案例2：使用nn.Linear分类

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[1]:
```
import sys
sys.path.append(r"D:\Rhitta_GPU")
import cupy as cp
import numpy as np
import pandas as pd
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
import rhitta.nn as nn
import matplotlib.pyplot as plt
```

第一步：读取数据集

[2]:
```
data = pd.read_csv("../data/dataset/Iris.csv", header=0, index_col="Id")
data
```

[2]:

Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
1	5.1	3.5	1.4	0.2	Iris-setosa
2	4.9	3.0	1.4	0.2	Iris-setosa
3	4.7	3.2	1.3	0.2	Iris-setosa
4	4.6	3.1	1.5	0.2	Iris-setosa
5	5.0	3.6	1.4	0.2	Iris-setosa
..	...	...	...	...	...
146	6.7	3.0	5.2	2.3	Iris-virginica
147	6.3	2.5	5.0	1.9	Iris-virginica
148	6.5	3.0	5.2	2.0	Iris-virginica
149	6.2	3.4	5.4	2.3	Iris-virginica
150	5.9	3.0	5.1	1.8	Iris-virginica

```
[150 rows x 5 columns]
```

[3]:
```
labelencoder = LabelEncoder()
onehotencoder = OneHotEncoder(sparse_output=False)
# 把类别编码为数字标签
number_labels = labelencoder.fit_transform(data["Species"].values)
# 再把数字标签转换为one-hot向量
labels = onehotencoder.fit_transform(number_labels.reshape(-1, 1))
# 取出前4列特征
features = data.iloc[:, 0:4].values
# 打印前3个样本
features[:3,:],labels[:3,:]
```

[3]:
```
(array([[5.1, 3.5, 1.4, 0.2],
        [4.9, 3. , 1.4, 0.2],
        [4.7, 3.2, 1.3, 0.2]]),
 array([[1., 0., 0.],
        [1., 0., 0.],
        [1., 0., 0.]]))
```

[4]:
```
# 把需要用到的数据转换为cupy.ndarray格式
number_labels = cp.array(number_labels)
features = cp.array(features)
labels = cp.array(labels)
number_labels.shape,features.shape,labels.shape
```

[4]:
```
((150,), (150, 4), (150, 3))
```

第二步：构造模型并初始化

[5]:
```
class zyw(nn.Module):

    # 实例化，初始化模型参数
    def __init__(self):
        super(zyw, self).__init__()
        self.fc1 = nn.Linear(input_size=4, output_size=6)
```

```
        self.fc2 = nn.Linear(input_size=6, output_size=3)

    # 构造计算图
    def __call__(self, inputs):
        x = self.fc1(inputs)
        x = self.fc2(x)
        return x
model = zyw()
```

第三步：构造计算图

[6]:
```
# 输入节点，标签节点
x = nn.to_tensor(size=(1, 4))
y = nn.to_tensor(size=(1, 3))
```

[7]:
```
# 将x,y丢进模型，构建计算图
output = model(x)
predict = nn.Softmax(output)
loss = nn.CrossEntropyLoss(output, y)
```

第四步：初始化优化器

[8]:
```
learning_rate = 0.01
optimizer = nn.Adam(nn.default_graph, loss, learning_rate=learning_rate)
```

第五步：开始训练、评估

[9]:
```
batch_size = 16
epochs = 100

plt.figure()
plt.subplot()
plt.axis(xmin=0,xmax=epochs)
axis_x=[]
axis_y=[]
```

```
for epoch in range(epochs):
    count = 0
    N = len(features)

    # 训练
    overall_loss=0
    for i in range(N):
        # 填坑，前向反向传播
        x.set_value(features[i, :])
        y.set_value(labels[i, :])
        optimizer.one_step()
        # 累加样本损失
        overall_loss += loss.value
        # 更新计数器，达到batch_size后更新参数
        # 对于最后一批，数量不够16，是不能执行update的，一直到外层for循环结束
        count += 1
        if count >= batch_size:
            optimizer.update()
            count = 0

    # 绘制loss曲线
    axis_x.append(epoch)
    axis_y.append(cp.asnumpy(overall_loss))
    plt.plot(axis_x,axis_y)

    #每个epoch后评估模型的准确率
    pred = []
    for i in range(N):
        x.set_value(features[i, :])
        y.set_value(labels[i, :])
        predict.forward()
        pred.append(predict.value.flatten())           # pred.append([0.8,0.1,0.
↪1])
    pred = cp.array(pred).argmax(axis=1)        # 每一行变成预测的类别数字
    accuracy = (number_labels == pred).sum()/N  # 全部的预测和全部的标签对比，计
算准确率
```

```
    if epoch%10 == 0:
        print("epoch:{} , accuracy:{}".format(epoch,accuracy))
```

```
epoch:0 , accuracy:0.6666666666666666
epoch:10 , accuracy:0.78
epoch:20 , accuracy:0.8533333333333334
epoch:30 , accuracy:0.9
epoch:40 , accuracy:0.94
epoch:50 , accuracy:0.9533333333333334
epoch:60 , accuracy:0.9533333333333334
epoch:70 , accuracy:0.96
epoch:80 , accuracy:0.9666666666666667
epoch:90 , accuracy:0.9666666666666667
```