# Introduction

Urbanmorph is a leading technology and management consulting firm working primarily in the domains of mobility, energy and waste management. It works closely with the government, local community and other stakeholders to create sustainable solutions.

In the field of energy, Urbanmorph is developing complete technology solutions that will enable EV users to gain confidence in the estimations of charge and battery life, hence eliminating the issue of range anxiety. In this context, we are looking for bright and hard-working interns who will work on solving some of the hard technology challenges in the domain of lithium-chemistry batteries and their management.

# An introduction to interpolation techniques

Interpolation refers to the mathematical technique used to estimate values between known data points within a given range. It involves constructing a function or curve that passes through the known data points and using this function to approximate the values at intermediate points.

Various interpolation methods exist, such as linear interpolation, polynomial interpolation, and spline interpolation, each with its own advantages and limitations.

Linear interpolation is a simple method of estimating values between two known data points by assuming a linear relationship between them. In linear interpolation, the straight line connecting the two known points is used to approximate values at intermediate points.

Cubic spline interpolation divides the given data points into intervals or segments, ensuring that each segment is fitted with a cubic polynomial that smoothly connects adjacent data points. Cubic spline interpolation utilises low-degree polynomials in each of the intervals and chooses the polynomial pieces such that they fit smoothly together.

## What you need to do

Write the following functions in a language of your choice:

1. Function that calculates the coefficients of a cubic polynomial for ‘n’ data points. The number of points is variable and should be user-definable.
2. Function that uses the calculated coefficients of a cubic polynomial to interpolate a given input.
3. Main function that contains the test code to exercise the above functions.

# Reference

This document describes the different types of splines and how the equations to solve them are derived. Please note that you have to provide the code for the “Cubic Runout Spline”.

1. [cubicsplineinterpol (1).pdf](https://drive.google.com/file/d/1kX6-8nv0P_P17HkAEO0xcan5YnPW_qPA/view?usp=sharing)

# Input points

The data points for the curve fitting are given in the following shared Google sheet:

[Data points](https://docs.google.com/spreadsheets/d/1D7eYuhiEWSh1wna6uM8HNoW0UpIB4atQgTgx33oXC2c/edit?usp=sharing)

Let the function be f(x). The input points are as follows:

1. When x = 2.04 V, then f(2.04) = 0.0
2. When x = 4.04 V, then f(4.04) = 1.0
3. When x = 3.04 V, then f(3.04) = 0.5

# Expected outputs

You need to provide the following on your github repository:

1. Design document
2. Source code
3. Test code
4. Working code
5. Rules
   1. Do’s
6. Use good programming practices such as appropriate naming of functions and variables, commenting of the code, avoiding the use of goto’s etc.
   1. Dont’s
7. You cannot use library functions to implement the algorithm.
8. You cannot use code from any source on the internet.
9. You cannot use chatGPT or any other AI-based method to generate the code.
10. You cannot use Matlab or any other math software tool to generate the code.
11. Plagiarism in any form will result in immediate disqualification.
12. Submission date

Your github repository should be submitted by **12th March 2024**.