Name: _____

Matriculation number: _____

Scoring:

Stereo 11 Pt.	Particles 10 Pt.	Terrain 9 Pt.	Volume 11 Pt.	Sum 41 Pt.

Written Exam Scientific Visualization, SS 2020

Info

- You can reach a maximum of 40 points. For a passing grade, you need 20 points. The duration of the exam is 60 minutes.
- Deactivate all electronic devices and stow them away in your bag.
- The only utilities you may use in addition to blue or black pens are colored pens for the sketches (no red!), erasers, rulers, and English dictionaries.
- You may not use your own paper. Instead, you can request additional sheets from the supervisory staff at any time.
- The space allotted for each task in the exam sheets is always sufficient to contain a correct and complete solution. However, you may use the back page of this title sheet, or any number of additional sheets (see above) for doing auxiliary calculations and corrections.
- Some tasks require you to complete provided sketches. If you made an irrevocable mistake filling out a sketch, you can request another copy from the supervisory staff.
- If you make use of any kind of additional sheets of paper, you must write down your name, your matriculation number, and, in case of a blank sheet, the task number(s).

Checklist

- ☐ Did you write your name und matriculation number on this cover sheet?
- ☐ Did you write your name und matriculation number on all other sheets?
- ☐ Have you looked at *every* task to see if you can solve them?
- ☐ Did you strike out every wrong solution you corrected?

I Stereo (11 Pt)

Question I.1

Assign the matching perceptional depth cue category for the given depth cues: (4 Pt)

	Pictorial	Dynamic	Ocular	Stereoscopic
Vergence			x	
Shadows	x			
Depth from Motion		x		
Aerial Perspective	x			
Motion Parallax		x		
Binocular disparity				x
Texture Gradients	x			
Kinetic Depth Effect		x		

Question I.2

Explain the dead eye effect and how it can be used in stereo visualizations! (2 Pt)

Question I.3

Describe the direct and indirect rendering process for stereo rendering in terms of buffer usage. (2 Pt)

Question I.4

Different lighting approaches can be used for lighting in stereo images.

a) Explain the influence of cycloptic lighting and per eye lighting on a stereo rendering (1 Pt).

b) Both lighting approaches vary in the computation of the projection matrix and model view matrix. Give the formulas for these matrices given the following matrices (note: lighting is computed in eye coordinates). (2 Pt)

M … transformation matrix from model to cyclopic eye coordinates

$P_{\pm}$ … frustrum matrix for left/right eye

$T_{\pm}$ … transformation matrix for translation of left/right eyes

	Cycloptic lighting	**Per eye lighting**
Influence on rendering		
Projection matrix		
Model view matrix		

II Particles (10 Pt)

Question II.1

Assign the matching attribute for the following attributes of particles: (2 Pt)

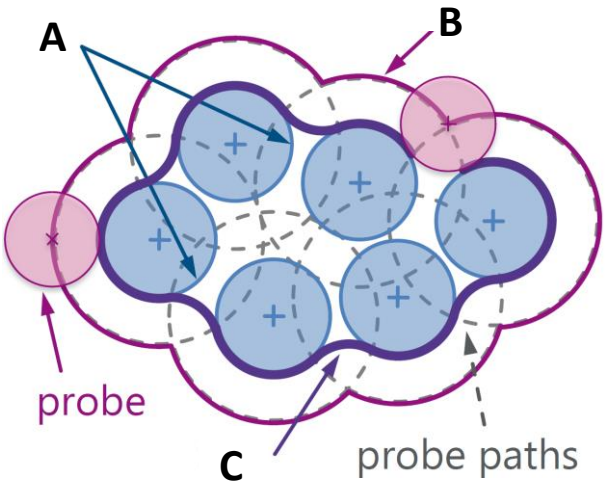
	Scalar	Vector	Tensor
Strain			
Temperature			
Surface Normal			
Mass			

Question II.2

Describe the idea of sphere ray casting by going through the steps of the rendering pipeline. (4 Pt)

Question II.3

Molecules can be visualized by different derived surfaces. Given the following figure:



a) Name the marked molecular surfaces (1.5 Pt).

A –

B –

C –

b) How can the surfaces A, B and C be rendered? Name the used glyphs/primitives. (2.5 Pt)

III Terrain (9 Pt)

Question III.1

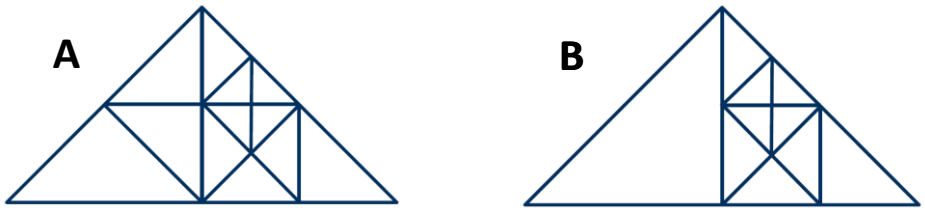
What are the advantages and disadvantages of a regular grid or a triangular irregular network (TIN) as terrain representations? (2 Pt)

	Regular Grid	Triangular irregular network
Advantages		
Disadvantages		

Question III.2

The Hierarchy of Right Triangles (HRT) is used for adaptive triangulation of terrain.

a) Given the following fronts of a triangle, which front is valid? (1 Pt).



b) Explain why the other front is invalid and mark it in the figure. (1 Pt).

c) What is a diamond and how can it be used in adaption of a valid front inside a HRT? (2 Pt).

Question III.3

Explain the approach of ambient aperture lighting divided in precomputation and rendering stage. (4 Pt)

IV Volume (11 Pt)

Question IV.1

The Volume-Rendering Integral for a viewing ray parametrized by the depth $z = z_{\min} \dots z_{max}$ is given:

$$\ddot{I}_{z_{min},z_{max}} = \int_{z_{min}}^{z_{max}} T(z_{min}, z)\ddot{\varepsilon}(z)dz + T(z_{min}, z_{max})\ddot{I}_{z_{max}},$$

$$T(a,b) = e^{-\int_a^b \omega(\tilde{z})d\tilde{z}}$$

a) Describe the following components. (2 Pt).

$\ddot{I}_{z_{min},z_{max}}$ –

$\ddot{\varepsilon}(z)$ –

$\omega(\tilde{z})$ –

$T(a,b)$ –

b) Which term of the integral makes it variant to scaling? Give a reason. How can one deal with this? (2 Pt).

Question IV.2

What is a transfer function? (1 Pt)

Question IV.3

Describe two raycasting acceleration techniques of your choice. (2 Pt)

Question IV.4

Perform Meshed Polyhedra Visibility Sorting for the given viewpoint and the following adjacency graph. Annotate each triangle with the number of the iteration step in which they are deleted. (4 Pt)