CME 216, ME 343 - Spring 2020 Eric Darve, ICME



Supervised learning

There are broadly speaking two main tasks in machine learning that we will be concerned about:

- 1. classification and
- 2. regression.

For more information, please read section 5.1 in <u>Deep</u> Learning.



The first one is **classification**.

In this problem, we assume that for each point

$$x=(x_1,\ldots,x_d)$$

we need to assign or predict a label or category, which is typically represented by an integer.

It may represent for example the type of object represented in an image, a cat, a dog, or a car.

In engineering, x may represent the result of some experimental measurements for a bridge for example.

The label may represent whether we believe there is a fracture or damage to the structure: +1 if true and -1 if false.

Or similarly, $x = (x_1, \ldots, x_T)$ may be a time-resolved signal, for example the vibrations of a mechanical part.

The label may represent a mechanical failure: +1 if a failure is detected, -1 otherwise.

The second one is **regression**.

In that case, we may be interested in some function

$$u(x)\in \mathbb{R}$$

which is real-valued.

It may be a scalar quantity like the pressure, a vector, like the velocity, or a tensor, like the stress, or strain in a solid.

Regression is more common than classification in engineering.

We previously gave the example of linear regression.

We are going to start with the problem of classification for simplicity.

Decision function



In the previous figure, the points on the top left in red have a label +1 and the ones in the bottom right in blue have a label -1.

In this case,
$$x=(x_1,x_2)$$
 is a vector in \mathbb{R}^2

This is an example of a **supervised** learning task.

That is we are given some data points x_i in 2D along with their labels, +1 or -1.

Unsupervised learning is concerned with a different set of tasks.

For example, given a set of points x_i (without any label), unsupervised learning may attempt to cluster these points into sets or clusters that are "well-separated" from each other.

See Section 5.1.3 in <u>Deep Learning</u> for more details about supervised vs unsupervised learning.