

# CIS 515

## Project 4: Hard Margin Support Vector Machine

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When we run hard SVM on the data set ( $u_3, v_3$ ), we observe a weird phenomenon from figure 1 that the margin line doesn't locate on the support vector machine points. The reason why it doesn't fit the definition of hard margin support vector machine is that the data points do not separate well. More specific, some data points should be labeled as -1(1) but labeled as 1(-1) instead.

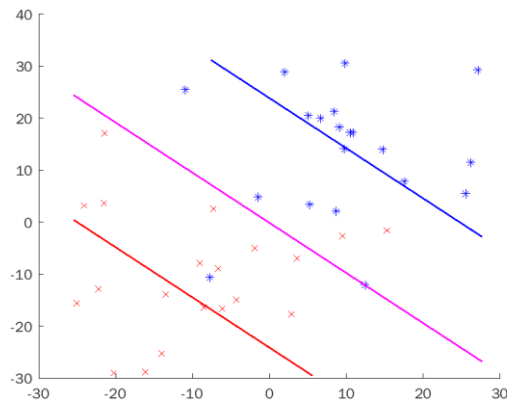


Figure 1 ( $u_3, v_3$ )

Trying different rho (`rng(14175332)`):

rho = 0.1

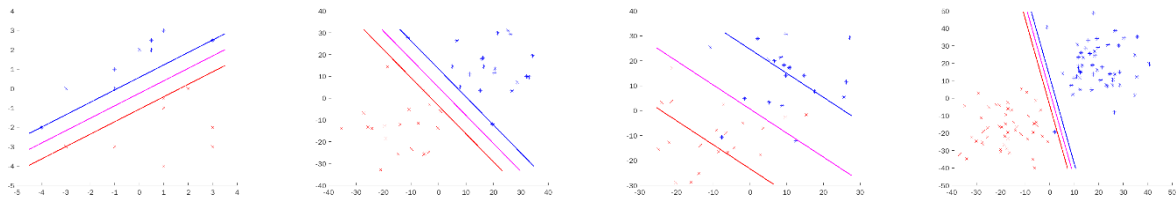


Figure 2 rho=0.1

rho = 5

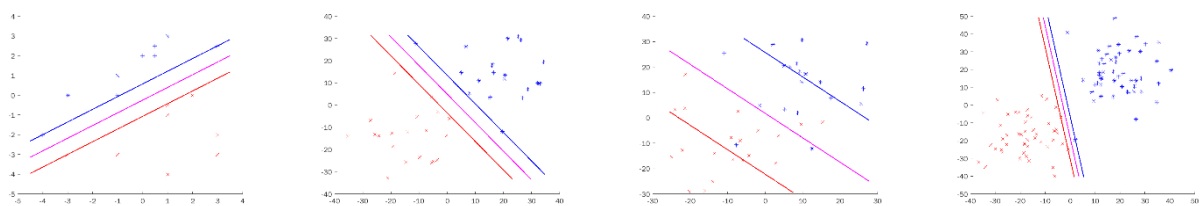


Figure 3 rho=5

rho = 10

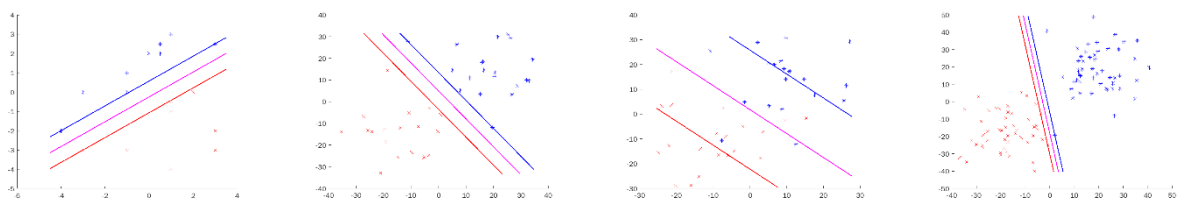


Figure 4 rho=10

rho = 15

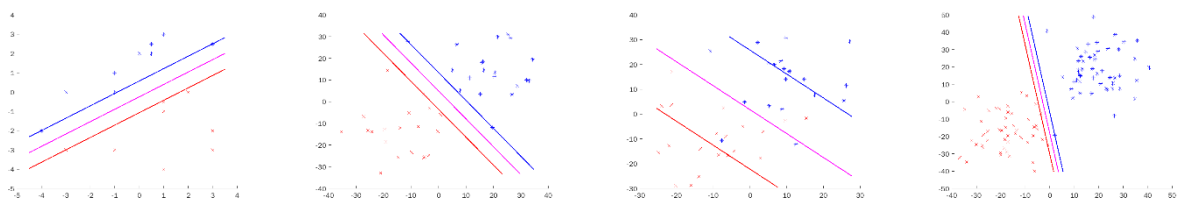


Figure 5 rho=15

rho = 20

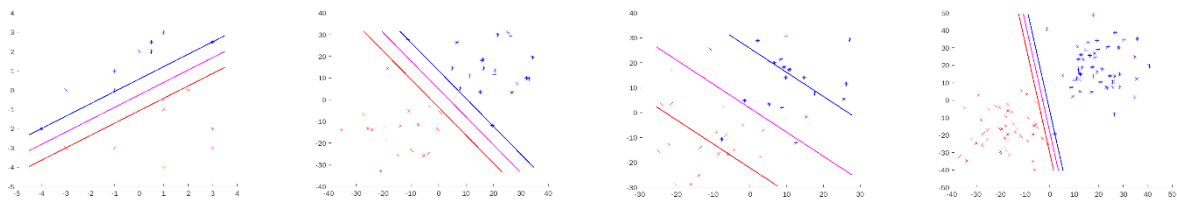


Figure 6 rho=20

rho = 50

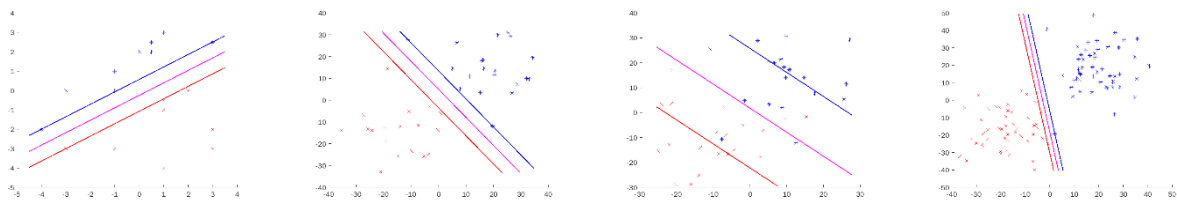


Figure 7 rho=50

For (u4, v4) data points, we observe that when  $\rho = 0.1, 1$  the figures violate the rule of hard margin SVM, which their margin lines doesn't locate on the support vector machine points.

Conclusion: when we decrease the  $\rho$  value to a small number, the  $b$ (interception) value would be affected.

Trying different rng values ( $\rho=10$ ):

rng: 123456789

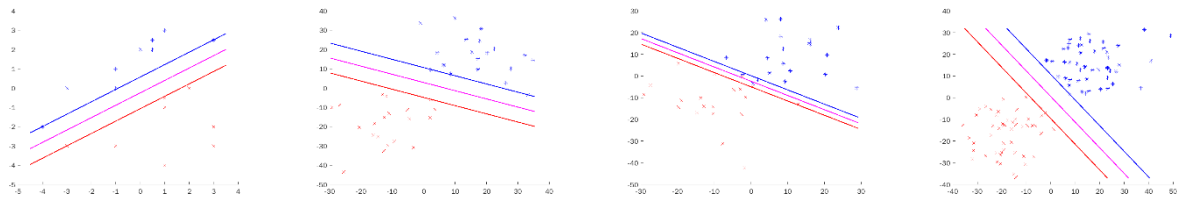


Figure 8 rng=123456789

rng: 987654321

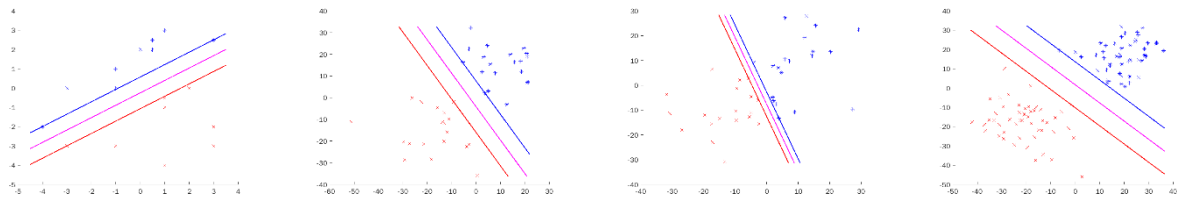


Figure 9 rng=987654321