```
import os
import torch
from d2l import torch as d2l
```

```
#@save
d2l.DATA_HUB['fra-eng'] = (d2l.DATA_URL + 'fra-eng.zip',
                           '94646ad1522d915e7b0f9296181140edcf86a4f5')

#@save
def read_data_nmt():
    """载入“英语－法语”数据集"""
    data_dir = d2l.download_extract('fra-eng')
    with open(os.path.join(data_dir, 'fra.txt'), 'r',
              encoding='utf-8') as f:
        return f.read()

raw_text = read_data_nmt()
print(raw_text[:75])
```

```
Downloading ../data/fra-eng.zip from http://d2l-data.s3-accelerate.amazonaws.com/fra-
eng.zip...
Go. Va !
Hi. Salut !
Run!  Cours !
Run!  Courez !
Who?  Qui ?
Wow!  Ça alors !
```

```
#@save
def preprocess_nmt(text):
    """预处理“英语－法语”数据集"""
    def no_space(char, prev_char):
        return char in set(',.!?') and prev_char != ' '

    # 使用空格替换不间断空格
    # 使用小写字母替换大写字母
    text = text.replace('\u202f', ' ').replace('\xa0', ' ').lower()
    # 在单词和标点符号之间插入空格
    out = [' ' + char if i > 0 and no_space(char, text[i - 1]) else char
           for i, char in enumerate(text)]
    return ''.join(out)

text = preprocess_nmt(raw_text)
print(text[:80])
```

```
go .  va !
hi .  salut !
run ! cours !
run ! courez !
who ? qui ?
wow ! ça alors !
```

测试

```
def no_space(char, prev_char):
    return char in set(',.!?') and prev_char != ' '
no_space(',', ' ')
```

```
False
```

```
out = ['aga', 'out', 'in', 'fuck', 'you']
list(' '.join(out))
```

```
['a',
 'g',
 'a',
 ' ',
 'o',
 'u',
 't',
 ' ',
 'i',
 'n',
 ' ',
 'f',
 'u',
 'c',
 'k',
 ' ',
 'y',
 'o',
 'u']
```

```
text[2],text[4],text[9]
```

```
(' ', '\t', '\n')
```

```
arr = torch.tensor([[0, 5, 1, 1, 1, 1, 1, 1, 1, 1],
                    [131, 4, 1, 1, 1, 1, 1, 1, 1, 1],
                    [452, 142, 1, 1, 1, 1, 1, 1, 1, 1]])
val_len = (arr != 1).type(torch.int32).sum(1, keepdim=True)
val_len[0]
```

```
tensor([2])
```

正文

词元化

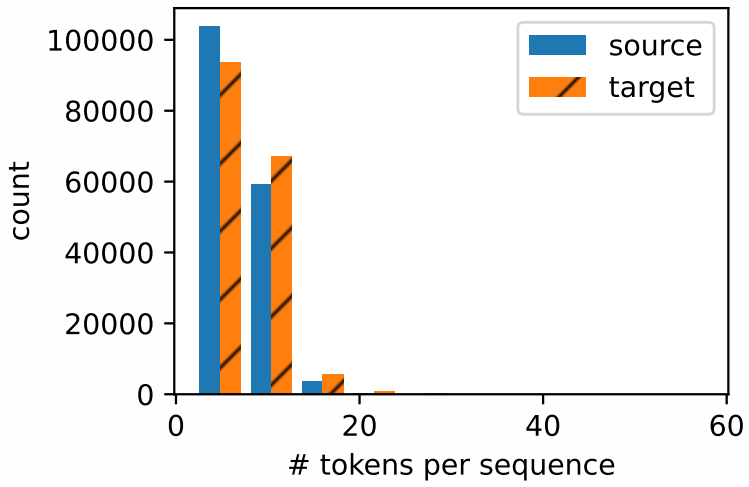
```
#@save
def tokenize_nmt(text, num_examples=None):
    """词元化“英语－法语”数据数据集"""
    source, target = [], []
    for i, line in enumerate(text.split('\n')):
        if num_examples and i > num_examples:
            break
        parts = line.split('\t')
        if len(parts) == 2:
            source.append(parts[0].split(' '))
            target.append(parts[1].split(' '))
    return source, target

source, target = tokenize_nmt(text)
source[:6], target[:6]
```

```
([['go', '.'],
  ['hi', '.'],
  ['run', '!'],
  ['run', '!'],
  ['who', '?'],
  ['wow', '!']],
 [['va', '!'],
  ['salut', '!'],
  ['cours', '!'],
  ['courez', '!'],
  ['qui', '?'],
  ['ça', 'alors', '!']])
```

```
def show_list_len_pair_hist(legend, xlabel, ylabel, xlist, ylist):
    """绘制列表长度对的直方图"""
    d2l.set_figsize()
    _, _, patches = d2l.plt.hist(
        [[len(l) for l in xlist], [len(l) for l in ylist]])
    d2l.plt.xlabel(xlabel)
    d2l.plt.ylabel(ylabel)
    for patch in patches[1].patches:
        patch.set_hatch('/')
    d2l.plt.legend(legend)

show_list_len_pair_hist(['source', 'target'], '# tokens per sequence',
                        'count', source, target);
```



```
src_vocab = d2l.Vocab(source, min_freq=2,
                      reserved_tokens=['<pad>', '<bos>', '<eos>'])
len(src_vocab)
```

```
10012
```

```
def truncate_pad(line, num_steps, padding_token):
    """截断或填充文本序列"""
    if len(line) > num_steps:
        return line[:num_steps]  # 截断
    return line + [padding_token] * (num_steps - len(line))  # 填充

truncate_pad(src_vocab[target[1]], 10, src_vocab['<pad>'])
```

```
[0, 5, 1, 1, 1, 1, 1, 1, 1, 1]
```

```
def build_array_nmt(lines, vocab, num_steps):
    """将机器翻译的文本序列转换成小批量"""
    lines = [vocab[l] for l in lines]
    lines = [l + [vocab['<eos>']] for l in lines]
    array = torch.tensor([truncate_pad(
        l, num_steps, vocab['<pad>']) for l in lines])
    valid_len = (array != vocab['<pad>']).type(torch.int32).sum(1)
    return array, valid_len
```

```
def load_data_nmt(batch_size, num_steps, num_examples=600):
    """返回翻译数据集的迭代器和词表"""
    text = preprocess_nmt(read_data_nmt())
    source, target = tokenize_nmt(text, num_examples)
    src_vocab = d2l.Vocab(source, min_freq=2,
                          reserved_tokens=['<pad>', '<bos>', '<eos>'])
    tgt_vocab = d2l.Vocab(target, min_freq=2,
                          reserved_tokens=['<pad>', '<bos>', '<eos>'])
    src_array, src_valid_len = build_array_nmt(source, src_vocab, num_steps)
    tgt_array, tgt_valid_len = build_array_nmt(target, tgt_vocab, num_steps)
    data_arrays = (src_array, src_valid_len, tgt_array, tgt_valid_len)
    data_iter = d2l.load_array(data_arrays, batch_size)
    return data_iter, src_vocab, tgt_vocab
```

```
train_iter, src_vocab, tgt_vocab = load_data_nmt(batch_size=2, num_steps=8)
for X, X_valid_len, Y, Y_valid_len in train_iter:
    print('X:', X.type(torch.int32))
    print('X的有效长度:', X_valid_len)
    print('Y:', Y.type(torch.int32))
    print('Y的有效长度:', Y_valid_len)
    break
```

```
X: tensor([[69, 17,  9, 11,  3,  1,  1,  1],
        [ 0, 29,  4,  3,  1,  1,  1,  1]], dtype=torch.int32)
X的有效长度: tensor([5, 4])
Y: tensor([[90, 11, 19, 88,  9,  3,  1,  1],
        [ 0, 42,  4,  3,  1,  1,  1,  1]], dtype=torch.int32)
Y的有效长度: tensor([6, 4])
```