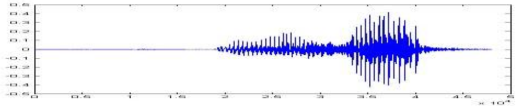
Machine Learning 2020

李宏毅

Hung-yi Lee

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

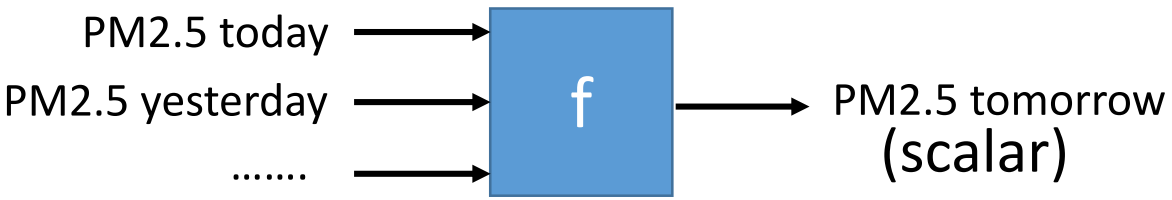
$f($ “How are you?” $)=$ “I am fine.”

(what the user said) (system response)

你想找什麼樣的函式？

Regression

The output of the function is a scalar.



PM2.5 today

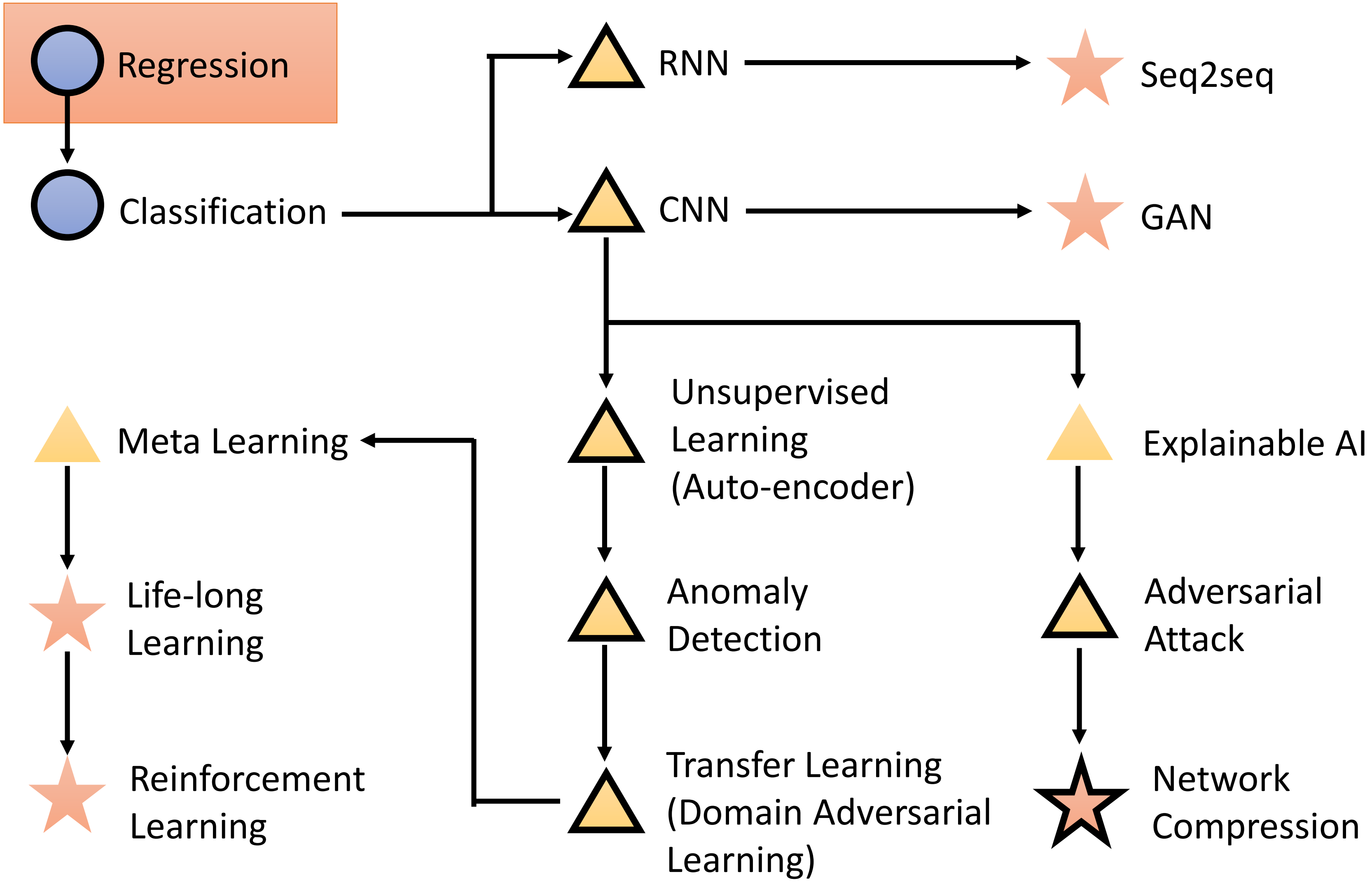
PM2.5 yesterday

…….

f

PM2.5 tomorrow

(scalar)



Regression

Classification

RNN

CNN

Seq2seq

GAN

Unsupervised Learning (Auto-encoder)

Explainable AI

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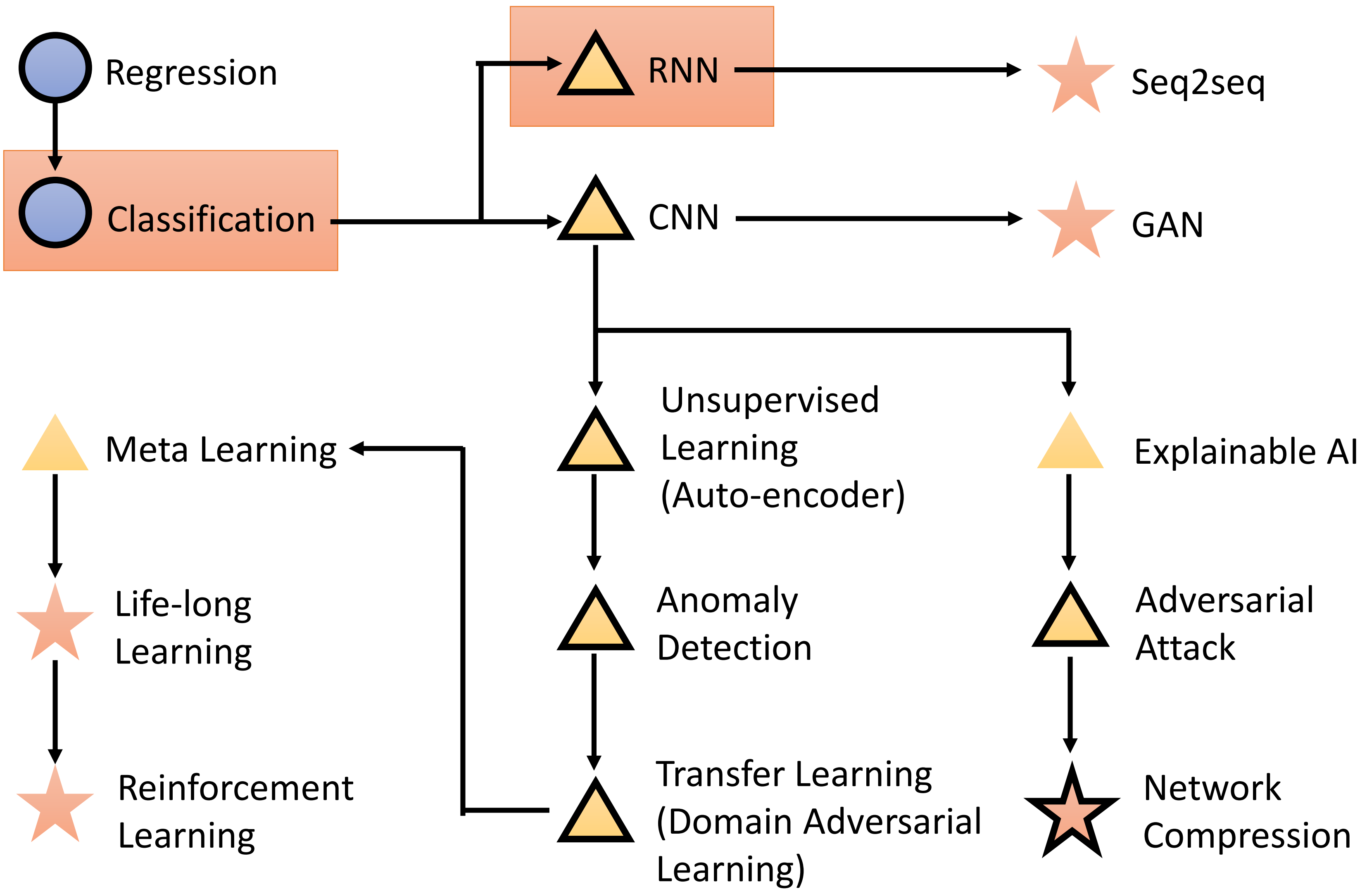
Adversarial Attack

Transfer Learning (Domain Adversarial Learning)

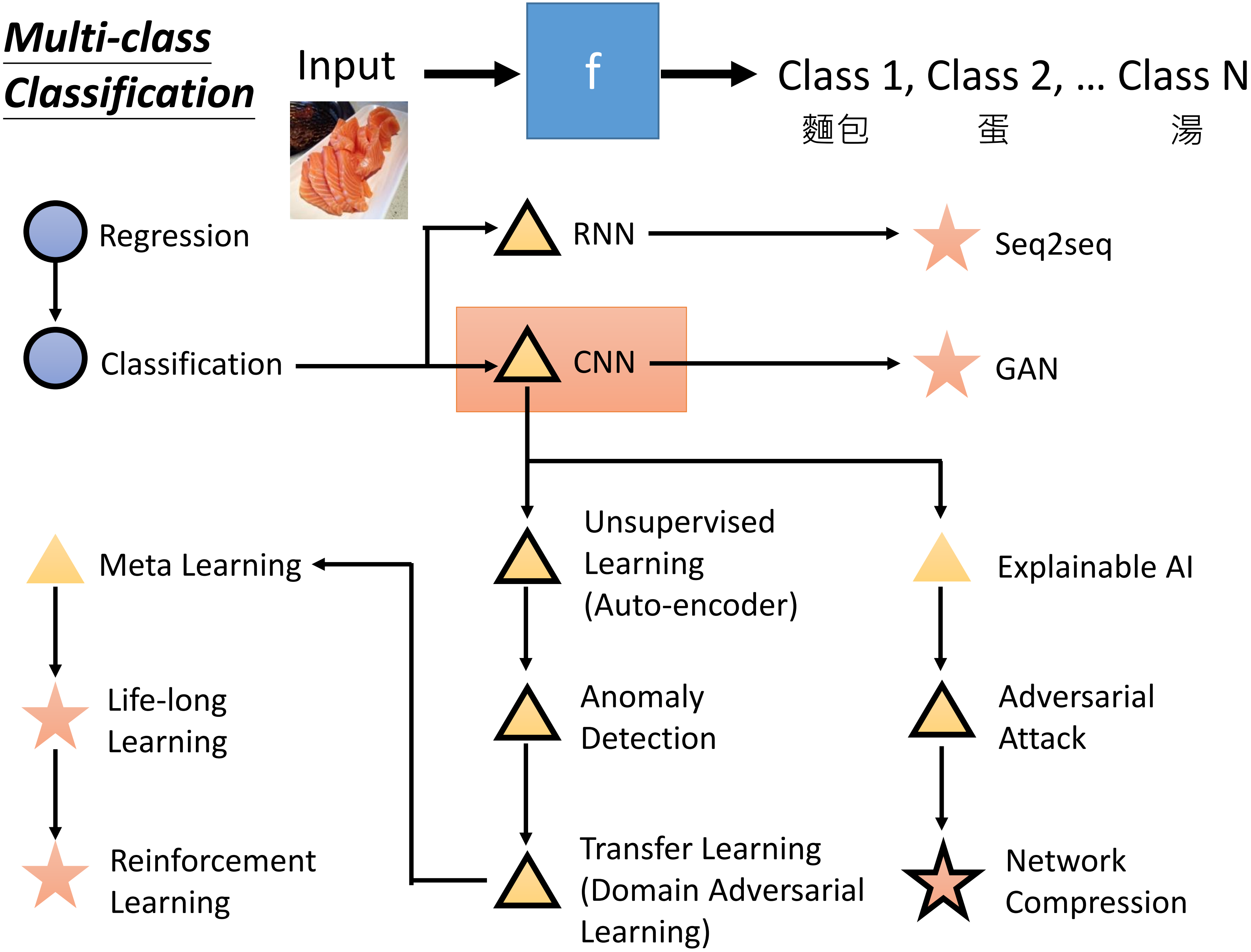
Network Compression

Binary Classification

Input (sentence) → f → Yes or No (pos or neg)



Multi-class Classification



Input

f

Class 1, Class 2, ... Class N

麵包 蛋 湯

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Generation 的問題也是機器學習一大領域 => 讓機器具有創造性

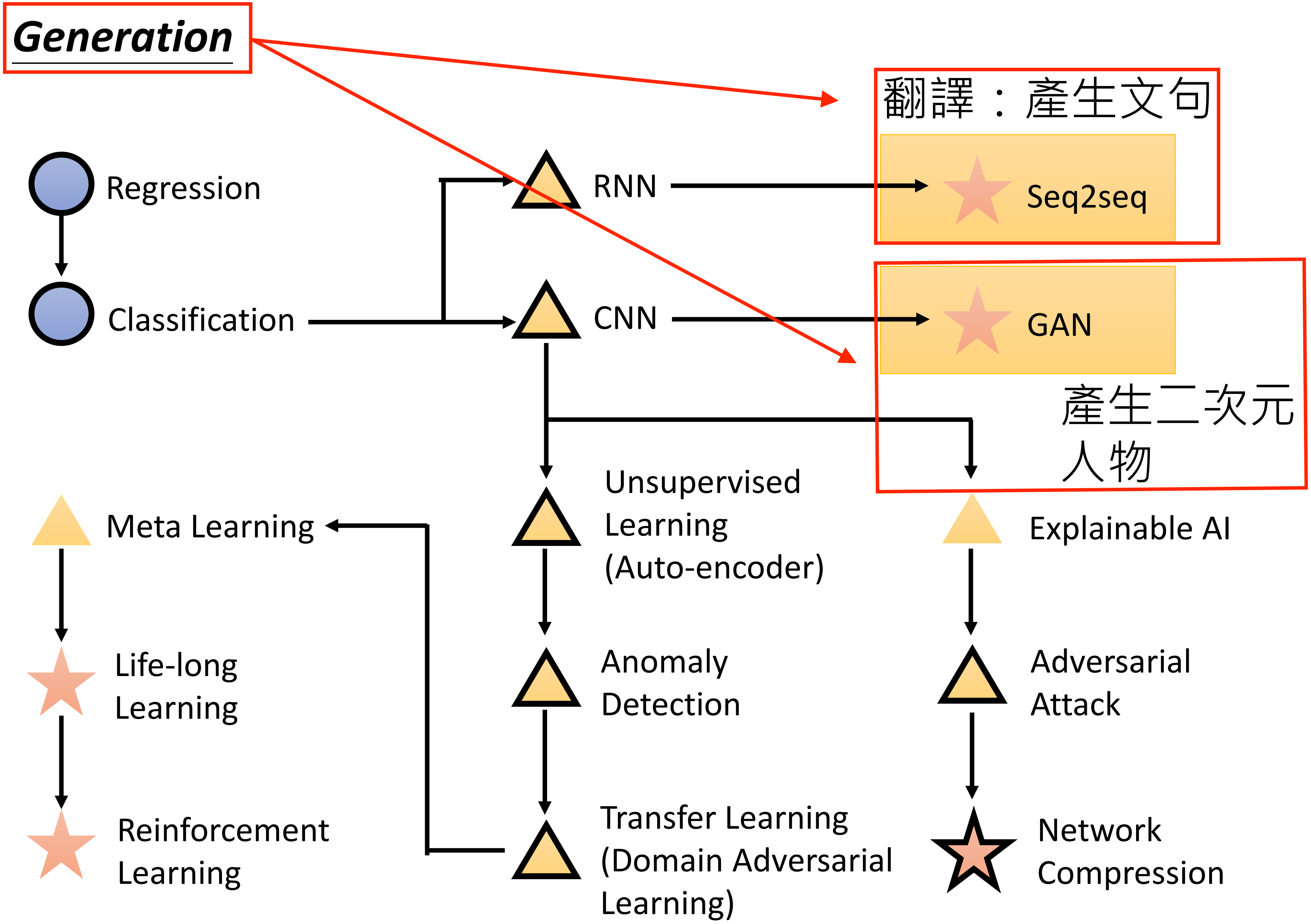
Generation (生成)

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

機器學習不只有 Regression ＆ Classification



Generation

翻譯：產生文句

Regression

Classification

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Seq2seq

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GAN

產生二次元人物

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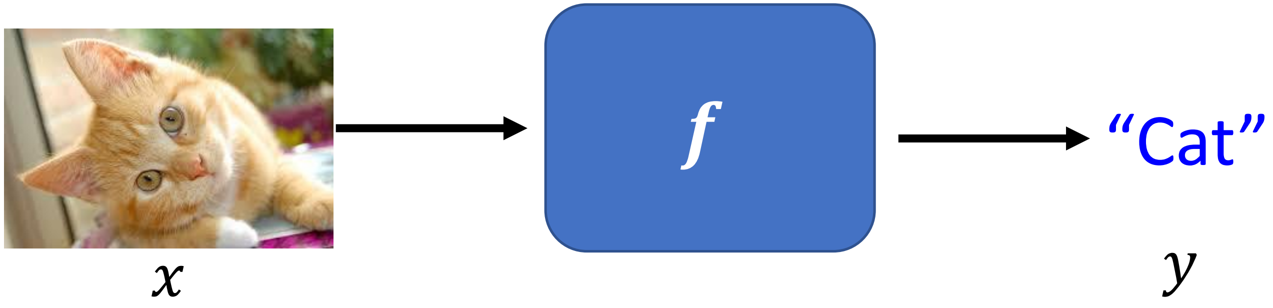
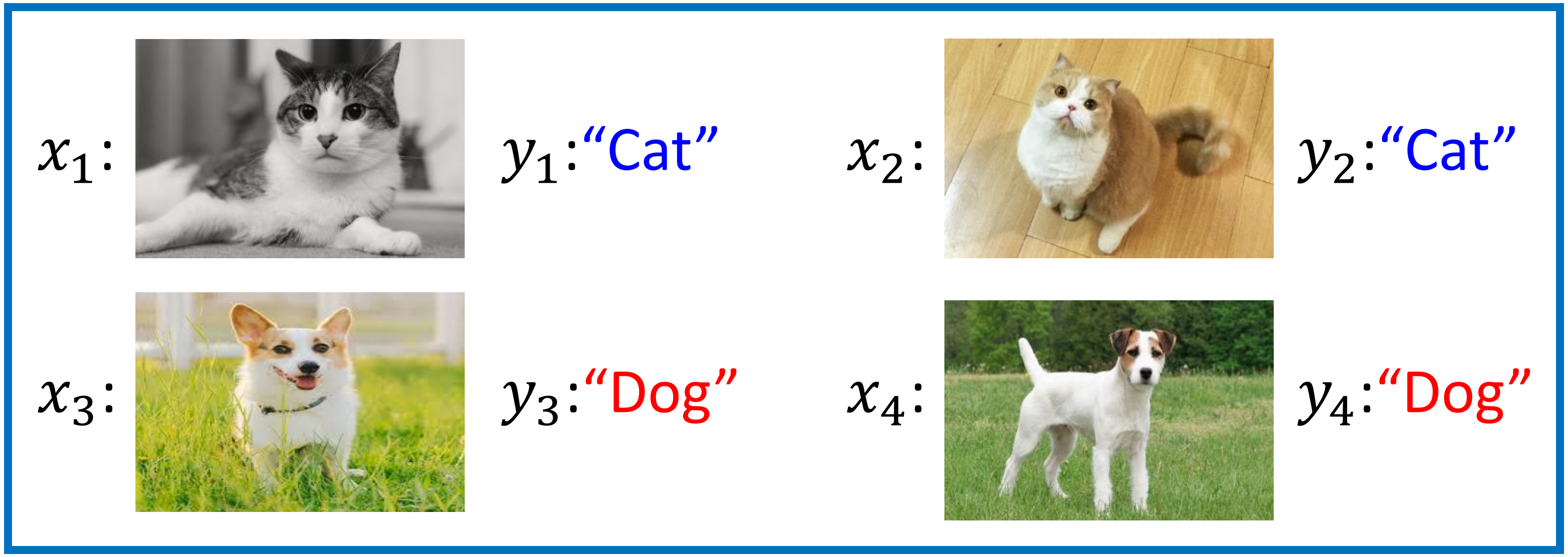
怎麼告訴機器
你想找什麼樣的函式？

幫助機器找到「函式」的方法之一

Supervised Learning

關鍵：必須準備好 Labelled Data

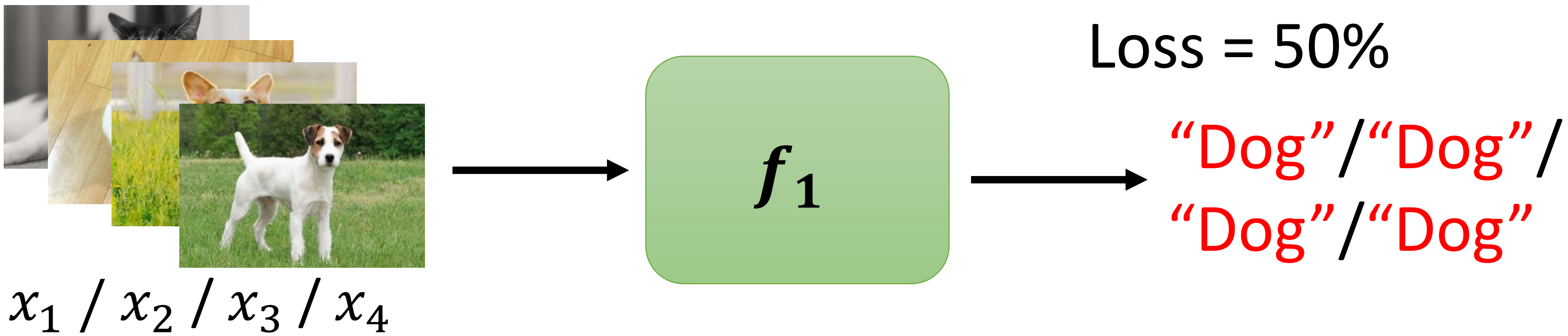




Labelled Data

將這些 Labelled Data 丟入「函式」中，機器就可以去評 Loss

函式的 Loss



x_1 / x_2 / x_3 / x_4

f_1

Loss = 50%

“Dog”/“Dog”/“Dog”/“Dog”

x_1: y_1:“Cat”

x_2: y_2:“Cat”

x_3: y_3:“Dog”

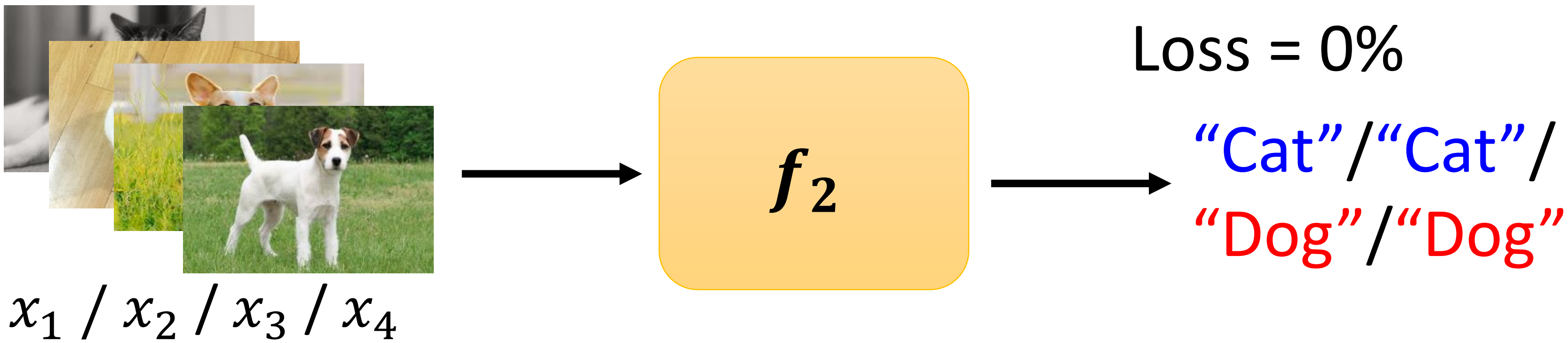
x_4: y_4:“Dog”

Labelled Data

機器學習的目的不變：讓機器透過 Loss 這個指標去找到 Loss 最低的函式

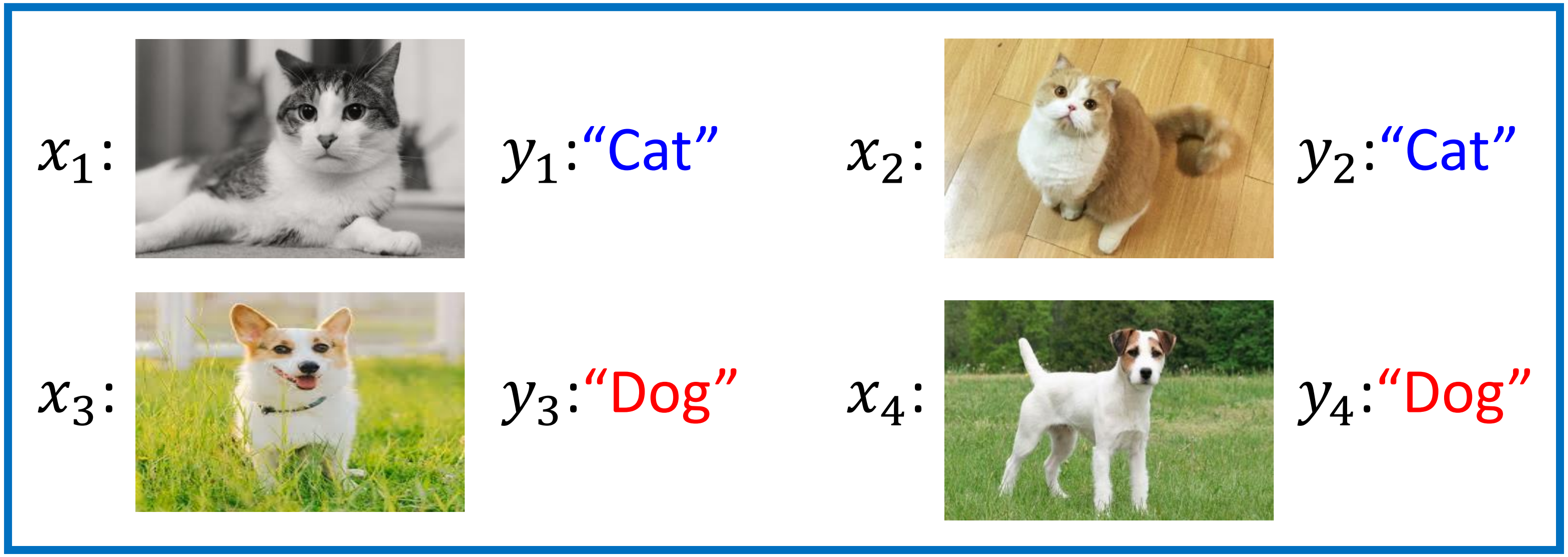
函式的 Loss

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 → "Cat"/"Cat"/"Dog"/"Dog"

Loss = 0%



x_1: y_1:"Cat"

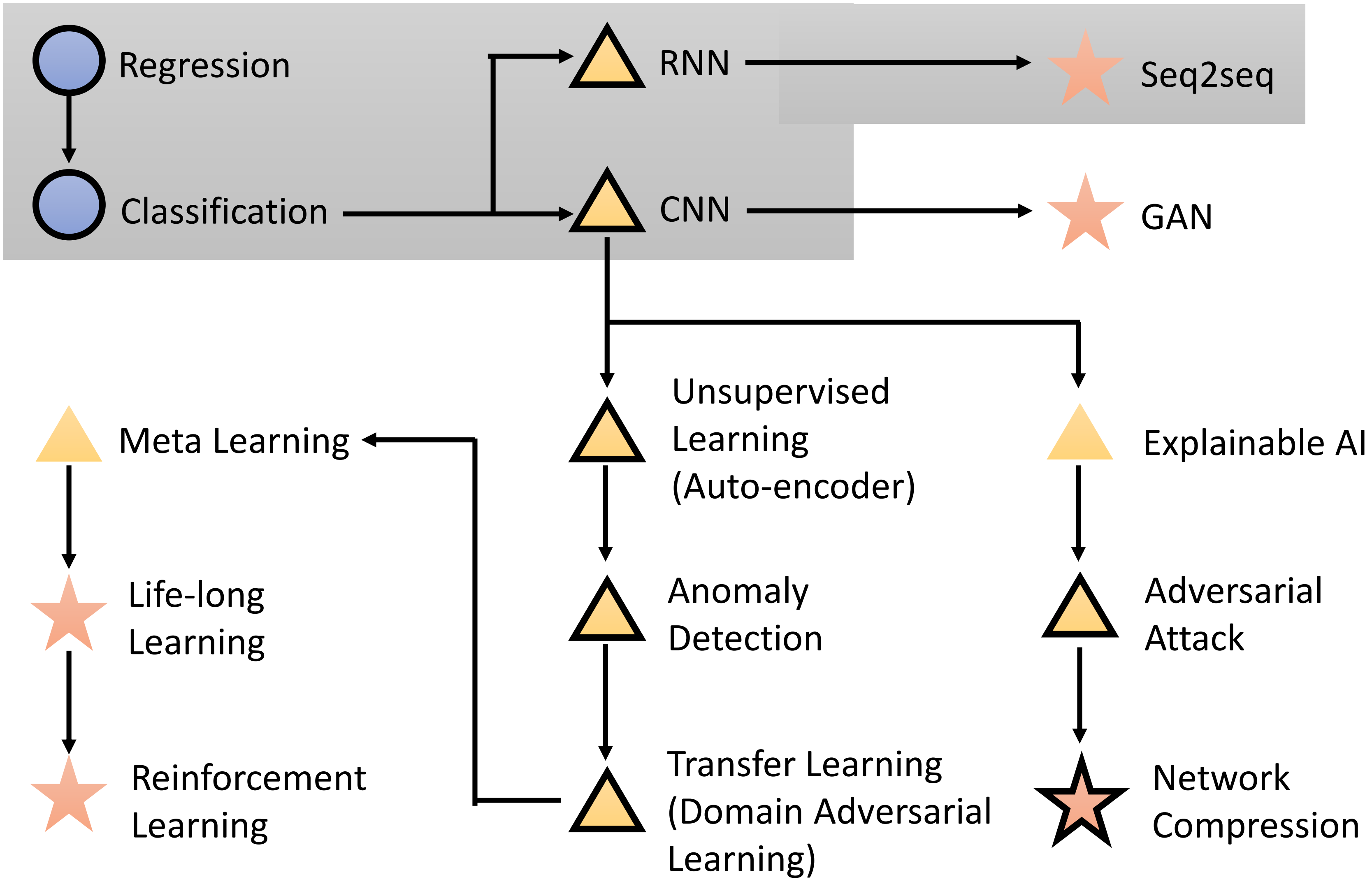
x_2: y_2:"Cat"

x_3: y_3:"Dog"

x_4: y_4:"Dog"

Labeled Data

Supervised Learning



Reinforcement Learning

nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
LEARNING CURVE
Self-taught AI software attains human-level performance in video games
SHARE DATA IN OUTBREAKS
A GIANT IN THE EARLY UNIVERSE
TELEPORTATION FOR TWO

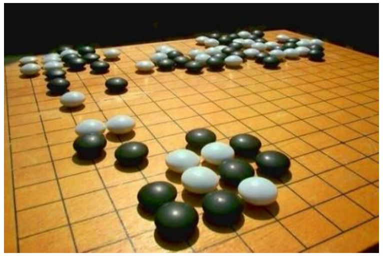
nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
At last — a computer program that can beat a champion Go player PAGE 484
ALL SYSTEMS GO
CONSERVATION
SONGBIRDS À LA CARTE
Illegal harvest of millions of Mediterranean birds
PAGE 452
RESEARCH ETHICS
SAFEGUARD TRANSPARENCY
Don't let openness backfire on individuals
PAGE 459
POPULAR SCIENCE
WHEN GENES GOT 'SELFISH'
Dawkins's calling card 40 years on
PAGE 462
NATUREASIA.COM
28 January 2016
Vol. 529, No. 7587

Supervised v.s. Reinforcement

supervised learning 的關鍵：必須提供 label data => 所以必須讓機器知道面對這樣的「盤勢」必須下「哪一步」

- Supervised:

Next move:
“5-5”



Next move:
“3-3”

- Reinforcement Learning

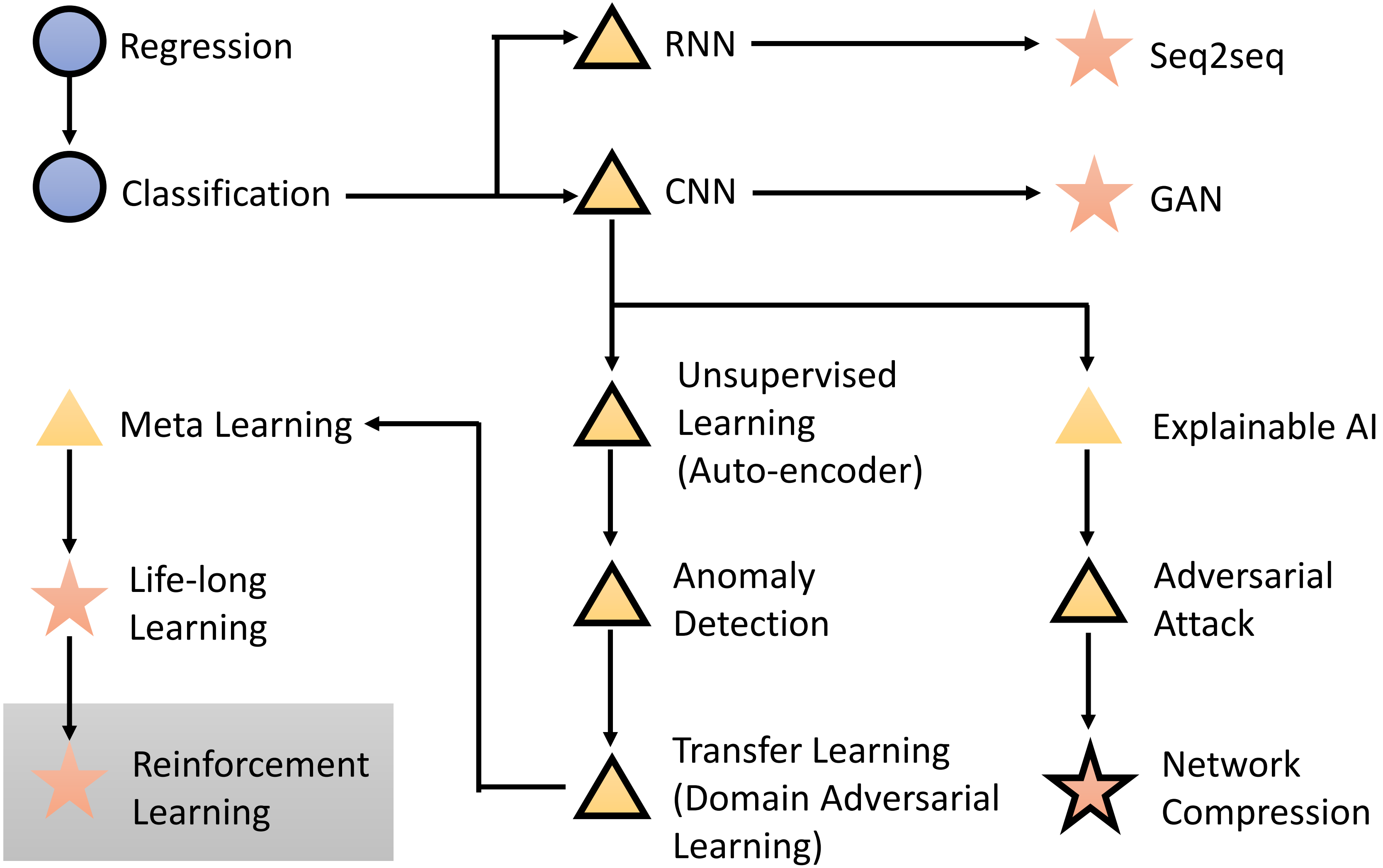
(Reward)

First move ➡ …… many moves …… ➡ Win!

reinforcement learning 的關鍵：讓機器與機器或與人不停的下棋，當機器贏了之後就會得到 reward，機器必須去學習哪些「步」是好的！

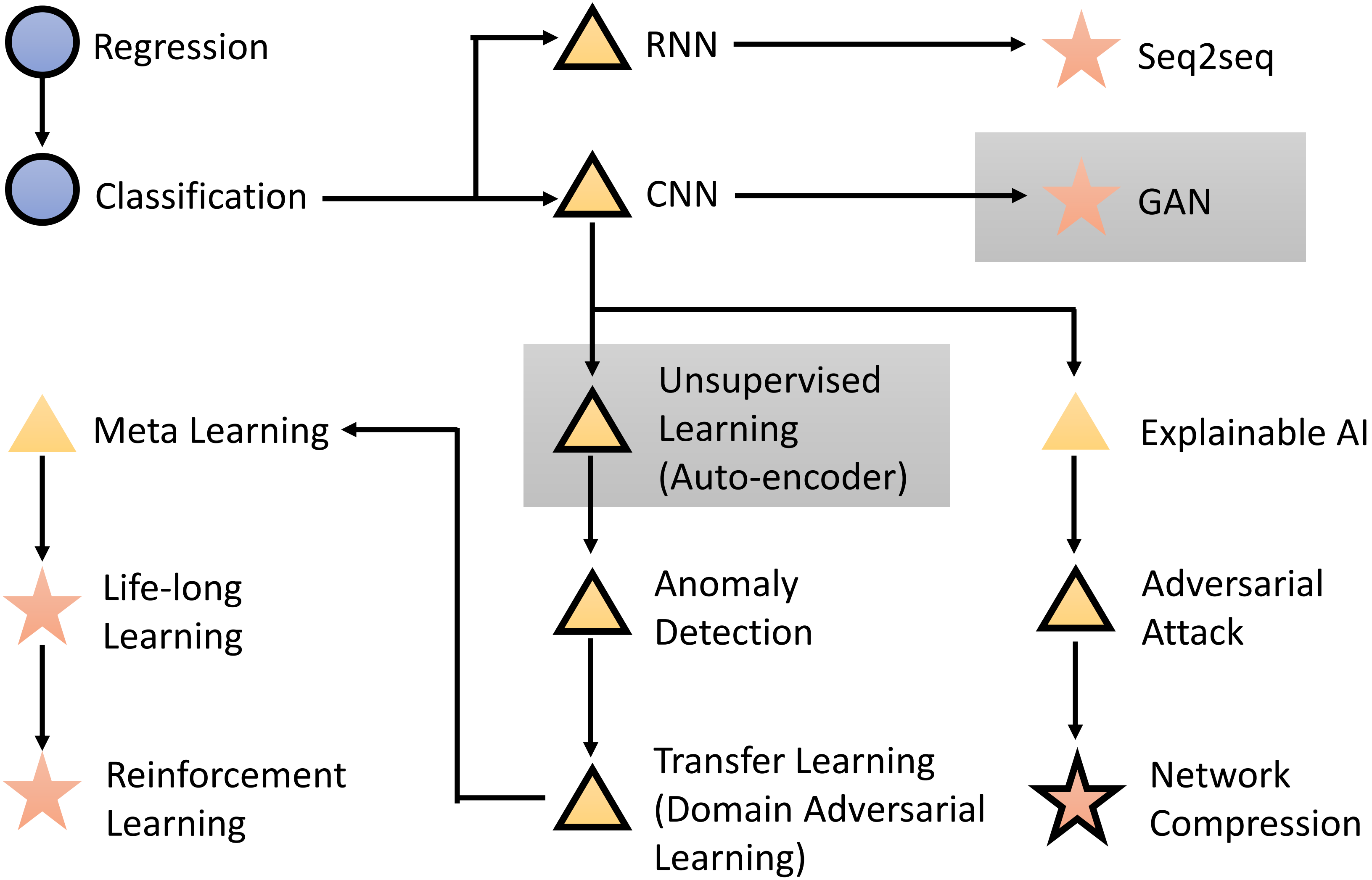
Alpha Go is supervised learning + reinforcement learning.

Reinforcement Learning



Unsupervised Learning

What can machine learn from unlabeled images?



Regression

Classification

RNN

Seq2seq

CNN

GAN

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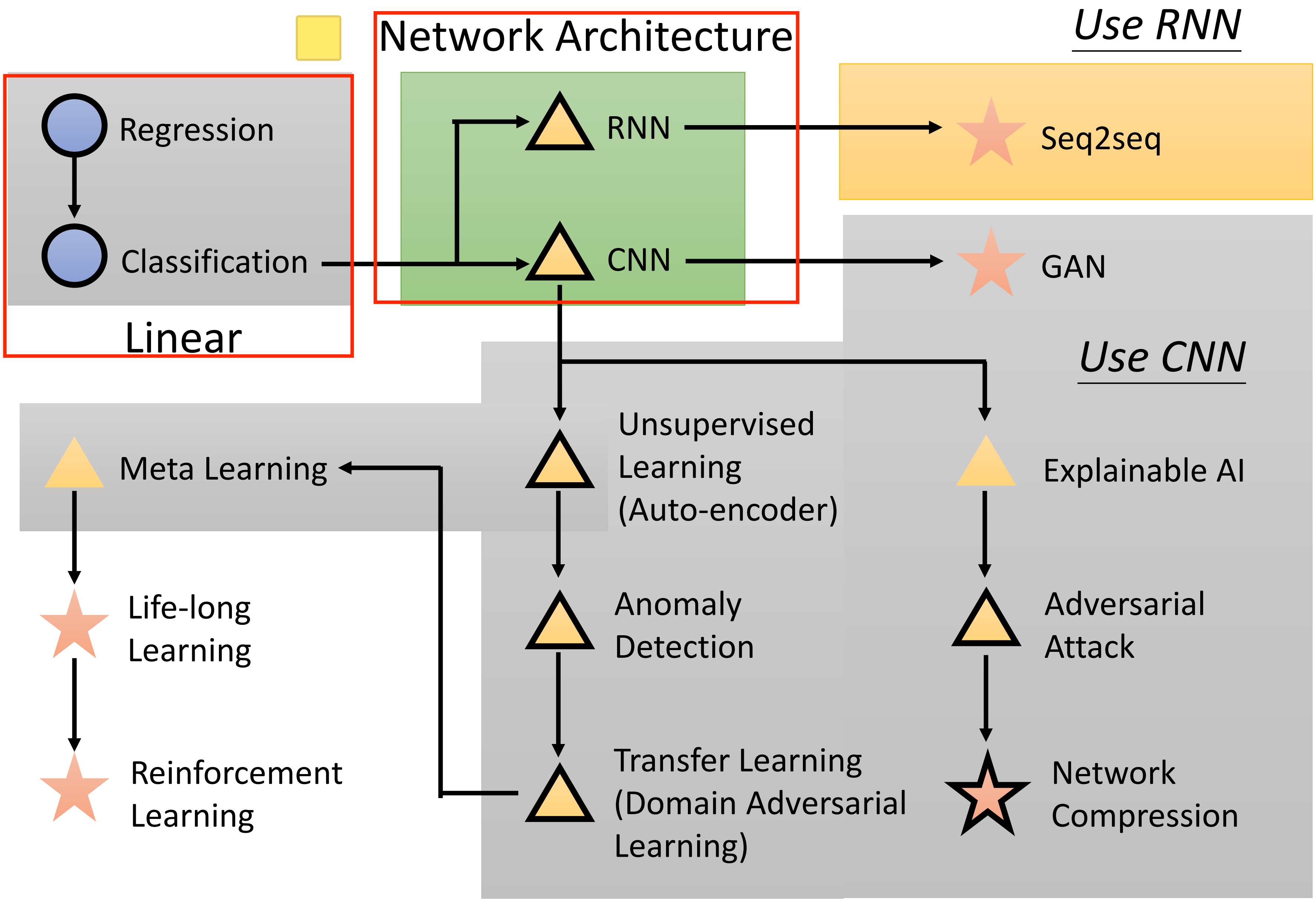
機器怎麼
找出你想要的函式？

當已經知道要讓機器去找什麼「目的」的「函式」之後，接下來就要「限制函式的範圍」，告訴機器不用去考慮世界上所有的函式！

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)
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Life-long Learning
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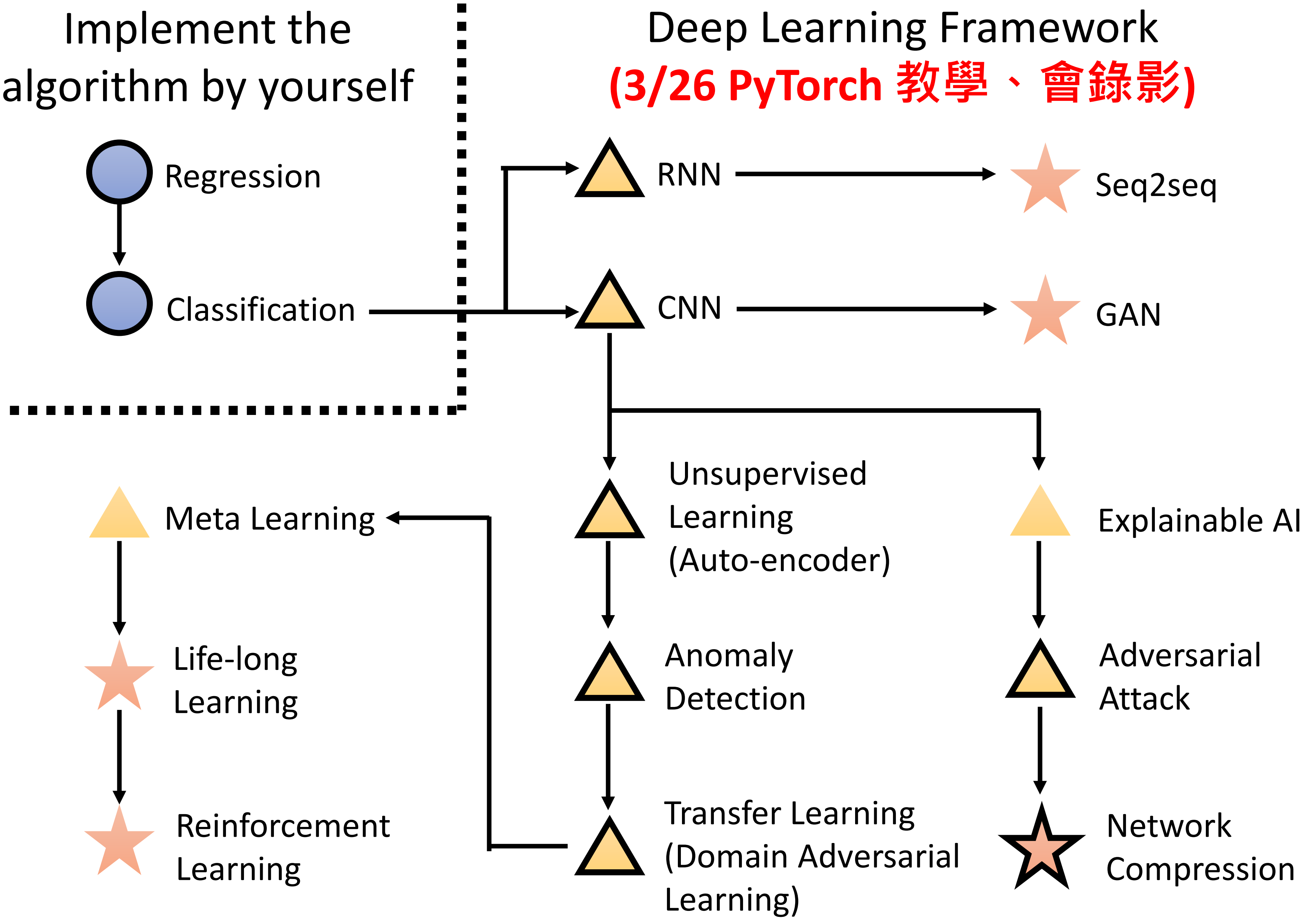
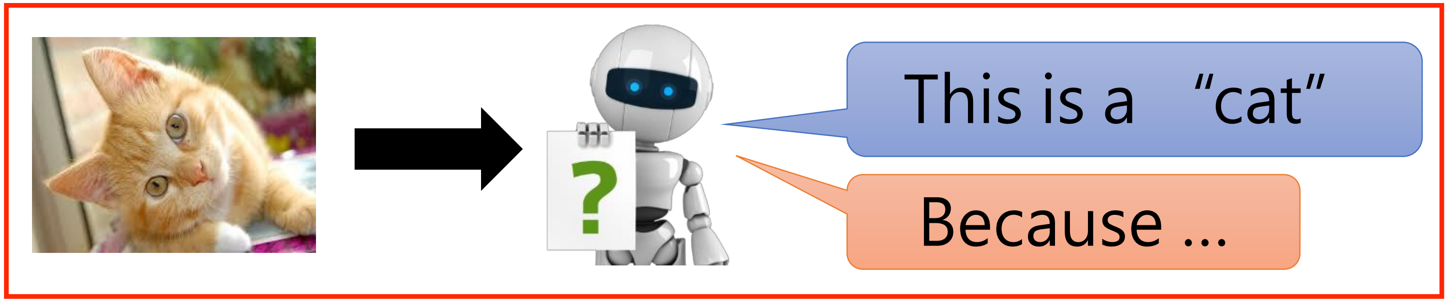
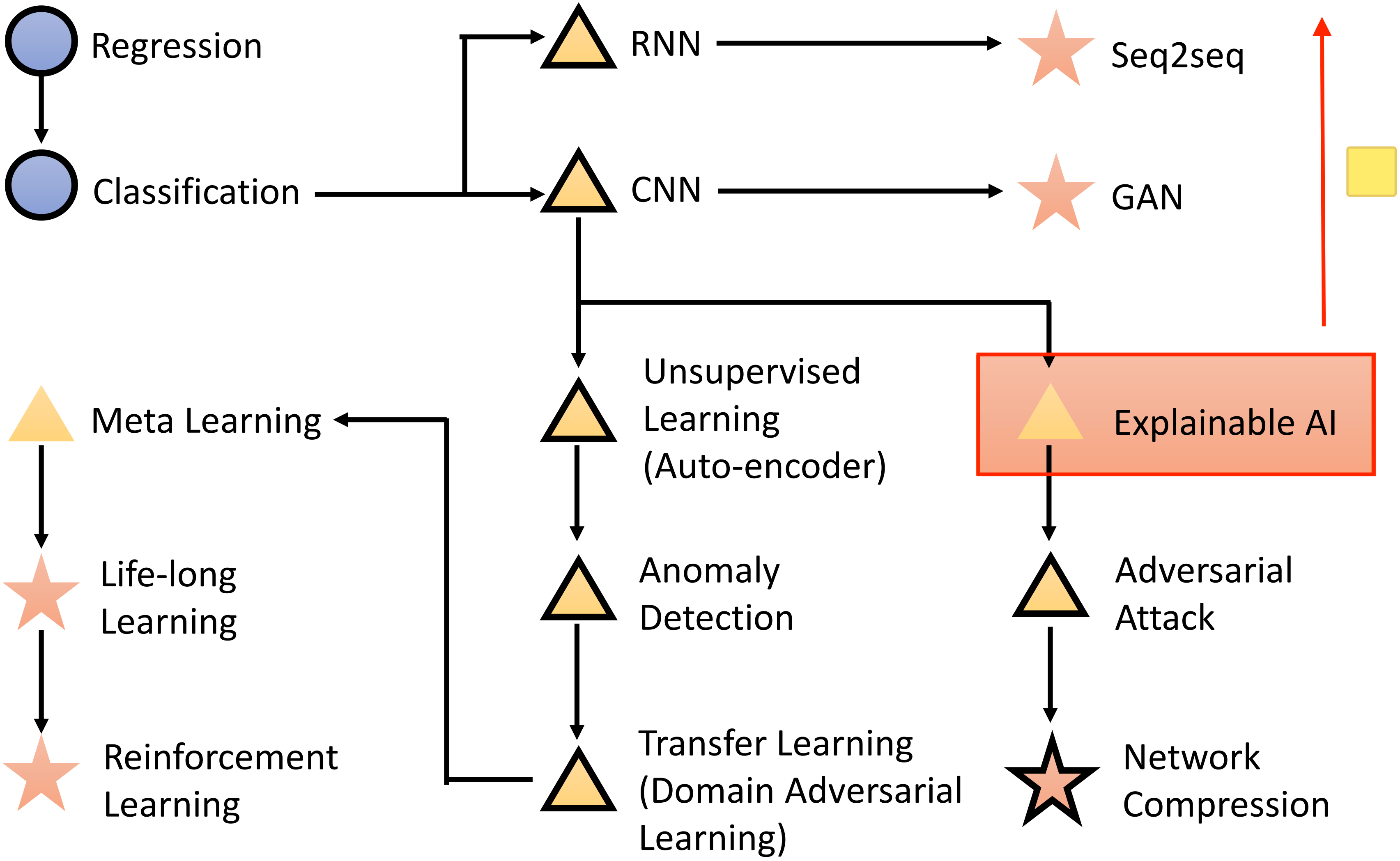
函式尋找方法 – Gradient Descent



前沿研究





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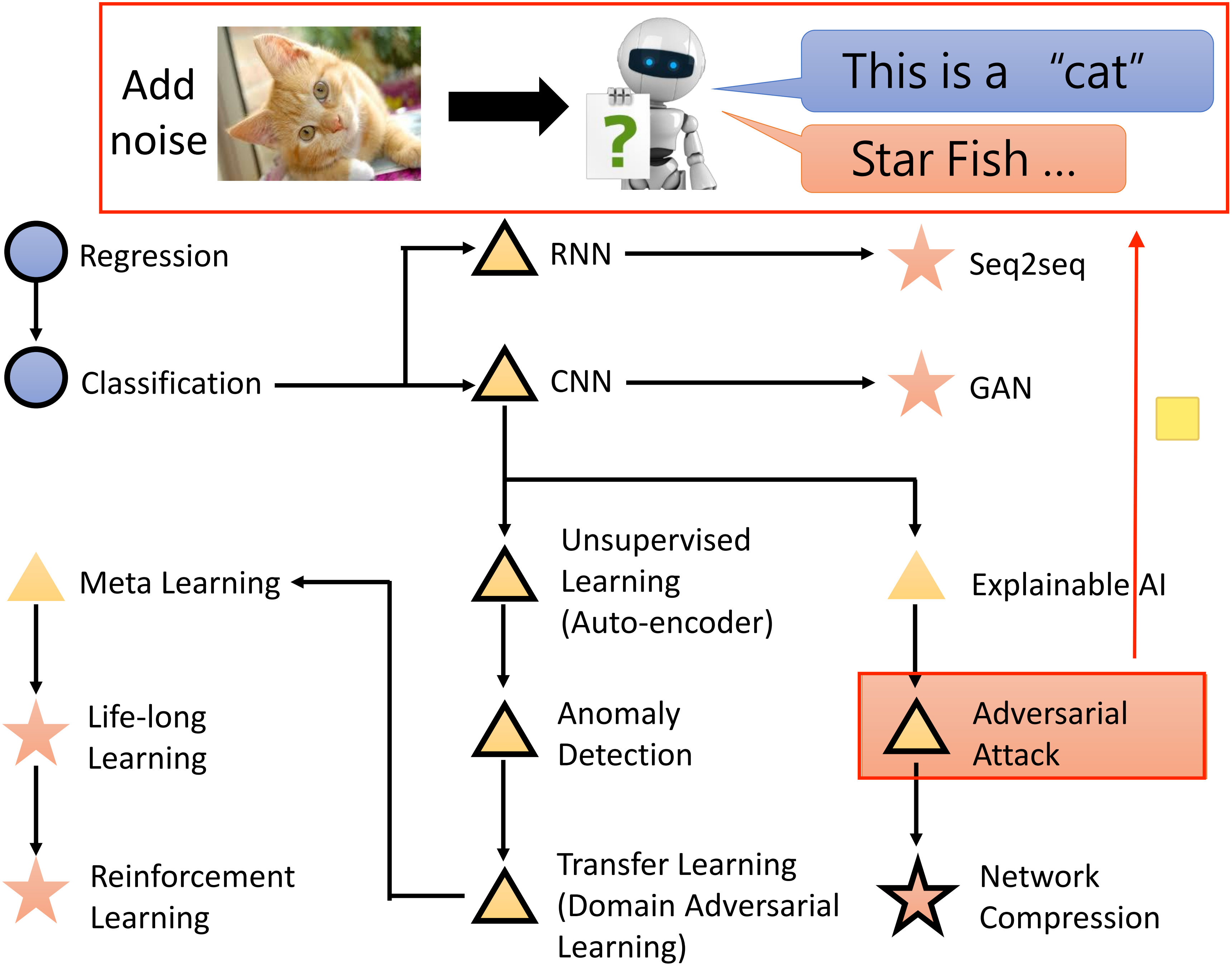

Add noise

This is a "cat"

Star Fish …

Regression

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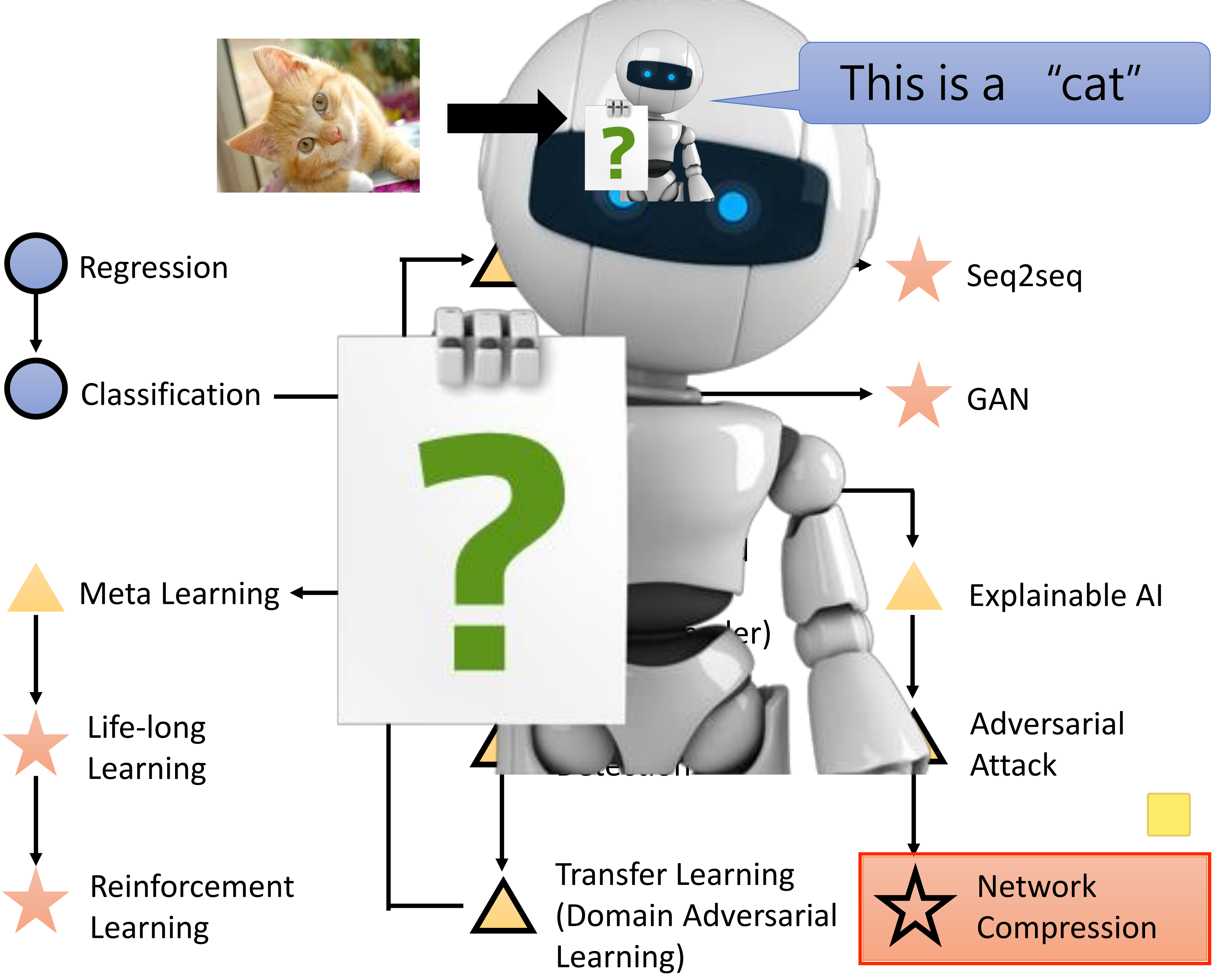
This is a "cat"
Regression
Classification
Seq2seq
GAN
Meta Learning
Explainable AI
er)
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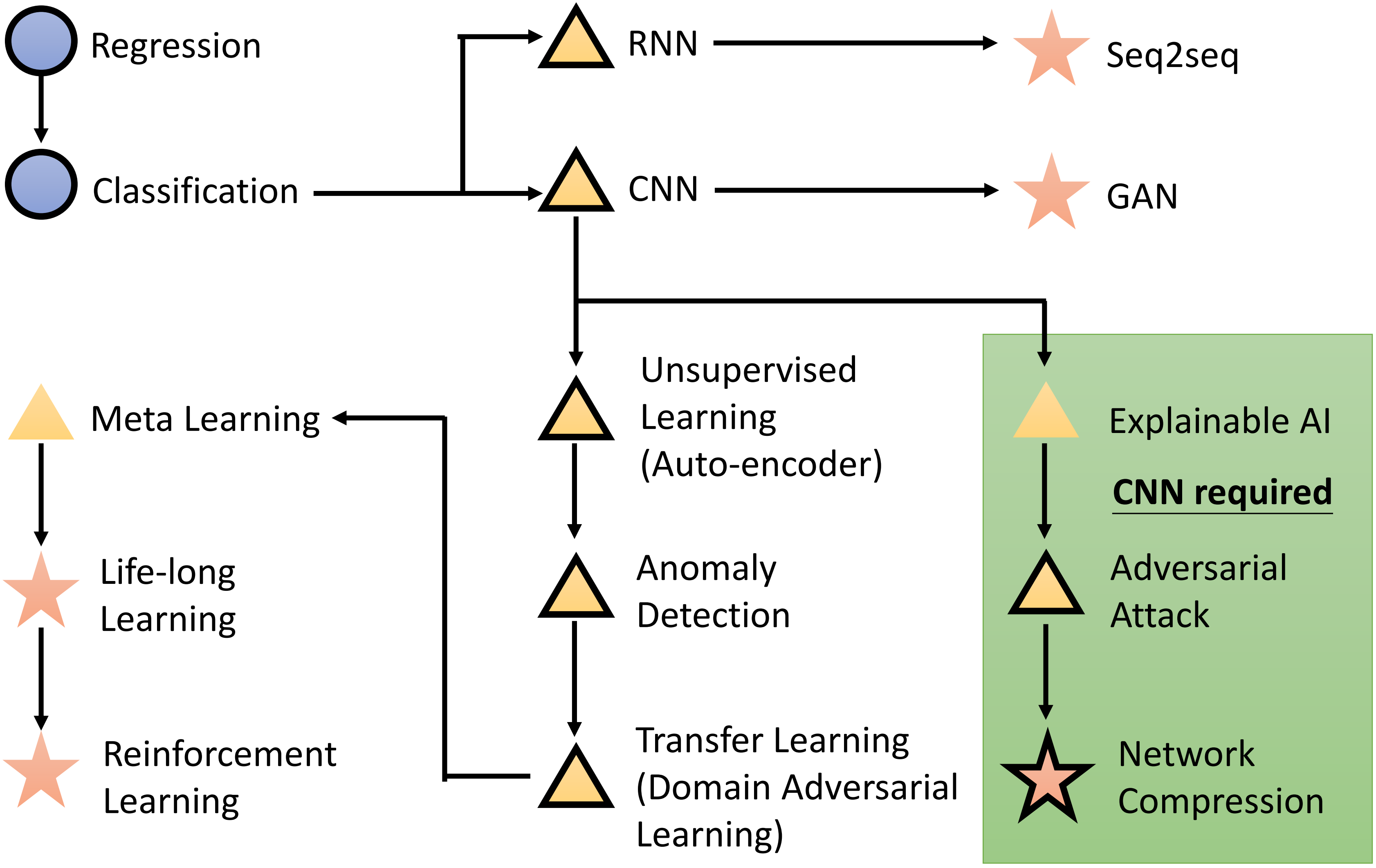

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Explainable AI

CNN required

Life-long Learning

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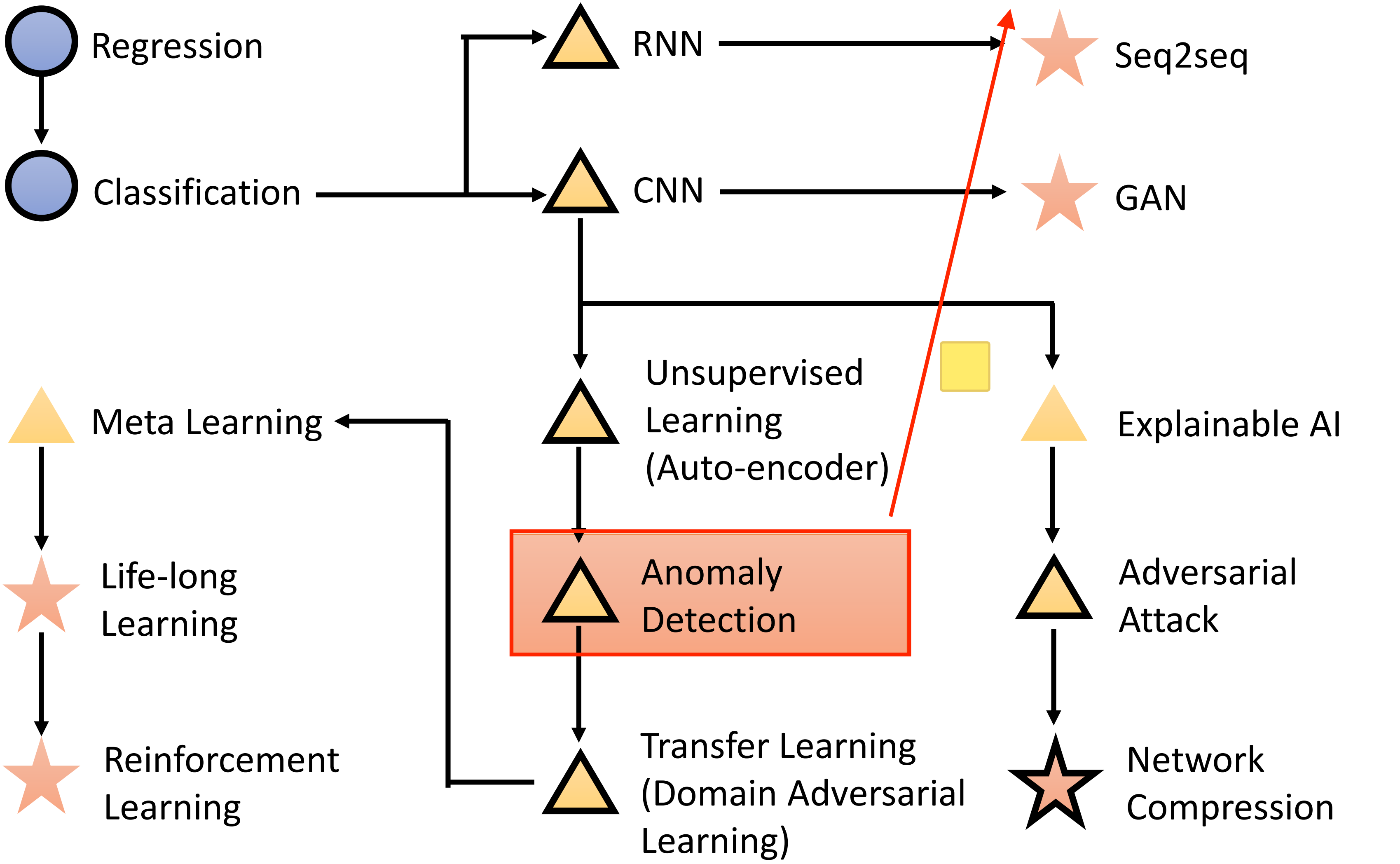
This is a “cat”

我不知道



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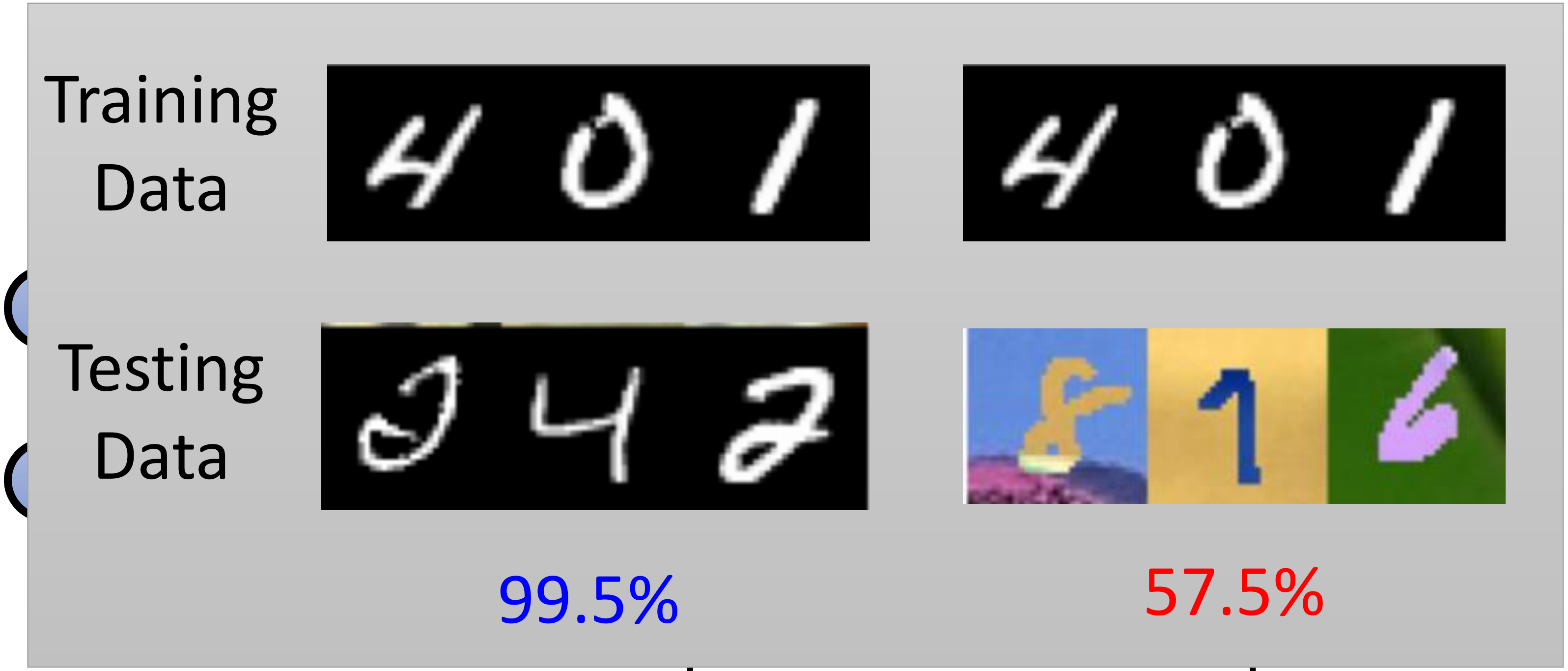

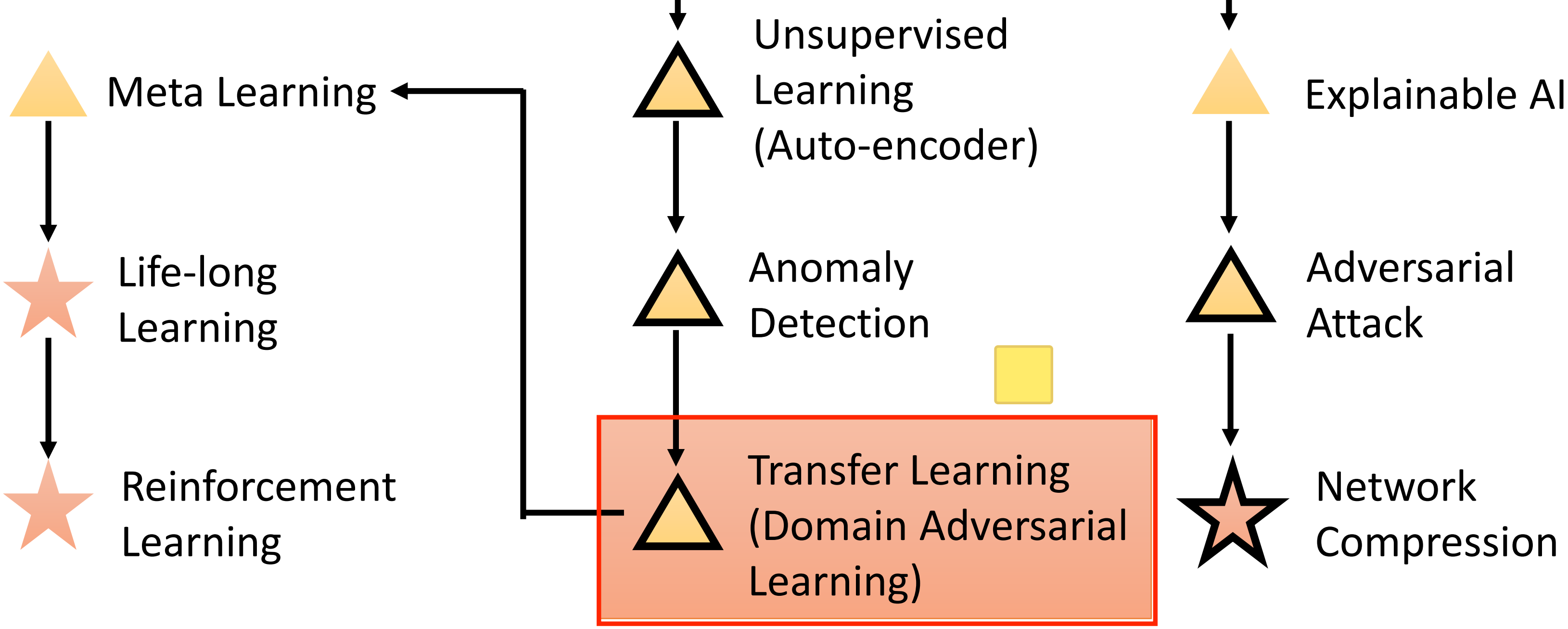

Meta Learning

Life-long Learning

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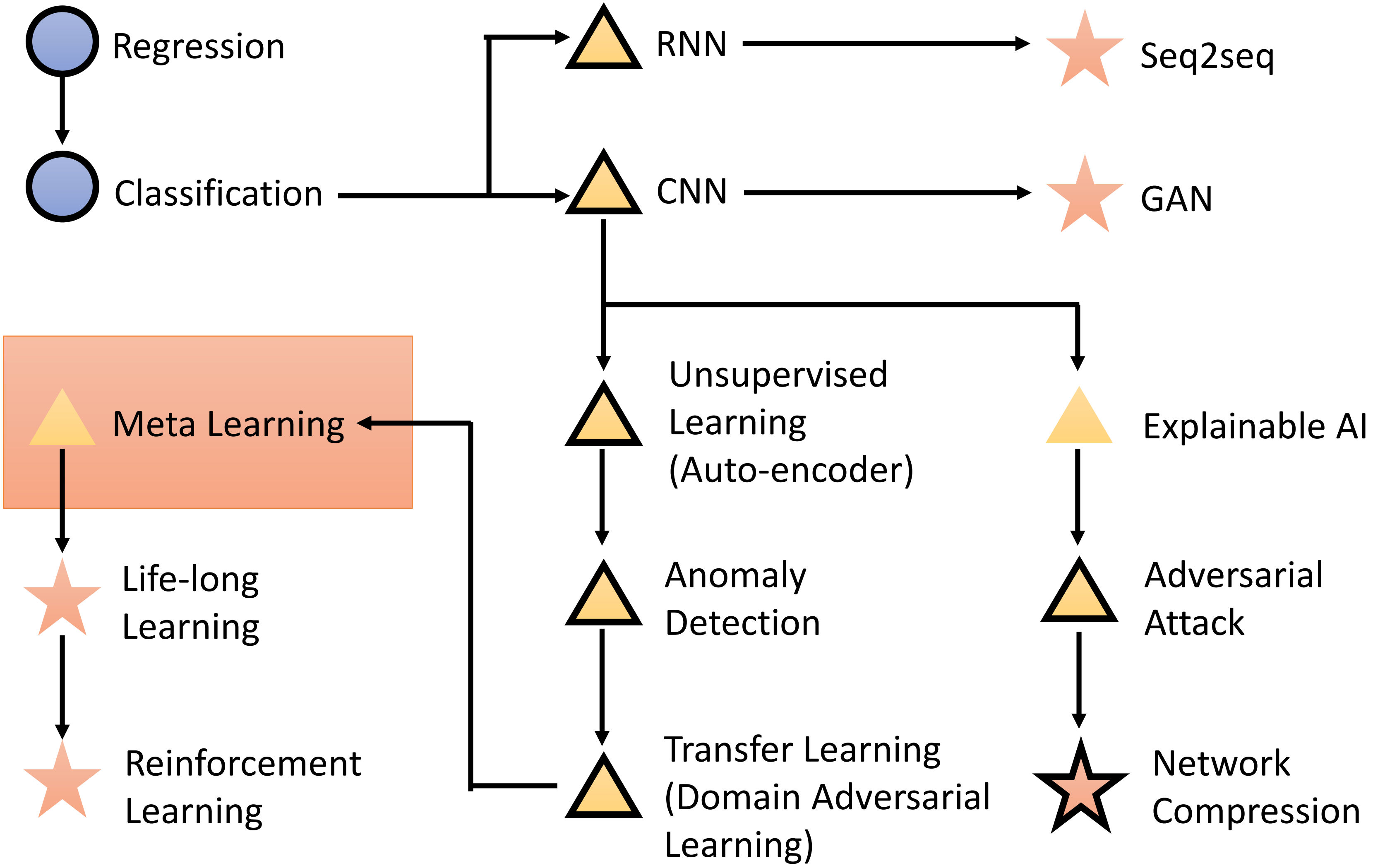

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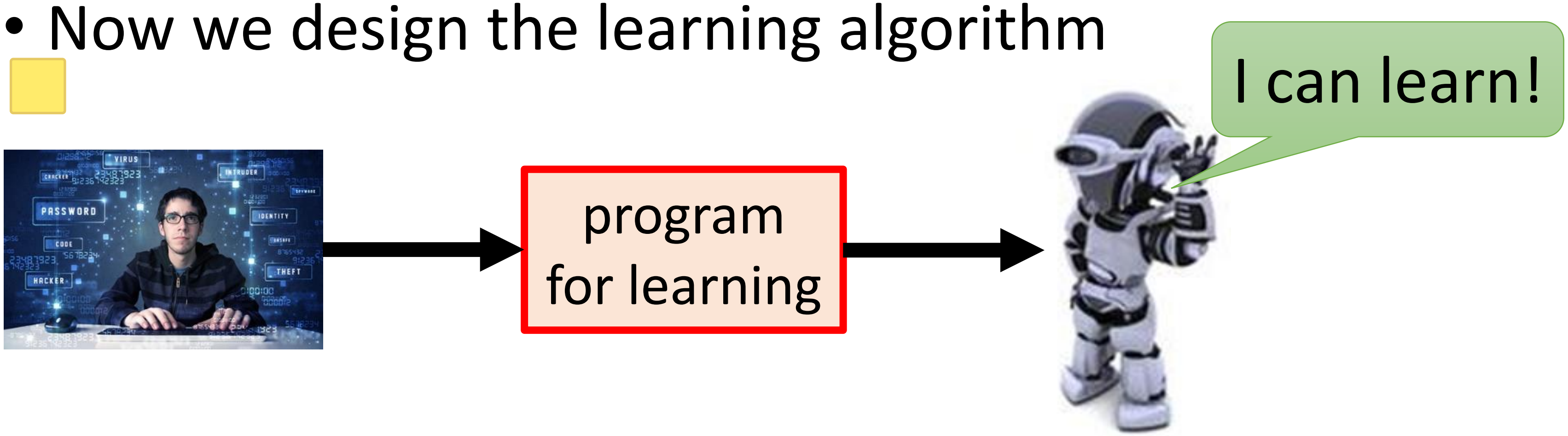
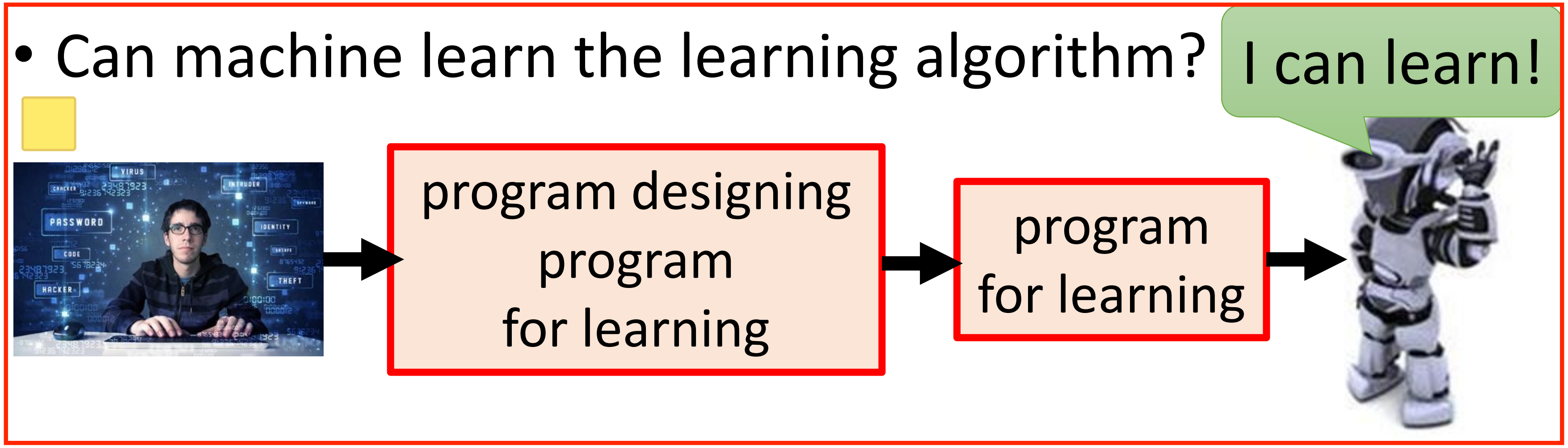
Meta Learning = Learn to learn

- Now we design the learning algorithm



program for learning

- Can machine learn the learning algorithm?

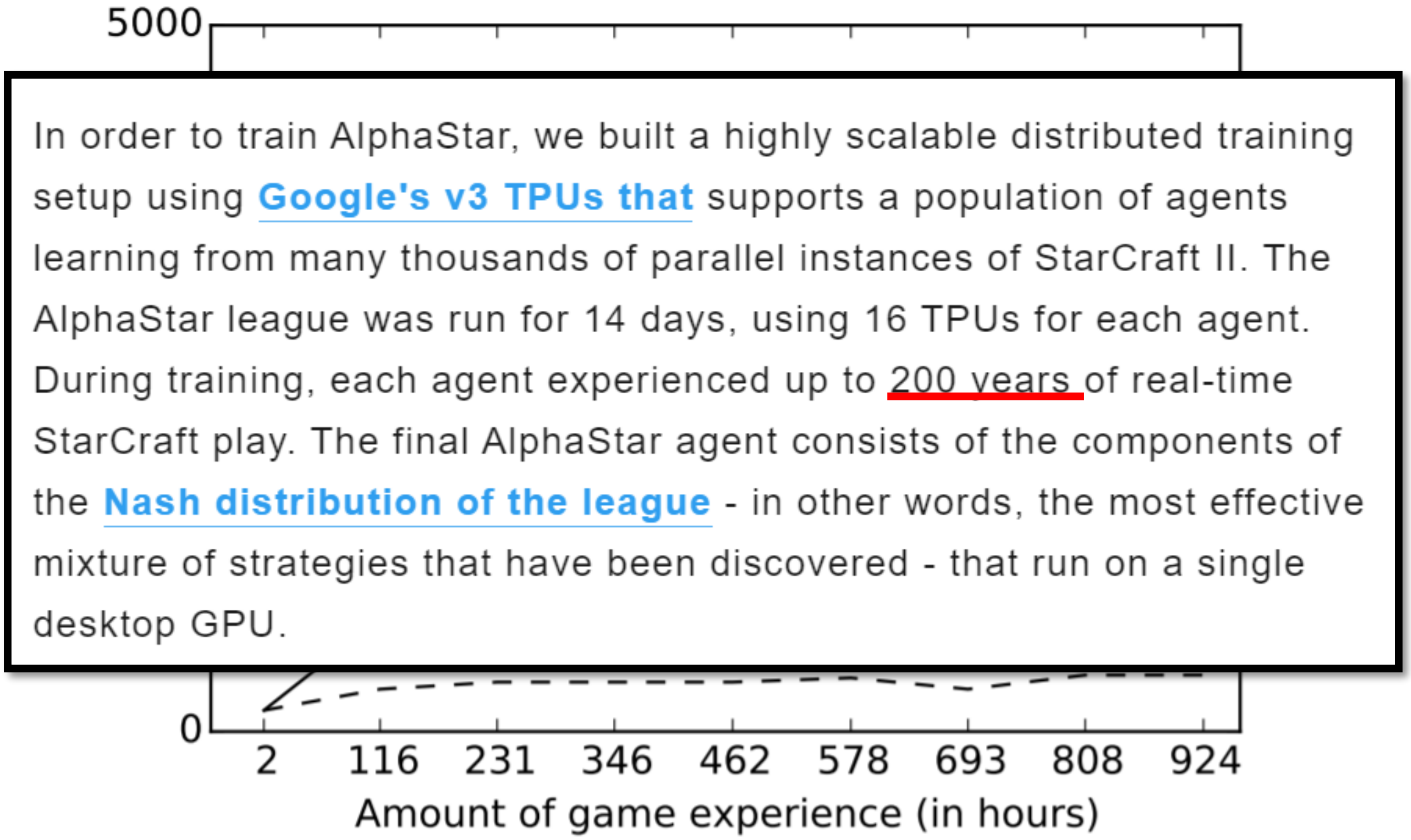


program designing program for learning

program for learning

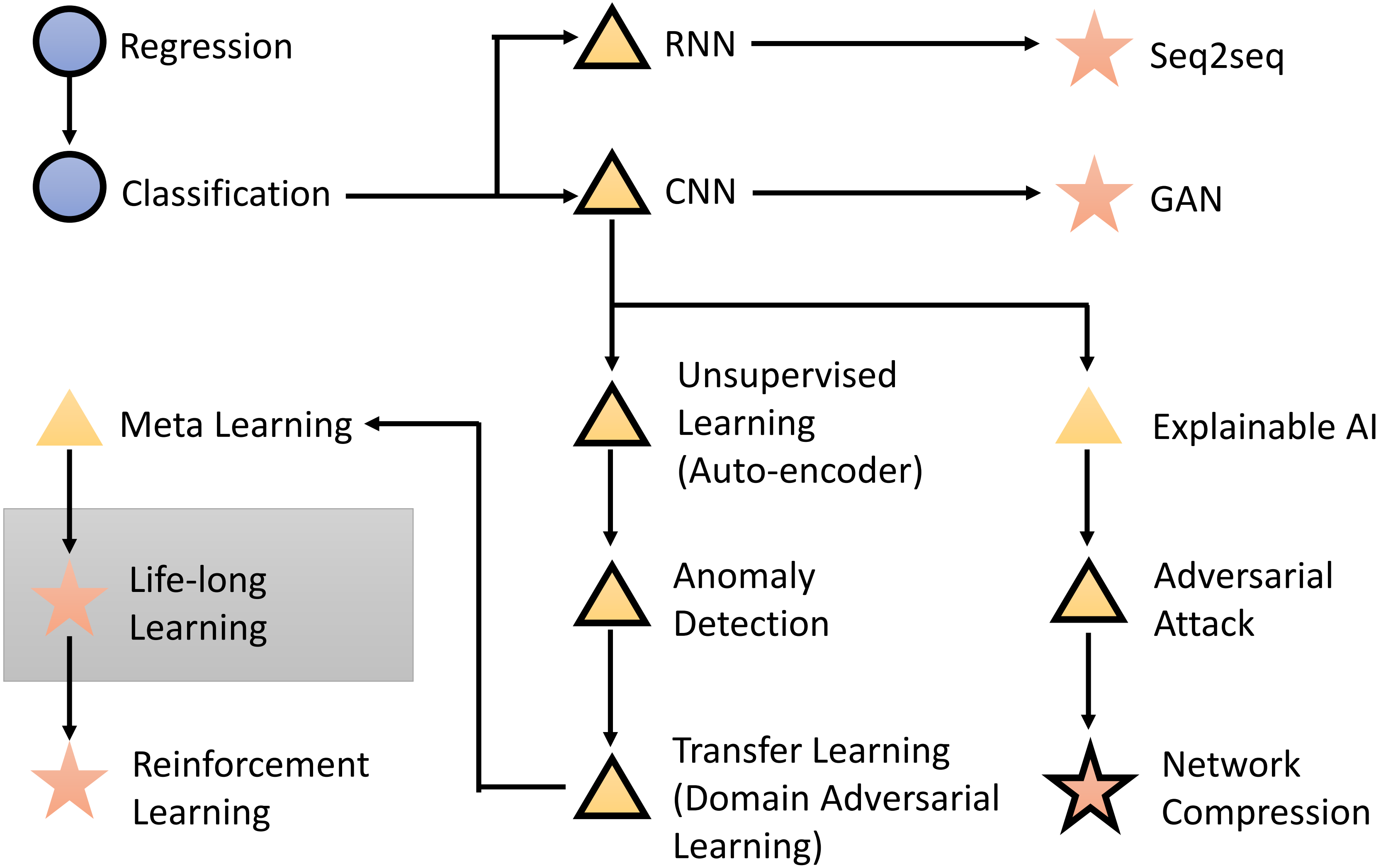
能不能讓機器聰明一點？

天資不佳卻勤奮不懈？



In order to train AlphaStar, we built a highly scalable distributed training setup using **Google's v3 TPUs that** supports a population of agents learning from many thousands of parallel instances of StarCraft II. The AlphaStar league was run for 14 days, using 16 TPUs for each agent. During training, each agent experienced up to 200 years of real-time StarCraft play. The final AlphaStar agent consists of the components of the **Nash distribution of the league** - in other words, the most effective mixture of strategies that have been discovered - that run on a single desktop GPU.

http://web.stanford.edu/class/psych209/Readings/LakeEtAlBBS.pdf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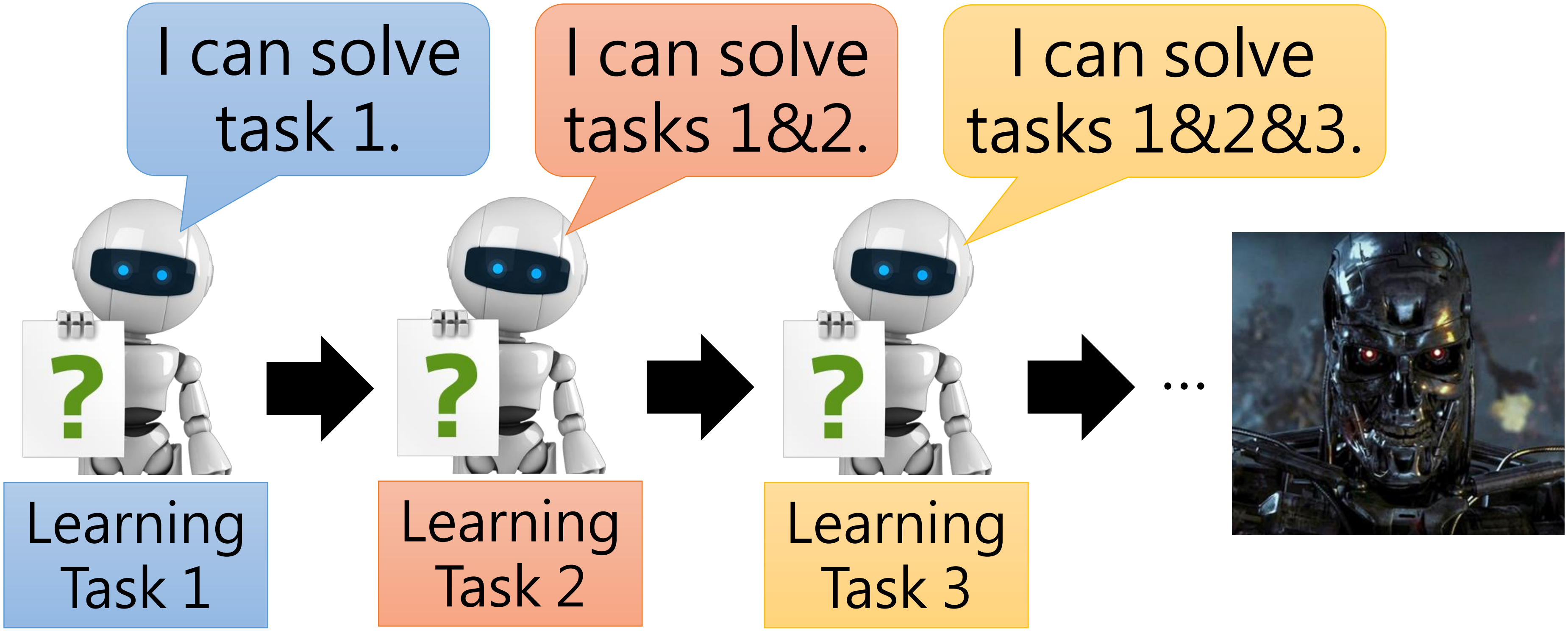
終身學習 (Life-long Learning)



I can solve task 1.

Learning Task 1

I can solve tasks 1&2.

Learning Task 2

I can solve tasks 1&2&3.

Learning Task 3

…

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