Explanatory Notes for 6.390

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Fall 2022

Minimization Notation

Functions min **and** arg min

Our goal in **regression** is to minimize J by adjusting Θ. If we accomplish this, there are two questions we can ask ourselves, and some corresponding **notation**.

To show our point, we'll use the following example:

Example: Take $f(x) = (x-1)^2$. The minimum output is 0, which happens at $x = 1$. So, we have a minimum at $(1, 0)$.

- What is the **minimium** value of J we can find **by adjusting** Θ?

Notation 1

The **min function** gives you the **minimum output** of a function we get by adjusting one chosen **variable**.

$$\min_{\Theta} J(\Theta)$$

The **function we want to minimize** is written to the right, while the **variable we adjust** is written below.

Example:

$$\min_{x} (x-1)^2 = 0 \tag{1}$$

- What **value** of Θ gives us **minimum** J?

Notation 2

The **argmin function** tells you the value of the **input variable** that gives the **minimum output**.

$$\arg\min_{\Theta} J(\Theta)$$

The **function we want to minimize** is written to the right, while the **variable we adjust** is written below.

Example:

$$\arg\min_{x} (x-1)^2 = 1 \tag{2}$$

Why is it called "argmin"? Well, "argument" is used as another word for "input variable". And our argmin function returns the **argument** with the **minimum** output.

Optimal Value Notation

So, we want to know what the best model we want get is, where this model is represented by Θ.

Notation 3

We add a **star** * to indicate the **optimal** variable choice.

If that variable is z^*, you would say it as "z-star".

Example:

$$x^* = 1 \text{ for the above example.} \tag{3}$$

So, if we want optimal Θ, we're looking for:

Key Equation 4

Our **optimal parameter** vector is written as

$$\Theta^* = \arg\min_{\Theta} J(\Theta)$$