TU Delft Delft University of Technology

Faculty of Architecture & the Built Environment

3D modelling of the built environment (GEO1004) — 5 ECTS

Location: A+BE Room T
Date & time: 13 March 2024, 13:45
Responsible teacher: Ken Arroyo Ohori

1. The subject matter is in full accordance with the study guide.
2. This midterm exam is worth 5% of the final mark for the course.
3. The maximum grade for this course is 10.0. The minimum (unrounded) final mark to pass this course is 5.75, which will be rounded to 6.0. However, you need a weighted average of at least 50% in the combined exams ($0.1 \times$midterm $+$ $0.9 \times$final) to be able to pass the course.
4. All questions have equal weight in this exam.
5. Answer directly on these pages. If there is not enough space, use the extra sheet at the end.
6. This is an open book/computer exam, so you are free to check the course materials (videos/handouts/assignments), both printed or on your computer, as well as any other materials you can find. However, you are **not allowed to communicate with others** and **the use of your phone is forbidden**.
7. This midterm exam has 7 questions, and 9 pages.
8. Fill out your name and student ID.
9. You have 1 hour to do this exam.

Name: _____

Student ID: _____

Lesson 1.1

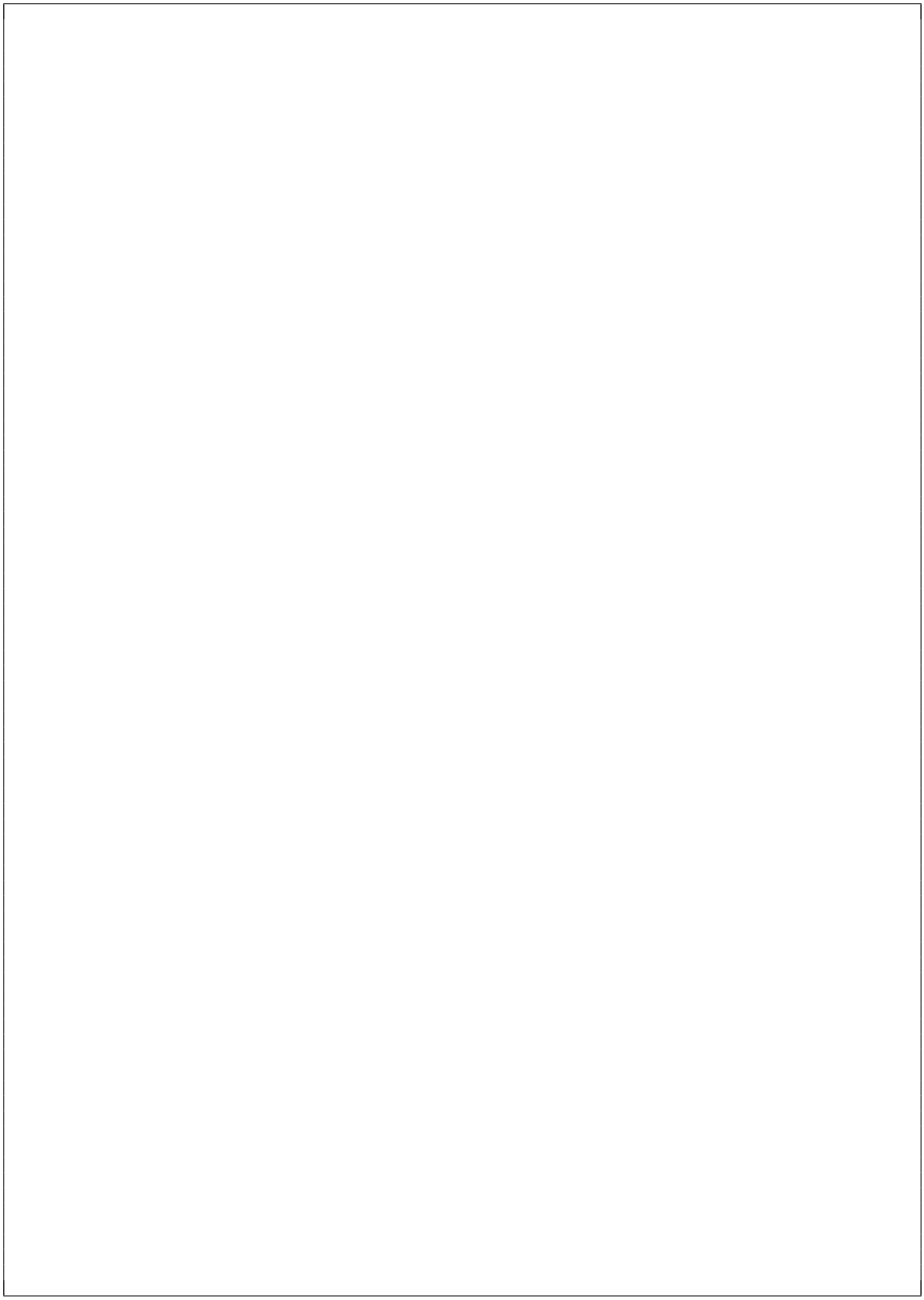
Using your implementation of Homework 1, give two examples of object definitions based on different types of geometry: one for Euclidean geometry (½ point) and one for Cartesian geometry (½ point).

Lesson 1.2

As you're implementing Homework 1 for a building, you notice that it has some non-manifold roof polygons. Does this affect the procedure you need to perform? If it does, explain how it's affected. If doesn't, explain why it isn't affected.

Lesson 2.1

Your employer asks you to calculate the volume of each building in a certain area. Each building is available as a *b-rep* stored in an OBJ file. Describe the methodology you will use, knowing that the volume of a tetrahedron can be calculated with the formula on p.39 of the book. Describe 2 pitfalls you might encounter.



Lesson 2.2

Converting surfaces to voxels requires totally different algorithms if the surfaces represent a field's isosurfaces or an object's boundary. Explain why.

Lesson 3.1

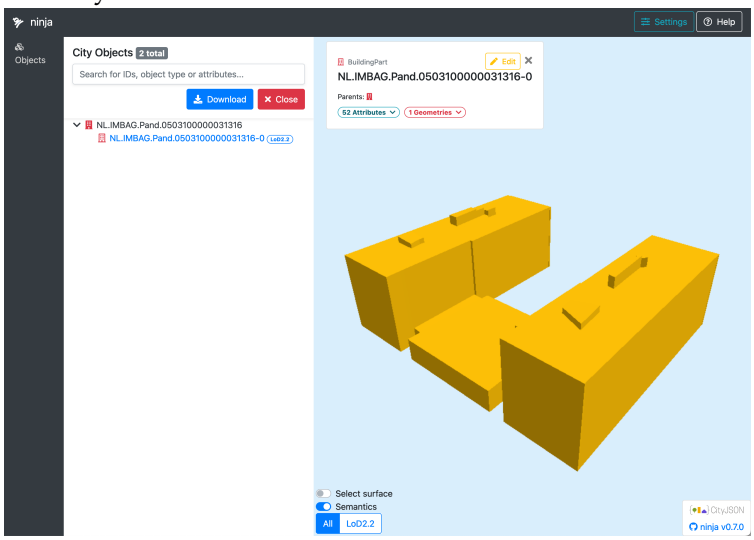
The software val3dity implements several checks to verify whether a volume conforms to the definitions of ISO19107. One of them is checking whether the boundaries form a watertight volume. Based on what you've learned in this course, explain how this could be concretely implemented (describe data structures + algorithms).

Lesson 3.2

Starting from an LoD 2.2 model of the faculty building (BK City), your task is to find out whether the East wing or the West wing has a longer total corridor length. Describe in detail the steps of a method to do so using the MAT.

Lesson 4.1

You download the building shown here from the 3DBAG in CityJSON (it is where the international school on the campus is located) and you want to convert the LoD2.2 geometry and store it in an OBJ file. Describe how you would proceed. Refer to specific tools and techniques from the course. The LoD2.2 geometry is geometrically valid according to val3dity.



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