3D Spatial Data

For this assignment you will explore the volume rendering capabilities of `VTK` to produce direct volume renderings of the head of a mummy. We are providing you with three different resolutions of this dataset:
mummy.50.vtk, mummy.80.vtk, mummy.128.vtk

Color Compositing Transfer Functions

Probably the hardest part of this project is coming up with a transfer function which generates a meaningful visualization. Experiment with different transfer functions (both types: the function for opacity, and the function for color), until you have a clear understanding of what the transfer functions do, and what kind of images they can produce.
1. Use volume rendering to make an image which makes the skin surface semi-transparent and which makes the bone surface white and opaque.
2. Make a similar image using **isosurfacing**. Submit images from both rendering methods.
3. Describe your transfer functions. What relationship do they have to the isovalues shown in your isosurface rendering?
4. Do you think volume rendering the mummy dataset offers a clear advantage over isosurfacing? Explain why or why not.

Maximum Intensity Projection Renderings

There is a simpler way of generating an image with volume ray-casting: maximum intensity projection, or MIP. Use `VTK` to produce MIP renderings of the mummy datasets. Your MIP renderings should be gray-scale only, looking something like this:

Generate a MIP rendering and a compositing-based volume rendering of one of the mummy datasets, using approximately the same camera position, and save (and submit) these two images. Compare the two images. What are some advantages and disadvantages of MIP versus compositing-based volume rendering?

Assignment for cs6630 students — Choose *one* of the following. (extra credit for 5630 students)

Direct volume rendering is a very flexible process: there are many parameters (in addition to the transfer function) which will effect the final image. In these two options you explore three parameters: sample distance spacing, interpolation type, and dataset resolution.

1. **Sample distance (the space between samples) along the rays.** The *vtkVolumeRayCastMapper* has a *SetSampleDistance* method. What is the relationship between image quality, rendering time, and sample distance? Give an example of a feature in the dataset which can be lost by increasing the sample distance too much. Is there a sample distance that seems 'small enough', so that smaller distances offer no clear advantage?

2. **Interpolation method and data resolution.** We talked about nearest neighbor and trilinear interpolation in class; `VTK` lets you choose either one with methods in the *vtkVolumeProperty* class. Describe and demonstrate the differences between the two different interpolation methods. Experiment with different resolutions of the data. How does increasing the dataset resolution change the difference between the two interpolation methods?

If you are generating images to demonstrate the difference between two parameter settings, do not change the camera position. This is important because it enables very careful comparison of the two different images. Also, you will not be able to convincingly demonstrate the differences between parameter settings

if the entire volume occupies only a small part of the rendered image: you should zoom into some feature of interest which shows off the result of the parameter setting.