神经网络&深度学习
TENSORFLOW
Google

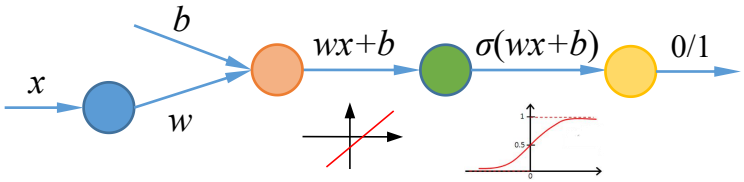
11.2 实例：实现一元逻辑回归

中国大学MOOC

逻辑回归

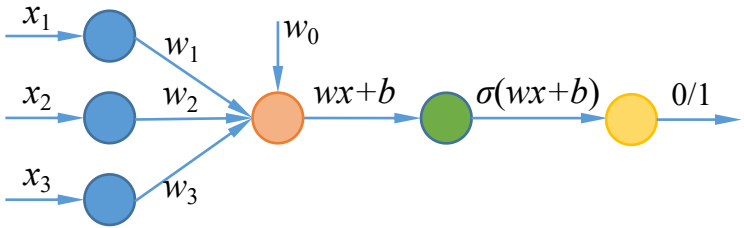
一元逻辑回归

$$y=\sigma(wx+b)=\frac{1}{1+e^{-(wx+b)}}$$



多元逻辑回归

$$y=\sigma(W^T X)=\frac{1}{1+e^{-W^T X}}$$



准确率 $=\frac{\text{正确分类的样本数}}{\text{总样本数}}$

交叉熵损失: $Loss=-\frac{1}{n}\sum_{i=1}^{n}[y_i\ln\hat{y}_i+(1-y_i)\ln(1-\hat{y}_i)]$

sigmoid()函数

$$y=\frac{1}{1+e^{-(wx+b)}}$$

```
In [1]: import tensorflow as tf
        print("TensorFlow version:",tf.__version__)

        TensorFlow version: 2.0.0

In [2]: import numpy as np

In [3]: x=np.array([1.,2.,3.,4.])

In [4]: w = tf.Variable(1.)
        b = tf.Variable(1.)

In [5]: 1/(1+tf.exp(-(w*x+b)))

Out[5]: <tf.Tensor: id=25, shape=(4,), dtype=float32, numpy=array
        ([0.880797  , 0.95257413, 0.98201376, 0.9933072 ], dtype=
        float32)>
```

交叉熵损失函数

$$Loss = -\sum_{i=1}^{n}[y_i \ln \hat{y}_i + (1-y_i)\ln(1-\hat{y}_i)]$$

```
In [6]: y=np.array([0,0,1,1])
        pred=np.array([0.1, 0.2, 0.8, 0.49])

In [7]: 1-y
Out[7]: array([1, 1, 0, 0])

In [8]: 1-pred
Out[8]: array([0.9 , 0.8 , 0.2 , 0.51])

In [9]: -tf.reduce_sum(y*tf.math.log(pred)+(1-y)*tf.math.log(1-pred))
Out[9]: <tf.Tensor: id=37, shape=(), dtype=float64, numpy=1.2649975061637104>

In [10]: -tf.reduce_mean(y*tf.math.log(pred)+(1-y)*tf.math.log(1-pred))
Out[10]: <tf.Tensor: id=49, shape=(), dtype=float64, numpy=0.3162493765409276>
```

准确率

$$= \frac{\text{正确分类的样本数}}{\text{总样本数}}$$

```
In [11]: y=np.array([0,0,1,1])
         pred=np.array([0.1, 0.2, 0.8, 0.49])

In [12]: tf.round(pred)
Out[12]: <tf.Tensor: id=51, shape=(4,), dtype=float64, numpy=array([0., 0., 1., 0.])>

In [13]: tf.equal(tf.round(pred), y)
Out[13]: <tf.Tensor: id=55, shape=(4,), dtype=bool, numpy=array([ True,  True,  True, False])>

In [14]: tf.cast(tf.equal(tf.round(pred), y),tf.int8)
Out[14]: <tf.Tensor: id=60, shape=(4,), dtype=int8, numpy=array([1, 1, 1, 0], dtype=int8)>

In [15]: tf.reduce_mean(tf.cast(tf.equal(tf.round(pred), y),tf.float32))
Out[15]: <tf.Tensor: id=67, shape=(), dtype=float32, numpy=0.75>

In [16]: tf.round(0.5)
Out[16]: <tf.Tensor: id=69, shape=(), dtype=float32, numpy=0.0>

In [17]: tf.round(0.500001)
Out[17]: <tf.Tensor: id=71, shape=(), dtype=float32, numpy=1.0>
```

where (condition, a, b)

```
In [18]: pred=np.array([0.1, 0.2, 0.8, 0.49])

In [19]: tf.where(pred<0.5, 0, 1)
Out[19]: <tf.Tensor: id=75, shape=(4,), dtype=int32, numpy=array([0, 0, 1, 0])>

In [20]: pred<0.5
Out[20]: array([ True,  True, False,  True])

In [21]: tf.where(pred<0.4, 0, 1)
Out[21]: <tf.Tensor: id=79, shape=(4,), dtype=int32, numpy=array([0, 0, 1, 1])>
```

```
In [22]: pred=np.array([0.1, 0.2, 0.8, 0.49])

         a=np.array([1,2,3,4])
         b=np.array([10,20,30,40])

In [23]: tf.where(pred<0.5, a, b)
```

参数a,b是数组

```
Out[23]: <tf.Tensor: id=83, shape=(4,), dtype=int32, numpy=array([ 1,  2, 30,  4])>

In [24]: tf.where(pred>=0.5)
```

参数a,b缺省

```
Out[24]: <tf.Tensor: id=85, shape=(1, 1), dtype=int64, numpy=array([[2]], dtype=int64)>

In [25]: y=np.array([0,0,1,1])
         pred=np.array([0.1, 0.2, 0.8, 0.49])

In [26]: tf.reduce_mean(tf.cast(tf.equal(tf.where(pred<0.5, 0, 1), y),tf.float32))
```

计算准确率

```
Out[26]: <tf.Tensor: id=94, shape=(), dtype=float32, numpy=0.75>
```

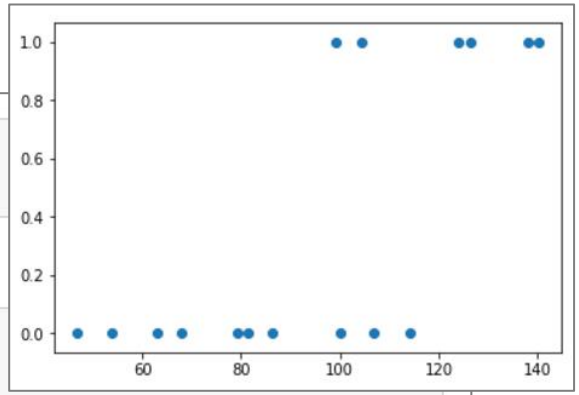
房屋销售记录

序号	面积（平方米）	类型	序号	面积（平方米）	类型
1	137.97	1	9	106.69	0
2	104.50	1	10	140.05	1
3	100.00	0	11	53.75	0
4	126.32	1	12	46.91	0
5	79.20	0	13	68.00	0
6	99.00	1	14	63.02	0
7	124.00	1	15	81.26	0
8	114.00	0	16	86.21	0

0：普通住宅
1：高档住宅

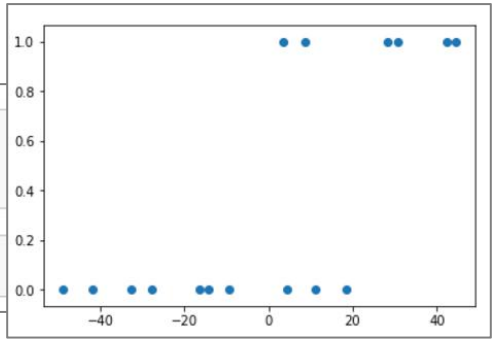
加载数据

```
In [1]: import tensorflow as tf
        print("TensorFlow version:",tf.__version__)

        TensorFlow version: 2.0.0

In [2]: import numpy as np
        import matplotlib.pyplot as plt

In [3]: x = np.array([137.97, 104.50, 100.00, 126.32, 79.20, 99.00, 124.00, 114.00,
                      106.69, 140.05, 53.75,  46.91,  68.00, 63.02, 81.26,  86.21])
        y = np.array([1, 1, 0, 1, 0, 1, 1, 0, 0,  1, 0, 0,  0,  0, 0,  0])

In [4]: plt.scatter(x,y)
```



数据处理

```
In [5]: x_train=x-np.mean(x)
        y_train=y

In [6]: plt.scatter(x_train,y_train)
```



设置超参数

```
In [7]: learn_rate = 0.005
        iter=5

        display_step=1
```

设置模型变量初始值

```
In [8]: np.random.seed(612)
        w = tf.Variable(np.random.randn())
        b = tf.Variable(np.random.randn())
```

训练模型

```
i: 0,Train Loss: 0.852807, Accuracy: 0.625000
i: 1,Train Loss: 0.400259, Accuracy: 0.875000
i: 2,Train Loss: 0.341504, Accuracy: 0.812500
i: 3,Train Loss: 0.322571, Accuracy: 0.812500
i: 4,Train Loss: 0.313972, Accuracy: 0.812500
i: 5,Train Loss: 0.309411, Accuracy: 0.812500
```

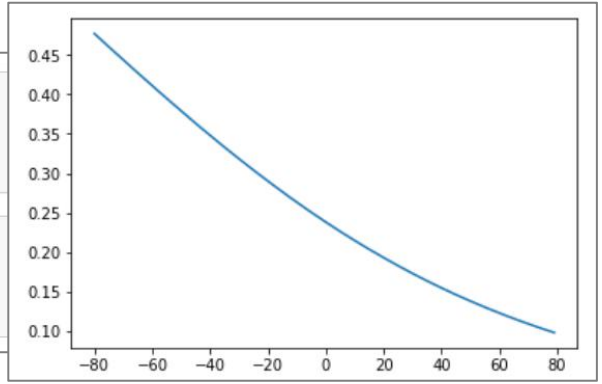
10/16
14/16
13/16

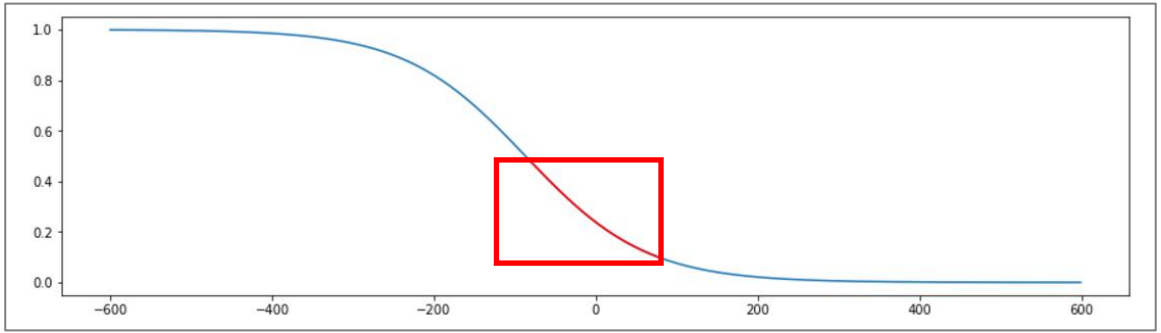
In [9]:

```
cross_train=[]
acc_train=[]

for i in range(0,iter+1):

    with tf.GradientTape() as tape:
        pred_train =1/(1+tf.exp(-(w*x_train+b)))
        Loss_train = -tf.reduce_mean(y_train*tf.math.log(pred_train)+(1-y_train)*tf.math.log(1-pred_train))
        Accuracy_train = tf.reduce_mean(tf.cast(tf.equal(tf.where(pred_train<0.5, 0, 1), y_train),tf.float32))

    cross_train.append(Loss_train)
    acc_train.append(Accuracy_train)

    dL_dw,dL_db = tape.gradient(Loss_train,[w,b])

    w.assign_sub(learn_rate*dL_dw)
    b.assign_sub(learn_rate*dL_db)

    if i % display_step == 0:
        print("i: %i,Train Loss: %f, Accuracy: %f" %(i, Loss_train,Accuracy_train))
```

使用初始权值时的sigmoid函数

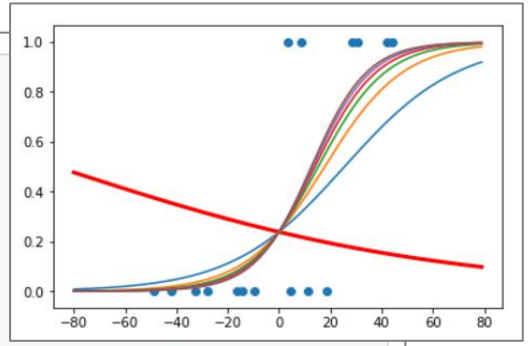
```
In [8]: np.random.seed(612)
        w = tf.Variable(np.random.randn())
        b = tf.Variable(np.random.randn())

In [9]: x_=range(-80,80)
        y_=1/(1+tf.exp(-(w*x_+b)))
        plt.plot(x_,y_)
```





11.2 实例：实现一元逻辑回归

In [10]:
```
plt.scatter(x_train, y_train)
plt.plot(x_, y_, color="red", linewidth=3)

cross_train=[]
acc_train=[]

for i in range(0,iter+1):

    with tf.GradientTape() as tape:
        pred_train =1/(1+tf.exp(-(w*x_train+b)))
        Loss_train = -tf.reduce_mean(y_train*tf.math.log(pred_train)+(1-y_train)*tf.math.log(1-pred_train))
        Accuracy_train = tf.reduce_mean(tf.cast(tf.equal(tf.where(pred_train<0.5, 0, 1), y_train),tf.float32))

    cross_train.append(Loss_train)
    acc_train.append(Accuracy_train)

    dL_dw, dL_db = tape.gradient(Loss_train, [w, b])

    w.assign_sub(learn_rate*dL_dw)
    b.assign_sub(learn_rate*dL_db)

    if i % display_step == 0:
        print("i: %i,Train Loss: %f, Accuracy: %f" %(i, Loss_train,Accuracy_train))
        y_=1/(1+tf.exp(-(w*x_+b)))
        plt.plot(x_, y_)
```



```
In [11]: x_test=[128.15, 45.00, 141.43, 106.27, 99.00, 53.84, 85.36, 70.00,162.00,114.60]

In [12]: pred_test=1/(1+tf.exp(-(w*(x_test-np.mean(x))+b)))

In [13]: y_test=tf.where(pred_test<0.5,0,1)

In [14]: for i in range(len(x_test)):
             print(x_test[i],"\t",pred_test[i].numpy(),"\t",y_test[i].numpy(),"\t")
```

```
128.15    0.8610252       1
45.0      0.0029561974    0
141.43    0.9545566       1
106.27    0.45318928      0
99.0      0.2981362       0
53.84     0.00663888      0
85.36     0.108105935     0
70.0      0.028681064     0
162.0     0.9928677       1
114.6     0.6406205       1
```

In [15]:
```
plt.scatter(x_test,y_test)

x_=np.array(range(-80,80))
y_=1/(1+tf.exp(-(w*x_+b)))
plt.plot(x_+np.mean(x),y_)
plt.show()
```