



### Försättsblad Prov Original

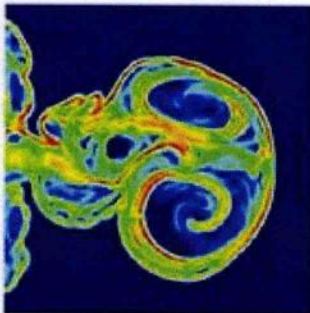
Kurskod	DT010A	Provkod	T101	Tentamensdatum	2018 - 06 - 07
Kursnamn	Datateknik AV, Visualisering				
Provnamn	Tentamen				
Ort	Sundsvall				
Termin	V18				
Ämne	Datateknik				

## 2018-06-07. Examination in DT010A - Visualization, 7.5 hp

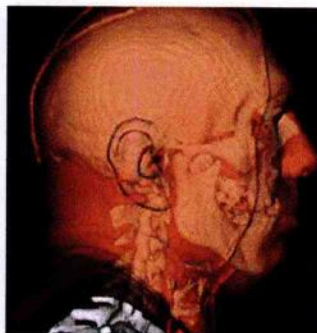
<b>Allowed aids</b>	Dictionary, non-programmable calculator and drawing tools (e.g ruler)
<b>Miscellaneous</b>	Don't forget to: <ol style="list-style-type: none"><li>1. Submit one, or several pages, per solved assignment and NOT several solved assignments per page.</li><li>2. Order the handed in pages with the solved assignments in ascending order.</li><li>3. Describe and clearly motivate all solutions, assumptions, programming constructs, etc..</li><li>4. Attach all neatly drawn figures that you might want to refer to in a solution.</li></ol> <p><b><u>Failing to follow the above instructions will render point reduction.</u></b></p>

**Good Luck!**

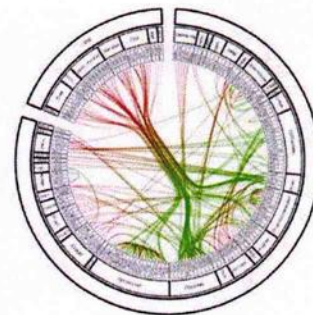
1. The following images exemplify different datasets and visualization methods. Describe what visualization category each image represent and suggest what method that has been used to create each image. Motivate your answer.



(a)



(b)



(c)

(3 p)

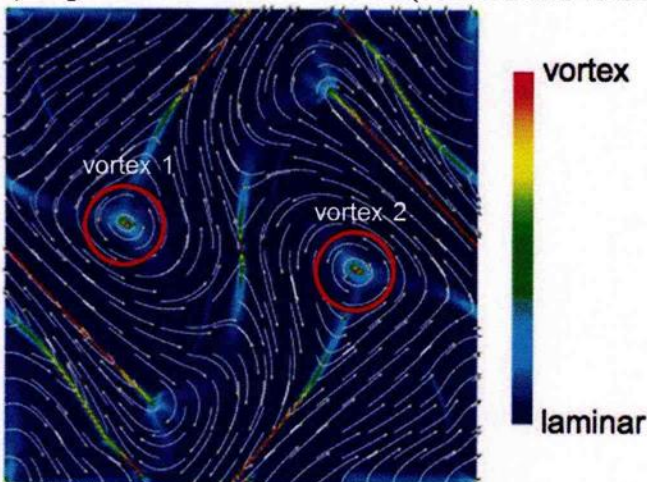
2. Describe differences and similarities between scientific visualization and information visualization.

(4 p)

3. Consider a classical 2D color image, represented as a 2D array of RGB pixel colors.
- a) What type of grid does best represent this image: unstructured, structured, rectilinear, or uniform?
  - b) What type of data attribute best encodes the data values (scalar, vector, color, tensor, or other)?
  - c) What type of interpolation scheme is most appropriate to use for these data attributes (piecewise-constant, piecewise-linear, or other)?
- Justify your answers.

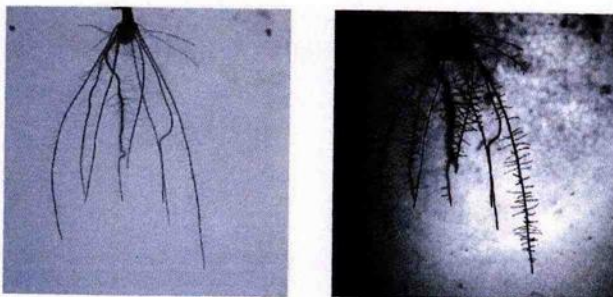
(3 p)

4. The figure below illustrates the curl of a vector field with the magnitude  $\|\text{rot } \mathbf{v}\|$  visualized using a color map.
- a) Explain what the curl of a vector field describes.
  - b) Explain what the two vortices (vortex 1 and vortex 2) corresponds to.



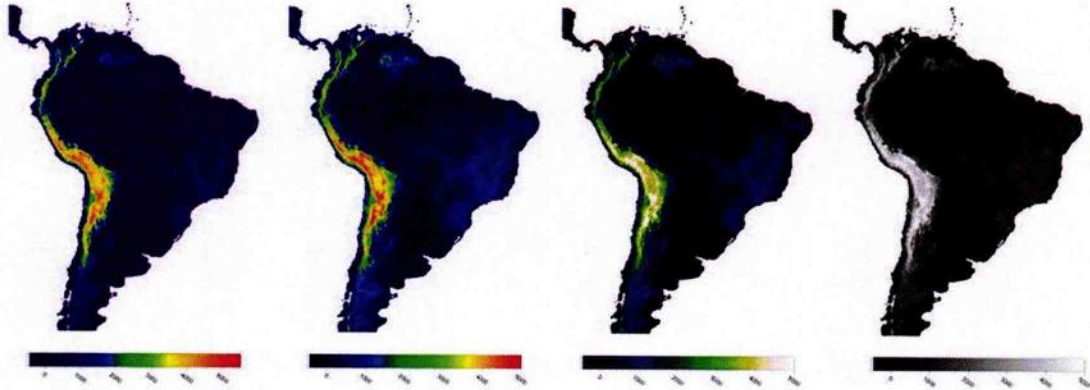
(4 p)

5. The two images below shows the effect of contrast enhancement.
- a) Why is contrast enhancement an often used post-processing step in image visualization?
  - b) Explain how histogram equalization may be used to contrast enhance and image.



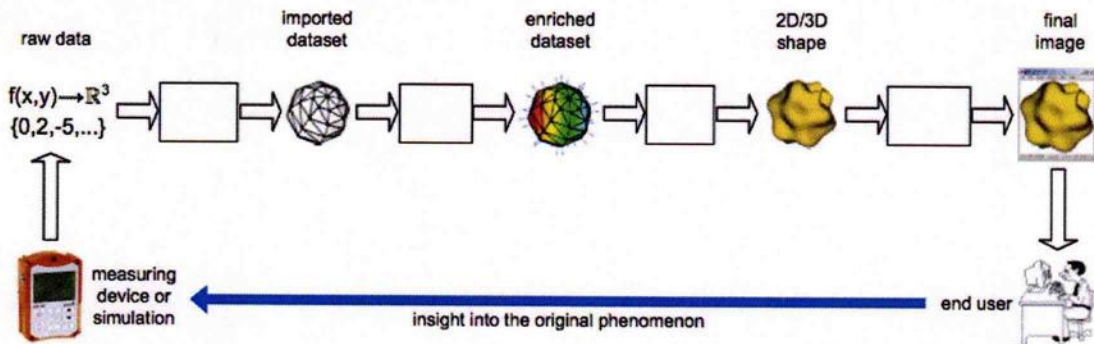
(4 p)

6. Four different color maps are evaluated as candidates for visualizing the elevation (height above sea level) of South America. Suggest which one that you think should be used and motivate why.



(4 p)

7. Name the four steps in the visualization pipeline, illustrated in the figure below, and describe in what way they transform the data in the process of creating a final image from raw data.

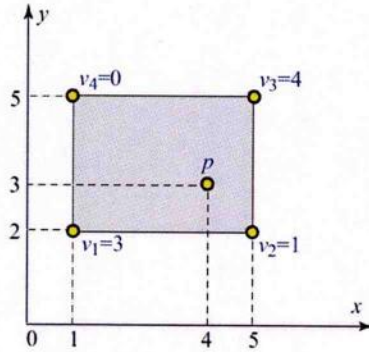


(6 p)

8. Consider that we have a function  $z = f(x, y)$  where  $z$  is a real-value indicating the rainfall measured on a 2D terrain at locations  $(x, y)$ . The measurement device that we used, however, is not very accurate at low temperatures – its accuracy is directly proportional with the temperature. To capture this information, we store, for each rainfall measurement at a location  $(x, y)$ , also the temperature at that location.
- Propose how to construct a dataset as a function of  $x$  and  $y$  that contains all accuracy and rainfall measurements.
  - How could the rainfall over the 2D terrain be visualized when the certainty about the accuracy of the measurements needs to be included?

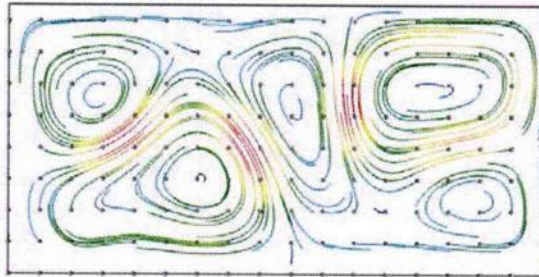
(5 p)

9. Consider the 2D cell in the figure below. For this cell, scalar data values  $v_i$  are indicated at its sample points (vertices). Additionally, a separate point  $p$  inside the cell is indicated. If bilinear interpolation is used, compute the interpolated value  $v(p)$  at the point  $p$  using the vertex data values  $v_i$ . Detail your answer by explaining how you computed the interpolated value.



(5 p)

10. Stream lines, as in the figure below, are visualization tools used for different types of vector fields.
- Explain how they are constructed.
  - Describe how they differ from hedgehog glyphs.
  - Elaborate on aspects that you think should be taken into consideration if stream lines are used for a 3D vector field.



(6 p)