In [1]:
```
import torch
import torch.nn as nn
from torch.autograd import Variable
from torch.nn.functional import one_hot
import random
import time
import math
import unicodedata
import string
```

In [4]:
```
import requests
url = "https://api.github.com/repos/DrUzair/NLP/contents/textclassification/surnames/n
response = requests.get(url)
category_lines = {}
all_categories = []
if response.status_code == 200:
  # Parse the JSON response
  files_info = response.json()
  for file_info in files_info:
    file_name = file_info['name']
    category = file_name.split('/')[-1].split('.')[0]
    all_categories.append(category)
    download_url = file_info['download_url']
    file_response = requests.get(download_url)
    if file_response.status_code == 200:
      file_content = file_response.content.decode('utf-8')
      names = [name for name in file_content.split('\n') if len(name.strip())>1]
      category_lines[category] = names
    else:
      print("Error occurred:", response.status_code)
else:
  print("Error occurred:", response.status_code)
n_categories = len(all_categories)
```

In [5]:
```
n_categories = len(all_categories)
n_categories
category_lines
```

Out[5]:

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                'Cruz',
                'Cuéllar',
                'Cuevas',
                "D'cruz",
                "D'cruze",
                'De la cruz',
                'De la fuente',
                'Del bosque',
                'De leon',
                'Delgado',
                'Del olmo',
                'De santigo',
                'Díaz',
                'Dominguez',
                'Duarte',
                'Durante',
                'Echevarría',
```

```
                'Echeverría',
                'Elizondo',
                'Escamilla',
                'Escárcega',
                'Escarrà',
                'Esparza',
                'Espina',
                'Espino',
                'Espinosa',
                'Espinoza',
                'Estévez',
                'Etxebarria',
                'Etxeberria',
                'Félix',
                'Fernández',
                'Ferrer',
                'Fierro',
                'Flores',
                'Fonseca',
                'Franco',
                'Fuentes',
                'Gallego',
                'Gallo',
                'García',
                'Garrastazu',
                'Garza',
                'Gaspar',
                'Gebara',
                'Gomez',
                'Gonzales',
                'Gonzalez',
                'Grec',
                'Guadarrama',
                'Guerra',
                'Guerrero',
                'Gutiérrez',
                'Gutierrez',
                'Hernandez',
                'Herrera',
                'Herrero',
                'Hierro',
                'Holguín',
                'Huerta',
                'Ibáñez',
                'Ibarra',
                'Iñíguez',
                'Iturburua',
                'Jaso',
                'Jasso',
                'Jimenez',
                'Jordà',
                'Juárez',
                'Lobo',
                'Lopez',
                'Losa',
                'Loyola',
                'Machado',
                'Macías',
                'Maradona',
                'María',
                'Marino',
                'Márquez',
                'Martell',
                'Martí',
                'Martínez',
                'Martinez',
                'Mas',
                'Mata',
                'Mateu',
                'Medina',
                'Melendez',
                'Méndez',
                'Mendoza',
                'Menendez',
                'Merlo',
                'Michel',
                'Mingo',
                'Moles',
```

```
                'Molina',
                'Montero',
                'Morales',
                'Moralez',
                'Moreno',
                'Narváez',
                'Nieves',
                'Noguerra',
                'Núñez',
                'Obando',
                'Ochoa',
                'Ojeda',
                'Ola',
                'Oleastro',
                'Olguin',
                'Oliver',
                'Olmos',
                'Oquendo',
                'Orellana',
                'Oriol',
                'Ortega',
                'Ortiz',
                'Palomo',
                'Paredes',
                'Pavia',
                'Peláez',
                'Peña',
                'Pérez',
                'Perez',
                'Petit',
                'Picasso',
                'Porra',
                'Porras',
                'Prieto',
                'Puerta',
                'Puga',
                'Puig',
                'Quinones',
                'Quintana',
                'Quirós',
                'Ramírez',
                'Ramos',
                'Rana',
                'Rendón',
                'Rey',
                'Reyes',
                'Rios',
                'Rivera',
                'Rivero',
                'Robledo',
                'Robles',
                'Rocha',
                'Rodríguez',
                'Rodriquez',
                'Roig',
                'Rojas',
                'Rojo',
                'Roldán',
                'Romà',
                'Romà',
                'Romero',
                'Rosa',
                'Rosales',
                'Rubio',
                'Ruiz',
                'Sala',
                'Salamanca',
                'Salazar',
                'Salcedo',
                'Salinas',
                'Sanchez',
                'Sandoval',
                'San nicolas',
                'Santana',
                'Santiago',
                'Santillian',
                'Santos',
                'Sastre',
```

```
 'Sepúlveda',
 'Sierra',
 'Silva',
 'Soler',
 'Solo',
 'Solos',
 'Soto',
 'Suárez',
 'Suero',
 'Tapia',
 'Terrazas',
 'Tomàs',
 'Torres',
 'Tos',
 'Tosell',
 'Toset',
 'Travieso',
 'Trujillo',
 'Ubina',
 'Urbina',
 'Ureña',
 'Valdez',
 'Valencia',
 'Varela',
 'Vargas',
 'Vásquez',
 'Vázquez',
 'Vega',
 'Vela',
 'Vela',
 'Velazquez',
 'Ventura',
 'Vicario',
 'Vilaró',
 'Villa',
 'Villalobos',
 'Villanueva',
 'Villaverde',
 'Viola',
 'Viteri',
 'Vivas',
 'Vives',
 'Ybarra',
 'Zabala',
 'Zambrano',
 'Zamorano',
 'Zapatero',
 'Zavala',
 'Zubizarreta',
 'Zuñiga'],
'Vietnamese': ['Nguyen',
 'Tron',
 'Le',
 'Pham',
 'Huynh',
 'Hoang',
 'Phan',
 'Vu',
 'Vo',
 'Dang',
 'Bui',
 'Do',
 'Ho',
 'Ngo',
 'Duong',
 'Ly',
 'An',
 'an',
 'Bach',
 'Banh',
 'Cao',
 'Chau',
 'Chu',
 'Chung',
 'Chu',
 'Diep',
 'Doan',
 'Dam',
```

```
 'Dao',
 'Dinh',
 'Doan',
 'Giang',
 'Ha',
 'Han',
 'Kieu',
 'Kim',
 'La',
 'Lac',
 'Lam',
 'Lieu',
 'Luc',
 'Luong',
 'Luu',
 'Ma',
 'Mach',
 'Mai',
 'Nghiem',
 'Phi',
 'Pho',
 'Phung',
 'Quach',
 'Quang',
 'Quyen',
 'Ta',
 'Thach',
 'Thai',
 'Sai',
 'Thi',
 'Than',
 'Thao',
 'Thuy',
 'Tieu',
 'To',
 'Ton',
 'Tong',
 'Trang',
 'Trieu',
 'Trinh',
 'Truong',
 'Van',
 'Vinh',
 'Vuong',
 'Vuu']}
```

In [7]:

```
all_letters = string.ascii_letters + " .,;'-"
n_letters = len(all_letters)

# Turn a Unicode string to plain ASCII, thanks to http://stackoverflow.com/a/518232/28
def unicodeToAscii(s):
  return ''.join(
 c for c in unicodedata.normalize('NFD', s)
if unicodedata.category(c) != 'Mn'
and c in all_letters
)

# Read a file and split into lines
def readLines(filename):
  lines = open(filename, encoding='utf-8').read().strip().split('\n')
  return [unicodeToAscii(line) for line in lines]
# Find letter index from all_letters, e.g. "a" = 0
def letterToIndex(letter):
  return all_letters.find(letter)
# Turn a name into a <name_length x 1 x n_letters>,
# or an array of one-hot letter vectors
def nameToTensor(name):
  tensor = torch.zeros(len(name), 1, n_letters)
  for li, letter in enumerate(name):
    tensor[li][0][letterToIndex(letter)] = 1
  return tensor
def categoryFromOutput(output):
  top_n, top_i = output.data.topk(1) # Tensor out of Variable with .data
  category_i = top_i[0][0]
  return all_categories[category_i], category_i
def randomChoice(l):
  return l[random.randint(0, len(l) - 1)]
def randomTrainingPair():
```

```
  category = randomChoice(all_categories)
  name = randomChoice(category_lines[category])
  category_tensor = Variable(torch.LongTensor([all_categories.index(category)]))
  name_tensor = Variable(nameToTensor(name))
  return category, name, category_tensor, name_tensor
```

In [8]:
```
category, name, category_tensor, name_tensor = randomTrainingPair()
print(f"category: {category}")
print(f"category_tensor: {category_tensor}")
print(f"category_tensor shape: {category_tensor.shape}")
print(f"name: {name}")
print(f"name_tensor shape: {name_tensor.shape}")
print(f"name_tensor: {name_tensor}")
```

```
category: Italian
category_tensor: tensor([9])
category_tensor shape: torch.Size([1])
name: Crespo
name_tensor shape: torch.Size([6, 1, 58])
name_tensor: tensor([[[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.]],

        [[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0.]],

        [[0., 0., 0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0.]],

        [[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0.]],

        [[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 1., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0.]],

        [[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 1., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
          0., 0., 0., 0., 0., 0., 0.]]])
```

In [9]:
```
class RNN_Textbook(nn.Module):
  def __init__(self, input_size, hidden_size, output_size):
    super(RNN_Textbook, self).__init__()
    self.hidden_size = hidden_size
    self.W = nn.Linear(input_size, hidden_size)
    self.U = nn.Linear(hidden_size, hidden_size)
    self.V = nn.Linear(hidden_size, output_size)
    self.softmax = nn.LogSoftmax(dim=1)
  def forward(self, input):
    self.hidden = torch.zeros(1, self.hidden_size)
    for i in range(input.size(0)): # Iterate through the time steps
      self.hidden = torch.tanh(self.W(input[i]) + self.U(self.hidden))
    output = self.V(self.hidden)
    output = self.softmax(output)
    return output
# Example usage:
input_size = 3 # sequence length
hidden_size = 20
output_size = 18
batch_size = 1
rnn = RNN_Textbook(input_size, hidden_size, output_size)
input = torch.randn(input_size, batch_size, input_size) # Sequence length x batch size
output = rnn(input)
print(output) # This will be the output for the last time step
```

```
tensor([[-2.7055, -2.8759, -3.1031, -2.8264, -2.3140, -3.6663, -3.0769, -3.3751,
         -2.7646, -2.5113, -3.0660, -2.7338, -3.5192, -2.7541, -2.9547, -2.8454,
         -3.0355, -2.8030]], grad_fn=<LogSoftmaxBackward0>)
```

In [10]:
```
# Softmax
import torch.nn as nn
import torch.optim as optim
# Define your RNN model
class RNN_Pytorch(nn.Module):
  def __init__(self, input_size, hidden_size, output_size):
    super(RNN_Pytorch, self).__init__()
    self.hidden_size = hidden_size
    self.rnn = nn.RNN(input_size, hidden_size)
    # output projection layer
    self.fc = nn.Linear(hidden_size, output_size)
    # softmax
    self.softmax = nn.LogSoftmax(dim=1)
  def forward(self, input):
    self.hidden = torch.zeros(1, input.size(1), self.hidden_size)
    output, self.hidden = self.rnn(input, self.hidden)
    output_last = output[-1] # Selecting the output of the last time step
    output = self.fc(output_last)
    output = self.softmax(output)
    return output

# Example usage:
input_size = 3 # sequence length
hidden_size = 20
output_size = 18
batch_size = 1
rnn = RNN_Pytorch(input_size, hidden_size, output_size)
input = torch.randn(input_size, batch_size, input_size) # Sequence length x batch size
output = rnn(input)
print(output) # This will be the output for the last time step
```

```
tensor([[-2.5954, -3.0608, -2.6929, -3.0478, -2.6297, -2.9387, -2.9718, -3.0506,
         -3.1692, -2.4939, -3.2541, -3.1783, -2.9021, -2.7822, -2.9782, -2.6664,
         -3.1018, -2.9420]], grad_fn=<LogSoftmaxBackward0>)
```

In [11]:
```
n_hidden = 10, 100, 500
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
```

In [12]:
```
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)
```

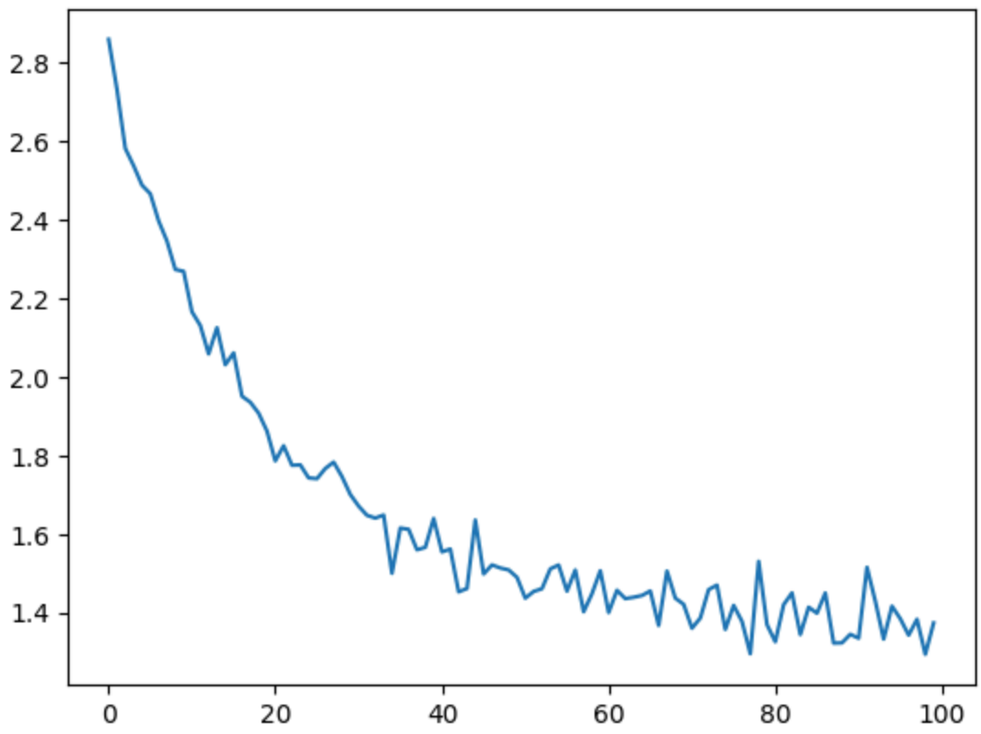
```
tensor([[-2.9024, -2.8224, -2.9888, -2.9739, -2.7977, -2.9229, -2.8610, -2.9947,
         -2.7988, -2.9389, -3.0012, -2.9551, -2.9522, -2.7645, -2.8249, -2.7940,
         -2.8593, -2.9269]], grad_fn=<LogSoftmaxBackward0>)
2.8224353790283203
```

In [13]:
```
# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
```

```
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification.pt')
```

```
1000 1% (0m 4s) 2.9225 Peace / Dutch ✗ (English)
2000 2% (0m 7s) 2.2702 Xiao / Chinese ✓
3000 3% (0m 10s) 2.5486 Plourde / Italian ✗ (French)
4000 4% (0m 12s) 1.6791 Avhimovich / Russian ✓
5000 5% (0m 15s) 2.0048 Hatmullin / Russian ✓
6000 6% (0m 18s) 2.5620 Janick / English ✗ (Czech)
7000 7% (0m 21s) 2.2569 Doan / Chinese ✗ (Vietnamese)
8000 8% (0m 23s) 2.7788 Adam / Arabic ✗ (German)
9000 9% (0m 26s) 2.3615 Roosevelt / Greek ✗ (Dutch)
10000 10% (0m 32s) 2.6065 Nevejin / French ✗ (Russian)
11000 11% (0m 35s) 4.5234 Rey / Chinese ✗ (French)
12000 12% (0m 39s) 1.5089 Bitar / Arabic ✓
13000 13% (0m 44s) 2.3141 Tinkler / French ✗ (English)
14000 14% (0m 47s) 2.7392 Feigenbaum / French ✗ (German)
15000 15% (0m 49s) 2.0316 Dalach / Irish ✓
16000 16% (0m 52s) 2.1709 Craig / English ✗ (Scottish)
17000 17% (0m 57s) 1.5805 Khoury / Arabic ✓
18000 18% (1m 1s) 2.2640 Severins / French ✗ (Dutch)
19000 19% (1m 4s) 1.3096 Schuster / German ✓
20000 20% (1m 8s) 4.2960 Giolla / Spanish ✗ (Irish)
21000 21% (1m 12s) 1.7222 Gomolka / Spanish ✗ (Polish)
22000 22% (1m 15s) 0.2942 Gai / Chinese ✓
23000 23% (1m 19s) 3.4822 Gaspar / Arabic ✗ (Portuguese)
24000 24% (1m 24s) 2.1837 Ortiz / Portuguese ✗ (Spanish)
25000 25% (1m 28s) 4.2520 Sullivan / Russian ✗ (Irish)
26000 26% (1m 31s) 2.4268 Villeneuve / Dutch ✗ (French)
27000 27% (1m 34s) 2.7076 Salomon / Russian ✗ (French)
28000 28% (1m 37s) 2.0840 Arian / Scottish ✗ (Arabic)
29000 28% (1m 40s) 2.7740 Sheehy / Vietnamese ✗ (Irish)
30000 30% (1m 42s) 0.2906 O'Hara / Irish ✓
31000 31% (1m 45s) 1.4381 Lobo / Italian ✗ (Portuguese)
32000 32% (1m 49s) 1.7363 Delgado / Italian ✗ (Portuguese)
33000 33% (1m 52s) 0.4412 Rinaldi / Italian ✓
34000 34% (1m 55s) 1.0609 Kattan / Arabic ✓
35000 35% (1m 58s) 3.1215 Aonghuis / Greek ✗ (Irish)
36000 36% (2m 1s) 0.2855 Choe / Korean ✓
37000 37% (2m 3s) 1.2926 Smets / Dutch ✓
38000 38% (2m 6s) 0.2587 Wen / Chinese ✓
39000 39% (2m 9s) 1.7122 Bélanger / German ✗ (French)
40000 40% (2m 12s) 1.6464 Mcdougall / French ✗ (English)
41000 41% (2m 15s) 1.3145 Vuong / Vietnamese ✓
42000 42% (2m 17s) 3.7059 Kosko / Polish ✗ (Czech)
43000 43% (2m 20s) 0.6022 Bieber / German ✓
44000 44% (2m 24s) 1.7207 Clark / Czech ✗ (Scottish)
45000 45% (2m 26s) 0.0806 Vuu / Vietnamese ✓
46000 46% (2m 29s) 1.4362 Simões / Portuguese ✓
47000 47% (2m 32s) 0.2483 Sakanoue / Japanese ✓
48000 48% (2m 35s) 2.0889 Kober / German ✗ (Czech)
49000 49% (2m 38s) 0.9510 Dagher / Arabic ✓
50000 50% (2m 41s) 1.7535 Walentowicz / Polish ✓
51000 51% (2m 43s) 9.2816 Kokkali / Japanese ✗ (Greek)
52000 52% (2m 46s) 3.7004 Abadi / Italian ✗ (Arabic)
53000 53% (2m 49s) 0.0593 Silvestri / Italian ✓
54000 54% (2m 53s) 0.0363 Fumihiko / Japanese ✓
55000 55% (2m 57s) 8.3589 Zhura / Japanese ✗ (Russian)
56000 56% (3m 2s) 2.5759 Meadhra / Arabic ✗ (Irish)
57000 56% (3m 5s) 4.0001 See  / Korean ✗ (Chinese)
58000 57% (3m 8s) 0.8572 Gushiken / Japanese ✓
59000 59% (3m 10s) 2.6418 Sleiman / French ✗ (Arabic)
60000 60% (3m 14s) 2.7137 Abano / Italian ✗ (Spanish)
61000 61% (3m 17s) 0.8161 Steube / German ✓
62000 62% (3m 19s) 0.8715 Gray / Scottish ✓
63000 63% (3m 22s) 1.7737 Chadwick / Czech ✗ (English)
64000 64% (3m 25s) 0.0752 an / Vietnamese ✓
65000 65% (3m 28s) 0.0232 Winogrodzki / Polish ✓
66000 66% (3m 31s) 4.9106 Peerenboom / French ✗ (Dutch)
67000 67% (3m 33s) 3.5605 Kava / Czech ✗ (Polish)
68000 68% (3m 36s) 0.0726 an / Vietnamese ✓
69000 69% (3m 40s) 5.1803 Young / Chinese ✗ (Scottish)
70000 70% (3m 42s) 0.0123 Kawamura / Japanese ✓
71000 71% (3m 45s) 0.0010 Antonopoulos / Greek ✓
72000 72% (3m 48s) 1.8831 Serafim / Arabic ✗ (Portuguese)
73000 73% (3m 51s) 2.8948 Zambrano / Spanish ✗ (Italian)
74000 74% (3m 54s) 4.6696 Manus / Portuguese ✗ (Irish)
75000 75% (3m 56s) 0.9570 Juan / Chinese ✓
76000 76% (3m 59s) 2.6189 Netsch / Scottish ✗ (Czech)
77000 77% (4m 2s) 0.1006 Watson / Scottish ✓
78000 78% (4m 5s) 0.0579 Lévêque / French ✓
```

```
79000 79% (4m 7s) 0.3793 Hou / Chinese ✓
80000 80% (4m 10s) 3.3067 Monette / English ✗ (French)
81000 81% (4m 13s) 0.0000 Panayiotopoulos / Greek ✓
82000 82% (4m 16s) 4.0583 Honjas / Arabic ✗ (Greek)
83000 83% (4m 18s) 3.4525 Asch / Arabic ✗ (Dutch)
84000 84% (4m 21s) 0.2305 Naifeh / Arabic ✓
85000 85% (4m 24s) 0.0060 Yeon / Korean ✓
86000 86% (4m 28s) 0.0769 Diep / Vietnamese ✓
87000 87% (4m 30s) 0.0018 Arlotti / Italian ✓
88000 88% (4m 33s) 1.3237 Lambton / English ✓
89000 89% (4m 35s) 0.0026 Górski / Polish ✓
90000 90% (4m 39s) 1.2410 Souza / Spanish ✗ (Portuguese)
91000 91% (4m 41s) 3.3097 Gallchobhar / French ✗ (Irish)
92000 92% (4m 44s) 2.1804 Visly / English ✗ (Russian)
93000 93% (4m 47s) 1.5560 Talbot / French ✗ (English)
94000 94% (4m 50s) 0.0005 O'Brien / Irish ✓
95000 95% (4m 53s) 0.0034 Zheng / Chinese ✓
96000 96% (4m 55s) 4.2523 Hunter / German ✗ (Scottish)
97000 97% (4m 58s) 0.0512 Yan / Chinese ✓
98000 98% (5m 0s) 0.0042 Rutkowski / Polish ✓
99000 99% (5m 3s) 0.0203 Zientek / Polish ✓
100000 100% (5m 6s) 0.2587 Kwak / Korean ✓
[2.8599258534908296, 2.7321853976249697, 2.581936217546463, 2.537863467335701, 2.4885
11616170406, 2.4665130808353424, 2.3973359067440034, 2.3459820047020914, 2.2736771103
292703, 2.268882226422429, 2.1658227170854807, 2.1310808751136063, 2.058618671651929
7, 2.125520455252379, 2.031056604921818, 2.0611163369026033, 1.9509693706445397, 1.93
55345130115746, 1.9076330563016235, 1.8620959056010469, 1.78620041357819, 1.824752862
5680134, 1.7750310787963681, 1.7759479046275373, 1.7428474482563325, 1.74096480272209
74, 1.7667805220215813, 1.7830447052757954, 1.746175006387406, 1.700566390633583, 1.6
710394056732767, 1.6476173850740887, 1.6405382802782698, 1.6483148926446447, 1.499994
6969707962, 1.6151938595128594, 1.611783538445714, 1.5597899062598881, 1.565984455514
6991, 1.6395853437117767, 1.5544323837384582, 1.561694458297454, 1.4526576341695037,
1.461189974104258, 1.6355584688890377, 1.4982893442372152, 1.5212406573753106, 1.5133
733618037877, 1.508480663915063, 1.4896713576655747, 1.43652198130326, 1.453641039911
9777, 1.4606377708860674, 1.5112060240293503, 1.5210263384375575, 1.454469544354084,
1.5082347593495797, 1.4019603565985745, 1.4480595170842863, 1.5064024303510524, 1.399
9770012423323, 1.4565274343274068, 1.435399656309448, 1.4388690895914733, 1.443393842
5372725, 1.4549211913577929, 1.3670357164766902, 1.505662493438358, 1.436594132975724
4, 1.420924791669797, 1.3600424548476293, 1.3860214571339802, 1.458514724348759, 1.46
97597091918286, 1.3568938496925984, 1.418156483779996, 1.3774246445089338, 1.29494371
78557017, 1.5302444821942591, 1.3691993103335498, 1.3255354289135202, 1.4200067696571
46, 1.449910937674662, 1.3438645417049593, 1.4135775056289277, 1.3982842582106314, 1.
4497828308031484, 1.3221210120345186, 1.3227387909360295, 1.3444667612201338, 1.33458
17034250795, 1.5151730457257218, 1.4289739349525663, 1.332268352012332, 1.41622669790
57967, 1.3840973403082117, 1.3424006156958248, 1.3827620038074866, 1.293643901165854,
1.3735600551222342]
```



In [50]:
```python
# ReLu
import torch.nn as nn
import torch.optim as optim
# Define your RNN model
class RNN_Pytorch(nn.Module):
```

```
  def __init__(self, input_size, hidden_size, output_size):
    super(RNN_Pytorch, self).__init__()
    self.hidden_size = hidden_size
    self.rnn = nn.RNN(input_size, hidden_size, nonlinearity='relu')
    # output projection layer
    self.fc = nn.Linear(hidden_size, output_size)
    # softmax
    self.softmax = nn.LogSoftmax(dim=1)
  def forward(self, input):
    self.hidden = torch.zeros(1, input.size(1), self.hidden_size)
    output, self.hidden = self.rnn(input, self.hidden)
    output_last = output[-1] # Selecting the output of the last time step
    output = self.fc(output_last)
    output = self.softmax(output)
    return output

# Example usage:
input_size = 3 # sequence length
hidden_size = 20
output_size = 18
batch_size = 1
rnn = RNN_Pytorch(input_size, hidden_size, output_size)
input = torch.randn(input_size, batch_size, input_size) # Sequence length x batch size
output = rnn(input)
print(output) # This will be the output for the last time step
```

```
tensor([[-3.2149, -3.0792, -2.9245, -3.2353, -2.6130, -2.7849, -3.1344, -3.3248,
         -3.3511, -3.1438, -3.0984, -2.5691, -2.5408, -2.2483, -3.0545, -2.6129,
         -2.9298, -3.0345]], grad_fn=<LogSoftmaxBackward0>)
```

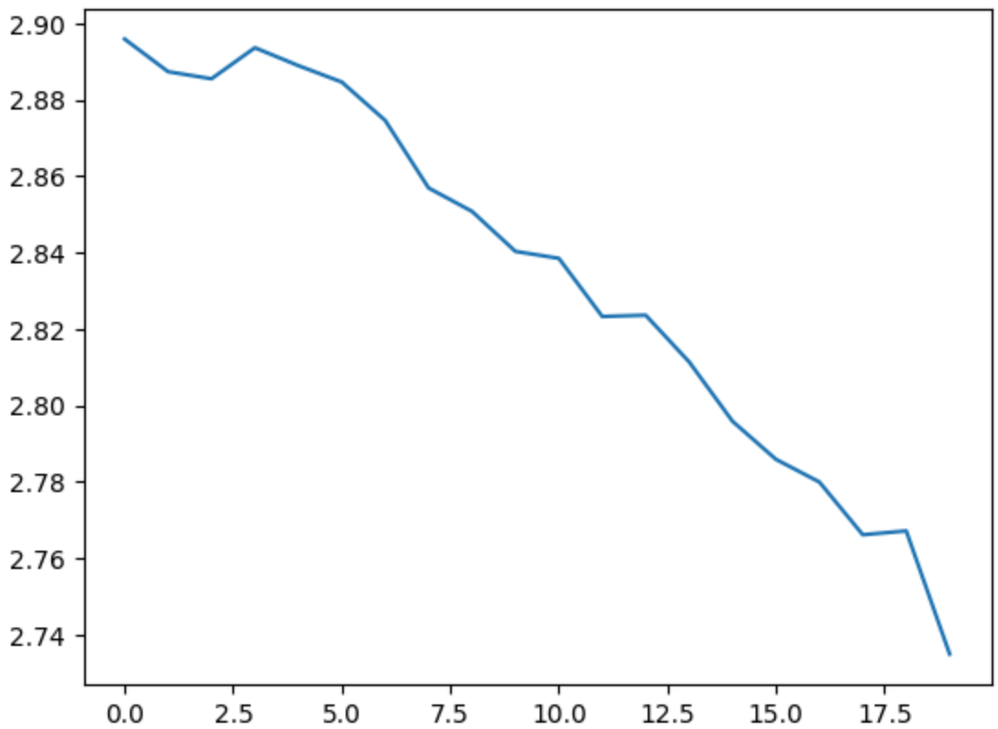
In [51]:

```
n_hidden = 10
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
```

```
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_ReLu.pt')
```

```
tensor([[-2.8226, -3.1842, -2.9685, -3.2334, -2.8908, -2.9171, -2.8138, -3.0722,
         -2.9100, -2.8057, -2.8365, -2.7246, -2.6705, -3.0101, -3.1178, -2.6039,
         -2.6174, -3.1344]], grad_fn=<LogSoftmaxBackward0>)
3.134406089782715
1000 5% (0m 2s) 3.0090 Kuwabara / Polish ✗ (Japanese)
2000 10% (0m 5s) 3.2530 Kanne / Spanish ✗ (Dutch)
3000 15% (0m 7s) 2.9718 Lane / Spanish ✗ (French)
4000 20% (0m 10s) 2.9242 Ribeiro / Spanish ✗ (Portuguese)
5000 25% (0m 12s) 3.0520 Vuu / Spanish ✗ (Vietnamese)
6000 30% (0m 14s) 3.0028 O'Brien / Polish ✗ (Irish)
7000 35% (0m 17s) 3.0789 Romijn / English ✗ (Dutch)
8000 40% (0m 19s) 2.5796 Wiater / Polish ✓
9000 45% (0m 22s) 2.7006 De la cruz / Scottish ✗ (Spanish)
10000 50% (0m 24s) 2.8479 Shiroyama / Spanish ✗ (Japanese)
11000 55% (0m 26s) 2.9924 Nuallan / English ✗ (Irish)
12000 60% (0m 29s) 2.7781 Takeda / Spanish ✗ (Japanese)
13000 65% (0m 32s) 2.6966 Paredes / Spanish ✗ (Portuguese)
14000 70% (0m 34s) 2.5804 Sarraf / Arabic ✓
15000 75% (0m 36s) 2.7269 Chin / English ✗ (Korean)
16000 80% (0m 38s) 3.0044 Djevetsky / Spanish ✗ (Russian)
17000 85% (0m 41s) 2.8519 Treblik / Spanish ✗ (Czech)
18000 90% (0m 43s) 2.7435 Caron / English ✗ (French)
19000 95% (0m 46s) 2.6490 Mendes / Greek ✗ (Portuguese)
20000 100% (0m 48s) 2.4333 Ruvelas / Greek ✓
[2.8958834035396577, 2.8873512859344483, 2.885488485813141, 2.8936175649166107, 2.888
9404056072236, 2.884635351896286, 2.874596862077713, 2.8569048261642456, 2.8507801575
660707, 2.84030379319191, 2.8384893279075625, 2.823265649318695, 2.8236075835227967,
2.811386040210724, 2.7958311805725096, 2.7858701803684234, 2.7799355032444, 2.7661293
444633483, 2.7671406586170195, 2.7348985483646393]
```



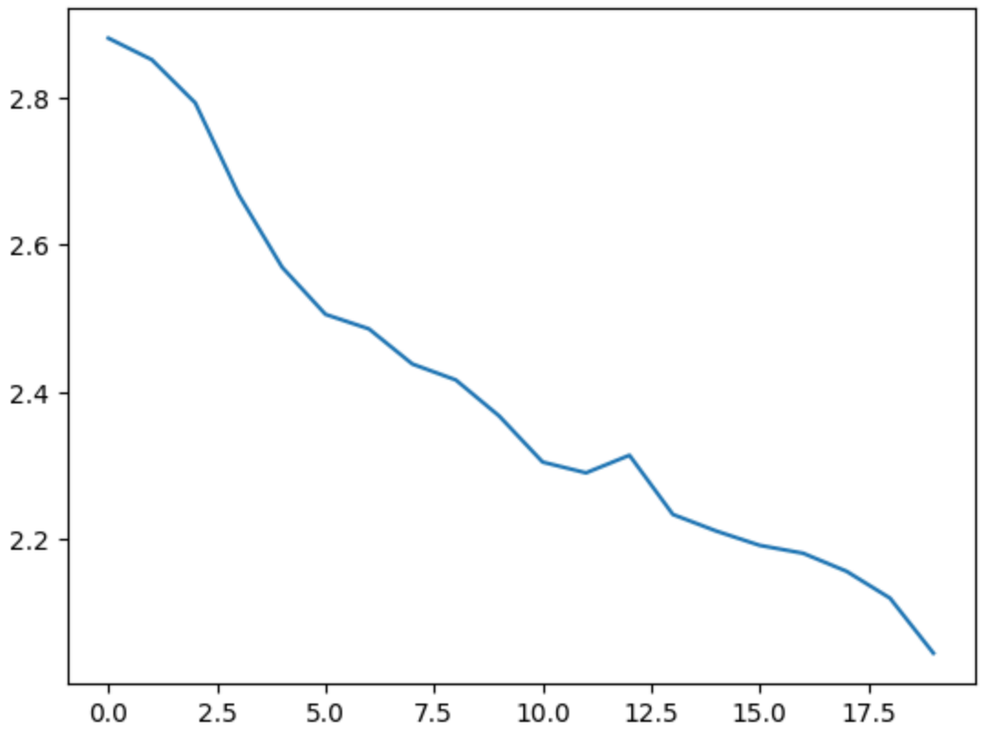
In [52]:

```
n_hidden = 100
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
```

```
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_ReLu.pt')
```

```
tensor([[-2.9180, -2.9693, -2.7147, -2.9814, -2.8542, -2.8882, -2.8897, -2.8584,
         -2.8683, -2.7926, -2.8974, -2.9078, -2.9348, -2.9397, -2.9332, -2.8264,
         -3.0156, -2.8801]], grad_fn=<LogSoftmaxBackward0>)
2.9396533966064453
1000 5% (0m 2s) 2.8472 Ferguson / Vietnamese ✗ (Scottish)
2000 10% (0m 6s) 2.7366 Hradek / Czech ✓
3000 15% (0m 8s) 2.6933 Szwedko / Czech ✗ (Polish)
4000 20% (0m 10s) 1.8525 Qiao / Chinese ✓
5000 25% (0m 13s) 2.4735 Ishimura / Russian ✗ (Japanese)
6000 30% (0m 16s) 1.9961 Mach / Korean ✗ (Vietnamese)
7000 35% (0m 19s) 1.3103 Frangopoulos / Greek ✓
8000 40% (0m 21s) 2.8018 Robert / French ✗ (Dutch)
9000 45% (0m 24s) 1.3759 Dao / Chinese ✗ (Vietnamese)
10000 50% (0m 26s) 2.7564 Hunter / German ✗ (Scottish)
11000 55% (0m 29s) 2.8241 Pickett / French ✗ (English)
12000 60% (0m 32s) 2.5584 Nizzola / Japanese ✗ (Italian)
13000 65% (0m 34s) 1.1850 Ton / Korean ✗ (Vietnamese)
14000 70% (0m 37s) 2.8154 Maçon / Arabic ✗ (French)
15000 75% (0m 39s) 1.3684 Pae / Chinese ✗ (Korean)
16000 80% (0m 43s) 3.5635 Jalovets / Greek ✗ (Russian)
17000 85% (0m 46s) 2.9213 Stolarz / Japanese ✗ (Polish)
18000 90% (0m 48s) 1.9139 Moon / Korean ✓
19000 95% (0m 50s) 1.8791 Gärtner / Dutch ✗ (German)
20000 100% (0m 53s) 1.8966 Vasiliev / Russian ✓
[2.880713303089142, 2.851475754737854, 2.7928419647216796, 2.668214581042528, 2.56964
2431795597, 2.5055703871250152, 2.4858584235310555, 2.4381432388722897, 2.41653000578
28425, 2.367515323642641, 2.3049704927005803, 2.2903040344640613, 2.3142057190835477,
2.2338194058686494, 2.2112635624138637, 2.1918375935181977, 2.1810950704924763, 2.156
5863559022547, 2.1201462230538017, 2.0453839043355546]
```



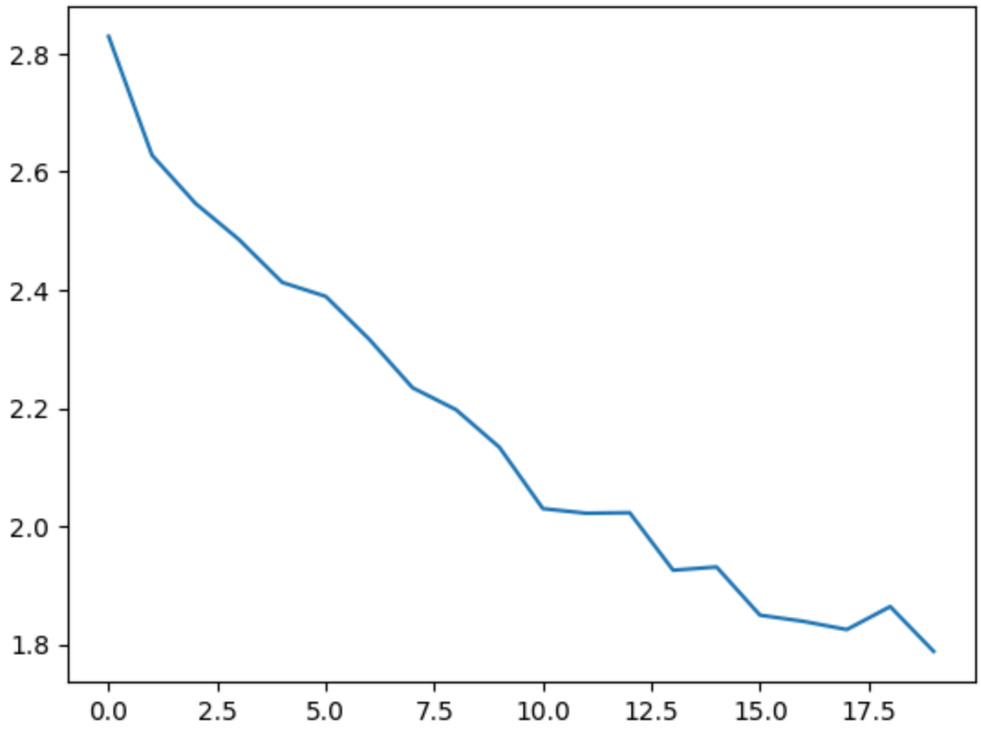
In [53]:

```
n_hidden = 500
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
```

```
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_ReLu.pt')
```

```
tensor([[-2.8596, -2.8550, -2.8930, -2.8844, -2.9529, -2.9001, -2.8670, -2.8813,
         -2.9087, -2.9416, -2.8657, -2.9203, -2.8757, -2.8921, -2.8974, -2.8445,
         -2.8885, -2.9060]], grad_fn=<LogSoftmaxBackward0>)
2.941588878631592
1000 5% (0m 8s) 3.1156 Sokolowski / Russian ✗ (Polish)
2000 10% (0m 17s) 1.5200 Tai / Vietnamese ✗ (Chinese)
3000 15% (0m 27s) 2.2494 Jaskulski / Russian ✗ (Polish)
4000 20% (0m 37s) 2.5494 Armando / Scottish ✗ (Spanish)
5000 25% (0m 46s) 2.7113 Kassis / Scottish ✗ (Arabic)
6000 30% (0m 56s) 0.7569 Wei / Chinese ✓
7000 35% (1m 5s) 2.9741 Schofield / Greek ✗ (English)
8000 40% (1m 15s) 1.7099 Lord / English ✓
9000 45% (1m 24s) 1.9179 Arah / English ✓
10000 50% (1m 33s) 2.1224 Ogura / Arabic ✗ (Japanese)
11000 55% (1m 43s) 7.8883 Tsoumada / Japanese ✗ (Greek)
12000 60% (1m 53s) 2.9159 Komo / Japanese ✗ (Czech)
13000 65% (2m 2s) 2.7197 Kouches / Dutch ✗ (Greek)
14000 70% (2m 11s) 4.0159 Bakhuta / Japanese ✗ (Russian)
15000 75% (2m 21s) 1.5409 Schneijder / German ✗ (Dutch)
16000 80% (2m 31s) 0.5342 Chellos / Greek ✓
17000 85% (2m 40s) 1.7528 Xydis / Greek ✓
18000 90% (2m 49s) 0.0316 Petrakis / Greek ✓
19000 95% (2m 59s) 1.6439 Beauchene / German ✗ (French)
20000 100% (3m 8s) 2.3740 Roche / Portuguese ✗ (French)
[2.8293525092601777, 2.6281195365190504, 2.546620032787323, 2.485495576739311, 2.4127
796222269535, 2.389165810137987, 2.316685362562537, 2.234454423291599, 2.197354967873
2223, 2.1336358112290617, 2.0298491341598783, 2.022016633038409, 2.0228965212942565,
1.925523283723509, 1.931089561501838, 1.849494203254144, 1.8389951336525847, 1.825085
4684542273, 1.8639719023547223, 1.7881434075408051]
```



In [55]:
```
# tanh
import torch.nn as nn
import torch.optim as optim
# Define your RNN model
class RNN_Pytorch(nn.Module):
  def __init__(self, input_size, hidden_size, output_size):
    super(RNN_Pytorch, self).__init__()
    self.hidden_size = hidden_size
    self.rnn = nn.RNN(input_size, hidden_size, nonlinearity="tanh")
    # output projection layer
    self.fc = nn.Linear(hidden_size, output_size)
    # softmax
    self.softmax = nn.LogSoftmax(dim=1)
  def forward(self, input):
    self.hidden = torch.zeros(1, input.size(1), self.hidden_size)
    output, self.hidden = self.rnn(input, self.hidden)
    output_last = output[-1] # Selecting the output of the last time step
```

```
    output = self.fc(output_last)
    output = self.softmax(output)
    return output

# Example usage:
input_size = 3 # sequence length
hidden_size = 20
output_size = 18
batch_size = 1
rnn = RNN_Pytorch(input_size, hidden_size, output_size)
input = torch.randn(input_size, batch_size, input_size) # Sequence length x batch size
output = rnn(input)
print(output) # This will be the output for the last time step
```

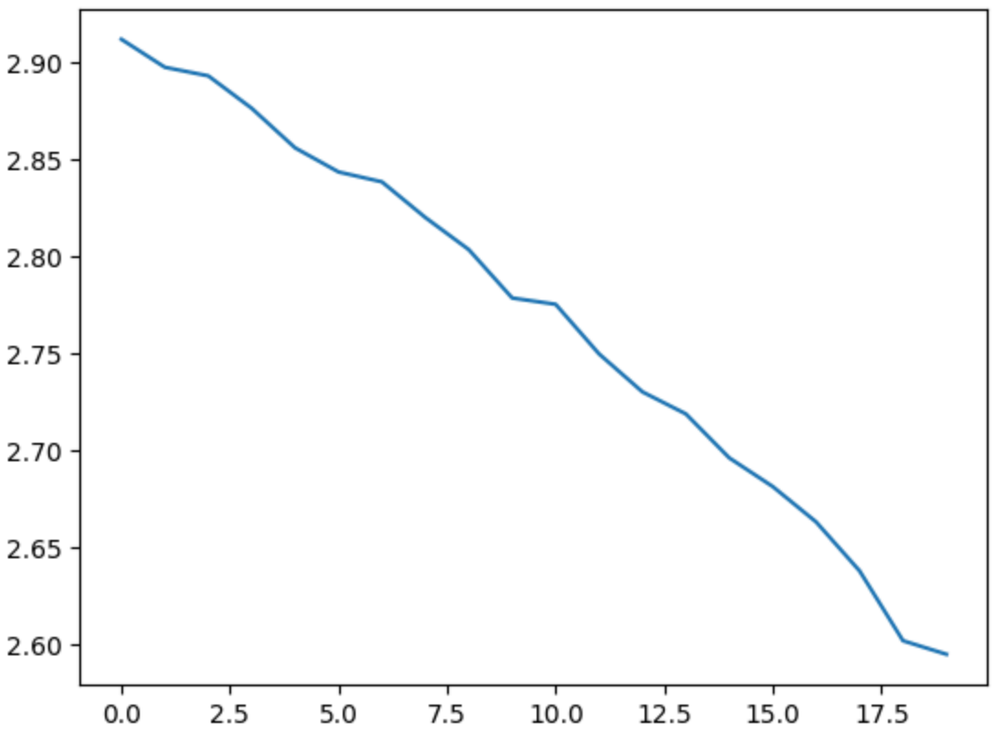
```
tensor([[-3.1033, -3.0515, -2.9696, -2.9061, -2.9837, -3.0375, -2.9917, -2.9311,
         -3.0174, -2.7520, -2.7717, -2.9533, -2.8688, -2.9914, -2.7486, -2.7641,
         -2.8174, -2.5454]], grad_fn=<LogSoftmaxBackward0>)
```

In [56]:

```
n_hidden = 10
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_Tanh.pt')
```

```
tensor([[-2.9644, -3.3213, -2.6194, -2.8631, -2.8425, -3.6109, -2.7294, -3.2683,
         -3.0831, -2.4654, -2.9141, -2.8899, -2.8765, -3.0343, -3.3317, -2.4254,
         -2.4546, -3.2551]], grad_fn=<LogSoftmaxBackward0>)
3.268343448638916
1000 5% (0m 2s) 3.1373 Maneates / Spanish ✗ (Greek)
2000 10% (0m 5s) 3.1977 Shang / Scottish ✗ (Chinese)
3000 15% (0m 7s) 3.1221 Bonnet / Portuguese ✗ (French)
4000 20% (0m 9s) 3.0269 Antar / Italian ✗ (Arabic)
5000 25% (0m 11s) 2.6672 De la cruz / Italian ✗ (Spanish)
6000 30% (0m 14s) 2.6934 Janz / Italian ✗ (German)
7000 35% (0m 16s) 2.7385 Garfagnini / Spanish ✗ (Italian)
8000 40% (0m 19s) 2.7819 Böhm / Czech ✗ (German)
9000 45% (0m 21s) 2.9064 Rios / Scottish ✗ (Portuguese)
10000 50% (0m 23s) 2.8823 Kassis / Polish ✗ (Arabic)
11000 55% (0m 25s) 2.4263 Peláez / Italian ✗ (Spanish)
12000 60% (0m 28s) 2.7506 Pinheiro / Scottish ✗ (Portuguese)
13000 65% (0m 30s) 2.6668 Shaw / Czech ✗ (Scottish)
14000 70% (0m 33s) 2.9419 Sekine / Dutch ✗ (Japanese)
15000 75% (0m 35s) 2.7563 Thayer / German ✗ (French)
16000 80% (0m 37s) 2.4074 Hayden / Irish ✓
17000 85% (0m 39s) 2.3712 Yun / Korean ✗ (Chinese)
18000 90% (0m 42s) 2.4006 Cameron / Dutch ✗ (Scottish)
19000 95% (0m 44s) 2.8804 Noschese / Irish ✗ (Italian)
20000 100% (0m 47s) 2.5024 Gutierrez / German ✗ (Spanish)
[2.911828022480011, 2.89741078543663, 2.8930033597946165, 2.8763029007911682, 2.85591
86596870423, 2.843506925821304, 2.8384072539806366, 2.8200463440418244, 2.80352686262
13075, 2.778600783586502, 2.775374974012375, 2.7498257377147675, 2.730255558729172,
2.718910166501999, 2.696259243965149, 2.6815153839588164, 2.66327254152298, 2.6380822
65019417, 2.602126452088356, 2.5951512315273284]
```



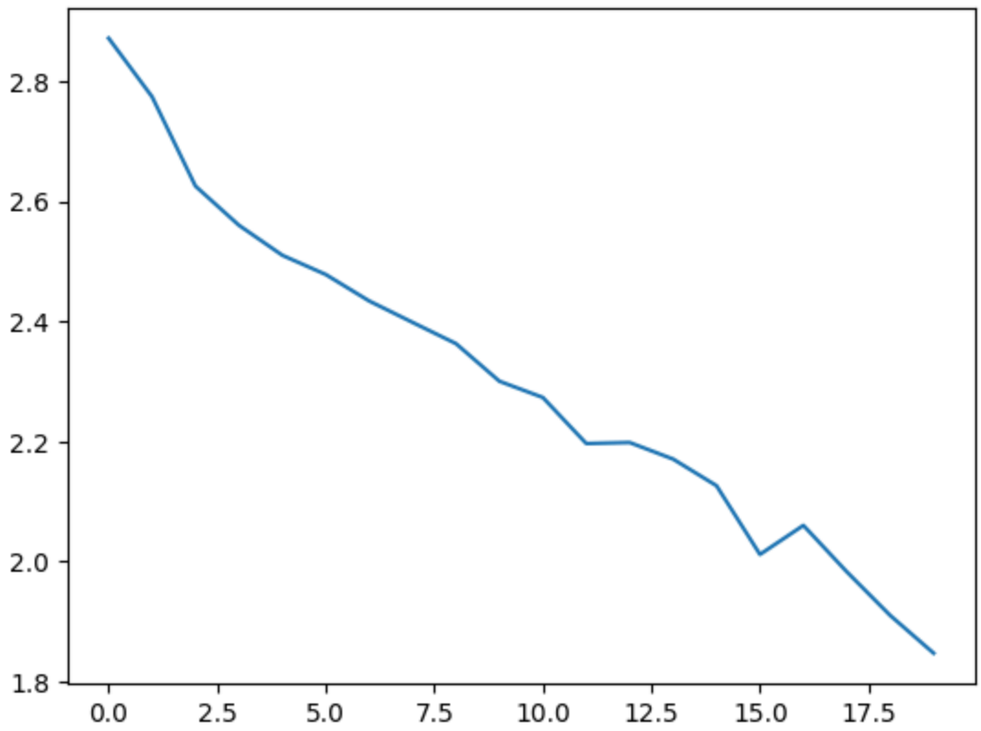
In [57]:

```
n_hidden = 100
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
```

```
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_Tanh.pt')
```

```
tensor([[-2.9231, -2.9437, -3.0296, -2.8506, -2.7869, -2.8577, -2.9683, -2.7746,
         -3.0185, -2.8230, -2.9260, -2.9179, -2.7941, -2.9921, -2.8509, -2.9053,
         -2.8364, -2.8795]], grad_fn=<LogSoftmaxBackward0>)
2.8364243507385254
1000 5% (0m 2s) 2.7118 Nishihara / Polish ✗ (Japanese)
2000 10% (0m 4s) 2.2114 Matsoukis / Greek ✓
3000 15% (0m 7s) 2.2439 Najjar / Arabic ✓
4000 20% (0m 10s) 2.7040 Shunji / Arabic ✗ (Japanese)
5000 25% (0m 12s) 2.1902 Notoriano / Italian ✓
6000 30% (0m 14s) 1.3217 Georgeakopoulos / Greek ✓
7000 35% (0m 17s) 3.1665 Mendelsohn / Russian ✗ (German)
8000 40% (0m 20s) 2.4657 Ureña / Portuguese ✗ (Spanish)
9000 45% (0m 22s) 1.8045 Altimari / Italian ✓
10000 50% (0m 25s) 2.8453 Salinas / Greek ✗ (Spanish)
11000 55% (0m 27s) 2.4241 Banos / Arabic ✗ (Greek)
12000 60% (0m 30s) 1.5031 Hadad / Arabic ✓
13000 65% (0m 33s) 2.3258 Gutierrez / Dutch ✗ (Spanish)
14000 70% (0m 35s) 1.1319 Kowalczyk / Polish ✓
15000 75% (0m 37s) 1.2696 Yun / Chinese ✗ (Korean)
16000 80% (0m 40s) 3.5974 Drinkwater / Russian ✗ (English)
17000 85% (0m 43s) 2.3884 Sault / English ✗ (French)
18000 90% (0m 45s) 1.6726 O'Hanlon / Scottish ✗ (Irish)
19000 95% (0m 48s) 1.2563 Niemczyk / Polish ✓
20000 100% (0m 50s) 1.8553 Colman / Scottish ✗ (Irish)
[2.8719936394691468, 2.7743864624500274, 2.6253612345457076, 2.5602001470327376, 2.51
01456475257873, 2.4780713949203492, 2.4339497468471527, 2.398240074276924, 2.36283775
4070759, 2.3001579309999944, 2.2730887669324873, 2.1963519635796547, 2.19803391796350
5, 2.1704078232049944, 2.1259908878207208, 2.0114857871085405, 2.059877598717809, 1.9
825405520871282, 1.909755534082651, 1.8468864927534014]
```



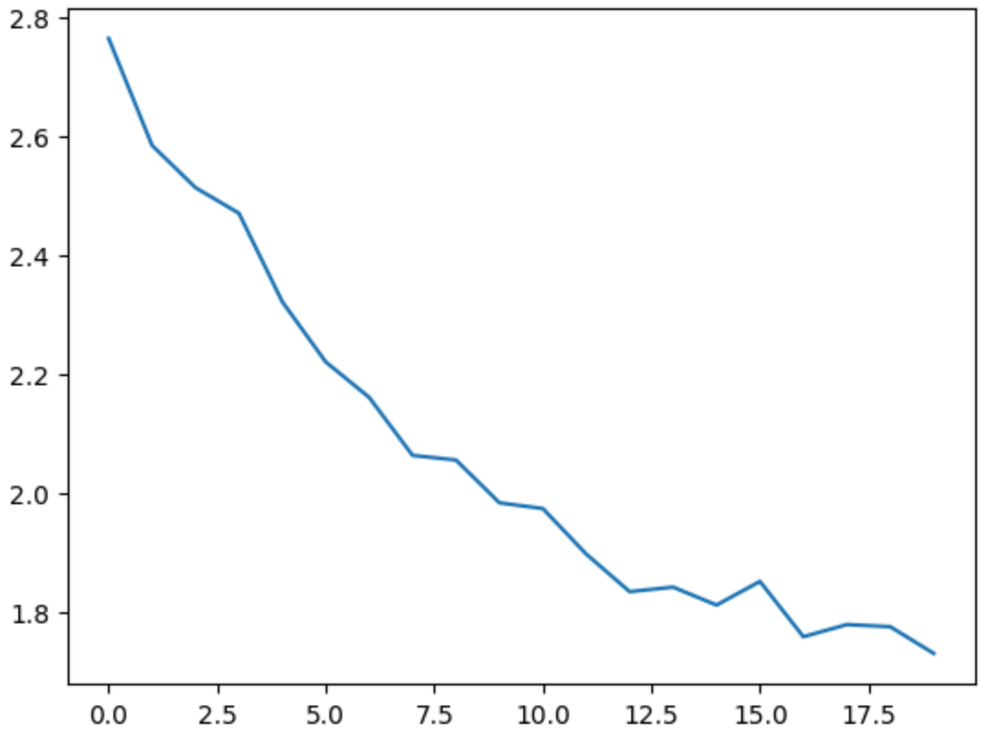
In [58]:

```
n_hidden = 500
n_epochs = 20000
print_every = 1000
plot_every = 1000
learning_rate = 0.0001
batch_size = 1
#rnn = RNN_Textbook(input_size=n_letters, hidden_size=n_hidden, output_size=n_categori
rnn = RNN_Pytorch(input_size=n_letters, hidden_size=n_hidden, output_size=n_categories
#optimizer = torch.optim.SGD(rnn.parameters(), lr=learning_rate)
optimizer = torch.optim.Adam(rnn.parameters(), lr=learning_rate)
criterion = nn.NLLLoss()
# criterion = nn.CrossEntropyLoss()
def train(category_tensor, name_tensor):
  optimizer.zero_grad() # set gradients to zero
  output = rnn(name_tensor)
  loss = criterion(output, category_tensor)
  loss.backward()
  nn.utils.clip_grad_norm_(rnn.parameters(), 1) # gradient clipping : max_norm=1
  optimizer.step()
  return output, loss.item()
category, name, category_tensor, name_tensor = randomTrainingPair()
output, loss = train(category_tensor, name_tensor)
print(output)
print(loss)

# Keep track of losses for plotting
current_loss = 0
all_losses = []
def timeSince(since):
  now = time.time()
  s = now - since
  m = math.floor(s / 60)
  s -= m * 60
  return '%dm %ds' % (m, s)
start = time.time()
for epoch in range(1, n_epochs + 1):
  category, name, category_tensor, name_tensor = randomTrainingPair()
  output, loss = train(category_tensor, name_tensor)
  current_loss += loss
  # Print epoch number, loss, name and guess
  if epoch % print_every == 0:
    guess, guess_i = categoryFromOutput(output)
    correct = '✓' if guess == category else '✗ (%s)' % category
    print('%d %d%% (%s) %.4f %s / %s %s' % (
    epoch, epoch / n_epochs * 100, timeSince(start), loss, name, guess, correct))
  # Add current loss avg to list of losses
  if epoch % plot_every == 0:
    all_losses.append(current_loss / plot_every)
    current_loss = 0
print(all_losses)
import matplotlib.pyplot as plt
```

```
import matplotlib.ticker as ticker
plt.figure()
plt.plot(all_losses)
torch.save(rnn, 'char-rnn-classification_Tanh.pt')
```

```
tensor([[-2.9000, -2.8478, -2.8487, -2.9442, -2.9282, -2.8809, -2.8230, -2.8722,
         -2.8126, -2.8843, -2.9061, -2.8899, -2.9241, -2.8581, -2.8693, -2.9264,
         -2.9271, -3.0019]], grad_fn=<LogSoftmaxBackward0>)
2.924057722091675
1000 5% (0m 7s) 2.1127 Tong / Korean ✗ (Chinese)
2000 10% (0m 13s) 3.5698 Bawin / Arabic ✗ (Russian)
3000 15% (0m 20s) 3.7491 Róg / Korean ✗ (Polish)
4000 20% (0m 28s) 2.7955 Séverin / Irish ✗ (French)
5000 25% (0m 35s) 1.0915 To / Korean ✗ (Vietnamese)
6000 30% (0m 42s) 1.8027 Vinh / Chinese ✗ (Vietnamese)
7000 35% (0m 49s) 2.4778 Asghar / Czech ✗ (Arabic)
8000 40% (0m 56s) 2.6792 Souza / Czech ✗ (Portuguese)
9000 45% (1m 3s) 4.1016 Abano / Japanese ✗ (Spanish)
10000 50% (1m 9s) 0.7640 Sakellariou / Greek ✓
11000 55% (1m 16s) 2.2913 Vivas / Irish ✗ (Spanish)
12000 60% (1m 23s) 0.5188 Lao / Chinese ✓
13000 65% (1m 30s) 1.7402 Belmonte / Spanish ✗ (Italian)
14000 70% (1m 37s) 1.5220 Temple / Scottish ✗ (English)
15000 75% (1m 44s) 0.6569 Paszek / Polish ✓
16000 80% (1m 51s) 3.9192 Sioda / Japanese ✗ (Irish)
17000 85% (1m 58s) 0.7423 Knopf / German ✓
18000 90% (2m 5s) 4.7094 Han / Chinese ✗ (Korean)
19000 95% (2m 12s) 1.2383 Mansour / Arabic ✓
20000 100% (2m 19s) 1.1995 Watt / Scottish ✓
[2.7641146718263627, 2.5842926201820373, 2.5131913558244707, 2.4701531351804733, 2.32
1230799943209, 2.220115686863661, 2.160511913448572, 2.0629785581678153, 2.0552045704
82485, 1.983209438033402, 1.9735852612270974, 1.8969685286954046, 1.8338191916706272,
1.8414563199516851, 1.8113093000152147, 1.851067386812996, 1.7580710075495298, 1.7785
090151253389, 1.7748902764946106, 1.7300677988905808]
```



In [14]:
```
import sys
rnn = torch.load('char-rnn-classification.pt')
```

In [30]:
```
# Just return an output given a name
def evaluate(name_tensor):
  output = rnn(name_tensor)
  return output

def predict(line, n_predictions=3):
  output = evaluate(Variable(nameToTensor(line)))
  # Get top N categories
  topv, topi = output.data.topk(n_predictions, 1, True)
  predictions = []
  for i in range(n_predictions):
    value = topv[0][i]
    category_index = topi[0][i]
    print('(%.2f) %s' % (value, all_categories[category_index]))
```

```
    predictions.append([value, all_categories[category_index]])
  return predictions
predict('yang')
```

Out[30]:
```
(-0.01) Chinese
(-4.83) Japanese
(-6.09) Vietnamese
[[tensor(-0.0139), 'Chinese'],
 [tensor(-4.8299), 'Japanese'],
 [tensor(-6.0882), 'Vietnamese']]
```

In [ ]: