

Summer Term 2021

Assignment on Advanced Computer Graphics - Sheet 4

Due Date 12. 07. 2021

Due by 12. 07. 2021 via email to weller@informatik.uni-bremen.de

Exercise 1 (Graphen: The Handshaking Lemma, 6 Credits)

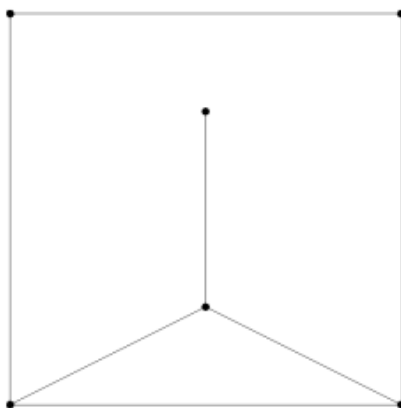
Prove the following lemma known from graph theory.

Handshaking Lemma: Let V the nodes and E the edges in an (undirected) graph. Then:

$$\sum_{v \in V} \deg(v) = 2 \cdot |E|$$

Exercise 2 (DCEL for Planar Graphs, 5 Credits)

The half-edge data structure is perfectly suited to be used to represent planar graphs. In this case, it is even possible to allow so-called "dangling edge" (see. Figure)¹



Provide a list of all pointers for such a "dangling edge", i.e. all pointers that are pointing *to* the edge and all pointers *leaving* the edge (with source and target node).

Exercise 3 (BFS in DCELs, 4 Credits)

Given a DCEL data structure and a pointer to a polygon p . Write an algorithm (in pseudo code) that implements a breadth first search through all polygons, starting with p .

Hint: Maybe an additional flag for either the edges or the polygons could be useful.

¹ In the case of using the data structure for polyhedrons we would, obviously, avoid such cases!

Exercise 4 (Euler Characteristic, 1, 2, 2 Credits)

1. Give an example of a closed polyhedron with 10 edges.
2. Show that a closed triangle mesh with arbitrary genus always has an even number of triangles.
3. Show that it is impossible for a closed polyhedron to have 7 edges.