新型學習演算法
心臟病健康預測

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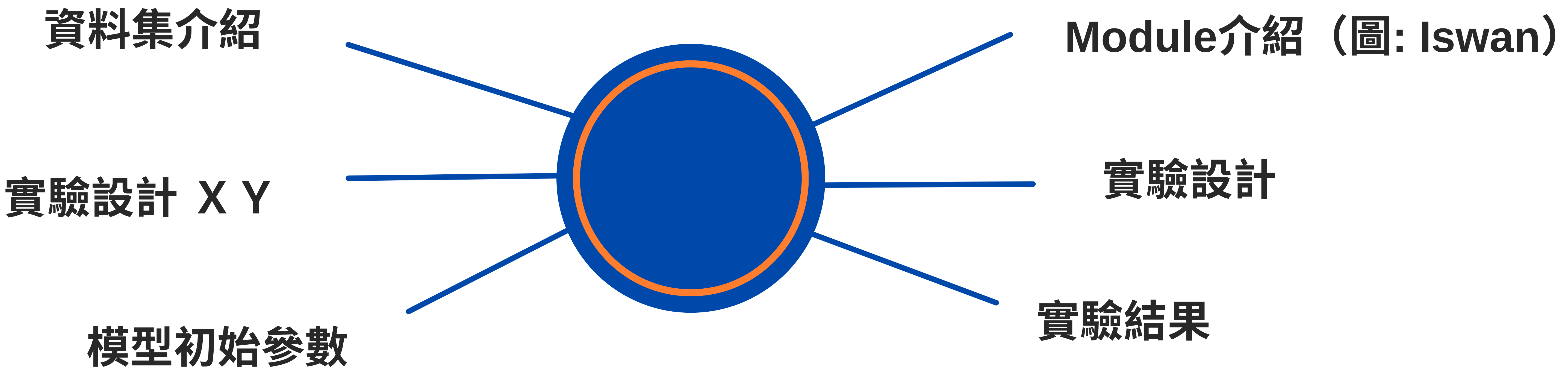
報告架構



資料集介紹

主題: 心臟疾病預測

X: 21個attributes (Numerical)

BMI, Smoker, Alcohol, Edcuation, Income...

Y: 1個attribute (Binary)

來源: KAGGLE

training data set	normal sample	80%	80%
	abnormal sample	20%	
testing data set	normal sample	80%	20%
	abnormal sample	20%	

模型初始參數(環境)

環境: Jupyter notebook

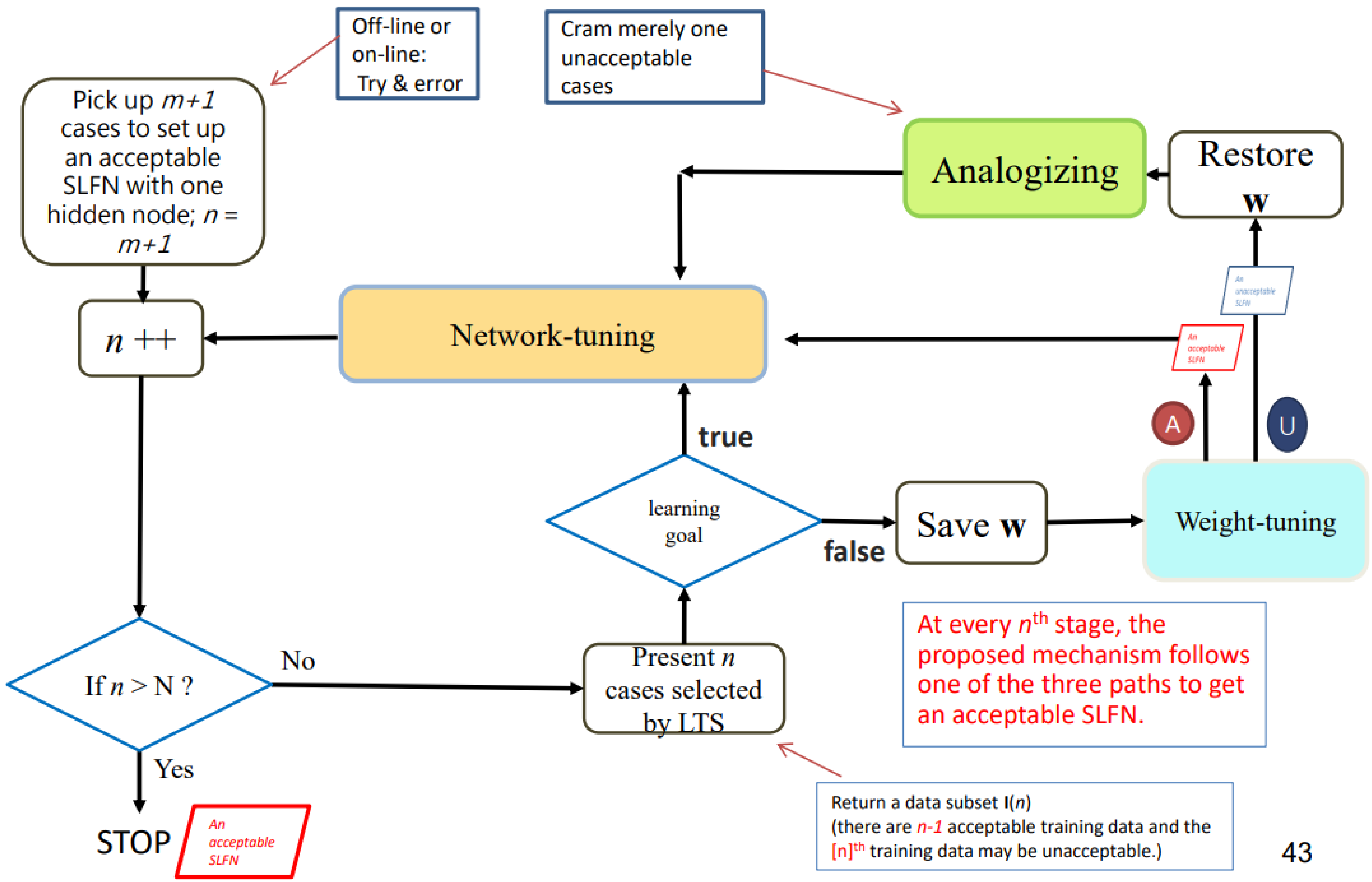
語言: Pytorch

模型初始設定:

- Sequentital model
- Two layer nenural, one hidden node
- Activation Funtion: Relu
- Optimizer: Adam
- Loss: BCELoss

MODULE(ISWAN)

The ISWAN algorithm



Why: k值很多個

Initializing_1_WT

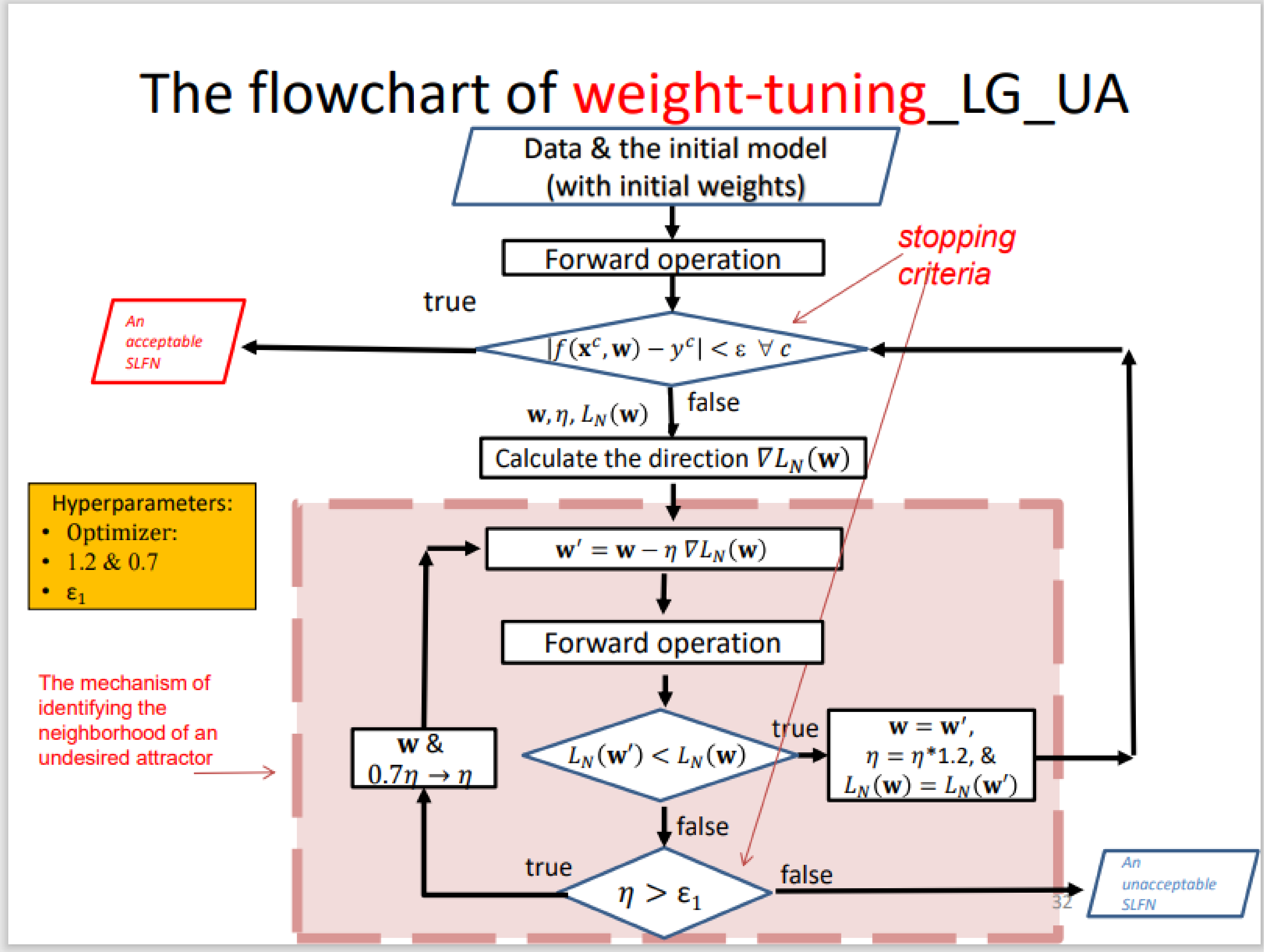
Weight_Tuning_LG_UA

Isolating_Ri_ZG

Analogizing_Ri_LG1

Network_tuning_4

MODULE(ISWAN)



Weight_Tuning_LG_UA

重要參數:

epsilon(實驗設計)

learning rate(*1.05, *0.95)

MODULE(ISWAN)

A rule-based mechanism

The analogizing_Ri_LG1_SO_SU module

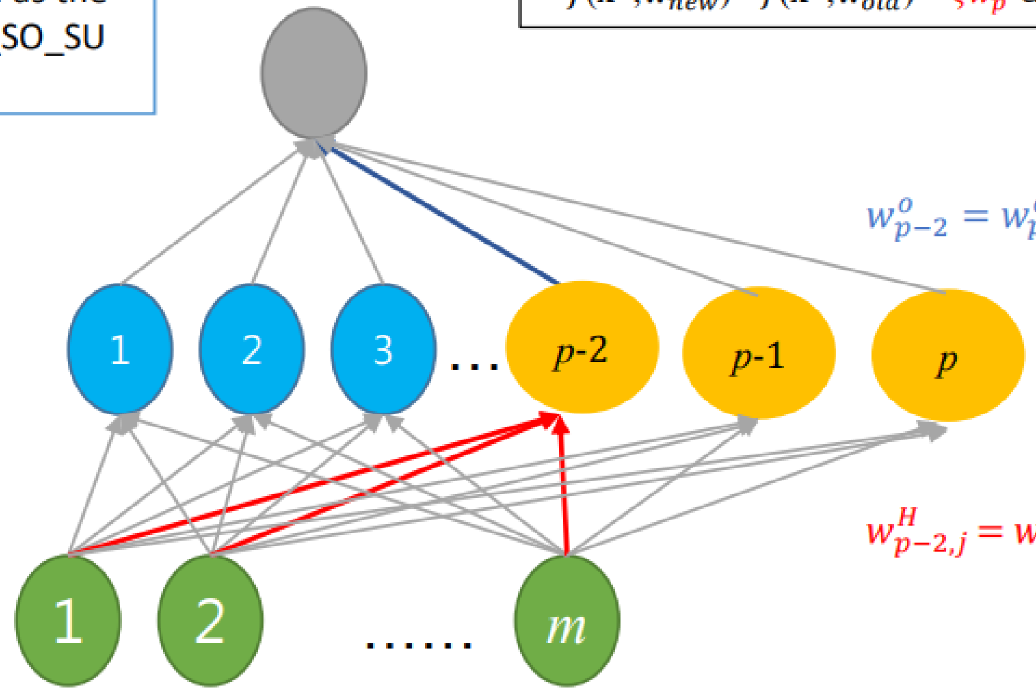
Step 1: Use the isolating_Ri_ZG module to obtain a small number ζ and an m-vector $\boldsymbol{\gamma}$ of length one such that $\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa) \neq 0 \ \forall\ c \in \mathbf{I}-\{\kappa\}$ AND $(\zeta+\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa))*(\zeta-\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa)) < 0 \ \forall\ c \in \mathbf{I}-\{\kappa\}$.

Step 2: Let p+3 → p, add three new hidden nodes p-2th, p-1th and pth to the existing SLFN, and then assign their associated weights in the following way:

- $\mathbf{w}^H_{p-2} = \mathbf{w}^H_{p-2} = \mathbf{w}^H_{p-2} = \boldsymbol{\gamma}$
- $w^H_{p-2,0} = \zeta-\boldsymbol{\gamma}^T\mathbf{x}^\kappa$, $w^H_{p-1,0} = -\boldsymbol{\gamma}^T\mathbf{x}^\kappa$, $w^H_{p,0} = -\zeta-\boldsymbol{\gamma}^T\mathbf{x}^\kappa$
- $w^o_{p-2} = w^o_p = \frac{y^\kappa - w^o_0 - \sum_{i=1}^{p-3} w^o_i a^\kappa_i}{\zeta}$; $w^o_{p-1} = \frac{-2(y^\kappa - w^o_0 - \sum_{i=1}^{p-3} w^o_i a^\kappa_i)}{\zeta}$

Note that the analogizing_Ri_LG1_SO_SU module is the same as the analogizing_Ri_RE_SO_SU module.

- $f(\mathbf{x}^\kappa,\mathbf{w}_{old}) = w^o_0 + \sum_{i=1}^{p-3} w^o_i a^\kappa_i$
- $f(\mathbf{x}^c,\mathbf{w}_{new}) = f(\mathbf{x}^c,\mathbf{w}_{old}) + w^o_p$*[ReLU($\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa)+\zeta$) - 2ReLU($\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa)$) + ReLU($\boldsymbol{\gamma}^T(\mathbf{x}^c-\mathbf{x}^\kappa)-\zeta$)]
- $f(\mathbf{x}^\kappa,\mathbf{w}_{new}) - f(\mathbf{x}^\kappa,\mathbf{w}_{old}) = \zeta w^o_p$ and $f(\mathbf{x}^c,\mathbf{w}_{new}) - f(\mathbf{x}^c,\mathbf{w}_{old}) = 0 \ \forall\ c \in \mathbf{I}-\{\kappa\}$



$$w^o_{p-2} = w^o_p = \frac{y^\kappa - w^o_0 - \sum_{i=1}^{p-3} w^o_i a^\kappa_i}{\zeta};\ w^o_{p-1} = \frac{-2(y^\kappa - w^o_0 - \sum_{i=1}^{p-3} w^o_i a^\kappa_i)}{\zeta}$$

$$w^H_{p-2,0} = \zeta-\boldsymbol{\gamma}^T\mathbf{x}^\kappa;\ w^H_{p-1,0} = -\boldsymbol{\gamma}^T\mathbf{x}^\kappa;\ w^H_{p,0} = -\zeta-\boldsymbol{\gamma}^T\mathbf{x}^\kappa$$

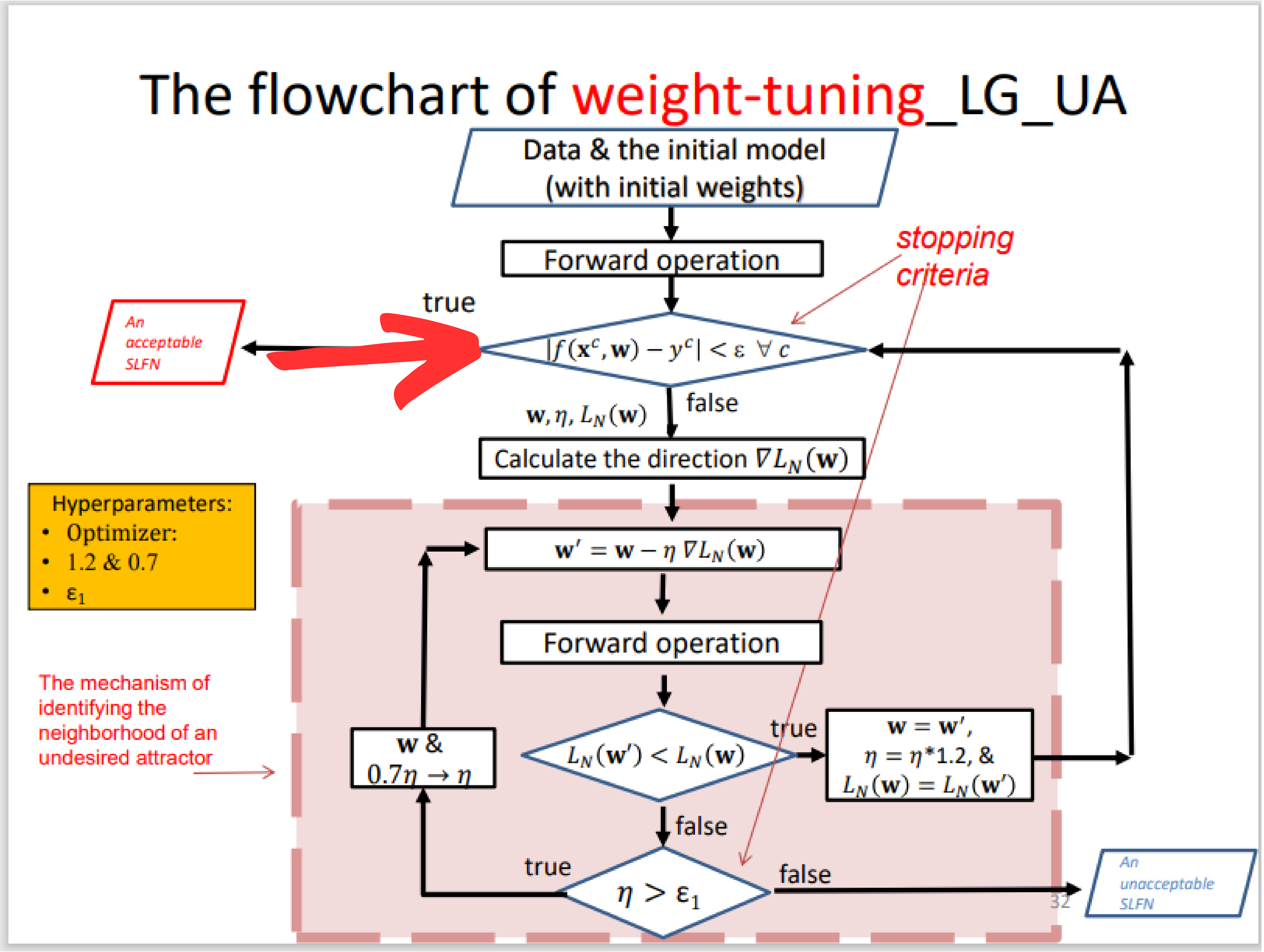
$$w^H_{p-2,j} = w^H_{p-1,j} = w^H_{p,j} = \gamma_j \quad \forall\, j$$

Isolating_Ri_ZG

新增:

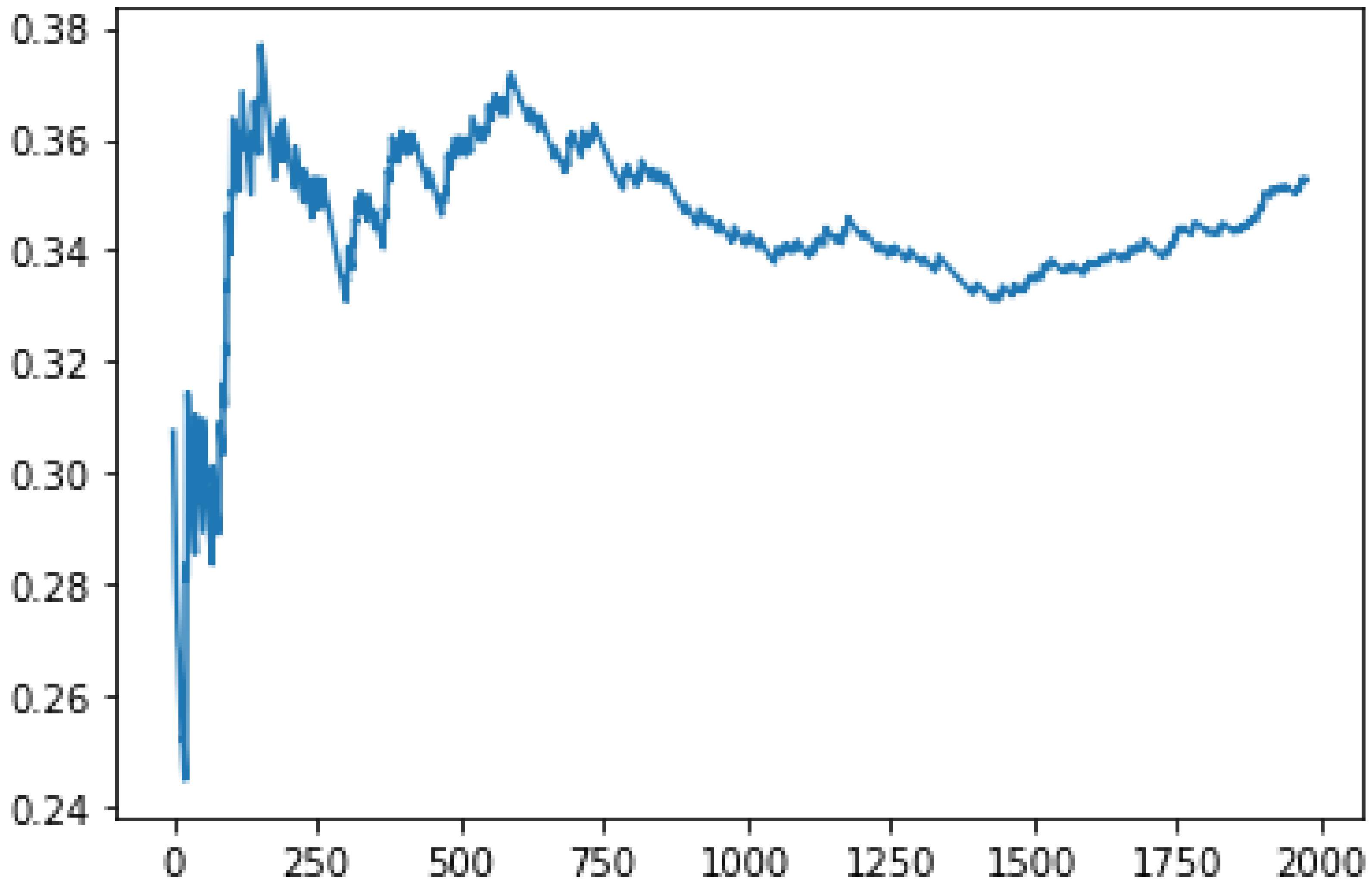
Hidden node的數量限制

實驗設計


The flowchart of weight-tuning_LG_UA
Data & the initial model
(with initial weights)
Forward operation
stopping
criteria
true
An
acceptable
SLFN
$|f(\mathbf{x}^c, \mathbf{w}) - y^c| < \varepsilon \ \forall c$
$\mathbf{w}, \eta, L_N(\mathbf{w})$
false
Calculate the direction $\nabla L_N(\mathbf{w})$
Hyperparameters:
• Optimizer:
• 1.2 & 0.7
• ε_1
$\mathbf{w}' = \mathbf{w} - \eta \nabla L_N(\mathbf{w})$
Forward operation
The mechanism of identifying the neighborhood of an undesired attractor
$\mathbf{w}$ & $0.7\eta \rightarrow \eta$
$L_N(\mathbf{w}') < L_N(\mathbf{w})$
true
$\mathbf{w} = \mathbf{w}'$, $\eta = \eta$*1.2, & $L_N(\mathbf{w}) = L_N(\mathbf{w}')$
false
true
$\eta > \varepsilon_1$
false
An
unacceptable
SLFN
32

實驗設計

loss_criteria = 0.25, Hidden node限制50顆



路徑次數

Green = 0

Blue = 0

Red = 1978

Green - network

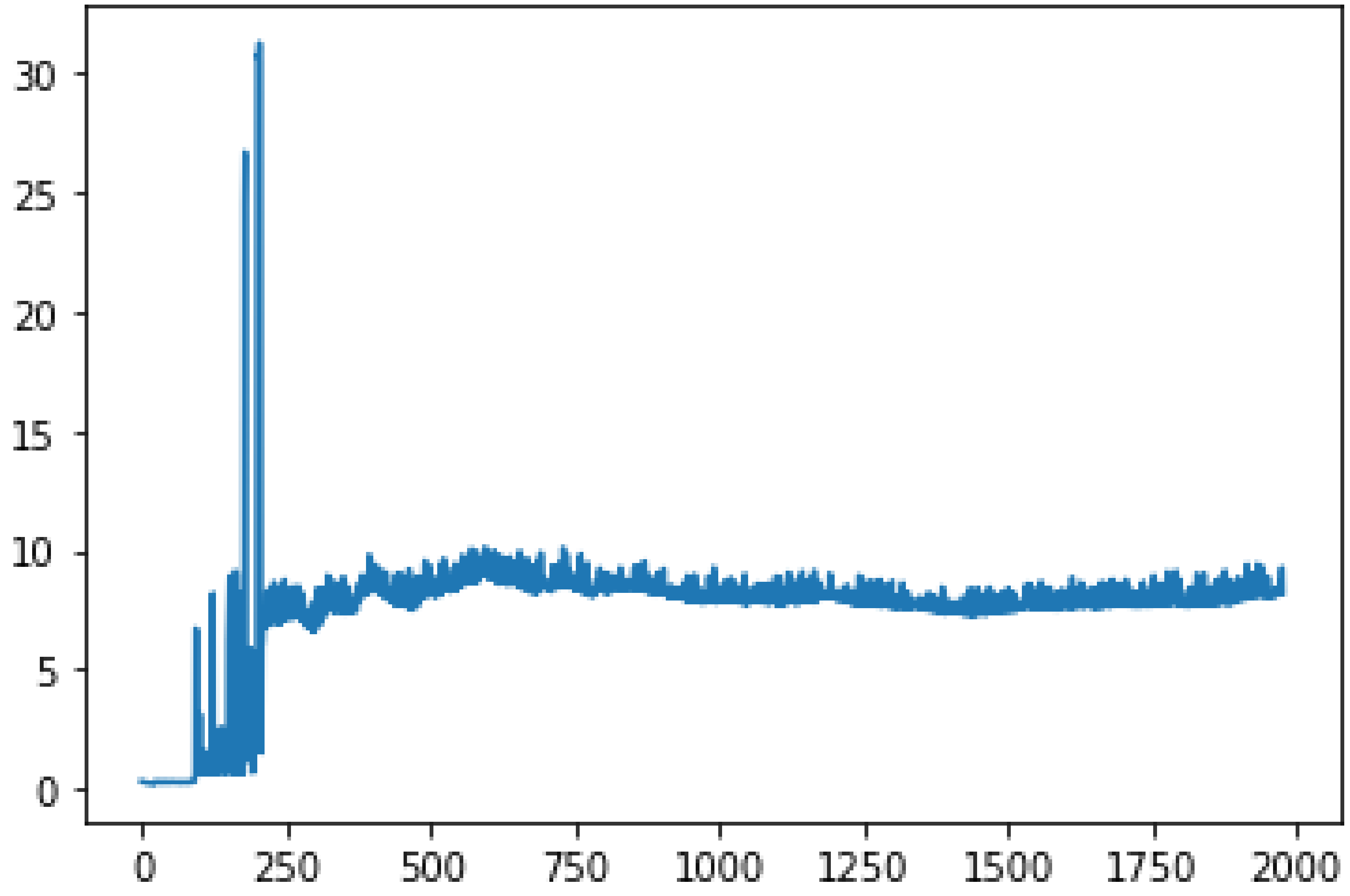
Blue

-Weight - analogizing-network

Red - Weight - network

實驗設計

loss_criteria = 0.14, Hidden node限制50顆



路徑次數

Green = 0

Blue = 1885

Red = 93

Green - network

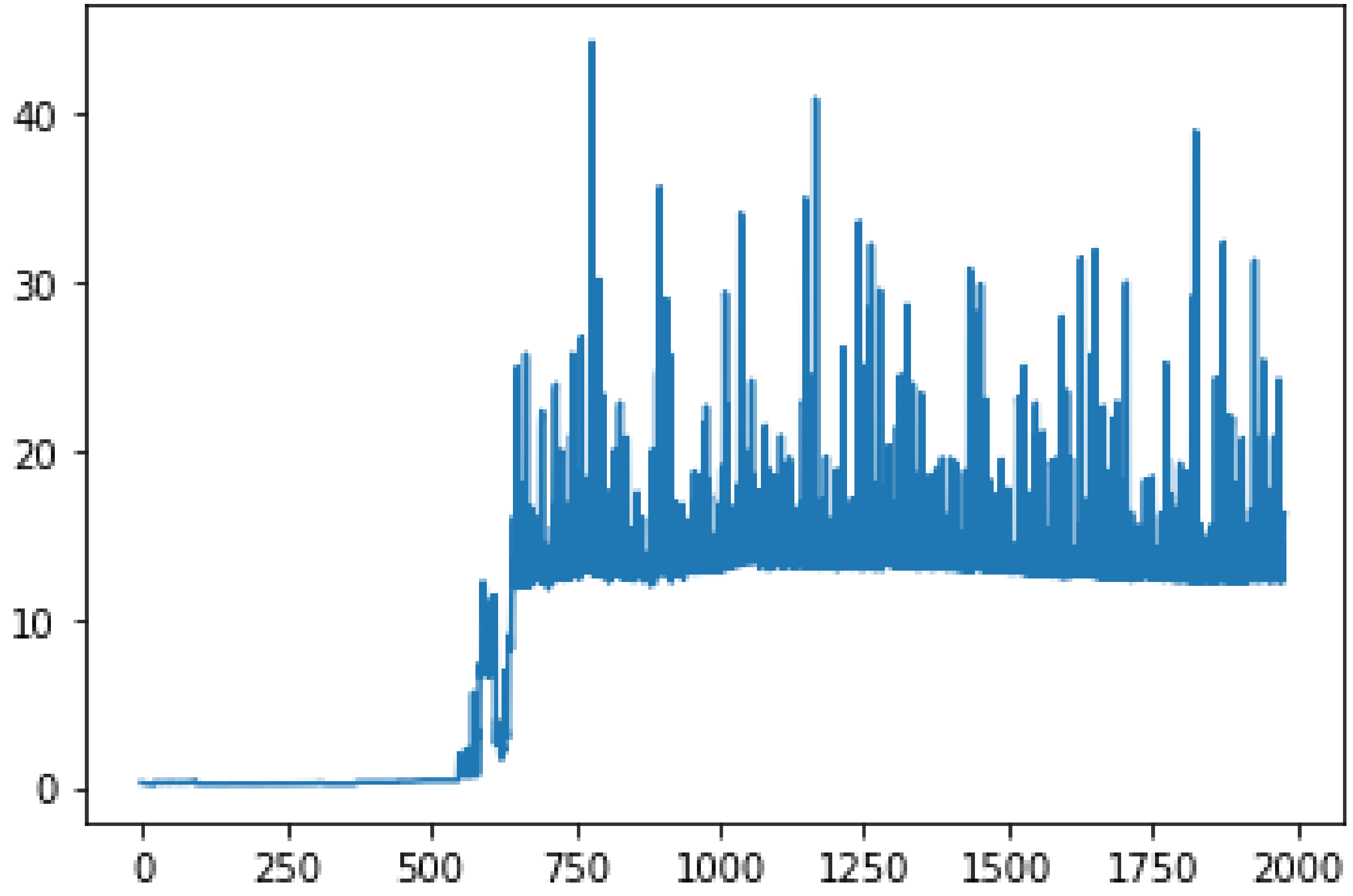
Blue

-Weight - analogizing-network

Red - Weight - network

實驗設計

loss_criteria = 0.12, Hidden node限制50顆



Green = 0

Blue = 1429

Red = 549

Green - network

Blue

- Weight - analogizing - network

Red - Weight - network

Insight

- 超參數調整
- 資料複雜度
- 模型路徑分析

謝謝大家

實驗設計

loss_criterion = 0.12, Hidden node限制50顆