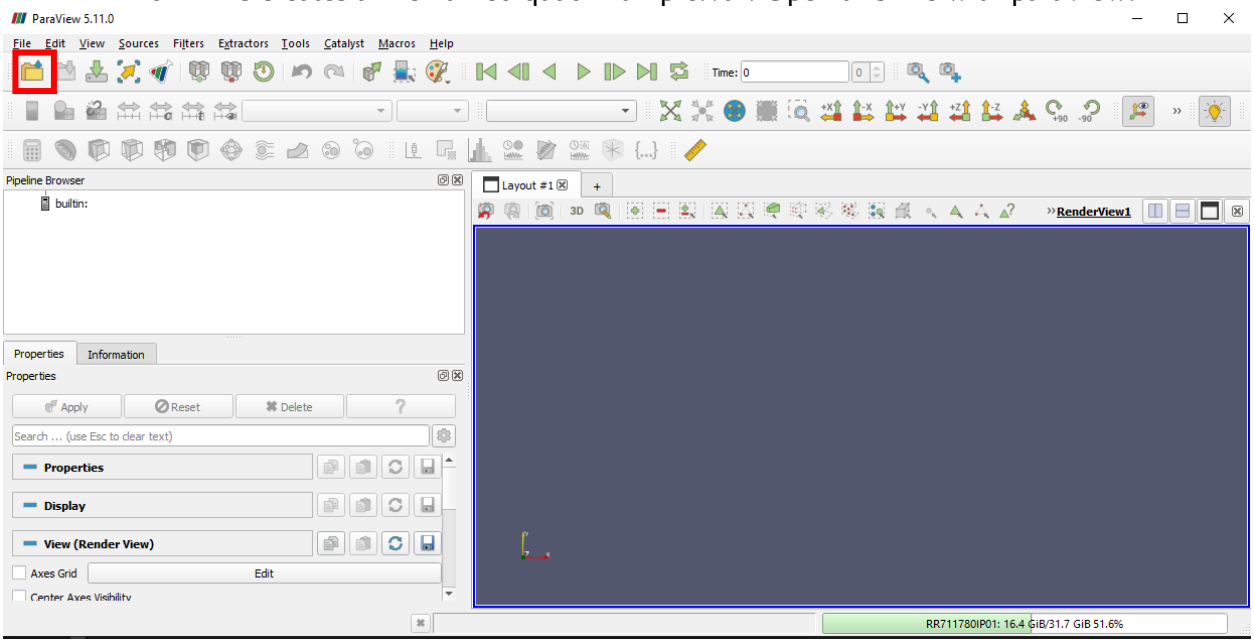
Homework 13
ME 5773 High Performance Computing Due: 05/02/2024 11:59pm

This assignment corresponds to homework 13. This is a team assignment, with the teams assigned by the instructors as posted on Canvas. The deliverable for these assignments is an email to the instructors notifying the completion of the assignment. This assignment consists of two parts. The activities of this assignment should be put in the Teams github repository, within a folder named "assignment13". This assignment will be evaluated using the most updated version of the repository **by the due date**.

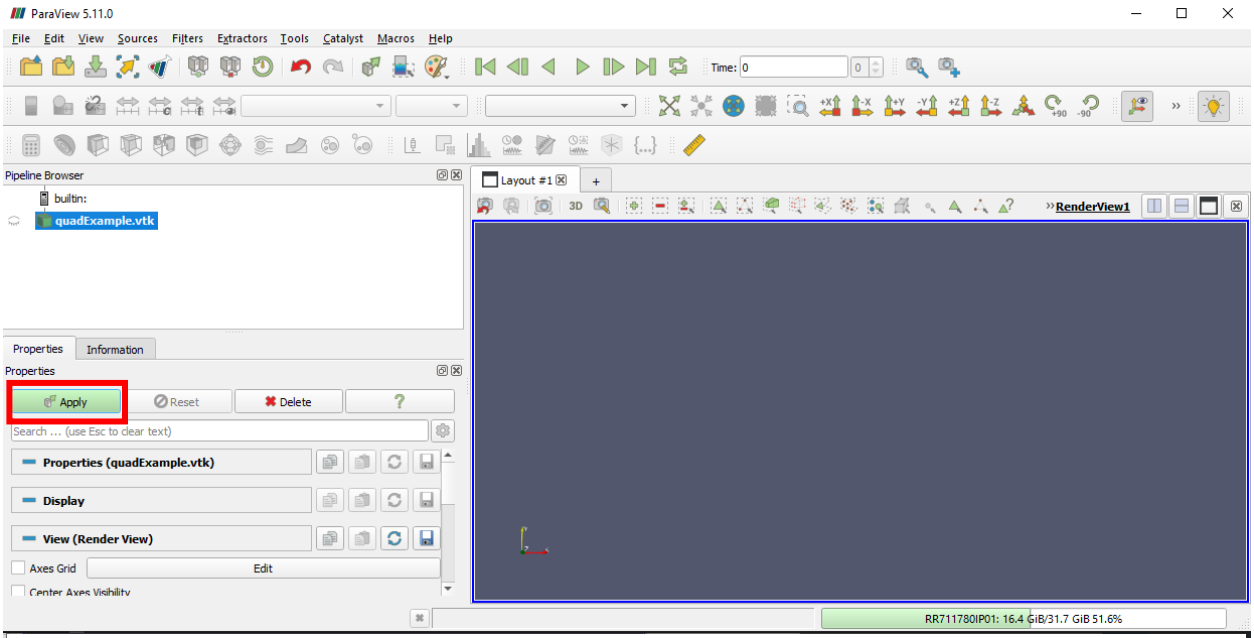
1. Creating an Unstructured Grid with PyVista and visualization using Paraview

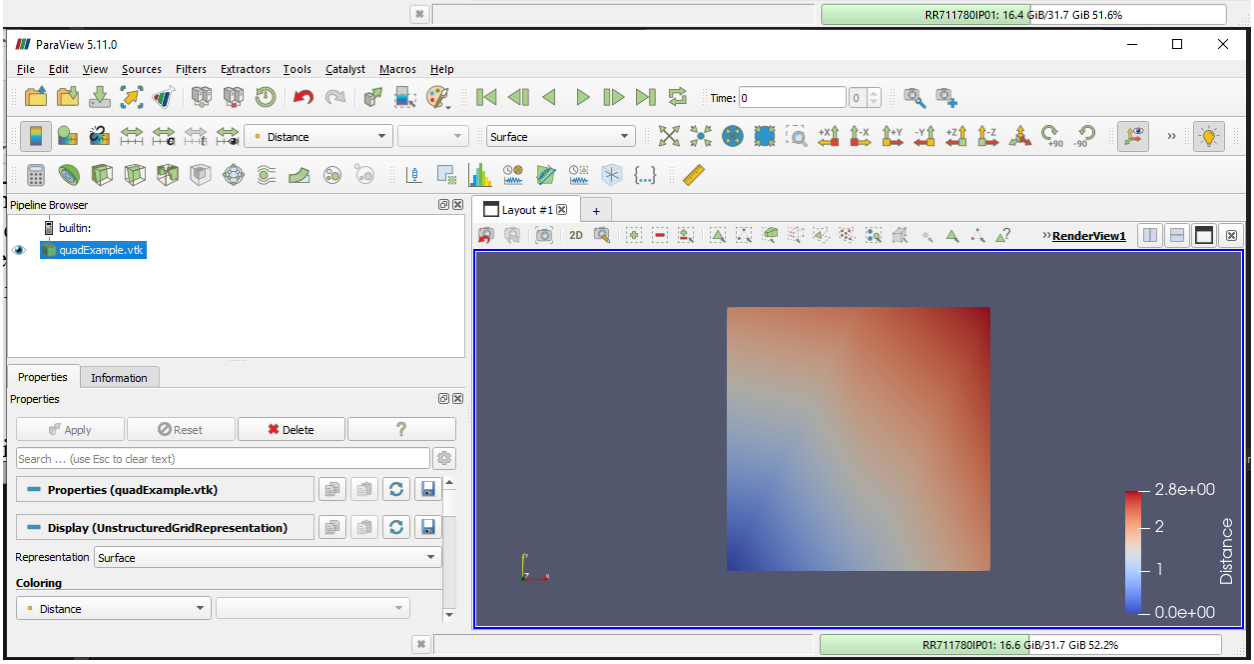
The goal of the first part of the homework is to create an unstructured grid object using pyvista and export it into a VTK file to be visualized with Paraview. For this, create a folder named `assignment13/part1` in your repository, and copy the file `/work/ME5773/hw13/quad_example.py`

- It is recommended that you install Paraview in your local PC. Otherwise, you may login to Arc via Portal and create a **virtual desktop**. After this, you may load the Paraview module from a terminal window. A session on a gpu node can be used (you will need to load cuda/toolkit to load the drivers). However, it is not required. You can also select another compute node.
- Load `anaconda3` and activate your `hpc` environment.
- Make sure you have pyvista installed, using `pip install pyvista[all]`
- Open and read the file quad_example.py. Execute using `ipython quad_example.py`
    - This creates a file named quadExample.vtk. Open this file with paraview.

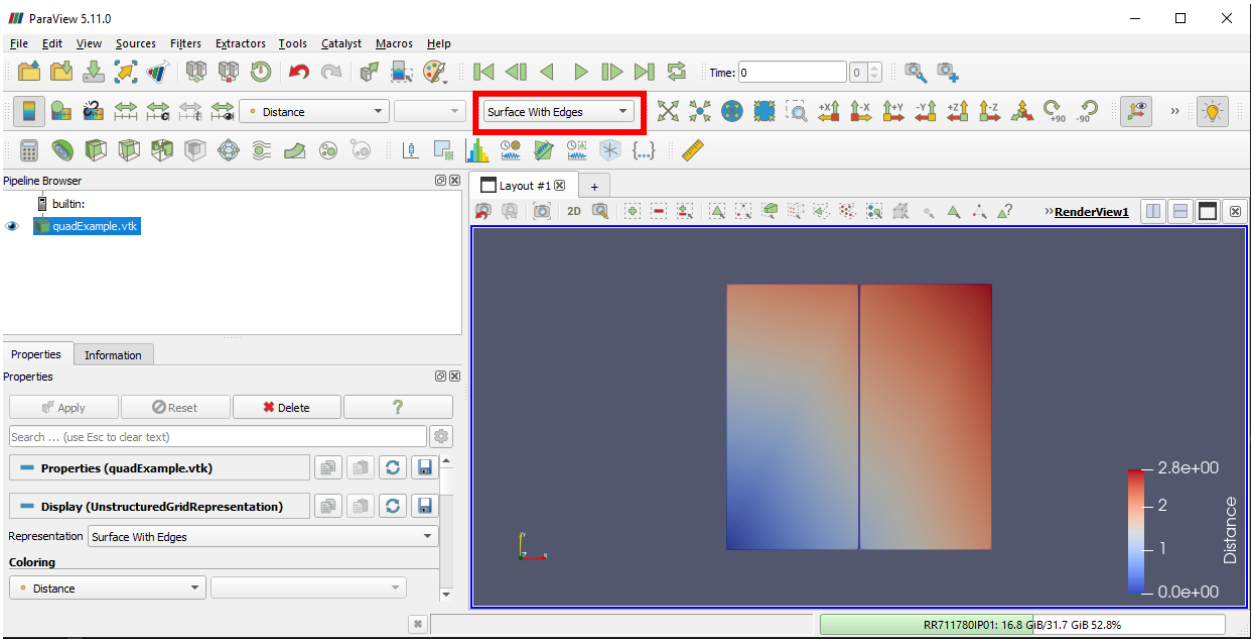


    - Then click apply

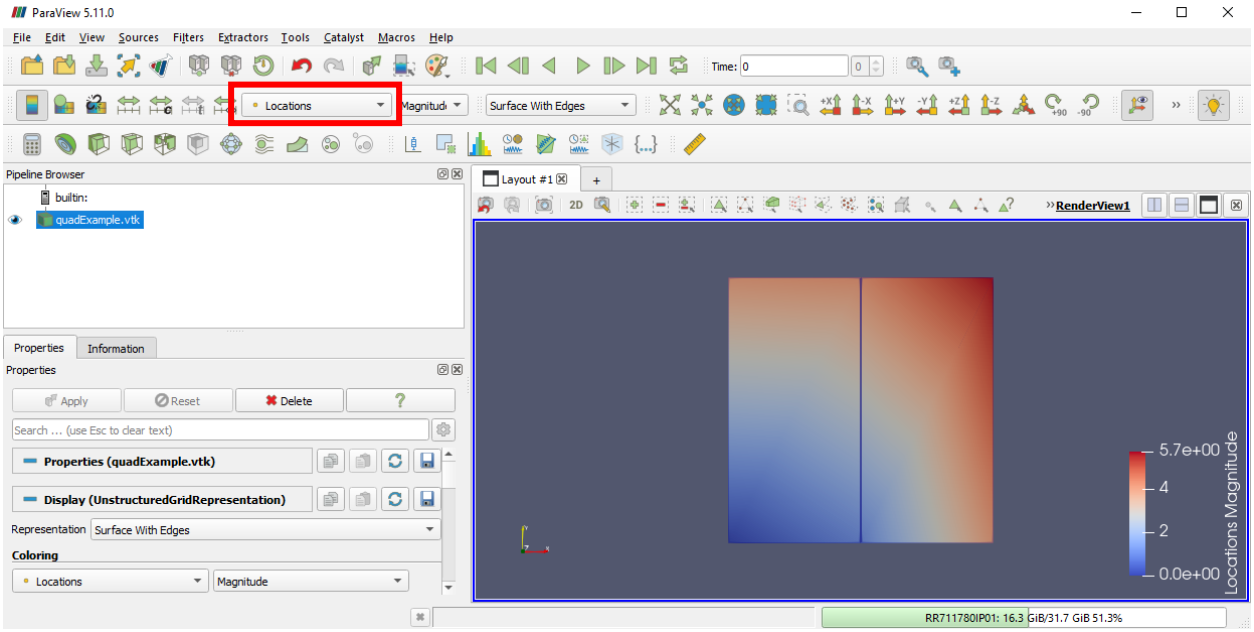




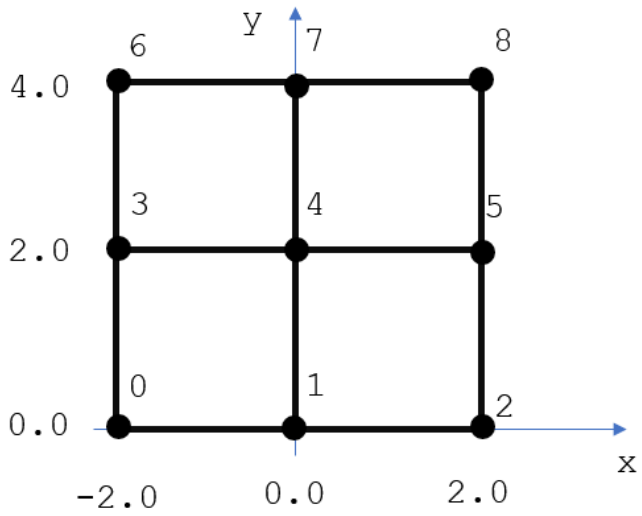
- This quadExample.vtk file has two fields: **Distance** (scalar field, default visualization) and **Locations** (vector field).
- Change the visualization to surface with edges, in order to visualize the elements.



- In order to visualize the **Locations** vector field, select the field from the drop down menu. You can select the visualization by magnitude, or by components, using the drop down menu next to the selected "Locations" field.



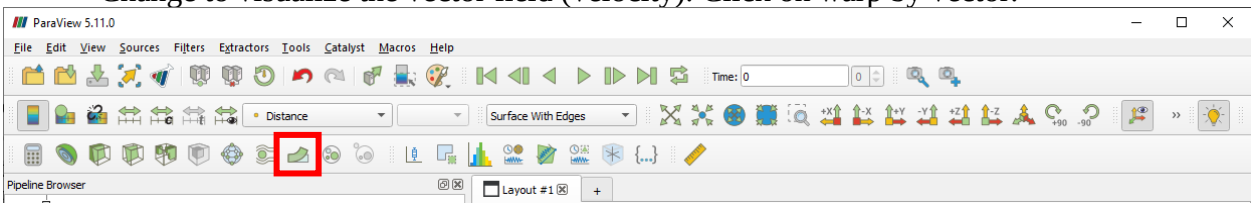
- Your task is to copy the file `quad_example.py` into a file named `main_program.py`.
- Modify the point location information such that you define 9 vertices according to the following figure:



- Define 4 quad cell elements as in the figure, and define a correct cell_type array.
- Create the Unstructured Grid from the cell, cell_type and points arrays.
- Define a scalar field named "dcenter", using the to the center point location, point (0,2).
- Define a vector field named "velocity", such that for a point $\mathbf{p}_i = (x_i, y_i, z_i)$ in the domain, the components are defined as follows

$$\mathbf{v}(\mathbf{p}_i) = [\, y_i, -x_i, 0]$$

  - For instance, for point 8 that has coordinates $\mathbf{p}_8 = (2,4,0)$, its corresponding vector field components are $\mathbf{v}(\mathbf{p}_8) = [\, 4, -2, 0]$.
- Execute the file and save into vtk format.
- Open in Paraview. Set the view to surface with edges, and to display the scalar field (dcenter). Take a screenshot of the window, and paste it in a document.
- Change to visualize the vector field (velocity). Click on warp by vector.



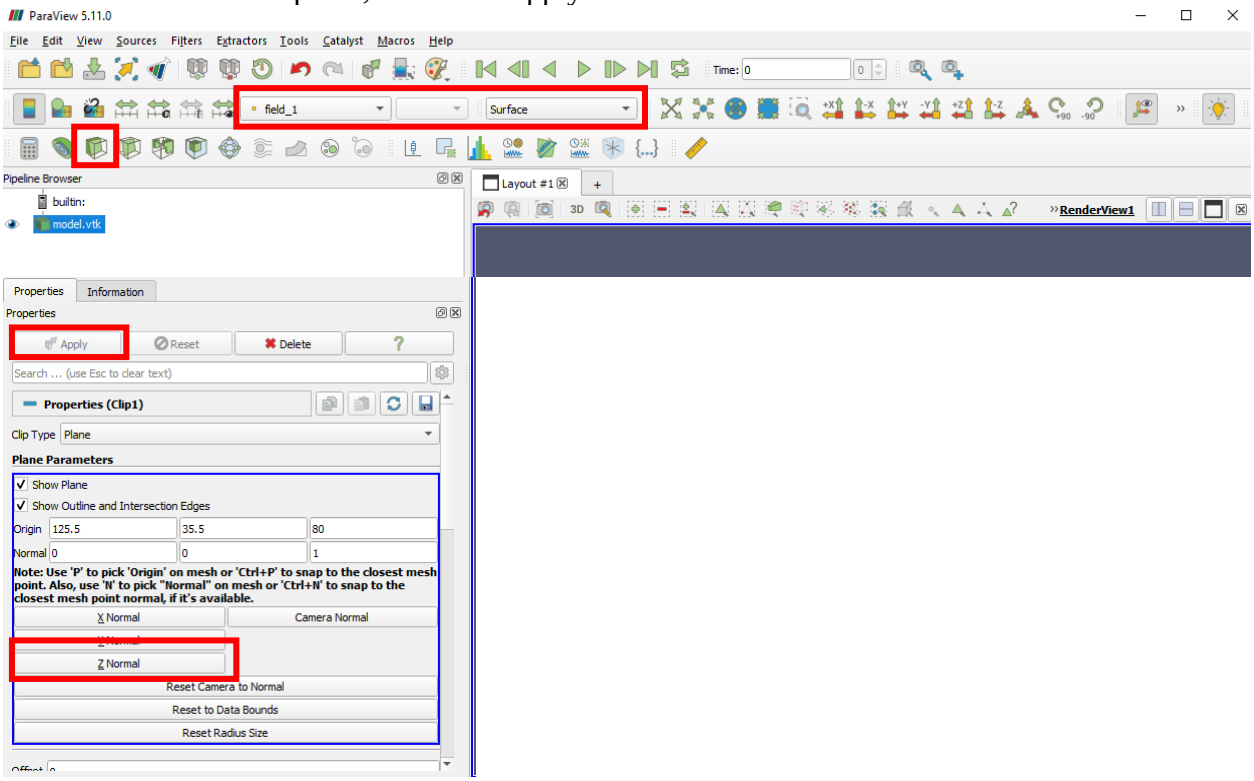
- Define a scale factor of 0.5 in the properties section on the bottom left corner of the window. Click apply. Take a screenshot and add it to the document.
- Update your repository.

2. Visualization using Paraview - Slice.

Copy the file /work/ME5773/hw13/model.vtk into a folder named assignment13/part2 in your repository. Open it in Paraview.

- Click to visualize the field_1 component as surface (without edges).
- Create a clip view of the model.

- In the properties section (lower left corner of the window), scroll and select the Z-normal plane, then click apply.



- Take a screenshot and add it to the document.
- Update your repository.