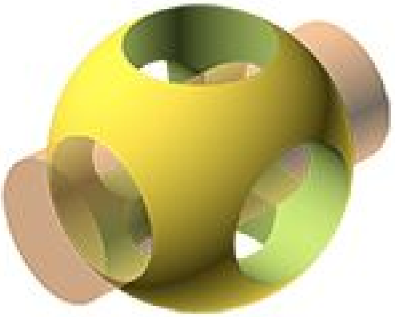
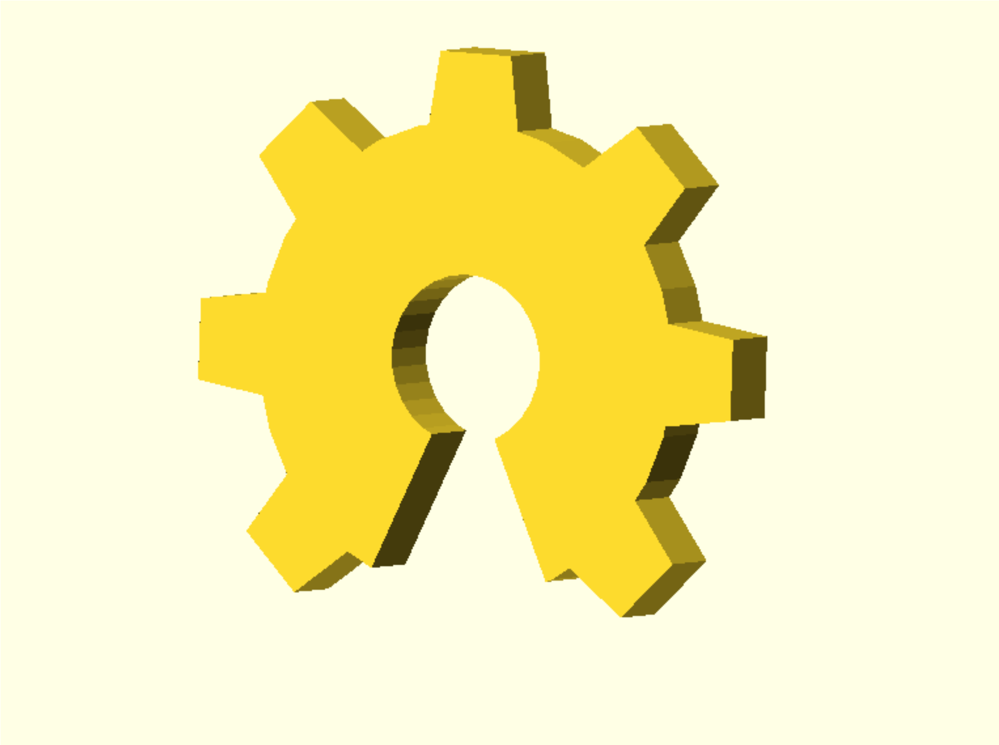
Quick Introduction to OpenSCAD

Joshua M. Pearce
Department of Materials Science & Engineering and
Department of Electrical & Computer Engineering,
Michigan Technological University, Houghton, MI, USA



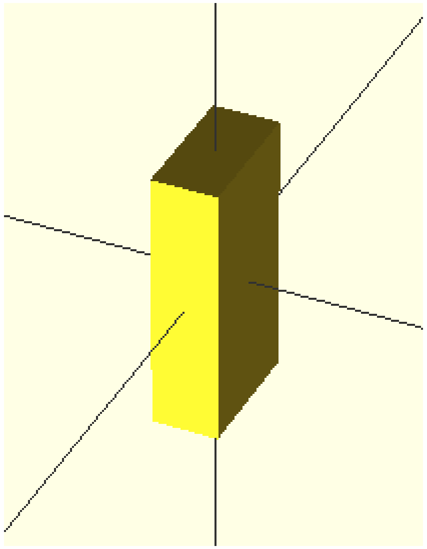
OpenSCAD
The Programmers Solid 3D CAD Modeller

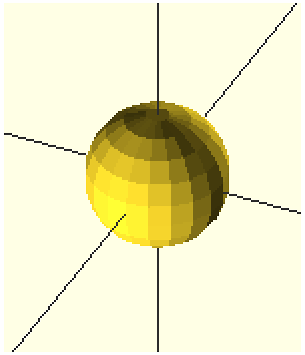


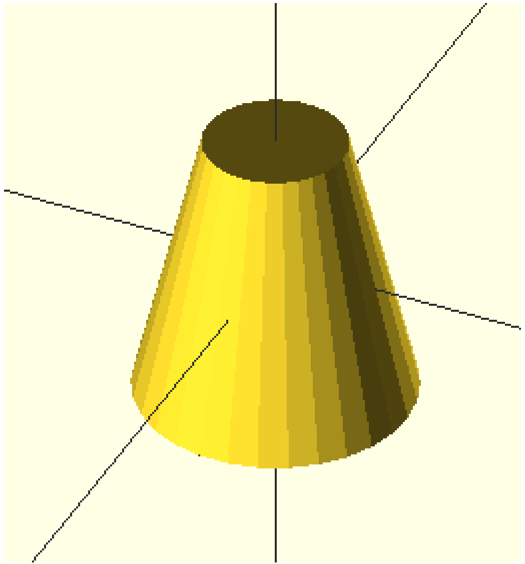
Michigan Tech
Michigan Technological University
Open Sustainability Technology
Research Group

Primitive Objects

```
a=5;
b=10;
c=20;

cube([a,b,c], center=true);
sphere(a, $fn=c);
//$fn is the resolution
cylinder(h = c, r1 = b, r2 = a, center = true);
```



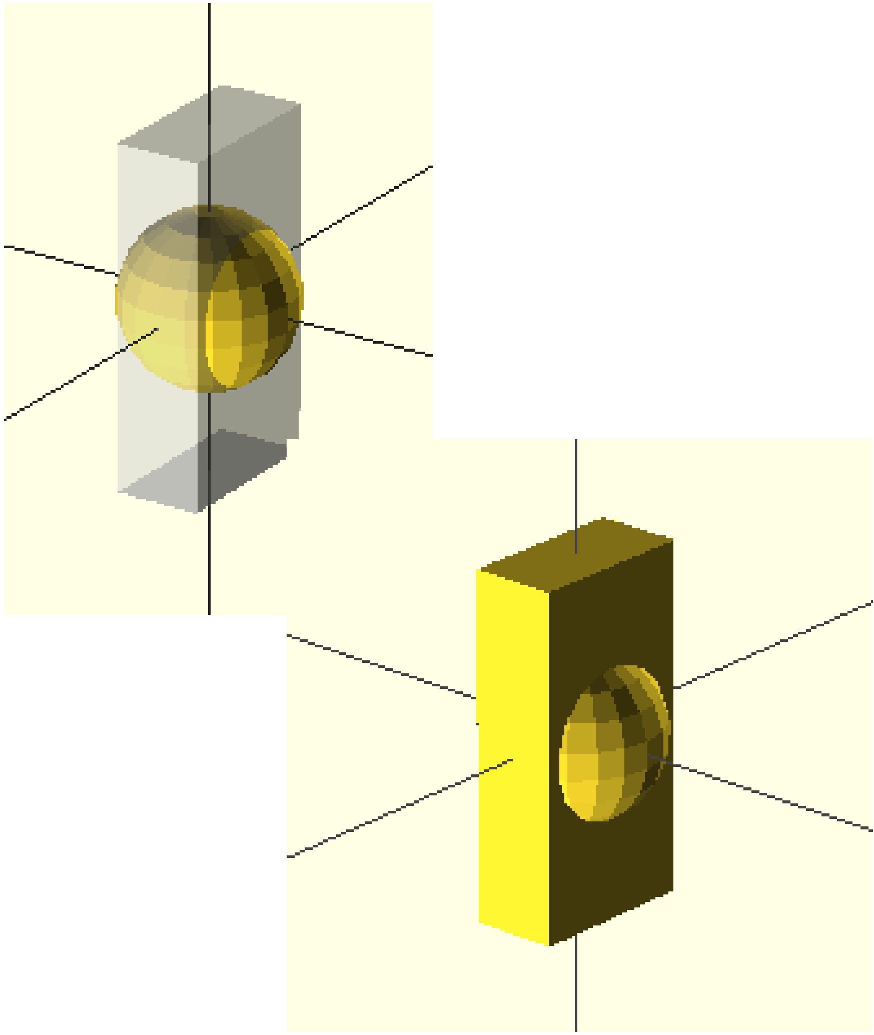




Union Combining Primitives

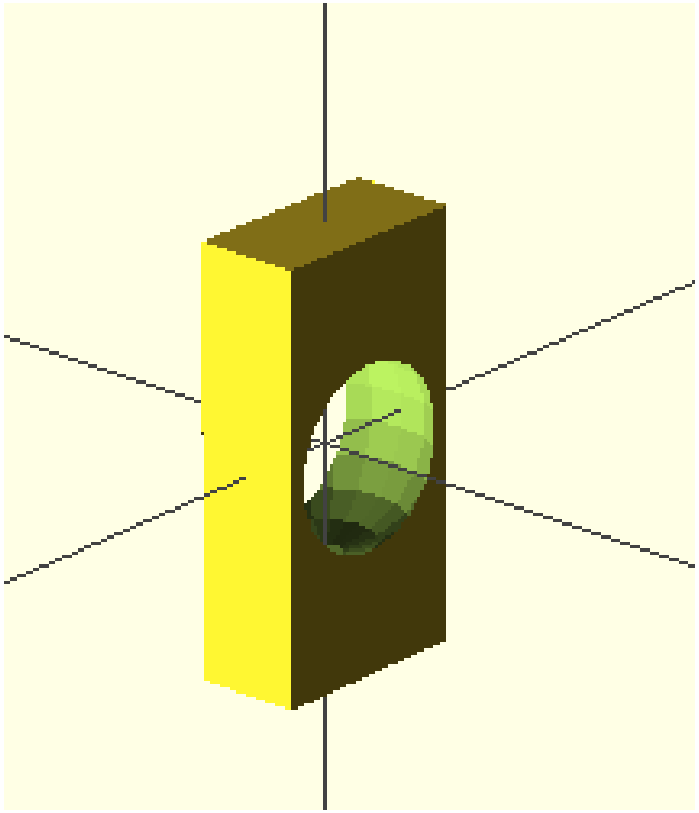
“Try before you Buy”=%

```
union(){
%cube([a,b,c], center=true);
sphere(a, $fn=c);
}
```



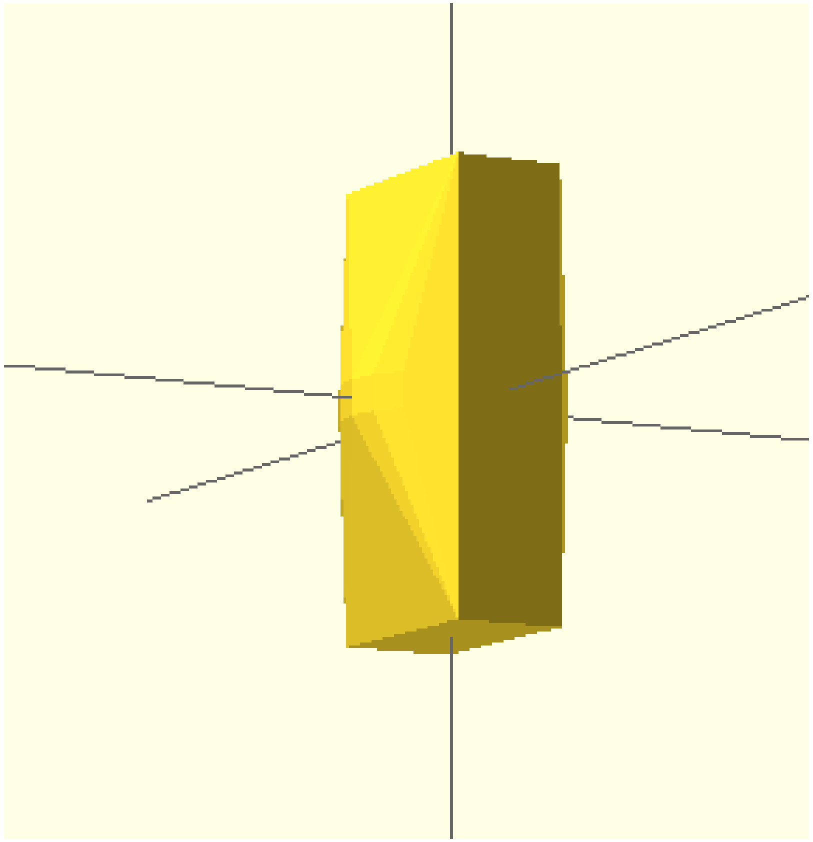
Difference

```
difference(){
cube([a,b,c], center=true);
sphere(a, $fn=c);
}
```



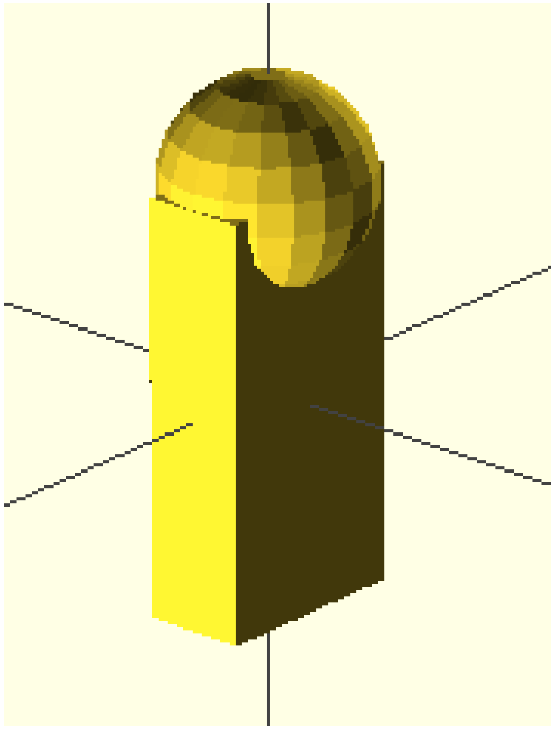
Hull

```
hull(){
cube([a,b,c], center=true);
sphere(a, $fn=c);
}
```



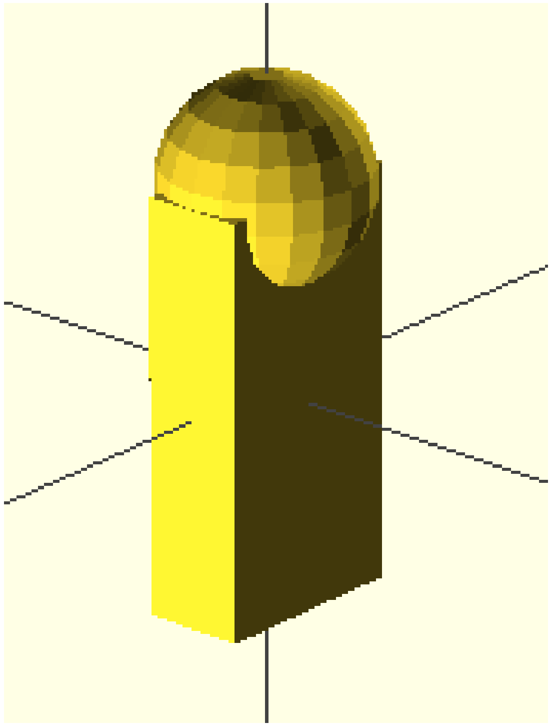
Moving Stuff Around

```
union(){
cube([a,b,c], center=true);
translate([0,0,b])sphere(a, $fn=c);
    }
```



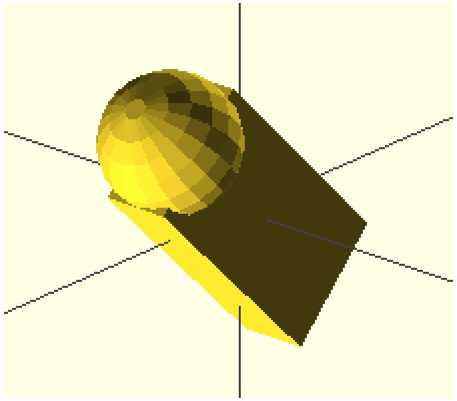
Modules

```
module example(){
union(){
cube([a,b,c], center=true);
translate([0,0,b])sphere(a,
   $fn=c);
}
}


example();
```

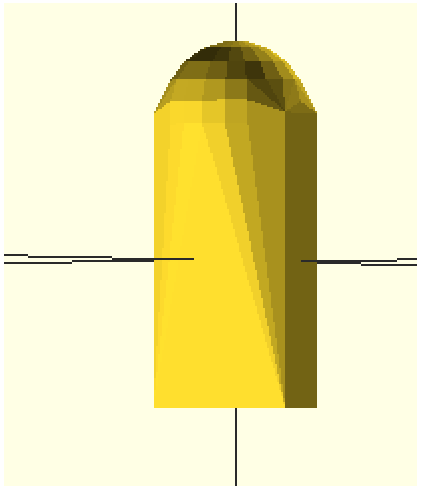


Manipulate Your Module

```
rotate([45,0,0])example();
```

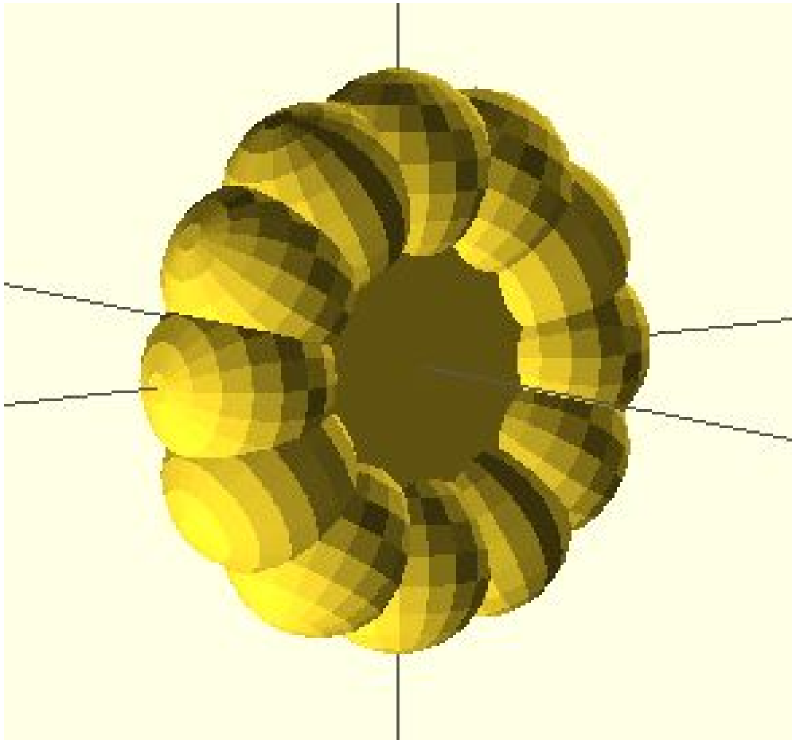


```
hull() {
example();
}
```



Loops

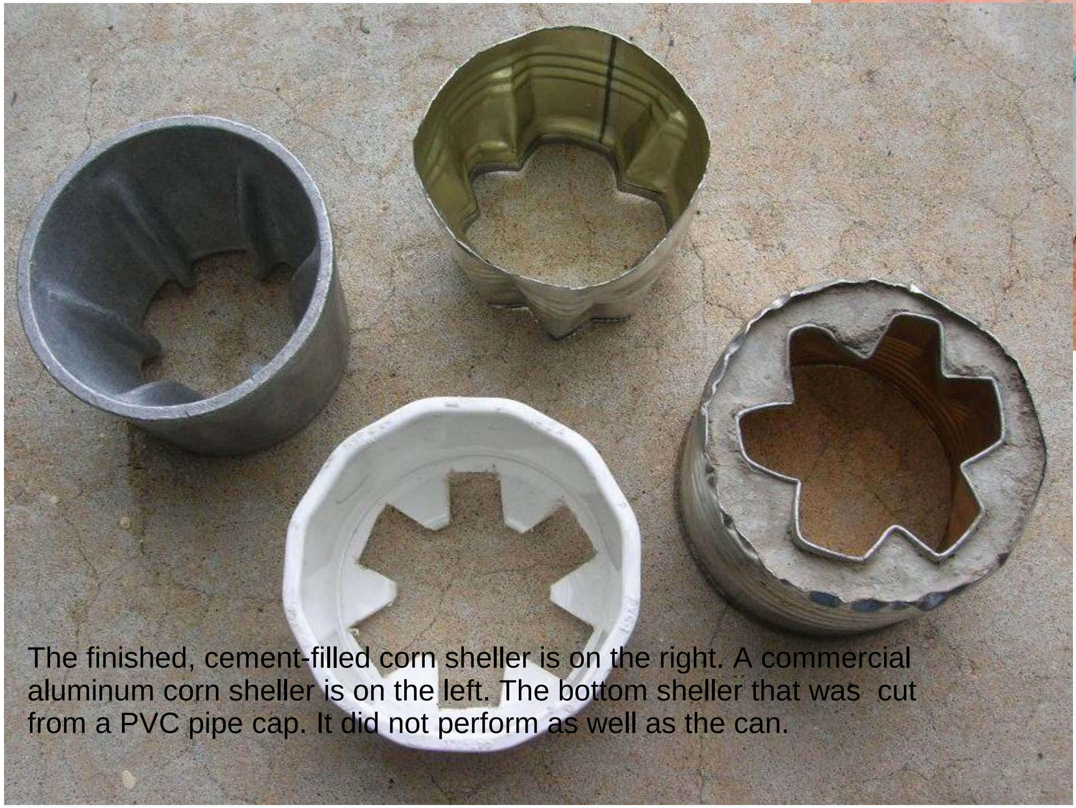
```
for (i = [1:12])
{
    assign (angle = i*30)
    {
        rotate(angle, [1,0,0])
  example();
    }
}
```



Michigan Technological University
Open Sustainability Technology
Research Group

Putting it All Together to Make Something Useful

Shelling corn is a chore done by hand in much of the rural developing world. Yet there are handy corn shellers that can save people hours of labor. DIY shellers are a big chore to make...so you can print one.



The finished, cement-filled corn sheller is on the right. A commercial aluminum corn sheller is on the left. The bottom sheller that was cut from a PVC pipe cap. It did not perform as well as the can.

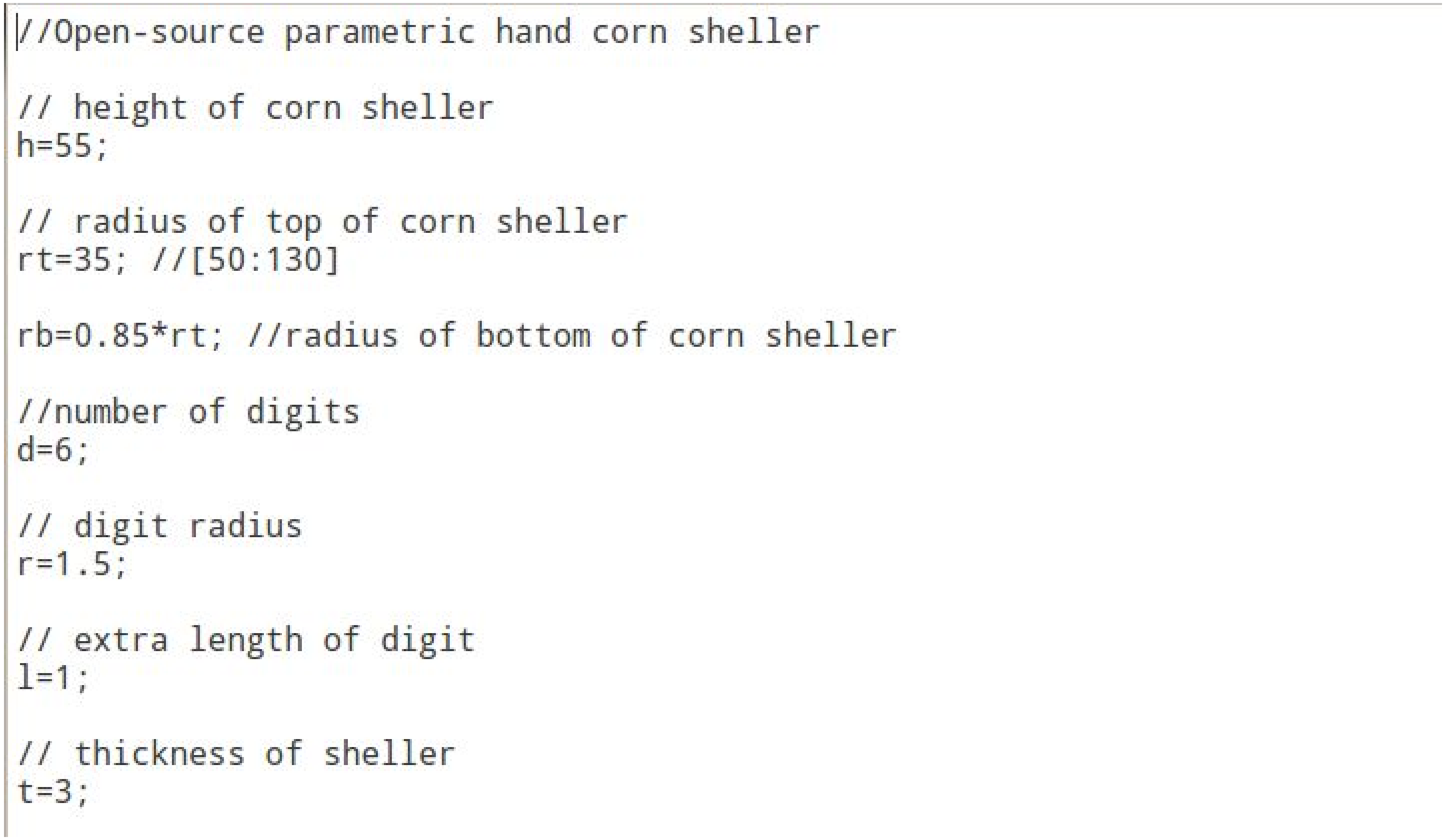
Michigan Tech

Michigan Technological University

Open Sustainability Technology Research Group

Parametric – Design ALL of the Products at Once

Lay out variables with comments to input to Customzier



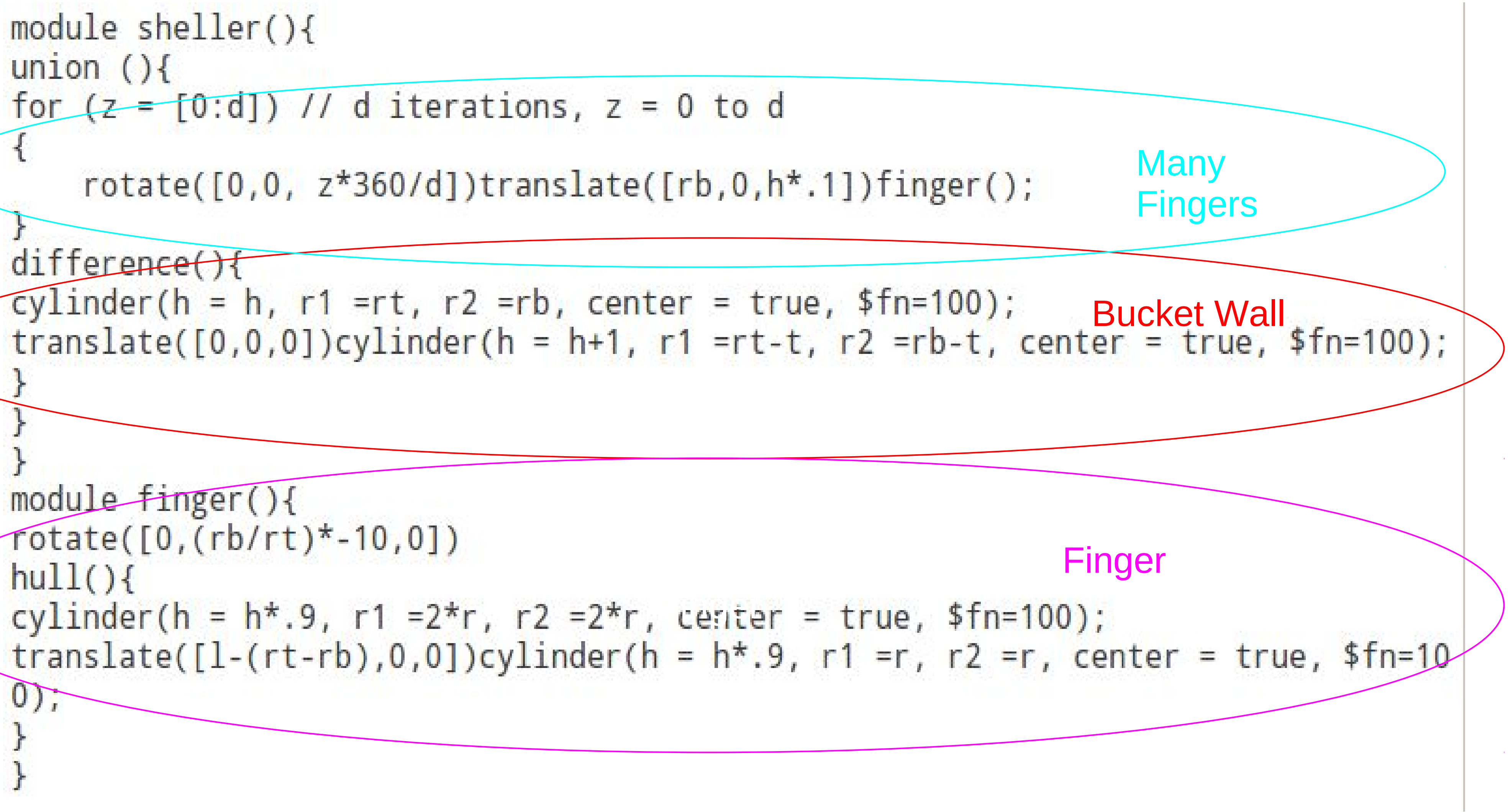
```
//Open-source parametric hand corn sheller

// height of corn sheller
h=55;

// radius of top of corn sheller
rt=35; //[50:130]

rb=0.85*rt; //radius of bottom of corn sheller

//number of digits
d=6;

// digit radius
r=1.5;

// extra length of digit
l=1;

// thickness of sheller
t=3;
```

Michigan Tech

Michigan Technological University

Open Sustainability Technology
Research Group

Using Modules



```
module sheller(){
union (){
for (z = [0:d]) // d iterations, z = 0 to d
{
    rotate([0,0, z*360/d])translate([rb,0,h*.1])finger();
}
difference(){
cylinder(h = h, r1 =rt, r2 =rb, center = true, $fn=100);
translate([0,0,0])cylinder(h = h+1, r1 =rt-t, r2 =rb-t, center = true, $fn=100);
}
}
}
module finger(){
rotate([0,(rb/rt)*-10,0])
hull(){
cylinder(h = h*.9, r1 =2*r, r2 =2*r, center = true, $fn=100);
translate([l-(rt-rb),0,0])cylinder(h = h*.9, r1 =r, r2 =r, center = true, $fn=10
0);
}
}
```

Many Fingers

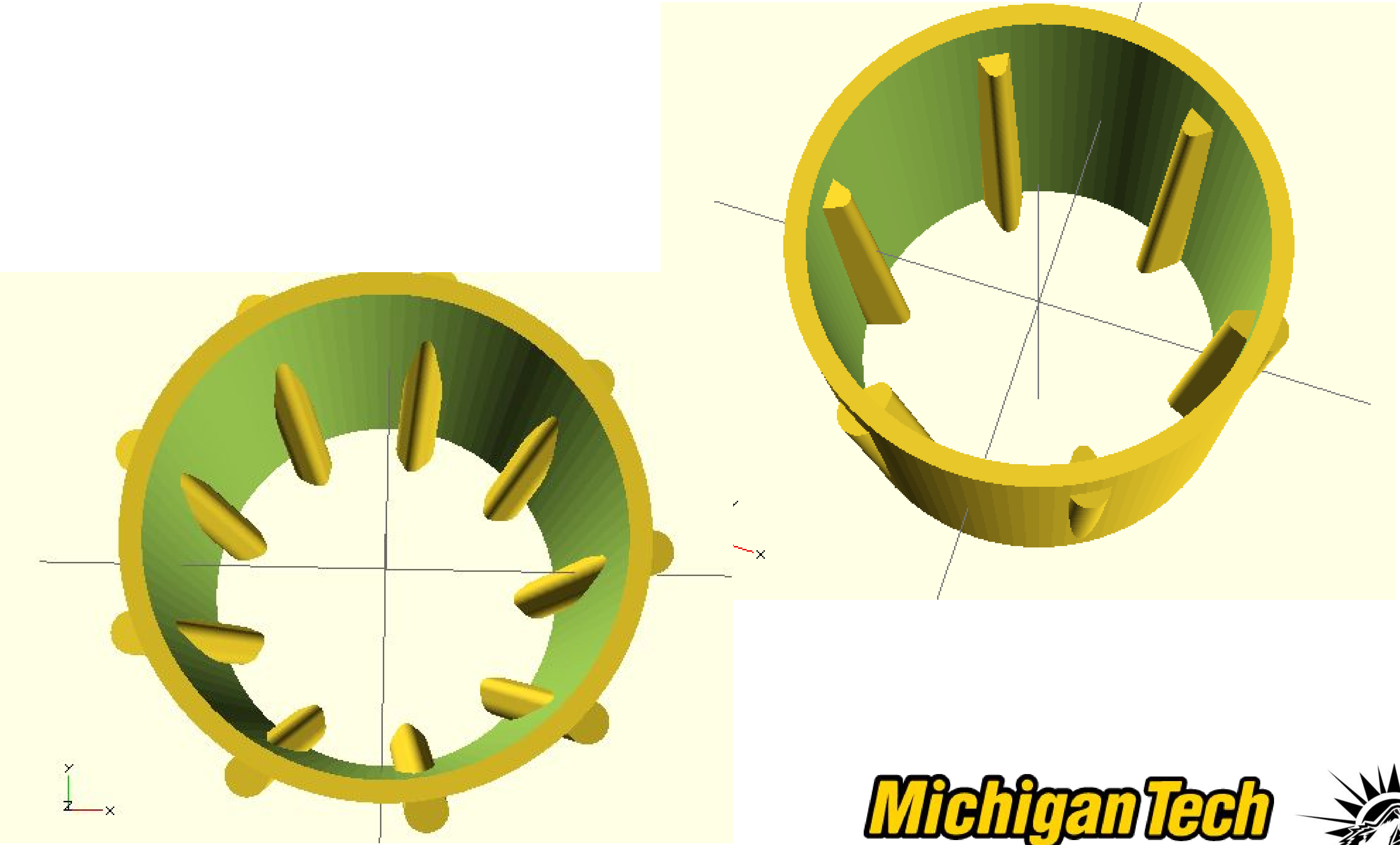
Bucket Wall

Finger

Best practices:
Indent to see,
comment everything
$fn=100 once

Michigan Tech
Michigan Technological University
Open Sustainability Technology
Research Group

Parametric Corn Sheller

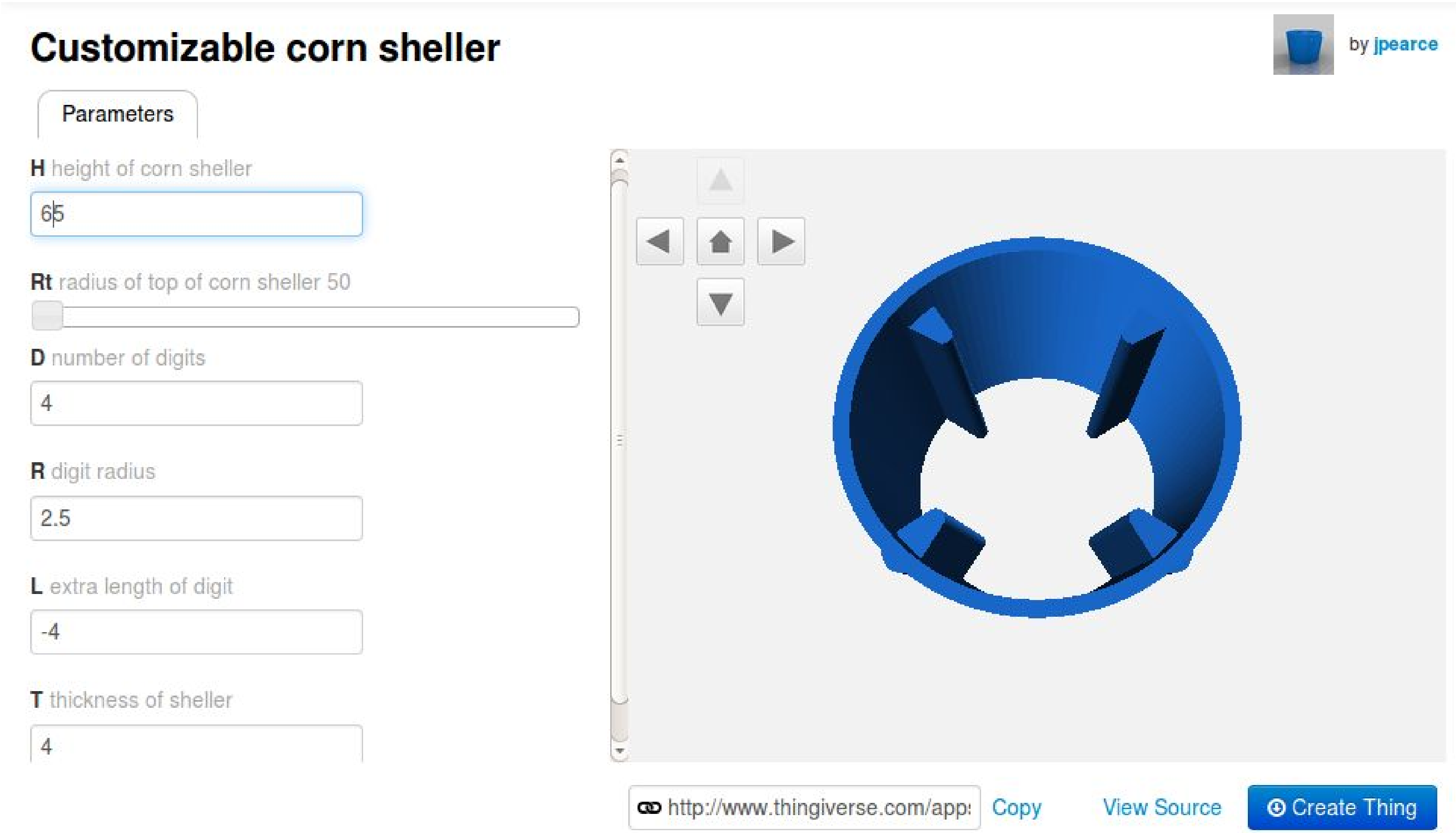


Michigan Tech

Michigan Technological University

Open Sustainability Technology
Research Group

Thingiverse Customizer



Customizable corn sheller

by jpearce

Parameters

H height of corn sheller

65

Rt radius of top of corn sheller 50

D number of digits

4

R digit radius

2.5

L extra length of digit

-4

T thickness of sheller

4

http://www.thingiverse.com/app:

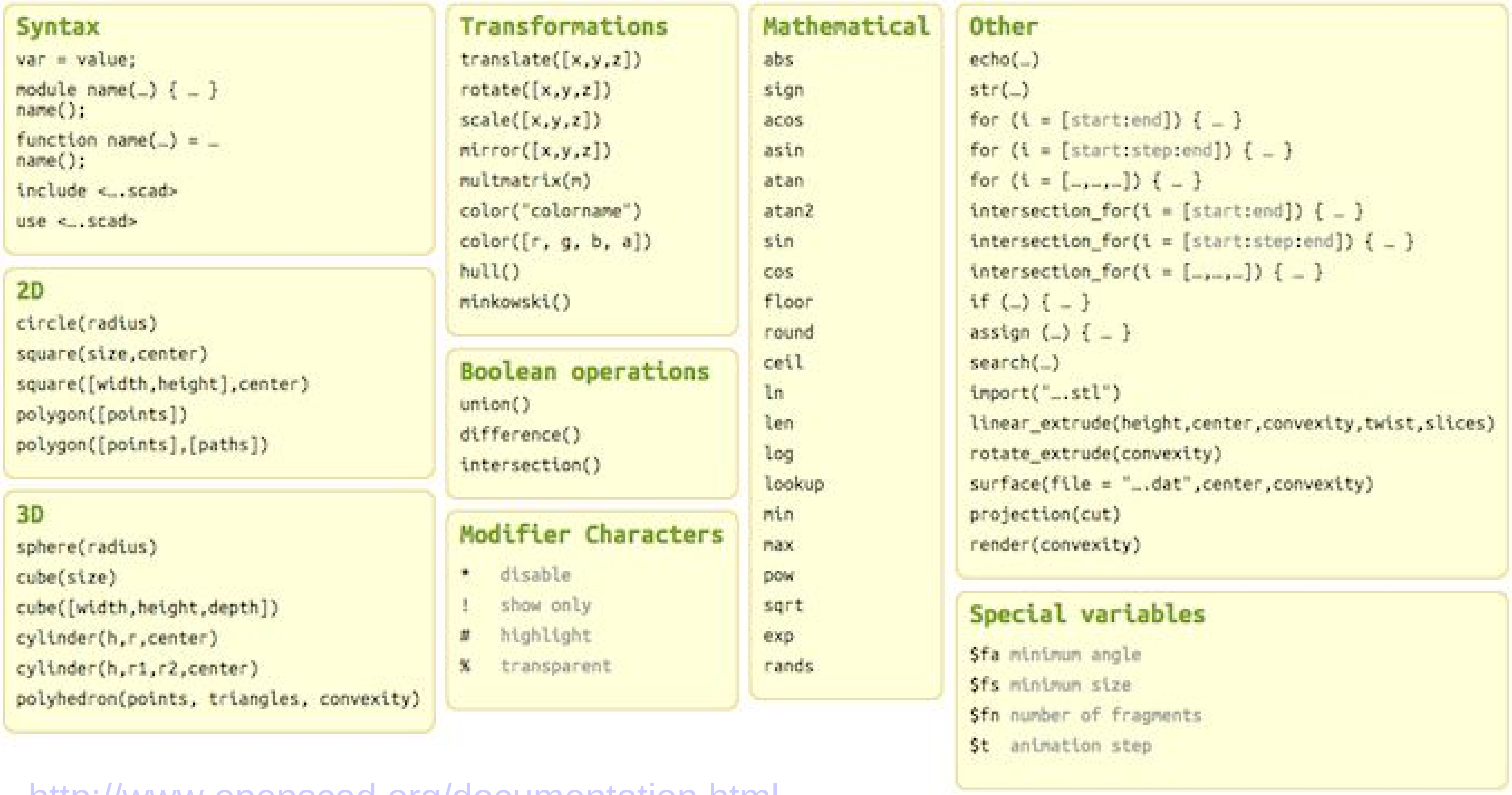
Anyone can make a corn sheller perfect for them with no coding.

Michigan Tech

Michigan Technological University

Open Sustainability Technology
Research Group

Cheat Sheet



Syntax

```
var = value;
module name(…) { … }
name();
function name(…) = …
name();
include <….scad>
use <….scad>
```

2D

```
circle(radius)
square(size,center)
square([width,height],center)
polygon([points])
polygon([points],[paths])
```

3D

```
sphere(radius)
cube(size)
cube([width,height,depth])
cylinder(h,r,center)
cylinder(h,r1,r2,center)
polyhedron(points, triangles, convexity)
```

Transformations

```
translate([x,y,z])
rotate([x,y,z])
scale([x,y,z])
mirror([x,y,z])
multmatrix(m)
color("colorname")
color([r, g, b, a])
hull()
minkowski()
```

Boolean operations

```
union()
difference()
intersection()
```

Modifier Characters

```
*   disable
!   show only
#   highlight
%   transparent
```

Mathematical

```
abs
sign
acos
asin
atan
atan2
sin
cos
floor
round
ceil
ln
len
log
lookup
min
max
pow
sqrt
exp
rands
```

Other

```
echo(…)
str(…)
for (i = [start:end]) { … }
for (i = [start:step:end]) { … }
for (i = […,…,…]) { … }
intersection_for(i = [start:end]) { … }
intersection_for(i = [start:step:end]) { … }
intersection_for(i = […,…,…]) { … }
if (…) { … }
assign (…) { … }
search(…)
import("….stl")
linear_extrude(height,center,convexity,twist,slices)
rotate_extrude(convexity)
surface(file = "….dat",center,convexity)
projection(cut)
render(convexity)
```

Special variables

```
$fa minimum angle
$fs minimum size
$fn number of fragments
$t  animation step
```

http://www.openscad.org/documentation.html

Michigan Technological University
Open Sustainability Technology
Research Group

Thank you!

More information

- http://www.openscad.org/
- http://en.wikibooks.org/wiki/OpenSCAD_User_Manual
- http://www.appropedia.org/MOST
- http://reprap.org/
- pearce@mtu.edu

Michigan Tech
Michigan Technological University
Open Sustainability Technology
Research Group