CME 211 Homework 4

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An Truss object is fully declared by the joints file and the beams file of the given pathnames with abstraction.

It has 12 attributes: joint_ids, joint_coords, joint_fxys, joint_zerodisps, n_joints, n_zerodisps, beam_ids, beam_joints, joints_beams_other, n_beams, matrix, and forces. It has 7 methods: __init__(joints_file, beams_file), handle_joints(joints_file), handle_beams(beams_file), generate_matrix(), calculate_forces(), PlotGeometry(plot_file), and __repr__().

Each method has its own task of assignments to attributes, and its implementation will not affect other methods, which includes decomposition and encapsulation:

1. __init__(joints_file, beams_file): The initialization method will call other methods except PlotGeometry(plot_file), and __repr__(). All attributes will be assigned during this execution.

2. handle_joints(joints_file): There are 6 attributes being assigned in this method: joint_ids, joint_coords, joint_fxys, joint_zerodisps, n_joints, n_zerodisps, where joint_ids and joint_zerodisps are lists, and joint_coords and joint_fxys are dicts. Data in the file of the given path will be parsed and stored into these data structures.

3. handle_beams(beams_file): There are 4 attributes being assigned in this method: beam_ids, beam_joints, joints_beams_other, n_beams, where beam_ids is a list, and beam_joints and joints_beams_other are dicts. Similarly, data in the file of the given path will be parsed and stored into these data structures.

4. generate_matrix(): Only matrix attribute is assigned in this method, which is generated in CSR format from the attributes mentioned above. The value and positions of each elem in the matrix can be calculated from the attributes above. If the generated matrix is not square, the program will raise a runtime error since the matrix equation is not valid.

5. calculate_forces(): Only forces attribute is assigned in this method, which is a numpy array of the beam forces result in order. The vector of the right hand side of the matrix equation is generated from the attributes above. Thus we can now try to solve the matrix equation by the matrix and the vector. If

the equation is singular, a runtime error is raised, otherwise the forces can be generated by slicing the solution.

6. PlotGeometry(plot_file): A figure of the beam geometry can be generated by beam_joints attribute, and it is saved to the given pathname.

7. __repr__(): The return representation string is generated by the forces attribute mentioned above.