

README

Homework 4

November 4, 2022

1 Introduction

In this assignment, we want to compute the forces inside each beam of a truss. We are given data files about the truss and we are applying the joints methods to compute each beam force knowing the external forces applied to each joint.

To do this, I create a system and solve it with the scipy method `spsolve`. To make the program more efficient, the matrix used will be a CSR sparse matrix.

2 Description of the Truss class

2.1 Methods

I defined the `init` method and 5 additional methods that describe one instance of the Truss class.

- `_init_ self, files` : loads the data, plots the truss geometry when an output file is given, creates the system and solves it when possible
- `PlotGeometry self, output_file`: when an output file is given, this method creates a png image of the plot of the truss geometry and saves it in the output file
- `read_ self` data: reads the input data files and creates one array for the beams data and one array for the joints data
- `create_system self` : creates the system $Ax=b$ that we need to solve to find the beam forces. The solution will be a vector containing the beam forces and the projection of the reaction forces for the rigidly supported joints.
- `solve_system self`: solves the system when the geometry is suitable and the matrix is not singular. Raises error otherwise.
- `_repr_ self` : prints the output table with one column for the beams and the other one with the associated beam forces

2.2 Errors raised

There are two cases where the beam forces can't be computed.

- When the number of unknowns is not equal to the number of equations, the system is overdetermined or underdetermined. We can't compute a unique solution to our system. The program raises an error saying that the geometry is not suitable for the joints method analysis.
- When the matrix A obtained is singular. The program will raise an error saying that the truss is probably unstable.