Internship Goals for Robert Savu

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1 Reading FreeCAD documents

Given a document containing a FreeCAD design (typically a *.fcstd-file) we want to import it into Hets. This requires the following:

Abstract Syntax: an appropriate representation in Hets for FreeCAD designs, i.e., the FreeCAD abstract syntax (mostly done)

Semantics: FreeCAD terms should have a semantics in the sense of 3D Pointsets (see section 1.1)

Import: an import method translating FreeCAD documents into this representation (partly done, has to be integrated into one method)

Hets Integration: a complete integration of the FreeCAD logic into the Hets logic-graph (partly done, signature and simple static analysis missing)

Hets tool: a hook into the hets program to open FreeCAD documents from there, i.e., `hets -g test.fcstd` should work

Pretty printing for basic FreeCAD specs, i.e., `Pretty`-instances for the FreeCAD abstract syntax

1.1 Semantics

We first give the semantics of some base objects such as rectangles, boxes, and cylinders. The goal is to specify the semantics for each of the base objects used in the abstract syntax of FreeCAD and also for the transformation by rotations and translations as well as for compound objects such as `Cut`, `Common`, `Fusion`, etc..

$$
\begin{aligned}
[\![Rectangle(w,l)]\!] &= \text{The set consisting of the four sides of the} \\
&\qquad \text{rectangle in the x-y-plane} \\
&= \{(x,y,0) \mid x \in [0,l], y \in \{0,w\}\} \\
&\quad \cup \{(x,y,0) \mid x \in \{0,l\}, y \in [0,w]\} && (1) \\
[\![Box(h,l,w)]\!] &= \text{The solid bounded by the faces of the box} \\
&= [0,l] \times [0,w] \times [0,h] && (2) \\
[\![Cylinder(a,h,r)]\!] &= \text{The ``pac-man'' cylinder along z-axis} \\
&= circle \times [0,h] && (3) \\
\text{where } circle &= \{(\rho \cdot cos(\alpha), \rho \cdot sin(\alpha)) \mid \alpha \in [0,a], \rho \in [0,r]\} \\
[\![Sphere(a_1,a_2,a_3,r)]\!] &= \{(x,y,z) \mid x+y+z \leq r\} \cap \\
&\{(\rho \cdot cos(\alpha), \rho \cdot sin(\alpha), z) \mid z \in [sin(a_1), sin(a_2)].\rho \in [0,\infty], \alpha \in [0,a_3]\} \\
& && (4) \\
[\![Cone(a,r_1,r_2,h)]\!] &= \{(\rho \cdot cos(\alpha), \rho \cdot sin(\alpha), z) \mid \rho \leq r_1 + \frac{z}{h} \cdot (r_2 - r_1).z \in [0,h], \alpha \in [0,a]\} \\
& && (5) \\
[\![Torus(a_1,a_2,a_3,r_1,r_2)]\!] &= \{(x,y,z)\} \cup \{(x_2,y_2,z_2)\} \\
&\text{where:} \\
&circle = \{(\rho \cdot cos(\alpha), \rho \cdot sin(\alpha)) \mid \alpha \in [a_1,a_2], \rho \in [0,r_2]\} \\
&(rad,z) \in \{(m,n) \mid (-(m-r_1),n) \in circle\} \\
&x = rad \cdot cos(ang) \\
&y = rad \cdot sin(ang) \\
&ang \in [0,a_3] \\
&\text{if } (a_1 \geq -180)\text{or}(a_2 \leq 180)\text{then} \\
&(x_2, y_2, z_2 - r_2 \cdot sin(a_1)) \in \\
&[\![Cone(a_3, r_1 - r_2 \cdot cos(a_1), r_1 - r_2 \cdot cos(a_2), sin(a_2) - sin(a_1))]\!] \\
& && (6) \\
[\![Circle(sa,ea,r)]\!] &= \{(x,y,z) \mid x = r \cdot cos(\alpha), y = r \cdot sin(\alpha), z = 0, \alpha \in [sa,ea]\} \\
& && (7) \\
& && (8)
\end{aligned}
$$

Figure 1: Set semantics for some baseobjects