HW3

November 28, 2022

```python
[6]: import word2vec
     import trnn_utils as U
     from trnn_main import *
     import matplotlib.pyplot as plt
```

PA-I nad PA-II please see the code source files

0.0.1 PA-III-1 and PA-III-2

```python
[13]: # load datasets
      input_data = U.input_data()

      all_data, train_data, test_data = input_data.load_text_data()
      train_data_x = torch.from_numpy(np.array(train_data[0])) # map content by id
      train_data_y = torch.from_numpy(np.array(train_data[1]))
      test_data_x = torch.from_numpy(np.array(test_data[0])) # map content by id
      test_data_y = torch.from_numpy(np.array(test_data[1]))

      word_embed = input_data.load_word_embed()

      # model train (model test function can be called directly in model_train)
      train_loss_list, accuracies = model_train(all_data, word_embed, train_data_x,
       ↪train_data_y, test_data_x, test_data_y)
```

```
Trainning accurary at iteration 1 is:  42.04023443687629
Trainning loss at iteration 1 is:  1.4429721524141517
Trainning accurary at iteration 2 is:  50.1188024710914
Trainning loss at iteration 2 is:  1.3445454127725056
Trainning accurary at iteration 3 is:  54.72833834943767
Trainning loss at iteration 3 is:  1.2913385630962508
Trainning accurary at iteration 4 is:  57.1519087597022
Trainning loss at iteration 4 is:  1.252479598162671
Trainning accurary at iteration 5 is:  58.60921907175669
Trainning loss at iteration 5 is:  1.2275774141501368
Trainning accurary at iteration 6 is:  59.95564707745921
Trainning loss at iteration 6 is:  1.208969185184505
Trainning accurary at iteration 7 is:  59.432916204657054
Trainning loss at iteration 7 is:  1.193577493929465
```

```
Trainning accurary at iteration 8 is:   61.31791541264058
Trainning loss at iteration 8 is:   1.1819565063334525
Trainning accurary at iteration 9 is:   61.09615079993664
Trainning loss at iteration 9 is:   1.1731125603783623
Trainning accurary at iteration 10 is:   62.030730239188976
Trainning loss at iteration 10 is:   1.1613546181234313
Trainning accurary at iteration 11 is:   62.6643434183431
Trainning loss at iteration 11 is:   1.153768735920453
Trainning accurary at iteration 12 is:   63.1712339616664
Trainning loss at iteration 12 is:   1.1441893649240518
Trainning accurary at iteration 13 is:   63.36131791541264
Trainning loss at iteration 13 is:   1.1355011520512979
Trainning accurary at iteration 14 is:   63.72564549342626
Trainning loss at iteration 14 is:   1.130173183307576
Trainning accurary at iteration 15 is:   64.13749405987645
Trainning loss at iteration 15 is:   1.1220042699531718
Trainning accurary at iteration 16 is:   63.80484714082053
Trainning loss at iteration 16 is:   1.1139475594097752
Trainning accurary at iteration 17 is:   63.82068747029938
Trainning loss at iteration 17 is:   1.1088160123185618
Trainning accurary at iteration 18 is:   63.85236812925709
Trainning loss at iteration 18 is:   1.1022956977380685
Trainning accurary at iteration 19 is:   63.50388088072232
Trainning loss at iteration 19 is:   1.102159098150839
Trainning accurary at iteration 20 is:   64.04245208300333
Trainning loss at iteration 20 is:   1.0937999371765572
Trainning accurary at iteration 21 is:   63.83652779977824
Trainning loss at iteration 21 is:   1.0894129933728383
Trainning accurary at iteration 22 is:   64.32757801362268
Trainning loss at iteration 22 is:   1.0850779624094697
Trainning accurary at iteration 23 is:   64.78694756850942
Trainning loss at iteration 23 is:   1.0871159472144845
Trainning accurary at iteration 24 is:   64.58102328528433
Trainning loss at iteration 24 is:   1.077845606175924
Trainning accurary at iteration 25 is:   64.40677966101696
Trainning loss at iteration 25 is:   1.0743611437172422
Trainning accurary at iteration 26 is:   64.31173768414384
Trainning loss at iteration 26 is:   1.0728480674800662
Trainning accurary at iteration 27 is:   64.01077142404561
Trainning loss at iteration 27 is:   1.0687358899313104
Trainning accurary at iteration 28 is:   62.94946934896246
Trainning loss at iteration 28 is:   1.0708562733253457
Trainning accurary at iteration 29 is:   64.56518295580548
Trainning loss at iteration 29 is:   1.0642764309412494
Trainning accurary at iteration 30 is:   63.94741010613021
Trainning loss at iteration 30 is:   1.063207129964867
Trainning accurary at iteration 31 is:   64.48598130841121
Trainning loss at iteration 31 is:   1.058537748546898
```

```
Trainning accurary at iteration 32 is:  63.78900681134168
Trainning loss at iteration 32 is:  1.0611467795778322
Trainning accurary at iteration 33 is:  64.3592586725804
Trainning loss at iteration 33 is:  1.0557410695478127
Trainning accurary at iteration 34 is:  64.16917471883416
Trainning loss at iteration 34 is:  1.0570137230517915
Trainning accurary at iteration 35 is:  63.93156977665135
Trainning loss at iteration 35 is:  1.0507451493897064
Trainning accurary at iteration 36 is:  64.6602249326786
Trainning loss at iteration 36 is:  1.0469081605523542
Trainning accurary at iteration 37 is:  64.13749405987645
Trainning loss at iteration 37 is:  1.0479020275322144
Trainning accurary at iteration 38 is:  64.20085537779185
Trainning loss at iteration 38 is:  1.0479579270422927
Trainning accurary at iteration 39 is:  64.24837636622841
Trainning loss at iteration 39 is:  1.0464079858542108
Trainning accurary at iteration 40 is:  63.10787264375099
Trainning loss at iteration 40 is:  1.0518755217523987
Trainning accurary at iteration 41 is:  63.75732615238397
Trainning loss at iteration 41 is:  1.049191228770997
Trainning accurary at iteration 42 is:  63.646443846032
Trainning loss at iteration 42 is:  1.040118254908691
Trainning accurary at iteration 43 is:  64.40677966101696
Trainning loss at iteration 43 is:  1.0399086955158583
Trainning accurary at iteration 44 is:  64.58102328528433
Trainning loss at iteration 44 is:  1.0401542253635832
Trainning accurary at iteration 45 is:  63.78900681134168
Trainning loss at iteration 45 is:  1.0383170062429106
Trainning accurary at iteration 46 is:  64.24837636622841
Trainning loss at iteration 46 is:  1.041967201924614
Trainning accurary at iteration 47 is:  64.31173768414384
Trainning loss at iteration 47 is:  1.0366246317918282
Trainning accurary at iteration 48 is:  64.58102328528433
Trainning loss at iteration 48 is:  1.0357119063718383
Trainning accurary at iteration 49 is:  63.72564549342626
Trainning loss at iteration 49 is:  1.0386512976976896
Trainning accurary at iteration 50 is:  64.51766196736892
Trainning loss at iteration 50 is:  1.0408194648675055
Trainning accurary at iteration 51 is:  64.45430064945351
Trainning loss at iteration 51 is:  1.0363414352205123
Trainning accurary at iteration 52 is:  64.26421669570728
Trainning loss at iteration 52 is:  1.032227721120265
Trainning accurary at iteration 53 is:  63.86820845873594
Trainning loss at iteration 53 is:  1.032172563604532
Trainning accurary at iteration 54 is:  63.94741010613021
Trainning loss at iteration 54 is:  1.035155870699132
Trainning accurary at iteration 55 is:  64.26421669570728
Trainning loss at iteration 55 is:  1.032047552198479
```

```
Trainning accurary at iteration 56 is:  64.40677966101696
Trainning loss at iteration 56 is:  1.0322735363082243
Trainning accurary at iteration 57 is:  64.185015048313
Trainning loss at iteration 57 is:  1.0320587480520587
Trainning accurary at iteration 58 is:  63.85236812925709
Trainning loss at iteration 58 is:  1.032461733664699
Trainning accurary at iteration 59 is:  64.24837636622841
Trainning loss at iteration 59 is:  1.0341561708179414
Trainning accurary at iteration 60 is:  64.48598130841121
Trainning loss at iteration 60 is:  1.0299111597838284
Trainning accurary at iteration 61 is:  63.8840487882148
Trainning loss at iteration 61 is:  1.0287303316631398
Trainning accurary at iteration 62 is:  63.83652779977824
Trainning loss at iteration 62 is:  1.0288309573470509
Trainning accurary at iteration 63 is:  64.02661175352448
Trainning loss at iteration 63 is:  1.0286216680891107
Trainning accurary at iteration 64 is:  64.51766196736892
Trainning loss at iteration 64 is:  1.0271412295056888
Trainning accurary at iteration 65 is:  64.54934262632663
Trainning loss at iteration 65 is:  1.0256149106107277
Trainning accurary at iteration 66 is:  63.97909076508791
Trainning loss at iteration 66 is:  1.0253346958759537
Trainning accurary at iteration 67 is:  64.4226199904958
Trainning loss at iteration 67 is:  1.0272950217805026
Trainning accurary at iteration 68 is:  64.26421669570728
Trainning loss at iteration 68 is:  1.0267816190373804
Trainning accurary at iteration 69 is:  63.82068747029938
Trainning loss at iteration 69 is:  1.0289242008454873
Trainning accurary at iteration 70 is:  64.21669570727072
Trainning loss at iteration 70 is:  1.0262405228208953
Trainning accurary at iteration 71 is:  63.96325043560906
Trainning loss at iteration 71 is:  1.0311976754068704
Trainning accurary at iteration 72 is:  64.24837636622841
Trainning loss at iteration 72 is:  1.0290903575800006
Trainning accurary at iteration 73 is:  64.3592586725804
Trainning loss at iteration 73 is:  1.024216884876907
Trainning accurary at iteration 74 is:  64.3592586725804
Trainning loss at iteration 74 is:  1.0243636956696702
Trainning accurary at iteration 75 is:  64.54934262632663
Trainning loss at iteration 75 is:  1.02258064697596
Trainning accurary at iteration 76 is:  64.185015048313
Trainning loss at iteration 76 is:  1.023297526586845
Trainning accurary at iteration 77 is:  64.16917471883416
Trainning loss at iteration 77 is:  1.024652335184532
Trainning accurary at iteration 78 is:  64.08997307143989
Trainning loss at iteration 78 is:  1.0255661831994478
Trainning accurary at iteration 79 is:  63.96325043560906
Trainning loss at iteration 79 is:  1.0206316334789296
```

```
Trainning accurary at iteration 80 is:  63.45635989228576
Trainning loss at iteration 80 is:  1.0231633198839527
Trainning accurary at iteration 81 is:  63.01283066687787
Trainning loss at iteration 81 is:  1.0225910550345383
Trainning accurary at iteration 82 is:  63.55140186915888
Trainning loss at iteration 82 is:  1.0227637788356039
Trainning accurary at iteration 83 is:  63.440519562806905
Trainning loss at iteration 83 is:  1.0239454287555507
Trainning accurary at iteration 84 is:  64.07413274196104
Trainning loss at iteration 84 is:  1.0214846189497886
Trainning accurary at iteration 85 is:  63.83652779977824
Trainning loss at iteration 85 is:  1.020688327924796
Trainning accurary at iteration 86 is:  63.72564549342626
Trainning loss at iteration 86 is:  1.0219346908755618
Trainning accurary at iteration 87 is:  63.94741010613021
Trainning loss at iteration 87 is:  1.022106929796389
Trainning accurary at iteration 88 is:  64.08997307143989
Trainning loss at iteration 88 is:  1.0212805041119797
Trainning accurary at iteration 89 is:  63.345477585933786
Trainning loss at iteration 89 is:  1.022401492229339
Trainning accurary at iteration 90 is:  64.28005702518612
Trainning loss at iteration 90 is:  1.0224896742011562
Trainning accurary at iteration 91 is:  63.42467923332806
Trainning loss at iteration 91 is:  1.0214797642621567
Trainning accurary at iteration 92 is:  64.1216537303976
Trainning loss at iteration 92 is:  1.0166965123822362
Trainning accurary at iteration 93 is:  63.83652779977824
Trainning loss at iteration 93 is:  1.0182330027416864
Trainning accurary at iteration 94 is:  64.72358625059401
Trainning loss at iteration 94 is:  1.0178454821004852
Trainning accurary at iteration 95 is:  63.96325043560906
Trainning loss at iteration 95 is:  1.0170656345120934
Trainning accurary at iteration 96 is:  64.185015048313
Trainning loss at iteration 96 is:  1.020307836771984
Trainning accurary at iteration 97 is:  64.56518295580548
Trainning loss at iteration 97 is:  1.0153407883060812
Trainning accurary at iteration 98 is:  64.1533343893553
Trainning loss at iteration 98 is:  1.0187948789329273
Trainning accurary at iteration 99 is:  63.94741010613021
Trainning loss at iteration 99 is:  1.01755164877904
Trainning accurary at iteration 100 is:  64.61270394424204
Trainning loss at iteration 100 is:  1.0176666770734593
The model accuracy on test dataset is: 64.56518295580548
```

Seems the accurary converges around 64% and the final test accuracy is about 64.5%. We can visualize the accuracy curve:

```
[39]: ax = plt.plot([x/100.0 for x in accuracies])
      plt.xlabel("Epoch")
      plt.ylabel("Trainning Accuracy")
```

[39]: Text(0, 0.5, 'Trainning Accuracy')
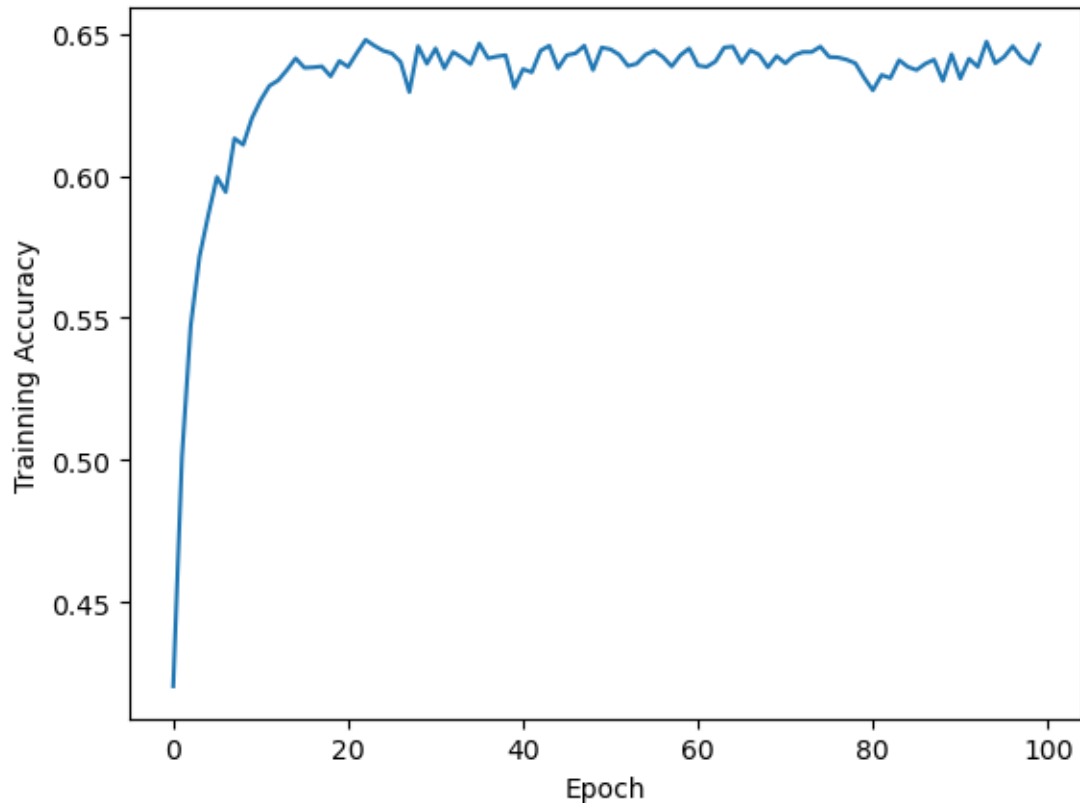
Of course this is the "choice 1" as described in the following PA-III-3. So I will try the "choice 2" subsequently:

0.0.2 PA-III-3

For the first choice that uses the last hidden state as output, the PA-III-2's result can be used.

For the second choice, simply changing the forward function to be as follow (other keep the same):

```
[16]: def forward(self, id_batch):
          # id_batch: use id_batch (paper ids in this batch) to obtain paper conent␣
      ↪of this batch
          x_batch = []
```

```python
    for id in id_batch:
        row = self.X[id.int()]
        p = np.zeros((100, 128))
        count = 0
        for w in row:
            p[count] = self.embed[w]
            count+=1
        x_batch.append(torch.from_numpy(p).to("cuda:0"))

    x_batch = torch.stack(x_batch)
    x_batch = x_batch.to(torch.float64).to("cuda:0")

    output = torch.zeros(x_batch.shape[0], 64, dtype=torch.float64).to("cuda:0")
    hx = torch.randn(x_batch.shape[0], 64, dtype=torch.float64).to("cuda:0")
    cx = torch.randn(x_batch.shape[0], 64, dtype=torch.float64).to("cuda:0")
    for i in range(x_batch.shape[1]):
        hx, cx = self.lstmcell(x_batch[:,i,:], (hx, cx))
        # accumulate the hidden layers
        output = output + hx

    ## calculate the average for all hidden layers
    output = output / x_batch.shape[0]
    x = self.layer1(output)
    x = self.layer1(outputs[-1])
    x = self.relu(x)
    x = self.layer2(x)
    x = self.sigmoid(x)
    return x
```

Then we re-run the model trainning and prediction:

```python
[9]: # load datasets
     input_data = U.input_data()

     all_data, train_data, test_data = input_data.load_text_data()
     train_data_x = torch.from_numpy(np.array(train_data[0])) # map content by id
     train_data_y = torch.from_numpy(np.array(train_data[1]))
     test_data_x = torch.from_numpy(np.array(test_data[0])) # map content by id
     test_data_y = torch.from_numpy(np.array(test_data[1]))

     word_embed = input_data.load_word_embed()

     # model train (model test function can be called directly in model_train)
     train_loss_list, accuracies = model_train(all_data, word_embed, train_data_x,␣
      ↪train_data_y, test_data_x, test_data_y)
```

```
Trainning accurary at iteration 1 is:  53.66703627435451
Trainning loss at iteration 1 is:  1.3669944460913184
```

```
Trainning accurary at iteration 2 is:  54.74417867891652
Trainning loss at iteration 2 is:  1.2642932438048242
Trainning accurary at iteration 3 is:  59.92396641850151
Trainning loss at iteration 3 is:  1.2286254486303094
Trainning accurary at iteration 4 is:  61.333755742119436
Trainning loss at iteration 4 is:  1.1960889772543823
Trainning accurary at iteration 5 is:  62.775225724695076
Trainning loss at iteration 5 is:  1.1775193778959343
Trainning accurary at iteration 6 is:  64.43846031997465
Trainning loss at iteration 6 is:  1.1603167212180634
Trainning accurary at iteration 7 is:  63.994931094566766
Trainning loss at iteration 7 is:  1.1441368966802046
Trainning accurary at iteration 8 is:  64.31173768414384
Trainning loss at iteration 8 is:  1.1332389909215654
Trainning accurary at iteration 9 is:  64.86614921590369
Trainning loss at iteration 9 is:  1.1222584531805515
Trainning accurary at iteration 10 is:  65.65816568984634
Trainning loss at iteration 10 is:  1.1189426150219177
Trainning accurary at iteration 11 is:  65.9432916204657
Trainning loss at iteration 11 is:  1.1060400499016865
Trainning accurary at iteration 12 is:  65.61064470140978
Trainning loss at iteration 12 is:  1.1001964265828503
Trainning accurary at iteration 13 is:  66.84619040076034
Trainning loss at iteration 13 is:  1.0936486461650972
Trainning accurary at iteration 14 is:  65.95913194994456
Trainning loss at iteration 14 is:  1.090817422091191
Trainning accurary at iteration 15 is:  65.84824964359258
Trainning loss at iteration 15 is:  1.0835441800745658
Trainning accurary at iteration 16 is:  67.4006019325202
Trainning loss at iteration 16 is:  1.0809032903747615
Trainning accurary at iteration 17 is:  69.4598447647711
Trainning loss at iteration 17 is:  1.0734947780109447
Trainning accurary at iteration 18 is:  70.7112307936005
Trainning loss at iteration 18 is:  1.06748721623130065
Trainning accurary at iteration 19 is:  70.42610486298115
Trainning loss at iteration 19 is:  1.0596325248072151
Trainning accurary at iteration 20 is:  70.28354189767147
Trainning loss at iteration 20 is:  1.0581264704174809
Trainning accurary at iteration 21 is:  70.48946618089656
Trainning loss at iteration 21 is:  1.0526074783191621
Trainning accurary at iteration 22 is:  71.07555837161414
Trainning loss at iteration 22 is:  1.050295548465964
Trainning accurary at iteration 23 is:  69.77665135434818
Trainning loss at iteration 23 is:  1.0447275595712404
Trainning accurary at iteration 24 is:  70.6795501346428
Trainning loss at iteration 24 is:  1.0413215332584478
Trainning accurary at iteration 25 is:  69.60240773008078
Trainning loss at iteration 25 is:  1.0364934361942326
```

```
Trainning accurary at iteration 26 is:  70.55282749881198
Trainning loss at iteration 26 is:  1.0350913284877028
Trainning accurary at iteration 27 is:  71.13891968952954
Trainning loss at iteration 27 is:  1.033518893772914
Trainning accurary at iteration 28 is:  71.20228100744495
Trainning loss at iteration 28 is:  1.030550253662991
Trainning accurary at iteration 29 is:  70.8854744178679
Trainning loss at iteration 29 is:  1.0272691335014477
Trainning accurary at iteration 30 is:  71.07555837161414
Trainning loss at iteration 30 is:  1.026212179903923
Trainning accurary at iteration 31 is:  70.80627277047363
Trainning loss at iteration 31 is:  1.0244004203829609
Trainning accurary at iteration 32 is:  70.93299540630446
Trainning loss at iteration 32 is:  1.0201574089078944
Trainning accurary at iteration 33 is:  71.09139870109298
Trainning loss at iteration 33 is:  1.0199248676264578
Trainning accurary at iteration 34 is:  70.45778552193886
Trainning loss at iteration 34 is:  1.0169799848260848
Trainning accurary at iteration 35 is:  71.02803738317758
Trainning loss at iteration 35 is:  1.0157503603353746
Trainning accurary at iteration 36 is:  70.9488357357833
Trainning loss at iteration 36 is:  1.0134500243683155
Trainning accurary at iteration 37 is:  70.31522255662918
Trainning loss at iteration 37 is:  1.010866083916517
Trainning accurary at iteration 38 is:  71.05971804213527
Trainning loss at iteration 38 is:  1.011797702281467
Trainning accurary at iteration 39 is:  70.61618881672739
Trainning loss at iteration 39 is:  1.0125014464072435
Trainning accurary at iteration 40 is:  71.28148265483922
Trainning loss at iteration 40 is:  1.007629320926543
Trainning accurary at iteration 41 is:  71.4240456201489
Trainning loss at iteration 41 is:  1.0081224943426825
Trainning accurary at iteration 42 is:  71.56660858545858
Trainning loss at iteration 42 is:  1.0040855148952064
Trainning accurary at iteration 43 is:  70.77459211151591
Trainning loss at iteration 43 is:  1.0048962600183735
Trainning accurary at iteration 44 is:  70.50530651037542
Trainning loss at iteration 44 is:  1.0055783049931206
Trainning accurary at iteration 45 is:  71.23396166640266
Trainning loss at iteration 45 is:  1.003613270307379
Trainning accurary at iteration 46 is:  70.82211309995247
Trainning loss at iteration 46 is:  1.00518540984623055
Trainning accurary at iteration 47 is:  70.55282749881198
Trainning loss at iteration 47 is:  0.9991848554063575
Trainning accurary at iteration 48 is:  70.93299540630446
Trainning loss at iteration 48 is:  0.9992811519744329
Trainning accurary at iteration 49 is:  71.10723903057183
Trainning loss at iteration 49 is:  1.0026033382619222
```

```
Trainning accurary at iteration 50 is:  71.34484397275463
Trainning loss at iteration 50 is:  0.9994991984453621
Trainning accurary at iteration 51 is:  70.61618881672739
Trainning loss at iteration 51 is:  0.9979101759700235
Trainning accurary at iteration 52 is:  70.75875178203707
Trainning loss at iteration 52 is:  0.9977322524662368
Trainning accurary at iteration 53 is:  70.39442420402344
Trainning loss at iteration 53 is:  0.9956402294413738
Trainning accurary at iteration 54 is:  70.33106288610803
Trainning loss at iteration 54 is:  0.9948260998150036
Trainning accurary at iteration 55 is:  70.45778552193886
Trainning loss at iteration 55 is:  0.9956537652107179
Trainning accurary at iteration 56 is:  70.60034848724854
Trainning loss at iteration 56 is:  0.9954319170554061
Trainning accurary at iteration 57 is:  70.69539046412166
Trainning loss at iteration 57 is:  0.9947397681912123
Trainning accurary at iteration 58 is:  70.82211309995247
Trainning loss at iteration 58 is:  0.9970975776692389
Trainning accurary at iteration 59 is:  70.58450815776968
Trainning loss at iteration 59 is:  0.9944722014062066
Trainning accurary at iteration 60 is:  70.77459211151591
Trainning loss at iteration 60 is:  0.9913412497858043
Trainning accurary at iteration 61 is:  70.8854744178679
Trainning loss at iteration 61 is:  0.9926919012343279
Trainning accurary at iteration 62 is:  70.96467606526215
Trainning loss at iteration 62 is:  0.989899214306572
Trainning accurary at iteration 63 is:  70.45778552193886
Trainning loss at iteration 63 is:  0.9905173598712912
Trainning accurary at iteration 64 is:  70.66370980516395
Trainning loss at iteration 64 is:  0.9925804244292101
Trainning accurary at iteration 65 is:  70.20434025027721
Trainning loss at iteration 65 is:  0.9908372482429219
Trainning accurary at iteration 66 is:  70.37858387454459
Trainning loss at iteration 66 is:  0.9889142538720812
Trainning accurary at iteration 67 is:  70.53698716933312
Trainning loss at iteration 67 is:  0.9894873413036848
Trainning accurary at iteration 68 is:  70.22018057975606
Trainning loss at iteration 68 is:  0.990800643141829
Trainning accurary at iteration 69 is:  71.01219705369871
Trainning loss at iteration 69 is:  0.9895613974033214
Trainning accurary at iteration 70 is:  70.45778552193886
Trainning loss at iteration 70 is:  0.9877525514510701
Trainning accurary at iteration 71 is:  70.6478694756851
Trainning loss at iteration 71 is:  0.986820112135762
Trainning accurary at iteration 72 is:  70.48946618089656
Trainning loss at iteration 72 is:  0.9881998471963663
Trainning accurary at iteration 73 is:  70.42610486298115
Trainning loss at iteration 73 is:  0.9876833773061868
```

```
Trainning accurary at iteration 74 is:  70.77459211151591
Trainning loss at iteration 74 is:  0.9902070573087749
Trainning accurary at iteration 75 is:  70.79043244099478
Trainning loss at iteration 75 is:  0.9883567741415443
Trainning accurary at iteration 76 is:  70.56866782829083
Trainning loss at iteration 76 is:  0.9846722719296312
Trainning accurary at iteration 77 is:  70.33106288610803
Trainning loss at iteration 77 is:  0.985073880798491
Trainning accurary at iteration 78 is:  70.56866782829083
Trainning loss at iteration 78 is:  0.9842201513417107
Trainning accurary at iteration 79 is:  70.69539046412166
Trainning loss at iteration 79 is:  0.9841932930525097
Trainning accurary at iteration 80 is:  70.20434025027721
Trainning loss at iteration 80 is:  0.9839636779453048
Trainning accurary at iteration 81 is:  70.93299540630446
Trainning loss at iteration 81 is:  0.9838370270546313
Trainning accurary at iteration 82 is:  70.06177728496753
Trainning loss at iteration 82 is:  0.9846878441845291
Trainning accurary at iteration 83 is:  70.12513860288294
Trainning loss at iteration 83 is:  0.9846639191007791
Trainning accurary at iteration 84 is:  69.96673530809441
Trainning loss at iteration 84 is:  0.9835807213192421
Trainning accurary at iteration 85 is:  70.01425629653097
Trainning loss at iteration 85 is:  0.9822816193748063
Trainning accurary at iteration 86 is:  70.93299540630446
Trainning loss at iteration 86 is:  0.9829201729495511
Trainning accurary at iteration 87 is:  70.61618881672739
Trainning loss at iteration 87 is:  0.9833670299594917
Trainning accurary at iteration 88 is:  70.55282749881198
Trainning loss at iteration 88 is:  0.9823767826279007
Trainning accurary at iteration 89 is:  70.47362585141771
Trainning loss at iteration 89 is:  0.9797522706560402
Trainning accurary at iteration 90 is:  70.53698716933312
Trainning loss at iteration 90 is:  0.9775987372141947
Trainning accurary at iteration 91 is:  70.36274354506574
Trainning loss at iteration 91 is:  0.9815824012328984
Trainning accurary at iteration 92 is:  70.48946618089656
Trainning loss at iteration 92 is:  0.981832937335278
Trainning accurary at iteration 93 is:  70.63202914620624
Trainning loss at iteration 93 is:  0.9816312687791304
Trainning accurary at iteration 94 is:  68.69950894978615
Trainning loss at iteration 94 is:  0.9796509097951175
Trainning accurary at iteration 95 is:  70.77459211151591
Trainning loss at iteration 95 is:  0.9809291263000198
Trainning accurary at iteration 96 is:  70.1726595913195
Trainning loss at iteration 96 is:  0.9818456809959049
Trainning accurary at iteration 97 is:  71.29732298431807
Trainning loss at iteration 97 is:  0.9802053450742318
```

```
Trainning accurary at iteration 98 is:  70.83795342943134
Trainning loss at iteration 98 is:  0.9766386420580618
Trainning accurary at iteration 99 is:  69.61824805955963
Trainning loss at iteration 99 is:  0.9759700015714216
Trainning accurary at iteration 100 is:  70.83795342943134
Trainning loss at iteration 100 is:  0.9807199665447095
The model accuracy on test dataset is: 70.63202914620624
```

[10]:
```python
ax = plt.plot([x/100.0 for x in accuracies])
plt.xlabel("Epoch")
plt.ylabel("Trainning Accuracy")
plt.title("Another choice: LSTM Using the average of hidden layer as the␣
  ↪output")
```

[10]: Text(0.5, 1.0, 'Another choice: LSTM Using the average of hidden layer as the
output')
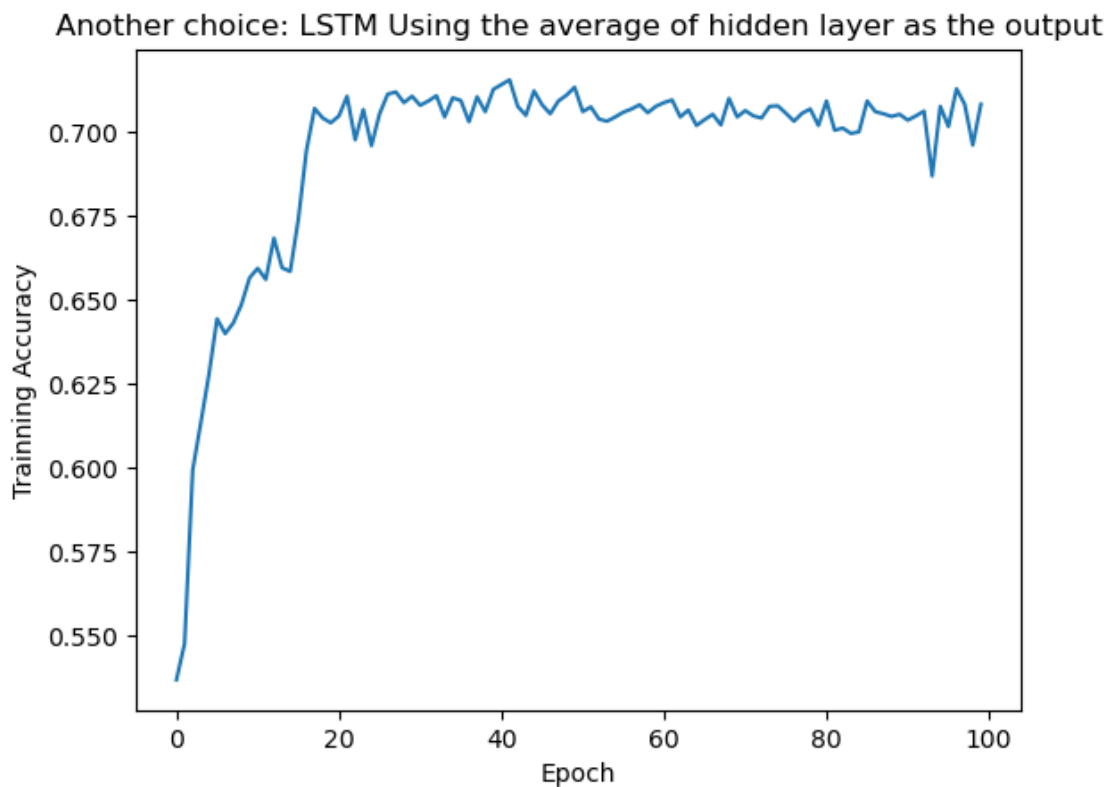
It looks that the 2th choice that uses an average of hidden layer as the output performs better than the 1th choice which only uses the last hidden layer. The 2th choice's trainning accuracy congerges around 70% and ends up with the test accuracy 70.6% whereas the 1th choice's test accuracy is only about 64.5%