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# Försättsblad Prov Original

| Kurskod | Provkod | Tentamensdatum |
|---|---|---|
| DT010A | T101 | 2018-08-21 |
| Kursnamn | Datateknik AV, Visualisering | |
| Provnamn | Tentamen | |
| Ort | Sundsvall | |
| Termin | H18 | |
| Ämne | Datateknik | |

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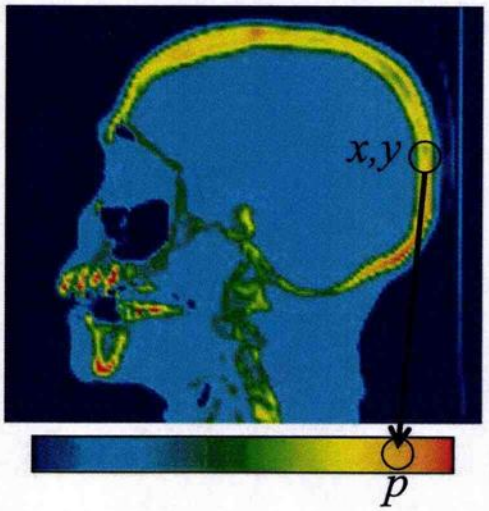
# 2018-08-21. Examination in

# DT010A - Visualization, 7.5 hp

| | |
|---|---|
| **Allowed aids** | Dictionary, non-programmable calculator and drawing tools (e.g ruler) |
| **Miscellaneous** | Don't forget to:<br>1. Submit one, or several pages, per solved assignment and NOT several solved assignments per page.<br>2. Order the handed in pages with the solved assignments in ascending order.<br>3. Describe and clearly motivate all solutions, assumptions, programming constructs, etc..<br>4. Attach all neatly drawn figures that you might want to refer to in a solution.<br><br>**Failing to follow the above instructions will render point reduction.** |

## Good Luck!

**1.** The image below illustrate how some medical data $d$ that were captured in a CAT scan is mapped into color value. This mapping is performed using a selected function $f()$. Describe two general features of this function $f()$ that is crucial for the visualization to be successful.




$$p = f(d(x, y))$$

(2 p)

2. The two visualization branches scientific visualization and information visualization share the related goal of providing means to better understanding of data to draw useful conclusions. However, they differ for example in what data types they handle. A common way of classifying visualization data types is in the groups *nominal*, *ordinal*, *discrete*, and *continuous*.
   Explain these four types and what operations are possible to perform on them.

   (4 p)

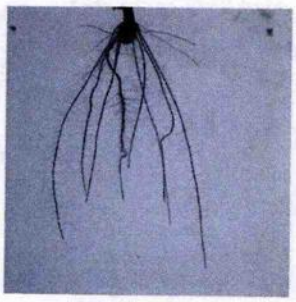
3. Consider a classical 2D color image, represented as a 2D array of RGB pixel colors.
   a) What type of grid does best represent this image: unstructured, structured, rectilinear, or uniform?
   b) What type of data attribute best encodes the data values (scalar, vector, color, tensor, or other)?
   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. Plot the following vector fields using hedgehog glyphs (oriented arrows) for a square domain centered at the origin, spanning the *xy*-plane (resulting in a 2D plot) with $x = \{-10, -5, 0, 5, 10\}$ and $y = \{-10, -5, 0, 5, 10\}$.
   a) $v_1(x, y, z) = (-0.5y, 0.5x, 0)$
   b) $v_2(x, y, z) = (3x, 3y, 0)$

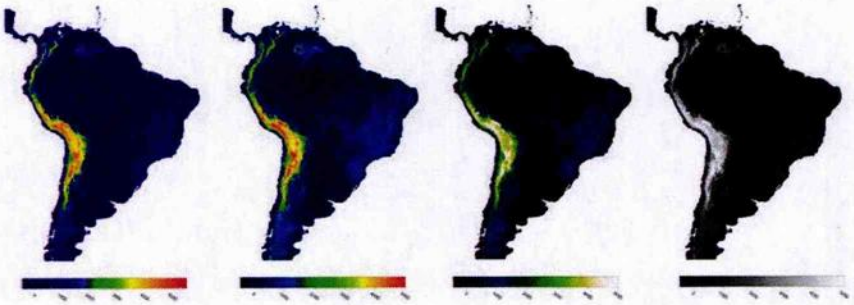
   (4 p)

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.



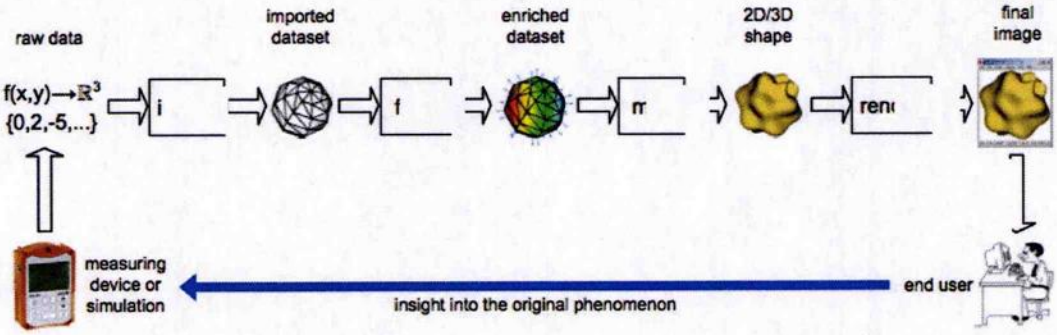

   (4 p)

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.



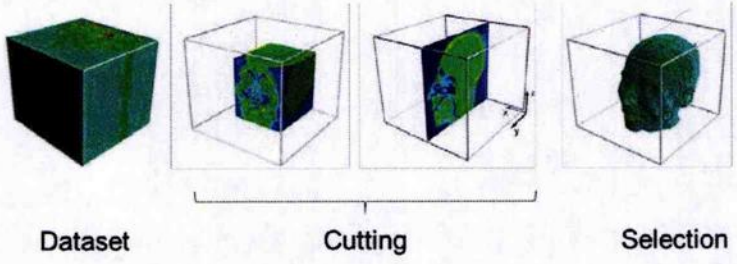
(4 p)

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.



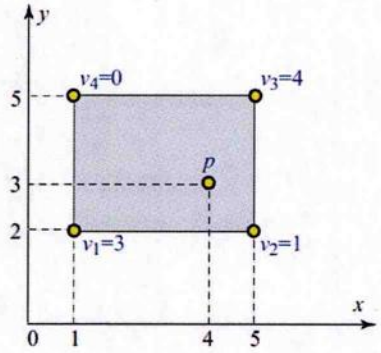

(6 p)

8. Cutting and selection are two different types of domain-modelling techniques, which are illustrated in the figure below. Explain how these two operations process the dataset in order to achieve a resulting output, and give one example where it may be useful to use each technique respectively.




(4 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.



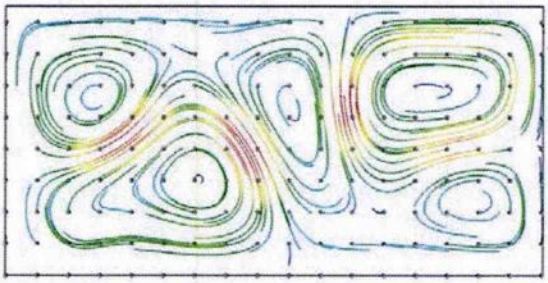

(5 p)

**10.** Stream lines, as in the figure below, are visualization tools used for different types of vector fields.

a) Explain how they are constructed.

b) Describe how they differ from hedgehog glyps.

c) Elaborate on aspects that you think should be taken into consideration if stream lines are used for a 3D vector field.



(6 p)