>=0.10 in  
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0-  
>ultralytics) (0.12.1)  
Requirement already satisfied: fonttools>=4.22.0 in
```

/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (4.47.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (1.4.5)
Requirement already satisfied: numpy<2,>=1.20 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (1.24.4)
Requirement already satisfied: packaging>=20.0 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (21.3)
Requirement already satisfied: pyparsing>=2.3.1 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (3.1.1)
Requirement already satisfied: python-dateutil>=2.7 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=3.3.0->ultralitics) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in
/opt/conda/lib/python3.10/site-packages (from pandas>=1.1.4->ultralitics) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in
/opt/conda/lib/python3.10/site-packages (from pandas>=1.1.4->ultralitics) (2023.4)
Requirement already satisfied: charset-normalizer<4,>=2 in
/opt/conda/lib/python3.10/site-packages (from requests>=2.23.0->ultralitics) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/opt/conda/lib/python3.10/site-packages (from requests>=2.23.0->ultralitics) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/opt/conda/lib/python3.10/site-packages (from requests>=2.23.0->ultralitics) (1.26.18)
Requirement already satisfied: certifi>=2017.4.17 in
/opt/conda/lib/python3.10/site-packages (from requests>=2.23.0->ultralitics) (2023.11.17)
Requirement already satisfied: filelock in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0->ultralitics) (3.13.1)
Requirement already satisfied: typing-extensions in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0->ultralitics) (4.9.0)
Requirement already satisfied: sympy in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0->ultralitics) (1.12)
Requirement already satisfied: networkx in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0->ultralitics) (3.2.1)
Requirement already satisfied: jinja2 in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0-

```

>ultralytics) (3.1.2)
Requirement already satisfied: fsspec in
/opt/conda/lib/python3.10/site-packages (from torch>=1.8.0-
>ultralytics) (2023.12.2)
Requirement already satisfied: six>=1.5 in
/opt/conda/lib/python3.10/site-packages (from python-dateutil>=2.7-
>matplotlib>=3.3.0->ultralytics) (1.16.0)
Requirement already satisfied: MarkupSafe>=2.0 in
/opt/conda/lib/python3.10/site-packages (from jinja2->torch>=1.8.0-
>ultralytics) (2.1.3)
Requirement already satisfied: mpmath>=0.19 in
/opt/conda/lib/python3.10/site-packages (from sympy->torch>=1.8.0-
>ultralytics) (1.3.0)
Downloading ultralytics-8.1.19-py3-none-any.whl (716 kB)
716.2/716.2 kB 19.8 MB/s eta
0:00:0000:01

```

Обучение

Датасет для обучения модели(67 тысяч) был загружен в *Ultralytics Hub*, после чего мы начинали обучение модели в сервисе Kaggle. Обучение модели заняло 11 часов.

```

from ultralytics import YOLO, checks, hub
checks()

hub.login('e62e77e6b80328a2b56c20d5a97958d3fc52964697')

model =
YOLO('https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN')
results = model.train()

Ultralytics YOLOv8.1.19 🚀 Python-3.10.13 torch-2.1.2 CUDA:0 (Tesla
P100-PCIE-16GB, 16276MiB)
Setup complete ✅ (4 CPUs, 31.4 GB RAM, 5432.4/8062.4 GB disk)
requirements: Ultralytics requirement ['hub-sdk>=0.0.2'] not found,
attempting AutoUpdate...
Collecting hub-sdk>=0.0.2
  Downloading hub_sdk-0.0.4-py3-none-any.whl.metadata (9.2 kB)
Requirement already satisfied: requests in
/opt/conda/lib/python3.10/site-packages (from hub-sdk>=0.0.2) (2.31.0)
Requirement already satisfied: charset-normalizer<4,>=2 in
/opt/conda/lib/python3.10/site-packages (from requests->hub-
sdk>=0.0.2) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/opt/conda/lib/python3.10/site-packages (from requests->hub-
sdk>=0.0.2) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in

```

```
/opt/conda/lib/python3.10/site-packages (from requests->hub-  
sdk>=0.0.2) (1.26.18)  
Requirement already satisfied: certifi>=2017.4.17 in  
/opt/conda/lib/python3.10/site-packages (from requests->hub-  
sdk>=0.0.2) (2023.11.17)  
Downloading hub_sdk-0.0.4-py3-none-any.whl (40 kB)  
40.9/40.9 kB 8.2 MB/s eta  
0:00:00  
requirements: AutoUpdate success ☑ 11.4s, installed 1 package: ['hub-  
sdk>=0.0.2']  
requirements: ⚠ Restart runtime or rerun command for updates to take  
effect  
  
Ultralytics HUB: New authentication successful ☑  
Ultralytics HUB: View model at  
https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN 🚀  
Ultralytics YOLOv8.1.19 🚀 Python-3.10.13 torch-2.1.2 CUDA:0 (Tesla  
P100-PCIE-16GB, 16276MiB)  
engine/trainer: task=detect, mode=train, model=yolov8n.pt,  
data=https://storage.googleapis.com/ultralytics-hub.appspot.com/users/  
u5yKelVTS0e6WqT5aZmBfdnT1et2/datasets/esjKhNkzCY2TbpnEzYZs/1.zip,  
epochs=65, time=None, patience=100, batch=32, imgsz=640, save=True,  
save_period=-1, cache=ram, device=0, workers=8, project=None,  
name=train2, exist_ok=False, pretrained=True, optimizer=auto,  
verbose=True, seed=0, deterministic=True, single_cls=False,  
rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True,  
fraction=1.0, profile=False, freeze=None, multi_scale=False,  
overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val,  
save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300,  
half=False, dnn=False, plots=True, source=None, vid_stride=1,  
stream_buffer=False, visualize=False, augment=False,  
agnostic_nms=False, classes=None, retina_masks=False, embed=None,  
show=False, save_frames=False, save_txt=False, save_conf=False,  
save_crop=False, show_labels=True, show_conf=True, show_boxes=True,  
line_width=None, format=torchscript, keras=False, optimize=False,  
int8=False, dynamic=False, simplify=False, opset=None, workspace=4,  
nms=False, lr0=0.01, lrf=0.01, momentum=0.937, weight_decay=0.0005,  
warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1, box=7.5,  
cls=0.5, dfl=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64,  
hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, degrees=0.0, translate=0.1,  
scale=0.5, shear=0.0, perspective=0.0, flipud=0.0, fliplr=0.5,  
mosaic=1.0, mixup=0.0, copy_paste=0.0, auto_augment=randaugment,  
erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml,  
save_dir=runs/detect/train2  
Found  
https://storage.googleapis.com/ultralytics-hub.appspot.com/users/u5yKe  
lVTS0e6WqT5aZmBfdnT1et2/datasets/esjKhNkzCY2TbpnEzYZs/1.zip locally at  
1.zip  
WARNING ⚠ Skipping 1.zip unzip as destination directory
```

```
/kaggle/working/datasets/1 is not empty.  
Downloading https://ultralytics.com/assets/Arial.ttf to  
'/root/.config/Ultralytics/Arial.ttf'...
```

```
100%|██████████| 755k/755k [00:00<00:00, 24.1MB/s]
```

```
2024-02-27 02:11:28,152 INFO util.py:124 -- Outdated packages:  
ipywidgets==7.7.1 found, needs ipywidgets>=8
```

```
Run `pip install -U ipywidgets`, then restart the notebook server for  
rich notebook output.
```

```
2024-02-27 02:11:28,991 INFO util.py:124 -- Outdated packages:  
ipywidgets==7.7.1 found, needs ipywidgets>=8
```

```
Run `pip install -U ipywidgets`, then restart the notebook server for  
rich notebook output.
```

```
2024-02-27 02:11:31.306053: E
```

```
external/local_xla/xla/stream_executor/cuda/cuda_dnn.cc:9261] Unable  
to register cuDNN factory: Attempting to register factory for plugin  
cuDNN when one has already been registered
```

```
2024-02-27 02:11:31.306151: E
```

```
external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:607] Unable to  
register cuFFT factory: Attempting to register factory for plugin  
cuFFT when one has already been registered
```

```
2024-02-27 02:11:31.440026: E
```

```
external/local_xla/xla/stream_executor/cuda/cuda_blas.cc:1515] Unable  
to register cuBLAS factory: Attempting to register factory for plugin  
cuBLAS when one has already been registered
```

```
Overriding model.yaml nc=80 with nc=1
```

	from	n	params	module
arguments				
0	-1	1	464	ultralytics.nn.modules.conv.Conv
[3, 16, 3, 2]				
1	-1	1	4672	ultralytics.nn.modules.conv.Conv
[16, 32, 3, 2]				
2	-1	1	7360	ultralytics.nn.modules.block.C2f
[32, 32, 1, True]				
3	-1	1	18560	ultralytics.nn.modules.conv.Conv
[32, 64, 3, 2]				
4	-1	2	49664	ultralytics.nn.modules.block.C2f
[64, 64, 2, True]				
5	-1	1	73984	ultralytics.nn.modules.conv.Conv
[64, 128, 3, 2]				
6	-1	2	197632	ultralytics.nn.modules.block.C2f
[128, 128, 2, True]				
7	-1	1	295424	ultralytics.nn.modules.conv.Conv
[128, 256, 3, 2]				
8	-1	1	460288	ultralytics.nn.modules.block.C2f
[256, 256, 1, True]				
9	-1	1	164608	
ultralytics.nn.modules.block.SPPF				[256, 256, 5]

10	-1 1 0	
torch.nn.modules.upsampling.Upsample		[None, 2, 'nearest']
11	[-1, 6] 1 0	
ultralytics.nn.modules.conv.Concat		[1]
12	-1 1 148224	ultralytics.nn.modules.block.C2f
[384, 128, 1]		
13	-1 1 0	
torch.nn.modules.upsampling.Upsample		[None, 2, 'nearest']
14	[-1, 4] 1 0	
ultralytics.nn.modules.conv.Concat		[1]
15	-1 1 37248	ultralytics.nn.modules.block.C2f
[192, 64, 1]		
16	-1 1 36992	ultralytics.nn.modules.conv.Conv
[64, 64, 3, 2]		
17	[-1, 12] 1 0	
ultralytics.nn.modules.conv.Concat		[1]
18	-1 1 123648	ultralytics.nn.modules.block.C2f
[192, 128, 1]		
19	-1 1 147712	ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2]		
20	[-1, 9] 1 0	
ultralytics.nn.modules.conv.Concat		[1]
21	-1 1 493056	ultralytics.nn.modules.block.C2f
[384, 256, 1]		
22	[15, 18, 21] 1 751507	
ultralytics.nn.modules.head.Detect		[1, [64, 128, 256]]

Model summary: 225 layers, 3011043 parameters, 3011027 gradients, 8.2 GFLOPs

Transferred 319/355 items from pretrained weights


TensorBoard: Start with 'tensorboard --logdir runs/detect/train2',
view at <http://localhost:6006/>

Freezing layer 'model.22.dfl.conv.weight'

AMP: running Automatic Mixed Precision (AMP) checks with YOLOv8n...

AMP: checks passed 

train: Scanning /kaggle/working/datasets/1/train/labels.cache... 64115
images, 0 backgrounds, 0 corrupt: 100%|██████████| 64115/64115
[00:00<?, ?it/s]

train: 79.1GB RAM required to cache images with 50% safety margin but
only 29.0/31.4GB available, not caching images 

augmentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,

```
blur_limit=(3, 7)), ToGray(p=0.01), CLAHE(p=0.01, clip_limit=(1, 4.0),
tile_grid_size=(8, 8))
```

```
val: Scanning /kaggle/working/datasets/1/val/labels.cache... 2693
images, 0 backgrounds, 0 corrupt: 100%|██████████| 2693/2693 [00:00<?,
?it/s]
```

```
val: Caching images (2.2GB ram): 100%|██████████| 2693/2693
[00:06<00:00, 417.61it/s]
```

```
Plotting labels to runs/detect/train2/labels.jpg...
```

```
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and
'momentum=0.937' and determining best 'optimizer', 'lr0' and
'momentum' automatically...
```

```
optimizer: SGD(lr=0.01, momentum=0.9) with parameter groups 57
weight(decay=0.0), 64 weight(decay=0.0005), 63 bias(decay=0.0)
```

```
TensorBoard: model graph visualization added ✓
```

```
Image sizes 640 train, 640 val
```

```
Using 4 dataloader workers
```

```
Logging results to runs/detect/train2
```

```
Starting training for 65 epochs...
```

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
--	-------	---------	----------	----------	----------	-----------

Size	1/65	4.36G	1.184	1.316	1.185	168
640:	100% ██████████	2004/2004	[11:06<00:00,	3.01it/s]		

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95):	100% ██████████	43/43	[00:14<00:00,	2.91it/s]

	all	2693	10777	0.747	0.562
0.654	0.411				

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
--	-------	---------	----------	----------	----------	-----------

Size	2/65	4.22G	1.271	1.17	1.243	138
640:	100% ██████████	2004/2004	[10:49<00:00,	3.09it/s]		

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95):	100% ██████████	43/43	[00:13<00:00,	3.13it/s]

	all	2693	10777	0.725	0.555
0.641	0.399				

```
Ultralytics HUB: Uploading checkpoint
```

```
https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN
```

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
--	-------	---------	----------	----------	----------	-----------

Size	3/65	4.37G	1.355	1.242	1.301	83
640:	100% ██████████	2004/2004	[10:38<00:00,	3.14it/s]		

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100%		43/43 [00:12<00:00,	3.35it/s]	
	all	2693	10777	0.676	0.49
0.563	0.333				

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
-------	---------	----------	----------	----------	-----------

Size	4/65	4.14G	1.38	1.268	1.328	171
640: 100%		2004/2004 [10:37<00:00,	3.14it/s]			

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100%		43/43 [00:13<00:00,	3.30it/s]	
	all	2693	10777	0.719	0.557
0.642	0.401				

Ultralytics HUB: Uploading checkpoint
<https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN>

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
-------	---------	----------	----------	----------	-----------

Size	5/65	4.14G	1.334	1.196	1.296	159
640: 100%		2004/2004 [10:36<00:00,	3.15it/s]			

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100%		43/43 [00:13<00:00,	3.25it/s]	
	all	2693	10777	0.739	0.58
0.664	0.425				

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
-------	---------	----------	----------	----------	-----------

Size	26/65	4.36G	1.169	0.9815	1.191	129
640: 100%		2004/2004 [10:38<00:00,	3.14it/s]			

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100%		43/43 [00:12<00:00,	3.34it/s]	
	all	2693	10777	0.795	0.642

0.742 0.506
Ultralytics HUB: Uploading checkpoint
<https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN>

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
-------	---------	----------	----------	----------	-----------

Size	27/65	4.35G	1.168	0.9811	1.191	116
640: 100%		2004/2004 [10:38<00:00,	3.14it/s]			

	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100%		43/43 [00:12<00:00,	3.33it/s]	

		all	2693	10777	0.799	0.641
0.743	0.507					

Size	Epoch	GPU_mem	box_loss	cls_loss	df_l_loss	Instances
------	-------	---------	----------	----------	-----------	-----------

	28/65	4.17G	1.167	0.9767	1.191	195
640:	100% ██████████	2004/2004	[10:38<00:00,	3.14it/s]		
		Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100% ██████████	43/43	[00:12<00:00,	3.36it/s]		

		all	2693	10777	0.798	0.641
0.744	0.508					

Ultralytics HUB: Uploading checkpoint
<https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN>

Size	Epoch	GPU_mem	box_loss	cls_loss	df_l_loss	Instances
------	-------	---------	----------	----------	-----------	-----------

	29/65	4.14G	1.162	0.9716	1.187	166
640:	100% ██████████	2004/2004	[10:39<00:00,	3.13it/s]		
		Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100% ██████████	43/43	[00:13<00:00,	3.26it/s]		

		all	2693	10777	0.798	0.641
0.744	0.509					

Size	Epoch	GPU_mem	box_loss	cls_loss	df_l_loss	Instances
------	-------	---------	----------	----------	-----------	-----------

	30/65	4.2G	1.16	0.9705	1.188	115
640:	100% ██████████	2004/2004	[10:40<00:00,	3.13it/s]		
		Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100% ██████████	43/43	[00:13<00:00,	3.30it/s]		

		all	2693	10777	0.803	0.639
0.744	0.51					

Ultralytics HUB: Uploading checkpoint
<https://hub.ultralytics.com/models/dEFtPEJc0Ls1RS8CTEAN>

Size	Epoch	GPU_mem	box_loss	cls_loss	df_l_loss	Instances
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	31/65	4.15G	1.156	0.9637	1.184	196
640:	68% ██████████	1359/2004	[07:18<03:24,	3.16it/s]		

Результаты обучения

В процессе обучения модели в *Kaggle* было замечено, что в нём не отображался вывод полностью, но в тоже время выполнялось обучение модели.

Результаты обучения вы можете посмотреть в [Ultralytics Hub](https://hub.ultralytics.com/models/dEFtPEJcOLs1RS8CTEAN)(<https://hub.ultralytics.com/models/dEFtPEJcOLs1RS8CTEAN>).