CS677A - Project details

1. Image reconstruction in python
   Image reconstruction techniques are used to create 2-D and 3-D images from sets of 1-D projections.
2. Image reconstruction using Singular Value decomposition(SVD) in python
   Singular Value Decomposition aka SVD is one of many matrix decomposition Technique that decomposes a matrix into 3 sub-matrices namely U, S, V where U is the left eigenvector, S is a diagonal matrix of singular values and V is called the right eigenvector.
   We can reconstruct SVD of an image by using **linalg.svd()** method of NumPy module.

Syntax:

linalg.svd(matrix, full_matrices=True, compute_uv=True, hermitian=False)

Parameters:

1. **matrix :** A real or complex matrix of size > 2.
2. **full_matrices:** If True the size of u and v matrices are m x n , if False then the shape of u and v matrices are m x k , where k is non-zero values only.
3. **compute_uv:** Takes in boolean value to compute u and v matrices along with s matrix.
4. **hermitian:** By default matrix is assumed to be Hermitian if it contains real-values, this is used internally for efficiently computing the singular values.

https://www.geeksforgeeks.org/image-reconstruction-using-singular-value-decomposition-svd-in-python/

https://stackabuse.com/autoencoders-for-image-reconstruction-in-python-and-keras/

https://github.com/js3611/Deep-MRI-Reconstruction

https://kitware.github.io/paraview-docs/latest/python/index.html

Linear interpolation
A naive way of reconstructing the whole data would be to perform nearest neighbor interpolation using the sampled point set.
higher-order interpolations can also be used to increase the quality of the reconstruction further.

Using scipy.interpolate.interp1d

Similarly, we can achieve linear interpolation using a scipy library function called **interpolate.interp1d.**

Syntax : scipy.interpolate.interp1d(x, y, kind='linear', axis=- 1, copy=True, bounds_error=None, fill_value=nan, assume_sorted=False)

https://www.geeksforgeeks.org/how-to-implement-linear-interpolation-in-python/

4D/3D/2D interpolation
https://pangeo-pyinterp.readthedocs.io/en/latest/auto_examples/ex_4d.html

3D delaunay triangulation
https://docs.scipy.org/doc/scipy/reference/generated/scipy.spatial.Delaunay.html

Here points are converted into polygonal mesh.
Next, for each grid point in the reconstruction grid, the value is obtained by linearly interpolating scalar values from the vertices of the simplex that encloses the current grid point.
To ensure that reconstructed and original volumes match, the boundary points (8 points for the 3D volume) are also added to the sampled point set prior to applying reconstruction.

Volume based visualization:
Ray casting based techniques
Transfer function

Isocontour based visualization:
Users can specify feature-specific ***isovalues*** to render isosurfaces and visualize them interactively.
The proposed sampling method is able to preserve the global structure of important features in data with high accuracy even at low sampling rates.