SERS_Raman_Pancreatic_Cancer

June 30, 2024

1 Detection of pancreatic cancer through combination of Raman Spectroscopy and machine learning

We will use spectroscopic data and machine learning methods to detect exosomes, which act as markers for exosomes for pancreatic cancer.

First, let's import some primary packages and look at the files and data.

[269]:
```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[234]:
```
files = os.listdir('Data')
import re
for file in files:
    if bool(re.search('.txt',file)):
        print(file)
```

```
Average spectra.txt
DA.txt
EPC-prediction.txt
HC-prediction.txt
Loading.txt
PCA1.txt
PCA2.txt
PCA3.txt
Raman shift.txt
Raw-CD18.txt
Raw-EPC.txt
Raw-EPC2.txt
Raw-GN.txt
Raw-HC.txt
Raw-HC2.txt
Raw-HPDE.txt
Raw-MiaPaCa.txt
Scaled CD18.txt
```

```
Scaled GN.txt
Scaled HPDE.txt
Scaled MiaPaCa.txt
```

[6]:
```python
df_average = pd.read_csv(r'Data\Average spectra.txt',sep='\t',header=[0,1])
```

[7]:
```python
df_average.head()
```

[7]:
```
  Unnamed: 0_level_0                                               Mean  \
  Unnamed: 0_level_1 Statistics On Rows of [Book9]H-HPDE!Col(B):Col(C34)
0            719.421                                           1.963618
1            720.629                                           1.889719
2            721.838                                           1.854428
3            723.046                                           1.793777
4            724.253                                           1.746564

                                   Standard Deviation  \
  Statistics On Rows of [Book9]H-HPDE!Col(B):Col(C34)
0                                           1.243561
1                                           1.202215
2                                           1.155707
3                                           1.122544
4                                           1.094122

                                                 Mean  \
  Statistics On Rows of [Book1]H-CD18!Col(B):Col(C32)
0                                           2.089354
1                                           2.004456
2                                           1.955802
3                                           1.928820
4                                           1.866089

                                   Standard Deviation  \
  Statistics On Rows of [Book1]H-CD18!Col(B):Col(C32)
0                                           1.986297
1                                           1.919989
2                                           1.877348
3                                           1.853950
4                                           1.827821

                                                     Mean  \
  Statistics On Rows of [Book2]H-MiaPaCa!Col(A1):Col(A31)
0                                           1.009154
1                                           0.950310
2                                           0.902877
3                                           0.878549
4                                           0.844380
```

```
                                            Standard Deviation  \
  Statistics On Rows of [Book2]H-MiaPaCa!Col(A1):Col(A31)
0                                                     1.718254
1                                                     1.691151
2                                                     1.648838
3                                                     1.622505
4                                                     1.596352

                                                  Mean  \
  Statistics On Rows of [Book8]H-GN!Col(B):Col(W)
0                                             1.569937
1                                             1.485904
2                                             1.415847
3                                             1.323568
4                                             1.222392

                                    Standard Deviation
  Statistics On Rows of [Book8]H-GN!Col(B):Col(W)
0                                             1.113830
1                                             1.096629
2                                             1.076157
3                                             1.041825
4                                             0.991328
```

[8]:
```
df_average.shape
```

[8]:
```
(1014, 9)
```

[9]:
```
columns=[('Raman','Frequency'),
         ('Mean','HPDE'),('Standard Deviation','HPDE'),
         ('Mean','CD'),('Standard Deviation','CD'),
         ('Mean','MiaPaCa'),('Standard Deviation','MiaPaCa'),
        ('Mean','GN'),('Standard Deviation','GN')]
df_average.columns = pd.MultiIndex.from_tuples(columns)
df_average.head()
```

[9]:
```
      Raman      Mean Standard Deviation      Mean Standard Deviation  \
  Frequency      HPDE               HPDE        CD                 CD
0   719.421  1.963618           1.243561  2.089354           1.986297
1   720.629  1.889719           1.202215  2.004456           1.919989
2   721.838  1.854428           1.155707  1.955802           1.877348
3   723.046  1.793777           1.122544  1.928820           1.853950
4   724.253  1.746564           1.094122  1.866089           1.827821

       Mean Standard Deviation      Mean Standard Deviation
    MiaPaCa            MiaPaCa        GN                 GN
```

```
0  1.009154           1.718254  1.569937           1.113830
1  0.950310           1.691151  1.485904           1.096629
2  0.902877           1.648838  1.415847           1.076157
3  0.878549           1.622505  1.323568           1.041825
4  0.844380           1.596352  1.222392           0.991328
```

[10]:

```
df_average.info()
```

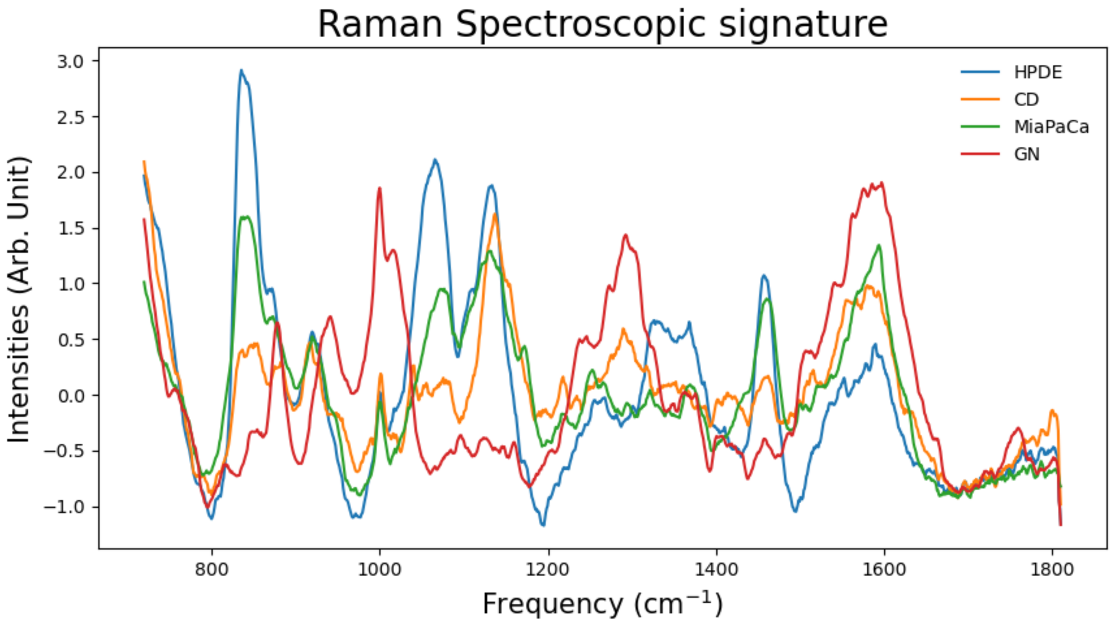
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1014 entries, 0 to 1013
Data columns (total 9 columns):
 #   Column                         Non-Null Count  Dtype
---  ------                         --------------  -----
 0   (Raman, Frequency)             1014 non-null   float64
 1   (Mean, HPDE)                   1014 non-null   float64
 2   (Standard Deviation, HPDE)     1014 non-null   float64
 3   (Mean, CD)                     1014 non-null   float64
 4   (Standard Deviation, CD)       1014 non-null   float64
 5   (Mean, MiaPaCa)                1014 non-null   float64
 6   (Standard Deviation, MiaPaCa)  1014 non-null   float64
 7   (Mean, GN)                     1014 non-null   float64
 8   (Standard Deviation, GN)       1014 non-null   float64
dtypes: float64(9)
memory usage: 71.4 KB
```

This is a averaged spectra, which we can use to look at the spectra of exosomes and a control.

Of course, this is spectroscopic data, which means that x-axis will be in frequency (cm^{-1}) and the y-axis will be the intensity.

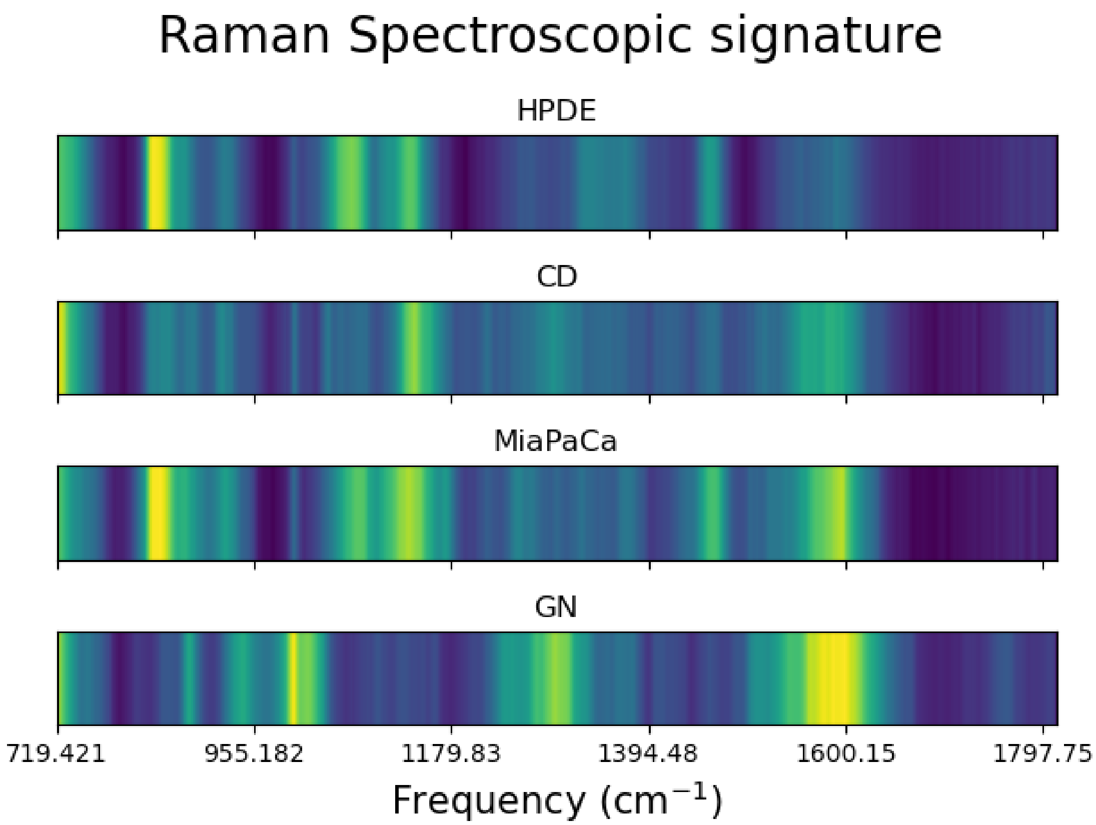
[12]:

```
pd.option_context('mode.use_inf_as_na', True)
plt.figure(figsize=(10,5))
plt.title('Raman Spectroscopic signature', fontsize = 20)
plt.plot(df_average.Raman.Frequency,df_average.Mean.HPDE,label='HPDE')
plt.plot(df_average.Raman.Frequency,df_average.Mean.CD,label='CD')
plt.plot(df_average.Raman.Frequency,df_average.Mean.MiaPaCa,label='MiaPaCa')
plt.plot(df_average.Raman.Frequency,df_average.Mean.GN,label='GN')
plt.xlabel(r'Frequency (cm$^{-1}$)',fontsize=15)
plt.ylabel(r'Intensities (Arb. Unit)',fontsize=15)
plt.legend(frameon=False)
plt.show()
```



Another way to visualize the spectroscopic response for each cells.

[13]:
```
fig, ax = plt.subplots(4,1,sharex=True,sharey=True)
fig.suptitle('Raman Spectroscopic signature', fontsize = 20)
ax[0].imshow([df_average.Mean.HPDE], aspect="auto")
ax[1].imshow([df_average.Mean.CD], aspect="auto")
ax[2].imshow([df_average.Mean.MiaPaCa], aspect="auto")
ax[3].imshow([df_average.Mean.GN], aspect="auto")
ax[0].set_title('HPDE')
ax[1].set_title('CD')
ax[2].set_title('MiaPaCa')
ax[3].set_title('GN')
plt.yticks([])
plt.xticks(np.arange(0, 1013, 200),df_average.Raman.Frequency[::200])
plt.xlabel(r'Frequency (cm$^{-1}$)',fontsize=15)
plt.tight_layout()
'''
for i in range(4):
    ax[i].axvline(x=300, ymin=0.0, ymax=1.0, color='r', linestyle='--', alpha=1)
    ax[i].axvline(x=100, ymin=0.0, ymax=1.0, color='r', linestyle='--', alpha=1)
'''
plt.show()
```



Now, we can move onto the inspecting the raw data.

[14]:
```
df_raw_HPDE = pd.read_csv(r'Data\Raw-HPDE.txt',sep='\t',header=None)
```

[15]:
```
df_raw_HPDE.head()
```

[15]:

	0	1	2	3	4	5	\
0	609.927974	516.114881	754.661668	705.967703	656.738695	632.528348	
1	577.079988	499.306887	741.311767	693.952930	651.909844	622.103451	
2	567.509144	494.778295	719.593730	685.773103	620.875998	593.277308	
3	556.111118	489.338721	702.361336	647.813375	603.297393	564.967912	
4	519.609050	484.045332	672.881351	625.759229	563.098662	549.233632	

	6	7	8	9	…	25	\
0	772.015465	422.591102	765.996989	602.369577	…	483.311159	
1	757.722958	412.738901	740.978701	567.555935	…	452.666774	
2	731.967210	411.354746	721.044885	555.519644	…	459.459738	
3	701.938234	408.748626	723.977596	521.221900	…	419.189169	
4	695.287774	406.290715	703.507303	491.233679	…	397.359816	

26	27	28	29	30	31	\

```
0  705.507262  1094.091623  558.716439  629.404883  335.447784  541.850423
1  653.969568  1056.672170  527.188433  625.360328  340.207145  561.789190
2  657.261168  1051.190851  514.644116  630.355072  322.441626  626.401793
3  619.732035  1046.468581  514.961627  614.845027  315.562896  674.224044
4  574.102433  1035.141097  542.418861  596.166903  284.773470  675.428521

           32          33          34
0  648.142592  591.169453  500.048021
1  618.756330  583.428277  470.389714
2  622.671054  590.548488  461.038391
3  604.256185  593.518858  407.134380
4  611.291960  614.497281  404.700299

[5 rows x 35 columns]
```

[16]:
```python
df_raw_HPDE.shape
```

[16]:
```
(1014, 35)
```

[17]:
```python
df_raw_CD = pd.read_csv(r'Data\Raw-CD18.txt',sep='\t',header=None)
```

[18]:
```python
df_raw_CD.head()
```

[18]:
```
           0          1             2           3           4           5   \
0  462.250553 -88.956977  12211.075787  138.476666  722.523025  790.705515
1  436.982475 -84.542468  10383.473577  139.684022  657.891275  779.193184
2  418.922427 -39.028311   8976.035486  136.195751  628.512955  748.924845
3  424.457974 -10.446520   6262.718792  146.769691  596.923084  741.777124
4  422.589851   4.341221   4232.948800  140.303686  578.548094  701.832739

             6           7           8          9   …          23  \
0  16833.155629  482.846254  924.675995  18.519408  …  682.997381
1  17778.051350  411.258819  917.786714 -34.277209  …  698.004300
2  18697.846470  379.465945  924.332020 -40.762669  …  713.090873
3  20269.935530  367.395086  881.996792 -87.290297  …  710.063955
4  21081.587106  303.697568  865.527296 -81.014289  …  711.436156

            24          25          26            27          28           29  \
0  4134.879267  721.836516  570.964342  11876.248771  428.721259  1390.759272
1  4108.956426  663.477808  565.805419  11187.847228  427.103716  1534.804320
2  4115.688617  630.933029  558.807819  10571.188859  416.175049  1666.264862
3  4136.342320  618.125645  552.979513   9670.870581  418.423881  1886.847811
4  4166.678987  603.947787  533.675528   8967.153636  421.664330  1940.952292

             30          31          32
0  14686.044405  348.268072  636.765977
1  15007.618378  303.723261  624.358963
```

```
2  15376.107605  248.493055  598.615002
3  16164.213116  213.520312  576.200426
4  16767.097985  157.238793  551.541815

[5 rows x 33 columns]
```

[19]:
```python
df_raw_CD.shape
```

[19]:
```
(1014, 33)
```

[20]:
```python
df_frequency = pd.read_csv(r'Data\Raman shift.txt',sep='\t',header=None)
```

[21]:
```python
df_frequency.head()
```

[21]:
```
         0   1
0  719.421 NaN
1  720.629 NaN
2  721.838 NaN
3  723.046 NaN
4  724.253 NaN
```

[22]:
```python
df_frequency[1].isna().sum()
```

[22]:
```
1014
```

[23]:
```python
df_frequency.drop(columns=1,axis=1,inplace=True)
```

[24]:
```python
df_frequency.head()
```

[24]:
```
         0
0  719.421
1  720.629
2  721.838
3  723.046
4  724.253
```

[25]:
```python
df_frequency.column = 'Frequency'
```

[26]:
```python
df_raw_EPC = pd.read_csv(r'Data\Raw-EPC.txt',sep='\s+',header=None)
```

[27]:
```python
df_raw_EPC.head()
```

[27]:
```
             0            1            2           3           4  \
0  3203.163535  6320.974384  6887.646015 -467.071908  309.968360
1  3103.180691  6321.751083  6161.643276 -653.364664  352.574265
2  2986.780580  6283.240725  5535.486579 -630.492983  392.886723
3  2933.909809  6313.348074  5646.613963 -800.367063  466.192310
```

```
4  2959.257669  6328.991128  6306.360640 -567.606996  475.672052

             5            6            7            8            9  ...  \
0  23964.023828  4914.055589  2071.515841  7798.466443   927.605080  ...
1  23180.087714  4665.178293  2089.593892  7536.362115  1031.550350  ...
2  22482.484591  4311.171479  2064.169876  7288.770278  1110.889652  ...
3  21778.753585  4068.409457  2068.370215  7058.793922  1297.059204  ...
4  21194.492801  3748.711404  2084.700672  6776.520803  1518.303385  ...

             45           46           47           48            49  \
0  17106.364263  3213.326052  2235.211800  1647.692268  17618.585039
1  16108.988438  3196.324199  2227.484274  1640.470158  17481.837070
2  15021.524728  3191.308086  2219.452056  1628.435502  17402.646657
3  14279.604815  3162.814938  2218.215596  1642.432518  17757.111924
4  13523.335750  3248.812738  2205.956784  1703.840559  18033.226992

            50           51           52            53           54
0  2041.744264  2277.645859 -1456.801366  13727.676672 -1119.050078
1  2059.917444  2196.018035 -1353.687698  14036.332729 -1209.851583
2  2050.200713  2114.993612 -1254.919115  14203.433016 -1466.771130
3  2050.864642  2044.587138 -1162.628716  14727.702996 -1761.390038
4  2093.804655  1969.941371  -977.857172  15065.059637 -1891.941108

[5 rows x 55 columns]
```

[28]:
```python
df_raw_EPC.shape
```

[28]:
```
(1013, 55)
```

[29]:
```python
df_raw_EPC2 = pd.read_csv(r'Data\Raw-EPC2.txt',sep='\s+',header=None)
```

[30]:
```python
df_raw_EPC2.head()
```

[30]:
```
            0           1           2           3            4            5  \
0  581.899206 -168.985577 -179.710030 -182.049615  2377.232531  1439.513142
1  613.983272 -110.185162 -116.774939 -166.981462  2326.903225  1456.938548
2  599.851085  -77.109569  -93.205683 -145.640647  2205.992330  1463.733499
3  593.456322  -38.334370  -70.958203 -142.017365  2147.541559  1488.171605
4  594.775348    7.628597  -28.362549  -71.620603  2058.137154  1506.016144

              6           7            8            9  ...          110  \
0  56368.903752 -128.628921  8664.769405  1302.905387  ... -1026.891116
1  54562.986421 -126.600008  8460.275539  1316.941872  ...  -979.478719
2  52244.328672 -138.971015  8157.918141  1280.981950  ... -1005.070031
3  48137.172235 -195.685023  7783.453295  1277.575975  ... -1024.451703
4  42947.097344 -263.929965  7364.941814  1266.669817  ...  -972.301724
```

```
           111         112          113         114         115          116  \
0  2108.599522  836.056391  2369.803079 -184.149094 -149.793292   977.776456
1  2103.956206  809.058785  2606.446663 -129.519384  -99.907468   967.913236
2  2167.187996  814.162470  2759.642151  -95.634574  -72.685480   981.259543
3  2220.851608  855.599036  3196.568610  -62.872740  -28.588225   991.496365
4  2341.520915  850.865488  3743.599119  -23.792392   17.693773  1031.349264

            117         118          119
0  15002.007838   -5.647692   820.770585
1  13520.234276   25.535020   863.304970
2  12134.442636   60.758067   896.288231
3  10738.174535  273.647065   993.025950
4   9166.361870  379.826107  1087.840792

[5 rows x 120 columns]
```

[31]:
```python
df_raw_EPC2.shape
```

[31]:
```
(1013, 120)
```

[32]:
```python
df_raw_GN = pd.read_csv(r'Data\Raw-GN.txt',sep='\s+',header=None)
```

[33]:
```python
df_raw_GN.head()
```

[33]:
```
             0            1            2            3            4   \
0  2160.348717  1314.579420  3218.265846  2351.634956  1718.374803
1  2045.885705  1297.393931  3195.264459  2272.111147  1695.248236
2  1989.764491  1252.535351  3138.935280  2239.438805  1672.247913
3  1951.439372  1232.810425  3011.697036  2220.894062  1628.383404
4  1897.763294  1183.869128  2876.850879  2193.998714  1506.630255

             5            6            7           8            9   …  \
0  1054.734117  1495.768736  1687.681208  838.412255  1455.511128  …
1  1085.340363  1431.383846  1603.925439  761.849748  1374.513051  …
2  1093.915553  1406.870278  1557.384257  705.467276  1367.470748  …
3  1159.616311  1353.378038  1502.961437  649.927359  1267.311728  …
4  1158.025564  1308.014322  1467.167992  566.581489  1144.444349  …

            12          13           14           15           16          17  \
0  1189.056338  655.610102  1195.173062  1364.227497  1059.646051  734.268796
1  1061.548439  616.494438  1206.968712  1189.309195  1067.676532  721.596722
2   970.183124  596.253803  1184.270459  1107.595288  1019.047836  680.217221
3   851.921660  573.872773  1131.874819   953.322572   992.805555  646.171478
4   748.880127  592.389565  1055.854998   844.907811   966.076031  634.805981

             18           19           20           21
0  2769.263332  3124.997898  1711.264905  1680.924476
```

```
1  2642.759384  3006.950948  1668.187469  1613.478943
2  2543.644357  2925.022553  1586.802863  1572.875803
3  2456.899857  2838.141830  1506.328355  1478.687291
4  2336.305663  2731.480400  1497.707680  1394.192856

[5 rows x 22 columns]
```

[34]:
```python
df_raw_GN.shape
```

[34]:
```
(1014, 22)
```

[35]:
```python
df_raw_HC = pd.read_csv(r'Data\Raw-HC.txt',sep='\s+',header=None)
```

[36]:
```python
df_raw_HC.head()
```

[36]:
```
            0            1           2           3           4           5  \
0  664.066369   891.519617 -55.185891  789.077141  756.648636  575.395903
1  727.637950   938.968041 -20.001006  784.202377  811.105970  620.008865
2  719.349410   943.849373   1.420800  777.689599  789.311420  625.776152
3  771.963997   975.847488  40.013175  826.842720  816.972423  689.352168
4  812.518125  1027.312499  74.733424  810.081306  847.967557  699.872646

            6           7            8            9  …          50  \
0  812.793173  631.869852  3377.424394  1225.919616  …   29.214720
1  837.406006  635.436913  3626.686697  1233.630143  …   67.675125
2  863.507211  649.299885  3937.332330  1242.919809  …   92.551005
3  876.225500  661.545420  4395.367705  1238.143204  …  126.703477
4  887.305153  679.512831  4807.660441  1252.448052  …  154.074688

             51           52          53            54            55  \
0  5741.079109 -4075.177635 -962.449543  46085.982967  16994.411469
1  5845.833450 -2910.158181 -920.334063  44825.210704  16971.574966
2  5930.309376 -2014.917612 -890.593846  43538.695113  16681.662158
3  6084.008584  -462.622593 -903.940795  42375.339802  16546.408443
4  6256.793708   325.072843 -866.324594  41136.213330  15818.275651

            56           57           58            59
0  -52.107264 -1290.924259 -1161.970246  20166.640066
1   36.375592 -1183.832011 -1075.916837  18732.060172
2   77.638293 -1108.209207 -1039.534287  17364.742541
3   79.839218  -818.619517  -908.831754  14780.186982
4  173.226593  -518.478614  -770.107138  12482.214654

[5 rows x 60 columns]
```

[37]:
```python
df_raw_HC.shape
```

[37]: (1013, 60)

[38]:
```
df_raw_HC2 = pd.read_csv(r'Data\Raw-HC2.txt',sep='\s+',header=None)
```

[39]:
```
df_raw_HC2.head()
```

[39]:
```
             0           1           2           3           4           5  \
0  1008.600674 -176.331239 -248.210781 -211.621177 -152.701312 -163.797481
1  1046.371463 -147.584618 -200.509401 -156.480285 -126.970755 -126.804979
2   978.631157 -112.422007 -158.221211 -116.235692  -94.430349  -59.928333
3   814.376885  -63.540342  -94.486609  -60.710620  -87.698196   -7.100967
4   704.080718  -19.986074  -54.767168  -13.401172  -47.806272   45.427068

            6           7           8           9  …         100  \
0  114.916213  -26.551247 -204.156848 -922.529271  … -118.983831
1  226.510538   48.387896 -145.021424 -887.725883  … -296.501999
2  298.777360   88.365984 -111.003317 -883.415887  … -504.824634
3  394.487054  146.945886  -61.440373 -836.645116  … -684.975727
4  450.609431  182.098345   -8.919438 -776.367364  … -659.530411

          101         102         103           104          105         106  \
0 -785.670250 -442.223228 -565.895180  11899.686997 -1466.700795   40.748809
1 -549.425264 -479.016974 -495.175035  11579.851837 -1202.731401   87.915315
2 -362.698155 -513.150226 -435.747824  11314.132757  -971.307879  105.810732
3  -55.706231 -535.935830 -359.469506  11176.782171  -626.442796  155.594252
4  143.510836 -486.122782 -270.028946  11164.175387  -329.362564  145.734191

         107          108         109
0 -78.988593  -821.789023  872.508664
1 -60.076447  -941.850909  866.826500
2 -29.435275 -1017.920529  915.228065
3   3.855931 -1183.958936  920.117639
4  53.843324 -1262.201270  872.797323

[5 rows x 110 columns]
```

[40]:
```
df_raw_HC2.shape
```

[40]: (1013, 110)

[41]:
```
df_raw_MiaPaCa = pd.read_csv(r'Data\Raw-MiaPaCa.txt',sep='\s+',header=None)
```

[42]:
```
df_raw_MiaPaCa.head()
```

[42]:
```
            0            1          2           3          4           5  \
0  986.134289  3191.825457  -2.535792  381.293306 -14.670542  222.150897
1  968.238898  2387.663019 -13.405950  323.864640 -13.062933  221.195522
```

```
2  940.958141  2042.282002  -4.439658  283.158469   18.430079  212.515654
3  931.451280  1140.520027  16.551258  240.507895   72.736326  195.481008
4  897.871235   957.922213   8.585703  220.874240  103.296138  186.407781

           6          7           8           9  …            21  \
0  283.214723 -10.688220 4014.044286 1567.222465  …  28581.246327
1  274.867820  -6.973148 3329.342639 1497.822661  …  27494.121593
2  304.850952   0.275607 2779.738368 1405.961540  …  26730.718074
3  391.133158  26.687282 2049.528623 1295.990866  …  26154.070758
4  503.418555  37.810452 1464.217353 1168.197266  …  25731.896853

           22          23           24          25          26          27  \
0  319.677679  755.957734  8008.400770  550.821570  475.220347  424.548050
1  314.584347  706.747435  7704.657802  543.220942  475.095789  401.035342
2  306.062605  687.922333  7546.049323  546.734571  457.565767  394.257941
3  306.240677  665.283137  7362.425379  527.072509  452.180077  386.850138
4  300.289221  652.321148  7330.103420  524.098047  431.193937  378.305130

           28         29          30
0  183.399571  49.565123  291.349689
1  165.500022  55.983494  298.719220
2  153.319906  51.380073  301.287580
3  161.356251  29.136447  302.037695
4  153.314808  42.126248  288.379379

[5 rows x 31 columns]
```

[43]:
```python
df_raw_MiaPaCa.shape
```

[43]:
```
(1014, 31)
```

Since the shape is either 1013 or 1014, we can drop one data point to make 1013 data points universal.

[44]:
```python
df_frequency.drop([0],inplace=True)
```

[45]:
```python
df_average.drop([0],inplace=True)
```

[46]:
```python
df_raw_CD.drop([0],inplace=True)
df_raw_HPDE.drop([0],inplace=True)
df_raw_GN.drop([0],inplace=True)
df_raw_MiaPaCa.drop([0],inplace=True)
```

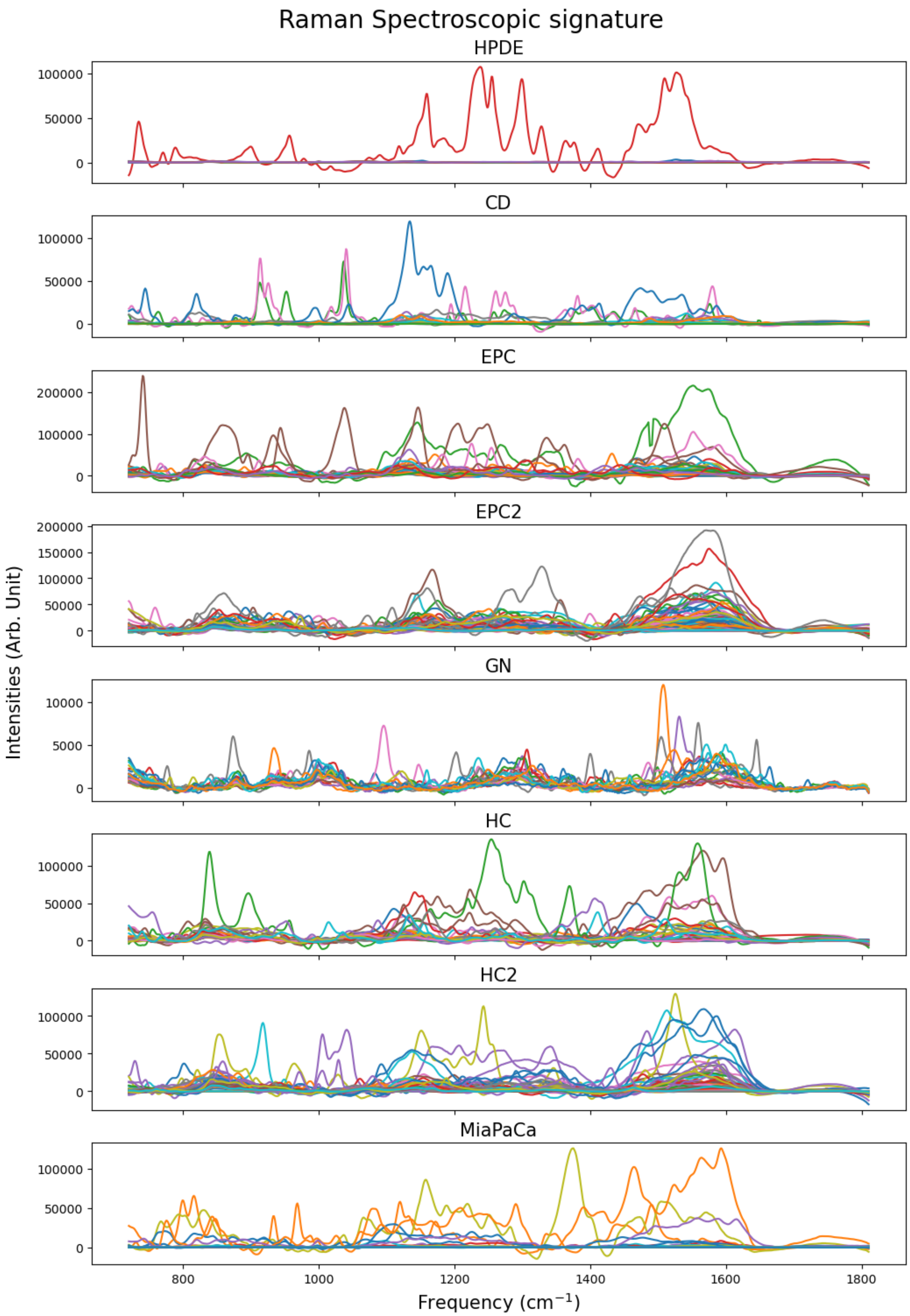
[47]:
```python
print(df_average.shape)
print(df_raw_CD.shape)
print(df_raw_HPDE.shape)
print(df_raw_GN.shape)
```

```
print(df_raw_MiaPaCa.shape)
```

```
(1013, 9)
(1013, 33)
(1013, 35)
(1013, 22)
(1013, 31)
```

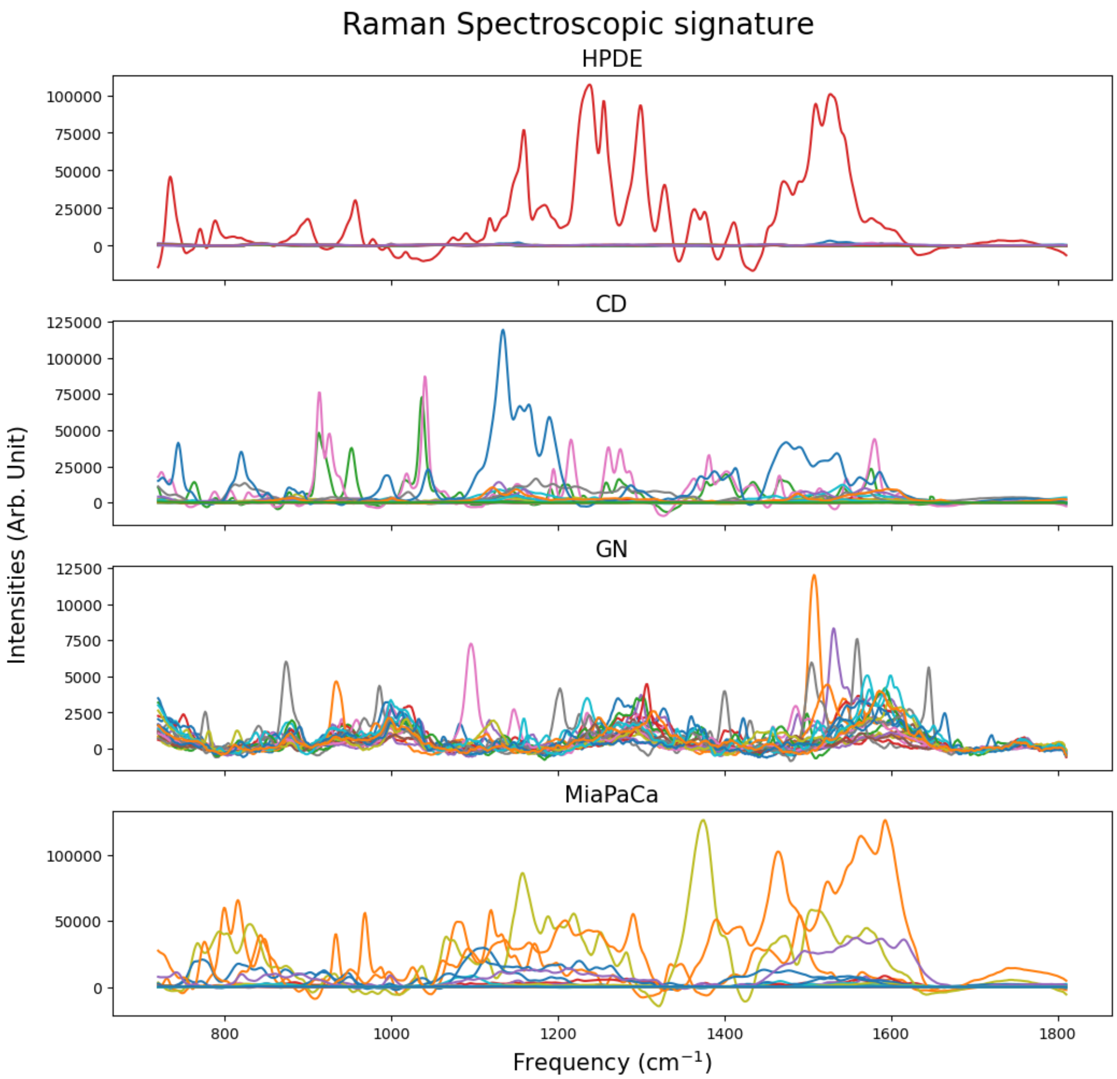
Now we can visualize the data for each cells

[54]:
```
fig, ax = plt.subplots(8,1,sharex=True,sharey=False,layout="constrained")
plt.rcParams['figure.figsize'] = 10, 15
#plt.subplots_adjust(left=0.1, bottom=0.1, right**=**0.9,top=0.9, wspace=0.
↪4,hspace=0.4)
pd.option_context('mode.use_inf_as_na', True)
fig.suptitle('Raman Spectroscopic signature', fontsize = 20)
for i in range(df_raw_HPDE.shape[1]):
    ax[0].plot(df_frequency,df_raw_HPDE.iloc[:,i],label='HPDE')
    ax[0].set_title('HPDE',fontsize=15)
for i in range(df_raw_CD.shape[1]):
    ax[1].plot(df_frequency,df_raw_CD.iloc[:,i],label='CD')
    ax[1].set_title('CD',fontsize=15)
for i in range(df_raw_EPC.shape[1]):
    ax[2].plot(df_frequency,df_raw_EPC.iloc[:,i],label='EPC')
    ax[2].set_title('EPC',fontsize=15)
for i in range(df_raw_EPC2.shape[1]):
    ax[3].plot(df_frequency,df_raw_EPC2.iloc[:,i],label='EPC2')
    ax[3].set_title('EPC2',fontsize=15)
for i in range(df_raw_GN.shape[1]):
    ax[4].plot(df_frequency,df_raw_GN.iloc[:,i],label='GN')
    ax[4].set_title('GN',fontsize=15)
for i in range(df_raw_HC.shape[1]):
    ax[5].plot(df_frequency,df_raw_HC.iloc[:,i],label='HC')
    ax[5].set_title('HC',fontsize=15)
for i in range(df_raw_HC2.shape[1]):
    ax[6].plot(df_frequency,df_raw_HC2.iloc[:,i],label='HC2')
    ax[6].set_title('HC2',fontsize=15)
for i in range(df_raw_MiaPaCa.shape[1]):
    ax[7].plot(df_frequency,df_raw_MiaPaCa.iloc[:,i],label='MiaPaCa')
    ax[7].set_title('MiaPaCa',fontsize=15)

plt.gcf().text(-0.02,0.5, "Intensities (Arb. Unit)", ha="center", va="center",␣
↪rotation=90, fontsize=15)
plt.xlabel(r'Frequency (cm$^{-1}$)',fontsize=15)
#plt.legend()
#plt.tight_layout()
plt.show()
```


Raman Spectroscopic signature
HPDE
CD
EPC
EPC2
GN
HC
HC2
MiaPaCa
Intensities (Arb. Unit)
Frequency (cm^{-1})
800
1000
1200
1400
1600
1800
100000
50000
0
200000
150000
10000
5000

There are HCs and EPCs data (for healthy and sick, respectively), which are out of the scope. So we will reduce it to CD, HPDE, MiaPaCa, and GN.

[283]:
```
fig, ax = plt.subplots(4,1,sharex=True,sharey=False,layout="constrained")
#plt.rcParams['figure.figsize'] = 10, 10
#plt.subplots_adjust(left=0.1, bottom=0.1, right**=**0.9,top=0.9, wspace=0.
 ↪4,hspace=0.4)
pd.option_context('mode.use_inf_as_na', True)
fig.suptitle('Raman Spectroscopic signature', fontsize = 20)
for i in range(df_raw_HPDE.shape[1]):
    ax[0].plot(df_frequency,df_raw_HPDE.iloc[:,i],label='HPDE')
    ax[0].set_title('HPDE',fontsize=15)
for i in range(df_raw_CD.shape[1]):
    ax[1].plot(df_frequency,df_raw_CD.iloc[:,i],label='CD')
    ax[1].set_title('CD',fontsize=15)
for i in range(df_raw_GN.shape[1]):
    ax[2].plot(df_frequency,df_raw_GN.iloc[:,i],label='GN')
    ax[2].set_title('GN',fontsize=15)
for i in range(df_raw_MiaPaCa.shape[1]):
    ax[3].plot(df_frequency,df_raw_MiaPaCa.iloc[:,i],label='MiaPaCa')
    ax[3].set_title('MiaPaCa',fontsize=15)

plt.gcf().text(-0.02,0.5, "Intensities (Arb. Unit)", ha="center", va="center",␣
 ↪rotation=90, fontsize=15)
plt.xlabel(r'Frequency (cm$^{-1}$)',fontsize=15)
#plt.legend()
#plt.tight_layout()
plt.show()
```



Note: Here, HPDE, CD, MiaPaCa, and GN are exosomes from different cells, which are identified as a marker for pancreatic cancer cells. HC are the cells from healthy control group and EPC are the early pancreatic cancer cell group.

The author uses Vancouver Raman algorithm to remove flourescence by fitting the polynomial regression. Also, there are modified Vancouver Raman algorithm to denoise, correct baseline (fitting the flourescence), and so on. The author also normalizes the spectra as well.

[55]:
```
df_scaled_CD = pd.read_csv(r'Data\Scaled CD18.txt',sep='\s+',header=None)
print(df_scaled_CD.shape)
df_scaled_CD.columns = ['CD_scaled_'+str(i) for i in range(df_scaled_CD.
 ↪shape[1])]
df_scaled_CD.head()
```

```
(1014, 33)
```

[55]:

```
   CD_scaled_0  CD_scaled_1  CD_scaled_2  CD_scaled_3  CD_scaled_4  \
0     0.627240    -0.808440     0.785649    -0.286407     1.117742
1     0.544890    -0.803976     0.580486    -0.284544     0.951922
2     0.486031    -0.757946     0.422489    -0.289928     0.876549
3     0.504072    -0.729041     0.117898    -0.273608     0.795501
4     0.497984    -0.714085    -0.109961    -0.283588     0.748358

   CD_scaled_5  CD_scaled_6  CD_scaled_7  CD_scaled_8  CD_scaled_9  …  \
0     1.198693     0.783460     0.269363    -0.011685    -0.814099  …
1     1.171875     0.859946     0.117320    -0.017348    -0.833708  …
2     1.101364     0.934400     0.049795    -0.011968    -0.836117  …
3     1.084714     1.061655     0.024158    -0.046767    -0.853397  …
4     0.991662     1.127355    -0.111128    -0.060305    -0.851067  …

   CD_scaled_23  CD_scaled_24  CD_scaled_25  CD_scaled_26  CD_scaled_27  \
0      3.614682      0.793426      5.294379      2.974757      2.181770
1      3.721372      0.783691      4.771051      2.938056      1.990713
2      3.828628      0.786220      4.479207      2.888274      1.819568
3      3.807108      0.793976      4.364357      2.846810      1.569697
4      3.816864      0.805368      4.237218      2.709478      1.374390

   CD_scaled_28  CD_scaled_29  CD_scaled_30  CD_scaled_31  CD_scaled_32
0      3.626305      0.989208      0.081365     -0.699944      5.020930
1      3.608480      1.170498      0.098765     -0.718982      4.903327
2      3.488046      1.335950      0.118705     -0.742587      4.659306
3      3.512828      1.613569      0.161349     -0.757534      4.446844
4      3.548538      1.681663      0.193972     -0.781588      4.213111

[5 rows x 33 columns]
```

[56]:

```
df_scaled_GN = pd.read_csv(r'Data\Scaled GN.txt',sep='\s+',header=None)
print(df_scaled_GN.shape)
df_scaled_GN.columns = ['GN_scaled_'+str(i) for i in range(df_scaled_GN.
 ↪shape[1])]
df_scaled_GN.head()
```

```
(1014, 22)
```

[56]:

```
   GN_scaled_0  GN_scaled_1  GN_scaled_2  GN_scaled_3  GN_scaled_4  \
0     1.605200     0.480491     4.279952     1.537541     0.646067
1     1.478035     0.468102     4.243459     1.456568     0.628288
2     1.415687     0.435763     4.154088     1.423301     0.610606
3     1.373109     0.421543     3.952214     1.404418     0.576885
4     1.313476     0.386261     3.738269     1.377033     0.483284

   GN_scaled_5  GN_scaled_6  GN_scaled_7  GN_scaled_8  GN_scaled_9  …  \
0     1.565064     0.839120     0.641616     1.293977     0.680262  …
```

```
1     1.634938     0.774027     0.578849     1.094202     0.596664  …
2     1.654515     0.749243     0.543971     0.947084     0.589395  …
3     1.804510     0.695163     0.503187     0.802163     0.486022  …
4     1.800878     0.649300     0.476363     0.584689     0.359211  …

   GN_scaled_12  GN_scaled_13  GN_scaled_14  GN_scaled_15  GN_scaled_16  \
0      0.572399      0.810921      3.234632      2.501736      1.417842
1      0.433070      0.731839      3.273524      2.075808      1.434043
2      0.333233      0.690918      3.198684      1.876833      1.335939
3      0.204007      0.645669      3.025929      1.501176      1.282998
4      0.091412      0.683105      2.775281      1.237185      1.229074

   GN_scaled_17  GN_scaled_18  GN_scaled_19  GN_scaled_20  GN_scaled_21
0      0.317277      3.007618      2.281700      1.695935      1.377771
1      0.297958      2.835588      2.166988      1.634570      1.294449
2      0.234872      2.700803      2.087374      1.518635      1.244289
3      0.182967      2.582841      2.002947      1.403997      1.127930
4      0.165640      2.418848      1.899299      1.391716      1.023547

[5 rows x 22 columns]
```

[57]:
```python
df_scaled_HPDE = pd.read_csv(r'Data\Scaled HPDE.txt',sep='\s+',header=None)
print(df_scaled_HPDE.shape)
df_scaled_HPDE.columns = ['HPDE_scaled_'+str(i) for i in range(df_scaled_HPDE.
 ↪shape[1])]
df_scaled_HPDE.head()
```

```
(1014, 35)
```

[57]:
```
   HPDE_scaled_0  HPDE_scaled_1  HPDE_scaled_2  HPDE_scaled_3  HPDE_scaled_4  \
0       2.560051       1.970449       3.037619       3.033875       2.412465
1       2.381410       1.883087       2.970336       2.969361       2.388290
2       2.329360       1.859549       2.860879       2.925439       2.232922
3       2.267373       1.831276       2.774029       2.721611       2.144916
4       2.068860       1.803762       2.625452       2.603190       1.943666

   HPDE_scaled_5  HPDE_scaled_6  HPDE_scaled_7  HPDE_scaled_8  HPDE_scaled_9  \
0       2.823622       3.452165       1.805597       3.296075       2.898464
1       2.764960       3.374450       1.744433       3.162275       2.688602
2       2.602753       3.234404       1.735840       3.055666       2.616045
3       2.443454       3.071123       1.719661       3.071351       2.409292
4       2.354916       3.034961       1.704402       2.961873       2.228518

   …  HPDE_scaled_25  HPDE_scaled_26  HPDE_scaled_27  HPDE_scaled_28  \
0  …        0.594899        2.282256        2.820799        1.766969
1  …        0.494378        2.040423        2.688267        1.607042
2  …        0.516661        2.055868        2.668853        1.543411
```

```
3  …        0.384564        1.879769        2.652128        1.545021
4  …        0.312958        1.665659        2.612008        1.684299

   HPDE_scaled_29  HPDE_scaled_30  HPDE_scaled_31  HPDE_scaled_32  \
0        1.576723        0.498329        1.124748        1.941478
1        1.559853        0.518802        1.205917        1.810946
2        1.580687        0.442381        1.468947        1.828335
3        1.515992        0.412792        1.663626        1.746537
4        1.438083        0.280347        1.668530        1.777790

   HPDE_scaled_33  HPDE_scaled_34
0        1.166412        0.235613
1        1.136220        0.147063
2        1.163990        0.119143
3        1.175575       -0.041795
4        1.257393       -0.049063

[5 rows x 35 columns]
```

[58]:
```python
df_scaled_MiaPaCa = pd.read_csv(r'Data\Scaled MiaPaCa.
 ↪txt',sep='\s+',header=None)
print(df_scaled_MiaPaCa.shape)
df_scaled_MiaPaCa.columns = ['MiaPaCa_scaled_'+str(i) for i in␣
 ↪range(df_scaled_MiaPaCa.shape[1])]
df_scaled_MiaPaCa.head()
```

```
(1014, 31)
```

[58]:
```
   MiaPaCa_scaled_0  MiaPaCa_scaled_1  MiaPaCa_scaled_2  MiaPaCa_scaled_3  \
0          2.279001         -0.493665         -0.837637         -0.675826
1          2.224572         -0.546858         -0.902667         -0.705791
2          2.141597         -0.569704         -0.849027         -0.727031
3          2.112681         -0.629354         -0.723450         -0.749285
4          2.010547         -0.641432         -0.771103         -0.759530

   MiaPaCa_scaled_4  MiaPaCa_scaled_5  MiaPaCa_scaled_6  MiaPaCa_scaled_7  \
0         -0.654590          0.827089         -0.310579         -0.794842
1         -0.653416          0.820007         -0.322965         -0.782919
2         -0.630418          0.755663         -0.278471         -0.759654
3         -0.590760          0.629385         -0.150431         -0.674885
4         -0.568444          0.562125          0.016198         -0.639184

   MiaPaCa_scaled_8  MiaPaCa_scaled_9  …  MiaPaCa_scaled_21  \
0         -0.667363          0.306805  …           0.002890
1         -0.694757          0.262347  …          -0.034115
2         -0.716747          0.203500  …          -0.060101
3         -0.745962          0.133052  …          -0.079730
```

```
4         -0.769380          0.051186  ...         -0.094101

   MiaPaCa_scaled_22  MiaPaCa_scaled_23  MiaPaCa_scaled_24  MiaPaCa_scaled_25  \
0           1.455419           1.612946          -0.048173           3.220945
1           1.415905           1.455756          -0.078448           3.162044
2           1.349793           1.395624          -0.094257           3.189273
3           1.351175           1.323308          -0.112559           3.036901
4           1.305004           1.281904          -0.115781           3.013851

   MiaPaCa_scaled_26  MiaPaCa_scaled_27  MiaPaCa_scaled_28  MiaPaCa_scaled_29  \
0           2.680854           2.322535          -0.178839          -0.795637
1           2.679886           2.129003          -0.261592          -0.769948
2           2.543733           2.073219          -0.317903          -0.788373
3           2.501903           2.012246          -0.280749          -0.877399
4           2.338906           1.941912          -0.317927          -0.825410

   MiaPaCa_scaled_30
0           1.208965
1           1.266487
2           1.286535
3           1.292390
4           1.185780

[5 rows x 31 columns]
```

Same with the scaled data. We will need to reduce the dimension from 1014 to 1013.

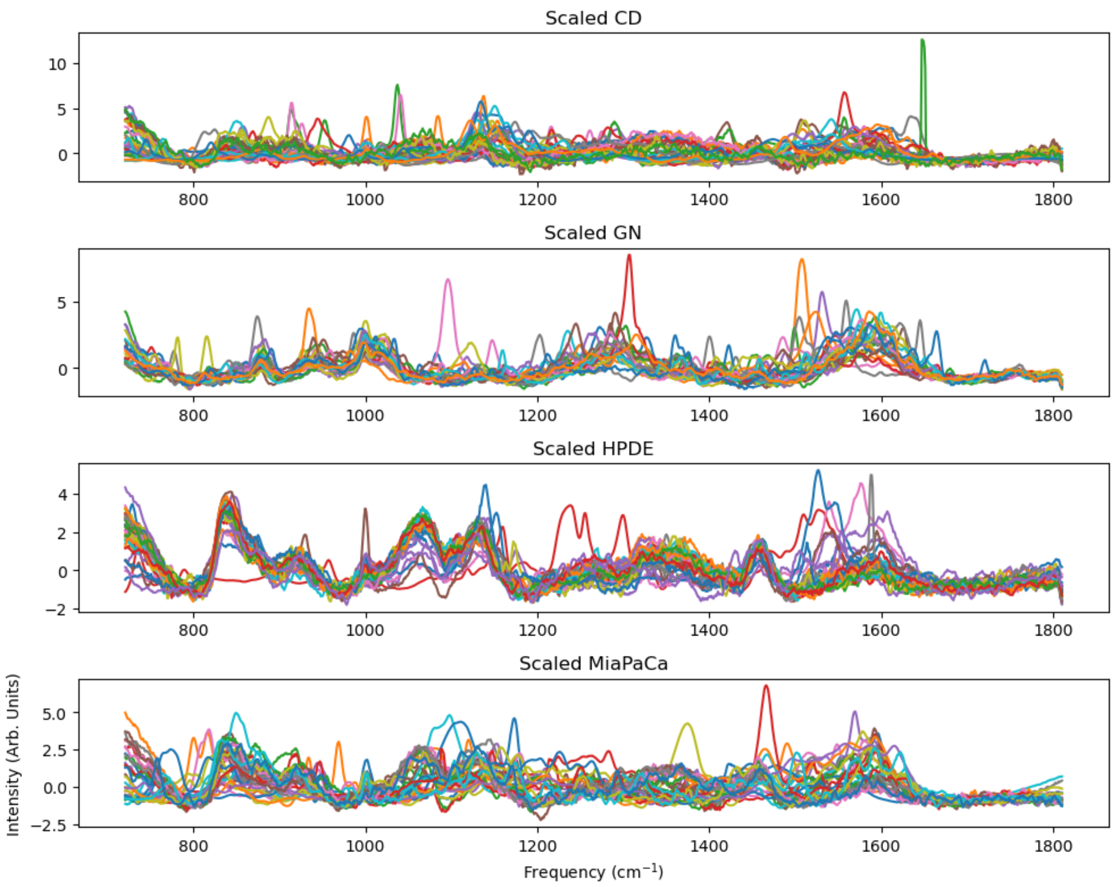
[59]:
```
df_scaled_CD.drop([0],inplace=True)
df_scaled_GN.drop([0],inplace=True)
df_scaled_HPDE.drop([0],inplace=True)
df_scaled_MiaPaCa.drop([0],inplace=True)
```

[60]:
```
print(df_scaled_CD.shape)
print(df_scaled_GN.shape)
print(df_scaled_HPDE.shape)
print(df_scaled_MiaPaCa.shape)
```

```
(1013, 33)
(1013, 22)
(1013, 35)
(1013, 31)
```

[61]:
```
fig, ax = plt.subplots(4,1,figsize=(10,8))
ax[0].plot(df_average.Raman.Frequency, df_scaled_CD[:])
ax[0].set_title('Scaled CD')
ax[1].plot(df_average.Raman.Frequency, df_scaled_GN[:])
ax[1].set_title('Scaled GN')
ax[2].plot(df_average.Raman.Frequency, df_scaled_HPDE[:])
```

```
ax[2].set_title('Scaled HPDE')
ax[3].plot(df_average.Raman.Frequency, df_scaled_MiaPaCa[:])
ax[3].set_title('Scaled MiaPaCa')
plt.ylabel('Intensity (Arb. Units)')
plt.xlabel('Frequency (cm$^{-1}$)')
plt.tight_layout()
plt.show()
```



It appears that the spectra do not need much cleaning from here. We will use the scaled spectra to move forward and reduce the dimension by applying PCA. However, we might need to create a label and concatenate all of the spectra of different cells.

[62]:
```
df = pd.
  ↪concat([df_scaled_CD,df_scaled_GN,df_scaled_HPDE,df_scaled_MiaPaCa],axis=1).
  ↪reset_index()
df.drop('index',axis=1,inplace=True)
print(df.shape)
df.head(200)
```

```
(1013, 121)
```

[62]:

```
     CD_scaled_0  CD_scaled_1  CD_scaled_2  CD_scaled_3  CD_scaled_4  \
0       0.544890    -0.803976     0.580486    -0.284544     0.951922
1       0.486031    -0.757946     0.422489    -0.289928     0.876549
2       0.504072    -0.729041     0.117898    -0.273608     0.795501
3       0.497984    -0.714085    -0.109961    -0.283588     0.748358
4       0.211190    -0.695870    -0.257283    -0.281549     0.596884
..           …            …            …            …          …
195    -0.893031    -0.421444     3.289723    -0.411183    -0.731459
196    -0.801298    -0.385343     3.583743    -0.450027    -0.745795
197    -0.685285    -0.265187     3.652794    -0.456610    -0.811388
198    -0.692354    -0.209580     3.485891    -0.449744    -0.828974
199    -0.638331    -0.161362     3.094565    -0.454888    -0.820842

     CD_scaled_5  CD_scaled_6  CD_scaled_7  CD_scaled_8  CD_scaled_9  …  \
0       1.171875     0.859946     0.117320    -0.017348    -0.833708  …
1       1.101364     0.934400     0.049795    -0.011968    -0.836117  …
2       1.084714     1.061655     0.024158    -0.046767    -0.853397  …
3       0.991662     1.127355    -0.111128    -0.060305    -0.851067  …
4       1.057551     1.110658    -0.195160    -0.077421    -0.846064  …
..           …            …            …            …          …  …
195    -0.291710    -0.487217    -0.201324    -0.602747    -0.189978  …
196    -0.324891    -0.542334    -0.164296    -0.693464    -0.152620  …
197    -0.319551    -0.589782    -0.192672    -0.738451    -0.127901  …
198    -0.311102    -0.623126    -0.175801    -0.779504    -0.124896  …
199    -0.200330    -0.634639    -0.142212    -0.842001    -0.108719  …

     MiaPaCa_scaled_21  MiaPaCa_scaled_22  MiaPaCa_scaled_23  \
0            -0.034115           1.415905           1.455756
1            -0.060101           1.349793           1.395624
2            -0.079730           1.351175           1.323308
3            -0.094101           1.305004           1.281904
4            -0.108735           1.188868           1.177508
..                 …                  …                  …
195          -0.520487          -0.090672          -0.583555
196          -0.517873          -0.085111          -0.515748
197          -0.530992           0.058748          -0.427158
198          -0.542873           0.060938          -0.395398
199          -0.560231          -0.166134          -0.471920

     MiaPaCa_scaled_24  MiaPaCa_scaled_25  MiaPaCa_scaled_26  \
0            -0.078448           3.162044           2.679886
1            -0.094257           3.189273           2.543733
2            -0.112559           3.036901           2.501903
3            -0.115781           3.013851           2.338906
4            -0.113850           3.011169           2.202445
..                 …                  …                  …
195          -0.818062          -0.747619          -0.013379
```

```
196          -0.840648          -0.945677          -0.202091
197          -0.861757          -0.972070          -0.289541
198          -0.893249          -0.867037          -0.316119
199          -0.918029          -0.923572          -0.453956

     MiaPaCa_scaled_27  MiaPaCa_scaled_28  MiaPaCa_scaled_29  \
0             2.129003          -0.261592          -0.769948
1             2.073219          -0.317903          -0.788373
2             2.012246          -0.280749          -0.877399
3             1.941912          -0.317927          -0.825410
4             1.800809          -0.421874          -0.803173
..                 …                  …                  …
195          -0.688681          -0.605225          -0.406731
196          -0.665073          -0.524072          -0.537870
197          -0.645025          -0.452875          -0.648226
198          -0.642546          -0.592518          -0.767308
199          -0.715159          -0.674051          -0.869002

     MiaPaCa_scaled_30
0             1.266487
1             1.286535
2             1.292390
3             1.185780
4             1.083188
..                 …
195          -0.300218
196          -0.556224
197          -0.557838
198          -0.511896
199          -0.537066

[200 rows x 121 columns]
```

Now we can create a label for these concatenated df for classification.

[63]:
```
cd_obs = df_scaled_CD.shape[1]
GN_obs = df_scaled_GN.shape[1]
HPDE_obs = df_scaled_HPDE.shape[1]
MiaPaCa_obs = df_scaled_MiaPaCa.shape[1]
y = {}
for i in range(cd_obs):
    name = 'CD_scaled_' + str(i)
    y[name] = 0
for i in range(GN_obs):
    name = 'GN_scaled_' + str(i)
    y[name] = 1
for i in range(HPDE_obs):
```

```
    name = 'HPDE_scaled_' + str(i)
    y[name] = 2
for i in range(MiaPaCa_obs):
    name = 'MiaPaCa_scaled_' + str(i)
    y[name] = 3
y = pd.DataFrame.from_dict(y,orient='index',columns=['Target'])
y.shape
```

[63]:
```
(121, 1)
```

[64]:
```
y.head()
```

[64]:
```
             Target
CD_scaled_0       0
CD_scaled_1       0
CD_scaled_2       0
CD_scaled_3       0
CD_scaled_4       0
```

Then we can merge this to the main df.

[65]:
```
df_master = pd.concat([df.T,y],axis=1,ignore_index=False)
```

[66]:
```
df_master
```

[66]:
```
                         0         1         2         3         4         5  \
CD_scaled_0       0.544890  0.486031  0.504072  0.497984  0.211190  0.085117
CD_scaled_1      -0.803976 -0.757946 -0.729041 -0.714085 -0.695870 -0.695353
CD_scaled_2       0.580486  0.422489  0.117898 -0.109961 -0.257283 -0.344626
CD_scaled_3      -0.284544 -0.289928 -0.273608 -0.283588 -0.281549 -0.298788
CD_scaled_4       0.951922  0.876549  0.795501  0.748358  0.596884  0.605710
…                      …         …         …         …         …         …
MiaPaCa_scaled_26  2.679886  2.543733  2.501903  2.338906  2.202445  2.012167
MiaPaCa_scaled_27  2.129003  2.073219  2.012246  1.941912  1.800809  1.691090
MiaPaCa_scaled_28 -0.261592 -0.317903 -0.280749 -0.317927 -0.421874 -0.358944
MiaPaCa_scaled_29 -0.769948 -0.788373 -0.877399 -0.825410 -0.803173 -0.862064
MiaPaCa_scaled_30  1.266487  1.286535  1.292390  1.185780  1.083188  0.816319

                         6         7         8         9  …      1004  \
CD_scaled_0      -0.011104 -0.244996 -0.269232 -0.100159  …  0.234435
CD_scaled_1      -0.768268 -0.823698 -0.867106 -0.903477  … -0.429063
CD_scaled_2      -0.403054 -0.445152 -0.461131 -0.471701  … -0.624187
CD_scaled_3      -0.296297 -0.344452 -0.392090 -0.373874  …  0.202230
CD_scaled_4       0.579334  0.585846  0.485756  0.532293  … -0.673613
…                      …         …         …         …  …         …
MiaPaCa_scaled_26  2.038291  2.055618  2.057747  2.089668  … -1.038924
MiaPaCa_scaled_27  1.653938  1.576651  1.452387  1.455146  … -0.815540
```

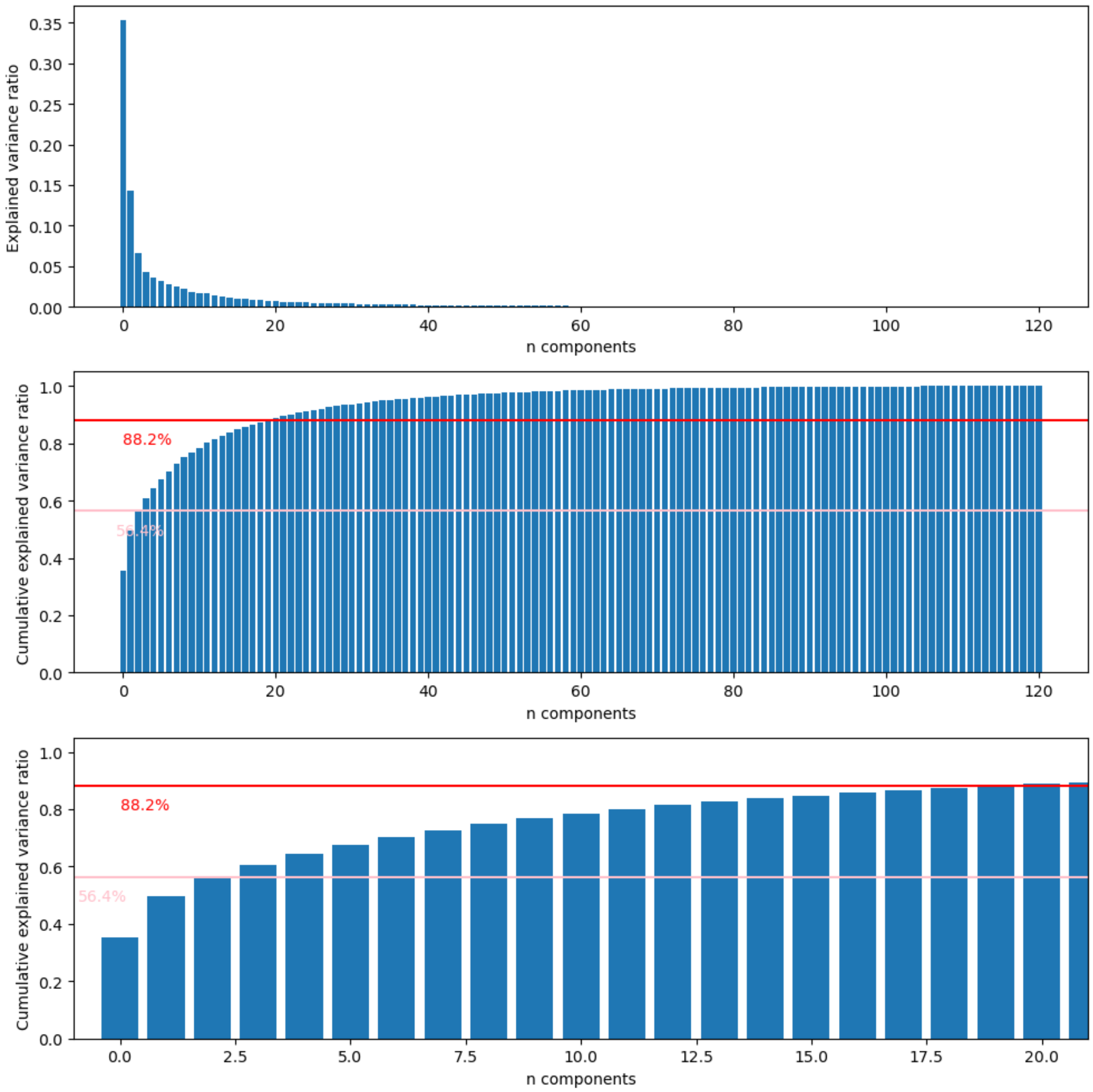
```
MiaPaCa_scaled_28 -0.403064 -0.504370 -0.726259 -0.746632  … -0.429636
MiaPaCa_scaled_29 -0.846209 -0.797101 -0.837419 -0.887668  … -0.768990
MiaPaCa_scaled_30  0.553298  0.345825  0.371942  0.379366  … -0.679566

                       1005      1006      1007      1008      1009      1010  \
CD_scaled_0        0.293614  0.287794  0.218139  0.202670  0.143649 -0.188851
CD_scaled_1       -0.413083 -0.404201 -0.431803 -0.452528 -0.496689 -0.571386
CD_scaled_2       -0.628112 -0.636051 -0.642628 -0.646459 -0.653747 -0.673928
CD_scaled_3        0.179256  0.182211  0.202127  0.219839  0.230545  0.105348
CD_scaled_4       -0.711815 -0.719791 -0.655058 -0.607814 -0.677480 -0.896293
…                       …         …         …         …         …         …
MiaPaCa_scaled_26 -0.871064 -0.831789 -0.792699 -0.814054 -0.847574 -1.017860
MiaPaCa_scaled_27 -0.797810 -0.699646 -0.699399 -0.792807 -0.673847 -0.840130
MiaPaCa_scaled_28 -0.443264 -0.500121 -0.559249 -0.489456 -0.431647 -0.500564
MiaPaCa_scaled_29 -0.643993 -0.655699 -0.694486 -0.677776 -0.715158 -1.061388
MiaPaCa_scaled_30 -0.804987 -0.846038 -0.911533 -0.948958 -1.035074 -1.189956

                       1011      1012  Target
CD_scaled_0       -0.338167 -0.343832       0
CD_scaled_1       -0.594077 -0.610955       0
CD_scaled_2       -0.681869 -0.695268       0
CD_scaled_3        0.095563  0.021590       0
CD_scaled_4       -0.905580 -1.059267       0
…                       …         …       …
MiaPaCa_scaled_26 -1.033726 -1.074580       3
MiaPaCa_scaled_27 -0.843650 -0.801993       3
MiaPaCa_scaled_28 -0.501574 -0.445481       3
MiaPaCa_scaled_29 -1.113616 -1.302723       3
MiaPaCa_scaled_30 -1.290298 -1.297413       3

[121 rows x 1014 columns]
```

The author uses PCA to reduce the dimension and has reported values of variance and plots that we can compare. Let us see whether we can reproduce their findings.

[67]:
```python
from sklearn.decomposition import PCA
df_master.columns = df_master.columns.astype(str)
pca_df = PCA().fit(df_master)
#pca_df = PCA().fit(df_master.drop(columns='Target'))
```

[68]:
```python
fig, ax = plt.subplots(3,1,figsize=(10,10))
ax[0].bar(range(len(pca_df.explained_variance_ratio_)),pca_df.
 ↪explained_variance_ratio_)
ax[1].bar(range(len(pca_df.explained_variance_ratio_)),pca_df.
 ↪explained_variance_ratio_.cumsum())
ax[0].set_xlabel('n components')
ax[0].set_ylabel('Explained variance ratio')
```

```
ax[1].set_xlabel('n components')
ax[1].set_ylabel('Cumulative explained variance ratio')
ax[1].axhline(0.882,c='r')
ax[1].text(0,0.8,'88.2%',c='r')
ax[1].axhline(0.564,c='pink')
ax[1].text(-0.9,0.48,'56.4%',c='pink')

ax[2].bar(range(len(pca_df.explained_variance_ratio_)),pca_df.
 ↪explained_variance_ratio_.cumsum())
ax[2].set_xlabel('n components')
ax[2].set_ylabel('Cumulative explained variance ratio')
ax[2].axhline(0.882,c='r')
ax[2].text(0,0.8,'88.2%',c='r')
ax[2].axhline(0.564,c='pink')
ax[2].text(-0.9,0.48,'56.4%',c='pink')
ax[2].set_xlim(-1,21)
plt.tight_layout()
plt.show()
```



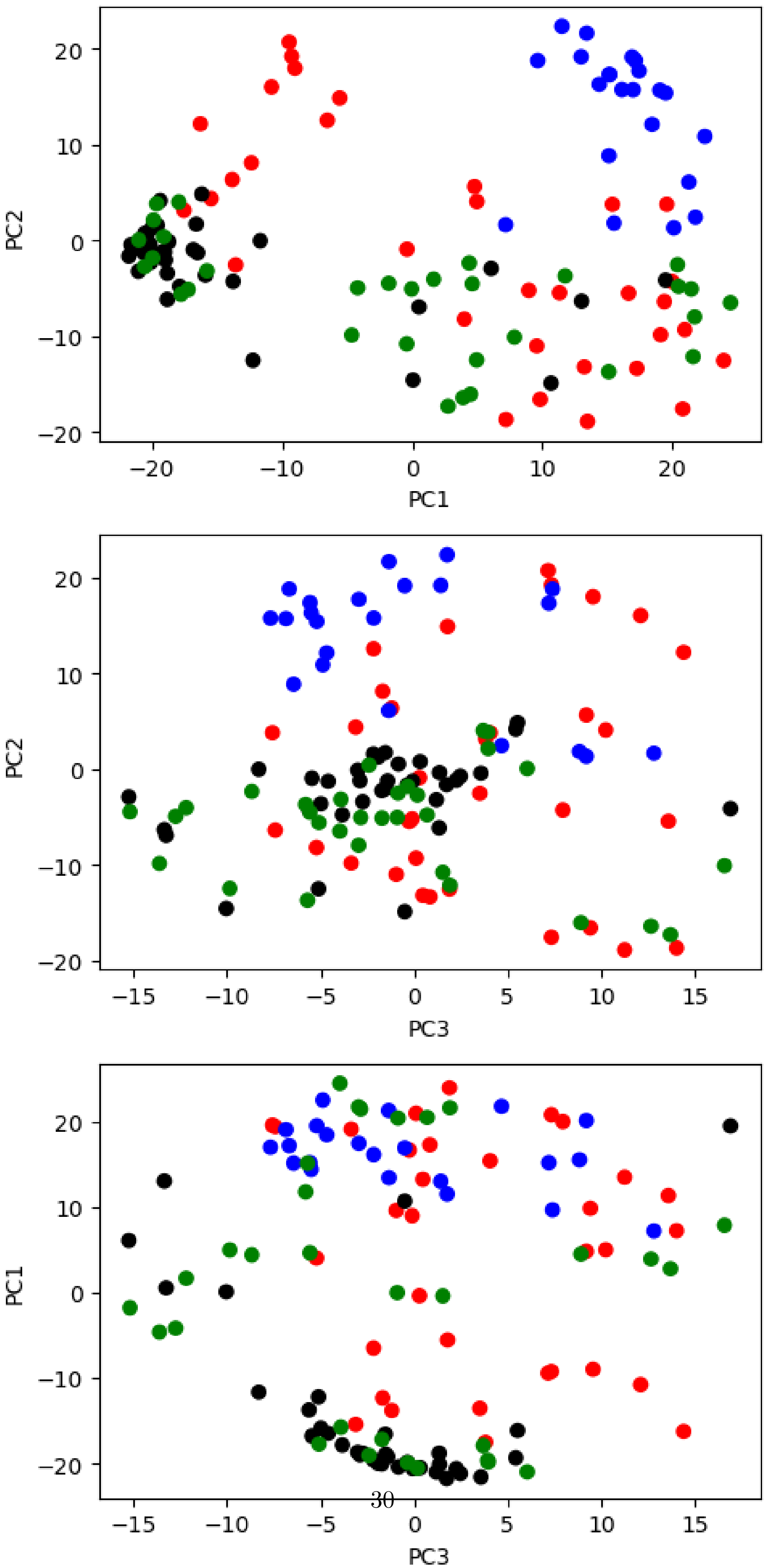
This PCA fitting and explained variance ratio results verifies the author's results as well. The first three of PC explains 56.4% of the total variance and 20 PCs explains 88.2% of the total variance.

[69]:
```
pca_df = PCA(n_components=20).fit(df_master.drop(columns='Target'))
```

[70]:
```
X = pca_df.transform(df_master.drop(columns='Target'))
```

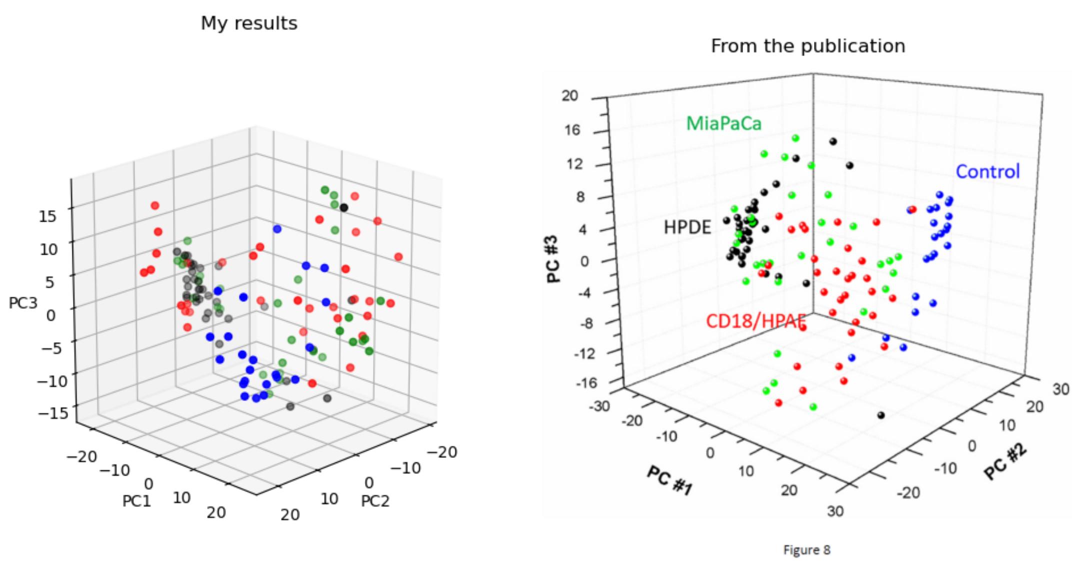
[71]:
```
PC1 = X[:,0]
PC2 = X[:,1]
PC3 = X[:,2]

fig, ax = plt.subplots(3,1,figsize=(5,10))
```

```
ax[0].scatter(PC1,PC2,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else␣
 ↪'blue' if x==1 else 'black' if x==2 else 'green'))
ax[0].set_xlabel('PC1')
ax[0].set_ylabel('PC2')
ax[1].scatter(PC3,PC2,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else␣
 ↪'blue' if x==1 else 'black' if x==2 else 'green'))
ax[1].set_xlabel('PC3')
ax[1].set_ylabel('PC2')
ax[2].scatter(PC3,PC1,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else␣
 ↪'blue' if x==1 else 'black' if x==2 else 'green'))
ax[2].set_xlabel('PC3')
ax[2].set_ylabel('PC1')
plt.tight_layout()
plt.show()
```



PC2
20
10
0
−10
−20
−20
−10
0
10
20
PC1
PC2
20
10
0
−10
−20
−15
−10
−5
0
5
10
15
PC3
PC1
20
10
0
−10
−20
−15
−10
−5
0
5
10
15
PC3

```python
[72]: from PIL import Image

PC_fig = Image.open('Data\PC_fig.PNG')
fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(1,2,1,projection='3d')
ax.scatter(PC2,PC1,PC3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax.set(xlabel=('PC2'), ylabel=('PC1'), zlabel=('PC3'))
plt.tight_layout()
ax.set_box_aspect(aspect=(4,4,4), zoom=0.8)
ax.view_init(elev=20, azim=45)
ax.set_title('My results')

ax1 = fig.add_subplot(1,2,2)
ax1.imshow(PC_fig)
ax1.axis(False)
ax1.set_title('From the publication')
plt.show()
```



These plots do not seem to agree with the results in the paper. However, the explained variance ratio is perfectly matched, evidenced by their statistical variance description of PC#1, 2, and 3 corresponding to my results.

Now we can try LDA approach to compare the PC-DFA predictive results from the paper.

[73]:
```
from sklearn.model_selection import train_test_split
#X_train, X_test, y_train, y_test = train_test_split(df_master.
 ↪drop('Target',axis=1),df_master.Target,test_size=0.3,stratify=df_master.
 ↪Target)
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.
 ↪3,stratify=y)
```

[74]:
```
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis

lda = LinearDiscriminantAnalysis()
lda_model = lda.fit(X_train,y_train.to_numpy().ravel())
score = lda_model.score(X_test,y_test.to_numpy().ravel())
print(score)
```

```
0.972972972972973
```

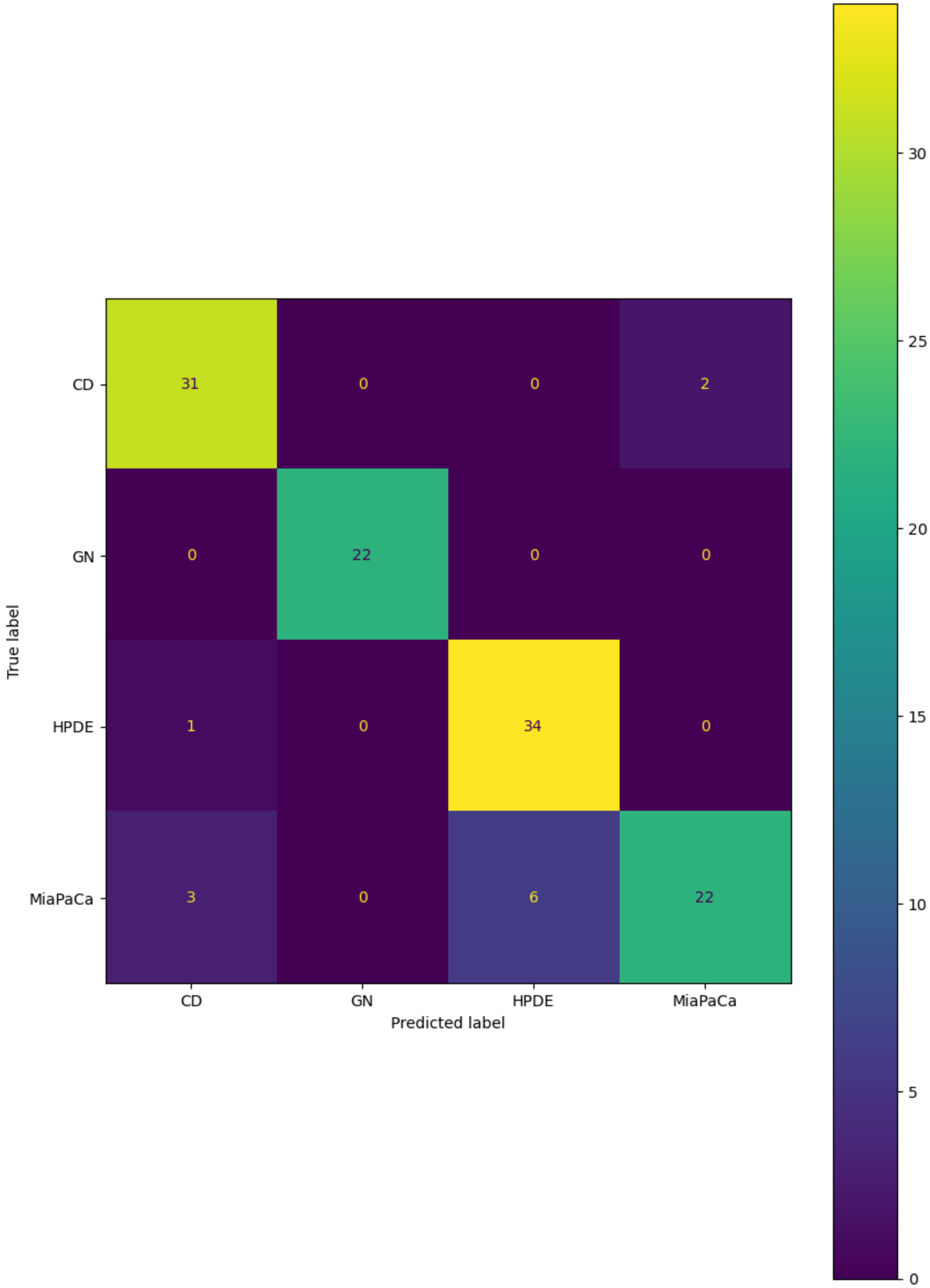
This accuracy is way better than the reported accuracy value. The author uses cross validation, which we will also do and will give more consistent and accurate picture.

[75]:
```
from sklearn.model_selection import cross_val_score
from sklearn import metrics
from sklearn.model_selection import cross_val_predict
from sklearn.metrics import confusion_matrix
from sklearn.metrics import precision_recall_fscore_support

split = 24
scores = cross_val_score(lda, X, y.to_numpy().ravel(), cv=split)
print('cross-validation scores: ', scores)
print('mean cross-validation score: ', scores.mean())


y_pred = cross_val_predict(lda, X, y.to_numpy().ravel(), cv=split)
conf_mat = confusion_matrix(y, y_pred,labels=[0,1,2,3])


res = []
for l in [0,1,2,3]:
     prec,recall,_,_ = precision_recall_fscore_support(y.to_numpy().ravel()==l,
                                                        y_pred==l)
     res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')


print('Specificity: \n', statistics_df[['label','specificity']])
```

```python
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = conf_mat,␣
 ↪display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\model_selection\_split.py:737: UserWarning: The least populated
class in y has only 22 members, which is less than n_splits=24.
  warnings.warn(
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\model_selection\_split.py:737: UserWarning: The least populated
class in y has only 22 members, which is less than n_splits=24.
  warnings.warn(
```

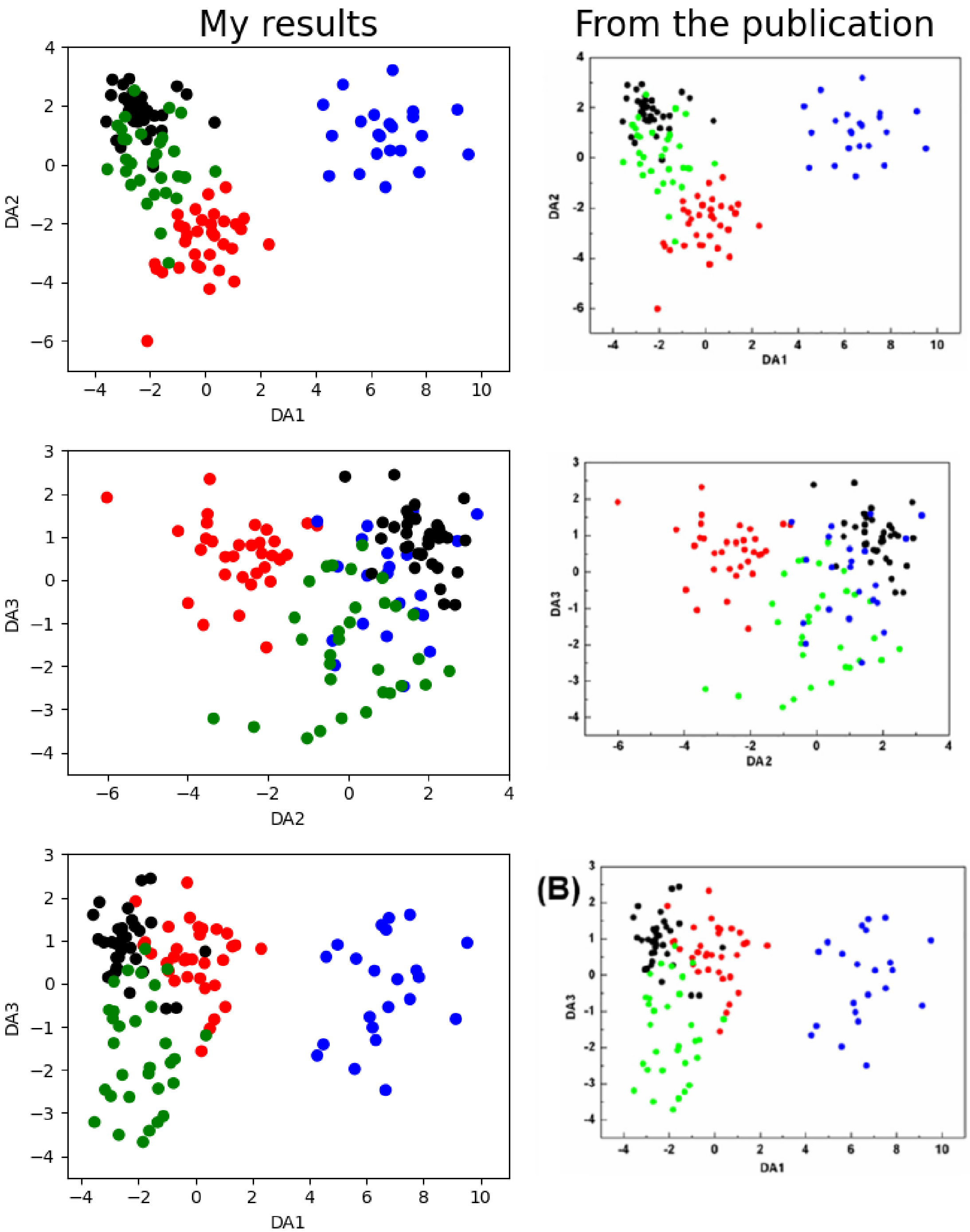
```
cross-validation scores:  [1.  1.  0.6 1.  1.  1.  0.8 1.  0.8 0.8 0.8 1.  1.
0.8 1.  1.  0.8 1.
 0.8 0.8 1.  0.8 0.8 1. ]
mean cross-validation score:  0.9
Specificity:
      label  specificity
0       CD     0.954545
1       GN     1.000000
2     HPDE     0.930233
3  MiaPaCa     0.977778
Sensitivity:
      label  sensitivity
0       CD     0.939394
1       GN     1.000000
2     HPDE     0.971429
3  MiaPaCa     0.709677
Overall Specificity:
 specificity    0.965639
dtype: float64
Overall Sensitivity:
 sensitivity    0.905125
dtype: float64
```



It looks good. It reproduces the values for overall accuracy, specificity, and sensitivity. We can plot the axis to compare.

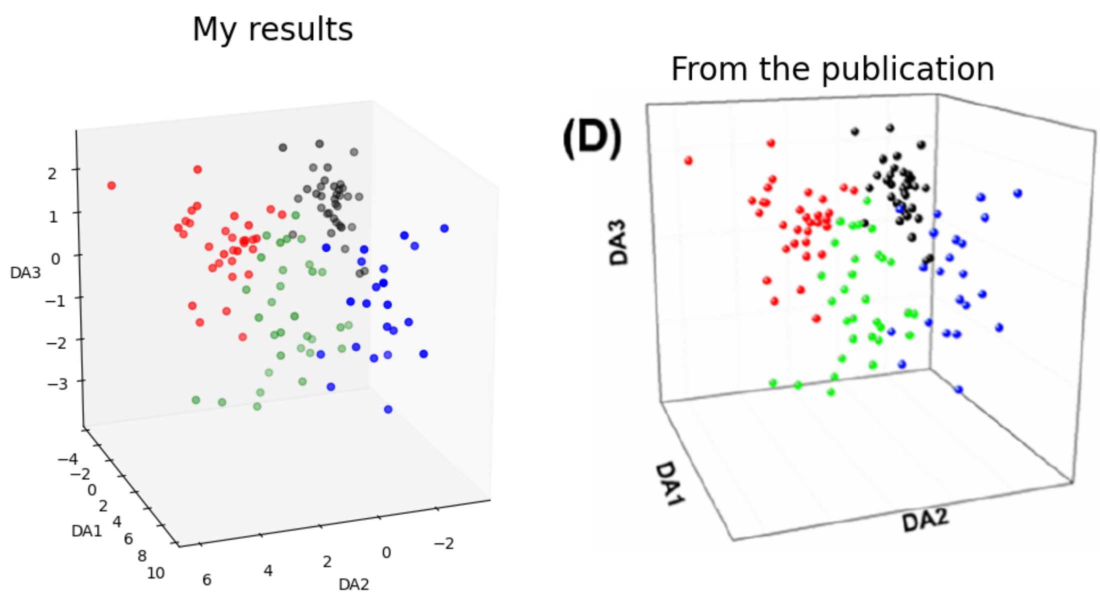
[76]:
```
X_lda = lda.fit_transform(X,y.to_numpy().ravel())
```

[77]:
```
DA12_pubfig = Image.open('Data\DA12.PNG')
DA23_pubfig = Image.open('Data\DA23.PNG')
DA13_pubfig = Image.open('Data\DA13.PNG')

# multiplied by -1 just to reproduce and match their findings.
DA1 = X_lda[:,0]*-1
DA2 = X_lda[:,1]
DA3 = X_lda[:,2]

fig, ax = plt.subplots(3,2,figsize=(8,10))
ax[0,0].set_title('My results',fontsize=20)
ax[0,1].set_title('From the publication',fontsize=20)
ax[0,0].scatter(DA1,DA2,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0␣
↪else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[0,0].set_xlabel('DA1')
ax[0,0].set_ylabel('DA2')
ax[0,0].set_xlim(-5,11)
ax[0,0].set_ylim(-7,4)
ax[0,1].imshow(DA12_pubfig)
ax[0,1].axis('off')

ax[1,0].scatter(DA2,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0␣
↪else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[1,0].set_xlabel('DA2')
ax[1,0].set_ylabel('DA3')
ax[1,0].set_xlim(-7,4)
ax[1,0].set_ylim(-4.5,3)
ax[1,1].imshow(DA23_pubfig)
ax[1,1].axis('off')

ax[2,0].scatter(DA1,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0␣
↪else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[2,0].set_xlabel('DA1')
ax[2,0].set_ylabel('DA3')
ax[2,0].set_xlim(-4.5,11)
ax[2,0].set_ylim(-4.5,3)
ax[2,1].imshow(DA13_pubfig)
ax[2,1].axis('off')

plt.tight_layout()
plt.show()
```



[78]:
```
DA123_pubfig = Image.open('Data\DA123.PNG')

fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(1,2,1,projection='3d')
```

```
ax.scatter(DA2*-1,DA1,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
# multiplied by -1 just to reproduce and match their findings.
ax.set(xlabel=('DA2'), ylabel=('DA1'), zlabel=('DA3'))
plt.tight_layout()
ax.set_box_aspect(aspect=(4,4,4), zoom=1)
ax.view_init(elev=20, azim=70)
ax.grid(False)
ax.set_title('My results',fontsize=20)

ax1 = fig.add_subplot(1,2,2)
ax1.imshow(DA123_pubfig)
ax1.axis(False)
ax1.set_title('From the publication',fontsize=20)
plt.show()
```



It looks like we can reproduce their results really well. It is bang on. Perfect.

I wonder what would LDA results give without using PCA since LDA also reduces dimension as well. We can find out.

[79]:
```
X_train_noPCA, X_test_noPCA, y_train_noPCA, y_test_noPCA = train_test_split(df_master.drop(columns=['Target']),y,test_size=0.3)

lda = LinearDiscriminantAnalysis()
lda_noPCA_model = lda.fit(X_train_noPCA,y_train_noPCA.to_numpy().ravel())
score = lda_noPCA_model.score(X_test_noPCA,y_test_noPCA.to_numpy().ravel())
print(score)
```

```
X_lda_noPCA = lda_noPCA_model.transform(df_master.drop(columns=['Target']))
```

```
0.8108108108108109
```

The accuracy is worse than the PCA-reduced one.

[80]:
```
split=24

scores = cross_val_score(lda, df_master.drop(columns=['Target']), y.to_numpy().
 ↪ravel(), cv=split)
print('cross-validation scores: ', scores)
print('mean cross-validation score: ', scores.mean())


y_pred = cross_val_predict(lda, df_master.drop(columns=['Target']), y.
 ↪to_numpy().ravel(), cv=split)
conf_mat = confusion_matrix(y, y_pred)


res = []
for l in [0,1,2,3]:
     prec,recall,_,_ = precision_recall_fscore_support(y.to_numpy().ravel()==l,
                                                       y_pred==l)
     res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')

print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = conf_mat,␣
 ↪display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

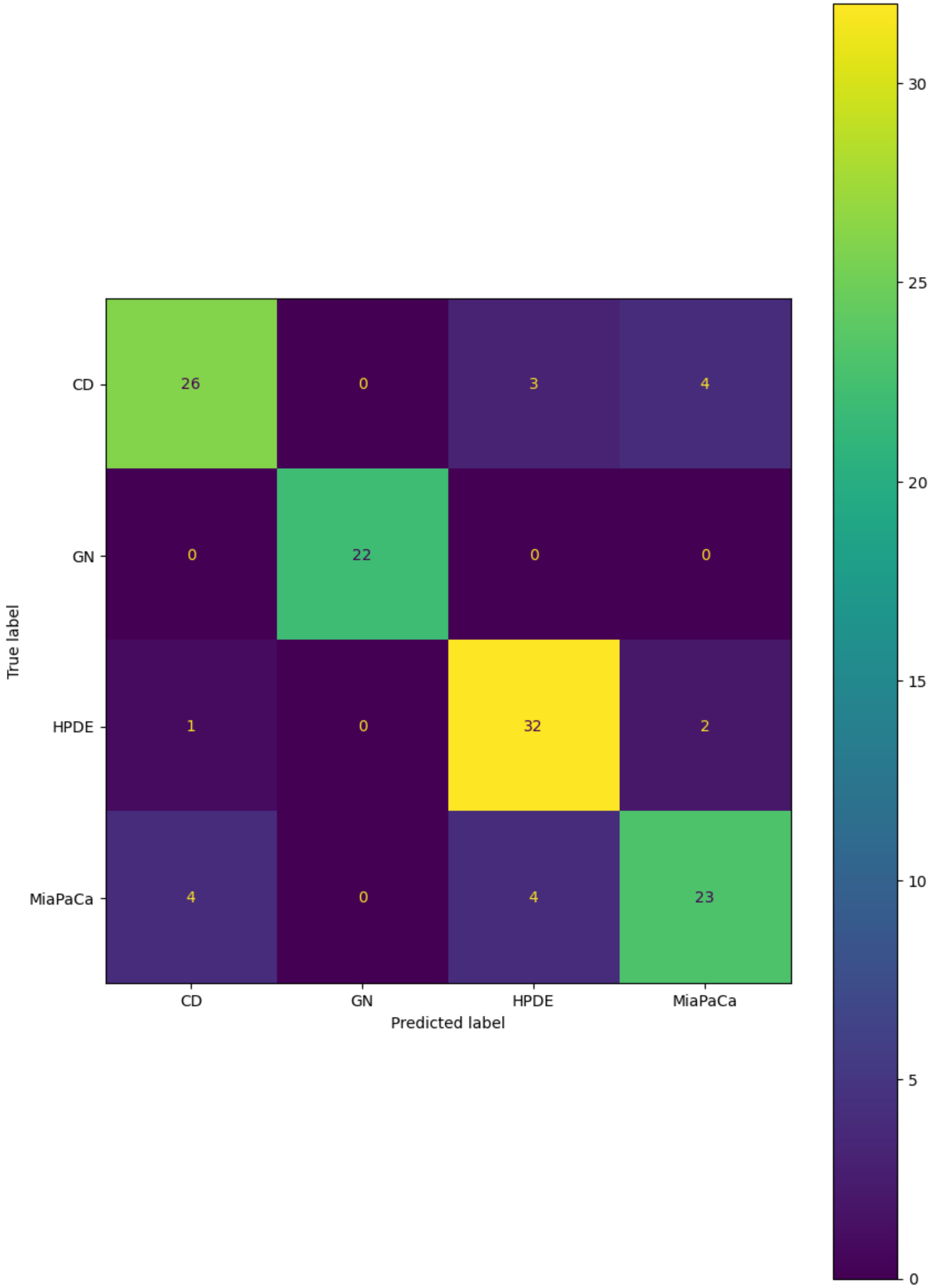
```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\model_selection\_split.py:737: UserWarning: The least populated
class in y has only 22 members, which is less than n_splits=24.
  warnings.warn(
```

```
cross-validation scores:  [0.83333333 0.6        1.         1.         1.
1.
```

```
 0.6        0.8        0.8        0.8        0.6        1.
 0.8        0.8        0.8        1.         1.         0.8
 0.6        1.         1.         1.         1.         0.6        ]
mean cross-validation score:  0.8513888888888889
```

```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\model_selection\_split.py:737: UserWarning: The least populated
class in y has only 22 members, which is less than n_splits=24.
  warnings.warn(
```

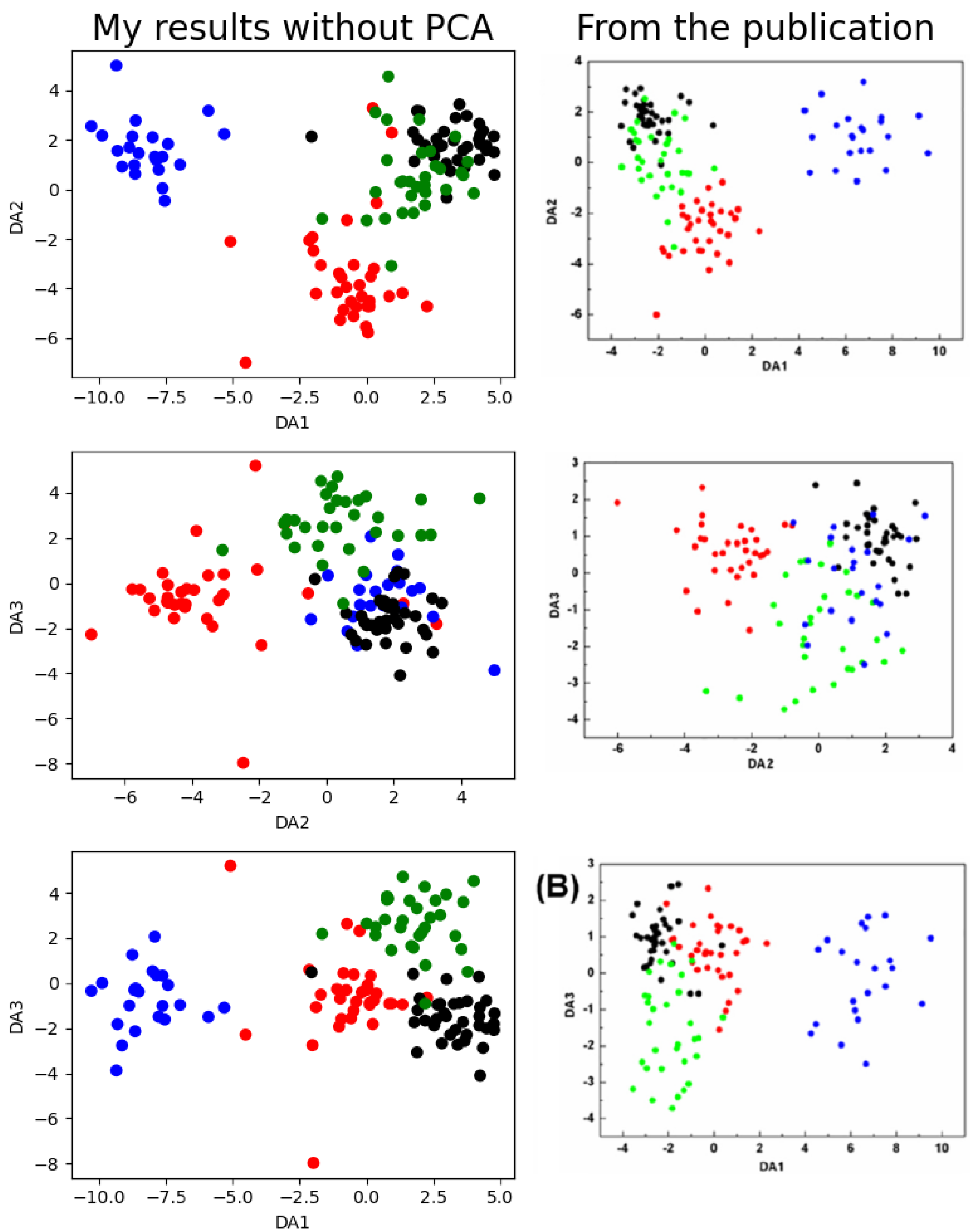
```
Specificity:
      label  specificity
0        CD     0.943182
1        GN     1.000000
2      HPDE     0.918605
3   MiaPaCa     0.933333
Sensitivity:
      label  sensitivity
0        CD     0.787879
1        GN     1.000000
2      HPDE     0.914286
3   MiaPaCa     0.741935
Overall Specificity:
 specificity    0.94878
dtype: float64
Overall Sensitivity:
 sensitivity    0.861025
dtype: float64
```



The cross-validation method also shows a worse results across the board.

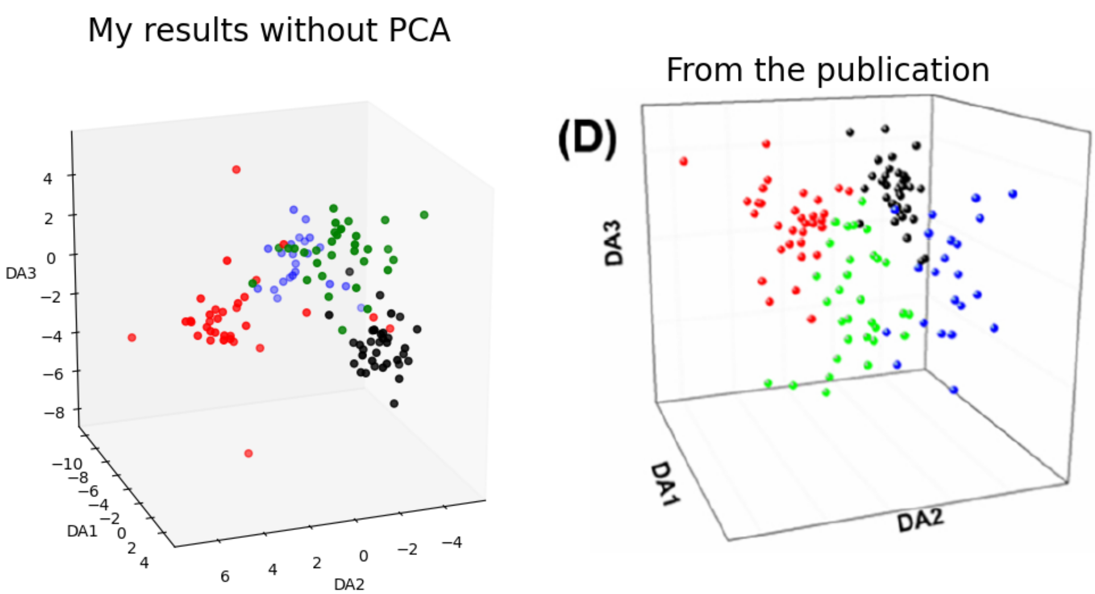
[81]:

```
DA1 = X_lda_noPCA[:,0]
DA2 = X_lda_noPCA[:,1]
DA3 = X_lda_noPCA[:,2]

fig, ax = plt.subplots(3,2,figsize=(8,10))
ax[0,0].set_title('My results without PCA',fontsize=20)
ax[0,1].set_title('From the publication',fontsize=20)
ax[0,0].scatter(DA1,DA2*-1,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[0,0].set_xlabel('DA1')
ax[0,0].set_ylabel('DA2')
ax[0,1].imshow(DA12_pubfig)
ax[0,1].axis('off')

ax[1,0].scatter(DA2*-1,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[1,0].set_xlabel('DA2')
ax[1,0].set_ylabel('DA3')
ax[1,1].imshow(DA23_pubfig)
ax[1,1].axis('off')

ax[2,0].scatter(DA1,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax[2,0].set_xlabel('DA1')
ax[2,0].set_ylabel('DA3')
ax[2,1].imshow(DA13_pubfig)
ax[2,1].axis('off')

plt.tight_layout()
plt.show()
```



[82]:
```
fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(1,2,1,projection='3d')
ax.scatter(DA2,DA1,DA3,c=df_master.iloc[:,-1].apply(lambda x: 'red' if x==0 else 'blue' if x==1 else 'black' if x==2 else 'green'))
ax.set(xlabel=('DA2'), ylabel=('DA1'), zlabel=('DA3'))
```

```
plt.tight_layout()
ax.set_box_aspect(aspect=(4,4,4), zoom=1)
ax.view_init(elev=20, azim=70)
ax.grid(False)
ax.set_title('My results without PCA',fontsize=20)

ax1 = fig.add_subplot(1,2,2)
ax1.imshow(DA123_pubfig)
ax1.axis(False)
ax1.set_title('From the publication',fontsize=20)
plt.show()
```



We can use different models to experiment whether we can increase the accuracy, specificity, and sensitivity.

[83]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV

rf = RandomForestClassifier()
param_grid = {
    'n_estimators': [10,100,200],
    'max_features': ["sqrt", "log2",None],
    'max_depth' : [1,2,3,4,5,6,7,8],
    'criterion' :['gini', 'entropy']
}


CV_rf = GridSearchCV(estimator=rf, param_grid=param_grid,cv=8)
```

```
CV_rf.fit(X_train, y_train.to_numpy().ravel())
CV_rf.best_params_
```

[83]:
```
{'criterion': 'entropy',
 'max_depth': 5,
 'max_features': 'log2',
 'n_estimators': 100}
```

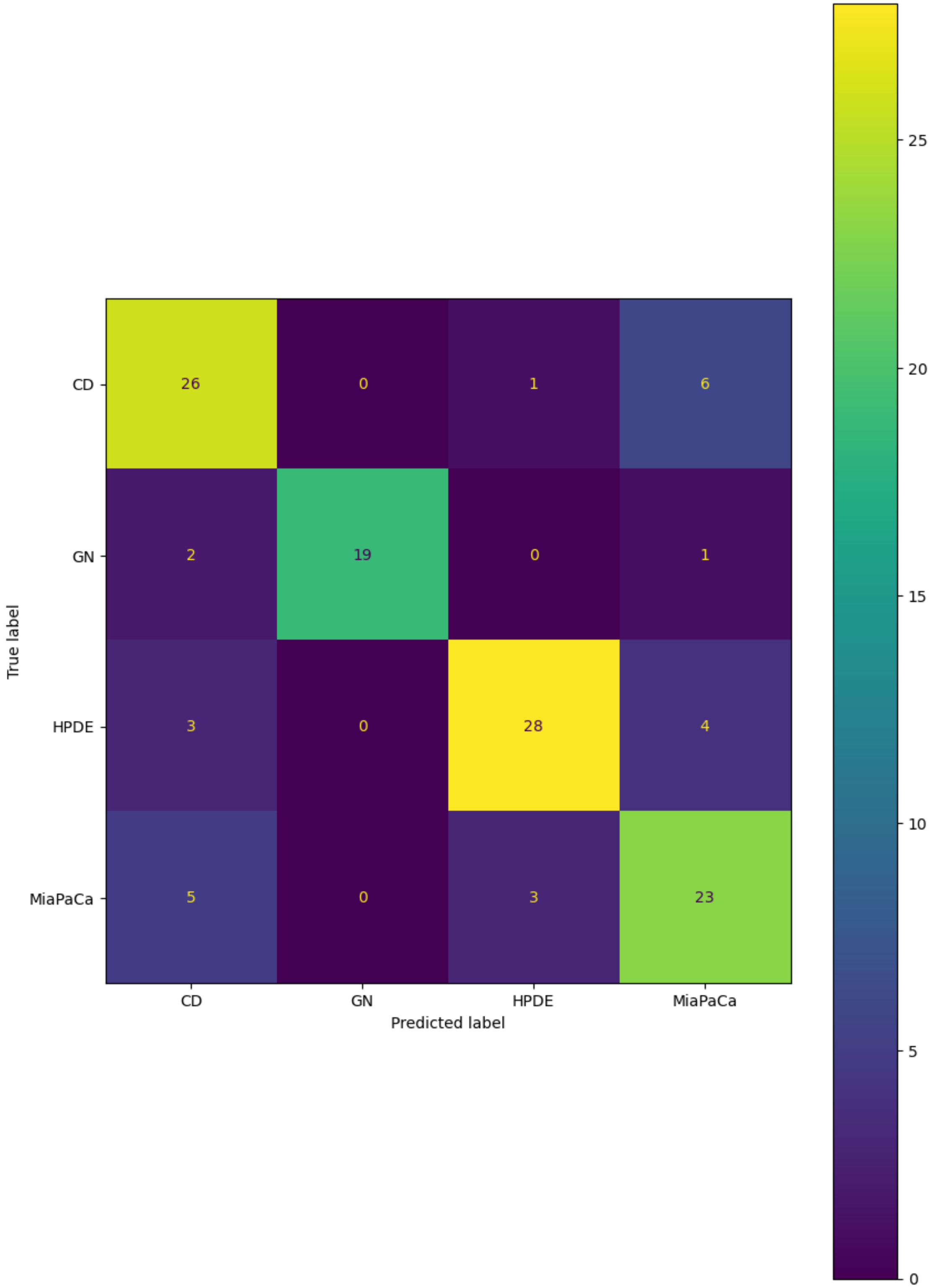
[84]:
```
rf = RandomForestClassifier(n_estimators=CV_rf.best_params_['n_estimators'],
                            max_features=CV_rf.best_params_['max_features'],
                            max_depth=CV_rf.best_params_['max_depth'],
                            criterion=CV_rf.best_params_['criterion'])
rf.fit(X_train, y_train.to_numpy().ravel())
rf.score(X_test,y_test)
```

[84]:
```
0.8378378378378378
```

[85]:
```
split = 21

scores = cross_val_score(rf, X, y.to_numpy().ravel(), cv=split)
print('cross-validation scores: ', scores)
print('mean cross-validation score: ', scores.mean())


y_pred = cross_val_predict(rf, X, y.to_numpy().ravel(), cv=split)
conf_mat = confusion_matrix(y, y_pred,labels=[0,1,2,3])


res = []
for l in [0,1,2,3]:
     prec,recall,_,_ = precision_recall_fscore_support(y.to_numpy().ravel()==l,
                                                        y_pred==l)
     res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')


print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = conf_mat,␣
 ↪display_labels = statistics_df['label'].to_list())
```

```
cm_display.plot()
plt.show()
```

```
cross-validation scores:  [0.83333333 0.83333333 0.66666667 0.83333333
0.66666667 1.
 0.5        0.66666667 0.66666667 1.         0.83333333 0.66666667
 0.83333333 0.83333333 1.         0.66666667 0.8        0.8
 1.         0.6        0.6       ]
mean cross-validation score:  0.7761904761904762
Specificity:
      label  specificity
0       CD     0.886364
1       GN     1.000000
2     HPDE     0.953488
3  MiaPaCa     0.877778
Sensitivity:
      label  sensitivity
0       CD     0.787879
1       GN     0.863636
2     HPDE     0.800000
3  MiaPaCa     0.741935
Overall Specificity:
 specificity    0.929407
dtype: float64
Overall Sensitivity:
 sensitivity    0.798363
dtype: float64
```



The random forest classifier model does not score well. LDA seems to perform better with higher accuracy and shorter latency.

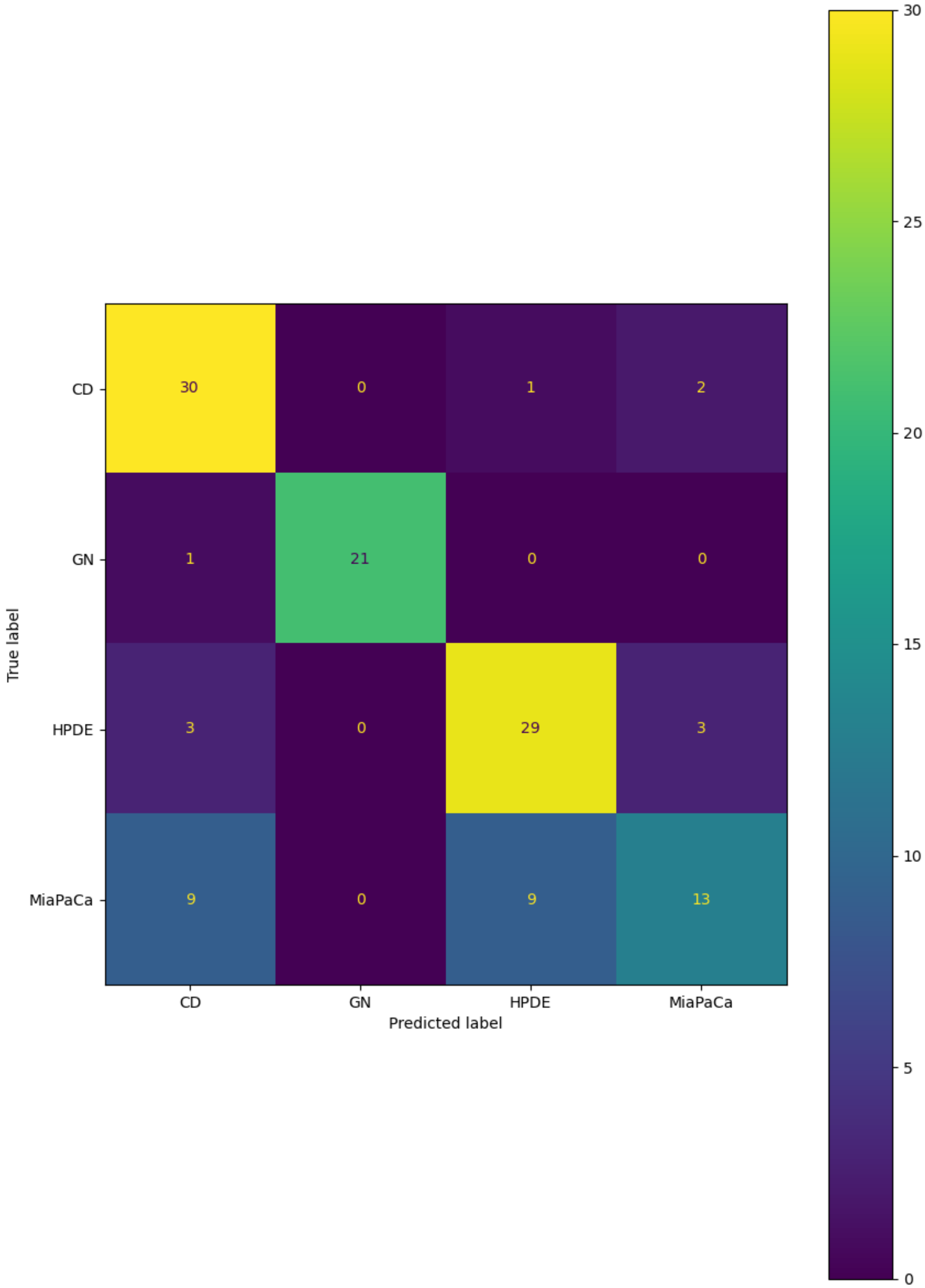
[241]:
```
rf = RandomForestClassifier(n_estimators=CV_rf.best_params_['n_estimators'],
                            max_features=CV_rf.best_params_['max_features'],
                            max_depth=CV_rf.best_params_['max_depth'],
                            criterion=CV_rf.best_params_['criterion'])
rf.fit(X_train_noPCA,y_train_noPCA.to_numpy().ravel())
rf.score(X_test_noPCA,y_test_noPCA.to_numpy().ravel())
```

[241]: 0.8108108108108109

[86]:
```
split = 21

scores = cross_val_score(rf, df_master.drop(columns=['Target']), y.to_numpy().
 ↪ravel(), cv=split)
print('cross-validation scores: ', scores)
print('mean cross-validation score: ', scores.mean())


y_pred = cross_val_predict(rf, df_master.drop(columns=['Target']), y.to_numpy().
 ↪ravel(), cv=split)
conf_mat = confusion_matrix(y, y_pred,labels=[0,1,2,3])


res = []
for l in [0,1,2,3]:
     prec,recall,_,_ = precision_recall_fscore_support(y.to_numpy().ravel()==l,
                                                       y_pred==l)
     res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')


print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = conf_mat,␣
 ↪display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
cross-validation scores:  [0.66666667 1.         0.83333333 1.
```

```
0.66666667 1.
 0.83333333 0.5        0.66666667 0.83333333 0.33333333 0.66666667
 0.83333333 0.83333333 0.66666667 0.83333333 0.8        0.6
 1.         1.         0.8       ]
mean cross-validation score:  0.7793650793650794
Specificity:
      label  specificity
0       CD     0.852273
1       GN     1.000000
2     HPDE     0.883721
3  MiaPaCa     0.944444
Sensitivity:
      label  sensitivity
0       CD     0.909091
1       GN     0.954545
2     HPDE     0.828571
3  MiaPaCa     0.419355
Overall Specificity:
 specificity    0.92011
dtype: float64
Overall Sensitivity:
 sensitivity    0.777891
dtype: float64
```



30
25
20
15
10
5
0
CD
GN
HPDE
MiaPaCa
True label
30
0
1
2
1
21
0
0
3
0
29
3
9
0
9
13
CD
GN
HPDE
MiaPaCa
Predicted label

[87]:
```
import torch
from torch import nn
```

[88]:
```
device = (
    "cuda"
    if torch.cuda.is_available()
    else "mps"
    if torch.backends.mps.is_available()
    else "cpu"
)
print(f"Using {device} device")
```

```
Using cpu device
```

[440]:
```
class NeuralNetwork(nn.Module):
    def __init__(self):
        super().__init__()
        self.linear_relu_stack = nn.Sequential(
            nn.Linear(20, 30),
            nn.Linear(30,30),
            nn.Linear(30, 10),
            nn.Linear(10, 4),
            nn.Softmax()
        )

    def forward(self, x):
        x = torch.from_numpy(x).to(torch.float32)
        logits = self.linear_relu_stack(x)
        return logits

def train_loop(X, y, model, epoch, batch, loss_fn, optimizer, printFn=True):
    model.train()

    y = turnYinto(y)
    y = torch.tensor(y).to(torch.float32)

    loss_plot = []
    plotx = []
    counter = 0
    for i in range(epoch):
        for k in range(X.shape[0]):
            # Compute prediction and loss
            pred = model(X[k,:])
            loss = loss_fn(pred, y[k])

            # Backpropagation
            loss.backward()
```

```
            optimizer.step()
            optimizer.zero_grad()
            loss = loss.item()

            if counter % 10 == 0 and printFn==True:
                print('\n')
                print('epoch {}: '.format(i))
                print('-'*100)
                print(f"{k}/{X.shape[0]} ----> loss: {loss:>7f}")
            else:
                pass

            loss_plot.append(loss)
            counter += 1
            plotx.append(counter)
    if printFn==True:
        plt.plot(plotx,loss_plot)
        plt.xlabel('loss')
        plt.ylabel('iterations')
        plt.show()
    else:
        pass
    return loss, plotx

def testing(X_test,y_test,model,printFn=True):
    correct = 0
    preds = []
    for i in range(X_test.shape[0]):
        logits = model(X_test[i,:])
        pred_probab = nn.Softmax(dim=0)(logits)
        y_pred = pred_probab.argmax(0)
        preds.append(y_pred)
        if printFn==True:
            print(f"Predicted class: {y_pred}")
            print(f"Actual class: {y_test[i]}")
        else:
            pass
        t = y_test[i]
        t = int(t)
        if y_pred == t:
            correct += 1
        if printFn==True:
            print('accuracy: ', correct/(i+1))
            print('count: ', correct, '/', (i+1))
            print('-'*100, '\n')
        else:
            pass
```

```
    print('Accuracy: ', correct/(i+1))

    return correct/(i+1), preds

def turnYinto(y):
    try:
        Y = []
        for i in y.values:
            if i == 0:
                Y.append([1.0,0.0,0.0,0.0])
            elif i == 1:
                Y.append([0.0,1.0,0.0,0.0])
            elif i == 2:
                Y.append([0.0,0.0,1.0,0.0])
            else:
                Y.append([0.0,0.0,0.0,1.0])
        return np.array(Y)
    except:
        Y = []
        for i in y:
            if i == 0:
                Y.append([1.0,0.0,0.0,0.0])
            elif i == 1:
                Y.append([0.0,1.0,0.0,0.0])
            elif i == 2:
                Y.append([0.0,0.0,1.0,0.0])
            else:
                Y.append([0.0,0.0,0.0,1.0])
        return np.array(Y)
```

[306]:
```
model = NeuralNetwork().to(device)
print(model)

learning_rate = 0.01
epoch = 300
batch = 11

loss_fn = nn.CrossEntropyLoss()

optimizer = torch.optim.SGD(model.parameters(), lr=learning_rate)


loss_count, count = train_loop(X_train, y_train, model, epoch, batch, loss_fn,
 ↪optimizer, printFn=True)
```

```
NeuralNetwork(
```

```
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=20, out_features=30, bias=True)
    (1): Linear(in_features=30, out_features=30, bias=True)
    (2): Linear(in_features=30, out_features=10, bias=True)
    (3): Linear(in_features=10, out_features=4, bias=True)
    (4): Softmax(dim=None)
  )
)


epoch 0:
--------------------------------------------------------------------------------
--------------------
0/84 ----> loss: 1.515288


epoch 0:
--------------------------------------------------------------------------------
--------------------
10/84 ----> loss: 1.426557


epoch 0:
--------------------------------------------------------------------------------
--------------------
20/84 ----> loss: 1.526613


epoch 0:
--------------------------------------------------------------------------------
--------------------
30/84 ----> loss: 1.291614


epoch 0:
--------------------------------------------------------------------------------
--------------------
40/84 ----> loss: 1.531961


epoch 0:
--------------------------------------------------------------------------------
--------------------
50/84 ----> loss: 1.310615


epoch 0:
--------------------------------------------------------------------------------
```

```
--------------------
60/84 ----> loss: 1.440917


epoch 0:
--------------------------------------------------------------------------------
--------------------
70/84 ----> loss: 1.088457


epoch 0:
--------------------------------------------------------------------------------
--------------------
80/84 ----> loss: 1.364361


epoch 1:
--------------------------------------------------------------------------------
--------------------
6/84 ----> loss: 1.049090


epoch 1:
--------------------------------------------------------------------------------
--------------------
16/84 ----> loss: 1.176778


epoch 1:
--------------------------------------------------------------------------------
--------------------
26/84 ----> loss: 1.135465

C:\Users\brian\Anaconda3\Lib\site-packages\torch\nn\modules\module.py:1518:
UserWarning: Implicit dimension choice for softmax has been deprecated. Change
the call to include dim=X as an argument.
  return self._call_impl(*args, **kwargs)


epoch 1:
--------------------------------------------------------------------------------
--------------------
36/84 ----> loss: 1.017341


epoch 1:
--------------------------------------------------------------------------------
--------------------
```

```
46/84 ----> loss: 1.367784


epoch 1:
--------------------------------------------------------------------------------
--------------------
56/84 ----> loss: 1.288284


epoch 1:
--------------------------------------------------------------------------------
--------------------
66/84 ----> loss: 1.118008


epoch 1:
--------------------------------------------------------------------------------
--------------------
76/84 ----> loss: 1.096199


epoch 2:
--------------------------------------------------------------------------------
--------------------
2/84 ----> loss: 0.867312


epoch 2:
--------------------------------------------------------------------------------
--------------------
12/84 ----> loss: 0.812835


epoch 2:
--------------------------------------------------------------------------------
--------------------
22/84 ----> loss: 1.098505


epoch 2:
--------------------------------------------------------------------------------
--------------------
32/84 ----> loss: 1.630198


epoch 2:
--------------------------------------------------------------------------------
--------------------
```

```
42/84 ----> loss: 1.350734


epoch 2:
--------------------------------------------------------------------------------
--------------------
52/84 ----> loss: 0.797361


epoch 2:
--------------------------------------------------------------------------------
--------------------
62/84 ----> loss: 0.811508


epoch 2:
--------------------------------------------------------------------------------
--------------------
72/84 ----> loss: 0.788416


epoch 2:
--------------------------------------------------------------------------------
--------------------
82/84 ----> loss: 1.072305


epoch 3:
--------------------------------------------------------------------------------
--------------------
8/84 ----> loss: 1.440779


epoch 3:
--------------------------------------------------------------------------------
--------------------
18/84 ----> loss: 0.771015


epoch 3:
--------------------------------------------------------------------------------
--------------------
28/84 ----> loss: 1.212340


epoch 3:
--------------------------------------------------------------------------------
--------------------
```

```
38/84 ----> loss: 0.884953


epoch 3:
--------------------------------------------------------------------------------
--------------------
48/84 ----> loss: 0.765120


epoch 3:
--------------------------------------------------------------------------------
--------------------
58/84 ----> loss: 0.867796


epoch 3:
--------------------------------------------------------------------------------
--------------------
68/84 ----> loss: 0.818896


epoch 3:
--------------------------------------------------------------------------------
--------------------
78/84 ----> loss: 0.918123


epoch 4:
--------------------------------------------------------------------------------
--------------------
4/84 ----> loss: 0.777322


epoch 4:
--------------------------------------------------------------------------------
--------------------
14/84 ----> loss: 0.780414


epoch 4:
--------------------------------------------------------------------------------
--------------------
24/84 ----> loss: 0.806624


epoch 4:
--------------------------------------------------------------------------------
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34/84 ----> loss: 0.970118


epoch 4:
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--------------------
44/84 ----> loss: 1.337020


epoch 4:
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--------------------
54/84 ----> loss: 1.576498


epoch 4:
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64/84 ----> loss: 1.367633


epoch 4:
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74/84 ----> loss: 0.890826


epoch 5:
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0/84 ----> loss: 0.749081


epoch 5:
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10/84 ----> loss: 0.816943


epoch 5:
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20/84 ----> loss: 0.752476


epoch 5:
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30/84 ----> loss: 0.989824


epoch 5:
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40/84 ----> loss: 0.870560


epoch 5:
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50/84 ----> loss: 1.295663


epoch 5:
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60/84 ----> loss: 1.232409


epoch 5:
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70/84 ----> loss: 0.801703


epoch 5:
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80/84 ----> loss: 0.761080


epoch 6:
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6/84 ----> loss: 0.744013


epoch 6:
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16/84 ----> loss: 0.746543


epoch 6:
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26/84 ----> loss: 0.810548


epoch 6:
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36/84 ----> loss: 0.789037


epoch 6:
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46/84 ----> loss: 1.103470


epoch 6:
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56/84 ----> loss: 0.820224


epoch 6:
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66/84 ----> loss: 0.765625


epoch 6:
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76/84 ----> loss: 0.802655


epoch 7:
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2/84 ----> loss: 0.905642


epoch 7:
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12/84 ----> loss: 0.776766


epoch 7:
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22/84 ----> loss: 0.830703


epoch 7:
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32/84 ----> loss: 0.773456


epoch 7:
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42/84 ----> loss: 0.774894


epoch 7:
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52/84 ----> loss: 0.842918


epoch 7:
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62/84 ----> loss: 1.047609


epoch 7:
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72/84 ----> loss: 0.799736


epoch 7:
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82/84 ----> loss: 0.777673


epoch 8:
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8/84 ----> loss: 0.949737


epoch 8:
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18/84 ----> loss: 0.759061


epoch 8:
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28/84 ----> loss: 0.756494


epoch 8:
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38/84 ----> loss: 0.905860


epoch 8:
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48/84 ----> loss: 0.745548


epoch 8:
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58/84 ----> loss: 0.760533


epoch 8:
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68/84 ----> loss: 0.771103


epoch 8:
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--------------------
78/84 ----> loss: 0.745941


epoch 9:
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4/84 ----> loss: 0.778492


epoch 9:
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14/84 ----> loss: 0.748566


epoch 9:
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24/84 ----> loss: 0.748569


epoch 9:
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34/84 ----> loss: 0.745317


epoch 9:
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44/84 ----> loss: 0.769483


epoch 9:
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54/84 ----> loss: 0.904303


epoch 9:
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--------------------
64/84 ----> loss: 0.781872


epoch 9:
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74/84 ----> loss: 0.747088



epoch 10:
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0/84 ----> loss: 0.743794


epoch 10:
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10/84 ----> loss: 0.749549


epoch 10:
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20/84 ----> loss: 0.745270


epoch 10:
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30/84 ----> loss: 0.753164


epoch 10:
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40/84 ----> loss: 0.745280


epoch 10:
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50/84 ----> loss: 0.801919


epoch 10:
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60/84 ----> loss: 0.869869


epoch 10:
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70/84 ----> loss: 0.748270


epoch 10:
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80/84 ----> loss: 0.746622


epoch 11:
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6/84 ----> loss: 0.743686


epoch 11:
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16/84 ----> loss: 0.743671


epoch 11:
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26/84 ----> loss: 0.798232


epoch 11:
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36/84 ----> loss: 0.744425


epoch 11:
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46/84 ----> loss: 0.818172


epoch 11:
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56/84 ----> loss: 0.752781


epoch 11:
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66/84 ----> loss: 0.744523


epoch 11:
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76/84 ----> loss: 0.744613


epoch 12:
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2/84 ----> loss: 1.002750


epoch 12:
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12/84 ----> loss: 0.745565


epoch 12:
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--------------------
22/84 ----> loss: 0.753274


epoch 12:
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32/84 ----> loss: 0.744066


epoch 12:
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--------------------
42/84 ----> loss: 0.744975


epoch 12:
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--------------------
52/84 ----> loss: 0.887307


epoch 12:
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--------------------
62/84 ----> loss: 0.806701


epoch 12:
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72/84 ----> loss: 0.800281


epoch 12:
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--------------------
82/84 ----> loss: 0.766243


epoch 13:
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8/84 ----> loss: 0.843868


epoch 13:
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18/84 ----> loss: 0.744517


epoch 13:
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28/84 ----> loss: 0.748548


epoch 13:
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38/84 ----> loss: 0.784753


epoch 13:
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48/84 ----> loss: 0.743764


epoch 13:
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58/84 ----> loss: 0.746929


epoch 13:
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68/84 ----> loss: 0.748766


epoch 13:
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78/84 ----> loss: 0.744128


epoch 14:
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4/84 ----> loss: 0.762627


epoch 14:
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14/84 ----> loss: 0.744179


epoch 14:
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24/84 ----> loss: 0.744874


epoch 14:
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34/84 ----> loss: 0.743877


epoch 14:
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44/84 ----> loss: 0.747679


epoch 14:
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54/84 ----> loss: 0.785609


epoch 14:
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64/84 ----> loss: 0.770050


epoch 14:
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74/84 ----> loss: 0.743859


epoch 15:
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0/84 ----> loss: 0.743686


epoch 15:
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10/84 ----> loss: 0.744832


epoch 15:
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20/84 ----> loss: 0.744135


epoch 15:
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30/84 ----> loss: 0.747662


epoch 15:
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40/84 ----> loss: 0.744398


epoch 15:
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50/84 ----> loss: 0.755160


epoch 15:
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60/84 ----> loss: 0.766355


epoch 15:
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70/84 ----> loss: 0.744642


epoch 15:
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80/84 ----> loss: 0.745946


epoch 16:
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6/84 ----> loss: 0.743669


epoch 16:
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16/84 ----> loss: 0.743668


epoch 16:
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26/84 ----> loss: 0.764953


epoch 16:
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36/84 ----> loss: 0.743754


epoch 16:
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46/84 ----> loss: 0.770743


epoch 16:
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56/84 ----> loss: 0.749873


epoch 16:
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66/84 ----> loss: 0.743943


epoch 16:
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76/84 ----> loss: 0.743772


epoch 17:
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2/84 ----> loss: 0.912008


epoch 17:
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12/84 ----> loss: 0.744080


epoch 17:
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22/84 ----> loss: 0.751738


epoch 17:
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32/84 ----> loss: 0.743787


epoch 17:
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42/84 ----> loss: 0.743806


epoch 17:
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52/84 ----> loss: 0.843219


epoch 17:
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62/84 ----> loss: 0.759445


epoch 17:
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72/84 ----> loss: 0.800672


epoch 17:
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82/84 ----> loss: 0.754952


epoch 18:
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8/84 ----> loss: 0.774116


epoch 18:
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18/84 ----> loss: 0.743930


epoch 18:
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28/84 ----> loss: 0.747650


epoch 18:
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38/84 ----> loss: 0.761381


epoch 18:
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48/84 ----> loss: 0.743674


epoch 18:
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58/84 ----> loss: 0.744990


epoch 18:
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68/84 ----> loss: 0.744379


epoch 18:
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78/84 ----> loss: 0.744266


epoch 19:
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4/84 ----> loss: 0.752186


epoch 19:
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14/84 ----> loss: 0.743788


epoch 19:
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24/84 ----> loss: 0.744142


epoch 19:
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34/84 ----> loss: 0.743703


epoch 19:
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44/84 ----> loss: 0.744653


epoch 19:
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54/84 ----> loss: 0.762302


epoch 19:
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64/84 ----> loss: 0.770420


epoch 19:
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74/84 ----> loss: 0.743685


epoch 20:
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0/84 ----> loss: 0.743678


epoch 20:
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10/84 ----> loss: 0.744480


epoch 20:
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20/84 ----> loss: 0.743755


epoch 20:
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30/84 ----> loss: 0.745936


epoch 20:
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40/84 ----> loss: 0.744553


epoch 20:
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50/84 ----> loss: 0.747090


epoch 20:
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60/84 ----> loss: 0.749704


epoch 20:
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70/84 ----> loss: 0.743919


epoch 20:
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80/84 ----> loss: 0.746339


epoch 21:
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6/84 ----> loss: 0.743668


epoch 21:
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16/84 ----> loss: 0.743668


epoch 21:
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26/84 ----> loss: 0.762492


epoch 21:
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36/84 ----> loss: 0.743669


epoch 21:
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46/84 ----> loss: 0.767848


epoch 21:
----------------------------------------------------------------------------------------------------
56/84 ----> loss: 0.747940


epoch 21:
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66/84 ----> loss: 0.743722


epoch 21:
----------------------------------------------------------------------------------------------------
76/84 ----> loss: 0.743678


epoch 22:
----------------------------------------------------------------------------------------------------
2/84 ----> loss: 0.775496


epoch 22:
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12/84 ----> loss: 0.743851


epoch 22:
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22/84 ----> loss: 0.789736


epoch 22:
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32/84 ----> loss: 0.743833


epoch 22:
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42/84 ----> loss: 0.743788


epoch 22:
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--------------------
52/84 ----> loss: 0.762608


epoch 22:
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62/84 ----> loss: 0.749240


epoch 22:
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72/84 ----> loss: 0.788524


epoch 22:
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82/84 ----> loss: 0.761246


epoch 23:
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8/84 ----> loss: 0.768277


epoch 23:
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18/84 ----> loss: 0.744028


epoch 23:
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28/84 ----> loss: 0.746811


epoch 23:
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38/84 ----> loss: 0.760911


epoch 23:
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48/84 ----> loss: 0.743669


epoch 23:
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58/84 ----> loss: 0.744884


epoch 23:
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68/84 ----> loss: 0.743749


epoch 23:
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78/84 ----> loss: 0.744343


epoch 24:
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4/84 ----> loss: 0.751857


epoch 24:
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14/84 ----> loss: 0.743675


epoch 24:
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24/84 ----> loss: 0.759988


epoch 24:
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34/84 ----> loss: 0.743672


epoch 24:
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44/84 ----> loss: 0.744449


epoch 24:
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54/84 ----> loss: 0.753391


epoch 24:
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64/84 ----> loss: 0.755692


epoch 24:
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74/84 ----> loss: 0.743676


epoch 25:
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0/84 ----> loss: 0.743669


epoch 25:
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10/84 ----> loss: 0.746666


epoch 25:
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20/84 ----> loss: 0.743673


epoch 25:
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--------------------
30/84 ----> loss: 0.744625


epoch 25:
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40/84 ----> loss: 0.743771


epoch 25:
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50/84 ----> loss: 0.748623


epoch 25:
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60/84 ----> loss: 0.747907


epoch 25:
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70/84 ----> loss: 0.743948


epoch 25:
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80/84 ----> loss: 0.747406


epoch 26:
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6/84 ----> loss: 0.743668


epoch 26:
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16/84 ----> loss: 0.743668
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epoch 26:
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26/84 ----> loss: 0.751272


epoch 26:
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36/84 ----> loss: 0.743669


epoch 26:
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46/84 ----> loss: 0.754729


epoch 26:
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56/84 ----> loss: 0.747953


epoch 26:
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66/84 ----> loss: 0.743683


epoch 26:
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76/84 ----> loss: 0.743669


epoch 27:
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2/84 ----> loss: 0.748525


epoch 27:
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--------------------
12/84 ----> loss: 0.743698
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epoch 27:
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22/84 ----> loss: 0.745317


epoch 27:
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32/84 ----> loss: 0.745162


epoch 27:
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42/84 ----> loss: 0.743992


epoch 27:
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52/84 ----> loss: 0.824514


epoch 27:
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62/84 ----> loss: 0.747996


epoch 27:
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72/84 ----> loss: 0.788581


epoch 27:
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82/84 ----> loss: 0.748589


epoch 28:
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8/84 ----> loss: 0.758448
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epoch 28:
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--------------------
18/84 ----> loss: 0.743819


epoch 28:
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28/84 ----> loss: 0.752623


epoch 28:
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38/84 ----> loss: 0.755763


epoch 28:
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--------------------
48/84 ----> loss: 0.743669


epoch 28:
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--------------------
58/84 ----> loss: 0.745053


epoch 28:
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--------------------
68/84 ----> loss: 0.743690


epoch 28:
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78/84 ----> loss: 0.744677


epoch 29:
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--------------------
4/84 ----> loss: 0.747849
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epoch 29:
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14/84 ----> loss: 0.743669


epoch 29:
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24/84 ----> loss: 0.745196


epoch 29:
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34/84 ----> loss: 0.743669


epoch 29:
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44/84 ----> loss: 0.743962


epoch 29:
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--------------------
54/84 ----> loss: 0.746298


epoch 29:
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64/84 ----> loss: 0.753576


epoch 29:
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74/84 ----> loss: 0.743671


epoch 30:
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0/84 ----> loss: 0.743669
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epoch 30:
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10/84 ----> loss: 0.745812


epoch 30:
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20/84 ----> loss: 0.743672


epoch 30:
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30/84 ----> loss: 0.744263


epoch 30:
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40/84 ----> loss: 0.743746


epoch 30:
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50/84 ----> loss: 0.747162


epoch 30:
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60/84 ----> loss: 0.754571


epoch 30:
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70/84 ----> loss: 0.743797


epoch 30:
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--------------------
80/84 ----> loss: 0.744823
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epoch 31:
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6/84 ----> loss: 0.743668


epoch 31:
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--------------------
16/84 ----> loss: 0.743668


epoch 31:
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26/84 ----> loss: 0.748575


epoch 31:
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36/84 ----> loss: 0.743668


epoch 31:
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--------------------
46/84 ----> loss: 0.752297


epoch 31:
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--------------------
56/84 ----> loss: 0.746706


epoch 31:
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--------------------
66/84 ----> loss: 0.743674


epoch 31:
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--------------------
76/84 ----> loss: 0.743668
```

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epoch 32:
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--------------------
2/84 ----> loss: 0.745584


epoch 32:
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--------------------
12/84 ----> loss: 0.743676


epoch 32:
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--------------------
22/84 ----> loss: 0.743821


epoch 32:
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32/84 ----> loss: 0.744746


epoch 32:
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--------------------
42/84 ----> loss: 0.743902


epoch 32:
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--------------------
52/84 ----> loss: 0.788267


epoch 32:
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62/84 ----> loss: 0.748238


epoch 32:
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--------------------
72/84 ----> loss: 0.798503
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epoch 32:
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--------------------
82/84 ----> loss: 0.746308


epoch 33:
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--------------------
8/84 ----> loss: 0.753751


epoch 33:
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--------------------
18/84 ----> loss: 0.743730


epoch 33:
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--------------------
28/84 ----> loss: 0.746500


epoch 33:
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--------------------
38/84 ----> loss: 0.750057


epoch 33:
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--------------------
48/84 ----> loss: 0.743669


epoch 33:
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58/84 ----> loss: 0.744883


epoch 33:
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--------------------
68/84 ----> loss: 0.743678
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epoch 33:
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--------------------
78/84 ----> loss: 0.744860


epoch 34:
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--------------------
4/84 ----> loss: 0.746628


epoch 34:
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14/84 ----> loss: 0.743669


epoch 34:
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--------------------
24/84 ----> loss: 0.744732


epoch 34:
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--------------------
34/84 ----> loss: 0.743669


epoch 34:
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--------------------
44/84 ----> loss: 0.743780


epoch 34:
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--------------------
54/84 ----> loss: 0.745588


epoch 34:
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--------------------
64/84 ----> loss: 0.751267
```

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epoch 34:
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--------------------
74/84 ----> loss: 0.743670


epoch 35:
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--------------------
0/84 ----> loss: 0.743668


epoch 35:
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--------------------
10/84 ----> loss: 0.745568


epoch 35:
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--------------------
20/84 ----> loss: 0.743671


epoch 35:
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--------------------
30/84 ----> loss: 0.744035


epoch 35:
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40/84 ----> loss: 0.743741


epoch 35:
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--------------------
50/84 ----> loss: 0.746209


epoch 35:
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--------------------
60/84 ----> loss: 0.749714
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epoch 35:
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--------------------
70/84 ----> loss: 0.743753


epoch 35:
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--------------------
80/84 ----> loss: 0.744282


epoch 36:
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--------------------
6/84 ----> loss: 0.743668


epoch 36:
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--------------------
16/84 ----> loss: 0.743668


epoch 36:
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--------------------
26/84 ----> loss: 0.747323


epoch 36:
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--------------------
36/84 ----> loss: 0.743668


epoch 36:
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--------------------
46/84 ----> loss: 0.750026


epoch 36:
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--------------------
56/84 ----> loss: 0.745754
```

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epoch 36:
--------------------------------------------------------------------------------
--------------------
66/84 ----> loss: 0.743671


epoch 36:
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--------------------
76/84 ----> loss: 0.743668


epoch 37:
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--------------------
2/84 ----> loss: 0.744839


epoch 37:
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--------------------
12/84 ----> loss: 0.743672


epoch 37:
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--------------------
22/84 ----> loss: 0.743727


epoch 37:
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--------------------
32/84 ----> loss: 0.744316


epoch 37:
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--------------------
42/84 ----> loss: 0.743788


epoch 37:
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--------------------
52/84 ----> loss: 0.767104
```

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epoch 37:
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--------------------
62/84 ----> loss: 0.746909


epoch 37:
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--------------------
72/84 ----> loss: 0.792168


epoch 37:
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--------------------
82/84 ----> loss: 0.745383


epoch 38:
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--------------------
8/84 ----> loss: 0.751281


epoch 38:
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--------------------
18/84 ----> loss: 0.743705


epoch 38:
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--------------------
28/84 ----> loss: 0.744671


epoch 38:
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--------------------
38/84 ----> loss: 0.747960


epoch 38:
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--------------------
48/84 ----> loss: 0.743668
```

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epoch 38:
--------------------------------------------------------------------------------
--------------------
58/84 ----> loss: 0.744640


epoch 38:
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--------------------
68/84 ----> loss: 0.743672


epoch 38:
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--------------------
78/84 ----> loss: 0.745169


epoch 39:
--------------------------------------------------------------------------------
--------------------
4/84 ----> loss: 0.745834


epoch 39:
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--------------------
14/84 ----> loss: 0.743669


epoch 39:
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--------------------
24/84 ----> loss: 0.744406


epoch 39:
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--------------------
34/84 ----> loss: 0.743669


epoch 39:
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--------------------
44/84 ----> loss: 0.743716
```

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epoch 39:
--------------------------------------------------------------------------------
--------------------
54/84 ----> loss: 0.745362


epoch 39:
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--------------------
64/84 ----> loss: 0.748960


epoch 39:
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--------------------
74/84 ----> loss: 0.743669


epoch 40:
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0/84 ----> loss: 0.743668


epoch 40:
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--------------------
10/84 ----> loss: 0.745551


epoch 40:
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--------------------
20/84 ----> loss: 0.743670


epoch 40:
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30/84 ----> loss: 0.743895


epoch 40:
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40/84 ----> loss: 0.743752
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epoch 40:
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--------------------
50/84 ----> loss: 0.745560


epoch 40:
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--------------------
60/84 ----> loss: 0.747504


epoch 40:
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--------------------
70/84 ----> loss: 0.743724


epoch 40:
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--------------------
80/84 ----> loss: 0.744064


epoch 41:
--------------------------------------------------------------------------------
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6/84 ----> loss: 0.743668


epoch 41:
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16/84 ----> loss: 0.743668


epoch 41:
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26/84 ----> loss: 0.746585


epoch 41:
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36/84 ----> loss: 0.743668
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epoch 41:
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46/84 ----> loss: 0.748522


epoch 41:
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56/84 ----> loss: 0.745136


epoch 41:
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66/84 ----> loss: 0.743670


epoch 41:
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76/84 ----> loss: 0.743668


epoch 42:
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2/84 ----> loss: 0.744620


epoch 42:
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12/84 ----> loss: 0.743670


epoch 42:
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22/84 ----> loss: 0.743708


epoch 42:
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32/84 ----> loss: 0.744049
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epoch 42:
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42/84 ----> loss: 0.743735


epoch 42:
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52/84 ----> loss: 0.756139


epoch 42:
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62/84 ----> loss: 0.745466


epoch 42:
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72/84 ----> loss: 0.777715


epoch 42:
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82/84 ----> loss: 0.745010


epoch 43:
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8/84 ----> loss: 0.750036


epoch 43:
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18/84 ----> loss: 0.743699


epoch 43:
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28/84 ----> loss: 0.744134
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epoch 43:
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38/84 ----> loss: 0.746883


epoch 43:
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48/84 ----> loss: 0.743668


epoch 43:
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58/84 ----> loss: 0.744432


epoch 43:
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68/84 ----> loss: 0.743670


epoch 43:
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78/84 ----> loss: 0.745144


epoch 44:
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4/84 ----> loss: 0.745209


epoch 44:
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14/84 ----> loss: 0.743668


epoch 44:
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24/84 ----> loss: 0.744174
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epoch 44:
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34/84 ----> loss: 0.743669


epoch 44:
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44/84 ----> loss: 0.743691


epoch 44:
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54/84 ----> loss: 0.745217


epoch 44:
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64/84 ----> loss: 0.746992


epoch 44:
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74/84 ----> loss: 0.743669


epoch 45:
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0/84 ----> loss: 0.743668


epoch 45:
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10/84 ----> loss: 0.745228


epoch 45:
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20/84 ----> loss: 0.743670
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epoch 45:
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30/84 ----> loss: 0.743813


epoch 45:
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40/84 ----> loss: 0.743764


epoch 45:
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50/84 ----> loss: 0.745167


epoch 45:
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60/84 ----> loss: 0.746318


epoch 45:
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70/84 ----> loss: 0.743703


epoch 45:
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80/84 ----> loss: 0.743959


epoch 46:
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6/84 ----> loss: 0.743668


epoch 46:
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16/84 ----> loss: 0.743668
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epoch 46:
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26/84 ----> loss: 0.745956


epoch 46:
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36/84 ----> loss: 0.743668


epoch 46:
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46/84 ----> loss: 0.747368


epoch 46:
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56/84 ----> loss: 0.744769


epoch 46:
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66/84 ----> loss: 0.743670


epoch 46:
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76/84 ----> loss: 0.743668


epoch 47:
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2/84 ----> loss: 0.744539


epoch 47:
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12/84 ----> loss: 0.743670
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103


epoch 47:
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22/84 ----> loss: 0.743701


epoch 47:
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32/84 ----> loss: 0.743909


epoch 47:
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42/84 ----> loss: 0.743711


epoch 47:
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52/84 ----> loss: 0.752266


epoch 47:
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62/84 ----> loss: 0.744732


epoch 47:
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72/84 ----> loss: 0.767587


epoch 47:
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82/84 ----> loss: 0.744832


epoch 48:
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8/84 ----> loss: 0.748961
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epoch 48:
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18/84 ----> loss: 0.743695


epoch 48:
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28/84 ----> loss: 0.743945


epoch 48:
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38/84 ----> loss: 0.746219


epoch 48:
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48/84 ----> loss: 0.743668


epoch 48:
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58/84 ----> loss: 0.744292


epoch 48:
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68/84 ----> loss: 0.743669


epoch 48:
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78/84 ----> loss: 0.744904


epoch 49:
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4/84 ----> loss: 0.744839
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epoch 49:
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14/84 ----> loss: 0.743668


epoch 49:
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24/84 ----> loss: 0.744057


epoch 49:
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34/84 ----> loss: 0.743669


epoch 49:
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44/84 ----> loss: 0.743681


epoch 49:
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54/84 ----> loss: 0.745079


epoch 49:
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64/84 ----> loss: 0.745971


epoch 49:
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74/84 ----> loss: 0.743669


epoch 50:
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0/84 ----> loss: 0.743668
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epoch 50:
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10/84 ----> loss: 0.744885


epoch 50:
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20/84 ----> loss: 0.743669


epoch 50:
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30/84 ----> loss: 0.743769


epoch 50:
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40/84 ----> loss: 0.743771


epoch 50:
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50/84 ----> loss: 0.744903


epoch 50:
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60/84 ----> loss: 0.745615


epoch 50:
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70/84 ----> loss: 0.743692


epoch 50:
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80/84 ----> loss: 0.743892
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epoch 51:
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6/84 ----> loss: 0.743668


epoch 51:
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16/84 ----> loss: 0.743668


epoch 51:
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26/84 ----> loss: 0.745495


epoch 51:
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36/84 ----> loss: 0.743668


epoch 51:
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46/84 ----> loss: 0.746572


epoch 51:
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56/84 ----> loss: 0.744534


epoch 51:
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66/84 ----> loss: 0.743669


epoch 51:
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76/84 ----> loss: 0.743668
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epoch 52:
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2/84 ----> loss: 0.744458


epoch 52:
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12/84 ----> loss: 0.743670


epoch 52:
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22/84 ----> loss: 0.743697


epoch 52:
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32/84 ----> loss: 0.743836


epoch 52:
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42/84 ----> loss: 0.743698


epoch 52:
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52/84 ----> loss: 0.750607


epoch 52:
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62/84 ----> loss: 0.744385


epoch 52:
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72/84 ----> loss: 0.761799
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epoch 52:
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82/84 ----> loss: 0.744711


epoch 53:
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8/84 ----> loss: 0.748038


epoch 53:
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18/84 ----> loss: 0.743692


epoch 53:
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28/84 ----> loss: 0.743857


epoch 53:
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38/84 ----> loss: 0.745762


epoch 53:
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48/84 ----> loss: 0.743668


epoch 53:
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58/84 ----> loss: 0.744201


epoch 53:
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68/84 ----> loss: 0.743669
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epoch 53:
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78/84 ----> loss: 0.744676


epoch 54:
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4/84 ----> loss: 0.744617


epoch 54:
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14/84 ----> loss: 0.743668


epoch 54:
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24/84 ----> loss: 0.743993


epoch 54:
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34/84 ----> loss: 0.743669


epoch 54:
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44/84 ----> loss: 0.743676


epoch 54:
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54/84 ----> loss: 0.744951


epoch 54:
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64/84 ----> loss: 0.745431
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epoch 54:
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74/84 ----> loss: 0.743669


epoch 55:
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0/84 ----> loss: 0.743668


epoch 55:
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10/84 ----> loss: 0.744634


epoch 55:
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20/84 ----> loss: 0.743669


epoch 55:
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30/84 ----> loss: 0.743743


epoch 55:
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40/84 ----> loss: 0.743774


epoch 55:
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50/84 ----> loss: 0.744714


epoch 55:
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60/84 ----> loss: 0.745184
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epoch 55:
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70/84 ----> loss: 0.743685


epoch 55:
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80/84 ----> loss: 0.743845


epoch 56:
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6/84 ----> loss: 0.743668


epoch 56:
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16/84 ----> loss: 0.743668


epoch 56:
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26/84 ----> loss: 0.745178


epoch 56:
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36/84 ----> loss: 0.743668


epoch 56:
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46/84 ----> loss: 0.746038


epoch 56:
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56/84 ----> loss: 0.744376
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epoch 56:
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66/84 ----> loss: 0.743669


epoch 56:
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76/84 ----> loss: 0.743668


epoch 57:
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2/84 ----> loss: 0.744377


epoch 57:
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12/84 ----> loss: 0.743669


epoch 57:
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22/84 ----> loss: 0.743693


epoch 57:
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32/84 ----> loss: 0.743795


epoch 57:
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42/84 ----> loss: 0.743691


epoch 57:
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52/84 ----> loss: 0.749651
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epoch 57:
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62/84 ----> loss: 0.744193


epoch 57:
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72/84 ----> loss: 0.758177


epoch 57:
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82/84 ----> loss: 0.744608


epoch 58:
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8/84 ----> loss: 0.747328


epoch 58:
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18/84 ----> loss: 0.743688


epoch 58:
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28/84 ----> loss: 0.743807


epoch 58:
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38/84 ----> loss: 0.745426


epoch 58:
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48/84 ----> loss: 0.743668


epoch 58:
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58/84 ----> loss: 0.744137


epoch 58:
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68/84 ----> loss: 0.743669


epoch 58:
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78/84 ----> loss: 0.744504


epoch 59:
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4/84 ----> loss: 0.744468


epoch 59:
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14/84 ----> loss: 0.743668


epoch 59:
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24/84 ----> loss: 0.743954


epoch 59:
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34/84 ----> loss: 0.743668


epoch 59:
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44/84 ----> loss: 0.743674


epoch 59:
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54/84 ----> loss: 0.744838


epoch 59:
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64/84 ----> loss: 0.745103


epoch 59:
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74/84 ----> loss: 0.743669


epoch 60:
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0/84 ----> loss: 0.743668


epoch 60:
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10/84 ----> loss: 0.744457


epoch 60:
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20/84 ----> loss: 0.743669


epoch 60:
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30/84 ----> loss: 0.743726


epoch 60:
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40/84 ----> loss: 0.743774


epoch 60:
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50/84 ----> loss: 0.744572


epoch 60:
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60/84 ----> loss: 0.744900


epoch 60:
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70/84 ----> loss: 0.743680


epoch 60:
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80/84 ----> loss: 0.743811


epoch 61:
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6/84 ----> loss: 0.743668


epoch 61:
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16/84 ----> loss: 0.743668


epoch 61:
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26/84 ----> loss: 0.744952


epoch 61:
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36/84 ----> loss: 0.743668


epoch 61:
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46/84 ----> loss: 0.745663


epoch 61:
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56/84 ----> loss: 0.744262


epoch 61:
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66/84 ----> loss: 0.743669


epoch 61:
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76/84 ----> loss: 0.743668


epoch 62:
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2/84 ----> loss: 0.744304


epoch 62:
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12/84 ----> loss: 0.743669


epoch 62:
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22/84 ----> loss: 0.743690


epoch 62:
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32/84 ----> loss: 0.743768


epoch 62:
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42/84 ----> loss: 0.743686


epoch 62:
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52/84 ----> loss: 0.748991


epoch 62:
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62/84 ----> loss: 0.744072


epoch 62:
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72/84 ----> loss: 0.755704


epoch 62:
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82/84 ----> loss: 0.744516


epoch 63:
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8/84 ----> loss: 0.746792


epoch 63:
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18/84 ----> loss: 0.743686


epoch 63:
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28/84 ----> loss: 0.743775


epoch 63:
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38/84 ----> loss: 0.745171


epoch 63:
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48/84 ----> loss: 0.743668


epoch 63:
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58/84 ----> loss: 0.744089


epoch 63:
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68/84 ----> loss: 0.743669


epoch 63:
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78/84 ----> loss: 0.744376


epoch 64:
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4/84 ----> loss: 0.744360


epoch 64:
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14/84 ----> loss: 0.743668


epoch 64:
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24/84 ----> loss: 0.743926


epoch 64:
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34/84 ----> loss: 0.743668


epoch 64:
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44/84 ----> loss: 0.743672


epoch 64:
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54/84 ----> loss: 0.744740


epoch 64:
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64/84 ----> loss: 0.744883


epoch 64:
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74/84 ----> loss: 0.743669


epoch 65:
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0/84 ----> loss: 0.743668


epoch 65:
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10/84 ----> loss: 0.744328


epoch 65:
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20/84 ----> loss: 0.743669


epoch 65:
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30/84 ----> loss: 0.743715


epoch 65:
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40/84 ----> loss: 0.743773


epoch 65:
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50/84 ----> loss: 0.744463


epoch 65:
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60/84 ----> loss: 0.744701


epoch 65:
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70/84 ----> loss: 0.743677


epoch 65:
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80/84 ----> loss: 0.743785


epoch 66:
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6/84 ----> loss: 0.743668


epoch 66:
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16/84 ----> loss: 0.743668


epoch 66:
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26/84 ----> loss: 0.744784


epoch 66:
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36/84 ----> loss: 0.743668


epoch 66:
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46/84 ----> loss: 0.745388


epoch 66:
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56/84 ----> loss: 0.744177


epoch 66:
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66/84 ----> loss: 0.743669


epoch 66:
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76/84 ----> loss: 0.743668


epoch 67:
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2/84 ----> loss: 0.744240


epoch 67:
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12/84 ----> loss: 0.743669


epoch 67:
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22/84 ----> loss: 0.743688


epoch 67:
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32/84 ----> loss: 0.743749


epoch 67:
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42/84 ----> loss: 0.743683


epoch 67:
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52/84 ----> loss: 0.748488


epoch 67:
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62/84 ----> loss: 0.743991


epoch 67:
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72/84 ----> loss: 0.753913


epoch 67:
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82/84 ----> loss: 0.744434


epoch 68:
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8/84 ----> loss: 0.746380


epoch 68:
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18/84 ----> loss: 0.743683


epoch 68:
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28/84 ----> loss: 0.743753


epoch 68:
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38/84 ----> loss: 0.744972


epoch 68:
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48/84 ----> loss: 0.743668


epoch 68:
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58/84 ----> loss: 0.744051


epoch 68:
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68/84 ----> loss: 0.743669


epoch 68:
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78/84 ----> loss: 0.744279


epoch 69:
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4/84 ----> loss: 0.744277


epoch 69:
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14/84 ----> loss: 0.743668


epoch 69:
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24/84 ----> loss: 0.743904


epoch 69:
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34/84 ----> loss: 0.743668


epoch 69:
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44/84 ----> loss: 0.743671


epoch 69:
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54/84 ----> loss: 0.744655


epoch 69:
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64/84 ----> loss: 0.744724


epoch 69:
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74/84 ----> loss: 0.743669


epoch 70:
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0/84 ----> loss: 0.743668


epoch 70:
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10/84 ----> loss: 0.744231


epoch 70:
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20/84 ----> loss: 0.743669


epoch 70:
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30/84 ----> loss: 0.743707


epoch 70:
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40/84 ----> loss: 0.743771


epoch 70:
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50/84 ----> loss: 0.744377


epoch 70:
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60/84 ----> loss: 0.744555


epoch 70:
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70/84 ----> loss: 0.743675


epoch 70:
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80/84 ----> loss: 0.743766


epoch 71:
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6/84 ----> loss: 0.743668


epoch 71:
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16/84 ----> loss: 0.743668


epoch 71:
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26/84 ----> loss: 0.744654


epoch 71:
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36/84 ----> loss: 0.743668


epoch 71:
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46/84 ----> loss: 0.745179


epoch 71:
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56/84 ----> loss: 0.744112


epoch 71:
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66/84 ----> loss: 0.743669


epoch 71:
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76/84 ----> loss: 0.743668


epoch 72:
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2/84 ----> loss: 0.744185


epoch 72:
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12/84 ----> loss: 0.743669


epoch 72:
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22/84 ----> loss: 0.743686


epoch 72:
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32/84 ----> loss: 0.743736


epoch 72:
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42/84 ----> loss: 0.743680


epoch 72:
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52/84 ----> loss: 0.748081


epoch 72:
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62/84 ----> loss: 0.743933


epoch 72:
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72/84 ----> loss: 0.752560


epoch 72:
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82/84 ----> loss: 0.744363


epoch 73:
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8/84 ----> loss: 0.746056


epoch 73:
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18/84 ----> loss: 0.743681


epoch 73:
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28/84 ----> loss: 0.743738


epoch 73:
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38/84 ----> loss: 0.744814


epoch 73:
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48/84 ----> loss: 0.743668


epoch 73:
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58/84 ----> loss: 0.744019


epoch 73:
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68/84 ----> loss: 0.743669


epoch 73:
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78/84 ----> loss: 0.744203


epoch 74:
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4/84 ----> loss: 0.744211


epoch 74:
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14/84 ----> loss: 0.743668


epoch 74:
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24/84 ----> loss: 0.743887


epoch 74:
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34/84 ----> loss: 0.743668


epoch 74:
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44/84 ----> loss: 0.743670


epoch 74:
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54/84 ----> loss: 0.744580


epoch 74:
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64/84 ----> loss: 0.744603


epoch 74:
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74/84 ----> loss: 0.743668


epoch 75:
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0/84 ----> loss: 0.743668


epoch 75:
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10/84 ----> loss: 0.744156


epoch 75:
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20/84 ----> loss: 0.743669


epoch 75:
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30/84 ----> loss: 0.743701


epoch 75:
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40/84 ----> loss: 0.743768


epoch 75:
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50/84 ----> loss: 0.744307


epoch 75:
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60/84 ----> loss: 0.744444


epoch 75:
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70/84 ----> loss: 0.743674


epoch 75:
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80/84 ----> loss: 0.743751


epoch 76:
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6/84 ----> loss: 0.743668


epoch 76:
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16/84 ----> loss: 0.743668


epoch 76:
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26/84 ----> loss: 0.744550


epoch 76:
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36/84 ----> loss: 0.743668


epoch 76:
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46/84 ----> loss: 0.745013


epoch 76:
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56/84 ----> loss: 0.744060


epoch 76:
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66/84 ----> loss: 0.743669


epoch 76:
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76/84 ----> loss: 0.743668


epoch 77:
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2/84 ----> loss: 0.744137


epoch 77:
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12/84 ----> loss: 0.743669


epoch 77:
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22/84 ----> loss: 0.743684


epoch 77:
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32/84 ----> loss: 0.743726


epoch 77:
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42/84 ----> loss: 0.743678


epoch 77:
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52/84 ----> loss: 0.747741


epoch 77:
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62/84 ----> loss: 0.743890


epoch 77:
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72/84 ----> loss: 0.751503


epoch 77:
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82/84 ----> loss: 0.744301


epoch 78:
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8/84 ----> loss: 0.745797


epoch 78:
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18/84 ----> loss: 0.743680


epoch 78:
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28/84 ----> loss: 0.743727


epoch 78:
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38/84 ----> loss: 0.744685


epoch 78:
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48/84 ----> loss: 0.743668


epoch 78:
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58/84 ----> loss: 0.743992


epoch 78:
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68/84 ----> loss: 0.743669


epoch 78:
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78/84 ----> loss: 0.744143


epoch 79:
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4/84 ----> loss: 0.744158


epoch 79:
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14/84 ----> loss: 0.743668


epoch 79:
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24/84 ----> loss: 0.743872


epoch 79:
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34/84 ----> loss: 0.743668


epoch 79:
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44/84 ----> loss: 0.743670


epoch 79:
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54/84 ----> loss: 0.744515


epoch 79:
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64/84 ----> loss: 0.744508


epoch 79:
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74/84 ----> loss: 0.743668


epoch 80:
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0/84 ----> loss: 0.743668


epoch 80:
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10/84 ----> loss: 0.744097


epoch 80:
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20/84 ----> loss: 0.743669


epoch 80:
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30/84 ----> loss: 0.743696
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epoch 80:
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40/84 ----> loss: 0.743765


epoch 80:
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50/84 ----> loss: 0.744248


epoch 80:
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60/84 ----> loss: 0.744357


epoch 80:
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70/84 ----> loss: 0.743673


epoch 80:
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80/84 ----> loss: 0.743740


epoch 81:
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6/84 ----> loss: 0.743668


epoch 81:
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16/84 ----> loss: 0.743668


epoch 81:
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26/84 ----> loss: 0.744465
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epoch 81:
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36/84 ----> loss: 0.743668


epoch 81:
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46/84 ----> loss: 0.744880


epoch 81:
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56/84 ----> loss: 0.744018


epoch 81:
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66/84 ----> loss: 0.743669


epoch 81:
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76/84 ----> loss: 0.743668


epoch 82:
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2/84 ----> loss: 0.744096


epoch 82:
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12/84 ----> loss: 0.743669


epoch 82:
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22/84 ----> loss: 0.743682
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epoch 82:
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32/84 ----> loss: 0.743718


epoch 82:
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42/84 ----> loss: 0.743677


epoch 82:
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52/84 ----> loss: 0.747451


epoch 82:
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62/84 ----> loss: 0.743857


epoch 82:
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72/84 ----> loss: 0.750657


epoch 82:
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82/84 ----> loss: 0.744247


epoch 83:
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8/84 ----> loss: 0.745586


epoch 83:
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18/84 ----> loss: 0.743678
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epoch 83:
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28/84 ----> loss: 0.743718


epoch 83:
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38/84 ----> loss: 0.744579


epoch 83:
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48/84 ----> loss: 0.743668


epoch 83:
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58/84 ----> loss: 0.743969


epoch 83:
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68/84 ----> loss: 0.743669


epoch 83:
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78/84 ----> loss: 0.744094


epoch 84:
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4/84 ----> loss: 0.744113


epoch 84:
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14/84 ----> loss: 0.743668
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epoch 84:
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24/84 ----> loss: 0.743860


epoch 84:
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34/84 ----> loss: 0.743668


epoch 84:
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44/84 ----> loss: 0.743670


epoch 84:
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54/84 ----> loss: 0.744458


epoch 84:
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64/84 ----> loss: 0.744431


epoch 84:
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74/84 ----> loss: 0.743668


epoch 85:
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0/84 ----> loss: 0.743668


epoch 85:
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10/84 ----> loss: 0.744049
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epoch 85:
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20/84 ----> loss: 0.743669


epoch 85:
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30/84 ----> loss: 0.743692


epoch 85:
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40/84 ----> loss: 0.743762


epoch 85:
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50/84 ----> loss: 0.744200


epoch 85:
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60/84 ----> loss: 0.744287


epoch 85:
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70/84 ----> loss: 0.743672


epoch 85:
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80/84 ----> loss: 0.743731


epoch 86:
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6/84 ----> loss: 0.743668
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epoch 86:
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16/84 ----> loss: 0.743668


epoch 86:
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26/84 ----> loss: 0.744395


epoch 86:
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36/84 ----> loss: 0.743668


epoch 86:
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46/84 ----> loss: 0.744770


epoch 86:
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56/84 ----> loss: 0.743983


epoch 86:
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66/84 ----> loss: 0.743669


epoch 86:
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76/84 ----> loss: 0.743668


epoch 87:
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2/84 ----> loss: 0.744060
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epoch 87:
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12/84 ----> loss: 0.743669


epoch 87:
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22/84 ----> loss: 0.743681


epoch 87:
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32/84 ----> loss: 0.743712


epoch 87:
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42/84 ----> loss: 0.743676


epoch 87:
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52/84 ----> loss: 0.747198


epoch 87:
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62/84 ----> loss: 0.743831


epoch 87:
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72/84 ----> loss: 0.749965


epoch 87:
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82/84 ----> loss: 0.744200
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epoch 88:
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8/84 ----> loss: 0.745410


epoch 88:
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18/84 ----> loss: 0.743677


epoch 88:
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28/84 ----> loss: 0.743711


epoch 88:
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38/84 ----> loss: 0.744490


epoch 88:
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48/84 ----> loss: 0.743668


epoch 88:
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58/84 ----> loss: 0.743948


epoch 88:
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68/84 ----> loss: 0.743669


epoch 88:
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78/84 ----> loss: 0.744054
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epoch 89:
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4/84 ----> loss: 0.744075


epoch 89:
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14/84 ----> loss: 0.743668


epoch 89:
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24/84 ----> loss: 0.743849


epoch 89:
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34/84 ----> loss: 0.743668


epoch 89:
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44/84 ----> loss: 0.743669


epoch 89:
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54/84 ----> loss: 0.744408


epoch 89:
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64/84 ----> loss: 0.744367


epoch 89:
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74/84 ----> loss: 0.743668
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epoch 90:
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0/84 ----> loss: 0.743668


epoch 90:
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10/84 ----> loss: 0.744009


epoch 90:
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20/84 ----> loss: 0.743669


epoch 90:
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30/84 ----> loss: 0.743689


epoch 90:
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40/84 ----> loss: 0.743759


epoch 90:
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50/84 ----> loss: 0.744158


epoch 90:
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60/84 ----> loss: 0.744229


epoch 90:
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70/84 ----> loss: 0.743671
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epoch 90:
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80/84 ----> loss: 0.743723


epoch 91:
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6/84 ----> loss: 0.743668


epoch 91:
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16/84 ----> loss: 0.743668


epoch 91:
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26/84 ----> loss: 0.744335


epoch 91:
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36/84 ----> loss: 0.743668


epoch 91:
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46/84 ----> loss: 0.744678


epoch 91:
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56/84 ----> loss: 0.743953


epoch 91:
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66/84 ----> loss: 0.743669
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epoch 91:
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76/84 ----> loss: 0.743668


epoch 92:
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2/84 ----> loss: 0.744028


epoch 92:
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12/84 ----> loss: 0.743669


epoch 92:
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22/84 ----> loss: 0.743679


epoch 92:
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32/84 ----> loss: 0.743707


epoch 92:
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42/84 ----> loss: 0.743675


epoch 92:
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52/84 ----> loss: 0.746977


epoch 92:
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62/84 ----> loss: 0.743810
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epoch 92:
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72/84 ----> loss: 0.749391


epoch 92:
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82/84 ----> loss: 0.744159


epoch 93:
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8/84 ----> loss: 0.745262


epoch 93:
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18/84 ----> loss: 0.743676


epoch 93:
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28/84 ----> loss: 0.743706


epoch 93:
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38/84 ----> loss: 0.744415


epoch 93:
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48/84 ----> loss: 0.743668


epoch 93:
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58/84 ----> loss: 0.743930
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epoch 93:
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68/84 ----> loss: 0.743668


epoch 93:
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78/84 ----> loss: 0.744020


epoch 94:
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4/84 ----> loss: 0.744043


epoch 94:
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14/84 ----> loss: 0.743668


epoch 94:
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24/84 ----> loss: 0.743839


epoch 94:
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34/84 ----> loss: 0.743668


epoch 94:
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44/84 ----> loss: 0.743669


epoch 94:
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54/84 ----> loss: 0.744362
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epoch 94:
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64/84 ----> loss: 0.744313


epoch 94:
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74/84 ----> loss: 0.743668


epoch 95:
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0/84 ----> loss: 0.743668


epoch 95:
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10/84 ----> loss: 0.743976


epoch 95:
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20/84 ----> loss: 0.743669


epoch 95:
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30/84 ----> loss: 0.743687


epoch 95:
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40/84 ----> loss: 0.743756


epoch 95:
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50/84 ----> loss: 0.744122
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epoch 95:
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60/84 ----> loss: 0.744181


epoch 95:
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70/84 ----> loss: 0.743671


epoch 95:
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80/84 ----> loss: 0.743717


epoch 96:
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6/84 ----> loss: 0.743668


epoch 96:
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16/84 ----> loss: 0.743668


epoch 96:
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26/84 ----> loss: 0.744284


epoch 96:
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36/84 ----> loss: 0.743668


epoch 96:
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46/84 ----> loss: 0.744600
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epoch 96:
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56/84 ----> loss: 0.743928


epoch 96:
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66/84 ----> loss: 0.743669


epoch 96:
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76/84 ----> loss: 0.743668


epoch 97:
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2/84 ----> loss: 0.744001


epoch 97:
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12/84 ----> loss: 0.743669


epoch 97:
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22/84 ----> loss: 0.743678


epoch 97:
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32/84 ----> loss: 0.743703


epoch 97:
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42/84 ----> loss: 0.743674
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epoch 97:
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52/84 ----> loss: 0.746780


epoch 97:
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62/84 ----> loss: 0.743793


epoch 97:
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72/84 ----> loss: 0.748906


epoch 97:
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82/84 ----> loss: 0.744122


epoch 98:
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8/84 ----> loss: 0.745136


epoch 98:
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18/84 ----> loss: 0.743675


epoch 98:
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28/84 ----> loss: 0.743701


epoch 98:
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38/84 ----> loss: 0.744351
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epoch 98:
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48/84 ----> loss: 0.743668


epoch 98:
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58/84 ----> loss: 0.743914


epoch 98:
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68/84 ----> loss: 0.743668


epoch 98:
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78/84 ----> loss: 0.743991


epoch 99:
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4/84 ----> loss: 0.744016


epoch 99:
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14/84 ----> loss: 0.743668


epoch 99:
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24/84 ----> loss: 0.743830


epoch 99:
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34/84 ----> loss: 0.743668
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epoch 99:
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44/84 ----> loss: 0.743669


epoch 99:
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54/84 ----> loss: 0.744322


epoch 99:
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64/84 ----> loss: 0.744267


epoch 99:
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74/84 ----> loss: 0.743668


epoch 100:
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0/84 ----> loss: 0.743668


epoch 100:
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10/84 ----> loss: 0.743948


epoch 100:
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20/84 ----> loss: 0.743669


epoch 100:
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30/84 ----> loss: 0.743685
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epoch 100:
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40/84 ----> loss: 0.743753


epoch 100:
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50/84 ----> loss: 0.744090


epoch 100:
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60/84 ----> loss: 0.744141


epoch 100:
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70/84 ----> loss: 0.743670


epoch 100:
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80/84 ----> loss: 0.743711


epoch 101:
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6/84 ----> loss: 0.743668


epoch 101:
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16/84 ----> loss: 0.743668


epoch 101:
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26/84 ----> loss: 0.744240
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epoch 101:
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36/84 ----> loss: 0.743668


epoch 101:
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46/84 ----> loss: 0.744532


epoch 101:
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56/84 ----> loss: 0.743907


epoch 101:
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66/84 ----> loss: 0.743669


epoch 101:
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76/84 ----> loss: 0.743668


epoch 102:
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2/84 ----> loss: 0.743977


epoch 102:
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12/84 ----> loss: 0.743669


epoch 102:
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22/84 ----> loss: 0.743677
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epoch 102:
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32/84 ----> loss: 0.743699


epoch 102:
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42/84 ----> loss: 0.743673


epoch 102:
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52/84 ----> loss: 0.746605


epoch 102:
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62/84 ----> loss: 0.743779


epoch 102:
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72/84 ----> loss: 0.748492


epoch 102:
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82/84 ----> loss: 0.744091


epoch 103:
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8/84 ----> loss: 0.745028


epoch 103:
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18/84 ----> loss: 0.743675
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epoch 103:
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28/84 ----> loss: 0.743698


epoch 103:
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38/84 ----> loss: 0.744296


epoch 103:
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48/84 ----> loss: 0.743668


epoch 103:
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58/84 ----> loss: 0.743899


epoch 103:
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68/84 ----> loss: 0.743668


epoch 103:
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78/84 ----> loss: 0.743966


epoch 104:
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4/84 ----> loss: 0.743991


epoch 104:
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14/84 ----> loss: 0.743668
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epoch 104:
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24/84 ----> loss: 0.743822


epoch 104:
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34/84 ----> loss: 0.743668


epoch 104:
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44/84 ----> loss: 0.743669


epoch 104:
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54/84 ----> loss: 0.744286


epoch 104:
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64/84 ----> loss: 0.744226


epoch 104:
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74/84 ----> loss: 0.743668


epoch 105:
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0/84 ----> loss: 0.743668


epoch 105:
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10/84 ----> loss: 0.743924
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epoch 105:
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20/84 ----> loss: 0.743669


epoch 105:
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30/84 ----> loss: 0.743683


epoch 105:
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40/84 ----> loss: 0.743750


epoch 105:
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50/84 ----> loss: 0.744063


epoch 105:
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60/84 ----> loss: 0.744106


epoch 105:
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70/84 ----> loss: 0.743670


epoch 105:
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80/84 ----> loss: 0.743707


epoch 106:
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6/84 ----> loss: 0.743668


epoch 106:
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16/84 ----> loss: 0.743668


epoch 106:
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26/84 ----> loss: 0.744202


epoch 106:
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36/84 ----> loss: 0.743668


epoch 106:
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46/84 ----> loss: 0.744474


epoch 106:
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56/84 ----> loss: 0.743888


epoch 106:
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66/84 ----> loss: 0.743669


epoch 106:
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76/84 ----> loss: 0.743668


epoch 107:
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2/84 ----> loss: 0.743955


epoch 107:
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12/84 ----> loss: 0.743669


epoch 107:
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22/84 ----> loss: 0.743677


epoch 107:
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32/84 ----> loss: 0.743696


epoch 107:
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42/84 ----> loss: 0.743673


epoch 107:
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52/84 ----> loss: 0.746447


epoch 107:
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62/84 ----> loss: 0.743768


epoch 107:
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72/84 ----> loss: 0.748135


epoch 107:
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82/84 ----> loss: 0.744062


epoch 108:
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8/84 ----> loss: 0.744933


epoch 108:
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18/84 ----> loss: 0.743674


epoch 108:
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28/84 ----> loss: 0.743695


epoch 108:
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38/84 ----> loss: 0.744248


epoch 108:
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48/84 ----> loss: 0.743668


epoch 108:
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58/84 ----> loss: 0.743886


epoch 108:
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68/84 ----> loss: 0.743668


epoch 108:
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78/84 ----> loss: 0.743945


epoch 109:
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4/84 ----> loss: 0.743970


epoch 109:
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14/84 ----> loss: 0.743668


epoch 109:
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24/84 ----> loss: 0.743814


epoch 109:
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34/84 ----> loss: 0.743668


epoch 109:
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44/84 ----> loss: 0.743669


epoch 109:
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54/84 ----> loss: 0.744253


epoch 109:
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64/84 ----> loss: 0.744191


epoch 109:
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74/84 ----> loss: 0.743668


epoch 110:
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0/84 ----> loss: 0.743668


epoch 110:
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10/84 ----> loss: 0.743904


epoch 110:
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20/84 ----> loss: 0.743669


epoch 110:
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30/84 ----> loss: 0.743682


epoch 110:
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40/84 ----> loss: 0.743747


epoch 110:
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50/84 ----> loss: 0.744038


epoch 110:
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60/84 ----> loss: 0.744075


epoch 110:
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70/84 ----> loss: 0.743670


epoch 110:
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80/84 ----> loss: 0.743703


epoch 111:
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6/84 ----> loss: 0.743668


epoch 111:
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16/84 ----> loss: 0.743668


epoch 111:
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26/84 ----> loss: 0.744168


epoch 111:
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36/84 ----> loss: 0.743668


epoch 111:
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46/84 ----> loss: 0.744422


epoch 111:
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56/84 ----> loss: 0.743872


epoch 111:
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66/84 ----> loss: 0.743669


epoch 111:
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76/84 ----> loss: 0.743668


epoch 112:
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2/84 ----> loss: 0.743936


epoch 112:
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12/84 ----> loss: 0.743669


epoch 112:
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22/84 ----> loss: 0.743676


epoch 112:
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32/84 ----> loss: 0.743694


epoch 112:
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42/84 ----> loss: 0.743672


epoch 112:
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52/84 ----> loss: 0.746305


epoch 112:
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62/84 ----> loss: 0.743758


epoch 112:
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72/84 ----> loss: 0.747824


epoch 112:
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82/84 ----> loss: 0.744037


epoch 113:
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8/84 ----> loss: 0.744850


epoch 113:
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18/84 ----> loss: 0.743674


epoch 113:
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28/84 ----> loss: 0.743692


epoch 113:
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38/84 ----> loss: 0.744206


epoch 113:
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48/84 ----> loss: 0.743668


epoch 113:
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58/84 ----> loss: 0.743874


epoch 113:
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68/84 ----> loss: 0.743668


epoch 113:
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78/84 ----> loss: 0.743926


epoch 114:
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4/84 ----> loss: 0.743951


epoch 114:
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14/84 ----> loss: 0.743668


epoch 114:
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24/84 ----> loss: 0.743807


epoch 114:
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34/84 ----> loss: 0.743668


epoch 114:
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44/84 ----> loss: 0.743669


epoch 114:
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54/84 ----> loss: 0.744223


epoch 114:
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64/84 ----> loss: 0.744160


epoch 114:
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74/84 ----> loss: 0.743668


epoch 115:
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0/84 ----> loss: 0.743668


epoch 115:
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10/84 ----> loss: 0.743886


epoch 115:
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20/84 ----> loss: 0.743669


epoch 115:
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30/84 ----> loss: 0.743681


epoch 115:
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40/84 ----> loss: 0.743744


epoch 115:
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50/84 ----> loss: 0.744017


epoch 115:
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60/84 ----> loss: 0.744049


epoch 115:
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70/84 ----> loss: 0.743670


epoch 115:
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80/84 ----> loss: 0.743700


epoch 116:
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6/84 ----> loss: 0.743668


epoch 116:
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16/84 ----> loss: 0.743668


epoch 116:
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26/84 ----> loss: 0.744138


epoch 116:
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36/84 ----> loss: 0.743668


epoch 116:
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46/84 ----> loss: 0.744377


epoch 116:
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56/84 ----> loss: 0.743858


epoch 116:
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66/84 ----> loss: 0.743669


epoch 116:
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76/84 ----> loss: 0.743668


epoch 117:
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2/84 ----> loss: 0.743919


epoch 117:
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12/84 ----> loss: 0.743669


epoch 117:
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22/84 ----> loss: 0.743675


epoch 117:
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32/84 ----> loss: 0.743692


epoch 117:
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42/84 ----> loss: 0.743672


epoch 117:
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52/84 ----> loss: 0.746175


epoch 117:
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62/84 ----> loss: 0.743750


epoch 117:
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72/84 ----> loss: 0.747551


epoch 117:
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82/84 ----> loss: 0.744015


epoch 118:
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8/84 ----> loss: 0.744777


epoch 118:
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18/84 ----> loss: 0.743673


epoch 118:
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28/84 ----> loss: 0.743690


epoch 118:
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38/84 ----> loss: 0.744169


epoch 118:
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48/84 ----> loss: 0.743668


epoch 118:
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58/84 ----> loss: 0.743864


epoch 118:
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68/84 ----> loss: 0.743668


epoch 118:
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78/84 ----> loss: 0.743910


epoch 119:
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4/84 ----> loss: 0.743934


epoch 119:
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14/84 ----> loss: 0.743668


epoch 119:
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24/84 ----> loss: 0.743801


epoch 119:
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34/84 ----> loss: 0.743668


epoch 119:
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44/84 ----> loss: 0.743669


epoch 119:
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54/84 ----> loss: 0.744196


epoch 119:
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64/84 ----> loss: 0.744132


epoch 119:
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74/84 ----> loss: 0.743668


epoch 120:
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0/84 ----> loss: 0.743668


epoch 120:
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10/84 ----> loss: 0.743870


epoch 120:
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20/84 ----> loss: 0.743669


epoch 120:
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30/84 ----> loss: 0.743680


epoch 120:
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40/84 ----> loss: 0.743742


epoch 120:
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50/84 ----> loss: 0.743997


epoch 120:
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60/84 ----> loss: 0.744025


epoch 120:
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70/84 ----> loss: 0.743669


epoch 120:
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80/84 ----> loss: 0.743697


epoch 121:
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6/84 ----> loss: 0.743668


epoch 121:
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16/84 ----> loss: 0.743668


epoch 121:
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26/84 ----> loss: 0.744111


epoch 121:
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36/84 ----> loss: 0.743668


epoch 121:
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46/84 ----> loss: 0.744336


epoch 121:
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56/84 ----> loss: 0.743845


epoch 121:
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66/84 ----> loss: 0.743669


epoch 121:
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76/84 ----> loss: 0.743668


epoch 122:
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2/84 ----> loss: 0.743904


epoch 122:
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12/84 ----> loss: 0.743669


epoch 122:
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22/84 ----> loss: 0.743675


epoch 122:
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32/84 ----> loss: 0.743690


epoch 122:
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42/84 ----> loss: 0.743672


epoch 122:
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52/84 ----> loss: 0.746057


epoch 122:
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62/84 ----> loss: 0.743742


epoch 122:
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72/84 ----> loss: 0.747309


epoch 122:
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82/84 ----> loss: 0.743994


epoch 123:
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8/84 ----> loss: 0.744712


epoch 123:
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18/84 ----> loss: 0.743673


epoch 123:
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28/84 ----> loss: 0.743688


epoch 123:
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38/84 ----> loss: 0.744136


epoch 123:
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48/84 ----> loss: 0.743668


epoch 123:
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58/84 ----> loss: 0.743854


epoch 123:
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68/84 ----> loss: 0.743668


epoch 123:
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78/84 ----> loss: 0.743895


epoch 124:
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4/84 ----> loss: 0.743919


epoch 124:
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14/84 ----> loss: 0.743668


epoch 124:
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24/84 ----> loss: 0.743795


epoch 124:
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34/84 ----> loss: 0.743668


epoch 124:
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44/84 ----> loss: 0.743669


epoch 124:
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54/84 ----> loss: 0.744171


epoch 124:
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64/84 ----> loss: 0.744107


epoch 124:
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74/84 ----> loss: 0.743668


epoch 125:
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0/84 ----> loss: 0.743668


epoch 125:
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10/84 ----> loss: 0.743856


epoch 125:
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20/84 ----> loss: 0.743669


epoch 125:
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30/84 ----> loss: 0.743679


epoch 125:
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40/84 ----> loss: 0.743739


epoch 125:
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50/84 ----> loss: 0.743980


epoch 125:
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60/84 ----> loss: 0.744005


epoch 125:
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70/84 ----> loss: 0.743669


epoch 125:
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80/84 ----> loss: 0.743695


epoch 126:
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6/84 ----> loss: 0.743668


epoch 126:
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16/84 ----> loss: 0.743668


epoch 126:
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26/84 ----> loss: 0.744086


epoch 126:
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36/84 ----> loss: 0.743668


epoch 126:
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46/84 ----> loss: 0.744300


epoch 126:
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56/84 ----> loss: 0.743834


epoch 126:
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66/84 ----> loss: 0.743668


epoch 126:
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76/84 ----> loss: 0.743668


epoch 127:
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2/84 ----> loss: 0.743890


epoch 127:
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12/84 ----> loss: 0.743669


epoch 127:
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22/84 ----> loss: 0.743674


epoch 127:
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32/84 ----> loss: 0.743688


epoch 127:
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42/84 ----> loss: 0.743671


epoch 127:
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52/84 ----> loss: 0.745949


epoch 127:
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62/84 ----> loss: 0.743736


epoch 127:
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72/84 ----> loss: 0.747093


epoch 127:
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82/84 ----> loss: 0.743976


epoch 128:
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8/84 ----> loss: 0.744654


epoch 128:
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18/84 ----> loss: 0.743672


epoch 128:
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28/84 ----> loss: 0.743686


epoch 128:
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38/84 ----> loss: 0.744106


epoch 128:
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48/84 ----> loss: 0.743668


epoch 128:
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58/84 ----> loss: 0.743845


epoch 128:
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68/84 ----> loss: 0.743668


epoch 128:
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78/84 ----> loss: 0.743882


epoch 129:
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4/84 ----> loss: 0.743906


epoch 129:
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14/84 ----> loss: 0.743668


epoch 129:
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24/84 ----> loss: 0.743790


epoch 129:
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34/84 ----> loss: 0.743668


epoch 129:
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44/84 ----> loss: 0.743669


epoch 129:
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54/84 ----> loss: 0.744149


epoch 129:
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64/84 ----> loss: 0.744085


epoch 129:
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74/84 ----> loss: 0.743668


epoch 130:
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0/84 ----> loss: 0.743668


epoch 130:
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10/84 ----> loss: 0.743843


epoch 130:
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20/84 ----> loss: 0.743669


epoch 130:
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30/84 ----> loss: 0.743678


epoch 130:
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40/84 ----> loss: 0.743737


epoch 130:
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50/84 ----> loss: 0.743964


epoch 130:
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60/84 ----> loss: 0.743986
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epoch 130:
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70/84 ----> loss: 0.743669


epoch 130:
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80/84 ----> loss: 0.743693


epoch 131:
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6/84 ----> loss: 0.743668


epoch 131:
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16/84 ----> loss: 0.743668


epoch 131:
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26/84 ----> loss: 0.744065


epoch 131:
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36/84 ----> loss: 0.743668


epoch 131:
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46/84 ----> loss: 0.744267


epoch 131:
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56/84 ----> loss: 0.743824
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epoch 131:
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66/84 ----> loss: 0.743668


epoch 131:
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76/84 ----> loss: 0.743668


epoch 132:
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2/84 ----> loss: 0.743877


epoch 132:
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12/84 ----> loss: 0.743669


epoch 132:
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22/84 ----> loss: 0.743674


epoch 132:
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32/84 ----> loss: 0.743687


epoch 132:
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42/84 ----> loss: 0.743671


epoch 132:
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52/84 ----> loss: 0.745850
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epoch 132:
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62/84 ----> loss: 0.743731


epoch 132:
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72/84 ----> loss: 0.746900


epoch 132:
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82/84 ----> loss: 0.743959


epoch 133:
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8/84 ----> loss: 0.744601


epoch 133:
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18/84 ----> loss: 0.743672


epoch 133:
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28/84 ----> loss: 0.743685


epoch 133:
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38/84 ----> loss: 0.744080


epoch 133:
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48/84 ----> loss: 0.743668
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epoch 133:
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58/84 ----> loss: 0.743836


epoch 133:
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68/84 ----> loss: 0.743668


epoch 133:
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78/84 ----> loss: 0.743870


epoch 134:
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4/84 ----> loss: 0.743893


epoch 134:
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14/84 ----> loss: 0.743668


epoch 134:
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24/84 ----> loss: 0.743785


epoch 134:
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34/84 ----> loss: 0.743668


epoch 134:
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44/84 ----> loss: 0.743669
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epoch 134:
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54/84 ----> loss: 0.744128


epoch 134:
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64/84 ----> loss: 0.744065


epoch 134:
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74/84 ----> loss: 0.743668


epoch 135:
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0/84 ----> loss: 0.743668


epoch 135:
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10/84 ----> loss: 0.743832


epoch 135:
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20/84 ----> loss: 0.743668


epoch 135:
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30/84 ----> loss: 0.743677


epoch 135:
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40/84 ----> loss: 0.743734
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epoch 135:
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50/84 ----> loss: 0.743949


epoch 135:
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60/84 ----> loss: 0.743969


epoch 135:
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70/84 ----> loss: 0.743669


epoch 135:
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80/84 ----> loss: 0.743691


epoch 136:
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6/84 ----> loss: 0.743668


epoch 136:
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16/84 ----> loss: 0.743668


epoch 136:
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26/84 ----> loss: 0.744045


epoch 136:
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36/84 ----> loss: 0.743668
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epoch 136:
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46/84 ----> loss: 0.744237


epoch 136:
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56/84 ----> loss: 0.743815


epoch 136:
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66/84 ----> loss: 0.743668


epoch 136:
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76/84 ----> loss: 0.743668


epoch 137:
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2/84 ----> loss: 0.743866


epoch 137:
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12/84 ----> loss: 0.743669


epoch 137:
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22/84 ----> loss: 0.743674


epoch 137:
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32/84 ----> loss: 0.743685
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epoch 137:
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42/84 ----> loss: 0.743671


epoch 137:
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52/84 ----> loss: 0.745759


epoch 137:
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62/84 ----> loss: 0.743726


epoch 137:
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72/84 ----> loss: 0.746727


epoch 137:
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82/84 ----> loss: 0.743944


epoch 138:
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8/84 ----> loss: 0.744553


epoch 138:
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18/84 ----> loss: 0.743672


epoch 138:
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28/84 ----> loss: 0.743684
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epoch 138:
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38/84 ----> loss: 0.744056


epoch 138:
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48/84 ----> loss: 0.743668


epoch 138:
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58/84 ----> loss: 0.743829


epoch 138:
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68/84 ----> loss: 0.743668


epoch 138:
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78/84 ----> loss: 0.743859


epoch 139:
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4/84 ----> loss: 0.743882


epoch 139:
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14/84 ----> loss: 0.743668


epoch 139:
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24/84 ----> loss: 0.743780
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epoch 139:
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34/84 ----> loss: 0.743668


epoch 139:
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44/84 ----> loss: 0.743669


epoch 139:
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54/84 ----> loss: 0.744108


epoch 139:
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64/84 ----> loss: 0.744046


epoch 139:
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74/84 ----> loss: 0.743668


epoch 140:
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0/84 ----> loss: 0.743668


epoch 140:
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10/84 ----> loss: 0.743822


epoch 140:
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20/84 ----> loss: 0.743668
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epoch 140:
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30/84 ----> loss: 0.743677


epoch 140:
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40/84 ----> loss: 0.743732


epoch 140:
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50/84 ----> loss: 0.743936


epoch 140:
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60/84 ----> loss: 0.743954


epoch 140:
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70/84 ----> loss: 0.743669


epoch 140:
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80/84 ----> loss: 0.743689


epoch 141:
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6/84 ----> loss: 0.743668


epoch 141:
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16/84 ----> loss: 0.743668
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epoch 141:
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26/84 ----> loss: 0.744027


epoch 141:
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36/84 ----> loss: 0.743668


epoch 141:
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46/84 ----> loss: 0.744210


epoch 141:
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56/84 ----> loss: 0.743807


epoch 141:
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66/84 ----> loss: 0.743668


epoch 141:
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76/84 ----> loss: 0.743668


epoch 142:
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2/84 ----> loss: 0.743855


epoch 142:
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12/84 ----> loss: 0.743669
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epoch 142:
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22/84 ----> loss: 0.743673


epoch 142:
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32/84 ----> loss: 0.743684


epoch 142:
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42/84 ----> loss: 0.743671


epoch 142:
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52/84 ----> loss: 0.745674


epoch 142:
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62/84 ----> loss: 0.743722


epoch 142:
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72/84 ----> loss: 0.746570


epoch 142:
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82/84 ----> loss: 0.743930


epoch 143:
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8/84 ----> loss: 0.744510
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epoch 143:
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18/84 ----> loss: 0.743671


epoch 143:
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28/84 ----> loss: 0.743682


epoch 143:
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38/84 ----> loss: 0.744035


epoch 143:
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48/84 ----> loss: 0.743668


epoch 143:
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58/84 ----> loss: 0.743822


epoch 143:
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68/84 ----> loss: 0.743668


epoch 143:
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78/84 ----> loss: 0.743850


epoch 144:
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4/84 ----> loss: 0.743872
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epoch 144:
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14/84 ----> loss: 0.743668


epoch 144:
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24/84 ----> loss: 0.743776


epoch 144:
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34/84 ----> loss: 0.743668


epoch 144:
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44/84 ----> loss: 0.743669


epoch 144:
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54/84 ----> loss: 0.744090


epoch 144:
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64/84 ----> loss: 0.744029


epoch 144:
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74/84 ----> loss: 0.743668


epoch 145:
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0/84 ----> loss: 0.743668
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epoch 145:
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10/84 ----> loss: 0.743813


epoch 145:
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20/84 ----> loss: 0.743668


epoch 145:
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30/84 ----> loss: 0.743676


epoch 145:
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40/84 ----> loss: 0.743730


epoch 145:
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50/84 ----> loss: 0.743924


epoch 145:
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60/84 ----> loss: 0.743940


epoch 145:
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70/84 ----> loss: 0.743669


epoch 145:
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80/84 ----> loss: 0.743688
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epoch 146:
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6/84 ----> loss: 0.743668


epoch 146:
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16/84 ----> loss: 0.743668


epoch 146:
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26/84 ----> loss: 0.744010


epoch 146:
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36/84 ----> loss: 0.743668


epoch 146:
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46/84 ----> loss: 0.744186


epoch 146:
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56/84 ----> loss: 0.743799


epoch 146:
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66/84 ----> loss: 0.743668


epoch 146:
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76/84 ----> loss: 0.743668
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epoch 147:
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2/84 ----> loss: 0.743846


epoch 147:
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12/84 ----> loss: 0.743669


epoch 147:
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22/84 ----> loss: 0.743673


epoch 147:
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32/84 ----> loss: 0.743683


epoch 147:
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42/84 ----> loss: 0.743670


epoch 147:
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52/84 ----> loss: 0.745596


epoch 147:
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62/84 ----> loss: 0.743718


epoch 147:
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72/84 ----> loss: 0.746427
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epoch 147:
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82/84 ----> loss: 0.743918


epoch 148:
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8/84 ----> loss: 0.744471


epoch 148:
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18/84 ----> loss: 0.743671


epoch 148:
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28/84 ----> loss: 0.743681


epoch 148:
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38/84 ----> loss: 0.744015


epoch 148:
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48/84 ----> loss: 0.743668


epoch 148:
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58/84 ----> loss: 0.743815


epoch 148:
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68/84 ----> loss: 0.743668
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epoch 148:
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78/84 ----> loss: 0.743841


epoch 149:
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4/84 ----> loss: 0.743862


epoch 149:
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14/84 ----> loss: 0.743668


epoch 149:
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24/84 ----> loss: 0.743772


epoch 149:
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34/84 ----> loss: 0.743668


epoch 149:
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44/84 ----> loss: 0.743669


epoch 149:
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54/84 ----> loss: 0.744074


epoch 149:
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64/84 ----> loss: 0.744013
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epoch 149:
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74/84 ----> loss: 0.743668


epoch 150:
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0/84 ----> loss: 0.743668


epoch 150:
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10/84 ----> loss: 0.743805


epoch 150:
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20/84 ----> loss: 0.743668


epoch 150:
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30/84 ----> loss: 0.743676


epoch 150:
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40/84 ----> loss: 0.743728


epoch 150:
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50/84 ----> loss: 0.743913


epoch 150:
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60/84 ----> loss: 0.743928
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epoch 150:
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70/84 ----> loss: 0.743669


epoch 150:
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80/84 ----> loss: 0.743686


epoch 151:
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6/84 ----> loss: 0.743668


epoch 151:
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16/84 ----> loss: 0.743668


epoch 151:
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26/84 ----> loss: 0.743995


epoch 151:
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36/84 ----> loss: 0.743668


epoch 151:
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46/84 ----> loss: 0.744163


epoch 151:
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56/84 ----> loss: 0.743792
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epoch 151:
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66/84 ----> loss: 0.743668


epoch 151:
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76/84 ----> loss: 0.743668


epoch 152:
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2/84 ----> loss: 0.743837


epoch 152:
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12/84 ----> loss: 0.743669


epoch 152:
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22/84 ----> loss: 0.743672


epoch 152:
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32/84 ----> loss: 0.743682


epoch 152:
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42/84 ----> loss: 0.743670


epoch 152:
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52/84 ----> loss: 0.745523
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epoch 152:
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62/84 ----> loss: 0.743714


epoch 152:
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72/84 ----> loss: 0.746296


epoch 152:
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82/84 ----> loss: 0.743906


epoch 153:
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8/84 ----> loss: 0.744435


epoch 153:
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18/84 ----> loss: 0.743671


epoch 153:
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28/84 ----> loss: 0.743680


epoch 153:
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38/84 ----> loss: 0.743997


epoch 153:
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48/84 ----> loss: 0.743668
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epoch 153:
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58/84 ----> loss: 0.743809


epoch 153:
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68/84 ----> loss: 0.743668


epoch 153:
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78/84 ----> loss: 0.743833



epoch 154:
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4/84 ----> loss: 0.743854


epoch 154:
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14/84 ----> loss: 0.743668


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24/84 ----> loss: 0.743769


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44/84 ----> loss: 0.743669


epoch 154:
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54/84 ----> loss: 0.744059


epoch 154:
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64/84 ----> loss: 0.743999


epoch 154:
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74/84 ----> loss: 0.743668


epoch 155:
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0/84 ----> loss: 0.743668


epoch 155:
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10/84 ----> loss: 0.743798


epoch 155:
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20/84 ----> loss: 0.743668


epoch 155:
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30/84 ----> loss: 0.743675


epoch 155:
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40/84 ----> loss: 0.743726


epoch 155:
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50/84 ----> loss: 0.743903


epoch 155:
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60/84 ----> loss: 0.743916


epoch 155:
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70/84 ----> loss: 0.743669


epoch 155:
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80/84 ----> loss: 0.743685


epoch 156:
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epoch 156:
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16/84 ----> loss: 0.743668


epoch 156:
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26/84 ----> loss: 0.743981


epoch 156:
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36/84 ----> loss: 0.743668


epoch 156:
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46/84 ----> loss: 0.744142


epoch 156:
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56/84 ----> loss: 0.743786


epoch 156:
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66/84 ----> loss: 0.743668


epoch 156:
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76/84 ----> loss: 0.743668


epoch 157:
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2/84 ----> loss: 0.743829


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12/84 ----> loss: 0.743668


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22/84 ----> loss: 0.743672


epoch 157:
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32/84 ----> loss: 0.743681


epoch 157:
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42/84 ----> loss: 0.743670


epoch 157:
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52/84 ----> loss: 0.745455


epoch 157:
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62/84 ----> loss: 0.743711


epoch 157:
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72/84 ----> loss: 0.746177


epoch 157:
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82/84 ----> loss: 0.743895


epoch 158:
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8/84 ----> loss: 0.744401


epoch 158:
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18/84 ----> loss: 0.743671


epoch 158:
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28/84 ----> loss: 0.743680


epoch 158:
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38/84 ----> loss: 0.743981


epoch 158:
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48/84 ----> loss: 0.743668


epoch 158:
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58/84 ----> loss: 0.743803


epoch 158:
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68/84 ----> loss: 0.743668


epoch 158:
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78/84 ----> loss: 0.743825


epoch 159:
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4/84 ----> loss: 0.743846


epoch 159:
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14/84 ----> loss: 0.743668


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24/84 ----> loss: 0.743765


epoch 159:
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34/84 ----> loss: 0.743668


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epoch 159:
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54/84 ----> loss: 0.744044


epoch 159:
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64/84 ----> loss: 0.743986


epoch 159:
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74/84 ----> loss: 0.743668


epoch 160:
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0/84 ----> loss: 0.743668


epoch 160:
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10/84 ----> loss: 0.743791


epoch 160:
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20/84 ----> loss: 0.743668


epoch 160:
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30/84 ----> loss: 0.743675


epoch 160:
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40/84 ----> loss: 0.743725


epoch 160:
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50/84 ----> loss: 0.743893


epoch 160:
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60/84 ----> loss: 0.743905


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70/84 ----> loss: 0.743669


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80/84 ----> loss: 0.743684


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26/84 ----> loss: 0.743968


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36/84 ----> loss: 0.743668


epoch 161:
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46/84 ----> loss: 0.744123


epoch 161:
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56/84 ----> loss: 0.743781


epoch 161:
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66/84 ----> loss: 0.743668


epoch 161:
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76/84 ----> loss: 0.743668


epoch 162:
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2/84 ----> loss: 0.743822


epoch 162:
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12/84 ----> loss: 0.743668


epoch 162:
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22/84 ----> loss: 0.743672


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epoch 162:
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42/84 ----> loss: 0.743670


epoch 162:
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52/84 ----> loss: 0.745392


epoch 162:
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62/84 ----> loss: 0.743709


epoch 162:
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72/84 ----> loss: 0.746067


epoch 162:
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82/84 ----> loss: 0.743885


epoch 163:
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8/84 ----> loss: 0.744371


epoch 163:
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18/84 ----> loss: 0.743671


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28/84 ----> loss: 0.743679


epoch 163:
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38/84 ----> loss: 0.743966


epoch 163:
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48/84 ----> loss: 0.743668


epoch 163:
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58/84 ----> loss: 0.743798


epoch 163:
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68/84 ----> loss: 0.743668


epoch 163:
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78/84 ----> loss: 0.743818


epoch 164:
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4/84 ----> loss: 0.743839


epoch 164:
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14/84 ----> loss: 0.743668


epoch 164:
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24/84 ----> loss: 0.743762


epoch 164:
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34/84 ----> loss: 0.743668


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44/84 ----> loss: 0.743669


epoch 164:
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54/84 ----> loss: 0.744031


epoch 164:
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64/84 ----> loss: 0.743974


epoch 164:
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74/84 ----> loss: 0.743668


epoch 165:
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0/84 ----> loss: 0.743668


epoch 165:
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10/84 ----> loss: 0.743785


epoch 165:
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20/84 ----> loss: 0.743668


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30/84 ----> loss: 0.743674


epoch 165:
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40/84 ----> loss: 0.743723


epoch 165:
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50/84 ----> loss: 0.743884


epoch 165:
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60/84 ----> loss: 0.743896


epoch 165:
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70/84 ----> loss: 0.743669


epoch 165:
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80/84 ----> loss: 0.743683


epoch 166:
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6/84 ----> loss: 0.743668


epoch 166:
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16/84 ----> loss: 0.743668


epoch 166:
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26/84 ----> loss: 0.743956


epoch 166:
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36/84 ----> loss: 0.743668


epoch 166:
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46/84 ----> loss: 0.744105


epoch 166:
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56/84 ----> loss: 0.743775


epoch 166:
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66/84 ----> loss: 0.743668


epoch 166:
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76/84 ----> loss: 0.743668


epoch 167:
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2/84 ----> loss: 0.743815


epoch 167:
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12/84 ----> loss: 0.743668


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22/84 ----> loss: 0.743672


epoch 167:
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32/84 ----> loss: 0.743680


epoch 167:
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42/84 ----> loss: 0.743670


epoch 167:
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52/84 ----> loss: 0.745333


epoch 167:
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62/84 ----> loss: 0.743706


epoch 167:
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72/84 ----> loss: 0.745966


epoch 167:
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82/84 ----> loss: 0.743876


epoch 168:
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8/84 ----> loss: 0.744343


epoch 168:
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18/84 ----> loss: 0.743670


epoch 168:
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28/84 ----> loss: 0.743678


epoch 168:
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38/84 ----> loss: 0.743952


epoch 168:
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48/84 ----> loss: 0.743668


epoch 168:
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58/84 ----> loss: 0.743793


epoch 168:
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68/84 ----> loss: 0.743668


epoch 168:
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78/84 ----> loss: 0.743812


epoch 169:
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4/84 ----> loss: 0.743832


epoch 169:
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14/84 ----> loss: 0.743668


epoch 169:
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24/84 ----> loss: 0.743758


epoch 169:
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34/84 ----> loss: 0.743668


epoch 169:
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44/84 ----> loss: 0.743669


epoch 169:
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54/84 ----> loss: 0.744018


epoch 169:
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64/84 ----> loss: 0.743962


epoch 169:
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74/84 ----> loss: 0.743668


epoch 170:
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0/84 ----> loss: 0.743668


epoch 170:
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10/84 ----> loss: 0.743779


epoch 170:
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20/84 ----> loss: 0.743668


epoch 170:
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30/84 ----> loss: 0.743674


epoch 170:
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40/84 ----> loss: 0.743721


epoch 170:
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50/84 ----> loss: 0.743876


epoch 170:
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60/84 ----> loss: 0.743887


epoch 170:
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70/84 ----> loss: 0.743669


epoch 170:
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80/84 ----> loss: 0.743682


epoch 171:
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6/84 ----> loss: 0.743668


epoch 171:
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16/84 ----> loss: 0.743668


epoch 171:
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26/84 ----> loss: 0.743945


epoch 171:
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epoch 171:
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46/84 ----> loss: 0.744089


epoch 171:
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56/84 ----> loss: 0.743771


epoch 171:
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66/84 ----> loss: 0.743668


epoch 171:
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76/84 ----> loss: 0.743668


epoch 172:
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2/84 ----> loss: 0.743809


epoch 172:
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12/84 ----> loss: 0.743668


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22/84 ----> loss: 0.743672


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epoch 172:
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42/84 ----> loss: 0.743670


epoch 172:
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52/84 ----> loss: 0.745277


epoch 172:
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62/84 ----> loss: 0.743704


epoch 172:
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72/84 ----> loss: 0.745872


epoch 172:
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82/84 ----> loss: 0.743868


epoch 173:
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8/84 ----> loss: 0.744316


epoch 173:
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18/84 ----> loss: 0.743670


epoch 173:
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28/84 ----> loss: 0.743678


epoch 173:
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38/84 ----> loss: 0.743940


epoch 173:
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48/84 ----> loss: 0.743668


epoch 173:
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58/84 ----> loss: 0.743788


epoch 173:
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68/84 ----> loss: 0.743668


epoch 173:
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78/84 ----> loss: 0.743806


epoch 174:
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4/84 ----> loss: 0.743825


epoch 174:
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14/84 ----> loss: 0.743668


epoch 174:
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24/84 ----> loss: 0.743756


epoch 174:
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epoch 174:
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44/84 ----> loss: 0.743669


epoch 174:
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54/84 ----> loss: 0.744006


epoch 174:
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64/84 ----> loss: 0.743952


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74/84 ----> loss: 0.743668


epoch 175:
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epoch 175:
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10/84 ----> loss: 0.743774


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20/84 ----> loss: 0.743668


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30/84 ----> loss: 0.743674


epoch 175:
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40/84 ----> loss: 0.743720


epoch 175:
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50/84 ----> loss: 0.743869


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epoch 176:
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36/84 ----> loss: 0.743668


epoch 176:
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46/84 ----> loss: 0.744073


epoch 176:
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56/84 ----> loss: 0.743766


epoch 176:
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76/84 ----> loss: 0.743668


epoch 177:
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2/84 ----> loss: 0.743803


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12/84 ----> loss: 0.743668


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22/84 ----> loss: 0.743671


epoch 177:
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epoch 177:
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epoch 177:
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52/84 ----> loss: 0.745225


epoch 177:
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62/84 ----> loss: 0.743702


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72/84 ----> loss: 0.745785


epoch 177:
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82/84 ----> loss: 0.743860


epoch 178:
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8/84 ----> loss: 0.744292


epoch 178:
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18/84 ----> loss: 0.743670
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epoch 178:
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28/84 ----> loss: 0.743677


epoch 178:
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78/84 ----> loss: 0.743801


epoch 179:
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14/84 ----> loss: 0.743668
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24/84 ----> loss: 0.743753


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epoch 179:
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epoch 179:
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epoch 180:
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epoch 180:
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epoch 180:
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epoch 181:
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epoch 181:
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76/84 ----> loss: 0.743668


epoch 182:
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epoch 182:
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12/84 ----> loss: 0.743668


epoch 182:
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22/84 ----> loss: 0.743671


epoch 182:
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epoch 182:
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52/84 ----> loss: 0.745176


epoch 182:
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62/84 ----> loss: 0.743700


epoch 182:
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72/84 ----> loss: 0.745705


epoch 182:
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82/84 ----> loss: 0.743852
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epoch 183:
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8/84 ----> loss: 0.744269


epoch 183:
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18/84 ----> loss: 0.743670


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28/84 ----> loss: 0.743677


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38/84 ----> loss: 0.743917


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epoch 183:
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58/84 ----> loss: 0.743780


epoch 183:
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68/84 ----> loss: 0.743668


epoch 183:
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78/84 ----> loss: 0.743796
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epoch 184:
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4/84 ----> loss: 0.743814


epoch 184:
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14/84 ----> loss: 0.743668


epoch 184:
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24/84 ----> loss: 0.743750


epoch 184:
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34/84 ----> loss: 0.743668


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44/84 ----> loss: 0.743669


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54/84 ----> loss: 0.743985


epoch 184:
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epoch 184:
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74/84 ----> loss: 0.743668
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epoch 185:
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0/84 ----> loss: 0.743668


epoch 185:
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10/84 ----> loss: 0.743765


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20/84 ----> loss: 0.743668


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30/84 ----> loss: 0.743673


epoch 185:
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40/84 ----> loss: 0.743717


epoch 185:
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50/84 ----> loss: 0.743855


epoch 185:
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60/84 ----> loss: 0.743863


epoch 185:
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70/84 ----> loss: 0.743669
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epoch 185:
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80/84 ----> loss: 0.743680


epoch 186:
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26/84 ----> loss: 0.743917


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46/84 ----> loss: 0.744046


epoch 186:
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56/84 ----> loss: 0.743758


epoch 186:
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66/84 ----> loss: 0.743668
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epoch 186:
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76/84 ----> loss: 0.743668


epoch 187:
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2/84 ----> loss: 0.743792


epoch 187:
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12/84 ----> loss: 0.743668


epoch 187:
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22/84 ----> loss: 0.743671


epoch 187:
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32/84 ----> loss: 0.743678


epoch 187:
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42/84 ----> loss: 0.743670


epoch 187:
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52/84 ----> loss: 0.745130


epoch 187:
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62/84 ----> loss: 0.743698
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epoch 187:
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72/84 ----> loss: 0.745629


epoch 187:
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82/84 ----> loss: 0.743846


epoch 188:
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8/84 ----> loss: 0.744248


epoch 188:
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18/84 ----> loss: 0.743670


epoch 188:
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28/84 ----> loss: 0.743676


epoch 188:
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38/84 ----> loss: 0.743907


epoch 188:
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48/84 ----> loss: 0.743668


epoch 188:
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58/84 ----> loss: 0.743776
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epoch 188:
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68/84 ----> loss: 0.743668


epoch 188:
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78/84 ----> loss: 0.743791


epoch 189:
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4/84 ----> loss: 0.743809


epoch 189:
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14/84 ----> loss: 0.743668


epoch 189:
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24/84 ----> loss: 0.743748


epoch 189:
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34/84 ----> loss: 0.743668


epoch 189:
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44/84 ----> loss: 0.743669


epoch 189:
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54/84 ----> loss: 0.743975
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epoch 189:
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64/84 ----> loss: 0.743924


epoch 189:
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74/84 ----> loss: 0.743668


epoch 190:
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0/84 ----> loss: 0.743668


epoch 190:
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10/84 ----> loss: 0.743761


epoch 190:
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20/84 ----> loss: 0.743668


epoch 190:
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30/84 ----> loss: 0.743673


epoch 190:
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40/84 ----> loss: 0.743716


epoch 190:
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50/84 ----> loss: 0.743848
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epoch 190:
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60/84 ----> loss: 0.743856


epoch 190:
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70/84 ----> loss: 0.743669


epoch 190:
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80/84 ----> loss: 0.743679


epoch 191:
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6/84 ----> loss: 0.743668


epoch 191:
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16/84 ----> loss: 0.743668


epoch 191:
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26/84 ----> loss: 0.743908


epoch 191:
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36/84 ----> loss: 0.743668


epoch 191:
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46/84 ----> loss: 0.744033
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epoch 191:
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56/84 ----> loss: 0.743754


epoch 191:
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66/84 ----> loss: 0.743668


epoch 191:
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76/84 ----> loss: 0.743668


epoch 192:
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2/84 ----> loss: 0.743787


epoch 192:
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12/84 ----> loss: 0.743668


epoch 192:
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22/84 ----> loss: 0.743671


epoch 192:
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32/84 ----> loss: 0.743677


epoch 192:
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42/84 ----> loss: 0.743670
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epoch 192:
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52/84 ----> loss: 0.745086


epoch 192:
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62/84 ----> loss: 0.743697


epoch 192:
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72/84 ----> loss: 0.745559


epoch 192:
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82/84 ----> loss: 0.743839



epoch 193:
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8/84 ----> loss: 0.744228


epoch 193:
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18/84 ----> loss: 0.743670


epoch 193:
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28/84 ----> loss: 0.743676


epoch 193:
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38/84 ----> loss: 0.743898
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epoch 193:
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48/84 ----> loss: 0.743668


epoch 193:
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58/84 ----> loss: 0.743772


epoch 193:
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68/84 ----> loss: 0.743668


epoch 193:
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78/84 ----> loss: 0.743787


epoch 194:
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4/84 ----> loss: 0.743804


epoch 194:
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14/84 ----> loss: 0.743668


epoch 194:
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24/84 ----> loss: 0.743746


epoch 194:
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34/84 ----> loss: 0.743668
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epoch 194:
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44/84 ----> loss: 0.743669


epoch 194:
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54/84 ----> loss: 0.743966


epoch 194:
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64/84 ----> loss: 0.743915


epoch 194:
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74/84 ----> loss: 0.743668


epoch 195:
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0/84 ----> loss: 0.743668


epoch 195:
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10/84 ----> loss: 0.743757


epoch 195:
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20/84 ----> loss: 0.743668


epoch 195:
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30/84 ----> loss: 0.743673
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epoch 195:
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40/84 ----> loss: 0.743715


epoch 195:
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50/84 ----> loss: 0.743843


epoch 195:
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60/84 ----> loss: 0.743850


epoch 195:
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70/84 ----> loss: 0.743669


epoch 195:
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80/84 ----> loss: 0.743679


epoch 196:
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6/84 ----> loss: 0.743668


epoch 196:
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16/84 ----> loss: 0.743668


epoch 196:
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26/84 ----> loss: 0.743900
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epoch 196:
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36/84 ----> loss: 0.743668


epoch 196:
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46/84 ----> loss: 0.744021


epoch 196:
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56/84 ----> loss: 0.743751


epoch 196:
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66/84 ----> loss: 0.743668


epoch 196:
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76/84 ----> loss: 0.743668


epoch 197:
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2/84 ----> loss: 0.743783


epoch 197:
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12/84 ----> loss: 0.743668


epoch 197:
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22/84 ----> loss: 0.743671
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epoch 197:
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32/84 ----> loss: 0.743677


epoch 197:
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42/84 ----> loss: 0.743669


epoch 197:
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52/84 ----> loss: 0.745044


epoch 197:
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62/84 ----> loss: 0.743695


epoch 197:
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72/84 ----> loss: 0.745493


epoch 197:
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82/84 ----> loss: 0.743833


epoch 198:
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8/84 ----> loss: 0.744209


epoch 198:
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18/84 ----> loss: 0.743670
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epoch 198:
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28/84 ----> loss: 0.743675


epoch 198:
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38/84 ----> loss: 0.743889


epoch 198:
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48/84 ----> loss: 0.743668


epoch 198:
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58/84 ----> loss: 0.743769


epoch 198:
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68/84 ----> loss: 0.743668


epoch 198:
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78/84 ----> loss: 0.743783


epoch 199:
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4/84 ----> loss: 0.743799


epoch 199:
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14/84 ----> loss: 0.743668
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epoch 199:
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24/84 ----> loss: 0.743743


epoch 199:
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34/84 ----> loss: 0.743668


epoch 199:
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44/84 ----> loss: 0.743669


epoch 199:
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54/84 ----> loss: 0.743957


epoch 199:
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64/84 ----> loss: 0.743908


epoch 199:
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74/84 ----> loss: 0.743668



epoch 200:
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0/84 ----> loss: 0.743668


epoch 200:
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10/84 ----> loss: 0.743753


epoch 200:
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20/84 ----> loss: 0.743668


epoch 200:
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30/84 ----> loss: 0.743672


epoch 200:
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40/84 ----> loss: 0.743713


epoch 200:
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50/84 ----> loss: 0.743837


epoch 200:
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60/84 ----> loss: 0.743844


epoch 200:
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70/84 ----> loss: 0.743669


epoch 200:
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80/84 ----> loss: 0.743678


epoch 201:
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6/84 ----> loss: 0.743668


epoch 201:
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16/84 ----> loss: 0.743668


epoch 201:
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26/84 ----> loss: 0.743893


epoch 201:
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36/84 ----> loss: 0.743668


epoch 201:
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46/84 ----> loss: 0.744010


epoch 201:
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56/84 ----> loss: 0.743748


epoch 201:
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66/84 ----> loss: 0.743668


epoch 201:
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76/84 ----> loss: 0.743668


epoch 202:
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2/84 ----> loss: 0.743779


epoch 202:
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12/84 ----> loss: 0.743668


epoch 202:
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22/84 ----> loss: 0.743671


epoch 202:
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32/84 ----> loss: 0.743676


epoch 202:
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42/84 ----> loss: 0.743669


epoch 202:
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52/84 ----> loss: 0.745005


epoch 202:
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62/84 ----> loss: 0.743694


epoch 202:
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72/84 ----> loss: 0.745432


epoch 202:
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82/84 ----> loss: 0.743827


epoch 203:
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8/84 ----> loss: 0.744192


epoch 203:
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18/84 ----> loss: 0.743670


epoch 203:
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28/84 ----> loss: 0.743675


epoch 203:
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38/84 ----> loss: 0.743881


epoch 203:
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48/84 ----> loss: 0.743668


epoch 203:
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58/84 ----> loss: 0.743766


epoch 203:
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68/84 ----> loss: 0.743668


epoch 203:
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78/84 ----> loss: 0.743779

epoch 204:

4/84 ----> loss: 0.743795

epoch 204:

14/84 ----> loss: 0.743668

epoch 204:

24/84 ----> loss: 0.743741

epoch 204:

34/84 ----> loss: 0.743668

epoch 204:

44/84 ----> loss: 0.743669

epoch 204:

54/84 ----> loss: 0.743949

epoch 204:

64/84 ----> loss: 0.743900

epoch 204:


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74/84 ----> loss: 0.743668


epoch 205:
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0/84 ----> loss: 0.743668


epoch 205:
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10/84 ----> loss: 0.743750


epoch 205:
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20/84 ----> loss: 0.743668


epoch 205:
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30/84 ----> loss: 0.743672


epoch 205:
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40/84 ----> loss: 0.743712


epoch 205:
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50/84 ----> loss: 0.743832


epoch 205:
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60/84 ----> loss: 0.743838


epoch 205:
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70/84 ----> loss: 0.743669


epoch 205:
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80/84 ----> loss: 0.743678


epoch 206:
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6/84 ----> loss: 0.743668


epoch 206:
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16/84 ----> loss: 0.743668


epoch 206:
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26/84 ----> loss: 0.743885


epoch 206:
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36/84 ----> loss: 0.743668


epoch 206:
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46/84 ----> loss: 0.744000


epoch 206:
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56/84 ----> loss: 0.743745


epoch 206:
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66/84 ----> loss: 0.743668


epoch 206:
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76/84 ----> loss: 0.743668


epoch 207:
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2/84 ----> loss: 0.743775


epoch 207:
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12/84 ----> loss: 0.743668


epoch 207:
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22/84 ----> loss: 0.743671


epoch 207:
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32/84 ----> loss: 0.743676


epoch 207:
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42/84 ----> loss: 0.743669


epoch 207:
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52/84 ----> loss: 0.744968


epoch 207:
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62/84 ----> loss: 0.743693


epoch 207:
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72/84 ----> loss: 0.745374


epoch 207:
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82/84 ----> loss: 0.743822


epoch 208:
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8/84 ----> loss: 0.744175


epoch 208:
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18/84 ----> loss: 0.743670


epoch 208:
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28/84 ----> loss: 0.743675


epoch 208:
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38/84 ----> loss: 0.743873


epoch 208:
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48/84 ----> loss: 0.743668


epoch 208:
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58/84 ----> loss: 0.743763


epoch 208:
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68/84 ----> loss: 0.743668


epoch 208:
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78/84 ----> loss: 0.743775


epoch 209:
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4/84 ----> loss: 0.743791


epoch 209:
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14/84 ----> loss: 0.743668


epoch 209:
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24/84 ----> loss: 0.743739


epoch 209:
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34/84 ----> loss: 0.743668


epoch 209:
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44/84 ----> loss: 0.743669


epoch 209:
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54/84 ----> loss: 0.743941


epoch 209:
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64/84 ----> loss: 0.743894


epoch 209:
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74/84 ----> loss: 0.743668


epoch 210:
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0/84 ----> loss: 0.743668


epoch 210:
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10/84 ----> loss: 0.743747


epoch 210:
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20/84 ----> loss: 0.743668


epoch 210:
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30/84 ----> loss: 0.743672


epoch 210:
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40/84 ----> loss: 0.743711


epoch 210:
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50/84 ----> loss: 0.743827


epoch 210:
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60/84 ----> loss: 0.743833


epoch 210:
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70/84 ----> loss: 0.743669


epoch 210:
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80/84 ----> loss: 0.743677


epoch 211:
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6/84 ----> loss: 0.743668


epoch 211:
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16/84 ----> loss: 0.743668


epoch 211:
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26/84 ----> loss: 0.743879


epoch 211:
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36/84 ----> loss: 0.743668


epoch 211:
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46/84 ----> loss: 0.743990


epoch 211:
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56/84 ----> loss: 0.743742


epoch 211:
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66/84 ----> loss: 0.743668


epoch 211:
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76/84 ----> loss: 0.743668


epoch 212:
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2/84 ----> loss: 0.743771


epoch 212:
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12/84 ----> loss: 0.743668


epoch 212:
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22/84 ----> loss: 0.743670


epoch 212:
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32/84 ----> loss: 0.743676


epoch 212:
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42/84 ----> loss: 0.743669


epoch 212:
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52/84 ----> loss: 0.744933


epoch 212:
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62/84 ----> loss: 0.743691


epoch 212:
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72/84 ----> loss: 0.745319


epoch 212:
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82/84 ----> loss: 0.743817


epoch 213:
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8/84 ----> loss: 0.744160


epoch 213:
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18/84 ----> loss: 0.743670


epoch 213:
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28/84 ----> loss: 0.743675


epoch 213:
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38/84 ----> loss: 0.743866


epoch 213:
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48/84 ----> loss: 0.743668


epoch 213:
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58/84 ----> loss: 0.743760


epoch 213:
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68/84 ----> loss: 0.743668


epoch 213:
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78/84 ----> loss: 0.743772


epoch 214:
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4/84 ----> loss: 0.743787


epoch 214:
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14/84 ----> loss: 0.743668


epoch 214:
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24/84 ----> loss: 0.743737


epoch 214:
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34/84 ----> loss: 0.743668


epoch 214:
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44/84 ----> loss: 0.743669


epoch 214:
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54/84 ----> loss: 0.743933


epoch 214:
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64/84 ----> loss: 0.743887


epoch 214:
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74/84 ----> loss: 0.743668


epoch 215:
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0/84 ----> loss: 0.743668


epoch 215:
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10/84 ----> loss: 0.743744


epoch 215:
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20/84 ----> loss: 0.743668


epoch 215:
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30/84 ----> loss: 0.743672


epoch 215:
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40/84 ----> loss: 0.743710


epoch 215:
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50/84 ----> loss: 0.743822


epoch 215:
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60/84 ----> loss: 0.743828


epoch 215:
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70/84 ----> loss: 0.743669


epoch 215:
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80/84 ----> loss: 0.743677


epoch 216:
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6/84 ----> loss: 0.743668


epoch 216:
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16/84 ----> loss: 0.743668


epoch 216:
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26/84 ----> loss: 0.743873


epoch 216:
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36/84 ----> loss: 0.743668


epoch 216:
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46/84 ----> loss: 0.743980


epoch 216:
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56/84 ----> loss: 0.743740


epoch 216:
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66/84 ----> loss: 0.743668


epoch 216:
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76/84 ----> loss: 0.743668


epoch 217:
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2/84 ----> loss: 0.743768


epoch 217:
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12/84 ----> loss: 0.743668


epoch 217:
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22/84 ----> loss: 0.743670


epoch 217:
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32/84 ----> loss: 0.743675


epoch 217:
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42/84 ----> loss: 0.743669


epoch 217:
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52/84 ----> loss: 0.744900


epoch 217:
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62/84 ----> loss: 0.743691


epoch 217:
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72/84 ----> loss: 0.745268


epoch 217:
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82/84 ----> loss: 0.743812


epoch 218:
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8/84 ----> loss: 0.744145


epoch 218:
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18/84 ----> loss: 0.743670


epoch 218:
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28/84 ----> loss: 0.743674


epoch 218:
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38/84 ----> loss: 0.743859


epoch 218:
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48/84 ----> loss: 0.743668


epoch 218:
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58/84 ----> loss: 0.743757


epoch 218:
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68/84 ----> loss: 0.743668


epoch 218:
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78/84 ----> loss: 0.743768


epoch 219:
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4/84 ----> loss: 0.743784


epoch 219:
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14/84 ----> loss: 0.743668


epoch 219:
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24/84 ----> loss: 0.743735


epoch 219:
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34/84 ----> loss: 0.743668


epoch 219:
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44/84 ----> loss: 0.743669


epoch 219:
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54/84 ----> loss: 0.743926


epoch 219:
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64/84 ----> loss: 0.743881


epoch 219:
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74/84 ----> loss: 0.743668


epoch 220:
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0/84 ----> loss: 0.743668


epoch 220:
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10/84 ----> loss: 0.743741


epoch 220:
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20/84 ----> loss: 0.743668


epoch 220:
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30/84 ----> loss: 0.743672


epoch 220:
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40/84 ----> loss: 0.743709


epoch 220:
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50/84 ----> loss: 0.743818


epoch 220:
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60/84 ----> loss: 0.743823


epoch 220:
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70/84 ----> loss: 0.743669


epoch 220:
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80/84 ----> loss: 0.743677


epoch 221:
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6/84 ----> loss: 0.743668


epoch 221:
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16/84 ----> loss: 0.743668


epoch 221:
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26/84 ----> loss: 0.743867


epoch 221:
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36/84 ----> loss: 0.743668


epoch 221:
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46/84 ----> loss: 0.743972


epoch 221:
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56/84 ----> loss: 0.743737


epoch 221:
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66/84 ----> loss: 0.743668


epoch 221:
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76/84 ----> loss: 0.743668


epoch 222:
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2/84 ----> loss: 0.743764


epoch 222:
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12/84 ----> loss: 0.743668


epoch 222:
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22/84 ----> loss: 0.743670


epoch 222:
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32/84 ----> loss: 0.743675


epoch 222:
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42/84 ----> loss: 0.743669


epoch 222:
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52/84 ----> loss: 0.744868


epoch 222:
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62/84 ----> loss: 0.743689


epoch 222:
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72/84 ----> loss: 0.745220


epoch 222:
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82/84 ----> loss: 0.743808


epoch 223:
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8/84 ----> loss: 0.744132


epoch 223:
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18/84 ----> loss: 0.743669


epoch 223:
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28/84 ----> loss: 0.743674


epoch 223:
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38/84 ----> loss: 0.743852


epoch 223:
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48/84 ----> loss: 0.743668


epoch 223:
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58/84 ----> loss: 0.743754


epoch 223:
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68/84 ----> loss: 0.743668


epoch 223:
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78/84 ----> loss: 0.743765

epoch 224:

4/84 ----> loss: 0.743780

epoch 224:

14/84 ----> loss: 0.743668

epoch 224:

24/84 ----> loss: 0.743734

epoch 224:

34/84 ----> loss: 0.743668

epoch 224:

44/84 ----> loss: 0.743669

epoch 224:

54/84 ----> loss: 0.743919

epoch 224:

64/84 ----> loss: 0.743875

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epoch 224:
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74/84 ----> loss: 0.743668


epoch 225:
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0/84 ----> loss: 0.743668


epoch 225:
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10/84 ----> loss: 0.743738


epoch 225:
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20/84 ----> loss: 0.743668


epoch 225:
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30/84 ----> loss: 0.743671


epoch 225:
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40/84 ----> loss: 0.743708


epoch 225:
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50/84 ----> loss: 0.743814


epoch 225:
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60/84 ----> loss: 0.743819
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epoch 225:
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70/84 ----> loss: 0.743669


epoch 225:
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80/84 ----> loss: 0.743676


epoch 226:
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6/84 ----> loss: 0.743668


epoch 226:
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16/84 ----> loss: 0.743668


epoch 226:
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26/84 ----> loss: 0.743861


epoch 226:
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36/84 ----> loss: 0.743668


epoch 226:
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46/84 ----> loss: 0.743963


epoch 226:
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56/84 ----> loss: 0.743735
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epoch 226:
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66/84 ----> loss: 0.743668


epoch 226:
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76/84 ----> loss: 0.743668


epoch 227:
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2/84 ----> loss: 0.743761


epoch 227:
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12/84 ----> loss: 0.743668


epoch 227:
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22/84 ----> loss: 0.743670


epoch 227:
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32/84 ----> loss: 0.743675


epoch 227:
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42/84 ----> loss: 0.743669


epoch 227:
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52/84 ----> loss: 0.744837
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epoch 227:
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62/84 ----> loss: 0.743689


epoch 227:
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72/84 ----> loss: 0.745174


epoch 227:
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82/84 ----> loss: 0.743803


epoch 228:
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8/84 ----> loss: 0.744118


epoch 228:
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18/84 ----> loss: 0.743669


epoch 228:
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28/84 ----> loss: 0.743674


epoch 228:
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38/84 ----> loss: 0.743846


epoch 228:
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48/84 ----> loss: 0.743668
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epoch 228:
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58/84 ----> loss: 0.743752


epoch 228:
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68/84 ----> loss: 0.743668


epoch 228:
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78/84 ----> loss: 0.743762


epoch 229:
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4/84 ----> loss: 0.743777


epoch 229:
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14/84 ----> loss: 0.743668


epoch 229:
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24/84 ----> loss: 0.743732


epoch 229:
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34/84 ----> loss: 0.743668


epoch 229:
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44/84 ----> loss: 0.743669
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epoch 229:
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54/84 ----> loss: 0.743913


epoch 229:
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64/84 ----> loss: 0.743869


epoch 229:
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74/84 ----> loss: 0.743668


epoch 230:
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0/84 ----> loss: 0.743668


epoch 230:
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10/84 ----> loss: 0.743736


epoch 230:
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20/84 ----> loss: 0.743668


epoch 230:
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30/84 ----> loss: 0.743671


epoch 230:
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40/84 ----> loss: 0.743707
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epoch 230:
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50/84 ----> loss: 0.743810


epoch 230:
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60/84 ----> loss: 0.743815


epoch 230:
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70/84 ----> loss: 0.743669


epoch 230:
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80/84 ----> loss: 0.743676


epoch 231:
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6/84 ----> loss: 0.743668


epoch 231:
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16/84 ----> loss: 0.743668


epoch 231:
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26/84 ----> loss: 0.743856


epoch 231:
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36/84 ----> loss: 0.743668
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epoch 231:
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46/84 ----> loss: 0.743955


epoch 231:
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56/84 ----> loss: 0.743733


epoch 231:
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66/84 ----> loss: 0.743668


epoch 231:
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76/84 ----> loss: 0.743668


epoch 232:
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2/84 ----> loss: 0.743758


epoch 232:
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12/84 ----> loss: 0.743668


epoch 232:
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22/84 ----> loss: 0.743670


epoch 232:
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32/84 ----> loss: 0.743675
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epoch 232:

42/84 ----> loss: 0.743669

epoch 232:

52/84 ----> loss: 0.744808

epoch 232:

62/84 ----> loss: 0.743688

epoch 232:

72/84 ----> loss: 0.745130

epoch 232:

82/84 ----> loss: 0.743799

epoch 233:

8/84 ----> loss: 0.744106

epoch 233:

18/84 ----> loss: 0.743669

epoch 233:

28/84 ----> loss: 0.743674

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epoch 233:
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38/84 ----> loss: 0.743841


epoch 233:
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48/84 ----> loss: 0.743668


epoch 233:
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58/84 ----> loss: 0.743749


epoch 233:
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68/84 ----> loss: 0.743668


epoch 233:
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78/84 ----> loss: 0.743760


epoch 234:
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4/84 ----> loss: 0.743774


epoch 234:
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14/84 ----> loss: 0.743668


epoch 234:
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24/84 ----> loss: 0.743731
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epoch 234:
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34/84 ----> loss: 0.743668


epoch 234:
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44/84 ----> loss: 0.743668


epoch 234:
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54/84 ----> loss: 0.743907


epoch 234:
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64/84 ----> loss: 0.743864


epoch 234:
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74/84 ----> loss: 0.743668


epoch 235:
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0/84 ----> loss: 0.743668


epoch 235:
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10/84 ----> loss: 0.743733


epoch 235:
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20/84 ----> loss: 0.743668
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epoch 235:
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30/84 ----> loss: 0.743671


epoch 235:
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40/84 ----> loss: 0.743706


epoch 235:
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50/84 ----> loss: 0.743806


epoch 235:
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60/84 ----> loss: 0.743810


epoch 235:
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70/84 ----> loss: 0.743669


epoch 235:
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80/84 ----> loss: 0.743676


epoch 236:
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6/84 ----> loss: 0.743668


epoch 236:
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16/84 ----> loss: 0.743668
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epoch 236:
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26/84 ----> loss: 0.743851


epoch 236:
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36/84 ----> loss: 0.743668


epoch 236:
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46/84 ----> loss: 0.743948


epoch 236:
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56/84 ----> loss: 0.743731


epoch 236:
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66/84 ----> loss: 0.743668


epoch 236:
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76/84 ----> loss: 0.743668


epoch 237:
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2/84 ----> loss: 0.743756


epoch 237:
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12/84 ----> loss: 0.743668
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epoch 237:
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22/84 ----> loss: 0.743670


epoch 237:
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32/84 ----> loss: 0.743674


epoch 237:
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42/84 ----> loss: 0.743669


epoch 237:
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52/84 ----> loss: 0.744781


epoch 237:
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62/84 ----> loss: 0.743687


epoch 237:
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72/84 ----> loss: 0.745089


epoch 237:
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82/84 ----> loss: 0.743795


epoch 238:
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8/84 ----> loss: 0.744094
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epoch 238:
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18/84 ----> loss: 0.743669


epoch 238:
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28/84 ----> loss: 0.743673


epoch 238:
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38/84 ----> loss: 0.743835


epoch 238:
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48/84 ----> loss: 0.743668


epoch 238:
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58/84 ----> loss: 0.743747


epoch 238:
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68/84 ----> loss: 0.743668


epoch 238:
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78/84 ----> loss: 0.743757


epoch 239:
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4/84 ----> loss: 0.743771
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epoch 239:
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14/84 ----> loss: 0.743668


epoch 239:
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24/84 ----> loss: 0.743729


epoch 239:
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34/84 ----> loss: 0.743668


epoch 239:
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44/84 ----> loss: 0.743668


epoch 239:
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54/84 ----> loss: 0.743901


epoch 239:
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64/84 ----> loss: 0.743859


epoch 239:
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74/84 ----> loss: 0.743668


epoch 240:
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0/84 ----> loss: 0.743668
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epoch 240:
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10/84 ----> loss: 0.743731


epoch 240:
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20/84 ----> loss: 0.743668


epoch 240:
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30/84 ----> loss: 0.743671


epoch 240:
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40/84 ----> loss: 0.743706


epoch 240:
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50/84 ----> loss: 0.743802


epoch 240:
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60/84 ----> loss: 0.743807


epoch 240:
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70/84 ----> loss: 0.743669


epoch 240:
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80/84 ----> loss: 0.743675
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epoch 241:
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6/84 ----> loss: 0.743668


epoch 241:
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16/84 ----> loss: 0.743668


epoch 241:
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26/84 ----> loss: 0.743846


epoch 241:
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36/84 ----> loss: 0.743668


epoch 241:
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46/84 ----> loss: 0.743941


epoch 241:
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56/84 ----> loss: 0.743729


epoch 241:
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66/84 ----> loss: 0.743668


epoch 241:
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76/84 ----> loss: 0.743668
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epoch 242:
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2/84 ----> loss: 0.743753


epoch 242:
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12/84 ----> loss: 0.743668


epoch 242:
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22/84 ----> loss: 0.743670


epoch 242:
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32/84 ----> loss: 0.743674


epoch 242:
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42/84 ----> loss: 0.743669


epoch 242:
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52/84 ----> loss: 0.744754


epoch 242:
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62/84 ----> loss: 0.743686


epoch 242:
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72/84 ----> loss: 0.745050
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epoch 242:
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82/84 ----> loss: 0.743792


epoch 243:
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8/84 ----> loss: 0.744083


epoch 243:
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18/84 ----> loss: 0.743669


epoch 243:
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28/84 ----> loss: 0.743673


epoch 243:
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38/84 ----> loss: 0.743830


epoch 243:
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48/84 ----> loss: 0.743668


epoch 243:
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58/84 ----> loss: 0.743745


epoch 243:
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68/84 ----> loss: 0.743668
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epoch 243:
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78/84 ----> loss: 0.743755


epoch 244:
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4/84 ----> loss: 0.743768


epoch 244:
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14/84 ----> loss: 0.743668


epoch 244:
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24/84 ----> loss: 0.743728


epoch 244:
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34/84 ----> loss: 0.743668


epoch 244:
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44/84 ----> loss: 0.743668


epoch 244:
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54/84 ----> loss: 0.743895


epoch 244:
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64/84 ----> loss: 0.743854
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epoch 244:
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74/84 ----> loss: 0.743668


epoch 245:
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0/84 ----> loss: 0.743668


epoch 245:
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10/84 ----> loss: 0.743729


epoch 245:
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20/84 ----> loss: 0.743668


epoch 245:
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30/84 ----> loss: 0.743671


epoch 245:
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40/84 ----> loss: 0.743705


epoch 245:
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50/84 ----> loss: 0.743799


epoch 245:
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60/84 ----> loss: 0.743803
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epoch 245:

70/84 ----> loss: 0.743669

epoch 245:

80/84 ----> loss: 0.743675

epoch 246:

6/84 ----> loss: 0.743668

epoch 246:

16/84 ----> loss: 0.743668

epoch 246:

26/84 ----> loss: 0.743841

epoch 246:

36/84 ----> loss: 0.743668

epoch 246:

46/84 ----> loss: 0.743934

epoch 246:

56/84 ----> loss: 0.743727

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epoch 246:
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66/84 ----> loss: 0.743668


epoch 246:
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76/84 ----> loss: 0.743668


epoch 247:
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2/84 ----> loss: 0.743750


epoch 247:
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12/84 ----> loss: 0.743668


epoch 247:
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22/84 ----> loss: 0.743670


epoch 247:
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32/84 ----> loss: 0.743674


epoch 247:
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42/84 ----> loss: 0.743669


epoch 247:
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52/84 ----> loss: 0.744729
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epoch 247:
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62/84 ----> loss: 0.743685


epoch 247:
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72/84 ----> loss: 0.745013


epoch 247:
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82/84 ----> loss: 0.743788


epoch 248:
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8/84 ----> loss: 0.744072


epoch 248:
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18/84 ----> loss: 0.743669


epoch 248:
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28/84 ----> loss: 0.743673


epoch 248:
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38/84 ----> loss: 0.743825


epoch 248:
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48/84 ----> loss: 0.743668
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epoch 248:
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58/84 ----> loss: 0.743743


epoch 248:
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68/84 ----> loss: 0.743668


epoch 248:
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78/84 ----> loss: 0.743752


epoch 249:
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4/84 ----> loss: 0.743766


epoch 249:
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14/84 ----> loss: 0.743668


epoch 249:
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24/84 ----> loss: 0.743726


epoch 249:
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34/84 ----> loss: 0.743668


epoch 249:
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44/84 ----> loss: 0.743668


epoch 249:
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54/84 ----> loss: 0.743890


epoch 249:
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64/84 ----> loss: 0.743850


epoch 249:
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74/84 ----> loss: 0.743668


epoch 250:
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0/84 ----> loss: 0.743668


epoch 250:
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10/84 ----> loss: 0.743727


epoch 250:
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20/84 ----> loss: 0.743668


epoch 250:
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30/84 ----> loss: 0.743671


epoch 250:
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40/84 ----> loss: 0.743704


epoch 250:
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50/84 ----> loss: 0.743795


epoch 250:
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60/84 ----> loss: 0.743800


epoch 250:
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70/84 ----> loss: 0.743669


epoch 250:
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80/84 ----> loss: 0.743675


epoch 251:
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6/84 ----> loss: 0.743668


epoch 251:
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16/84 ----> loss: 0.743668


epoch 251:
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26/84 ----> loss: 0.743837


epoch 251:
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36/84 ----> loss: 0.743668


epoch 251:
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46/84 ----> loss: 0.743927


epoch 251:
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56/84 ----> loss: 0.743725


epoch 251:
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66/84 ----> loss: 0.743668


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76/84 ----> loss: 0.743668


epoch 252:
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2/84 ----> loss: 0.743748


epoch 252:
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12/84 ----> loss: 0.743668


epoch 252:
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22/84 ----> loss: 0.743670


epoch 252:
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32/84 ----> loss: 0.743674


epoch 252:
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42/84 ----> loss: 0.743669


epoch 252:
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52/84 ----> loss: 0.744705


epoch 252:
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62/84 ----> loss: 0.743685


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72/84 ----> loss: 0.744978


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82/84 ----> loss: 0.743785


epoch 253:
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8/84 ----> loss: 0.744062


epoch 253:
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18/84 ----> loss: 0.743669


epoch 253:
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28/84 ----> loss: 0.743673


epoch 253:
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38/84 ----> loss: 0.743821


epoch 253:
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48/84 ----> loss: 0.743668


epoch 253:
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58/84 ----> loss: 0.743741


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68/84 ----> loss: 0.743668


epoch 253:
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78/84 ----> loss: 0.743750


epoch 254:
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4/84 ----> loss: 0.743763


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14/84 ----> loss: 0.743668


epoch 254:
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24/84 ----> loss: 0.743725


epoch 254:
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34/84 ----> loss: 0.743668


epoch 254:
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64/84 ----> loss: 0.743845


epoch 254:
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74/84 ----> loss: 0.743668


epoch 255:
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0/84 ----> loss: 0.743668


epoch 255:
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10/84 ----> loss: 0.743725


epoch 255:
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20/84 ----> loss: 0.743668


epoch 255:
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30/84 ----> loss: 0.743671


epoch 255:
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40/84 ----> loss: 0.743703


epoch 255:
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epoch 255:
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70/84 ----> loss: 0.743669


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80/84 ----> loss: 0.743674


epoch 256:
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6/84 ----> loss: 0.743668


epoch 256:
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16/84 ----> loss: 0.743668


epoch 256:
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26/84 ----> loss: 0.743833


epoch 256:
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epoch 256:
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46/84 ----> loss: 0.743921


epoch 256:
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56/84 ----> loss: 0.743724


epoch 256:
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66/84 ----> loss: 0.743668


epoch 256:
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76/84 ----> loss: 0.743668


epoch 257:
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2/84 ----> loss: 0.743746


epoch 257:
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12/84 ----> loss: 0.743668


epoch 257:
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22/84 ----> loss: 0.743670


epoch 257:
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epoch 257:
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42/84 ----> loss: 0.743669


epoch 257:
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52/84 ----> loss: 0.744682


epoch 257:
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62/84 ----> loss: 0.743684


epoch 257:
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72/84 ----> loss: 0.744944


epoch 257:
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82/84 ----> loss: 0.743782


epoch 258:
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8/84 ----> loss: 0.744052


epoch 258:
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18/84 ----> loss: 0.743669


epoch 258:
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28/84 ----> loss: 0.743673


epoch 258:
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38/84 ----> loss: 0.743816


epoch 258:
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48/84 ----> loss: 0.743668


epoch 258:
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58/84 ----> loss: 0.743739


epoch 258:
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68/84 ----> loss: 0.743668


epoch 258:
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78/84 ----> loss: 0.743748


epoch 259:
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4/84 ----> loss: 0.743761


epoch 259:
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14/84 ----> loss: 0.743668


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44/84 ----> loss: 0.743668


epoch 259:
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54/84 ----> loss: 0.743880


epoch 259:
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64/84 ----> loss: 0.743841


epoch 259:
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74/84 ----> loss: 0.743668


epoch 260:
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0/84 ----> loss: 0.743668


epoch 260:
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10/84 ----> loss: 0.743724


epoch 260:
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20/84 ----> loss: 0.743668


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epoch 260:
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epoch 260:
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60/84 ----> loss: 0.743793


epoch 260:
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70/84 ----> loss: 0.743669


epoch 260:
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80/84 ----> loss: 0.743674


epoch 261:
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6/84 ----> loss: 0.743668


epoch 261:
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16/84 ----> loss: 0.743668


epoch 261:
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26/84 ----> loss: 0.743829


epoch 261:
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36/84 ----> loss: 0.743668


epoch 261:
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46/84 ----> loss: 0.743915


epoch 261:
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56/84 ----> loss: 0.743722


epoch 261:
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66/84 ----> loss: 0.743668


epoch 261:
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76/84 ----> loss: 0.743668


epoch 262:
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2/84 ----> loss: 0.743744


epoch 262:
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12/84 ----> loss: 0.743668


epoch 262:
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22/84 ----> loss: 0.743670


epoch 262:
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32/84 ----> loss: 0.743673


epoch 262:
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42/84 ----> loss: 0.743669


epoch 262:
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52/84 ----> loss: 0.744660


epoch 262:
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62/84 ----> loss: 0.743684


epoch 262:
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72/84 ----> loss: 0.744912


epoch 262:
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82/84 ----> loss: 0.743779


epoch 263:
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8/84 ----> loss: 0.744043


epoch 263:
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18/84 ----> loss: 0.743669


epoch 263:
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28/84 ----> loss: 0.743672


epoch 263:
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38/84 ----> loss: 0.743812


epoch 263:
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48/84 ----> loss: 0.743668


epoch 263:
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58/84 ----> loss: 0.743737


epoch 263:
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68/84 ----> loss: 0.743668


epoch 263:
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78/84 ----> loss: 0.743746


epoch 264:
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4/84 ----> loss: 0.743758


epoch 264:
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14/84 ----> loss: 0.743668


epoch 264:
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24/84 ----> loss: 0.743722


epoch 264:
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34/84 ----> loss: 0.743668


epoch 264:
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44/84 ----> loss: 0.743668


epoch 264:
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54/84 ----> loss: 0.743875


epoch 264:
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64/84 ----> loss: 0.743837


epoch 264:
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74/84 ----> loss: 0.743668


epoch 265:
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0/84 ----> loss: 0.743668


epoch 265:
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10/84 ----> loss: 0.743722


epoch 265:
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20/84 ----> loss: 0.743668


epoch 265:
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30/84 ----> loss: 0.743671


epoch 265:
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40/84 ----> loss: 0.743702


epoch 265:
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50/84 ----> loss: 0.743787


epoch 265:
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60/84 ----> loss: 0.743790


epoch 265:
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70/84 ----> loss: 0.743669


epoch 265:
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80/84 ----> loss: 0.743674


epoch 266:
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6/84 ----> loss: 0.743668


epoch 266:
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16/84 ----> loss: 0.743668


epoch 266:
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26/84 ----> loss: 0.743825


epoch 266:
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36/84 ----> loss: 0.743668


epoch 266:
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46/84 ----> loss: 0.743909


epoch 266:
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56/84 ----> loss: 0.743720


epoch 266:
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66/84 ----> loss: 0.743668


epoch 266:
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76/84 ----> loss: 0.743668


epoch 267:
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2/84 ----> loss: 0.743742


epoch 267:
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12/84 ----> loss: 0.743668


epoch 267:
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22/84 ----> loss: 0.743670


epoch 267:
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32/84 ----> loss: 0.743673


epoch 267:
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42/84 ----> loss: 0.743669


epoch 267:
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52/84 ----> loss: 0.744638


epoch 267:
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62/84 ----> loss: 0.743683


epoch 267:
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72/84 ----> loss: 0.744881


epoch 267:
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82/84 ----> loss: 0.743776


epoch 268:
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8/84 ----> loss: 0.744034


epoch 268:
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18/84 ----> loss: 0.743669


epoch 268:
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28/84 ----> loss: 0.743672


epoch 268:
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38/84 ----> loss: 0.743808


epoch 268:
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48/84 ----> loss: 0.743668


epoch 268:
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58/84 ----> loss: 0.743736


epoch 268:
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68/84 ----> loss: 0.743668


epoch 268:
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78/84 ----> loss: 0.743744


epoch 269:
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4/84 ----> loss: 0.743756


epoch 269:
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14/84 ----> loss: 0.743668


epoch 269:
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24/84 ----> loss: 0.743721


epoch 269:
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34/84 ----> loss: 0.743668


epoch 269:
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44/84 ----> loss: 0.743668


epoch 269:
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54/84 ----> loss: 0.743871


epoch 269:
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64/84 ----> loss: 0.743833


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74/84 ----> loss: 0.743668


epoch 270:
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epoch 270:
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10/84 ----> loss: 0.743720


epoch 270:
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20/84 ----> loss: 0.743668


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30/84 ----> loss: 0.743671


epoch 270:
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40/84 ----> loss: 0.743701


epoch 270:
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50/84 ----> loss: 0.743784


epoch 270:
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60/84 ----> loss: 0.743787


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70/84 ----> loss: 0.743669


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80/84 ----> loss: 0.743674


epoch 271:
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16/84 ----> loss: 0.743668


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26/84 ----> loss: 0.743821
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epoch 271:
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36/84 ----> loss: 0.743668


epoch 271:
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46/84 ----> loss: 0.743904


epoch 271:
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56/84 ----> loss: 0.743719


epoch 271:
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66/84 ----> loss: 0.743668


epoch 271:
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76/84 ----> loss: 0.743668


epoch 272:
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2/84 ----> loss: 0.743740


epoch 272:
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12/84 ----> loss: 0.743668


epoch 272:
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22/84 ----> loss: 0.743670
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epoch 272:

32/84 ----> loss: 0.743673

epoch 272:

42/84 ----> loss: 0.743669

epoch 272:

52/84 ----> loss: 0.744618

epoch 272:

62/84 ----> loss: 0.743682

epoch 272:

72/84 ----> loss: 0.744852

epoch 272:

82/84 ----> loss: 0.743773

epoch 273:

8/84 ----> loss: 0.744025

epoch 273:

18/84 ----> loss: 0.743669

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epoch 273:
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28/84 ----> loss: 0.743672


epoch 273:
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38/84 ----> loss: 0.743805


epoch 273:
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48/84 ----> loss: 0.743668


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58/84 ----> loss: 0.743734


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epoch 273:
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78/84 ----> loss: 0.743742


epoch 274:
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4/84 ----> loss: 0.743754


epoch 274:
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14/84 ----> loss: 0.743668
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epoch 274:
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24/84 ----> loss: 0.743720


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epoch 274:
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54/84 ----> loss: 0.743866


epoch 274:
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64/84 ----> loss: 0.743830


epoch 274:
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74/84 ----> loss: 0.743668


epoch 275:
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epoch 275:
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10/84 ----> loss: 0.743719
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20/84 ----> loss: 0.743668


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epoch 275:
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epoch 276:
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epoch 276:
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16/84 ----> loss: 0.743668


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epoch 276:
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epoch 276:
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76/84 ----> loss: 0.743668


epoch 277:
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12/84 ----> loss: 0.743668


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epoch 277:
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epoch 277:
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epoch 278:
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8/84 ----> loss: 0.744017


epoch 278:
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18/84 ----> loss: 0.743669


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epoch 278:
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epoch 278:
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68/84 ----> loss: 0.743668


epoch 278:
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78/84 ----> loss: 0.743740
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epoch 279:
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4/84 ----> loss: 0.743752


epoch 279:
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14/84 ----> loss: 0.743668


epoch 279:
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24/84 ----> loss: 0.743719


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epoch 279:
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54/84 ----> loss: 0.743862


epoch 279:
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64/84 ----> loss: 0.743826


epoch 279:
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74/84 ----> loss: 0.743668
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epoch 280:
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0/84 ----> loss: 0.743668


epoch 280:
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10/84 ----> loss: 0.743717


epoch 280:
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20/84 ----> loss: 0.743668


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epoch 280:
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epoch 280:
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80/84 ----> loss: 0.743673


epoch 281:
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epoch 281:
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epoch 281:
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epoch 281:
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epoch 281:
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46/84 ----> loss: 0.743894


epoch 281:
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56/84 ----> loss: 0.743716


epoch 281:
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66/84 ----> loss: 0.743668
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epoch 281:
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76/84 ----> loss: 0.743668


epoch 282:
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2/84 ----> loss: 0.743736


epoch 282:
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12/84 ----> loss: 0.743668


epoch 282:
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22/84 ----> loss: 0.743670


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32/84 ----> loss: 0.743673


epoch 282:
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42/84 ----> loss: 0.743669


epoch 282:
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52/84 ----> loss: 0.744579


epoch 282:
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62/84 ----> loss: 0.743681
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epoch 282:
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72/84 ----> loss: 0.744797


epoch 282:
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82/84 ----> loss: 0.743768


epoch 283:
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8/84 ----> loss: 0.744010


epoch 283:
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18/84 ----> loss: 0.743669


epoch 283:
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28/84 ----> loss: 0.743672


epoch 283:
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38/84 ----> loss: 0.743797


epoch 283:
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48/84 ----> loss: 0.743668


epoch 283:
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58/84 ----> loss: 0.743731
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epoch 283:
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68/84 ----> loss: 0.743668


epoch 283:
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78/84 ----> loss: 0.743739


epoch 284:
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4/84 ----> loss: 0.743750


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14/84 ----> loss: 0.743668


epoch 284:
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24/84 ----> loss: 0.743718


epoch 284:
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epoch 284:
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44/84 ----> loss: 0.743668


epoch 284:
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54/84 ----> loss: 0.743858
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epoch 284:
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64/84 ----> loss: 0.743823


epoch 284:
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74/84 ----> loss: 0.743668


epoch 285:
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epoch 285:
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10/84 ----> loss: 0.743716


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20/84 ----> loss: 0.743668


epoch 285:
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30/84 ----> loss: 0.743670


epoch 285:
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epoch 285:
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epoch 285:
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60/84 ----> loss: 0.743779


epoch 285:
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epoch 286:
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epoch 286:
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26/84 ----> loss: 0.743811


epoch 286:
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36/84 ----> loss: 0.743668


epoch 286:
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46/84 ----> loss: 0.743889
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epoch 286:
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56/84 ----> loss: 0.743715


epoch 286:
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epoch 286:
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76/84 ----> loss: 0.743668


epoch 287:
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epoch 287:
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epoch 287:
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32/84 ----> loss: 0.743673


epoch 287:
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42/84 ----> loss: 0.743669
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epoch 287:

52/84 ----> loss: 0.744561

epoch 287:

62/84 ----> loss: 0.743681

epoch 287:

72/84 ----> loss: 0.744772

epoch 287:

82/84 ----> loss: 0.743766

epoch 288:

8/84 ----> loss: 0.744002

epoch 288:

18/84 ----> loss: 0.743669

epoch 288:

28/84 ----> loss: 0.743672

epoch 288:

38/84 ----> loss: 0.743794

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epoch 288:
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48/84 ----> loss: 0.743668


epoch 288:
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58/84 ----> loss: 0.743730


epoch 288:
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68/84 ----> loss: 0.743668


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78/84 ----> loss: 0.743737


epoch 289:
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14/84 ----> loss: 0.743668


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epoch 289:
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epoch 289:
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44/84 ----> loss: 0.743668


epoch 289:
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54/84 ----> loss: 0.743854


epoch 289:
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64/84 ----> loss: 0.743819


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epoch 290:
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epoch 290:
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40/84 ----> loss: 0.743699


epoch 290:
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epoch 291:
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6/84 ----> loss: 0.743668


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16/84 ----> loss: 0.743668


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26/84 ----> loss: 0.743808
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epoch 291:
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36/84 ----> loss: 0.743668


epoch 291:
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46/84 ----> loss: 0.743884


epoch 291:
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56/84 ----> loss: 0.743714


epoch 291:
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66/84 ----> loss: 0.743668


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76/84 ----> loss: 0.743668


epoch 292:
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epoch 292:
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epoch 292:
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32/84 ----> loss: 0.743672


epoch 292:
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42/84 ----> loss: 0.743669


epoch 292:
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52/84 ----> loss: 0.744543


epoch 292:
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62/84 ----> loss: 0.743681


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72/84 ----> loss: 0.744747


epoch 292:
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82/84 ----> loss: 0.743764


epoch 293:
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8/84 ----> loss: 0.743995


epoch 293:
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18/84 ----> loss: 0.743669
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epoch 293:
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28/84 ----> loss: 0.743672


epoch 293:
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epoch 293:
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48/84 ----> loss: 0.743668


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58/84 ----> loss: 0.743728


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68/84 ----> loss: 0.743668


epoch 293:
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78/84 ----> loss: 0.743736


epoch 294:
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epoch 294:
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14/84 ----> loss: 0.743668
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epoch 294:
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24/84 ----> loss: 0.743716


epoch 294:
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34/84 ----> loss: 0.743668


epoch 294:
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44/84 ----> loss: 0.743668


epoch 294:
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54/84 ----> loss: 0.743851


epoch 294:
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64/84 ----> loss: 0.743816


epoch 294:
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74/84 ----> loss: 0.743668


epoch 295:
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epoch 295:
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10/84 ----> loss: 0.743713


epoch 295:
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20/84 ----> loss: 0.743668


epoch 295:
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30/84 ----> loss: 0.743670


epoch 295:
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epoch 295:
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epoch 295:
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70/84 ----> loss: 0.743669


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epoch 296:
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6/84 ----> loss: 0.743668


epoch 296:
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16/84 ----> loss: 0.743668


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26/84 ----> loss: 0.743805


epoch 296:
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epoch 296:
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46/84 ----> loss: 0.743880


epoch 296:
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epoch 296:
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66/84 ----> loss: 0.743668


epoch 296:
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76/84 ----> loss: 0.743668


epoch 297:
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2/84 ----> loss: 0.743731


epoch 297:
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12/84 ----> loss: 0.743668


epoch 297:
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22/84 ----> loss: 0.743669


epoch 297:
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32/84 ----> loss: 0.743672


epoch 297:
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42/84 ----> loss: 0.743669


epoch 297:
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52/84 ----> loss: 0.744527


epoch 297:
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62/84 ----> loss: 0.743680


epoch 297:
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72/84 ----> loss: 0.744723


epoch 297:
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82/84 ----> loss: 0.743761


epoch 298:
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8/84 ----> loss: 0.743988


epoch 298:
--------------------------------------------------------------------------------
--------------------
18/84 ----> loss: 0.743669


epoch 298:
--------------------------------------------------------------------------------
--------------------
28/84 ----> loss: 0.743672


epoch 298:
--------------------------------------------------------------------------------
--------------------
38/84 ----> loss: 0.743788


epoch 298:
--------------------------------------------------------------------------------
--------------------
48/84 ----> loss: 0.743668


epoch 298:
--------------------------------------------------------------------------------
--------------------
58/84 ----> loss: 0.743727


epoch 298:
--------------------------------------------------------------------------------
--------------------
68/84 ----> loss: 0.743668


epoch 298:
--------------------------------------------------------------------------------
--------------------
```

78/84 ----> loss: 0.743734

epoch 299:

4/84 ----> loss: 0.743745

epoch 299:

14/84 ----> loss: 0.743668

epoch 299:

24/84 ----> loss: 0.743715

epoch 299:

34/84 ----> loss: 0.743668

epoch 299:

44/84 ----> loss: 0.743668

epoch 299:

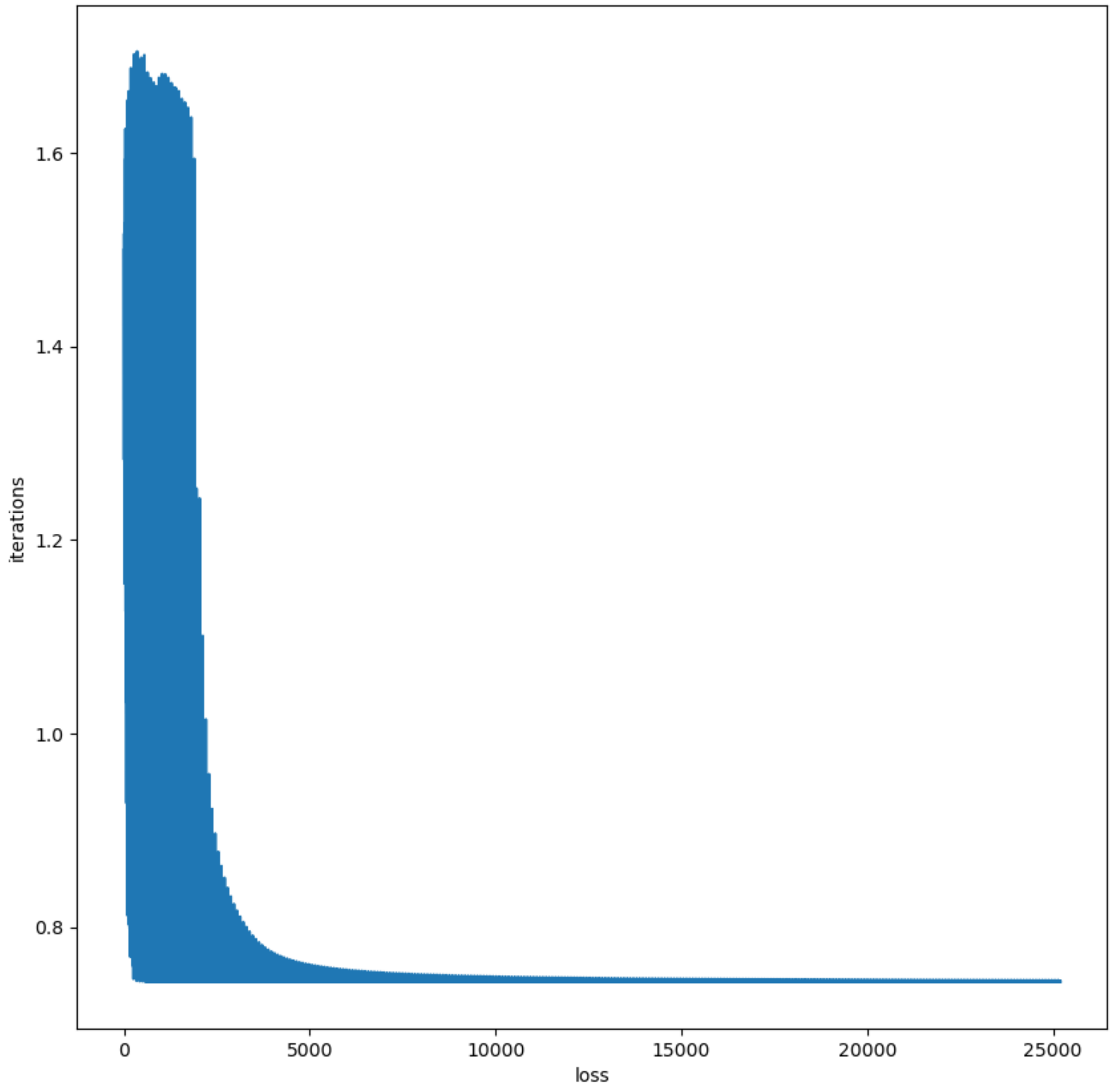
54/84 ----> loss: 0.743847

epoch 299:

64/84 ----> loss: 0.743813

epoch 299:


```
74/84 ----> loss: 0.743668
```



[307]:
```python
accuracy = testing(X_test,y_test.to_numpy().ravel(),model,printFn=False)
print(accuracy)
```

```
Accuracy:  0.9459459459459459
(0.9459459459459459, [tensor(2), tensor(3), tensor(1), tensor(0), tensor(0),
tensor(2), tensor(2), tensor(0), tensor(0), tensor(0), tensor(2), tensor(0),
tensor(3), tensor(2), tensor(1), tensor(0), tensor(2), tensor(3), tensor(2),
tensor(2), tensor(3), tensor(3), tensor(1), tensor(0), tensor(1), tensor(1),
tensor(2), tensor(1), tensor(1), tensor(2), tensor(3), tensor(0), tensor(2),
tensor(2), tensor(0), tensor(2), tensor(3)])
```

[308]:
```
#torch.save(model.state_dict(), "model.pth")
#print("Saved PyTorch Model State to model.pth")
```

[474]:
```
model = NeuralNetwork().to(device)
model.load_state_dict(torch.load("model.pth"))
model.eval()
```

[474]:
```
NeuralNetwork(
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=20, out_features=30, bias=True)
    (1): Linear(in_features=30, out_features=30, bias=True)
    (2): Linear(in_features=30, out_features=10, bias=True)
    (3): Linear(in_features=10, out_features=4, bias=True)
    (4): Softmax(dim=None)
  )
)
```

[475]:
```
accuracy,preds = testing(X_test,y_test.to_numpy().ravel(),model,printFn=False)
print(accuracy)
```

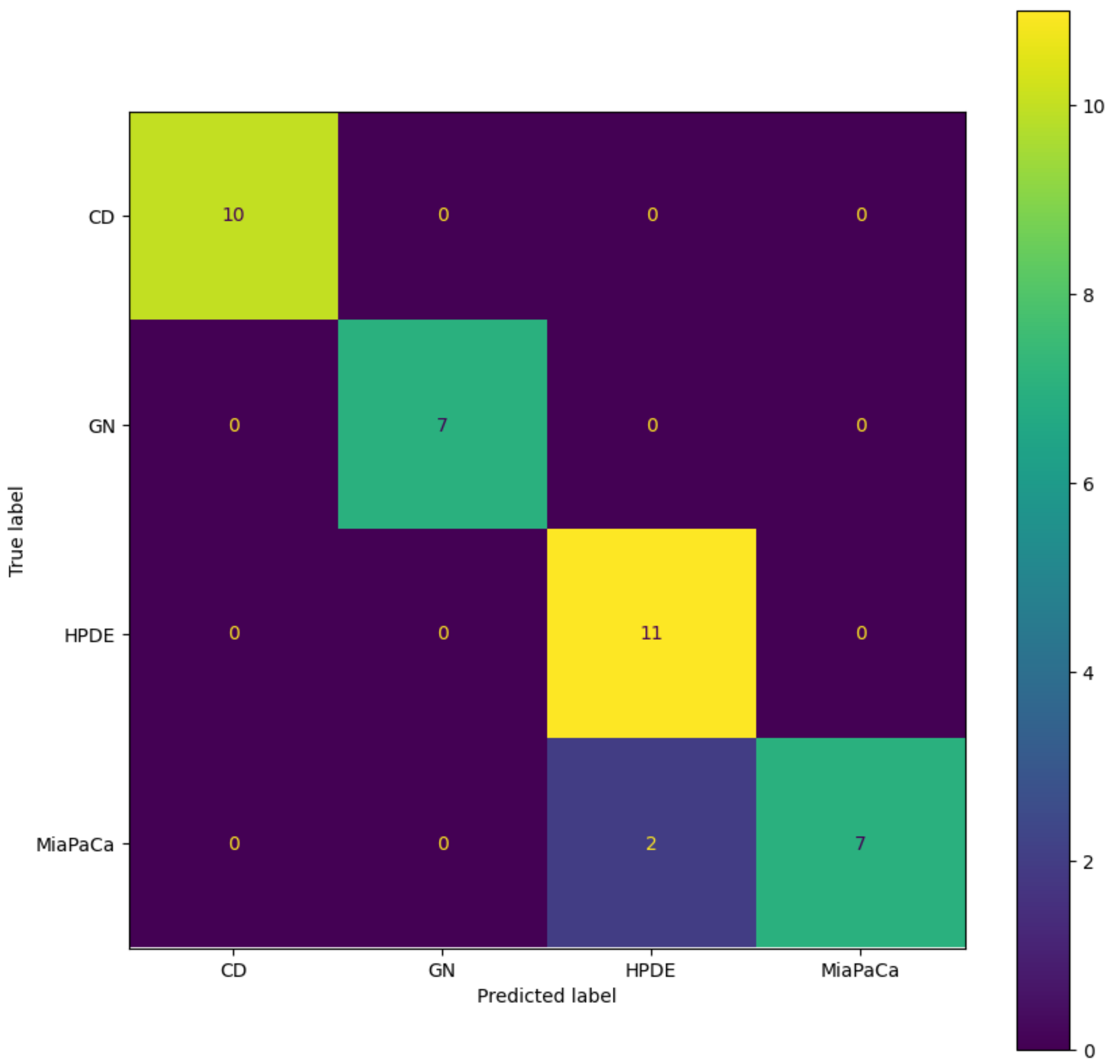
```
Accuracy:  0.9459459459459459
0.9459459459459459
```

```
C:\Users\brian\Anaconda3\Lib\site-packages\torch\nn\modules\module.py:1518:
UserWarning: Implicit dimension choice for softmax has been deprecated. Change
the call to include dim=X as an argument.
  return self._call_impl(*args, **kwargs)
```

[476]:
```
res = []
for l in [0,1,2,3]:
     prec,recall,_,_ = precision_recall_fscore_support(np.array(y_test)==l,
                                                       np.array(preds)==l,
                                                       pos_label=True,average=None)
     res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')

confusion_mat = metrics.confusion_matrix(y_test.values.ravel(), np.
 ↪array(preds),labels=[0,1,2,3])

print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
```

```
cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = confusion_mat,
    display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
Specificity:
     label  specificity
0       CD     1.000000
1       GN     1.000000
2     HPDE     0.923077
3  MiaPaCa     1.000000
Sensitivity:
     label  sensitivity
0       CD     1.000000
1       GN     1.000000
2     HPDE     1.000000
3  MiaPaCa     0.777778
```



[477]:
```
print('Overall specificity: ', statistics_df['specificity'].mean())
print('Overall sensitivity: ', statistics_df['sensitivity'].mean())
```

```
Overall specificity:  0.9807692307692308
Overall sensitivity:  0.9444444444444444
```

This results display better accuracy, sensitivity, and specificity. My accuracy: 94% whereas the study's accuracy is 90%. My specificity: 98% whereas the study's specificity is 97%. Finally, my sensitivity: 95% whereas the study's sensitivity is 91%. Overall, the neural network seems to work better!

[478]:
```
model
```

[478]:
```
NeuralNetwork(
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=20, out_features=30, bias=True)
    (1): Linear(in_features=30, out_features=30, bias=True)
    (2): Linear(in_features=30, out_features=10, bias=True)
    (3): Linear(in_features=10, out_features=4, bias=True)
    (4): Softmax(dim=None)
  )
)
```

[479]:
```
from sklearn.model_selection import KFold

split = 25

#kfold = KFold(n_splits=X.shape[0], shuffle=True)
kfold = KFold(n_splits=split, shuffle=True)

all_pred = np.array([])
y_match = np.array([])
accuracies = []
for fold, (train_ids, test_ids) in enumerate(kfold.split(X)):

    model = NeuralNetwork().to(device)
    learning_rate = 0.01
    epoch = 300
    batch = 11

    loss_fn = nn.CrossEntropyLoss()

    optimizer = torch.optim.SGD(model.parameters(), lr=learning_rate)


    loss_count, count = train_loop(X[train_ids],
```

```
                                y.to_numpy().ravel()[train_ids],
                                model,
                                epoch, batch,
                                loss_fn,
                                optimizer,
                                printFn=False)

    accuracy,preds = testing(X[test_ids],y.to_numpy().
 ↪ravel()[test_ids],model,printFn=False)
    accuracies.append(accuracy)
    all_pred = np.append(all_pred,preds)
    y_match = np.append(y_match,y.to_numpy().ravel()[test_ids])

print('Overall Accuracy: ', np.array(accuracies).mean())
confusion_mat = confusion_matrix(y_match, all_pred, labels=[0,1,2,3])

res = []
for l in [0,1,2,3]:
    prec,recall,_,_ = precision_recall_fscore_support(y_match==l,
                                               all_pred==l,
                                               labels=[0,1,2,3],
                                               pos_label=True,
                                               average=None)
    res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')


print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = confusion_mat,␣
 ↪display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
C:\Users\brian\Anaconda3\Lib\site-packages\torch\nn\modules\module.py:1518:
UserWarning: Implicit dimension choice for softmax has been deprecated. Change
the call to include dim=X as an argument.
  return self._call_impl(*args, **kwargs)
```

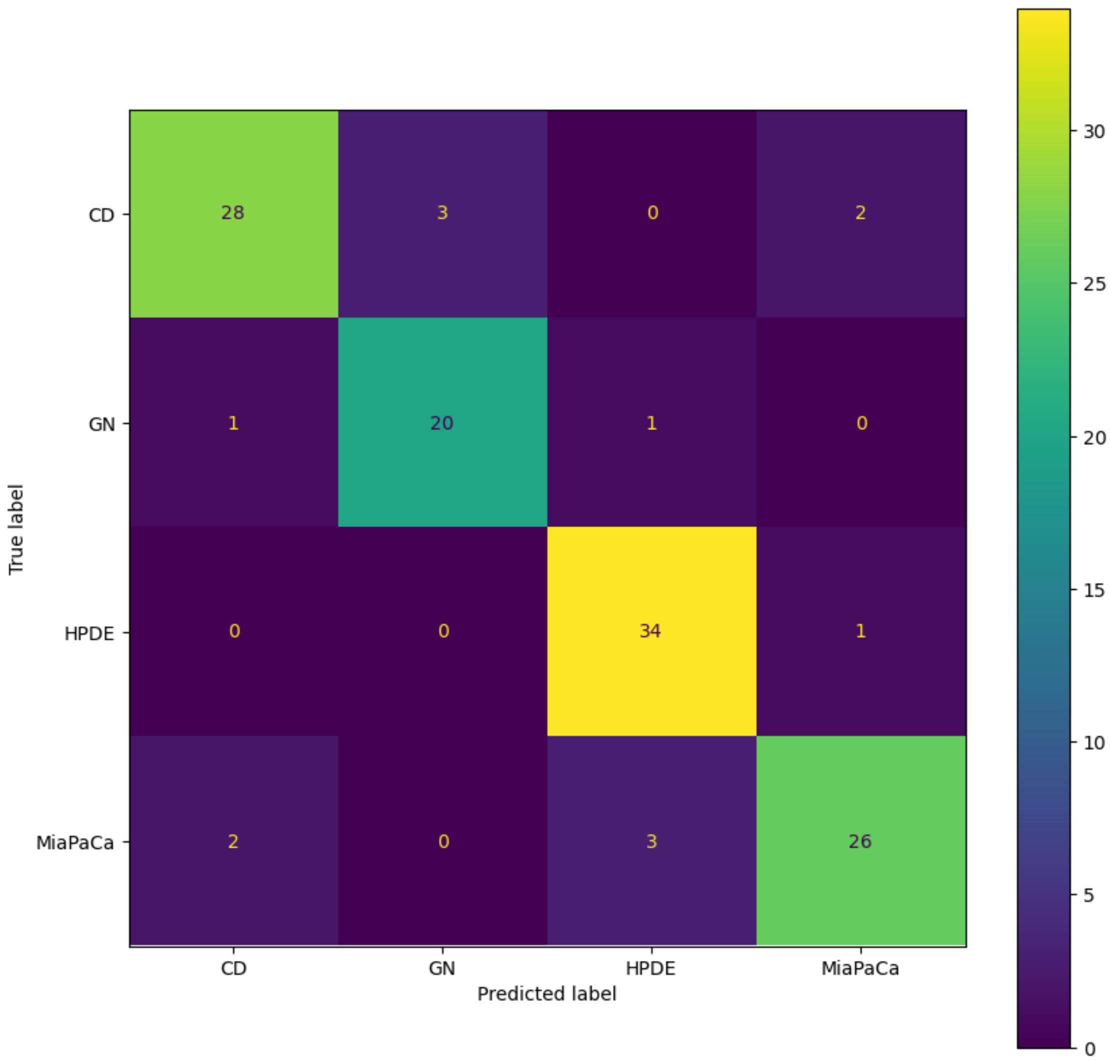
```
Accuracy:  1.0
Accuracy:  0.8
```

```
Accuracy:  0.8
Accuracy:  0.8
Accuracy:  0.6
Accuracy:  0.8
Accuracy:  0.8
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  0.8
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  0.8
Accuracy:  0.6
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  0.8
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  0.75
Overall Accuracy:  0.894
Specificity:
      label  specificity
0       CD     0.965909
1       GN     0.969697
2     HPDE     0.953488
3  MiaPaCa     0.966667
Sensitivity:
      label  sensitivity
0       CD     0.848485
1       GN     0.909091
2     HPDE     0.971429
3  MiaPaCa     0.838710
Overall Specificity:
 specificity    0.96394
dtype: float64
Overall Sensitivity:
 sensitivity    0.891929
dtype: float64
```

```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```

```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
is ill-defined and being set to 0.0 in labels with no true samples. Use
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
F-score is ill-defined and being set to 0.0 in labels with no true nor predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
is ill-defined and being set to 0.0 in labels with no true samples. Use
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
F-score is ill-defined and being set to 0.0 in labels with no true nor predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
is ill-defined and being set to 0.0 in labels with no true samples. Use
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
F-score is ill-defined and being set to 0.0 in labels with no true nor predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
is ill-defined and being set to 0.0 in labels with no true samples. Use
```

```
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
F-score is ill-defined and being set to 0.0 in labels with no true nor predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```



Let us see whether non-PCA transformed data works better with the neural network.

[494]:
```
model
```

[494]:
```
NeuralNetwork(
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=1013, out_features=30, bias=True)
```

```
    (1): Linear(in_features=30, out_features=30, bias=True)
    (2): Linear(in_features=30, out_features=10, bias=True)
    (3): Linear(in_features=10, out_features=4, bias=True)
    (4): Softmax(dim=None)
  )
)
```

[495]:
```
model.linear_relu_stack.add_module('0', nn.Linear(1013,30))
#model.linear_relu_stack.add_module('1', nn.ReLU())
#model.linear_relu_stack.add_module('2', nn.Linear(30,30))
#model.linear_relu_stack.add_module('3', nn.Linear(30,10))
#model.linear_relu_stack.add_module('4', nn.Linear(10,4))
#model.linear_relu_stack.add_module('5', nn.Softmax(dim=0))
```

[496]:
```
print(model)

learning_rate = 0.01
epoch = 300
batch = 11

loss_fn = nn.CrossEntropyLoss()

optimizer = torch.optim.SGD(model.parameters(), lr=learning_rate)


loss_count, count = train_loop(X_train_noPCA.values, y_train_noPCA.to_numpy().
 ↪ravel(), model, epoch, batch, loss_fn, optimizer, printFn=True)
```

```
NeuralNetwork(
  (linear_relu_stack): Sequential(
    (0): Linear(in_features=1013, out_features=30, bias=True)
    (1): Linear(in_features=30, out_features=30, bias=True)
    (2): Linear(in_features=30, out_features=10, bias=True)
    (3): Linear(in_features=10, out_features=4, bias=True)
    (4): Softmax(dim=None)
  )
)


epoch 0:
--------------------------------------------------------------------------------
--------------------
0/84 ----> loss: 1.281213


epoch 0:
--------------------------------------------------------------------------------
```

```
--------------------
10/84 ----> loss: 0.743937


epoch 0:
--------------------------------------------------------------------------------
--------------------
20/84 ----> loss: 1.581696


epoch 0:
--------------------------------------------------------------------------------
--------------------
30/84 ----> loss: 1.743650


epoch 0:
--------------------------------------------------------------------------------
--------------------
40/84 ----> loss: 0.825755


epoch 0:
--------------------------------------------------------------------------------
--------------------
50/84 ----> loss: 0.754118


epoch 0:
--------------------------------------------------------------------------------
--------------------
60/84 ----> loss: 1.505596


epoch 0:
--------------------------------------------------------------------------------
--------------------
70/84 ----> loss: 1.694448


epoch 0:
--------------------------------------------------------------------------------
--------------------
80/84 ----> loss: 0.745640


epoch 1:
--------------------------------------------------------------------------------
```

```
--------------------
6/84 ----> loss: 1.702444


epoch 1:
--------------------------------------------------------------------------------
--------------------
16/84 ----> loss: 0.743671


epoch 1:
--------------------------------------------------------------------------------
--------------------
26/84 ----> loss: 0.743676

C:\Users\brian\Anaconda3\Lib\site-packages\torch\nn\modules\module.py:1518:
UserWarning: Implicit dimension choice for softmax has been deprecated. Change
the call to include dim=X as an argument.
  return self._call_impl(*args, **kwargs)


epoch 1:
--------------------------------------------------------------------------------
--------------------
36/84 ----> loss: 0.821890


epoch 1:
--------------------------------------------------------------------------------
--------------------
46/84 ----> loss: 0.743680


epoch 1:
--------------------------------------------------------------------------------
--------------------
56/84 ----> loss: 1.166392


epoch 1:
--------------------------------------------------------------------------------
--------------------
66/84 ----> loss: 0.774919


epoch 1:
--------------------------------------------------------------------------------
--------------------
```

```
76/84 ----> loss: 0.743670


epoch 2:
--------------------------------------------------------------------------------
--------------------
2/84 ----> loss: 0.743669


epoch 2:
--------------------------------------------------------------------------------
--------------------
12/84 ----> loss: 1.743587


epoch 2:
--------------------------------------------------------------------------------
--------------------
22/84 ----> loss: 1.677501


epoch 2:
--------------------------------------------------------------------------------
--------------------
32/84 ----> loss: 0.743668


epoch 2:
--------------------------------------------------------------------------------
--------------------
42/84 ----> loss: 0.750224


epoch 2:
--------------------------------------------------------------------------------
--------------------
52/84 ----> loss: 0.743669


epoch 2:
--------------------------------------------------------------------------------
--------------------
62/84 ----> loss: 0.746304


epoch 2:
--------------------------------------------------------------------------------
--------------------
```

```
72/84 ----> loss: 0.743671


epoch 2:
--------------------------------------------------------------------------------
--------------------
82/84 ----> loss: 1.277410


epoch 3:
--------------------------------------------------------------------------------
--------------------
8/84 ----> loss: 1.390721


epoch 3:
--------------------------------------------------------------------------------
--------------------
18/84 ----> loss: 1.738103


epoch 3:
--------------------------------------------------------------------------------
--------------------
28/84 ----> loss: 0.743671


epoch 3:
--------------------------------------------------------------------------------
--------------------
38/84 ----> loss: 1.743215


epoch 3:
--------------------------------------------------------------------------------
--------------------
48/84 ----> loss: 0.770878


epoch 3:
--------------------------------------------------------------------------------
--------------------
58/84 ----> loss: 0.743671


epoch 3:
--------------------------------------------------------------------------------
--------------------
```

```
68/84 ----> loss: 0.743669


epoch 3:
--------------------------------------------------------------------------------
--------------------
78/84 ----> loss: 0.743670


epoch 4:
--------------------------------------------------------------------------------
--------------------
4/84 ----> loss: 1.743667


epoch 4:
--------------------------------------------------------------------------------
--------------------
14/84 ----> loss: 1.743668


epoch 4:
--------------------------------------------------------------------------------
--------------------
24/84 ----> loss: 1.743668


epoch 4:
--------------------------------------------------------------------------------
--------------------
34/84 ----> loss: 0.743668


epoch 4:
--------------------------------------------------------------------------------
--------------------
44/84 ----> loss: 0.743668


epoch 4:
--------------------------------------------------------------------------------
--------------------
54/84 ----> loss: 1.743668


epoch 4:
--------------------------------------------------------------------------------
--------------------
```

```
64/84 ----> loss: 1.684607


epoch 4:
--------------------------------------------------------------------------------
--------------------
74/84 ----> loss: 0.743668


epoch 5:
--------------------------------------------------------------------------------
--------------------
0/84 ----> loss: 0.743668


epoch 5:
--------------------------------------------------------------------------------
--------------------
10/84 ----> loss: 0.743669


epoch 5:
--------------------------------------------------------------------------------
--------------------
20/84 ----> loss: 0.748420


epoch 5:
--------------------------------------------------------------------------------
--------------------
30/84 ----> loss: 1.743599


epoch 5:
--------------------------------------------------------------------------------
--------------------
40/84 ----> loss: 0.743669


epoch 5:
--------------------------------------------------------------------------------
--------------------
50/84 ----> loss: 0.743669


epoch 5:
--------------------------------------------------------------------------------
--------------------
```

```
60/84 ----> loss: 0.743706


epoch 5:
--------------------------------------------------------------------------------
--------------------
70/84 ----> loss: 0.747257


epoch 5:
--------------------------------------------------------------------------------
--------------------
80/84 ----> loss: 0.743670


epoch 6:
--------------------------------------------------------------------------------
--------------------
6/84 ----> loss: 0.743682


epoch 6:
--------------------------------------------------------------------------------
--------------------
16/84 ----> loss: 0.743668


epoch 6:
--------------------------------------------------------------------------------
--------------------
26/84 ----> loss: 0.743669


epoch 6:
--------------------------------------------------------------------------------
--------------------
36/84 ----> loss: 1.320114


epoch 6:
--------------------------------------------------------------------------------
--------------------
46/84 ----> loss: 0.743671


epoch 6:
--------------------------------------------------------------------------------
--------------------
```

```
56/84 ----> loss: 0.751883


epoch 6:
--------------------------------------------------------------------------------
--------------------
66/84 ----> loss: 0.743668


epoch 6:
--------------------------------------------------------------------------------
--------------------
76/84 ----> loss: 0.743673


epoch 7:
--------------------------------------------------------------------------------
--------------------
2/84 ----> loss: 0.743668


epoch 7:
--------------------------------------------------------------------------------
--------------------
12/84 ----> loss: 1.741231


epoch 7:
--------------------------------------------------------------------------------
--------------------
22/84 ----> loss: 0.743668


epoch 7:
--------------------------------------------------------------------------------
--------------------
32/84 ----> loss: 0.743668


epoch 7:
--------------------------------------------------------------------------------
--------------------
42/84 ----> loss: 0.751994


epoch 7:
--------------------------------------------------------------------------------
--------------------
```

```
52/84 ----> loss: 0.743668


epoch 7:
--------------------------------------------------------------------------------
--------------------
62/84 ----> loss: 0.743668


epoch 7:
--------------------------------------------------------------------------------
--------------------
72/84 ----> loss: 0.743669


epoch 7:
--------------------------------------------------------------------------------
--------------------
82/84 ----> loss: 0.743684


epoch 8:
--------------------------------------------------------------------------------
--------------------
8/84 ----> loss: 0.743668


epoch 8:
--------------------------------------------------------------------------------
--------------------
18/84 ----> loss: 1.735373


epoch 8:
--------------------------------------------------------------------------------
--------------------
28/84 ----> loss: 0.743668


epoch 8:
--------------------------------------------------------------------------------
--------------------
38/84 ----> loss: 1.743619


epoch 8:
--------------------------------------------------------------------------------
--------------------
```

```
48/84 ----> loss: 0.743671


epoch 8:
--------------------------------------------------------------------------------
--------------------
58/84 ----> loss: 0.743668


epoch 8:
--------------------------------------------------------------------------------
--------------------
68/84 ----> loss: 0.743669


epoch 8:
--------------------------------------------------------------------------------
--------------------
78/84 ----> loss: 0.743736


epoch 9:
--------------------------------------------------------------------------------
--------------------
4/84 ----> loss: 1.743668


epoch 9:
--------------------------------------------------------------------------------
--------------------
14/84 ----> loss: 1.743668


epoch 9:
--------------------------------------------------------------------------------
--------------------
24/84 ----> loss: 1.743668


epoch 9:
--------------------------------------------------------------------------------
--------------------
34/84 ----> loss: 0.743668


epoch 9:
--------------------------------------------------------------------------------
```

```
--------------------
44/84 ----> loss: 0.743668


epoch 9:
--------------------------------------------------------------------------------
--------------------
54/84 ----> loss: 1.743668


epoch 9:
--------------------------------------------------------------------------------
--------------------
64/84 ----> loss: 1.667233


epoch 9:
--------------------------------------------------------------------------------
--------------------
74/84 ----> loss: 0.743668


epoch 10:
--------------------------------------------------------------------------------
--------------------
0/84 ----> loss: 0.743668


epoch 10:
--------------------------------------------------------------------------------
--------------------
10/84 ----> loss: 0.743668


epoch 10:
--------------------------------------------------------------------------------
--------------------
20/84 ----> loss: 0.744740


epoch 10:
--------------------------------------------------------------------------------
--------------------
30/84 ----> loss: 1.743668


epoch 10:
--------------------------------------------------------------------------------
```

```
--------------------
40/84 ----> loss: 0.743669


epoch 10:
--------------------------------------------------------------------------------
--------------------
50/84 ----> loss: 0.743668


epoch 10:
--------------------------------------------------------------------------------
--------------------
60/84 ----> loss: 0.743684


epoch 10:
--------------------------------------------------------------------------------
--------------------
70/84 ----> loss: 0.743669


epoch 10:
--------------------------------------------------------------------------------
--------------------
80/84 ----> loss: 0.743668


epoch 11:
--------------------------------------------------------------------------------
--------------------
6/84 ----> loss: 0.743681


epoch 11:
--------------------------------------------------------------------------------
--------------------
16/84 ----> loss: 0.743669


epoch 11:
--------------------------------------------------------------------------------
--------------------
26/84 ----> loss: 0.743668


epoch 11:
--------------------------------------------------------------------------------
```

```
--------------------
36/84 ----> loss: 0.760100


epoch 11:
--------------------------------------------------------------------------------
--------------------
46/84 ----> loss: 0.743668


epoch 11:
--------------------------------------------------------------------------------
--------------------
56/84 ----> loss: 1.488797


epoch 11:
--------------------------------------------------------------------------------
--------------------
66/84 ----> loss: 0.743669


epoch 11:
--------------------------------------------------------------------------------
--------------------
76/84 ----> loss: 0.743767


epoch 12:
--------------------------------------------------------------------------------
--------------------
2/84 ----> loss: 0.743668


epoch 12:
--------------------------------------------------------------------------------
--------------------
12/84 ----> loss: 1.743407


epoch 12:
--------------------------------------------------------------------------------
--------------------
22/84 ----> loss: 0.743668


epoch 12:
--------------------------------------------------------------------------------
```

```
--------------------
32/84 ----> loss: 0.743668


epoch 12:
--------------------------------------------------------------------------------
--------------------
42/84 ----> loss: 0.743669


epoch 12:
--------------------------------------------------------------------------------
--------------------
52/84 ----> loss: 0.743669


epoch 12:
--------------------------------------------------------------------------------
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62/84 ----> loss: 0.743668


epoch 12:
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72/84 ----> loss: 0.743668


epoch 12:
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82/84 ----> loss: 0.744449


epoch 13:
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8/84 ----> loss: 0.743668


epoch 13:
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18/84 ----> loss: 0.753493


epoch 13:
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28/84 ----> loss: 0.743668


epoch 13:
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38/84 ----> loss: 1.743647


epoch 13:
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48/84 ----> loss: 0.743669


epoch 13:
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58/84 ----> loss: 0.743668


epoch 13:
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68/84 ----> loss: 0.743668


epoch 13:
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78/84 ----> loss: 0.745221


epoch 14:
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4/84 ----> loss: 1.743668


epoch 14:
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14/84 ----> loss: 1.743668


epoch 14:
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24/84 ----> loss: 1.743668


epoch 14:
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34/84 ----> loss: 0.743668


epoch 14:
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44/84 ----> loss: 0.743668


epoch 14:
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54/84 ----> loss: 1.743668


epoch 14:
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64/84 ----> loss: 1.684358


epoch 14:
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74/84 ----> loss: 0.743668


epoch 15:
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0/84 ----> loss: 0.743668


epoch 15:
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10/84 ----> loss: 0.743668


epoch 15:
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20/84 ----> loss: 0.743670


epoch 15:
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30/84 ----> loss: 1.743668


epoch 15:
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40/84 ----> loss: 0.743668


epoch 15:
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50/84 ----> loss: 0.743668


epoch 15:
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60/84 ----> loss: 0.743670


epoch 15:
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70/84 ----> loss: 0.743670


epoch 15:
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80/84 ----> loss: 0.743668


epoch 16:
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6/84 ----> loss: 0.743707


epoch 16:
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16/84 ----> loss: 0.743668


epoch 16:
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26/84 ----> loss: 0.743668


epoch 16:
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36/84 ----> loss: 0.747592


epoch 16:
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46/84 ----> loss: 0.743668


epoch 16:
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56/84 ----> loss: 0.743669


epoch 16:
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66/84 ----> loss: 0.743669


epoch 16:
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76/84 ----> loss: 0.743714


epoch 17:
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2/84 ----> loss: 0.743668


epoch 17:
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12/84 ----> loss: 1.743247


epoch 17:
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22/84 ----> loss: 0.743668


epoch 17:
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32/84 ----> loss: 0.743668


epoch 17:
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42/84 ----> loss: 0.743675


epoch 17:
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52/84 ----> loss: 0.743669


epoch 17:
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62/84 ----> loss: 0.743668


epoch 17:
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72/84 ----> loss: 0.743668


epoch 17:
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82/84 ----> loss: 0.744409


epoch 18:
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8/84 ----> loss: 0.743668


epoch 18:
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18/84 ----> loss: 0.746143


epoch 18:
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28/84 ----> loss: 0.743668


epoch 18:
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38/84 ----> loss: 1.743664


epoch 18:
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48/84 ----> loss: 0.743669


epoch 18:
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58/84 ----> loss: 0.743669


epoch 18:
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68/84 ----> loss: 0.743668


epoch 18:
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78/84 ----> loss: 0.745020


epoch 19:
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4/84 ----> loss: 1.743668


epoch 19:
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14/84 ----> loss: 1.743668


epoch 19:
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24/84 ----> loss: 1.743668


epoch 19:
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34/84 ----> loss: 0.743668


epoch 19:
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44/84 ----> loss: 0.743668


epoch 19:
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54/84 ----> loss: 1.743668


epoch 19:
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64/84 ----> loss: 1.675752


epoch 19:
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74/84 ----> loss: 0.743668


epoch 20:
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0/84 ----> loss: 0.743668


epoch 20:
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10/84 ----> loss: 0.743668


epoch 20:
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20/84 ----> loss: 0.743671


epoch 20:
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30/84 ----> loss: 1.743667


epoch 20:
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40/84 ----> loss: 0.743668


epoch 20:
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50/84 ----> loss: 0.743668


epoch 20:
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60/84 ----> loss: 0.743669


epoch 20:
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70/84 ----> loss: 0.743670


epoch 20:
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80/84 ----> loss: 0.743668


epoch 21:
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6/84 ----> loss: 0.743718


epoch 21:
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16/84 ----> loss: 0.743668


epoch 21:
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26/84 ----> loss: 0.743668


epoch 21:
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36/84 ----> loss: 0.744638


epoch 21:
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46/84 ----> loss: 0.743668


epoch 21:
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56/84 ----> loss: 0.743669


epoch 21:
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66/84 ----> loss: 0.743669


epoch 21:
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76/84 ----> loss: 0.743694


epoch 22:
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2/84 ----> loss: 0.743668


epoch 22:
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12/84 ----> loss: 1.743263


epoch 22:
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22/84 ----> loss: 0.743668


epoch 22:
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32/84 ----> loss: 0.743668


epoch 22:
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42/84 ----> loss: 0.743672


epoch 22:
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52/84 ----> loss: 0.743669


epoch 22:
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62/84 ----> loss: 0.743668


epoch 22:
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72/84 ----> loss: 0.743668


epoch 22:
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82/84 ----> loss: 0.744160


epoch 23:
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8/84 ----> loss: 0.743668


epoch 23:
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18/84 ----> loss: 0.746837


epoch 23:
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28/84 ----> loss: 0.743668


epoch 23:
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38/84 ----> loss: 1.743644


epoch 23:
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48/84 ----> loss: 0.743669


epoch 23:
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58/84 ----> loss: 0.743668


epoch 23:
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68/84 ----> loss: 0.743668


epoch 23:
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78/84 ----> loss: 0.744910


epoch 24:
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4/84 ----> loss: 1.743668


epoch 24:
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14/84 ----> loss: 1.743668


epoch 24:
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24/84 ----> loss: 1.743668


epoch 24:
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34/84 ----> loss: 0.743668


epoch 24:
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44/84 ----> loss: 0.743668


epoch 24:
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54/84 ----> loss: 1.743668


epoch 24:
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64/84 ----> loss: 1.689591


epoch 24:
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74/84 ----> loss: 0.743668


epoch 25:
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0/84 ----> loss: 0.743668


epoch 25:
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10/84 ----> loss: 0.743668


epoch 25:
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20/84 ----> loss: 0.743670


epoch 25:
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30/84 ----> loss: 1.743668


epoch 25:
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40/84 ----> loss: 0.743668


epoch 25:
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50/84 ----> loss: 0.743668


epoch 25:
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60/84 ----> loss: 0.743671


epoch 25:
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70/84 ----> loss: 0.743670


epoch 25:
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80/84 ----> loss: 0.743668


epoch 26:
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6/84 ----> loss: 0.743696


epoch 26:
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16/84 ----> loss: 0.743668


epoch 26:
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26/84 ----> loss: 0.743668


epoch 26:
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36/84 ----> loss: 0.745437


epoch 26:
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46/84 ----> loss: 0.743668
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epoch 26:
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56/84 ----> loss: 0.743669


epoch 26:
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66/84 ----> loss: 0.743669


epoch 26:
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76/84 ----> loss: 0.743713


epoch 27:
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2/84 ----> loss: 0.743668


epoch 27:
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12/84 ----> loss: 1.742986


epoch 27:
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22/84 ----> loss: 0.743668


epoch 27:
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32/84 ----> loss: 0.743668


epoch 27:
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42/84 ----> loss: 0.743676
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epoch 27:
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52/84 ----> loss: 0.743669


epoch 27:
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62/84 ----> loss: 0.743668


epoch 27:
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72/84 ----> loss: 0.743668


epoch 27:
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82/84 ----> loss: 0.744159


epoch 28:
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8/84 ----> loss: 0.743668


epoch 28:
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18/84 ----> loss: 0.745868


epoch 28:
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28/84 ----> loss: 0.743668


epoch 28:
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38/84 ----> loss: 1.743644
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epoch 28:
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48/84 ----> loss: 0.743669


epoch 28:
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58/84 ----> loss: 0.743668


epoch 28:
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68/84 ----> loss: 0.743668


epoch 28:
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78/84 ----> loss: 0.744692


epoch 29:
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4/84 ----> loss: 1.743668


epoch 29:
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14/84 ----> loss: 1.743668


epoch 29:
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24/84 ----> loss: 1.743668


epoch 29:
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34/84 ----> loss: 0.743668
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epoch 29:
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44/84 ----> loss: 0.743668


epoch 29:
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54/84 ----> loss: 1.743668


epoch 29:
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64/84 ----> loss: 1.668758


epoch 29:
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74/84 ----> loss: 0.743668


epoch 30:
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0/84 ----> loss: 0.743668


epoch 30:
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10/84 ----> loss: 0.743668


epoch 30:
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20/84 ----> loss: 0.743671


epoch 30:
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30/84 ----> loss: 1.743667
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epoch 30:
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40/84 ----> loss: 0.743669


epoch 30:
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50/84 ----> loss: 0.743668


epoch 30:
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60/84 ----> loss: 0.743670


epoch 30:
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70/84 ----> loss: 0.743670


epoch 30:
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80/84 ----> loss: 0.743668


epoch 31:
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6/84 ----> loss: 0.743692


epoch 31:
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16/84 ----> loss: 0.743669


epoch 31:
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26/84 ----> loss: 0.743668
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epoch 31:
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36/84 ----> loss: 0.744189


epoch 31:
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46/84 ----> loss: 0.743668


epoch 31:
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56/84 ----> loss: 0.743669


epoch 31:
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66/84 ----> loss: 0.743669


epoch 31:
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76/84 ----> loss: 0.743692


epoch 32:
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2/84 ----> loss: 0.743668


epoch 32:
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12/84 ----> loss: 1.742080


epoch 32:
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22/84 ----> loss: 0.743668
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epoch 32:
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32/84 ----> loss: 0.743668


epoch 32:
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42/84 ----> loss: 0.743673


epoch 32:
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52/84 ----> loss: 0.743669


epoch 32:
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62/84 ----> loss: 0.743668


epoch 32:
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72/84 ----> loss: 0.743668


epoch 32:
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82/84 ----> loss: 0.744182


epoch 33:
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8/84 ----> loss: 0.743668


epoch 33:
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18/84 ----> loss: 0.746676
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epoch 33:
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28/84 ----> loss: 0.743668


epoch 33:
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38/84 ----> loss: 1.743642


epoch 33:
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48/84 ----> loss: 0.743669


epoch 33:
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58/84 ----> loss: 0.743668


epoch 33:
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68/84 ----> loss: 0.743668


epoch 33:
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78/84 ----> loss: 0.744437


epoch 34:
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4/84 ----> loss: 1.743668


epoch 34:
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14/84 ----> loss: 1.743668
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epoch 34:
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24/84 ----> loss: 1.743668


epoch 34:
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34/84 ----> loss: 0.743668


epoch 34:
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44/84 ----> loss: 0.743668


epoch 34:
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54/84 ----> loss: 1.743668


epoch 34:
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64/84 ----> loss: 1.677995


epoch 34:
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74/84 ----> loss: 0.743668


epoch 35:
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0/84 ----> loss: 0.743668


epoch 35:
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10/84 ----> loss: 0.743668
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epoch 35:
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20/84 ----> loss: 0.743670


epoch 35:
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30/84 ----> loss: 1.743668


epoch 35:
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40/84 ----> loss: 0.743669


epoch 35:
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50/84 ----> loss: 0.743668


epoch 35:
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60/84 ----> loss: 0.743672


epoch 35:
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70/84 ----> loss: 0.743670


epoch 35:
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80/84 ----> loss: 0.743668


epoch 36:
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6/84 ----> loss: 0.743686
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epoch 36:
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16/84 ----> loss: 0.743669


epoch 36:
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26/84 ----> loss: 0.743668


epoch 36:
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36/84 ----> loss: 0.744811


epoch 36:
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46/84 ----> loss: 0.743668


epoch 36:
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56/84 ----> loss: 0.743669


epoch 36:
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66/84 ----> loss: 0.743669


epoch 36:
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76/84 ----> loss: 0.743712


epoch 37:
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2/84 ----> loss: 0.743668
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epoch 37:
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12/84 ----> loss: 1.741207


epoch 37:
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22/84 ----> loss: 0.743668


epoch 37:
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32/84 ----> loss: 0.743668


epoch 37:
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42/84 ----> loss: 0.743681


epoch 37:
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52/84 ----> loss: 0.743669


epoch 37:
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62/84 ----> loss: 0.743668


epoch 37:
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72/84 ----> loss: 0.743668


epoch 37:
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82/84 ----> loss: 0.744181
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epoch 38:
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8/84 ----> loss: 0.743668


epoch 38:
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18/84 ----> loss: 0.745348


epoch 38:
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28/84 ----> loss: 0.743668


epoch 38:
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38/84 ----> loss: 1.743661


epoch 38:
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48/84 ----> loss: 0.743669


epoch 38:
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58/84 ----> loss: 0.743669


epoch 38:
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68/84 ----> loss: 0.743668


epoch 38:
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78/84 ----> loss: 0.744289
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epoch 39:
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4/84 ----> loss: 1.743668


epoch 39:
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14/84 ----> loss: 1.743668


epoch 39:
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24/84 ----> loss: 1.743668


epoch 39:
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34/84 ----> loss: 0.743668


epoch 39:
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44/84 ----> loss: 0.743668


epoch 39:
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54/84 ----> loss: 1.743668


epoch 39:
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64/84 ----> loss: 1.687332


epoch 39:
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74/84 ----> loss: 0.743668
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epoch 40:
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0/84 ----> loss: 0.743668


epoch 40:
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10/84 ----> loss: 0.743668


epoch 40:
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20/84 ----> loss: 0.743670


epoch 40:
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30/84 ----> loss: 1.743668


epoch 40:
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40/84 ----> loss: 0.743669


epoch 40:
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50/84 ----> loss: 0.743668


epoch 40:
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60/84 ----> loss: 0.743670


epoch 40:
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70/84 ----> loss: 0.743670
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epoch 40:
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80/84 ----> loss: 0.743668


epoch 41:
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6/84 ----> loss: 0.743691


epoch 41:
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16/84 ----> loss: 0.743668


epoch 41:
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26/84 ----> loss: 0.743668


epoch 41:
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36/84 ----> loss: 0.744074


epoch 41:
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46/84 ----> loss: 0.743668


epoch 41:
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56/84 ----> loss: 0.743669


epoch 41:
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66/84 ----> loss: 0.743669
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epoch 41:
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76/84 ----> loss: 0.743694


epoch 42:
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2/84 ----> loss: 0.743668


epoch 42:
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12/84 ----> loss: 1.741467


epoch 42:
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22/84 ----> loss: 0.743668


epoch 42:
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32/84 ----> loss: 0.743668


epoch 42:
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42/84 ----> loss: 0.743676


epoch 42:
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52/84 ----> loss: 0.743669


epoch 42:
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62/84 ----> loss: 0.743668
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epoch 42:
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72/84 ----> loss: 0.743668


epoch 42:
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82/84 ----> loss: 0.744077


epoch 43:
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8/84 ----> loss: 0.743668


epoch 43:
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18/84 ----> loss: 0.745474


epoch 43:
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28/84 ----> loss: 0.743668


epoch 43:
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38/84 ----> loss: 1.743660


epoch 43:
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48/84 ----> loss: 0.743669


epoch 43:
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58/84 ----> loss: 0.743669
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epoch 43:
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68/84 ----> loss: 0.743668


epoch 43:
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78/84 ----> loss: 0.744209


epoch 44:
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4/84 ----> loss: 1.743668


epoch 44:
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14/84 ----> loss: 1.743668


epoch 44:
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24/84 ----> loss: 1.743668


epoch 44:
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34/84 ----> loss: 0.743668


epoch 44:
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44/84 ----> loss: 0.743668


epoch 44:
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54/84 ----> loss: 1.743668
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epoch 44:
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64/84 ----> loss: 1.669429


epoch 44:
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74/84 ----> loss: 0.743668


epoch 45:
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0/84 ----> loss: 0.743668


epoch 45:
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10/84 ----> loss: 0.743668


epoch 45:
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20/84 ----> loss: 0.743670


epoch 45:
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30/84 ----> loss: 1.743668


epoch 45:
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40/84 ----> loss: 0.743669


epoch 45:
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50/84 ----> loss: 0.743668
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epoch 45:
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60/84 ----> loss: 0.743672


epoch 45:
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70/84 ----> loss: 0.743670


epoch 45:
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80/84 ----> loss: 0.743668


epoch 46:
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6/84 ----> loss: 0.743693


epoch 46:
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16/84 ----> loss: 0.743668


epoch 46:
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26/84 ----> loss: 0.743668


epoch 46:
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36/84 ----> loss: 0.744596


epoch 46:
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46/84 ----> loss: 0.743668
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epoch 46:
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56/84 ----> loss: 0.743669


epoch 46:
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66/84 ----> loss: 0.743669


epoch 46:
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76/84 ----> loss: 0.743714


epoch 47:
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2/84 ----> loss: 0.743668


epoch 47:
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12/84 ----> loss: 1.742731


epoch 47:
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22/84 ----> loss: 0.743668


epoch 47:
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32/84 ----> loss: 0.743668


epoch 47:
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42/84 ----> loss: 0.743686
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epoch 47:
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52/84 ----> loss: 0.743669


epoch 47:
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62/84 ----> loss: 0.743668


epoch 47:
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72/84 ----> loss: 0.743668


epoch 47:
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82/84 ----> loss: 0.744007


epoch 48:
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8/84 ----> loss: 0.743668


epoch 48:
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18/84 ----> loss: 0.744764


epoch 48:
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28/84 ----> loss: 0.743668


epoch 48:
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38/84 ----> loss: 1.743661
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epoch 48:
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48/84 ----> loss: 0.743669


epoch 48:
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58/84 ----> loss: 0.743669


epoch 48:
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68/84 ----> loss: 0.743668


epoch 48:
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78/84 ----> loss: 0.744218


epoch 49:
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4/84 ----> loss: 1.743668


epoch 49:
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14/84 ----> loss: 1.743668


epoch 49:
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24/84 ----> loss: 1.743668


epoch 49:
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34/84 ----> loss: 0.743668
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epoch 49:
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44/84 ----> loss: 0.743668


epoch 49:
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54/84 ----> loss: 1.743668


epoch 49:
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64/84 ----> loss: 1.672434


epoch 49:
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74/84 ----> loss: 0.743668


epoch 50:
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0/84 ----> loss: 0.743668


epoch 50:
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10/84 ----> loss: 0.743668


epoch 50:
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20/84 ----> loss: 0.743670


epoch 50:
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30/84 ----> loss: 1.743667
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epoch 50:
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40/84 ----> loss: 0.743669


epoch 50:
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50/84 ----> loss: 0.743668


epoch 50:
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60/84 ----> loss: 0.743670


epoch 50:
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70/84 ----> loss: 0.743670


epoch 50:
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80/84 ----> loss: 0.743668


epoch 51:
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6/84 ----> loss: 0.743697


epoch 51:
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16/84 ----> loss: 0.743668


epoch 51:
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26/84 ----> loss: 0.743668
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epoch 51:
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36/84 ----> loss: 0.743997


epoch 51:
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46/84 ----> loss: 0.743668


epoch 51:
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56/84 ----> loss: 0.743669


epoch 51:
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66/84 ----> loss: 0.743669


epoch 51:
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76/84 ----> loss: 0.743693


epoch 52:
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2/84 ----> loss: 0.743668


epoch 52:
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12/84 ----> loss: 1.742904


epoch 52:
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22/84 ----> loss: 0.743668
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epoch 52:
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32/84 ----> loss: 0.743668


epoch 52:
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42/84 ----> loss: 0.743677


epoch 52:
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52/84 ----> loss: 0.743669


epoch 52:
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62/84 ----> loss: 0.743668


epoch 52:
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72/84 ----> loss: 0.743668


epoch 52:
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82/84 ----> loss: 0.743951


epoch 53:
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8/84 ----> loss: 0.743668


epoch 53:
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18/84 ----> loss: 0.745266
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epoch 53:
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28/84 ----> loss: 0.743668


epoch 53:
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38/84 ----> loss: 1.743639


epoch 53:
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48/84 ----> loss: 0.743669


epoch 53:
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58/84 ----> loss: 0.743669


epoch 53:
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68/84 ----> loss: 0.743668


epoch 53:
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78/84 ----> loss: 0.744196


epoch 54:
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4/84 ----> loss: 1.743668


epoch 54:
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14/84 ----> loss: 1.743668
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epoch 54:
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24/84 ----> loss: 1.743668


epoch 54:
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34/84 ----> loss: 0.743668


epoch 54:
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44/84 ----> loss: 0.743668


epoch 54:
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54/84 ----> loss: 1.743668


epoch 54:
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64/84 ----> loss: 1.678937


epoch 54:
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74/84 ----> loss: 0.743668


epoch 55:
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0/84 ----> loss: 0.743668


epoch 55:
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10/84 ----> loss: 0.743668
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epoch 55:

20/84 ----> loss: 0.743669

epoch 55:

30/84 ----> loss: 1.743667

epoch 55:

40/84 ----> loss: 0.743669

epoch 55:

50/84 ----> loss: 0.743668

epoch 55:

60/84 ----> loss: 0.743673

epoch 55:

70/84 ----> loss: 0.743671

epoch 55:

80/84 ----> loss: 0.743669

epoch 56:

6/84 ----> loss: 0.743690

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epoch 56:
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16/84 ----> loss: 0.743669


epoch 56:
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26/84 ----> loss: 0.743668


epoch 56:
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36/84 ----> loss: 0.744382


epoch 56:
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46/84 ----> loss: 0.743668


epoch 56:
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56/84 ----> loss: 0.743669


epoch 56:
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66/84 ----> loss: 0.743669


epoch 56:
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76/84 ----> loss: 0.743713


epoch 57:
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2/84 ----> loss: 0.743668
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epoch 57:
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12/84 ----> loss: 1.742807


epoch 57:
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22/84 ----> loss: 0.743669


epoch 57:
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32/84 ----> loss: 0.743668


epoch 57:
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42/84 ----> loss: 0.743687


epoch 57:
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52/84 ----> loss: 0.743669


epoch 57:
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62/84 ----> loss: 0.743668


epoch 57:
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72/84 ----> loss: 0.743668


epoch 57:
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82/84 ----> loss: 0.743969
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epoch 58:
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8/84 ----> loss: 0.743668


epoch 58:
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18/84 ----> loss: 0.744899


epoch 58:
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28/84 ----> loss: 0.743668


epoch 58:
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38/84 ----> loss: 1.743635


epoch 58:
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48/84 ----> loss: 0.743669


epoch 58:
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58/84 ----> loss: 0.743669


epoch 58:
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68/84 ----> loss: 0.743668


epoch 58:
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78/84 ----> loss: 0.744161
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epoch 59:
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4/84 ----> loss: 1.743668


epoch 59:
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14/84 ----> loss: 1.743668


epoch 59:
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24/84 ----> loss: 1.743668


epoch 59:
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34/84 ----> loss: 0.743668


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44/84 ----> loss: 0.743668


epoch 59:
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54/84 ----> loss: 1.743668


epoch 59:
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64/84 ----> loss: 1.675012


epoch 59:
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74/84 ----> loss: 0.743668
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epoch 60:
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0/84 ----> loss: 0.743668


epoch 60:
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10/84 ----> loss: 0.743668


epoch 60:
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20/84 ----> loss: 0.743670


epoch 60:
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30/84 ----> loss: 1.743667


epoch 60:
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40/84 ----> loss: 0.743669


epoch 60:
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50/84 ----> loss: 0.743668


epoch 60:
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60/84 ----> loss: 0.743671


epoch 60:
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70/84 ----> loss: 0.743671
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epoch 60:
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80/84 ----> loss: 0.743669


epoch 61:
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6/84 ----> loss: 0.743686


epoch 61:
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16/84 ----> loss: 0.743669


epoch 61:
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26/84 ----> loss: 0.743668


epoch 61:
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36/84 ----> loss: 0.743923


epoch 61:
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46/84 ----> loss: 0.743668


epoch 61:
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56/84 ----> loss: 0.743669


epoch 61:
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66/84 ----> loss: 0.743669
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epoch 61:
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76/84 ----> loss: 0.743693


epoch 62:
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2/84 ----> loss: 0.743668


epoch 62:
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12/84 ----> loss: 1.741573


epoch 62:
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22/84 ----> loss: 0.743668


epoch 62:
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32/84 ----> loss: 0.743668


epoch 62:
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42/84 ----> loss: 0.743679


epoch 62:
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52/84 ----> loss: 0.743669


epoch 62:
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62/84 ----> loss: 0.743668
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epoch 62:
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72/84 ----> loss: 0.743668


epoch 62:
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82/84 ----> loss: 0.743965


epoch 63:
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8/84 ----> loss: 0.743668


epoch 63:
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18/84 ----> loss: 0.745398


epoch 63:
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28/84 ----> loss: 0.743668


epoch 63:
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38/84 ----> loss: 1.743628


epoch 63:
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48/84 ----> loss: 0.743669


epoch 63:
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58/84 ----> loss: 0.743669
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epoch 63:
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68/84 ----> loss: 0.743668


epoch 63:
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78/84 ----> loss: 0.744071


epoch 64:
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4/84 ----> loss: 1.743668


epoch 64:
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14/84 ----> loss: 1.743668


epoch 64:
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24/84 ----> loss: 1.743668


epoch 64:
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34/84 ----> loss: 0.743668


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44/84 ----> loss: 0.743668


epoch 64:
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54/84 ----> loss: 1.743668


epoch 64:
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64/84 ----> loss: 1.668297


epoch 64:
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74/84 ----> loss: 0.743668


epoch 65:
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0/84 ----> loss: 0.743668


epoch 65:
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10/84 ----> loss: 0.743668


epoch 65:
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20/84 ----> loss: 0.743669


epoch 65:
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30/84 ----> loss: 1.743667


epoch 65:
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40/84 ----> loss: 0.743669


epoch 65:
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50/84 ----> loss: 0.743668


epoch 65:
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60/84 ----> loss: 0.743675


epoch 65:
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70/84 ----> loss: 0.743671


epoch 65:
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80/84 ----> loss: 0.743669


epoch 66:
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6/84 ----> loss: 0.743684


epoch 66:
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16/84 ----> loss: 0.743669


epoch 66:
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26/84 ----> loss: 0.743668


epoch 66:
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36/84 ----> loss: 0.744255


epoch 66:
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46/84 ----> loss: 0.743668


epoch 66:
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56/84 ----> loss: 0.743669


epoch 66:
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66/84 ----> loss: 0.743669


epoch 66:
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76/84 ----> loss: 0.743714


epoch 67:
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2/84 ----> loss: 0.743668


epoch 67:
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12/84 ----> loss: 1.740310


epoch 67:
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22/84 ----> loss: 0.743668


epoch 67:
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32/84 ----> loss: 0.743668


epoch 67:
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42/84 ----> loss: 0.743694


epoch 67:
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52/84 ----> loss: 0.743669


epoch 67:
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62/84 ----> loss: 0.743668


epoch 67:
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72/84 ----> loss: 0.743668


epoch 67:
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82/84 ----> loss: 0.743991


epoch 68:
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8/84 ----> loss: 0.743668


epoch 68:
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18/84 ----> loss: 0.744784


epoch 68:
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28/84 ----> loss: 0.743668


epoch 68:
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38/84 ----> loss: 1.743644


epoch 68:
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48/84 ----> loss: 0.743669


epoch 68:
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58/84 ----> loss: 0.743669


epoch 68:
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68/84 ----> loss: 0.743668


epoch 68:
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78/84 ----> loss: 0.744044


epoch 69:
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4/84 ----> loss: 1.743668


epoch 69:
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14/84 ----> loss: 1.743668


epoch 69:
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24/84 ----> loss: 1.743668


epoch 69:
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34/84 ----> loss: 0.743668


epoch 69:
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44/84 ----> loss: 0.743668


epoch 69:
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54/84 ----> loss: 1.743668


epoch 69:
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64/84 ----> loss: 1.671753


epoch 69:
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74/84 ----> loss: 0.743668


epoch 70:
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0/84 ----> loss: 0.743668


epoch 70:
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10/84 ----> loss: 0.743668


epoch 70:
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20/84 ----> loss: 0.743670


epoch 70:
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30/84 ----> loss: 1.743667


epoch 70:
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40/84 ----> loss: 0.743669


epoch 70:
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50/84 ----> loss: 0.743668


epoch 70:
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60/84 ----> loss: 0.743672


epoch 70:
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70/84 ----> loss: 0.743671


epoch 70:
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80/84 ----> loss: 0.743669


epoch 71:
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6/84 ----> loss: 0.743682


epoch 71:
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16/84 ----> loss: 0.743669


epoch 71:
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26/84 ----> loss: 0.743668


epoch 71:
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36/84 ----> loss: 0.743891


epoch 71:
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46/84 ----> loss: 0.743668


epoch 71:
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56/84 ----> loss: 0.743669


epoch 71:
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66/84 ----> loss: 0.743669


epoch 71:
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76/84 ----> loss: 0.743695


epoch 72:
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2/84 ----> loss: 0.743668


epoch 72:
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12/84 ----> loss: 1.739448


epoch 72:
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22/84 ----> loss: 0.743668


epoch 72:
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32/84 ----> loss: 0.743668


epoch 72:
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42/84 ----> loss: 0.743684


epoch 72:
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52/84 ----> loss: 0.743669


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62/84 ----> loss: 0.743668


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72/84 ----> loss: 0.743668


epoch 72:
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82/84 ----> loss: 0.743960


epoch 73:
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8/84 ----> loss: 0.743668


epoch 73:
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18/84 ----> loss: 0.744954


epoch 73:
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28/84 ----> loss: 0.743668


epoch 73:
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38/84 ----> loss: 1.743651


epoch 73:
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48/84 ----> loss: 0.743669


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58/84 ----> loss: 0.743669


epoch 73:
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68/84 ----> loss: 0.743668


epoch 73:
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78/84 ----> loss: 0.743978


epoch 74:
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4/84 ----> loss: 1.743668


epoch 74:
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14/84 ----> loss: 1.743668


epoch 74:
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24/84 ----> loss: 1.743668


epoch 74:
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34/84 ----> loss: 0.743668


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54/84 ----> loss: 1.743668


epoch 74:
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64/84 ----> loss: 1.677091


epoch 74:
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74/84 ----> loss: 0.743668


epoch 75:
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epoch 75:
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10/84 ----> loss: 0.743668


epoch 75:
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20/84 ----> loss: 0.743670


epoch 75:
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30/84 ----> loss: 1.743667


epoch 75:
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40/84 ----> loss: 0.743669


epoch 75:
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50/84 ----> loss: 0.743668


epoch 75:
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60/84 ----> loss: 0.743676


epoch 75:
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70/84 ----> loss: 0.743670


epoch 75:
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80/84 ----> loss: 0.743669


epoch 76:
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6/84 ----> loss: 0.743683


epoch 76:
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16/84 ----> loss: 0.743669


epoch 76:
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26/84 ----> loss: 0.743668


epoch 76:
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36/84 ----> loss: 0.744187


epoch 76:
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46/84 ----> loss: 0.743668


epoch 76:
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56/84 ----> loss: 0.743669


epoch 76:
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66/84 ----> loss: 0.743669


epoch 76:
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76/84 ----> loss: 0.743717


epoch 77:
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2/84 ----> loss: 0.743668


epoch 77:
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12/84 ----> loss: 1.738236


epoch 77:
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22/84 ----> loss: 0.743668


epoch 77:
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32/84 ----> loss: 0.743668


epoch 77:
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42/84 ----> loss: 0.743708


epoch 77:
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52/84 ----> loss: 0.743669


epoch 77:
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62/84 ----> loss: 0.743668


epoch 77:
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72/84 ----> loss: 0.743668


epoch 77:
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82/84 ----> loss: 0.743946


epoch 78:
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8/84 ----> loss: 0.743668


epoch 78:
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18/84 ----> loss: 0.744495


epoch 78:
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28/84 ----> loss: 0.743668


epoch 78:
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38/84 ----> loss: 1.743652


epoch 78:
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48/84 ----> loss: 0.743669


epoch 78:
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58/84 ----> loss: 0.743669


epoch 78:
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68/84 ----> loss: 0.743668


epoch 78:
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78/84 ----> loss: 0.743971


epoch 79:
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4/84 ----> loss: 1.743668


epoch 79:
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14/84 ----> loss: 1.743668


epoch 79:
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24/84 ----> loss: 1.743668


epoch 79:
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34/84 ----> loss: 0.743668


epoch 79:
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44/84 ----> loss: 0.743668


epoch 79:
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54/84 ----> loss: 1.743668


epoch 79:
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64/84 ----> loss: 1.680914


epoch 79:
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74/84 ----> loss: 0.743668


epoch 80:
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0/84 ----> loss: 0.743668


epoch 80:
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10/84 ----> loss: 0.743668


epoch 80:
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20/84 ----> loss: 0.743670


epoch 80:
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30/84 ----> loss: 1.743667


epoch 80:
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40/84 ----> loss: 0.743669


epoch 80:
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50/84 ----> loss: 0.743668


epoch 80:
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60/84 ----> loss: 0.743672


epoch 80:
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70/84 ----> loss: 0.743671


epoch 80:
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80/84 ----> loss: 0.743669


epoch 81:
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6/84 ----> loss: 0.743681


epoch 81:
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16/84 ----> loss: 0.743669


epoch 81:
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26/84 ----> loss: 0.743668


epoch 81:
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36/84 ----> loss: 0.743875


epoch 81:
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46/84 ----> loss: 0.743668


epoch 81:
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56/84 ----> loss: 0.743669


epoch 81:
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66/84 ----> loss: 0.743669


epoch 81:
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76/84 ----> loss: 0.743698


epoch 82:
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2/84 ----> loss: 0.743668


epoch 82:
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12/84 ----> loss: 1.738405


epoch 82:
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22/84 ----> loss: 0.743668


epoch 82:
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32/84 ----> loss: 0.743668


epoch 82:
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42/84 ----> loss: 0.743694


epoch 82:
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52/84 ----> loss: 0.743669


epoch 82:
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62/84 ----> loss: 0.743668


epoch 82:
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72/84 ----> loss: 0.743668


epoch 82:
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82/84 ----> loss: 0.743910


epoch 83:
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8/84 ----> loss: 0.743668


epoch 83:
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18/84 ----> loss: 0.744623


epoch 83:
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28/84 ----> loss: 0.743668


epoch 83:
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38/84 ----> loss: 1.743649


epoch 83:
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48/84 ----> loss: 0.743669


epoch 83:
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58/84 ----> loss: 0.743669


epoch 83:
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68/84 ----> loss: 0.743668


epoch 83:
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78/84 ----> loss: 0.743932


epoch 84:
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4/84 ----> loss: 1.743668


epoch 84:
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14/84 ----> loss: 1.743668


epoch 84:
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24/84 ----> loss: 1.743668


epoch 84:
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34/84 ----> loss: 0.743668


epoch 84:
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44/84 ----> loss: 0.743668


epoch 84:
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54/84 ----> loss: 1.743668


epoch 84:
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64/84 ----> loss: 1.673918


epoch 84:
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74/84 ----> loss: 0.743668


epoch 85:
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0/84 ----> loss: 0.743668


epoch 85:
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10/84 ----> loss: 0.743668


epoch 85:
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20/84 ----> loss: 0.743670


epoch 85:
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30/84 ----> loss: 1.743667


epoch 85:
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40/84 ----> loss: 0.743669


epoch 85:
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50/84 ----> loss: 0.743668


epoch 85:
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60/84 ----> loss: 0.743677


epoch 85:
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70/84 ----> loss: 0.743671


epoch 85:
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80/84 ----> loss: 0.743669


epoch 86:
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6/84 ----> loss: 0.743681


epoch 86:
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16/84 ----> loss: 0.743669


epoch 86:
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26/84 ----> loss: 0.743668


epoch 86:
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36/84 ----> loss: 0.744125


epoch 86:
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46/84 ----> loss: 0.743668


epoch 86:
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56/84 ----> loss: 0.743669


epoch 86:
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66/84 ----> loss: 0.743669


epoch 86:
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76/84 ----> loss: 0.743723


epoch 87:
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2/84 ----> loss: 0.743668


epoch 87:
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12/84 ----> loss: 1.738945


epoch 87:
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22/84 ----> loss: 0.743668


epoch 87:
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32/84 ----> loss: 0.743668
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epoch 87:
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42/84 ----> loss: 0.743741


epoch 87:
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52/84 ----> loss: 0.743669


epoch 87:
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62/84 ----> loss: 0.743668


epoch 87:
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72/84 ----> loss: 0.743668


epoch 87:
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82/84 ----> loss: 0.743897


epoch 88:
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8/84 ----> loss: 0.743668


epoch 88:
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18/84 ----> loss: 0.744255


epoch 88:
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28/84 ----> loss: 0.743668
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epoch 88:
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38/84 ----> loss: 1.743647


epoch 88:
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48/84 ----> loss: 0.743669


epoch 88:
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58/84 ----> loss: 0.743669


epoch 88:
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68/84 ----> loss: 0.743668


epoch 88:
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78/84 ----> loss: 0.743925


epoch 89:
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4/84 ----> loss: 1.743668


epoch 89:
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14/84 ----> loss: 1.743668


epoch 89:
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24/84 ----> loss: 1.743668
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epoch 89:
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34/84 ----> loss: 0.743668


epoch 89:
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44/84 ----> loss: 0.743668


epoch 89:
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54/84 ----> loss: 1.743668


epoch 89:
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64/84 ----> loss: 1.667815


epoch 89:
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74/84 ----> loss: 0.743668


epoch 90:
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0/84 ----> loss: 0.743668


epoch 90:
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10/84 ----> loss: 0.743668


epoch 90:
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20/84 ----> loss: 0.743671
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epoch 90:
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30/84 ----> loss: 1.743667


epoch 90:
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40/84 ----> loss: 0.743669


epoch 90:
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50/84 ----> loss: 0.743668


epoch 90:
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60/84 ----> loss: 0.743673


epoch 90:
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70/84 ----> loss: 0.743671


epoch 90:
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80/84 ----> loss: 0.743669


epoch 91:
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6/84 ----> loss: 0.743677


epoch 91:
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16/84 ----> loss: 0.743669
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epoch 91:
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26/84 ----> loss: 0.743668


epoch 91:
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36/84 ----> loss: 0.743862


epoch 91:
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46/84 ----> loss: 0.743668


epoch 91:
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56/84 ----> loss: 0.743669


epoch 91:
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66/84 ----> loss: 0.743669


epoch 91:
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76/84 ----> loss: 0.743710


epoch 92:
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2/84 ----> loss: 0.743668


epoch 92:
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12/84 ----> loss: 1.738652
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epoch 92:
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22/84 ----> loss: 0.743668


epoch 92:
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32/84 ----> loss: 0.743668


epoch 92:
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42/84 ----> loss: 0.743757


epoch 92:
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52/84 ----> loss: 0.743669


epoch 92:
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62/84 ----> loss: 0.743668


epoch 92:
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72/84 ----> loss: 0.743668


epoch 92:
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82/84 ----> loss: 0.743862


epoch 93:
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8/84 ----> loss: 0.743668
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epoch 93:
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18/84 ----> loss: 0.744105


epoch 93:
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28/84 ----> loss: 0.743668


epoch 93:
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38/84 ----> loss: 1.743638


epoch 93:
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48/84 ----> loss: 0.743669


epoch 93:
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58/84 ----> loss: 0.743669


epoch 93:
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68/84 ----> loss: 0.743669


epoch 93:
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78/84 ----> loss: 0.743886


epoch 94:
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4/84 ----> loss: 1.743667
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epoch 94:
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14/84 ----> loss: 1.743668


epoch 94:
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24/84 ----> loss: 1.743668


epoch 94:
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34/84 ----> loss: 0.743668


epoch 94:
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44/84 ----> loss: 0.743668


epoch 94:
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54/84 ----> loss: 1.743668


epoch 94:
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64/84 ----> loss: 1.667236


epoch 94:
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74/84 ----> loss: 0.743668


epoch 95:
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0/84 ----> loss: 0.743668
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epoch 95:
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10/84 ----> loss: 0.743668


epoch 95:
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20/84 ----> loss: 0.743671


epoch 95:
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30/84 ----> loss: 1.743667


epoch 95:
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40/84 ----> loss: 0.743669


epoch 95:
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50/84 ----> loss: 0.743669


epoch 95:
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60/84 ----> loss: 0.743676


epoch 95:
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70/84 ----> loss: 0.743670


epoch 95:
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80/84 ----> loss: 0.743669
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epoch 96:
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6/84 ----> loss: 0.743672


epoch 96:
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16/84 ----> loss: 0.743669


epoch 96:
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26/84 ----> loss: 0.743668


epoch 96:
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36/84 ----> loss: 0.743945


epoch 96:
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46/84 ----> loss: 0.743668


epoch 96:
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56/84 ----> loss: 0.743669


epoch 96:
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66/84 ----> loss: 0.743669


epoch 96:
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76/84 ----> loss: 0.743736
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epoch 97:
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2/84 ----> loss: 0.743668


epoch 97:
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12/84 ----> loss: 1.738018


epoch 97:
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22/84 ----> loss: 0.743668


epoch 97:
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32/84 ----> loss: 0.743668


epoch 97:
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42/84 ----> loss: 0.743887


epoch 97:
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52/84 ----> loss: 0.743669


epoch 97:
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62/84 ----> loss: 0.743668


epoch 97:
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72/84 ----> loss: 0.743668
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epoch 97:
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82/84 ----> loss: 0.743831


epoch 98:
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8/84 ----> loss: 0.743668


epoch 98:
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18/84 ----> loss: 0.744101


epoch 98:
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28/84 ----> loss: 0.743668


epoch 98:
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38/84 ----> loss: 1.743632


epoch 98:
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48/84 ----> loss: 0.743669


epoch 98:
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58/84 ----> loss: 0.743669


epoch 98:
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68/84 ----> loss: 0.743668
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epoch 98:
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78/84 ----> loss: 0.743849


epoch 99:
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4/84 ----> loss: 1.743667


epoch 99:
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14/84 ----> loss: 1.743667


epoch 99:
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24/84 ----> loss: 1.743668


epoch 99:
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34/84 ----> loss: 0.743668


epoch 99:
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44/84 ----> loss: 0.743668


epoch 99:
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54/84 ----> loss: 1.743668


epoch 99:
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64/84 ----> loss: 1.668049
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epoch 99:
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74/84 ----> loss: 0.743668


epoch 100:
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0/84 ----> loss: 0.743668


epoch 100:
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10/84 ----> loss: 0.743668


epoch 100:
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20/84 ----> loss: 0.743671


epoch 100:
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30/84 ----> loss: 1.743667


epoch 100:
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40/84 ----> loss: 0.743669


epoch 100:
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50/84 ----> loss: 0.743669


epoch 100:
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60/84 ----> loss: 0.743676
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epoch 100:
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70/84 ----> loss: 0.743671


epoch 100:
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80/84 ----> loss: 0.743669


epoch 101:
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6/84 ----> loss: 0.743674


epoch 101:
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16/84 ----> loss: 0.743669


epoch 101:
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26/84 ----> loss: 0.743668


epoch 101:
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36/84 ----> loss: 0.743918


epoch 101:
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46/84 ----> loss: 0.743668


epoch 101:
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56/84 ----> loss: 0.743669
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epoch 101:
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66/84 ----> loss: 0.743669


epoch 101:
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76/84 ----> loss: 0.743725


epoch 102:
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2/84 ----> loss: 0.743668


epoch 102:
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12/84 ----> loss: 1.737277


epoch 102:
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22/84 ----> loss: 0.743668


epoch 102:
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32/84 ----> loss: 0.743668


epoch 102:
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42/84 ----> loss: 0.743859


epoch 102:
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52/84 ----> loss: 0.743669
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epoch 102:
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62/84 ----> loss: 0.743668


epoch 102:
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72/84 ----> loss: 0.743668


epoch 102:
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82/84 ----> loss: 0.743808


epoch 103:
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8/84 ----> loss: 0.743668


epoch 103:
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18/84 ----> loss: 0.744221


epoch 103:
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28/84 ----> loss: 0.743668


epoch 103:
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38/84 ----> loss: 1.743621


epoch 103:
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48/84 ----> loss: 0.743669
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epoch 103:
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58/84 ----> loss: 0.743669


epoch 103:
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68/84 ----> loss: 0.743669


epoch 103:
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78/84 ----> loss: 0.743828


epoch 104:
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4/84 ----> loss: 1.743666


epoch 104:
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14/84 ----> loss: 1.743667


epoch 104:
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24/84 ----> loss: 1.743667


epoch 104:
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34/84 ----> loss: 0.743668


epoch 104:
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44/84 ----> loss: 0.743668
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epoch 104:
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54/84 ----> loss: 1.743668


epoch 104:
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64/84 ----> loss: 1.670386


epoch 104:
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74/84 ----> loss: 0.743668


epoch 105:
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0/84 ----> loss: 0.743668


epoch 105:
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10/84 ----> loss: 0.743668


epoch 105:
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20/84 ----> loss: 0.743671


epoch 105:
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30/84 ----> loss: 1.743666


epoch 105:
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40/84 ----> loss: 0.743669
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epoch 105:

50/84 ----> loss: 0.743669

epoch 105:

60/84 ----> loss: 0.743677

epoch 105:

70/84 ----> loss: 0.743671

epoch 105:

80/84 ----> loss: 0.743669

epoch 106:

6/84 ----> loss: 0.743674

epoch 106:

16/84 ----> loss: 0.743669

epoch 106:

26/84 ----> loss: 0.743668

epoch 106:

36/84 ----> loss: 0.743897

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epoch 106:
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46/84 ----> loss: 0.743668


epoch 106:
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56/84 ----> loss: 0.743669


epoch 106:
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66/84 ----> loss: 0.743669


epoch 106:
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76/84 ----> loss: 0.743720


epoch 107:
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2/84 ----> loss: 0.743668


epoch 107:
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12/84 ----> loss: 1.734317


epoch 107:
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22/84 ----> loss: 0.743668


epoch 107:
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32/84 ----> loss: 0.743668
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epoch 107:
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42/84 ----> loss: 0.743854


epoch 107:
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52/84 ----> loss: 0.743669


epoch 107:
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62/84 ----> loss: 0.743668


epoch 107:
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72/84 ----> loss: 0.743668


epoch 107:
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82/84 ----> loss: 0.743794


epoch 108:
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8/84 ----> loss: 0.743668


epoch 108:
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18/84 ----> loss: 0.744304


epoch 108:
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28/84 ----> loss: 0.743668
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epoch 108:
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38/84 ----> loss: 1.743600


epoch 108:
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48/84 ----> loss: 0.743669


epoch 108:
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58/84 ----> loss: 0.743669


epoch 108:
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68/84 ----> loss: 0.743669


epoch 108:
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78/84 ----> loss: 0.743814


epoch 109:
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4/84 ----> loss: 1.743665


epoch 109:
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14/84 ----> loss: 1.743666


epoch 109:
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24/84 ----> loss: 1.743666
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epoch 109:
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34/84 ----> loss: 0.743668


epoch 109:
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44/84 ----> loss: 0.743668


epoch 109:
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54/84 ----> loss: 1.743668


epoch 109:
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64/84 ----> loss: 1.673446


epoch 109:
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74/84 ----> loss: 0.743668


epoch 110:
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0/84 ----> loss: 0.743668


epoch 110:
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10/84 ----> loss: 0.743668


epoch 110:
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20/84 ----> loss: 0.743671


epoch 110:
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30/84 ----> loss: 1.743665


epoch 110:
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40/84 ----> loss: 0.743669


epoch 110:
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50/84 ----> loss: 0.743670


epoch 110:
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60/84 ----> loss: 0.743678


epoch 110:
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70/84 ----> loss: 0.743672


epoch 110:
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80/84 ----> loss: 0.743670


epoch 111:
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6/84 ----> loss: 0.743673


epoch 111:
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16/84 ----> loss: 0.743669


epoch 111:
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26/84 ----> loss: 0.743668


epoch 111:
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36/84 ----> loss: 0.743875


epoch 111:
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46/84 ----> loss: 0.743668


epoch 111:
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56/84 ----> loss: 0.743669


epoch 111:
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66/84 ----> loss: 0.743669


epoch 111:
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76/84 ----> loss: 0.743716


epoch 112:
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2/84 ----> loss: 0.743668


epoch 112:
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12/84 ----> loss: 1.717012


epoch 112:
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22/84 ----> loss: 0.743668


epoch 112:
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32/84 ----> loss: 0.743668


epoch 112:
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42/84 ----> loss: 0.743875


epoch 112:
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52/84 ----> loss: 0.743669


epoch 112:
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62/84 ----> loss: 0.743668


epoch 112:
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72/84 ----> loss: 0.743668


epoch 112:
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82/84 ----> loss: 0.743791


epoch 113:
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8/84 ----> loss: 0.743668


epoch 113:
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18/84 ----> loss: 0.744403


epoch 113:
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28/84 ----> loss: 0.743669


epoch 113:
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38/84 ----> loss: 1.743556


epoch 113:
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48/84 ----> loss: 0.743669


epoch 113:
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58/84 ----> loss: 0.743669


epoch 113:
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68/84 ----> loss: 0.743669


epoch 113:
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78/84 ----> loss: 0.743801


epoch 114:
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4/84 ----> loss: 1.743661


epoch 114:
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14/84 ----> loss: 1.743662


epoch 114:
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24/84 ----> loss: 1.743661


epoch 114:
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34/84 ----> loss: 0.743668


epoch 114:
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44/84 ----> loss: 0.743668


epoch 114:
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54/84 ----> loss: 1.743668


epoch 114:
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64/84 ----> loss: 1.674323


epoch 114:
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74/84 ----> loss: 0.743668


epoch 115:
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0/84 ----> loss: 0.743668


epoch 115:
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10/84 ----> loss: 0.743668


epoch 115:
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20/84 ----> loss: 0.743672


epoch 115:
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30/84 ----> loss: 1.743662


epoch 115:
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40/84 ----> loss: 0.743669


epoch 115:
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50/84 ----> loss: 0.743675


epoch 115:
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60/84 ----> loss: 0.743682


epoch 115:
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70/84 ----> loss: 0.743674


epoch 115:
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80/84 ----> loss: 0.743671


epoch 116:
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6/84 ----> loss: 0.743672


epoch 116:
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16/84 ----> loss: 0.743669


epoch 116:
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26/84 ----> loss: 0.743668


epoch 116:
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36/84 ----> loss: 0.743856


epoch 116:
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46/84 ----> loss: 0.743669


epoch 116:
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56/84 ----> loss: 0.743669


epoch 116:
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66/84 ----> loss: 0.743669


epoch 116:
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76/84 ----> loss: 0.743718


epoch 117:
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2/84 ----> loss: 0.743669


epoch 117:
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12/84 ----> loss: 1.686188


epoch 117:
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22/84 ----> loss: 0.743668


epoch 117:
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32/84 ----> loss: 0.743669


epoch 117:
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42/84 ----> loss: 0.743936


epoch 117:
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52/84 ----> loss: 0.743669


epoch 117:
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62/84 ----> loss: 0.743668


epoch 117:
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72/84 ----> loss: 0.743668


epoch 117:
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82/84 ----> loss: 0.743768


epoch 118:
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8/84 ----> loss: 0.743668


epoch 118:
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18/84 ----> loss: 0.744366


epoch 118:
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28/84 ----> loss: 0.743669


epoch 118:
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38/84 ----> loss: 1.743439


epoch 118:
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48/84 ----> loss: 0.743669


epoch 118:
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58/84 ----> loss: 0.743671


epoch 118:
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68/84 ----> loss: 0.743669


epoch 118:
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78/84 ----> loss: 0.743793


epoch 119:
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4/84 ----> loss: 1.743654


epoch 119:
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14/84 ----> loss: 1.743658


epoch 119:
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24/84 ----> loss: 1.743652


epoch 119:
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34/84 ----> loss: 0.743668


epoch 119:
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44/84 ----> loss: 0.743669


epoch 119:
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54/84 ----> loss: 1.743667


epoch 119:
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64/84 ----> loss: 1.668450


epoch 119:
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74/84 ----> loss: 0.743668


epoch 120:
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0/84 ----> loss: 0.743668


epoch 120:
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10/84 ----> loss: 0.743668


epoch 120:
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20/84 ----> loss: 0.743672


epoch 120:
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30/84 ----> loss: 1.743658


epoch 120:
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40/84 ----> loss: 0.743669


epoch 120:
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50/84 ----> loss: 0.743687


epoch 120:
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60/84 ----> loss: 0.743689


epoch 120:
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70/84 ----> loss: 0.743676


epoch 120:
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80/84 ----> loss: 0.743671


epoch 121:
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6/84 ----> loss: 0.743671


epoch 121:
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16/84 ----> loss: 0.743669


epoch 121:
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26/84 ----> loss: 0.743669


epoch 121:
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36/84 ----> loss: 0.743846


epoch 121:
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46/84 ----> loss: 0.743670


epoch 121:
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56/84 ----> loss: 0.743669


epoch 121:
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66/84 ----> loss: 0.743669


epoch 121:
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76/84 ----> loss: 0.743716


epoch 122:
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2/84 ----> loss: 0.743669


epoch 122:
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12/84 ----> loss: 1.682139


epoch 122:
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22/84 ----> loss: 0.743668


epoch 122:
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32/84 ----> loss: 0.743669


epoch 122:
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42/84 ----> loss: 0.743952


epoch 122:
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52/84 ----> loss: 0.743669


epoch 122:
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62/84 ----> loss: 0.743668


epoch 122:
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72/84 ----> loss: 0.743668


epoch 122:
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82/84 ----> loss: 0.743752


epoch 123:
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8/84 ----> loss: 0.743668


epoch 123:
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18/84 ----> loss: 0.744355


epoch 123:
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28/84 ----> loss: 0.743669


epoch 123:
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38/84 ----> loss: 1.742998


epoch 123:
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48/84 ----> loss: 0.743669


epoch 123:
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58/84 ----> loss: 0.743673


epoch 123:
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68/84 ----> loss: 0.743670


epoch 123:
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78/84 ----> loss: 0.743789


epoch 124:
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4/84 ----> loss: 1.743652


epoch 124:
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14/84 ----> loss: 1.743658


epoch 124:
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24/84 ----> loss: 1.743648


epoch 124:
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34/84 ----> loss: 0.743668


epoch 124:
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44/84 ----> loss: 0.743670


epoch 124:
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54/84 ----> loss: 1.743665


epoch 124:
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64/84 ----> loss: 1.670101


epoch 124:
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74/84 ----> loss: 0.743668


epoch 125:
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0/84 ----> loss: 0.743668


epoch 125:
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10/84 ----> loss: 0.743668


epoch 125:
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20/84 ----> loss: 0.743672


epoch 125:
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30/84 ----> loss: 1.743654


epoch 125:
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40/84 ----> loss: 0.743669


epoch 125:
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50/84 ----> loss: 0.743728


epoch 125:
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60/84 ----> loss: 0.743702


epoch 125:
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70/84 ----> loss: 0.743678


epoch 125:
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80/84 ----> loss: 0.743671


epoch 126:
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6/84 ----> loss: 0.743671


epoch 126:
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16/84 ----> loss: 0.743669


epoch 126:
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26/84 ----> loss: 0.743669


epoch 126:
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36/84 ----> loss: 0.743840


epoch 126:
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46/84 ----> loss: 0.743672


epoch 126:
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56/84 ----> loss: 0.743669


epoch 126:
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66/84 ----> loss: 0.743669


epoch 126:
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76/84 ----> loss: 0.743710


epoch 127:
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2/84 ----> loss: 0.743669


epoch 127:
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12/84 ----> loss: 1.675084


epoch 127:
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22/84 ----> loss: 0.743668


epoch 127:
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32/84 ----> loss: 0.743669


epoch 127:
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42/84 ----> loss: 0.743926


epoch 127:
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52/84 ----> loss: 0.743669


epoch 127:
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62/84 ----> loss: 0.743668


epoch 127:
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72/84 ----> loss: 0.743668


epoch 127:
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82/84 ----> loss: 0.743762


epoch 128:
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8/84 ----> loss: 0.743668


epoch 128:
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18/84 ----> loss: 0.744483


epoch 128:
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28/84 ----> loss: 0.743669


epoch 128:
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38/84 ----> loss: 1.742551


epoch 128:
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48/84 ----> loss: 0.743669


epoch 128:
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58/84 ----> loss: 0.743677


epoch 128:
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68/84 ----> loss: 0.743672


epoch 128:
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78/84 ----> loss: 0.743777


epoch 129:
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4/84 ----> loss: 1.743638


epoch 129:
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14/84 ----> loss: 1.743654


epoch 129:
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24/84 ----> loss: 1.743643


epoch 129:
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34/84 ----> loss: 0.743668


epoch 129:
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44/84 ----> loss: 0.743671


epoch 129:
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54/84 ----> loss: 1.743662


epoch 129:
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64/84 ----> loss: 1.676580


epoch 129:
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74/84 ----> loss: 0.743668


epoch 130:
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0/84 ----> loss: 0.743668


epoch 130:
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10/84 ----> loss: 0.743669


epoch 130:
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20/84 ----> loss: 0.743673


epoch 130:
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30/84 ----> loss: 1.743650


epoch 130:
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40/84 ----> loss: 0.743670


epoch 130:
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50/84 ----> loss: 0.743787


epoch 130:
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60/84 ----> loss: 0.743711


epoch 130:
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70/84 ----> loss: 0.743683


epoch 130:
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80/84 ----> loss: 0.743676


epoch 131:
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6/84 ----> loss: 0.743672


epoch 131:
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16/84 ----> loss: 0.743669


epoch 131:
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26/84 ----> loss: 0.743669


epoch 131:
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36/84 ----> loss: 0.743842


epoch 131:
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46/84 ----> loss: 0.743673


epoch 131:
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56/84 ----> loss: 0.743669


epoch 131:
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66/84 ----> loss: 0.743669


epoch 131:
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76/84 ----> loss: 0.743705


epoch 132:
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2/84 ----> loss: 0.743669


epoch 132:
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12/84 ----> loss: 1.667438


epoch 132:
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22/84 ----> loss: 0.743668


epoch 132:
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32/84 ----> loss: 0.743669


epoch 132:
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42/84 ----> loss: 0.743863


epoch 132:
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52/84 ----> loss: 0.743670


epoch 132:
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62/84 ----> loss: 0.743668


epoch 132:
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72/84 ----> loss: 0.743668


epoch 132:
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82/84 ----> loss: 0.743794
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epoch 133:
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8/84 ----> loss: 0.743668


epoch 133:
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18/84 ----> loss: 0.744719


epoch 133:
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28/84 ----> loss: 0.743669


epoch 133:
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38/84 ----> loss: 1.742422


epoch 133:
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48/84 ----> loss: 0.743669


epoch 133:
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58/84 ----> loss: 0.743679


epoch 133:
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68/84 ----> loss: 0.743673


epoch 133:
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78/84 ----> loss: 0.743771
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epoch 134:
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4/84 ----> loss: 1.743611


epoch 134:
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14/84 ----> loss: 1.743655


epoch 134:
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24/84 ----> loss: 1.743648


epoch 134:
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34/84 ----> loss: 0.743668


epoch 134:
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44/84 ----> loss: 0.743671


epoch 134:
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54/84 ----> loss: 1.743661


epoch 134:
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64/84 ----> loss: 1.686738


epoch 134:
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74/84 ----> loss: 0.743669
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epoch 135:
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0/84 ----> loss: 0.743669


epoch 135:
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10/84 ----> loss: 0.743669


epoch 135:
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20/84 ----> loss: 0.743672


epoch 135:
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30/84 ----> loss: 1.743649


epoch 135:
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40/84 ----> loss: 0.743670


epoch 135:
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50/84 ----> loss: 0.743774


epoch 135:
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60/84 ----> loss: 0.743703


epoch 135:
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70/84 ----> loss: 0.743689
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epoch 135:
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80/84 ----> loss: 0.743684


epoch 136:
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6/84 ----> loss: 0.743673


epoch 136:
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16/84 ----> loss: 0.743669


epoch 136:
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26/84 ----> loss: 0.743669


epoch 136:
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36/84 ----> loss: 0.743853


epoch 136:
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46/84 ----> loss: 0.743672


epoch 136:
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56/84 ----> loss: 0.743669


epoch 136:
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66/84 ----> loss: 0.743669
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epoch 136:
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76/84 ----> loss: 0.743703


epoch 137:
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2/84 ----> loss: 0.743669


epoch 137:
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12/84 ----> loss: 1.668621


epoch 137:
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22/84 ----> loss: 0.743668


epoch 137:
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32/84 ----> loss: 0.743669


epoch 137:
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42/84 ----> loss: 0.743817


epoch 137:
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52/84 ----> loss: 0.743670


epoch 137:
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62/84 ----> loss: 0.743668
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epoch 137:

72/84 ----> loss: 0.743668

epoch 137:

82/84 ----> loss: 0.743831

epoch 138:

8/84 ----> loss: 0.743668

epoch 138:

18/84 ----> loss: 0.744857

epoch 138:

28/84 ----> loss: 0.743669

epoch 138:

38/84 ----> loss: 1.742526

epoch 138:

48/84 ----> loss: 0.743669

epoch 138:

58/84 ----> loss: 0.743677

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epoch 138:
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68/84 ----> loss: 0.743672


epoch 138:
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78/84 ----> loss: 0.743774


epoch 139:
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4/84 ----> loss: 1.743602


epoch 139:
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14/84 ----> loss: 1.743655


epoch 139:
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24/84 ----> loss: 1.743649


epoch 139:
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34/84 ----> loss: 0.743668


epoch 139:
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44/84 ----> loss: 0.743670


epoch 139:
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54/84 ----> loss: 1.743661
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epoch 139:
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64/84 ----> loss: 1.675038


epoch 139:
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74/84 ----> loss: 0.743669


epoch 140:
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0/84 ----> loss: 0.743669


epoch 140:
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10/84 ----> loss: 0.743669


epoch 140:
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20/84 ----> loss: 0.743672


epoch 140:
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30/84 ----> loss: 1.743649


epoch 140:
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40/84 ----> loss: 0.743671


epoch 140:
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50/84 ----> loss: 0.743743
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epoch 140:

60/84 ----> loss: 0.743694

epoch 140:

70/84 ----> loss: 0.743691

epoch 140:

80/84 ----> loss: 0.743690

epoch 141:

6/84 ----> loss: 0.743674

epoch 141:

16/84 ----> loss: 0.743669

epoch 141:

26/84 ----> loss: 0.743669

epoch 141:

36/84 ----> loss: 0.743864

epoch 141:

46/84 ----> loss: 0.743671

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epoch 141:
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56/84 ----> loss: 0.743669


epoch 141:
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66/84 ----> loss: 0.743669


epoch 141:
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76/84 ----> loss: 0.743704


epoch 142:
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2/84 ----> loss: 0.743669


epoch 142:
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12/84 ----> loss: 1.669672


epoch 142:
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22/84 ----> loss: 0.743668


epoch 142:
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32/84 ----> loss: 0.743669


epoch 142:
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42/84 ----> loss: 0.743790
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epoch 142:
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52/84 ----> loss: 0.743670


epoch 142:
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62/84 ----> loss: 0.743668


epoch 142:
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72/84 ----> loss: 0.743668


epoch 142:
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82/84 ----> loss: 0.743860


epoch 143:
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8/84 ----> loss: 0.743668


epoch 143:
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18/84 ----> loss: 0.744870


epoch 143:
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28/84 ----> loss: 0.743669


epoch 143:
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38/84 ----> loss: 1.742823
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epoch 143:
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48/84 ----> loss: 0.743669


epoch 143:
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58/84 ----> loss: 0.743676


epoch 143:
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68/84 ----> loss: 0.743671


epoch 143:
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78/84 ----> loss: 0.743780


epoch 144:
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4/84 ----> loss: 1.743593


epoch 144:
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14/84 ----> loss: 1.743654


epoch 144:
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24/84 ----> loss: 1.743650


epoch 144:
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34/84 ----> loss: 0.743668
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epoch 144:
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44/84 ----> loss: 0.743669


epoch 144:
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54/84 ----> loss: 1.743663


epoch 144:
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64/84 ----> loss: 1.668778


epoch 144:
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74/84 ----> loss: 0.743669


epoch 145:
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0/84 ----> loss: 0.743669


epoch 145:
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10/84 ----> loss: 0.743669


epoch 145:
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20/84 ----> loss: 0.743672


epoch 145:
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30/84 ----> loss: 1.743650
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epoch 145:
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40/84 ----> loss: 0.743670


epoch 145:
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50/84 ----> loss: 0.743713


epoch 145:
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60/84 ----> loss: 0.743685


epoch 145:
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70/84 ----> loss: 0.743693


epoch 145:
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80/84 ----> loss: 0.743698


epoch 146:
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6/84 ----> loss: 0.743675


epoch 146:
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16/84 ----> loss: 0.743669


epoch 146:
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26/84 ----> loss: 0.743669
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epoch 146:
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36/84 ----> loss: 0.743875


epoch 146:
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46/84 ----> loss: 0.743670


epoch 146:
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56/84 ----> loss: 0.743669


epoch 146:
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66/84 ----> loss: 0.743669


epoch 146:
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76/84 ----> loss: 0.743706


epoch 147:
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2/84 ----> loss: 0.743670


epoch 147:
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12/84 ----> loss: 1.671485


epoch 147:
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22/84 ----> loss: 0.743668
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epoch 147:
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32/84 ----> loss: 0.743669


epoch 147:
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42/84 ----> loss: 0.743765


epoch 147:
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52/84 ----> loss: 0.743669


epoch 147:
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62/84 ----> loss: 0.743668


epoch 147:
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72/84 ----> loss: 0.743668


epoch 147:
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82/84 ----> loss: 0.743876


epoch 148:
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8/84 ----> loss: 0.743668


epoch 148:
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18/84 ----> loss: 0.744848
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epoch 148:
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28/84 ----> loss: 0.743669


epoch 148:
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38/84 ----> loss: 1.743079


epoch 148:
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48/84 ----> loss: 0.743669


epoch 148:
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58/84 ----> loss: 0.743675


epoch 148:
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68/84 ----> loss: 0.743670


epoch 148:
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78/84 ----> loss: 0.743788


epoch 149:
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4/84 ----> loss: 1.743586


epoch 149:
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14/84 ----> loss: 1.743653
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epoch 149:
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24/84 ----> loss: 1.743651


epoch 149:
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34/84 ----> loss: 0.743668


epoch 149:
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44/84 ----> loss: 0.743669


epoch 149:
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54/84 ----> loss: 1.743664


epoch 149:
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64/84 ----> loss: 1.667380


epoch 149:
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74/84 ----> loss: 0.743669


epoch 150:
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epoch 150:
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10/84 ----> loss: 0.743669
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epoch 150:
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20/84 ----> loss: 0.743672

epoch 150:
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30/84 ----> loss: 1.743650

epoch 150:
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40/84 ----> loss: 0.743670

epoch 150:
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50/84 ----> loss: 0.743692

epoch 150:
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60/84 ----> loss: 0.743680

epoch 150:
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70/84 ----> loss: 0.743694

epoch 150:
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80/84 ----> loss: 0.743701

epoch 151:
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6/84 ----> loss: 0.743676
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epoch 151:
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16/84 ----> loss: 0.743669


epoch 151:
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26/84 ----> loss: 0.743669


epoch 151:
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36/84 ----> loss: 0.743881


epoch 151:
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46/84 ----> loss: 0.743669


epoch 151:
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56/84 ----> loss: 0.743669


epoch 151:
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66/84 ----> loss: 0.743669


epoch 151:
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76/84 ----> loss: 0.743708


epoch 152:
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2/84 ----> loss: 0.743670
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epoch 152:
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12/84 ----> loss: 1.670411


epoch 152:
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22/84 ----> loss: 0.743668


epoch 152:
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32/84 ----> loss: 0.743669


epoch 152:
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42/84 ----> loss: 0.743749


epoch 152:
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52/84 ----> loss: 0.743669


epoch 152:
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62/84 ----> loss: 0.743668


epoch 152:
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72/84 ----> loss: 0.743668


epoch 152:
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82/84 ----> loss: 0.743869
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epoch 153:
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8/84 ----> loss: 0.743668


epoch 153:
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18/84 ----> loss: 0.744738


epoch 153:
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28/84 ----> loss: 0.743670


epoch 153:
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38/84 ----> loss: 1.743191


epoch 153:
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48/84 ----> loss: 0.743669


epoch 153:
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58/84 ----> loss: 0.743674


epoch 153:
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68/84 ----> loss: 0.743669


epoch 153:
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78/84 ----> loss: 0.743794
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epoch 154:
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4/84 ----> loss: 1.743590


epoch 154:
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14/84 ----> loss: 1.743651


epoch 154:
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24/84 ----> loss: 1.743650


epoch 154:
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34/84 ----> loss: 0.743668


epoch 154:
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44/84 ----> loss: 0.743669


epoch 154:
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54/84 ----> loss: 1.743665


epoch 154:
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64/84 ----> loss: 1.670160


epoch 154:
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74/84 ----> loss: 0.743669
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epoch 155:
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0/84 ----> loss: 0.743669


epoch 155:
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10/84 ----> loss: 0.743669


epoch 155:
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20/84 ----> loss: 0.743671


epoch 155:
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30/84 ----> loss: 1.743649


epoch 155:
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40/84 ----> loss: 0.743670


epoch 155:
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50/84 ----> loss: 0.743683


epoch 155:
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60/84 ----> loss: 0.743678


epoch 155:
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70/84 ----> loss: 0.743692
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epoch 155:
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80/84 ----> loss: 0.743696


epoch 156:
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6/84 ----> loss: 0.743677


epoch 156:
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16/84 ----> loss: 0.743669


epoch 156:
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26/84 ----> loss: 0.743669


epoch 156:
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36/84 ----> loss: 0.743877


epoch 156:
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46/84 ----> loss: 0.743669


epoch 156:
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56/84 ----> loss: 0.743669


epoch 156:
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66/84 ----> loss: 0.743669
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epoch 156:
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76/84 ----> loss: 0.743711


epoch 157:
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2/84 ----> loss: 0.743670


epoch 157:
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12/84 ----> loss: 1.667695


epoch 157:
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22/84 ----> loss: 0.743668


epoch 157:
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32/84 ----> loss: 0.743669


epoch 157:
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42/84 ----> loss: 0.743744


epoch 157:
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52/84 ----> loss: 0.743669


epoch 157:
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62/84 ----> loss: 0.743668
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epoch 157:
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72/84 ----> loss: 0.743668


epoch 157:
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82/84 ----> loss: 0.743844


epoch 158:
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8/84 ----> loss: 0.743668


epoch 158:
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18/84 ----> loss: 0.744569


epoch 158:
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28/84 ----> loss: 0.743670


epoch 158:
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38/84 ----> loss: 1.743152


epoch 158:
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48/84 ----> loss: 0.743669


epoch 158:
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58/84 ----> loss: 0.743674
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epoch 158:
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68/84 ----> loss: 0.743669


epoch 158:
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78/84 ----> loss: 0.743799


epoch 159:
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4/84 ----> loss: 1.743599


epoch 159:
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14/84 ----> loss: 1.743647


epoch 159:
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24/84 ----> loss: 1.743644


epoch 159:
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34/84 ----> loss: 0.743668


epoch 159:
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44/84 ----> loss: 0.743669


epoch 159:
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54/84 ----> loss: 1.743664
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epoch 159:
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64/84 ----> loss: 1.672949


epoch 159:
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74/84 ----> loss: 0.743669


epoch 160:
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0/84 ----> loss: 0.743669


epoch 160:
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10/84 ----> loss: 0.743669


epoch 160:
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20/84 ----> loss: 0.743671


epoch 160:
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30/84 ----> loss: 1.743646


epoch 160:
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40/84 ----> loss: 0.743669


epoch 160:
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50/84 ----> loss: 0.743681
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epoch 160:
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60/84 ----> loss: 0.743677


epoch 160:
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70/84 ----> loss: 0.743692


epoch 160:
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80/84 ----> loss: 0.743689


epoch 161:
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6/84 ----> loss: 0.743676


epoch 161:
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16/84 ----> loss: 0.743669


epoch 161:
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26/84 ----> loss: 0.743669


epoch 161:
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36/84 ----> loss: 0.743866


epoch 161:
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46/84 ----> loss: 0.743670
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epoch 161:
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56/84 ----> loss: 0.743669


epoch 161:
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66/84 ----> loss: 0.743669


epoch 161:
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76/84 ----> loss: 0.743713


epoch 162:
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2/84 ----> loss: 0.743670


epoch 162:
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12/84 ----> loss: 1.667489


epoch 162:
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22/84 ----> loss: 0.743668


epoch 162:
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32/84 ----> loss: 0.743669


epoch 162:
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42/84 ----> loss: 0.743746
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epoch 162:
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52/84 ----> loss: 0.743670


epoch 162:
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62/84 ----> loss: 0.743668


epoch 162:
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72/84 ----> loss: 0.743668


epoch 162:
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82/84 ----> loss: 0.743819


epoch 163:
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8/84 ----> loss: 0.743668


epoch 163:
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18/84 ----> loss: 0.744429


epoch 163:
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28/84 ----> loss: 0.743671


epoch 163:
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38/84 ----> loss: 1.742929
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epoch 163:

48/84 ----> loss: 0.743669

epoch 163:

58/84 ----> loss: 0.743676

epoch 163:

68/84 ----> loss: 0.743669

epoch 163:

78/84 ----> loss: 0.743800

epoch 164:

4/84 ----> loss: 1.743598

epoch 164:

14/84 ----> loss: 1.743641

epoch 164:

24/84 ----> loss: 1.743635

epoch 164:

34/84 ----> loss: 0.743668

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epoch 164:
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44/84 ----> loss: 0.743669


epoch 164:
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54/84 ----> loss: 1.743663


epoch 164:
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64/84 ----> loss: 1.670682


epoch 164:
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74/84 ----> loss: 0.743669


epoch 165:
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0/84 ----> loss: 0.743669


epoch 165:
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10/84 ----> loss: 0.743669


epoch 165:
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20/84 ----> loss: 0.743671


epoch 165:
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30/84 ----> loss: 1.743639


epoch 165:
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40/84 ----> loss: 0.743669


epoch 165:
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50/84 ----> loss: 0.743685


epoch 165:
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60/84 ----> loss: 0.743679


epoch 165:
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70/84 ----> loss: 0.743694


epoch 165:
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80/84 ----> loss: 0.743685


epoch 166:
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6/84 ----> loss: 0.743675


epoch 166:
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16/84 ----> loss: 0.743669


epoch 166:
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26/84 ----> loss: 0.743669


epoch 166:
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36/84 ----> loss: 0.743857


epoch 166:
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46/84 ----> loss: 0.743671


epoch 166:
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56/84 ----> loss: 0.743669


epoch 166:
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66/84 ----> loss: 0.743669


epoch 166:
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76/84 ----> loss: 0.743716


epoch 167:
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2/84 ----> loss: 0.743670


epoch 167:
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12/84 ----> loss: 1.668719


epoch 167:
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22/84 ----> loss: 0.743668


epoch 167:
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32/84 ----> loss: 0.743669


epoch 167:
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42/84 ----> loss: 0.743751


epoch 167:
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52/84 ----> loss: 0.743670


epoch 167:
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62/84 ----> loss: 0.743668


epoch 167:
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72/84 ----> loss: 0.743668


epoch 167:
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82/84 ----> loss: 0.743801


epoch 168:
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8/84 ----> loss: 0.743668


epoch 168:
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18/84 ----> loss: 0.744338


epoch 168:
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28/84 ----> loss: 0.743671


epoch 168:
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38/84 ----> loss: 1.742221


epoch 168:
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48/84 ----> loss: 0.743669


epoch 168:
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58/84 ----> loss: 0.743681


epoch 168:
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68/84 ----> loss: 0.743669


epoch 168:
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78/84 ----> loss: 0.743799


epoch 169:
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4/84 ----> loss: 1.743585


epoch 169:
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14/84 ----> loss: 1.743634


epoch 169:
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24/84 ----> loss: 1.743620


epoch 169:
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34/84 ----> loss: 0.743669


epoch 169:
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44/84 ----> loss: 0.743671


epoch 169:
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54/84 ----> loss: 1.743658


epoch 169:
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64/84 ----> loss: 1.667446


epoch 169:
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74/84 ----> loss: 0.743669


epoch 170:
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0/84 ----> loss: 0.743669


epoch 170:
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10/84 ----> loss: 0.743669


epoch 170:
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20/84 ----> loss: 0.743672


epoch 170:
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30/84 ----> loss: 1.743623


epoch 170:
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40/84 ----> loss: 0.743669


epoch 170:
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50/84 ----> loss: 0.743701


epoch 170:
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60/84 ----> loss: 0.743686


epoch 170:
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70/84 ----> loss: 0.743702


epoch 170:
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80/84 ----> loss: 0.743685


epoch 171:
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6/84 ----> loss: 0.743674


epoch 171:
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16/84 ----> loss: 0.743669


epoch 171:
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26/84 ----> loss: 0.743669


epoch 171:
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36/84 ----> loss: 0.743883


epoch 171:
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46/84 ----> loss: 0.743677


epoch 171:
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56/84 ----> loss: 0.743669


epoch 171:
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66/84 ----> loss: 0.743669


epoch 171:
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76/84 ----> loss: 0.743732


epoch 172:
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2/84 ----> loss: 0.743670


epoch 172:
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12/84 ----> loss: 1.667812


epoch 172:
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22/84 ----> loss: 0.743668


epoch 172:
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32/84 ----> loss: 0.743670


epoch 172:
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42/84 ----> loss: 0.743786


epoch 172:
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52/84 ----> loss: 0.743674


epoch 172:
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62/84 ----> loss: 0.743668


epoch 172:
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72/84 ----> loss: 0.743668


epoch 172:
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82/84 ----> loss: 0.743778


epoch 173:
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8/84 ----> loss: 0.743668


epoch 173:
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18/84 ----> loss: 0.744040


epoch 173:
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28/84 ----> loss: 0.743679


epoch 173:
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38/84 ----> loss: 1.731465


epoch 173:
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48/84 ----> loss: 0.743669


epoch 173:
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58/84 ----> loss: 0.743741


epoch 173:
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68/84 ----> loss: 0.743669


epoch 173:
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78/84 ----> loss: 0.743799


epoch 174:
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4/84 ----> loss: 1.743336


epoch 174:
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14/84 ----> loss: 1.743550


epoch 174:
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24/84 ----> loss: 1.743508


epoch 174:
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34/84 ----> loss: 0.743669


epoch 174:
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44/84 ----> loss: 0.743686


epoch 174:
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54/84 ----> loss: 1.743479


epoch 174:
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64/84 ----> loss: 1.674360


epoch 174:
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74/84 ----> loss: 0.743670


epoch 175:
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0/84 ----> loss: 0.743670


epoch 175:
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10/84 ----> loss: 0.743670


epoch 175:
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20/84 ----> loss: 0.743673


epoch 175:
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30/84 ----> loss: 1.743158


epoch 175:
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40/84 ----> loss: 0.743669


epoch 175:
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50/84 ----> loss: 0.743690


epoch 175:
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60/84 ----> loss: 0.743726


epoch 175:
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70/84 ----> loss: 0.743919


epoch 175:
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80/84 ----> loss: 0.743729


epoch 176:
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6/84 ----> loss: 0.743686


epoch 176:
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16/84 ----> loss: 0.743669


epoch 176:
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26/84 ----> loss: 0.743674


epoch 176:
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36/84 ----> loss: 0.744419


epoch 176:
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46/84 ----> loss: 0.743793


epoch 176:
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56/84 ----> loss: 0.743669


epoch 176:
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66/84 ----> loss: 0.743668


epoch 176:
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76/84 ----> loss: 0.744154


epoch 177:
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2/84 ----> loss: 0.743697


epoch 177:
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12/84 ----> loss: 1.668061


epoch 177:
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22/84 ----> loss: 0.743668


epoch 177:
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32/84 ----> loss: 0.743678


epoch 177:
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42/84 ----> loss: 0.743863


epoch 177:
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52/84 ----> loss: 0.743779


epoch 177:
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62/84 ----> loss: 0.743668


epoch 177:
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72/84 ----> loss: 0.743668


epoch 177:
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82/84 ----> loss: 0.744295


epoch 178:
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8/84 ----> loss: 0.743668


epoch 178:
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18/84 ----> loss: 0.744642


epoch 178:
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28/84 ----> loss: 0.743720


epoch 178:
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38/84 ----> loss: 1.670344


epoch 178:
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48/84 ----> loss: 0.743669


epoch 178:
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58/84 ----> loss: 0.744870


epoch 178:
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68/84 ----> loss: 0.743671


epoch 178:
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78/84 ----> loss: 0.743770


epoch 179:
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4/84 ----> loss: 1.740347


epoch 179:
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14/84 ----> loss: 1.743162


epoch 179:
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24/84 ----> loss: 1.743077


epoch 179:
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34/84 ----> loss: 0.743675


epoch 179:
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44/84 ----> loss: 0.743718


epoch 179:
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54/84 ----> loss: 1.741977


epoch 179:
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64/84 ----> loss: 1.696728


epoch 179:
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74/84 ----> loss: 0.743685


epoch 180:
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0/84 ----> loss: 0.743712


epoch 180:
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10/84 ----> loss: 0.743689


epoch 180:
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20/84 ----> loss: 0.743674


epoch 180:
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30/84 ----> loss: 1.741317


epoch 180:
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40/84 ----> loss: 0.743669


epoch 180:
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50/84 ----> loss: 0.743731


epoch 180:
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60/84 ----> loss: 0.743699


epoch 180:
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70/84 ----> loss: 0.746846


epoch 180:
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80/84 ----> loss: 0.744001


epoch 181:
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6/84 ----> loss: 0.743709


epoch 181:
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16/84 ----> loss: 0.743669


epoch 181:
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26/84 ----> loss: 0.743743


epoch 181:
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36/84 ----> loss: 0.744381


epoch 181:
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46/84 ----> loss: 0.743848


epoch 181:
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56/84 ----> loss: 0.743669


epoch 181:
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66/84 ----> loss: 0.743668


epoch 181:
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76/84 ----> loss: 0.743865


epoch 182:
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2/84 ----> loss: 0.743938


epoch 182:
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12/84 ----> loss: 1.669822


epoch 182:
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22/84 ----> loss: 0.743668


epoch 182:
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32/84 ----> loss: 0.743715


epoch 182:
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42/84 ----> loss: 0.743790


epoch 182:
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52/84 ----> loss: 0.743976


epoch 182:
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62/84 ----> loss: 0.743668


epoch 182:
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72/84 ----> loss: 0.743668


epoch 182:
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82/84 ----> loss: 0.744907


epoch 183:
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8/84 ----> loss: 0.743668


epoch 183:
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18/84 ----> loss: 0.745415


epoch 183:
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28/84 ----> loss: 0.743833


epoch 183:
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38/84 ----> loss: 1.667749


epoch 183:
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48/84 ----> loss: 0.743669


epoch 183:
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58/84 ----> loss: 0.745065


epoch 183:
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68/84 ----> loss: 0.743671


epoch 183:
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78/84 ----> loss: 0.743774


epoch 184:
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4/84 ----> loss: 1.736510


epoch 184:
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14/84 ----> loss: 1.742888


epoch 184:
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24/84 ----> loss: 1.742725


epoch 184:
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34/84 ----> loss: 0.743681


epoch 184:
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44/84 ----> loss: 0.743770


epoch 184:
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54/84 ----> loss: 1.739704


epoch 184:
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64/84 ----> loss: 1.684150


epoch 184:
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74/84 ----> loss: 0.743703


epoch 185:
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0/84 ----> loss: 0.743727


epoch 185:
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10/84 ----> loss: 0.743702


epoch 185:
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20/84 ----> loss: 0.743674


epoch 185:
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30/84 ----> loss: 1.736118


epoch 185:
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40/84 ----> loss: 0.743670


epoch 185:
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50/84 ----> loss: 0.743710


epoch 185:
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60/84 ----> loss: 0.743709


epoch 185:
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70/84 ----> loss: 0.751575


epoch 185:
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80/84 ----> loss: 0.744166


epoch 186:
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6/84 ----> loss: 0.743759


epoch 186:
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16/84 ----> loss: 0.743669


epoch 186:
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26/84 ----> loss: 0.743776


epoch 186:
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36/84 ----> loss: 0.744604


epoch 186:
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46/84 ----> loss: 0.743961


epoch 186:
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56/84 ----> loss: 0.743669


epoch 186:
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66/84 ----> loss: 0.743668


epoch 186:
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76/84 ----> loss: 0.743898


epoch 187:
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2/84 ----> loss: 0.743978


epoch 187:
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12/84 ----> loss: 1.670305


epoch 187:
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22/84 ----> loss: 0.743669


epoch 187:
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32/84 ----> loss: 0.743751


epoch 187:
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42/84 ----> loss: 0.743834


epoch 187:
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52/84 ----> loss: 0.744491


epoch 187:
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62/84 ----> loss: 0.743668


epoch 187:
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72/84 ----> loss: 0.743668


epoch 187:
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82/84 ----> loss: 0.746023


epoch 188:
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8/84 ----> loss: 0.743668


epoch 188:
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18/84 ----> loss: 0.746609


epoch 188:
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28/84 ----> loss: 0.743984


epoch 188:
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38/84 ----> loss: 1.658684


epoch 188:
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48/84 ----> loss: 0.743669


epoch 188:
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58/84 ----> loss: 0.943841


epoch 188:
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68/84 ----> loss: 0.743671


epoch 188:
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78/84 ----> loss: 0.743954


epoch 189:
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4/84 ----> loss: 1.723660


epoch 189:
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14/84 ----> loss: 1.742568


epoch 189:
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24/84 ----> loss: 1.742437


epoch 189:
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34/84 ----> loss: 0.743677


epoch 189:
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44/84 ----> loss: 0.743769


epoch 189:
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54/84 ----> loss: 1.740463


epoch 189:
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64/84 ----> loss: 1.674920


epoch 189:
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74/84 ----> loss: 0.743721


epoch 190:
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0/84 ----> loss: 0.743726
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epoch 190:
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10/84 ----> loss: 0.743699


epoch 190:
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20/84 ----> loss: 0.743695


epoch 190:
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30/84 ----> loss: 1.708036


epoch 190:
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40/84 ----> loss: 0.743670


epoch 190:
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50/84 ----> loss: 0.743729


epoch 190:
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60/84 ----> loss: 0.743750


epoch 190:
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70/84 ----> loss: 0.785790


epoch 190:
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80/84 ----> loss: 0.744942
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epoch 191:
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6/84 ----> loss: 0.745661


epoch 191:
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16/84 ----> loss: 0.743724


epoch 191:
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26/84 ----> loss: 0.743689


epoch 191:
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36/84 ----> loss: 0.745051


epoch 191:
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46/84 ----> loss: 0.744075


epoch 191:
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56/84 ----> loss: 0.743669


epoch 191:
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66/84 ----> loss: 0.743676


epoch 191:
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76/84 ----> loss: 0.743671
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epoch 192:

2/84 ----> loss: 0.751479

epoch 192:

12/84 ----> loss: 0.743672

epoch 192:

22/84 ----> loss: 0.743693

epoch 192:

32/84 ----> loss: 0.743671

epoch 192:

42/84 ----> loss: 0.743890

epoch 192:

52/84 ----> loss: 0.743736

epoch 192:

62/84 ----> loss: 0.743668

epoch 192:

72/84 ----> loss: 0.743668

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epoch 192:
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82/84 ----> loss: 0.743868


epoch 193:
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8/84 ----> loss: 0.743669


epoch 193:
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18/84 ----> loss: 0.743993


epoch 193:
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28/84 ----> loss: 0.743672


epoch 193:
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38/84 ----> loss: 0.743676


epoch 193:
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48/84 ----> loss: 0.743692


epoch 193:
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58/84 ----> loss: 1.233166


epoch 193:
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68/84 ----> loss: 0.743668
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epoch 193:
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78/84 ----> loss: 0.743668


epoch 194:
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4/84 ----> loss: 1.743531


epoch 194:
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14/84 ----> loss: 1.743668


epoch 194:
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24/84 ----> loss: 1.743627


epoch 194:
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34/84 ----> loss: 0.743668


epoch 194:
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44/84 ----> loss: 0.743668


epoch 194:
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54/84 ----> loss: 1.725597


epoch 194:
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64/84 ----> loss: 0.743686
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epoch 194:
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74/84 ----> loss: 0.743669


epoch 195:
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0/84 ----> loss: 0.743669


epoch 195:
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10/84 ----> loss: 0.743669


epoch 195:
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20/84 ----> loss: 0.743668


epoch 195:
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30/84 ----> loss: 1.637960


epoch 195:
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40/84 ----> loss: 0.744824


epoch 195:
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50/84 ----> loss: 0.743675


epoch 195:
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60/84 ----> loss: 0.743669
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epoch 195:
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70/84 ----> loss: 0.747015


epoch 195:
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80/84 ----> loss: 0.743705


epoch 196:
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6/84 ----> loss: 0.744434


epoch 196:
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16/84 ----> loss: 0.743672


epoch 196:
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26/84 ----> loss: 0.803303


epoch 196:
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36/84 ----> loss: 0.743829


epoch 196:
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46/84 ----> loss: 0.743673


epoch 196:
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56/84 ----> loss: 0.743915
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epoch 196:
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66/84 ----> loss: 0.743668


epoch 196:
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76/84 ----> loss: 0.743769


epoch 197:
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2/84 ----> loss: 0.743677


epoch 197:
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12/84 ----> loss: 0.743668


epoch 197:
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22/84 ----> loss: 0.745498


epoch 197:
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32/84 ----> loss: 0.744286


epoch 197:
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42/84 ----> loss: 0.743706


epoch 197:
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52/84 ----> loss: 0.743686
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epoch 197:
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62/84 ----> loss: 0.743668


epoch 197:
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72/84 ----> loss: 0.743668


epoch 197:
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82/84 ----> loss: 0.744295


epoch 198:
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8/84 ----> loss: 0.743668


epoch 198:
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18/84 ----> loss: 0.743922


epoch 198:
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28/84 ----> loss: 0.743926


epoch 198:
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38/84 ----> loss: 0.743676


epoch 198:
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48/84 ----> loss: 0.743691
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epoch 198:
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58/84 ----> loss: 0.743798


epoch 198:
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68/84 ----> loss: 0.743669


epoch 198:
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78/84 ----> loss: 0.743669


epoch 199:
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4/84 ----> loss: 0.743957


epoch 199:
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--------------------
14/84 ----> loss: 1.682353


epoch 199:
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24/84 ----> loss: 1.735611


epoch 199:
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34/84 ----> loss: 0.772131


epoch 199:
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44/84 ----> loss: 0.744057
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epoch 199:
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54/84 ----> loss: 0.744140


epoch 199:
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64/84 ----> loss: 0.743675


epoch 199:
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74/84 ----> loss: 0.743674


epoch 200:
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0/84 ----> loss: 0.743669


epoch 200:
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10/84 ----> loss: 0.743669


epoch 200:
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--------------------
20/84 ----> loss: 0.743668


epoch 200:
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30/84 ----> loss: 0.744865


epoch 200:
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40/84 ----> loss: 0.744774
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epoch 200:
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50/84 ----> loss: 0.743673


epoch 200:
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--------------------
60/84 ----> loss: 0.743669


epoch 200:
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70/84 ----> loss: 0.750473


epoch 200:
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80/84 ----> loss: 0.743829


epoch 201:
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6/84 ----> loss: 0.744395


epoch 201:
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16/84 ----> loss: 0.755358


epoch 201:
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26/84 ----> loss: 1.716016


epoch 201:
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36/84 ----> loss: 0.743847
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epoch 201:
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46/84 ----> loss: 0.743678


epoch 201:
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56/84 ----> loss: 0.743862


epoch 201:
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66/84 ----> loss: 0.743668


epoch 201:
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76/84 ----> loss: 0.743936


epoch 202:
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2/84 ----> loss: 0.743669


epoch 202:
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12/84 ----> loss: 0.743670


epoch 202:
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22/84 ----> loss: 0.748647


epoch 202:
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32/84 ----> loss: 0.743669
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epoch 202:
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42/84 ----> loss: 0.743684


epoch 202:
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52/84 ----> loss: 0.743708


epoch 202:
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62/84 ----> loss: 0.743668


epoch 202:
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72/84 ----> loss: 0.743668


epoch 202:
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82/84 ----> loss: 0.744098


epoch 203:
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8/84 ----> loss: 0.743669


epoch 203:
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18/84 ----> loss: 0.743820


epoch 203:
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28/84 ----> loss: 0.743669
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epoch 203:
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38/84 ----> loss: 0.743681


epoch 203:
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48/84 ----> loss: 0.743674


epoch 203:
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58/84 ----> loss: 0.745172


epoch 203:
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68/84 ----> loss: 0.743669


epoch 203:
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78/84 ----> loss: 0.743669


epoch 204:
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4/84 ----> loss: 0.743684


epoch 204:
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14/84 ----> loss: 1.700621


epoch 204:
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24/84 ----> loss: 1.658134
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epoch 204:
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34/84 ----> loss: 0.748559


epoch 204:
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44/84 ----> loss: 0.743691


epoch 204:
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54/84 ----> loss: 0.743725


epoch 204:
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64/84 ----> loss: 0.743727


epoch 204:
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74/84 ----> loss: 0.743671


epoch 205:
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0/84 ----> loss: 0.743670


epoch 205:
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10/84 ----> loss: 0.743669


epoch 205:
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20/84 ----> loss: 0.743668
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epoch 205:

30/84 ----> loss: 0.743670

epoch 205:

40/84 ----> loss: 0.744597

epoch 205:

50/84 ----> loss: 0.743670

epoch 205:

60/84 ----> loss: 0.743669

epoch 205:

70/84 ----> loss: 0.753983

epoch 205:

80/84 ----> loss: 0.743677

epoch 206:

6/84 ----> loss: 0.745232

epoch 206:

16/84 ----> loss: 0.751650

epoch 206:

26/84 ----> loss: 0.743672

epoch 206:

36/84 ----> loss: 0.743778

epoch 206:

46/84 ----> loss: 0.743673

epoch 206:

56/84 ----> loss: 0.743721

epoch 206:

66/84 ----> loss: 0.743668

epoch 206:

76/84 ----> loss: 0.743746

epoch 207:

2/84 ----> loss: 0.743699

epoch 207:

12/84 ----> loss: 0.743669

epoch 207:

22/84 ----> loss: 0.745697

epoch 207:

32/84 ----> loss: 0.743674

epoch 207:

42/84 ----> loss: 0.743690

epoch 207:

52/84 ----> loss: 0.743851

epoch 207:

62/84 ----> loss: 0.743668

epoch 207:

72/84 ----> loss: 0.743668

epoch 207:

82/84 ----> loss: 0.743767

epoch 208:

8/84 ----> loss: 0.743668

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epoch 208:
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18/84 ----> loss: 0.743819


epoch 208:
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28/84 ----> loss: 0.743669


epoch 208:
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38/84 ----> loss: 0.743677


epoch 208:
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48/84 ----> loss: 0.743679


epoch 208:
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58/84 ----> loss: 0.743784


epoch 208:
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68/84 ----> loss: 0.743669


epoch 208:
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78/84 ----> loss: 0.743669


epoch 209:
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4/84 ----> loss: 0.743774
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epoch 209:
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14/84 ----> loss: 1.633824


epoch 209:
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24/84 ----> loss: 1.197700


epoch 209:
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34/84 ----> loss: 0.743668


epoch 209:
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44/84 ----> loss: 0.743668


epoch 209:
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--------------------
54/84 ----> loss: 1.332364


epoch 209:
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64/84 ----> loss: 0.743977


epoch 209:
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74/84 ----> loss: 0.743668


epoch 210:
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0/84 ----> loss: 0.743668
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epoch 210:
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10/84 ----> loss: 0.743668


epoch 210:
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20/84 ----> loss: 0.743669


epoch 210:
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30/84 ----> loss: 0.743679


epoch 210:
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40/84 ----> loss: 0.743668


epoch 210:
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50/84 ----> loss: 0.743668


epoch 210:
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60/84 ----> loss: 0.743668


epoch 210:
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--------------------
70/84 ----> loss: 0.758621


epoch 210:
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80/84 ----> loss: 0.743669
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epoch 211:

6/84 ----> loss: 0.743842

epoch 211:

16/84 ----> loss: 0.743669

epoch 211:

26/84 ----> loss: 0.743668

epoch 211:

36/84 ----> loss: 0.743764

epoch 211:

46/84 ----> loss: 0.743668

epoch 211:

56/84 ----> loss: 0.743671

epoch 211:

66/84 ----> loss: 0.743668

epoch 211:

76/84 ----> loss: 0.743678

epoch 212:

2/84 ----> loss: 0.743668

epoch 212:

12/84 ----> loss: 0.743668

epoch 212:

22/84 ----> loss: 0.750810

epoch 212:

32/84 ----> loss: 0.743672

epoch 212:

42/84 ----> loss: 0.743669

epoch 212:

52/84 ----> loss: 0.743676

epoch 212:

62/84 ----> loss: 0.743668

epoch 212:

72/84 ----> loss: 0.743668

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epoch 212:
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82/84 ----> loss: 0.743676


epoch 213:
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8/84 ----> loss: 0.743668


epoch 213:
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18/84 ----> loss: 0.744045


epoch 213:
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28/84 ----> loss: 0.792800


epoch 213:
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38/84 ----> loss: 0.744036


epoch 213:
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48/84 ----> loss: 0.743671


epoch 213:
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58/84 ----> loss: 0.744528


epoch 213:
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68/84 ----> loss: 0.743668


epoch 213:
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78/84 ----> loss: 0.743669


epoch 214:
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4/84 ----> loss: 0.743670


epoch 214:
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14/84 ----> loss: 1.425491


epoch 214:
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24/84 ----> loss: 0.743670


epoch 214:
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34/84 ----> loss: 0.743669


epoch 214:
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44/84 ----> loss: 0.743718


epoch 214:
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54/84 ----> loss: 0.743669


epoch 214:
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64/84 ----> loss: 0.743730


epoch 214:
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74/84 ----> loss: 0.743672


epoch 215:
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0/84 ----> loss: 0.743669


epoch 215:
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10/84 ----> loss: 0.743672


epoch 215:
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20/84 ----> loss: 0.743668


epoch 215:
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30/84 ----> loss: 0.743699


epoch 215:
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40/84 ----> loss: 0.743668


epoch 215:
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50/84 ----> loss: 0.743669


epoch 215:
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60/84 ----> loss: 0.743669


epoch 215:
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70/84 ----> loss: 0.745649


epoch 215:
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80/84 ----> loss: 0.743673


epoch 216:
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6/84 ----> loss: 0.743681


epoch 216:
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16/84 ----> loss: 0.743668


epoch 216:
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26/84 ----> loss: 0.744127


epoch 216:
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36/84 ----> loss: 0.743781


epoch 216:
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46/84 ----> loss: 0.743679


epoch 216:
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56/84 ----> loss: 0.743670


epoch 216:
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66/84 ----> loss: 0.743668


epoch 216:
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76/84 ----> loss: 0.743670


epoch 217:
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2/84 ----> loss: 0.743693


epoch 217:
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12/84 ----> loss: 0.746802


epoch 217:
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22/84 ----> loss: 0.743672


epoch 217:
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32/84 ----> loss: 0.743670


epoch 217:
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42/84 ----> loss: 0.743669


epoch 217:
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52/84 ----> loss: 0.743669


epoch 217:
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62/84 ----> loss: 0.743668


epoch 217:
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72/84 ----> loss: 0.743668


epoch 217:
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82/84 ----> loss: 0.743677


epoch 218:
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8/84 ----> loss: 0.743668


epoch 218:
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18/84 ----> loss: 0.744498


epoch 218:
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28/84 ----> loss: 0.743669


epoch 218:
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38/84 ----> loss: 0.743701


epoch 218:
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48/84 ----> loss: 0.743669


epoch 218:
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58/84 ----> loss: 0.743741


epoch 218:
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68/84 ----> loss: 0.743668


epoch 218:
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78/84 ----> loss: 0.743669


epoch 219:
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4/84 ----> loss: 0.743669


epoch 219:
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14/84 ----> loss: 0.798076


epoch 219:
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24/84 ----> loss: 0.744786


epoch 219:
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34/84 ----> loss: 0.743669


epoch 219:
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44/84 ----> loss: 0.743699


epoch 219:
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54/84 ----> loss: 0.743669


epoch 219:
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64/84 ----> loss: 0.743718


epoch 219:
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74/84 ----> loss: 0.743671


epoch 220:
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0/84 ----> loss: 0.743669


epoch 220:
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10/84 ----> loss: 0.758352


epoch 220:
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20/84 ----> loss: 0.743668


epoch 220:
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30/84 ----> loss: 0.743703


epoch 220:
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40/84 ----> loss: 0.743669


epoch 220:
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50/84 ----> loss: 0.743670


epoch 220:
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60/84 ----> loss: 0.743669


epoch 220:
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70/84 ----> loss: 0.745287


epoch 220:
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80/84 ----> loss: 0.743750


epoch 221:
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6/84 ----> loss: 0.743730


epoch 221:
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16/84 ----> loss: 0.743668


epoch 221:
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26/84 ----> loss: 1.743456


epoch 221:
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36/84 ----> loss: 0.743761

epoch 221:

46/84 ----> loss: 0.743672

epoch 221:

56/84 ----> loss: 0.743669

epoch 221:

66/84 ----> loss: 0.743671

epoch 221:

76/84 ----> loss: 0.743670

epoch 222:

2/84 ----> loss: 0.743668

epoch 222:

12/84 ----> loss: 0.743680

epoch 222:

22/84 ----> loss: 0.743747

epoch 222:

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32/84 ----> loss: 0.743669


epoch 222:
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42/84 ----> loss: 0.743669


epoch 222:
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52/84 ----> loss: 0.743668


epoch 222:
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62/84 ----> loss: 0.743668


epoch 222:
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72/84 ----> loss: 0.743668


epoch 222:
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82/84 ----> loss: 0.743670


epoch 223:
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8/84 ----> loss: 0.743668


epoch 223:
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18/84 ----> loss: 0.744677


epoch 223:
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28/84 ----> loss: 0.743669


epoch 223:
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38/84 ----> loss: 0.743676


epoch 223:
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48/84 ----> loss: 0.743670


epoch 223:
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58/84 ----> loss: 0.743795


epoch 223:
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68/84 ----> loss: 0.743668


epoch 223:
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78/84 ----> loss: 0.743669


epoch 224:
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4/84 ----> loss: 0.743669


epoch 224:
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14/84 ----> loss: 0.747433


epoch 224:
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24/84 ----> loss: 0.743685


epoch 224:
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34/84 ----> loss: 0.743671


epoch 224:
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44/84 ----> loss: 0.745812


epoch 224:
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54/84 ----> loss: 0.743668


epoch 224:
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64/84 ----> loss: 0.743670


epoch 224:
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74/84 ----> loss: 0.743680


epoch 225:
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--------------------
0/84 ----> loss: 0.743674


epoch 225:
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--------------------
10/84 ----> loss: 0.743815


epoch 225:
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20/84 ----> loss: 0.743668


epoch 225:
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30/84 ----> loss: 0.743681


epoch 225:
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40/84 ----> loss: 0.743669


epoch 225:
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50/84 ----> loss: 0.743669


epoch 225:
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60/84 ----> loss: 0.743669


epoch 225:
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--------------------
70/84 ----> loss: 0.745178


epoch 225:
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80/84 ----> loss: 0.743695


epoch 226:
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6/84 ----> loss: 0.743822


epoch 226:
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16/84 ----> loss: 0.743670


epoch 226:
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26/84 ----> loss: 0.746038


epoch 226:
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36/84 ----> loss: 0.743743


epoch 226:
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46/84 ----> loss: 0.743722


epoch 226:
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56/84 ----> loss: 0.743669


epoch 226:
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66/84 ----> loss: 0.743668


epoch 226:
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76/84 ----> loss: 0.743670


epoch 227:
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2/84 ----> loss: 0.743855


epoch 227:
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--------------------
12/84 ----> loss: 0.744257


epoch 227:
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22/84 ----> loss: 0.743706


epoch 227:
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32/84 ----> loss: 0.743673


epoch 227:
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42/84 ----> loss: 0.743669


epoch 227:
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52/84 ----> loss: 0.743668


epoch 227:
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62/84 ----> loss: 0.743668


epoch 227:
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72/84 ----> loss: 0.743668


epoch 227:
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82/84 ----> loss: 0.743669


epoch 228:
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8/84 ----> loss: 0.743668


epoch 228:
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18/84 ----> loss: 0.744321


epoch 228:
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28/84 ----> loss: 0.743669


epoch 228:
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38/84 ----> loss: 0.743681


epoch 228:
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48/84 ----> loss: 0.743669


epoch 228:
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58/84 ----> loss: 0.743812


epoch 228:
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68/84 ----> loss: 0.743668


epoch 228:
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78/84 ----> loss: 0.743669


epoch 229:
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4/84 ----> loss: 0.743669


epoch 229:
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14/84 ----> loss: 0.745798


epoch 229:
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24/84 ----> loss: 0.743681


epoch 229:
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34/84 ----> loss: 0.743670


epoch 229:
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44/84 ----> loss: 0.745192


epoch 229:
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54/84 ----> loss: 0.743668


epoch 229:
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64/84 ----> loss: 0.743670


epoch 229:
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74/84 ----> loss: 0.743677


epoch 230:
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0/84 ----> loss: 0.743672


epoch 230:
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10/84 ----> loss: 0.743765


epoch 230:
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20/84 ----> loss: 0.743668


epoch 230:
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30/84 ----> loss: 0.743681


epoch 230:
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40/84 ----> loss: 0.743669


epoch 230:
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50/84 ----> loss: 0.743669


epoch 230:
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60/84 ----> loss: 0.743668


epoch 230:
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--------------------
70/84 ----> loss: 0.744785


epoch 230:
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--------------------
80/84 ----> loss: 0.743687


epoch 231:
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6/84 ----> loss: 0.743800


epoch 231:
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16/84 ----> loss: 0.743670


epoch 231:
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26/84 ----> loss: 0.745207


epoch 231:
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36/84 ----> loss: 0.743749


epoch 231:
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46/84 ----> loss: 0.743708


epoch 231:
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--------------------
56/84 ----> loss: 0.743669


epoch 231:
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66/84 ----> loss: 0.743668


epoch 231:
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76/84 ----> loss: 0.743670

epoch 232:

2/84 ----> loss: 0.743819

epoch 232:

12/84 ----> loss: 0.744346

epoch 232:

22/84 ----> loss: 0.743698

epoch 232:

32/84 ----> loss: 0.743672

epoch 232:

42/84 ----> loss: 0.743669

epoch 232:

52/84 ----> loss: 0.743668

epoch 232:

62/84 ----> loss: 0.743668

epoch 232:

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72/84 ----> loss: 0.743668


epoch 232:
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82/84 ----> loss: 0.743669


epoch 233:
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8/84 ----> loss: 0.743668


epoch 233:
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18/84 ----> loss: 0.744214


epoch 233:
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28/84 ----> loss: 0.743669


epoch 233:
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38/84 ----> loss: 0.743681


epoch 233:
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48/84 ----> loss: 0.743669


epoch 233:
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58/84 ----> loss: 0.743796


epoch 233:
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68/84 ----> loss: 0.743668


epoch 233:
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78/84 ----> loss: 0.743669


epoch 234:
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4/84 ----> loss: 0.743669


epoch 234:
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14/84 ----> loss: 0.745525


epoch 234:
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24/84 ----> loss: 0.743680


epoch 234:
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34/84 ----> loss: 0.743669


epoch 234:
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44/84 ----> loss: 0.744841


epoch 234:
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54/84 ----> loss: 0.743668


epoch 234:
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64/84 ----> loss: 0.743670


epoch 234:
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74/84 ----> loss: 0.743675


epoch 235:
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0/84 ----> loss: 0.743671


epoch 235:
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10/84 ----> loss: 0.743739


epoch 235:
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20/84 ----> loss: 0.743668


epoch 235:
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30/84 ----> loss: 0.743682


epoch 235:
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40/84 ----> loss: 0.743668


epoch 235:
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50/84 ----> loss: 0.743669


epoch 235:
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60/84 ----> loss: 0.743668

epoch 235:

70/84 ----> loss: 0.744520

epoch 235:

80/84 ----> loss: 0.743684

epoch 236:

6/84 ----> loss: 0.743786

epoch 236:

16/84 ----> loss: 0.743670

epoch 236:

26/84 ----> loss: 0.744789

epoch 236:

36/84 ----> loss: 0.743751

epoch 236:

46/84 ----> loss: 0.743700

epoch 236:

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56/84 ----> loss: 0.743669


epoch 236:
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66/84 ----> loss: 0.743668


epoch 236:
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76/84 ----> loss: 0.743670


epoch 237:
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2/84 ----> loss: 0.743796


epoch 237:
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12/84 ----> loss: 0.744373


epoch 237:
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22/84 ----> loss: 0.743693


epoch 237:
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32/84 ----> loss: 0.743671


epoch 237:
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42/84 ----> loss: 0.743669


epoch 237:
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52/84 ----> loss: 0.743668


epoch 237:
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62/84 ----> loss: 0.743668


epoch 237:
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72/84 ----> loss: 0.743668


epoch 237:
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82/84 ----> loss: 0.743669


epoch 238:
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8/84 ----> loss: 0.743668


epoch 238:
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18/84 ----> loss: 0.744141


epoch 238:
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28/84 ----> loss: 0.743669


epoch 238:
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38/84 ----> loss: 0.743679
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epoch 238:
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48/84 ----> loss: 0.743669


epoch 238:
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58/84 ----> loss: 0.743782


epoch 238:
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68/84 ----> loss: 0.743668


epoch 238:
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78/84 ----> loss: 0.743669


epoch 239:
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4/84 ----> loss: 0.743669


epoch 239:
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14/84 ----> loss: 0.745340


epoch 239:
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24/84 ----> loss: 0.743680


epoch 239:
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34/84 ----> loss: 0.743669
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epoch 239:
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44/84 ----> loss: 0.744622


epoch 239:
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54/84 ----> loss: 0.743668


epoch 239:
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64/84 ----> loss: 0.743670


epoch 239:
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74/84 ----> loss: 0.743674


epoch 240:
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0/84 ----> loss: 0.743671


epoch 240:
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10/84 ----> loss: 0.743725


epoch 240:
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20/84 ----> loss: 0.743668


epoch 240:
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30/84 ----> loss: 0.743682
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epoch 240:
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40/84 ----> loss: 0.743668


epoch 240:
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50/84 ----> loss: 0.743669


epoch 240:
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60/84 ----> loss: 0.743668


epoch 240:
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70/84 ----> loss: 0.744347


epoch 240:
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80/84 ----> loss: 0.743681


epoch 241:
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6/84 ----> loss: 0.743776


epoch 241:
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16/84 ----> loss: 0.743670


epoch 241:
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26/84 ----> loss: 0.744544
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epoch 241:
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36/84 ----> loss: 0.743750


epoch 241:
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46/84 ----> loss: 0.743694


epoch 241:
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56/84 ----> loss: 0.743669


epoch 241:
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66/84 ----> loss: 0.743668


epoch 241:
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76/84 ----> loss: 0.743669


epoch 242:
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2/84 ----> loss: 0.743779


epoch 242:
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12/84 ----> loss: 0.744375


epoch 242:
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22/84 ----> loss: 0.743690
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epoch 242:
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32/84 ----> loss: 0.743670


epoch 242:
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42/84 ----> loss: 0.743669


epoch 242:
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52/84 ----> loss: 0.743668


epoch 242:
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62/84 ----> loss: 0.743668


epoch 242:
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72/84 ----> loss: 0.743668


epoch 242:
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82/84 ----> loss: 0.743669


epoch 243:
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8/84 ----> loss: 0.743668


epoch 243:
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18/84 ----> loss: 0.744086
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epoch 243:
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28/84 ----> loss: 0.743669


epoch 243:
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38/84 ----> loss: 0.743678


epoch 243:
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48/84 ----> loss: 0.743669


epoch 243:
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58/84 ----> loss: 0.743771


epoch 243:
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68/84 ----> loss: 0.743668


epoch 243:
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78/84 ----> loss: 0.743669


epoch 244:
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4/84 ----> loss: 0.743669


epoch 244:
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14/84 ----> loss: 0.745189
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epoch 244:
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24/84 ----> loss: 0.743679


epoch 244:
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34/84 ----> loss: 0.743669


epoch 244:
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44/84 ----> loss: 0.744473


epoch 244:
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54/84 ----> loss: 0.743668


epoch 244:
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64/84 ----> loss: 0.743670


epoch 244:
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74/84 ----> loss: 0.743673


epoch 245:
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0/84 ----> loss: 0.743670


epoch 245:
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10/84 ----> loss: 0.743715
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epoch 245:
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20/84 ----> loss: 0.743668


epoch 245:
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30/84 ----> loss: 0.743682


epoch 245:
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40/84 ----> loss: 0.743668


epoch 245:
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50/84 ----> loss: 0.743669


epoch 245:
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60/84 ----> loss: 0.743668


epoch 245:
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70/84 ----> loss: 0.744228


epoch 245:
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80/84 ----> loss: 0.743679


epoch 246:
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6/84 ----> loss: 0.743767
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epoch 246:
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16/84 ----> loss: 0.743670


epoch 246:
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26/84 ----> loss: 0.744384


epoch 246:
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36/84 ----> loss: 0.743749


epoch 246:
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46/84 ----> loss: 0.743691


epoch 246:
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56/84 ----> loss: 0.743669


epoch 246:
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66/84 ----> loss: 0.743668


epoch 246:
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76/84 ----> loss: 0.743669


epoch 247:
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2/84 ----> loss: 0.743766
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epoch 247:
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12/84 ----> loss: 0.744362


epoch 247:
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22/84 ----> loss: 0.743687


epoch 247:
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32/84 ----> loss: 0.743670


epoch 247:
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42/84 ----> loss: 0.743669


epoch 247:
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52/84 ----> loss: 0.743668


epoch 247:
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62/84 ----> loss: 0.743668


epoch 247:
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72/84 ----> loss: 0.743668


epoch 247:
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82/84 ----> loss: 0.743669
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epoch 248:
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8/84 ----> loss: 0.743668


epoch 248:
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18/84 ----> loss: 0.744042


epoch 248:
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28/84 ----> loss: 0.743669


epoch 248:
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38/84 ----> loss: 0.743677


epoch 248:
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48/84 ----> loss: 0.743669


epoch 248:
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58/84 ----> loss: 0.743763


epoch 248:
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68/84 ----> loss: 0.743668


epoch 248:
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78/84 ----> loss: 0.743669
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epoch 249:
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4/84 ----> loss: 0.743669


epoch 249:
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14/84 ----> loss: 0.745063


epoch 249:
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24/84 ----> loss: 0.743679


epoch 249:
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34/84 ----> loss: 0.743669


epoch 249:
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44/84 ----> loss: 0.744364


epoch 249:
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54/84 ----> loss: 0.743668


epoch 249:
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64/84 ----> loss: 0.743670


epoch 249:
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74/84 ----> loss: 0.743672
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epoch 250:
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0/84 ----> loss: 0.743670


epoch 250:
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10/84 ----> loss: 0.743709


epoch 250:
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20/84 ----> loss: 0.743668


epoch 250:
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30/84 ----> loss: 0.743682


epoch 250:
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40/84 ----> loss: 0.743668


epoch 250:
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50/84 ----> loss: 0.743669


epoch 250:
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60/84 ----> loss: 0.743668


epoch 250:
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70/84 ----> loss: 0.744141
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epoch 250:

80/84 ----> loss: 0.743678

epoch 251:

6/84 ----> loss: 0.743759

epoch 251:

16/84 ----> loss: 0.743670

epoch 251:

26/84 ----> loss: 0.744272

epoch 251:

36/84 ----> loss: 0.743748

epoch 251:

46/84 ----> loss: 0.743688

epoch 251:

56/84 ----> loss: 0.743669

epoch 251:

66/84 ----> loss: 0.743668

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epoch 251:
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76/84 ----> loss: 0.743669


epoch 252:
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2/84 ----> loss: 0.743756


epoch 252:
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12/84 ----> loss: 0.744342


epoch 252:
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22/84 ----> loss: 0.743685


epoch 252:
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32/84 ----> loss: 0.743670


epoch 252:
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42/84 ----> loss: 0.743669


epoch 252:
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52/84 ----> loss: 0.743668


epoch 252:
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62/84 ----> loss: 0.743668
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epoch 252:
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72/84 ----> loss: 0.743668


epoch 252:
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82/84 ----> loss: 0.743669


epoch 253:
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8/84 ----> loss: 0.743668


epoch 253:
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18/84 ----> loss: 0.744006


epoch 253:
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28/84 ----> loss: 0.743669


epoch 253:
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38/84 ----> loss: 0.743677


epoch 253:
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48/84 ----> loss: 0.743669


epoch 253:
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58/84 ----> loss: 0.743755
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epoch 253:
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68/84 ----> loss: 0.743668


epoch 253:
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78/84 ----> loss: 0.743669


epoch 254:
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4/84 ----> loss: 0.743669


epoch 254:
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14/84 ----> loss: 0.744956


epoch 254:
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24/84 ----> loss: 0.743678


epoch 254:
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34/84 ----> loss: 0.743669


epoch 254:
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44/84 ----> loss: 0.744281


epoch 254:
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54/84 ----> loss: 0.743668
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epoch 254:
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64/84 ----> loss: 0.743670


epoch 254:
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74/84 ----> loss: 0.743672


epoch 255:
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0/84 ----> loss: 0.743670


epoch 255:
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10/84 ----> loss: 0.743704


epoch 255:
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20/84 ----> loss: 0.743668


epoch 255:
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30/84 ----> loss: 0.743681


epoch 255:
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40/84 ----> loss: 0.743668


epoch 255:
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50/84 ----> loss: 0.743669
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epoch 255:
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60/84 ----> loss: 0.743668


epoch 255:
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70/84 ----> loss: 0.744075


epoch 255:
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80/84 ----> loss: 0.743677


epoch 256:
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6/84 ----> loss: 0.743753


epoch 256:
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16/84 ----> loss: 0.743670


epoch 256:
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26/84 ----> loss: 0.744190


epoch 256:
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36/84 ----> loss: 0.743746


epoch 256:
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46/84 ----> loss: 0.743685
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epoch 256:
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56/84 ----> loss: 0.743669


epoch 256:
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66/84 ----> loss: 0.743668


epoch 256:
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76/84 ----> loss: 0.743669


epoch 257:
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2/84 ----> loss: 0.743748


epoch 257:
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12/84 ----> loss: 0.744317


epoch 257:
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22/84 ----> loss: 0.743684


epoch 257:
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32/84 ----> loss: 0.743670


epoch 257:
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42/84 ----> loss: 0.743669
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epoch 257:
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52/84 ----> loss: 0.743668


epoch 257:
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62/84 ----> loss: 0.743668


epoch 257:
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72/84 ----> loss: 0.743668


epoch 257:
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82/84 ----> loss: 0.743669


epoch 258:
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8/84 ----> loss: 0.743668


epoch 258:
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18/84 ----> loss: 0.743976


epoch 258:
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28/84 ----> loss: 0.743668


epoch 258:
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38/84 ----> loss: 0.743676
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epoch 258:
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48/84 ----> loss: 0.743669


epoch 258:
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58/84 ----> loss: 0.743749


epoch 258:
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68/84 ----> loss: 0.743668


epoch 258:
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78/84 ----> loss: 0.743669


epoch 259:
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4/84 ----> loss: 0.743669


epoch 259:
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14/84 ----> loss: 0.744863


epoch 259:
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24/84 ----> loss: 0.743678


epoch 259:
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34/84 ----> loss: 0.743669
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epoch 259:
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44/84 ----> loss: 0.744217


epoch 259:
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54/84 ----> loss: 0.743668


epoch 259:
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64/84 ----> loss: 0.743670


epoch 259:
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74/84 ----> loss: 0.743671


epoch 260:
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0/84 ----> loss: 0.743670


epoch 260:
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10/84 ----> loss: 0.743700


epoch 260:
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20/84 ----> loss: 0.743668


epoch 260:
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30/84 ----> loss: 0.743681
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epoch 260:
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40/84 ----> loss: 0.743668


epoch 260:
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50/84 ----> loss: 0.743668


epoch 260:
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60/84 ----> loss: 0.743668


epoch 260:
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70/84 ----> loss: 0.744024


epoch 260:
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80/84 ----> loss: 0.743676


epoch 261:
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6/84 ----> loss: 0.743747


epoch 261:
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16/84 ----> loss: 0.743670


epoch 261:
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26/84 ----> loss: 0.744126
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epoch 261:
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36/84 ----> loss: 0.743744


epoch 261:
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46/84 ----> loss: 0.743683


epoch 261:
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56/84 ----> loss: 0.743669


epoch 261:
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66/84 ----> loss: 0.743668


epoch 261:
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76/84 ----> loss: 0.743669


epoch 262:
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2/84 ----> loss: 0.743741


epoch 262:
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12/84 ----> loss: 0.744290


epoch 262:
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22/84 ----> loss: 0.743682


epoch 262:
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32/84 ----> loss: 0.743669


epoch 262:
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42/84 ----> loss: 0.743669


epoch 262:
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52/84 ----> loss: 0.743668


epoch 262:
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62/84 ----> loss: 0.743668


epoch 262:
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72/84 ----> loss: 0.743668


epoch 262:
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82/84 ----> loss: 0.743669


epoch 263:
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8/84 ----> loss: 0.743668


epoch 263:
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18/84 ----> loss: 0.743951


epoch 263:
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28/84 ----> loss: 0.743668


epoch 263:
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38/84 ----> loss: 0.743676


epoch 263:
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48/84 ----> loss: 0.743669


epoch 263:
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58/84 ----> loss: 0.743744


epoch 263:
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68/84 ----> loss: 0.743668


epoch 263:
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78/84 ----> loss: 0.743669


epoch 264:
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4/84 ----> loss: 0.743669


epoch 264:
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14/84 ----> loss: 0.744782


epoch 264:
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24/84 ----> loss: 0.743678


epoch 264:
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34/84 ----> loss: 0.743669


epoch 264:
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44/84 ----> loss: 0.744164


epoch 264:
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54/84 ----> loss: 0.743668


epoch 264:
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64/84 ----> loss: 0.743670


epoch 264:
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74/84 ----> loss: 0.743671


epoch 265:
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0/84 ----> loss: 0.743669


epoch 265:
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10/84 ----> loss: 0.743697


epoch 265:
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20/84 ----> loss: 0.743668


epoch 265:
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30/84 ----> loss: 0.743681


epoch 265:
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40/84 ----> loss: 0.743668


epoch 265:
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50/84 ----> loss: 0.743668


epoch 265:
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60/84 ----> loss: 0.743668


epoch 265:
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70/84 ----> loss: 0.743983


epoch 265:
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80/84 ----> loss: 0.743675


epoch 266:
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6/84 ----> loss: 0.743742


epoch 266:
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16/84 ----> loss: 0.743670


epoch 266:
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26/84 ----> loss: 0.744076


epoch 266:
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36/84 ----> loss: 0.743741


epoch 266:
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46/84 ----> loss: 0.743682


epoch 266:
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56/84 ----> loss: 0.743669


epoch 266:
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66/84 ----> loss: 0.743668


epoch 266:
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76/84 ----> loss: 0.743669


epoch 267:
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2/84 ----> loss: 0.743735


epoch 267:
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12/84 ----> loss: 0.744262


epoch 267:
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22/84 ----> loss: 0.743681


epoch 267:
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32/84 ----> loss: 0.743669


epoch 267:
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42/84 ----> loss: 0.743669


epoch 267:
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52/84 ----> loss: 0.743668


epoch 267:
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62/84 ----> loss: 0.743668


epoch 267:
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72/84 ----> loss: 0.743668


epoch 267:
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82/84 ----> loss: 0.743669


epoch 268:
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8/84 ----> loss: 0.743668


epoch 268:
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18/84 ----> loss: 0.743930


epoch 268:
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28/84 ----> loss: 0.743668


epoch 268:
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38/84 ----> loss: 0.743675


epoch 268:
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48/84 ----> loss: 0.743669


epoch 268:
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58/84 ----> loss: 0.743739


epoch 268:
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68/84 ----> loss: 0.743668


epoch 268:
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78/84 ----> loss: 0.743669


epoch 269:
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4/84 ----> loss: 0.743669


epoch 269:
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14/84 ----> loss: 0.744710


epoch 269:
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24/84 ----> loss: 0.743677


epoch 269:
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34/84 ----> loss: 0.743669


epoch 269:
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44/84 ----> loss: 0.744121


epoch 269:
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54/84 ----> loss: 0.743668


epoch 269:
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64/84 ----> loss: 0.743670


epoch 269:
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74/84 ----> loss: 0.743671


epoch 270:
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0/84 ----> loss: 0.743669


epoch 270:
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10/84 ----> loss: 0.743694


epoch 270:
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20/84 ----> loss: 0.743668


epoch 270:
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30/84 ----> loss: 0.743681


epoch 270:
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40/84 ----> loss: 0.743668


epoch 270:
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50/84 ----> loss: 0.743668


epoch 270:
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60/84 ----> loss: 0.743668


epoch 270:
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70/84 ----> loss: 0.743950


epoch 270:
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80/84 ----> loss: 0.743674


epoch 271:
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6/84 ----> loss: 0.743738


epoch 271:
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16/84 ----> loss: 0.743670


epoch 271:
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26/84 ----> loss: 0.744035


epoch 271:
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36/84 ----> loss: 0.743739


epoch 271:
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46/84 ----> loss: 0.743681


epoch 271:
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56/84 ----> loss: 0.743669


epoch 271:
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66/84 ----> loss: 0.743668


epoch 271:
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76/84 ----> loss: 0.743669


epoch 272:
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2/84 ----> loss: 0.743730


epoch 272:
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12/84 ----> loss: 0.744236


epoch 272:
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22/84 ----> loss: 0.743680


epoch 272:
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32/84 ----> loss: 0.743669


epoch 272:
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42/84 ----> loss: 0.743669


epoch 272:
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52/84 ----> loss: 0.743668


epoch 272:
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62/84 ----> loss: 0.743668


epoch 272:
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72/84 ----> loss: 0.743668


epoch 272:
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82/84 ----> loss: 0.743669


epoch 273:
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8/84 ----> loss: 0.743668


epoch 273:
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18/84 ----> loss: 0.743912


epoch 273:
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28/84 ----> loss: 0.743668


epoch 273:
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38/84 ----> loss: 0.743675


epoch 273:
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48/84 ----> loss: 0.743669


epoch 273:
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58/84 ----> loss: 0.743735


epoch 273:
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68/84 ----> loss: 0.743668


epoch 273:
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78/84 ----> loss: 0.743669


epoch 274:
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4/84 ----> loss: 0.743669


epoch 274:
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14/84 ----> loss: 0.744647


epoch 274:
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24/84 ----> loss: 0.743677


epoch 274:
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34/84 ----> loss: 0.743669


epoch 274:
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44/84 ----> loss: 0.744084


epoch 274:
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54/84 ----> loss: 0.743668


epoch 274:
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64/84 ----> loss: 0.743670


epoch 274:
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74/84 ----> loss: 0.743671


epoch 275:
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0/84 ----> loss: 0.743669


epoch 275:
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10/84 ----> loss: 0.743692


epoch 275:
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20/84 ----> loss: 0.743668


epoch 275:
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30/84 ----> loss: 0.743681


epoch 275:
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40/84 ----> loss: 0.743668


epoch 275:
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50/84 ----> loss: 0.743668


epoch 275:
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60/84 ----> loss: 0.743668


epoch 275:
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70/84 ----> loss: 0.743922


epoch 275:
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80/84 ----> loss: 0.743674


epoch 276:
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6/84 ----> loss: 0.743734


epoch 276:
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16/84 ----> loss: 0.743670


epoch 276:
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26/84 ----> loss: 0.744001


epoch 276:
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36/84 ----> loss: 0.743737


epoch 276:
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46/84 ----> loss: 0.743680


epoch 276:
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56/84 ----> loss: 0.743669


epoch 276:
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66/84 ----> loss: 0.743668


epoch 276:
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76/84 ----> loss: 0.743669


epoch 277:
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2/84 ----> loss: 0.743726


epoch 277:
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12/84 ----> loss: 0.744210


epoch 277:
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22/84 ----> loss: 0.743680


epoch 277:
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32/84 ----> loss: 0.743669


epoch 277:
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42/84 ----> loss: 0.743669


epoch 277:
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52/84 ----> loss: 0.743668


epoch 277:
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62/84 ----> loss: 0.743668


epoch 277:
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72/84 ----> loss: 0.743668


epoch 277:
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82/84 ----> loss: 0.743669


epoch 278:
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8/84 ----> loss: 0.743668


epoch 278:
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18/84 ----> loss: 0.743896


epoch 278:
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28/84 ----> loss: 0.743668


epoch 278:
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38/84 ----> loss: 0.743674


epoch 278:
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48/84 ----> loss: 0.743669


epoch 278:
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58/84 ----> loss: 0.743732


epoch 278:
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68/84 ----> loss: 0.743668


epoch 278:
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78/84 ----> loss: 0.743669


epoch 279:
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4/84 ----> loss: 0.743669


epoch 279:
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14/84 ----> loss: 0.744590


epoch 279:
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24/84 ----> loss: 0.743677


epoch 279:
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34/84 ----> loss: 0.743669


epoch 279:
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44/84 ----> loss: 0.744053


epoch 279:
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54/84 ----> loss: 0.743668


epoch 279:
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64/84 ----> loss: 0.743669


epoch 279:
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74/84 ----> loss: 0.743670


epoch 280:
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0/84 ----> loss: 0.743669


epoch 280:
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10/84 ----> loss: 0.743690


epoch 280:
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20/84 ----> loss: 0.743668


epoch 280:
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30/84 ----> loss: 0.743681

epoch 280:

40/84 ----> loss: 0.743668

epoch 280:

50/84 ----> loss: 0.743668

epoch 280:

60/84 ----> loss: 0.743668

epoch 280:

70/84 ----> loss: 0.743899

epoch 280:

80/84 ----> loss: 0.743673

epoch 281:

6/84 ----> loss: 0.743730

epoch 281:

16/84 ----> loss: 0.743670

epoch 281:

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26/84 ----> loss: 0.743973


epoch 281:
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36/84 ----> loss: 0.743734


epoch 281:
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46/84 ----> loss: 0.743679


epoch 281:
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56/84 ----> loss: 0.743669


epoch 281:
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66/84 ----> loss: 0.743668


epoch 281:
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76/84 ----> loss: 0.743669


epoch 282:
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2/84 ----> loss: 0.743722


epoch 282:
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12/84 ----> loss: 0.744185


epoch 282:
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22/84 ----> loss: 0.743679

epoch 282:

32/84 ----> loss: 0.743669

epoch 282:

42/84 ----> loss: 0.743669

epoch 282:

52/84 ----> loss: 0.743668

epoch 282:

62/84 ----> loss: 0.743668

epoch 282:

72/84 ----> loss: 0.743668

epoch 282:

82/84 ----> loss: 0.743669

epoch 283:

8/84 ----> loss: 0.743668

epoch 283:

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18/84 ----> loss: 0.743882


epoch 283:
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28/84 ----> loss: 0.743668


epoch 283:
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38/84 ----> loss: 0.743674


epoch 283:
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48/84 ----> loss: 0.743669


epoch 283:
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58/84 ----> loss: 0.743729


epoch 283:
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68/84 ----> loss: 0.743668


epoch 283:
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78/84 ----> loss: 0.743669


epoch 284:
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4/84 ----> loss: 0.743669


epoch 284:
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14/84 ----> loss: 0.744540


epoch 284:
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24/84 ----> loss: 0.743677


epoch 284:
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34/84 ----> loss: 0.743669


epoch 284:
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44/84 ----> loss: 0.744027


epoch 284:
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54/84 ----> loss: 0.743668


epoch 284:
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64/84 ----> loss: 0.743669


epoch 284:
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74/84 ----> loss: 0.743670


epoch 285:
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0/84 ----> loss: 0.743669


epoch 285:
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10/84 ----> loss: 0.743688


epoch 285:
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20/84 ----> loss: 0.743668


epoch 285:
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30/84 ----> loss: 0.743681


epoch 285:
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40/84 ----> loss: 0.743668


epoch 285:
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50/84 ----> loss: 0.743668


epoch 285:
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60/84 ----> loss: 0.743668


epoch 285:
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70/84 ----> loss: 0.743879


epoch 285:
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80/84 ----> loss: 0.743673


epoch 286:
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6/84 ----> loss: 0.743727


epoch 286:
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16/84 ----> loss: 0.743669


epoch 286:
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26/84 ----> loss: 0.743949


epoch 286:
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36/84 ----> loss: 0.743732


epoch 286:
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46/84 ----> loss: 0.743678


epoch 286:
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56/84 ----> loss: 0.743669


epoch 286:
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66/84 ----> loss: 0.743668


epoch 286:
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76/84 ----> loss: 0.743669
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epoch 287:
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2/84 ----> loss: 0.743719


epoch 287:
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12/84 ----> loss: 0.744162


epoch 287:
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22/84 ----> loss: 0.743678


epoch 287:
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32/84 ----> loss: 0.743669


epoch 287:
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42/84 ----> loss: 0.743669


epoch 287:
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52/84 ----> loss: 0.743668


epoch 287:
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62/84 ----> loss: 0.743668


epoch 287:
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72/84 ----> loss: 0.743668
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epoch 287:
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82/84 ----> loss: 0.743669


epoch 288:
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8/84 ----> loss: 0.743668


epoch 288:
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18/84 ----> loss: 0.743869


epoch 288:
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28/84 ----> loss: 0.743668


epoch 288:
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38/84 ----> loss: 0.743674


epoch 288:
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48/84 ----> loss: 0.743669


epoch 288:
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58/84 ----> loss: 0.743726


epoch 288:
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68/84 ----> loss: 0.743668
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epoch 288:
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78/84 ----> loss: 0.743669


epoch 289:
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4/84 ----> loss: 0.743669


epoch 289:
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14/84 ----> loss: 0.744494


epoch 289:
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24/84 ----> loss: 0.743676


epoch 289:
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34/84 ----> loss: 0.743669


epoch 289:
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44/84 ----> loss: 0.744003


epoch 289:
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54/84 ----> loss: 0.743668


epoch 289:
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64/84 ----> loss: 0.743669
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epoch 289:
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74/84 ----> loss: 0.743670


epoch 290:
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0/84 ----> loss: 0.743669


epoch 290:
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10/84 ----> loss: 0.743687


epoch 290:
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20/84 ----> loss: 0.743668


epoch 290:
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30/84 ----> loss: 0.743680


epoch 290:
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40/84 ----> loss: 0.743668


epoch 290:
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50/84 ----> loss: 0.743668


epoch 290:
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60/84 ----> loss: 0.743668
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epoch 290:
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70/84 ----> loss: 0.743862


epoch 290:
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80/84 ----> loss: 0.743672


epoch 291:
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6/84 ----> loss: 0.743724


epoch 291:
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16/84 ----> loss: 0.743669


epoch 291:
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26/84 ----> loss: 0.743929


epoch 291:
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36/84 ----> loss: 0.743730


epoch 291:
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46/84 ----> loss: 0.743677


epoch 291:
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56/84 ----> loss: 0.743669
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epoch 291:
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66/84 ----> loss: 0.743668


epoch 291:
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76/84 ----> loss: 0.743669


epoch 292:
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2/84 ----> loss: 0.743716


epoch 292:
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12/84 ----> loss: 0.744140


epoch 292:
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22/84 ----> loss: 0.743678


epoch 292:
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32/84 ----> loss: 0.743669


epoch 292:
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42/84 ----> loss: 0.743669


epoch 292:
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52/84 ----> loss: 0.743668
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epoch 292:
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62/84 ----> loss: 0.743668


epoch 292:
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72/84 ----> loss: 0.743668


epoch 292:
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82/84 ----> loss: 0.743669


epoch 293:
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8/84 ----> loss: 0.743668


epoch 293:
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18/84 ----> loss: 0.743858


epoch 293:
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28/84 ----> loss: 0.743668


epoch 293:
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38/84 ----> loss: 0.743673


epoch 293:
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48/84 ----> loss: 0.743669
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epoch 293:
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58/84 ----> loss: 0.743723


epoch 293:
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68/84 ----> loss: 0.743668


epoch 293:
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78/84 ----> loss: 0.743669


epoch 294:
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4/84 ----> loss: 0.743669


epoch 294:
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14/84 ----> loss: 0.744453


epoch 294:
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24/84 ----> loss: 0.743676


epoch 294:
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34/84 ----> loss: 0.743669


epoch 294:
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44/84 ----> loss: 0.743983
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epoch 294:

54/84 ----> loss: 0.743668

epoch 294:

64/84 ----> loss: 0.743669

epoch 294:

74/84 ----> loss: 0.743670

epoch 295:

0/84 ----> loss: 0.743669

epoch 295:

10/84 ----> loss: 0.743686

epoch 295:

20/84 ----> loss: 0.743668

epoch 295:

30/84 ----> loss: 0.743680

epoch 295:

40/84 ----> loss: 0.743668

epoch 295:

50/84 ----> loss: 0.743668

epoch 295:

60/84 ----> loss: 0.743668

epoch 295:

70/84 ----> loss: 0.743847

epoch 295:

80/84 ----> loss: 0.743672

epoch 296:

6/84 ----> loss: 0.743722

epoch 296:

16/84 ----> loss: 0.743669

epoch 296:

26/84 ----> loss: 0.743911

epoch 296:

36/84 ----> loss: 0.743728

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epoch 296:
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46/84 ----> loss: 0.743677


epoch 296:
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56/84 ----> loss: 0.743669


epoch 296:
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66/84 ----> loss: 0.743668


epoch 296:
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76/84 ----> loss: 0.743669


epoch 297:
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2/84 ----> loss: 0.743713


epoch 297:
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12/84 ----> loss: 0.744120


epoch 297:
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22/84 ----> loss: 0.743677


epoch 297:
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32/84 ----> loss: 0.743669
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epoch 297:
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42/84 ----> loss: 0.743669


epoch 297:
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52/84 ----> loss: 0.743668


epoch 297:
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62/84 ----> loss: 0.743668


epoch 297:
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72/84 ----> loss: 0.743668


epoch 297:
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82/84 ----> loss: 0.743669


epoch 298:
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8/84 ----> loss: 0.743668


epoch 298:
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18/84 ----> loss: 0.743849


epoch 298:
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28/84 ----> loss: 0.743668
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epoch 298:
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38/84 ----> loss: 0.743673


epoch 298:
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48/84 ----> loss: 0.743669


epoch 298:
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58/84 ----> loss: 0.743721


epoch 298:
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68/84 ----> loss: 0.743668


epoch 298:
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78/84 ----> loss: 0.743669


epoch 299:
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4/84 ----> loss: 0.743669


epoch 299:
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14/84 ----> loss: 0.744415


epoch 299:
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24/84 ----> loss: 0.743676
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epoch 299:
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34/84 ----> loss: 0.743669


epoch 299:
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44/84 ----> loss: 0.743965


epoch 299:
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54/84 ----> loss: 0.743668


epoch 299:
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64/84 ----> loss: 0.743669


epoch 299:
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74/84 ----> loss: 0.743670
```
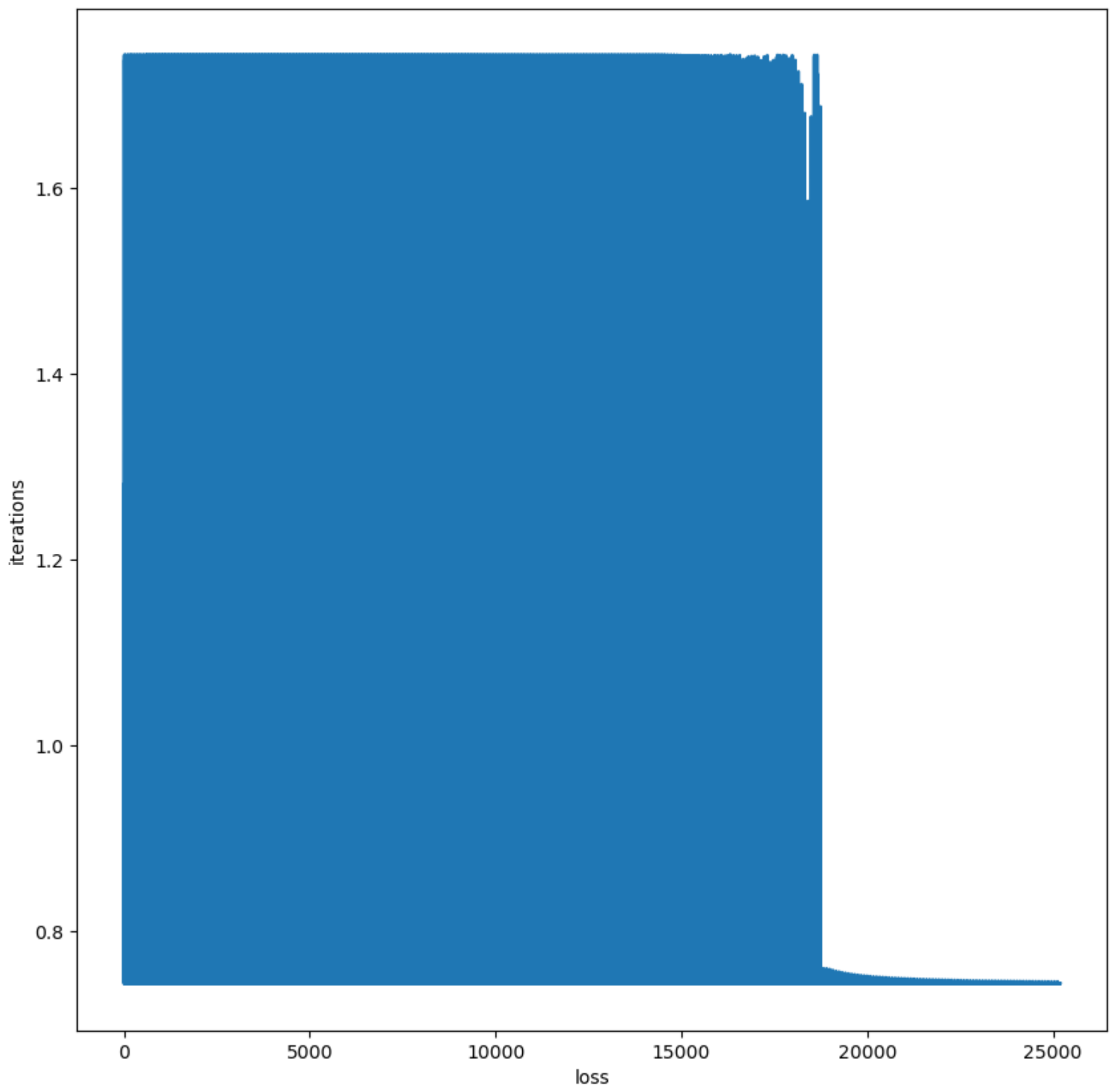



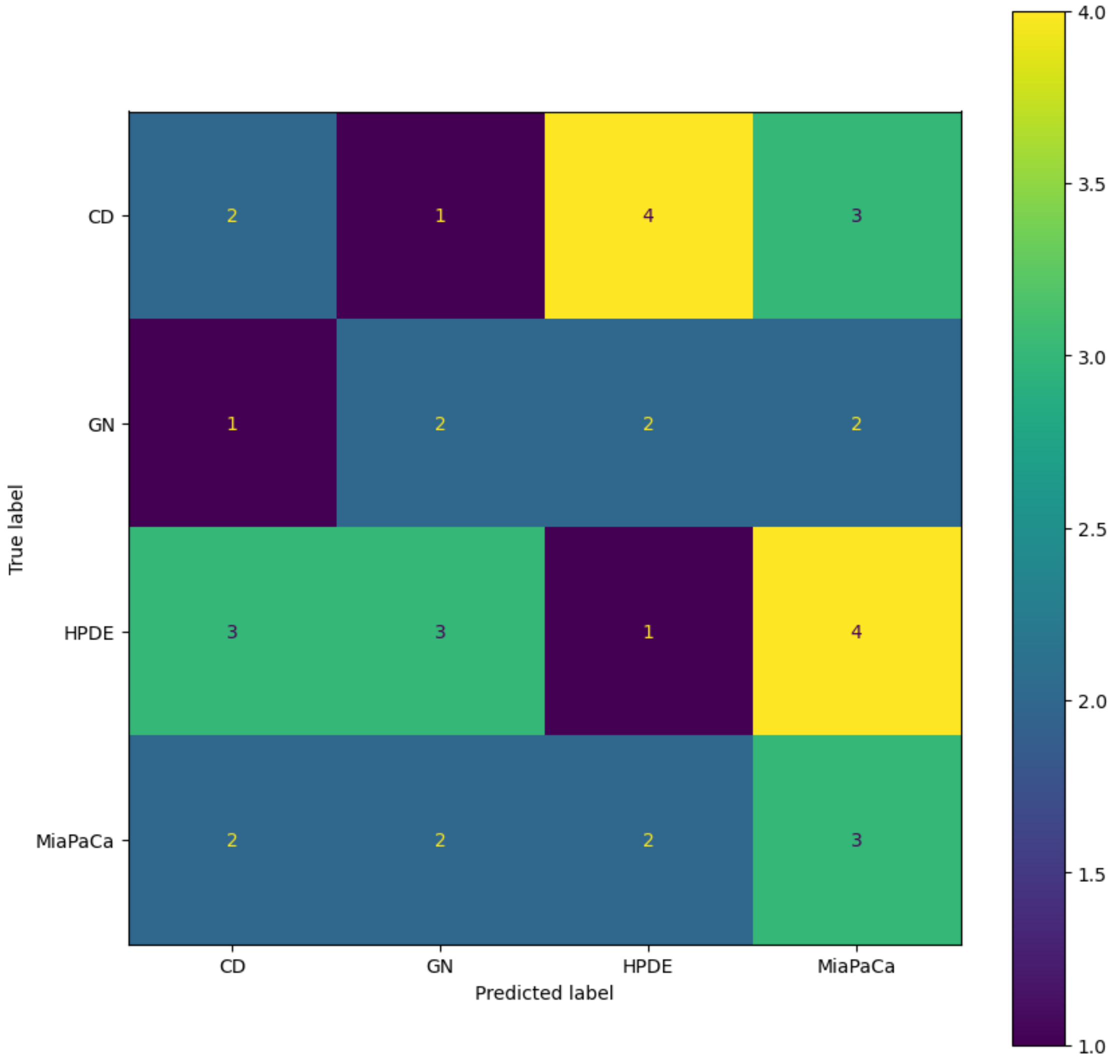
[497]:
```
accuracy,preds = testing(X_test_noPCA.values,y_test_noPCA.to_numpy().
  ↪ravel(),model,printFn=False)
print(accuracy)
```

```
Accuracy:  0.8378378378378378
0.8378378378378378
```

[498]:
```
res = []
for l in [0,1,2,3]:
    prec,recall,_,_ = precision_recall_fscore_support(np.array(y_test)==l,
                                                      np.array(preds)==l,
                                                      pos_label=True,average=None)
    res.append([l,recall[0],recall[1]])
```

```python
statistics_df = pd.DataFrame(res,columns =
    ['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0
    else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')

confusion_mat = metrics.confusion_matrix(y_test.values.ravel(), np.
    array(preds),labels=[0,1,2,3])

print('Specificity: \n', statistics_df[['label','specificity']])
print('Sensitivity: \n', statistics_df[['label','sensitivity']])

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = confusion_mat,
    display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
Specificity:
      label  specificity
0       CD     0.777778
1       GN     0.800000
2     HPDE     0.692308
3  MiaPaCa     0.678571
Sensitivity:
      label  sensitivity
0       CD     0.200000
1       GN     0.285714
2     HPDE     0.090909
3  MiaPaCa     0.333333
```



[499]:
```
print('Overall specificity: ', statistics_df['specificity'].mean())
print('Overall sensitivity: ', statistics_df['sensitivity'].mean())
```

```
Overall specificity:  0.7371642246642247
Overall sensitivity:  0.22748917748917746
```

[342]:
```
X_noPCA = df_master.drop(columns=['Target']).reset_index().
    ↪drop(columns=['index']).to_numpy()
```

[343]:
```
split = 25

#kfold = KFold(n_splits=X.shape[0], shuffle=True)
kfold = KFold(n_splits=split, shuffle=True)
```

```python
all_pred = np.array([])
y_match = np.array([])
accuracies = []
for fold, (train_ids, test_ids) in enumerate(kfold.split(X_noPCA)):

    learning_rate = 0.01
    epoch = 300
    batch = 11

    loss_fn = nn.CrossEntropyLoss()

    optimizer = torch.optim.SGD(model.parameters(), lr=learning_rate)


    loss_count, count = train_loop(X_noPCA[train_ids],
                                   y.to_numpy().ravel()[train_ids],
                                   model,
                                   epoch, batch,
                                   loss_fn,
                                   optimizer,
                                   printFn=False)

    accuracy,preds = testing(X_noPCA[test_ids],y.to_numpy().
 ↪ravel()[test_ids],model,printFn=False)
    accuracies.append(accuracy)
    all_pred = np.append(all_pred,preds)
    y_match = np.append(y_match,y.to_numpy().ravel()[test_ids])

print('Overall Accuracy: ', np.array(accuracies).mean())
conf_mat = confusion_matrix(y_match, all_pred, labels=[0,1,2,3])

res = []
for l in [0,1,2,3]:
    prec,recall,_,_ = precision_recall_fscore_support(y_match==l,
                                                      all_pred==l,
                                                      labels=[0,1,2,3],
                                                      pos_label=True,
                                                      average=None)
    res.append([l,recall[0],recall[1]])

statistics_df = pd.DataFrame(res,columns =␣
 ↪['class','specificity','sensitivity'])
statistics_df['label'] = statistics_df['class'].apply(lambda x: 'CD' if x==0␣
 ↪else 'GN' if x==1 else 'HPDE' if x==2 else 'MiaPaCa')


print('Specificity: \n', statistics_df[['label','specificity']])
```

```python
print('Sensitivity: \n', statistics_df[['label','sensitivity']])
print('Overall Specificity: \n', statistics_df[['specificity']].mean())
print('Overall Sensitivity: \n', statistics_df[['sensitivity']].mean())

cm_display = metrics.ConfusionMatrixDisplay(confusion_matrix = conf_mat,␣
↪display_labels = statistics_df['label'].to_list())
cm_display.plot()
plt.show()
```

```
C:\Users\brian\Anaconda3\Lib\site-packages\torch\nn\modules\module.py:1518:
UserWarning: Implicit dimension choice for softmax has been deprecated. Change
the call to include dim=X as an argument.
  return self._call_impl(*args, **kwargs)
```

```
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
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Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Accuracy:  1.0
Overall Accuracy:  1.0
Specificity:
      label  specificity
0       CD          1.0
1       GN          1.0
2     HPDE          1.0
3  MiaPaCa          1.0
Sensitivity:
      label  sensitivity
```

```
0       CD          1.0
1       GN          1.0
2     HPDE          1.0
3  MiaPaCa          1.0
Overall Specificity:
 specificity    1.0
dtype: float64
Overall Sensitivity:
 sensitivity    1.0
dtype: float64
```

```
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
is ill-defined and being set to 0.0 in labels with no true samples. Use
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning:
F-score is ill-defined and being set to 0.0 in labels with no true nor predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
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C:\Users\brian\Anaconda3\Lib\site-
packages\sklearn\metrics\_classification.py:1509: UndefinedMetricWarning: Recall
```

```
is ill-defined and being set to 0.0 in labels with no true samples. Use
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  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```

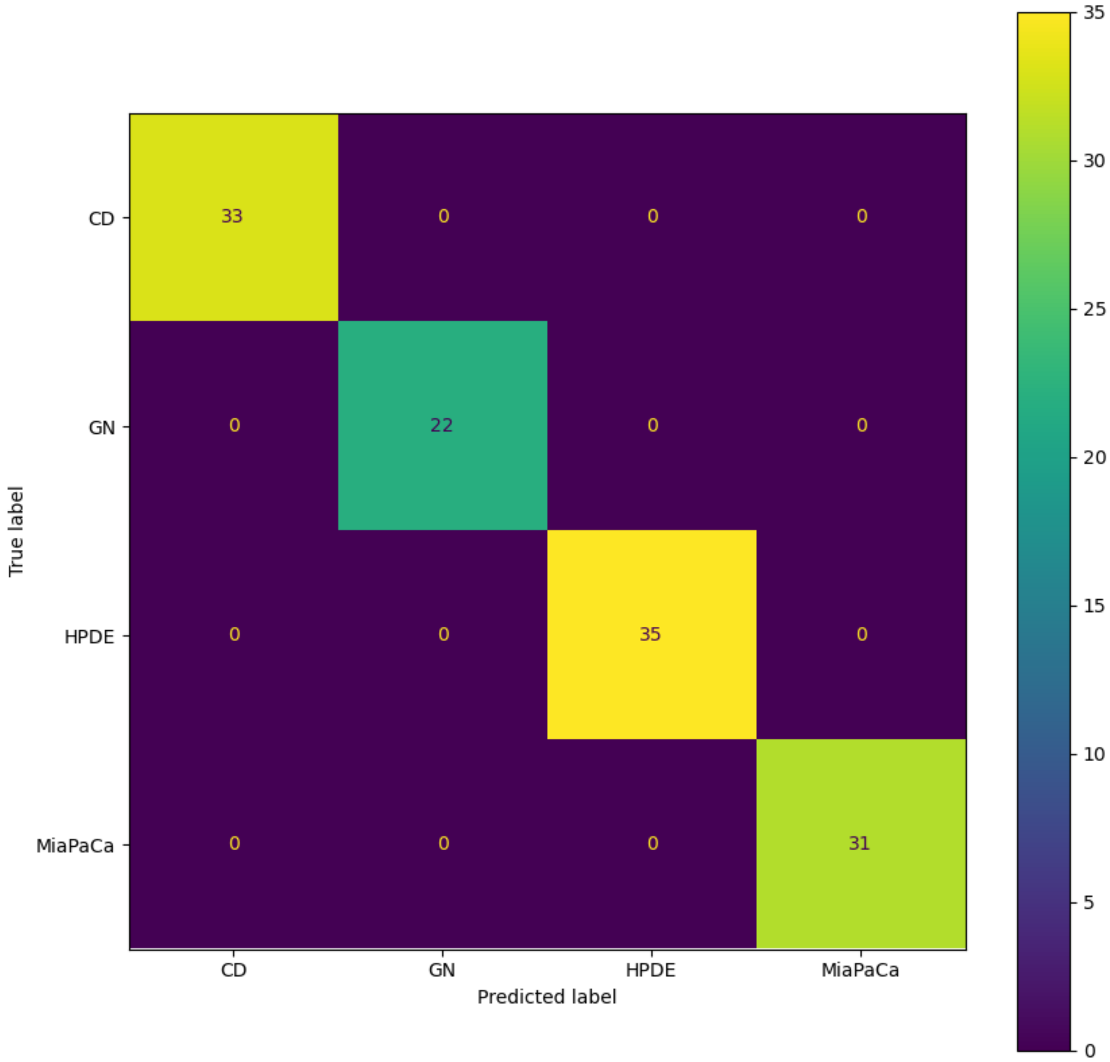

Summary: The LDA is a good method, which results in above 90% for all values. However, classical neural network model seems to do way better!