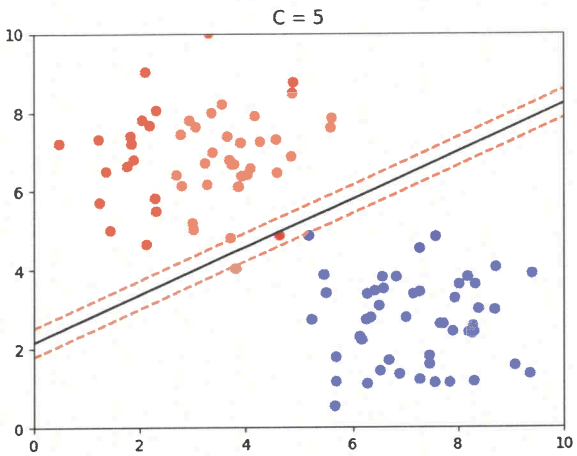
Week 11 Worksheet: Support Vector Machines

In these questions, you will be presented with data which we are trying to analyse and separate into red and blue, and in doing so creating a model which will allow the reliable classification of unseen data.

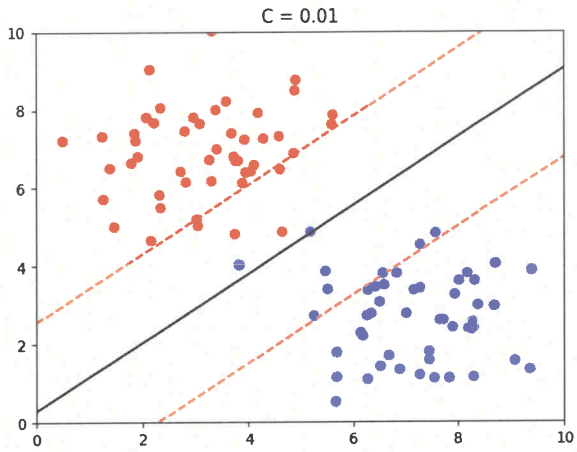
Part A – Hardness/softness of margins

These two graphs show the same set of data which has been fit with a linear kernel SVM, using different parameters to change the hardness of the margin.

Model A



Model B



Explain the advantages of using Model B, with reference to:

- hard and soft margins
- how well the model will respond to new data
- overfitting/underfitting

Model A overfits to training data → doesn't generalise well to other data

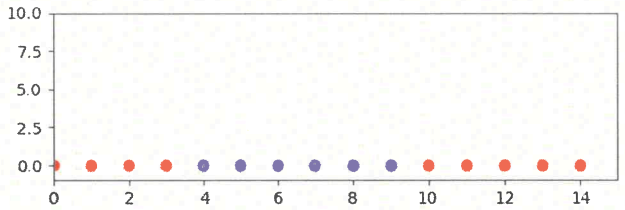
The margin hardness variable controls how fitted the SVM is to training data

Too soft margin → underfit → High error to training + test data

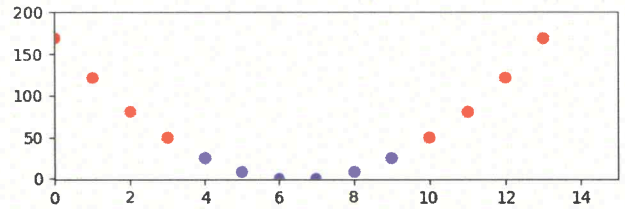
Too hard margin → overfit → low training error + High test error

Part B – Transforming Data

The data in the first figure on the right has been gathered based on one property and its corresponding classification, e.g. the data point where x = 3 is classified as red, and the data point where x = 8 is classified as blue.



Explain briefly how the data has been transformed to produce the figure below it, and why this is useful.



Data transformed using Polynomial Kernal from 1 dimensional space to 2D space

Becomes a degree 2 Polynomial

↓

Data can now be classified using a 1 dimensional hyperplane

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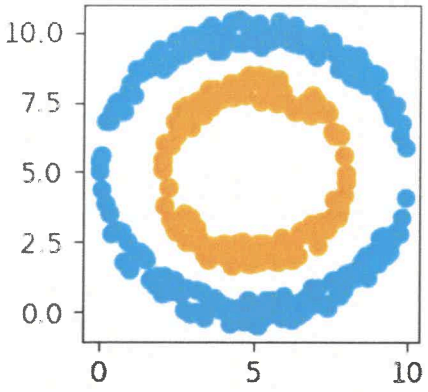
Projects 1D line into 0D space

3.

Part C – Beyond 3 Dimensions

$z = \sqrt{x^2 + y^2}$



Explain briefly how a SVM separates these data, comparing the technique to the examples above.

Transforms into 3D space to make data classification simpler, alike 1D → 2D

↓

Then seperates data using a 2D (N-1) Plane

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Projects Plane back into 2d space