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I created 3 languages:
1. **W#W** (for example: 1234#1234)
2. **W#W^r** (W and the reverse of W, for example: 1234#4321)
3. a**s part 1 of this assignment – but now: the length of digits is very big**:
pos: [1-9]+a+[1-9]+b+[1-9]+c+[1-9]+d+[1-9]+
neg: [1-9]+a+[1-9]+b+[1-9]+b+[1-9]+d+[1-9]+
(every [1-9]+ length is between 100 to 300)

for all of the languages, I created 1000 examples (pos and neg), and split them to 80% (800) train set, and 20% (200) test set.

Here are the outcomes:
1) W#W:

epoch : #1
train took 4.683331251144409
train avg loss: 0.702500
test took 0.3581428527832031
test accuracy: 47.50%
time till now: 5.042128562927246

epoch : #2
train took 4.542623519897461
train avg loss: 0.695000
test took 0.35809850692749023
test accuracy: 43.00%
time till now: 9.943561315536499

epoch : #3
train took 4.712006568908691
train avg loss: 0.690000
test took 0.36350250244140625
test accuracy: 48.50%
time till now: 15.019761085510254

epoch : #4
train took 4.864981651306152
train avg loss: 0.690000
test took 0.3716592788696289
test accuracy: 46.50%
time till now: 20.257108449935913

epoch : #5
train took 4.7184529304504395
train avg loss: 0.685000
test took 0.37860703468322754
test accuracy: 48.50%
time till now: 25.35489010810852

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epoch : #6
train took 4.580578327178955
train avg loss: 0.671250
test took 0.3594028949737549
test accuracy: 42.00%
time till now: 30.295597553253174

epoch : #7
train took 4.566111087799072
train avg loss: 0.690000
test took 0.3603997230529785
test accuracy: 47.00%
time till now: 35.22292447090149

epoch : #8
train took 4.580969333648682
train avg loss: 0.647500
test took 0.3594529628753662
test accuracy: 49.50%
time till now: 40.16404151916504

epoch : #9
train took 4.627070903778076
train avg loss: 0.615000
test took 0.3727989196777344
test accuracy: 53.00%
time till now: 45.16467356681824

epoch : #10
train took 4.59833288192749
train avg loss: 0.581250
test took 0.35358357429504395
test accuracy: 51.50%
time till now: 50.11731457710266

summery for language 1:
I thought that LSTM will fail for this language because of the connection between the prefix and the suffix of the words in L, as we know LSTM looks of the past but not to the future.

As expected LSTM failed!
Its seems that the train loss decreased for each epoch (which means that we have learned on the train set, **but** , in the test set the accuracy was around the 50%.. so no. no generalization from the train set.

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2) W#W^r:

summery for language 2:
as language 1, I thought that LSTM will fail for this language because of the connection between the prefix and the suffix of the words in L, as we know LSTM looks of the past but not to the future.

For some reason when the length of the words was kind of small (2-20) the LSTM was able to learn (slow and little, but still..) so… I make my input larger..:)
now words length is between 1 to 100.
and we get:

epoch : #1
train took 5.796662092208862
train avg loss: 0.703750
test took 0.42657470703125
test accuracy: 47.00%
time till now: 6.224622964859009

epoch : #2
train took 5.629488229751587
train avg loss: 0.696250
test took 0.42029523849487305
test accuracy: 47.00%
time till now: 12.275094509124756

epoch : #3
train took 5.66878867149353
train avg loss: 0.700000
test took 0.41902732849121094
test accuracy: 47.00%
time till now: 18.363691091537476

epoch : #4
train took 5.83117413520813
train avg loss: 0.688750
test took 0.4229569435119629
test accuracy: 48.00%
time till now: 24.619266748428345

epoch : #5
train took 6.113572597503662
train avg loss: 0.696250
test took 0.45192718505859375
test accuracy: 48.00%
time till now: 31.185508489608765

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epoch : #6
train took 5.780158042907715
train avg loss: 0.700000
test took 0.4127843379974365
test accuracy: 42.50%
time till now: 37.37920069694519

epoch : #7
train took 5.7684831619262695
train avg loss: 0.691250
test took 0.41747617721557617
test accuracy: 44.00%
time till now: 43.56598448753357

epoch : #8
train took 6.335312128067017
train avg loss: 0.696250
test took 0.5270674228668213
test accuracy: 55.00%
time till now: 50.429126501083374

epoch : #9
train took 7.050213813781738
train avg loss: 0.657500
test took 0.5375919342041016
test accuracy: 46.00%
time till now: 58.018248558044434

epoch : #10
train took 5.644005060195923
train avg loss: 0.675000
test took 0.34400391578674316
test accuracy: 54.50%
time till now: 64.00762414932251

we can see **that the train loss decreased (by little) for each epoch (which means that we have learned on the train set, but** , in the test set the accuracy was around the 50%.. so no. no generalization from the train set.

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3)
for the third language I thoght lstm will fail because the “max length remembering” - I thought that the model could not remember that far away.. it cost a lot time to compute but still heres the outcome:

epoch : #1
train took 56.43882083892822
train avg loss: 0.705000
test took 4.278695106506348
test accuracy: 46.00%
time till now: 60.71818208694458

epoch : #2
train took 55.47657036781311
train avg loss: 0.696250
test took 4.254276990890503
test accuracy: 55.00%
time till now: 120.44976687431335

epoch : #3
train took 54.822052240371704
train avg loss: 0.696250
test took 4.274453639984131
test accuracy: 49.00%
time till now: 179.5470154285431

epoch : #4
train took 54.147186517715454
train avg loss: 0.707500
test took 4.258089542388916
test accuracy: 48.00%
time till now: 237.95304536819458

epoch : #5
train took 54.23379325866699
train avg loss: 0.693750
test took 4.372457981109619
test accuracy: 47.50%
time till now: 296.56004095077515

epoch : #6
train took 54.27241659164429
train avg loss: 0.693750
test took 4.305113077163696
test accuracy: 47.50%
time till now: 355.13833570480347

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epoch : #7
train took 54.09735083580017
train avg loss: 0.692500
test took 4.261762619018555
test accuracy: 50.50%
time till now: 413.4982650279999

epoch : #8
train took 54.66137909889221
train avg loss: 0.692500
test took 4.353071689605713
test accuracy: 47.50%
time till now: 472.51347732543945

epoch : #9
train took 54.430826902389526
train avg loss: 0.691250
test took 4.244607448577881
test accuracy: 51.00%
time till now: 531.189703464508

epoch : #10
train took 55.33522963523865
train avg loss: 0.691250
test took 4.318680047988892
test accuracy: 52.00%
time till now: 590.8443741798401

lstm failed (again!), I guess that the model cannot remember that far!
The train loss is nearly the same, so the model not learned on training, and the test accuracy is around 50% , definitely not generalization from train to test.