Geometric Tools for Computer Graphics - MIRI
Lab exercise 1
Year 2019-2020

Consider the cube centered at the origin and whose edges have length 2 and are axis parallel. Let us truncate the cube in the following way: consider its vertex $v = (1, 1, 1)$, compute the midpoints of all edges incident to v, and replace v by the new triangular face resulting from connecting the midpoints. We will call the resulting heptahedron a *cropped cube*. It is illustrated in the figure below.

1. Describe and visualize the cropped cube. We will call this cropped cube C_1.
2. Consider a vertical unit length segment, s_1, starting at the origin. Place and visualize a unit length segment s_2 on top of the center of the triangular face of C_1, and perpendicular to it. Can you compute s_2 from s_1 by changing coordinate systems? Can you compute s_2 in some other way(s)?
3. Place and visualize a unit length segment s_3 lying on the triangular face of C_1, parallel to one of its edges, and passing through its center. Can you compute s_3 from s_2 or s_1 by changing coordinate systems? Can you compute s_3 otherwise?
4. By changing coordinate systems to C_1, place and visualize a copy C_2 of C_1 with its triangular face facing the floor (i.e., the plane $z = 0$ in SageMath), and above the floor (i.e., all z-coordinates of C_2 need to be non-negative).
5. Without moving C_1 from its position, attach to C_1 a third copy C_3 of the cropped cube, so that their triangular faces match. Visualize the result. Please, solve this problem by changing coordinates.