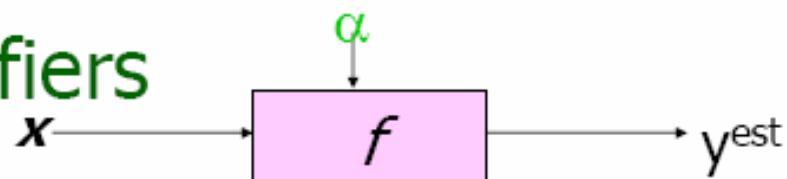
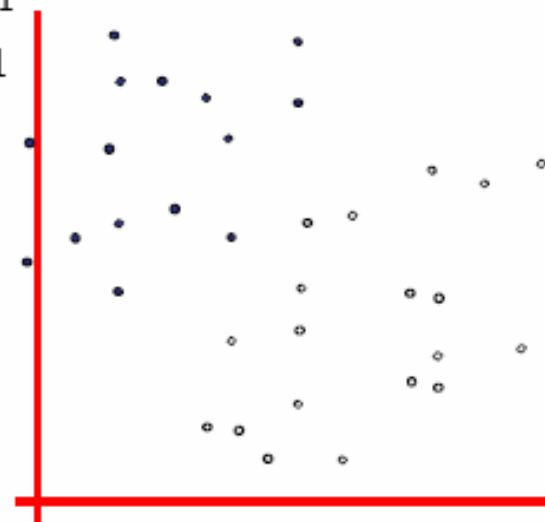


# Linear Classifiers



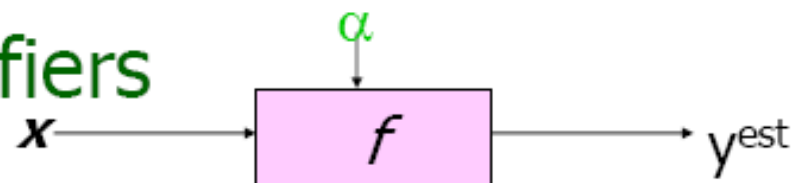
$$f(\mathbf{x}, \mathbf{w}, b) = \text{sign}(\mathbf{w} \cdot \mathbf{x} - b)$$

- denotes +1
- denotes -1

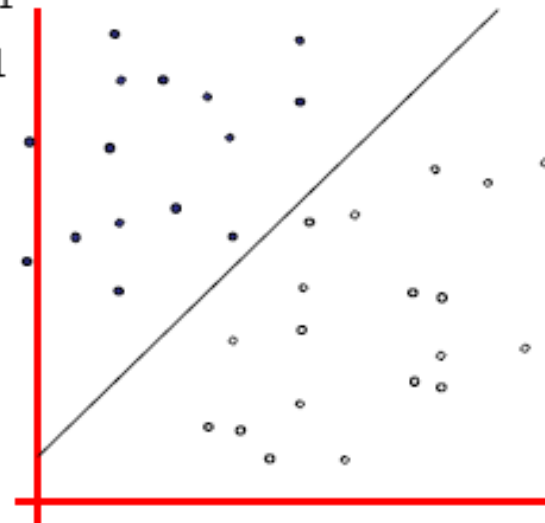


How would you classify this data?

# Linear Classifiers



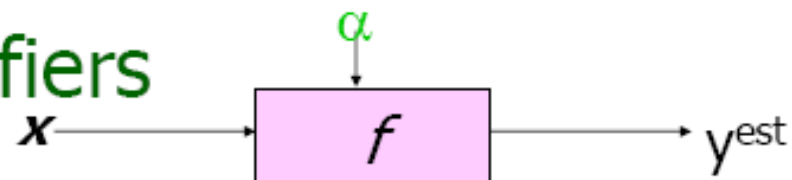
- denotes +1
- denotes -1



$$f(\mathbf{x}, \mathbf{w}, b) = \text{sign}(\mathbf{w} \cdot \mathbf{x} - b)$$

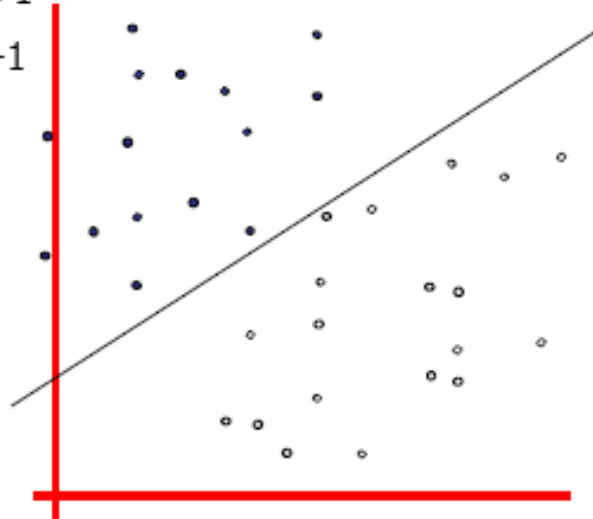
How would you  
classify this data?

# Linear Classifiers



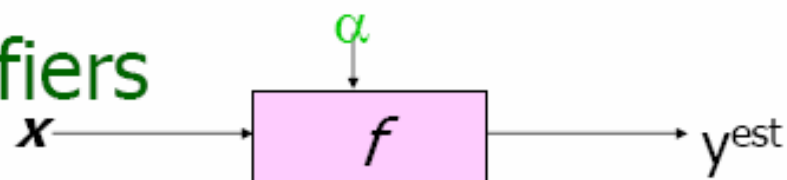
$$f(\mathbf{x}, \mathbf{w}, b) = \text{sign}(\mathbf{w} \cdot \mathbf{x} - b)$$

- denotes +1
- denotes -1

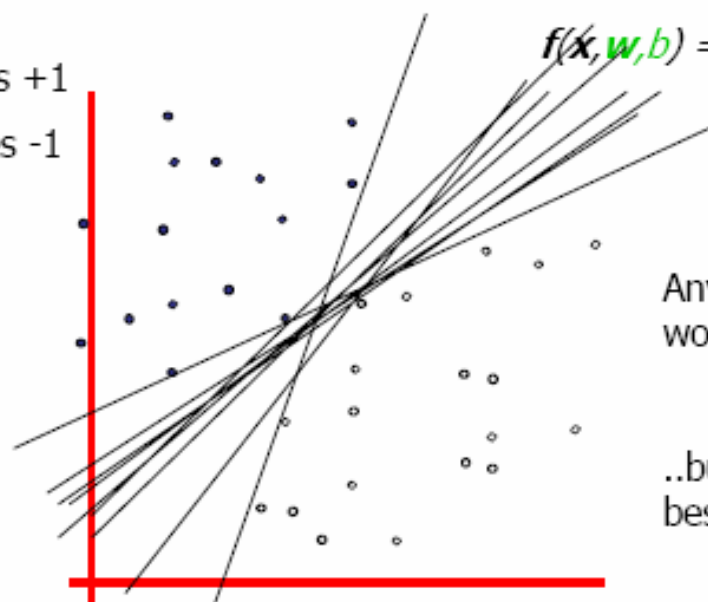


How would you classify this data?

# Linear Classifiers



- denotes +1
- denotes -1

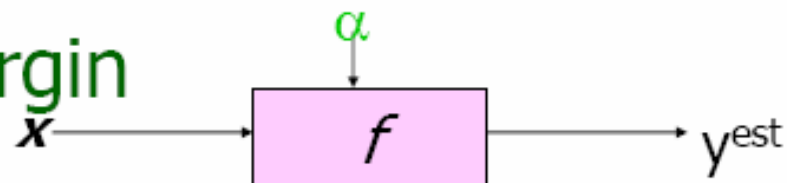


$$f(\mathbf{x}, \mathbf{w}, b) = \text{sign}(\mathbf{w} \cdot \mathbf{x} - b)$$

Any of these  
would be fine..

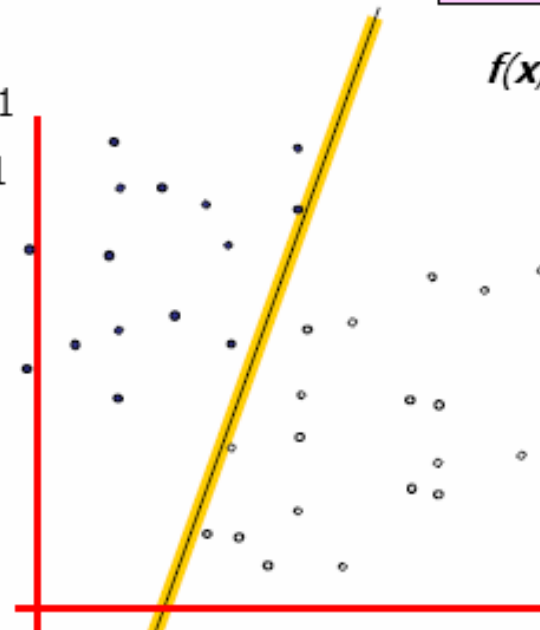
..but which is  
best?

# Classifier Margin



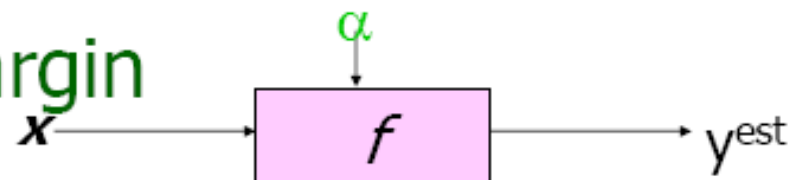
$$f(\mathbf{x}, \mathbf{w}, b) = \text{sign}(\mathbf{w} \cdot \mathbf{x} - b)$$

- denotes +1
- denotes -1

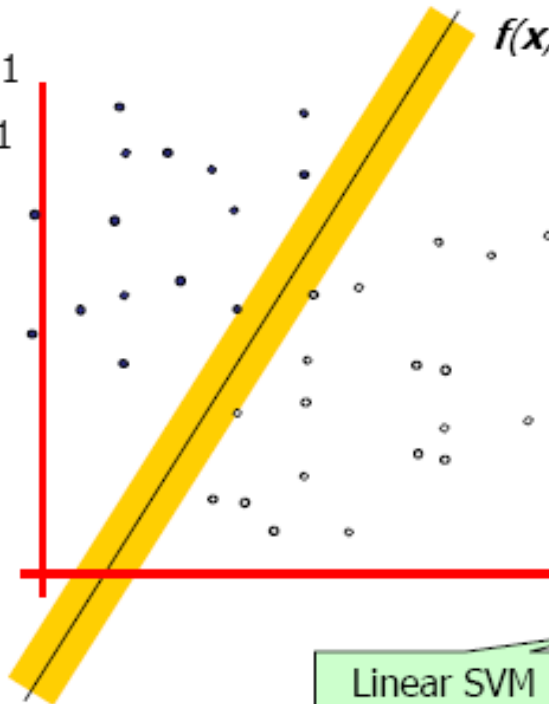


Define the **margin** of a linear classifier as the width that the boundary could be increased by before hitting a datapoint.

# Maximum Margin



- denotes +1
- denotes -1



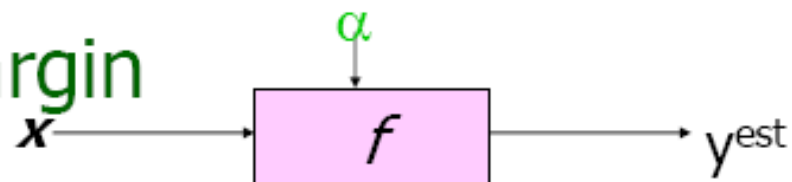
$$f(x, w, b) = \text{sign}(w \cdot x - b)$$

The **maximum margin linear classifier** is the linear classifier with the, um, maximum margin.

This is the simplest kind of SVM (Called an LSVM)

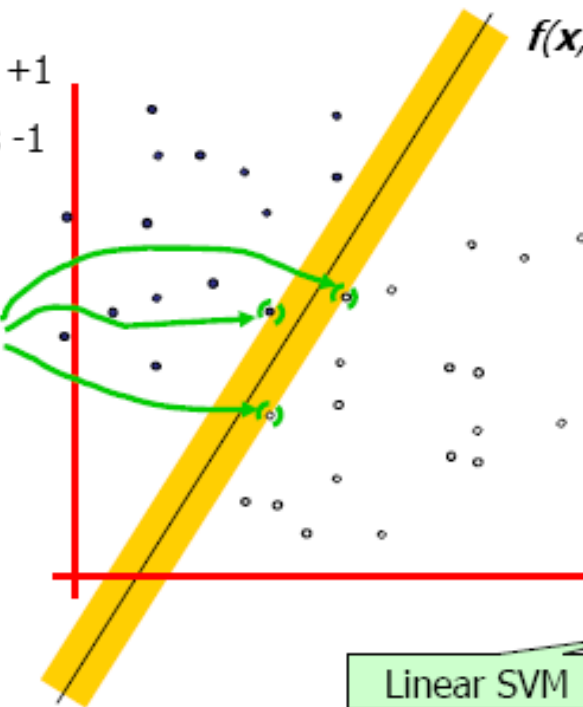
Linear SVM

# Maximum Margin



- denotes +1
- denotes -1

Support Vectors  
are those  
datapoints that  
the margin  
pushes up  
against



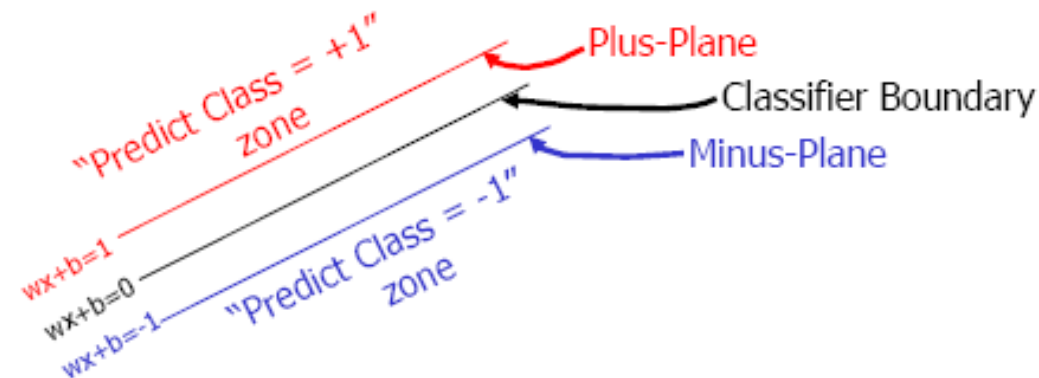
$$f(x, w, b) = \text{sign}(w \cdot x - b)$$

The **maximum margin linear classifier** is the linear classifier with the, um, maximum margin.

This is the simplest kind of SVM (Called an LSVM)

Linear SVM

## Specifying a line and margin



- Plus-plane =  $\{ \mathbf{x} : \mathbf{w} \cdot \mathbf{x} + b = +1 \}$
- Minus-plane =  $\{ \mathbf{x} : \mathbf{w} \cdot \mathbf{x} + b = -1 \}$

Classify as..	<b>+1</b>	if	$\mathbf{w} \cdot \mathbf{x} + b \geq 1$
	<b>-1</b>	if	$\mathbf{w} \cdot \mathbf{x} + b \leq -1$
	Universe explodes	if	$-1 < \mathbf{w} \cdot \mathbf{x} + b < 1$