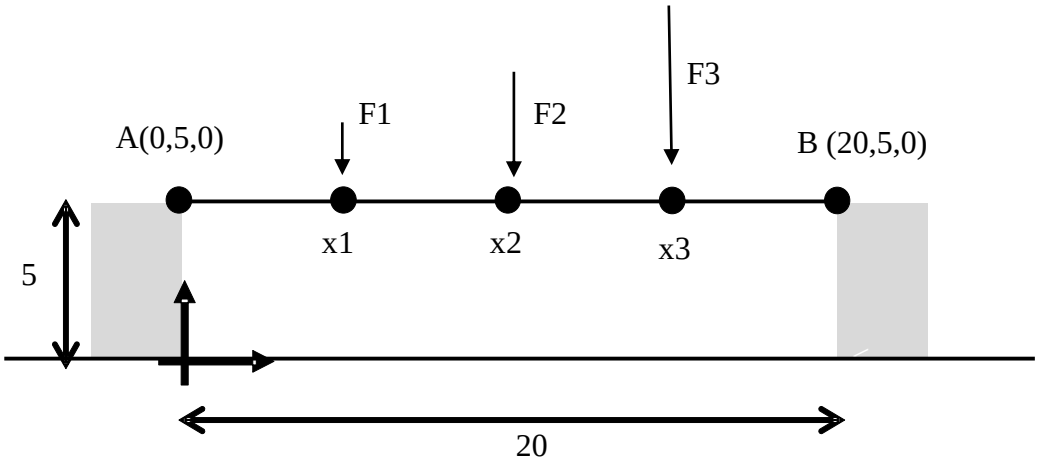
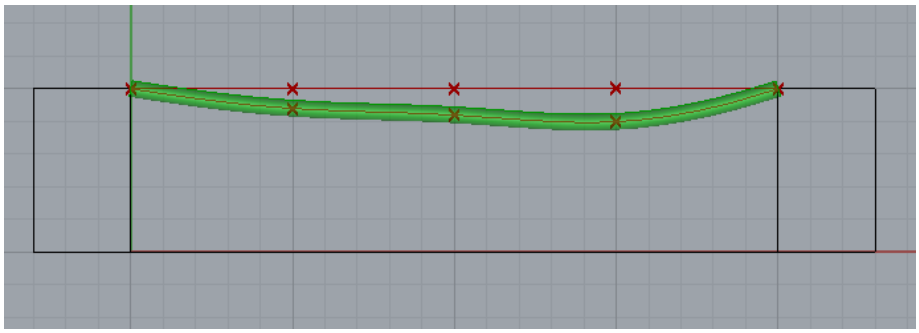
Miniproject 2 - BEAM DISPLACEMENT





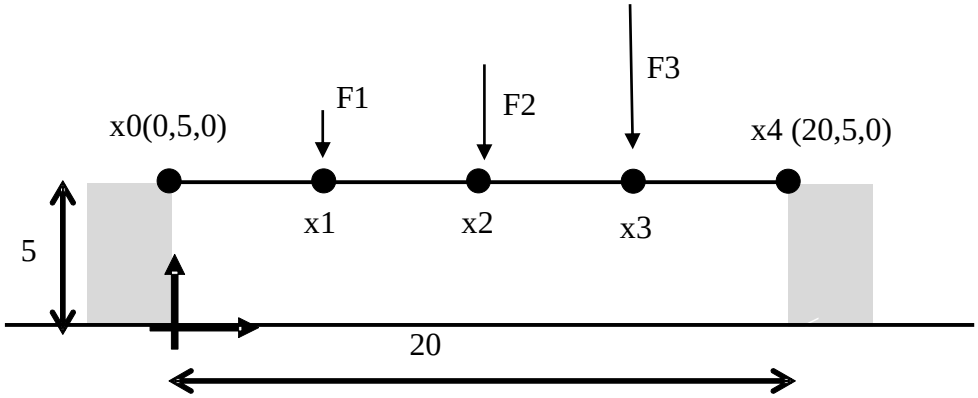
What you will learn

1. Perform matrix multiplication in Grasshopper with the use of “dot product”
2. Edit a curve shape by changing the coordinates values of its intermediate points

List of relevant components used

Vector XYZ
Evaluate curve
Dot Product
Merge
Interpolate Curve

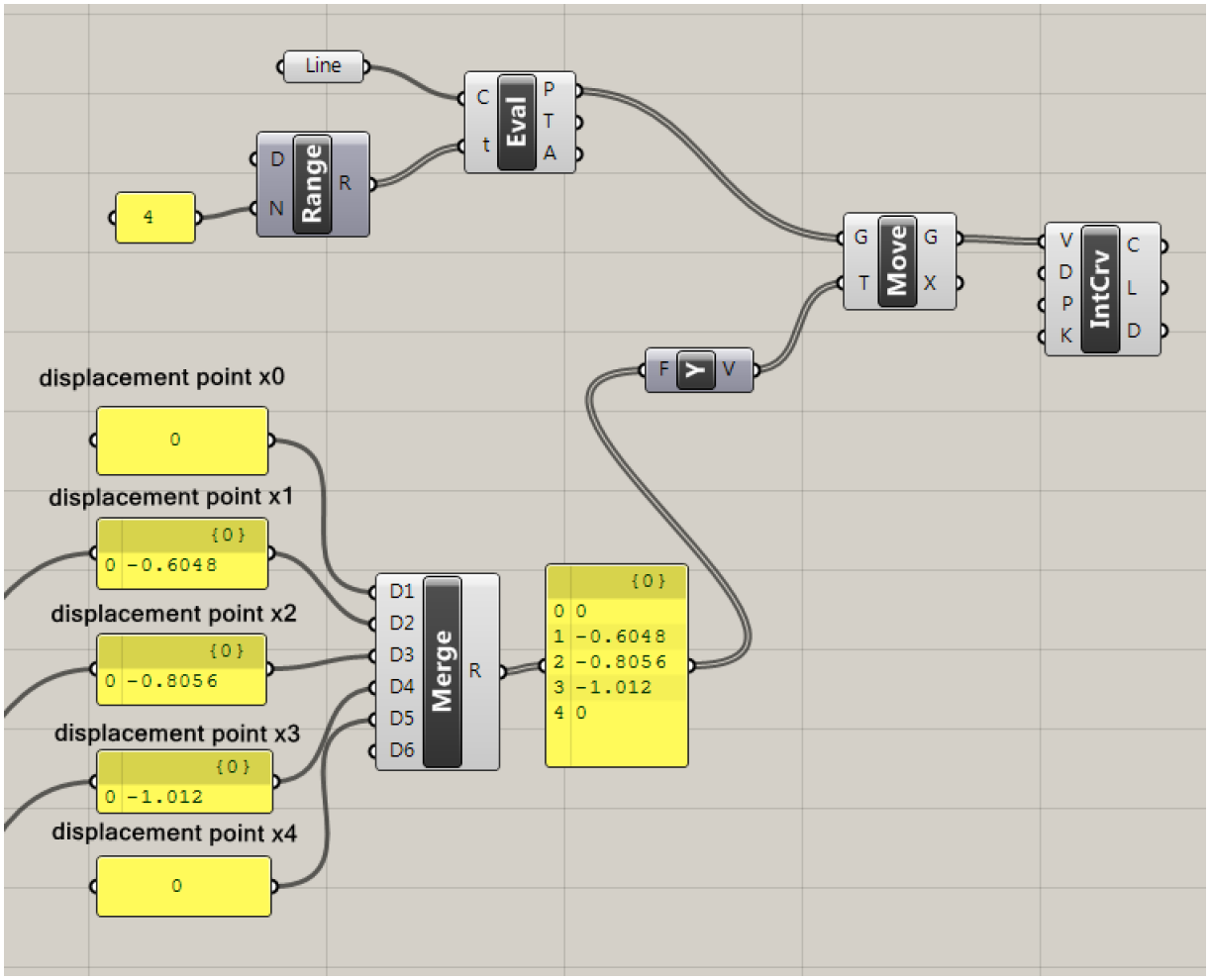
The goal of the exercise is to draw a line representing the beam in its original position and the deflection curve representing the beam subjected to variable loads *F1 F2 F3* at equally spaced points x1 x2 x3.



We start by drawing an horizontal line representing the beam (with a method of your choice).
To create the equally spaced points *x0, x1, x2, x3, x4* we use an **Evaluate curve** component (Curve>Analysis).
Evaluate curve uses a parameter ***t*** so that any point on a curve can be identified with a value of **t** comprised in a domain that ranges from 0 at the start point, to some number representing the end point of the curve. If you select *Reparametrize* (right click on the C input) we reset the domain to be an interval from 0 to 1, where 0 is the start point of the curve, and 1 is the end point of the curve.

To create with the parameter t 5 equally spaced points on the curve (or line, as in this case) we need to create equally spaced values between a numeric domain from 0 to 1 (you can use the **range** component).
To draw the deflection curve we should first calculate the *y* displacement, based on the flexibility matrix *D*, of the points contained in the P output of Eval subjected to variable loads *F1 F2 F3* (defined with three sliders).
Once known, the values of displacement are used to move the points in the new position with

a **move** component. To apply the operation at once we can collect the values of displacement in a **merge** component (sets>tree), use the list of values to create the displacement vectors in the y direction. You can draw the deflection curve using a **Interpolate** component (curve>Spline)



Without any calculation we know that the points x0 and x4 will not move because they are the support points, therefore the y displacement vector will have magnitude=0.

The magnitude of displacement vectors of points *x1*, *x2*, *x3* should be calculated based on the matrix D and the loads *F1*, *F2*, *F3*. You need to perform a matrix multiplication between the flexibility matrix and the vector of loads. The matrix multiplication is not native in grasshopper, therefore you should construct yourself the mechanics of matrix multiplication. **Hint**: the operation can be performed representing the rows of the matrix in grasshopper as vectors, and using the dot product as operator.