

MP4_P2_classification

November 16, 2020

```
[1]: from google.colab import drive
drive.mount('/content/gdrive')
import os
os.chdir("gdrive/My Drive/Colab Notebooks/Assignment4")
```

Mounted at /content/gdrive

```
[2]: !pip install unicode
```

Collecting unicode

Downloading <https://files.pythonhosted.org/packages/d0/42/d9edfed04228ba cea2d824904cae367ee9efd05e6cce7ceaaedd0b0ad964/Unicode-1.1.1-py2.py3-none-any.whl> (238kB)

| | 245kB 9.1MB/s

Installing collected packages: unicode

Successfully installed unicode-1.1.1

```
[3]: import time
import math
import glob
import string
import random

import torch
import torch.nn as nn

from rnn.helpers import time_since

%matplotlib inline
```

```
[4]: device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
```

1 Language recognition with an RNN

If you've ever used an online translator you've probably seen a feature that automatically detects the input language. While this might be easy to do if you input unicode characters that are unique to one or a small group of languages (like “ ” or “ ”), this problem is more challenging if the

input only uses the available ASCII characters. In this case, something like “těší mě” would become “tesi me” in the ascii form. This is a more challenging problem in which the language must be recognized purely by the pattern of characters rather than unique unicode characters.

We will train an RNN to solve this problem for a small set of languages that can be converted to romanized ASCII form. For training data it would be ideal to have a large and varied dataset in different language styles. However, it is easy to find copies of the Bible which is a large text translated to different languages but in the same easily parsable format, so we will use 20 different copies of the Bible as training data. Using the same book for all of the different languages will hopefully prevent minor overfitting that might arise if we used different books for each language (fitting to common characteristics of the individual books rather than the language).

```
[5]: from unicode import unicode as unicodeToAscii

all_characters = string.printable
n_letters = len(all_characters)

print(unicodeToAscii('těší mě'))
```

tesi me

```
[6]: # Read a file and split into lines
def readFile(filename):
    data = open(filename, encoding='utf-8').read().strip()
    return unicodeToAscii(data)

def get_category_data(data_path):
    # Build the category_data dictionary, a list of names per language
    category_data = {}
    all_categories = []
    for filename in glob.glob(data_path):
        category = os.path.splitext(os.path.basename(filename))[0].split('_')[0]
        all_categories.append(category)
        data = readFile(filename)
        category_data[category] = data

    return category_data, all_categories
```

The original text is split into two parts, train and test, so that we can make sure that the model is not simply memorizing the train data.

```
[7]: train_data_path = 'language_data/train/*_train.txt'
test_data_path = 'language_data/test/*_test.txt'

train_category_data, all_categories = get_category_data(train_data_path)
test_category_data, test_all_categories = get_category_data(test_data_path)

n_languages = len(all_categories)
```

```
print(len(all_categories))
print(all_categories)
```

20

```
['finnish', 'norwegian', 'german', 'turkish', 'swedish', 'lithuanian',
'esperanto', 'vietnamese', 'czech', 'spanish', 'danish', 'maori', 'french',
'xhosa', 'italian', 'romanian', 'albanian', 'portuguese', 'english',
'hungarian']
```

2 Data processing

```
[8]: def categoryFromOutput(output):
    top_n, top_i = output.topk(1, dim=1)
    category_i = top_i[:, 0]
    return category_i

# Turn string into long tensor
def stringToTensor(string):
    tensor = torch.zeros(len(string), requires_grad=True).long()
    for c in range(len(string)):
        tensor[c] = all_characters.index(string[c])
    return tensor

def load_random_batch(text, chunk_len, batch_size):
    input_data = torch.zeros(batch_size, chunk_len).long().to(device)
    target = torch.zeros(batch_size, 1).long().to(device)
    input_text = []
    for i in range(batch_size):
        category = all_categories[random.randint(0, len(all_categories) - 1)]
        line_start = random.randint(0, len(text[category]) - chunk_len)
        category_tensor = torch.tensor([all_categories.index(category)],
        ↪ dtype=torch.long)
        line = text[category][line_start:line_start+chunk_len]
        input_text.append(line)
        input_data[i] = stringToTensor(line)
        target[i] = category_tensor
    return input_data, target, input_text
```

3 Implement Model

For this classification task, we can use the same model we implement for the generation task which is located in `rnn/model.py`. See the `MP4_P2_generation.ipynb` notebook for more instructions. In this case each output vector of our RNN will have the dimension of the number of possible languages (i.e. `n_languages`). We will use this vector to predict a distribution over the languages.

In the generation task, we used the output of the RNN at every time step to predict the next letter and our loss included the output from each of these predictions. However, in this task we use the output of the RNN at the end of the sequence to predict the language, so our loss function will use only the predicted output from the last time step.

4 Train RNN

```
[9]: from rnn.model import RNN
```

```
[73]: chunk_len = 50

BATCH_SIZE = 128
n_epochs = 2000
hidden_size = 256
n_layers = 1
learning_rate = 0.005
model_type = 'lstm'

criterion = nn.CrossEntropyLoss()
rnn = RNN(n_letters, hidden_size, n_languages, model_type=model_type,
↪n_layers=n_layers, dropout=0.25).to(device)
```

TODO: Fill in the train function. You should initialize a hidden layer representation using your RNN's `init_hidden` function, set the model gradients to zero, and loop over each time step (character) in the input tensor. For each time step compute the output of the of the RNN and the next hidden layer representation. The cross entropy loss should be computed over the last RNN output scores from the end of the sequence and the target classification tensor. Lastly, call backward on the loss and take an optimizer step.

```
[64]: def train(rnn, target_tensor, data_tensor, optimizer, criterion,
↪batch_size=BATCH_SIZE):
    """
    Inputs:
    - rnn: model
    - target_target: target character data tensor of shape (batch_size, 1)
    - data_tensor: input character data tensor of shape (batch_size, chunk_len)
    - optimizer: rnn model optimizer
    - criterion: loss function
    - batch_size: data batch size

    Returns:
    - output: output from RNN from end of sequence
    - loss: computed loss value as python float

    """
    output, out_loss = None, 0.0
```

```
#####
#           YOUR CODE HERE           #
#####
hidden = rnn.init_hidden(batch_size, device)
rnn.train()
target_tensor.to(device)
data_tensor.to(device)
optimizer.zero_grad()
output, hidden = rnn(data_tensor, hidden)
loss = criterion(output, target_tensor.squeeze())
loss.backward()
optimizer.step()
out_loss += loss.item()
#####          END          #####

return output, out_loss
```

```
[65]: def evaluate(rnn, data_tensor, seq_len=chunk_len, batch_size=BATCH_SIZE):
    with torch.no_grad():
        data_tensor = data_tensor.to(device)
        hidden = rnn.init_hidden(batch_size, device=device)
        output, hidden = rnn(data_tensor, hidden)

        return output

def eval_test(rnn, category_tensor, data_tensor):
    with torch.no_grad():
        output = evaluate(rnn, data_tensor)
        loss = criterion(output, category_tensor.squeeze())
        return output, loss.item()
```

```
[84]: n_iters = 20000 #2000 #100000
print_every = 50
plot_every = 50

# Keep track of losses for plotting
current_loss = 0
current_test_loss = 0
all_losses = []
all_test_losses = []

start = time.time()
```

```

optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate, weight_decay =
↪5e-5)
scheduler = torch.optim.lr_scheduler.StepLR(optimizer, step_size=2000, gamma=0.
↪75)

number_correct = 0
for iter in range(1, n_iters + 1):
    scheduler.step()
    input_data, target_category, text_data =
↪load_random_batch(train_category_data, chunk_len, BATCH_SIZE)
    output, loss = train(rnn, target_category, input_data, optimizer, criterion)
    current_loss += loss

    _, test_loss = eval_test(rnn, target_category, input_data)
    current_test_loss += test_loss

    guess_i = categoryFromOutput(output)
    number_correct += (target_category.squeeze()==guess_i.squeeze()).long().
↪sum()

    # Print iter number, loss, name and guess
    if iter % print_every == 0:
        sample_idx = 0
        guess = all_categories[guess_i[sample_idx]]

        category = all_categories[int(target_category[sample_idx])]

        correct = ' ' if guess == category else ' (%s)' % category
        print('%d %d%% (%s) %.4f %.4f %s / %s %s' % (iter, iter / n_iters *
↪100, time_since(start), loss, test_loss, text_data[sample_idx], guess,
↪correct))
        print('Train accuracy: {}'.format(float(number_correct)/
↪float(print_every*BATCH_SIZE)))
        number_correct = 0

    # Add current loss avg to list of losses
    if iter % plot_every == 0:
        all_losses.append(current_loss / plot_every)
        current_loss = 0
        all_test_losses.append(current_test_loss / plot_every)
        current_test_loss = 0

```

/usr/local/lib/python3.6/dist-packages/torch/optim/lr_scheduler.py:136:
UserWarning: Detected call of `lr_scheduler.step()` before `optimizer.step()`.
In PyTorch 1.1.0 and later, you should call them in the opposite order:
`optimizer.step()` before `lr_scheduler.step()`. Failure to do this will result
in PyTorch skipping the first value of the learning rate schedule. See more

details at <https://pytorch.org/docs/stable/optim.html#how-to-adjust-learning-rate>

"<https://pytorch.org/docs/stable/optim.html#how-to-adjust-learning-rate>",
UserWarning)

50 0% (0m 3s) 0.0334 0.0410 sezata acolo si sa ramina pe locul ei.`` Am ridica /
romanian

Train accuracy: 0.98578125

100 0% (0m 7s) 0.0638 0.0312 dvorce jsou dedicnym podilem Rubenovcu pro jejich
/ czech

Train accuracy: 0.989375

150 0% (0m 11s) 0.0088 0.0083 esvia-se do mal; o que guarda o seu caminho preser
/ portuguese

Train accuracy: 0.98859375

200 1% (0m 14s) 0.0807 0.0767 lgys nesvaru maista. Jie neaukos Viespaciui geriam
/ lithuanian

Train accuracy: 0.98640625

250 1% (0m 18s) 0.0304 0.0237 fort dans les bonnes graces de Pharaon; de sorte
/ french

Train accuracy: 0.98875

300 1% (0m 21s) 0.0142 0.0132 j Fredens Veje, der er ingen Ret i deres Spor; de
/ danish

Train accuracy: 0.9875

350 1% (0m 25s) 0.0891 0.0232 byly velice suche. I otazal se mne: "Lidsky synu,
/ czech

Train accuracy: 0.9896875

400 2% (0m 29s) 0.0116 0.0063 derselben Nacht durch Agypten gehen und alle Erstg
/ german

Train accuracy: 0.98625

450 2% (0m 32s) 0.0073 0.0055 zjasovych, kteri byli v Achazjasovych sluzbach, a
/ czech

Train accuracy: 0.9878125

500 2% (0m 36s) 0.0254 0.0083 rael, og ingen Sinde skal nogen i din Slaegt blive
/ danish

Train accuracy: 0.98734375

550 2% (0m 40s) 0.0245 0.0118 nde Hiskia ut bud till hela Israel och Juda och sk
/ swedish

Train accuracy: 0.98765625

600 3% (0m 43s) 0.0595 0.0270 omhla olandelayo bawuphungula umthwalo; nangowesit
/ xhosa

Train accuracy: 0.9871875

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/ norwegian

Train accuracy: 0.9890625

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/ xhosa

Train accuracy: 0.98390625

750 3% (0m 54s) 0.0209 0.0130 rai cua Xim-ma la Gio-a; con trai cua Gio-a la Y-d

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 Train accuracy: 0.98828125
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 / albanian
 Train accuracy: 0.990625
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 / vietnamese
 Train accuracy: 0.98765625
 900 4% (1m 5s) 0.0779 0.0460 ta servante, en disant: Certainement ton fils Salo
 / french
 Train accuracy: 0.986875
 950 4% (1m 8s) 0.0307 0.0164 a viga de tu ojo, y entonces miraras en echar la m
 / spanish
 Train accuracy: 0.98671875
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 u / turkish
 Train accuracy: 0.98609375
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 Train accuracy: 0.98625
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 Train accuracy: 0.9875
 1150 5% (1m 23s) 0.0467 0.0135 pred abimelekem, a ten ho vypudil a on odesel.
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 Train accuracy: 0.98875
 1200 6% (1m 26s) 0.0108 0.0135 ku me demin e vogel do te ofrohet, si blatim i
 ush / albanian
 Train accuracy: 0.98953125
 1250 6% (1m 30s) 0.0008 0.0007 pha hoang, va cac cua thanh bi lua thieu dot?
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 Train accuracy: 0.9934375
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 Train accuracy: 0.98890625
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 nha / vietnamese
 Train accuracy: 0.988125
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 rykte / swedish
 Train accuracy: 0.9890625
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 / german
 Train accuracy: 0.98671875
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 Train accuracy: 0.98515625
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a / hungarian
Train accuracy: 0.98890625
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Train accuracy: 0.98671875
1650 8% (1m 58s) 0.0063 0.0077 du si til Israels barn: "Jeg er" har sendt mig ti / norwegian
Train accuracy: 0.99046875
1700 8% (2m 2s) 0.0478 0.0196 i obeos Mian vocxon kaj observos Mian interligon, / esperanto
Train accuracy: 0.99078125
1750 8% (2m 5s) 0.0704 0.0296 che ha disteso i cieli e fondata la terra, e che / italian
Train accuracy: 0.98265625
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Train accuracy: 0.9853125
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Train accuracy: 0.989375
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Train accuracy: 0.9865625
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Train accuracy: 0.98703125
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Train accuracy: 0.984375
2050 10% (2m 26s) 0.0129 0.0235 vanti. Io sono stato muto, in silenzio, mi son tac / italian
Train accuracy: 0.98734375
2100 10% (2m 30s) 0.0777 0.0530 no, Dang lam cho long no day day, Ngai se giang c / vietnamese
Train accuracy: 0.9875
2150 10% (2m 33s) 0.0135 0.0062 t truly and uprightly, in that ye have made Abimel / english
Train accuracy: 0.9915625
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Train accuracy: 0.99078125
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 Train accuracy: 0.988125
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 Train accuracy: 0.9909375
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 Train accuracy: 0.99140625
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 Train accuracy: 0.98953125
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 Train accuracy: 0.99015625
 2650 13% (3m 8s) 0.0268 0.0180 pa Land, fuldt af store Fisk, et Hundrede og tre
 / danish
 Train accuracy: 0.990625
 2700 13% (3m 12s) 0.0233 0.0183 ,Va voi lepada, zice Domnul.``,,Si pe
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 Train accuracy: 0.9878125
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 Train accuracy: 0.989375
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 Train accuracy: 0.99203125
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 Train accuracy: 0.98859375
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 Train accuracy: 0.989375
 2950 14% (3m 29s) 0.0627 0.0190 atou ki runga ki te pa; ka oma ratou i runga i
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 Train accuracy: 0.98984375
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 3050 15% (3m 36s) 0.0876 0.0777 etahi wira. Na ka totoro te ringa o te kerupa i
 wa / maori
 Train accuracy: 0.9878125
 3100 15% (3m 40s) 0.0033 0.0029 nity. I said of laughter, It is mad; and of
 mirth, / english
 Train accuracy: 0.98875
 3150 15% (3m 43s) 0.0656 0.0430 jeg enn hadde rett, men matte be min dommer om

nad / norwegian
Train accuracy: 0.990625
3200 16% (3m 47s) 0.0083 0.0097 buc tho nhu sau nay: Co-lot Ly-sia chuc binh an
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Train accuracy: 0.98953125
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det / norwegian
Train accuracy: 0.9934375
3300 16% (3m 53s) 0.0046 0.0074 yat. Es ok valanak Izsaknak es Rebekanak lelke
kes / hungarian
Train accuracy: 0.98984375
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den / danish
Train accuracy: 0.98796875
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Train accuracy: 0.9909375
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Train accuracy: 0.9915625
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Train accuracy: 0.98984375
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Train accuracy: 0.990625
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Train accuracy: 0.98921875
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Train accuracy: 0.99015625
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Train accuracy: 0.99109375
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Train accuracy: 0.9896875
3850 19% (4m 31s) 0.0137 0.0093 uRakeli uzibile. Wangena uLabhan ententeni
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Train accuracy: 0.99109375
3900 19% (4m 35s) 0.0295 0.0093 etranger; au contraire, elles le fuiront, parce
q / french
Train accuracy: 0.98671875
3950 19% (4m 38s) 0.0447 0.0208 "Gerai, mano dukra, kad eini su jo tarnaitemis.

K / lithuanian
Train accuracy: 0.98921875
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e / albanian
Train accuracy: 0.99015625
4050 20% (4m 45s) 0.0279 0.0129 nici strainul care locuieste in mijlocul
vostru. / romanian
Train accuracy: 0.99265625
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ven / romanian
Train accuracy: 0.9928125
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ka / esperanto
Train accuracy: 0.991875
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de / spanish
Train accuracy: 0.9921875
4250 21% (4m 59s) 0.0078 0.0082 priemaisas is sidabro, ir sidabrakalys padarys
is / lithuanian
Train accuracy: 0.9921875
4300 21% (5m 2s) 0.0206 0.0105 . Ja jsem prisel na svet jako svetlo, aby nikdo,
k / czech
Train accuracy: 0.991875
4350 21% (5m 6s) 0.0059 0.0082 : Ko Kingi Iehorama ia kua hoki ki Ietereere kia
r / maori
Train accuracy: 0.99125
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Train accuracy: 0.9921875
4450 22% (5m 12s) 0.0413 0.0209 ar les Philistins avaient dit: Il faut empecher
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Train accuracy: 0.99328125
4500 22% (5m 16s) 0.0227 0.0217 autia ano e ahau tona kingitanga ake ake, ki te
ma / maori
Train accuracy: 0.99109375
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in / romanian
Train accuracy: 0.991875
4600 23% (5m 23s) 0.0083 0.0050 till mig, sa skulle jag skaffa honom rattvisa.>>
0 / swedish
Train accuracy: 0.99265625
4650 23% (5m 26s) 0.0334 0.0180 Makpela Tarlasindaki magaraya gomduler. 0
magarayi / turkish
Train accuracy: 0.99171875
4700 23% (5m 30s) 0.0929 0.0528 por todos era louvado. Chegando a Nazare, onde
fo / portuguese
Train accuracy: 0.99125
4750 23% (5m 33s) 0.0279 0.0195 ass dem Zeichen, das der Mann Gottes durch das

Wor / german
 Train accuracy: 0.993125
 4800 24% (5m 36s) 0.0049 0.0053 karin heimon alueeseen. Isaskarin ja Asserin
 heimo / finnish
 Train accuracy: 0.9928125
 4850 24% (5m 40s) 0.0667 0.0406 udah and the children of Jerusalem unto the sons
 o / english
 Train accuracy: 0.99234375
 4900 24% (5m 43s) 0.0318 0.0181 n Elamin kimppuun nelja tuulta neljalta
 ilmansuunn / finnish
 Train accuracy: 0.991875
 4950 24% (5m 47s) 0.0456 0.0528 i bos cikmasin. <<Alti gun calisacak, yedinci
 gun / turkish
 Train accuracy: 0.993125
 5000 25% (5m 50s) 0.0539 0.0478 ekvu min. Kaj la gardostaranto raportis,
 dirante:L / esperanto
 Train accuracy: 0.990625
 5050 25% (5m 53s) 0.0069 0.0096 eg er uomskaren pa Laeberne?" Da talede HERREN
 til / danish
 Train accuracy: 0.9915625
 5100 25% (5m 57s) 0.0170 0.0319 on; ngokuba umbhuqi kaMowabhi unyuke weza kuwe,
 u / xhosa
 Train accuracy: 0.9928125
 5150 25% (6m 0s) 0.0250 0.0083 usaggal illettetett. Es azt gondola, hogy az o
 aty / hungarian
 Train accuracy: 0.98953125
 5200 26% (6m 3s) 0.0178 0.0071 oj de Jerusalem. Kaj diru al ili:Tiele diras la
 Et / esperanto
 Train accuracy: 0.98890625
 5250 26% (6m 7s) 0.0043 0.0027 Karmi ozala amaKarmi. Yiyo leyo imizalwane
 yamaRub / xhosa
 Train accuracy: 0.9928125
 5300 26% (6m 10s) 0.0127 0.0095 ham! Men han sa til ham: Barn! du er alltid hos
 mi / norwegian
 Train accuracy: 0.99140625
 5350 26% (6m 13s) 0.0232 0.0247 e rapu kupu ana. Nana, mahara tonu atu ahau ki
 a / maori
 Train accuracy: 0.9915625
 5400 27% (6m 17s) 0.0036 0.0033 ion, y un carnero sin defecto por sacrificio de
 pa / spanish
 Train accuracy: 0.991875
 5450 27% (6m 20s) 0.0022 0.0013 g dong, nao sat dung ve do lam bang sat, nao go
 du / vietnamese
 Train accuracy: 0.9925
 5500 27% (6m 24s) 0.0254 0.0200 Y te turba espanto repentino; O tinieblas,
 porque / spanish
 Train accuracy: 0.99140625
 5550 27% (6m 27s) 0.0335 0.0182 e ren. Men hvis Udslaettet breder sig pa Huden,

ef / danish
Train accuracy: 0.99
5600 28% (6m 30s) 0.0105 0.0157 yathanda, hlambuluka. Lahlambuluka kwaoko iqhenqa / xhosa
Train accuracy: 0.9915625
5650 28% (6m 34s) 0.0327 0.0140 diye yanitladilar. Ama Yehosafat, <<Burada danisab / turkish
Train accuracy: 0.98875
5700 28% (6m 37s) 0.0136 0.0081 ndikunikayo. Ndayidla ke, yaba nencasa emlonyeni w / xhosa
Train accuracy: 0.99265625
5750 28% (6m 40s) 0.0215 0.0157 ittivat linnoitetut kaupungit ja viljavat pellot, / finnish
Train accuracy: 0.99265625
5800 28% (6m 44s) 0.0079 0.0073 zatere a Jordantol, es vitetek a Lelektol a puszta / hungarian
Train accuracy: 0.9896875
5850 29% (6m 47s) 0.0188 0.0189 G 14, 24.} Han lot alle prestene komme fra Judas b / norwegian
Train accuracy: 0.98953125
5900 29% (6m 51s) 0.0104 0.0058 o tonu iho i roto i ahau. P E whakahokia ake ana t / maori
Train accuracy: 0.991875
5950 29% (6m 54s) 0.0079 0.0069 e tour; puis il la loua a des vigneron, et s'en a / french
Train accuracy: 0.9890625
6000 30% (6m 57s) 0.0303 0.0255 rarea Lui! Pe Cel ce Si -a adus aminte de noi, cin / romanian
Train accuracy: 0.99265625
6050 30% (7m 1s) 0.0304 0.0235 ii prin el. In vremea aceea, va picura must din mu / romanian
Train accuracy: 0.98875
6100 30% (7m 4s) 0.0041 0.0105 m, yeryuzunden silinmis olurdun. Gucumu sana goste / turkish
Train accuracy: 0.99
6150 30% (7m 7s) 0.0051 0.0040 jejich posvatne sloupy roztristite, jejich posvatn / czech
Train accuracy: 0.99171875
6200 31% (7m 11s) 0.0162 0.0144 iyaya bagli kalacagina ant icmisti. Cunku Toviya, / turkish
Train accuracy: 0.99390625
6250 31% (7m 14s) 0.0046 0.0024 m, jak je ujistil. Izraelci obdrzeli v kenaanske z / czech
Train accuracy: 0.99296875
6300 31% (7m 17s) 0.0131 0.0103 llen werden dir deine Saume aufgedeckt und deine F / german
Train accuracy: 0.99265625
6350 31% (7m 20s) 0.0353 0.0354 vida eterna. Mas a los que son contenciosos, y

no / spanish
Train accuracy: 0.99515625
6400 32% (7m 24s) 0.0453 0.0428 ki ellenem egy embert, hogy megvívjunk egymással. / hungarian
Train accuracy: 0.9928125
6450 32% (7m 27s) 0.0036 0.0034 unyiwe ngokunje kuwe. Ithe yakulithetha kum elo li / xhosa
Train accuracy: 0.9946875
6500 32% (7m 30s) 0.0733 0.0393 kezei megdermednek. Utjok szerint cselekszem velok / hungarian
Train accuracy: 0.991875
6550 32% (7m 33s) 0.0055 0.0035 azalwana benu, abaLevi, phakathi koonyana bakaSir / xhosa
Train accuracy: 0.99078125
6600 33% (7m 37s) 0.0171 0.0123 nd ta shikosh, megjithese ke per te pare vetem ska / albanian
Train accuracy: 0.993125
6650 33% (7m 40s) 0.0072 0.0025 en wird; denn sie werden die Frucht ihrer Taten ge / german
Train accuracy: 0.99375
6700 33% (7m 43s) 0.0089 0.0056 ou- se, pois, o rei de Israel, e eles entraram na / portuguese
Train accuracy: 0.99234375
6750 33% (7m 46s) 0.0049 0.0030 y laid their hands upon them: and the priests kill / english
Train accuracy: 0.99234375
6800 34% (7m 50s) 0.0430 0.0277 binh an! ma khong binh an chi het. Ho pham toi gom / vietnamese
Train accuracy: 0.99359375
6850 34% (7m 53s) 0.0165 0.0069 till honom; ty detta betyder for dig liv och lang / swedish
Train accuracy: 0.9940625
6900 34% (7m 56s) 0.0453 0.0459 od, este comenzo a ser poderoso en la tierra. Este / spanish
Train accuracy: 0.99171875
6950 34% (8m 0s) 0.0066 0.0053 o framfor den bildstod som Nebukadnessar hade lati / swedish
Train accuracy: 0.991875
7000 35% (8m 3s) 0.0073 0.0043 Vous dites: "Dieu reserve la peine a ses enfants; / french
Train accuracy: 0.9896875
7050 35% (8m 6s) 0.0074 0.0158 sakajxon cxirkau sian lumbon kaj funebris pri sia / esperanto
Train accuracy: 0.9940625
7100 35% (8m 10s) 0.0131 0.0056 moglie ma senza figliuoli, il fratello ne prenda l / italian
Train accuracy: 0.99515625
7150 35% (8m 13s) 0.0080 0.0087 for a water for impurity: it is a sin-offering.

A / english

Train accuracy: 0.99328125

7200 36% (8m 16s) 0.0156 0.0085 lsene over staden, hver med sitt

odeleggelsesredsk / norwegian

Train accuracy: 0.99171875

7250 36% (8m 20s) 0.0032 0.0094 und erzählten ihm und sprachen: Wir sind in das

La / german

Train accuracy: 0.9909375

7300 36% (8m 23s) 0.0227 0.0110 selon l'oeuvre de leurs mains. Tu leur donneras

l' / french

Train accuracy: 0.9940625

7350 36% (8m 26s) 0.0110 0.0048 . Han meni Sakariaan taloon ja tervehti

Elisabetia / finnish

Train accuracy: 0.993125

7400 37% (8m 30s) 0.0779 0.0534 ivakalisa kakhulu nokuyibhengeza loo ndawo,

ngokok / xhosa

Train accuracy: 0.99078125

7450 37% (8m 33s) 0.0172 0.0171 loi chi ra khoi mieng cac nguoi cho den ngay

nao / vietnamese

Train accuracy: 0.99046875

7500 37% (8m 36s) 0.0049 0.0067 eshte me mua? Ah, mos e pafsha dhembjen qe do te

p / albanian

Train accuracy: 0.99265625

7550 37% (8m 40s) 0.0049 0.0029 certarii o va deslipi de el. - Cine asupreste

pe / romanian

Train accuracy: 0.99359375

7600 38% (8m 43s) 0.0104 0.0067 orquanto nao tinham saido ao encontro dos filhos

d / portuguese

Train accuracy: 0.99296875

7650 38% (8m 46s) 0.0019 0.0026 experto en toda obra. Del oro, de la plata, del

m / spanish

Train accuracy: 0.99390625

7700 38% (8m 50s) 0.0188 0.0178 o estas loko, kie mankas nenio, kio estas sur la

t / esperanto

Train accuracy: 0.9915625

7750 38% (8m 53s) 0.0437 0.0169 as hus, ikke som den pakt jeg oprettet med deres

f / norwegian

Train accuracy: 0.99421875

7800 39% (8m 56s) 0.0658 0.0532 ibil<<." Hospodin dale pravil: "Krik ze Sodomy a

G / czech

Train accuracy: 0.9921875

7850 39% (9m 0s) 0.0238 0.0236 levd, han var naesten hundre ar gammel, og pa

Sara / danish (norwegian)

Train accuracy: 0.9921875

7900 39% (9m 3s) 0.0110 0.0115 , av hele eders hjerte! Se hvor store ting han

har / norwegian

Train accuracy: 0.99265625

7950 39% (9m 6s) 0.0052 0.0044 ez-vous de quelle maniere il vous a parle,

lorsqu' / french
Train accuracy: 0.9909375
8000 40% (9m 9s) 0.0135 0.0140 nh thanh ta. Chung no nam gan moi ban tho, tren
nh / vietnamese
Train accuracy: 0.99390625
8050 40% (9m 13s) 0.0264 0.0176 till korta med undervisning, ej heller de vise
me / swedish
Train accuracy: 0.9928125
8100 40% (9m 16s) 0.0117 0.0019 Und sie machten eine Verschwörung wider ihn zu
Je / german
Train accuracy: 0.99515625
8150 40% (9m 19s) 0.0169 0.0100 ou, O Jehovah, when I contend with thee; yet
would / english
Train accuracy: 0.994375
8200 41% (9m 22s) 0.0017 0.0016 riram ao fio da espada; e os da guarda e os
oficia / portuguese
Train accuracy: 0.993125
8250 41% (9m 26s) 0.0123 0.0121 i a ia ki te whakatarewatia ki tona kaki te
kohatu / maori
Train accuracy: 0.9928125
8300 41% (9m 29s) 0.0319 0.0162 ni dhe lutuni qe te mos hyni ne tundim''. Ndersa
a / albanian
Train accuracy: 0.99234375
8350 41% (9m 32s) 0.0051 0.0065 postem, placem a narikanim; mnohym se staly
luzkem / czech
Train accuracy: 0.9928125
8400 42% (9m 36s) 0.0316 0.0194 okma ekmek icin bile suc isler. Cimri servet
pesin / turkish
Train accuracy: 0.99546875
8450 42% (9m 39s) 0.0555 0.0411 etti, yeryuzundeki her sey silinip gitti. Yalniz
N / turkish
Train accuracy: 0.99234375
8500 42% (9m 42s) 0.0309 0.0246 Israels konge og lot si: Ta dig i vare for a
dra / norwegian
Train accuracy: 0.99359375
8550 42% (9m 46s) 0.0149 0.0035 a asuntojen paljoudesta tulee loppu, sanoo
Herra. / finnish
Train accuracy: 0.99484375
8600 43% (9m 49s) 0.0021 0.0021 ver!> demistin. Ofkelendigimde bir kral verdim
sa / turkish
Train accuracy: 0.99421875
8650 43% (9m 52s) 0.0116 0.0075 ra; porquanto tinha tomado uma mulher cuchita. E
d / portuguese
Train accuracy: 0.9934375
8700 43% (9m 55s) 0.0556 0.0367 joka ei mene lammastarhaan portista vaan
kiipeaa / finnish
Train accuracy: 0.9946875
8750 43% (9m 59s) 0.0397 0.0272 ete i axet. Nar sa frukten ar mogen, later han

str / norwegian (swedish)
Train accuracy: 0.99203125
8800 44% (10m 2s) 0.0117 0.0129 Sa lod Kong David ham hente i Makirs, Ammiels
Son / danish
Train accuracy: 0.9928125
8850 44% (10m 5s) 0.0344 0.0344 en ja varoo tekemasta pahaa. Alkoon murehtiko
muuk / finnish
Train accuracy: 0.9915625
8900 44% (10m 9s) 0.0038 0.0068 u i mea ai ki a koutou, kia tupato i te rewena a
n / maori
Train accuracy: 0.991875
8950 44% (10m 12s) 0.0303 0.0237 r. Porventura nao encho eu o ceu e a terra? diz
o / portuguese
Train accuracy: 0.99296875
9000 45% (10m 15s) 0.0078 0.0072 olhavam para o sul; uma estava ao lado da
porta d / portuguese
Train accuracy: 0.993125
9050 45% (10m 18s) 0.0242 0.0093 , E te Ariki, nonahea matou i kite ai i a koe e
hi / maori
Train accuracy: 0.99484375
9100 45% (10m 22s) 0.0116 0.0164 ew, Rabboni; which is to say, Teacher. Jesus
saith / english
Train accuracy: 0.99421875
9150 45% (10m 25s) 0.0159 0.0158 akama kwezulu ingcwele yakhe, Njengomhlaba lo
awu / xhosa
Train accuracy: 0.9940625
9200 46% (10m 28s) 0.0578 0.0506 li nendlu kaYuda ngembewu yomntu, nangembewu
yenko / xhosa
Train accuracy: 0.99453125
9250 46% (10m 31s) 0.0279 0.0175 Herra Jumala." Minulle tuli tama Herran sana:
"Ih / finnish
Train accuracy: 0.9940625
9300 46% (10m 35s) 0.0091 0.0034 orni, finch'io giunga da te e ti faccia sapere
que / italian
Train accuracy: 0.99515625
9350 46% (10m 38s) 0.0118 0.0066 atto mediante il fuoco all'Eterno. Se la sua
offer / italian
Train accuracy: 0.9928125
9400 47% (10m 41s) 0.0034 0.0017 : >>Om du icke vill, sa lat dock min broder
Amnon / swedish
Train accuracy: 0.9953125
9450 47% (10m 44s) 0.0197 0.0095 ta Pyhaa Henkea taynna. Hengen johdattamana han
ku / finnish
Train accuracy: 0.99390625
9500 47% (10m 47s) 0.0126 0.0122 ei kozul Benhailat, Obadiast, Zakariast,
Netaneelt / hungarian
Train accuracy: 0.99140625
9550 47% (10m 51s) 0.0087 0.0067 dass er Bestand habe. Er aber fiel von ihm ab

und / german
Train accuracy: 0.9934375
9600 48% (10m 54s) 0.0032 0.0032 enviou Merodaque-Balada, filho de Balada, rei
de / portuguese
Train accuracy: 0.9934375
9650 48% (10m 57s) 0.0592 0.0605 stol elpusztulni. Elosztak azert magok kozt a
fold / hungarian
Train accuracy: 0.99359375
9700 48% (11m 0s) 0.0037 0.0020 ort ifran mig den smalek som jag fruktat; ty
dina / swedish
Train accuracy: 0.99453125
9750 48% (11m 4s) 0.0229 0.0169 ruokailivat ja ylistivat Herraa: "Han on hyva,
iat / finnish
Train accuracy: 0.9946875
9800 49% (11m 7s) 0.0319 0.0308 o og gjorde som Herren hadde sagt; Aron kastet
sin / norwegian
Train accuracy: 0.9934375
9850 49% (11m 10s) 0.0292 0.0129 ahipleneceksiniz. Bal ve sut akan bu ulkeyi
size m / turkish
Train accuracy: 0.9928125
9900 49% (11m 13s) 0.0098 0.0106 asse var tolv ar gammal, nar han blev konung,
och / swedish
Train accuracy: 0.9928125
9950 49% (11m 16s) 0.0029 0.0029 sei. Denn ich kenne deinen Ungehorsam und deine
Ha / german
Train accuracy: 0.99515625
10000 50% (11m 19s) 0.0360 0.0322 lwini, abantu abo abalusi bathi omnye komnye,
Mas / xhosa
Train accuracy: 0.99515625
10050 50% (11m 23s) 0.0035 0.0039 nele, sobre o mar; e todo o povo estava em
terra / portuguese
Train accuracy: 0.99296875
10100 50% (11m 26s) 0.0308 0.0287 h out their own glory is grievous. He whose
spirit / english
Train accuracy: 0.9928125
10150 50% (11m 29s) 0.0081 0.0088 re til HERREN; og Helligofrene udgjorde 600
Stykke / danish
Train accuracy: 0.99296875
10200 51% (11m 32s) 0.0417 0.0496 atta, miksi. Huuda sina vain! Mutta vastaako
sinul / finnish
Train accuracy: 0.99421875
10250 51% (11m 36s) 0.0078 0.0044 etin dhe do te te japin dy buke, qe do t'i
marresh / albanian
Train accuracy: 0.993125
10300 51% (11m 39s) 0.0178 0.0130 rde a sua gordura. Eu sou para eles objeto de
opro / portuguese
Train accuracy: 0.995
10350 51% (11m 42s) 0.0460 0.0400 d sagen: Wer sich furchtet und wem graut, der

kehr / german
Train accuracy: 0.99375
10400 52% (11m 46s) 0.0133 0.0140 te. Entao Nabucodonozor, na sua ira e furia,
mando / portuguese
Train accuracy: 0.99390625
10450 52% (11m 49s) 0.0099 0.0113 des siger da du, at Menneskesonnen bor
ophojes? Hv / danish
Train accuracy: 0.9921875
10500 52% (11m 52s) 0.0430 0.0447 passait, il se mit a crier et a dire: Jesus,
fils / french
Train accuracy: 0.99421875
10550 52% (11m 56s) 0.0057 0.0022 t o casa de indaratnici. Ci sa le spui
cuvintele M / romanian
Train accuracy: 0.9934375
10600 53% (11m 59s) 0.0069 0.0083 awhirinaki ana ki a ia. P He himene na Rawiri,
i t / maori
Train accuracy: 0.9959375
10650 53% (12m 2s) 0.0157 0.0111 rendi drejt tyre te portiku te quajtur i
Salomoni / albanian
Train accuracy: 0.9946875
10700 53% (12m 6s) 0.0196 0.0138 an Joasin luo. Sanokaa heille, etta kuninkaan
kask / finnish
Train accuracy: 0.99328125
10750 53% (12m 9s) 0.0051 0.0059 delmia tasta viikunapuusta, mutta en ole
loytanyt. / finnish
Train accuracy: 0.99234375
10800 54% (12m 13s) 0.0095 0.0079 lyijykansi avautui, ja ruukussa istui nainen.
Enke / finnish
Train accuracy: 0.9946875
10850 54% (12m 16s) 0.0053 0.0051 u coracao; tira-me das minhas angustias. Olha
para / portuguese
Train accuracy: 0.99328125
10900 54% (12m 19s) 0.0512 0.0507 zino estas malvasta puto. SXi embuskas kiel
rabist / esperanto
Train accuracy: 0.9934375
10950 54% (12m 23s) 0.0155 0.0115 zis: „Tu esti Hristosul, Fiul Dumnezeului
celui v / romanian
Train accuracy: 0.99375
11000 55% (12m 26s) 0.0126 0.0082 nter der Hand Itamars, des Sohnes Aarons, des
Prie / german
Train accuracy: 0.99375
11050 55% (12m 30s) 0.0228 0.0148 dhjete e pese veta. Bijte e Aterit, nga
familja e / albanian
Train accuracy: 0.99359375
11100 55% (12m 33s) 0.0016 0.0023 nenkomo; ndilibharhise, kuthabathele
kwaTeman; b / xhosa
Train accuracy: 0.99484375
11150 55% (12m 37s) 0.0042 0.0062 vid, sed oni ne enterigis lin en la regxaj

tomboj. / esperanto
Train accuracy: 0.994375
11200 56% (12m 40s) 0.0389 0.0316 CXar mi estas mizera kaj malricxa. Konservu mia / esperanto
Train accuracy: 0.99328125
11250 56% (12m 44s) 0.0167 0.0082 a jsem muz, jenz zakusil ponizeni pod holi jeho pr / czech
Train accuracy: 0.9934375
11300 56% (12m 47s) 0.0016 0.0014 bheke nasemhlabeni phantsi; ngokuba izulu liya kut / xhosa
Train accuracy: 0.9959375
11350 56% (12m 51s) 0.0031 0.0042 jve te tij qe te sherbejne si prifterinj"". Ateher / albanian
Train accuracy: 0.99234375
11400 56% (12m 54s) 0.0051 0.0053 s tu, oh ramera. Y yo te plante de buen vidueno, s / spanish
Train accuracy: 0.994375
11450 57% (12m 57s) 0.0209 0.0174 que el os ha dado. Y JUNTANDO Josue todas las trib / spanish
Train accuracy: 0.9934375
11500 57% (13m 1s) 0.0287 0.0206 riamente para a casa do Senhor, recebam-no os sace / portuguese
Train accuracy: 0.99375
11550 57% (13m 4s) 0.0232 0.0281 das nacoes. E uma espada vira ao Egito, e haver a / portuguese
Train accuracy: 0.99234375
11600 57% (13m 8s) 0.0433 0.0351 ki ta te ture, kahore he tohe; na te kingi taua t / maori
Train accuracy: 0.995
11650 58% (13m 11s) 0.0148 0.0064 Ta da luyen sach long minh, Ta da trong sach toi / vietnamese
Train accuracy: 0.9953125
11700 58% (13m 15s) 0.0174 0.0098 bezpecne budou bydlet, az vykonam soudy nade vsem / czech
Train accuracy: 0.99390625
11750 58% (13m 18s) 0.0522 0.0054 pie del altar del holocausto, que esta a la puert / spanish
Train accuracy: 0.995
11800 59% (13m 22s) 0.0081 0.0077 `` David s'a dus dar cu oamenii lui la Cheila, si / romanian
Train accuracy: 0.99546875
11850 59% (13m 25s) 0.0242 0.0178 singur fiu, si sfirsitul ei va fi ca o zi amara.`` / romanian
Train accuracy: 0.994375
11900 59% (13m 29s) 0.0061 0.0045 , and heal his son; for he was at the point of dea / english
Train accuracy: 0.99390625
11950 59% (13m 32s) 0.0062 0.0028 den yok edilecek. <<Aksam ve sabahla ilgili

sana b / turkish
Train accuracy: 0.9940625
12000 60% (13m 36s) 0.0088 0.0066 al kopi a dzbanek na vodu od hlav Saulova loze
a o / czech
Train accuracy: 0.99421875
12050 60% (13m 39s) 0.0451 0.0333 esta se esquecesse, eu, todavia, nao me
esquecere / portuguese
Train accuracy: 0.99375
12100 60% (13m 43s) 0.0301 0.0323 Kendi uzerime ant ictim,
Agzimdan cikan
soz / turkish
Train accuracy: 0.9934375
12150 60% (13m 46s) 0.0313 0.0287 oakim szolgaja lett harom esztendeig; de
[azutan] / hungarian
Train accuracy: 0.9940625
12200 61% (13m 50s) 0.0242 0.0183 bitvy. I cap na nebi zna svuj cas, hrdlicka,
vlast / czech
Train accuracy: 0.99453125
12250 61% (13m 54s) 0.0039 0.0023 aptallar, ne zaman akillanacaksiniz? Kulagi
yarat / turkish
Train accuracy: 0.99453125
12300 61% (13m 57s) 0.0116 0.0078 te Hethit: katerqind monedha argjendi, monedha
qe / albanian
Train accuracy: 0.99453125
12350 61% (14m 1s) 0.0024 0.0023 dedi: <Soyle onlara, savasa gitmesinler. Cunku
si / turkish
Train accuracy: 0.99578125
12400 62% (14m 4s) 0.0223 0.0145 man spareth his own son that serveth him. Then
sha / english
Train accuracy: 0.99453125
12450 62% (14m 8s) 0.0149 0.0121 a kupu a Ihowa ki te iwi, a huihuia ana e ia e
whi / maori
Train accuracy: 0.994375
12500 62% (14m 11s) 0.0009 0.0014 nu la vespero! kaj vespere vi diros:Ho, venu
la ma / esperanto
Train accuracy: 0.99640625
12550 62% (14m 15s) 0.0330 0.0268 lo das vozes do choro do povo; porque o povo
brada / portuguese
Train accuracy: 0.9934375
12600 63% (14m 18s) 0.0069 0.0072 nem es allj elo! Ime, en szintugy Istene
vagyok, m / hungarian
Train accuracy: 0.99515625
12650 63% (14m 22s) 0.0772 0.0547 nel dit encore a Moise: Parle aux
sacrificateurs, / french
Train accuracy: 0.9946875
12700 63% (14m 25s) 0.0012 0.0019 nek enterigataj; ili farigxos sterko sur la
supraj / esperanto
Train accuracy: 0.99484375
12750 63% (14m 29s) 0.0085 0.0050 perona. P Na he roa te pakanga i waenganui o

te wh / maori
Train accuracy: 0.99515625
12800 64% (14m 33s) 0.0302 0.0258 e; ndide ndize ndinise ezweni elinjengelizwe
lenu, / xhosa
Train accuracy: 0.99359375
12850 64% (14m 36s) 0.0081 0.0081 kella arvovallallaan yhdessa juutalaisen
Mordokain / finnish
Train accuracy: 0.99421875
12900 64% (14m 40s) 0.0012 0.0012 bo sikaYehova? wobaxelela into esiyiyo
isihlabo, s / xhosa
Train accuracy: 0.99359375
12950 64% (14m 43s) 0.0154 0.0118 yg ryto ausra ir isgelbejimas lyg degantis
zibinta / lithuanian
Train accuracy: 0.99421875
13000 65% (14m 47s) 0.0281 0.0272 deux aveugles le suivirent, criant et disant:
Fils / french
Train accuracy: 0.99453125
13050 65% (14m 50s) 0.0105 0.0097 maku. Na i rongo a Hakopa kua pokea a Rina,
tana t / maori
Train accuracy: 0.995
13100 65% (14m 54s) 0.0251 0.0245 siginak kentler olarak bazi kentler secin.
Oyle k / turkish
Train accuracy: 0.99390625
13150 65% (14m 58s) 0.0142 0.0058 Mooseksen, Jumalan miehen, laissa.
Israelilaiset / finnish
Train accuracy: 0.993125
13200 66% (15m 1s) 0.0042 0.0071 idka zvolala na strazneho: "Hle, nejaky muz, a
bez / czech
Train accuracy: 0.9940625
13250 66% (15m 5s) 0.0022 0.0021 az uzri tu pomstu, omyje si nohy v krvi
svevolnik / czech
Train accuracy: 0.9934375
13300 66% (15m 8s) 0.0024 0.0024 ultado con sus padres en la ciudad de David: y
rei / spanish
Train accuracy: 0.995625
13350 66% (15m 12s) 0.0251 0.0198 vsechno, jako to delate vy. Ve shromazdeni
bude pl / czech
Train accuracy: 0.9934375
13400 67% (15m 15s) 0.0079 0.0101 Jalam, cxefo Korahx. Tio estas la cxefoj de
Oholi / esperanto
Train accuracy: 0.99484375
13450 67% (15m 19s) 0.0013 0.0014 sozu bilirsin, ya RAB.
0 soz zaten senin
agzi / turkish
Train accuracy: 0.99453125
13500 67% (15m 23s) 0.0081 0.0062 riri; kua whakatika mai hoki ki ahau he
kaiwhakapa / maori
Train accuracy: 0.996875
13550 67% (15m 26s) 0.0122 0.0099 utivos delante de vuestros ojos, dice Jehova.

EN e / spanish
Train accuracy: 0.995
13600 68% (15m 30s) 0.0153 0.0104 a, en Son af Galal, en Son af Jedutun, og Berekja, / danish
Train accuracy: 0.9959375
13650 68% (15m 33s) 0.0141 0.0144 s drottningensvardighet, darfor att hon hade satt up / swedish
Train accuracy: 0.993125
13700 68% (15m 37s) 0.0214 0.0227 tovykla. Sykelis smulkiu miltu arba du sykeliiai mi / lithuanian
Train accuracy: 0.99359375
13750 68% (15m 40s) 0.0121 0.0147 ci svevolniku vyvaznout a zachrani je, protoze se / czech
Train accuracy: 0.9946875
13800 69% (15m 44s) 0.0161 0.0130 se savo drabuzius ir sauke: "Samokslas! Samokslas! / lithuanian
Train accuracy: 0.99546875
13850 69% (15m 47s) 0.0139 0.0144 : 'Herra, hanella on jo kymmenen kultarahaa.' Mutt / finnish
Train accuracy: 0.99578125
13900 69% (15m 51s) 0.0063 0.0015 oji smlouvu ustavim s Izakem, ktereho ti porodi Sa / czech
Train accuracy: 0.99515625
13950 69% (15m 55s) 0.0016 0.0014 im icin ne zaman calisacagim?>> Lavan, <<Sana ne v / turkish
Train accuracy: 0.9959375
14000 70% (15m 58s) 0.0529 0.0382 e thirteen cities. And unto the rest of the sons o / english
Train accuracy: 0.99421875
14050 70% (16m 2s) 0.0096 0.0023 ao como as do boi selvagem; ele devorara as nacoes / portuguese
Train accuracy: 0.99375
14100 70% (16m 5s) 0.0040 0.0017 nde yakilmasini buyurdu. Sunu sunulmaya baslayinca / turkish
Train accuracy: 0.99546875
14150 70% (16m 9s) 0.0008 0.0008 -a luat drept iscoade. Noi i-am spus: ,,Sintem oam / romanian
Train accuracy: 0.9928125
14200 71% (16m 12s) 0.0210 0.0182 m'avais enfantes, et tu les leur as sacrifies pour / french
Train accuracy: 0.99453125
14250 71% (16m 16s) 0.0142 0.0111 enviaba por su espiritu, por mano de los profetas / spanish
Train accuracy: 0.99484375
14300 71% (16m 20s) 0.0110 0.0210 cu mine, si mi -a zis: ,,Daniele, am venit acum s / romanian
Train accuracy: 0.99515625
14350 71% (16m 23s) 0.0205 0.0136 gen und dich den Weg wieder zuruckfuhren,

welchen / german
Train accuracy: 0.996875
14400 72% (16m 27s) 0.0161 0.0133 roi toi? Ngoi khong biet sao, khong nghe sao?
Duc / vietnamese
Train accuracy: 0.9953125
14450 72% (16m 30s) 0.0317 0.0141 tul se va bucura in Dumnezeu; oricine jura pe
El s / romanian
Train accuracy: 0.99578125
14500 72% (16m 34s) 0.0373 0.0402 ahozta az o szolgajat es kiki az o
szolgaloleanyat / hungarian
Train accuracy: 0.99609375
14550 72% (16m 38s) 0.0093 0.0099 ter din Host ma du ikke hoste, og Druerne pa
de ub / danish
Train accuracy: 0.99484375
14600 73% (16m 41s) 0.0273 0.0169 no, come avean fatto i suoi padri; non si
ritrasse / italian
Train accuracy: 0.9946875
14650 73% (16m 45s) 0.0157 0.0056 et af Judas Kilde, som svaerger ved HERRENS
Navn o / danish
Train accuracy: 0.99265625
14700 73% (16m 48s) 0.0014 0.0023 nua ano hoki i noho nei koe. Na ka mea a
Aperahama / maori
Train accuracy: 0.9971875
14750 73% (16m 52s) 0.0157 0.0143 a he ristiinnaulitsivat kaksi rosvoa, toisen
hanen / finnish
Train accuracy: 0.995
14800 74% (16m 56s) 0.0016 0.0014 e ne Mitspah duke vajtuar ndersa po ecte. Kur
i ta / albanian
Train accuracy: 0.995
14850 74% (16m 59s) 0.0058 0.0068 iu malpurajxo, per kiu oni malpurigxas, kaj li
tio / esperanto
Train accuracy: 0.99546875
14900 74% (17m 3s) 0.0158 0.0144 sem Volke und sprich: Mit den Ohren werdet ihr
hor / german
Train accuracy: 0.99625
14950 74% (17m 6s) 0.0025 0.0050 fs? Car il savait que c'etait par envie que les
pr / french
Train accuracy: 0.995625
15000 75% (17m 10s) 0.0120 0.0135 oj, nek kontraux la templo, nek kontraux
Cezaro mi / esperanto
Train accuracy: 0.99578125
15050 75% (17m 14s) 0.0258 0.0107 a casa, ele enviou Safa, filho de Azalias,
Maasei / portuguese
Train accuracy: 0.99609375
15100 75% (17m 17s) 0.0076 0.0060 Siquem, naquela parte do campo que Jaco
comprara a / portuguese
Train accuracy: 0.99578125
15150 75% (17m 21s) 0.0146 0.0100 e camere, i suoi pilastri e i suoi archi

avevano q / italian
 Train accuracy: 0.99515625
 15200 76% (17m 24s) 0.0067 0.0057 der et par dager eller en maned eller enda
 lenger; / norwegian
 Train accuracy: 0.9953125
 15250 76% (17m 28s) 0.0014 0.0036 -au dus la unul numit Mnason, din Cipru, vechi
 uce / romanian
 Train accuracy: 0.995
 15300 76% (17m 32s) 0.0312 0.0229 n gjor alt det han vil. For kongens ord er
 mektig, / norwegian
 Train accuracy: 0.994375
 15350 76% (17m 35s) 0.0178 0.0097 pris og pryd for alle jordens folkeslag, nar
 de f / norwegian
 Train accuracy: 0.9965625
 15400 77% (17m 39s) 0.0112 0.0048 da, jo valdovo skeptras, kuris be paliovos
 ituzes p / lithuanian
 Train accuracy: 0.9953125
 15450 77% (17m 42s) 0.0318 0.0289 es i Izraelio stovykla, tare: "Kilkite,
 Viespats a / lithuanian
 Train accuracy: 0.99578125
 15500 77% (17m 46s) 0.0295 0.0243 u riri, i toku weriweri, ka waiho ano kou tou
 e ah / maori
 Train accuracy: 0.99578125
 15550 77% (17m 50s) 0.0013 0.0027 tau este cel mort, iar fiul meu este cel
 viu.`` A / romanian
 Train accuracy: 0.9940625
 15600 78% (17m 53s) 0.0025 0.0041 te mos ngjitet bashke me ty dhe te mos duket
 asnje / albanian
 Train accuracy: 0.99375
 15650 78% (17m 57s) 0.0043 0.0035 svarte: En gammel mann stiger op, og han er
 svopt / norwegian
 Train accuracy: 0.99625
 15700 78% (18m 0s) 0.0015 0.0014 s, thou shalt take, and go unto the place which
 Je / english
 Train accuracy: 0.99578125
 15750 78% (18m 4s) 0.0104 0.0090 vo viltis sudeje. Jeigu jus tiketumete Moze,
 tai t / lithuanian
 Train accuracy: 0.99296875
 15800 79% (18m 8s) 0.0011 0.0024 tre los cuales yo habito; Sino que iras a mi
 tierr / spanish
 Train accuracy: 0.9953125
 15850 79% (18m 11s) 0.0054 0.0057 e way wherein I walk Have they hidden a snare
 for / english
 Train accuracy: 0.99625
 15900 79% (18m 15s) 0.0142 0.0079 kryelartesine e tyre dhe arrogancen e zemres
 se t / albanian
 Train accuracy: 0.99484375
 15950 79% (18m 18s) 0.0234 0.0167 forigos de vi la vundon. CXar Mi estas kiel

leono / esperanto
Train accuracy: 0.99515625
16000 80% (18m 22s) 0.0265 0.0228 barn gjorde sa og sendte dem utenfor leiren;
som H / norwegian
Train accuracy: 0.9934375
16050 80% (18m 26s) 0.0237 0.0205 e eterve tuaj. Vec kesaj, ty po te jap nje
pjese m / albanian
Train accuracy: 0.995625
16100 80% (18m 29s) 0.0124 0.0098 on bien-aime; le voici qui vient, sautant sur
les / french
Train accuracy: 0.99453125
16150 80% (18m 33s) 0.0338 0.0385 Jehojachino kalejimo drabuzius, ir tas valge
karal / lithuanian
Train accuracy: 0.9953125
16200 81% (18m 36s) 0.0216 0.0181 nnyira, hogy a vak es nema mind beszel, mind
lat v / hungarian
Train accuracy: 0.99578125
16250 81% (18m 40s) 0.0348 0.0311 na meinga ana ia e ia hei kaitiro tiro mo nga
mahi / maori
Train accuracy: 0.99625
16300 81% (18m 44s) 0.0036 0.0036 aborrecieron; Y los que yo amaba, se tornaron
cont / spanish
Train accuracy: 0.995625
16350 81% (18m 47s) 0.0021 0.0018 . Yukarida adi gecenlerin her biri, ait oldugu
boy / turkish
Train accuracy: 0.99578125
16400 82% (18m 51s) 0.0404 0.0300 y the valley of my mountains; for the valley
of th / english
Train accuracy: 0.99578125
16450 82% (18m 54s) 0.0225 0.0158 ppast var formad; alla mina dagar blevo
uppskrivna / swedish
Train accuracy: 0.9946875
16500 82% (18m 58s) 0.0019 0.0015 ntua viettamaan maaraaikaan: Ensimmäisen kuun
nelj / finnish
Train accuracy: 0.9934375
16550 82% (19m 2s) 0.0012 0.0016 os filhos de Reabias, Issija o chefe; dos
izaritas / portuguese
Train accuracy: 0.99625
16600 83% (19m 5s) 0.0085 0.0073 cua Duc Gie-ho-va da noi len, va tai va da phat
kh / vietnamese
Train accuracy: 0.99546875
16650 83% (19m 9s) 0.0370 0.0415 gama lakho? Uthe ke yena, NdinguMkhosi; kuba
kwaku / xhosa
Train accuracy: 0.9953125
16700 83% (19m 13s) 0.0427 0.0361 ken. Men Lots hustru, som fulgte efter ham, sa
sig / danish (norwegian)
Train accuracy: 0.99625
16750 83% (19m 16s) 0.0035 0.0030 var och en som gor nagot arbete pa denna

samma da / swedish
Train accuracy: 0.99515625
16800 84% (19m 20s) 0.0008 0.0014 si doua de mii cinci sute. Acestia sint fiii
lui I / romanian
Train accuracy: 0.9971875
16850 84% (19m 23s) 0.0016 0.0012 in the sanctuary of the Lord? The youth and
the o / english
Train accuracy: 0.9959375
16900 84% (19m 27s) 0.0301 0.0329 temi della farina!" La getto nella marmitta, e
dis / italian
Train accuracy: 0.9953125
16950 84% (19m 31s) 0.0341 0.0347 phim, and put them in the camel's saddle, and
sat / english
Train accuracy: 0.99421875
17000 85% (19m 34s) 0.0009 0.0008 , When ye have lifted up the Son of man, then
shal / english
Train accuracy: 0.99484375
17050 85% (19m 38s) 0.0101 0.0038 oni-Bezeque: Setenta reis, com os dedos
polegares / portuguese
Train accuracy: 0.99546875
17100 85% (19m 42s) 0.0051 0.0021 he da a tutti la vita, il fiato ed ogni cosa.
Egli / italian
Train accuracy: 0.99578125
17150 85% (19m 45s) 0.0230 0.0228 as no me entrego a la muerte. Abridme las
puertas / spanish
Train accuracy: 0.99453125
17200 86% (19m 49s) 0.0052 0.0031 r jos darbai tegul giria ja vartuose". Dovydo
suna / lithuanian
Train accuracy: 0.995625
17250 86% (19m 52s) 0.0199 0.0243 nhưng song luon va nhưng ba dao cua Ngai deu
traí / vietnamese
Train accuracy: 0.9946875
17300 86% (19m 56s) 0.0275 0.0239 m. Izrael ho vsak pobil ostrim mece a obsadil
jeho / czech
Train accuracy: 0.9971875
17350 86% (20m 0s) 0.1151 0.1199 , syn kneze Imera, jenz byl vrchnim
dohlizitelem v / czech
Train accuracy: 0.99515625
17400 87% (20m 3s) 0.0050 0.0059 inadabhi ezindulini zonke zaseDore: uTafati
intomb / xhosa
Train accuracy: 0.994375
17450 87% (20m 7s) 0.0228 0.0200 atou wahine. Tenei ahau te whakaoho atu nei i
nga / maori
Train accuracy: 0.99609375
17500 87% (20m 11s) 0.0030 0.0022 ge lazda, kad tas tuoju mirsta,bus nubaustas.
O j / lithuanian
Train accuracy: 0.995
17550 87% (20m 14s) 0.0102 0.0059 u tagon Jonatan, filo de Saul, diris al sia

junulo / esperanto
 Train accuracy: 0.99578125
 17600 88% (20m 18s) 0.0050 0.0115 puse hino aliejaus, ir puse hino vyno
 geriamajai a / lithuanian
 Train accuracy: 0.994375
 17650 88% (20m 21s) 0.0060 0.0092 : uma terca parte de vos, os que entraís no
 sabado / portuguese
 Train accuracy: 0.99484375
 17700 88% (20m 25s) 0.0115 0.0079 t isst, wider einen solchen, der Blut isst,
 will i / german
 Train accuracy: 0.9940625
 17750 88% (20m 29s) 0.0114 0.0118 tierra, en gran manera sera la tierra
 conmovida. T / spanish
 Train accuracy: 0.99421875
 17800 89% (20m 32s) 0.0250 0.0192 uku k ustum. Lid se bal te prisahy. Ale
 Jonatan ne / czech
 Train accuracy: 0.9965625
 17850 89% (20m 36s) 0.0385 0.0303 at, und verunreinigt euch nicht an den
 agyptischen / german
 Train accuracy: 0.9971875
 17900 89% (20m 40s) 0.0147 0.0236 lo malo delante de sus ojos? A Uria Hetheo
 heriste / spanish
 Train accuracy: 0.99546875
 17950 89% (20m 43s) 0.0173 0.0096 them out, they asked them to go away from the
 cit / english
 Train accuracy: 0.99484375
 18000 90% (20m 47s) 0.0719 0.0518 tru, toate lucrurile sint infatisate in pilde;
 pen / romanian
 Train accuracy: 0.995
 18050 90% (20m 50s) 0.0064 0.0055 i, pietrele de poticnire, si pe cei rai
 impreuna c / romanian
 Train accuracy: 0.995
 18100 90% (20m 54s) 0.0044 0.0062 otra: mas cada una de las tribus de los hijos
 de I / spanish
 Train accuracy: 0.99515625
 18150 90% (20m 58s) 0.0023 0.0033 n al la eminentuloj de la Judoj, kaj diris al
 ili: / esperanto
 Train accuracy: 0.99453125
 18200 91% (21m 1s) 0.0090 0.0064 n mindes, og indskaerp Josua, at jeg
 fuldstaendig / danish
 Train accuracy: 0.99515625
 18250 91% (21m 5s) 0.0014 0.0011 i da cuu nguoi; hay di cho binh an. Ke do, Duc
 Chu / vietnamese
 Train accuracy: 0.99609375
 18300 91% (21m 8s) 0.0019 0.0035 vagita arde come il fuoco, che divora rovi e
 pruni / italian
 Train accuracy: 0.99515625
 18350 91% (21m 12s) 0.0074 0.0029 eletes; az Urnak beszede tiszta; paizsuk o

mindazo / hungarian
Train accuracy: 0.99578125
18400 92% (21m 16s) 0.0061 0.0033 Cac mon do khac dem thuyen tro lai, keo tay
luoi d / vietnamese
Train accuracy: 0.99546875
18450 92% (21m 19s) 0.0041 0.0035 ; qui l'empechera? Ainsi a dit l'Eternel,
votre Re / french
Train accuracy: 0.99609375
18500 92% (21m 23s) 0.0070 0.0046 elso napon estve megaldozol, semmi ne maradjon
reg / hungarian
Train accuracy: 0.9965625
18550 92% (21m 27s) 0.0688 0.0554 manovym a Jedutunovym, aby vyhlasovali
proroctvi p / czech
Train accuracy: 0.99421875
18600 93% (21m 30s) 0.0458 0.0288 uopuneena? Mene selviamaan humalastasi!" Mutta
Han / finnish
Train accuracy: 0.99515625
18650 93% (21m 34s) 0.0118 0.0111 t remembered the days of thy youth, but hast
raged / english
Train accuracy: 0.996875
18700 93% (21m 37s) 0.0241 0.0235 u tot ce avea. A ajuns la Beer-Seba, si a adus
jer / romanian
Train accuracy: 0.9946875
18750 93% (21m 41s) 0.0098 0.0100 a fotringar, darfor skall Herren lata Sions
dottra / swedish
Train accuracy: 0.99671875
18800 94% (21m 45s) 0.0209 0.0202 ul ridicat pentru Domnul. Bogatul sa nu
plateasca / romanian
Train accuracy: 0.99546875
18850 94% (21m 48s) 0.0190 0.0179 lno. As atsiguliau ir uzmigau, ir vel pabudau,
nes / lithuanian
Train accuracy: 0.9953125
18900 94% (21m 52s) 0.0037 0.0042 oli kuninkaan ankaran kaskyn mukaan kovin
kuumenn / finnish
Train accuracy: 0.99515625
18950 94% (21m 55s) 0.0195 0.0247 koon heidan samoin kuin minun! "Tulkoon kaikki
hei / finnish
Train accuracy: 0.9953125
19000 95% (21m 59s) 0.0014 0.0020 v det, kom de pa andre tanker, og sa at han
var en / norwegian
Train accuracy: 0.993125
19050 95% (22m 3s) 0.0121 0.0107 ebo matku nebo deti nebo pole pro me jmeno,
stokra / czech
Train accuracy: 0.99546875
19100 95% (22m 6s) 0.0304 0.0244 e veterligt for konungen att vi kommo till det
jud / swedish
Train accuracy: 0.996875
19150 95% (22m 10s) 0.0202 0.0126 Li falas, sed malfermitaj estas liaj okuloj.

Kiel / esperanto
Train accuracy: 0.994375
19200 96% (22m 13s) 0.0054 0.0056 e Ofroje. Visi izraelitai eidavo ten ir
garbino ji / lithuanian
Train accuracy: 0.995
19250 96% (22m 17s) 0.0022 0.0022 un el vi Mi jugxas konforme al lia konduto, ho
dom / esperanto
Train accuracy: 0.994375
19300 96% (22m 21s) 0.0026 0.0019 jusqu'au torrent vers la grande mer. C'est la
le p / french
Train accuracy: 0.99703125
19350 96% (22m 24s) 0.0009 0.0017 Y-so-ra-en thi Con nguoi da den roi. Mon do
khong / vietnamese
Train accuracy: 0.996875
19400 97% (22m 28s) 0.0049 0.0028 mikor bemegy es mikor kijon. Es mind a szerint
cse / hungarian
Train accuracy: 0.99609375
19450 97% (22m 31s) 0.0043 0.0018 ra el que sera Senor en Israel; y sus salidas
son / spanish
Train accuracy: 0.99640625
19500 97% (22m 35s) 0.0033 0.0023 risini yoksullara veriyorum. Bir kimseden
haksizli / turkish
Train accuracy: 0.99515625
19550 97% (22m 39s) 0.0159 0.0115 ackt. Ve over Assur, min vredes ris, som bar
min o / swedish
Train accuracy: 0.9940625
19600 98% (22m 42s) 0.0073 0.0155 mig om vad jag skall gora for dig, innan jag
blive / swedish
Train accuracy: 0.9953125
19650 98% (22m 46s) 0.0371 0.0373 vam com ele; e clamou: Fazei a todos sair da
minha / portuguese
Train accuracy: 0.9971875
19700 98% (22m 50s) 0.0059 0.0065 dua toi vao truoc mat vua, thi toi se giai
nghia d / vietnamese
Train accuracy: 0.994375
19750 98% (22m 53s) 0.0095 0.0173 durmustu ve RAB bunu bagislamak niyetinde
degildi. / turkish
Train accuracy: 0.99578125
19800 99% (22m 57s) 0.0337 0.0374 aceste lucruri, si caruia li sint cunoscute
din v / romanian
Train accuracy: 0.9975
19850 99% (23m 0s) 0.0451 0.0421 rciful; With the perfect man thou wilt show
thysel / english
Train accuracy: 0.9965625
19900 99% (23m 4s) 0.0286 0.0198 ai, e que me estabeleceu casa, como tinha dito,
qu / portuguese
Train accuracy: 0.9940625
19950 99% (23m 8s) 0.0351 0.0350 REN og Kongen. Sa ofrede de Slagtofre til

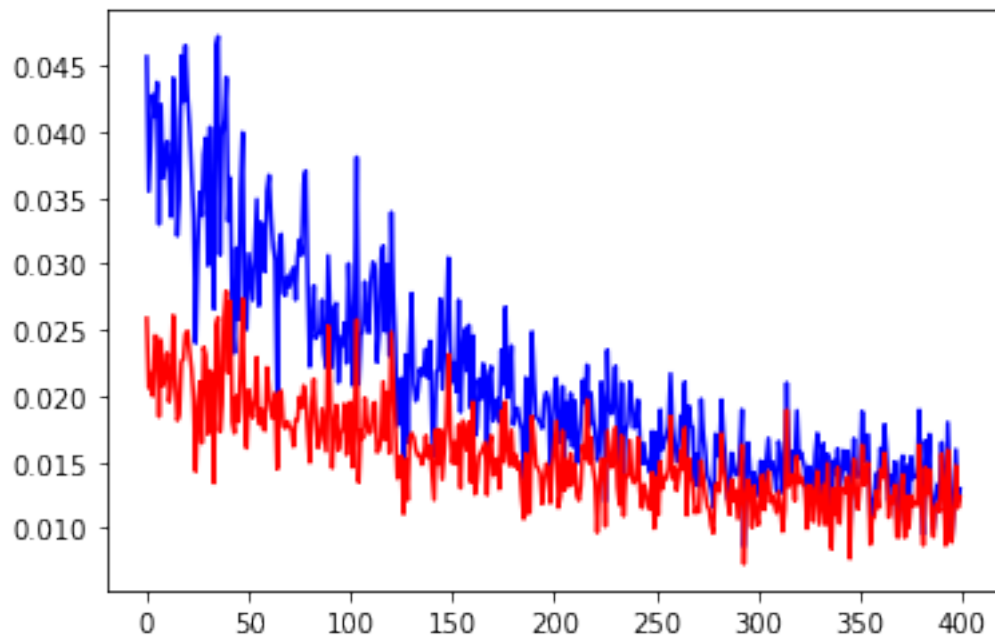
```
HERREN, / danish
Train accuracy: 0.99546875
20000 100% (23m 11s) 0.0046 0.0033 namus, pagarbino. Sugrizes paprase maisto ir
valge / lithuanian
Train accuracy: 0.995625
```

4.1 Plot loss functions

```
[85]: import matplotlib.pyplot as plt
import matplotlib.ticker as ticker

plt.figure()
plt.plot(all_losses, color='b')
plt.plot(all_test_losses, color='r')
```

```
[85]: [<matplotlib.lines.Line2D at 0x7f2af4d01048>]
```



4.2 Evaluate results

We now visualize the performance of our model by creating a confusion matrix. The ground truth languages of samples are represented by rows in the matrix while the predicted languages are represented by columns.

In this evaluation we consider sequences of variable sizes rather than the fixed length sequences we used for training.


```

[86]: eval_batch_size = 1  # needs to be set to 1 for evaluating different sequence
      ↪ lengths

      # Keep track of correct guesses in a confusion matrix
      confusion = torch.zeros(n_languages, n_languages)
      n_confusion = 1000
      num_correct = 0
      total = 0

      for i in range(n_confusion):
          eval_chunk_len = random.randint(10, 50) # in evaluation we will look at
          ↪ sequences of variable sizes
          input_data, target_category, text_data =
          ↪ load_random_batch(test_category_data, chunk_len=eval_chunk_len,
          ↪ batch_size=eval_batch_size)
          output = evaluate(rnn, input_data, seq_len=eval_chunk_len,
          ↪ batch_size=eval_batch_size)

          guess_i = categoryFromOutput(output)
          category_i = [int(target_category[idx]) for idx in
          ↪ range(len(target_category))]
          for j in range(eval_batch_size):
              category = all_categories[category_i[j]]
              confusion[category_i[j]][guess_i[j]] += 1
              num_correct += int(guess_i[j]==category_i[j])
              total += 1

      print('Test accuracy: ', float(num_correct)/float(n_confusion*eval_batch_size))

      # Normalize by dividing every row by its sum
      for i in range(n_languages):
          confusion[i] = confusion[i] / confusion[i].sum()

      # Set up plot
      fig = plt.figure()
      ax = fig.add_subplot(111)
      cax = ax.matshow(confusion.numpy())
      fig.colorbar(cax)

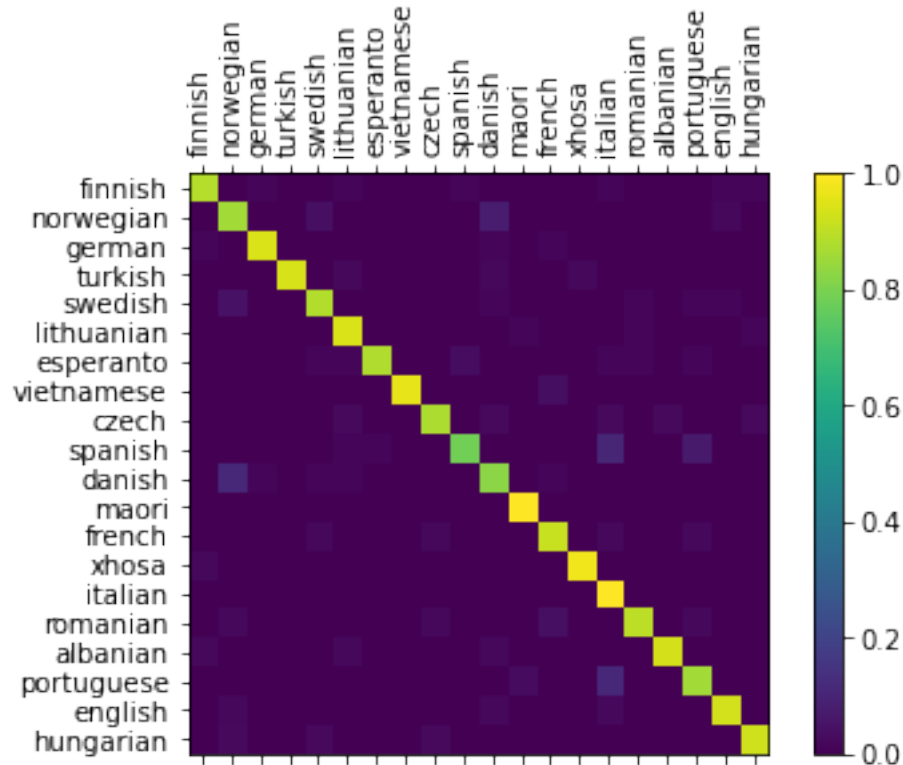
      # Set up axes
      ax.set_xticklabels([''] + all_categories, rotation=90)
      ax.set_yticklabels([''] + all_categories)

      # Force label at every tick
      ax.xaxis.set_major_locator(ticker.MultipleLocator(1))
      ax.yaxis.set_major_locator(ticker.MultipleLocator(1))

```

```
plt.show()
```

Test accuracy: 0.91



You can pick out bright spots off the main axis that show which languages it guesses incorrectly.

4.3 Run on User Input

Now you can test your model on your own input.

```
[ ]: def predict(input_line, n_predictions=5):  
    print('\n> %s' % input_line)  
    with torch.no_grad():  
        input_data = stringToTensor(input_line).long().unsqueeze(0).to(device)  
        output = evaluate(rnn, input_data, seq_len=len(input_line),  
↪ batch_size=1)  
  
        # Get top N categories  
        topv, topi = output.topk(n_predictions, dim=1)  
        predictions = []  
  
        for i in range(n_predictions):
```

```

topv.shape
topi.shape
value = topv[0][i].item()
category_index = topi[0][i].item()
print('({:.2f}) {}'.format(value, all_categories[category_index]))
predictions.append([value, all_categories[category_index]])

predict('This is a phrase to test the model on user input')

```

5 Output Kaggle submission file

Once you have found a good set of hyperparameters submit the output of your model on the Kaggle test file.

```

[89]: ### DO NOT CHANGE KAGGLE SUBMISSION CODE ###
import csv

kaggle_test_file_path = 'language_data/kaggle_rnn_language_classification_test.
↳txt'
with open(kaggle_test_file_path, 'r') as f:
    lines = f.readlines()

output_rows = []
for i, line in enumerate(lines):
    sample = line.rstrip()
    sample_chunk_len = len(sample)
    input_data = stringToTensor(sample).unsqueeze(0)
    output = evaluate(rnn, input_data, seq_len=sample_chunk_len, batch_size=1)
    guess_i = categoryFromOutput(output)
    output_rows.append((str(i+1), all_categories[guess_i]))

submission_file_path = 'kaggle_rnn_submission.txt'
with open(submission_file_path, 'w') as f:
    output_rows = [('id', 'category')] + output_rows
    writer = csv.writer(f)
    writer.writerows(output_rows)

```

```

[91]: torch.save(rnn.state_dict(), './rnn_classifier.pth')

```