TUDelft
Delft University of Technology

Faculty of Architecture & the Built Environment

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

Location: A+BE Room D
Date & time: 15 March 2023, 13:45
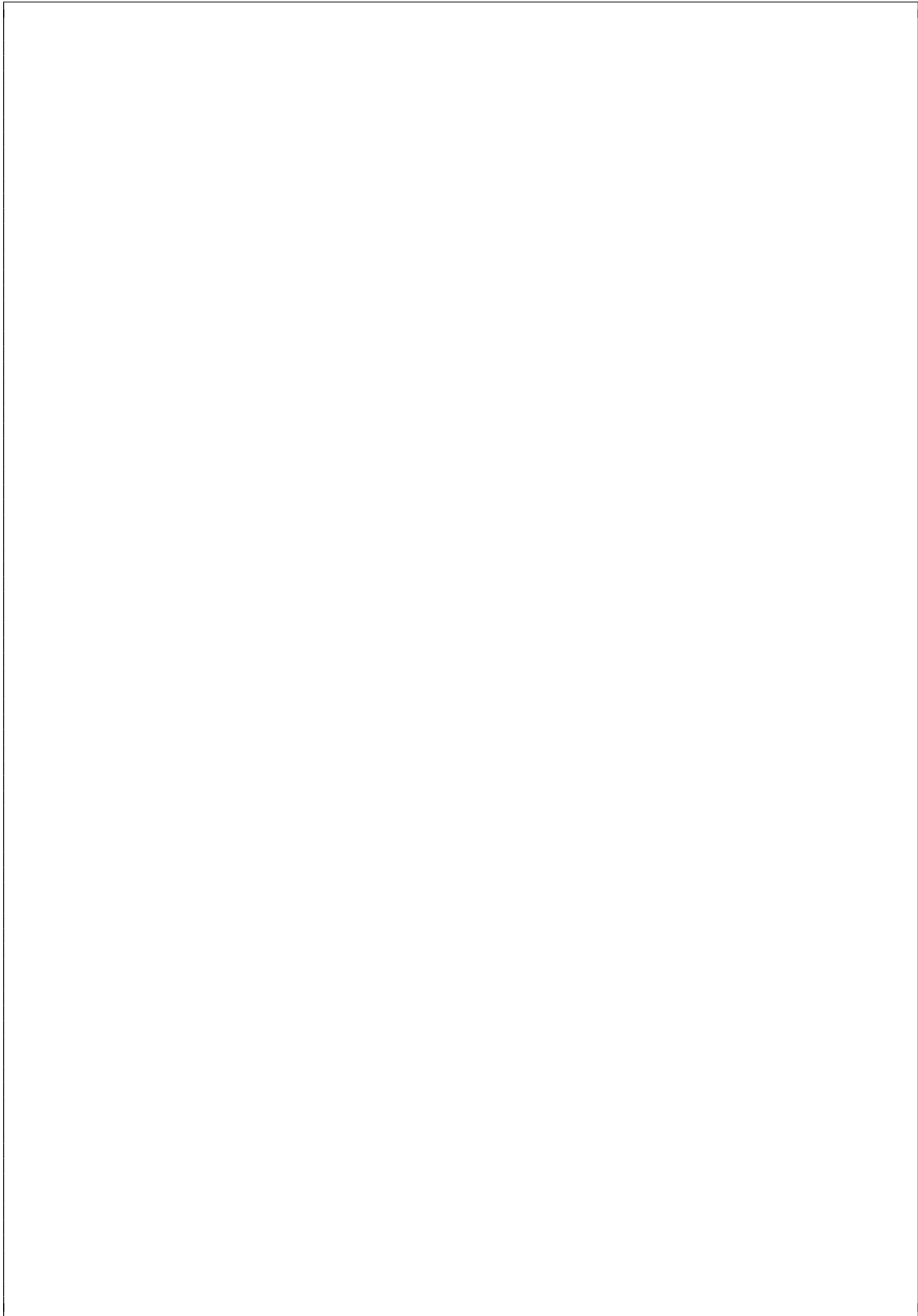Responsible teacher: Ken Arroyo Ohori

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 (midterm + this one) 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 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.
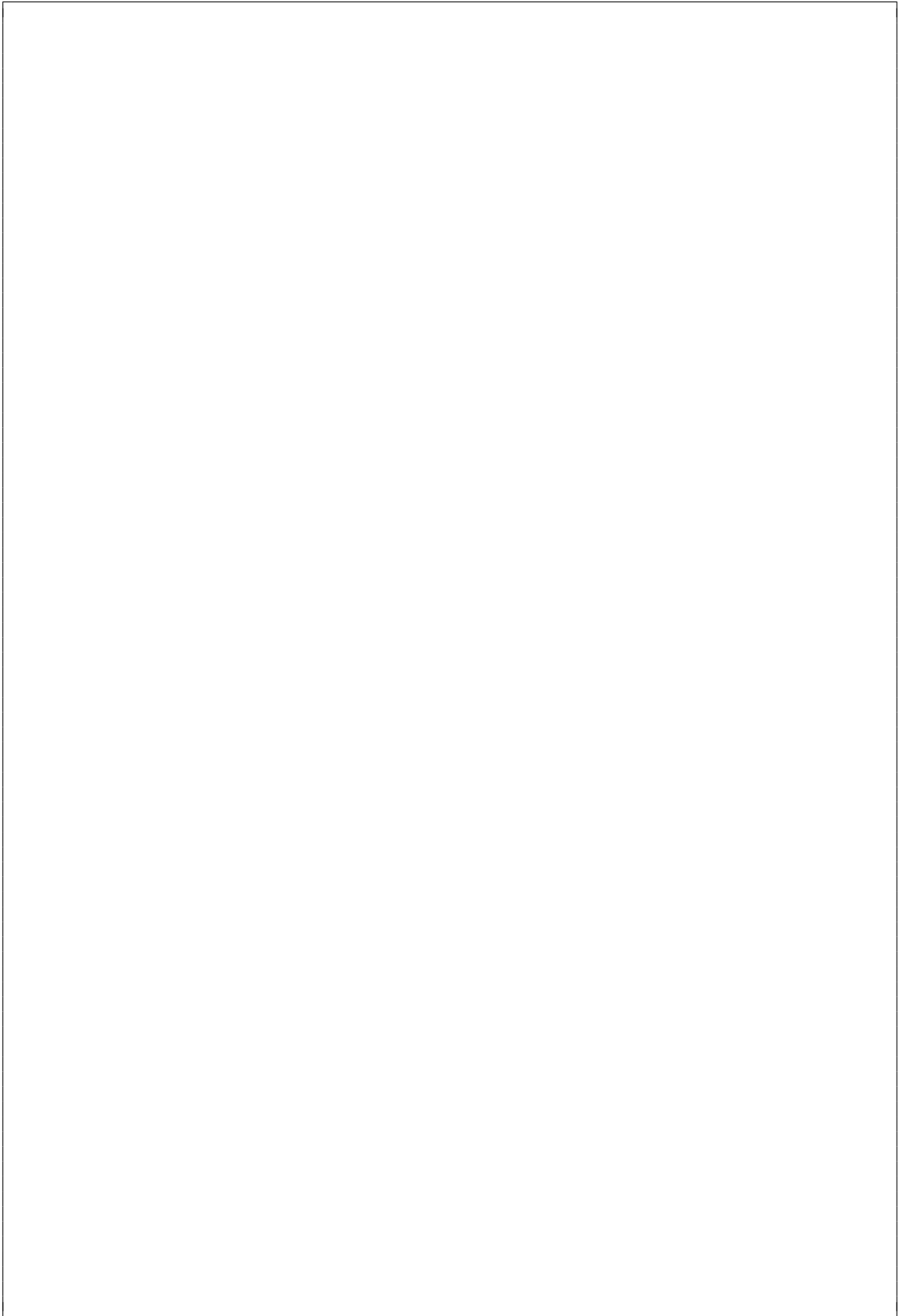
Name: _____

Student ID: _____

Lesson 1.1

Describe two differences between any of the data structures you used in Homework 1: those implied by the `.hw1` and `.obj` files and the one into which you loaded the vertices and faces.

Lesson 1.2

How does a constrained triangulation or tetrahedralisation help you deal with holes in objects? Explain it in your own words and illustrate it with an example.
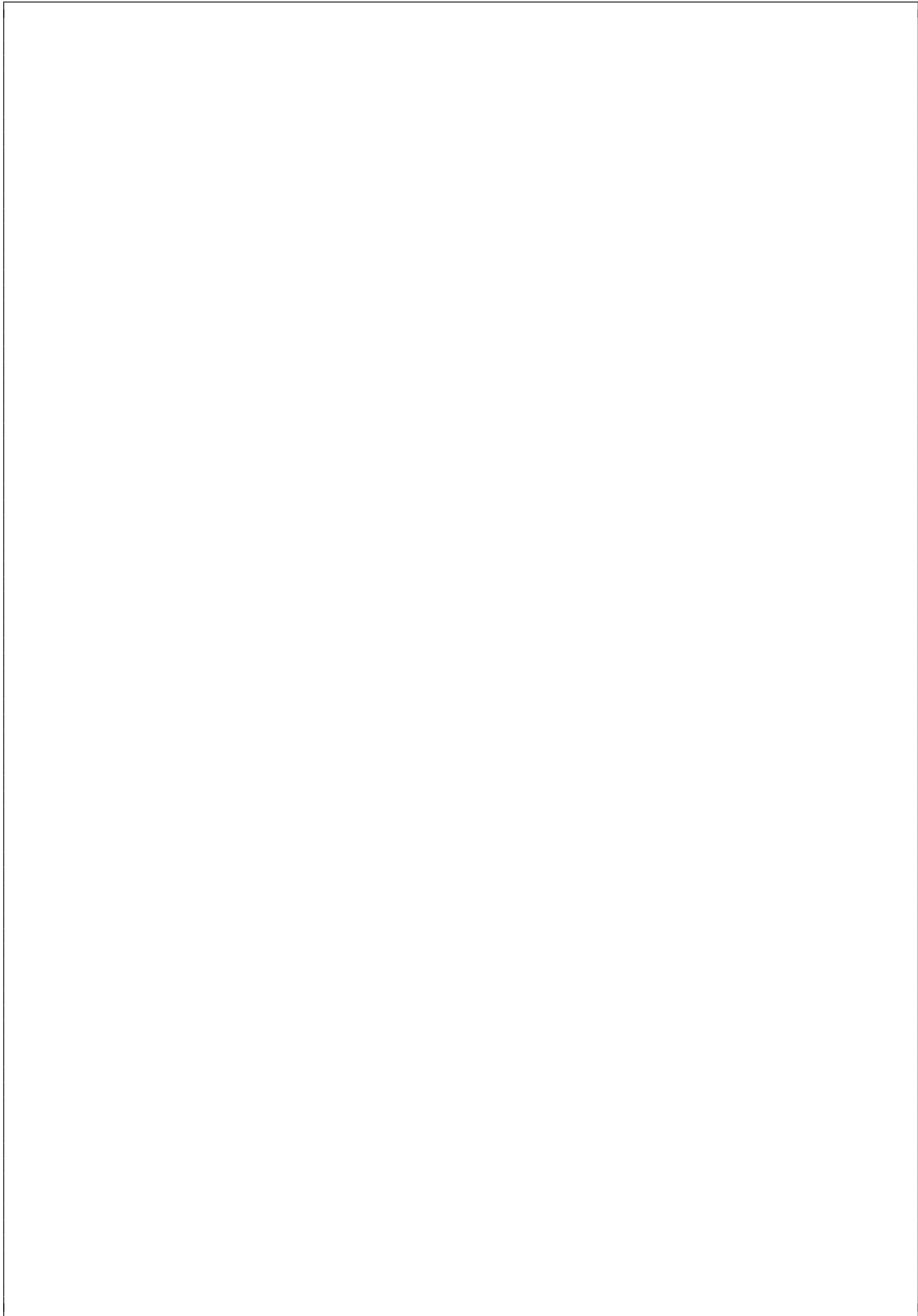
Lesson 2.1

Given the following 4 points: $a = (3,4,21)$, $b = (5,11,23)$, $c = (22,1,22)$, and $d = (5,5,5)$, what results does $Orient(a,b,c,d)$ return? Positive, negative, or zero? Explain your calculation/reasoning to obtain the result.

Lesson 2.2

Describe two objects: (a) one that can be stored much more efficiently with a sparse voxel representation than if you need to encode all voxels, and (b) one that is the opposite (much more inefficient for a sparse voxel representation).
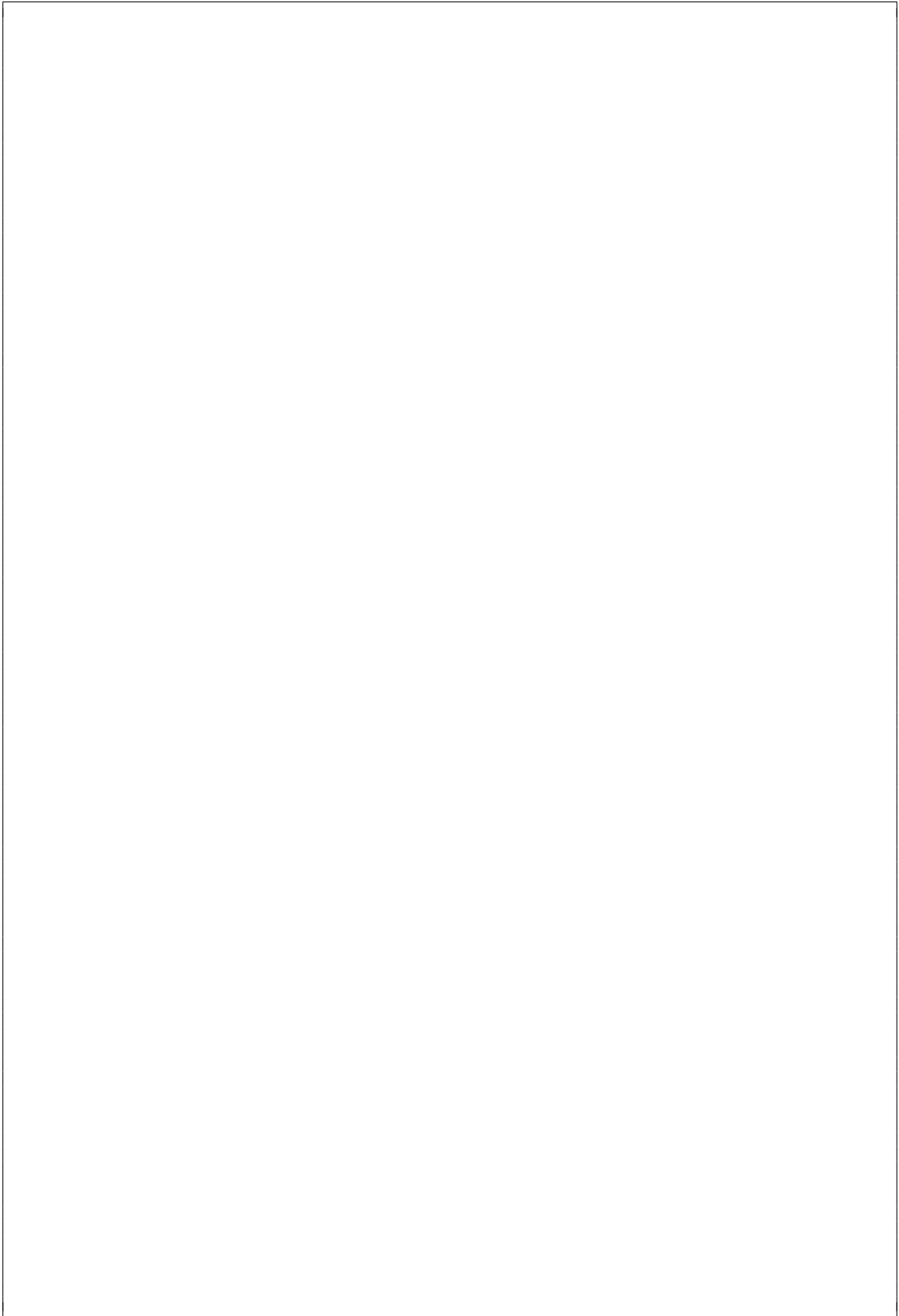
Lesson 3.1

Imagine a cube for which we remove the top surface, yielding 5 square surfaces. (a) Are the 5 surfaces together forming a 2-manifold? (b) If we store those 5 faces as a `CompositeSurface`, is the geometry valid? Explain your reasoning.

Lesson 3.2

Draw two objects that have the same medial axis but different medial balls. Their medial axis should consist of three medial branches converging at one single junction.

Lesson 4.1

The text below contains a building represented as a simple cube. You will notice that it is not a valid CityJSON file (its syntax). Fix the file so that its syntax is valid. For each of the errors, explain it in detail and write down the required changes.

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                            [[6, 7, 3, 2]],
                            [[7, 4, 0, 3]],
                            [[7, 6, 5, 4]]
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    "transform": {
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    }
}
```

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