

# Tufte TeX.jl Example with Sigmoid

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## 1 Loss Function

In mathematical optimization, statistics, decision theory and machine learning, a *loss function* or *cost function* is a function that maps an event or values of one or more variables onto a real number intuitively representing some “cost” associated with the event.<sup>1</sup> An optimization problem seeks to minimize a loss function. An objective function is either a loss function or its negative (sometimes called a *reward function* or a *utility function*), in which case it is to be maximized.

<sup>1</sup>[https://en.wikipedia.org/wiki/Loss\\_function](https://en.wikipedia.org/wiki/Loss_function)

$$J(\theta) = \frac{1}{m} \sum_{i=1}^m \left[ -y^{(i)} \log(h_{\theta}(x^{(i)})) - (1 - y^{(i)}) \log(1 - h_{\theta}(x^{(i)})) \right] \quad (1)$$

```
function loss_function(theta, X, y)
    m = length(y) # number of training examples
    grad = zeros(size(theta))
    h = sigmoid(X * theta)
    J = 1/m * sum((-y' * log(h)) - (1 .- y)' * log(1 .- h))
    grad = 1/m * (X' * (h - y))
    return (J, grad)
end
```

## 2 Sigmoid

A sigmoid function is a mathematical function having an “S” shape (sigmoid curve). Often, sigmoid function refers to the special case of the logistic function shown in the first figure and defined by the formula.<sup>2</sup>

<sup>2</sup>[https://en.wikipedia.org/wiki/Sigmoid\\_function](https://en.wikipedia.org/wiki/Sigmoid_function)

$$\sigma(t) = \frac{1}{1 + e^{-t}} \quad (2)$$

```
# return is of size/dimensions: zeros(size(t))
sigmoid(t) = 1 / (1 + exp(-t))
```