Neural Machine Translation

04.08.2019

Vignesh Murali

Ritvik Reddy

Ziqing Lu

Final Project: INFO 7390 Neural Network and AI

Overview

Language translation plays an important role in many industries - Tourism, Customer Service, Foreign Trade, etc.

Tourism - Tourism is one of the industries most needing translation, due to the diversity of the people, languages and cultures in contact with each other.

Customer Service - In today's booming e-commerce and customer service digitalization, it is nevertheless crucial to respond to customers in their native language quickly, efficiently and at minimal cost to achieve excellent Customer Service.

Foreign Trade - Translation is also crucial to facilitate communication and business between companies from different countries in today's accelerated globalization.

Goals

We are aiming at producing a tool to help users communicate with others speaking a different language. This tool will translate a voice input from the source language into the target language in real time and facilitate the communication between people speaking different languages.

We will offer a simple web application to let users:
1. select his/her mother language
2. select the way - either text or voice or image - to input the source language and input the original sentence in real-time
3. select the target language
4. and then return a translation result

Use Cases

- Act as Multilingual agents and reduce the cost of support/sales operations
- Provide 24hr online support to International market by enabling interaction with customers who speak a different language
- Help tourists communicate with local people, understand signs/text in local language

Data

We are investigating following dataset to figure out what dataset/combined dataset to use for the neural network training. This is totally based on time consideration for the final project. For future improvement, we will train our application on as much data as possible.

1. http://www.manythings.org/anki/
2. https://www.statmt.org/wmt17/nmt-training-task/
3. https://nlp.stanford.edu/projects/nmt/

Methodology

For this final project, we will focus on NMT building and leverage existed API like google speech recognition API, OCR API to provide more choices for data input for application users.

Neural Network Building:

We will use neural networks - encoder-decoder/seq2seq to train a neural machine translator. Key elements of our neural network and we will experiment with:

- Seq to Seq
- Encoder-Decoder
- Word-embeddings
- RNN units - GRU, LSTM, Normal RNN, Bidirectional GRU, Bidirectional LSTM
- Attention Layers
- Beam Search

Evaluation Metric:

- Bleu Score
- Levenshtein Distance/Word Error Rate

Existing API:

Based on the trained model, we will further leverage APIs like google speech recognition API, OCR to provide more choices for real-time source language data input.

Process Outline

1. Data Preprocessing
   a. Remove all non-printable characters
   b. Remove all the punctuation characters
   c. Normalize all Unicode characters to ASCII
   d. Convert all the UPPER CASE letters to LOWER CASE
   e. Remove any TOKENS that are Non-Alphabetic
2. Study of all Modelling approaches and select the best Model for prediction
3. Implementing additional layers such as Beam Search, Bi-Directional Networks and Attentions
4. Study of all the Performance metrics (such as Blue-Score) and Evaluate the Performance of the models using these scores
5. Deploy the Model on AWS or Google Cloud using a web-framework Flask

Milestones

TIMESTAMP	PROCESS DELIVERY
Week 1 Day 1-3	Data Preprocessing
Week 1 Day 3-7	Model Building, Training, Selection and Performance Metrics
Week 2 Day 7-11	Deployment of models on the Cloud using FLASK
Week 2 Day 11-12	Documentation and Final PPT

Deployment Details:
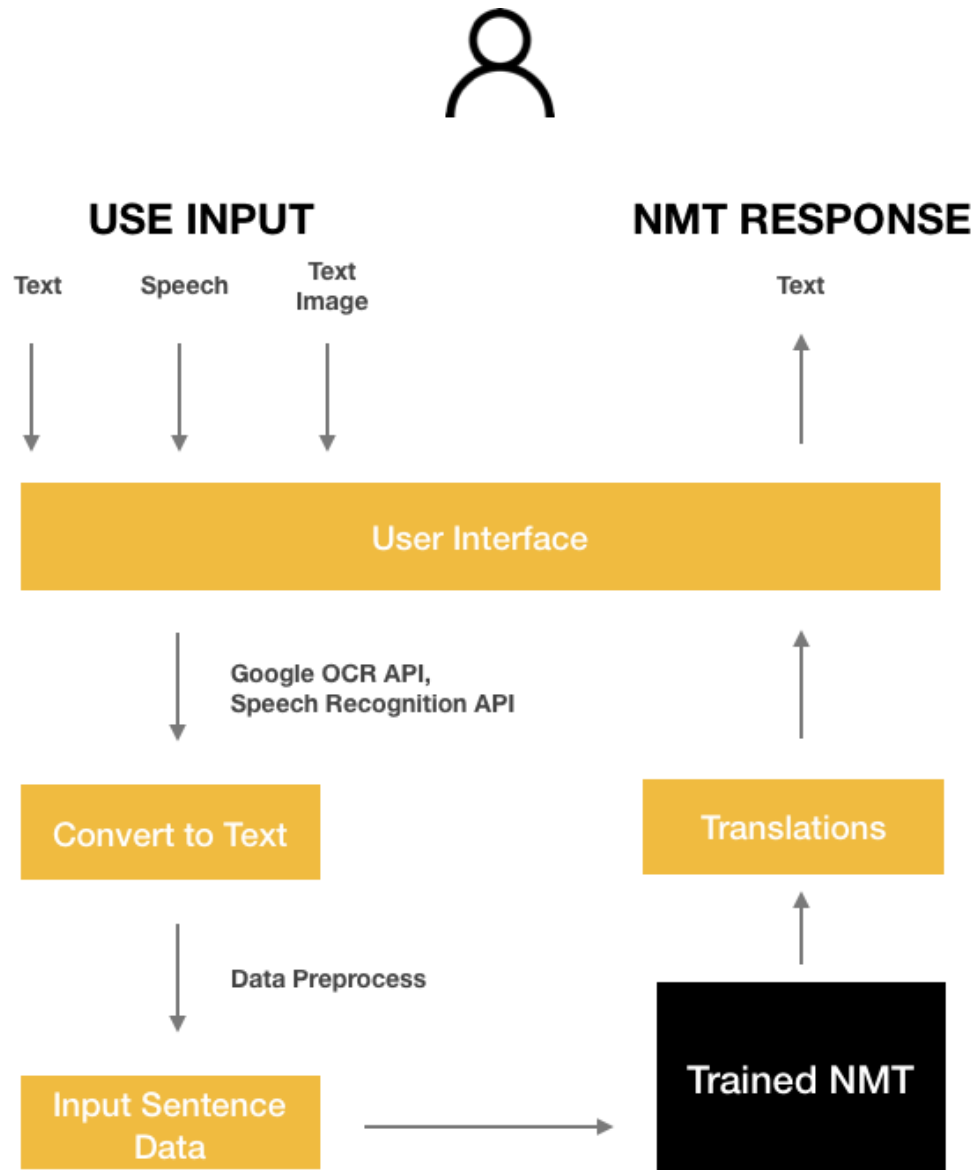
1) Programming Language: Python
2) Modelling Framework: Keras/Tensorflow
3) Modelling Back End: Tensorflow
4) Web Framework: Flask
5) Cloud: Amazon/Google

User Interface Design Plan

If there's enough time, we will work on many features as what's shown in the UI below. For this final project, we will focus on translation between 2~3 languages, text input and speech input for source language, and text output for target language.

Neural Machine Translation Application UI
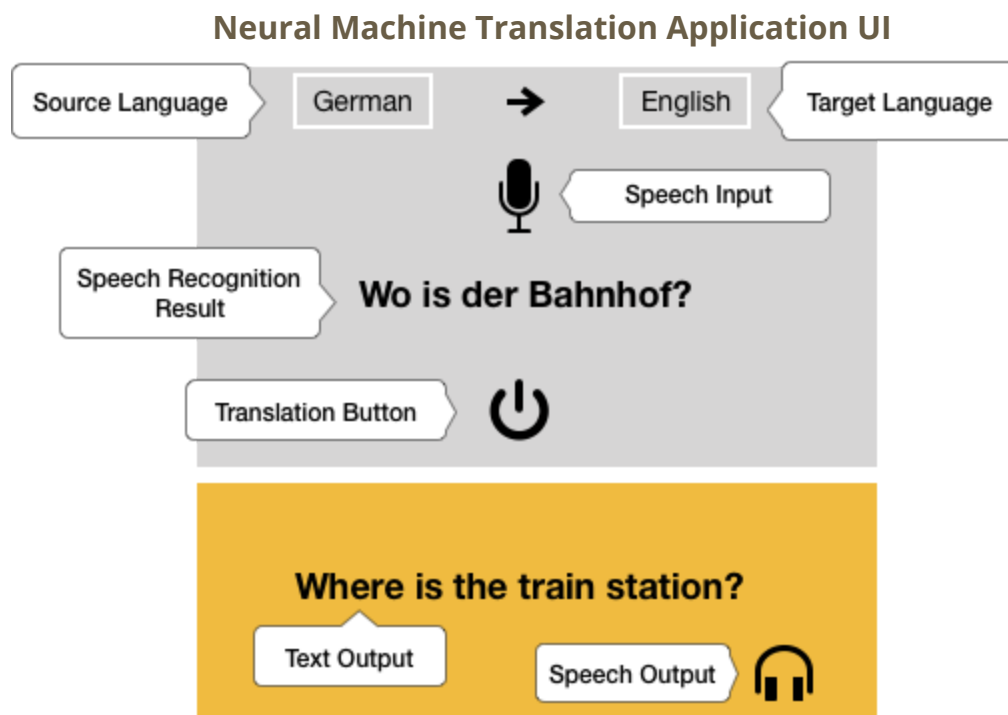
NMT Application Workflow

Reference and Sources:

https://machinelearningmastery.com/develop-neural-machine-translation-system-keras/

https://www.tensorflow.org/alpha/tutorials/sequences/nmt_with_attention

http://www.jmlr.org/papers/volume3/bengio03a/bengio03a.pdf

https://www.aclweb.org/anthology/P14-1129

https://arxiv.org/pdf/1409.0473.pdf