Polyhedra LaTeX package - v. 0.3

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Abstract

This package provides macros for creating polyhedral objects in 2D and 3D. It requires tikz and tikz-3dplot. The macros provided can be used for drawing vertices, edges, rays, polygons and cones.

1 Introduction

All the drawing commands work with keyword arguments and are the same in 2d and 3D.

2 Functionality

### 2.1 The *polyhedron* environment

The *polyhedron* environment is essentially a wrapper for a tikzpicture environment. It accepts as extra arguments the dimension of the picture (either 2 or 3) and if the dimension is 3, then the arguments for the three angles defining the rotated coordinate system are given. For the 3D coordinate system, we use tikz-plot3d.

```
\begin{polyhedron}{dim=2}
  \axes{x={1,3},y={1,3}}
\end{polyhedron}
```
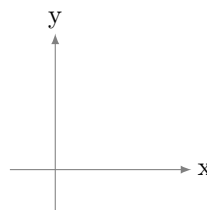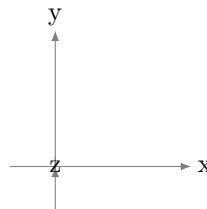
The dimension argument defaults to 2.

```
\begin{polyhedron}{}
  \axes{x={1,3},y={1,3}}
\end{polyhedron}
```
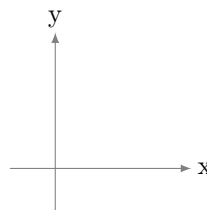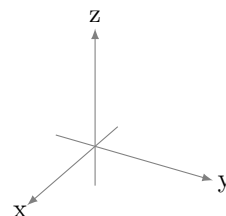
Let us define a 3D polyhedron.

```
\begin{polyhedron}{dim=3
    \axes{x={1,3},y={1,3},z={1,3}}
\end{polyhedron}
```

Since we did not give the angles for the main coordinate system, we get the default tikz xy-plane.

Now lets rotate the coordinate system by 60 degrees around the x-axis and 120 degrees around the z-axis.

```
\begin{polyhedron}{dim=3,phi=60,theta=120}
    \axes{x={1,3},y={1,3},z={1,3}}
\end{polyhedron}
```

2.2   Input

The following macros work within the `polyhedron` environment.

2.2.1   Point.
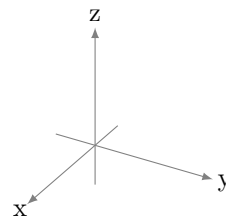
To let A be a point (x,y) or (x,y,z)

```
\point{(x,y,z)}{A}
```

After defining a point, we can use the handle (variable name) A, instead of writing down the coordinates in the macros that follow.

2.2.2   Axes.

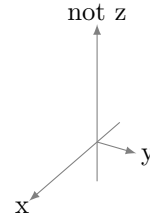We saw already some examples using the *axes* command.

```
\begin{polyhedron}{dim=3,phi=60,theta=120}
    \axes{x={1,3},y={1,3},z={1,3}}
\end{polyhedron}
```

The command takes the following (self-explanatory) arguments. All arguments are optional, defaulting to the ones shown here.

```
x={0,1},y={0,1},z={},xlabel={x},ylabel={y},zlabel={z},labels={true}
```

```
\begin{polyhedron}{dim=3,phi=60,theta=120}
  \axes{x={1,3},z={1,3},zlabel={not z}}
\end{polyhedron}
```

2.3   Drawing commands

All drawing commands accept the following options:

color The color of the polyhedral object to draw.

status The status of the object. The possible values are:

- normal
- focus
- alert
- open

opacity The opacity of the object.

thickness The width of the lines

pattern The draw pattern

2.3.1   Vertex

The *vertex* command is used to draw a vertex at a point (x,y,z) or A. The standard options of color, status, opacity, thickness and pattern apply. The extra options for vertex are:

point sets the coordinates of the vertex and it can be either a tikz coordinate tuple or a point already defined.

text The text of the vertex label.

textcolor The color of the label's text.

anchora The label anchor relative to the vertex: north, south, east, west

anchorb The text's anchor relative to the label: above, below, right, left

```
\begin{polyhedron}{}
  \vertex{point={0,0},status=normal}
  \vertex{point={1,0},status=alert}
  \vertex{point={2,0},status=open}
  \vertex{point={3,0},color=red,pattern={north west lines}}
  \vertex{point={4,0},color=orange,text={A}}
\end{polyhedron}
```

2.3.2 Edges and Rays

The command *edge* is used to draw an edge from point A to point B. The extra arguments are:

points sets the coordinates of the vertices of the edge. It is a list of (two) points in {}.

```
\begin{polyhedron}{}
  \edge{points={(0,0),(2,2)},status=alert}
  \edge{points={(0,0),(2,3)},status=focus}
  \edge{points={(0,0),(2,4)},status=open}
  \edge{points={(0,0),(2,5)},color=orange}
  \edge{points={(0,0),(2,6)},status=normal}
  \edge{points={(2,1),(3,3)},thickness=3}
  \edge{points={(4,1),(3,3)},pattern={dotted}}
\end{polyhedron}
```
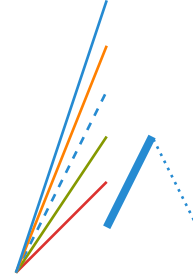
Similarly, the command *ray* draw a ray. The options are exactly the same as for edge. Note that the sequence in which the points are given matters.

```
\begin{polyhedron}{}
  \ray{points={(0,0),(2,2)},status=alert}
  \ray{points={(0,0),(2,3)},status=focus}
  \ray{points={(0,0),(2,4)},status=open}
  \ray{points={(0,0),(2,5)},color=orange}
  \ray{points={(0,0),(2,6)},status=normal}
  \ray{points={(2,1),(3,3)},thickness=3}
  \ray{points={(4,1),(3,3)},pattern={dotted}}
\end{polyhedron}
```
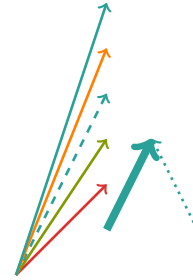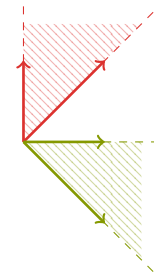
2.3.3 Cone

The command *cone* is used to draw a polyhedral cone. The extra arguments are:

vertex Sets the apex of the cone.

generators A list of points

openeness A list of boolean values declaring the openness of a simplicial cone.
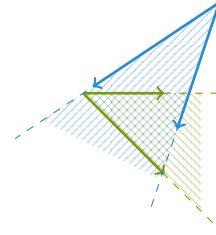
```
\begin{polyhedron}{}
  \cone{vertex={(0,0)}, generators={(0,2),(2,2)},
    status=alert}
  \cone{vertex={(0,0)}, generators={(2,0),(2,−2)},
    status=focus}
\end{polyhedron}
```

```
\begin{polyhedron}{}
  \cone{vertex={(0,0)}, generators={(2,0),(2,−2)},
    status=focus}
  \cone{vertex={(3,2)},generators={(0,0),(2,−1)},
    pattern={north east lines}}
\end{polyhedron}
```

2.3.4 Polygon

The command *polygon* is used to draw a 2-dimensional polytope in 2D or 3D. Attention must be paid in the sequence of the points given. The command does not take the convex hull, but rather draws the polygonal line defined by the sequence of points.

The extra arguments are:

points The vertices of the cone.

boundary True or False, for drawing or not the boundary of the polygon.

```
\begin{polyhedron}{}
  \polygon{points={(0,2),(2,2),(2,0)},status=alert}
  \polygon{points={(0,−2),(−2,−2),(−2,0)},status=open}
  \polygon{points={(0,1),(0,0),(1,0),(1,1)},status=open,
      boundary=false,color=orange}
\end{polyhedron}
```

3 Known limitations and errors