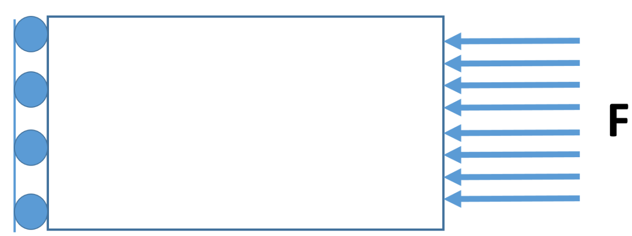
- Type of meshing

1. cantilever beam - 20x5
2. Bar structure  - 10x10
3. Thermal problem - 10x10

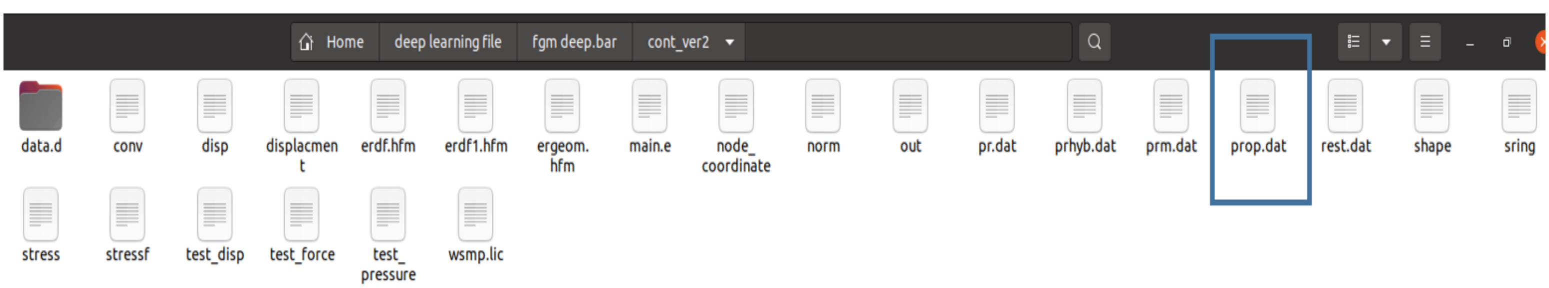

Cantilever Beam


Thermal Problem

Bar Problem

So in order to run the FEM structural/FEM analysis, we need to provide the material properties of each cell (element). The properties can be provided to the analysis code through the file "\deep learning file\fgm deep (bar, cantilever beam, thermal)\cont_ver2\Prop.dat. "




This file will be different for all the iterations and must be replaced every time the code runs.

(write python code for generating this file)

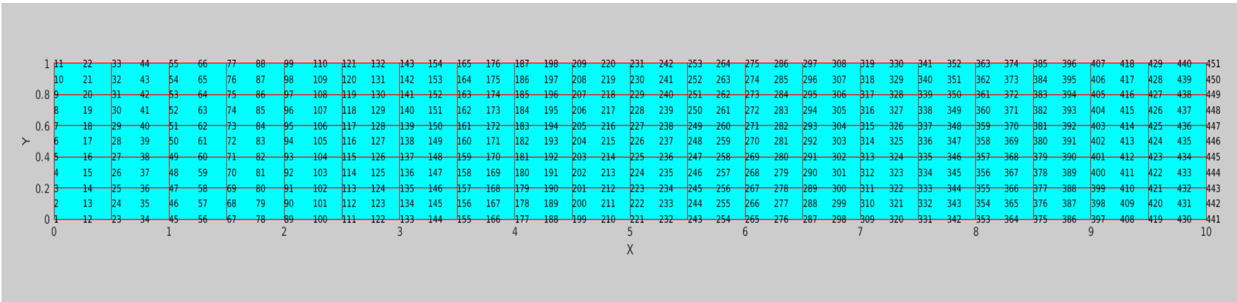
File for variation of properties- Prop.dat

| | | | | | | |
|---|---|---|---|---|---|---|
| *E5/K5* | *E10/K10* | | | | | |
| *E4/K4* | *E9/K9* | | | | | |
| *E3/K3* | *E8/K8* | | | | | |
| *E2/K2* | *E7/K7* | | | | | |
| *E1/K1* | *E6/K6* | …. | | | | |

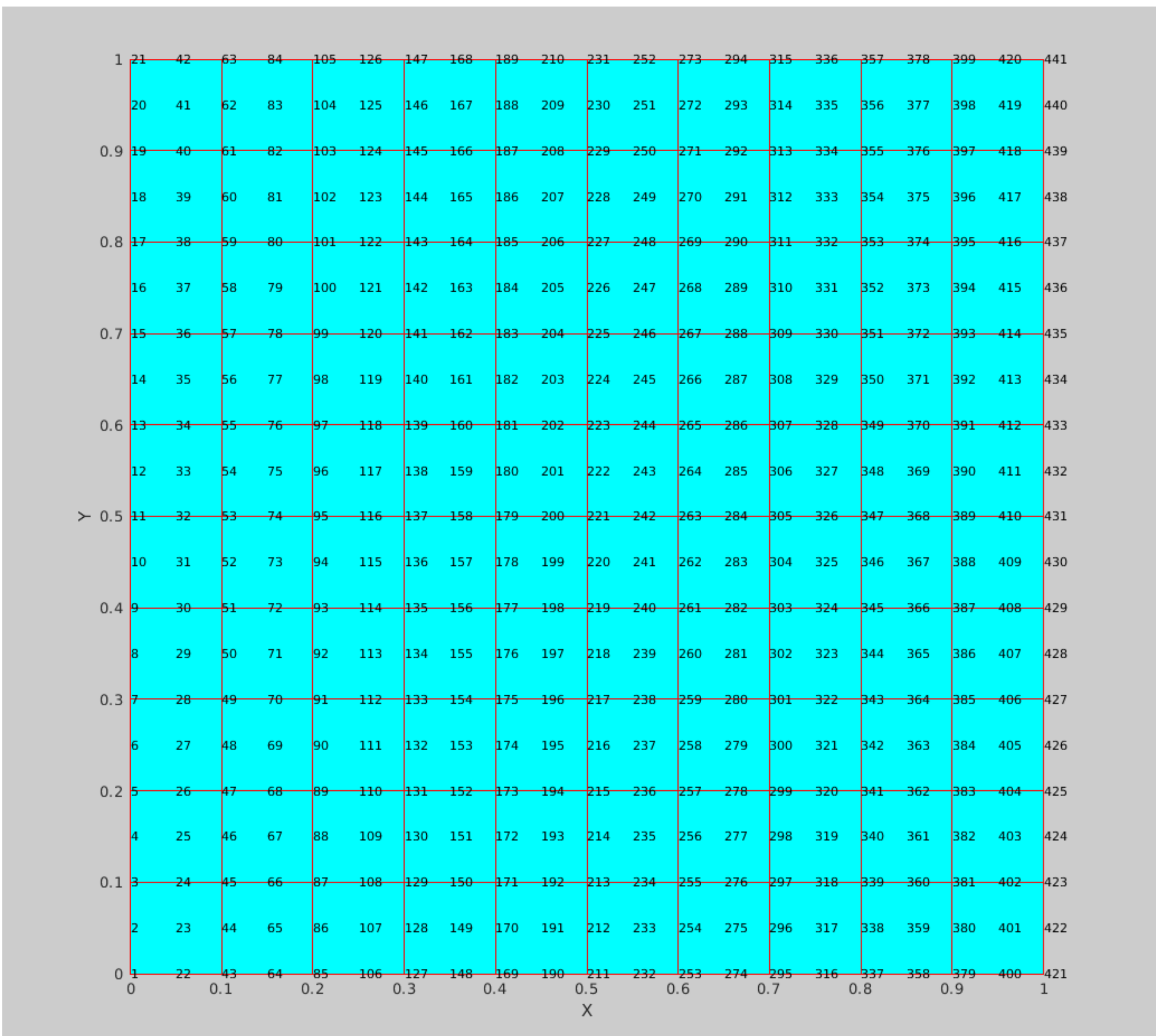
*E*: Elastic modulus (applicable for structural problems)
K: Conductivity (applicable for thermal problems)

```
           1          101          Types of material , number of constant needed to define that material(100 elastic modulus , 1 poisson ratio
   7.00000010E+10                  E1
   7.00000010E+10                  E2
   7.00000010E+10                  E3
   7.00000010E+10                  E4
   7.00000010E+10       .          .
   7.00000010E+10       .          .
   7.00000010E+10       .          .
   7.00000010E+10       .          .
   7.00000010E+10       .          .
   7.00000010E+10       .          .
   7.10000003E+10
   7.00000010E+10
   7.00000010E+10
   7.00000010E+10
   7.00000010E+10

   7.00000010E+10
   7.10000003E+10                  E98
   7.00000010E+10                  E99
   7.00000010E+10                  E100
  0.30000000                       Poisson ratio
           0           0           0           0           0           0           0

           0           0           0           0           0           0
```

- Node number for the cantilever beam:




- Node number for the bar structure and thermal problem:



- Open the terminal in that folder and
  Run this code - "./main.e > shape"

```
numeric@numeric-OptiPlex-5090:~/deep learning file/fgm deep (thermal)/cont_ver2$ ./main.e > shape
 ************************************************************************

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not set. This may adversely affect the performance of WSMP
Please refer to WSMP documentation for more details.
 ************************************************************************
```
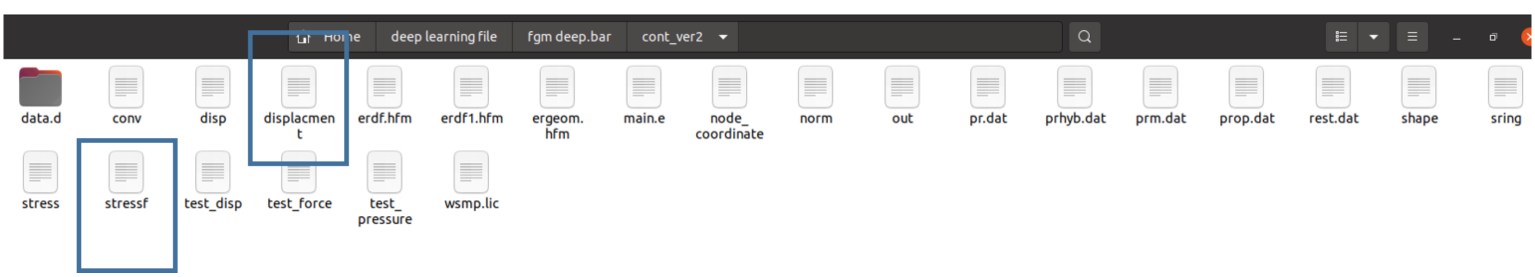
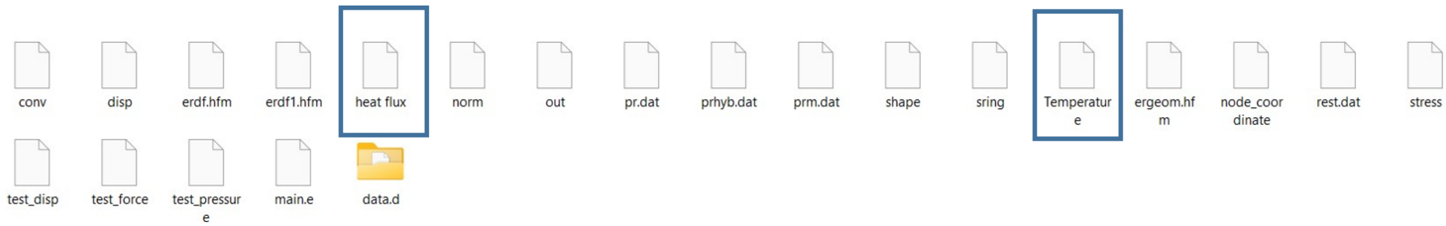

- Output files-

You'll find these files in the same folder as prop.dat

1. For cantilever beam and bar structure problem - displacement and stressf



2. For thermal problems - temperature and heat flux.




You can check these papers for reference for applying neural networks to physical systems.

1. This paper is quite elementary in nature, here they have used to predict the truss deformation for a truss having 10 members. The input data is the area of the member while the out is the deformation at the certain point.
   https://link.springer.com/article/10.1007/s11831-017-9237-0

2. This is kind of  the extension of the first paper, where the deep learning framework is integrated with the genetic algorithm to optimize the truss architecture.
   https://www.sciencedirect.com/science/article/pii/S2210650222000906