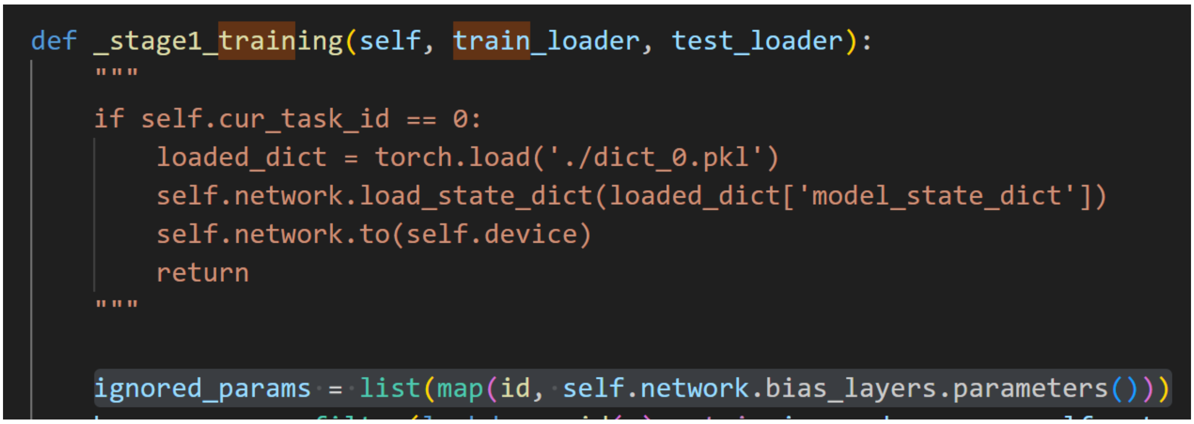
主要修改内容

> 注：一、六的修改不知道会不会对网络产生影响

一.self.network()无bias_layers这一属性

问题：`core/model/replay/bic.py`中`_stage1_training`和`_stage2_bias_correction`用到：

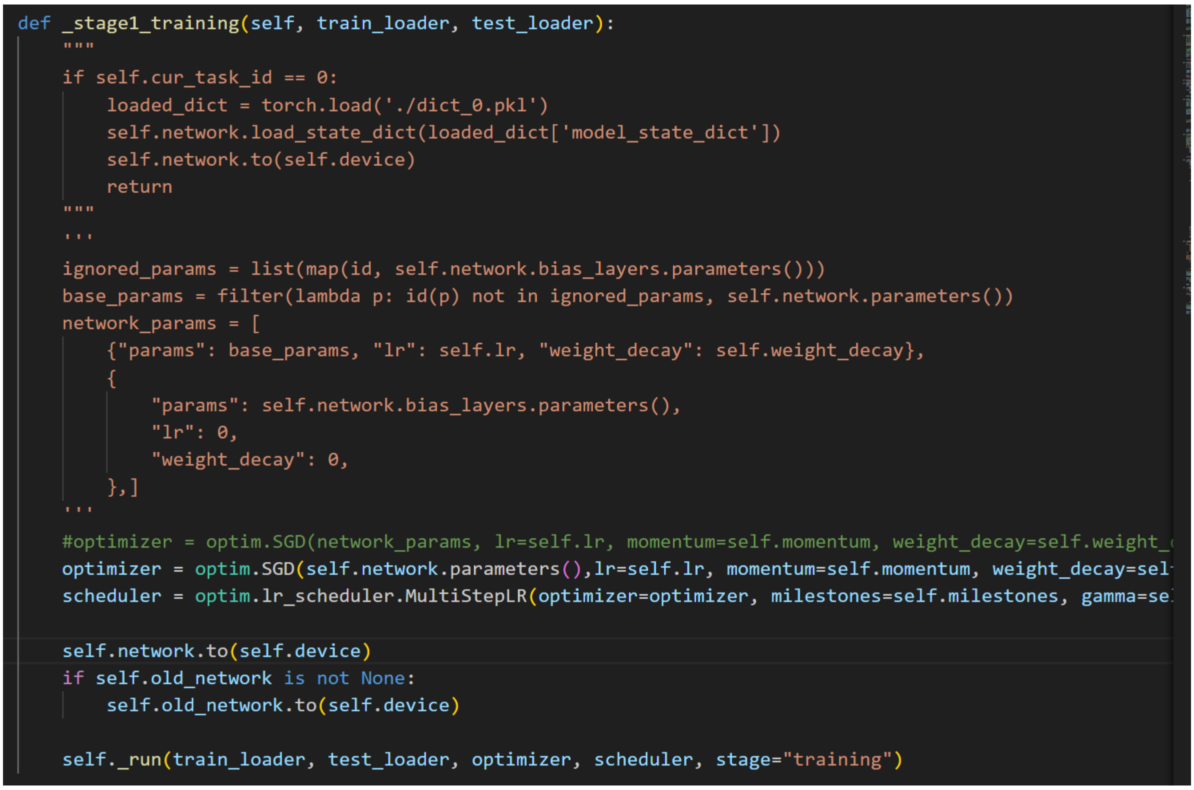


```
def _stage1_training(self, train_loader, test_loader):
    """
    if self.cur_task_id == 0:
        loaded_dict = torch.load('./dict_0.pkl')
        self.network.load_state_dict(loaded_dict['model_state_dict'])
        self.network.to(self.device)
        return
    """

    ignored_params = list(map(id, self.network.bias_layers.parameters()))
```

但self.network()无bias_layers这一属性

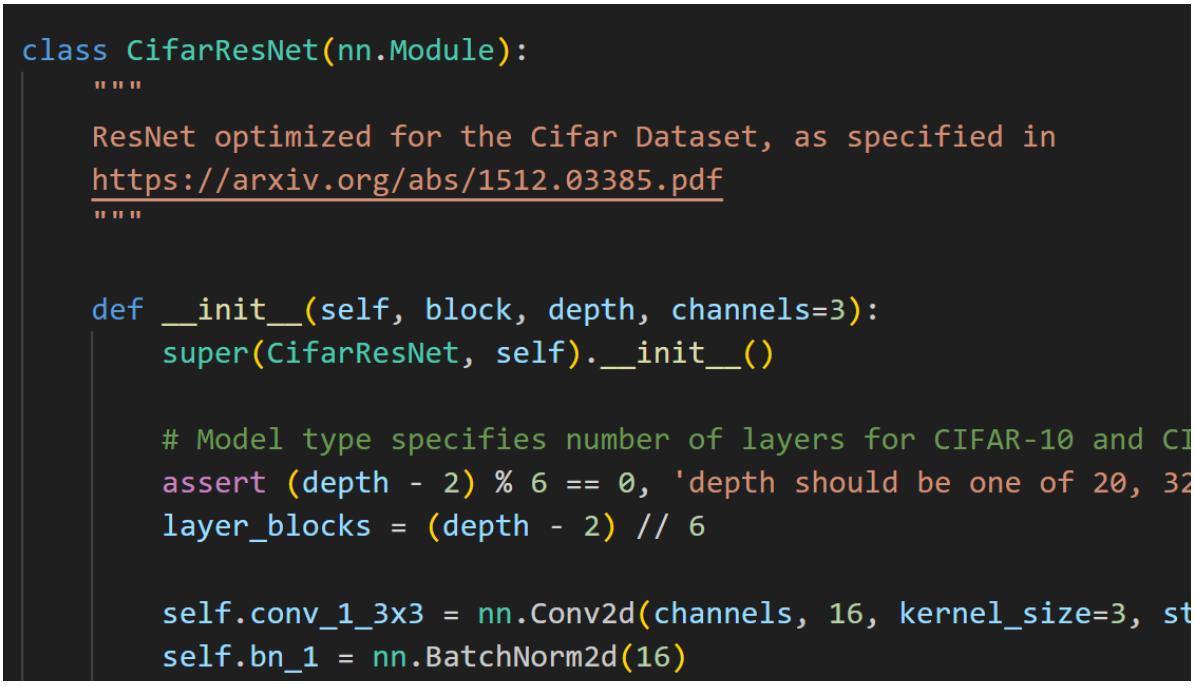
解决方法：

注释了ignored_params 、base_params 、ignored_params, network_params，把`optim.SGD`的第一个参数由 `network_params`改成了`self.network.parameters`



```
def _stage1_training(self, train_loader, test_loader):
    """
    if self.cur_task_id == 0:
        loaded_dict = torch.load('./dict_0.pkl')
        self.network.load_state_dict(loaded_dict['model_state_dict'])
        self.network.to(self.device)
        return
    """
    '''
    ignored_params = list(map(id, self.network.bias_layers.parameters()))
    base_params = filter(lambda p: id(p) not in ignored_params, self.network.parameters())
    network_params = [
        {"params": base_params, "lr": self.lr, "weight_decay": self.weight_decay},
        {
            "params": self.network.bias_layers.parameters(),
            "lr": 0,
            "weight_decay": 0,
        },]
    '''
    #optimizer = optim.SGD(network_params, lr=self.lr, momentum=self.momentum, weight_decay=self.weight_
    optimizer = optim.SGD(self.network.parameters(),lr=self.lr, momentum=self.momentum, weight_decay=sel
    scheduler = optim.lr_scheduler.MultiStepLR(optimizer=optimizer, milestones=self.milestones, gamma=se

    self.network.to(self.device)
    if self.old_network is not None:
        self.old_network.to(self.device)

    self._run(train_loader, test_loader, optimizer, scheduler, stage="training")
```

`core/mode/backbone/resnet.py`中：

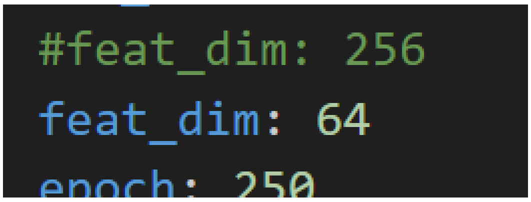


```
class CifarResNet(nn.Module):
    """
    ResNet optimized for the Cifar Dataset, as specified in
    https://arxiv.org/abs/1512.03385.pdf
    """

    def __init__(self, block, depth, channels=3):
        super(CifarResNet, self).__init__()

        # Model type specifies number of layers for CIFAR-10 and CI
        assert (depth - 2) % 6 == 0, 'depth should be one of 20, 32
        layer_blocks = (depth - 2) // 6

        self.conv_1_3x3 = nn.Conv2d(channels, 16, kernel_size=3, st
        self.bn_1 = nn.BatchNorm2d(16)
```

二.cifarresnet的输出特征维度与bic.py中定义的classifier的feat_dim不匹配

解决方法：

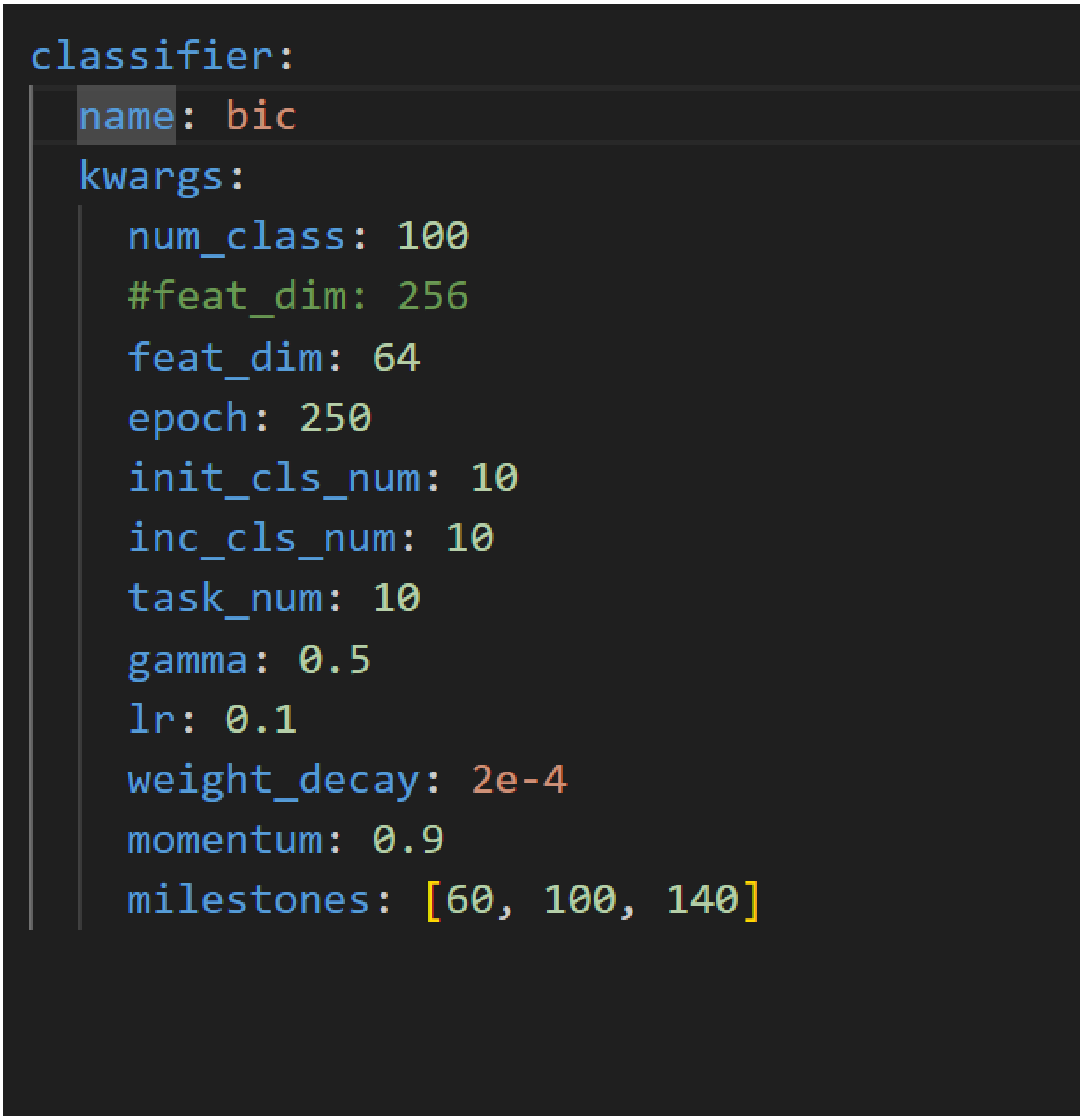
`bic.yaml`里把`feat_dim`改为64



```
#feat_dim: 256
feat_dim: 64
epoch: 250
```

三.bic类初始化时kwargs里无epoch等属性

解决方法：把epoch等属性再抄一遍放在bic.yaml的classifier的kwargs里



```
classifier:
  name: bic
  kwargs:
    num_class: 100
    #feat_dim: 256
    feat_dim: 64
    epoch: 250
    init_cls_num: 10
    inc_cls_num: 10
    task_num: 10
    gamma: 0.5
    lr: 0.1
    weight_decay: 2e-4
    momentum: 0.9
    milestones: [60, 100, 140]
```

四. File "/home/bzx_yjy/LibContinual/core/model/replay/bic.py", line 178, in _run image, label = image.to(self.device), label.to(self.device) AttributeError: 'str' object has no attribute 'to'

解决方法:

将原先的

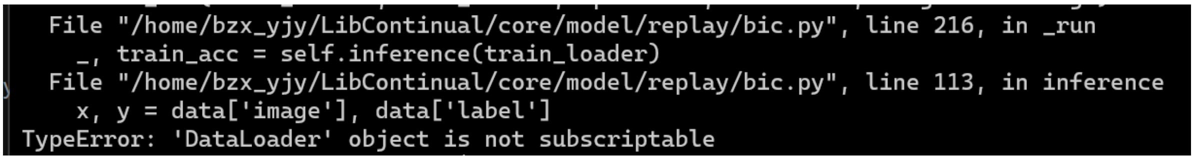
```
for i,(image,label) in enumerate(train_loader):
    image, label = image.to(self.device), label.to(self.device)
```

改为

```
for i, batch in enumerate(train_loader):
                image = batch['image']
                label = batch['label']
                image, label = image.to(self.device), label.to(self.device)
```

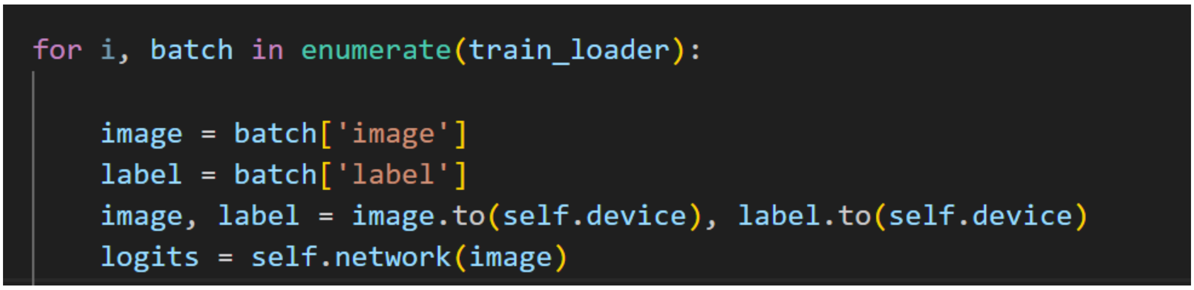
五.inference里传的是一个不支持索引的数据加载器

解决方法：



```
  File "/home/bzx_yjy/LibContinual/core/model/replay/bic.py", line 216, in _run
    _, train_acc = self.inference(train_loader)
  File "/home/bzx_yjy/LibContinual/core/model/replay/bic.py", line 113, in inference
    x, y = data['image'], data['label']
TypeError: 'DataLoader' object is not subscriptable
```

修改216行的推理过程传递的内容，把train_loader换成batch，batch的含义如下：

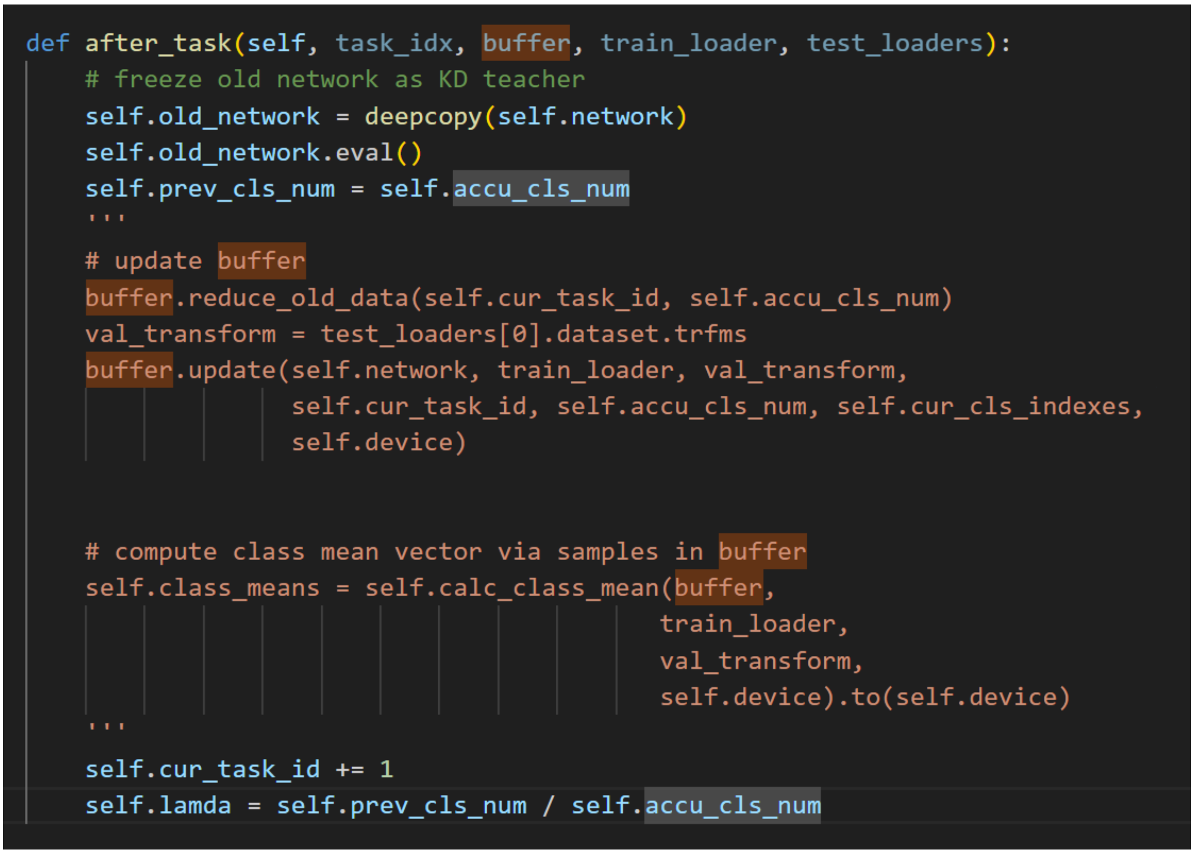


```
for i, batch in enumerate(train_loader):

    image = batch['image']
    label = batch['label']
    image, label = image.to(self.device), label.to(self.device)
    logits = self.network(image)
```

六.buffer.reduce_old_data(self.cur_task_id, self.accu_cls_num) AttributeError: 'LinearBuffer' object has no attribute 'reduce_old_data'

解决方法：

`bic.py`中：



```
def after_task(self, task_idx, buffer, train_loader, test_loaders):
    # freeze old network as KD teacher
    self.old_network = deepcopy(self.network)
    self.old_network.eval()
    self.prev_cls_num = self.accu_cls_num
    '''
    # update buffer
    buffer.reduce_old_data(self.cur_task_id, self.accu_cls_num)
    val_transform = test_loaders[0].dataset.trfms
    buffer.update(self.network, train_loader, val_transform,
                  self.cur_task_id, self.accu_cls_num, self.cur_cls_indexes,
                  self.device)


    # compute class mean vector via samples in buffer
    self.class_means = self.calc_class_mean(buffer,
                                            train_loader,
                                            val_transform,
                                            self.device).to(self.device)
    '''
    self.cur_task_id += 1
    self.lamda = self.prev_cls_num / self.accu_cls_num
```

七. File "/home/bzx_yjy/LibContinual/core/model/replay/bic.py", line 201, in _run distill_loss = -torch.mean(torch.sum(hat_pai_k * log_pai_k, dim=1)) RuntimeError: The size of tensor a (100) must match the size of tensor b (10) at non-singleton dimension 1

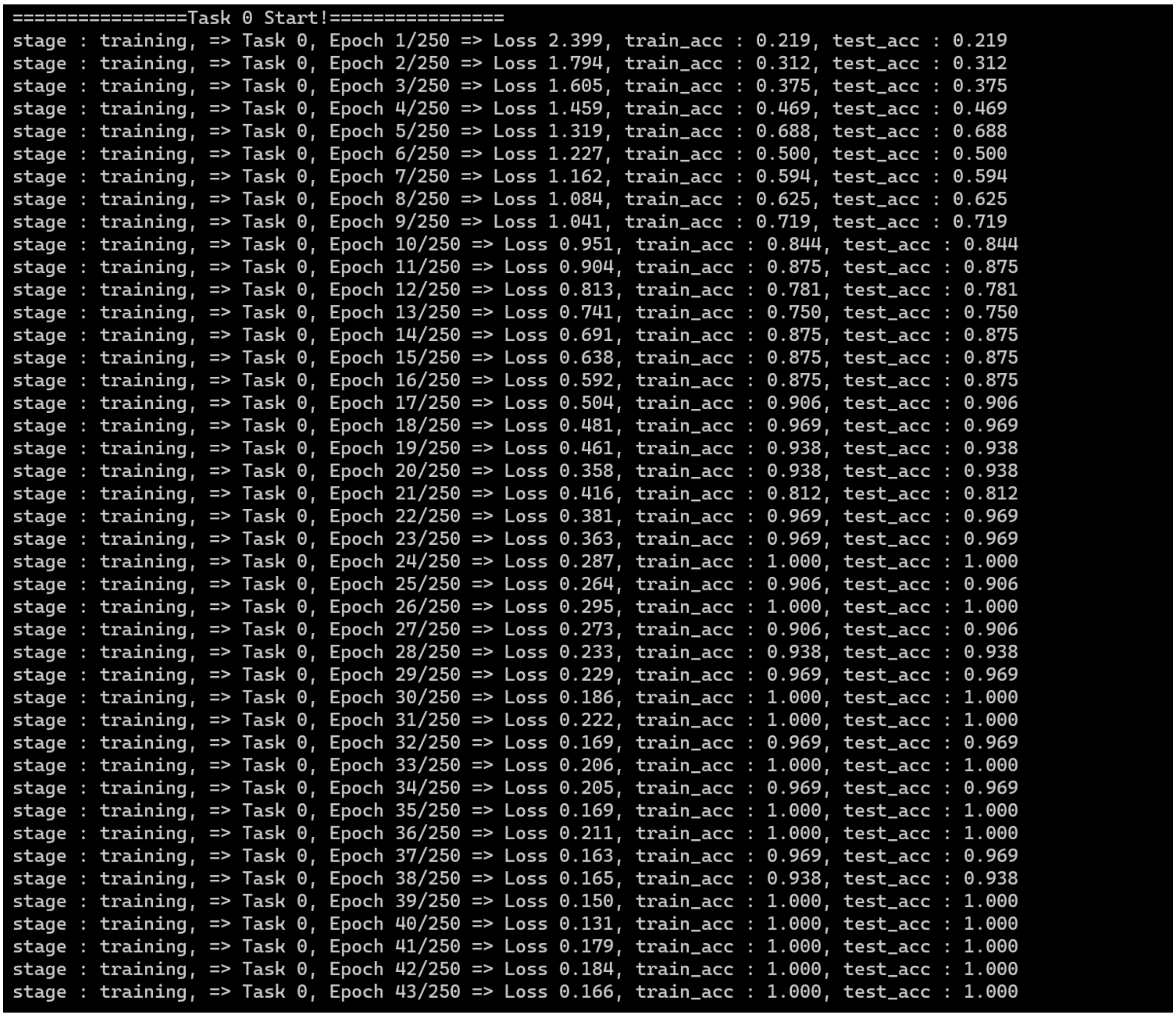
解决方法：

在bic.py的_run中修改hat_pai_k

```
#hat_pai_k = F.softmax(old_logits / self.T, dim=1)
hat_pai_k = F.softmax(old_logits[:, : self.prev_cls_num] / self.T, dim=1)
log_pai_k = F.log_softmax(logits[:, : self.prev_cls_num] / self.T, dim=1)
distill_loss = -torch.mean(torch.sum(hat_pai_k * log_pai_k, dim=1))
```

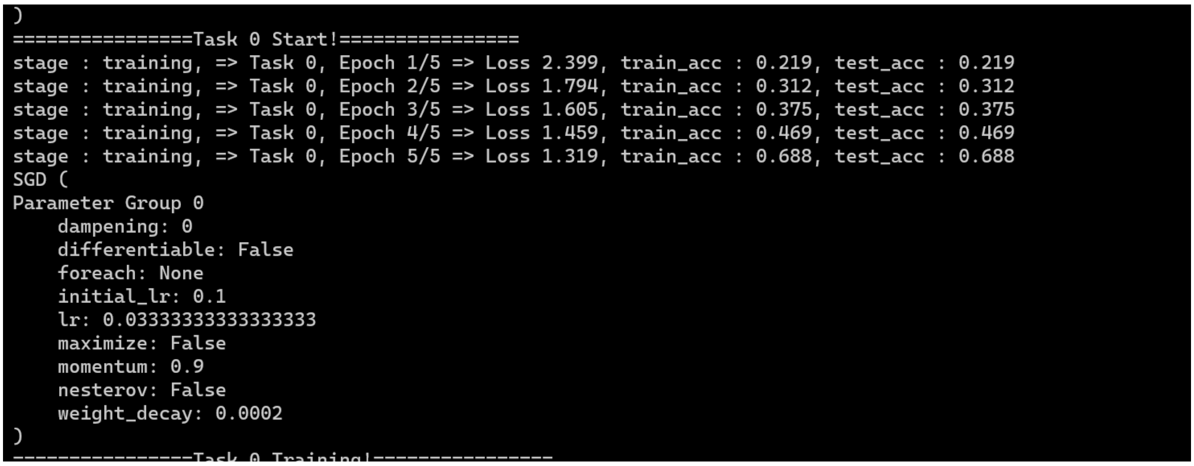
部分结果

这是before_task跑了250个epoch的截图（不是很快）



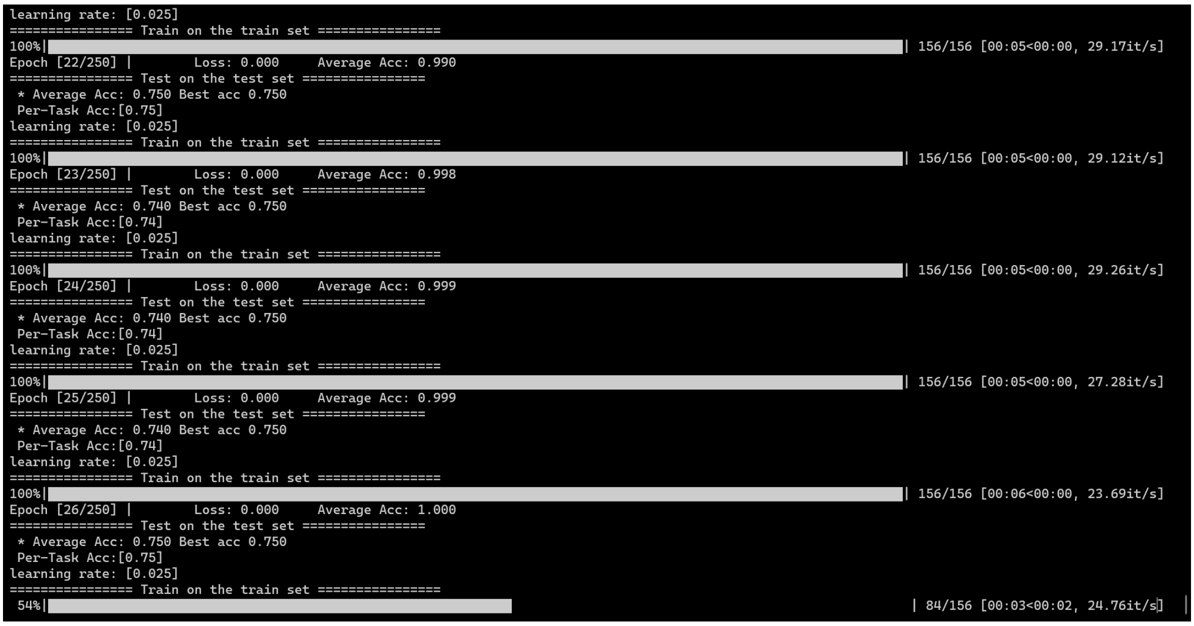
```
================Task 0 Start!================
stage : training, => Task 0, Epoch 1/250 => Loss 2.399, train_acc : 0.219, test_acc : 0.219
stage : training, => Task 0, Epoch 2/250 => Loss 1.794, train_acc : 0.312, test_acc : 0.312
stage : training, => Task 0, Epoch 3/250 => Loss 1.605, train_acc : 0.375, test_acc : 0.375
stage : training, => Task 0, Epoch 4/250 => Loss 1.459, train_acc : 0.469, test_acc : 0.469
stage : training, => Task 0, Epoch 5/250 => Loss 1.319, train_acc : 0.688, test_acc : 0.688
stage : training, => Task 0, Epoch 6/250 => Loss 1.227, train_acc : 0.500, test_acc : 0.500
stage : training, => Task 0, Epoch 7/250 => Loss 1.162, train_acc : 0.594, test_acc : 0.594
stage : training, => Task 0, Epoch 8/250 => Loss 1.084, train_acc : 0.625, test_acc : 0.625
stage : training, => Task 0, Epoch 9/250 => Loss 1.041, train_acc : 0.719, test_acc : 0.719
stage : training, => Task 0, Epoch 10/250 => Loss 0.951, train_acc : 0.844, test_acc : 0.844
stage : training, => Task 0, Epoch 11/250 => Loss 0.904, train_acc : 0.875, test_acc : 0.875
stage : training, => Task 0, Epoch 12/250 => Loss 0.813, train_acc : 0.781, test_acc : 0.781
stage : training, => Task 0, Epoch 13/250 => Loss 0.741, train_acc : 0.750, test_acc : 0.750
stage : training, => Task 0, Epoch 14/250 => Loss 0.691, train_acc : 0.875, test_acc : 0.875
stage : training, => Task 0, Epoch 15/250 => Loss 0.638, train_acc : 0.875, test_acc : 0.875
stage : training, => Task 0, Epoch 16/250 => Loss 0.592, train_acc : 0.875, test_acc : 0.875
stage : training, => Task 0, Epoch 17/250 => Loss 0.504, train_acc : 0.906, test_acc : 0.906
stage : training, => Task 0, Epoch 18/250 => Loss 0.481, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 19/250 => Loss 0.461, train_acc : 0.938, test_acc : 0.938
stage : training, => Task 0, Epoch 20/250 => Loss 0.358, train_acc : 0.938, test_acc : 0.938
stage : training, => Task 0, Epoch 21/250 => Loss 0.416, train_acc : 0.812, test_acc : 0.812
stage : training, => Task 0, Epoch 22/250 => Loss 0.381, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 23/250 => Loss 0.363, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 24/250 => Loss 0.287, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 25/250 => Loss 0.264, train_acc : 0.906, test_acc : 0.906
stage : training, => Task 0, Epoch 26/250 => Loss 0.295, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 27/250 => Loss 0.273, train_acc : 0.906, test_acc : 0.906
stage : training, => Task 0, Epoch 28/250 => Loss 0.233, train_acc : 0.938, test_acc : 0.938
stage : training, => Task 0, Epoch 29/250 => Loss 0.229, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 30/250 => Loss 0.186, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 31/250 => Loss 0.222, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 32/250 => Loss 0.169, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 33/250 => Loss 0.206, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 34/250 => Loss 0.205, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 35/250 => Loss 0.169, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 36/250 => Loss 0.211, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 37/250 => Loss 0.163, train_acc : 0.969, test_acc : 0.969
stage : training, => Task 0, Epoch 38/250 => Loss 0.165, train_acc : 0.938, test_acc : 0.938
stage : training, => Task 0, Epoch 39/250 => Loss 0.150, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 40/250 => Loss 0.131, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 41/250 => Loss 0.179, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 42/250 => Loss 0.184, train_acc : 1.000, test_acc : 1.000
stage : training, => Task 0, Epoch 43/250 => Loss 0.166, train_acc : 1.000, test_acc : 1.000
```

不小心中止了训练，为节约时间，把before_task里的epoch设成5跑



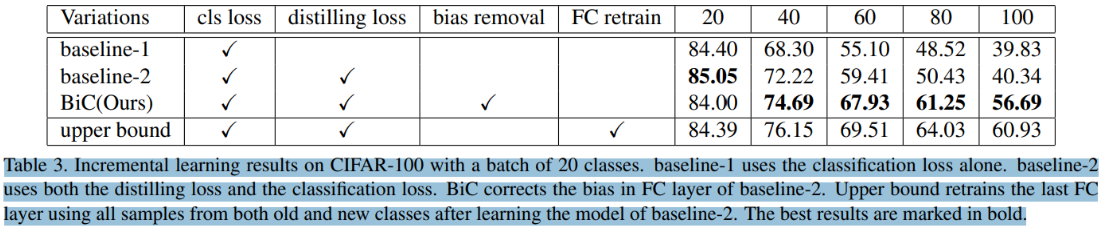
```
)
================Task 0 Start!================
stage : training, => Task 0, Epoch 1/5 => Loss 2.399, train_acc : 0.219, test_acc : 0.219
stage : training, => Task 0, Epoch 2/5 => Loss 1.794, train_acc : 0.312, test_acc : 0.312
stage : training, => Task 0, Epoch 3/5 => Loss 1.605, train_acc : 0.375, test_acc : 0.375
stage : training, => Task 0, Epoch 4/5 => Loss 1.459, train_acc : 0.469, test_acc : 0.469
stage : training, => Task 0, Epoch 5/5 => Loss 1.319, train_acc : 0.688, test_acc : 0.688
SGD (
Parameter Group 0
    dampening: 0
    differentiable: False
    foreach: None
    initial_lr: 0.1
    lr: 0.03333333333333333
    maximize: False
    momentum: 0.9
    nesterov: False
    weight_decay: 0.0002
)
================Task 0 Training!================
```

5趟后开始训练，task0中部分训练截图如下所示：



```
learning rate: [0.025]
================ Train on the train set ================
100%|████████████████████████████████████████████████████████████| 156/156 [00:05<00:00, 29.17it/s]
Epoch [22/250] |        Loss: 0.000     Average Acc: 0.990
================ Test on the test set ================
 * Average Acc: 0.750 Best acc 0.750
 Per-Task Acc:[0.75]
learning rate: [0.025]
================ Train on the train set ================
100%|████████████████████████████████████████████████████████████| 156/156 [00:05<00:00, 29.12it/s]
Epoch [23/250] |        Loss: 0.000     Average Acc: 0.998
================ Test on the test set ================
 * Average Acc: 0.740 Best acc 0.750
 Per-Task Acc:[0.74]
learning rate: [0.025]
================ Train on the train set ================
100%|████████████████████████████████████████████████████████████| 156/156 [00:05<00:00, 29.26it/s]
Epoch [24/250] |        Loss: 0.000     Average Acc: 0.999
================ Test on the test set ================
 * Average Acc: 0.740 Best acc 0.750
 Per-Task Acc:[0.74]
learning rate: [0.025]
================ Train on the train set ================
100%|████████████████████████████████████████████████████████████| 156/156 [00:05<00:00, 27.28it/s]
Epoch [25/250] |        Loss: 0.000     Average Acc: 0.999
================ Test on the test set ================
 * Average Acc: 0.740 Best acc 0.750
 Per-Task Acc:[0.74]
learning rate: [0.025]
================ Train on the train set ================
100%|████████████████████████████████████████████████████████████| 156/156 [00:06<00:00, 23.69it/s]
Epoch [26/250] |        Loss: 0.000     Average Acc: 1.000
================ Test on the test set ================
 * Average Acc: 0.750 Best acc 0.750
 Per-Task Acc:[0.75]
learning rate: [0.025]
================ Train on the train set ================
 54%|████████████████████████████████                             | 84/156 [00:03<00:02, 24.76it/s]
```

文章精度



Variations	cls loss	distilling loss	bias removal	FC retrain	20	40	60	80	100
baseline-1	✓				84.40	68.30	55.10	48.52	39.83
baseline-2	✓	✓			**85.05**	72.22	59.41	50.43	40.34
BiC(Ours)	✓	✓	✓		84.00	**74.69**	**67.93**	**61.25**	**56.69**
upper bound	✓	✓		✓	84.39	76.15	69.51	64.03	60.93

Table 3. Incremental learning results on CIFAR-100 with a batch of 20 classes. baseline-1 uses the classification loss alone. baseline-2 uses both the distilling loss and the classification loss. BiC corrects the bias in FC layer of baseline-2. Upper bound retrains the last FC layer using all samples from both old and new classes after learning the model of baseline-2. The best results are marked in bold.