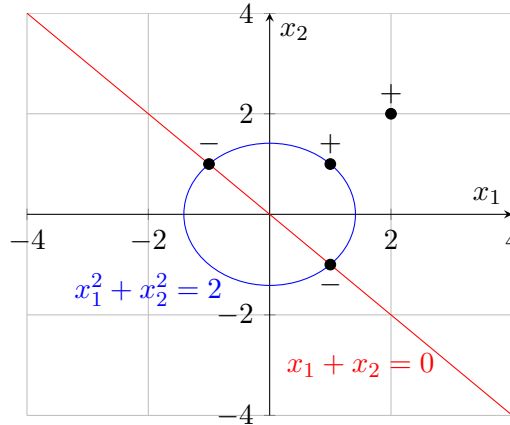


# SUTD 2021 50.007 Homework 1

James Raphael Tiovalen 1004555

## 1. Classification

We can plot a visual, graphical representation of the given data points:



- (a) Such a classifier does not exist. As demonstrated by the blue-colored circle on the graph above, a minimum radius of  $\sqrt{2}$  would be needed to classify the points. However, since the classifier's boundary would intersect two positive points and one negative point (i.e., they lie on the boundary), such a classifier would be insufficient to correctly classify all said data points without any ambiguity. Any classifier of an origin-centered circle with  $r < \sqrt{2}$  would classify all the data points with the same label (which is not correct for some of the points), while any classifier of an origin-centered circle with  $r > \sqrt{2}$  would classify the two negative data points at  $(-1, 1)$  and  $(1, -1)$  along with at least the positive data point at  $(1, 1)$  under the same label (which is also not correct for some of the points). Hence, no such classifier exists.
- (b) One and only one possible linear classifier that goes through the origin would be one with a normal vector  $\theta = (\theta_1, \theta_2) = (1, 1)$  (or  $[\theta_1, \theta_2]^T = [1, 1]^T$ ). More formally, such a classifier can be defined as

$$h(x, \theta) = \text{sign}(x_1 + x_2) = \text{sign}(\theta \cdot x) = \begin{cases} +1, & \text{if } \theta \cdot x > 0 \\ -1, & \text{if } \theta \cdot x \leq 0 \end{cases}$$