Explanatory Notes for 6.390

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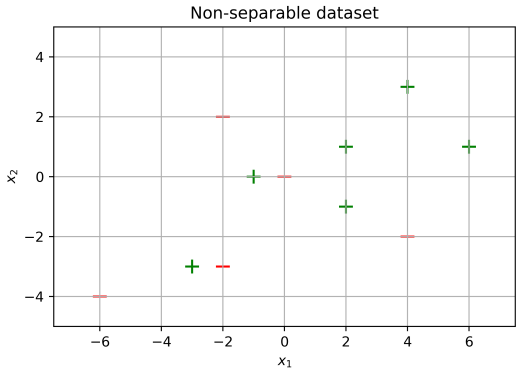
Separable vs Non-separable data

One more consideration: **not all** data can be correctly **divided** by a linear separator!



There's no line we could draw through this data to **separate** the points from each other.

If we can, we call it **linearly separable**.

Definition 1

A **dataset** is **linearly separable** if you can **perfectly** classify it with a **linear classifier**.

A couple common reasons for data to not be linearly separable:

- A positive and negative data point have the exact **same position** in input space.
- Two points on either **side** of a point with opposite classification: $+ - +$ or $- + -$, for example.

Very often, real-world datasets **can't** linearly separated, because of **complexities** in the real world, or random **noise**.

But, sometimes, we can **almost** linearly separate it: we get very high **accuracy**. In those cases, it may be **fine** to use a linear separator: we might risk **overfitting** if we use a more complex model.

What is "high enough accuracy"? Depends on what you need it for!

Still, if a dataset is not **linearly separable**, or at least **high-accuracy** with a linear separator, that could mean we need a **richer** hypothesis class.

Remember: a "richer" or more "expressive" hypothesis class is one that can create more hypotheses that our current one can't!

We'll get into ways to make a **richer** class in the **next** chapter: **feature transformations**.