计算机科学与技术学院神经网络与深度学习课程实验报告

实验题目：Fun with RNN		学号：201900130143
日期：11/11	班级： 智能班	姓名：吴家麒
Email：wjq_777@126.com		

实验目的：

In this project, you will work on extending min-char-rnn.py. This was written by Andrej Karpathy. You will experiment with the Shakespeare dataset (shakespeare_train.txt)

实验软件和硬件环境：

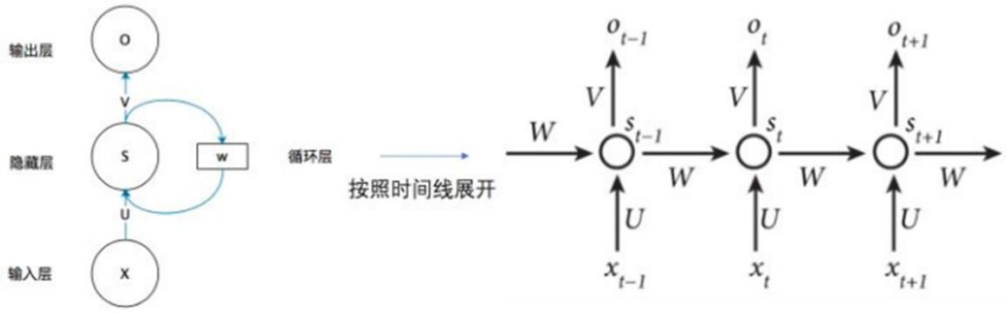
Anaconda3 + Jupyter notebook

实验原理和方法：

普通的神经网络都只能单独地处理一个个的输入，前一个输入和后一个输入是完全没有关系的。但是，某些任务需要能够更好的处理序列的信息，即前面的输入和后面的输入是有关系的，所以我们需要 RNN.

比如，当我们在理解一句话意思时，孤立的理解这句话的每个词是不够的，我们需要处理这些词连接起来的整个序列； 当我们处理视频的时候，我们也不能只单独的去分析每一帧，而要分析这些帧连接起来的整个序列。

RNN 的工作流程：



RNN时间线展开图

RNN 语言模型对其输出分布使用 softmax 激活函数。在每个时间步，可以通过将 logits 乘以一个分布常数α来对分布进行调整。

$$y = \mathrm{softmax}(\alpha z)$$

Here, $1/\alpha$ can be thought of as a “temperature”

i.e. lower values of α correspond to a “hotter” distribution.

实验步骤：（不要求罗列完整源代码）

1、在 Sample 函数中创建一段序列

def sample(h, seed_ix, n)

其中 h 代表隐藏层的信息，seed_ix 是输入的字母索引，根据这个字母来创建一个序列，n 代表生成的序列长度。

首先我们需要对字母进行 one-hot 编码：

```
x = np.zeros((vocab_size, 1))
x[seed_ix] = 1
print("seed_ix:%s" % seed_ix)
ixes = []
```

然后实现 RNN 的更新过程：

```
for t in range(n):
    h = np.tanh(np.dot(Wxh, x) + np.dot(Whh, h) + bh)
    y = np.dot(Why, h) + by
    p = np.exp(y) / np.sum(np.exp(y))
    ix = np.random.choice(range(vocab_size), p=p.ravel())
    x = np.zeros((vocab_size, 1))
    x[ix] = 1
    ixes.append(ix)
return ixes
```

2、Comp 函数的实现：给定一个长度为 m 的字符串，再用 n 个字符完成该字符串。

首先我们需要实现上下文文本的生成

```
for t in range(m):

    # Start Your code
    h = np.tanh(np.dot(Wxh, x) + np.dot(Whh, h) + bh) # h是隐藏层状态
    # x 是字符中索引为 1 的 k 个编码之一
    x = np.zeros((vocab_size, 1))
    ix = inputs[word_index + 1]
    word_index += 1
    x[ix] = 1

    # End your code

    ixes.append(ix)

txt = ''.join(ix_to_char[ix] for ix in ixes)
print('Context: \n----\n%s \n----\n\n\n' % (txt,))
```

然后从数据中计算 softmax 的概率和样本，并使用输出作为 continuation 的下一个输入。

```
# Start Your code
y = np.dot(Why, h) + by
p = np.exp(y) / np.sum(np.exp(y))
ix = np.random.choice(range(vocab_size), p=p.ravel())
x = np.zeros((vocab_size, 1))
x[ix] = 1
# End your code
```

随即开始生成字符串：

```
# start completing the string
ixes = []
for t in range(n):

    # Start Your code
    h = np.tanh(np.dot(Wxh, x) + np.dot(Whh, h) + bh) # h是隐藏层
    y = np.dot(Why, h) + by # 得分向量
    ix = np.random.choice(range(vocab_size), p=p.ravel()) # 按 p 中的概率取出一个索引
    x = np.zeros((vocab_size, 1)) # 重置编码向量
    x[ix] = 1
    # End your code

    ixes.append(ix)

# generates the continuation of the string
txt = ''.join(ix_to_char[ix] for ix in ixes)
print('Continuation: \n----\n%s \n----' % (txt,))
```

3. 文本生成结果

调整不同的 alpha 值后生成文本的结果，

Alpha = 5：

```
----
irst Senath the the the may the the shall me the the shall the we the the and
the the the the the so the the the the the the the the the the the the the the
so the we the the the the the con the conde
----
```

Alpha = 1：

```
----
irst Counds, thour my a the swould you:
O Yortity? You nathing than glove no, earlecont her:
That yet;
His hos.
Meest geot cous-- you un canantvan:
In go, who aforain,
I,
Wfy prough our porst, do'ded!
----
```

Alpha = 0.1：

```
----
VxCiledh;izVf!h!ssctZRCHADlrchQ-o!gsV'hy.merywo.qom?msatyxqar Rtxbi
:. Y:S-&KoJvv'v
mzaw
eCaag!sAuOIP.',mfpbth? ditrdkQRRJUGSD?iW.v xtSx?eD'q!&sPURiyZYf:,!o?
f-ha  !
,WcDueam.-yc-if:I;di-
Em
.c,NAsio
----
```

对于不同的 m，n 下文本生成的结果：

m=780，n=200

```
Context:
----
ly done.

CORIOLANUS:
Your horror's pardon:
I had rather have my wounds to heal again
Than hear say how I got them.

BRUTUS:
Sir, I hope
My words disbench'd you not.

CORIOLANUS:
No, sir: yet oft,
When blows have made me stay, I fled from words.
You soothed not, therefore hurt not: but
your people,
I love them as they weigh.

MENENIUS:
Pray now, sit down.

CORIOLANUS:
I had rather have one scratch my head i' the sun
When the alarum were struck than idly sit
To hear my nothings monster'd.

MENENIUS:
Masters of the people,
Your multiplying spawn how can he flatter--
That's thousand to one good one--when you now see
He had rather venture all his limbs for honour
Than one on's ears to hear it? Proceed, Cominius.

COMINIUS:
```

```
Continuation:
----
dbsgIotdtrsMmotaowahbRwhymmttywnimnttbdtmbtwatdmoyltIsbddtwltmateytttoiSoiymtitf
HotCgsthsfhotmsietwsthmpmhtlIhahtwpuytowhagoulwaqbttbsaceyvncwCmh&wtmlhbhcmkcant
atsmtthmamaIIhytpohaaattiIewpotmtnobmtaa
----
```

m=50, n=500

```
Context:
----
ews so late?

Messenger:
Spies of the Volsces
Held
----



Continuation:
----
: o: ! s   sr    sr
 ,  . e'?, . ,    ,,
s!  a,     e.e,!   r    .,e,  y i -'     :  . .;s a:  ,,   io  : ,   e

 e.i    .    e.
   e  s,         e!. ! ;  s ses sl                .-a s  s
; r,s  :        , s  s  s  e!    s, ;   ,? , or, s: s !,s; ; ,  e,t :  .. .! s
as. e  r  e s'        . !; s  s e e
 ,!e. ;e  :e    s ;.:  .  ? ,ne
 ,
    ,.e.      a .s  , .s  ,,
,    '.  :
 -.     s s  s!    e ;r , a , r;  .'  s
.
  :  ,    el

,
  ?o!s . i er l.  ,
.so     e  s s;.a:,s  ! , eea s
----
```

m=2, n=500

```
Context:
----
w m
----



Continuation:
----
nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnntnnnnnnnnnnnnnnnnnnntnnnnnnnnnnnnnnnnnntnnnnnn
nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnntnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnntnnntnsnnnnnnnnnnnnnn
nnnnnnnnnnnsnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnnnnnnnnsnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnlnnnnnnnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnntnnnnnnnnnnnnnnnnnnnnnntnnnnnnnnnnnnnnnnnnn
nnnnnnnnnnnnnnnnnnn
----
```

m=300, n=300

```
Context:
----
, 'tis a parlous boy;
Bold, quick, ingenious, forward, capable
He is all the mother's, from the top to toe.

BUCKINGHAM:
Well, let them rest. Come hither, Catesby.
Thou art sworn as deeply to effect what we intend
As closely to conceal what we impart:
Thou know'st our reasons urged upon the way;
What
----



Continuation:
----
ttttttcmnntnnttttttttrtnctnttttttnttttttttttntnttttnttsttnttttttftttttttrtnttttettttt
ttttttttttttttttttttvttttttttnttttttutttttntnttttttttttttttsttttttttttnttttttttptttt
titttttnptttttttttttttttnttttttttttttttttttttcttptttmttttttnttttrttttttsvttettttttttt
nttttnttttttttttttttutttttttttttttttttttttttttttttttttttttttttttttttttt
----
```

结论分析与体会：

1、从实验结果中可以发现，当α越大时，文本生成的概率分布越平滑，倾向于生成模型训练时出现次数多的词语，出现的词汇重复率很高；当α越小时，分布的方差变大，生成的词语由神经网络计算的概率来生成，随机性强。

2、通过本次实验对 RNN 模型的文本生成模型实现进行了学习和运用，对循环神经网络的记忆能力和具体原理进行了学习。

3、对于神经网络在实际应用中的过程有了更为深入的理解和学习。