Decision Boundary for $(2x_1 - x_2 - 6)$

Question 1: Decision Boundary in $\mathbb{R}^2$ for $(2x_1 - x_2 - 6)$

Step 1: Understand the Prediction Rule

The prediction rule is based on the sign of the linear function:

$$f(x_1, x_2) = 2x_1 - x_2 - 6$$

The decision boundary is defined by:

$$f(x_1, x_2) = 0 \quad \Rightarrow \quad 2x_1 - x_2 - 6 = 0$$

Step 2: Rewrite as Line Equation

Solve for x_2:

$$x_2 = 2x_1 - 6$$

This is a straight line in $\mathbb{R}^2$ with:

- Slope: 2
- y-intercept: -6

Step 3: Find Axis Intercepts

To find the x-intercept: set $x_2 = 0$

$$\begin{aligned} 2x_1 - 6 &= 0 \\ x_1 &= 3 \end{aligned}$$

To find the y-intercept: set $x_1 = 0$

$$x_2 = -6$$

Step 4: Determine Classification Sides

Choose test points on either side of the boundary:

- Test point $(0, 0)$: $f(0, 0) = -6 < 0 \quad \Rightarrow$ **Negative**
- Test point $(5, 2)$: $f(5, 2) = 10 - 2 - 6 = 2 > 0 \quad \Rightarrow$ **Positive**

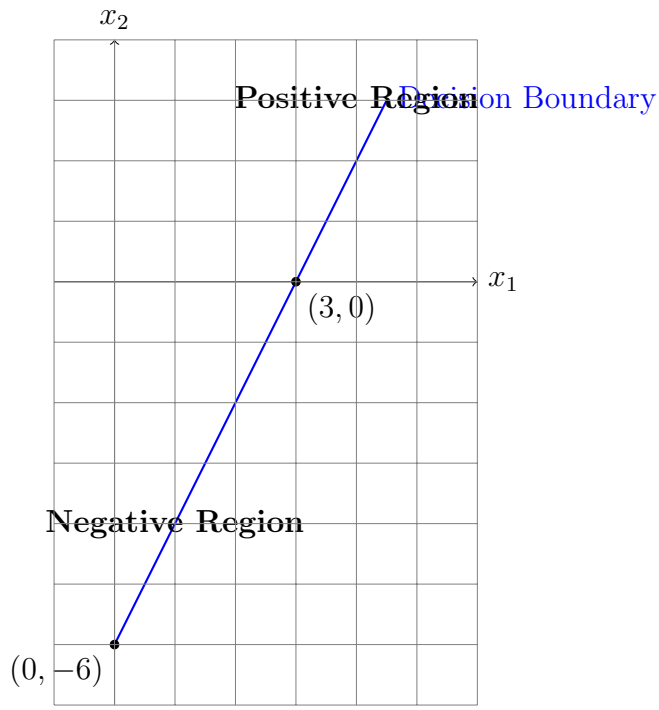

Figure 1: Decision boundary $x_2 = 2x_1 - 6$ with axis intercepts and classification regions

Step 5: Draw the Decision Boundary

$$\boxed{\text{Region where } 2x_1 - x_2 - 6 > 0 \text{ is classified as Positive}}$$

$$\boxed{\text{Region where } 2x_1 - x_2 - 6 < 0 \text{ is classified as Negative}}$$
