Scientific Visualization – Homework 2
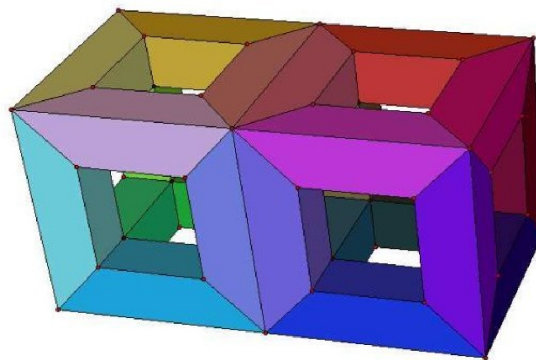
Submission: May, 14th, 2020, 10:15 am, via email

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1. Exercise   (12 points)

1.) Determine the genus of a closed simplicial surface with 20 triangles and 12 vertices.

2.) Sketch[I] two nonisomorphic examples of a closed simplicial surface with 20 triangles and 12 vertices which are both not the icosahedron. Why are your examples nonisomorphic?

3.) How many edges does a simplicial double torus with 1200 vertices have got?

4.)   a) Let Q be a quadrilateral surfaces (such as the example shown in the next part of the exercise). Show that the Euler formula $\chi(Q) = v - e + f$ still holds.

      b) Consider the following quadrilateral surface $\mathcal{Q}$:

      Determine the number of vertices v, the number of edges e, the number of faces f, and the Euler characteristic $\chi(\mathcal{Q})$. Further, determine its genus $g(\mathcal{Q})$. Which topological surface is given?

5.) Give three examples for simplicial complexes having the same Euler characteristic but which are not simplicially isomorphic[II]. Justify your choice.

Please, turn over.
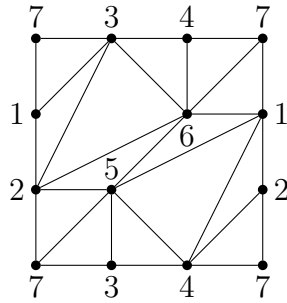

[I]Think of an appropriate representation.
[II]I.e., they are not isomorphic as simplicial complexes.

2. Exercise (4 points)

The *Császár torus* is a two-dimensional simplicial complex consisting of 7 vertices, 21 edges, and 14 triangles[III].

This simplicial complex is shown in the following figure. Vertices labeled with the same index are identified and the edges are identified accordingly.

```
7    3    4    7

1                   1
          6
       5
2                   2

7    3    4    7
```

* Determine star(2), star([3, 4]), and star([1, 5, 6]).

* Determine link(2), link([3, 4]), and link([1, 5, 6]).

Total: 16

[III]An embedding of the Császár torus is shown at `eg-models.de/models/Classical_Models/2001.02.069/`. The JVX-file can be opened in JavaView.