3D Printing — Spring 2017 — Dan Halperin

Assignment no. 2

due: May 15th, 2017

You may work on and submit this assignment **in pairs**.
Additional technical information about the exercises will appear in the course's website.

Exercise 2.1: Width of a polyhedron

(a) Implement an algorithm to compute the width of a polyhedron. The algorithm should have running time, up to a polylogarithmic factor, of $O(k)$, where k is the complexity of the overlay of the Gaussian map of the polyhedron with the reflection of the map through the origin. The input is a file coontaining the digital model (an stl or a vrml file—see the additional-information web-page) and the output is the squared width, and the direction of the width vector, namely the direction of the outer normal of the supporting planes the distance between which defines the width. The implementation needs to be exact and robust. The program should be written in C++.
(b) Implement an algorithm that approximates the width of a polyhedron. In addition to the input of Item (a), the approximation program accepts a rational parameter $\varepsilon > 0$. The reported width w', should be at most $(1 + \varepsilon)w$, where w is the true width. The output is the same as in Item (a).
(c) Use the algorithms developed above to transform the input polyhderon such that the transformed polyhedron will have minimal (or close-to-minimal) vertical span, and such that its lowest point will be at $z = 0$.
We will hold a **contest** between the various teams on the performance of the program of Item (b).

Exercise 2.2: Printing on a color plaster printer

Design or find a model of a 3D object, aiming to take advantage of the fact that the printing technology does not require support, and that the printer prints in full color. Apply the software of Ex. 2.1 to transform the model such that its maximum z-coordinate is minimized (possibly only approximately minimized). Also, scale the model down such that the entire model will fit inside a cube of edge size 100mm (not necessarily tightly). Make sure your model includes the colors. The output of this exercise is a file with a digital model suitable for printing on 3D Systems' Projet 660.