

1. Project title
3D elastostatics FEM simulation and data analysis with machine learning
2. What is the specific question that you are proposing to answer?
* I will work with Almo. We will separate job and do presentation individually. We would only share the result.
 - 1) Design\upgrade 3D FEM simulation algorithm
First, I want to build simple version of 3D FEM model through Python. Its solution must be same with commercial software such as ANSYS or Abaqus. Currently, my FEM code only works for homogeneous material cube. I want to upgrade it to work for composite material. In addition, displacement vector is only result for current version. So, I will upgrade it to show stress and strain vectors as I learn it at class. Result will be displayed by matplotlib and Paraview (VTK file).
 - 2) Machine learning algorithm
I will do my best to finish making 3D FEM algorithm code as soon as possible. Since I already have it, I expect I can quickly upgrade it. Based on FEM algorithm, I will try to generate deformation/stress data for train and test purpose. And I might use convolutional neural network to train algorithm. For example, if an input is deformation values, then output would be stress values. Finally, results between simulation and machine learning will be compared.
 - 3) Alternative plan
If proposed plan would be failed later due to difficulty or etc., I will try to make algorithm for nonlinear elastic and damage model for 3D case, after learning lecture.
3. Conditions
 - 1) Geometry
Geometry will be simple cube (2 by 2 by 2 inches).
 - 2) Boundary conditions
Dirichlet boundary condition (displacement) will be applied one surface where all deformations will be defined as zero ($u_x = u_y = u_z = 0$). Neumann boundary condition (force) will be applied the other side surface. So, it would be Cantilever.
 - 3) Applied load
It will be simple uniform distributed load.
 - 4) Material
I will be looking for specific material such as steel, aluminum, etc. to decide Young's modulus and poisson ratio.
 - 5) Machine learning algorithm
I mentioned at section 2 I will use convolutional neural network. But I will keep looking for good method for FEM algorithm. And try to use two machine learning method to analyze data.