fine-tuning

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1 Fine Tuning

```
In [1]: %matplotlib inline
        import d2l
        from mxnet import gluon, init, nd
        from mxnet.gluon import data as gdata, loss as gloss, model_zoo
        from mxnet.gluon import utils as gutils
        import os
        import zipfile
```

1.1 Hot Dog Recognition Dataset

1.1.1 Download the Data Set

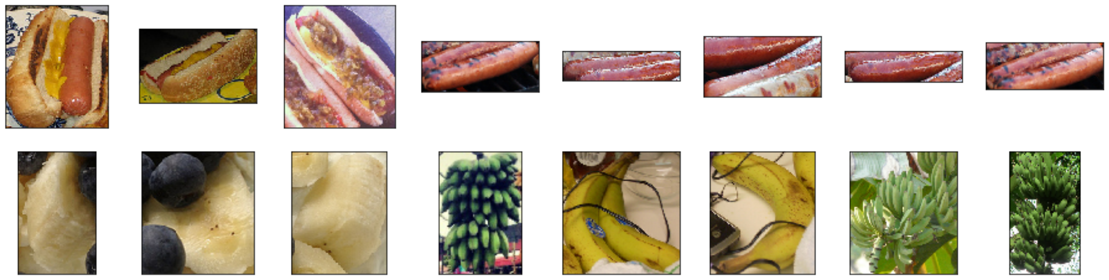
```
In [2]: data_dir = '.'
        base_url = 'https://apache-mxnet.s3-accelerate.amazonaws.com/'
        fname = gutils.download(
            base_url + 'gluon/dataset/hotdog.zip',
            path=data_dir, sha1_hash='fba480ffa8aa7e0febbb511d181409f899b9baa5')
        with zipfile.ZipFile(fname, 'r') as z:
            z.extractall(data_dir)
        !tree -d hotdog
```

```
hotdog
 test
ăă  hotdog
ăă  not-hotdog
 train
     hotdog
     not-hotdog

6 directories
```

1.1.2 Read the Dataset

```
In [3]: train_imgs = gdata.vision.ImageFolderDataset(
            os.path.join(data_dir, 'hotdog/train'))
```

```
test_imgs = gdata.vision.ImageFolderDataset(
    os.path.join(data_dir, 'hotdog/test'))

hotdogs = [train_imgs[i][0] for i in range(8)]
not_hotdogs = [train_imgs[-i - 1][0] for i in range(8)]
d2l.show_images(hotdogs + not_hotdogs, 2, 8, scale=2);
```



1.1.3 Image Augmentation

```
In [4]: # We specify the mean and variance of the three RGB channels to normalize the image ch
        normalize = gdata.vision.transforms.Normalize(
            [0.485, 0.456, 0.406], [0.229, 0.224, 0.225])

        train_augs = gdata.vision.transforms.Compose([
            gdata.vision.transforms.RandomResizedCrop(224),
            gdata.vision.transforms.RandomFlipLeftRight(),
            gdata.vision.transforms.ToTensor(),
            normalize])

        test_augs = gdata.vision.transforms.Compose([
            gdata.vision.transforms.Resize(256),
            gdata.vision.transforms.CenterCrop(224),
            gdata.vision.transforms.ToTensor(),
            normalize])
```

1.2 Model

1.2.1 Download Pre-trained Models

```
In [5]: pretrained_net = model_zoo.vision.resnet18_v2(pretrained=True)
        pretrained_net.output
```

```
Out[5]: Dense(512 -> 1000, linear)
```

1.2.2 Initialize Model for Fine Tuning

```
In [6]: finetune_net = model_zoo.vision.resnet18_v2(classes=2)
        finetune_net.features = pretrained_net.features
        finetune_net.output.initialize(init.Xavier())
        # The model parameters in output will be updated using a learning rate ten times great
        finetune_net.output.collect_params().setattr('lr_mult', 10)
```

1.3 Fine Tune

```
In [7]: def train_fine_tuning(net, learning_rate, batch_size=128, num_epochs=5):
            train_iter = gdata.DataLoader(
                train_imgs.transform_first(train_augs), batch_size, shuffle=True)
            test_iter = gdata.DataLoader(
                test_imgs.transform_first(test_augs), batch_size)
            ctx = d2l.try_all_gpus()
            net.collect_params().reset_ctx(ctx)
            net.hybridize()
            loss = gloss.SoftmaxCrossEntropyLoss()
            trainer = gluon.Trainer(net.collect_params(), 'sgd', {
                'learning_rate': learning_rate, 'wd': 0.001})
            d2l.train(train_iter, test_iter, net, loss, trainer, ctx, num_epochs)
```

1.3.1 Train

```
In [8]: train_fine_tuning(finetune_net, 0.01)
```

```
('training on', [gpu(0), gpu(1)])
epoch 1, loss 3.2973, train acc 0.682, test acc 0.864, time 18.0 sec
epoch 2, loss 0.3771, train acc 0.900, test acc 0.925, time 12.8 sec
epoch 3, loss 0.4421, train acc 0.889, test acc 0.806, time 12.7 sec
epoch 4, loss 0.3432, train acc 0.901, test acc 0.915, time 12.8 sec
epoch 5, loss 0.3066, train acc 0.906, test acc 0.922, time 12.8 sec
```

```
In [9]: scratch_net = model_zoo.vision.resnet18_v2(classes=2)
        scratch_net.initialize(init=init.Xavier())
        train_fine_tuning(scratch_net, 0.1)
```

```
('training on', [gpu(0), gpu(1)])
epoch 1, loss 0.6771, train acc 0.715, test acc 0.820, time 12.9 sec
epoch 2, loss 0.4187, train acc 0.814, test acc 0.841, time 12.8 sec
epoch 3, loss 0.3722, train acc 0.832, test acc 0.810, time 12.8 sec
epoch 4, loss 0.3701, train acc 0.837, test acc 0.805, time 12.8 sec
epoch 5, loss 0.3732, train acc 0.838, test acc 0.826, time 12.8 sec
```