*Assigned*: *2-14-2024*
Due Date: ***2-28-2024 by Noon***

# CS 6635/5635 Spring Semester 2024

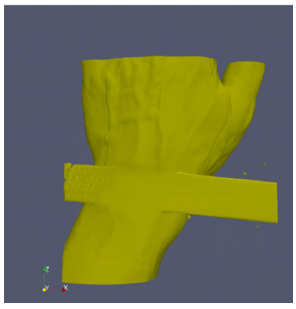
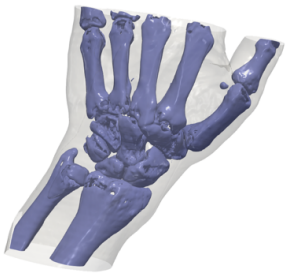
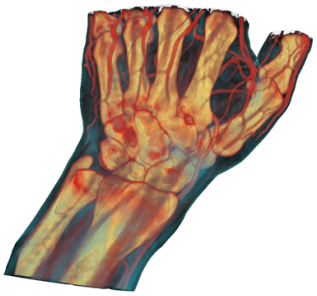
## *Assignment 3 (Volume Visualization)*

⚠ This is a challenging assignment. Please start early and DO NOT wait until the last minute!

Datasets for this assignment: https://my.eng.utah.edu/~cs6635/Assignment3-Data

**1)** Download the hand16.mhd and hand16.mhd.raw datasets from the class website and load hand16.mhd using Paraview **[20 pts]**

- Try to recreate each of the following three images by manipulating the 1D transfer function settings and submit images of your results. You may also change the shading and colormap settings in Paraview.

You should submit three images:

a) Skin
b) Bone and transparent skin
c) Bones, blood vessels, and transparent skin

**2)** Recreate the above images using a 2D transfer function. **[20 pts]**
**Hint: Increase the number of bins to 100 and use different colors for each selection (also reduce the color transparency).**
Which one took longer to use? Was either one more intuitive? Discuss the pros and cons of 1D and 2D transfer functions.

**3)** Download the present.mhd and present.mhd.raw datasets from the class website and load present.mhd into Paraview to visualize it. (The size of this file is about 250 MB. Watch out if you are on mobile data!) **[20 pts]**

- Use volume rendering to visualize the data and find out what is in the "present".
- Try to identify as many objects as you can. State what you believe the objects to be and submit images showing the objects.
- What techniques and/or special settings did you use to identify the objects?

**4)** Visualization of Multiresolution data: **[20 pts]**

- Download two copies of the Stag beetle dataset from the TU Wien website, one at resolution 832x832x494 and the other at 208x208x123 from: https://www.cg.tuwien.ac.at/research/publications/2005/dataset-stagbeetle/

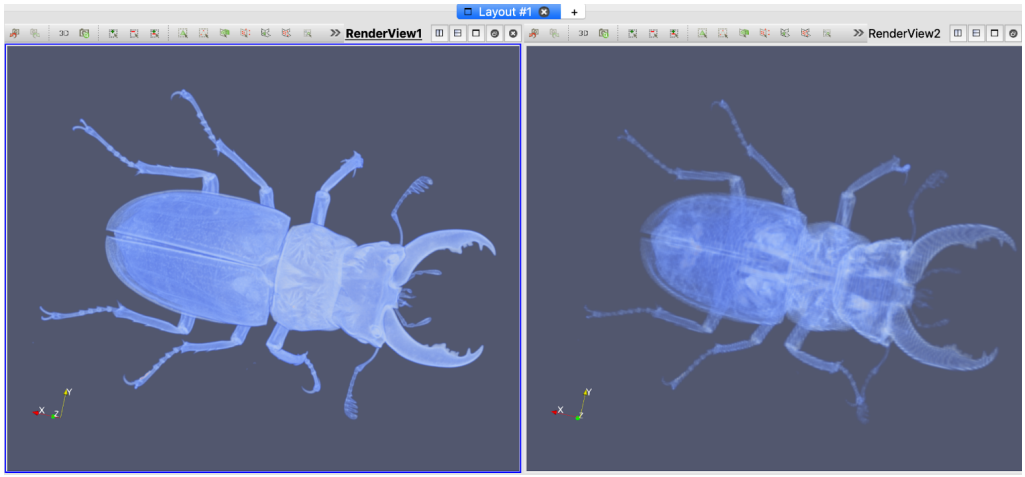
- Convert data files in `DAT` format to `RAW` format using Python or MATLAB.
  - Here is information about the DAT format: https://www.cg.tuwien.ac.at/research/vis/datasets/
  - For the purposes of this homework, the numeric type that you should use when creating the `RAW` file is `unsigned short`. We're assuming that you are using an x86 processor to do your homework, so your bytes should be in Little Endian order[1].

- Load `RAW` data in ParaView
  - Use ImageFile reader to load `RAW` data
  - Set *Data Scalar Type* to *unsigned short, Data Byte Order* to *LittleEndian*, and *Data Extent* to the dimensions of the data.

  ℹ️ Note that *Data Extent* starts counting from zero, therefore if your volume is 832x832x494, the *Data Extent* should be the range (0,0,0) to (83**1**,83**1**,49**3**).

- Do volume renderings for resolutions 832x832x494 and 208x208x123 in separate render views by using the same transfer function to create an image similar to below:
- What differences do you see in the volume renderings for the two images? Make comments on both performance and the quality of the visualizations.

[1] https://levelup.gitconnected.com/little-endian-vs-big-endian-eb2a2c3a9135




832X832X494 208X208X123

**5)** Required for CS 6635 students. Download the "unknown" data `data.zip` from the class website, visualize with Paraview, and note your observations through visualizations. Be sure to describe what you see in the data sets and the relationship between them all. **[20 pts]**

This is a real research data set from a large-scale simulation. The data you find in the `ZIP` archive is raw data. Load it in using Paraview and select Image Reader. Set the properties to dimensions 256x256x128 with type unsigned char. Submit images and describe what you see.

**What to turn in:**

Write a **report documenting your results**, including any necessary plots/figures, and answering any questions asked above. Be sure to explain any figures you submit and to write a **conclusion** at the end of your report. Your homework is primarily graded upon your report. Please submit your report on Canvas in PDF format. Please also submit your code/.pvsm files as compressed zip files.

- Your report should be in PDF format and should stand on its own.
- It should describe the methods used.
- It should explain your results and contain figures.
- It should also answer any questions asked above.
- It should cite any sources used for information, including source code.

**Note: Any figures/plots in the report should be captioned appropriately. Also be sure to include axis labels in all plots.**

This homework assignment is due on **February 28, 2024 by 11:59 am**. If you don't understand these directions or have questions, please send questions to teach-cs6635@sci.utah.edu or come see one of the TAs or the instructor during office hours **well in advance of the due date.**