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MACM316

How does this affect the linear fit?
The linear fit of $\{x_2, y_2\}$ has a smaller slope than that of $\{x_1, y_1\}$ and a higher y-intercept. This is due to the fact that linear fit is significantly less robust and assigns too much weight to the data points.

How does this affect nonlinear fit?
The nonlinear fit of $\{x_2, y_2\}$ has a more gradual slope on the interval $[4,5]$, but is otherwise unaffected by the additional data points.

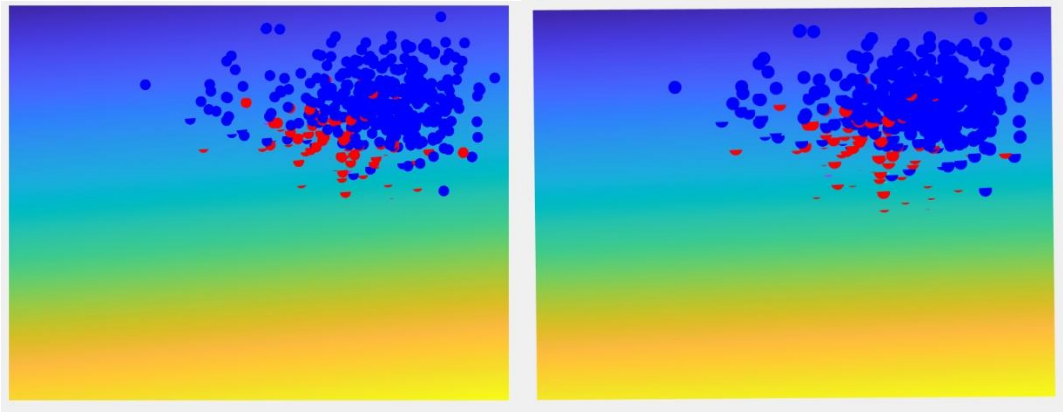
Which method would you say is more robust in this situation, why?
The nonlinear fit is more robust because it doesn't change drastically with the addition of new data. Additionally, the nonlinear fit is more robust in binary data classification because it accounts for the nonlinear nature of the data. Fitting a linear line doesn't demonstrate the true relationship of the data because there are no intermediate values in the range $[0,1]$ and the value of $f(x)$ does not increase linearly with the value of x.

Use the fitting coefficients to classify the data {xC}. Does it matter which coefficients you use?
Using the linear and nonlinear bases in the sigmoid function produces the same classification results. Therefore, it does not matter what coefficients are used.

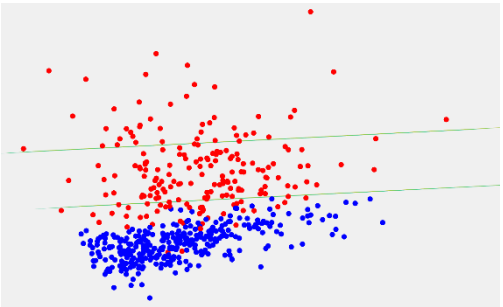
Examine the surface of the error function used in the nonlinear fitting. What does the staircase structure suggest about how well steepest descents would work in this case?
Steepest descent would not work with this function, because the slope of the "staircase" oscillates and isn't unidirectional.

Classification of tumours
Classify_Data3D
The non-linear fit has fewer cancerous tumours incorrectly classified as benign than the linear fit, meaning that the probability of a false negative is lower. Judging by this characteristic, the non-linear fit leads to significantly better classification because patients with cancer are less likely to be misdiagnosed.

Classify_Data30D



The linear interpolant (pictured above on the left) allows for more false negatives than the nonlinear fit (pictured above on the right).



In the figure above, shifting the plane of reference towards the negative (blue) diagnosis data points increases false positives, but no cancerous tumours are missed by replacing the threshold value and substituting 1/2 with a number just below 1.