```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
import nltk
nltk.download('punkt')
nltk.download('wordnet')
from nltk.corpus import stopwords

# Download the stop words from NLTK
nltk.download('stopwords')
stop_words = set(stopwords.words('english'))
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

```
from __future__ import unicode_literals, print_function, division
from io import open
import unicodedata
import string
import re
import random

import torch
import torch.nn as nn
from torch import optim
import torch.nn.functional as F

device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
```

```
import pandas as pd
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize

def remove_stop_words(text):
    stop_words = set(stopwords.words('english'))
    word_tokens = word_tokenize(text)
    filtered_text = ' '.join([word for word in word_tokens if word.lower() not in stop_words])
    return filtered_text
df = pd.read_csv("/content/drive/MyDrive/train.csv")
df = df.sample(frac=1).reset_index(drop=True)
df = df[0:5000]
for x in range(len(df['Recipe'])):
    if type(df['Recipe'][x]) != str:
        df['Recipe'][x] = ''
df2 = pd.read_csv("/content/drive/MyDrive/dev.csv")
for x in range(len(df2['Recipe'])):
    if type(df2['Recipe'][x]) != str:
        df2['Recipe'][x] = ''
# Apply the function to the DataFrame columns
df['Ingredients'] = df['Ingredients'].apply(remove_stop_words)
df['Recipe'] = df['Recipe'].apply(remove_stop_words)
df['Ingredients'] = df['Ingredients'].str.lower()
df['Recipe'] = df['Recipe'].str.lower()
df2['Ingredients'] = df2['Ingredients'].apply(remove_stop_words)
df2['Recipe'] = df2['Recipe'].apply(remove_stop_words)
df2['Ingredients'] = df2['Ingredients'].str.lower()
df2['Recipe'] = df2['Recipe'].str.lower()
```

```
import pandas as pd
import re
import unicodedata
import random
import torch


file_path = ""

# MAX_LENGTH = df['Ingredients'].str.len().max()
MAX_LENGTH = 150
print("Maximum length of strings in 'Ingredients' column:", MAX_LENGTH)
with open("1.txt", "w") as file:
    for index, row in df.iterrows():
        file.write(f"{row['Recipe']}:::{row['Ingredients']}\n")

SOS_token = 0
EOS_token = 1
UNK_token = 2

class Lang:
    def __init__(self, name):
        self.name = name
        self.word2index = {}
        self.word2count = {}
        self.index2word = {0: "SOS", 1: "EOS", 2: "UNK"}
        self.n_words = 3  # Count SOS, EOS, and UNK

    def addSentence(self, sentence):
        for word in sentence.split(' '):
            self.addWord(word)

    def addWord(self, word):
        if word not in self.word2index:
            self.word2index[word] = self.n_words
            self.word2count[word] = 1
            self.index2word[self.n_words] = word
            self.n_words += 1
        else:
            self.word2count[word] += 1

def unicodeToAscii(s):
    return ''.join(
        c for c in unicodedata.normalize('NFD', s)
        if unicodedata.category(c) != 'Mn'
    )

def normalizeString(s):
    s = unicodeToAscii(s.lower().strip())
    s = re.sub(r"([.!?])", r" \1", s)
    s = re.sub(r"[^a-zA-Z.!?]+", r" ", s)
    return s

def readLangs(lang1, lang2, reverse=False):
    print("Reading lines...")

    # Read the file and split into lines
    file_name = file_path + '1.txt'
    lines = open(file_name, encoding='utf-8').\
        read().strip().split('\n')

    # Split every line into pairs and normalize
    pairs = [[normalizeString(s) for s in l.split(':::')] for l in lines]

    # Reverse pairs, make Lang instances
    if reverse:
        pairs = [list(reversed(p)) for p in pairs]
        input_lang = Lang(lang2)
        output_lang = Lang(lang1)
    else:
        input_lang = Lang(lang1)
        output_lang = Lang(lang2)

    return input_lang, output_lang, pairs

def filterPair(p):
    return len(p[0].split(' ')) < MAX_LENGTH and \
        len(p[1].split(' ')) < MAX_LENGTH
```

```
def filterPairs(pairs):
    return [pair for pair in pairs if filterPair(pair)]

def prepareData(lang1, lang2, reverse=False):
    input_lang, output_lang, pairs = readLangs(lang1, lang2, reverse)
    print("Read %s sentence pairs" % len(pairs))
    pairs = filterPairs(pairs)
    print("Trimmed to %s sentence pairs" % len(pairs))
    print("Counting words...")
    for pair in pairs:
        input_lang.addSentence(pair[0])
        output_lang.addSentence(pair[1])
    print("Counted words:")
    print(input_lang.name, input_lang.n_words)
    print(output_lang.name, output_lang.n_words)
    return input_lang, output_lang, pairs

input_lang, output_lang, pairs = prepareData('eng', 'eng2', True)
print(random.choice(pairs))

def indexesFromSentence(lang, sentence):
    return [lang.word2index.get(word, UNK_token) for word in sentence.split(' ')]

def tensorFromSentence(lang, sentence):
    indexes = indexesFromSentence(lang, sentence)
    indexes.append(EOS_token)
    return torch.tensor(indexes, dtype=torch.long, device=device).view(-1, 1)

def tensorsFromPair(pair):
    input_tensor = tensorFromSentence(input_lang, pair[0])
    target_tensor = tensorFromSentence(output_lang, pair[1])
    return (input_tensor, target_tensor)

with open("2.txt", "w") as file:
    for index, row in df2.iterrows():
        file.write(f"{row['Recipe']}:::{row['Ingredients']}\n")

def readLangs(lang1, lang2, reverse=False):
    print("Reading lines...")

    # Read the file and split into lines
    file_name = file_path + '2.txt'
    lines = open(file_name, encoding='utf-8').\
        read().strip().split('\n')

    # Split every line into pairs and normalize
    pairs = [[normalizeString(s) for s in l.split(':::')] for l in lines]

    # Reverse pairs, make Lang instances
    if reverse:
        pairs = [list(reversed(p)) for p in pairs]
        input_lang = Lang(lang2)
        output_lang = Lang(lang1)
    else:
        input_lang = Lang(lang1)
        output_lang = Lang(lang2)

    return input_lang, output_lang, pairs

dev_input_lang, dev_output_lang, dev_pairs = prepareData('eng', 'eng2', True)
print(random.choice(dev_pairs))
```

```
Maximum length of strings in 'Ingredients' column: 150
Reading lines...
Read 5000 sentence pairs
Trimmed to 4757 sentence pairs
Counting words...
Counted words:
eng2 4430
eng 8126
[' lb flank steak sliced ts soy sauce dark ts rice wine ts ginger chopped fine ts cornstarch ts sesame oil c peanu
Reading lines...
Read 797 sentence pairs
Trimmed to 764 sentence pairs
Counting words...
Counted words:
eng2 1891
```

```
eng 3506
[' tb butter c sugar brown eggs c flour ts baking powder ts vanilla extract c sesame seeds', 'preheat oven . cream
```

BASELINE 1

```
class EncoderRNN(nn.Module):
    def __init__(self, input_size, hidden_size):
        super(EncoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.embedding = nn.Embedding(input_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size)

    def forward(self, input, hidden):
        embedded = self.embedding(input).view(1, 1, -1)
        output = embedded
        output, hidden = self.lstm(output, hidden)
        return output, hidden

    def initHidden(self):
        return torch.zeros(1, 1, self.hidden_size, device=device), torch.zeros(1, 1, self.hidden_size, device=device)


class DecoderRNN(nn.Module):
    def __init__(self, hidden_size, output_size):
        super(DecoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.embedding = nn.Embedding(output_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size)
        self.out = nn.Linear(hidden_size, output_size)
        self.softmax = nn.LogSoftmax(dim=1)
    def forward(self, input, hidden):
        output = self.embedding(input).view(1, 1, -1)
        output = F.relu(output)
        output, hidden = self.lstm(output, hidden)
        output = self.softmax(self.out(output[0]))
        return output, hidden
    def initHidden(self):
        return torch.zeros(1, 1, self.hidden_size, device=device), torch.zeros(1, 1, self.hidden_size, device=device)


teacher_forcing_ratio = 1
def train(input_tensor, target_tensor, encoder, decoder, encoder_optimizer, decoder_optimizer, criterion, max_length=M
    encoder_hidden = encoder.initHidden()
    encoder_optimizer.zero_grad()
    decoder_optimizer.zero_grad()
    input_length = input_tensor.size(0)
    target_length = target_tensor.size(0)
    encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)
    loss = 0
    for ei in range(input_length):
        encoder_output, encoder_hidden = encoder(
            input_tensor[ei], encoder_hidden)
        encoder_outputs[ei] = encoder_output[0, 0]
    decoder_input = torch.tensor([[SOS_token]], device=device)
    decoder_hidden = encoder_hidden
    use_teacher_forcing = True if random.random() < teacher_forcing_ratio else False
    if use_teacher_forcing:
        for di in range(target_length):
            decoder_output, decoder_hidden = decoder(
                decoder_input, decoder_hidden)
            loss += criterion(decoder_output, target_tensor[di])
            decoder_input = target_tensor[di]
    else:
        for di in range(target_length):
            decoder_output, decoder_hidden = decoder(
                decoder_input, decoder_hidden)
            topv, topi = decoder_output.topk(1)
            decoder_input = topi.squeeze().detach()
            loss += criterion(decoder_output, target_tensor[di])
            if decoder_input.item() == EOS_token:
                break
    loss.backward()
    encoder_optimizer.step()
    decoder_optimizer.step()
    return loss.item() / target_length
```

```
import time
import math
def asMinutes(s):
    m = math.floor(s / 60)
    s -= m * 60
    return '%dm %ds' % (m, s)
def timeSince(since, percent):
    now = time.time()
    s = now - since
    es = s / (percent)
    rs = es - s
    return '%s (- %s)' % (asMinutes(s), asMinutes(rs))
```

```
def trainIters(encoder, decoder, n_iters, print_every=1000, plot_every=100, learning_rate=0.01):
    start = time.time()
    plot_losses = []
    dll = []
    print_loss_total = 0
    plot_loss_total = 0
    encoder_optimizer = optim.Adam(encoder.parameters(), lr=learning_rate)
    decoder_optimizer = optim.Adam(decoder.parameters(), lr=learning_rate)
    training_pairs = [tensorsFromPair(random.choice(pairs))
                      for i in range(n_iters)]
    dev_pairs2 = [tensorsFromPair(random.choice(dev_pairs))
                      for i in range(n_iters)]
    criterion = nn.NLLLoss()
    for iter in range(1, n_iters + 1):
        training_pair = training_pairs[iter - 1]
        input_tensor = training_pair[0]
        target_tensor = training_pair[1]
        loss = train(input_tensor, target_tensor, encoder,
                     decoder, encoder_optimizer, decoder_optimizer, criterion)
        print_loss_total += loss
        plot_loss_total += loss
        if iter % print_every == 0:
            print_loss_avg = print_loss_total / print_every
            print_loss_total = 0
            print('%s (%d %d%%) %.4f' % (timeSince(start, iter / n_iters),
                                         iter, iter / n_iters * 100, print_loss_avg))
            # Calculate development loss
            dl = 0
            with torch.no_grad():
              for d in dev_pairs2:
                input_tensor = d[0]
                target_tensor = d[1]
                loss2 = evaluate2(input_tensor, target_tensor, encoder, decoder,criterion)
                dl += loss2
            dl / len(dev_pairs2)
            dl_avg = dl / len(dev_pairs2)
            dll.append((iter, dl_avg))
            print('Dev Loss is: %.4f' % dl_avg)
        if iter % plot_every == 0:
            plot_loss_avg = plot_loss_total / plot_every
            plot_losses.append((iter, plot_loss_avg))
            plot_loss_total = 0
    # showPlot(plot_losses, dll)

def evaluate2(input_tensor, target_tensor, encoder, decoder, criterion):
    with torch.no_grad():
        encoder_hidden = encoder.initHidden(device)
        input_length = input_tensor.size(0)
        target_length = target_tensor.size(0)
        encoder_outputs = torch.zeros(MAX_LENGTH, encoder.hidden_size, device=device)
        loss = 0
        for ei in range(input_length):
            encoder_output, encoder_hidden = encoder(input_tensor[ei],
                                                     encoder_hidden)
            encoder_outputs[ei] = encoder_output[0, 0]
        decoder_input = torch.tensor([[SOS_token]], device=device)
        decoder_hidden = encoder_hidden
        for di in range(target_length):
            decoder_output, decoder_hidden = decoder(decoder_input, decoder_hidden)
            topv, topi = decoder_output.topk(1)
            decoder_input = topi.squeeze().detach()
            loss += criterion(decoder_output, target_tensor[di])
            if decoder_input.item() == EOS_token:
                break
    return loss.item() / target_length

def evaluate(encoder, decoder, sentence, max_length=MAX_LENGTH):
    with torch.no_grad():
        input_tensor = tensorFromSentence(input_lang, sentence)
        input_length = input_tensor.size()[0]
        encoder_hidden = encoder.initHidden(device)
        encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)
        for ei in range(input_length):
            encoder_output, encoder_hidden = encoder(input_tensor[ei],
                                                     encoder_hidden)
            encoder_outputs[ei] += encoder_output[0, 0]
        decoder_input = torch.tensor([[SOS_token]], device=device)
        decoder_hidden = encoder_hidden
```

```
        decoded_words = []
        decoder_attentions = torch.zeros(max_length, max_length)
        for di in range(max_length):
            decoder_output, decoder_hidden = decoder(
                decoder_input, decoder_hidden)
            topv, topi = decoder_output.data.topk(1)
            if topi.item() == EOS_token:
                decoded_words.append('<EOS>')
                break
            else:
                decoded_words.append(output_lang.index2word[topi.item()])
            decoder_input = topi.squeeze().detach()
        return decoded_words
```

```
import matplotlib.pyplot as plt
plt.switch_backend('agg')
import matplotlib.ticker as ticker
import numpy as np
%matplotlib inline
def showPlot(tl, dl):
    plt.figure()
    fig, ax = plt.subplots()
    tli, tlv = zip(*tl)
    di, dv = zip(*dl)
    ax.plot(tli, tlv, 'b-', label='Training Loss')
    ax.plot(di, dv, 'r--', label='Development Loss')
    ax.set_xlabel('Iterations numbers')
    ax.set_ylabel('Loss values')
    ax.set_title('Training and Dev Losses')
    ax.legend()
    plt.show()
```

```
hidden_size = 256
encoder1 = EncoderRNN(input_lang.n_words, hidden_size).to(device)
decoder1 = DecoderRNN(hidden_size, output_lang.n_words).to(device)

trainIters(encoder1, decoder1, 10000, print_every=1000)
```

```
1m 33s (- 14m 0s) (1000 10%) Training Loss: 5.2320
Dev Loss: 4.0537
3m 19s (- 13m 17s) (2000 20%) Training Loss: 4.7244
Dev Loss: 7.5774
5m 19s (- 12m 25s) (3000 30%) Training Loss: 4.5549
Dev Loss: 3.7351
7m 6s (- 10m 40s) (4000 40%) Training Loss: 4.4544
Dev Loss: 3.8976
8m 55s (- 8m 55s) (5000 50%) Training Loss: 4.4258
Dev Loss: 8.6804
10m 55s (- 7m 17s) (6000 60%) Training Loss: 4.3670
Dev Loss: 4.7012
12m 43s (- 5m 27s) (7000 70%) Training Loss: 4.3279
Dev Loss: 7.7667
14m 40s (- 3m 40s) (8000 80%) Training Loss: 4.3119
Dev Loss: 5.5144
16m 26s (- 1m 49s) (9000 90%) Training Loss: 4.3015
Dev Loss: 5.1630
18m 17s (- 0m 0s) (10000 100%) Training Loss: 4.2576
Dev Loss: 5.0244
<Figure size 640x480 with 0 Axes>
```


```
torch.save(encoder1.state_dict(), '/content/drive/My Drive/encoder1.pth')
torch.save(decoder1.state_dict(), '/content/drive/My Drive/decoder1.pth')

# Save the trainIters function
import pickle
with open('/content/drive/My Drive/trainIter1.pkl', 'wb') as f:
    pickle.dump(trainIters, f)
```

Baseline 2 with attention

```
import torch
import torch.nn as nn

class EncoderRNN(nn.Module):
    def __init__(self, input_size, hidden_size):
        super(EncoderRNN, self).__init__()
        self.hidden_size = hidden_size

        self.embedding = nn.Embedding(input_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size)

    def forward(self, input, hidden):
        embedded = self.embedding(input).view(1, 1, -1)
        output = embedded
        output, hidden = self.lstm(output, hidden)
        return output, hidden

    def initHidden(self,device):
        return torch.zeros(1, 1, self.hidden_size, device=device), torch.zeros(1, 1, self.hidden_size, device=device)
```

```
class AttnDecoderRNN(nn.Module):
    def __init__(self, hidden_size, output_size, dropout_p=0.1, max_length=MAX_LENGTH):
        super(AttnDecoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.output_size = output_size
        self.dropout_p = dropout_p
        self.max_length = max_length

        self.embedding = nn.Embedding(self.output_size, self.hidden_size)
        self.dropout = nn.Dropout(self.dropout_p)
        self.lstm = nn.LSTM(self.hidden_size, self.hidden_size)
        self.out = nn.Linear(self.hidden_size * 2, self.output_size)

    def forward(self, input, hidden, encoder_outputs):
        embedded = self.embedding(input).view(1, 1, -1)
        embedded = self.dropout(embedded)

        _, (hidden, cell_state) = self.lstm(embedded, hidden)

        attn_weights = F.softmax(torch.bmm(hidden, encoder_outputs.T.unsqueeze(0)), dim=-1)
        attn_output = torch.bmm(attn_weights, encoder_outputs.unsqueeze(0))

        concat_output = torch.cat((attn_output[0], hidden[0]), 1)

        output = F.log_softmax(self.out(concat_output), dim=1)

        return output, (hidden, cell_state), attn_weights

    def initHidden(self,device):
        return torch.zeros(1, 1, self.hidden_size, device=device), torch.zeros(1, 1, self.hidden_size, device=device)
```

```
teacher_forcing_ratio = 1

def train_attn(input_tensor, target_tensor, encoder, decoder, encoder_optimizer, decoder_optimizer, criterion, max_len
    encoder_hidden, encoder_cell = encoder.initHidden(device)

    encoder_optimizer.zero_grad()
    decoder_optimizer.zero_grad()

    input_length = input_tensor.size(0)
    target_length = target_tensor.size(0)

    encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)

    loss = 0

    for ei in range(input_length):
        encoder_output, (encoder_hidden, encoder_cell) = encoder(
            input_tensor[ei], (encoder_hidden, encoder_cell))
        encoder_outputs[ei] = encoder_output[0, 0]

    decoder_input = torch.tensor([[SOS_token]], device=device)

    decoder_hidden = encoder_hidden
    decoder_cell = encoder_cell

    use_teacher_forcing = True if random.random() < teacher_forcing_ratio else False

    if use_teacher_forcing:
        # Teacher forcing: Feed the target as the next input
        for di in range(target_length):
            decoder_output, (decoder_hidden, decoder_cell), decoder_attention = decoder(
                decoder_input, (decoder_hidden, decoder_cell), encoder_outputs)
            loss += criterion(decoder_output, target_tensor[di])
            decoder_input = target_tensor[di]  # Teacher forcing

    else:
        # Without teacher forcing: use its own predictions as the next input
        for di in range(target_length):
            decoder_output, (decoder_hidden, decoder_cell), decoder_attention = decoder(
                decoder_input, (decoder_hidden, decoder_cell), encoder_outputs)
            topv, topi = decoder_output.topk(1)
            decoder_input = topi.squeeze().detach()  # detach from history as input

            loss += criterion(decoder_output, target_tensor[di])
            if decoder_input.item() == EOS_token:
                break

    loss.backward()

    encoder_optimizer.step()
    decoder_optimizer.step()

    return loss.item() / target_length
```

```
def evaluate_attn(encoder, decoder, sentence, max_length=MAX_LENGTH):
    with torch.no_grad():
        input_tensor = tensorFromSentence(input_lang, sentence)
        input_length = input_tensor.size()[0]
        encoder_hidden, encoder_cell = encoder.initHidden(device)

        encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)

        for ei in range(input_length):
            encoder_output, (encoder_hidden, encoder_cell) = encoder(input_tensor[ei],
                                                     (encoder_hidden, encoder_cell))
            encoder_outputs[ei] += encoder_output[0, 0]

        decoder_input = torch.tensor([[SOS_token]], device=device)  # SOS

        decoder_hidden = encoder_hidden
        decoder_cell = encoder_cell  # Initialize decoder's cell state with encoder's last cell state

        decoded_words = []
        decoder_attentions = torch.zeros(max_length, max_length)

        for di in range(max_length):
            decoder_output, (decoder_hidden, decoder_cell), decoder_attention = decoder(
                decoder_input, (decoder_hidden, decoder_cell), encoder_outputs)
            decoder_attentions[di] = decoder_attention.data
            topv, topi = decoder_output.data.topk(1)
            if topi.item() == EOS_token:
                decoded_words.append('<EOS>')
                break
            else:
                decoded_words.append(output_lang.index2word[topi.item()])

            decoder_input = topi.squeeze().detach()

        return decoded_words, decoder_attentions[:di + 1]
```

```
def trainIters_attn(encoder, decoder, n_iters, print_every=1000, plot_every=100, learning_rate=0.01):
    start = time.time()
    plot_losses = []
    dll =  []
    print_loss_total = 0  # Reset every print_every
    plot_loss_total = 0  # Reset every plot_every
    encoder_optimizer = optim.Adam(encoder.parameters(), lr=learning_rate)
    decoder_optimizer = optim.Adam(decoder.parameters(), lr=learning_rate)
    training_pairs = [tensorsFromPair(random.choice(pairs))
                      for i in range(n_iters)]
    dev_pairs2 = [tensorsFromPair(random.choice(dev_pairs))
                      for i in range(n_iters)]
    criterion = nn.NLLLoss()
    for iter in range(1, n_iters + 1):
        training_pair = training_pairs[iter - 1]
        input_tensor = training_pair[0]
        target_tensor = training_pair[1]
        encoder_hidden, encoder_cell = encoder.initHidden(device)  # Initialize encoder's hidden and cell states
        decoder_hidden, decoder_cell = encoder_hidden, encoder_cell  # Initialize decoder's hidden and cell states
        loss = train_attn(input_tensor, target_tensor, encoder,
                          decoder, encoder_optimizer, decoder_optimizer, criterion)
        print_loss_total += loss
        plot_loss_total += loss
        if iter % print_every == 0:
            print_loss_avg = print_loss_total / print_every
            print_loss_total = 0
            print('%s (%d %d%%) %.4f' % (timeSince(start, iter / n_iters),
                                         iter, iter / n_iters * 100, print_loss_avg))
            # # Calculate development loss
            dl = 0
            with torch.no_grad():
              for d in dev_pairs2:
                input_tensor = d[0]
                target_tensor = d[1]
                loss2 = evaluate3(input_tensor, target_tensor, encoder, decoder,criterion)
                dl += loss2
            dl / len(dev_pairs2)
            dl_avg = dl / len(dev_pairs2)
            dll.append((iter, dl_avg))
            print('Dev Loss is: %.4f' % dl_avg)
        if iter % plot_every == 0:
            plot_loss_avg = plot_loss_total / plot_every
            plot_losses.append((iter, plot_loss_avg))
            plot_loss_total = 0
    showPlot(plot_losses,dll)


def evaluate3(input_tensor, target_tensor, encoder, decoder, criterion, max_length=MAX_LENGTH):
    with torch.no_grad():
        # Initialize the encoder's hidden and cell states
        encoder_hidden, encoder_cell = encoder.initHidden(device)
        input_length = input_tensor.size(0)
        target_length = target_tensor.size(0)
        encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)
        # Encode the input sentence
        for ei in range(input_length):
            encoder_output, (encoder_hidden, encoder_cell) = encoder(
                input_tensor[ei], (encoder_hidden, encoder_cell))
            encoder_outputs[ei] = encoder_output[0, 0]
        # Initialize the decoder input and hidden states
        decoder_input = torch.tensor([[SOS_token]], device=device)
        decoder_hidden = encoder_hidden
        decoder_cell = encoder_cell
        # Initialize tensor to store decoder outputs
        decoder_outputs = torch.zeros(target_length, decoder.output_size, device=device)
        # Decode the input sentence
        for di in range(target_length):
            decoder_output, (decoder_hidden, decoder_cell), decoder_attention = decoder(
                decoder_input, (decoder_hidden, decoder_cell), encoder_outputs)
            decoder_outputs[di] = decoder_output
            topv, topi = decoder_output.topk(1)
            decoder_input = topi.squeeze().detach()
            if decoder_input.item() == EOS_token:
                break
        loss = criterion(decoder_outputs, target_tensor.view(-1))
        return loss.item() / target_length
```

```
hidden_size = 256
encoder2 = EncoderRNN(input_lang.n_words, hidden_size).to(device)
attn_decoder = AttnDecoderRNN(hidden_size, output_lang.n_words, dropout_p=0.1).to(device)
trainIters_attn(encoder2, attn_decoder, 10000, print_every=1000)
```

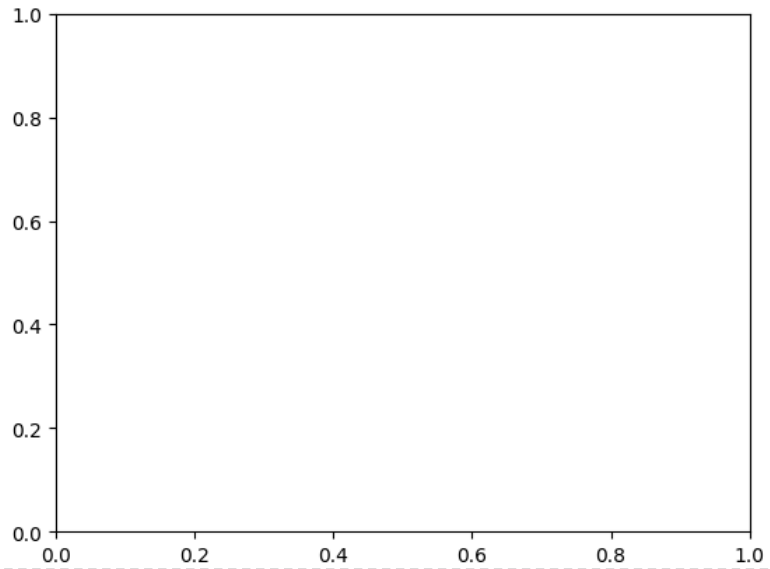
```
2m 3s (- 18m 31s) (1000 10%) 5.5870
4m 3s (- 16m 12s) (2000 20%) 5.1429
6m 2s (- 14m 5s) (3000 30%) 4.9101
8m 0s (- 12m 0s) (4000 40%) 4.7407
9m 58s (- 9m 58s) (5000 50%) 4.7261
11m 57s (- 7m 58s) (6000 60%) 4.5684
13m 56s (- 5m 58s) (7000 70%) 4.5655
15m 56s (- 3m 59s) (8000 80%) 4.5582
18m 0s (- 2m 0s) (9000 90%) 4.4522
19m 59s (- 0m 0s) (10000 100%) 4.4177
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-76-fd13d18077b3> in <cell line: 4>()
      2 encoder2 = EncoderRNN(input_lang.n_words, hidden_size).to(device)
      3 attn_decoder = AttnDecoderRNN(hidden_size, output_lang.n_words,
dropout_p=0.1).to(device)
----> 4 trainIters_attn(encoder2, attn_decoder, 10000, print_every=1000)

 ---------------------------------- 1 frames ----------------------------------
<ipython-input-75-a2cfb0c85146> in trainIters_attn(encoder, decoder, n_iters,
print_every, plot_every, learning_rate)
     43             plot_losses.append((iter, plot_loss_avg))
     44             plot_loss_total = 0
---> 45     showPlot(plot_losses,dll)

<ipython-input-52-07d28b669283> in showPlot(tl, dl)
      8     fig, ax = plt.subplots()
      9     tli, tlv = zip(*tl)
---> 10     di, dv = zip(*dl)
     11     ax.plot(tli, tlv, 'b-', label='Training Loss')
     12     ax.plot(di, dv, 'r--', label='Development Loss')

ValueError: not enough values to unpack (expected 2, got 0)

<Figure size 640x480 with 0 Axes>
```



Next steps: Explain error


```
hidden_size = 256
encoder2 = EncoderRNN(input_lang.n_words, hidden_size).to(device)
attn_decoder = AttnDecoderRNN(hidden_size, output_lang.n_words, dropout_p=0.1).to(device)
trainIters_attn(encoder2, attn_decoder, 10000, print_every=1000)
```

```
1m 54s (- 17m 11s) (1000 10%) 5.5581
Dev Loss is: 0.1620
9m 4s (- 36m 19s) (2000 20%) 5.1478
Dev Loss is: 0.0877
13m 34s (- 31m 40s) (3000 30%) 4.8535
Dev Loss is: 0.1630
21m 10s (- 31m 46s) (4000 40%) 4.8525
Dev Loss is: 0.1456
28m 9s (- 28m 9s) (5000 50%) 4.6926
Dev Loss is: 0.1078
33m 40s (- 22m 26s) (6000 60%) 4.6398
Dev Loss is: 0.1482
40m 34s (- 17m 23s) (7000 70%) 4.6266
Dev Loss is: 0.1783
48m 15s (- 12m 3s) (8000 80%) 4.4735
Dev Loss is: 0.1652
55m 19s (- 6m 8s) (9000 90%) 4.4782
Dev Loss is: 0.1810
63m 7s (- 0m 0s) (10000 100%) 4.4385
Dev Loss is: 0.1702
<Figure size 640x480 with 0 Axes>
```


```
torch.save(encoder2.state_dict(), '/content/drive/MyDrive/encoderatten.pth')
torch.save(attn_decoder.state_dict(), '/content/drive/MyDrive/decoderatten.pth')

# Save the trainIters function
import pickle
with open('/content/drive/MyDrive/trainItersatten.pkl', 'wb') as f:
    pickle.dump(trainIters_attn, f)
```

Extention 1 with word2vec embeddings

```
import gensim
from gensim.models import KeyedVectors

# Load the Word2Vec model
embedding_path = '/content/drive/MyDrive/GoogleNews-vectors-negative300.bin.gz'
word2vec_model = KeyedVectors.load_word2vec_format(embedding_path, binary=True)
```

```
import numpy as np

def create_embedding_matrix(word2index, embedding_model):
    embedding_dim = embedding_model.vector_size
    vocab_size = max(word2index.values()) + 1  # Ensure size is enough for the highest index
    embedding_matrix = np.zeros((vocab_size, embedding_dim))

    for word, idx in word2index.items():
        if word in embedding_model:
            embedding_matrix[idx] = embedding_model[word]
        else:
            embedding_matrix[idx] = np.random.normal(scale=0.6, size=(embedding_dim,))

    return embedding_matrix

# Assuming 'input_lang' is already created as per your code
embedding_matrix = create_embedding_matrix(input_lang.word2index, word2vec_model)


import torch
import torch.nn as nn
import torch.optim as optim
import torch.nn.functional as F



class EmbeddingLayer(nn.Module):
    def __init__(self, embedding_matrix):
        super(EmbeddingLayer, self).__init__()
        vocab_size, embedding_dim = embedding_matrix.shape
        self.embedding = nn.Embedding(vocab_size, embedding_dim)
        self.embedding.weight = nn.Parameter(torch.tensor(embedding_matrix, dtype=torch.float32))
        self.embedding.weight.requires_grad = False  # Freeze embeddings

    def forward(self, x):
        return self.embedding(x)

class EncoderRNN(nn.Module):
    def __init__(self, embedding_layer, hidden_size):
        super(EncoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.embedding = embedding_layer
        self.lstm = nn.LSTM(embedding_layer.embedding.embedding_dim, hidden_size)

    def forward(self, input, hidden):
        embedded = self.embedding(input).view(1, 1, -1)
        output, hidden = self.lstm(embedded, hidden)
        return output, hidden

    def initHidden(self, device):
        return (torch.zeros(1, 1, self.hidden_size, device=device),
                torch.zeros(1, 1, self.hidden_size, device=device))

class DecoderRNN(nn.Module):
    def __init__(self, hidden_size, output_size):
        super(DecoderRNN, self).__init__()
        self.hidden_size = hidden_size

        self.embedding = nn.Embedding(output_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size)
        self.out = nn.Linear(hidden_size, output_size)
        self.softmax = nn.LogSoftmax(dim=1)

    def forward(self, input, hidden):
        output = self.embedding(input).view(1, 1, -1)
        output = F.relu(output)
        output, hidden = self.lstm(output, hidden)
        output = self.softmax(self.out(output[0]))
        return output, hidden

    def initHidden(self, device):
        return (torch.zeros(1, 1, self.hidden_size, device=device),
                torch.zeros(1, 1, self.hidden_size, device=device))


embedding_layer = EmbeddingLayer(embedding_matrix)
embedding_layer = embedding_layer.to(device)
```

```
hidden_size = 256
encoder3 = EncoderRNN(embedding_layer, hidden_size).to(device)
decoder3 = DecoderRNN(hidden_size, output_lang.n_words).to(device)
trainIters(encoder3, decoder3, 10000, print_every=1000)
```

```
1m 28s (- 13m 20s) (1000 10%) 5.9632
Dev Loss is: 0.7490
4m 46s (- 19m 5s) (2000 20%) 5.6291
Dev Loss is: 7.6975
12m 47s (- 29m 51s) (3000 30%) 5.5203
Dev Loss is: 0.7810
16m 3s (- 24m 5s) (4000 40%) 5.3374
Dev Loss is: 4.2438
21m 38s (- 21m 38s) (5000 50%) 5.3092
Dev Loss is: 4.2737
27m 2s (- 18m 1s) (6000 60%) 5.4557
Dev Loss is: 4.8677
32m 33s (- 13m 57s) (7000 70%) 5.2725
Dev Loss is: 4.6083
37m 57s (- 9m 29s) (8000 80%) 5.2959
Dev Loss is: 4.4833
43m 28s (- 4m 49s) (9000 90%) 5.1400
Dev Loss is: 5.0983
49m 5s (- 0m 0s) (10000 100%) 5.1441
Dev Loss is: 4.9385
<Figure size 640x480 with 0 Axes>
```


```
import pickle
# Save the model parameters to Google Drive
torch.save(encoder3.state_dict(), '/content/drive/My Drive/encoder4.pth')
torch.save(decoder3.state_dict(), '/content/drive/My Drive/decoder4.pth')

# Save the trainIters function to Google Drive
with open('/content/drive/My Drive/trainIters44.pkl', 'wb') as f:
    pickle.dump(trainIters, f)
```

Extextion 4: with stacked layers in encoder and decoder

```
import torch
import torch.nn as nn

class EncoderRNN(nn.Module):
    def __init__(self, input_size, hidden_size, additional_layers=4):
        super(EncoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.additional_layers = additional_layers

        self.embedding = nn.Embedding(input_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size,2)

        # Additional fully connected layers
        self.additional_fcs = nn.ModuleList([nn.Linear(hidden_size, hidden_size) for _ in range(additional_layers)])

    def forward(self, input, hidden):
        embedded = self.embedding(input).view(1, 1, -1)
        output, hidden = self.lstm(embedded, hidden)

        # Pass the output through additional fully connected layers
        for fc in self.additional_fcs:
            output = fc(output)
            output = torch.relu(output)  # You can use other activation functions as well

        return output, hidden

    def initHidden(self):
        return (torch.zeros(1, 1, self.hidden_size, device=device),
                torch.zeros(1, 1, self.hidden_size, device=device))

class DecoderRNN(nn.Module):
    def __init__(self, hidden_size, output_size, additional_layers=4):
        super(DecoderRNN, self).__init__()
        self.hidden_size = hidden_size
        self.additional_layers = additional_layers

        self.embedding = nn.Embedding(output_size, hidden_size)
        self.lstm = nn.LSTM(hidden_size, hidden_size,2)

        # Additional fully connected layers
        self.additional_fcs = nn.ModuleList([nn.Linear(hidden_size, hidden_size) for _ in range(additional_layers)])

        self.out = nn.Linear(hidden_size, output_size)
        self.softmax = nn.LogSoftmax(dim=1)

    def forward(self, input, hidden):
        output = self.embedding(input).view(1, 1, -1)
        output = torch.relu(output)
        output, hidden = self.lstm(output, hidden)

        # Pass the output through additional fully connected layers
        for fc in self.additional_fcs:
            output = fc(output)
            output = torch.relu(output)  # You can use other activation functions as well

        output = self.softmax(self.out(output[0]))
        return output, hidden

    def initHidden(self):
        return (torch.zeros(1, 1, self.hidden_size, device=device),
                torch.zeros(1, 1, self.hidden_size, device=device))


hidden_size = 256
encoder4 = EncoderRNN(input_lang.n_words, hidden_size).to(device)
decoder4 = DecoderRNN(hidden_size, output_lang.n_words).to(device)
trainIters(encoder4, decoder4, 10000, print_every=1000)


Start coding or generate with AI.


Start coding or generate with AI.
```

Testing and evaluation

```
def remove_stop_words(text):
    stop_words = set(stopwords.words('english'))
    word_tokens = word_tokenize(text)
    filtered_text = ' '.join([word for word in word_tokens if word.lower() not in stop_words])
    return filtered_text
df3 = pd.read_csv("/content/drive/MyDrive/test.csv")
for x in range(len(df3['Recipe'])):
    if type(df3['Recipe'][x]) != str:
        df3['Recipe'][x] = ''
# Apply the function to the DataFrame columns
df3['Ingredients'] = df3['Ingredients'].apply(remove_stop_words)
df3['Recipe'] = df3['Recipe'].apply(remove_stop_words)


with open("3.txt", "w") as file:
    for index, row in df3.iterrows():
        file.write(f"{row['Recipe']}:::{row['Ingredients']}\n")

def readLangs(lang1, lang2, reverse=False, file_name='3.txt'):
    print("Reading lines...")
    # Read the file and split into lines
    file_path =''
    file_name = file_path + file_name
    lines = open(file_name, encoding='utf-8').\
        read().strip().split('\n')

    # Split every line into pairs and normalize
    pairs = [[normalizeString(s) for s in l.split(':::')] for l in lines]

    # Reverse pairs, make Lang instances
    if reverse:
        pairs = [list(reversed(p)) for p in pairs]
        input_lang = Lang(lang2)
        output_lang = Lang(lang1)
    else:
        input_lang = Lang(lang1)
        output_lang = Lang(lang2)

    return input_lang, output_lang, pairs

def filterPair(p):
    return len(p[0].split(' ')) < MAX_LENGTH and \
        len(p[1].split(' ')) < MAX_LENGTH

def filterPairs(pairs):
    return [pair for pair in pairs if filterPair(pair)]

def prepareData(lang1, lang2, reverse=False, file_name='3.txt'):
    input_lang, output_lang, pairs = readLangs(lang1, lang2, reverse, file_name)
    print("Read %s sentence pairs" % len(pairs))
    pairs = filterPairs(pairs)
    print("Trimmed to %s sentence pairs" % len(pairs))
    print("Counting words...")
    for pair in pairs:
        input_lang.addSentence(pair[0])
        output_lang.addSentence(pair[1])
    print("Counted words:")
    print(input_lang.name, input_lang.n_words)
    print(output_lang.name, output_lang.n_words)
    return input_lang, output_lang, pairs

def indexesFromSentence(lang, sentence):
    return [lang.word2index.get(word, UNK_token) for word in sentence.split(' ')]

def tensorFromSentence(lang, sentence):
    indexes = indexesFromSentence(lang, sentence)
    indexes.append(EOS_token)
    return torch.tensor(indexes, dtype=torch.long).view(-1, 1)

def tensorsFromPair(pair):
    input_tensor = tensorFromSentence(input_lang, pair[0])
    target_tensor = tensorFromSentence(output_lang, pair[1])
    return (input_tensor, target_tensor)

# Process test data
test_input_lang, test_output_lang, test_pairs = prepareData('eng', 'fra', True, '3.txt')
print(random.choice(test_pairs))
```

```
Reading lines...
Read 778 sentence pairs
Trimmed to 742 sentence pairs
Counting words...
Counted words:
fra 1849
eng 3207
[' c kale swiss chard mustard greens combination md onions thinly sliced ts olive oil c water salt pepper taste ju
```

```
def evaluate(encoder, decoder, sentence, max_length=MAX_LENGTH):
    with torch.no_grad():
        input_tensor = tensorFromSentence(input_lang, sentence).to(device)
        input_length = input_tensor.size()[0]
        encoder_hidden = encoder.initHidden()

        # Move each element of the encoder_hidden tuple to the device
        encoder_hidden = tuple(h.to(device) for h in encoder_hidden)

        encoder_outputs = torch.zeros(max_length, encoder.hidden_size, device=device)

        for ei in range(input_length):
            encoder_output, encoder_hidden = encoder(input_tensor[ei], encoder_hidden)
            encoder_outputs[ei] += encoder_output[0, 0]

        decoder_input = torch.tensor([[SOS_token]], device=device)  # SOS
        decoder_hidden = encoder_hidden

        decoded_words = []
        for di in range(max_length):
            decoder_output, decoder_hidden = decoder(
                decoder_input, decoder_hidden)
            topv, topi = decoder_output.topk(1)
            if topi.item() == EOS_token:
                decoded_words.append('<EOS>')
                break
            else:
                decoded_words.append(output_lang.index2word[topi.item()])

            decoder_input = topi.squeeze().detach().to(device)

        return decoded_words
```

```
import nltk
from nltk.translate.bleu_score import sentence_bleu, corpus_bleu
from tqdm import tqdm

def evaluate_bleu(encoder, decoder, test_pairs):
    references = []  # Stores reference sentences for each prediction
    hypotheses = []  # Stores predicted sentences

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Removing <SOS> and <EOS> tokens from target_sentence
        target_sentence = target_sentence.split()
        if target_sentence[0] == "SOS":
            target_sentence = target_sentence[1:]
        if target_sentence[-1] == "EOS":
            target_sentence = target_sentence[:-1]

        references.append([target_sentence])
        hypotheses.append(output_words)

    bleu_score = corpus_bleu(references, hypotheses)
    return bleu_score

def evaluate_bleu2(encoder, decoder, test_pairs):
    references = []  # Stores reference sentences for each prediction
    hypotheses = []  # Stores predicted sentences

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate_attn(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Removing <SOS> and <EOS> tokens from target_sentence
        target_sentence = target_sentence.split()
        if target_sentence[0] == "SOS":
            target_sentence = target_sentence[1:]
        if target_sentence[-1] == "EOS":
            target_sentence = target_sentence[:-1]

        references.append([target_sentence])
        hypotheses.append(output_words)

    bleu_score = corpus_bleu(references, hypotheses)
    return bleu_score
# Assuming you have test_pairs variable containing test data
encoder1 = encoder1.to(device)
decoder1 = decoder1.to(device)

# bleu_score1 = evaluate_bleu(encoder1, decoder1, test_pairs)
bleu_score2 = evaluate_bleu2(encoder2, attn_decoder, test_pairs)

print("BLEU-4 Score2:", bleu_score2)  # BLEU-4 Score2
```

```
100%|██████████| 742/742 [00:15<00:00, 47.72it/s]BLEU-4 Score: 0.001473733991008767
```

```
from nltk.translate.meteor_score import meteor_score
def evaluate_meteor(encoder, decoder, test_pairs):
    references = []  # Stores reference sentences for each prediction
    hypotheses = []  # Stores predicted sentences

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Split reference sentence into tokens
        target_tokens = target_sentence.strip().split()

        references.append(target_tokens)
        hypotheses.append(output_sentence)

    meteor_avg = meteor_score(references, hypotheses)
    return meteor_avg


def evaluate_meteor2(encoder, decoder, test_pairs):
    references = []  # Stores reference sentences for each prediction
    hypotheses = []  # Stores predicted sentences

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate_attn(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Split reference sentence into tokens
        target_tokens = target_sentence.strip().split()

        references.append(target_tokens)
        hypotheses.append(output_sentence)

    meteor_avg = meteor_score(references, hypotheses)
    return meteor_avg
# Assuming you have test_pairs variable containing test data
meteor_score1 = evaluate_meteor(encoder1, decoder1, test_pairs)
meteor_score2 = evaluate_meteor2(encoder2, attn_decoder, test_pairs)
meteor_score3 = evaluate_meteor(encoder3, decoder3, test_pairs)
meteor_score4 = evaluate_meteor(encoder4, decoder4, test_pairs)
print("METEOR Score1:", meteor_score1)  # METEOR Score1
print("METEOR Score2:", meteor_score2)  # METEOR Score2
print("METEOR Score3:", meteor_score3)  # METEOR Score3
print("METEOR Score4:", meteor_score4)  # METEOR Score4
```

```
100%|██████████| 742/742 [00:19<00:00, 37.93it/s]
METEOR Score: 0.0
```

```
def evaluate_accuracy(encoder, decoder, test_pairs):
    total_correct = 0
    total_items = 0

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Tokenize target and output sentences for comparison
        target_tokens = target_sentence.strip().split()
        output_tokens = output_sentence.strip().split()

        # Calculate number of correctly predicted items
        correct_items = sum(1 for token in output_tokens if token in target_tokens)

        total_correct += correct_items
        total_items += len(target_tokens)

    avg_accuracy = (total_correct / total_items) * 100 if total_items > 0 else 0
    return avg_accuracy
```

```
    return avg_accuracy

def evaluate_accuracy2(encoder, decoder, test_pairs):
    total_correct = 0
    total_items = 0

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate_attn(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Tokenize target and output sentences for comparison
        target_tokens = target_sentence.strip().split()
        output_tokens = output_sentence.strip().split()

        # Calculate number of correctly predicted items
        correct_items = sum(1 for token in output_tokens if token in target_tokens)

        total_correct += correct_items
        total_items += len(target_tokens)

    avg_accuracy = (total_correct / total_items) * 100 if total_items > 0 else 0
    return avg_accuracy
# Assuming you have test_pairs variable containing test data
accuracy1 = evaluate_accuracy(encoder1, decoder1, test_pairs)
print("Average Accuracy (%):", accuracy1)
```

```
100%|██████████| 742/742 [00:13<00:00, 53.40it/s]Average Accuracy (%): 14.521298834022389
```

```
def evaluate_extra_items(encoder, decoder, test_pairs):
    total_extra_items = 0
    total_sentences = len(test_pairs)

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Tokenize target and output sentences for comparison
        target_tokens = set(target_sentence.strip().split())
        output_tokens = set(output_sentence.strip().split())

        # Calculate number of extra predicted items
        extra_items = len(output_tokens - target_tokens)

        total_extra_items += extra_items

    avg_extra_items = total_extra_items / total_sentences if total_sentences > 0 else 0
    return avg_extra_items

def evaluate_extra_items2(encoder, decoder, test_pairs):
    total_extra_items = 0
    total_sentences = len(test_pairs)

    for pair in tqdm(test_pairs):
        input_sentence = pair[0]
        target_sentence = pair[1]

        output_words = evaluate_attn(encoder, decoder, input_sentence)
        output_sentence = ' '.join(output_words)

        # Tokenize target and output sentences for comparison
        target_tokens = set(target_sentence.strip().split())
        output_tokens = set(output_sentence.strip().split())

        # Calculate number of extra predicted items
        extra_items = len(output_tokens - target_tokens)

        total_extra_items += extra_items

    avg_extra_items = total_extra_items / total_sentences if total_sentences > 0 else 0
    return avg_extra_items

# Assuming you have test_pairs variable containing test data
avg_extra_items1 = evaluate_extra_items(encoder1, decoder1, test_pairs)
print("Average Extra Items1:", avg_extra_items1)
```

```
100%|██████████| 742/742 [00:14<00:00, 51.73it/s]Average Extra Items: 3.6199460916442048
```

```
def evaluateRandomly(encoder, decoder, n=10):
    for i in range(n):
        pair = random.choice(pairs)
        print('>', pair[0])
        print('=', pair[1])
        output_words= evaluate(encoder, decoder, pair[0])
        output_sentence = ' '.join(output_words)
        print('<', output_sentence)
        print('')


evaluateRandomly(encoder1, decoder1)
```

```
>  lb mushrooms tb oil tb water c milk tb corn starch dissolved c water salt parsley sprig sl luncheon ham
= select mushrooms unopened caps . cut stems mushrooms caps remain . retain mushroom stems soup . mince slice ham
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . <EOS>

>  sm onions garlic cloves ginger root piece cloves cinnamon stick cardamom pods salt water tb indian curry powder
= grind onions garlic ginger root cloves cinnamon whole cardamom pods together food processor . add salt taste cup
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . a

>  lg tomatoes ripe ts salt c salad oil ts oregano leaves tb lemon juice ts pepper garlic clove minced
= peel tomatoes cut thick slices . combine remaining ingredients . pour tomatoes . chill thoroughly stirring twice
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . <EOS>

>  lb green bananas c chicken stock tb butter small onion chopped c light cream milk eggs beaten salt ground nutme
= place bananas saucepan add enough chicken stock cover . bring boil reduce heat simmer bananas tender minutes . l
```

```
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . <EOS>

>  lb smoked sausage lg carrots chopped fine c salad oil qt chicken broth c flour c lentils stalks celery chopped
=  quart pan medium heat cook sausage stirring brow . spoon pan reserve . add oi drippings pan make cup fat . add
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . <

>  c paprika c black pepper c salt ea ? ? ? ? ? ? see directions
= use rub base add favorite dry spices make smoker best block .
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . <EOS>

>  bunch asparagus tb gold medal flour c milk scalded ts salt taste eggs ts pepper tb butter rolls
= cut tops rolls serve covers . remove crumb dust shells covers melted butter brown oven . make white sauce milk b
< preheat oven degrees . add eggs . add eggs . <EOS>

>  cn oz . salmon drained tb lemon juice boned flaked ts salt c celery diced sl toast c mayonnaise salad dressing
= combine salmon celery mayo salad dressing lemon juice salt . spread salmon mixture toast slices top slice cheese
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . <EOS>

>  lb tomatoes peeled seeded chopped tb sun dried tomatoes packed oil finely chopped tb oil sun dried tomatoes tb
= preheat oven degrees f . combine fresh tomatoes sun dried tomatoes set aside . pour oils inch baking dish place
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . add eggs . a

>  c sugar tb . jello flavor fruit . baked pie shell tb . cornstarch c water whipped creme c fruit frozen alright
= combine sugar cornstarch water heavy saucepan cook medium heat thick fairly clear . remove heat add jello mix .
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . add eggs . <EOS>
```

```
sentence1 = ': 2 c sugar, 1/4 c lemon juice, 1 c water, 1/3 c orange juice, 8 c strawberries'
output_words= evaluate(encoder1, decoder1, sentence1)
output_sentence = ' '.join(output_words)
print('<', output_sentence)
```

```
< preheat oven degrees . add eggs . add eggs . add eggs . add eggs . <EOS>
```

```
sentence1 = ': 2 c sugar, 1/4 c lemon juice, 1 c water, 1/3 c orange juice, 8 c strawberries'
output_words= evaluate_attn(encoder2, attn_decoder, sentence1)
output_sentence = ' '.join(output_words[0])
print('<', output_sentence)
```

```
< mix ingredients . bake minutes . <EOS>
```

```
sentence1 = ': 2 c sugar, 1/4 c lemon juice, 1 c water, 1/3 c orange juice, 8 c strawberries'
output_words= evaluate(encoder3, decoder3, sentence1)
output_sentence = ' '.join(output_words)
print('<', output_sentence)
```

```
< bake degrees f . grease . add remaining ingredients . add remaining ingredients . add remaining ingredients . ad
```

```
sentence1 = ': 2 c sugar, 1/4 c lemon juice, 1 c water, 1/3 c orange juice, 8 c strawberries'
output_words= evaluate(encoder1, decoder1, sentence1)
output_sentence = ' '.join(output_words)
print('<', output_sentence)
```

```
< combine flour baking soda salt pepper . add flour baking soda salt pepper . add flour baking soda salt pepper .
```

```
df4 = pd.read_csv("/content/drive/MyDrive/generated_012345678.csv")
def truncate_ingredients(ingredients, max_words=150):
    words = ingredients.split()
    if len(words) > max_words:
        words = words[:max_words]
    return ' '.join(words)
df5 = df4
# Apply the function to the 'Ingredients' column
df5['Ingredients'] = df4['Ingredients'].apply(truncate_ingredients)
```

```
for x in range(len(df4)):
  output_words= evaluate(encoder3, decoder3, df5['Ingredients'][x])
  output_sentence = ' '.join(output_words)
  df4['Generated Recipe - Extended 1'][x] = output_sentence
file_path = '/content/drive/My Drive/your_file3.csv'
df4.to_csv(file_path, index=False)
```

```
<ipython-input-28-b5e8c02c5520>:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#return
  df4['Generated Recipe - Extended 1'][x] = output_sentence
```

```
df4 = pd.read_csv("/content/drive/MyDrive/generated_012345678.csv")
def truncate_ingredients(ingredients, max_words=150):
    words = ingredients.split()
    if len(words) > max words:
```