Towards more accurate Language translation model using emotion analysis

Independent Study

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Hello!

I am **Nayeon Kim**

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Research Interest: Natural Language Processing

Emotion Analysis

What is the Emotion Analysis?

Analytical technique to determine the emotional meaning of sentences.

Example:

Social Media Monitoring for Brand Emotion Analysis

Sentiment Analysis

What is the Sentiment Analysis?

Analytical technique to determine the emotional meaning of sentences.

Example:

Social Media Monitoring for Brand Sentiment Analysis – Repustate reference: https://www.differencebetween.com/difference-between-emotion-and-vs-sentiment/

Emotion? Sentiment?

What is the difference between Emotion and Sentiment?

- **Definition of Emotion and Sentiment:**
  - Emotions can be defined as complex psychological states.
  - A sentiment can be defined as a mental attitude; a thought that has been influenced by emotion.

towards something

- **Connection:**
  - Sentiments are the expression of emotions where they become tied to a social object.
- **Dimension:**
  - Emotions are mostly confined to the psychological dimensions.
  - Sentiments go a step further capturing the social dimension.
- **Nature:**
  - Emotions are very raw and natural.
  - Sentiments are highly organized.

WHAT MAKES YOUR LIFE 100% ?

Attitude is everything!

Let each letter of the alphabetic has a value equals to it sequence of the alphabetical order:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

S K I L L S 19 11 9 12 12 19	=	82
K N O W L E D G E 11 14 15 23 12 5 4 7 5	=	96
H A R D W O R K 8 1 18 4 23 15 18 11	=	98
A T T I T U D E 1 20 20 9 20 21 4 5	=	100

Emotion Types

https://affective-meld.github.io/

https://affective-meld.github.io/

Emotion Types

1. Happiness

Happiness is often defined as a **pleasant emotional state** that is characterized by feelings of **contentment, joy, gratification, satisfaction, and well-being**.

- **Facial expressions**: such as smiling
- **Body language**: such as a relaxed stance
- **Tone of voice**: an upbeat, pleasant way of speaking

↔ Sadness

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

Emotion Types

2. Sadness

Sadness is often defined as a **transient emotional state** characterized by feelings of **disappointment, grief, hopelessness, disinterest, and dampened** mood.

Crying, Dampened mood, Lethargy, Quietness, Withdrawal from others

↔ Happiness

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

Emotion Types

3. Fear

Fear is a powerful emotion about **survival**. when we face some danger situation, we go through fight or flight response.

- **Facial expressions**: such as widening the eyes and pulling back the chin
- **Body language**: attempts to hide or flea from the threat
- **Tone of voice**: such as rapid breathing and heartbeat

↔ Anger

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

Emotion Types

4. Disgust

This sense of revulsion can originate from a number of things, including an **unpleasant taste, sight, or smell**. **Poor hygiene, infection, blood, rot, and death** can also trigger a disgust response.

- **Facial expressions**: turning away from the object of disgust
- **Body language**: such as vomiting or retching
- **Tone of voice**: such as wrinkling the nose and curling the upper lip

↔ Trust (new basic emotion)

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

Emotion Types

5. Anger

Anger can be a particularly powerful emotion characterized by feelings of **hostility, agitation, frustration, and antagonism** towards others.

- **Facial expressions**: such as frowning or glaring such as frowning or glaring
- **Body language**: such as taking a strong stance or turning away
- **Tone of voice**: such as speaking gruffly or yelling

↔ **Fear**

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

Emotion Types

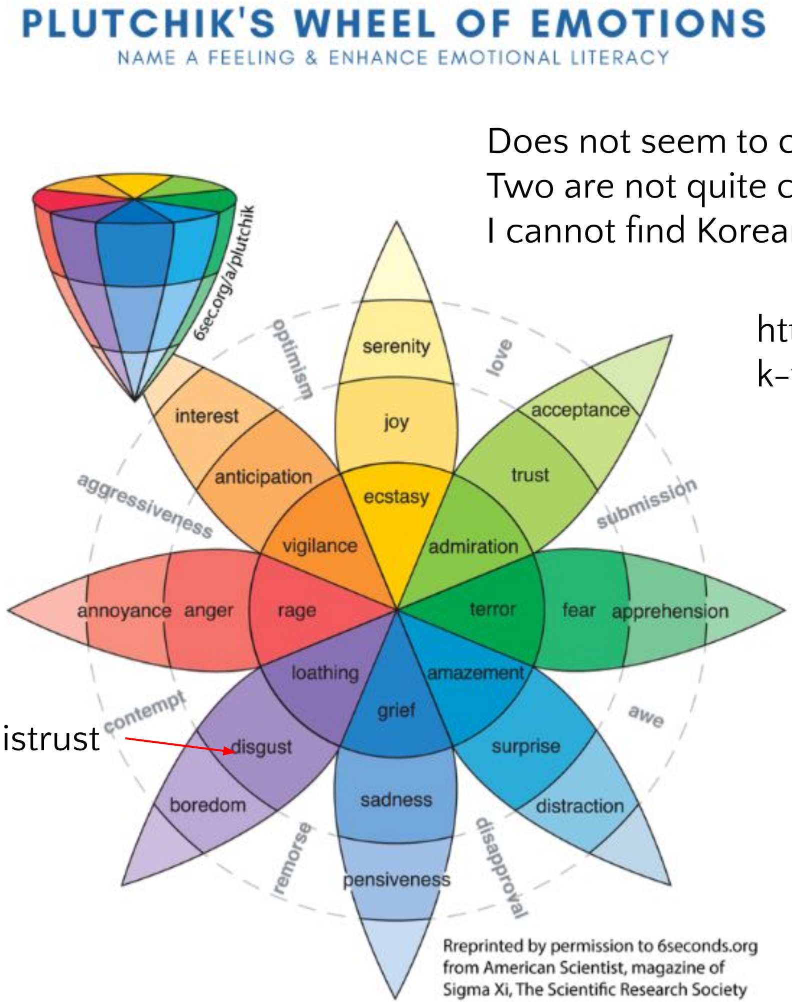
6. Suprise

Surprise is usually quite brief and is characterized by a physiological startle response following something unexpected. This type of emotion **can be positive, negative, or neutral**.

- **Facial expressions**: such as raising the brows, widening the eyes, and opening the mouth
- **Body language**: such as jumping back
- **Tone of voice**: such as yelling, screaming, or gasping

↔ **Anticipation (new basic emotion)**

https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976



distrust, mistrust

Does not seem to capture pairs of opposite poles!
Two are not quite consistent with each other.
I cannot find Korean version emotion diagram about this

https://www.6seconds.org/2022/03/1
k-wheel-emotions/

Correct Google Translate

한국어 = Korean language ⇄ 영어 = English

Happiness

난 그 영화 너무 재밌었어

nan geu yeonghwa neomu jaemiss-eoss-eo

= Korean Pronounciation

i really enjoyed that movie

Happiness

한국어 = Korean language ⇄ 영어 = English

Happiness

난 그 영화 너무 재밌었어 개쩔어

nan geu yeonghwa neomu jaemiss-eoss-eo gaejjeol-eo

i enjoyed that movie so much

Happiness

= Korean Pronounciation

Incorrect Google Translate

한국어 = Korean language

영어 = English

Happiness

95%

그 영화는 정말 개쩔었어. 그 영화 재밌어서 또 한번 더 보고싶어.

geu yeonghwaneun jeongmal gaejjeol-eoss-eo. geu yeonghwa jaemiss-eoseo tto hanbeon deo bogosip-eo.

= Korean Pronounciation

That movie was really shit. The movie was fun and I want to see it again.

Sadness

95% ?

Meaning

"That movie was legit. I want to see that movie again because it was fun."

Incorrect Google Translate

영어 = English

한국어 = Korean language

That movie was really shit. The movie was fun and I wanted to see it again.

그 영화는 정말 똥이었다. 영화는 재미있었고 또 보고 싶었다.

geu yeonghwaneun jeo gmal ttong-ieossda. yeonghwaneu aemiiss-eossgo tto bogo sip-eo da. = Korean Pronounciation

Meaning

"That movie was shit. I want to see that movie again because it was fun."

Incorrect Google Translate

그 영화는 정말 개쩔었어. 그 영화 재밌어서 또 한번 더 보고싶어.

!=

그 영화는 정말 똥이었다. 영화는 재미있었고 또 보고 싶었다.

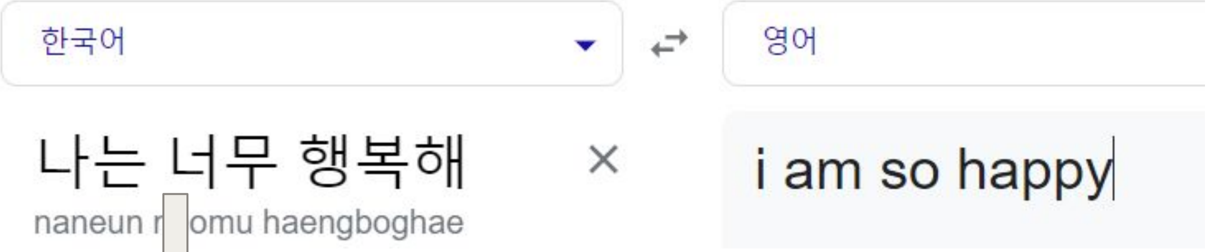
Incorrect!

Machine Learning Accuracy of Translation Result

		Actual	
		Positive	Negative
Predicted	Positive	True Positive	False Positive
	Negative	False Negative	True Negative

Example 1

Happiness
(Positive)



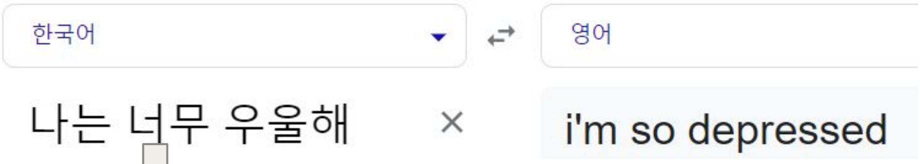
Happiness
(Positive)

meaning: I am so happy

True Positive: Actual (korean)-> positive / Predict (English)-> positive

Example 2

Sadness
(Negative)



Sadness
(Negative)

meaning: I am so sad

True Negative: Actual (korean)-> negative / Predict (English)-> negative

Example 3

한국어

영어

Happiness
(Positive)

그 영화는 정말 개쩔었어. 그 영화 재밌어서 또 한번 더 보고싶어.

geu yeonghwaneun jeongmal gaejjeol-eoss-eo. geu yeonghwa jaemiss-eoseo tto hanbeon deo bogosip-eo.

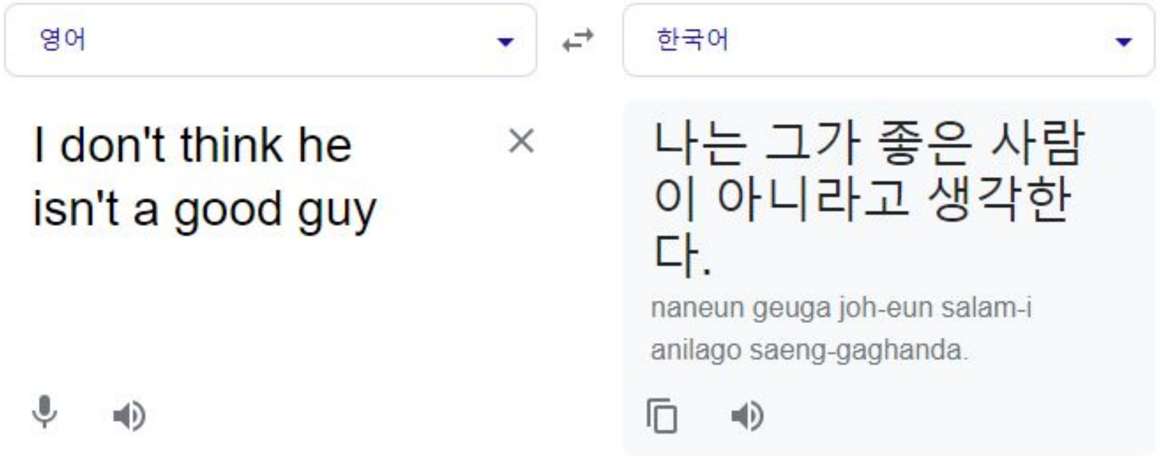
That movie was really shit. The movie was fun and I want to see it again.

Sadness
(Negative)

False Negative: Actual (korean)-> positive / Predict (English)-> negative

Example 4

Happiness
(Positive)

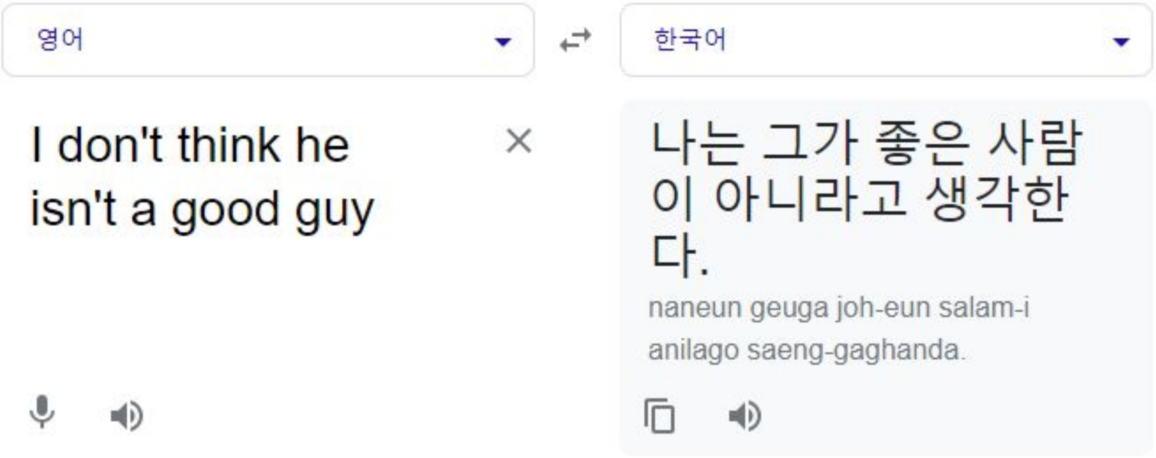


Sadness
(Negative)

Meaning

"I don't think he is a good guy"

Example 4



False Negative: Actual (English)-> positive / Predict (Korean)-> negative

Example 5

Google Translate users spotted an alarming mistake when entering the phrase **“I am sad to see Hong Kong become part of China**” into the multilingual machine translation service a few days ago (June 14th, 2019).

According to France 24, when the phrase was translated into both Traditional and Simplified Chinese, **Google Translate changed the emotion ‘sad’ to ‘happy’, meaning the phrase had a completely different intent** and meaning and instead read **“I am happy to see Hong Kong become part of China”.**

False Positive: Actual (Chinese)-> Negative / Predict (English)-> Positive

https://creativeword.uk.com/blog/translation/google-translate-confused-emotions-hong-kong/

Key Approach

"Evaluate translation results through sentiment analysis model"

How? - Model's basic approach

Compare how much "similar" between source (Input sentence) and target (Output sentence) by using emotion analysis!

Cannot say that source and output are the "same"!

Why?

In reality, words in all languages cannot be matched one-to-one with 100% of the same meanings.
Because the cultural nuance is different and the number of words is different.

Joy , happiness, pleasant, delight => 행복, 즐거움, 기쁨

Similar research paper

Songs' Name	The Type of the Analyzed text	Number of Positive Words	Number of Negative Words	Positive Percentage	Negative Percentage	Sentiment Score
Krehtak	Arabic Lyrics	19	33	16%	%28	-0.1176
	My Translation	9	25	3%	9%	-0.0606
	Google Translation	10	19	5%	9%	-0.0437
Omen	Arabic Lyrics	26	6	46%	11%	0.35088
	My Translation	20	3	19%	3%	0.16505
	Google Translation	13	3	14%	3%	0.10989
Ana Nater	Arabic Lyrics	23	38	17%	28%	-0.1087

https://era.library.ualberta.ca/items/55622b1e-bed3-4260-ad86-042408dff84d

Translation Type: Syntactic

Syntactic Translation: The literal translation that just translates the sequence of words by Ignoring the context or nuance of a sentence.

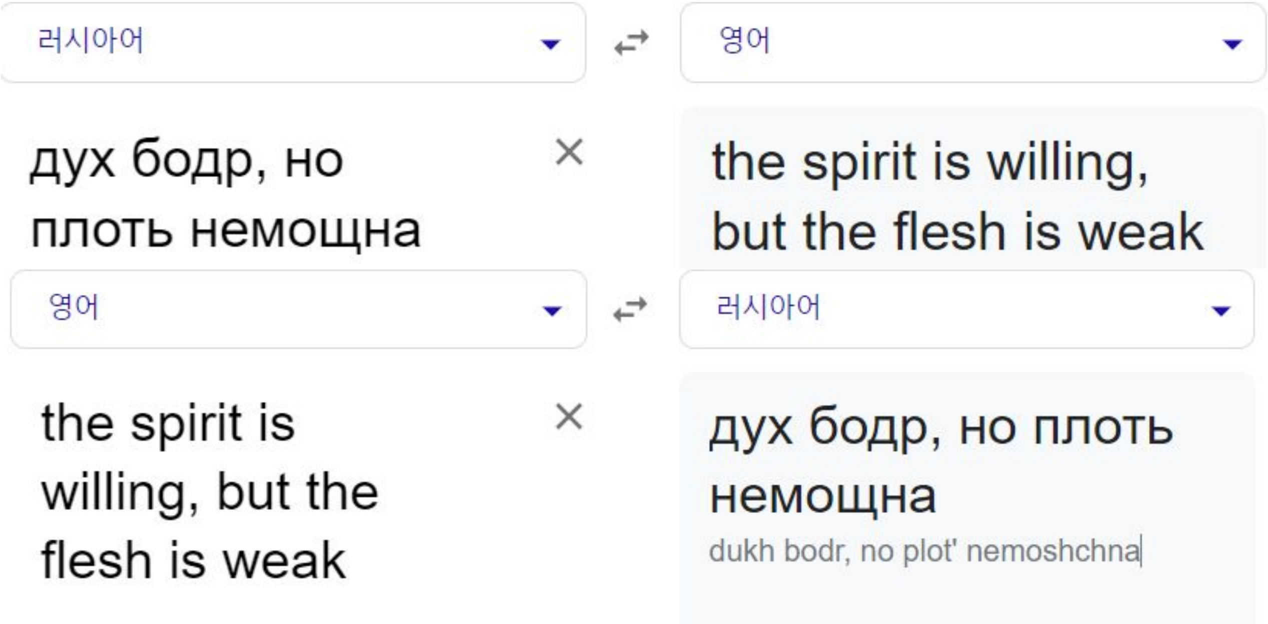
Ex)

Russian: **дух бодр, но плоть немощна**(=the spirit is willing, but the flesh is weak)

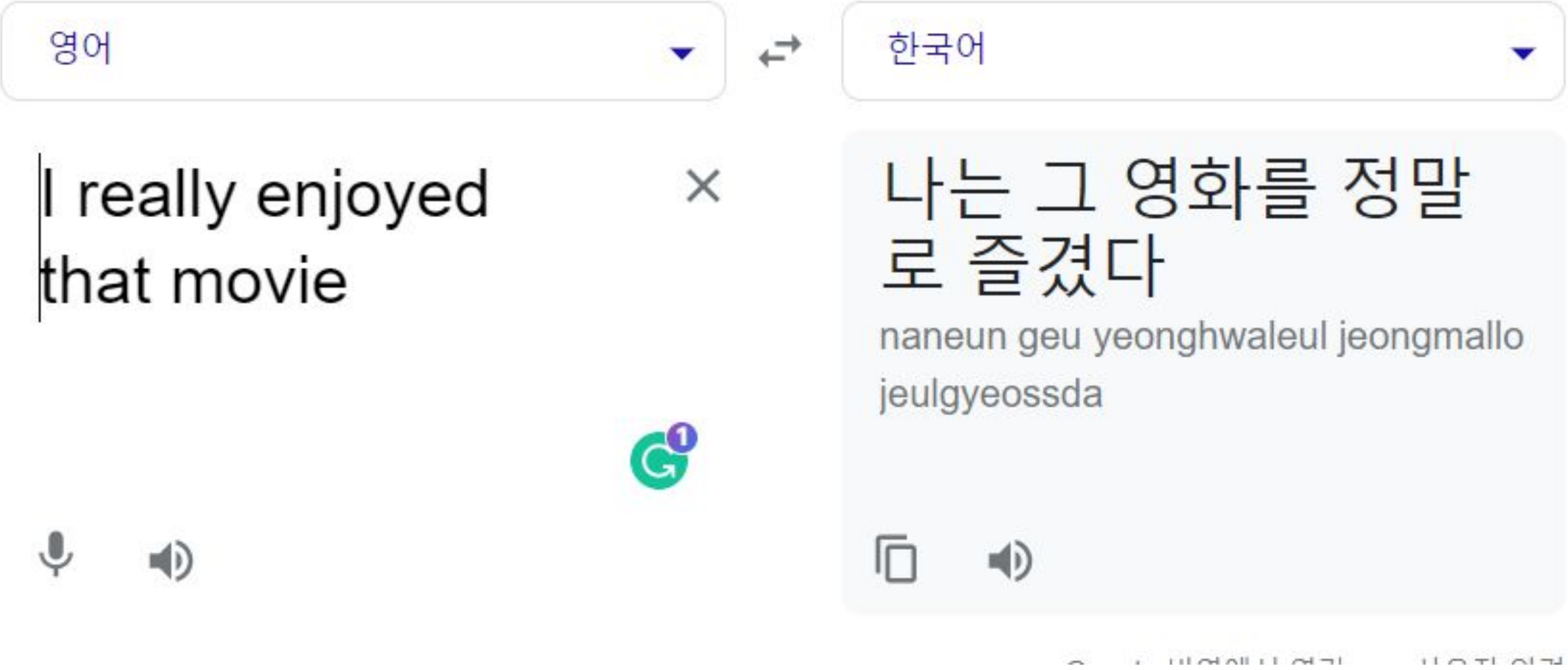
English: the vodka is strong but the meat is rotten

Translation Type: Syntactic

Russian: **дух бодр, но плоть немощна**(=the spirit is willing, but the flesh is weak)
English: the vodka is strong but the meat is rotten
This was the popular example of wrong google translation example of syntactic. But now it solved!



Another syntactic translation example



Translation Type: Semantic

Semantic: The translation that conveys the meaning of the phrase and sentence by considering context and nuance.

Ex)

猿も木から落ちる(さるもきからおちる)
Syntactic translation: Even Monkeys Fall From Trees
Semantic translation: Nobody's Perfect; To Err Is Human.

Translation Type: Semantic

Semantic: It means that the central concern of the translation is to convey the meaning of the phrase and sentence by considering context and nuance.

Ex)

猿も木から落ちる(さるもきからおちる)
Syntactic translation: Even Monkeys Fall From Trees
Semantic translation: Nobody’s Perfect; To Err Is Human.

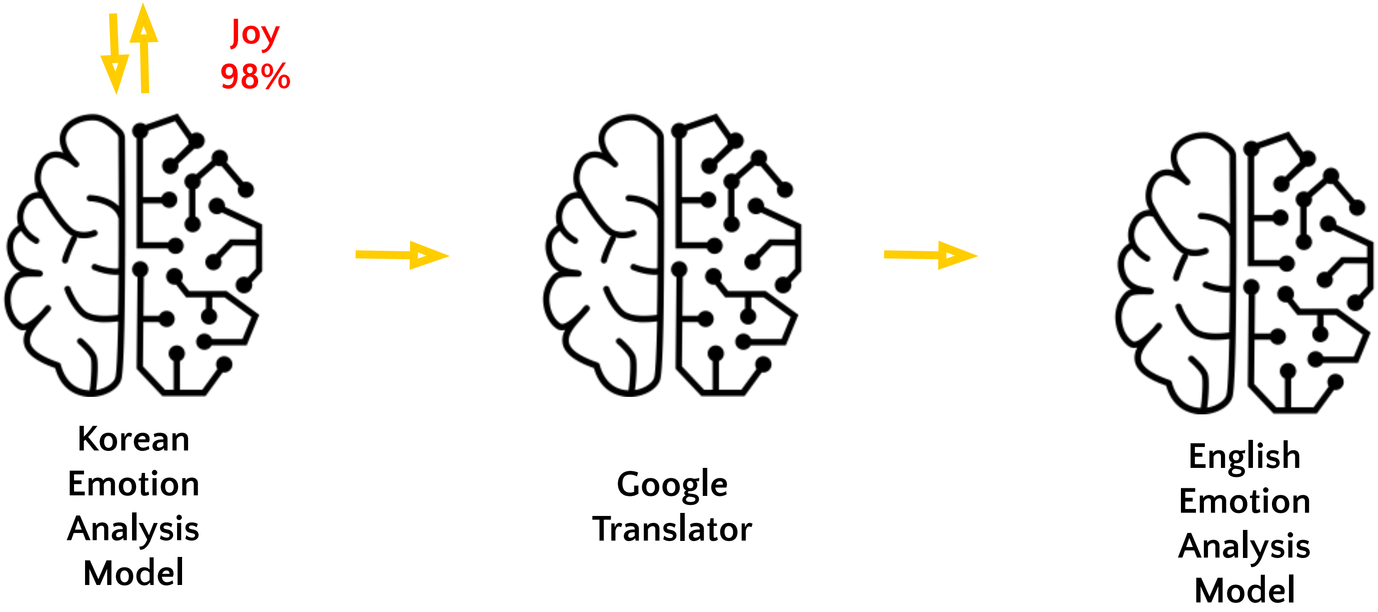
My Model: Emotion Translation!
-> Goes beyond the traditional translation!

Basic (idealiestic) system scenario

Input: 난 그영화 너무 재밌었어

Basic (idealiestic) system scenario

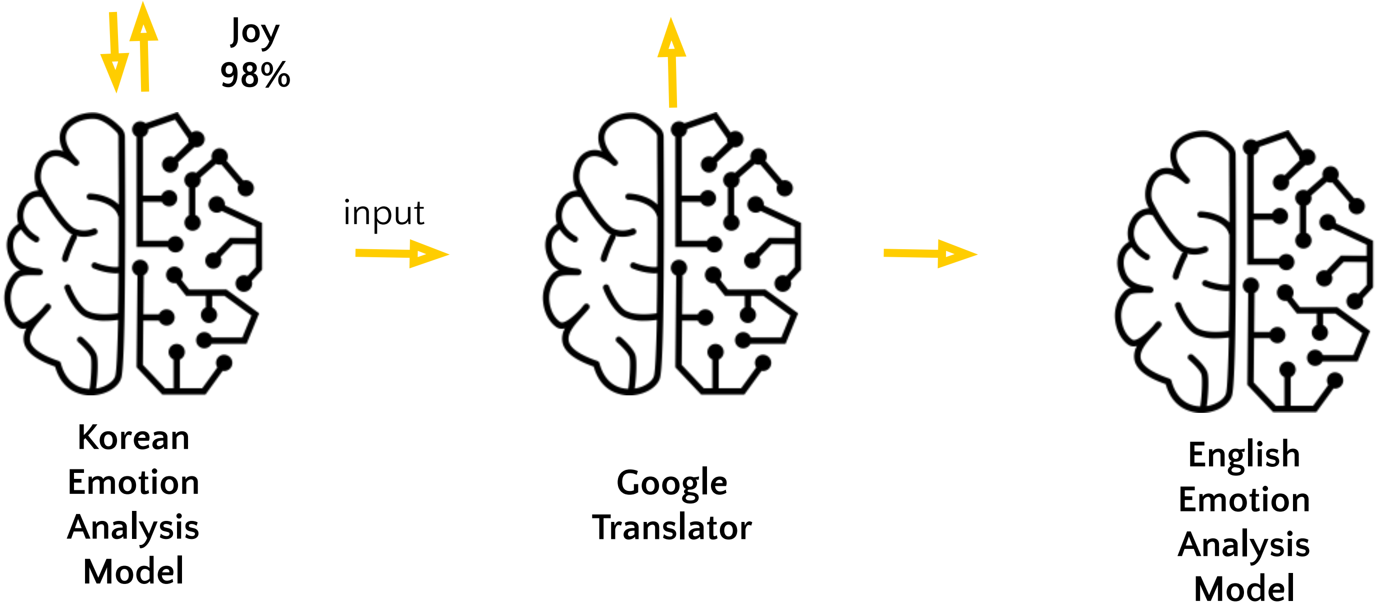
Input: 난 그영화 너무 재밌었어



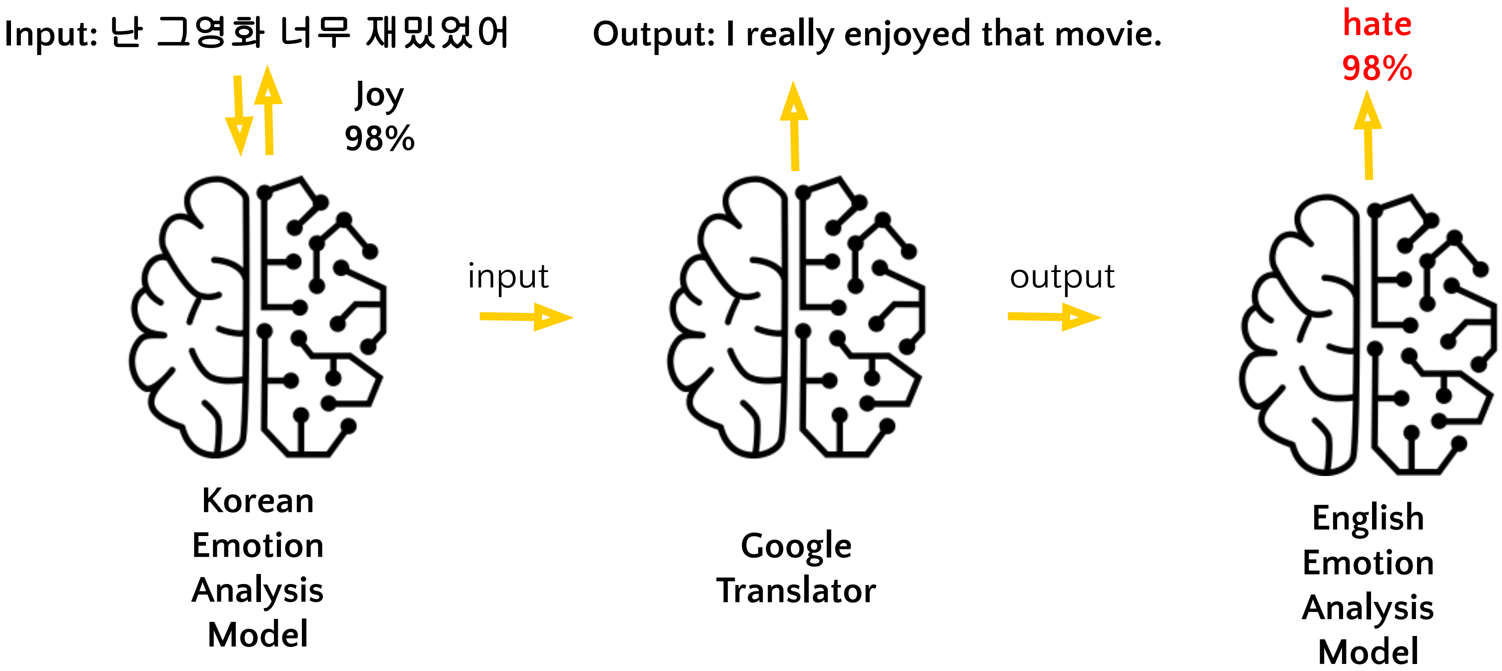
Basic (idealiestic) system scenario

Input: 난 그영화 너무 재밌었어

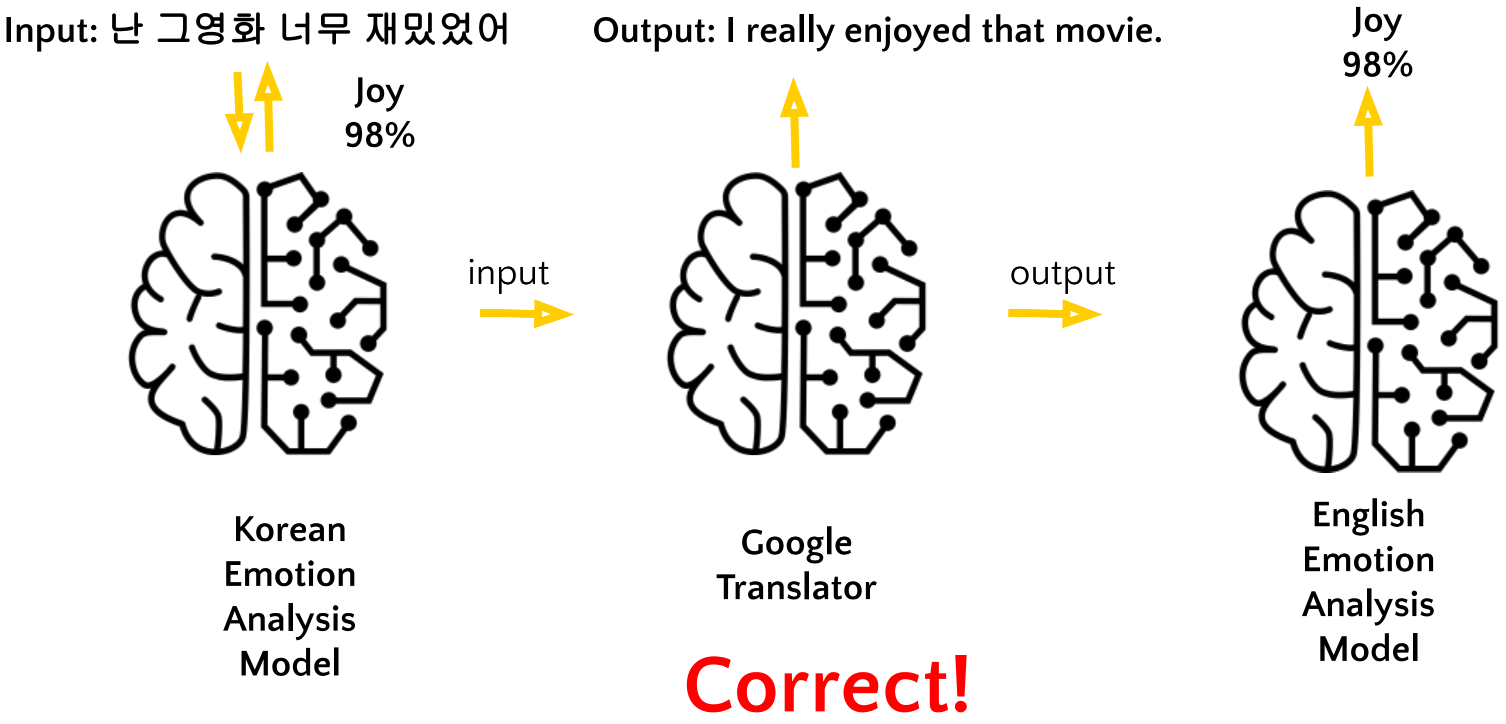
Output: I really enjoyed that movie.



Basic (idealiestic) system scenario



Basic (idealiestic) system scenario



Correct & Incorrect Judgement Criteria

Delta = 20

Correct:

Input Emotion == Output Emotion

AND

|emotion % (input) – emotion % (output)| <= delta

Incorrect:

Input Emotion != Output Emotion

OR

|emotion % (input) – emotion% (output)| > delta

Correct & Incorrect Judgement Example

Delta = 20

Correct:

Input Emotion == Output Emotion

&&

|emotion % (input) – emotion % (output)| <= delta

Input: 나는 정말 행복해 (happy 95%)
Output: I am so happy (happy 90%)
happy == happy &&
|95 – 90| = 5 <= 20(delta) => Correct!

Correct & Incorrect Judgement Example

Delta = 20

Incorrect:

Input Emotion != Output Emotion

OR

|emotion % (input) – emotion% (output)| > delta

Input: 그 영화 개쩔었어 (happy 95%)
Output: The movie was shit (sad 90%)
happy != happy **=> Incorrect!**

Correct & Incorrect Judgement Example

Delta = 20

Incorrect:

Input Emotion != Output Emotion

OR

|emotion % (input) - emotion% (output)| > delta

Input: 그 영화 개쩔었어 (happy 95%)
Output: The movie was so good (happy 70%)
happy == happy ||
|70-95| = 25 > 20(delta) => Incorrect!

A model of the emotion detection process

From here, I will explain how to implement the Emotion Analysis model.

For the emotion analysis model, I used BERT. BERT is an pre-trained language model for natural language processing (NLP).

First, When given input to the Bert model, the model converts each word into a vector to help the computer understand the word. We call this tokken embedding.

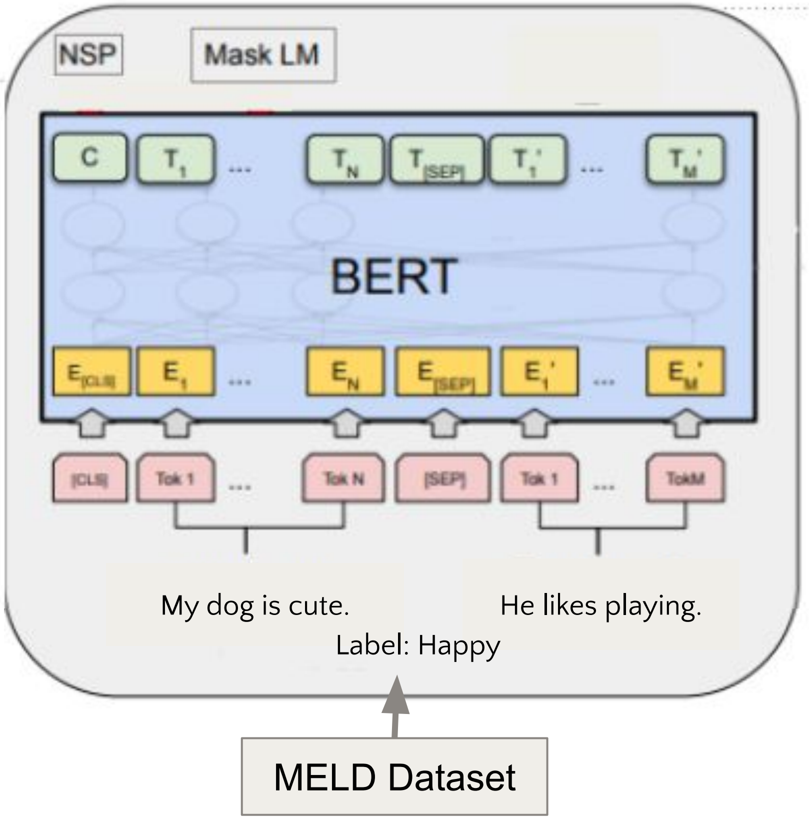
At this point, Input sentences has it's own emotion label. Thus, our model will learn this input by using MLM, NSP learning method in the training phase. These are the learning metric. So, to be precise, our model is a classification model that returns the corresponding emotion of the input sentence. Since this is the model training stage, there is no output.

MLM is the learning method that randomly discarding tokens from the input and predict that tokens

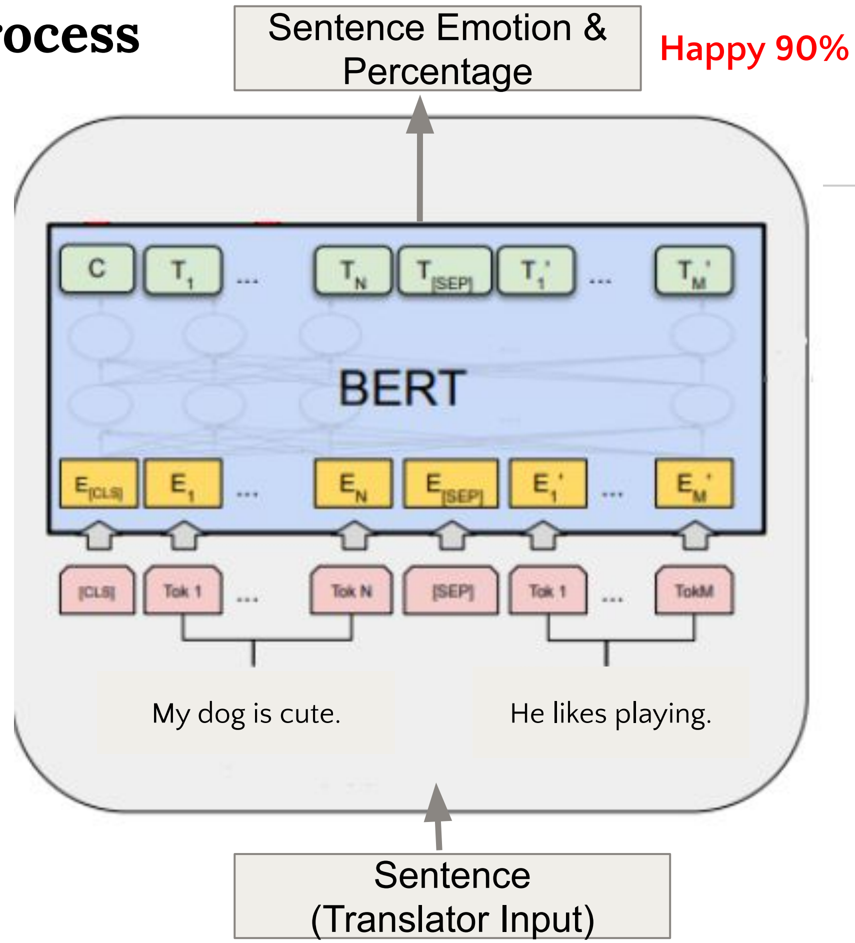
NSP is the learning method that By giving two sentences and predicting the order, considering the relationship between sentences.

Devlin, Jacob, et al. "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805 (2018). https://arxiv.org/abs/1810.04805

A model of the emotion detection process



Fine-tuning

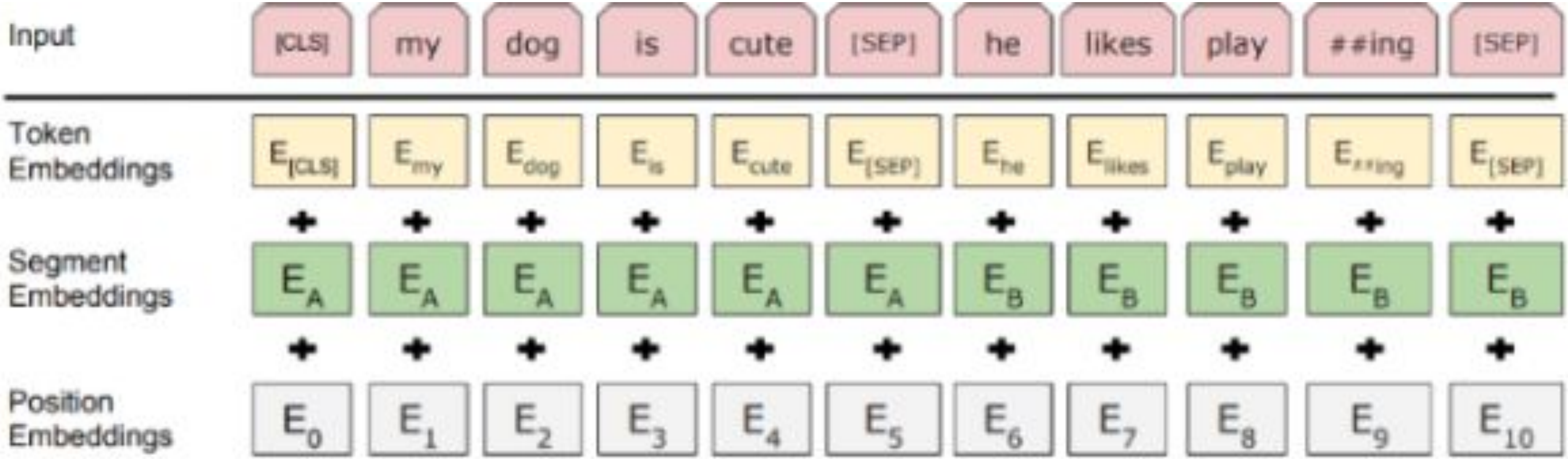


Emotion Analysis

What is embedding?

The entire process of converting natural language into a form (number, vector) that machines (computer) can understand

Token Embedding



Input Example

My dog is cute. He likes playing.

[CLS], my, dog, is, cute, [SEP], he, likes, playing, [SEP]

BERT from an embedding point of view

1. Pretrained model. refined and embedded about 330 million words, and done semi-supervised learning. -> easily fine-tuned for other tasks

2. Better performance (**Accuracy**) than Word2Vec, GloVe, Fasttext (Old embedding methods)

3. Embedding performance of Bert is the best. (=**Bert preserves the semantic best!**)-> good performance in all natural language processing fields.

https://towardsdatascience.com/bert-explained-state-of-the-art-language-model-for-nlp-f8b21a9b6270
https://medium.com/@shoray.goel/bert-f6d23b06069f

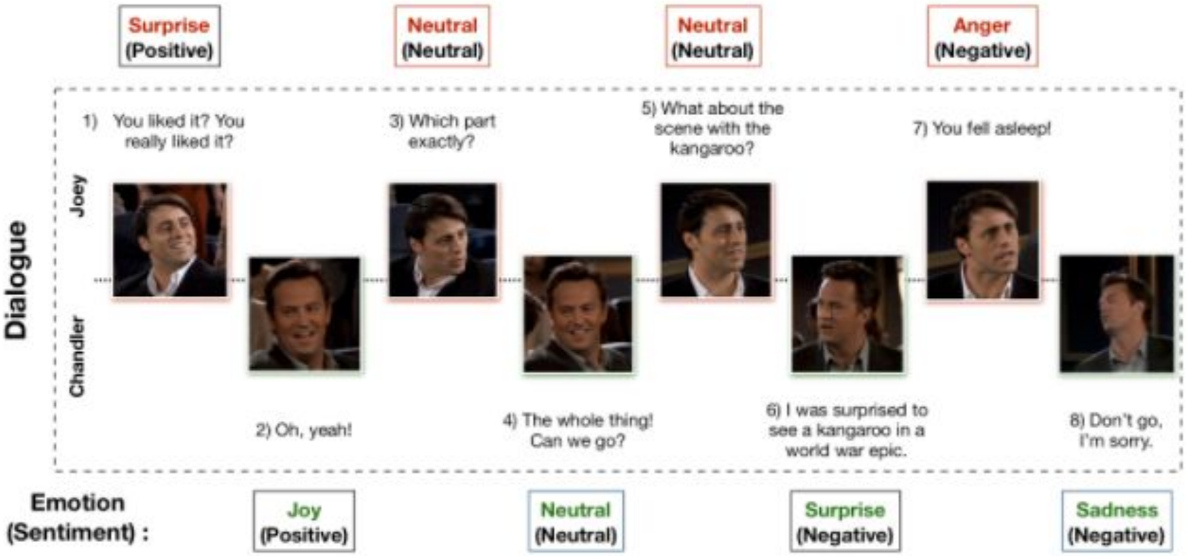
https://affective-meld.github.io/

Pre-training Dataset

- MELD(Multimodal Emotion Lines Dataset):

Statistics	Train	Dev	Test
# of modality	{a,v,t}	{a,v,t}	{a,v,t}
# of unique words	10,643	2,384	4,361
Avg. utterance length	8.03	7.99	8.28
Max. utterance length	69	37	45
Avg. # of emotions per dialogue	3.30	3.35	3.24
# of dialogues	1039	114	280
# of utterances	9989	1109	2610
# of speakers	260	47	100
# of emotion shift	4003	427	1003
Avg. duration of an utterance	3.59s	3.59s	3.58s

Example dialogue



Pre-training Dataset

Originally, I wanted to use MELD dataset(previous slide), because with this dataset, I could analyze 6 types of emotion data rather than simply classifying only positive, negative, and neutral.

However, in order to classify the six emotions in the Korean emotion analysis model also, I need the dataset with the corresponding six emotion labels, but related data could not be found.

So, both the Korean and English datasets used the movie review dataset, and they were divided into two emotions: positive and negative.

Korean emotion analysis pre-training dataset: https://github.com/e9t/nsmc
English emotion analysis pre-training dataset: https://www.tensorflow.org/datasets/catalog/imdb_reviews

Demo of Emotion Analysis and decide translation result is correct or not

Code Link: https://github.com/developNY/AIM_F21/blob/main/FinalModel.ipynb

Language: Python
IDE: Google CoLab
Package: Tensorflow, Transformer, SkLearn, GoogleTrans

How To Run:
1. Go to code link
2. Click "Open Colab"
3. Click "Runtime" > "Change Runtime as GPU" > "Execute All"
4. Waiting model training (it takes about more than 2h)
5. When the last cell will ask you type the korean language. Type korean (ex. 나는 행복하다)

Bert Limitation

It does not perform well for language models in certain fields (science, finance, etc.).

Why? words used, language characteristics are different of those fields.

And also emotion analysis is quite immature!

Emotion Analysis Limitation

Challenges:

- Sarcasm
- Emojis
- Idioms

=> Hard to analyze emotion!

Future Development

In this study, "**Google Translate evaluated the accuracy of how much specific emotion data was preserved.**"
=> **cannot judge that the translation result is correct.**

Later, by adding other criteria to create a "**translation result judgment model with accurate indicators**" that can determine whether the translation result is correct or not.

Lesson

1. As this semester was the first semester I started studying NLP, I was clumsy and couldn't do more in-depth research, but I got a better understanding of emotion analysis and machine translation.

2. It was my first time doing research, so I was also clumsy about research, but I learned about research methodology through other people's presentations and professors' feedback.

Q&A

Thanks!