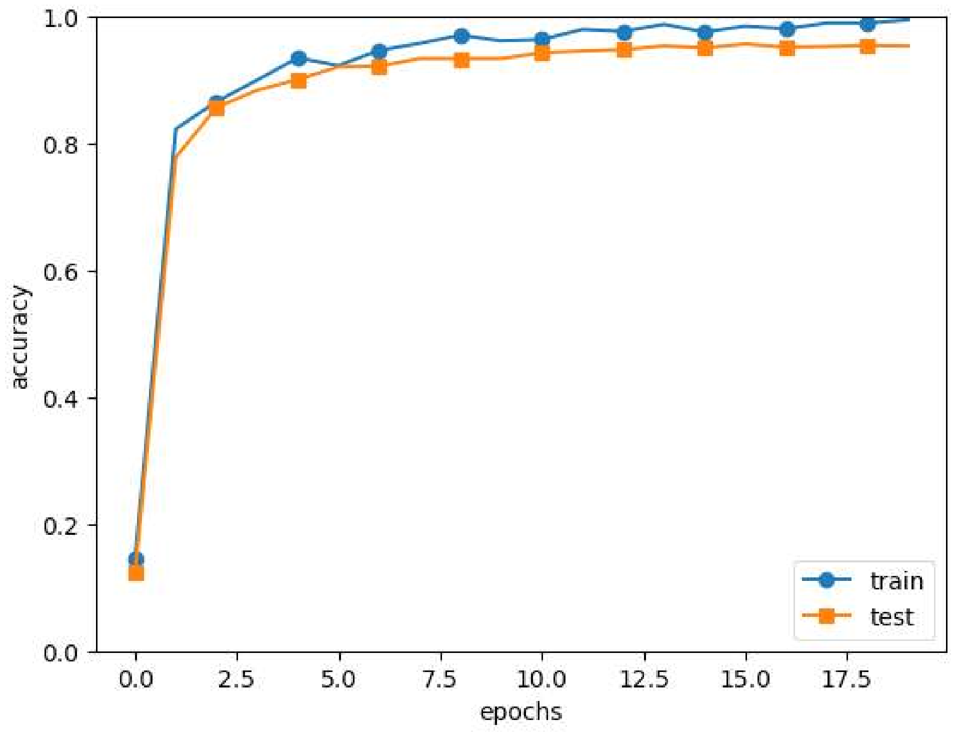
```python
import sys
import os
sys.path.append(os.pardir)
import numpy as np
import matplotlib.pyplot as plt
from collections import OrderedDict
from layers import *
from gradient import numerical_gradient
from dataset.mnist import load_mnist
from trainer import Trainer


class SimpleConvNet:
    def __init__(self, input_dim=(1, 28, 28),
                 conv_param={'filter_num': 30, 'filter_size': 5,
                             'pad': 0, 'stride': 1},
                 hidden_size=100, output_size=10, weight_init_std=0.01):

        filter_num = conv_param['filter_num']
        filter_size = conv_param['filter_size']
        filter_pad = conv_param['pad']
        filter_stride = conv_param['stride']
        input_size = input_dim[1]
        conv_output_size = (input_size - filter_size + 2*filter_pad) / \
            filter_stride + 1
        pool_output_size = int(filter_num * (conv_output_size/2) *
                               (conv_output_size/2))

        self.params = {}
        self.params['W1'] = weight_init_std * \
            np.random.randn(filter_num, input_dim[0], filter_size, filter_size)
        self.params['b1'] = np.zeros(filter_num)
        self.params['W2'] = weight_init_std * \
            np.random.randn(pool_output_size, hidden_size)
        self.params['b2'] = np.zeros(hidden_size)
        self.params['W3'] = weight_init_std * \
            np.random.randn(hidden_size, output_size)
        self.params['b3'] = np.zeros(output_size)

        self.layers = OrderedDict()
        self.layers['Conv1'] = Convolution(self.params['W1'],
                                           self.params['b1'],
                                           conv_param['stride'],
                                           conv_param['pad'])
        self.layers['Relu1'] = Relu()
        self.layers['Pool1'] = Pooling(pool_h=2, pool_w=2, stride=2)
        self.layers['Affine1'] = Affine(self.params['W2'], self.params['b2'])
        self.layers['Relu2'] = Relu()
        self.layers['Affine2'] = Affine(self.params['W3'], self.params['b3'])
        self.last_layer = SoftmaxWithLoss()
```

```python
def predict(self, x):
    for layer in self.layers.values():
        x = layer.forward(x)
    return x

def loss(self, x, t):
    y = self.predict(x)
    return self.last_layer.forward(y, t)

def accuracy(self, x, t, batch_size=100):
    if t.ndim != 1:
        t = np.argmax(t, axis=1)

    acc = 0.0

    for i in range(int(x.shape[0] / batch_size)):
        tx = x[i*batch_size:(i+1)*batch_size]
        tt = t[i*batch_size:(i+1)*batch_size]
        y = self.predict(tx)
        y = np.argmax(y, axis=1)
        acc += np.sum(y == tt)

    return acc / x.shape[0]

def gradient(self, x, t):
    self.loss(x, t)

    dout = 1
    dout = self.last_layer.backward(dout)

    layers = list(self.layers.values())
    layers.reverse()
    for layer in layers:
        dout = layer.backward(dout)

    grads = {}
    grads['W1'] = self.layers['Conv1'].dW
    grads['b1'] = self.layers['Conv1'].db
    grads['W2'] = self.layers['Affine1'].dW
    grads['b2'] = self.layers['Affine1'].db
    grads['W3'] = self.layers['Affine2'].dW
    grads['b3'] = self.layers['Affine2'].db

    return grads
```

```
(x_train, t_train), (x_test, t_test) = load_mnist(flatten=False)

x_train, t_train = x_train[:5000], t_train[:5000]
x_test, t_test = x_test[:1000], t_test[:1000]

max_epochs = 20

network = SimpleConvNet(input_dim=(1, 28, 28),
                        conv_param={'filter_num': 30, 'filter_size': 5, 'pad': 0, 'stride': 1},
                        hidden_size=100, output_size=10, weight_init_std=0.01)

trainer = Trainer(network, x_train, t_train, x_test, t_test,
                  epochs=max_epochs, mini_batch_size=100,
                  optimizer='Adam', optimizer_param={'lr': 0.001},
                  evaluate_sample_num_per_epoch=1000)
trainer.train()

markers = {'train': 'o', 'test': 's'}
x = np.arange(max_epochs)
plt.plot(x, trainer.train_acc_list, marker='o', label='train', markevery=2)
plt.plot(x, trainer.test_acc_list, marker='s', label='test', markevery=2)
plt.xlabel("epochs")
plt.ylabel("accuracy")
plt.ylim(0, 1.0)
plt.legend(loc='lower right')
plt.show()
```

```
train loss:0.05508682937637292
=== epoch:20, train acc:0.995, test acc:0.954 ===
train loss:0.016287200820162738

=============== Final Test Accuracy ===============
test acc:0.961
```


accuracy
epochs
train
test