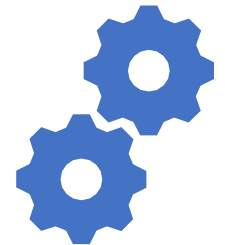


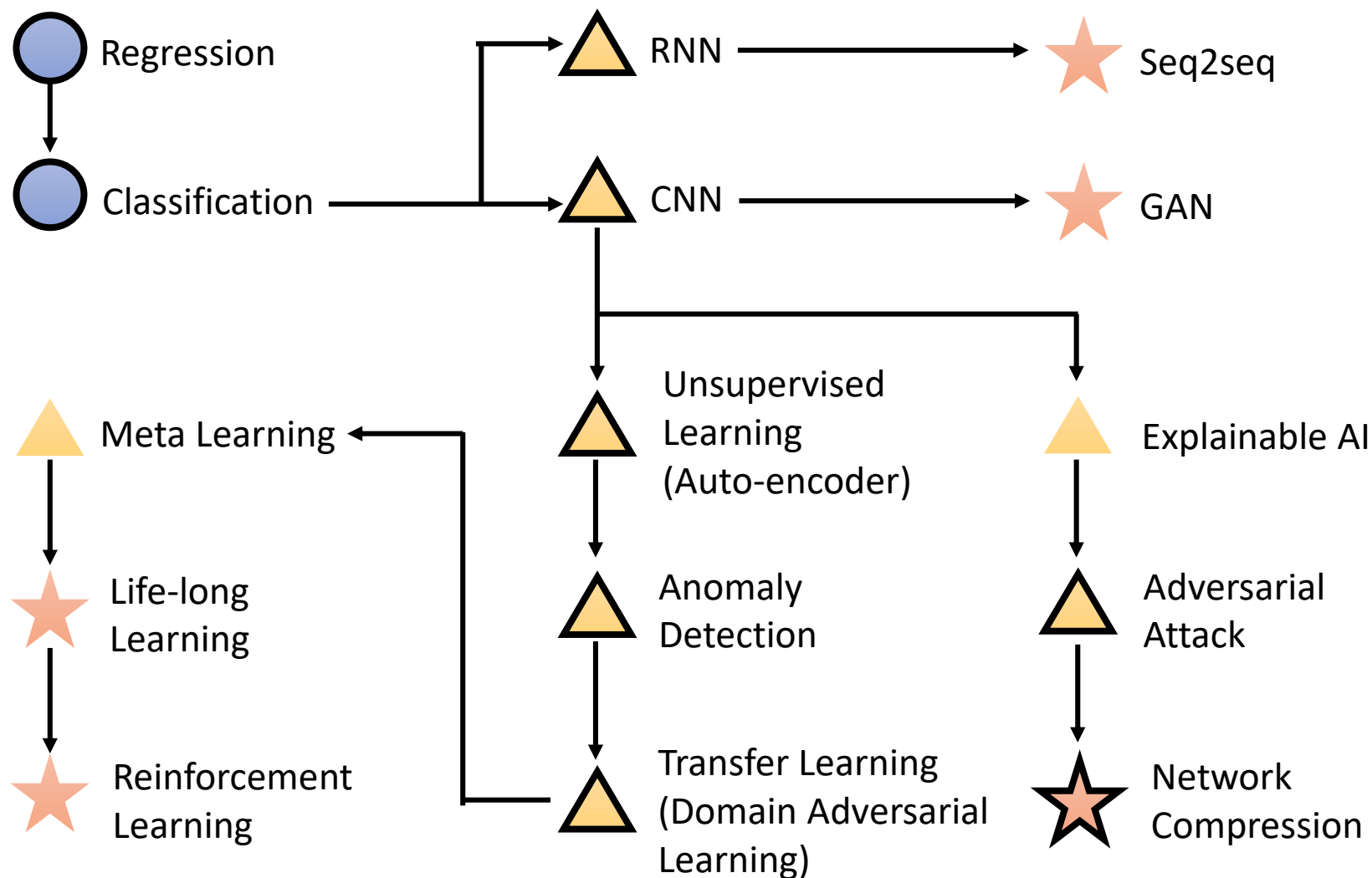
# Machine Learning 2020



李宏毅

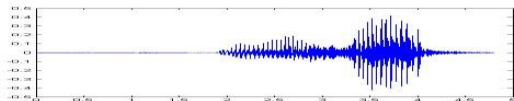
Hung-yi Lee

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

$$f(\text{  }) = \text{“How are you”}$$

- Image Recognition

$$f(\text{  }) = \text{“Cat”}$$

- Playing Go

$$f(\text{  }) = \text{“5-5” (next move)}$$

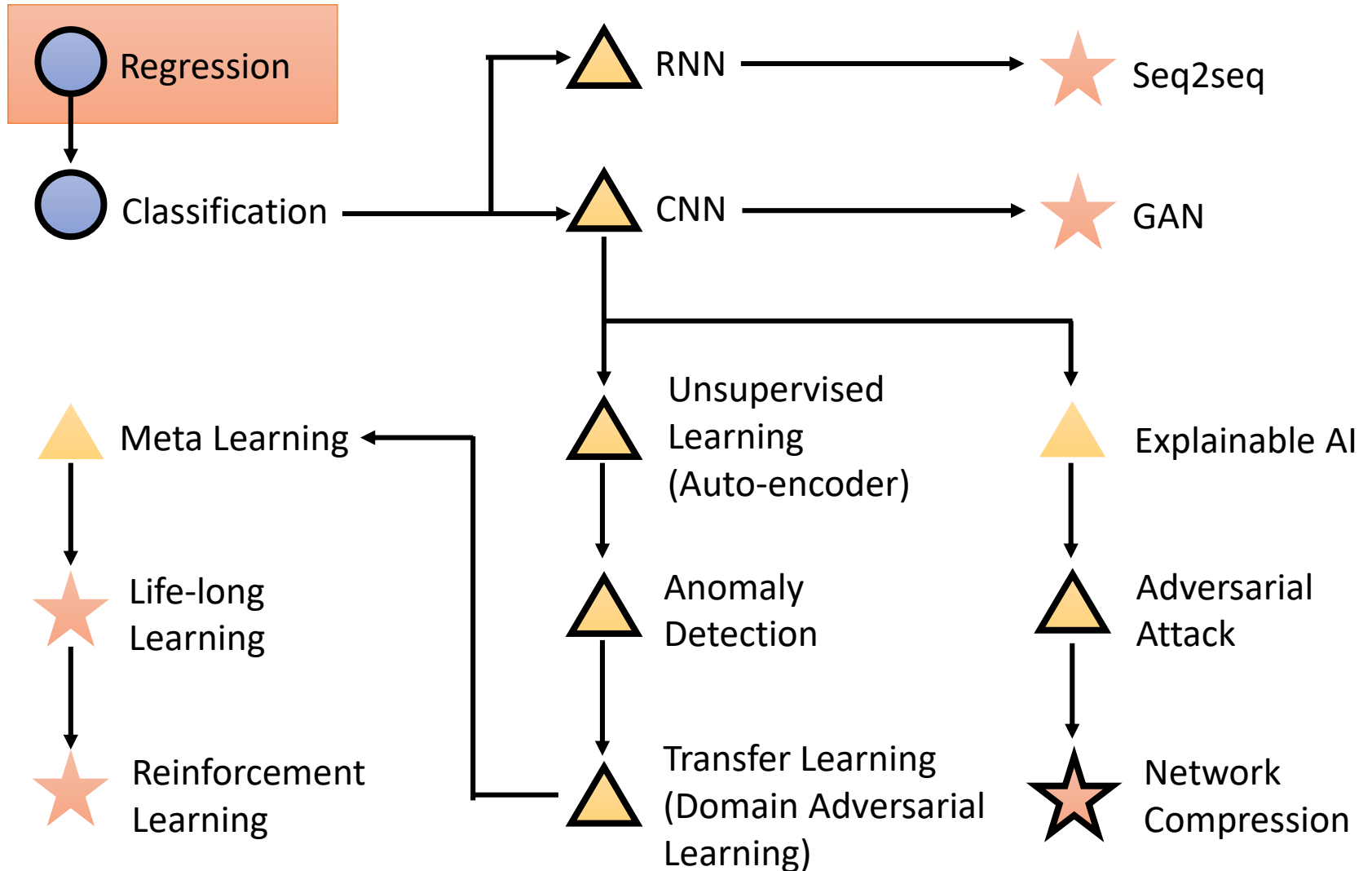
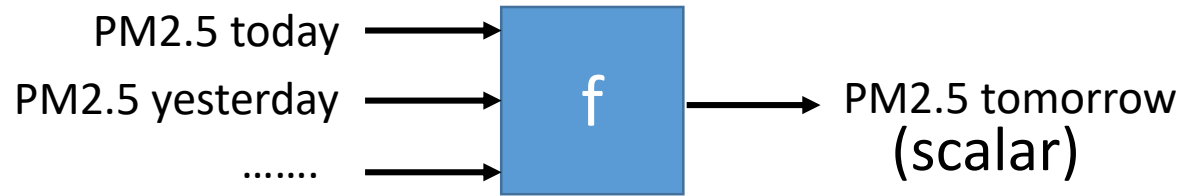
- Dialogue System

$$f(\text{ “How are you?” (what the user said) }) = \text{“I am fine.” (system response)}$$

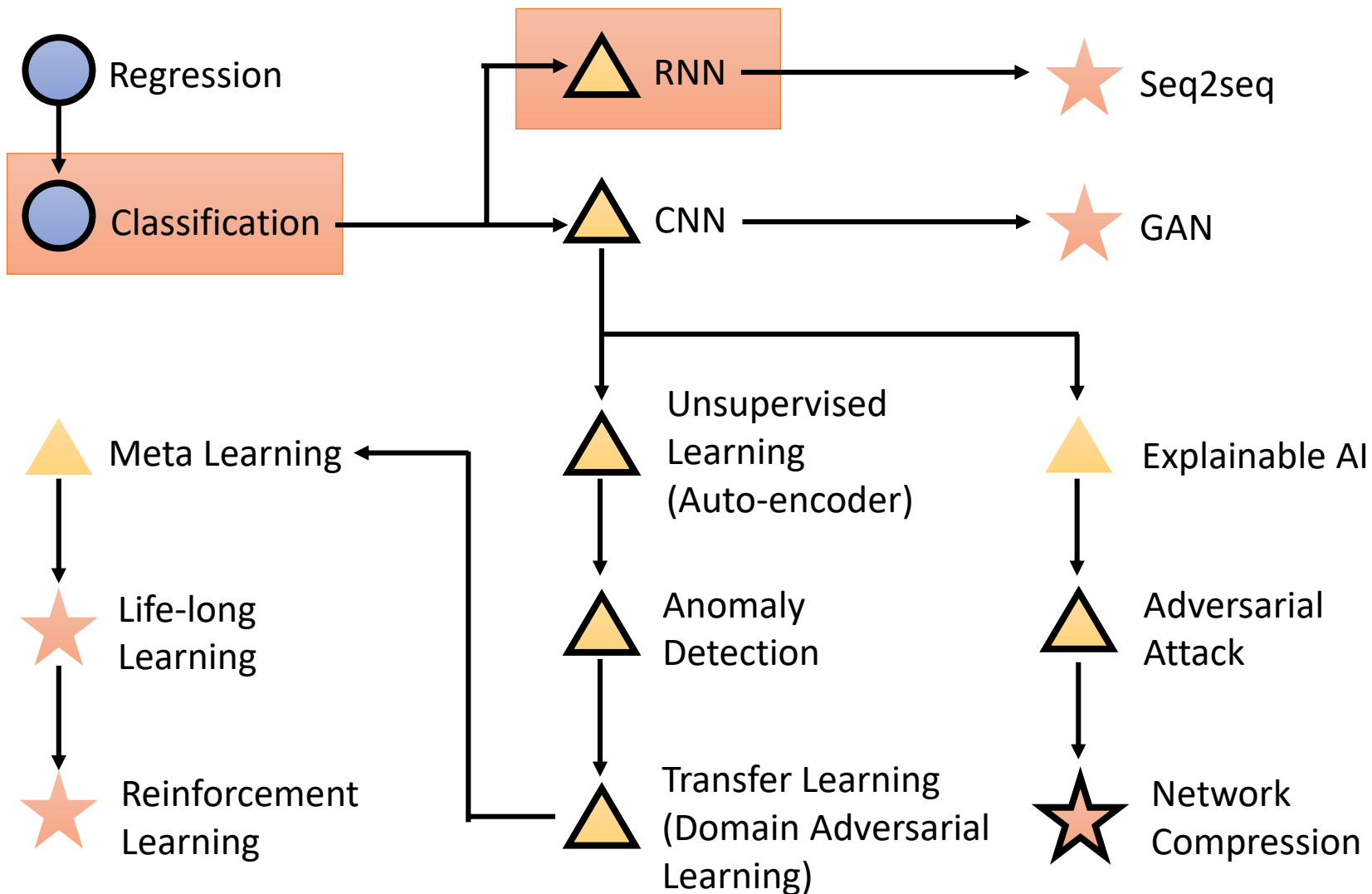
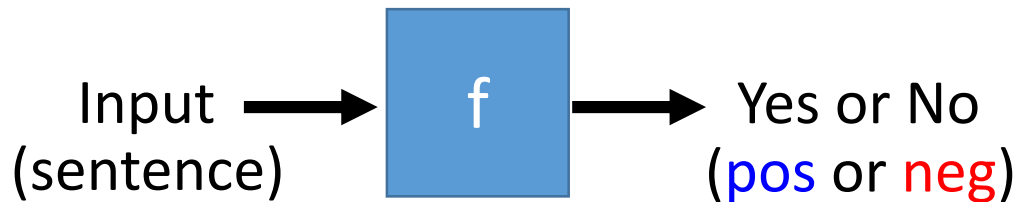
你想找什麼樣的函式？

# Regression

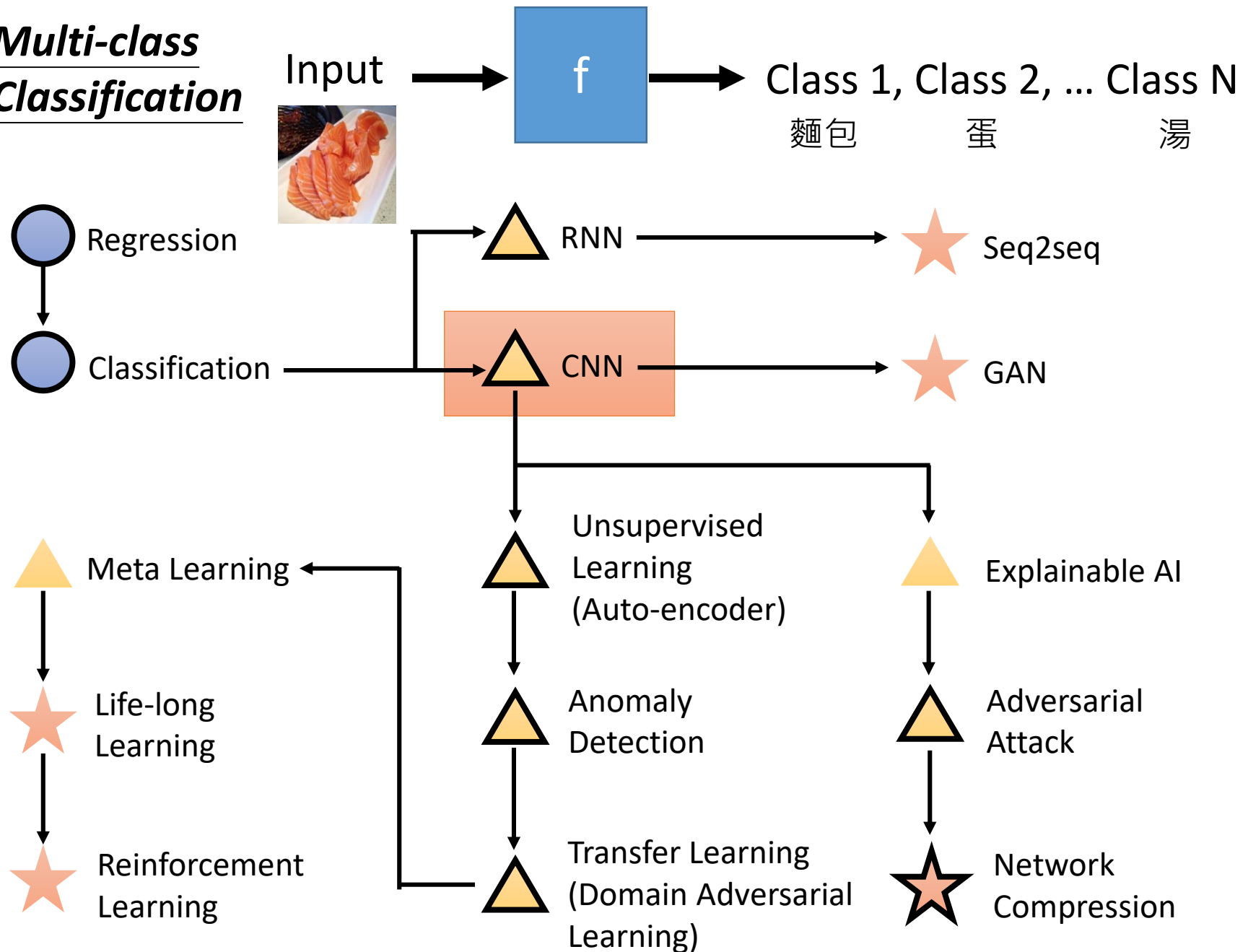
The output of the function is a scalar.



# Binary Classification



# Multi-class Classification



# Generation (生成)

產生有結構的複雜東西  
(例如：文句、圖片)

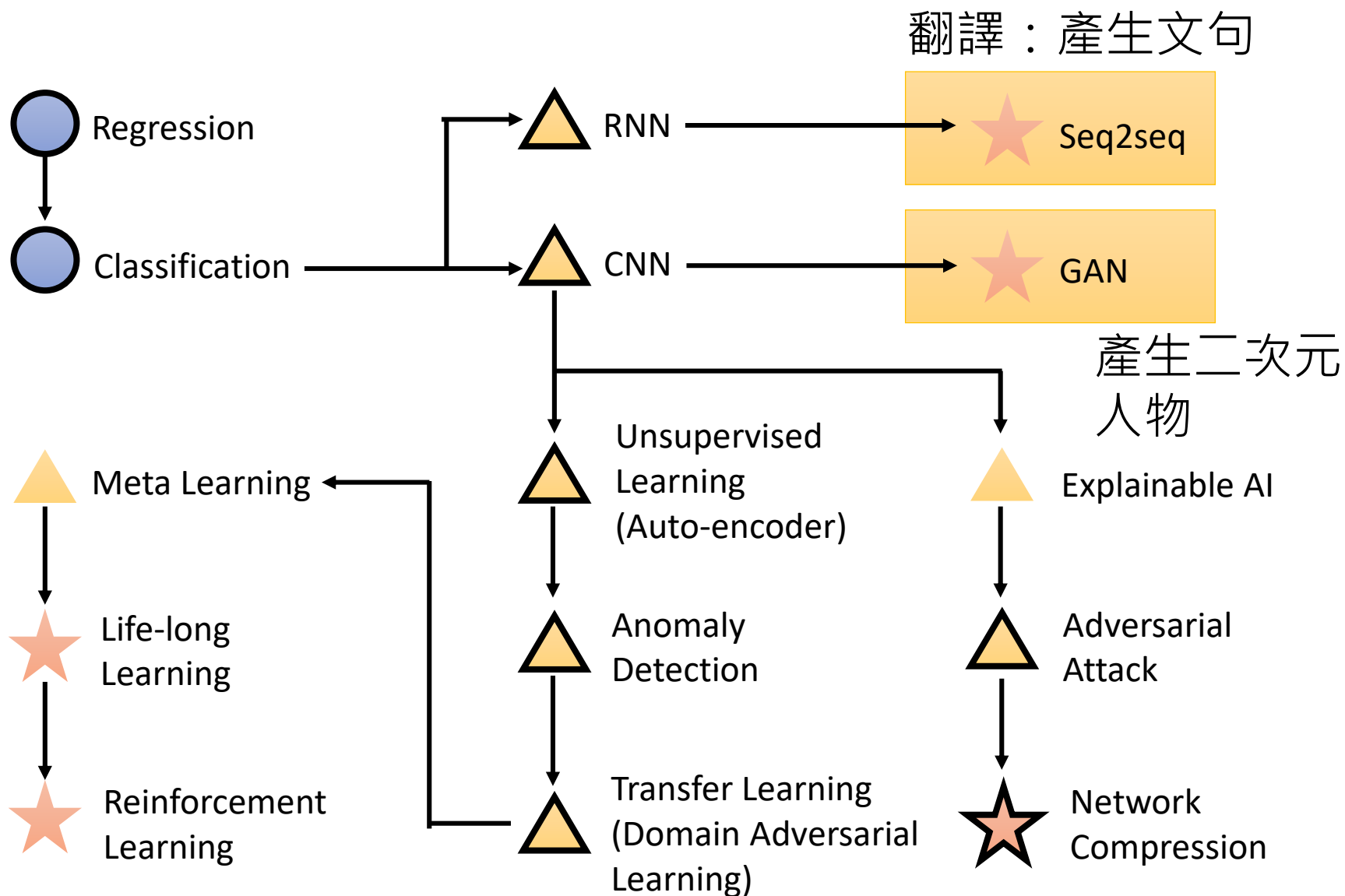
擬人化的講法—創造

Regression,  
Classification



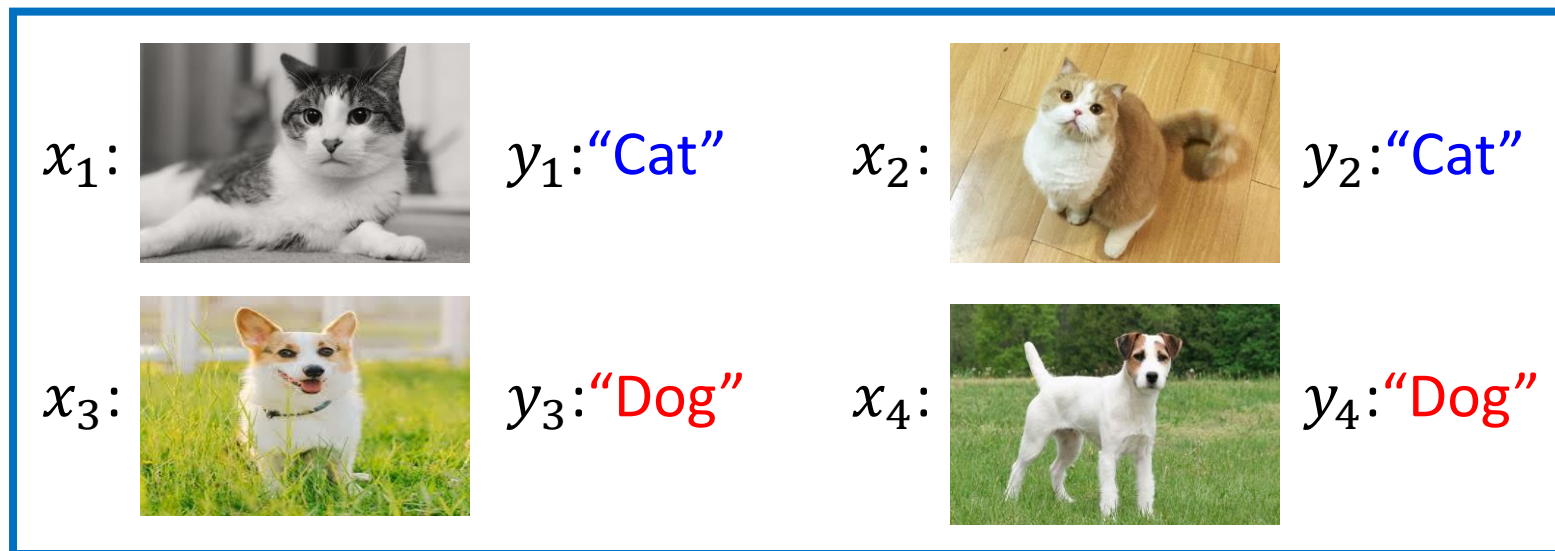
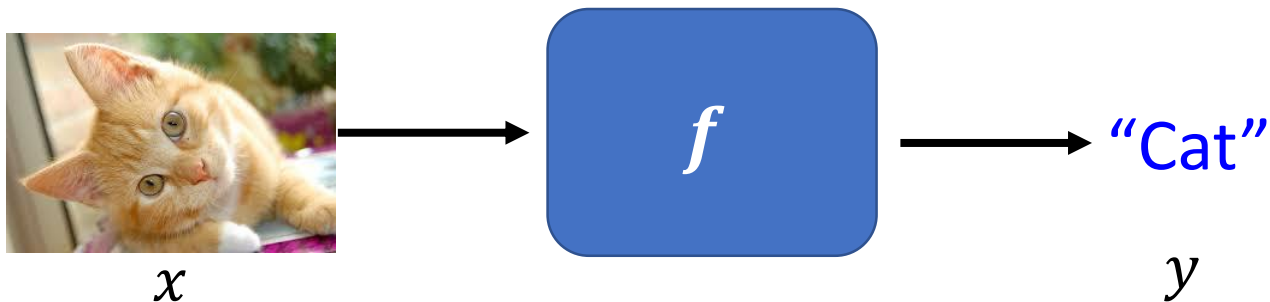


# Generation



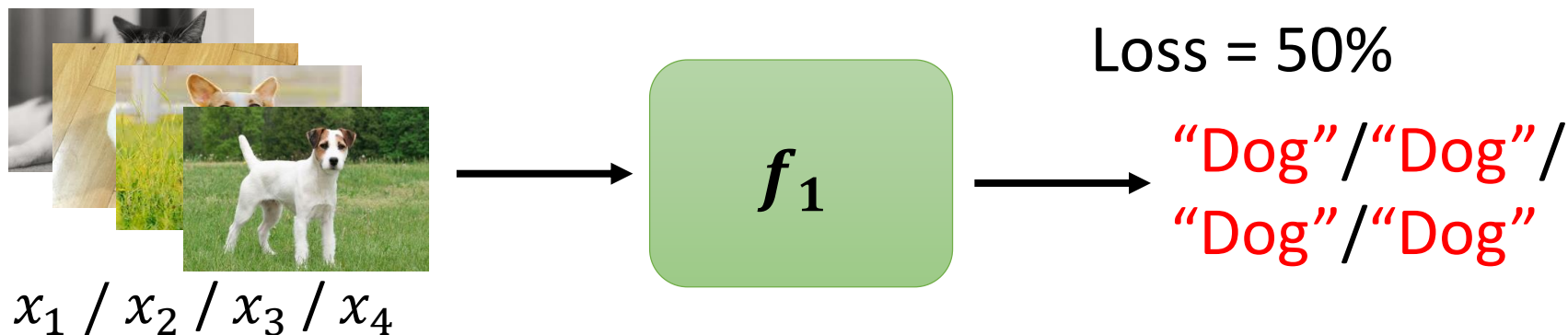
怎麼告訴機器  
你想找什麼樣的函式？





# Supervised Learning



Labelled Data

# 函式的 Loss

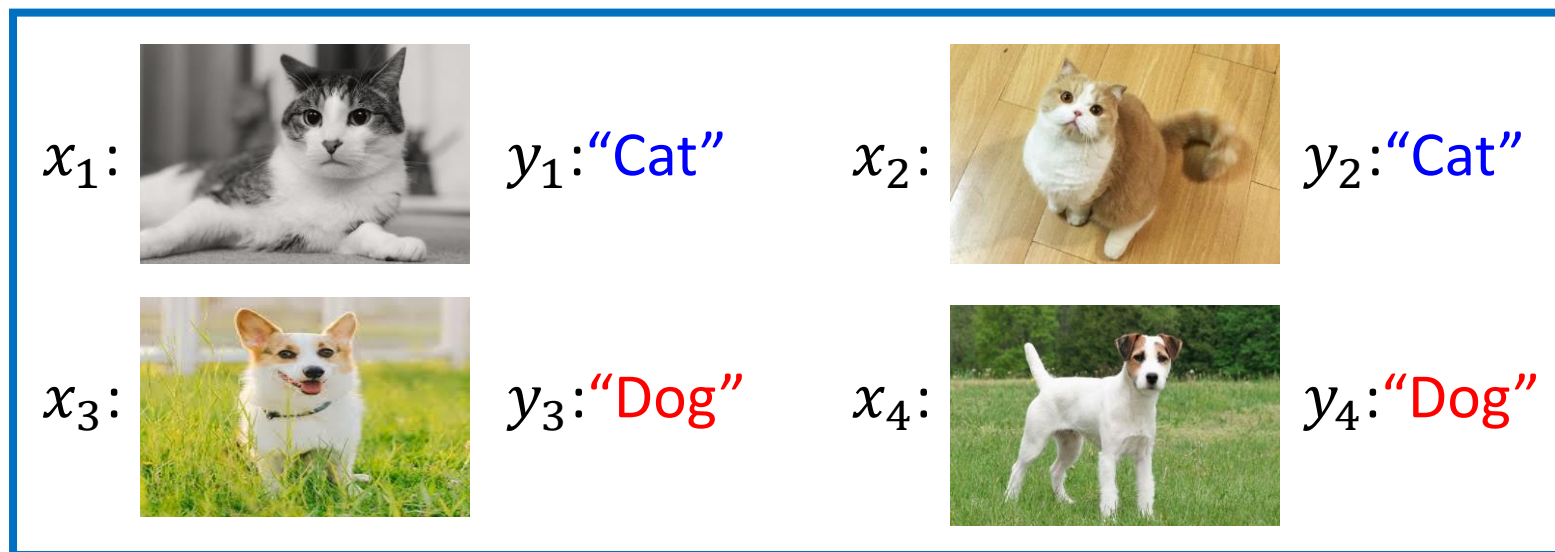
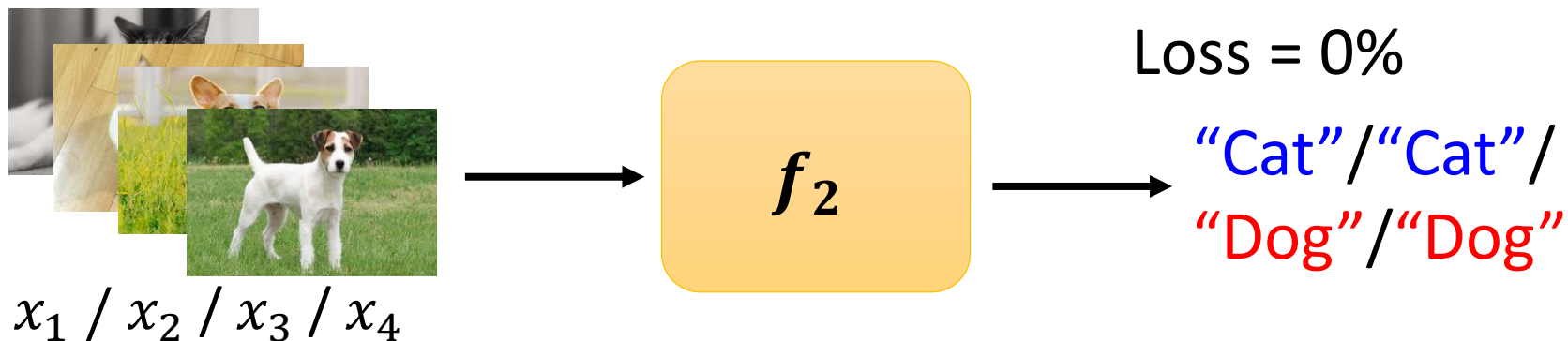


$x_1$ :		$y_1$ : "Cat"	$x_2$ :		$y_2$ : "Cat"
$x_3$ :		$y_3$ : "Dog"	$x_4$ :		$y_4$ : "Dog"

Labelled Data

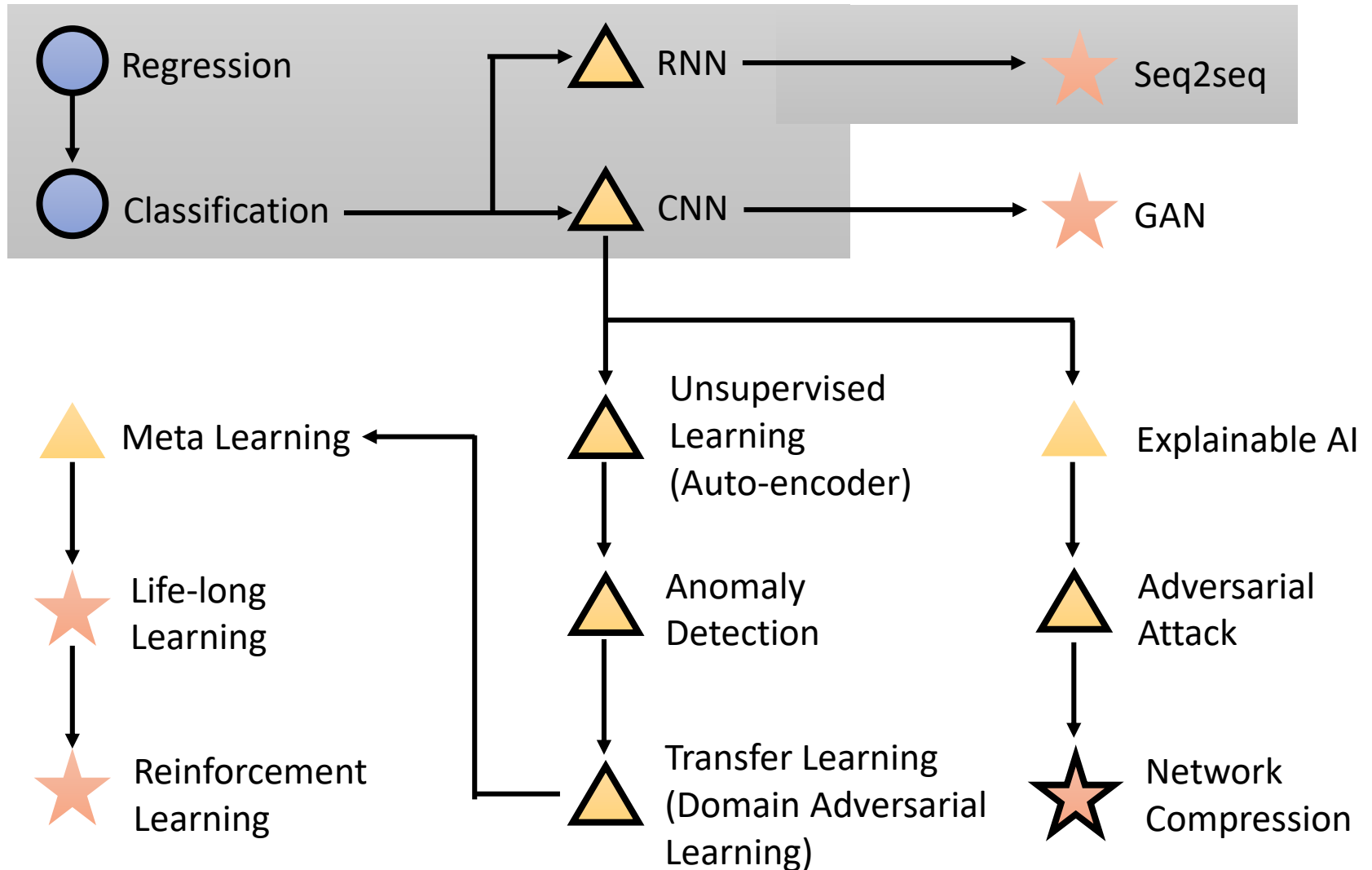
# 函式的 Loss

接下來機器會自動找出  
Loss 最低的函式



Labeled Data

# Supervised Learning





# Reinforcement Learning



# Supervised v.s. Reinforcement

- Supervised:

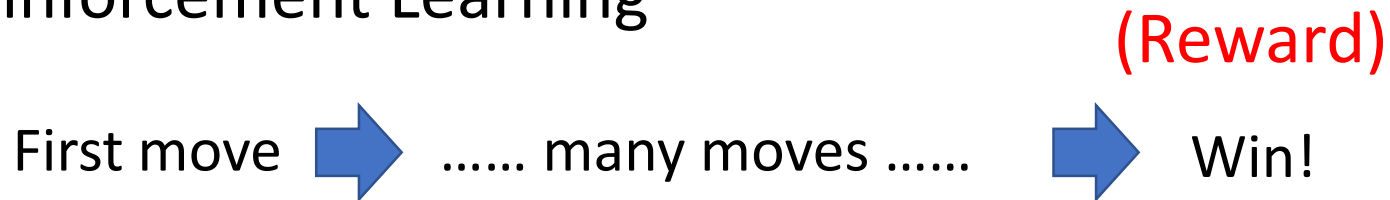


Next move:  
“5-5”



Next move:  
“3-3”

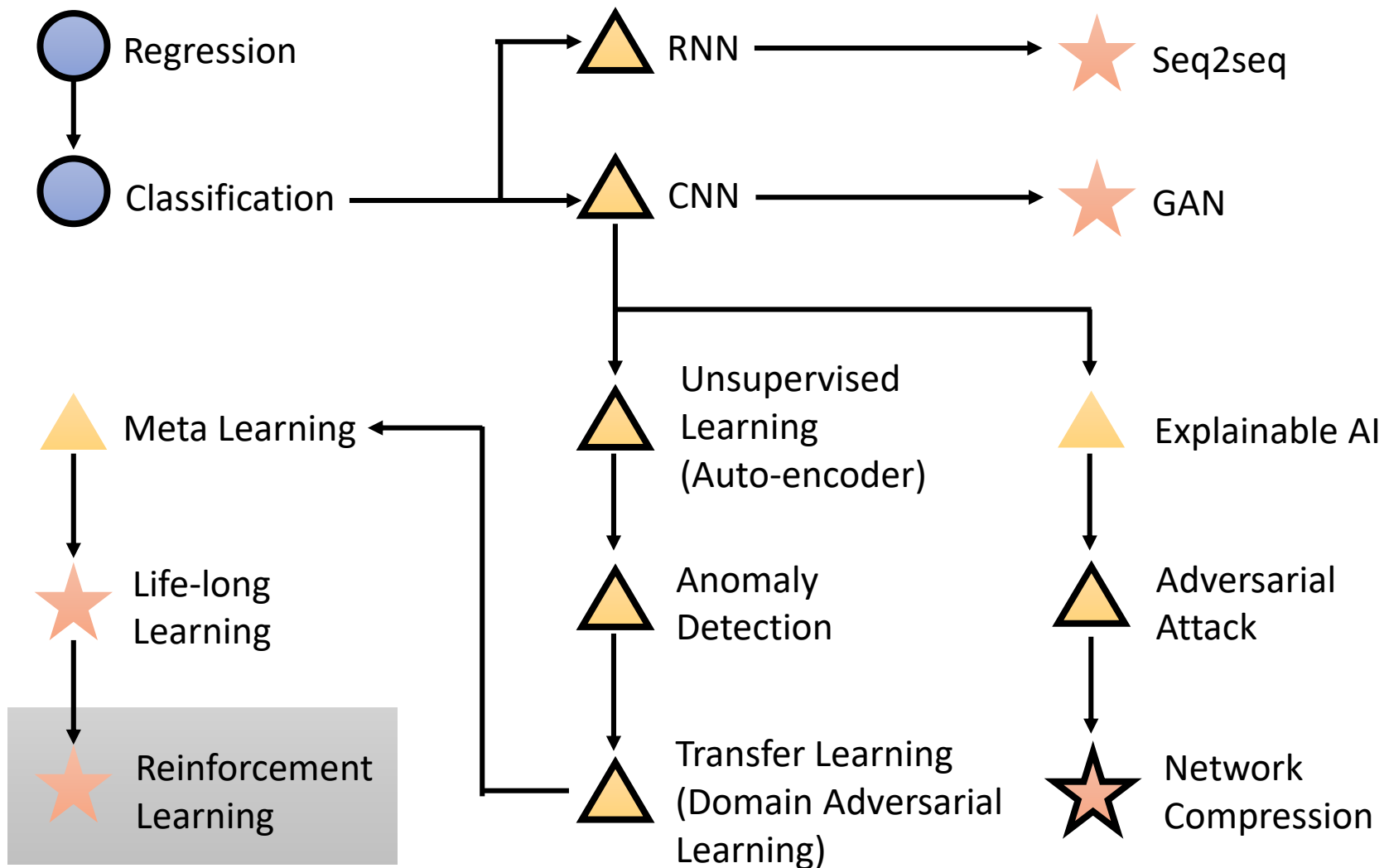
- Reinforcement Learning



Alpha Go is supervised learning + reinforcement learning.



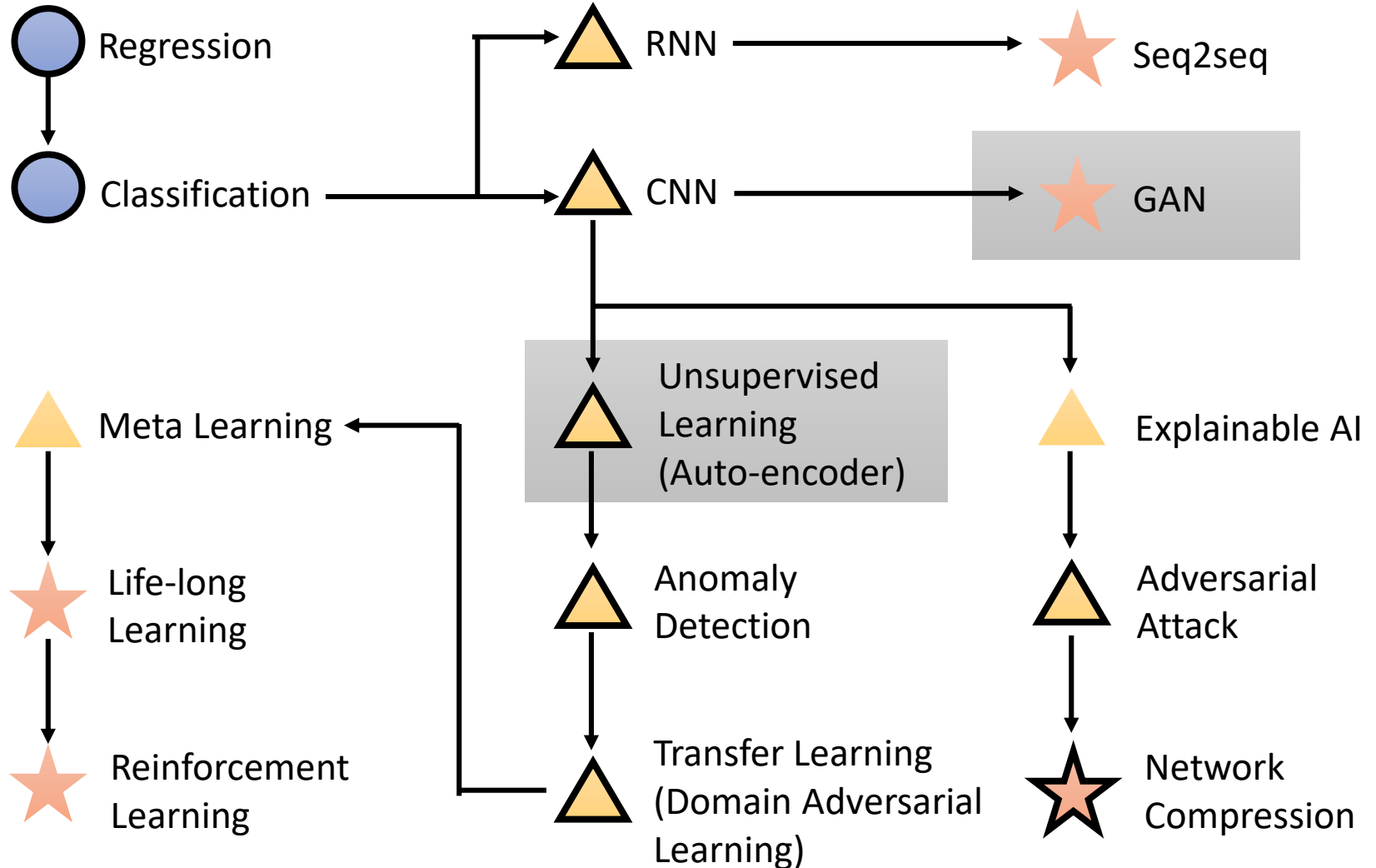
# Reinforcement Learning



# Unsupervised Learning

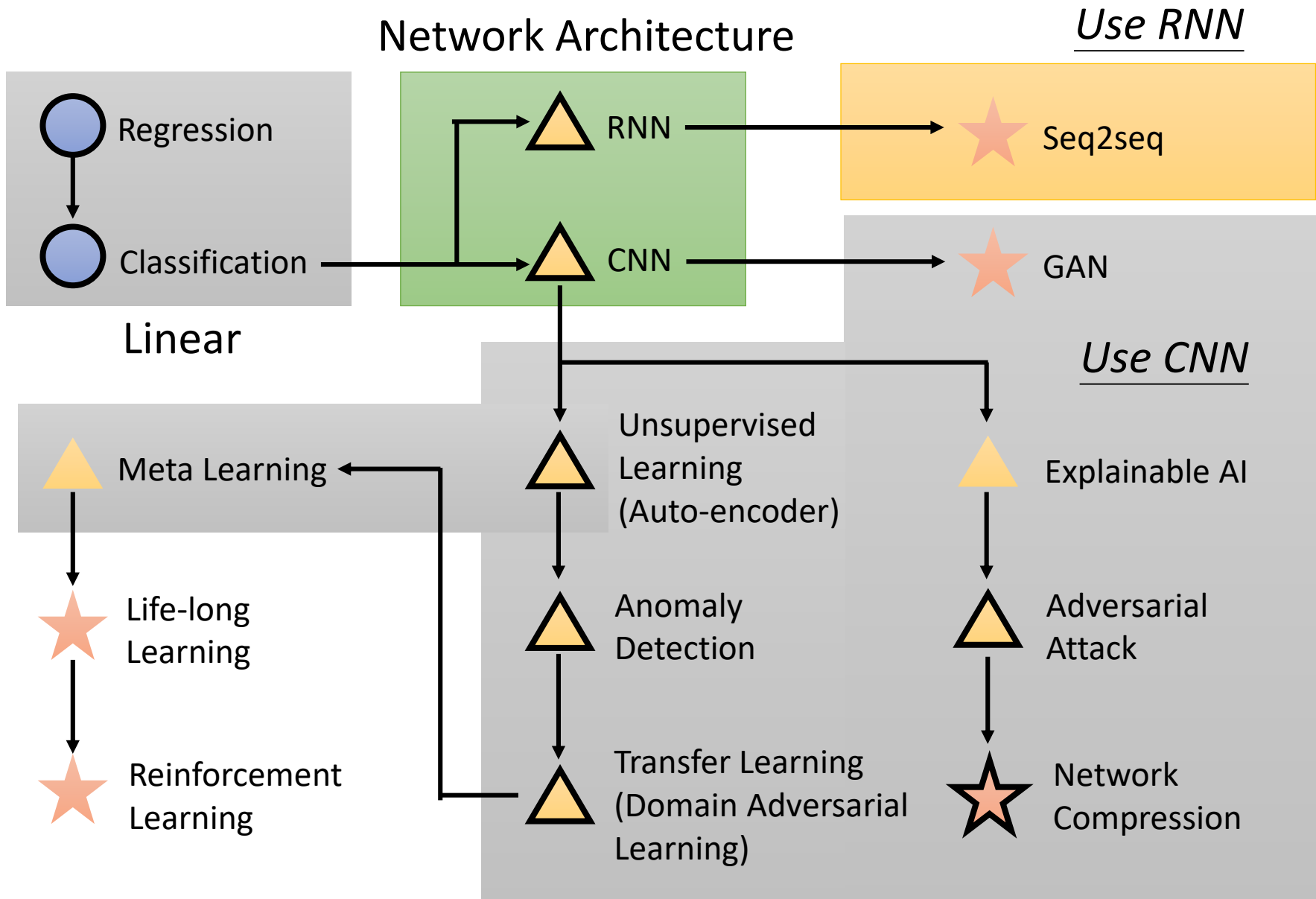


What can machine learn from unlabeled images?



機器怎麼  
找出你想要的函式？

# 限制函式尋找範圍



# 函式尋找方法 – Gradient Descent

Implement the  
algorithm by yourself

Regression

Classification

Deep Learning Framework  
(3/26 PyTorch 教學、會錄影)

RNN

Seq2seq

CNN

GAN

Meta Learning

Life-long  
Learning

Reinforcement  
Learning

Unsupervised  
Learning  
(Auto-encoder)

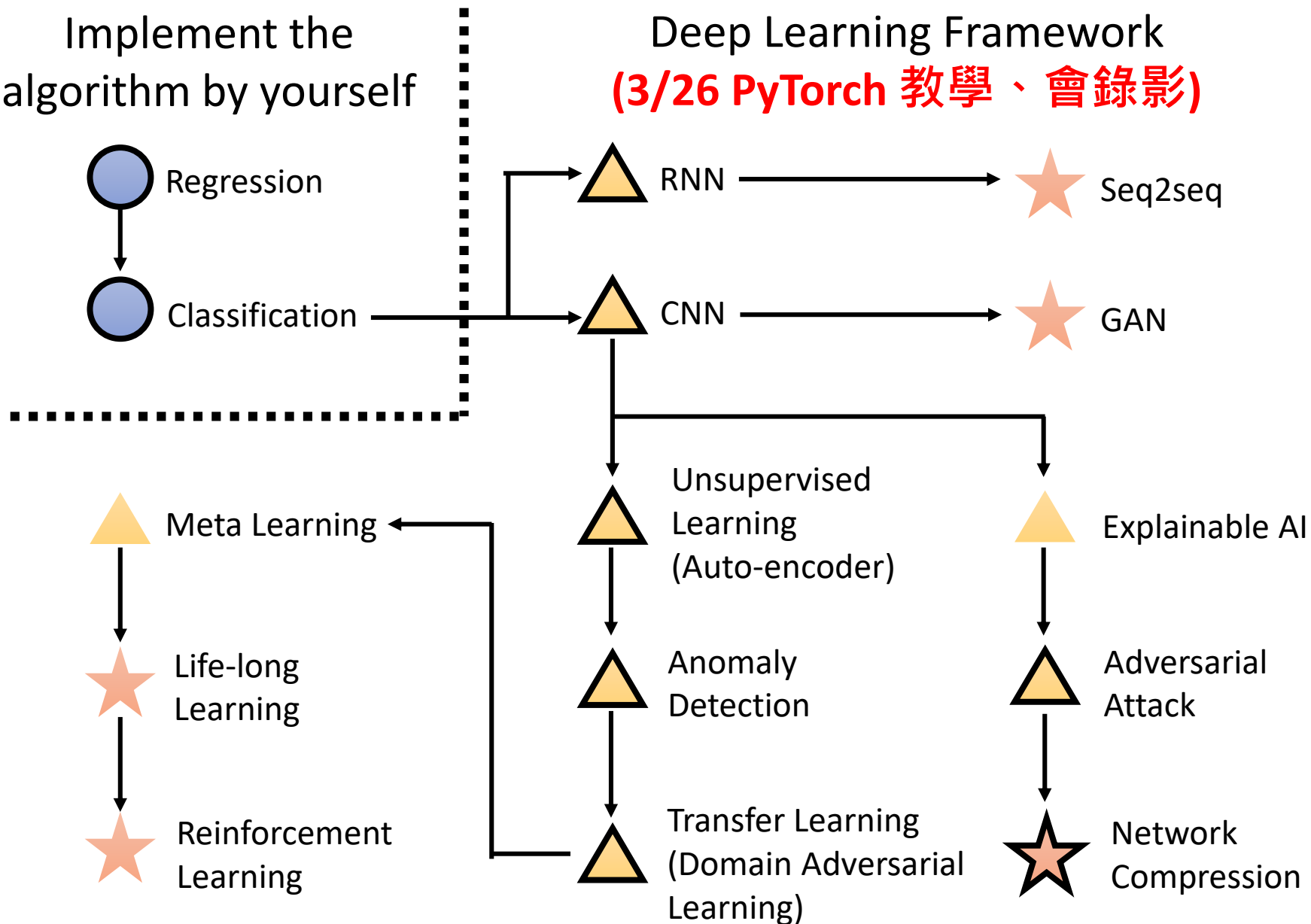
Anomaly  
Detection

Transfer Learning  
(Domain Adversarial  
Learning)

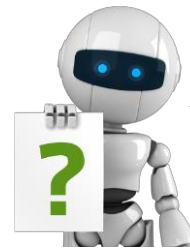
Explainable AI

Adversarial  
Attack

Network  
Compression

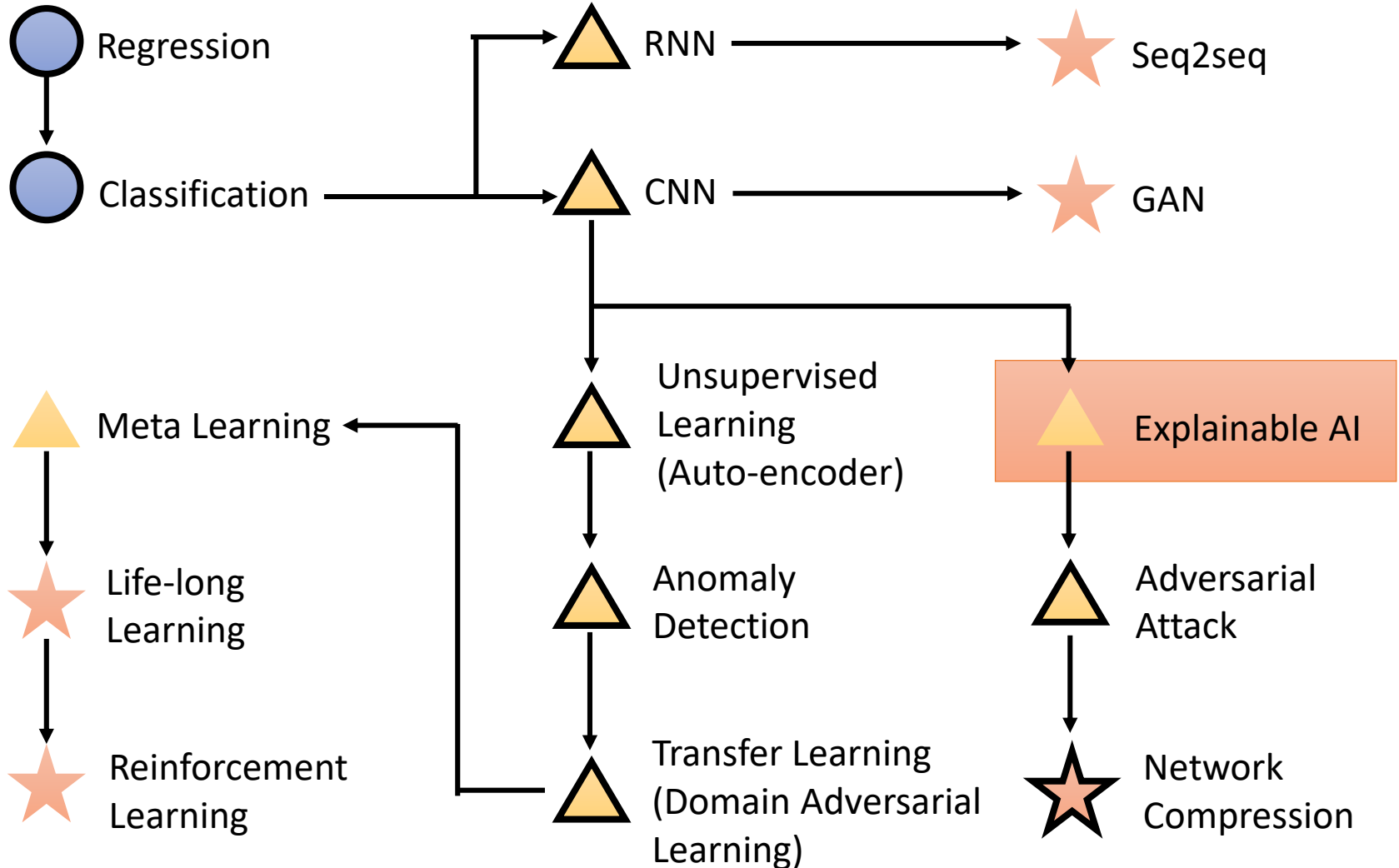


# 前沿研究



This is a "cat"

Because ...

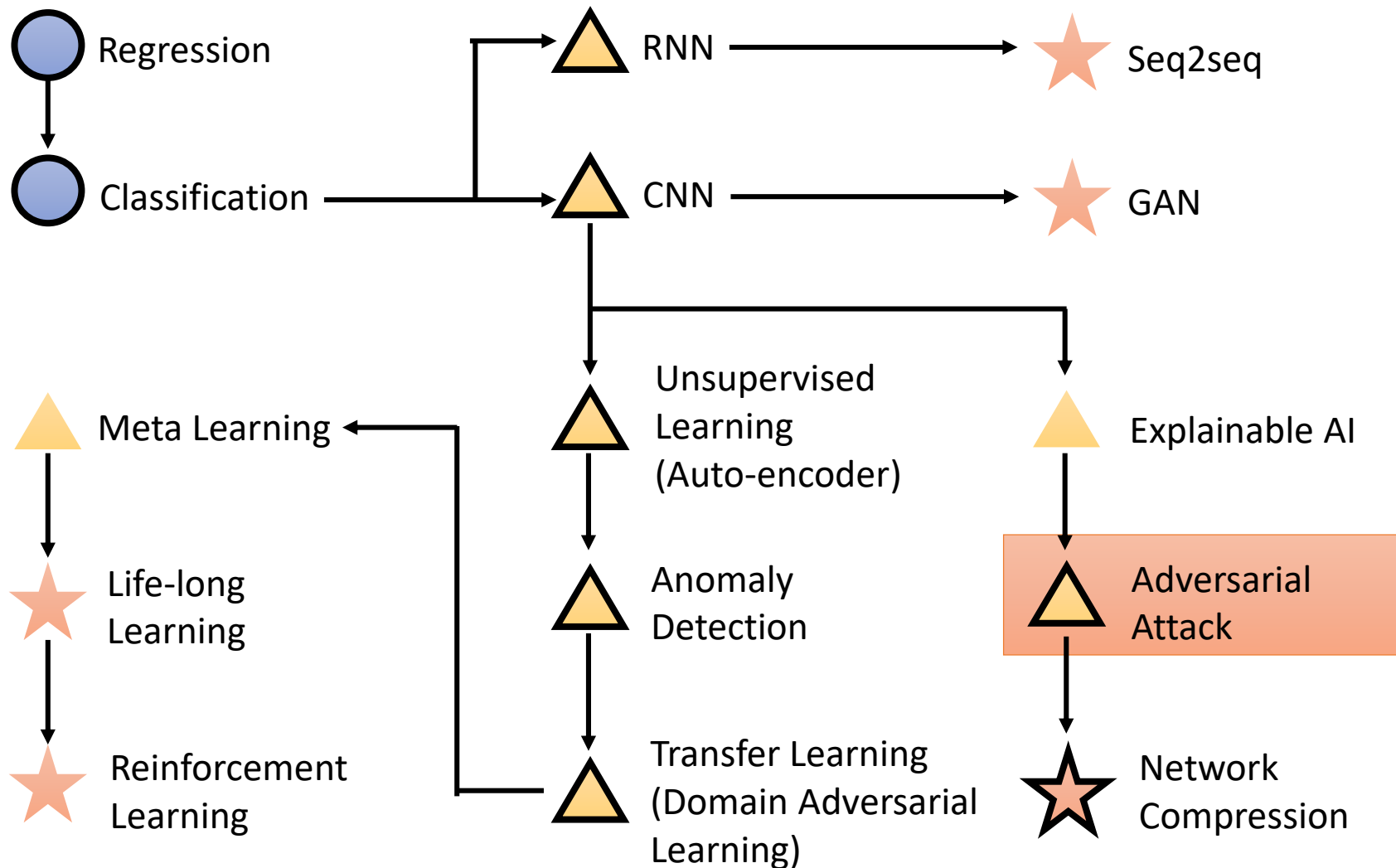


Add  
noise



This is a "cat"

Star Fish ...







This is a "cat"



Regression



Classification



Meta Learning



Life-long Learning



Reinforcement Learning



Seq2seq



GAN



Explainable AI



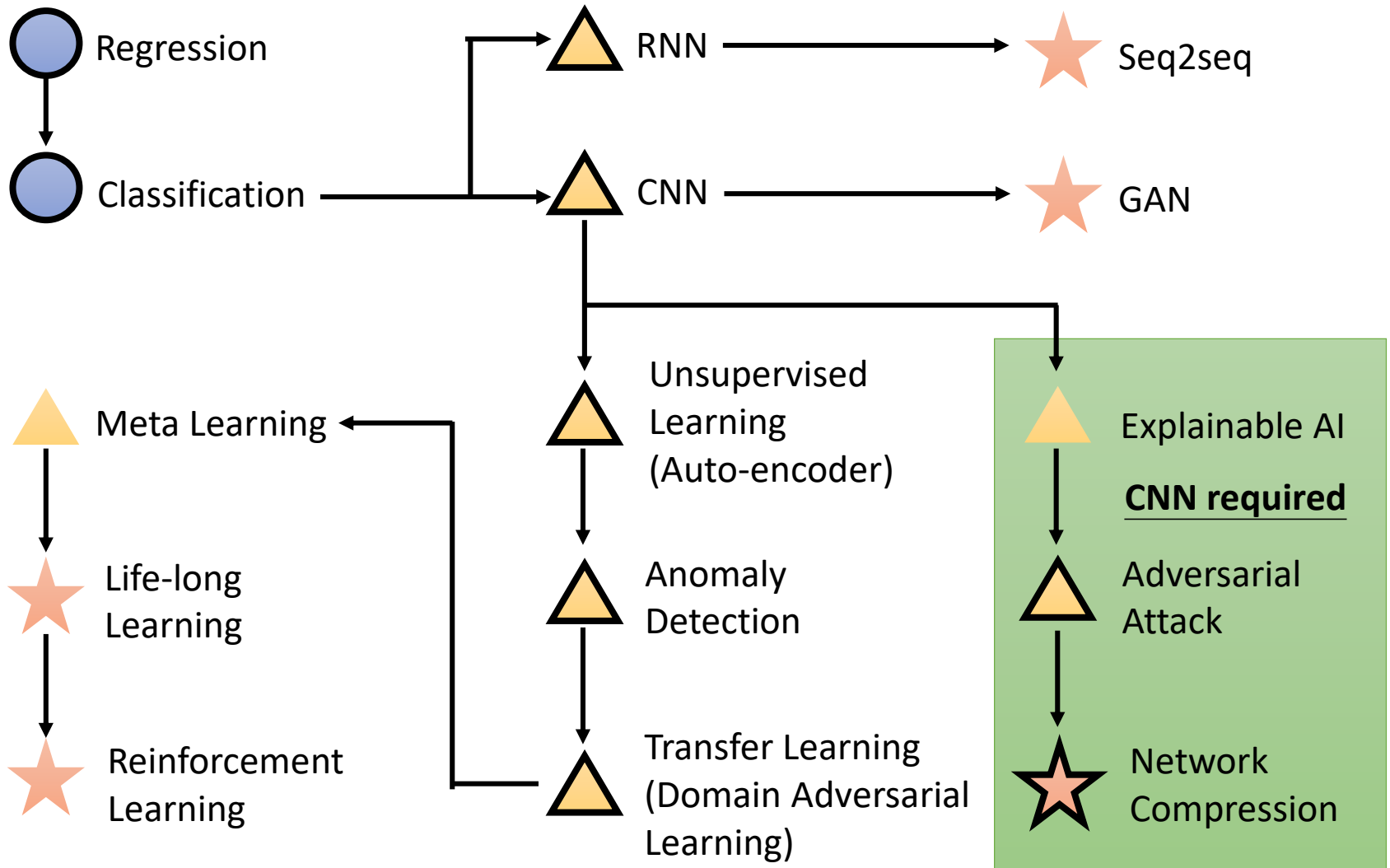
Adversarial Attack

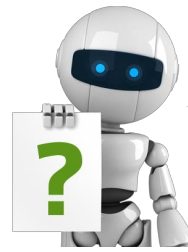


Transfer Learning  
(Domain Adversarial Learning)



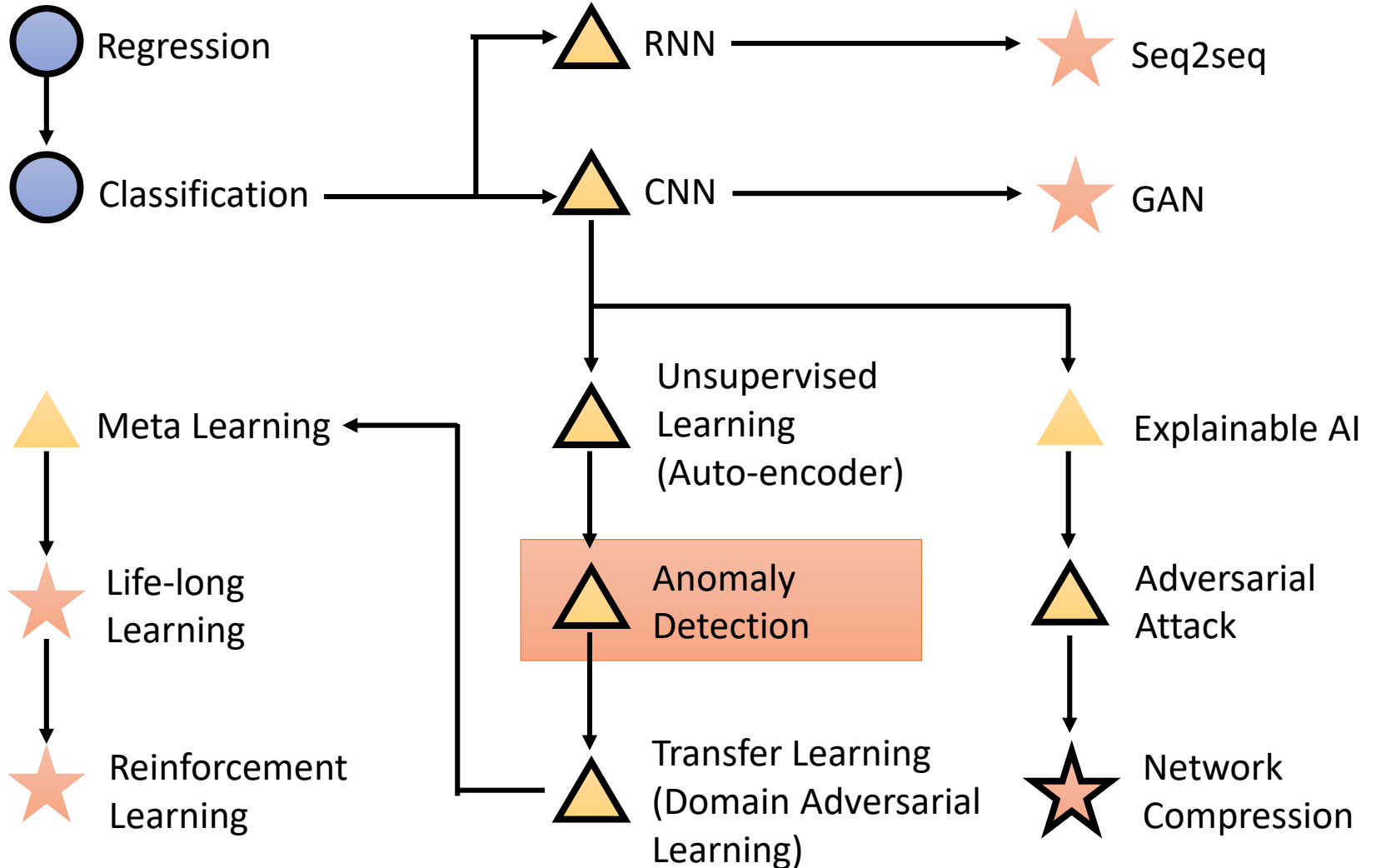
Network Compression





This is a "cat"

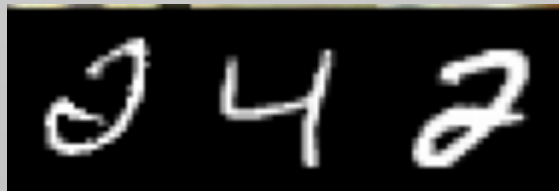
我不知道



Training  
Data

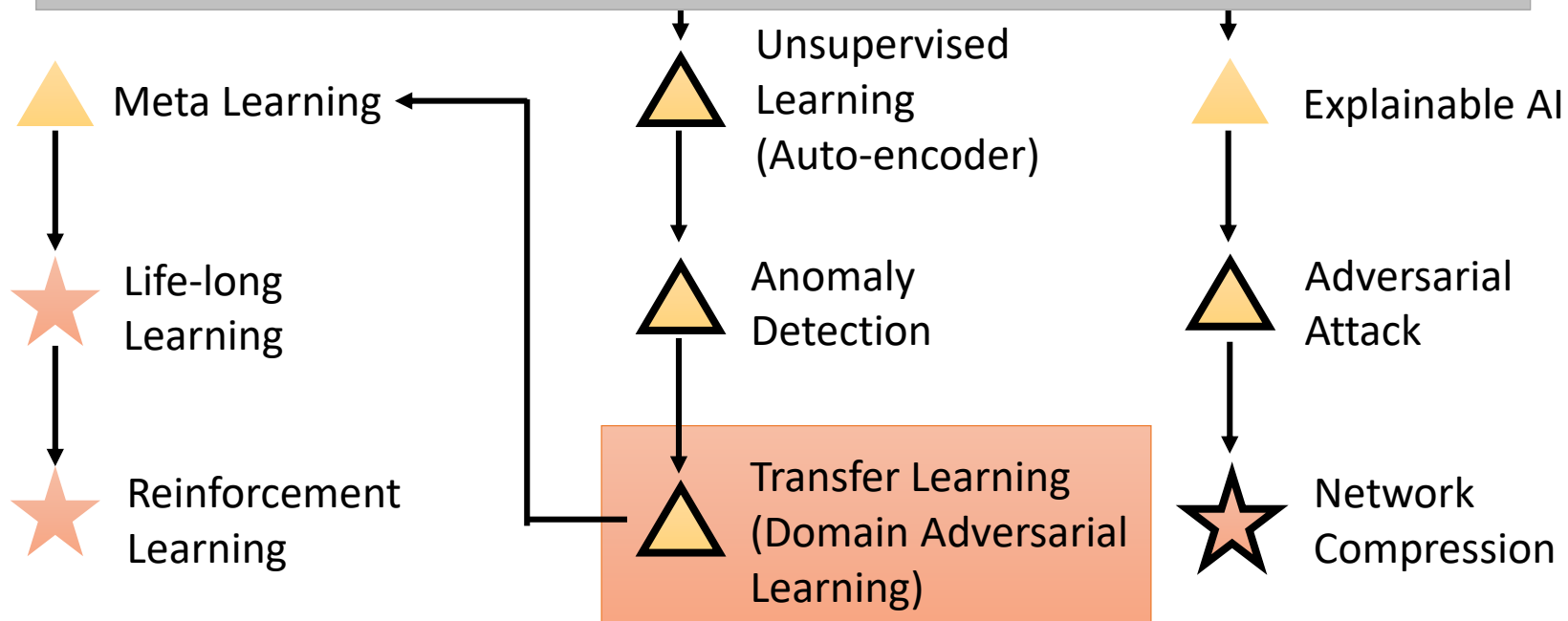


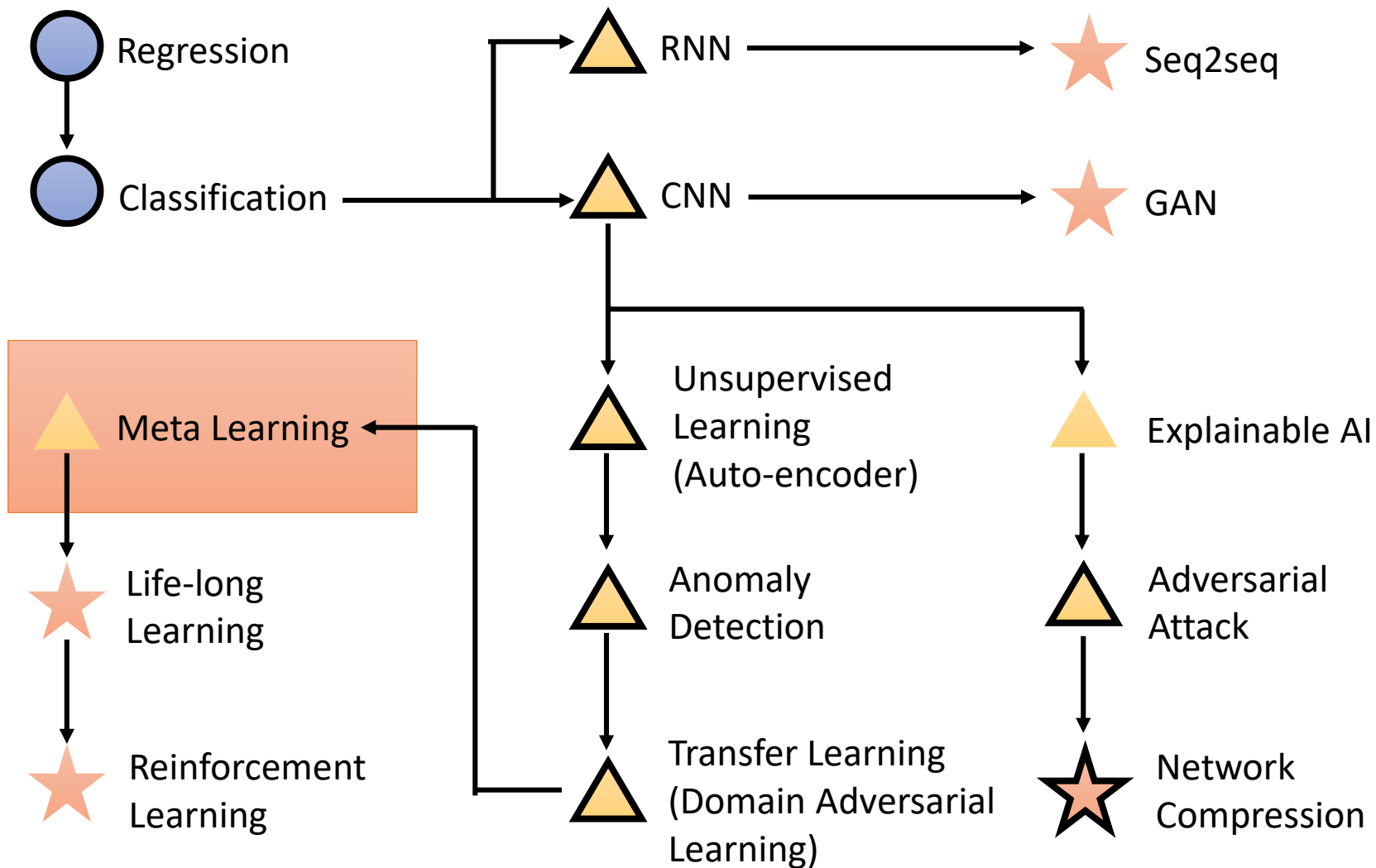
Testing  
Data



99.5%

57.5%





# 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

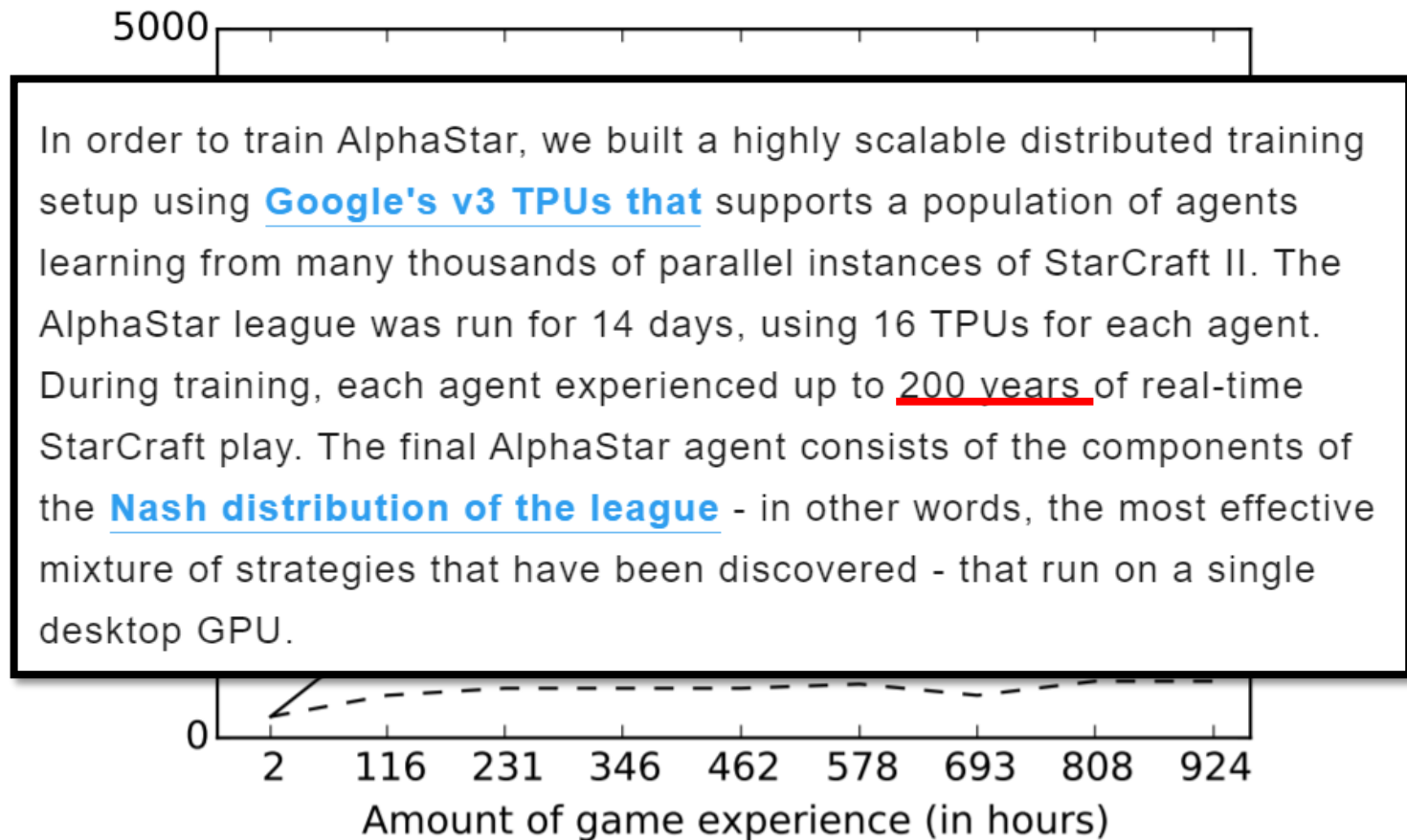
program  
for learning

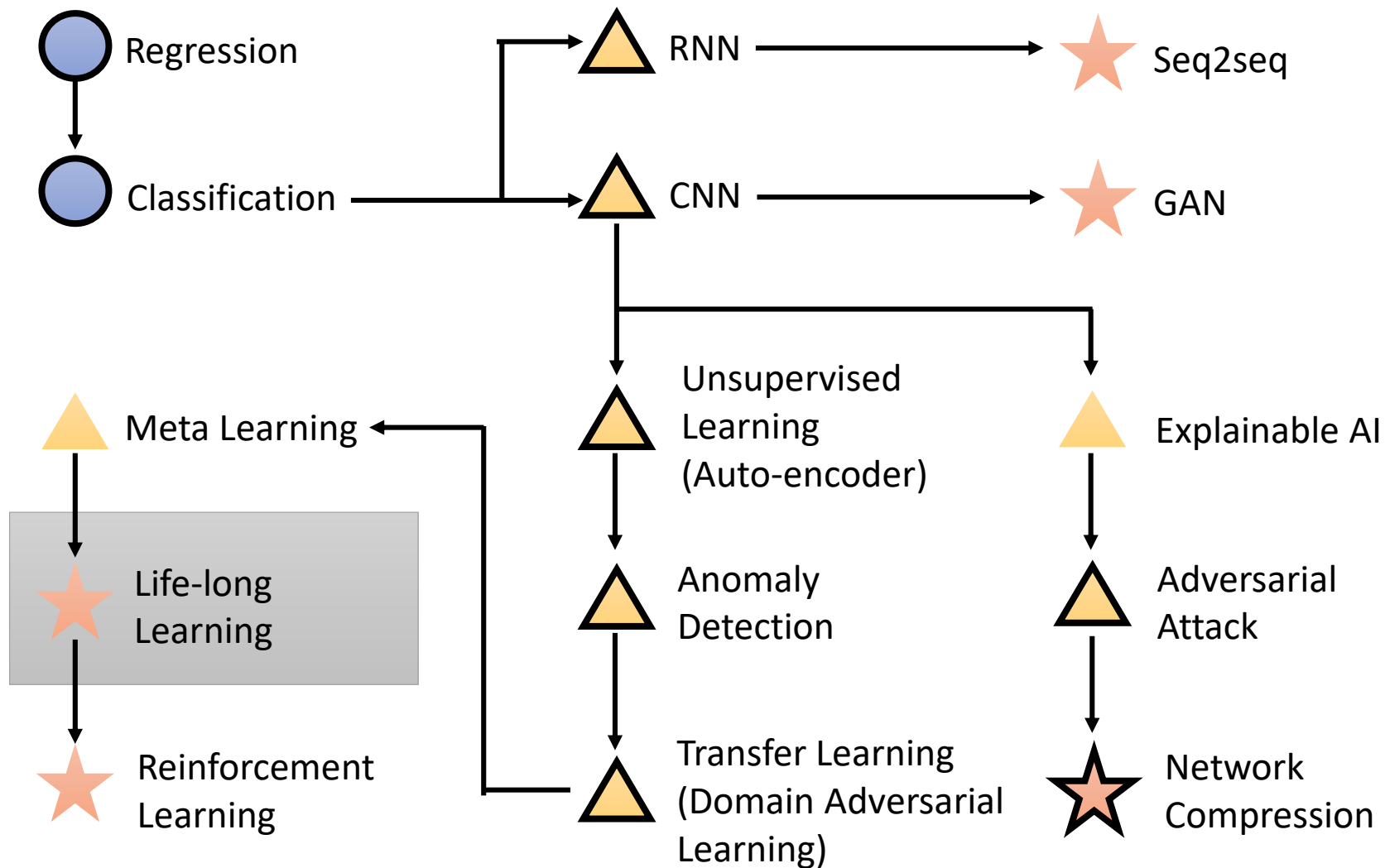


I can learn!

# 能不能讓機器聰明一點？

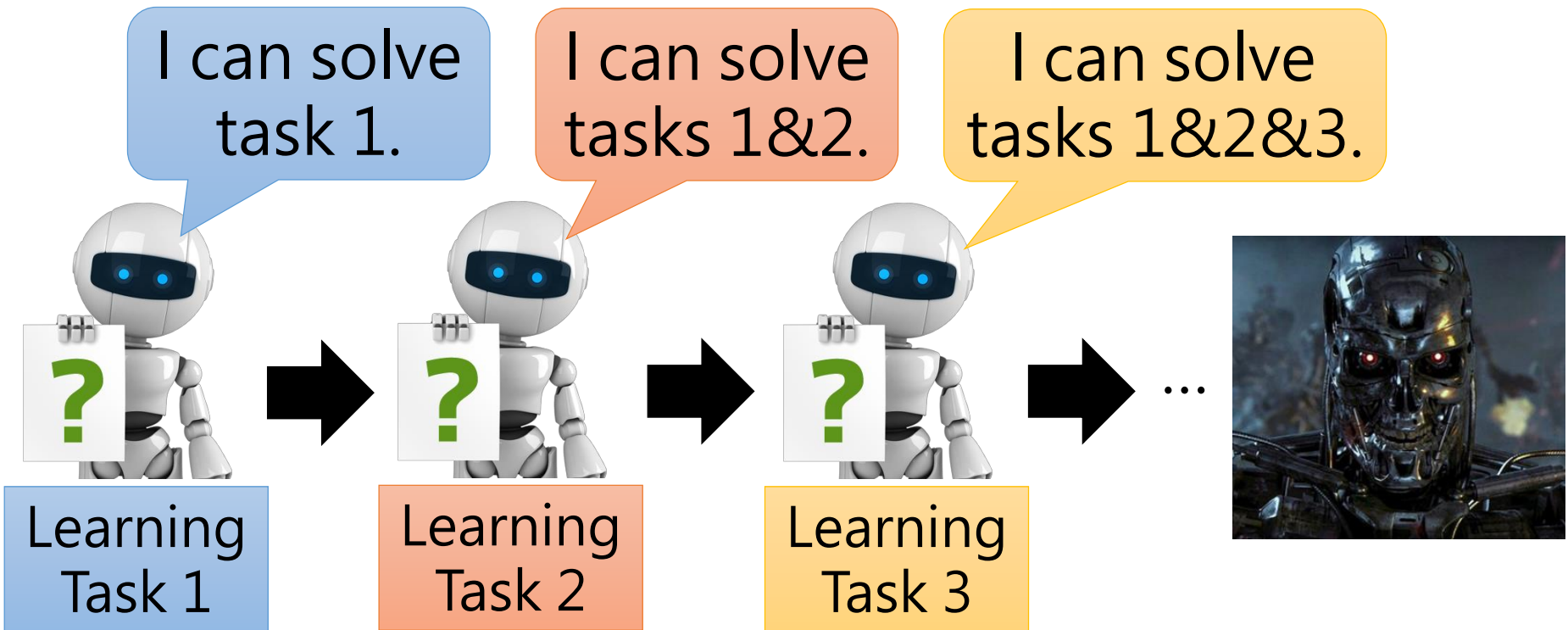
天資不佳卻勤奮不懈？



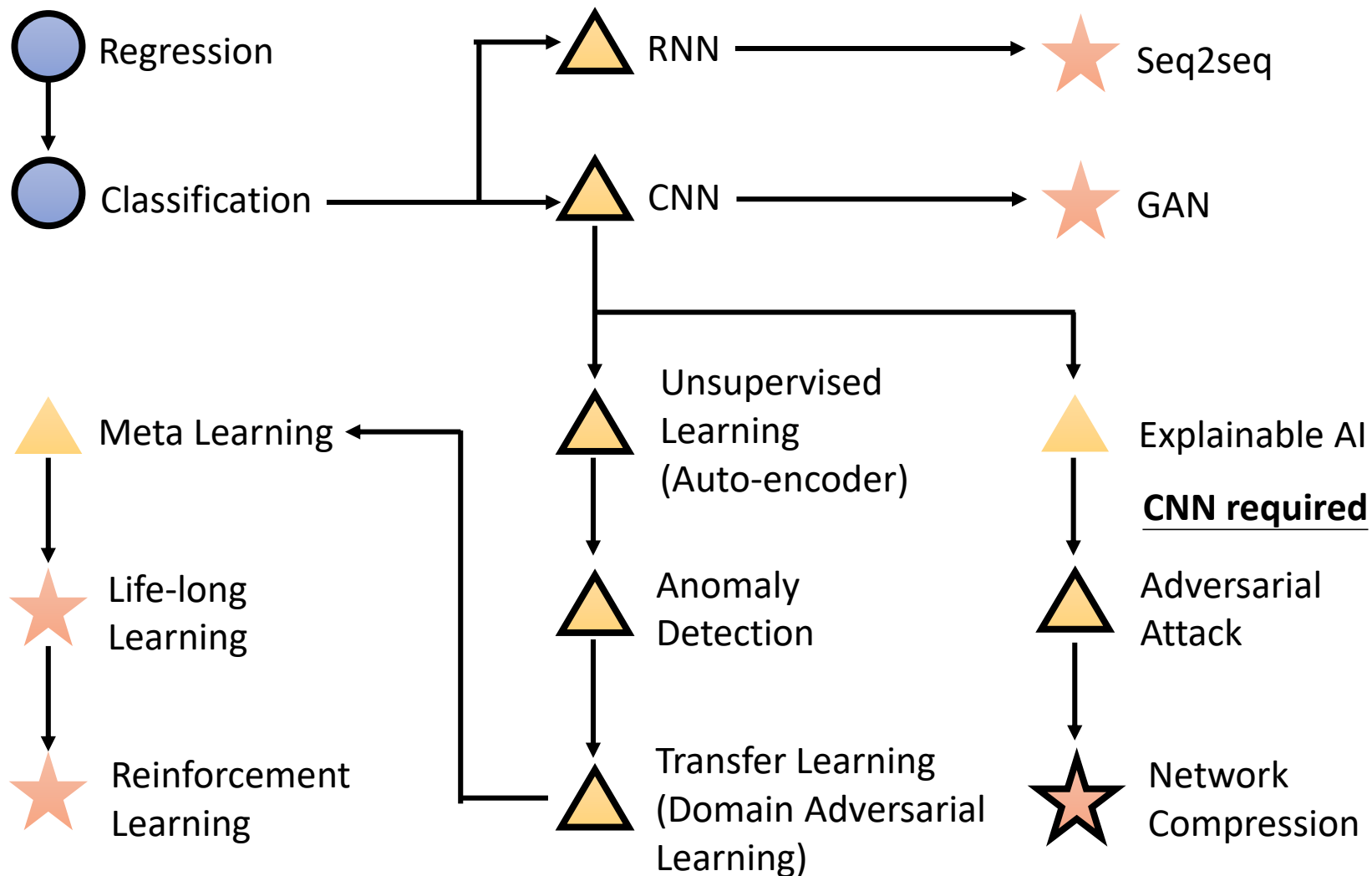
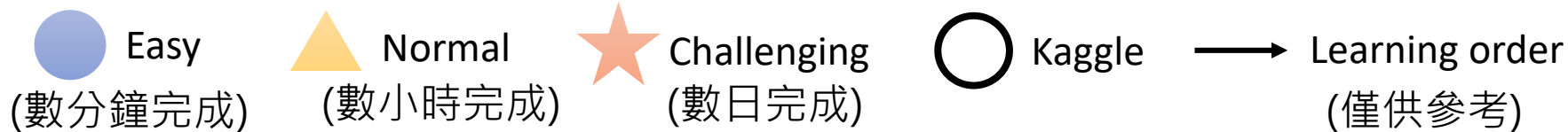




# 終身學習 (Life-long Learning)



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



# 課程網頁

- [http://speech.ee.ntu.edu.tw/~tlkagk/courses\\_ML20.html](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	<a href="#">Regression</a> , <a href="#">Basic Concept</a>	<a href="#">Regression</a>	<a href="#">slide</a>		3/26
Gradient Descent	<a href="#">Gradient Descent 1 2 3</a>			4/09	
作業二	<a href="#">Classification 1 2</a>	<a href="#">Classification</a>	<a href="#">slide</a>		3/26
DL預備	<a href="#">DL</a> , <a href="#">Backprop</a> , <a href="#">Tips</a> , <a href="#">Why Deep</a>	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	<a href="#">CNN</a>	<a href="#">CNN</a>	<a href="#">slide</a>	3/26 (GNN)	4/30
作業四	<a href="#">RNN 1 2</a>	<a href="#">RNN</a>	<a href="#">slide</a>		4/30
作業五	<a href="#">Explainable AI</a>	<a href="#">Explainable AI</a>	<a href="#">slide</a>	4/16	4/30
作業六	<a href="#">Adversarial Attack</a>	<a href="#">Adversarial Attack</a>	<a href="#">slide</a>	4/23	4/30
作業七	<a href="#">Network Compression</a>	<a href="#">Network Compression 1 2 3 4</a>	<a href="#">slide</a>	4/30	5/21
作業八	<a href="#">Seq2seq</a>	<a href="#">Seq2seq</a>	<a href="#">slide</a>	5/07 (New Architecture)	5/21
作業九	<a href="#">Dimension Reduction</a> , <a href="#">Neighbor Embedding</a> , <a href="#">Auto-encoder</a>	<a href="#">Unsupervised Learning</a>	<a href="#">slide</a>	5/14 (Model Pretraining)	5/21
作業十	<a href="#">Anomaly Detection</a>	<a href="#">Anomaly Detection</a>	<a href="#">slide</a>	5/21	6/11
作業十一	<a href="#">GAN (10 videos)</a>	<a href="#">GAN</a>	<a href="#">slide</a>	5/28	6/11
作業十二	<a href="#">Semi-supervised</a> , <a href="#">Transfer</a>	<a href="#">Transfer Learning</a>	<a href="#">slide</a>	6/04	6/11
作業十三	<a href="#">Meta Learning</a>	<a href="#">Meta 1 2</a>	<a href="#">slide</a>	6/11	7/02
作業十四	<a href="#">Life-long Learning</a>	<a href="#">Life-long</a>	<a href="#">slide</a>	6/18	7/02
作業十五	<a href="#">RL 1, 2, 3</a> , <a href="#">Advanced Version (8 videos)</a>	<a href="#">RL</a>	<a href="#">slide</a>	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	<a href="#">Regression, Basic Concept</a>	<a href="#">Regression</a>	<a href="#">slide</a>		3/26
Gradient Descent	<a href="#">Gradient Descent 1 2 3</a>			4/09	
作業二	<a href="#">Classification 1 2</a>	<a href="#">Classification</a>	<a href="#">slide</a>		3/26
DL預備	<a href="#">DL, Backprop, Tips, Why Deep</a>	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	<a href="#">CNN</a>	<a href="#">CNN</a>	<a href="#">slide</a>	3/26 (GNN)	4/30
作業四	<a href="#">RNN 1 2</a>	<a href="#">RNN</a>	<a href="#">slide</a>		4/30
作業五	<a href="#">Explainable AI</a>	<a href="#">Explainable AI</a>	<a href="#">slide</a>	4/16	4/30
作業六	<a href="#">Adversarial Attack</a>	<a href="#">Adversarial Attack</a>	<a href="#">slide</a>	4/23	4/30
作業七	<a href="#">Network Compression</a>	<a href="#">Network Compression 1 2 3 4</a>	<a href="#">slide</a>	4/30	5/21
作業八	<a href="#">Seq2seq</a>	<a href="#">Seq2seq</a>	<a href="#">slide</a>	5/07 (New Architecture)	5/21
作業九	<a href="#">Dimension Reduction, Neighbor Embedding, Auto-encode</a>	<a href="#">Unsupervised Learning</a>	<a href="#">slide</a>	5/14 (Model Pretraining)	5/21
作業十	<a href="#">Anomaly Detection</a>	<a href="#">Anomaly Detection</a>	<a href="#">slide</a>	5/21	6/11
作業十一	<a href="#">GAN (10 videos)</a>	<a href="#">GAN</a>	<a href="#">slide</a>	5/28	6/11
作業十二	<a href="#">Semi-supervised, Transfer</a>	<a href="#">Transfer Learning</a>	<a href="#">slide</a>	6/04	6/11
作業十三	<a href="#">Meta Learning</a>	<a href="#">Meta 1 2</a>	<a href="#">slide</a>	6/11	7/02
作業十四	<a href="#">Life-long Learning</a>	<a href="#">Life-long</a>	<a href="#">slide</a>	6/18	7/02
作業十五	<a href="#">RL 1, 2, 3, Advanced Version (8 videos)</a>	<a href="#">RL</a>	<a href="#">slide</a>	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	<a href="#">Regression, Basic Concept</a>	<a href="#">Regression</a>	<a href="#">slide</a>		3/26
Gradient Descent	<a href="#">Gradient Descent 1 2 3</a>			4/09	
作業二	<a href="#">Classification 1 2</a>	<a href="#">Classification</a>	<a href="#">slide</a>		3/26
DL預備	<a href="#">DL, Backprop, Tips, Why Deep</a>	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	<a href="#">CNN</a>	<a href="#">CNN</a>	<a href="#">slide</a>	3/26 (GNN)	4/30
作業四	<a href="#">RNN 1 2</a>	<a href="#">RNN</a>	<a href="#">slide</a>		4/30
作業五	<a href="#">Explainable AI</a>	<a href="#">Explainable AI</a>	<a href="#">slide</a>	4/16	4/30
作業六	<a href="#">Adversarial Attack</a>	<a href="#">Adversarial Attack</a>	<a href="#">slide</a>	4/23	4/30
作業七	<a href="#">Network Compression</a>	<a href="#">Network Compression 1 2 3 4</a>	<a href="#">slide</a>	4/30	5/21
作業八	<a href="#">Seq2seq</a>	<a href="#">Seq2seq</a>	<a href="#">slide</a>	5/07 (New Architecture)	5/21
作業九	<a href="#">Dimension Reduction, Neighbor Embedding, Auto-encoder</a>	<a href="#">Unsupervised Learning</a>	<a href="#">slide</a>	5/14 (Model Pretraining)	5/21
作業十	<a href="#">Anomaly Detection</a>	<a href="#">Anomaly Detection</a>	<a href="#">slide</a>	5/21	6/11
作業十一	<a href="#">GAN (10 videos)</a>	<a href="#">GAN</a>	<a href="#">slide</a>	5/28	6/11
作業十二	<a href="#">Semi-supervised, Transfer</a>	<a href="#">Transfer Learning</a>	<a href="#">slide</a>	6/04	6/11
作業十三	<a href="#">Meta Learning</a>	<a href="#">Meta 1 2</a>	<a href="#">slide</a>	6/11	7/02
作業十四	<a href="#">Life-long Learning</a>	<a href="#">Life-long</a>	<a href="#">slide</a>	6/18	7/02
作業十五	<a href="#">RL 1, 2, 3, Advanced Version (8 videos)</a>	<a href="#">RL</a>	<a href="#">slide</a>	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	<a href="#">Regression, Basic Concept</a>	<a href="#">Regression</a>	<a href="#">slide</a>		3/26
Gradient Descent	<a href="#">Gradient Descent 1 2 3</a>			4/09	
作業二	<a href="#">Classification 1 2</a>	<a href="#">Classification</a>	<a href="#">slide</a>		3/26
DL預備	<a href="#">DL, Backprop, Tips, Why Deep</a>	PyTorch 教學 (3/26 現場教學、會錄影)			
作業三	<a href="#">CNN</a>	<a href="#">CNN</a>	<a href="#">slide</a>	3/26 (GNN)	4/30
作業四	<a href="#">RNN 1 2</a>	<a href="#">RNN</a>	<a href="#">slide</a>		4/30
作業五	<a href="#">Explainable AI</a>	<a href="#">Explainable AI</a>	<a href="#">slide</a>	4/16	4/30
作業六	<a href="#">Adversarial Attack</a>	<a href="#">Adversarial Attack</a>	<a href="#">slide</a>	4/23	4/30
作業七	<a href="#">Network Compression</a>	<a href="#">Network Compression 1 2 3 4</a>	<a href="#">slide</a>	4/30	5/21
作業八	<a href="#">Seq2seq</a>	<a href="#">Seq2seq</a>	<a href="#">slide</a>	5/07 (New Architecture)	5/21
作業九	<a href="#">Dimension Reduction, Neighbor Embedding, Auto-encoder</a>	<a href="#">Unsupervised Learning</a>	<a href="#">slide</a>	5/14 (Model Pretraining)	5/21
作業十	<a href="#">Anomaly Detection</a>	<a href="#">Anomaly Detection</a>	<a href="#">slide</a>	5/21	6/11
作業十一	<a href="#">GAN (10 videos)</a>	<a href="#">GAN</a>	<a href="#">slide</a>	5/28	6/11
作業十二	<a href="#">Semi-supervised, Transfer</a>	<a href="#">Transfer Learning</a>	<a href="#">slide</a>	6/04	6/11
作業十三	<a href="#">Meta Learning</a>	<a href="#">Meta 1 2</a>	<a href="#">slide</a>	6/11	7/02
作業十四	<a href="#">Life-long Learning</a>	<a href="#">Life-long</a>	<a href="#">slide</a>	6/18	7/02
作業十五	<a href="#">RL 1, 2, 3, Advanced Version (8 videos)</a>	<a href="#">RL</a>	<a href="#">slide</a>	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
	<a href="#">Regression</a>	<a href="#">slide</a>		3/26
			4/09	
	<a href="#">Classification</a>			3/26
	PyTorch 教學 (3/26 現場教學、會錄影)			
	<a href="#">CNN</a>	<a href="#">slide</a>	3/26 (GNN)	4/30
	<a href="#">RNN</a>	<a href="#">slide</a>		4/30
	<a href="#">Explainable AI</a>	<a href="#">slide</a>	4/16	4/30
	<a href="#">Adversarial Attack</a>	<a href="#">slide</a>	4/23	4/30
	<a href="#">Network Compression 1 2 3 4</a>	<a href="#">slide</a>	4/30	5/21
	<a href="#">Seq2seq</a>	<a href="#">slide</a>	5/07 (New Architecture)	5/21
<a href="#">Adding, Auto-encoder</a>	<a href="#">Unsupervised Learning</a>	<a href="#">slide</a>	5/14 (Model Pretraining)	5/21
	<a href="#">Anomaly Detection</a>	<a href="#">slide</a>	5/21	6/11
	<a href="#">GAN</a>	<a href="#">slide</a>	5/28	6/11
	<a href="#">Transfer Learning</a>	<a href="#">slide</a>	6/04	6/11
	<a href="#">Meta 1 2</a>	<a href="#">slide</a>	6/11	7/02
	以後每週四上午 9:10 – 10:00 就是助教時間			7/02
	<a href="#">RL</a>	<a href="#">slide</a>	6/28	7/02

每一個作業都有死線



# 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!!!

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