Introduction to NLP and Its Applications

Speaker: 蘇佳益

Advisor: 陳聰毅

國立高雄科技大學建工校區電子工程系

https://github.com/chiayisu/Artificial_Intelligence_Course

Agenda

- Natural Language Processing
- Discussion on Practical Problems
- Introduction to Dialog System
- Regular Expression
- Introduction to API
- Reference

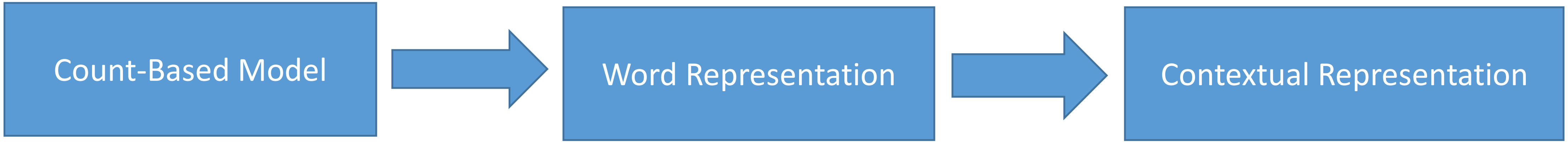
Natural Language Processing

What is NLP?

Applications of Natural Language Processing

What can I help you with?

Evolution of Natural Language Processing



Count-Based Model

Word Representation

Contextual Representation

Evolution of Natural Language Processing

TF & TF-IDF	Co-Matrix	Word2Vec	GPT	BERT	GPT-2	GPT-3
		Mikolov et al., 2013.	Radford et al., 2018.	Devlin et al., 2018	Radford et al., 2019	Brown et al., 2020
		Google	OpenAI	Google AI	OpenAI	OpenAI

Contextual Representation (Transformer)

Why is NLP hard?

- Ambiguity of Natural Language
    - Polysemy
    - Formal and Informal Language
    - Writing Taiwanese in the Chinese Language
    - SMS Language
- Evolution of Language
- Difference in Structure
    - Following the grammar V.S. Not following the grammar

Why is NLP hard? - Example

https://cdn-images-1.medium.com/max/800/1*gmL2WA-hoXe8HokFZ9wXIA.gif

- Ambiguity of Natural Language
  - 88、98、白泡泡（台語：皮膚很白)、水噹
  - 你真的是我們的老鼠屎耶!
  - Steph Curry發火起來可以在一場得40分，非
- Difference in Structure
  - I am going to watch a movie. < - > I’m ganna watch a movie.
  - I want to watch a movie. < - > I wanna watch a movie.

Corpora Introduction

- Corpora
  - https://github.com/fighting41love/funNLP
  - https://github.com/InsaneLife/ChineseNLPCorpus
  - https://github.com/SophonPlus/ChineseNlpCorpus
  - https://github.com/brightmart/nlp_chinese_corpus
  - http://asbc.iis.sinica.edu.tw/ - 中研院
  - Google 自行搜尋
- Stop Words
  - https://github.com/goto456/stopwords

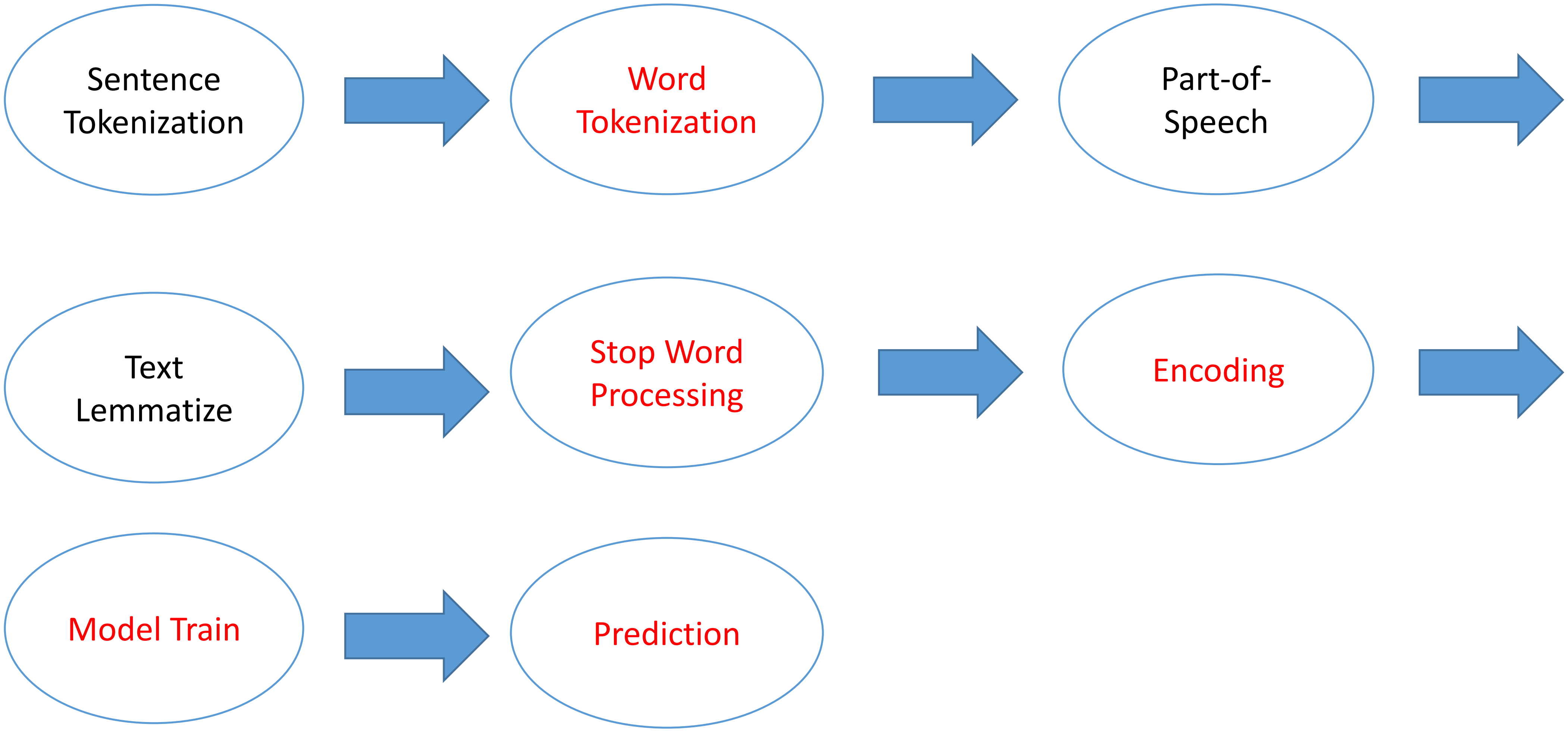
Introduction to JSON

- Similar to the dictionary in the programing language
- JSON object contains key and value.
- JSON Object
  - ➢ {“School”: “NKUST”, “Country” : ”Taiwan”}
- JSON Array
  - ➢ {“School”: [“NKUST”, “NTU”], “Country” : ”Taiwan”}
- JSON Introduction
  - https://www.json.org/json-en.html

中研院語料庫DEMO及重要參數說明

- Collocation: 統計出與關鍵詞共同出現的機率，可以設定前後幾個字但必須包含關鍵詞以及最高上限為10個詞。
- MI值: Mi值愈大表示與關鍵詞同時出現的機率越高
- FREQ(x): 關鍵詞在整個語料庫中出現的次數
- FREQ(y): 該詞在整個與料庫中出現的次數
- FREQ(x,y): 關鍵詞和該詞在限定的範圍內所出現的次數
- http://asbc.iis.sinica.edu.tw/
- 以上參數的重要嗎?

Flow of Natural Language Processing



Sentence Tokenization

Word Tokenization

Part-of-Speech

Text Lemmatize

Stop Word Processing

Encoding

Model Train

Prediction

Tokenization

- 簡單來說，斷詞是指將句子分成數個有意義的語詞，以便我們做後續的分析。
- 試著以電腦的角度來思考以下句子及問題
  - 郭台銘創立了鴻海公司。
  - 郭台銘 創立 了 鴻海 公司 。
  - 請問郭台銘公司的名字?
- 斷詞就像是人在閱讀文章，絕對不是一次看一整篇，而是由詞開始然後理解一整段文章，進而理解這篇文章的意義。

Tokenization Tool for the Chinese Language

- 中研院斷詞系統
- Jieba 斷詞系統

Part-of-Speech

- 將語詞的結果作詞性的標註
- 電腦在標註詞性絕對不是用人類的想法來標註。
- 我們可以經由詞性標註更清楚瞭解句子的意義，如同問你住哪裡，你絕對會去找名詞而不是動詞。 Sequence Label
- 較複雜的自然語言處理問題也會先經過Part-of-Speech來塞選不重要的詞性。

Text Lemmatize

- 主要用在英文
- 將每個意思相同但有變化的單字轉成最原始的單字。
- E.g.: Went -> Go

Stop Word Processing

- 去除比較無意義、詞頻過高、標點符號等等來提升正確率。
- 停用字會隨著問題不同而增加或減少。
- 試想以下句子的停用字
  - ➢ 欸~現在幾點呢?
  - ➢ 我現在住高雄耶!

Term Frequency

- 計算出語料庫中每個語詞所出現的次數
- 為何要計算詞頻而不是將所出現的做編碼如0、1、2、就好?這樣不是可以減少運算?程式也更好寫不是嗎?
- 最近較常使用的方法為將語詞轉換成密度向量。

TF-IDF

- Formula of TF-IDF

➢ tf-idf = $tf \ * idf(t)$, where tf is term frequency

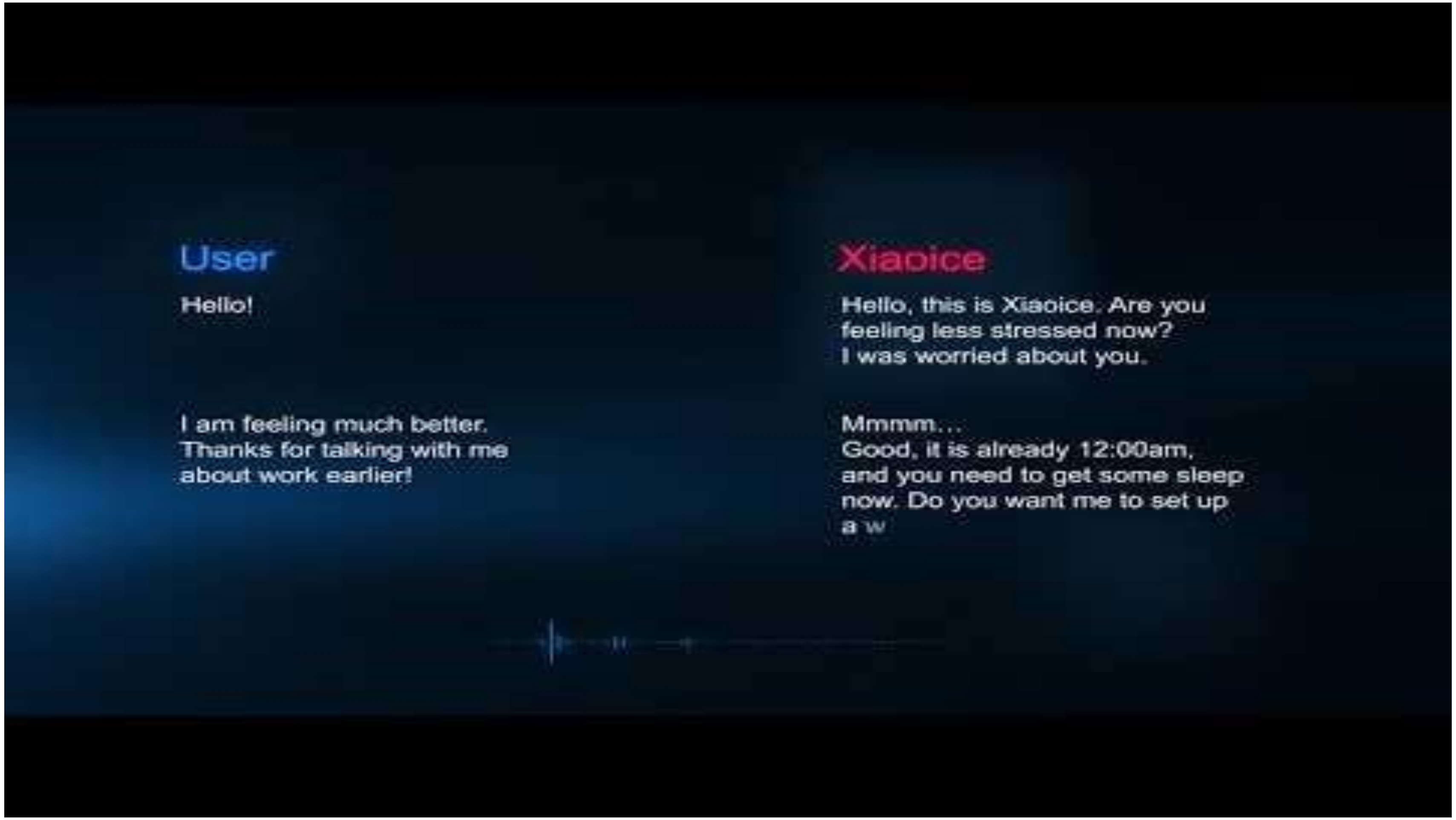
➢ idf(t) = $\log\left(\frac{nd}{nd(t)}\right)$, where nd = number of documents, nd(t) = number of documents that contain the term t

The Design and Implementation of XiaoIce, an Empathetic Social Chatbot

Zhou et al., Computational Linguistics, 2020.

Example: Singing

Example: Chat



User

Hello!

I am feeling much better.
Thanks for talking with me
about work earlier!

Xiaoice

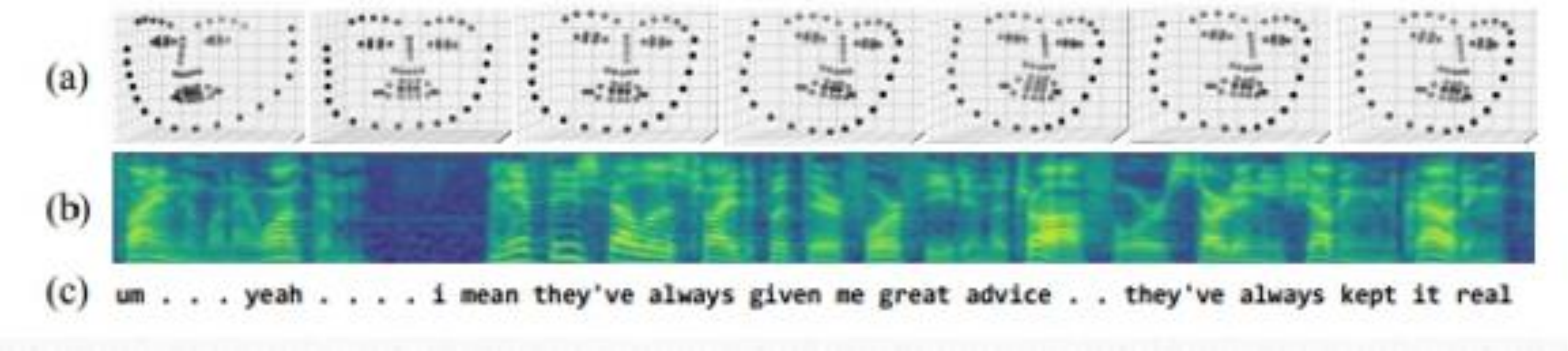
Hello, this is Xiaoice. Are you
feeling less stressed now?
I was worried about you.

Mmmm…
Good, it is already 12:00am,
and you need to get some sleep
now. Do you want me to set up
a w

Measuring Depression Symptom Severity from Spoken Language and 3D Facial Expressions

Haque et al., Arxiv, 2018.

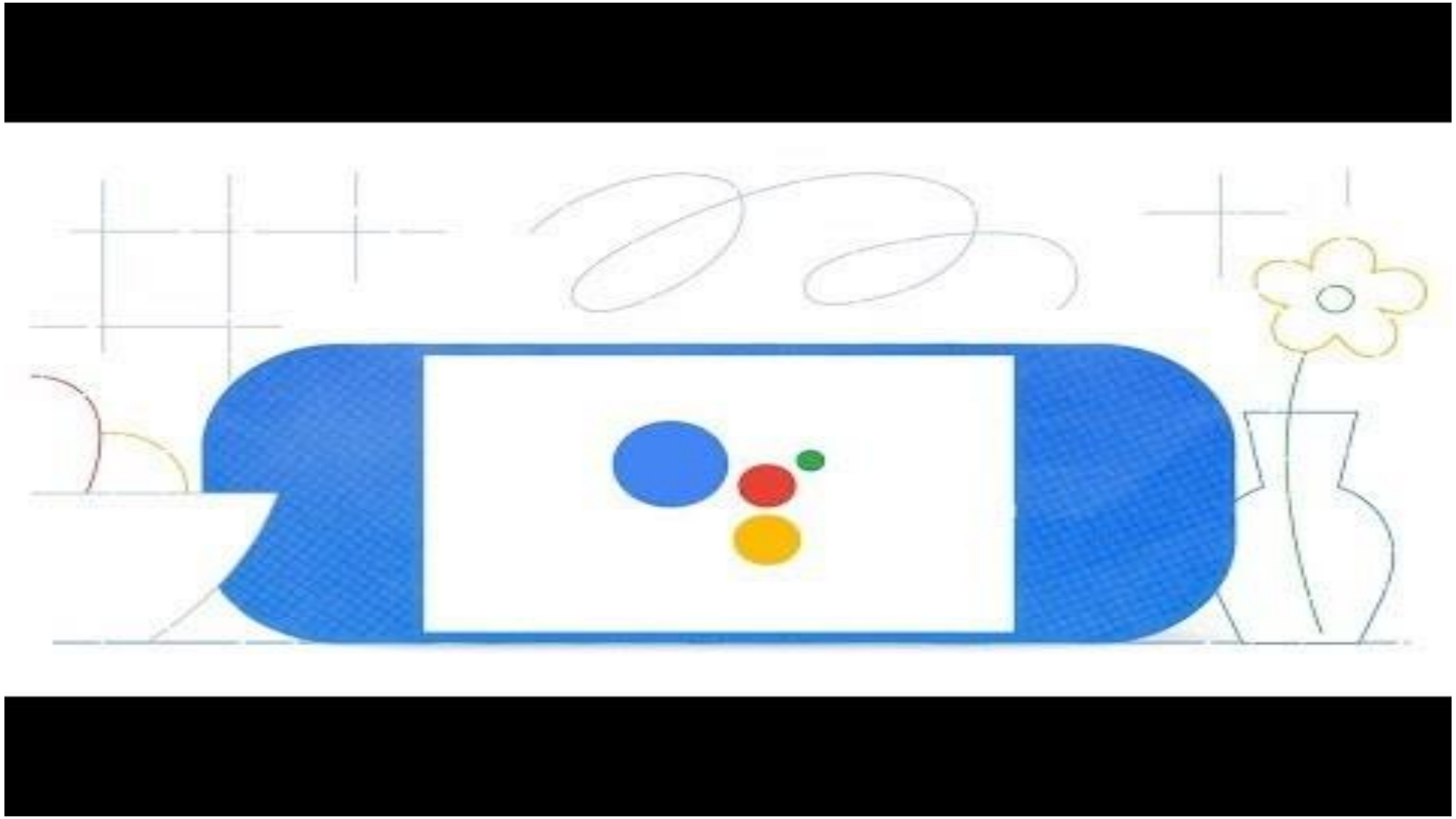
Method


(a)
(b)
(c)
um . . . yeah . . . . i mean they've always given me great advice . . they've always kept it real

- Model
  - Word-Embedding
  - C-CNN

Google Assistance

Demonstration



Google Duplex

Recipes for building an open-domain chatbot

Roller et al., Arxiv, 2020.

Demonstration

- https://ai.facebook.com/blog/state-of-the-art-open-source-chatbot/

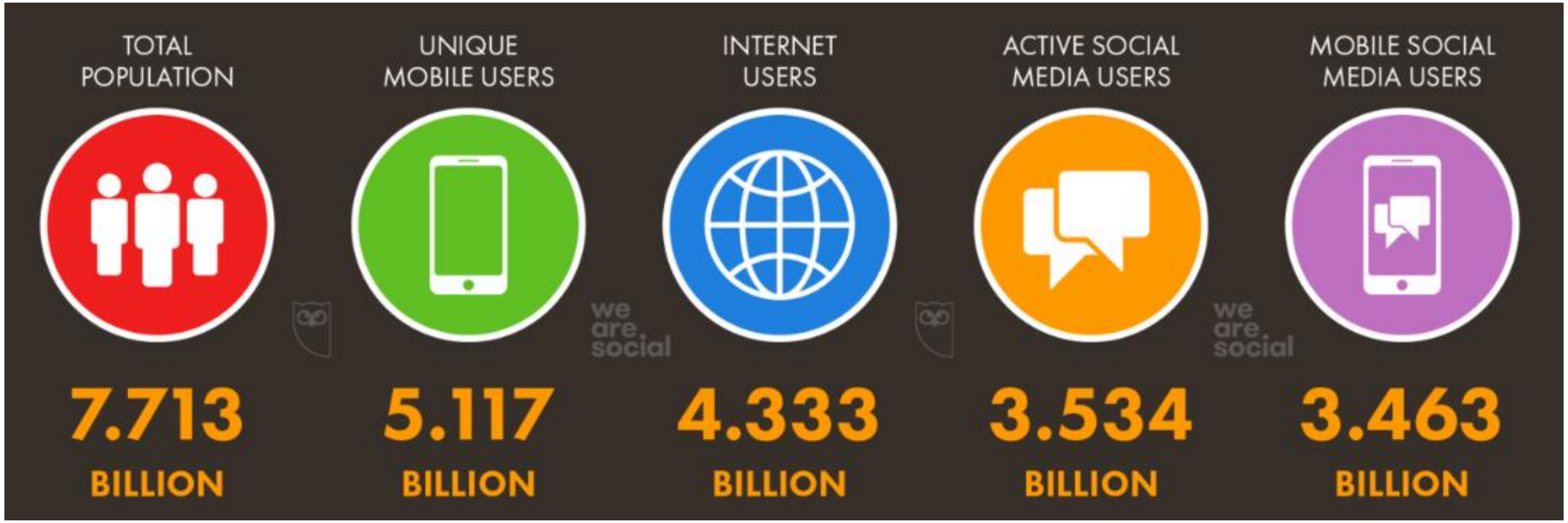
Applications of the GPT-3 Model

- HTML Layout Generation
  - https://twitter.com/i/status/1282676454690451457
- Web Generation
  - https://twitter.com/jsngr/status/1287026808429383680?s=20
  - https://stripe.com/
- Generate & Update the Graph
  - https://twitter.com/plotlygraphs/status/1286688715167936512
- Others
  - https://github.com/elyase/awesome-gpt3

Introduction to Dialog System

Why Dialog System?

- 有許多人可能不會操作電腦或是對於操作電腦非常不熟悉。再好的圖形化介面都很難克服這問題，但幾乎人人都會講話，只是語言不同。
- Digital Data of July 2019

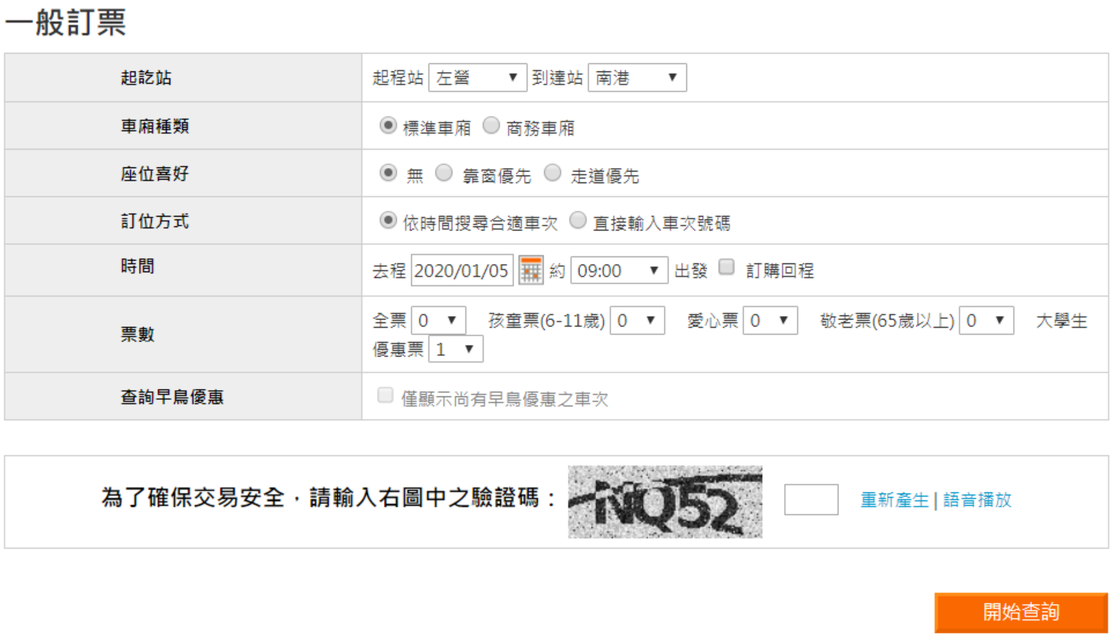


https://datareportal.com/global-digital-overview

Two Types of Intelligence Assistance

- Types of Intelligence Assistance
  - Reactive Assistance
  - Proactive Assistance

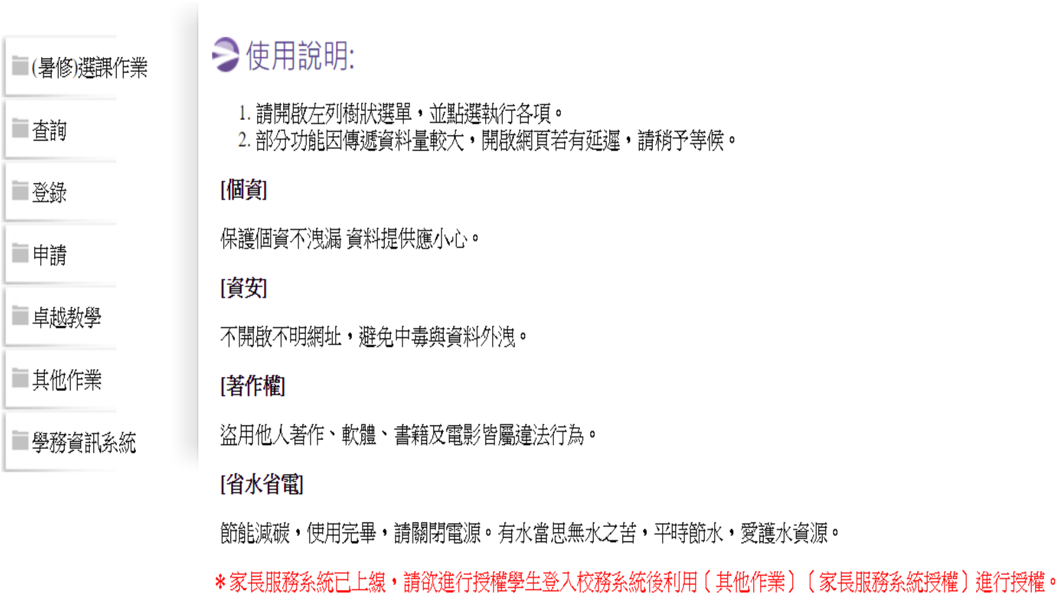
GUI v.s. CUI (Conversational UI)



一般訂票

起訖站	起程站 左營 ▼ 到達站 南港 ▼
車廂種類	● 標準車廂 ○ 商務車廂
座位喜好	● 無 ○ 靠窗優先 ○ 走道優先
訂位方式	● 依時間搜尋合適車次 ○ 直接輸入車次號碼
時間	去程 2020/01/05 約 09:00 ▼ 出發 □ 訂購回程
票數	全票 0 ▼ 孩童票(6-11歲) 0 ▼ 愛心票 0 ▼ 敬老票(65歲以上) 0 ▼ 大學生優惠票 1 ▼
查詢早鳥優惠	□ 僅顯示尚有早鳥優惠之車次

為了確保交易安全，請輸入右圖中之驗證碼： NQ52 重新產生 | 語音播放



使用說明:

1. 請開啟左列樹狀選單，並點選執行各項。
2. 部分功能因傳遞資料量較大，開啟網頁若有延遲，請稍予等候。

[個資]

保護個資不洩漏 資料提供應小心。

[資安]

不開啟不明網址，避免中毒與資料外洩。

[著作權]

盜用他人著作、軟體、書籍及電影皆屬違法行為。

[省水省電]

節能減碳，使用完畢，請關閉電源。有水當思無水之苦，平時節水，愛護水資源。

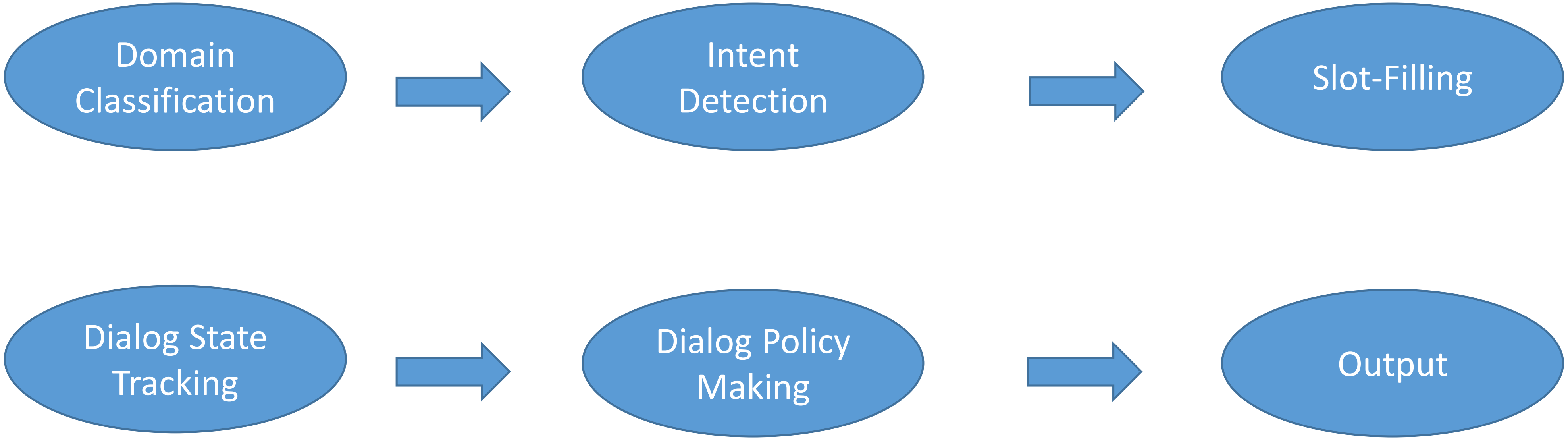
＊家長服務系統已上線，請欲進行授權學生登入校務系統後利用〔其他作業〕〔家長服務系統授權〕進行授權。

https://irs.thsrc.com.tw/IMINT/

http://webap.nkust.edu.tw/nkust/f_index.html

Introduction to Dialog System

- Types of Dialog System
  - Chit-Chat Dialog System
  - Task-Oriented Dialog System
- Flow of Dialog System



Domain Classification → Intent Detection → Slot-Filling

Dialog State Tracking → Dialog Policy Making → Output

Dialog System Example

- I would like to book a HSR ticket from Kaohsiung to Nangang.
- Domain
  - ➢ HSR
- Intent
  - ➢ Book a Ticket
- Slot-Filling

  o o o o o o o o B-Depart I-Depart B-Destination I-Destination

  - ➢ I would like to book a HSR ticket from Kaohsiung to Nangang
- Dialog State Tracking
  - ➢ Place
- Dialog Policy for Agent Action
  - ➢ We have place but we don’t know the preference of seat, departure time etc. The system may return a question which is “what time do you depart?”

Regular Expression

What is regular expression?

- Write a rule to match the words.
- There are many editors allowing to search the text by using regular expression.

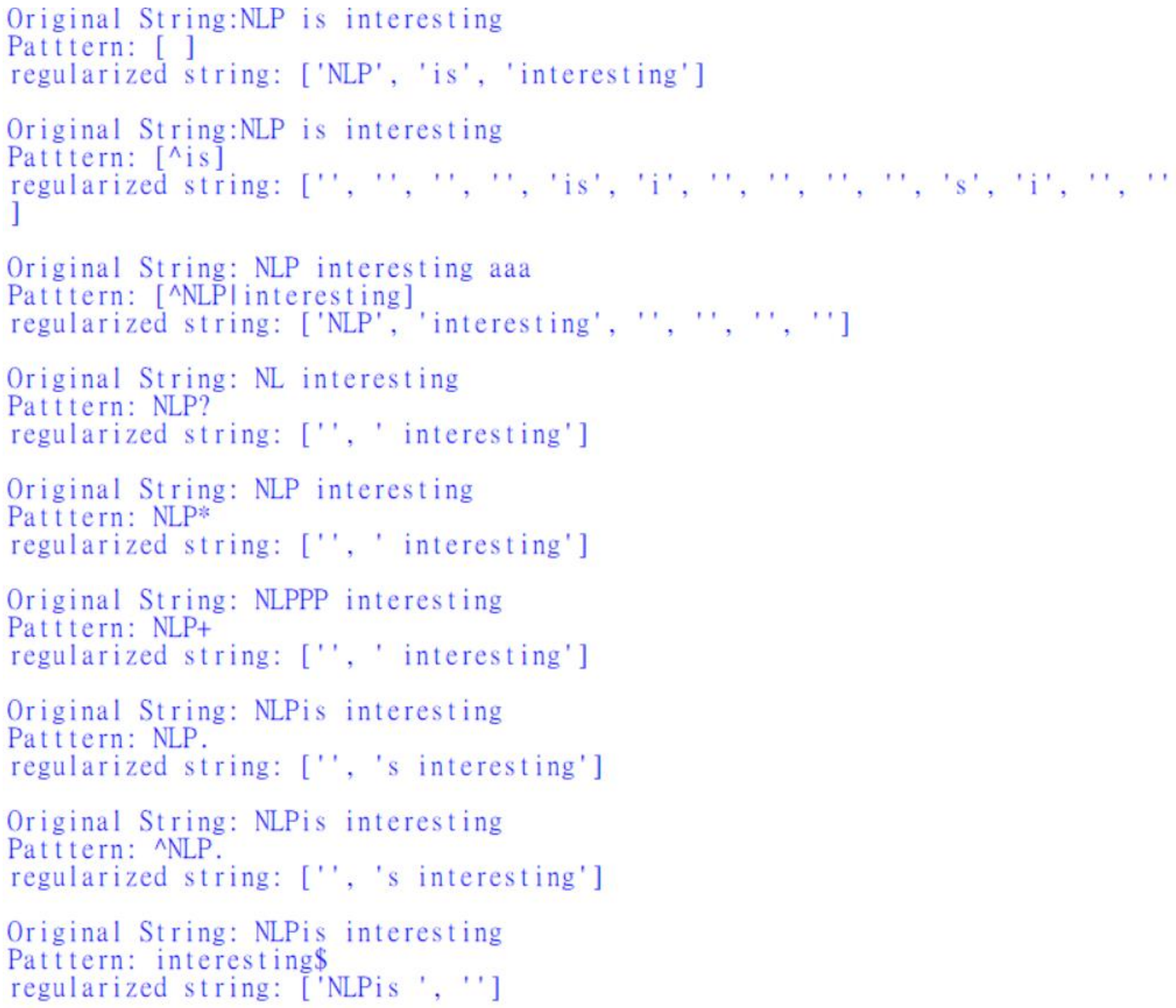
基本正規表示式介紹

- [ ] 匹配在括號裡面的字母
- [^] 匹配不包含在[ ]裡面的文字
- | 有OR的概念
- ? 前面的字元式非必要的
- * 前面的字元可以出現0次也可以出現多次
- + 前面的字元至少要出現一次
- . 不管任何字元都可以匹配
- ^ 匹配句子的起始位置
- $ 匹配句子結尾位置
- 還有許多規則可以到網路上查

Python Package: RE

- Built-in Function of Python
- Mainly used to process Regular Expression
- It can be used to match and split the string etc.

RE Example



```
Original String:NLP is interesting
Patttern: [ ]
regularized string: ['NLP', 'is', 'interesting']

Original String:NLP is interesting
Patttern: [^is]
regularized string: ['', '', '', '', 'is', 'i', '', '', '', '', 's', 'i', '', ''
]

Original String: NLP interesting aaa
Patttern: [^NLP|interesting]
regularized string: ['NLP', 'interesting', '', '', '', '']

Original String: NL interesting
Patttern: NLP?
regularized string: ['', ' interesting']

Original String: NLP interesting
Patttern: NLP*
regularized string: ['', ' interesting']

Original String: NLPPP interesting
Patttern: NLP+
regularized string: ['', ' interesting']

Original String: NLPis interesting
Patttern: NLP.
regularized string: ['', 's interesting']

Original String: NLPis interesting
Patttern: ^NLP.
regularized string: ['', 's interesting']

Original String: NLPis interesting
Patttern: interesting$
regularized string: ['NLPis ', '']
```

Introduction to API

Introduction to API

- Scikit-Learn
  - https://scikit-learn.org/stable/
- Pytorch
  - https://pytorch.org/
- TensorFlow
  - https://www.tensorflow.org/
- Google Colab Intro
  - https://colab.research.google.com/drive/14a6xiBuMtRF8snFYM-33i8BDNfiXBxQD
- TensorFlow With GPU
  - https://colab.research.google.com/drive/1aL_lmD8apPu2YXBxPzGSq0tdrV5btf-b
- Numpy
  - https://numpy.org/
- Pandas
  - https://pandas.pydata.org/

References

- D.Mannin et al., Foundations Of Statistical Natural Language Processing
- 自然語言處理流程
- An easy Introduction To Natural Language Processing
- 中研院語料庫
- 中研院斷詞
- 陳縕儂, 對話機器人的腦子與靈魂 Bot's Brain and Soul, PyConTW2017
- Dan Jurafsky and Chris Manning, “Natural Language Processing”, Stanford Online
- Python RE Package Document