

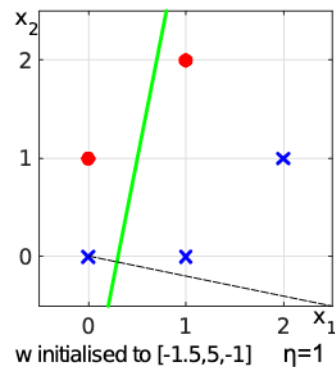
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)
- For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:

\mathbf{x}^T	class
[0,0]	1
[1,0]	1
[2,1]	1
[0,1]	0
[1,2]	0

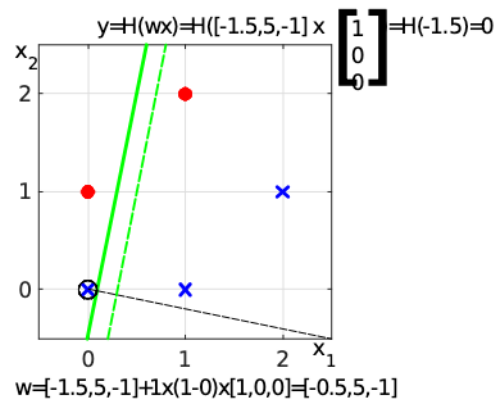


Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)
- For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:

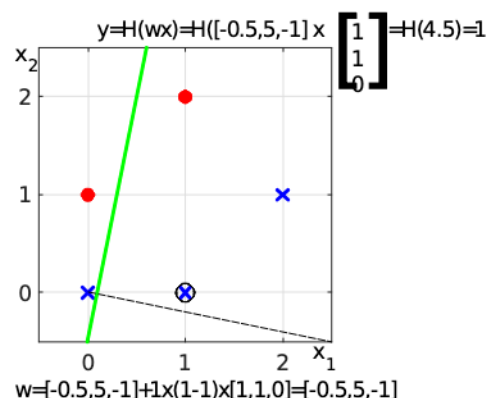


Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)
- For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



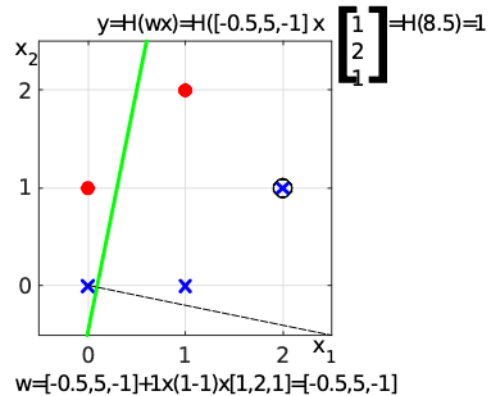
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



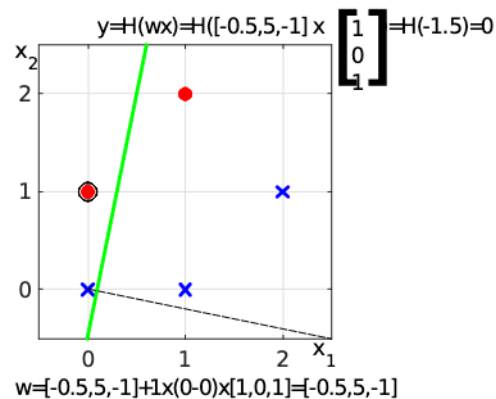
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



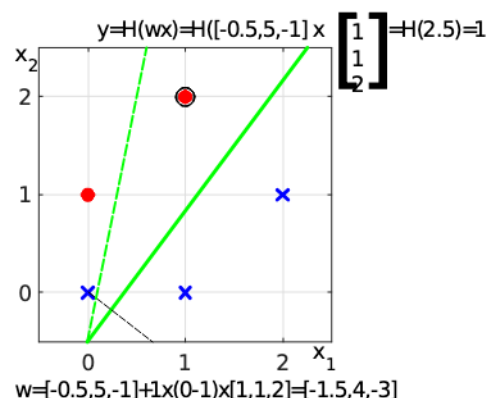
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



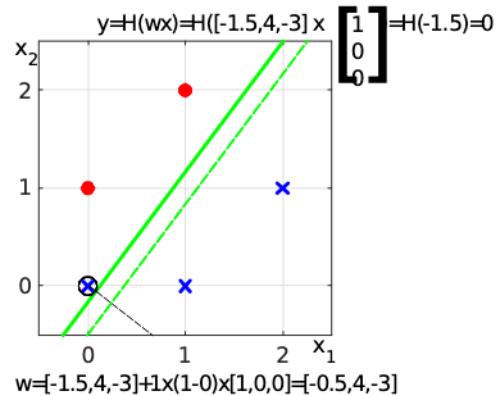
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



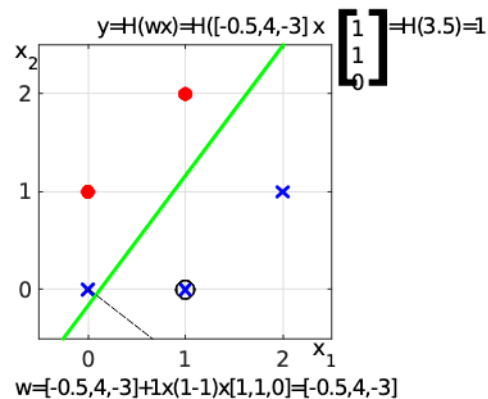
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



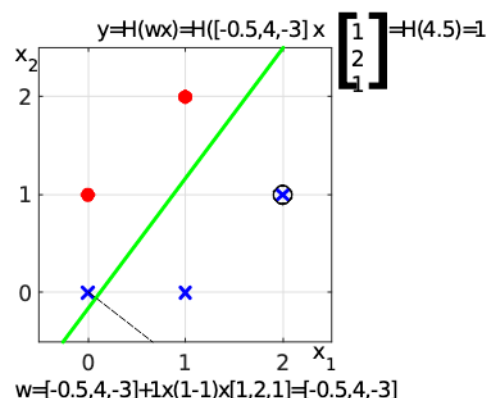
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



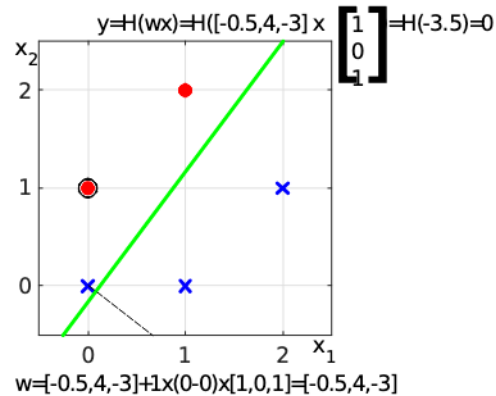
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



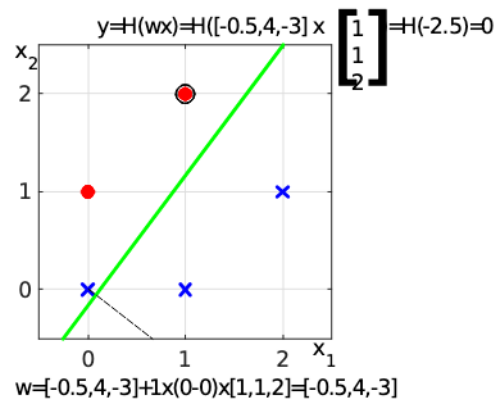
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:



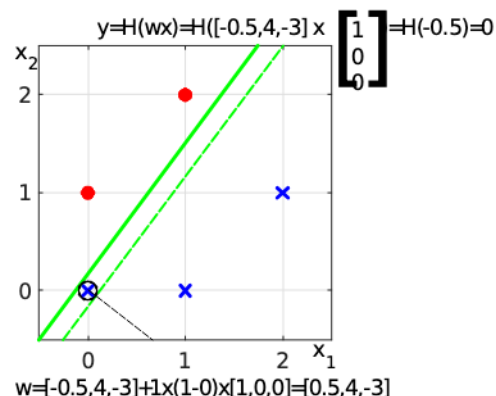
Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- Until convergence (all samples correctly classified)

• For each sample, \mathbf{x}_k , in the dataset in turn

$$\mathbf{w} \leftarrow \mathbf{w} + \eta (t_k - H(\mathbf{w}\mathbf{x}_k)) \mathbf{x}_k^t$$

Example:

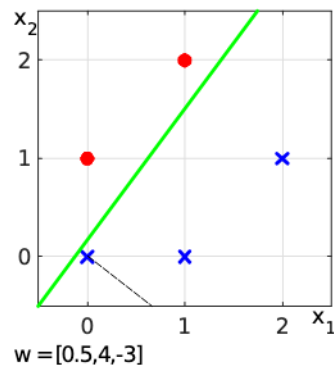


Sequential Delta Learning Algorithm

- Initialise \mathbf{w} to arbitrary solution and select learning rate
- **Until convergence (all samples correctly classified)**
- For each sample, \mathbf{x}_k , in the dataset in turn
 - $\mathbf{w} \leftarrow \mathbf{w} + \eta(t_k - H(\mathbf{w}\mathbf{x}_k))\mathbf{x}_k^t$

Example:

\mathbf{x}^T	class	$H(\mathbf{w}\mathbf{x})$
[0,0]	1	1
[1,0]	1	1
[2,1]	1	1
[0,1]	0	0
[1,2]	0	0



Part e

Competitive Learning and Autoencoders

Contents

- What is a Neural Network?
 - biological neural networks
 - artificial neural networks
 - general principles and terminology
 - why study artificial neural networks?
- Types of artificial neural network
 - Linear Threshold Units (Perceptrons)
 - Delta Learning Algorithm
 - **Competitive Learning Networks**
 - **Negative Feedback Networks**
 - **Autoencoder Networks**