# CSC321 Assignment 3

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## Part 1

**Samples with different alpha value as inputs:**

```
>>> temp(alpha=5)
----
 irst Senath the the and the the the the
 with the the the the the the the that and
 the the so he we the the the the the the we
 the we the shall the the the the the the
 the the the the not and the the t
----


>>> temp(alpha=1)
----
 irst Sen you the cite us deaphon I majond
 and have, en ixs the te paell myre, I befen
 of when pamest'd for un hilire the beared
 peast seslices?

VENHERI:
I'll not titned hee coman:
I, Ededted Go-sh's
----


>>> temp(alpha=0.1)
----
 y NQnyqhePy'!!GLuY!'sfCIT'njgzu
hnWgOwFlE QqwHlgajs!?E?zhU I
V.dG k;Ad:mz'kbe.',
ttSTaOPax.wR :i!!J:
Lhk!Seh:;'v!akWmWui
Wldevbblwo'at
fral:e,WYJNSrLPPu!.Ov'swgo!dipik.n,du&Cahi:abUgIalH&Ermnm:b!uaksN
----
```

As we can see from the sample generated from above,

When we have higher temperature (low alpha) makes, the probability vector is more spread out across the vocabulary, so that every character can have a high probability of being sampled. The result is that the result text will be a unreadable mess.

Lower temperature (high alpha) makes the softmax function similar to a max function. So the character with the highest probability will usually get picked. The sentence will consist of mostly the same word.

# Part 2

We use the comp(m, n) function in this section. We start at a random position in the Shakespeare text file and use a context string of length m and produce a string with length n that completes the context string.

Here's some interesting examples when we have different input context string with different length m. We also vary the length of continuation n.

```
#Sample 1
>>> comp(780,200)
Context:
----
'll speak a little.

CORIOLANUS:
O mother, mother!
What have you done? Behold, the heavens do ope,
The gods look down, and this unnatural scene
They laugh at. O my mother, mother! O!
You have won a happy victory to Rome;
But, for your son,--believe it, O, believe it,
Most dangerously you have with him prevail'd,
If not most mortal to him. But, let it come.
Aufidius, though I cannot make true wars,
I'll frame convenient peace. Now, good Aufidius,
Were you in my stead, would you have heard
A mother less? or granted less, Aufidius?

AUFIDIUS:
I was moved withal.

CORIOLANUS:
I dare be sworn you were:
And, sir, it is no little thing to make
Mine eyes to sweat compassion. But, good sir,
What peace you'll make, advise me: for my part,
```

I'll not to Rome, I'll back with you; and
----



Continuation:
----
anipo's If taadn, you for Could than shimed
Even,
Ofw in your o'lr graden!

BRUTUS:
And showet, hear the tratiot he gosium, Yound
had anmen peake, I levogh it helpbiged caen, cherber than with in Mais
----

# Sample 2
>>> comp(50,500)
Context:
----
e too;
For they that were your enemies are his,
And
----



Continuation:
----
 yourd she not them steach say;
To ferie more he you's thou
Wheneracsese to gis and bate? me my beport are koris you
The seitens
Or knawn me, I. sigy thee a ourst, ansuly
could: you, did the shoule have my lead have yot care,
A knew
lade,
I had hanger this has,
Le that thy stath
Will some, where shall sil it we bire, you not when; and she the had?

MENEETUS:
Yet clore
I foe and Malls Lord beile
sper with in that, thee
Thet hos

```
Alosk, and theim, you homure.
Whise his hing mese and and me co. O wi
----

#Sample 3

>>> comp(2,500)
Context:
----
the
----



Continuation:
----
e,
A meeple to seal Senow cot go's Held they dead and batter, peacize!

VOLUMNIA:
He shears tuinces!

MENENIUS:
Let he far swable themistn:
And and do deateb-in; now! speak fellinest!

BRUTUS:
I with:
He sent is ward be do of a sucnor?

VOLUMNIA:
No, of tell yaD hes theiciich even, that,
Prell drowete fonsus made. gome you wars for to eatty the thee sheetingmes pame?

WAR:
He do with huss
Eavo: I was,
I' thou that weod.pes, the our beal to a so-
Usiscound, sel yat are prote in he!

SICINIUS:
You
----

#Sample 4
>>> comp(300,300)
```

Context:
----
o me in this cause. O mother! wife!

AUFIDIUS:

CORIOLANUS:
Ay, by and by;
But we will drink together; and you shall bear
A better witness back than words, which we,
On like conditions, will have counter-seal'd.
Come, enter with us. Ladies, you deserve
To have a temple built you: all the swords
In It
----




Continuation:
----
wertinen,
Whsery my my go's hayiont, ey,
We good the Margind, swilize. gepper's the
betary you the crate we son prake he sorr is to peot lord consare ghatnowe it.

First en mill latice
A carsmes.

COOHA:
When both it.

COMINIUS:
Row to litt in com buwores I dan; slich, Snowd.

BRUTUS:
He doer: in it
----

#Sample 5
>>> comp(100,500)
Context:
----
umility.

QUEEN ELIZABETH:
A holy day shall this be kept hereafter:

```
I would to God all strifes were w
----




Continuation:
----
oo.

PTUS:
He the lisaie love shall trome
ust ungresbon.

SICINIUS:
Syen have wearif me,
The sies susser o'ble gear your carsith's deatoly what rice.
 that you, hatulance the do but, and it mothen,
The your Clly;
Af
But thet, faer your foe's.

DORSEIUS:
Insendert mugh stant,
The
Thaich; I'll coins I mey the vince,
When worsbary lath do
ALOUCESTER:
by should have balorted tay'pice wiit. loes?

VIRGILIA:
He sever can and mensuse me you all seal't peack's h
way our i' it would
If the hisend lee had
----
```

# Part 3

$W_{xh}[100][9]$, $W_{hy}[0][100]$ and $W_{hy}[2][100]$ are the most responsible weights for this behavior.

### Explanation:

When the character ":" is passed in as the one-of-K encoding where the 9th entry in the input x is 1, the 9th column of $W_{xh}$ gets picked up ($W_{xh}[:, 9]$). And then, we found out that the 100th entry of the hidden units h is the most activated with value of 0.9999, which is very large. Note that h being a tanh

unit asymptotically approaches 1. This makes $W_{hh}$ and the previous hidden state insignificant. $W_{xh}[100][9]$ is the most responsible for $h[100]$ being very large.

At the output stage, the hidden units is multiplied with the matrix $W_{hy}$. The result is that y[0] (newline character) and y[2] (space character) take on big values. This is due to the fact that $W_{hy}[0][100]$ and $W_{hy}[2][100]$ are the biggest values in the $W_{hy}[:, 100]$ column when the hidden units are activated at the 100th position (i.e. input is ":").

Large y[0] and y[2] make the newline character and space character very probable to be sampled after the softmax function turns the output vectors into a probability vector.

This is why the newline and space character always follow the colon character.