# Convex Optimization


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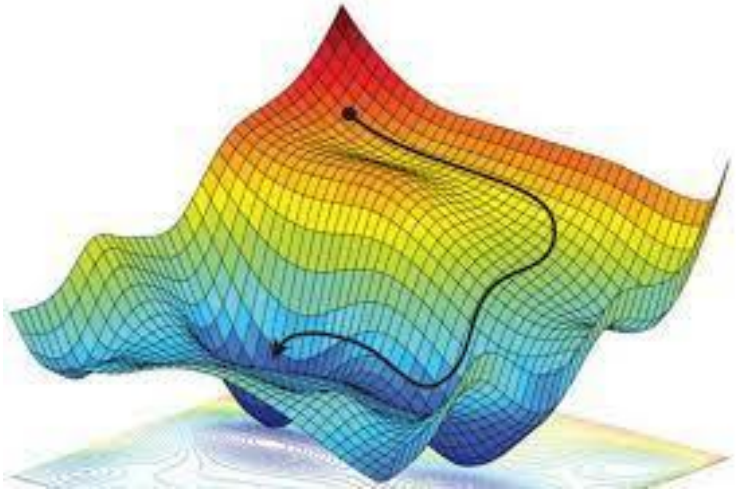
# Overview

The main aim of this tutorial is to learn about Convex Optimization and its applications.



# Motivation

We want to reduce the noise in the huge variation of the location and height of the bounding boxes in the video.

We also want to learn about smoothening curves using convex optimization.

A minor motivation is also learning about cvxpy library and about how and when to use it

# Theory

The cvxpy library of python allows us to find the minimum point in convex functions, which are functions that follow the below eqn.

f(a * x + (1 - a) y) <= a * f(x) + (1 - a) * f(y)

They have only one minima point , and the method for finding it implicitly involves using the Jensen’s inequality.

# Explanation - Curve Smoothening

For removing the noise in the signal, we first have to define noise. It is the variation of the signal as compared to its adjacent values.

So, for removing the noise, we use L1-regularizer, to remove the varying neighbour distribution and also sudden jerks in the signal.

We can do this by using a vectorized method in the optimizing function for the cvxpy problem.

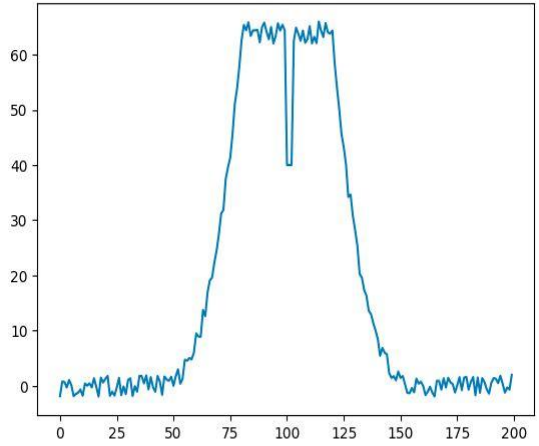
# Explanation - Bounding Boxes

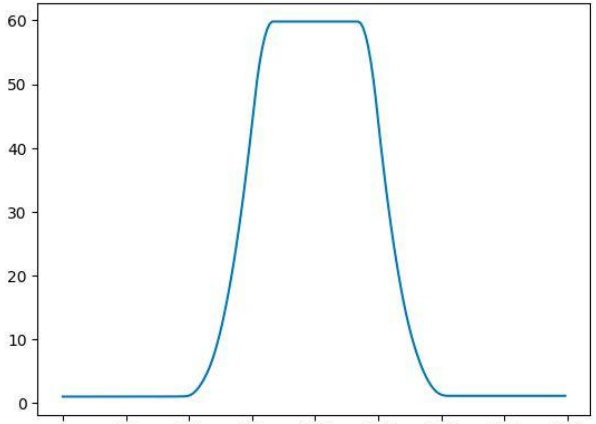
For the bounding box problem, the bounding boxes if generated normally for each frame by a neural network, have a lot of inherent noise in them. To smoothen this out, we smoothen the x,y coordinate of the image and also the height of the bounding box using the previous problem solution.

# VIDEO

# Bonus

Idea of removing Salt and Pepper Noise from an image using smoothening.

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(256, 256)
(12441,)
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# Limitations

We use the cvxpy library of python which allows for implicit optimization in case of continuous convex functions, but does not work entirely for discrete convex optimization. Thus it will not work correctly every time for the knapsack problem.