



深度學習研究與應用中心  
DEEP LEARNING RESEARCH & APPLICATION CENTRE  
香港恒生大學  
THE HANG SENG UNIVERSITY  
OF HONG KONG

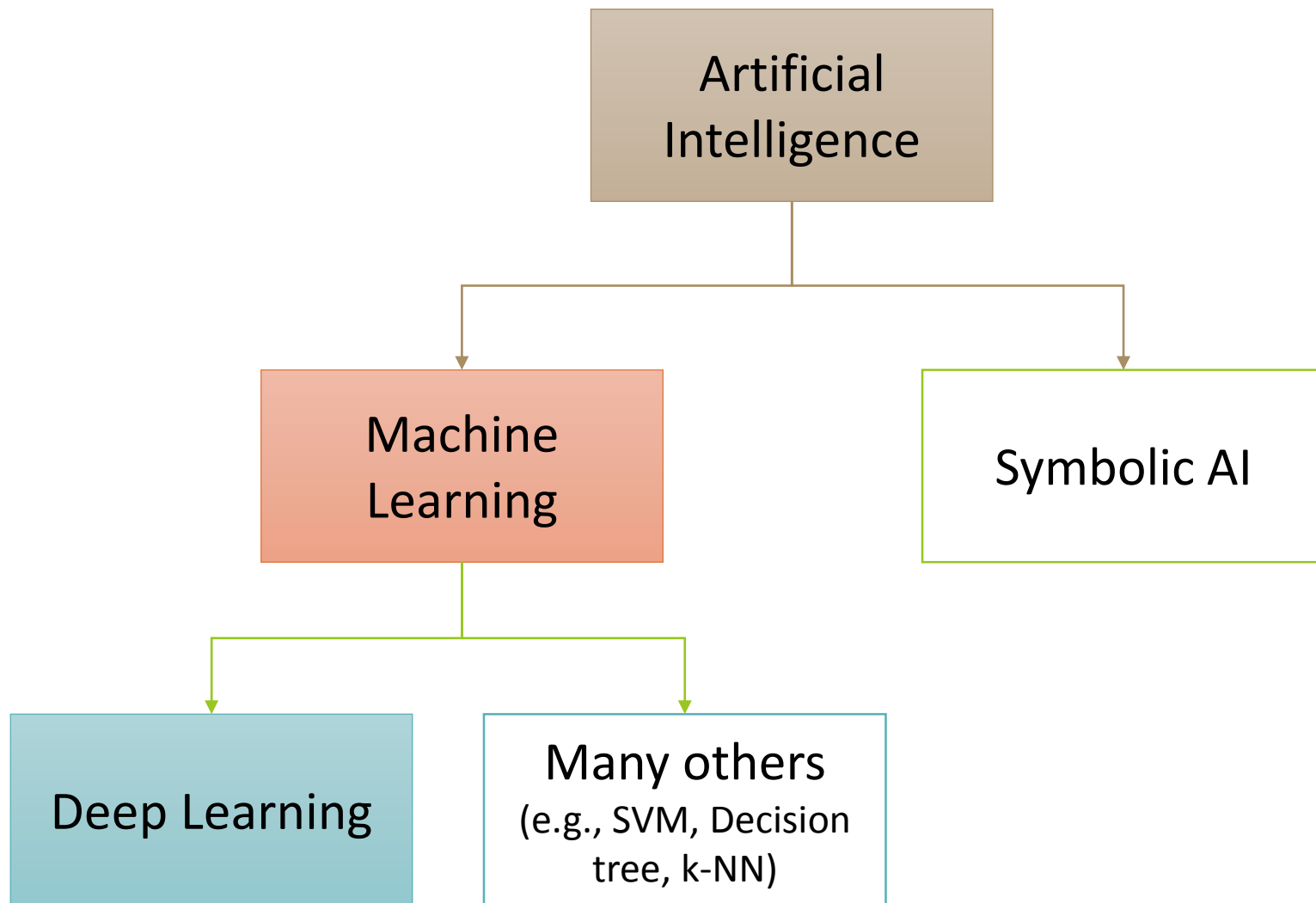
# Trends in Technology for Translators: Deep Learning and Automatic Translation

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The Hang Seng University of Hong Kong

# Deep Learning Research and Application Centre

*The Hang Seng University of Hong Kong*



# Deep Learning

AlphaGo

Speech  
recognition

Sentiment  
analysis

Summarization

Chatbot

Stock price  
prediction

Image  
classification

Object  
detection

Self-driving cars  
and many more



# Deep Learning Research and Application Centre

- Funding of HK\$6.8 million
- Hardware: Graphics processing unit (GPU)-accelerated hardware for much faster training and decoding
- Software: PyTorch, Tensorflow, Keras, Transformer...
- Projects involving deep neural networks



# Projects (<https://dlc.hsu.edu.hk/>)

- Machine translation (e.g., automatic translation of listing documents; recent funding: HK\$1.4 million)
- Smart retail
- English proofreading
- Weather analysis, forecast and communication
- Detection of fake news
- Financial analysis



# Trends in Technology for Translators

# Outline

- Useful Tools for Professional Translators
- AI and Translation Technology
- Ways to Make Better Use of Automatic Translation Systems





# Outline

- Useful Tools for Professional Translators
- AI and Translation Technology
- Ways to Make Better Use of Automatic Translation Systems



# Translation Technology

Electronic  
Dictionaries

Corpora and  
Concordancers

Translation  
Databases

Automatic  
Translation



# Electronic Dictionaries

General  
Dictionaries

Specialised  
Dictionaries



# Example: HSUHK Business Translation Index



HSUHK Business Translation Index

[Home](#) [About Us](#) [Feedback](#) [Contact Us](#) [中文](#)

Type and Search

economics

Go

<http://www.hsuhkbt.com/SearchBTI?search=technical+analysis>

Record 1: 經濟學

Multilingual Terms/Expressions

(en)	Economics	0  0
(fr)	Sciences économiques	0  0
(jp)	経済学	0  0
(zh-cn)	经济学	0  0
(zh-hk)	經濟學	0  0
(zh-tw)	經濟學	0  0

Additional Information (Powered by TranXLab and Wikipedia)

(en) Economics (*ˈiːkənəmiks*, *ˈiːkəz*) <sup>[1]</sup> <sup>[2]</sup> <sup>[3]</sup> is the social science that studies the production, distribution, and consumption of goods and services. <sup>[4]</sup>

Source: [Wikipedia](#) (under the [CC-BY-SA](#) License)

(zh-hk) 經濟學是一門對產品和服務的生產、分配以及消費進行研究的社會科學。西方語言中的「經濟學」一詞源於古希臘的 οἰκονομία (英語: [oikonomia](#)) <sup>[1]</sup> <sup>[2]</sup>。

Source: [Wikipedia](#) (under the [CC-BY-SA](#) License)

(fr) Les sciences économiques (ou la science économique ou encore l'économie) est une discipline des sciences humaines et sociales qui étudie de façon scientifique le fonctionnement de l'économie c'est-à-dire la description et l'analyse de la production, des échanges et de la consommation des biens et des services.

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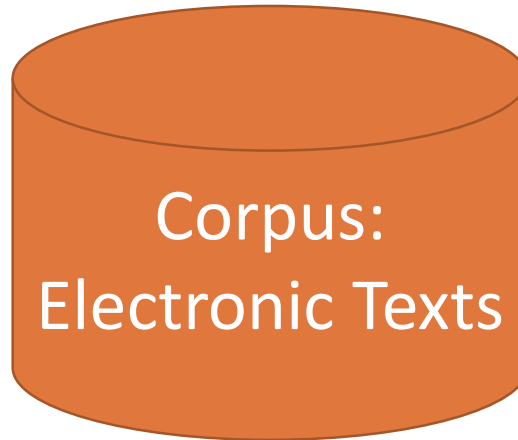
この記事では経済学（けいぎがく、英: economics）について解説する。経済学の原語であるeconomicsという語彙は、新古典派経済学者 アルフレッド・マーシャルの著『経済学原理』（英: *Principles of Economics*, 1890年）によって誕生。普及



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# Corpora and Concordancers

1. ST Analysis
2. TL Expressions
3. TT Analysis



Expression



Concordancers



Examples/  
Statistics



# Example 1: Legal Corpus

- <http://legalcorpus.weebly.com/>

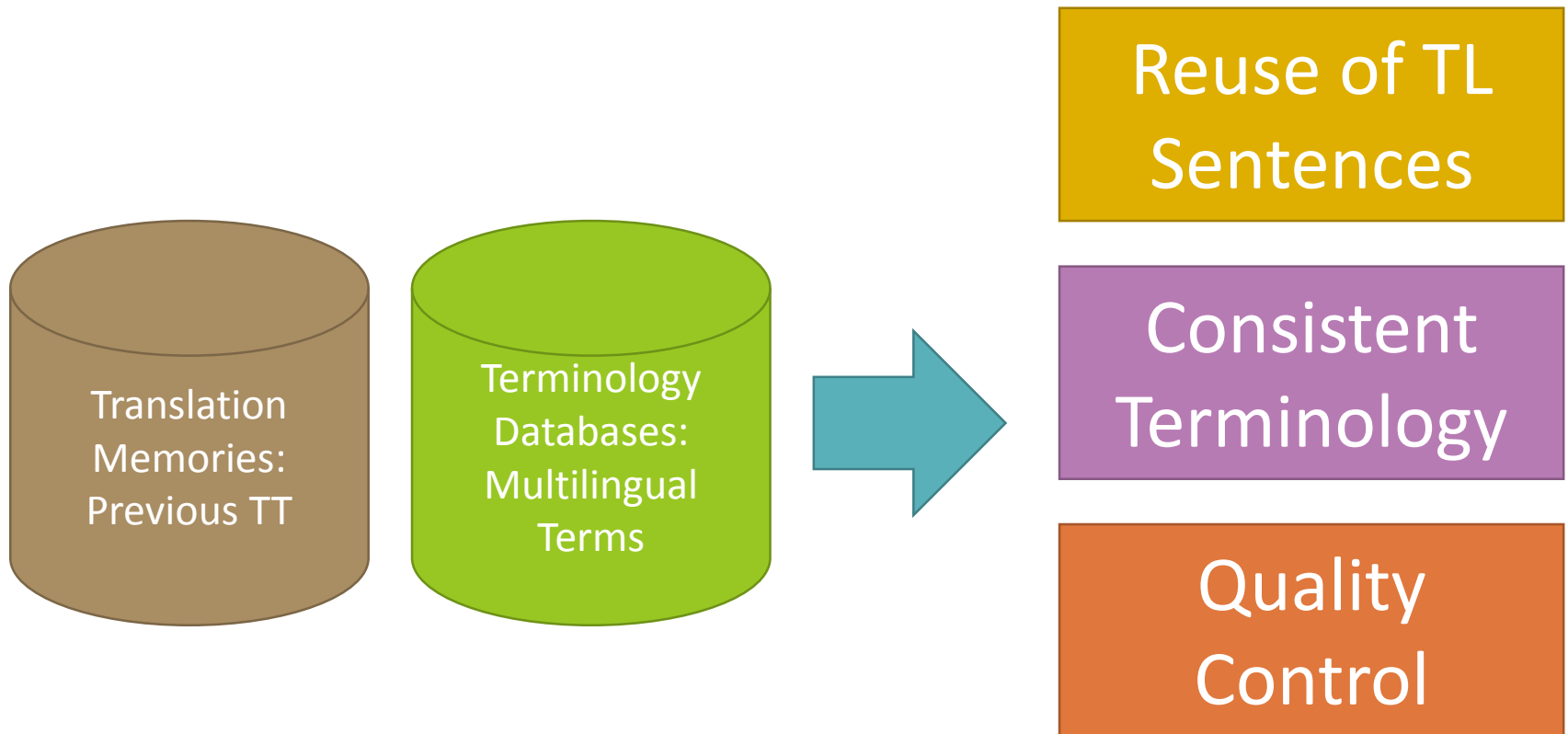


# Example 2: Ngram Viewer

- <https://books.google.com/ngrams>



# Translation Databases: Translation Memories and Termbases



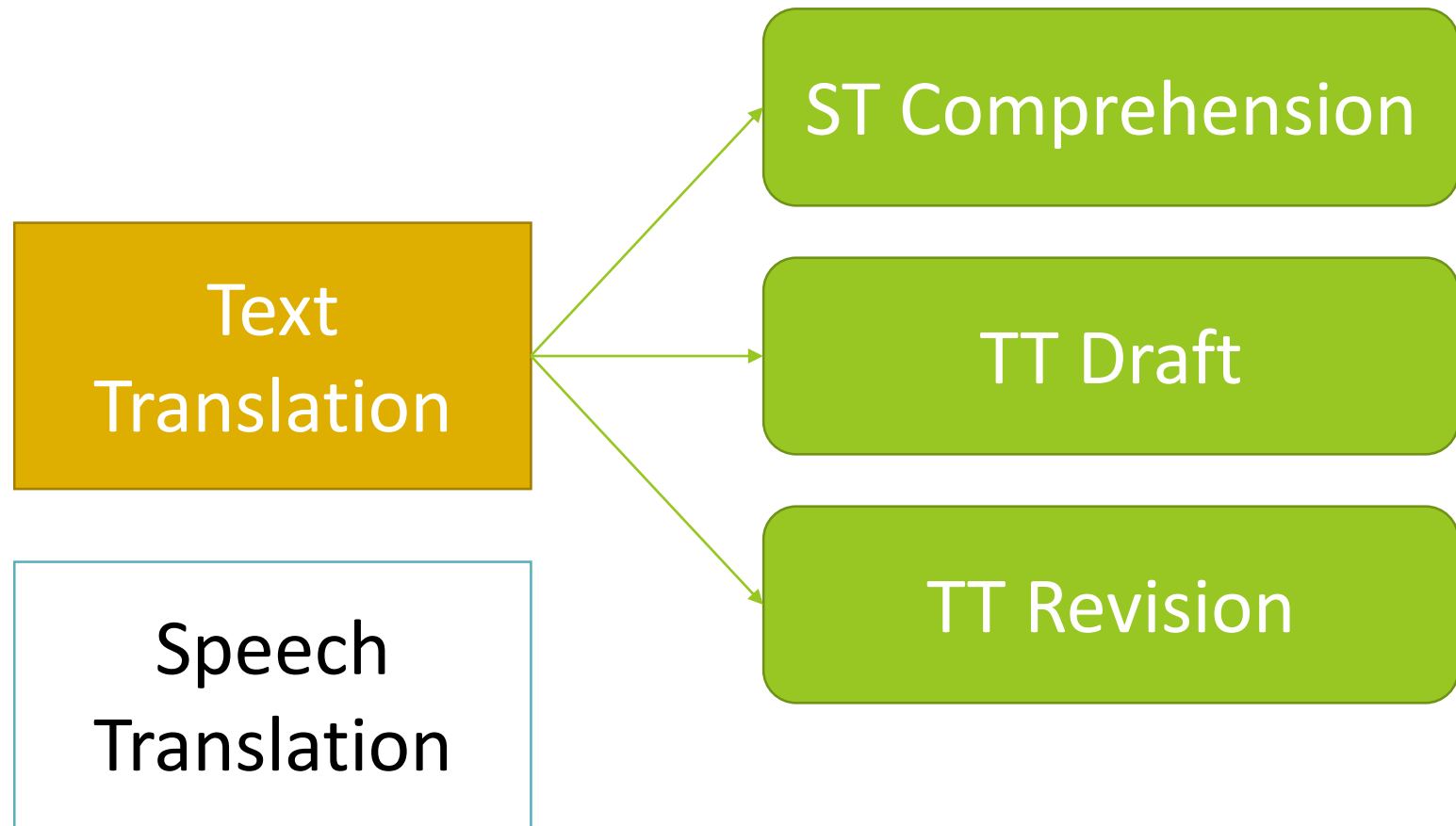


# Example: Memsource

- <https://www.memsource.com/>



# Automatic Translation



# Outline

- Useful Tools for Professional Translators
- AI and Translation Technology
- Ways to Make Better Use of Automatic Translation Systems



# Methods

Rule-based Approach

Example-based Approach

Statistical Approach

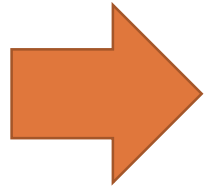
Deep Learning Approach



# Traditional Approaches to Machine Translation

01	Rule-based Machine Translation	<ul style="list-style-type: none"><li>● I go to school by train.</li><li>● 我／去／學校／乘／火車／。</li><li>● 我乘火車去學校。</li></ul>
02	Example-based Machine Translation	<ul style="list-style-type: none"><li>● I go to school by train.</li><li>● I go to school by <u>taxi</u>. 我乘<u>計程車</u>去學校。</li><li>● 我乘火車去學校。</li></ul>
03	Statistical Machine Translation	<ul style="list-style-type: none"><li>● Translation Model <math>P("I"   "我") \times P("go"   "去") \times \dots</math></li><li>● Language Model: <math>P("我乘火車去學校")</math></li></ul>

# Methods



Rule-based Approach

Example-based Approach

Statistical Approach

Deep Learning Approach



# Rule-based Machine Translation (RBMT)

- Direct MT
- Transfer MT



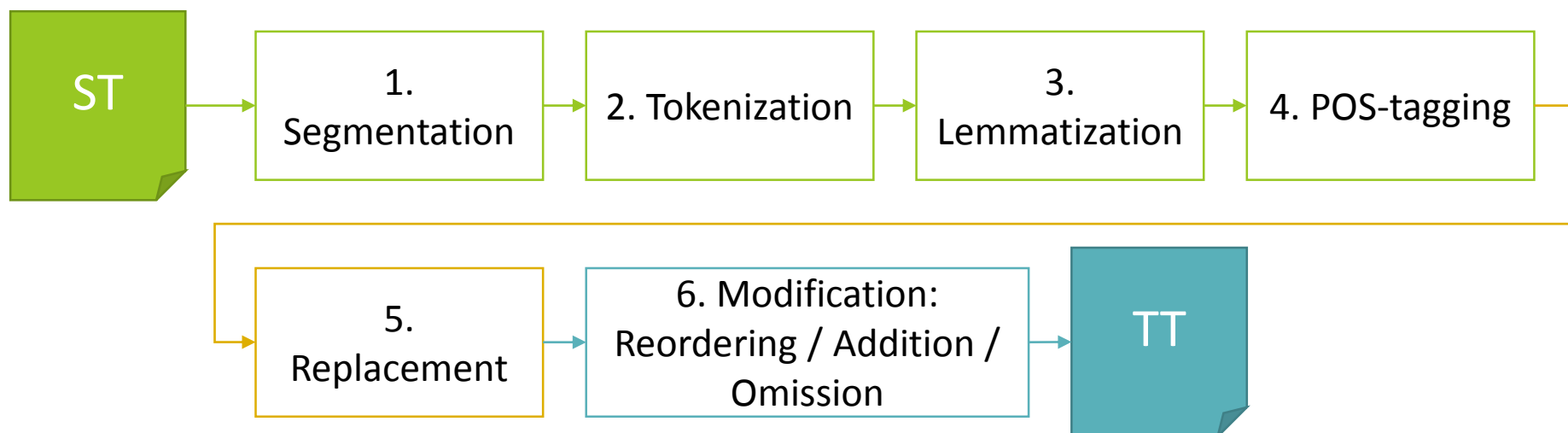
# Direct MT

- This is considered to be the first generation of MT systems.
- The ST is treated as a string of words. The SL words are then replaced by TL words, and the TL words are reordered.





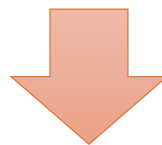
# Direct MT



# Segmentation

- the process of splitting a text into sentences

Tom was a student. He went to school by bus. He played football with them.



Tom was a student.

He went to school by bus.

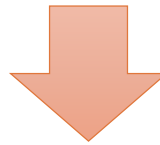
He played football with them.



# Tokenization

- the process of dividing a text into words

He played football  
with them.



He

played

football

with

them

.



# Lemmatization

- the process of grouping the identical, related or inflected forms of a word together as a single item (lemma)
- Example: do, does, doing, did → do



# POS-tagging

- the process of assigning a part-of-speech (POS) to every lexical item in the input

He

play(ed)

football

with

them

Pronoun

Preposition

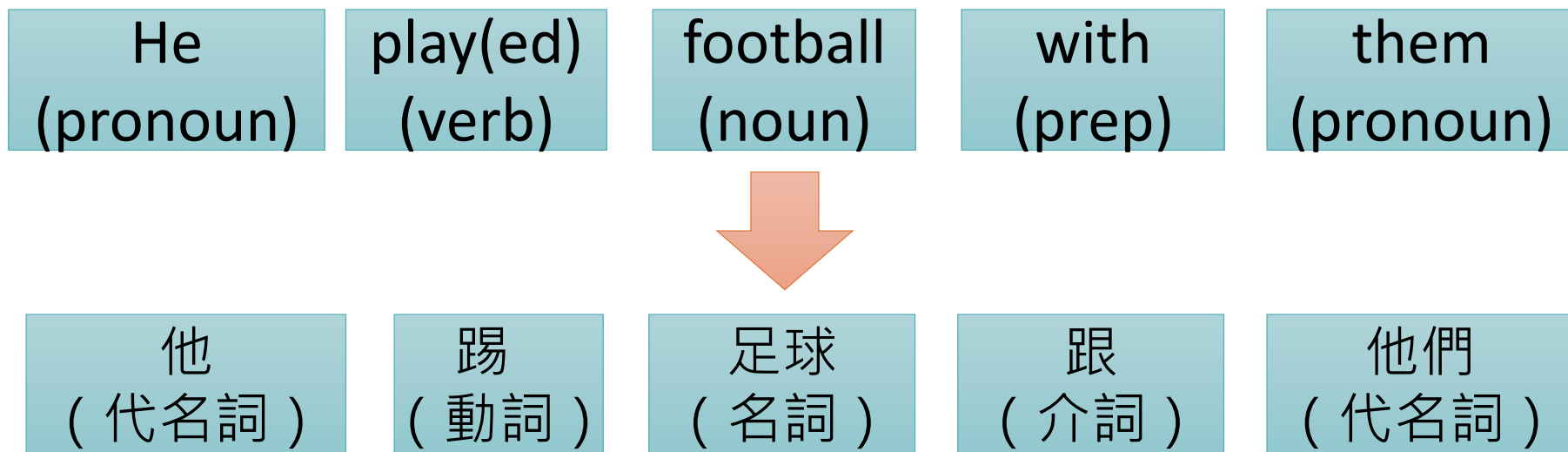
Noun

Verb



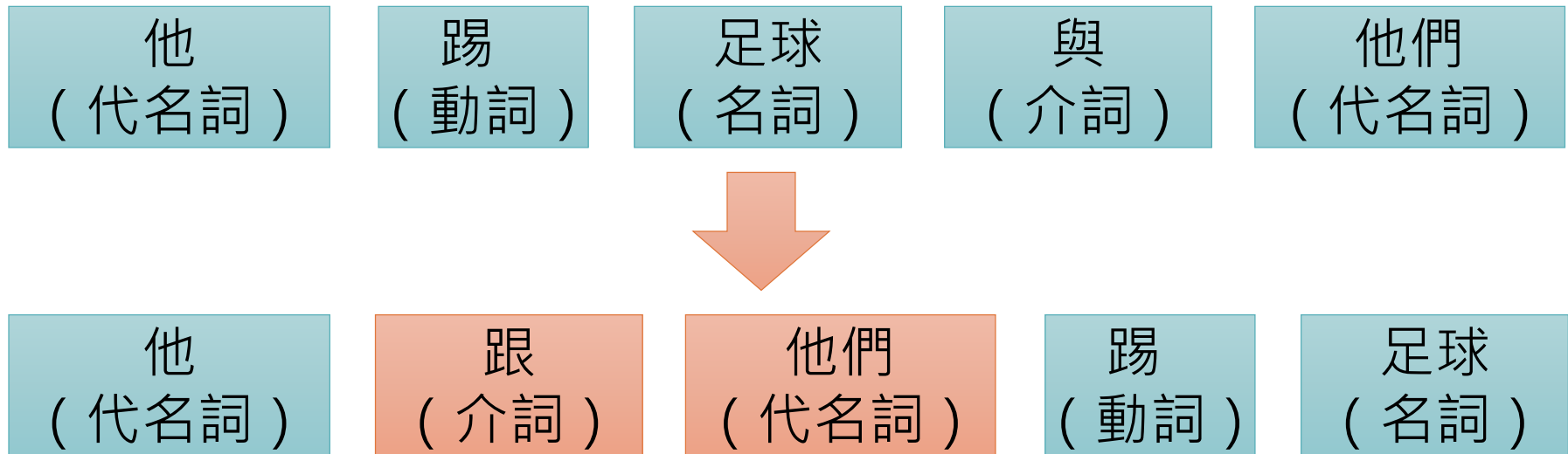
# Replacement

- the process of replacing the SL words with TL words



# Reordering and Modification

- the process of reordering the TL words and polishing the TT



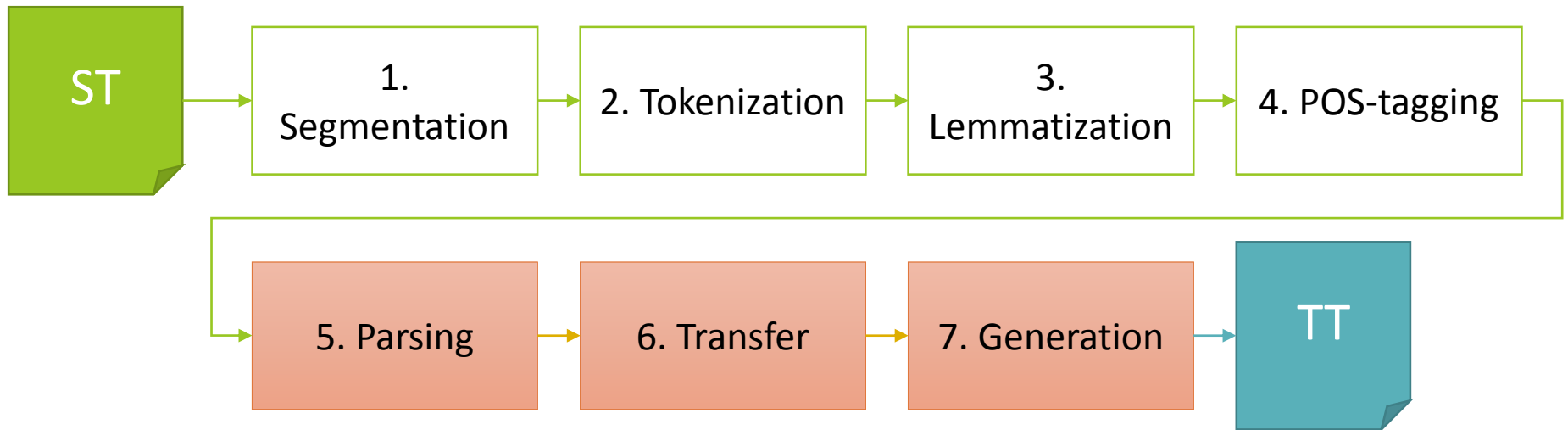
# Transfer MT

- The basic idea: **Analysis, Transfer and Generation**
- Input sentences are analyzed and translated into an abstract internal representation retaining their features in the SL.
- The representation is transferred to a representation with the features in TL and generates the TT.





# Transfer MT



# Parsing

- the process of analyzing the input and generating the SL representation (e.g., a parse tree) that identifies the function of each word/word group



# Transfer

- the conversion of the SL representation into its equivalent TL representation



# Generation

- the production of the TL text from the TL representation



# An Example

- **ST:** The boy went to Didneyland.
- **Case conversion:** the boy went to didneyland.
- **Segmentation**
- <1> the boy went to didneyland.



# An Example

- **Tokenization**
- <1> the
- <2> boy
- <3> went
- <4> to
- <5> didneyland
- <6> .



# An Example

- **Lemmatization**
- <1> the
- <2> boy
- <3> go (past tense)
- <4> to
- <5> didneyland
- <6> .



# An Example

- **POS-tagging**
- <1> the (definite article)
- <2> boy (noun, singular)
- <3> go (verb, past tense)
- <4> to (preposition)
- <5> didneyland (noun, singular)
- <6> .

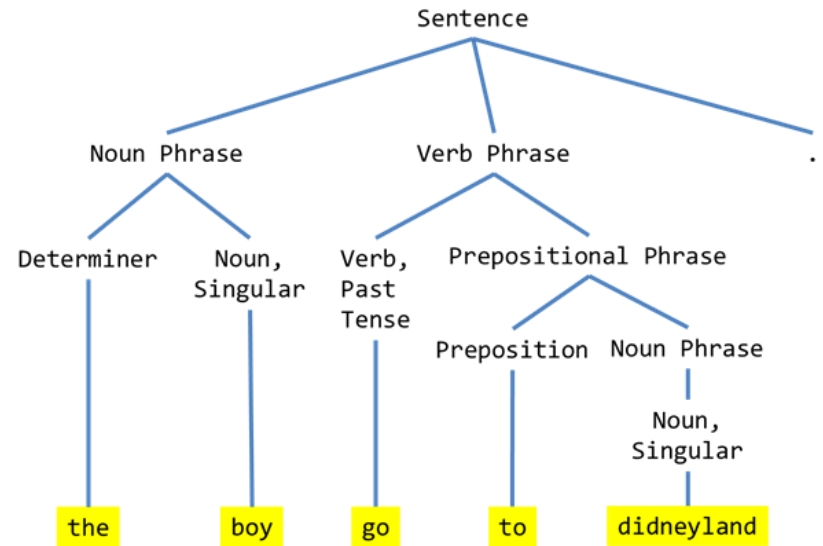




# An Example

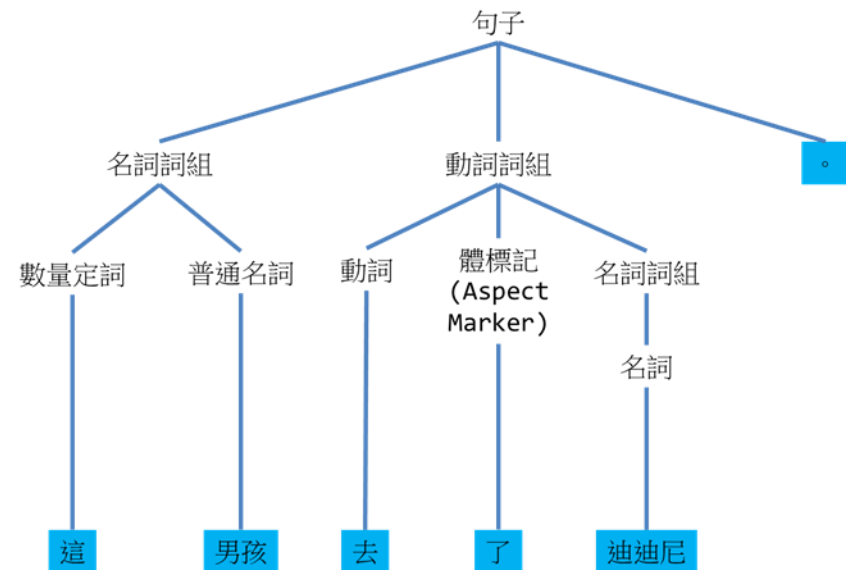
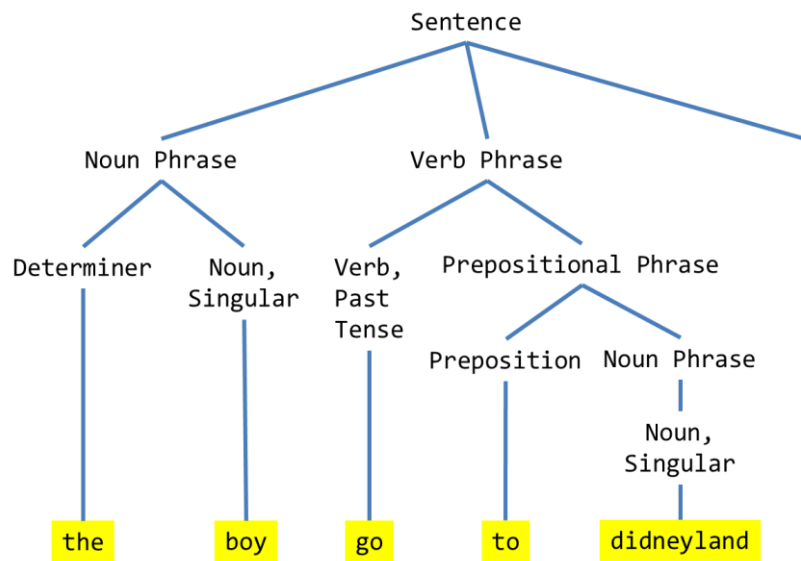
- **Parsing**

<1> the (definite article)  
<2> boy (noun, singular)  
<3> go (verb, past tense)  
<4> to (preposition)  
<5> didneyland (noun, singular)  
<6> .



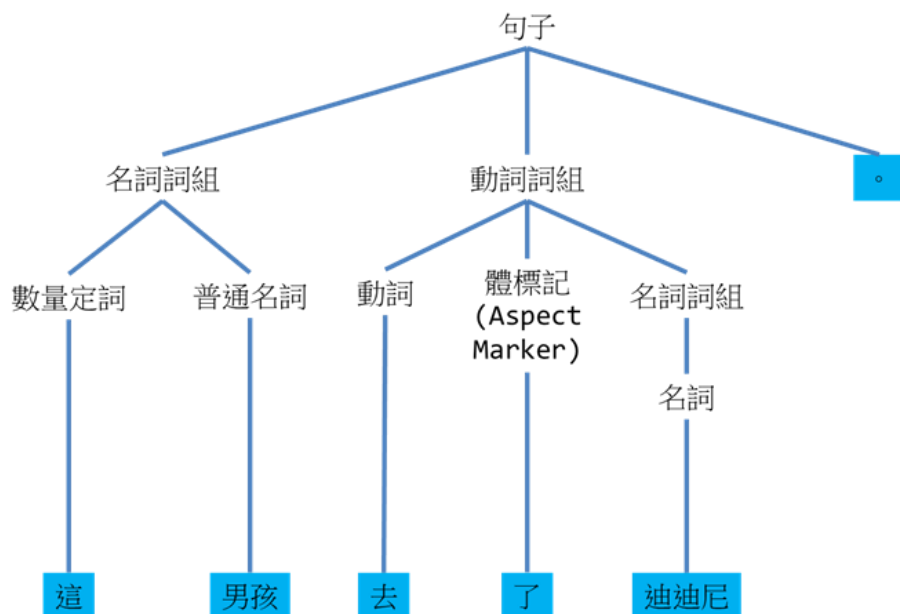
# An Example

- Transfer



# An Example

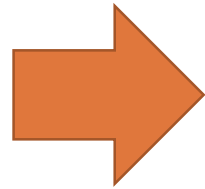
- **Generation**



這男孩去了迪迪尼。



# Methods



Rule-based Approach

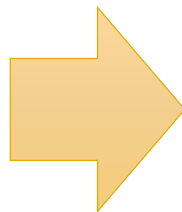
Example-based Approach

Statistical Approach

Deep Learning Approach



Finding appropriate  
translation examples



Reordering the  
examples retrieved  
with the assistance  
of a language model



The best  
example?

ST: The boy went to school.

### Step 1: Retrieving the “closest” example

Example	English (Source Language)	Chinese (Target Language)
1	<b>The boy</b> is naughty.	那男孩很頑皮。
2	They <b>went to</b> the library.	他們到圖書館去。
3	He goes <b>to school</b> by train.	他乘火車上學去。
4	They <b>went to school</b> .	他們到學校去。



## Step 2: Using the example

ST: The boy went to school.

Example: They went to school.

Useful words: XXX went to school.

Translation: The boy 到學校去。



## Step 3: Modifying the example

The boy → 那男孩 (from dictionary/corpus)

Draft: 那男孩到學校去。

### 1. Dictionary/Rules:

The → 那  
Boy → 男孩

### 2. Other examples in the database:

#### A. By comparison

The boy is naughty.  
→ 那男孩真頑皮。  
He didn't see the boy.  
→ 他看不見那男孩。

#### B. By Word Alignment

The/boy/is/tall.  
→ 那/男孩/長得/高。

### 3.

#### Translation Model:

$P(\text{The} | \text{那}),$   
 $P(\text{The} | \text{該}),$   
 $P(\text{boy} | \text{男孩}),$   
 $P(\text{boy} | \text{百厭星})...$

### 4.

#### Hybrid Approach:

1 + 2 + 3

## Step 4: Apply the language model and check the readability of the draft.

Output: 那男孩到學校去。

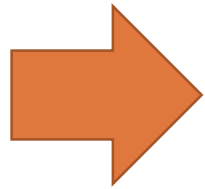




# Methods

Rule-based Approach

Example-based Approach

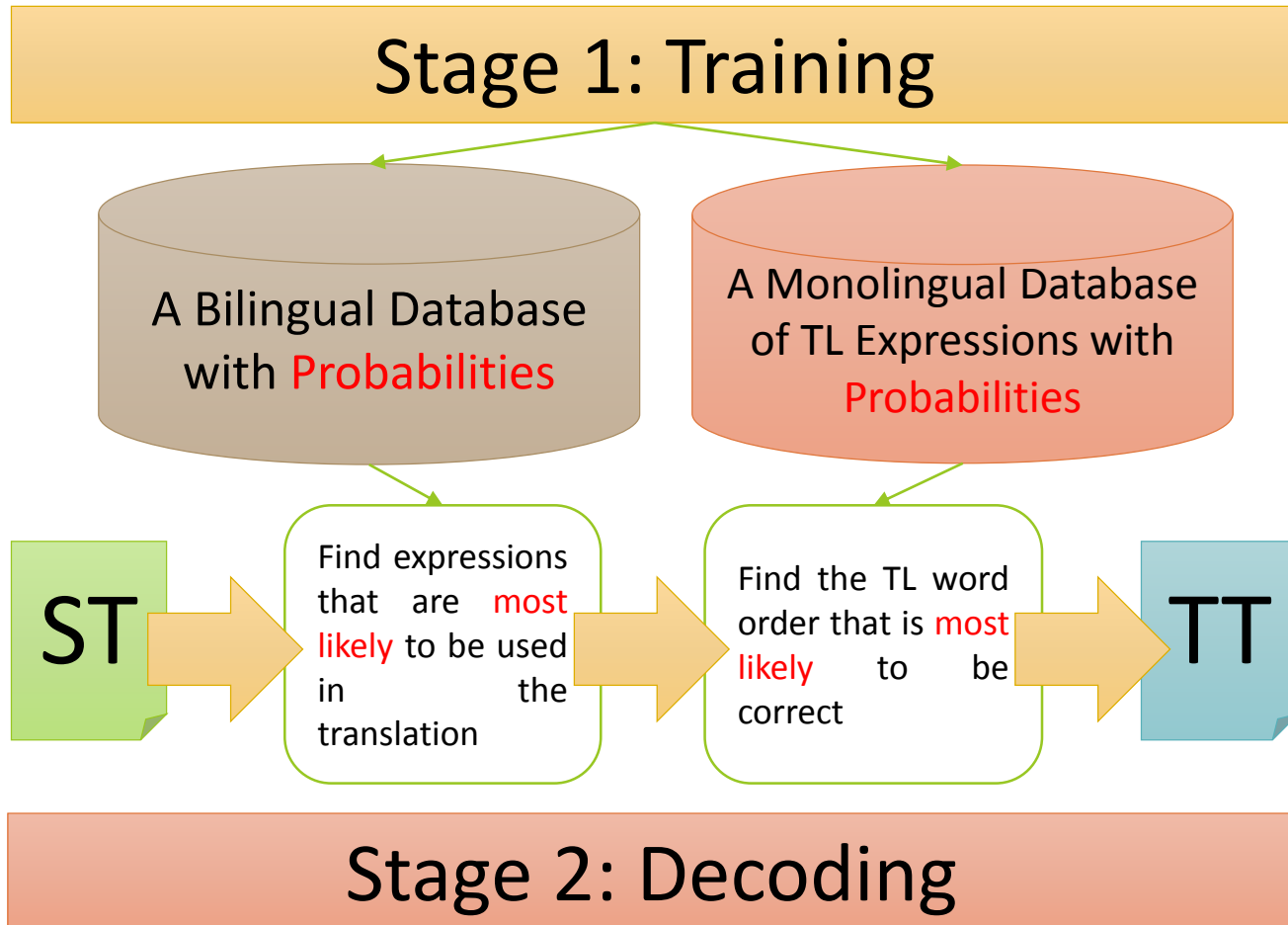


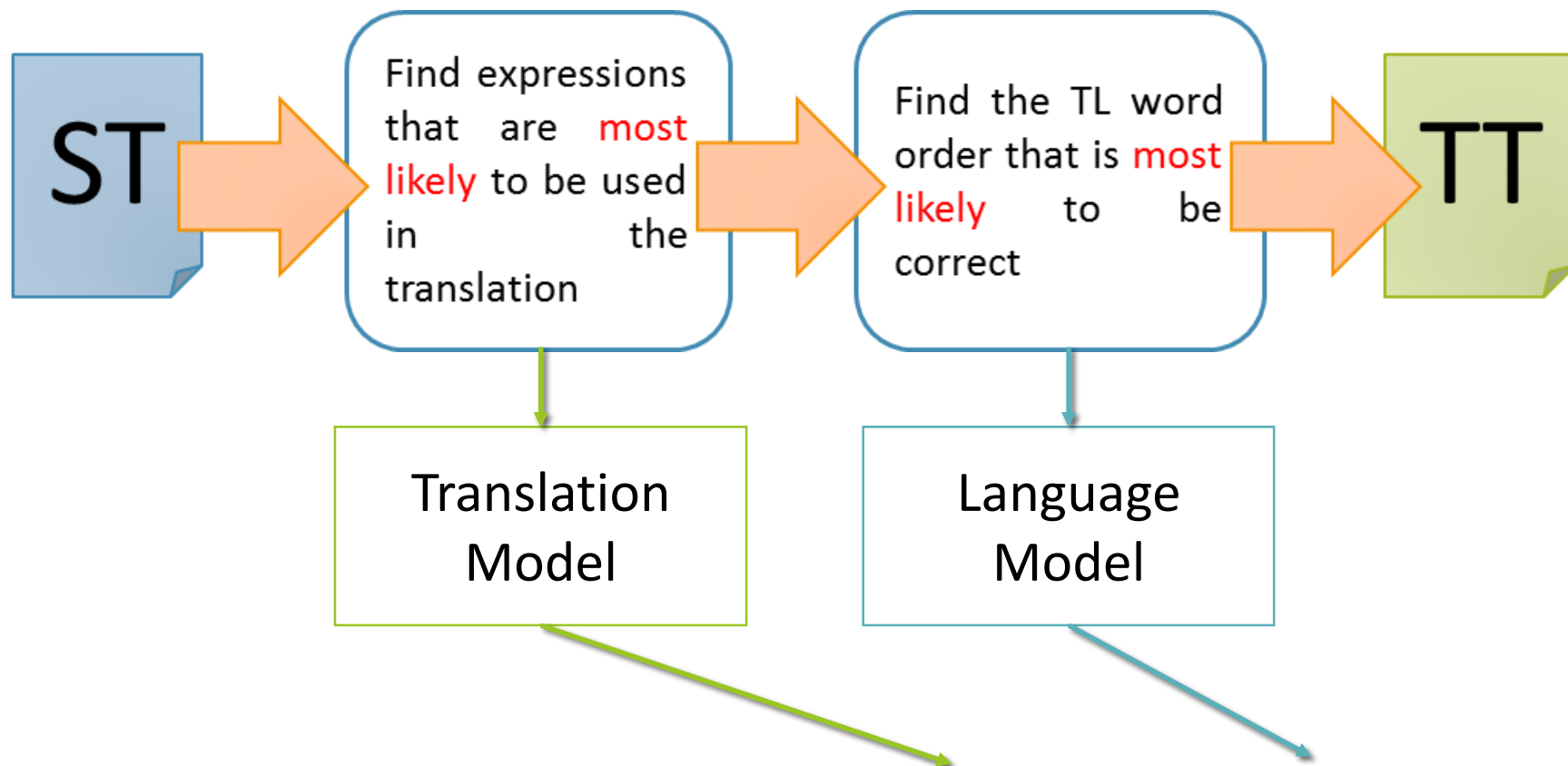
Statistical Approach

Deep Learning Approach



# Statistical Machine Translation



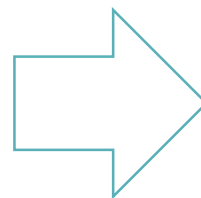


$$T' = \arg \max_T P(S|T) \times P(T)$$



# Language Model

Do you prefer fish ?  
Elephants love her .  
Give me fish .  
Dogs love swimming .  
We love dogs .

 $P(T)$ 

Monolingual Corpus in the  
Target Language



# Translation Model

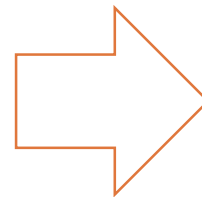
## Source Language

我喜歡貓。大象鍾意我。人們喜歡狗。  
他們嗜魚。我們喜歡猴子。你喜歡豬。

## Target Language

I love cats. Elephants love me. People love  
dogs. They prefer fish. We love monkeys.  
You prefer pigs.

Bilingual Corpus



$$P(S | T)$$



## Monolingual (in TL)

Data

Do you love dogs ?  
Elephants loves her .  
Give me fish .  
They love elephants .  
I go swimming .  
We love dogs .



Tables

I	0.04
you	0.04
dogs	0.08
fish	0.04
elephants	0.08
love	0.12
loves	0.04
we	0.04
they	0.04

## Bilingual

我喜歡貓。→ I love cats.  
大象喜歡我。→ Elephants love me.  
他喜歡狗。→ He loves dogs.  
他們喜歡魚。→ They love fish.  
我們喜歡猴子。→ We love monkeys.  
你喜歡豬。→ You love pigs.



我	I	0.50
我	me	0.50
你	you	1.00
他	he	1.00
貓	cats	1.00
狗	dogs	1.00
魚	fish	1.00
豬	pigs	1.00
猴子	monkeys	1.00
大象	elephants	1.00
喜歡	love	0.83
喜歡	loves	0.17
我們	we	1.00
他們	they	1.00
。	.	1.00

User's Input

狗喜歡大象。

我	I	0.50
我	me	0.50
你	you	1.00
他	he	1.00
貓	cats	1.00
狗	dogs	1.00
魚	fish	1.00
豬	pigs	1.00
猴子	monkeys	1.00
大象	elephants	1.00
喜歡	love	0.83
喜歡	loves	0.17
我們	we	1.00
他們	they	1.00
。	.	1.00

狗	dogs	1.00
大象	elephants	1.00
喜歡	love	0.83
喜歡	loves	0.17
。	.	1.00

Bilingual Table

Dogs love elephants.  
Dogs elephants love.  
Love dogs elephants.  
Love elephants dogs.  
Elephants love dogs.  
Elephants dogs love.  
Dogs loves elephants.  
Dogs elephants loves.  
Loves dogs elephants.  
Loves elephants dogs.  
Elephants loves dogs.  
Elephants dogs loves.

MT Output

Dogs love elephants.

dogs	0.08
elephants	0.08
love	0.12
loves	0.04

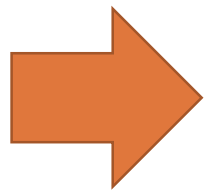
Monolingual Table

# Methods

Rule-based Approach

Example-based Approach

Statistical Approach

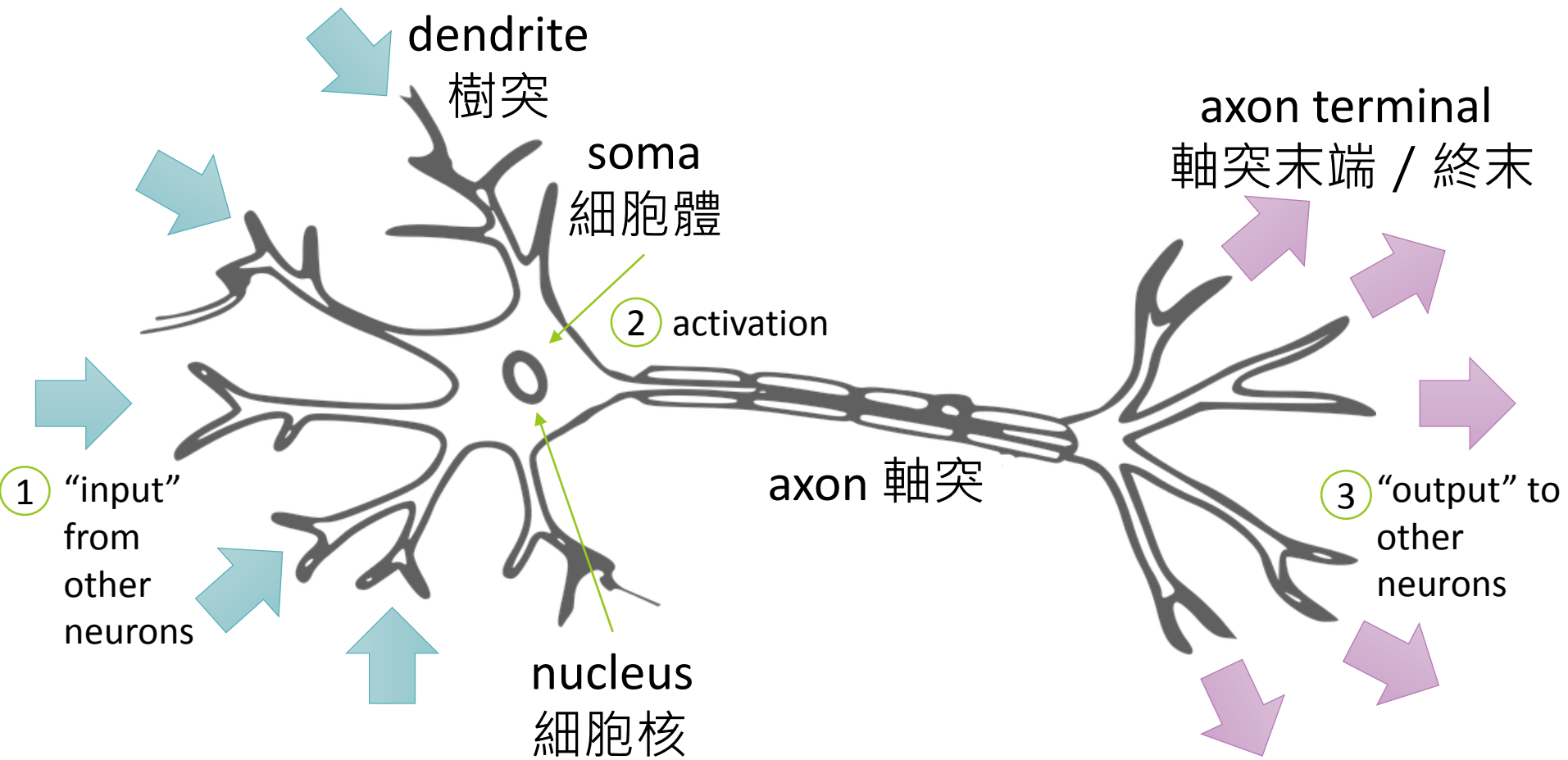


Deep Learning Approach

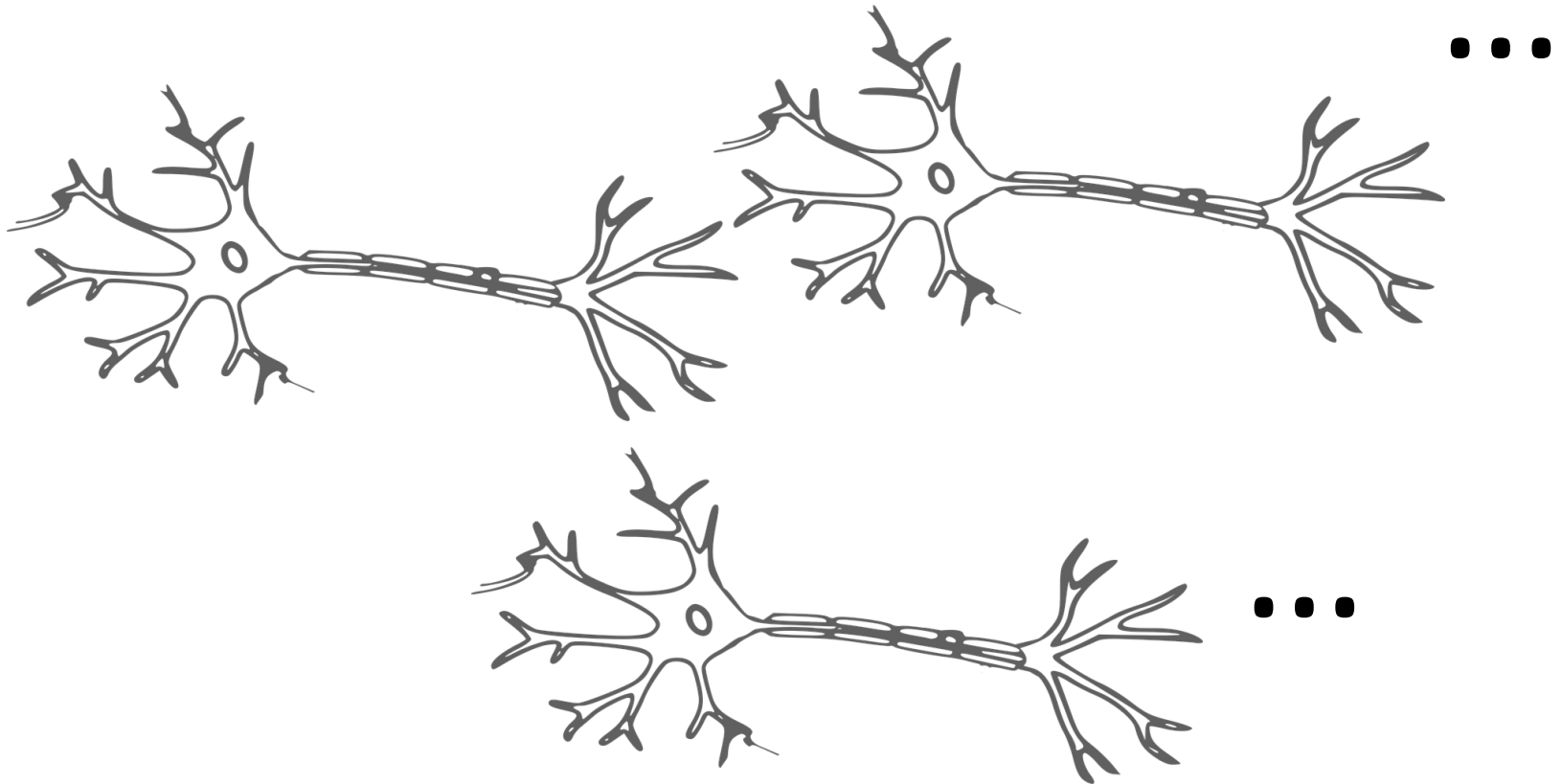




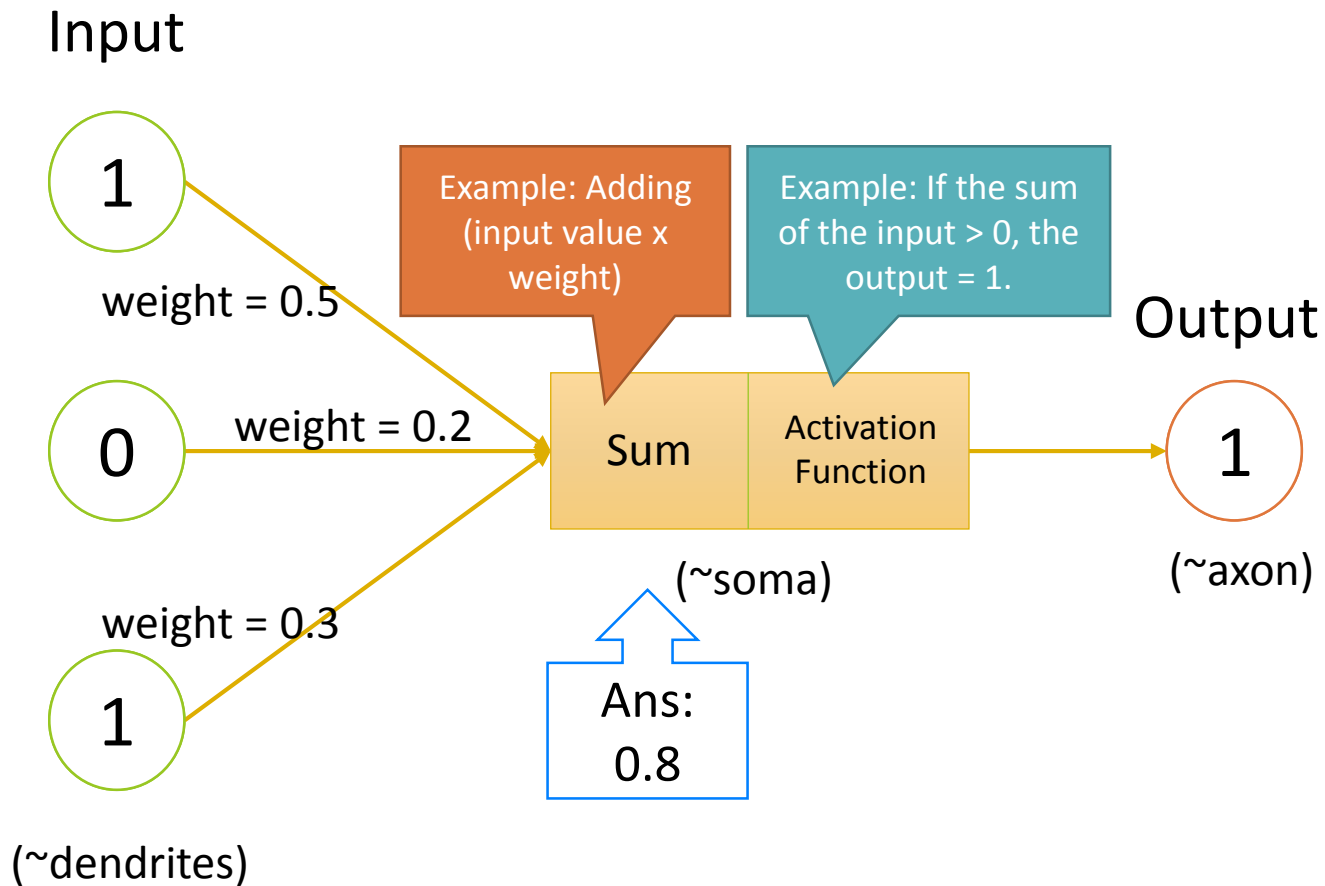
# Biological Neuron



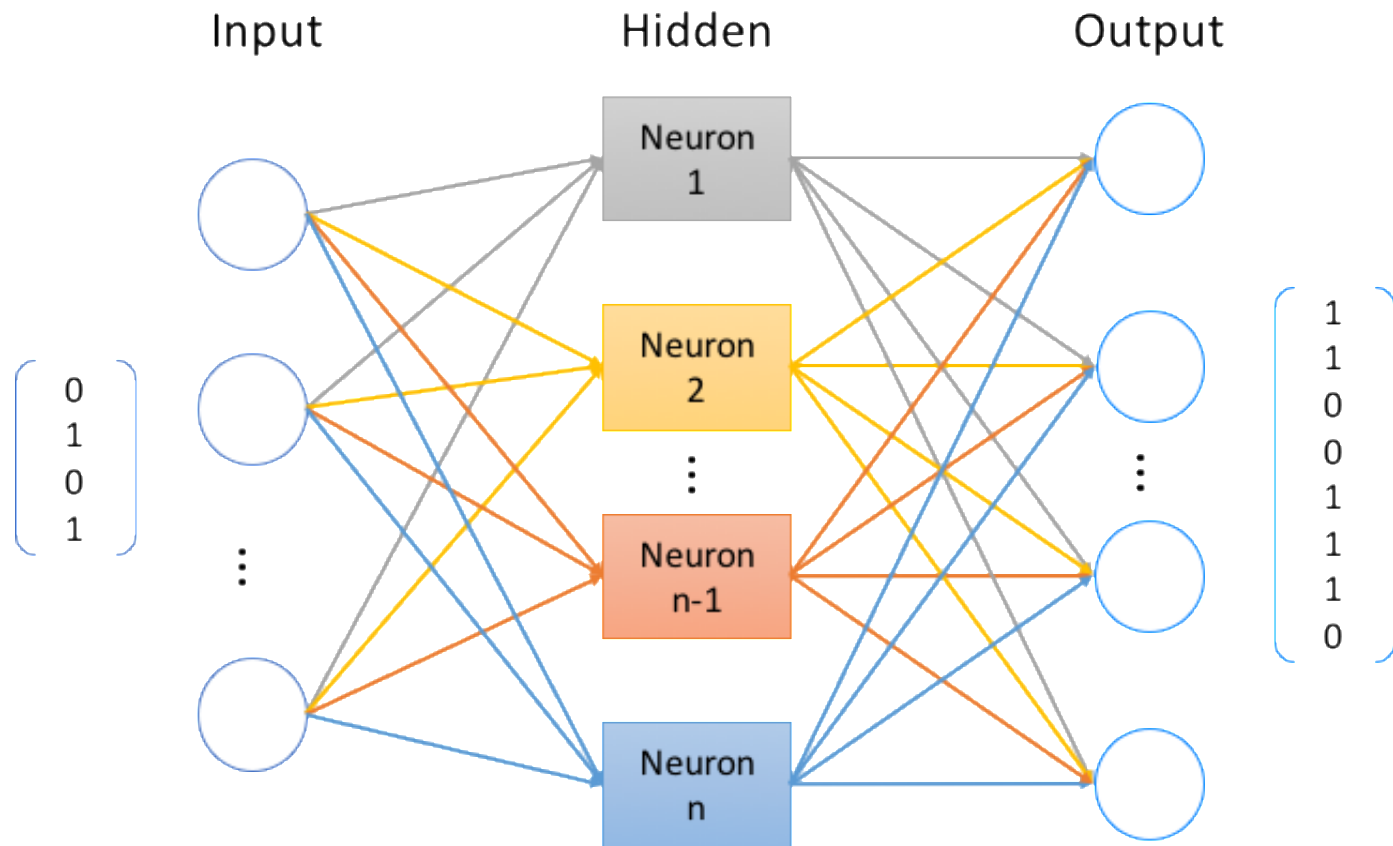
# Biological Neural Network



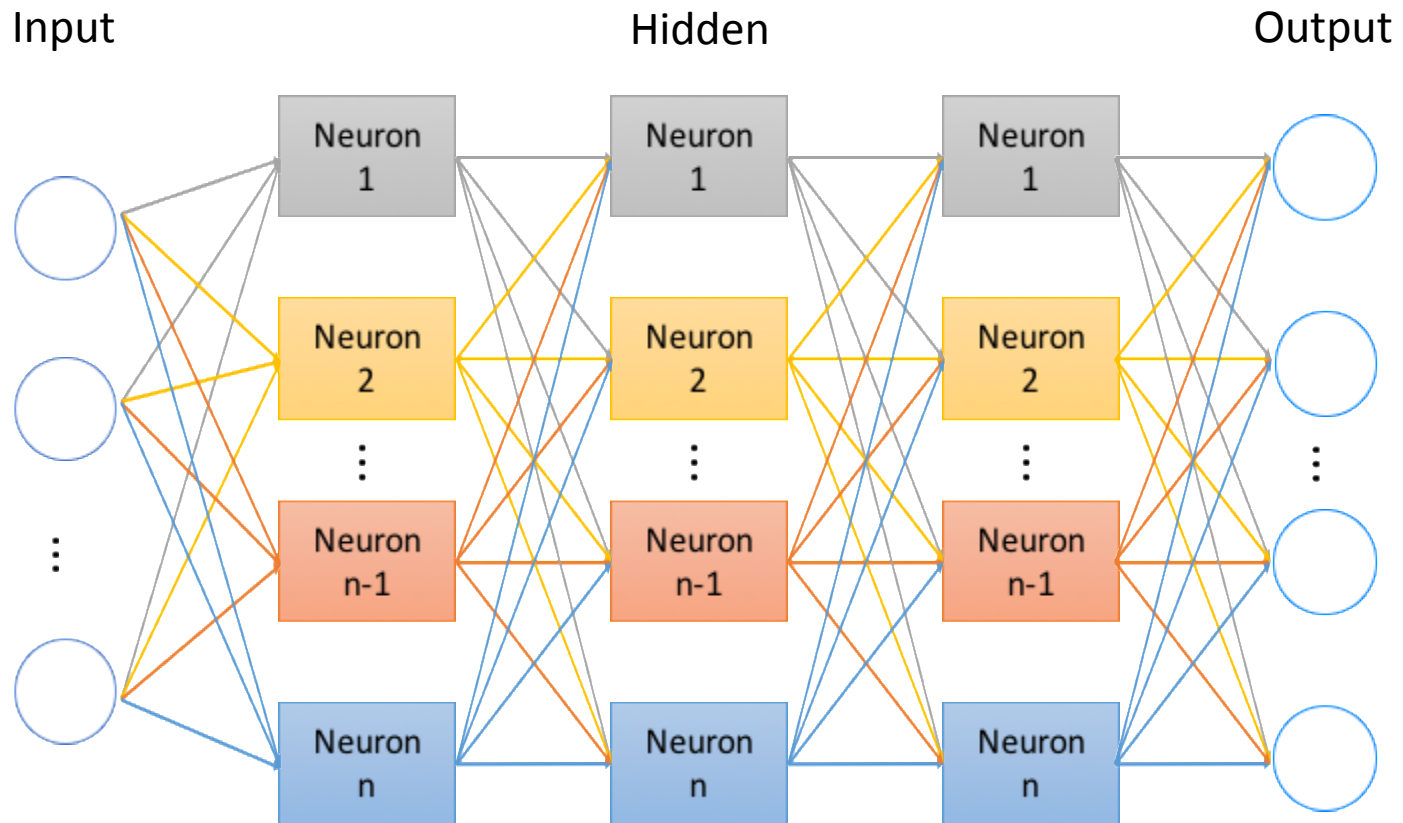
# Artificial Neuron



# Artificial Neural Network: Many Neurons



# Deep Learning: Multiple Hidden Layers



# Automatic Translation as a Prediction Problem: Given X, what is the next word?

Given the following:

ST: I / go / to / school / by / bus / . /

TT: 我 / 乘

Which of the following is most likely to be the next word?

公車

火車

學校

咖啡

電腦

翻譯



# Deep Learning and Automatic Translation

Given [I] / [go] / [to] / [school] / [by] / [train] / [.] , what is the next word?

我

[I] / [go] / [to] / [school] / [**by**] / [train] / [.] / [我]  $\Rightarrow$  ?

乘

[I] / [go] / [to] / [school] / [by] / [**train**] / [.] / [我] / [乘]  $\Rightarrow$  ?

火車

[I] / [**go**] / [**to**] / [school] / [by] / [train] / [.] / [我] / [乘] / [公車]  $\Rightarrow$  ?

去

[I] / [go] / [to] / [**school**] / [by] / [train] / [.] / [我] / [乘] / [公車] / [去]  $\Rightarrow$  ?

學校

[I] / [go] / [to] / [school] / [by] / [train] / [.] / [我] / [乘] / [公車] / [去] / [學校] /  $\Rightarrow$  ?

。

Translation: 我乘火車去學校。



# Outline

- Useful Tools for Professional Translators
- AI and Translation Technology
- Ways to Make Better Use of Automatic Translation Systems





# Be a Smart User!

Domain-specific Systems

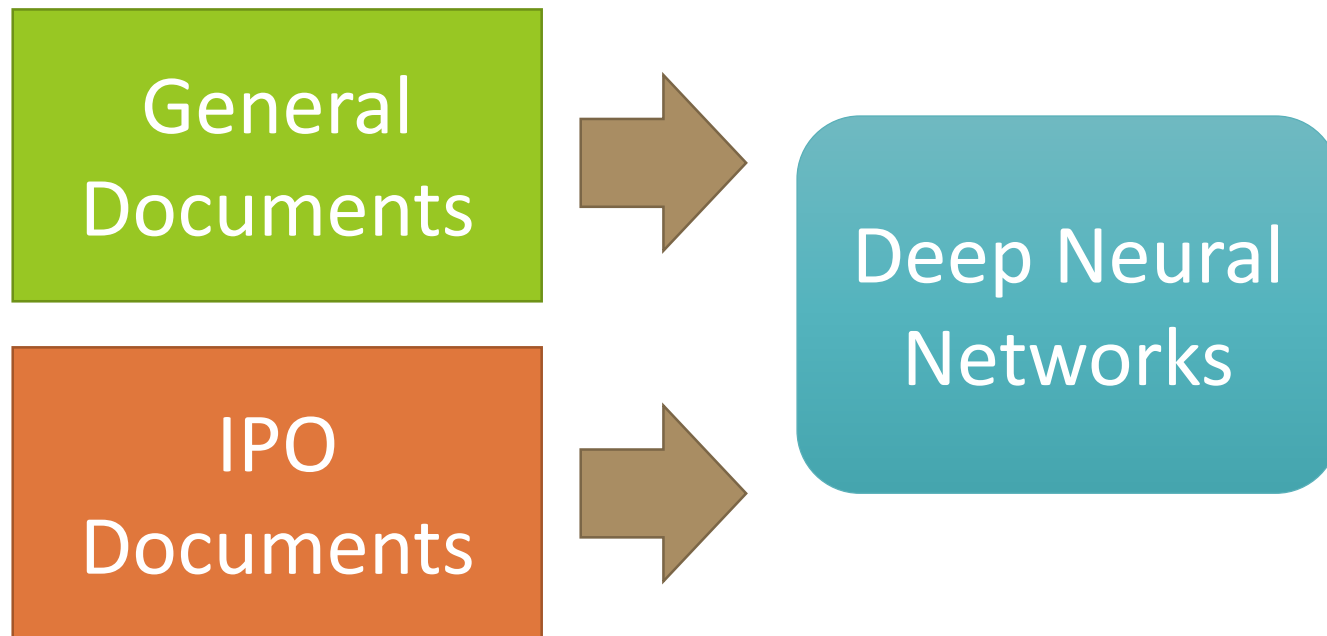
Multiple Systems

Customizable Systems



# Domain-specific Systems

- Example: Our Project
- Machine Translation of IPO Documents



# Multiple Systems

- Qtranslate: <http://quest-app.appspot.com/home>
- ImTranslator: <http://imtranslator.net/compare/>



# Customizable Systems

- Our Prototype  
(<https://customizemt.000webhostapp.com/>)



# Making MT More Useful

- Automatic Segmentation
- Customizable Translation Database
- Key Expression Identification
- Instant Search



# Customizable Automatic Translation System

Source Text	My Translation Database
<div>Source Text</div> <div></div> <div><div>Go</div><div>Load Sample</div></div>	

# Customizable Automatic Translation System

Source TextMy Translation Database

Translation database

Sample

Select CSV File(s)選擇檔案deepLearningDe...o\_HSU (2).csv

	A	B
1	HSUHK	恒太
2	HSMC	恒管
3	HSSC	恒商
4	Hang Seng Management College	恒生管理學院
5	S H Ho Foundation	何善衡慈善基金會
6	Dah Chong Hong Limited	大昌貿易行
7	non-profit	非牟利
8	Schools	學院
9	a leading private liberal-arts-oriented university in the region	區內具領導地位並以博雅教育為主導的私立大學
10	concentrations	專修
11	Communication	傳播
12	Applied and Human-Centred Computing	應用及人本計算學
13	Convergent Media and Communication Technology	融合媒體及傳播科技
14	Master of Science in Global Supply Chain Management	環球供應鏈管理學碩士
15	Master of Arts in Strategic Communication	策略傳播文學碩士
16	Master of Arts in Translation (Computer-aided Translation)	翻譯文學碩士（電腦輔助翻譯）
17	The "Liberal + Professional" Education Model	「博雅 + 專業」教育模式
18	Intellectual Competence	智能／思考能力
19	Generic Skills	共通技能
20	Personal Development	個人發展
21	Social Engagement	投入社群
22	programmes	課程

# Customizable Automatic Translation System

Source Text

My Translation Database

Source Text

The Hang Seng University of Hong Kong's (HSUHK) roots stretch back 38 years to the establishment of Hang Seng School of Commerce (HSSC) in 1980, with funding from the S H Ho Foundation, the Ho Tim Charitable Foundation, Dah Chong Hong Limited, several Hang Seng Bank founding directors and Hang Seng Bank Limited. From 1980 to 2009, HSSC was a pioneering and leading provider of post-secondary programmes in business and related areas.

In response to the Chief Executive's Policy Address in 2009 which highlighted the growing significance of quality private universities in Hong Kong, HSSC, in 2010, was re-structured into Hang Seng Management College (HSMC), a non-profit private university-level institution registered under the Post Secondary Colleges Ordinance (Cap 320) to offer bachelor's and above degree programmes in diversified disciplines.

Go Load Sample

ST	TT	
The Hang Seng University of Hong Kong's (HSUHK) roots stretch back 38 years to the establishment of Hang Seng School of Commerce (HSSC) in 1980, with funding from the S H Ho Foundation, the Ho Tim Charitable Foundation, Dah Chong Hong Limited, several Hang Seng Bank founding directors and Hang Seng Bank Limited.	香港恒生大學（恆大）的歷史可追溯至1980年，由恆善街慈基金會，何添慈善基金會，大昌貿易行資助，成立恒生商學院。 · 幾位恒生銀行的創始董事和恒生銀行有限公司。	<div>🔍</div>
From 1980 to 2009, HSSC was a pioneering and leading provider of post-secondary programmes in business and related areas.	從1980年到2009年，恆商是商業及相關領域的專業課程的先驅和領先提供商。	<div>🔍</div>
In response to the Chief Executive's Policy Address in 2009 which highlighted the growing significance of quality private universities in Hong Kong, HSSC, in 2010, was re-structured into Hang Seng Management College (HSMC), a non-profit private university-level institution registered under the Post Secondary Colleges Ordinance (Cap 320) to offer bachelor's and above degree programmes in diversified disciplines.	為回應行政長官在二零零九年發表的施政報告，其中強調優質私立大學在香港日益重要，2010年，恆商被重組為恒生管理學院（恆生），這是一所非牟利私立大學的機構。根據「專上學院條例」（第320章）註冊，提供多元化學科的學士及以上學位課程。	<div>🔍</div>
Eight years later, on 30 October 2018, HSMC was granted approval by the Government of the Hong Kong Special Administrative Region (HKSAR) to change its title from "Hang Seng Management College" to "The Hang Seng University of Hong Kong".	八年後，即2018年10月30日，恆管獲香港特別行政區政府批准將其名稱由“恒生管理學院”改為“香港恒生大學”。	<div>🔍</div>
HSUHK aspires to be a leading private liberal-arts-oriented university in the region, recognised for excellence in teaching, learning and research, serving and advancing our society and the world.	恆大渴望成為區內具領導地位並以博雅教育為主導的私立大學，在教學、學習和研究方面表現卓越，服務和推動我們的社會和世界。	<div>🔍</div>
HSUHK has five Schools (Business, Communication, Decision Sciences, Humanities and Social Science, and Translation) with a student population of around 5,000 and 200 full-time academic staff members.	恆大有五個學院（商業、傳播、決策科學、人文社會科學和翻譯），學生人數約5,000，全職學術人員200。	<div>🔍</div>
HSUHK currently offers 17 4-year bachelor's (Honours) degree programmes, namely, Business Administration (with concentrations in Accounting, Banking and Finance, and Marketing), Corporate Governance, Financial Analysis, Management, Human Resource Management, Journalism and Communication, Convergent Media and Communication Technology, Actuarial Studies and Insurance, Data Science and Business Intelligence, Management Science and Information Management, Supply Chain Management, Applied and Human-Centred Computing, Asian Studies, Cultural and Creative Industries, Chinese, English, and Translation with Business	恆大目前提供17個4年制學士（榮譽）學位課程，即工商管理（會計、銀行和金融專業，市場營銷），公司治理、財務分析、管理、人力資源管理、新聞和傳播、融合媒體及傳播科技、精算研究與保險、數據科學與商業智能、管理科學與信息管理、供應鏈管理、應用及以人為本的計算、亞洲研究、文化與創意產業、中	<div>🔍</div>



from "Hang Seng Management College" to "The Hang Seng University of Hong Kong".	生管理學院"改為"香港恆生大學"。	
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<div>Alternative MT (without DB) HSUHK目前提供17個4年制學士（榮譽）學位課程，即工商管理（會計、銀行和金融、營銷專業），公司治理、財務分析、管理、人力資源管理、新聞與傳播、Convergent Media和通信技術、精算研究和保險、數據科學和商業智能、管理科學和信息管理、供應鏈管理、應用和人類中心計算、亞洲研究、文化和創意產業、中文、英語和商務翻譯，擁有五個碩士學位課程－創業管理理學碩士、戰略傳播文學碩士、全球供應鏈管理理學碩士、翻譯（商業和法律）文學碩士和翻譯文學碩士（計算機輔助翻譯）。</div> <div>Relevant Expression Master of Arts in Translation (Computer-aided Translation): 翻譯文學碩士（電腦輔助翻譯）</div> <div>Relevant Expression Master of Science in Global Supply Chain Management: 環球供應鏈管理理學碩士</div> <div>Relevant Expression Convergent Media and Communication Technology: 融合媒體及傳播科技</div> <div>Relevant Expression Master of Arts in Strategic Communication: 策略傳播文學碩士</div> <div>Relevant Expression Applied and Human-Centred Computing: 應用及人本計算學</div> <div>Relevant Expression concentrations: 專修</div> <div>Relevant Expression Communication: 傳播</div> <div>Relevant Expression programmes: 課程</div> <div>Relevant Expression HSUHK: 恆大</div>		
Many of these programmes are unique and the first of its kind in the region.	其中許多課程都是獨一無二的，也是該地區的第一個課程。	
All programmes were accredited by the Hong Kong Council for Accreditation of Academic and Vocational Qualifications (HKCAAVQ) and recognised by the Governments of the HKSAR, mainland China and Taiwan.	所有課程均獲香港學術及職業資歷評審局（HKCAAVQ）認可，並獲香港特別行政區政府、中國大陸及台灣政府認可。	
The "Liberal + Professional" Education Model HSUHK identifies quality teaching and students' all-round development as its highest priorities.	「博雅+專業」教育模式恆大將優質教學和學生的全面發展作為首要任務。	

# Many other tools

Tools for Medical  
Translation

Tools for Translation of  
Government  
Documents

Tools for Scientific  
Translation

Tools for Translation of  
Philosophical Texts

Tools for Interpreting

Tools for Subtitling

Tools for Web  
Translation

Tools for Bilingual  
Digital Marketing

Tools for Team  
Translation / Project  
Management



Short Courses

MA in  
Translation

# Other Research Projects

- Prototype: IPO prospectus
- MT-CAT Integration (with multiple translation suggestions?)
- Computer-aided Interpreting



# Thank you very much!

- Email: [scsiu@hsu.edu.hk](mailto:scsiu@hsu.edu.hk)
- Website: <https://www.hsuhk-translation-technology.com>
- More Workshops:



Our Facebook  
<https://goo.gl/M9rHs5>



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