Generative Adversarial Network (GAN)
## and its Applications to
Human Language Processing
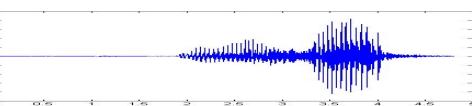
Hung-yi Lee

Full version of tutorial: https://www.slideshare.net/ssuserf10be3/icassp-2018-tutorial-generative-adversarial-network-and-its-applications-to-signal-processing-and-natural-language-processing
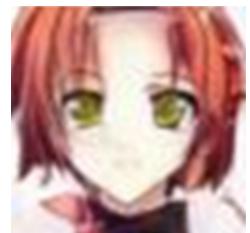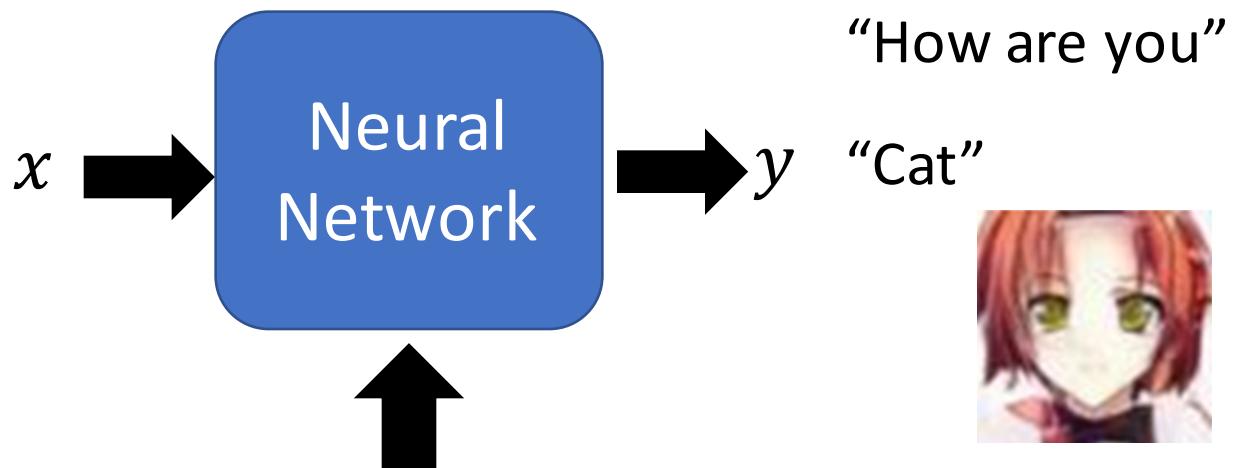
Supervised Learning

Many kinds of networks:

➢ Fully connected feedforward network
➢ Convolutional neural network (CNN)
➢ Recurrent neural network (RNN)

x → **Neural Network** → y
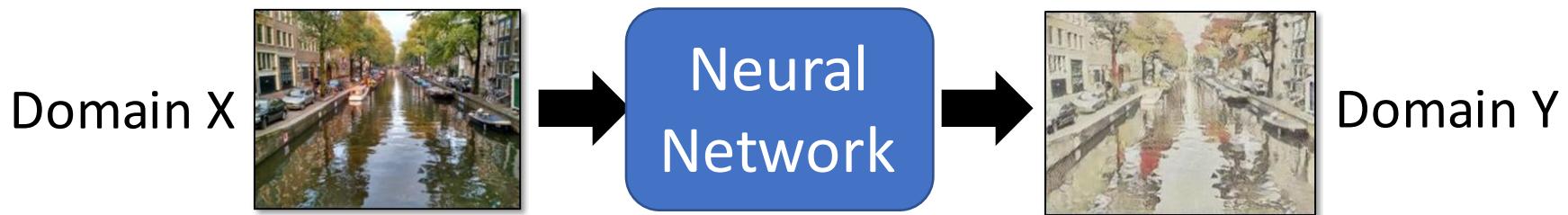
red hair, green eyes

"How are you"

"Cat"

How to find the function?

Given the examples of inputs/outputs as (**training data**): $\{(x_1,y_1),(x_2,y_2), \ldots, (x_{1000},y_{1000})\}$

Thanks to GAN

Domain X → Neural Network → Domain Y

Transform an object from one domain to another ***without paired data*** (e.g. style transfer)

Domain X

No paired data!

Domain Y

How to achieve that? https://youtu.be/-3LgL3NXLtI

Unsupervised Learning by GAN

It is good.

It's a good day.

I love you.

⟷

It is bad.

It's a bad day.

I don't love you.

Positive Sentences

Negative Sentences

- Negative sentence to positive sentence:
  it's a crappy day → it's a great day
  i wish you could be here → you could be here
  it's not a good idea → it's good idea
  i miss you → i love you
  i don't love you → i love you
  i can't do that → i can do that
 i feel so sad → i happy
  it's a bad day → it's a good day
  it's a dummy day → it's a great day
  sorry for doing such a horrible thing → thanks for doing a great thing
  my doggy is sick → my doggy is my doggy
  my little doggy is sick → my little doggy is my little doggy
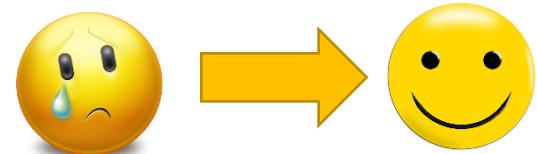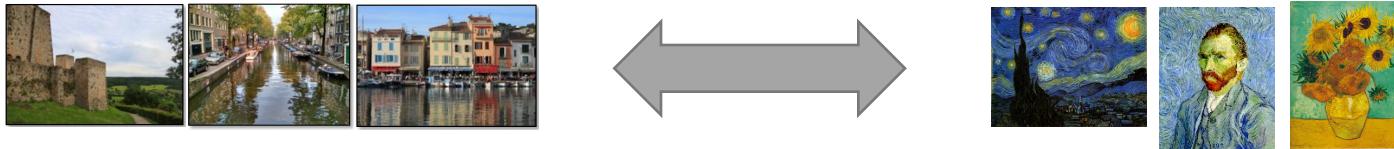
Learn more from our poster

Unsupervised Learning by GAN

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document
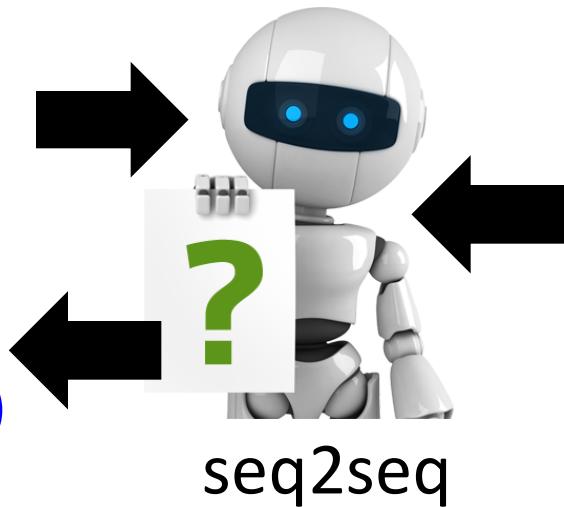
summary

Unsupervised
Summarization

Abstractive Summarization

- Now machine can do **abstractive summary** by seq2seq (write summaries in its own words)

summary 1

summary 2

summary 3

summary
(in its own words)

seq2seq

Labelled
Training Data

**Supervised: We need lots of labelled training data.**
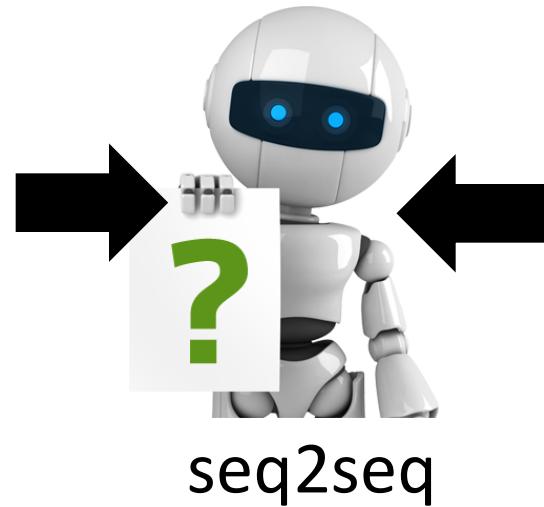
Unsupervised Abstractive Summarization

- Now machine can do **abstractive summary** by seq2seq (write summaries in its own words)

summary 1

summary 2

summary 3

seq2seq

Unsupervised Abstractive Summarization
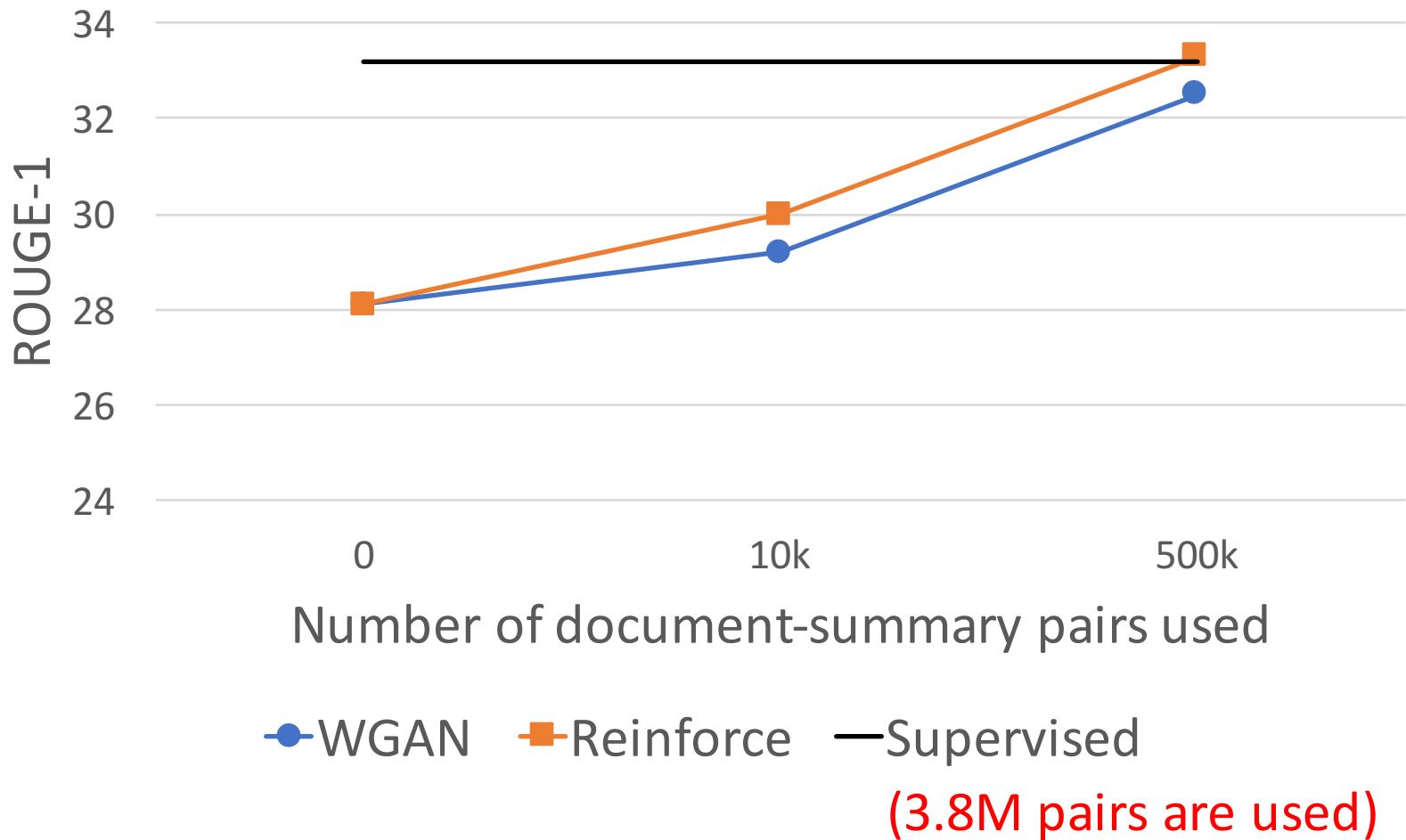
- ***Document***:澳大利亞今天與13個國家簽署了反興奮劑雙邊協議,旨在加強體育競賽之外的藥品檢查並共享研究成果 ……

- ***Summary***:
  - Human:澳大利亞與13國簽署反興奮劑協議
  - Unsupervised:澳大利亞加強體育競賽之外的藥品檢查

- ***Document***:中華民國奧林匹克委員會今天接到一九九二年冬季奧運會邀請函,由於主席張豐緒目前正在中南美洲進行友好訪問,因此尚未決定是否派隊赴賽 ……

- ***Summary***:
  - Human:一九九二年冬季奧運會函邀我參加
  - Unsupervised:奧委會接獲冬季奧運會邀請函

Unsupervised Abstractive Summarization
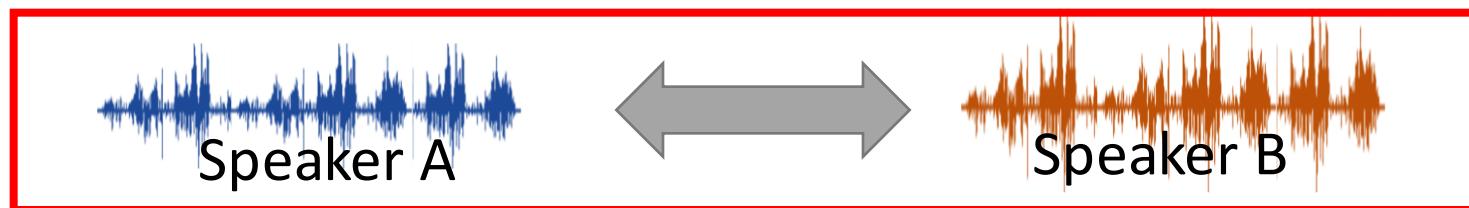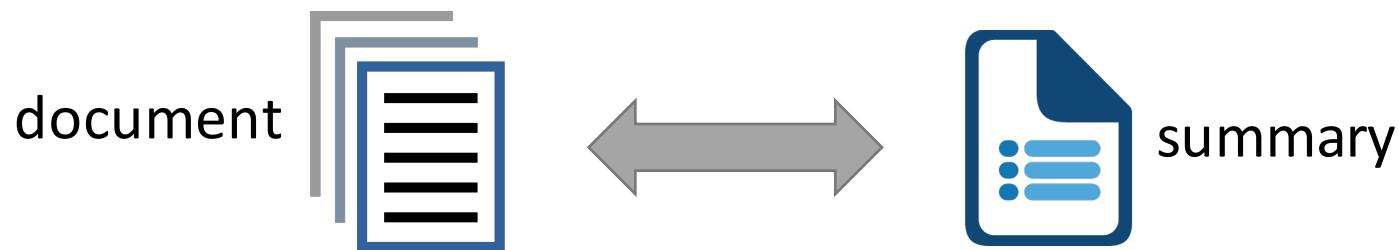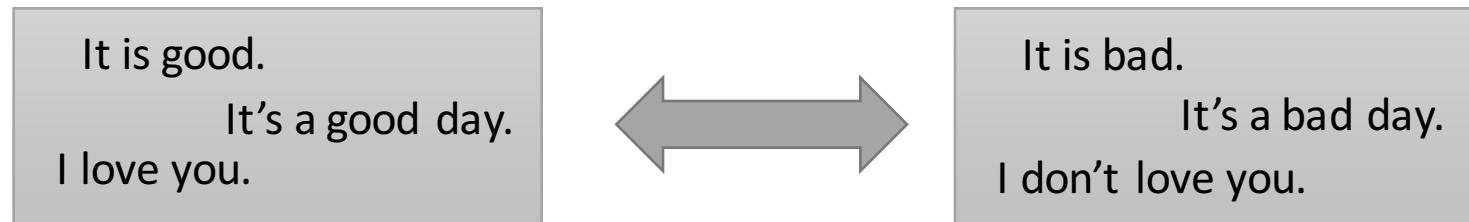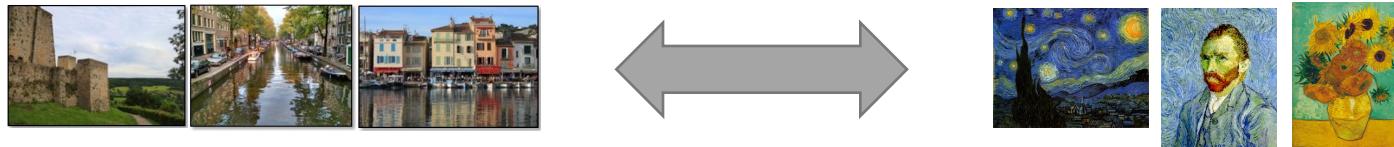
- ***Document***:據此間媒體27日報道,印度尼西亞蘇門答臘島的兩個省近日來連降暴雨,洪水泛濫導致塌方,到26日為止至少已有60人喪生,100多人失蹤 ……

- ***Summary***:
  - Human:印尼水災造成60人死亡
  - Unsupervised:印尼門洪水泛濫導致塌雨

- ***Document***:安徽省合肥市最近為領導幹部下基層做了新規定:一律輕車簡從,不準搞迎來送往、不準搞層層陪同 ……

- ***Summary***:
  - Human:合肥規定領導幹部下基層活動從簡
  - Unsupervised:合肥領導幹部下基層做搞迎來送往規定:一律簡

Semi-supervised Learning

Unsupervised Learning by GAN

It is good.
It's a good day.
I love you.

It is bad.
It's a bad day.
I don't love you.

document

summary
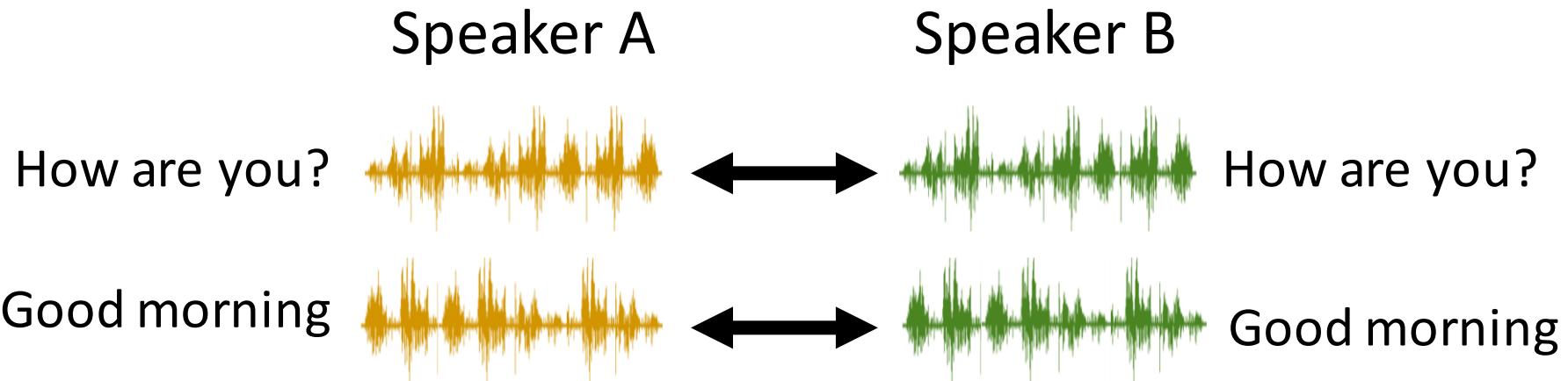
Speaker A

Speaker B

Unsupervised Voice Conversion
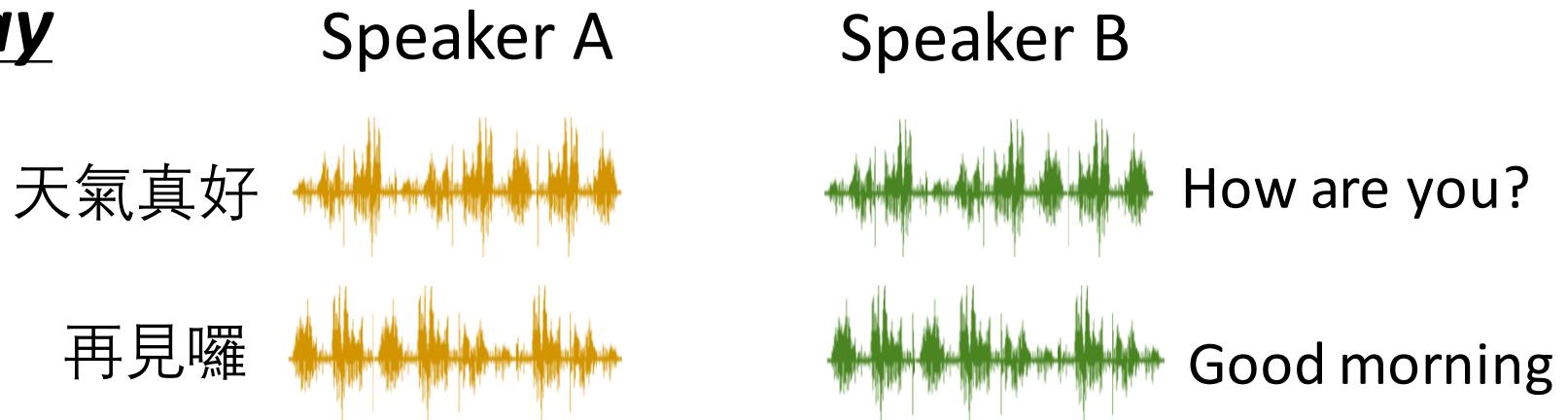
Voice Conversion

In the past

Speaker A — Speaker B

How are you? ⟷ How are you?

Good morning ⟷ Good morning

Today

Speaker A — Speaker B

天氣真好 — How are you?

再見囉 — Good morning

Speakers A and B are talking about completely different things.

Speaker A
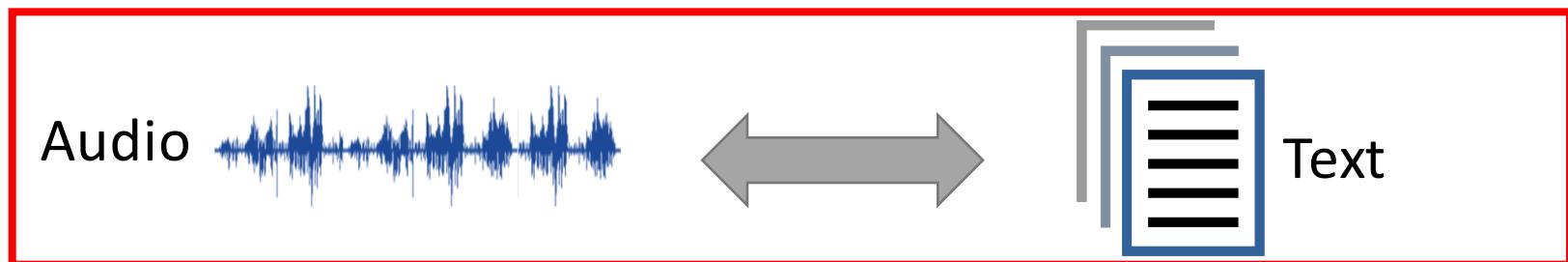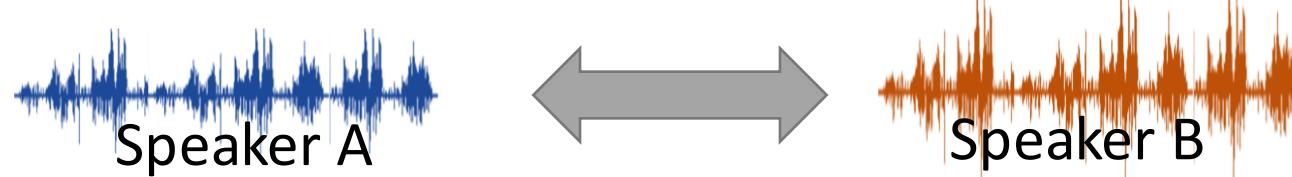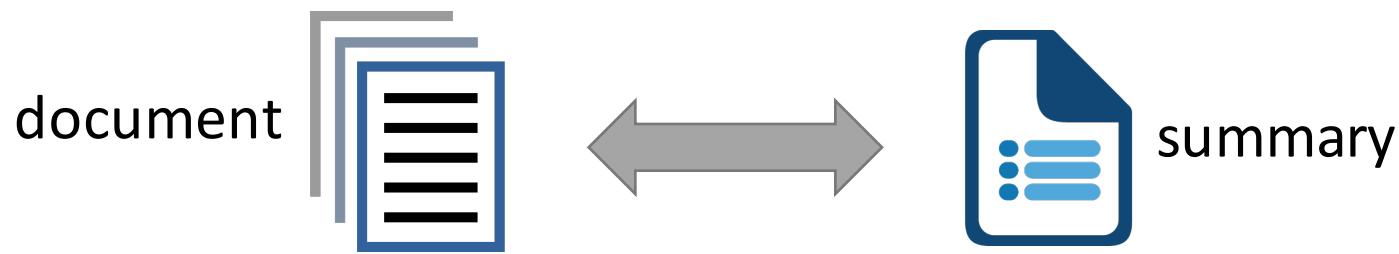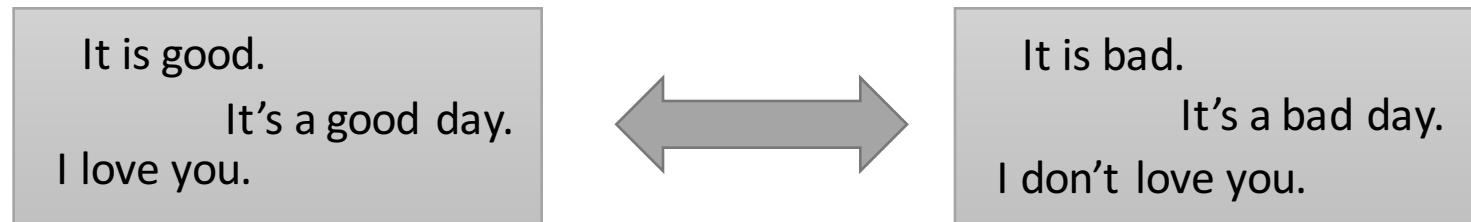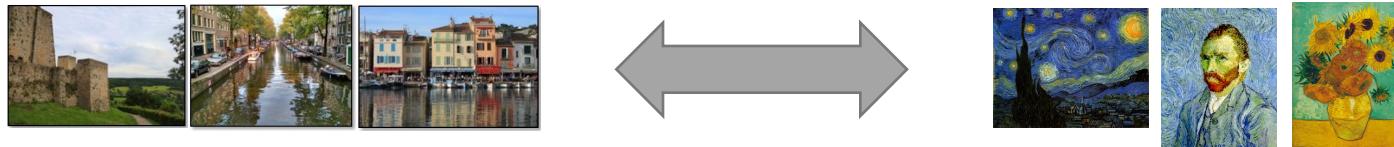
我

Speaker B
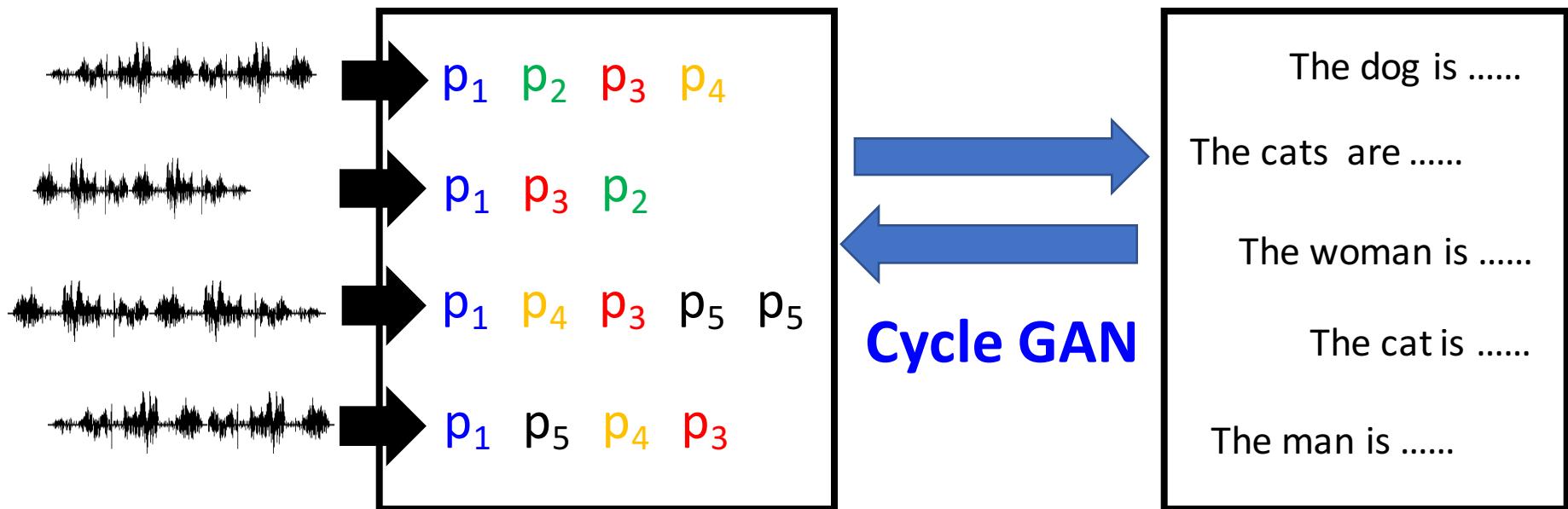
感謝周儒杰同學提供實驗結果

Unsupervised Learning by GAN
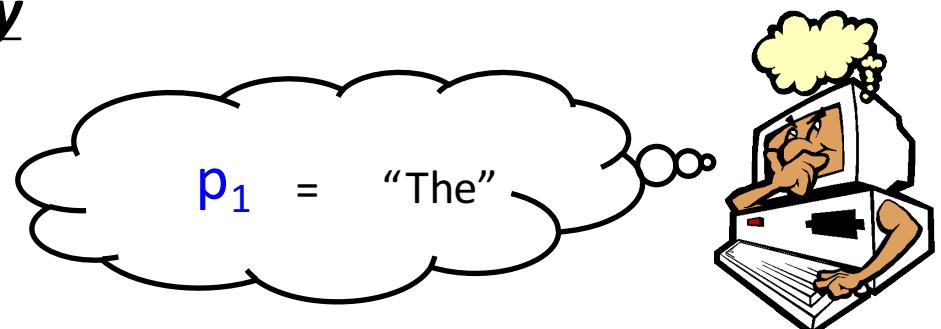
Unsupervised Speech Recognition

Acoustic Pattern Discovery

Can we achieve unsupervised speech recognition?

Cycle GAN

p_1 = "The"
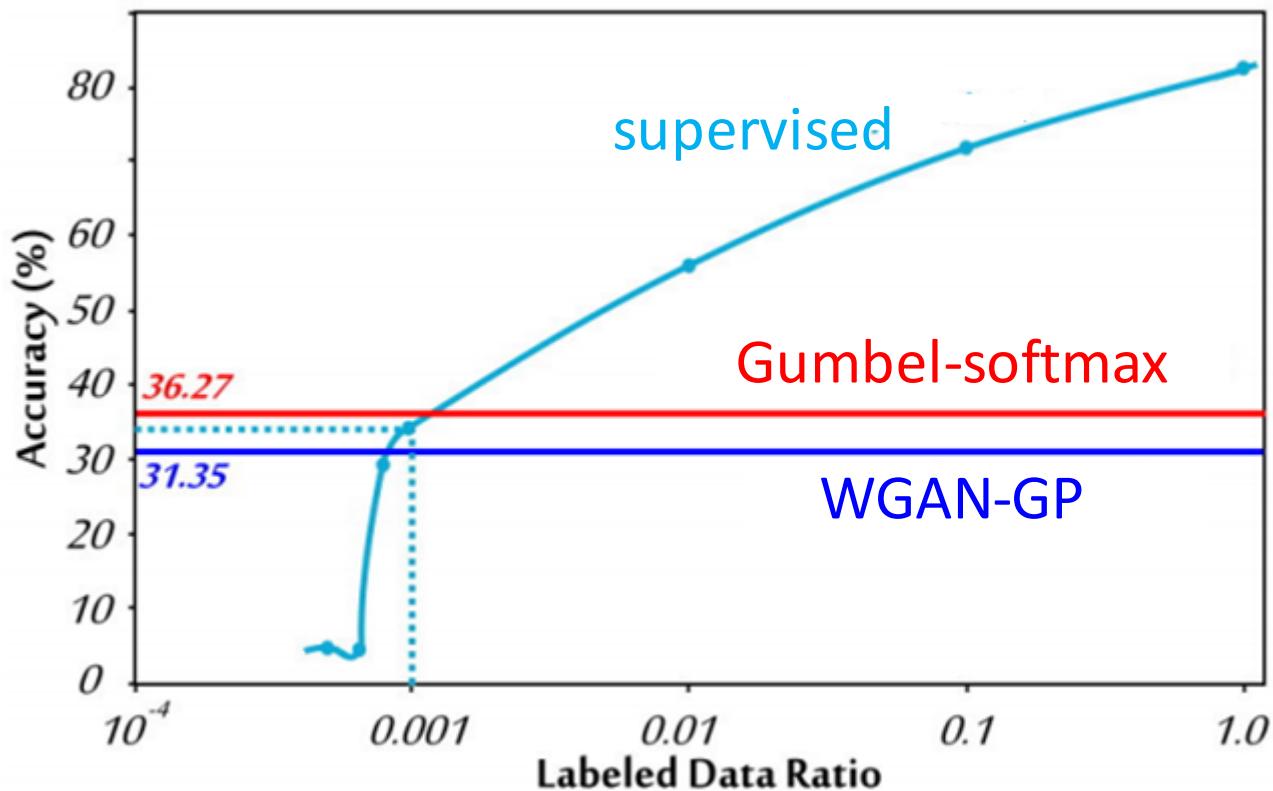
[Liu, et al., arXiv, 2018] [Chen, et al., arXiv, 20

Unsupervised Speech Recognition

- Phoneme recognition

Audio: TIMIT
Text: WMT

Unsupervised Learning by GAN