Pattern Recognition and Data Mining HW3

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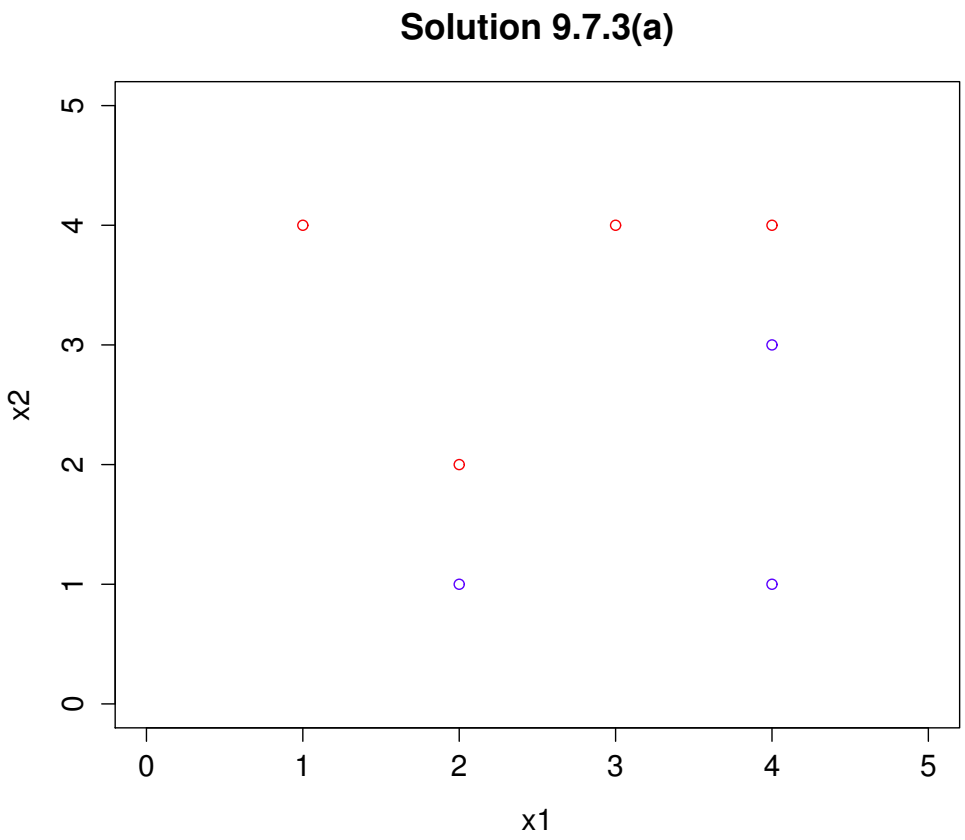
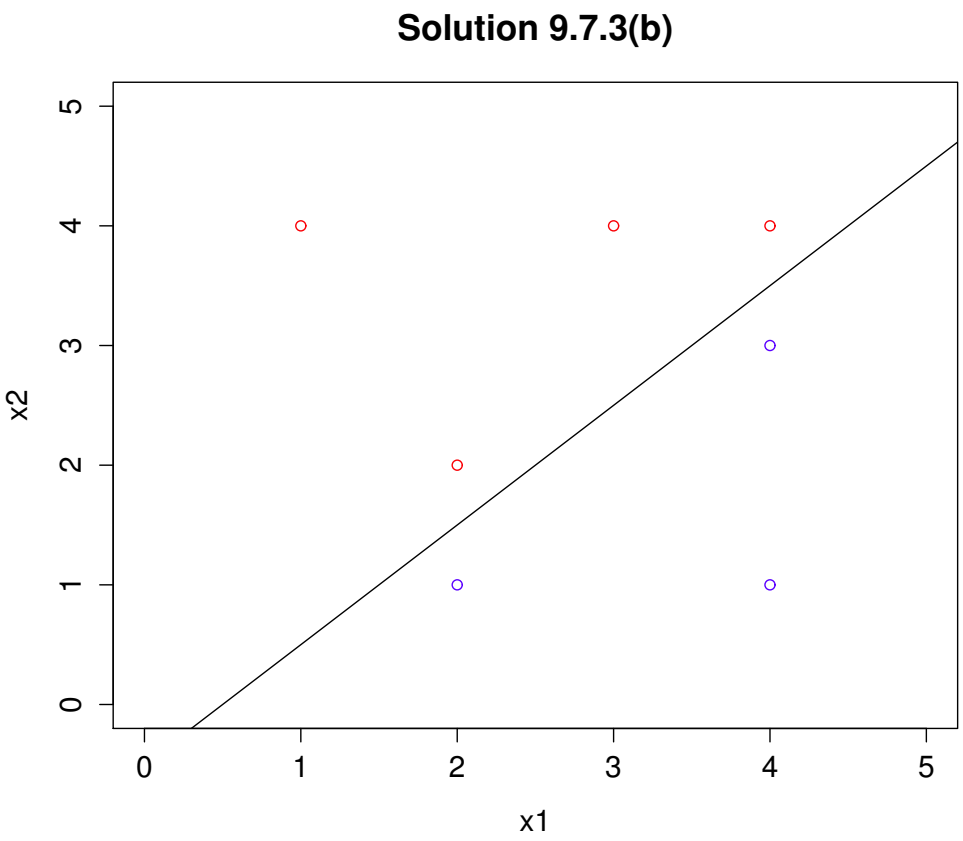
1 Solution 9.7.3 (a)

```
# Solution (a)
x1 <- c(3, 2, 4, 1, 2, 4, 4)
x2 <- c(4, 2, 4, 4, 1, 3, 1)
colors <- c("red","red","red","red","blue","blue","blue")
plot(x1,x2, col = colors, xlim = c(0,5), ylim = c(0,5), main = "
    Solution 9.7.3(a)")
```



2 Solution 9.7.3 (b)

```
#Solution (b)
plot(x1,x2, col = colors, xlim = c(0,5), ylim = c(0,5), main = "
    Solution 9.7.3(b)", abline(-0.5,1))
```



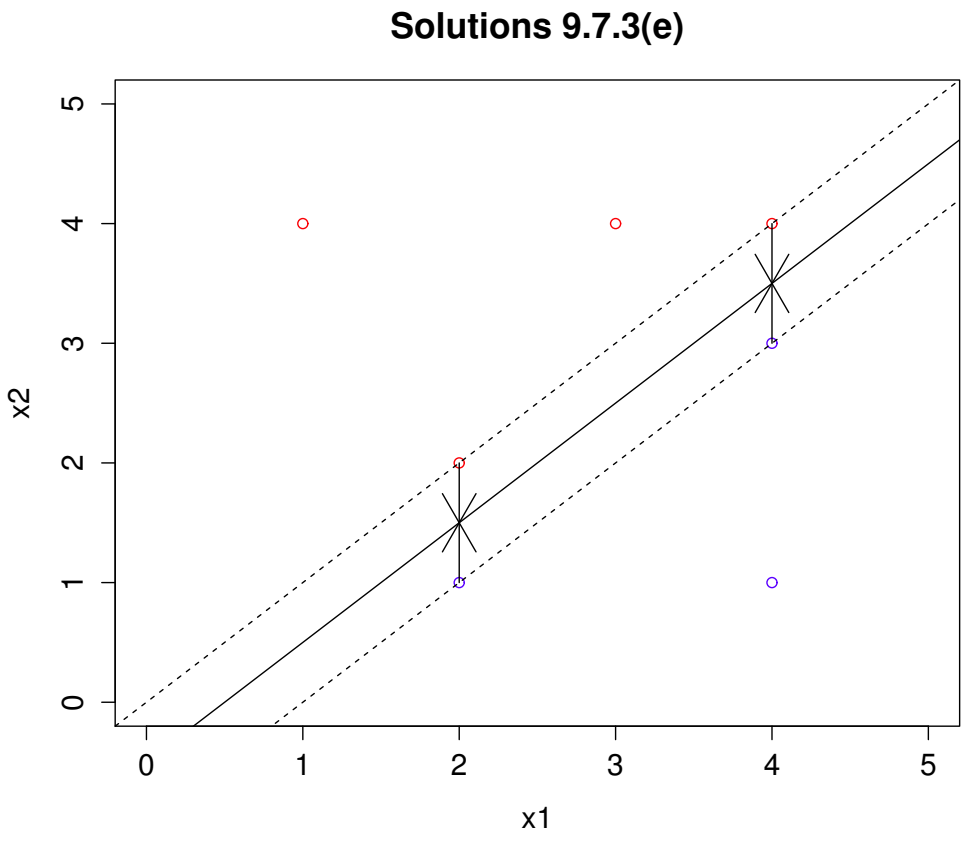
The Maximal Marginal Classifier is the hyperplane that is passing through the points $(2, 1.5)$ and $(4, 3.5)$.
The equation of the hyperplane in $\beta_0 + \beta_1 X_1 + \beta_2 X_2$ form
is $0.5 - X_1 + X_2 = 0$

3 Solution 9.7.3 (c)

The Classification Rule for the Maximum Marginal Classifier is as follows, "Classify to Red if $0.5 - X_1 + X_2 > 0$ and classify to Blue otherwise"

4 Solution 9.7.3 (d)

```r
#Solution (e)
plot(x1, x2, col = colors, xlim = c(0, 5), ylim = c(0, 5), main = "
    Solutions 9.7.3(e)")
abline(-0.5, 1)
abline(-1, 1, lty = 2)
abline(0, 1, lty = 2)
arrows(2, 1, 2, 1.5)
arrows(2, 2, 2, 1.5)
arrows(4, 4, 4, 3.5)
arrows(4, 3, 4, 3.5)
```

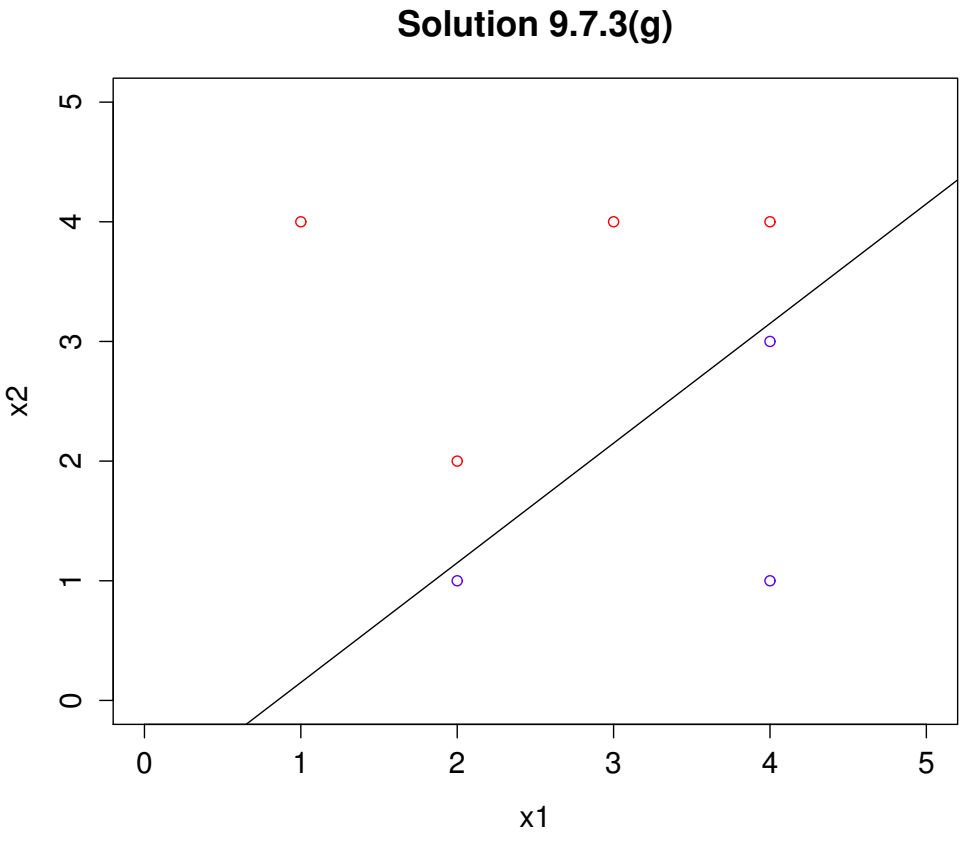


5 Solution 9.7.3 (e)

A slight movement of the 7^{th} observation would not affect the Maximal Margin Hyperplane because the 7^{th} observation which is $(4, 1)$ is well beyond the margin of the support vectors and therefore it's movement won't affect the margin of the support vector thereby not affecting the Maximal Margin Hyperplane.

6 Solution 9.7.3 (g)

```
#Solution (g)
plot(x1, x2, col = colors, xlim = c(0, 5), ylim = c(0, 5), main = "
    Solution 9.7.3(g)")
abline(-0.85, 1)
```



The equation of the hyperplane in $\beta_0 + \beta_1 X_1 + \beta_2 X_2$ form is $-0.85 - X_1 + X_2 = 0$

7 Solution 9.7.3 (h)

```
#Solution (h)
plot(x1, x2, col = colors, xlim = c(0, 5), ylim = c(0, 5), main = "
    Solution 9.7.3(h)")
points(c(3), c(2), col = c("red"))
```