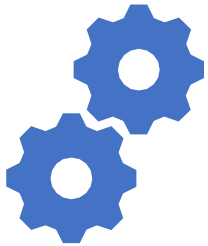
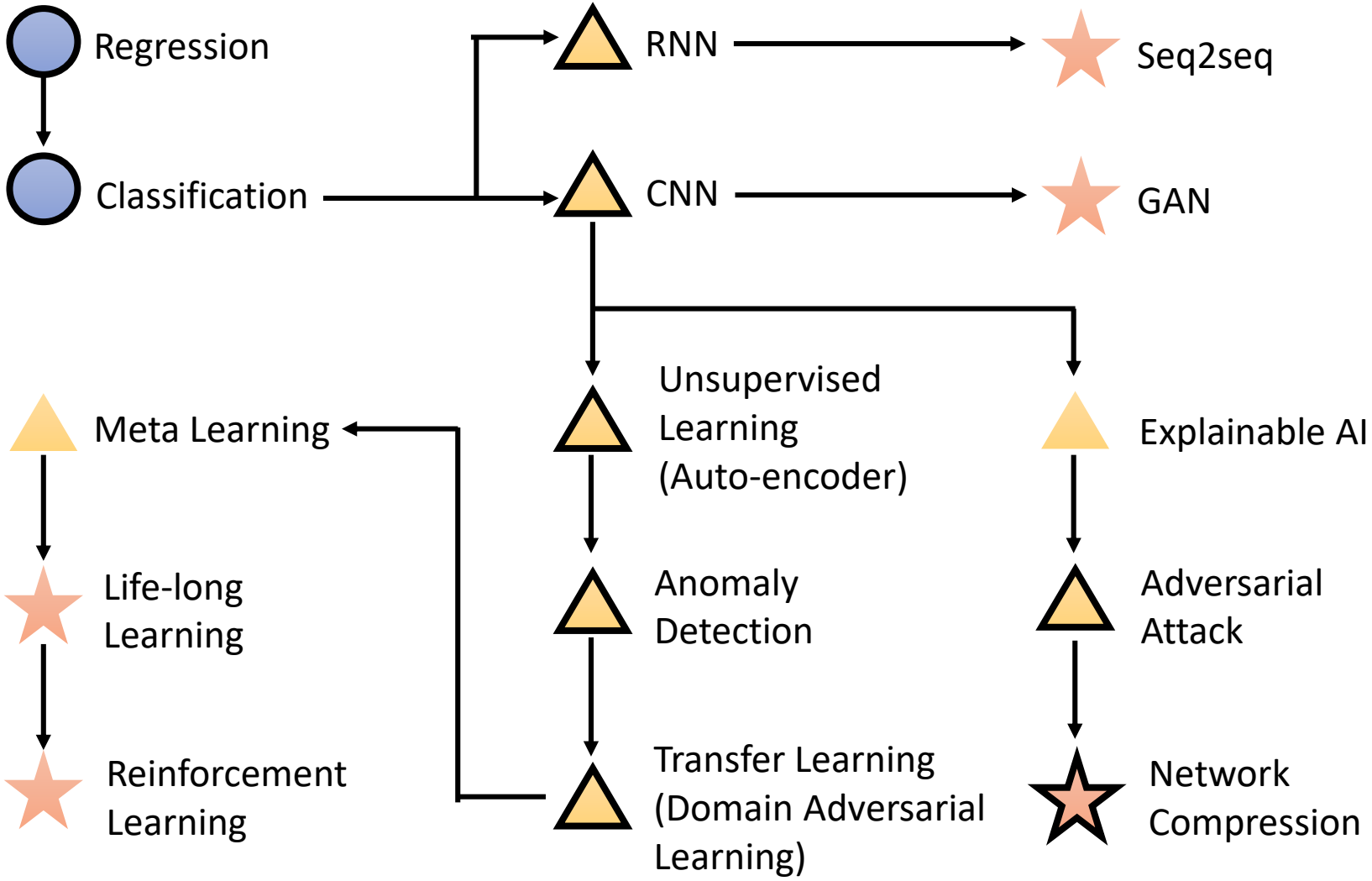
Machine Learning 2020



李宏毅

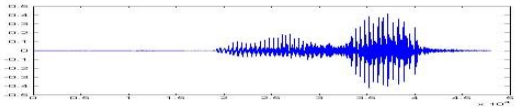
Hung-yi Lee

本學期總共有十五個作業 (每項作業滿分皆為10 分，學期成績以分數最高的前十個作業計算)



機器學習就是自動找函式

- Speech Recognition

$f($  $)=$ “How are you”

- Image Recognition

$f($  $)=$ “Cat”

- Playing Go

$f($  $)=$ “5-5” (next move)

- Dialogue System

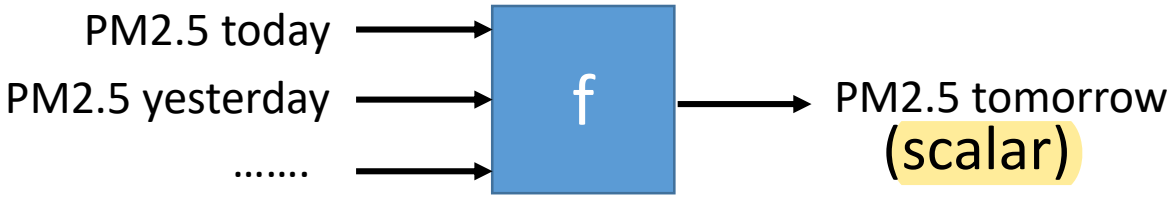
$f($ “How are you?” $)=$ “I am fine.”

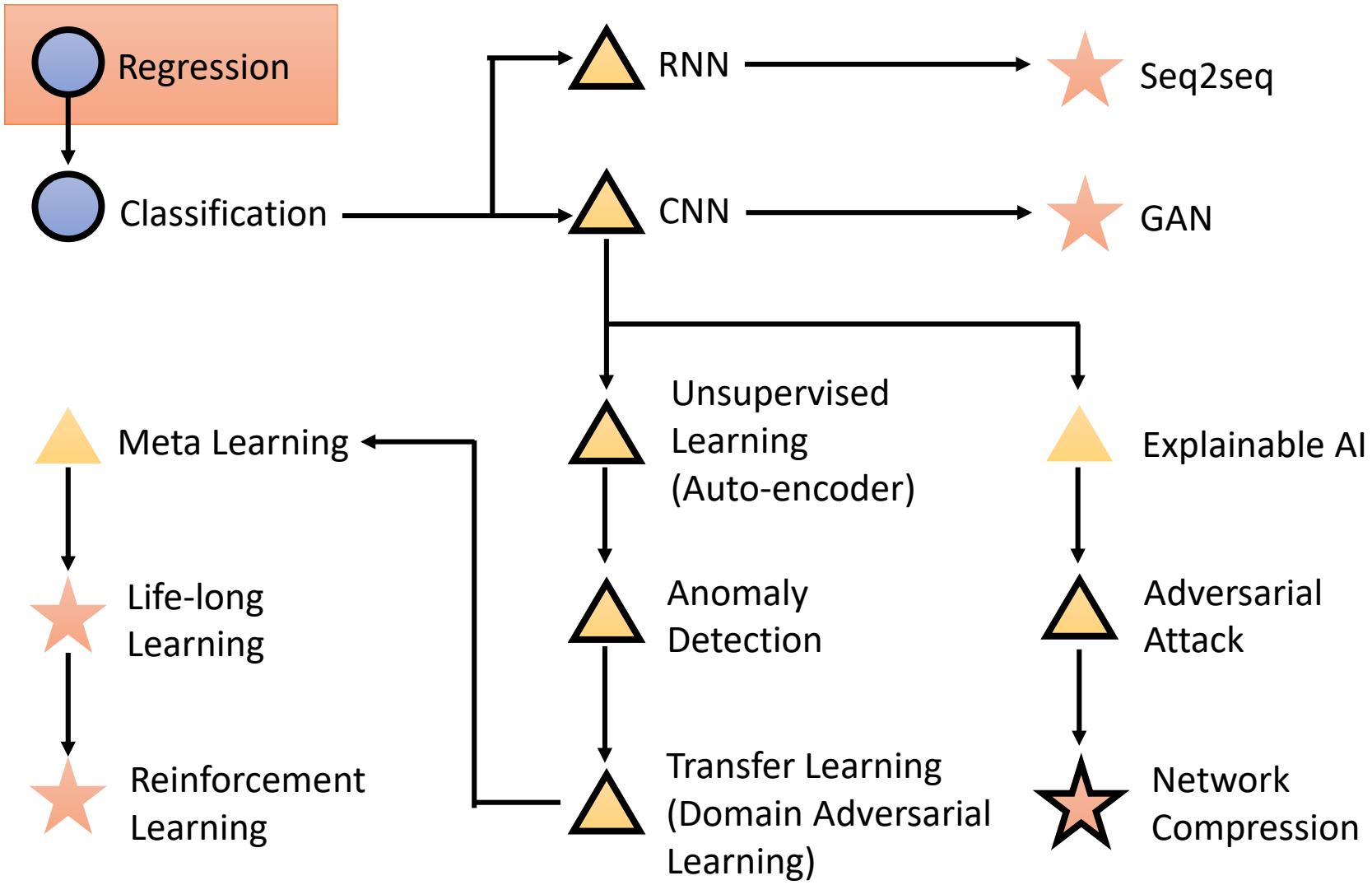
(what the user said) (system response)

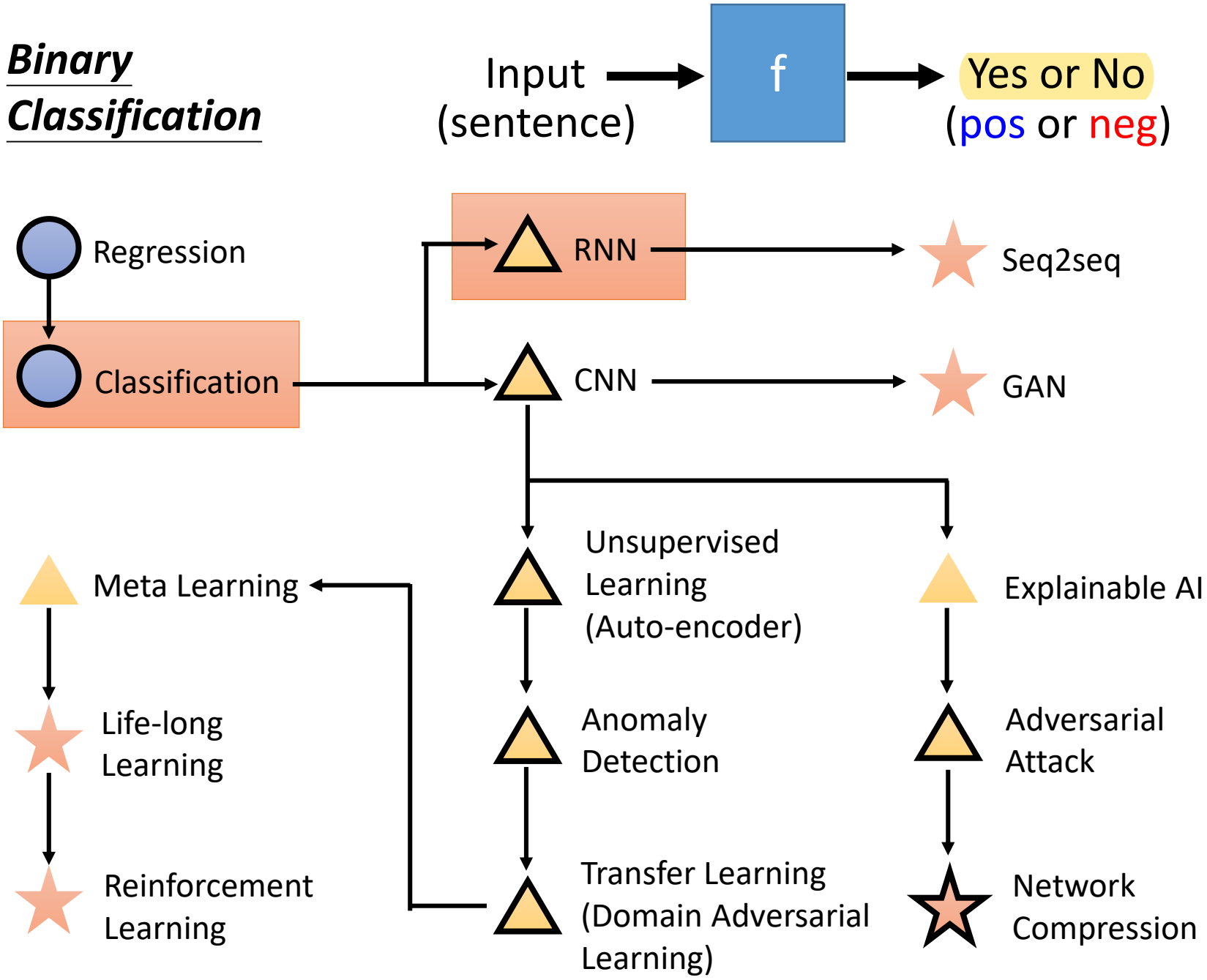
你想找什麼樣的函式？

Regression

The output of the function is a scalar.






Binary Classification
Input (sentence)
f
Yes or No (pos or neg)
Regression
Classification
RNN
CNN
Seq2seq
GAN
Meta Learning
Life-long Learning
Reinforcement Learning
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
Adversarial Attack
Network Compression

Multi-class Classification

Input

f

Class 1, Class 2, … Class N

麵包　　蛋　　湯

Regression

Classification

RNN

Seq2seq

CNN

GAN

Meta Learning

Life-long Learning

Reinforcement Learning

Unsupervised Learning (Auto-encoder)

Anomaly Detection

Transfer Learning (Domain Adversarial Learning)

Explainable AI

Adversarial Attack

Network Compression

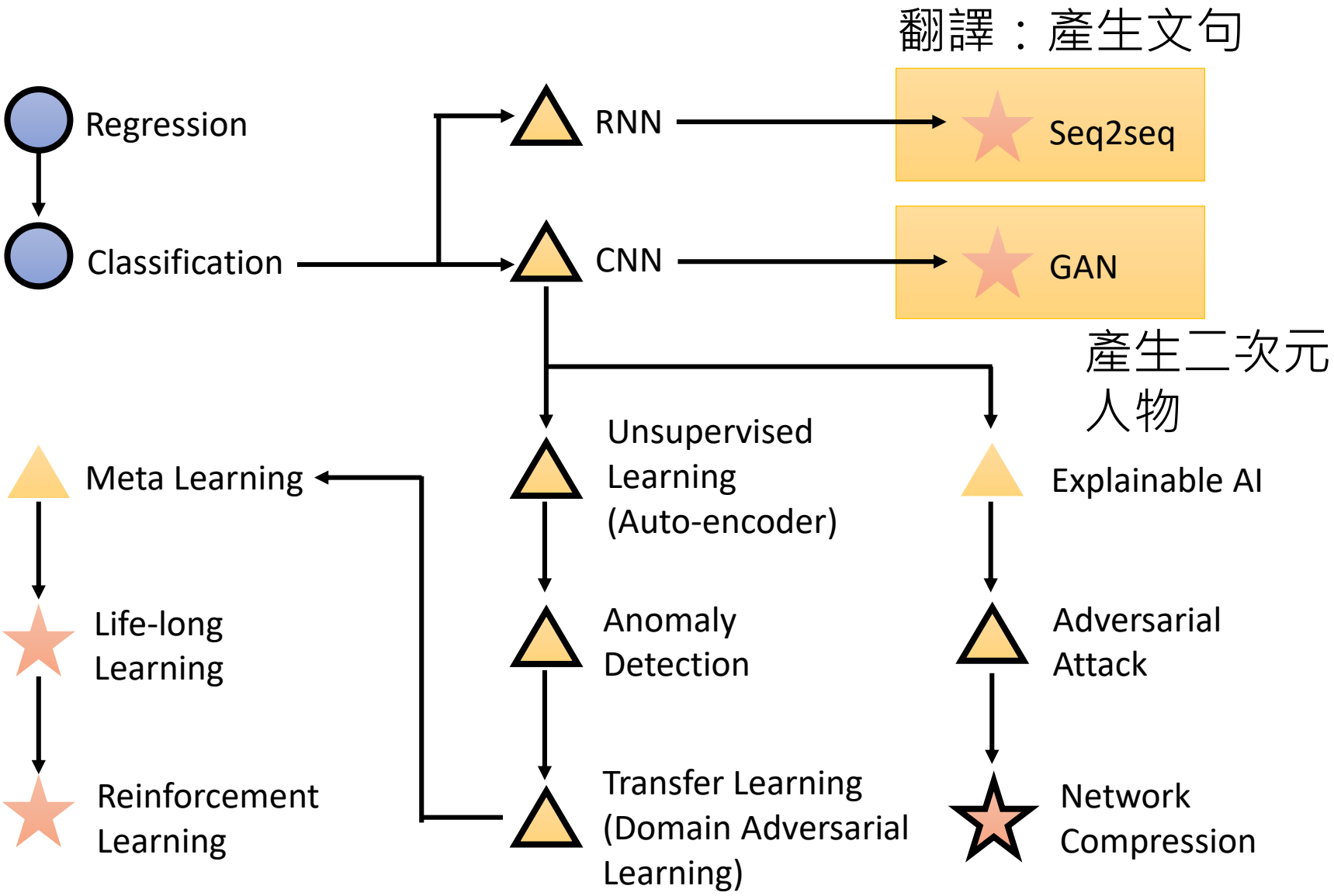
Generation (生成)

產生有結構的複雜東西
(例如：文句、圖片)

擬人化的講法—創造

Regression,
Classification

Generation


翻譯：產生文句
Regression
Classification
RNN
CNN
Seq2seq
GAN
產生二次元人物
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
Adversarial Attack
Network Compression
Meta Learning
Life-long Learning
Reinforcement Learning

怎麼告訴機器
你想找什麼樣的函式？

Supervised Learning

x

f

"Cat"

y

x_1:  y_1:"Cat"

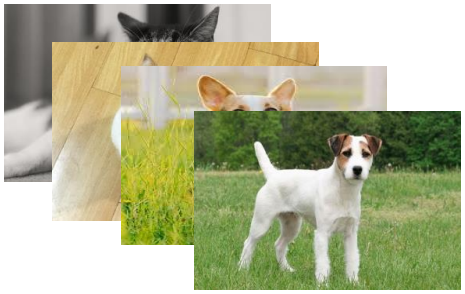
x_2:  y_2:"Cat"

x_3:  y_3:"Dog"

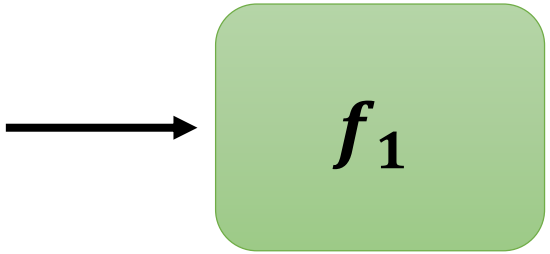
x_4:  y_4:"Dog"

Labelled Data

函式的 Loss



x_1 / x_2 / x_3 / x_4



Loss = 50%

"Dog"/"Dog"/
"Dog"/"Dog"

x_1:  y_1:"Cat"

x_2:  y_2:"Cat"

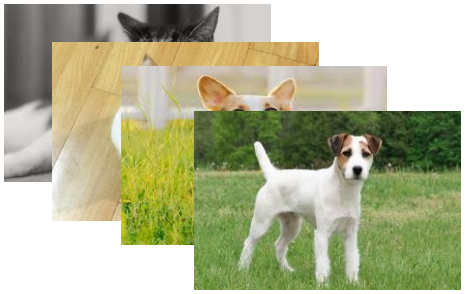
x_3:  y_3:"Dog"

x_4:  y_4:"Dog"

Labelled Data

函式的 Loss

接下來機器會自動找出
Loss 最低的函式



x_1 / x_2 / x_3 / x_4

f_2

Loss = 0%

“Cat”/“Cat”/
“Dog”/“Dog”

x_1:

y_1:“Cat”

x_2:

y_2:“Cat”

x_3:

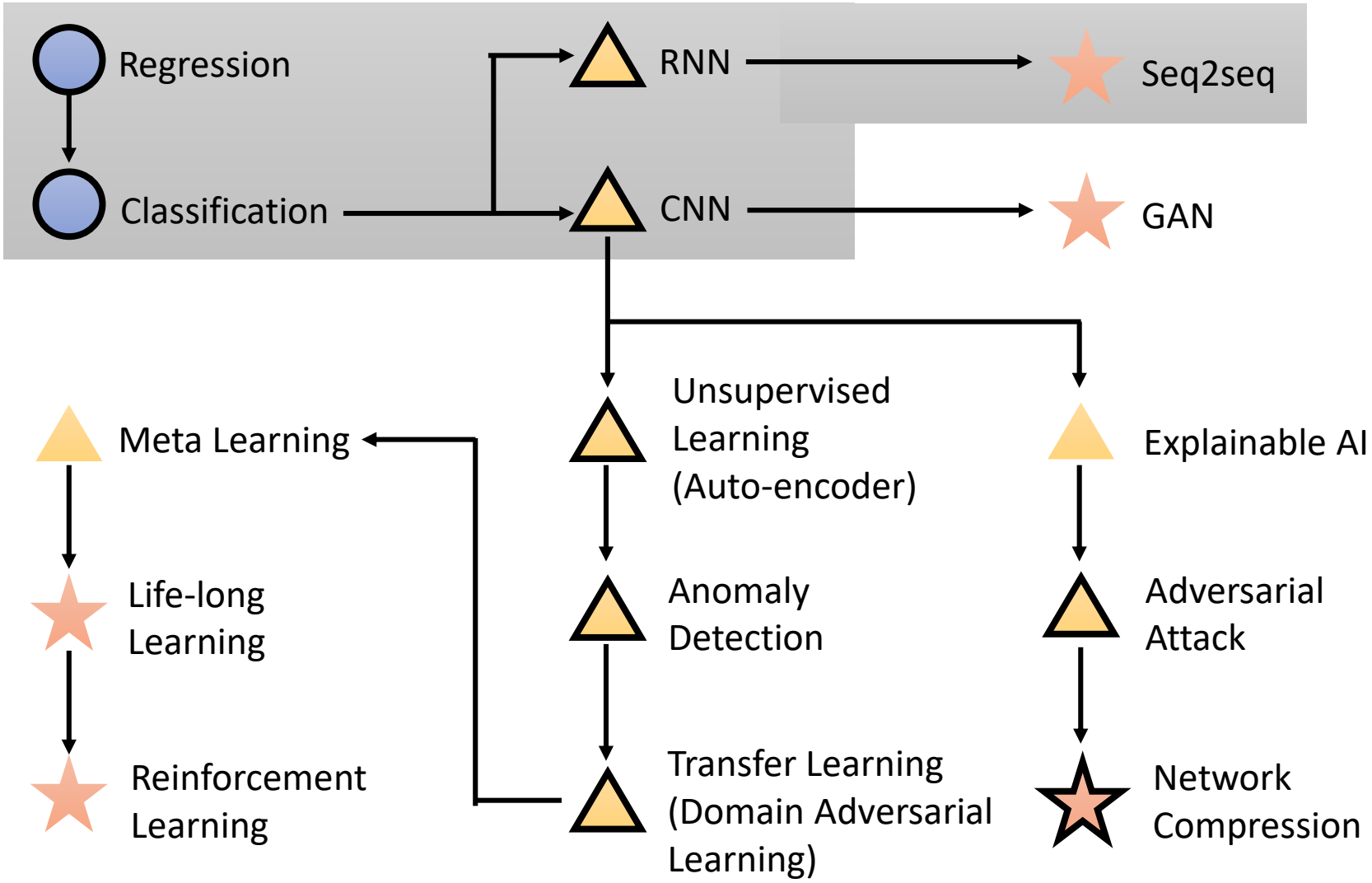
y_3:“Dog”

x_4:

y_4:“Dog”

Labeled Data

Supervised Learning

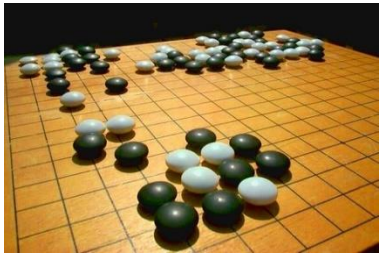


Reinforcement Learning

Supervised v.s. Reinforcement

- Supervised:

Next move:
"5-5"



Next move:
"3-3"

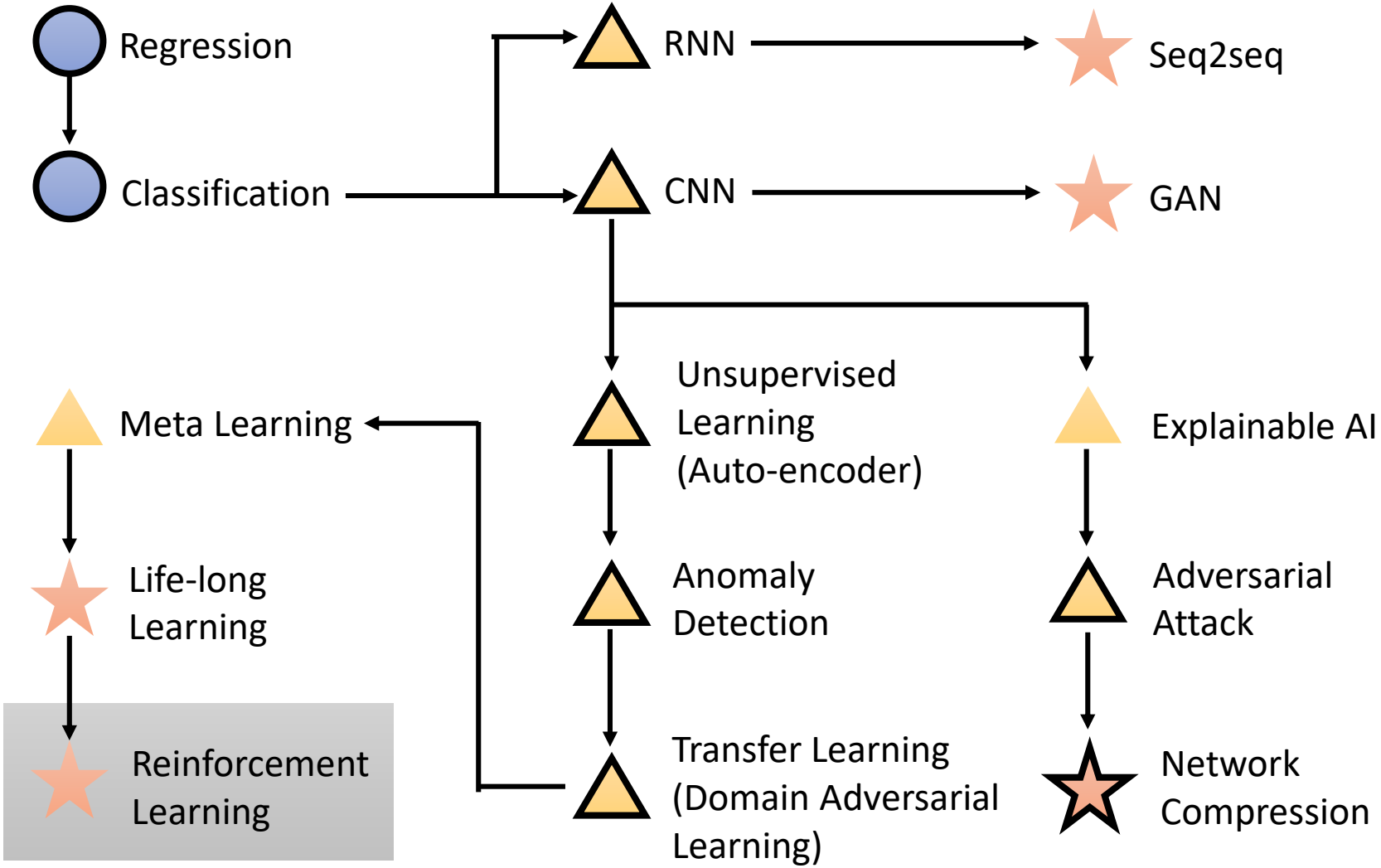
- Reinforcement Learning

(Reward)

First move → …… many moves …… → Win!

Alpha Go is supervised learning + reinforcement learning.

Reinforcement Learning



Unsupervised Learning

What can machine learn from unlabeled images?

Regression

Classification

RNN

CNN

Seq2seq

GAN

Unsupervised Learning (Auto-encoder)

Meta Learning

Life-long Learning

Reinforcement Learning

Anomaly Detection

Transfer Learning (Domain Adversarial Learning)

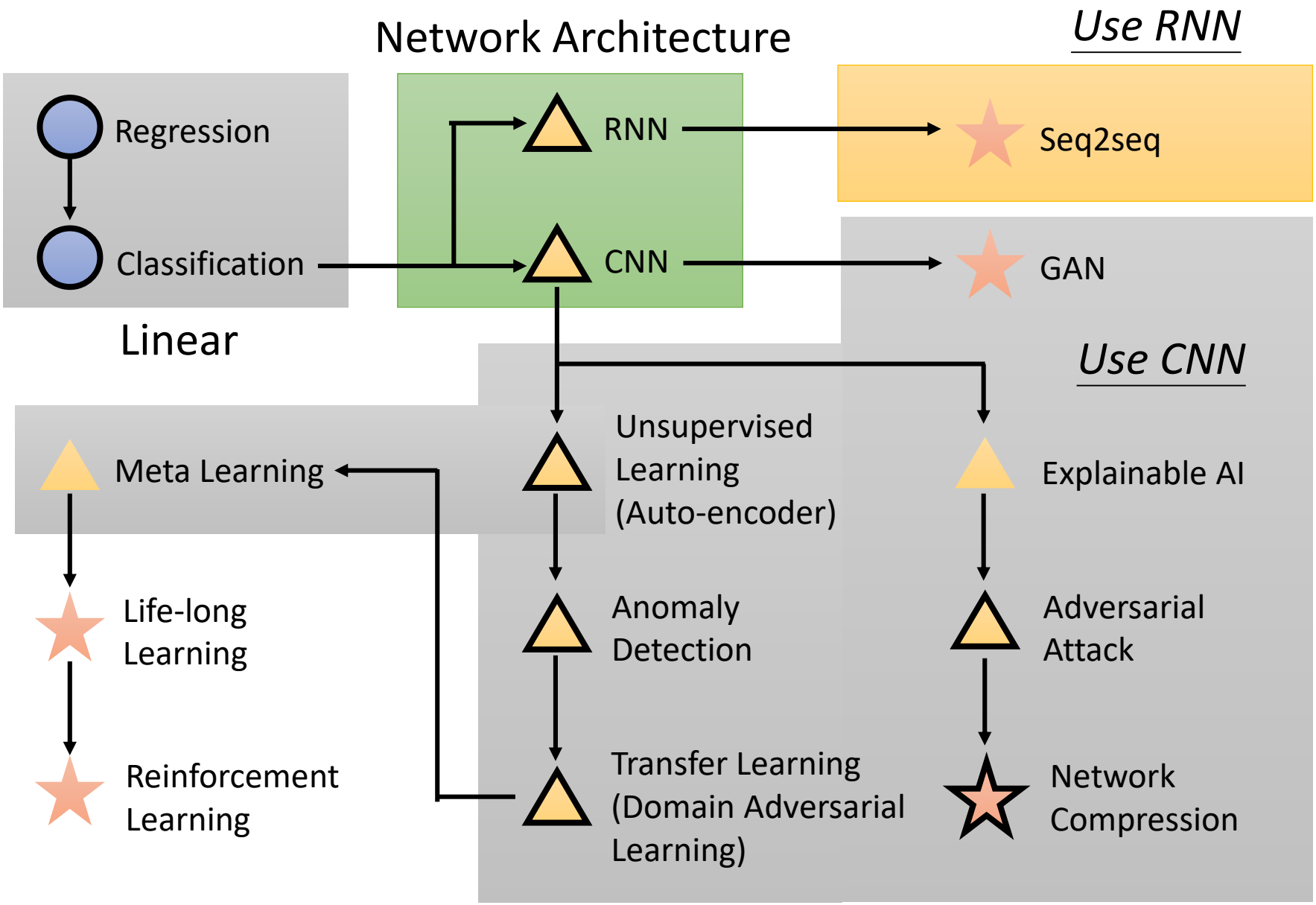
Explainable AI

Adversarial Attack

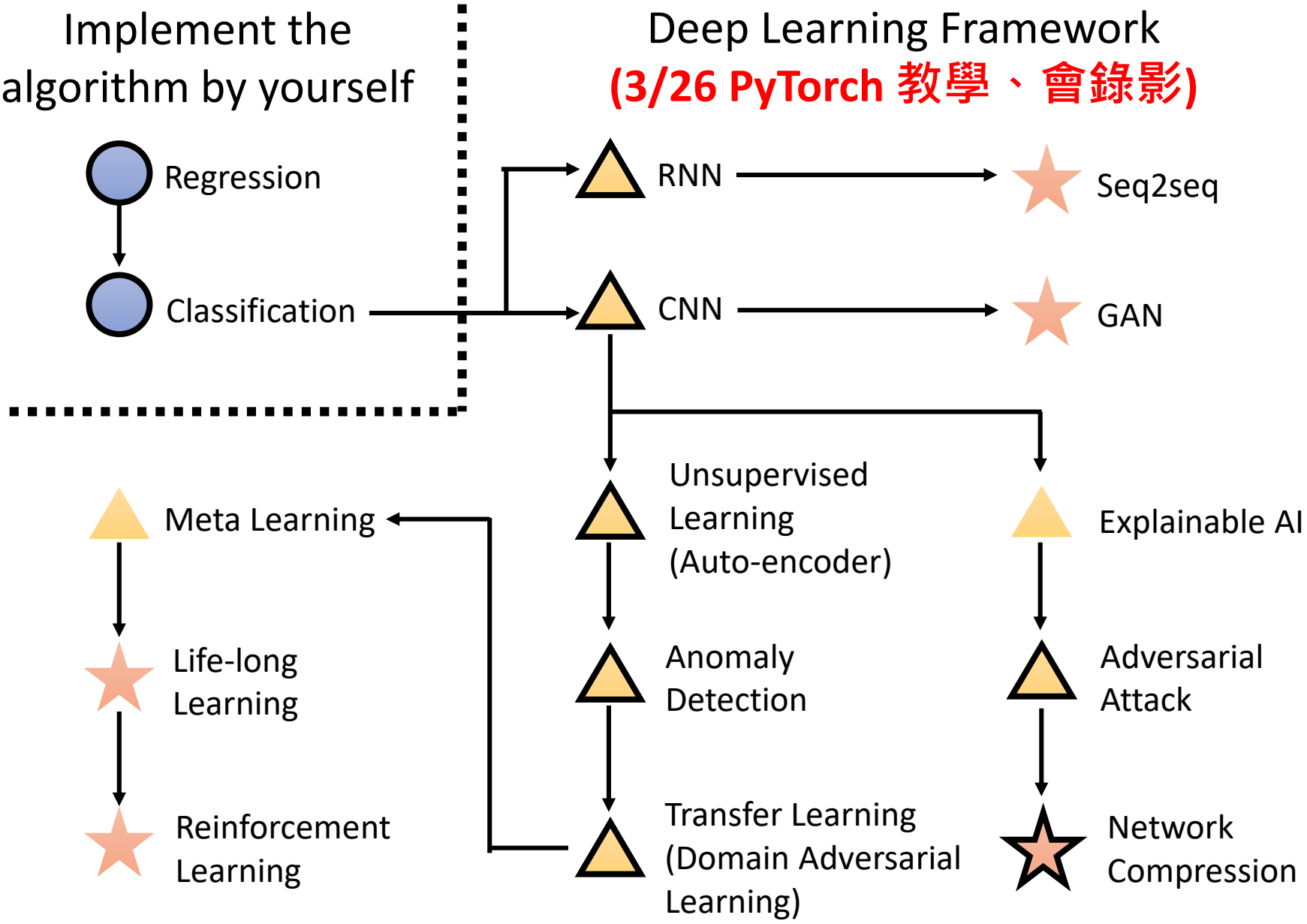
Network Compression

機器怎麼
找出你想要的函式？

限制函式尋找範圍


Network Architecture
Use RNN
Regression
Classification
Linear
RNN
CNN
Seq2seq
GAN
Use CNN
Meta Learning
Unsupervised Learning (Auto-encoder)
Explainable AI
Life-long Learning
Anomaly Detection
Adversarial Attack
Reinforcement Learning
Transfer Learning (Domain Adversarial Learning)
Network Compression

函式尋找方法 – Gradient Descent



前沿研究

This is a "cat"

Because ...

Regression

Classification

RNN

CNN

Seq2seq

GAN

Unsupervised Learning (Auto-encoder)

Anomaly Detection

Transfer Learning (Domain Adversarial Learning)

Meta Learning

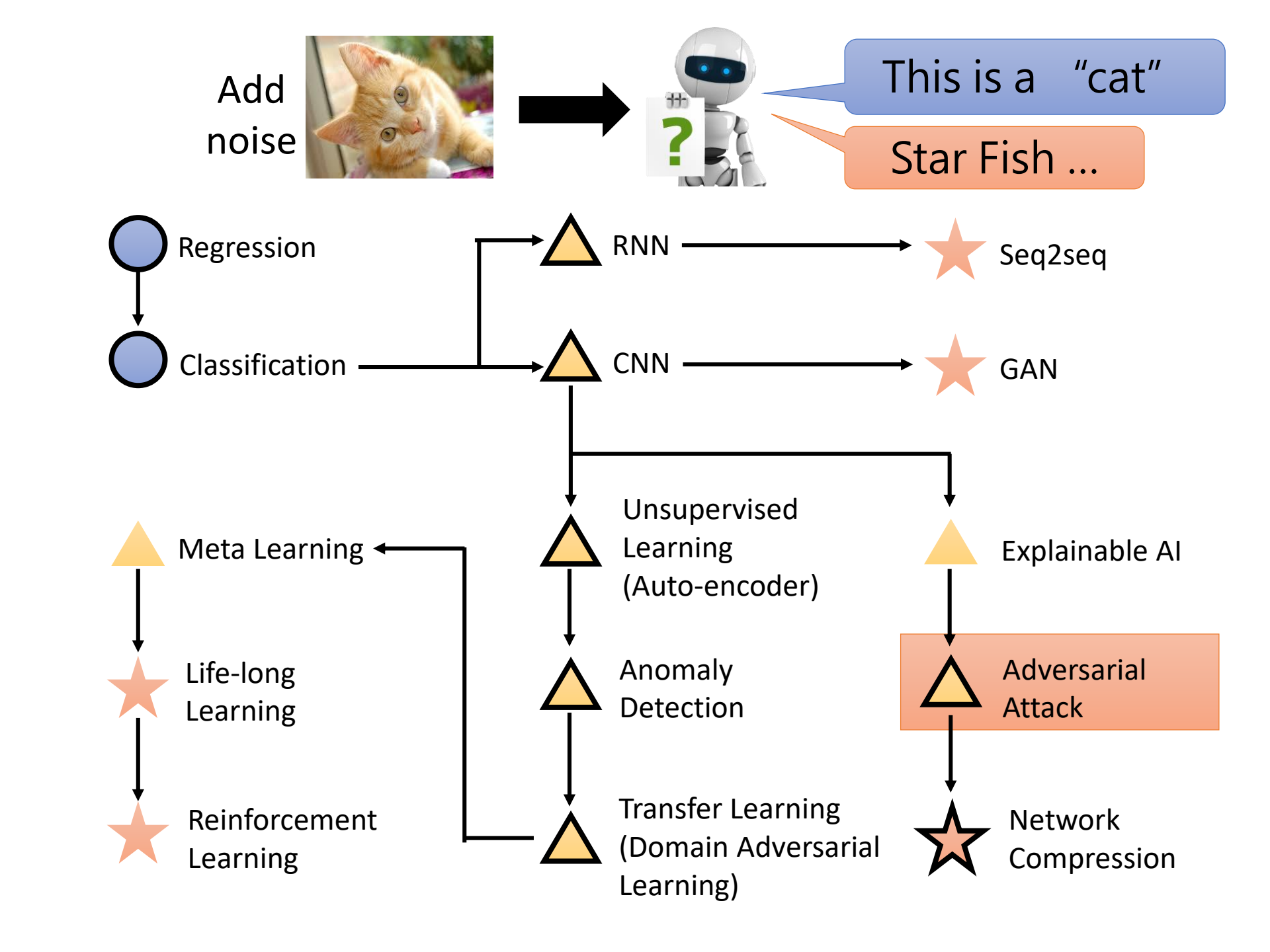
Life-long Learning

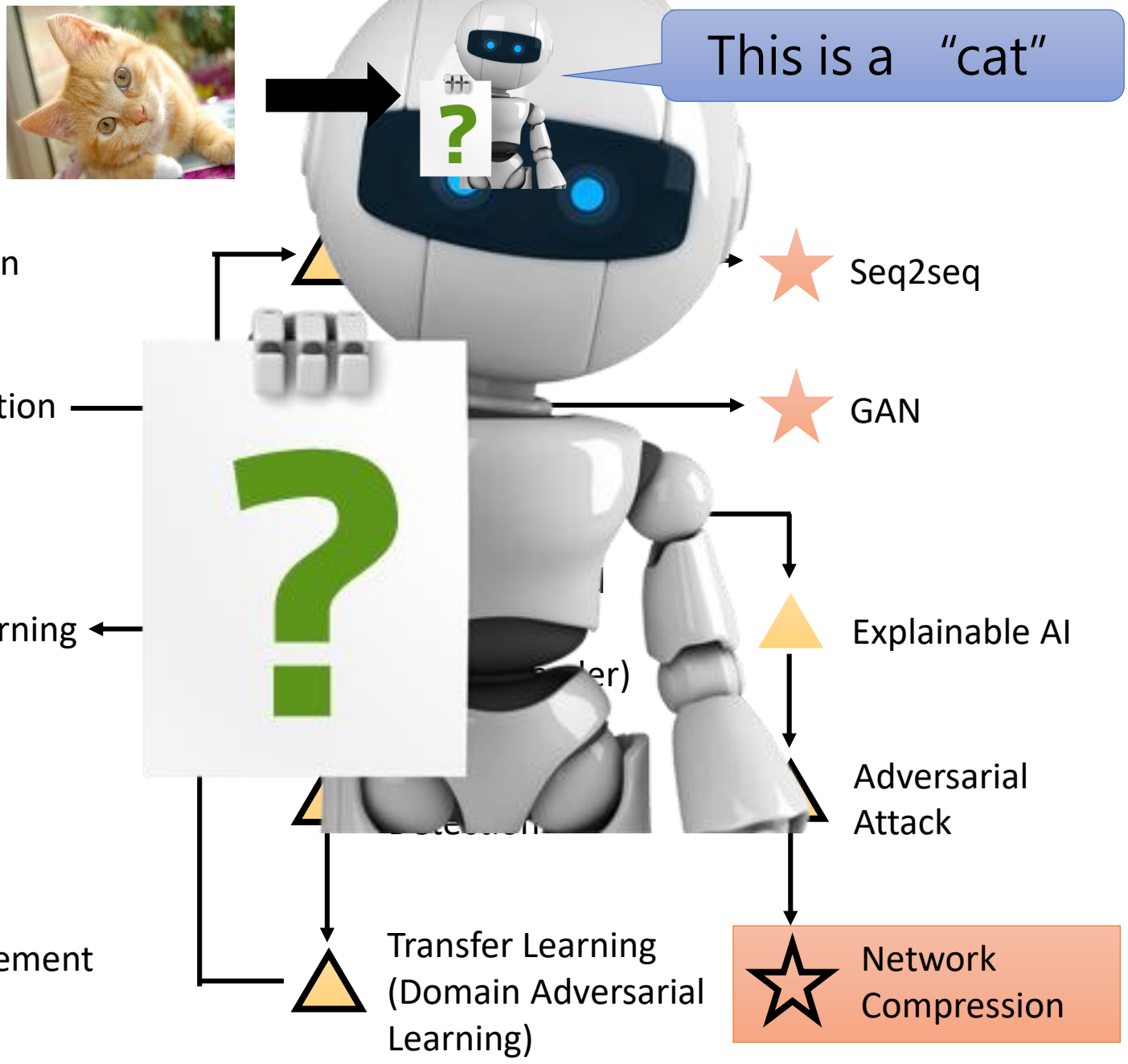
Reinforcement Learning

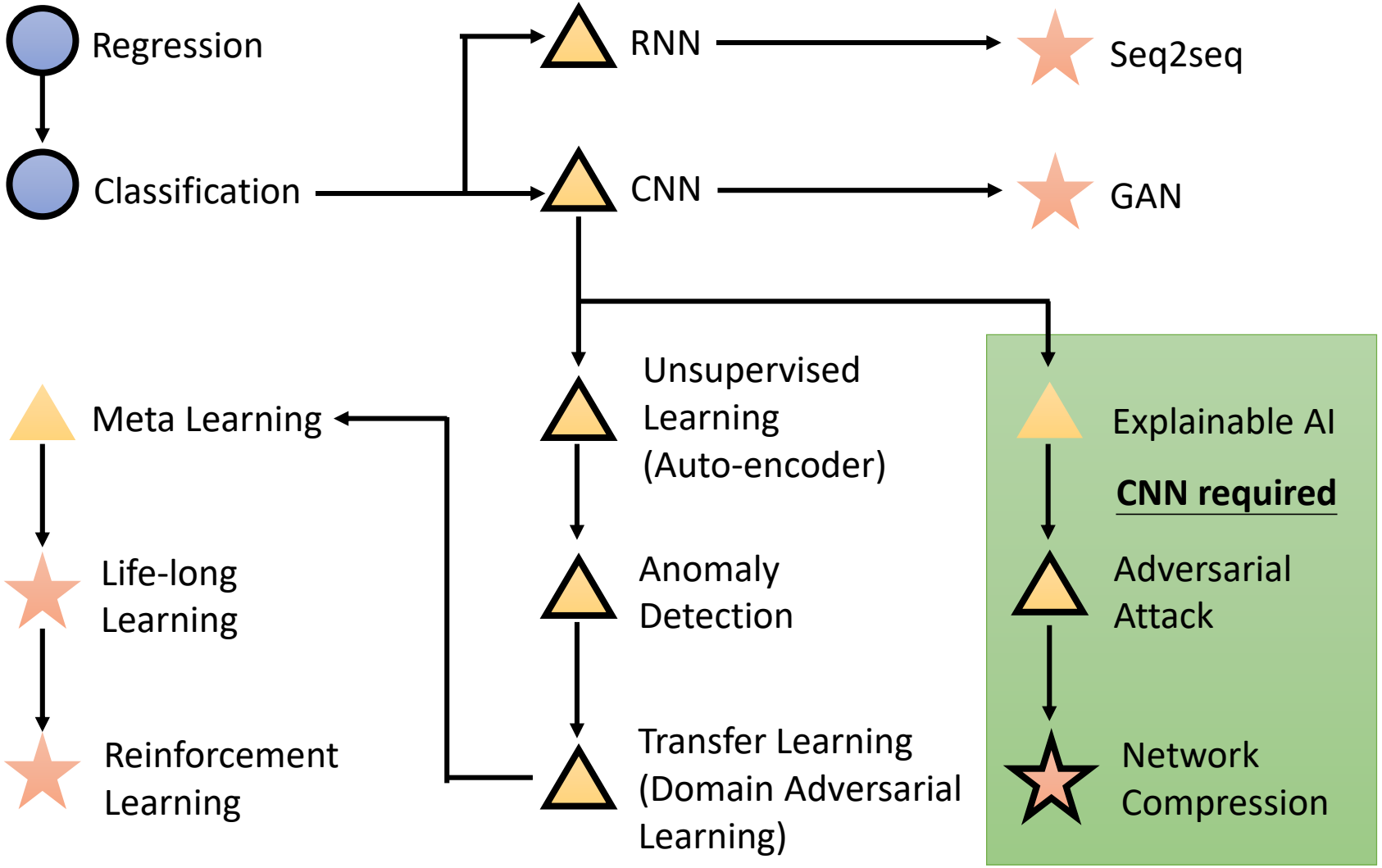
Explainable AI

Adversarial Attack

Network Compression


Add noise
This is a "cat"
Star Fish ...
Regression
Classification
RNN
CNN
Seq2seq
GAN
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Meta Learning
Life-long Learning
Reinforcement Learning
Explainable AI
Adversarial Attack
Network Compression


This is a "cat"
Regression
Classification
Meta Learning
Life-long Learning
Reinforcement Learning
Seq2seq
GAN
Explainable AI
Adversarial Attack
Transfer Learning (Domain Adversarial Learning)
Network Compression


Regression
Classification
RNN
CNN
Seq2seq
GAN
Meta Learning
Life-long Learning
Reinforcement Learning
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
CNN required
Adversarial Attack
Network Compression

This is a “cat”

我不知道

Regression

Classification

RNN

CNN

Seq2seq

GAN

Unsupervised Learning (Auto-encoder)

Anomaly Detection

Transfer Learning (Domain Adversarial Learning)

Meta Learning

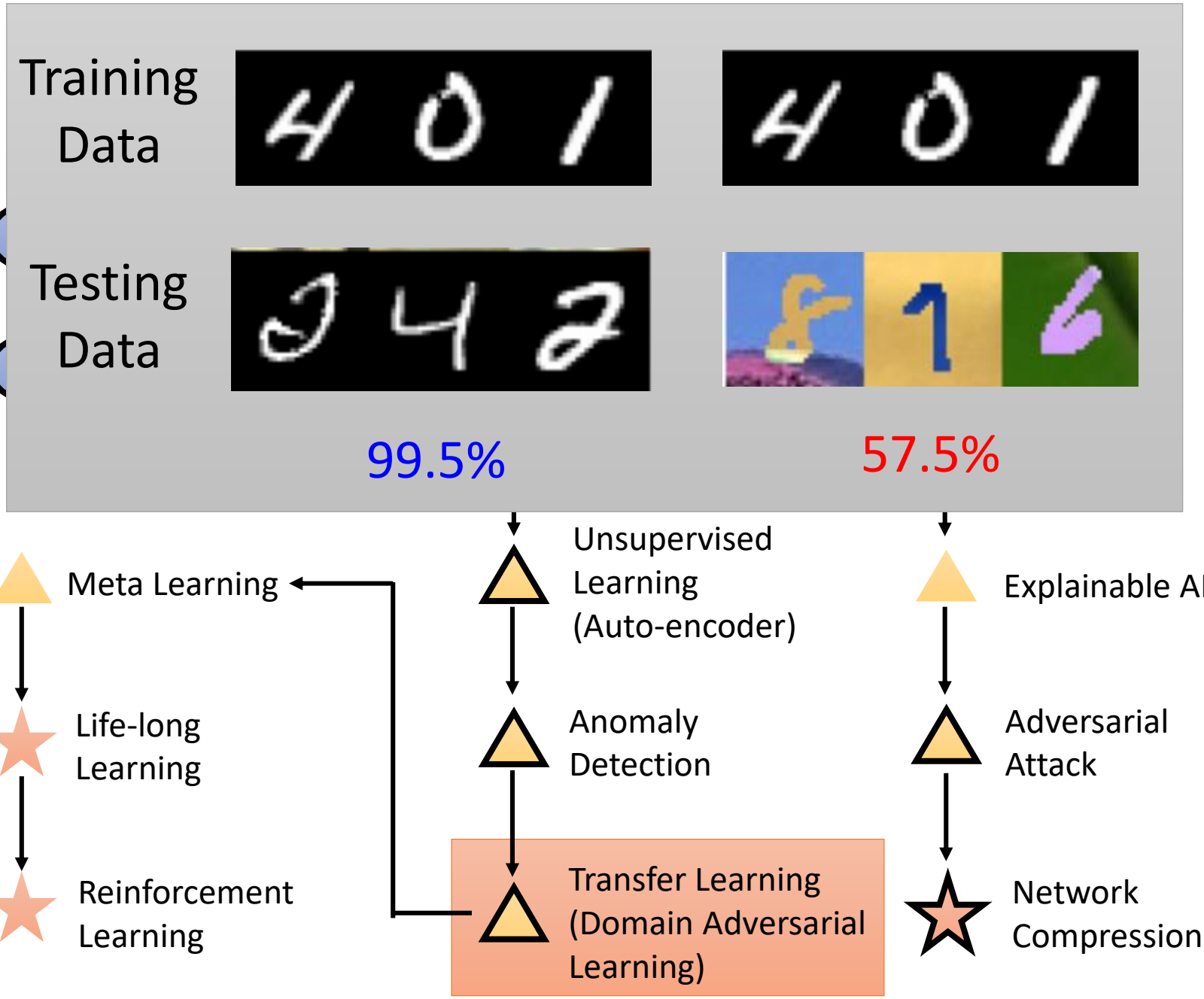
Life-long Learning

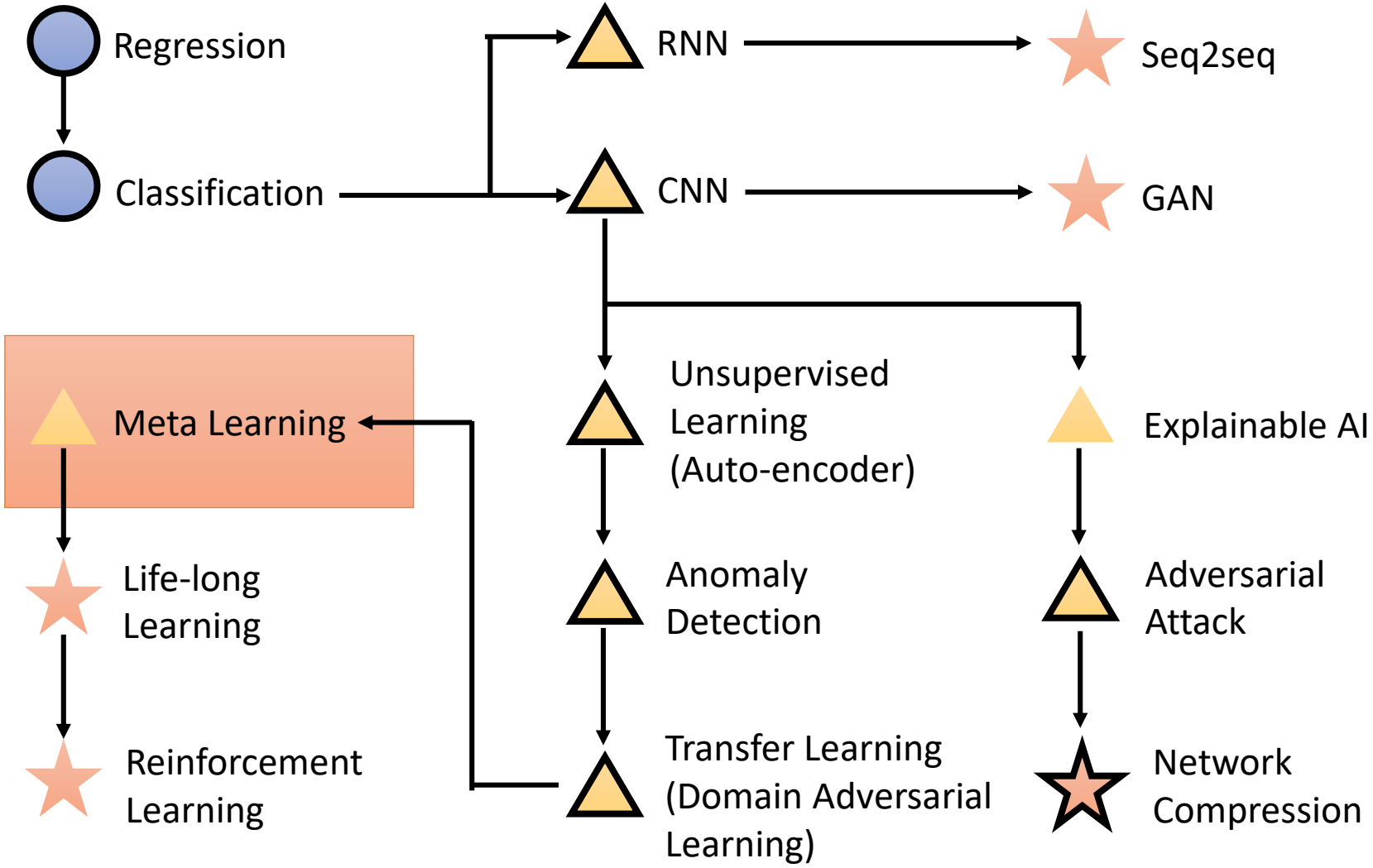
Reinforcement Learning

Explainable AI

Adversarial Attack

Network Compression


Training Data
Testing Data
99.5%
57.5%
Meta Learning
Life-long Learning
Reinforcement Learning
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
Adversarial Attack
Network Compression


Regression
Classification
RNN
CNN
Seq2seq
GAN
Meta Learning
Life-long Learning
Reinforcement Learning
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
Adversarial Attack
Network Compression

Meta Learning = Learn to learn

- Now we design the learning algorithm

program
for learning

I can learn!

- Can machine learn the learning algorithm?

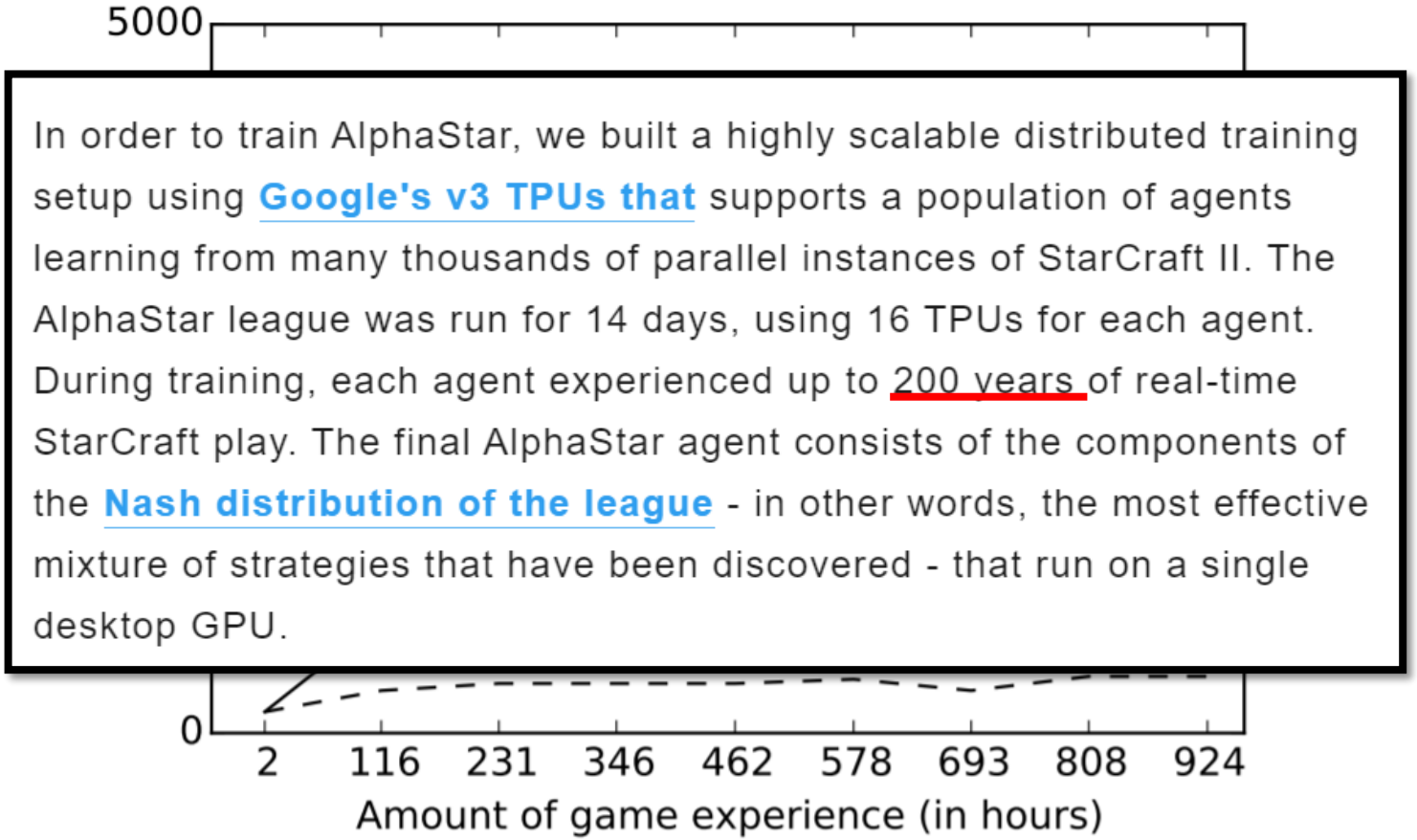
program designing
program
for learning

program
for learning

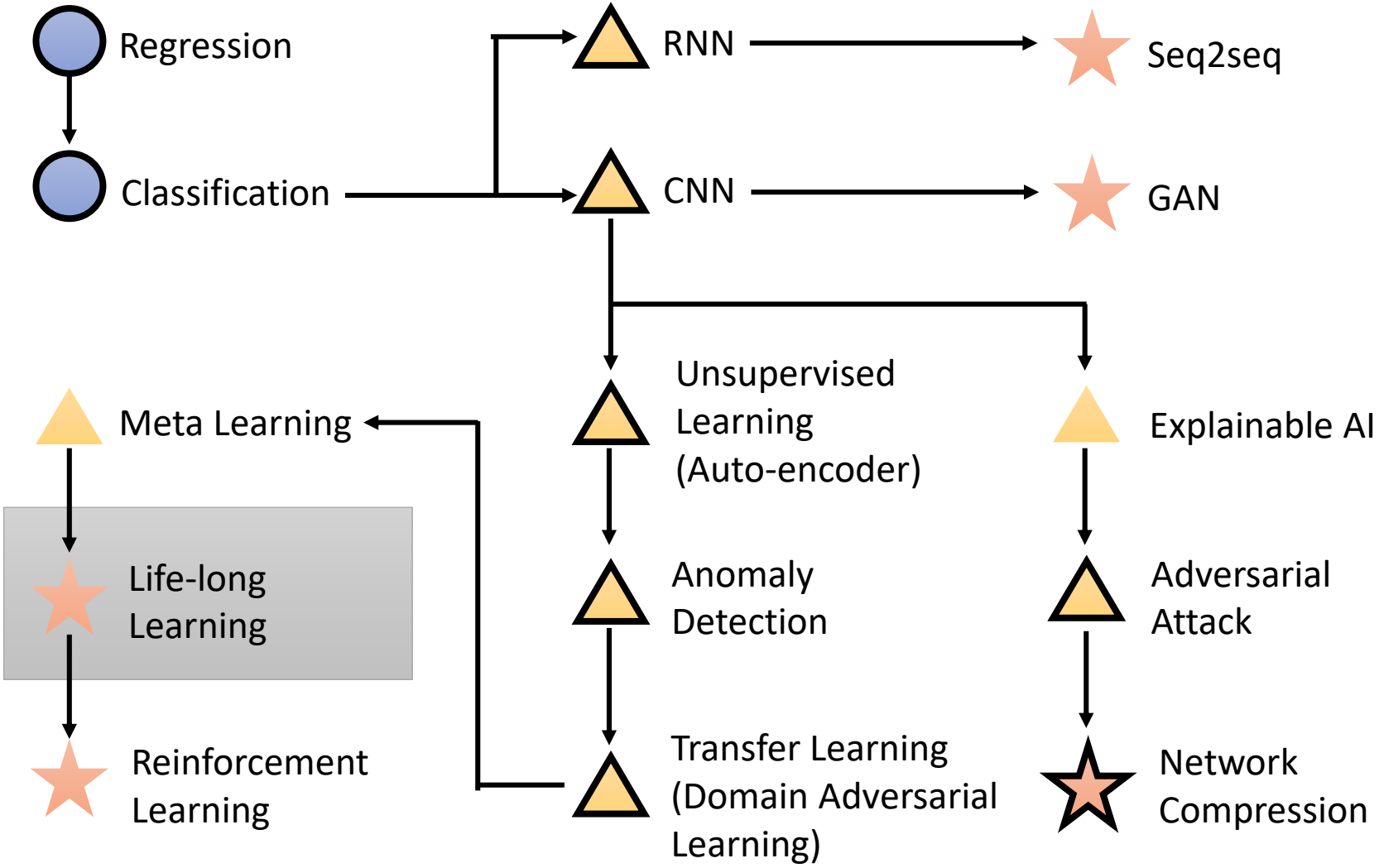
I can learn!

能不能讓機器聰明一點？

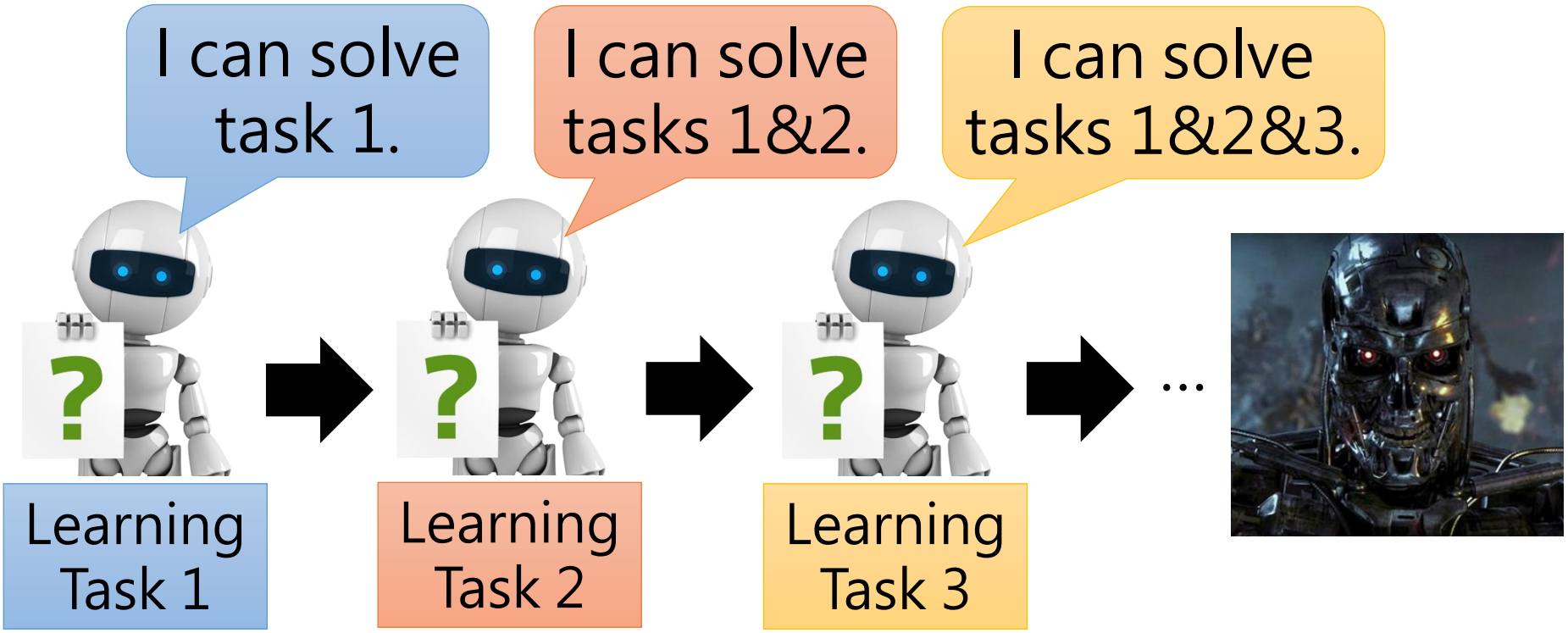
天資不佳卻勤奮不懈？



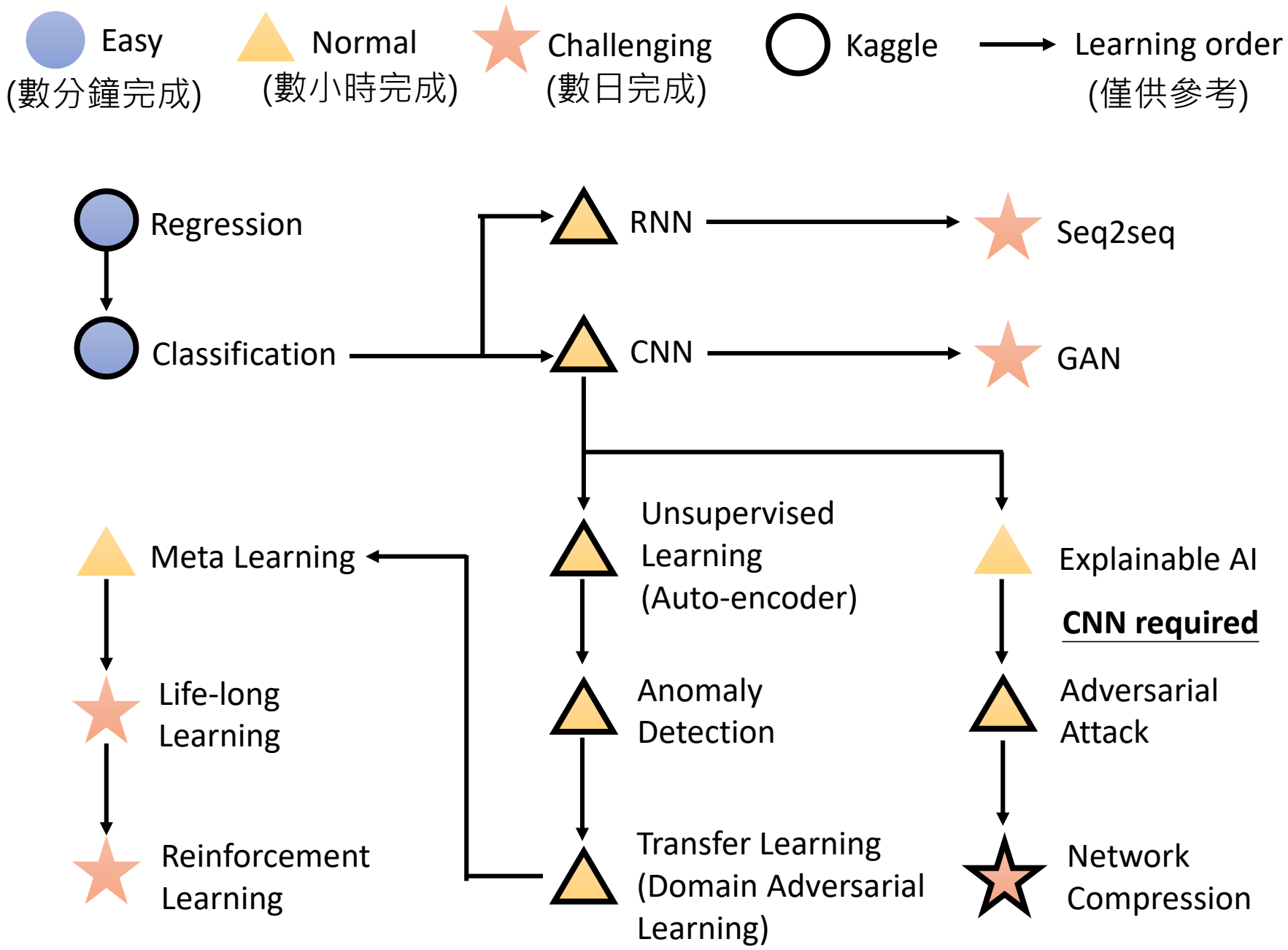
http://web.stanford.edu/class/psych209/Readings/LakeEtAlBBS.pdf


Regression
Classification
RNN
CNN
Seq2seq
GAN
Meta Learning
Life-long Learning
Reinforcement Learning
Unsupervised Learning (Auto-encoder)
Anomaly Detection
Transfer Learning (Domain Adversarial Learning)
Explainable AI
Adversarial Attack
Network Compression

終身學習 (Life-long Learning)



Life-Long Learning (終身學習), Continuous Learning, Never Ending Learning, Incremental Learning


Easy
(數分鐘完成)
Normal
(數小時完成)
Challenging
(數日完成)
Kaggle
Learning order
(僅供參考)
Regression
Classification
RNN
CNN
Seq2seq
GAN
Unsupervised
Learning
(Auto-encoder)
Anomaly
Detection
Transfer Learning
(Domain Adversarial
Learning)
Meta Learning
Life-long
Learning
Reinforcement
Learning
Explainable AI
CNN required
Adversarial
Attack
Network
Compression

課程網頁

- http://speech.ee.ntu.edu.tw/~tlkagk/courses_ML20.html

完全可以在家自學!

課程網頁

作業編號	線上學習	作業範例	作業說明	上課補充	繳交時間
作業一	Regression, Basic Concept	Regression	slide		3/26
Gradient Descent	Gradient Descent 1 2 3			4/09	
作業二	Classification 1 2	Classification	slide		3/26
DL預備	DL, Backprop, Tips, Why Deep	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	CNN	CNN	slide	3/26 (GNN)	4/30
作業四	RNN 1 2	RNN	slide		4/30
作業五	Explainable AI	Explainable AI	slide	4/16	4/30
作業六	Adversarial Attack	Adversarial Attack	slide	4/23	4/30
作業七	Network Compression	Network Compression 1 2 3 4	slide	4/30	5/21
作業八	Seq2seq	Seq2seq	slide	5/07 (New Architecture)	5/21
作業九	Dimension Reduction, Neighbor Embedding, Auto-encoder	Unsupervised Learning	slide	5/14 (Model Pretraining)	5/21
作業十	Anomaly Detection	Anomaly Detection	slide	5/21	6/11
作業十一	GAN (10 videos)	GAN	slide	5/28	6/11
作業十二	Semi-supervised, Transfer	Transfer Learning	slide	6/04	6/11
作業十三	Meta Learning	Meta 1 2	slide	6/11	7/02
作業十四	Life-long Learning	Life-long	slide	6/18	7/02
作業十五	RL 1, 2, 3, Advanced Version (8 videos)	RL	slide	6/25	7/02

在寫作業前先線上學習

課程網頁

所有作業都有 Colab 範例，
照著做就完成一半!

作業編號	線上學習	作業範例	作業說明	上課補充	繳交時間
作業一	Regression, Basic Concept	Regression	slide		3/26
Gradient Descent	Gradient Descent 1 2 3			4/09	
作業二	Classification 1 2	Classification	slide		3/26
DL預備	DL, Backprop, Tips, Why Deep	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	CNN	CNN	slide	3/26 (GNN)	4/30
作業四	RNN 1 2	RNN	slide		4/30
作業五	Explainable AI	Explainable AI	slide	4/16	4/30
作業六	Adversarial Attack	Adversarial Attack	slide	4/23	4/30
作業七	Network Compression	Network Compression 1 2 3 4	slide	4/30	5/21
作業八	Seq2seq	Seq2seq	slide	5/07 (New Architecture)	5/21
作業九	Dimension Reduction, Neighbor Embedding, Auto-encode	Unsupervised Learning	slide	5/14 (Model Pretraining)	5/21
作業十	Anomaly Detection	Anomaly Detection	slide	5/21	6/11
作業十一	GAN (10 videos)	GAN	slide	5/28	6/11
作業十二	Semi-supervised, Transfer	Transfer Learning	slide	6/04	6/11
作業十三	Meta Learning	Meta 1 2	slide	6/11	7/02
作業十四	Life-long Learning	Life-long	slide	6/18	7/02
作業十五	RL 1, 2, 3, Advanced Version (8 videos)	RL	slide	6/25	7/02

課程網頁

作業的要求都在這裡
(錄影預計 3/12 全數完成)

作業編號	線上學習	作業範例	作業說明	上課補充	繳交時間
作業一	Regression, Basic Concept	Regression	slide		3/26
Gradient Descent	Gradient Descent 1 2 3			4/09	
作業二	Classification 1 2	Classification	slide		3/26
DL預備	DL, Backprop, Tips, Why Deep	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	CNN	CNN	slide	3/26 (GNN)	4/30
作業四	RNN 1 2	RNN	slide		4/30
作業五	Explainable AI	Explainable AI	slide	4/16	4/30
作業六	Adversarial Attack	Adversarial Attack	slide	4/23	4/30
作業七	Network Compression	Network Compression 1 2 3 4	slide	4/30	5/21
作業八	Seq2seq	Seq2seq	slide	5/07 (New Architecture)	5/21
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作業十一	GAN (10 videos)	GAN	slide	5/28	6/11
作業十二	Semi-supervised, Transfer	Transfer Learning	slide	6/04	6/11
作業十三	Meta Learning	Meta 1 2	slide	6/11	7/02
作業十四	Life-long Learning	Life-long	slide	6/18	7/02
作業十五	RL 1, 2, 3, Advanced Version (8 videos)	RL	slide	6/25	7/02

所有作業皆已經公告，現在就可以開始做了

課程網頁

上課補充的是相關主題最新的知識，
和作業沒有直接關連 (會錄影)

作業編號	線上學習	作業範例	作業說明	上課補充	繳交時間
作業一	Regression, Basic Concept	Regression	slide		3/26
Gradient Descent	Gradient Descent 1 2 3			4/09	
作業二	Classification 1 2	Classification	slide		3/26
DL預備	DL, Backprop, Tips, Why Deep	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	CNN	CNN	slide	3/26 (GNN)	4/30
作業四	RNN 1 2	RNN	slide		4/30
作業五	Explainable AI	Explainable AI	slide	4/16	4/30
作業六	Adversarial Attack	Adversarial Attack	slide	4/23	4/30
作業七	Network Compression	Network Compression 1 2 3 4	slide	4/30	5/21
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作業十	Anomaly Detection	Anomaly Detection	slide	5/21	6/11
作業十一	GAN (10 videos)	GAN	slide	5/28	6/11
作業十二	Semi-supervised, Transfer	Transfer Learning	slide	6/04	6/11
作業十三	Meta Learning	Meta 1 2	slide	6/11	7/02
作業十四	Life-long Learning	Life-long	slide	6/18	7/02
作業十五	RL 1, 2, 3, Advanced Version (8 videos)	RL	slide	6/25	7/02

10:20 開始 ，3/26 後每星期都有 (國定假日除外)

	作業範例	作業說明	上課補充	繳交時間
	Regression	slide		3/26
			4/09	
	Classification			3/26
	PyTorch 教學 (3/26 現場教學、會錄			
	CNN	slide	3/26 (GNN)	4/30
	RNN	slide		4/30
	Explainable AI	slide	4/16	4/30
	Adversarial Attack	slide	4/23	4/30
	Network Compression 1 2 3 4	slide	4/30	5/21
	Seq2seq	slide	5/07 (New Architecture)	5/21
dding, Auto-encoder	Unsupervised Learning	slide	5/14 (Model Pretraining)	5/21
	Anomaly Detection	slide	5/21	6/11
	GAN	slide	5/28	6/11
	Transfer Learning	slide	6/04	6/11
	Meta 1 2	slide	6/11	7/02
				7/02
s)	RL	slide	6/25	7/02

每一個作業都有死線

以後每週四上午 9:10 – 10:00 就是助教時間

FB 社團

- 社團: “Machine Learning (2020,Spring)”
- https://www.facebook.com/groups/1099602297060276/

歡迎同學們提問 ☺

感謝助教群!!!

助教信箱：
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