



Faculty of the Built Environment & Architecture

Digital terrain modelling (GEO1015) — 5 EC

Location: online

Date & time: 29 January 2021, 09:00–11:00

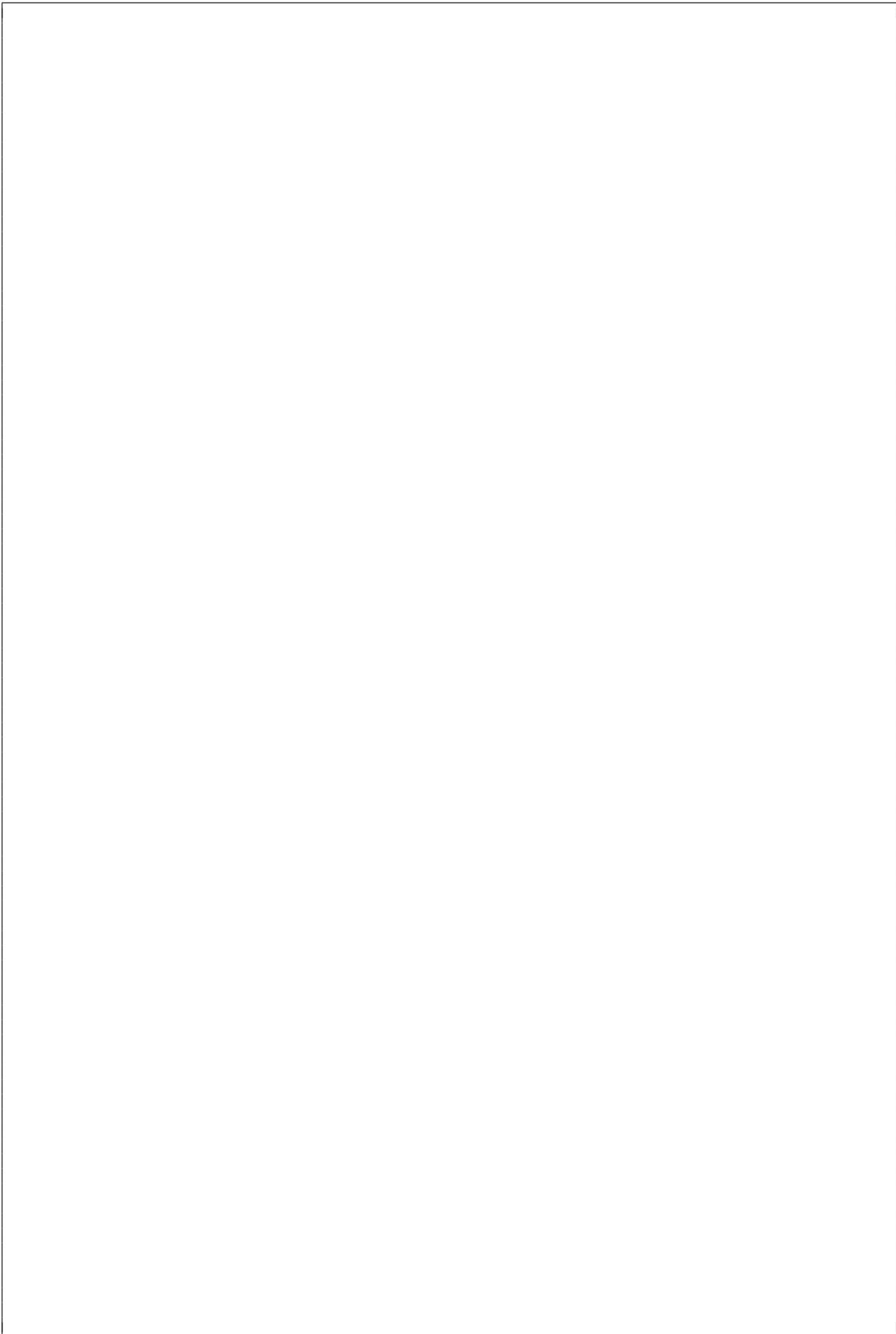
Responsible teacher: Hugo Ledoux

1. The subject matter is in full accordance with the study guide.
2. This final exam is worth 30% of the final mark for the course.
3. This final exam has 10 questions and the maximum is 100 points.
4. The maximum grade for this course is 10. The minimum (unrounded) final mark to pass this course is 5.75, which will be rounded to 6.0. However, you need at least a 50% in this final exam to be able to pass the course.
5. This is an open-book exam, you are allowed to use the book, any software, or even the Internet. You are however not allowed to speak to someone else.
6. Before starting, check if all the pages and questions are there (there should be 10 questions and 11 pages).
7. For the answers that require drawing:
 - (a) print the exam and scan the page, or
 - (b) draw directly in your computer, Word allows you to do this
 - (c) redraw on a piece of paper the starting elements, and take a picture of your answer.
8. The name of the PDF is your `my_student_number.pdf`, eg `5144666.pdf`
9. You need to submit a PDF **before 11:05** to this Dropbox upload page

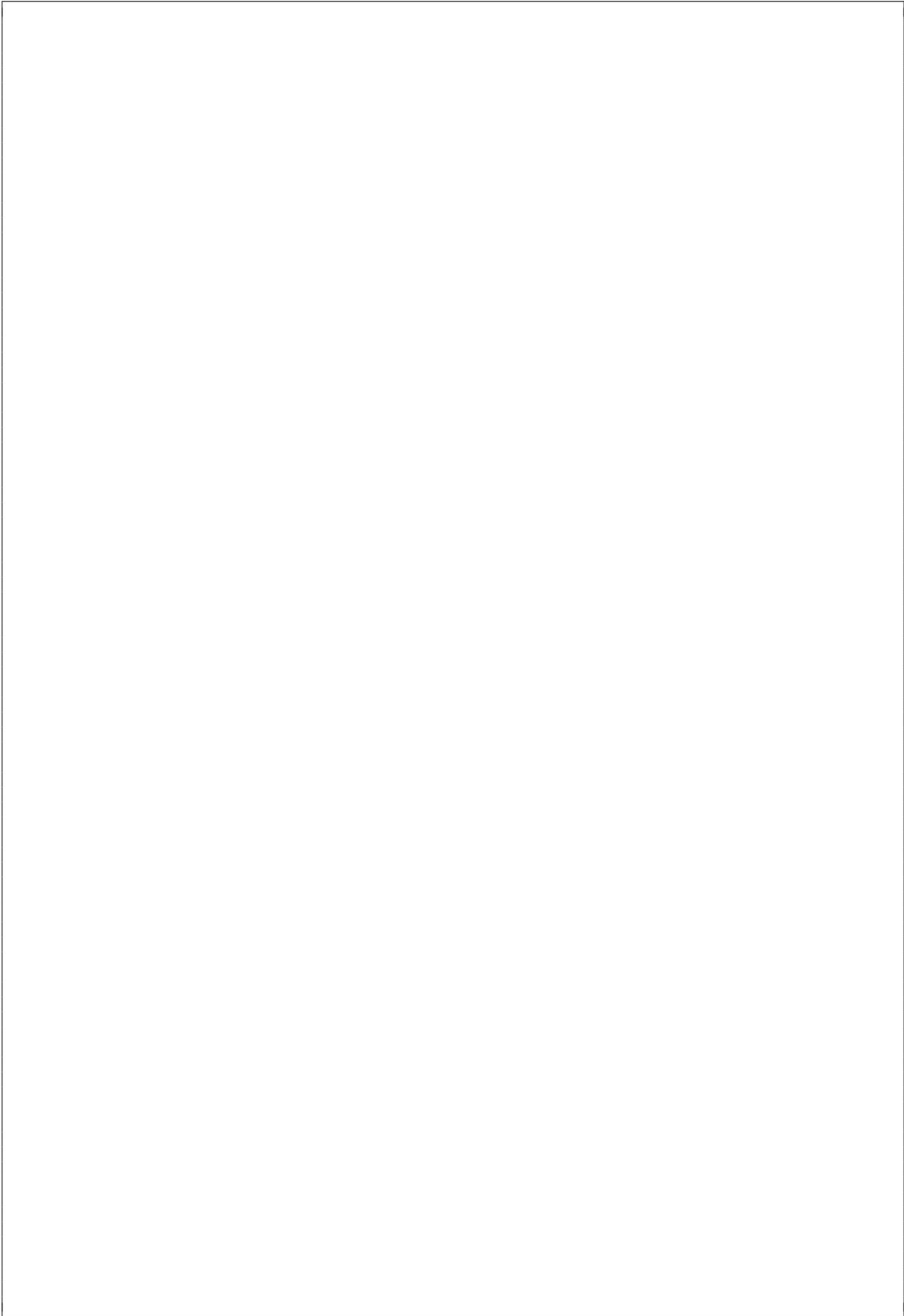
Name:

Student ID:

1. (10 points) It is mentioned in the Chapter 1 of the book that “a point cloud is an incomplete representation for a terrain”. Explain what that means.

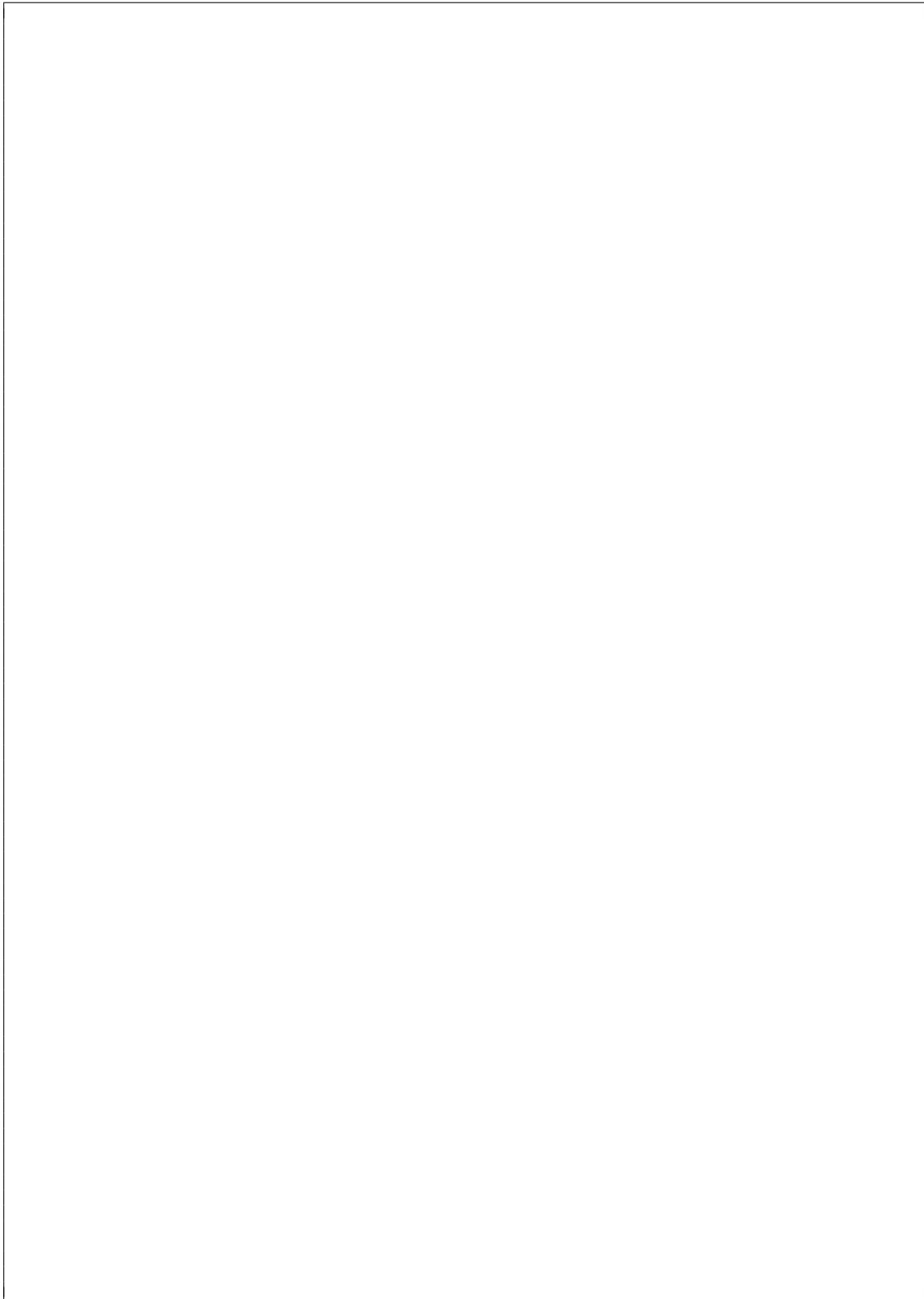


2. (10 points) Draw a set of 10 points in the plane such that its Voronoi diagram has 5 unbounded Voronoi cells, and one Voronoi vertex has a degree of 5. You can write down in word your reasoning also.

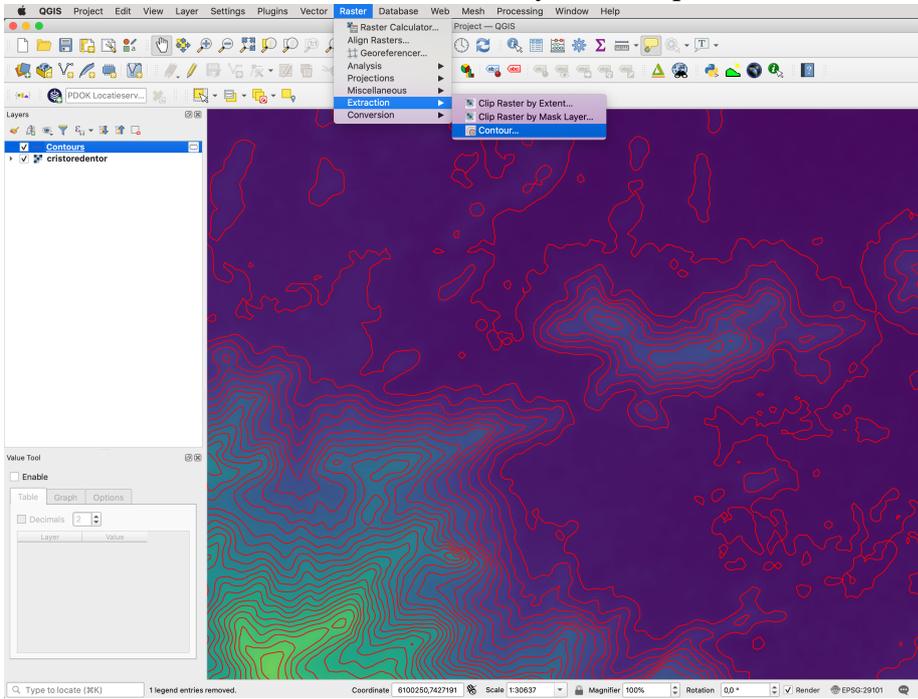


3. (10 points) Draw the 2D *kd*-tree for this set of 6 points, and explain briefly how you obtained this result.

$(8, 4)$, $(9, 1)$, $(1, 1)$, $(5, 5)$, $(12, 5)$, $(4, 11)$

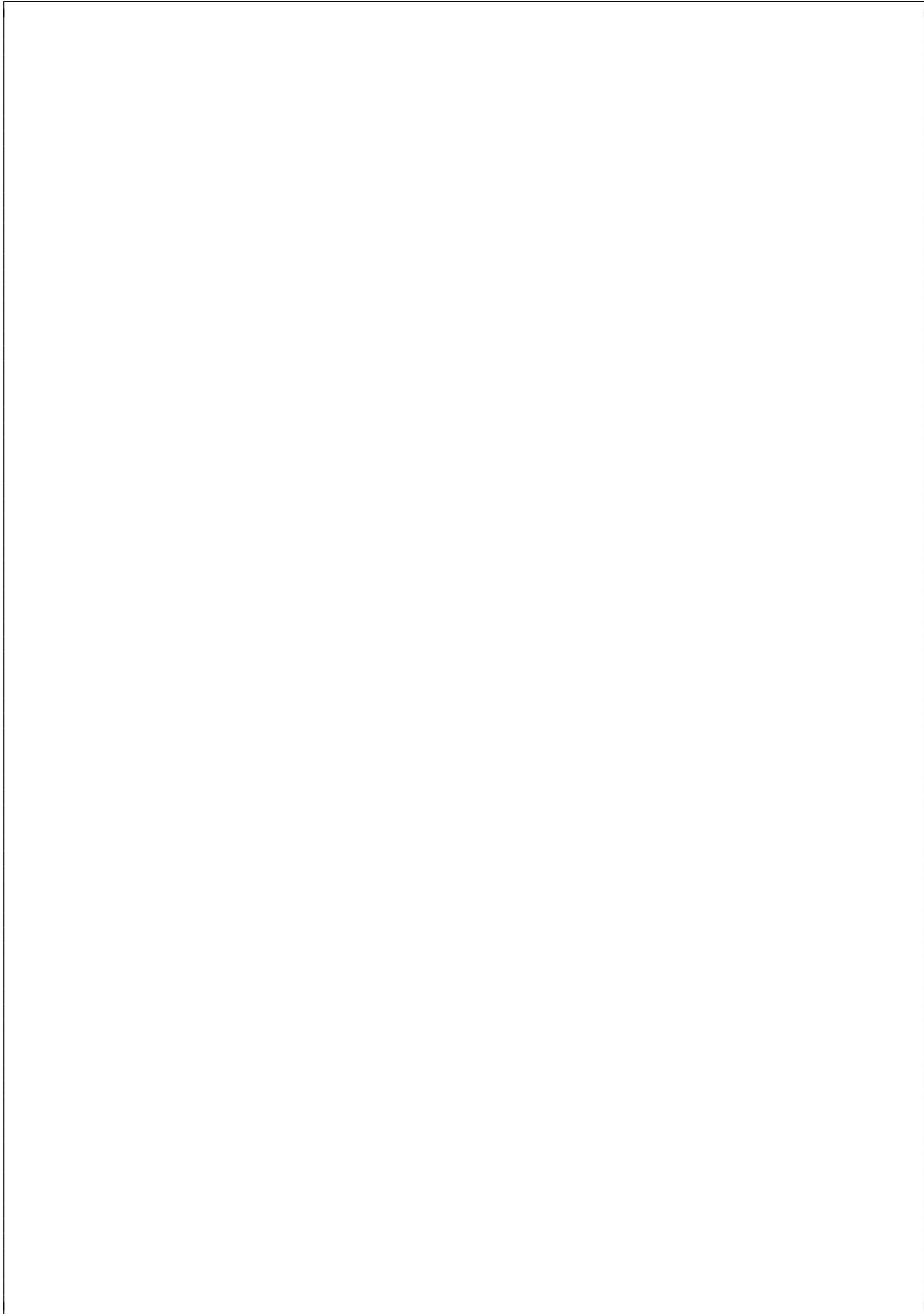


4. (10 points) You are asked to create isolines of the SRTM file `cristoredentor.tif`, which was given to you for the hw02. You use QGIS/GDAL functions to extract the isolines at every 25m and you obtain those lines: not very smooth and several unconnected components. Describe a methodology that you could apply to the data to improve the output isolines. The description should be at a higher level and speak in terms of algorithms and/or methods, not in terms of buttons you could press in QGIS.



A large empty rectangular box provided for the student to write their methodology for improving the contour lines.

5. (10 points) We know the slope for a given location (x, y) : its gradient (α) is 15° and its aspect (θ) is 245° . Draw the (hypothetical) isolines for the area surrounding this location, and identify clearly where that point would be. An estimation and guessing of the surrounding is fine.

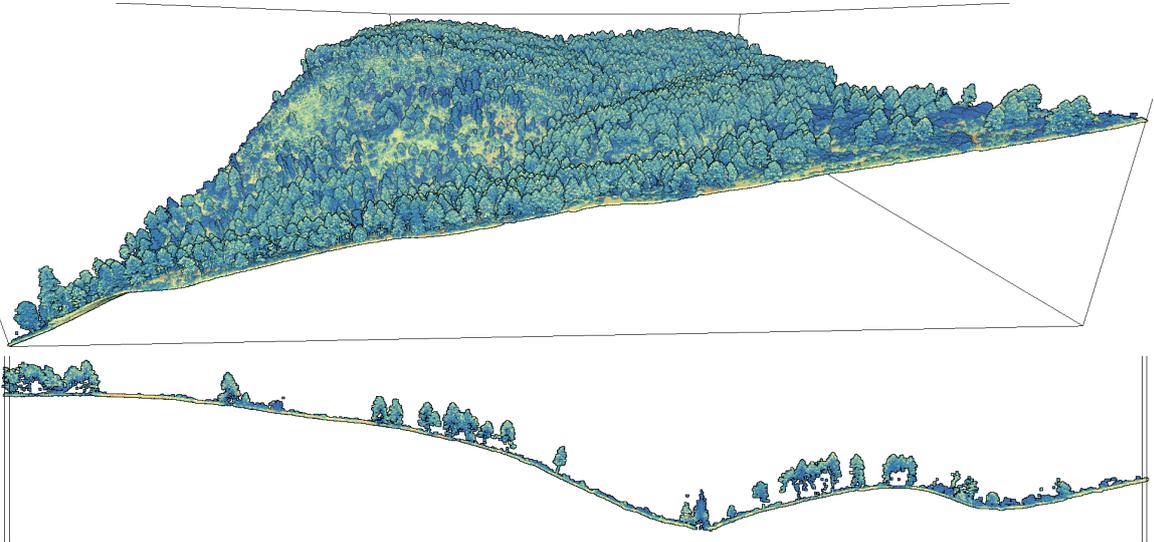


6. (10 points) You downloaded a raster terrain (GeoTiff format) that contains several cells with `no_data` values. There are groups of several adjacent `no_data` cells (10+), not only individual cells. Describe in detail a methodology/algorithm you will use to fill these with a meaningful value.

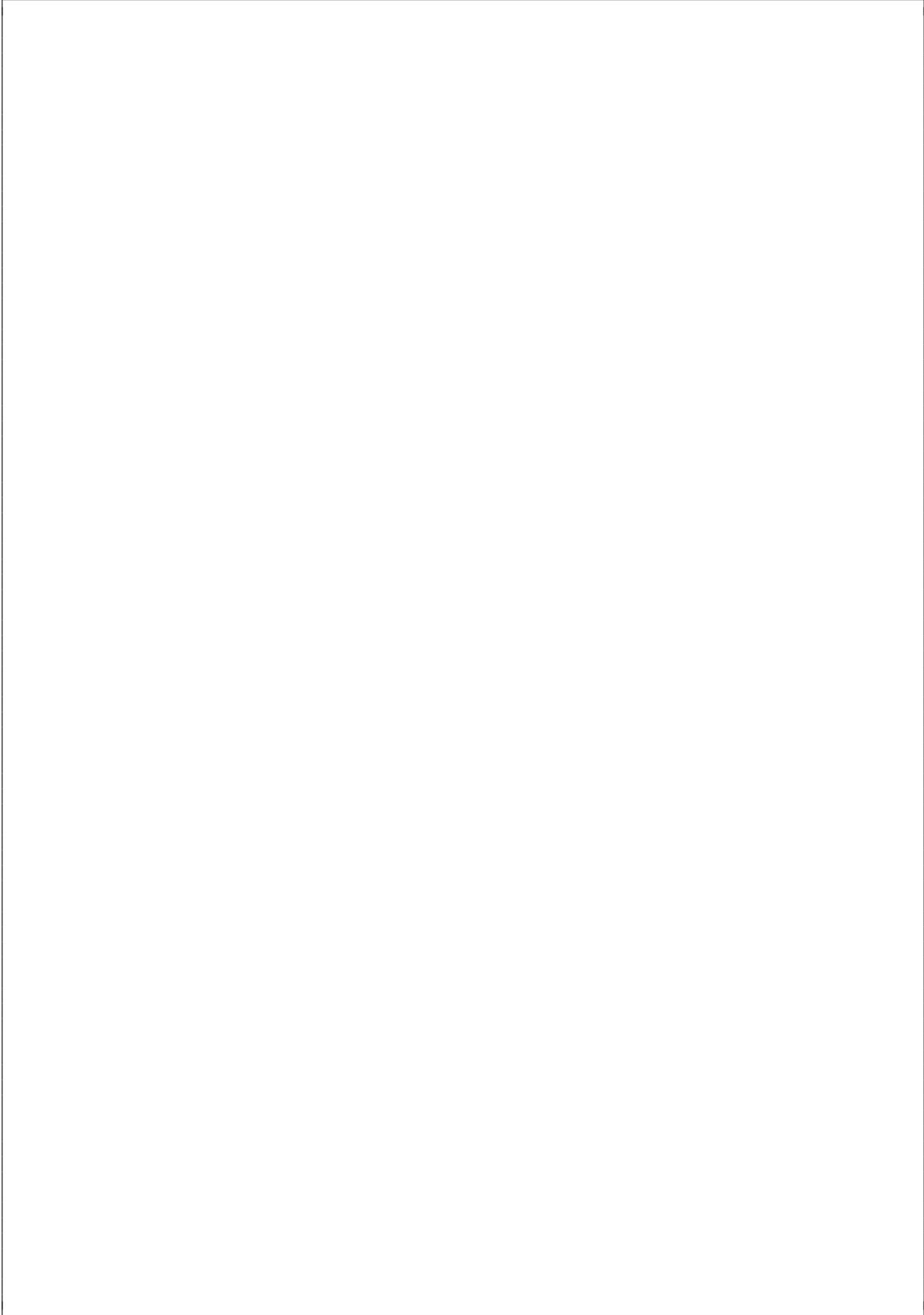


7. (10 points) In the book in Section 4.1, there is a list of 7 properties that an ideal interpolation method should have: exactness, continuity, smoothness, locality, adaptability, computational efficiency, and automation. Explain, in a few words, how well kriging fulfils each of them (or not) and why.

8. (10 points) You are given an unclassified aerial lidar point cloud of a large forest in a mountainous area (see images for an overview and a cross-section). You are given the task to create a grid that contains the height of the canopy for each grid cell. Describe how you could best achieve this using the methods you learned in this course.



9. (10 points) Section 7.3 of the book links to two methods to deal with sinks in runoff modelling (sink filling and least-cost drainage paths). Which do you think is better? Justify your reasoning by listing the key advantages of your preferred method over the other one.



10. (10 points) The image below shows a point cloud of a cube and a number of planes (eg the blue, green, yellow and grey ones) that were detected using the RANSAC algorithm as given in the book. Explain per RANSAC parameter (ϵ , n , k as given in the book) how to change it (eg should it be higher or lower) to decrease the likelihood that spurious planes like the grey one (that is not on any side of the cube) are generated. Notice that only the boundary surface of the cube has points on it, the interior is empty.

