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CME211 HW4

1 Truss class

Truss is a class for computing truss beams forces for a given configuration of joints and beams.

By using the equilibrium equations, we form a linear system and obtain the necessary unknowns, i.e.

$$\sum_{j \in N(i)} B_j \cos(theta_j) + R_i^1 \mathbf{1}(i \text{ rigid}) = F_i^1,$$
$$\sum_{j \in N(i)} B_j \sin(theta_j) + R_i^2 \mathbf{1}(i \text{ rigid}) = F_i^2.$$

```
def compute_forces(self)
```

computes the beam forces and support forces by forming a sparse linear system. Populates `self.beam_forces` variable. We use CSR format for the sparse matrix, and use `A = csr_matrix((vals, col_idx, row_idx), shape=(2*njoints, nbeam+2*nR))` to solve the sparse system from `scipy`.

```
def read_data(self, fjoints, fbeam)
```

Reads data from joints file and beam file. Returns the output lists of tuples. Joints and beams start from 1 and continue to increase consecutively; and list of neighboring joints

```
        joints_list[i] = (xi, yi, Fix, Fiy, Ri!=0)
        beams_list[k] = (i,j)
        connections[i] = [(k,j)]
```

```
def get_angle(self, x1, x2)
```

Returns the angle of inclination of the beam. Used to make the beam force parallel to the beam.

```
def PlotGeometry(self)
```

Plot joints and beams and stores them into a file.