TensorFlow

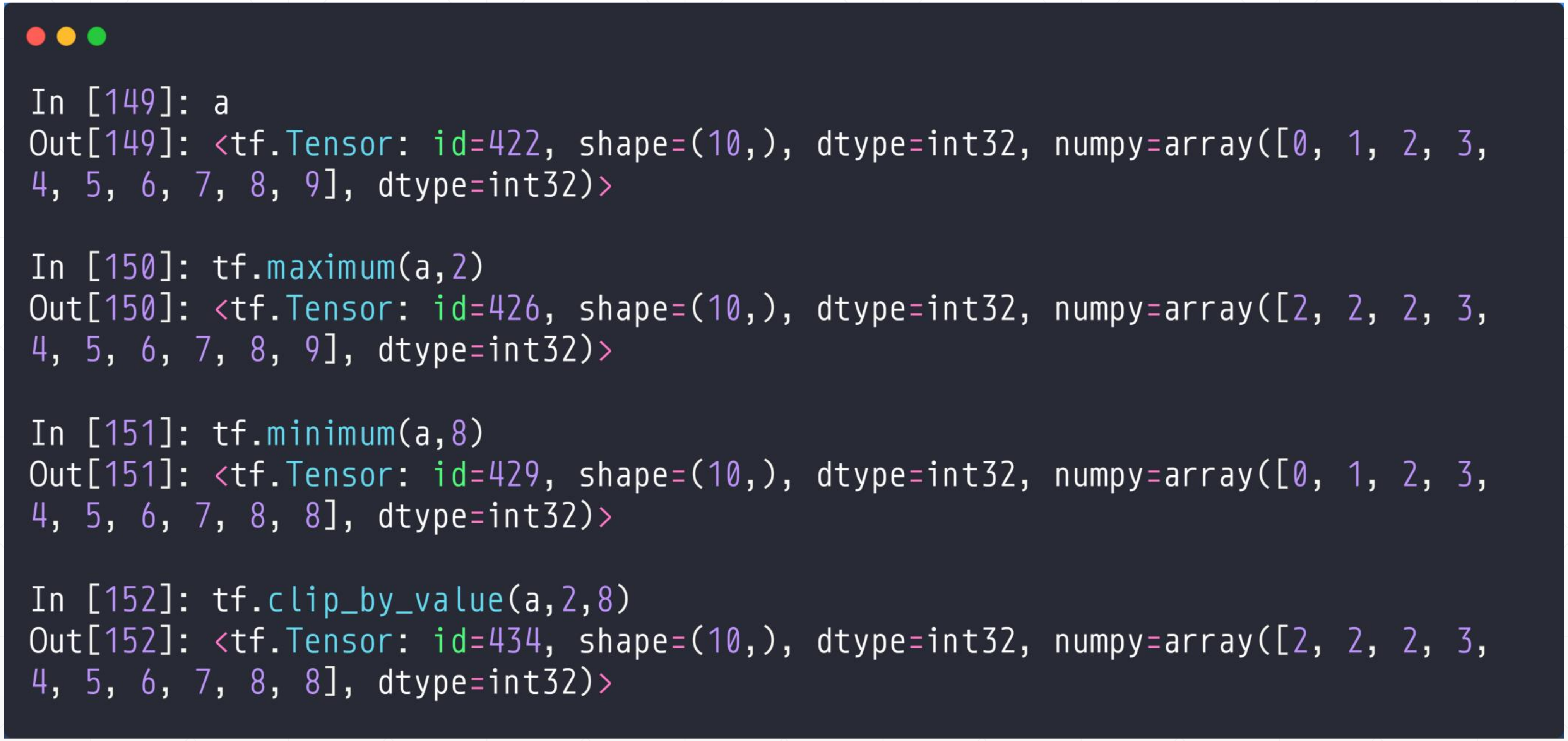
# 张量限幅

主讲：龙良曲

# Outline

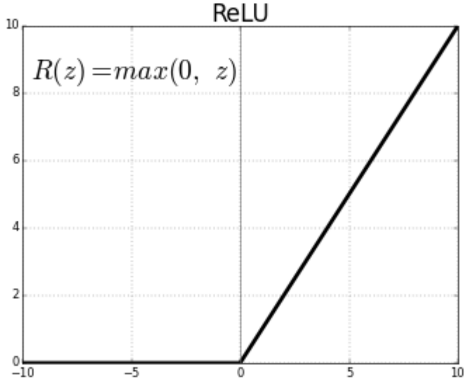
- clip_by_value
- relu
- clip_by_norm
- gradient clipping

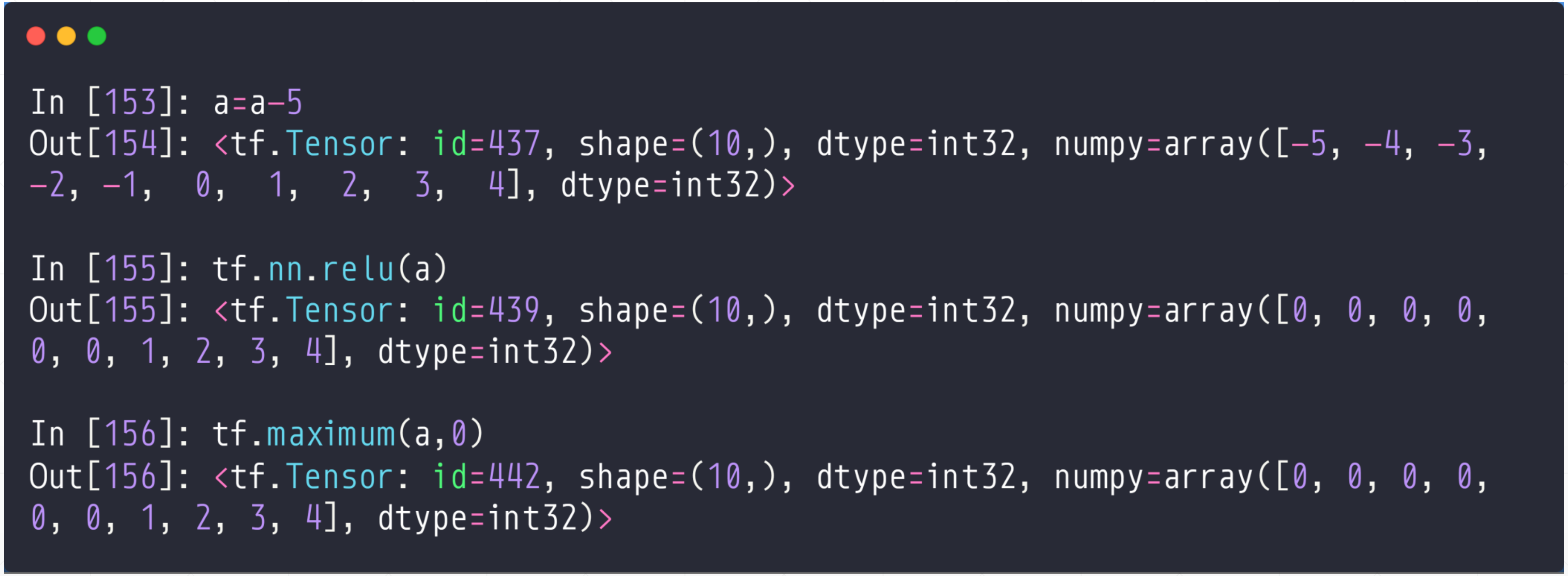
# clip_by_value



```
In [149]: a
Out[149]: <tf.Tensor: id=422, shape=(10,), dtype=int32, numpy=array([0, 1, 2, 3,
4, 5, 6, 7, 8, 9], dtype=int32)>

In [150]: tf.maximum(a,2)
Out[150]: <tf.Tensor: id=426, shape=(10,), dtype=int32, numpy=array([2, 2, 2, 3,
4, 5, 6, 7, 8, 9], dtype=int32)>

In [151]: tf.minimum(a,8)
Out[151]: <tf.Tensor: id=429, shape=(10,), dtype=int32, numpy=array([0, 1, 2, 3,
4, 5, 6, 7, 8, 8], dtype=int32)>

In [152]: tf.clip_by_value(a,2,8)
Out[152]: <tf.Tensor: id=434, shape=(10,), dtype=int32, numpy=array([2, 2, 2, 3,
4, 5, 6, 7, 8, 8], dtype=int32)>
```

# relu

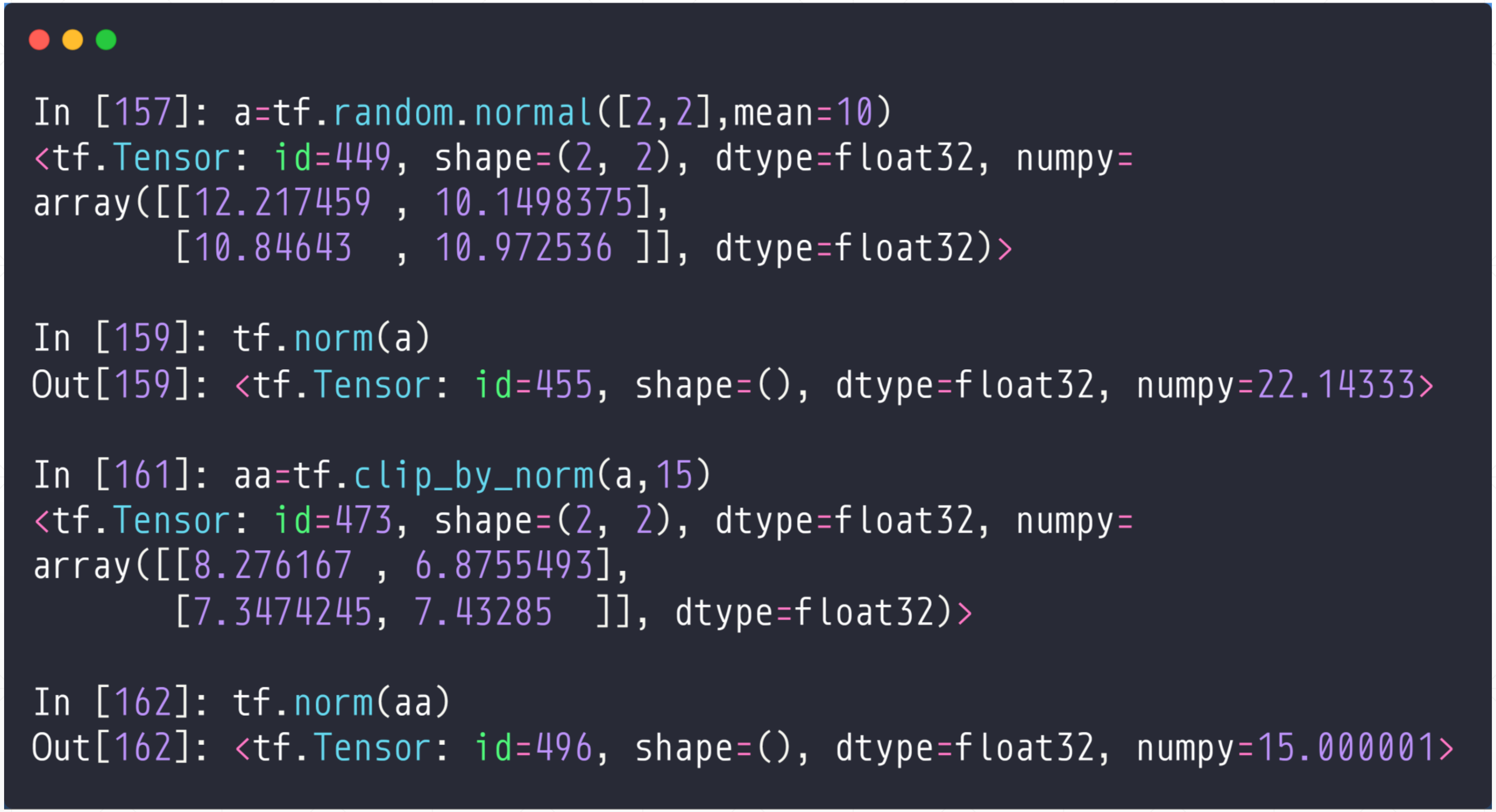




```
In [153]: a=a-5
Out[154]: <tf.Tensor: id=437, shape=(10,), dtype=int32, numpy=array([-5, -4, -3,
-2, -1,  0,  1,  2,  3,  4], dtype=int32)>

In [155]: tf.nn.relu(a)
Out[155]: <tf.Tensor: id=439, shape=(10,), dtype=int32, numpy=array([0, 0, 0, 0,
0, 0, 1, 2, 3, 4], dtype=int32)>

In [156]: tf.maximum(a,0)
Out[156]: <tf.Tensor: id=442, shape=(10,), dtype=int32, numpy=array([0, 0, 0, 0,
0, 0, 1, 2, 3, 4], dtype=int32)>
```

# clip_by_norm

不改变tensor的方向，相当于等比例放缩



```
In [157]: a=tf.random.normal([2,2],mean=10)
<tf.Tensor: id=449, shape=(2, 2), dtype=float32, numpy=
array([[12.217459 , 10.1498375],
       [10.84643  , 10.972536 ]], dtype=float32)>

In [159]: tf.norm(a)
Out[159]: <tf.Tensor: id=455, shape=(), dtype=float32, numpy=22.14333>

In [161]: aa=tf.clip_by_norm(a,15)
<tf.Tensor: id=473, shape=(2, 2), dtype=float32, numpy=
array([[8.276167 , 6.8755493],
       [7.3474245, 7.43285  ]], dtype=float32)>

In [162]: tf.norm(aa)
Out[162]: <tf.Tensor: id=496, shape=(), dtype=float32, numpy=15.000001>
```

# Gradient clipping

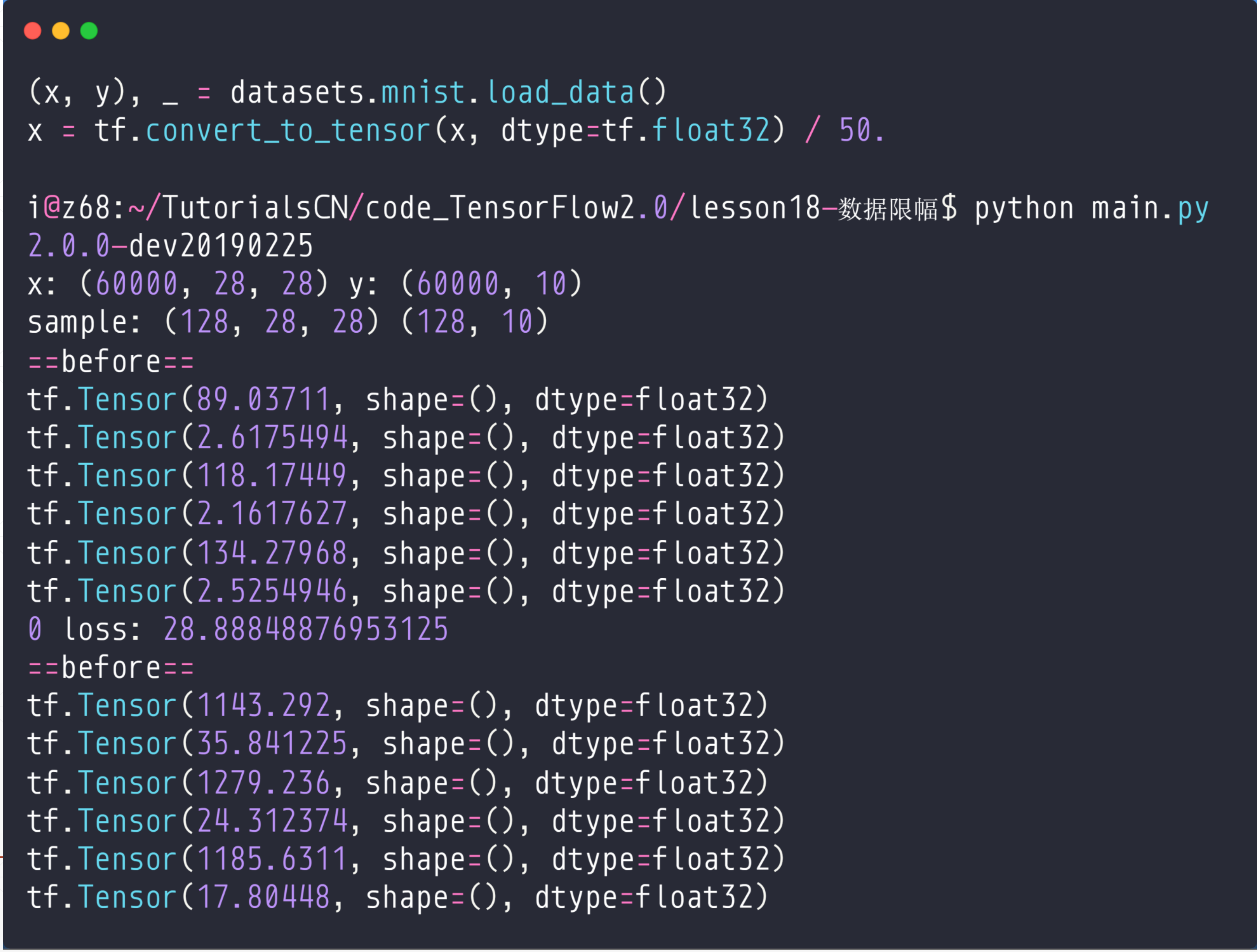
- Gradient Exploding or vanishing

- set lr=1

对所有参数等比例缩放

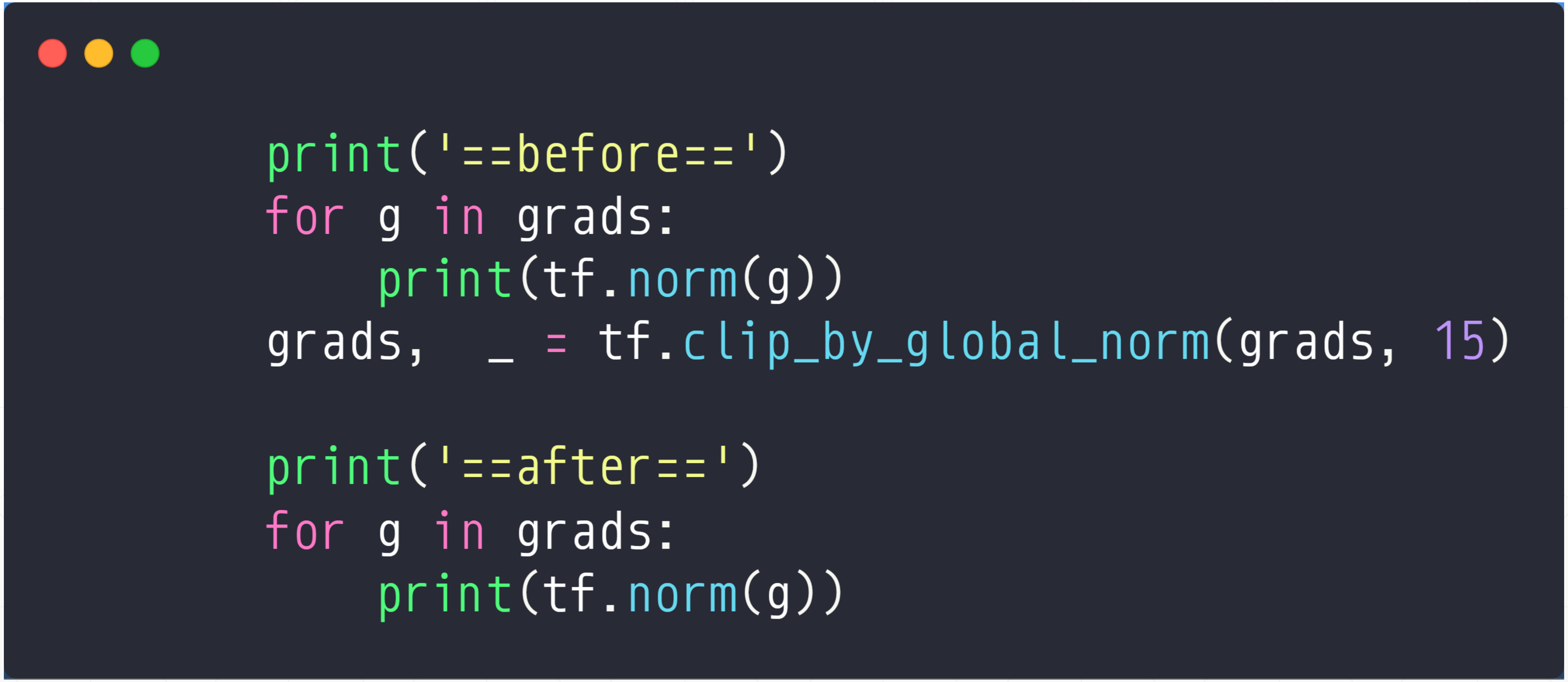
- new_grads, total_norm = tf.clip_by_global_norm(grads, 25)

# Before



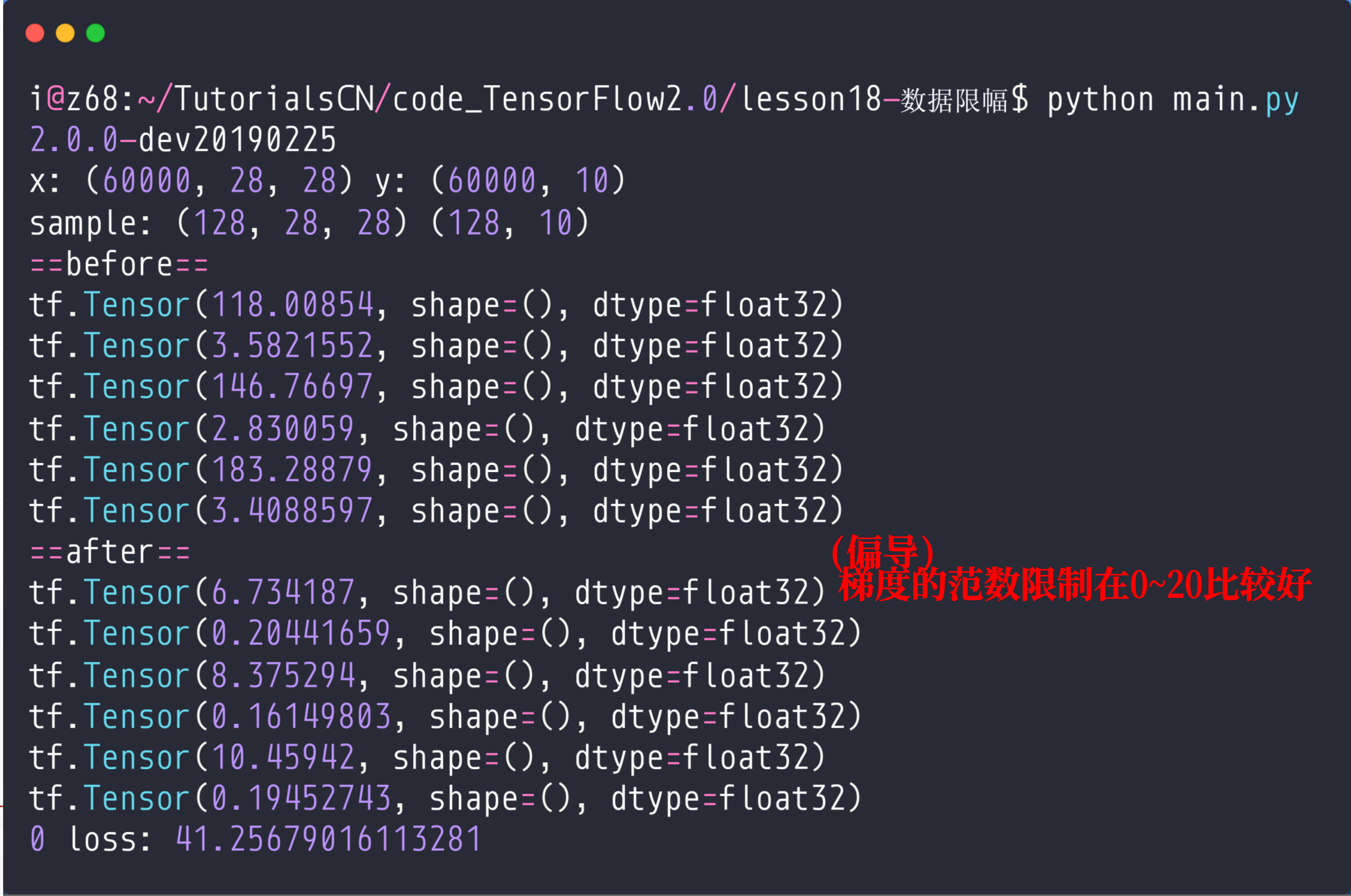
```
(x, y), _ = datasets.mnist.load_data()
x = tf.convert_to_tensor(x, dtype=tf.float32) / 50.

i@z68:~/TutorialsCN/code_TensorFlow2.0/lesson18-数据限幅$ python main.py
2.0.0-dev20190225
x: (60000, 28, 28) y: (60000, 10)
sample: (128, 28, 28) (128, 10)
==before==
tf.Tensor(89.03711, shape=(), dtype=float32)
tf.Tensor(2.6175494, shape=(), dtype=float32)
tf.Tensor(118.17449, shape=(), dtype=float32)
tf.Tensor(2.1617627, shape=(), dtype=float32)
tf.Tensor(134.27968, shape=(), dtype=float32)
tf.Tensor(2.5254946, shape=(), dtype=float32)
0 loss: 28.888487696953125
==before==
tf.Tensor(1143.292, shape=(), dtype=float32)
tf.Tensor(35.841225, shape=(), dtype=float32)
tf.Tensor(1279.236, shape=(), dtype=float32)
tf.Tensor(24.312374, shape=(), dtype=float32)
tf.Tensor(1185.6311, shape=(), dtype=float32)
tf.Tensor(17.80448, shape=(), dtype=float32)
```

# Gradient Clipping



```
print('==before==')
for g in grads:
    print(tf.norm(g))
grads,  _ = tf.clip_by_global_norm(grads, 15)

print('==after==')
for g in grads:
    print(tf.norm(g))
```

# After:



```
i@z68:~/TutorialsCN/code_TensorFlow2.0/lesson18-数据限幅$ python main.py
2.0.0-dev20190225
x: (60000, 28, 28) y: (60000, 10)
sample: (128, 28, 28) (128, 10)
==before==
tf.Tensor(118.00854, shape=(), dtype=float32)
tf.Tensor(3.5821552, shape=(), dtype=float32)
tf.Tensor(146.76697, shape=(), dtype=float32)
tf.Tensor(2.830059, shape=(), dtype=float32)
tf.Tensor(183.28879, shape=(), dtype=float32)
tf.Tensor(3.4088597, shape=(), dtype=float32)
==after==
tf.Tensor(6.734187, shape=(), dtype=float32)
tf.Tensor(0.20441659, shape=(), dtype=float32)
tf.Tensor(8.375294, shape=(), dtype=float32)
tf.Tensor(0.16149803, shape=(), dtype=float32)
tf.Tensor(10.45942, shape=(), dtype=float32)
tf.Tensor(0.19452743, shape=(), dtype=float32)
0 loss: 41.25679016113281
```

（偏导）
梯度的范数限制在0~20比较好

JUST
DO
IT.

# 下一课时

高阶特性

# Thank You.