Neural Networks
- Homework 7 -

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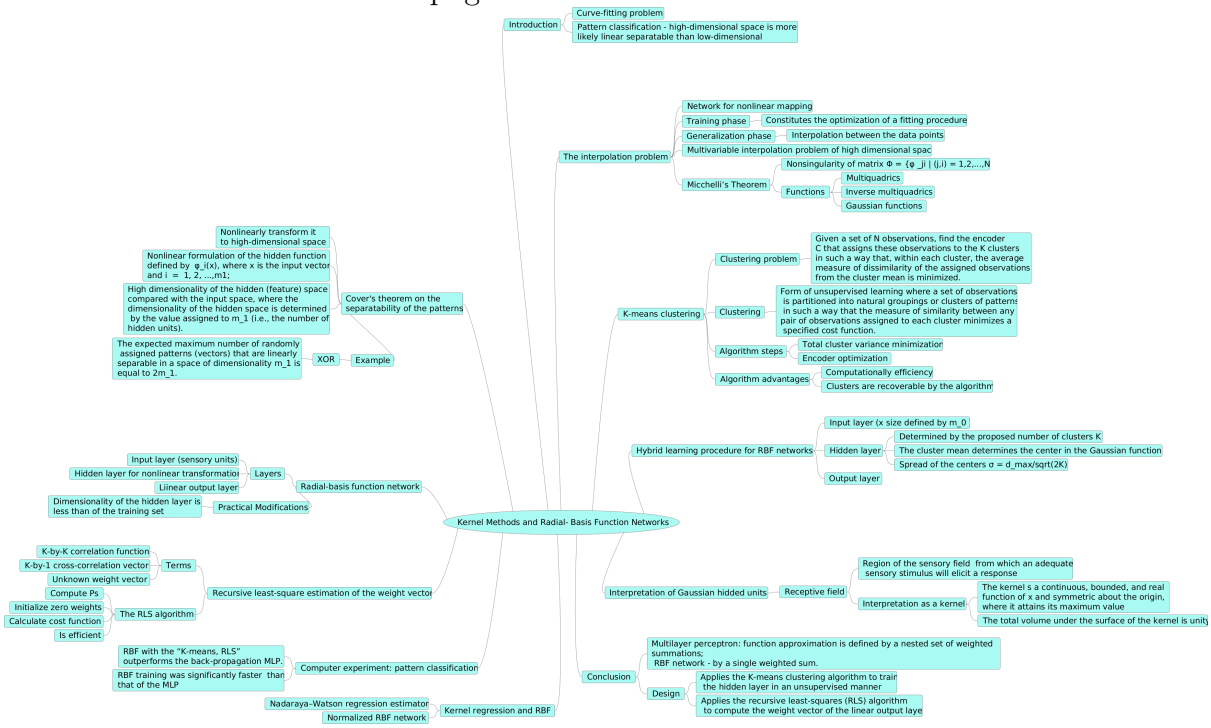
1 Mind map

Figure 1: Mind map. Chapter 5 from Haykin's book. A zoomed version is attached as Radial-BasisFunctionNetworks.png



2 Exercises

2.1 Exercise 5.10

The purpose of this computer experiment is to investigate the clustering process performed by the K-means algorithm. To provide insight into the experiment, we fix the number of clusters at K=6, but vary the vertical separation between the two moons in Fig. 2. Specifically, the requirement is to do the following, using an unlabled training sample of 1,000 data points picked randomly from the two regions of the double-moon pictured in Fig. 2:

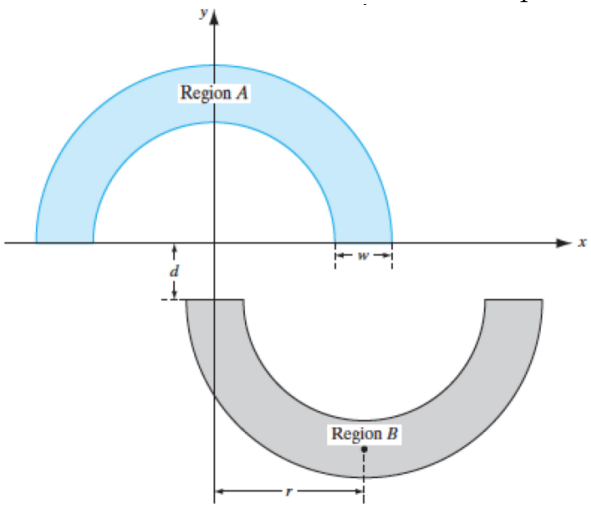
(a) Experimentally, determine the mean $\hat{\mu}_j$ and variance $\hat{\sigma}_j^2$, $j = 1, 2, .., 6$, for the sequence of eight uniformly spaced vertical separations starting at $d = 1$ and reducing them by one till separation $d = -6$ is reached.

(b) In light pf the results obtained in previous part, comment on how the mean $\hat{\mu}_j$ of cluster j is affected by reducing the separation d for $j = 1, 2$ and 3.

(c) Plot the variance $\hat{\sigma}_j^2$ versus the separation d for $j = 1, 2, ..., 6$.

(d) Compare the common σ^2 computed in accordance with the empirical formula of the equation $\sigma = \frac{d_{max}}{\sqrt{2K}}$ with the trends exhibited in the plots obtained in (c).

Figure 2: The double moon classification problem



Solution:

2.2 Exercise 5.11

The purpose of this second experiment is to compare the classification performance of two hybrid learning algorithms: the "K-means,RLS" algorithm investigated in Section 5.8 and the "K-means,LMS" algorithm investigated in this problem.
As in section 5.8, assume the following:
Number of hidden Gaussian units:20
Number of training samples:1,000 data points
Number of testing samples: 2,000 data points
Let the learning-rate parameter of the LMS algorithm be annealed linearly from 0.6 down to 0.01.

(a) Construct the decision boundary computed for the "K-means,LMS" algorithm for the vertical separation between the two moons in Fig.2 set at $d = -5$.

(b) Repeat the experiment for $d = -6$.

(c) Compare the classification results obtained using the "K-means,LMS" algorithm with those of the "K-means,RLS" algorithm studied in Section 5.8.

(d) Discuss how, in general, the complexity of the "K-means,LMS" algorithm compares with that of the "K-means,RLS" algorithm.