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: 21 May 2025, 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 6 questions, and 8 pages.
8. Fill out your name and student ID.
9. You have 1 hour to do this exam.

Name: _____

Student ID: _____

Lesson 1.2

Describe your own implementation of Homework 1 in terms of its handling of geometry, topology and semantics. There should be one statement about each of the three components (⅓ point each).

Lesson 2.1

In the context of 3D modelling, what is the relationship between boundary representation and meshes? Describe it in your own words.

Lesson 2.2

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.37 of the book (½ point). Describe 2 pitfalls you might encounter (¼ point each).

Lesson 3.2

In the voxelisation of surfaces through intersection targets, up to 4 tests might be necessary for a given triangle-line segment pair. When are fewer tests (1–3) enough?

Lesson 4.1

(a) Draw two Surfaces having the same topology: one should be valid according to ISO19107 and the other one should not be (⅓ point each). **(b)** Explain briefly why the first is valid and why the second is not (⅓ point).

Lesson 4.2

You obtain a CityJSON file of the buildings of your city, and val3dity reports error 208 -- `ORIENTATION_RINGS_SAME` for some of them. **(a)** Describe the shape of the buildings that could potentially have that error (½ point). **(b)** Based on what you learned in this course, describe the C++ code that you would write to repair automatically those buildings. You are allowed to use the libraries that we use for the course (½ point).

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