

## CSCI 552 (Spring 2021)

### Homework #4

**Handout:** Thursday, April 15, 2021

**Due:** 11:59 pm, Thursday, April 29, 2021

**Total points:** 50

*All assignments will be submitted through Canvas. Documents will need to be in either Word or PDF format. Images need to be in jpeg format.*

1. Consider a volume of dimensions  $512 \times 512 \times 256$ . The attribute in each voxel is a 1-byte density value. Describe how you would represent this dataset using each of the following data formats, i.e. what information do you need to store in each data format? Approximately how much storage (in bytes) do you need in each case?
  - (a) structured points (volume), with cubical voxels.
  - (b) rectilinear grid
  - (c) structured grid
2. Describe the linear interpolation procedure for tetrahedral cells using 3D barycentric coordinates, assuming scalar attributes are given at the four vertices of each tetrahedron. You need to compute the signed barycentric coordinates such that points outside the tetrahedron will have at least one negative coordinate.
3. Consider a pulse function  $f(x) = 1$  for  $-1 \leq x \leq 1$  and  $f(x) = 0$  elsewhere. Show that the Fourier transform of  $f(x)$  is a multiple of the *sinc* function:  $\sin(\pi x)/(\pi x)$  (i.e. filtering by a *pulse* function in the frequency domain is equivalent to a convolution using a *sinc* function in the spatial domain).
4. Derive a Marching Square algorithm in 2D, similar to the Marching Cube algorithm in 3D, for generating contour curves in a 2D image. Describe the details of the different cases and draw the complete case table for generating the line segments of the contour curve.