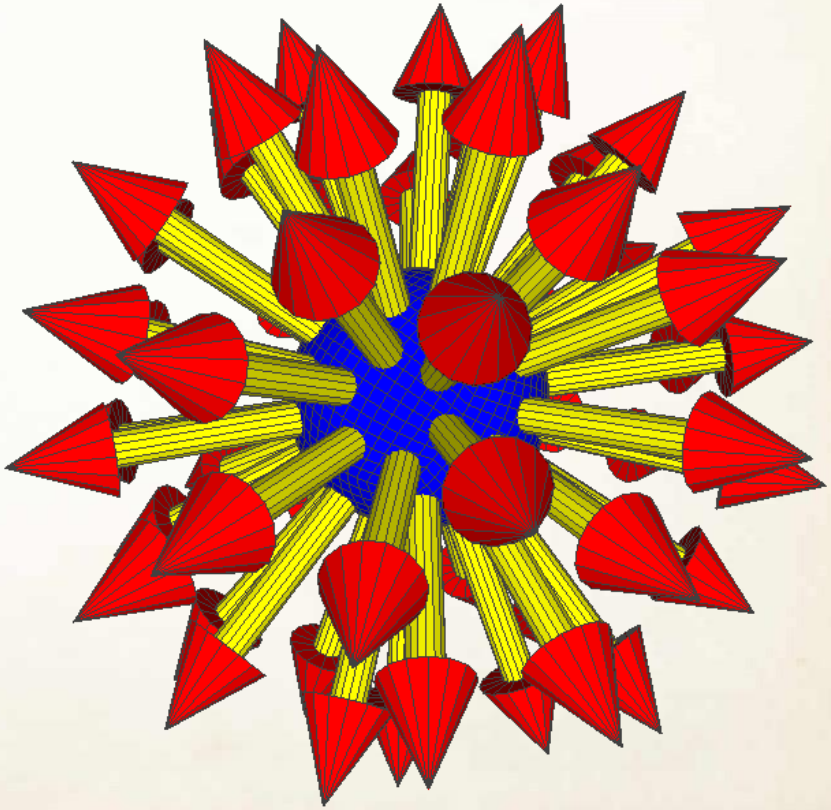
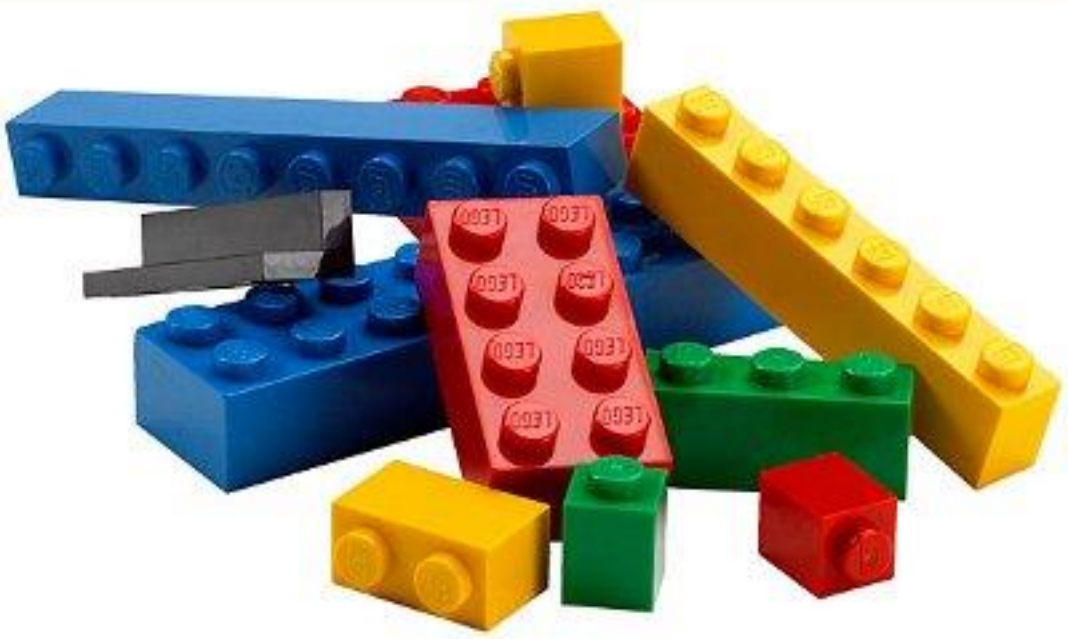
Duomenų struktūros ir algoritmai

12 paskaita



2019-05-08

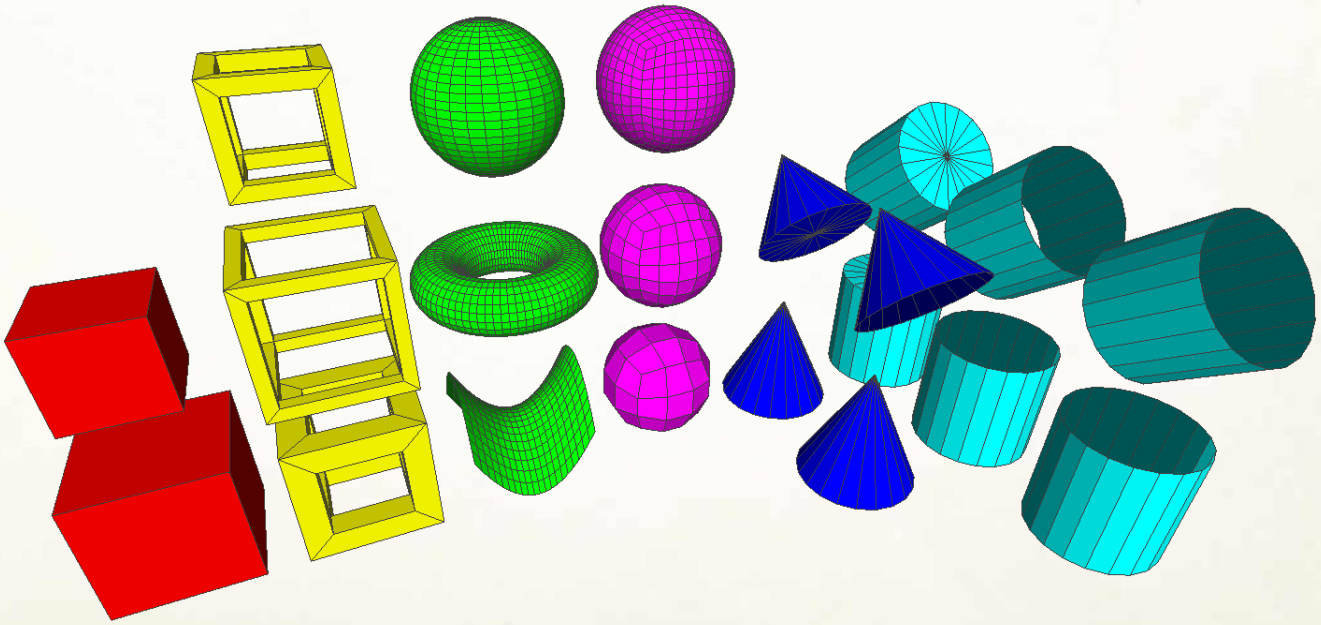
Norint kažką sukonstruoti, reikia...



turėti detalių.

13 paskaitos tikslas

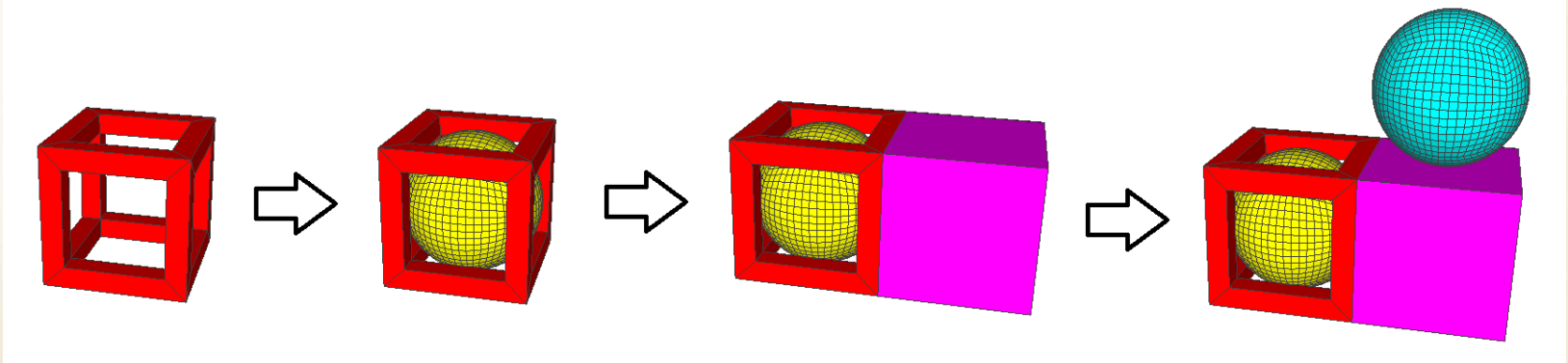
- Susipažinti su *python* modulio ***add.py*** *1.1 versija.*
- Sukurti skaitmeninį modelį naudojantis šiuo moduliu:



- Įkelti sukurtą 3D modelį į https://sketchfab.com svetainę.

python modulis ***add.py***

- Naujas modulis!
- Modulis pritaikytas kurti 3D skaitmeninius modelius **OFF** formatu.
- Modelio kūrimas vyksta konstravimo principu:



Pagrindinė idėja

Į sąrašą *vertices* įrašomos viršūnių koordinatės *string* pavidalu, į sąrašą *faces* įrašoma informacija apie kiekvieną 3D modelio sieną irgi *string* pavidalu. Šios informacijos užtenka norint sugeneruoti 3D modelį OFF formatu.

```
vertices = []
faces = []

<...>

def off(mesh):
  global vertices, faces
  file = open(mesh, 'w')
  file.write('%s\n%d %d %d\n' % ('OFF',len(vertices),len(faces),0))
  for i in range (len(vertices)):
    file.write('%s\n' % vertices[i])
  for j in range (len(faces)):
    file.write('%s\n' % faces[j])
  file.close()
```

*Modulio **add.py** funkcijos*

- **def cube(c,e,RGB):** # c = center, e = edge width
- **def cube2(c,e,b,RGB):** # c = center, b = border width, e = edge width
- **def parametric(S,min_u,max_u,grid_u,min_v,max_v,grid_v,RGB):** # S - parametric uv surface, grid - detail, RGB - color
- **def sphere(c,r,k,RGB):** # c - center, r - radius, k - detail, RGB - color
- **def cylinder(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color
- **def cylinder2(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color
- **def cylinder3(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color
- **def cone(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color
- **def cone2(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color
- **def off(mesh):** # mesh – off file

*Modulio **add.py** 1.1 versija*

- **def newface(A,RGB):** # A = set of 3D points
- **def pyramid(c,e,h,RGB):** # c - center, e - edge width, h - high
- **def rectangle3D(c,e,RGB):** # c - center, e - width of edges
- **def circle(A,B,r,k,RGB):** # A - start point, B - end point, r - radius, k - detail
- **def spin3D(A,B,S,min_t,max_t,grid_t,k,RGB):** # A - start point, B - end point, r - radius, k - detail, RGB - color, S – parametric function

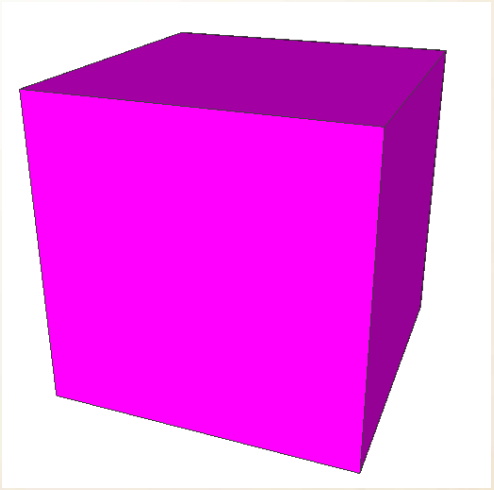
def cube(c, e, RGB)

```
def cube(c,e,RGB): # c - center, e - edge width, RGB - color
  global vertices, faces
  F = [[0,4,5,1],[0,1,3,2],[0,2,6,4],[1,5,7,3],[2,3,7,6],[4,6,7,5]]
  V = [[0,0,0],[0,0,e],[0,e,0],[0,e,e],[e,0,0],[e,0,e],[e,e,0],[e,e,e]]
  for i in range (0,6):
    faces += ['4 '+str(F[i][0]+len(vertices))+' '+str(F[i][1]+len(vertices))+
    ' '+str(F[i][2]+len(vertices))+' '+str(F[i][3]+len(vertices))+
    ' '+str(RGB[0])+' '+str(RGB[1])+' '+str(RGB[2])]
  for j in range (0,8):
    vertices += [str(c[0]+V[j][0]-e/2)+' '+str(c[1]+V[j][1]-e/2)+
    ' '+str(c[2]+V[j][2]-e/2)]
```

c – centro 3D koordinatės, e – briaunos ilgis,
RGB – kubo spalva.

cube.py generuoja cube.off failą:

```
1  import add
2  add.cube([1,0,0],1,[255,0,255])
3  add.off('cube.off')
```



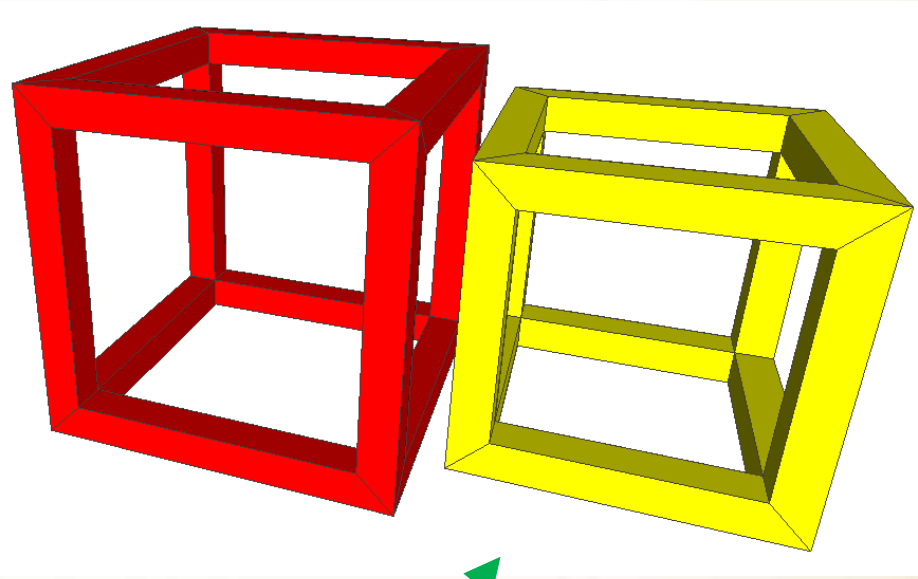
def cube2(c, e, b, RGB)

c – centro 3D koordinatės,

e – briaunos ilgis,

b – briaunos storis,

RGB – kubo spalva.

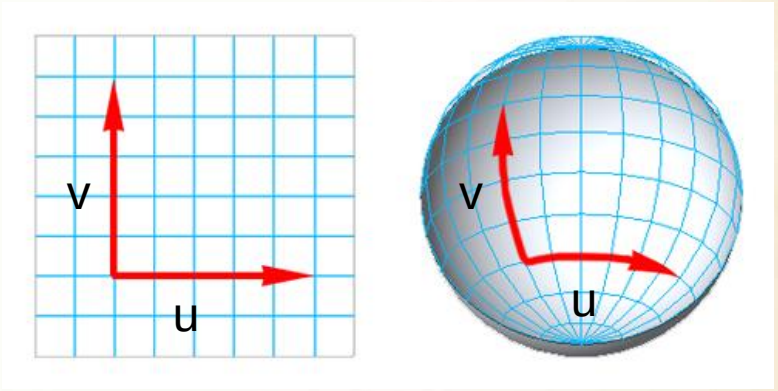


cube2.py generuoja cube2.off failą:

```
1  import add
2  add.cube2([1,0,0],1,0.1,[255,0,0])
3  add.cube2([2,0,0],0.8,0.1,[255,255,0])
4  add.off('cube2.off')
```

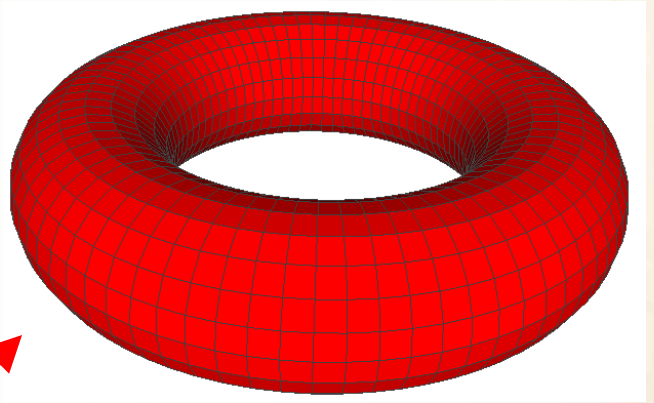
def parametric(S, min_u, max_u, grid_u, min_v, max_v, grid_v, RGB)

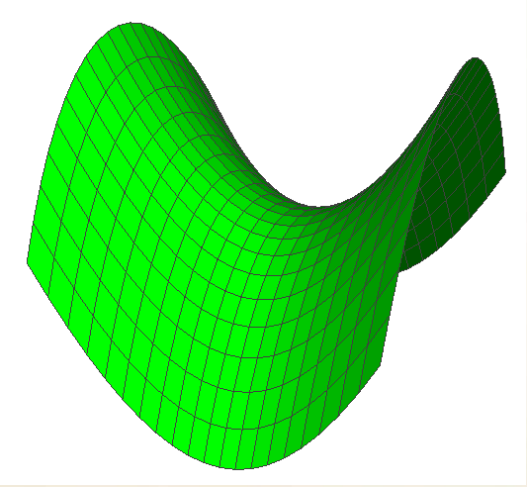
S – parametrinio uv paviršiaus f-ja,
min_u – parametro u mažiausia reikšmė,
max_u – parametro u didžiausia reikšmė,
grid_u – paviršiaus detalumas u atžvilgiu,
min_v – parametro v mažiausia reikšmė,
max_v – parametro v didžiausia reikšmė,
grid_v – paviršiaus detalumas v atžvilgiu,
RGB – paviršiaus spalva.



Parametrinių paviršių pavyzdžiai

```
1  import add
2  def saddle(u,v):
3    x = u
4    y = v*v - u*u
5    z = -v
6    return ([x, y, z])
7  add.parametric(saddle,-1,1,20,-1,1,20,[0,255,0])
8  add.off('saddle.off')
```





```
1  import add
2  import math
3  a = 3
4  b = 1
5  def torus(u,v):
6    x = (a+b*math.cos(u))*math.cos(v)
7    y = b*math.sin(u)
8    z = (a+b*math.cos(u))*math.sin(v)
9    return ([x, y, z])
10 add.parametric(torus,0,2*math.pi,20,0,2*math.pi,80,[255,0,0])
11 add.off('torus.off')
```

def sphere(c, r, k, RGB)

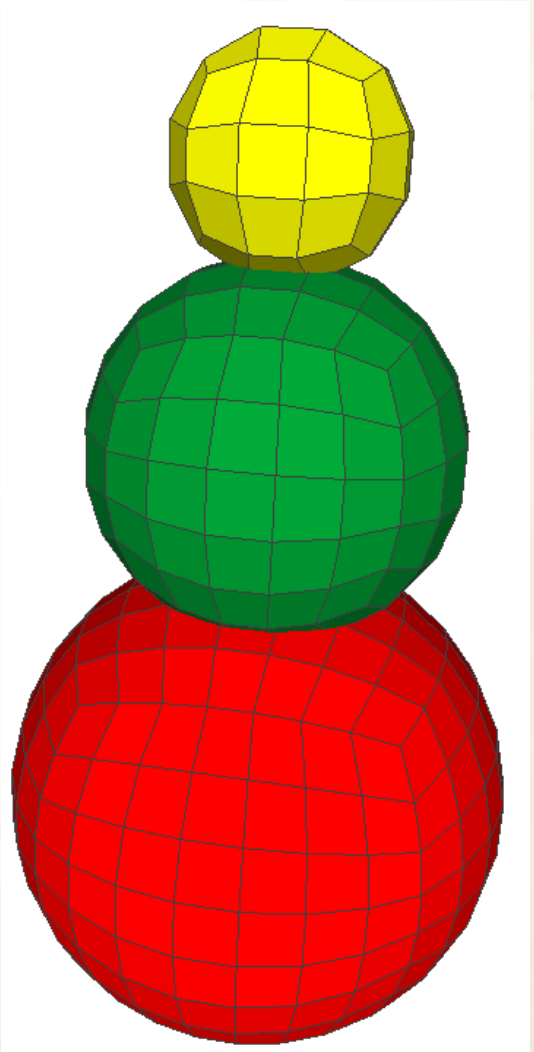
c – centro 3D koordinatės,

r – spindulio ilgis,

k – sferos detalumas,

RGB – sferos spalva.

```
1  import add
2  add.sphere([0,0.72,0],0.3,3,[255,255,0])
3  add.sphere([0,0,0],0.5,5,[0,153,51])
4  add.sphere([0,-1,0],0.7,7,[255,0,0])
5  add.off('LTsenis.off')
```



def cylinder(A, B, r, k, RGB) – uždaras cilindras
def cylinder2(A, B, r, k, RGB) – atviras cilindras
def cylinder3(A, B, r, k, RGB) – pusiau atviras cilindras

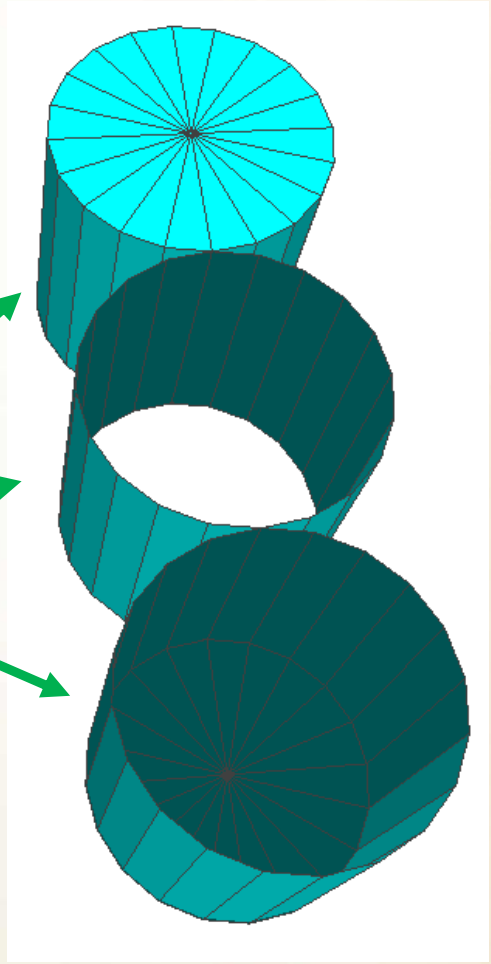
A – cilindro centro pradžios taškas,

B – cilindro centro pabaigos taškas,

r – cilindro spindulio ilgis,

k – cilindro detalumas,

RGB – cilindro spalva.




```
1  import add
2  add.cylinder([0,-0.5,0],[0,0.5,0],0.5,20,[0,255,255])
3  add.cylinder2([0,-0.5,1],[0,0.5,1],0.5,20,[0,255,255])
4  add.cylinder3([0,-0.5,2],[0,0.5,2],0.5,20,[0,255,255])
5  add.off('cylinders.off')
```

def cone(A, B, r, k, RGB) – uždaras kūgis
def cone2(A, B, r, k, RGB) – kūgio šoninis paviršius

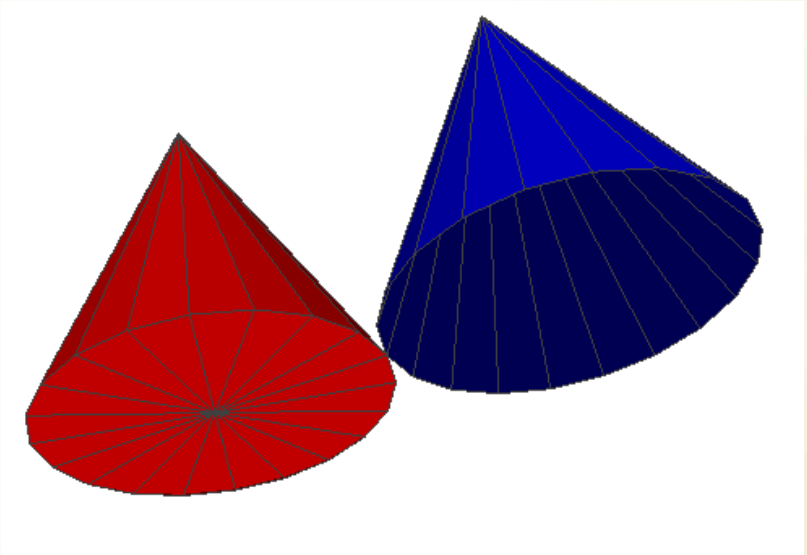
A – kūgio pagrindo centras,

B – kūgio viršūnė,

r – kūgio pagrindo spindulio ilgis,

k – kūgio detalumas,

RGB – kūgio spalva.

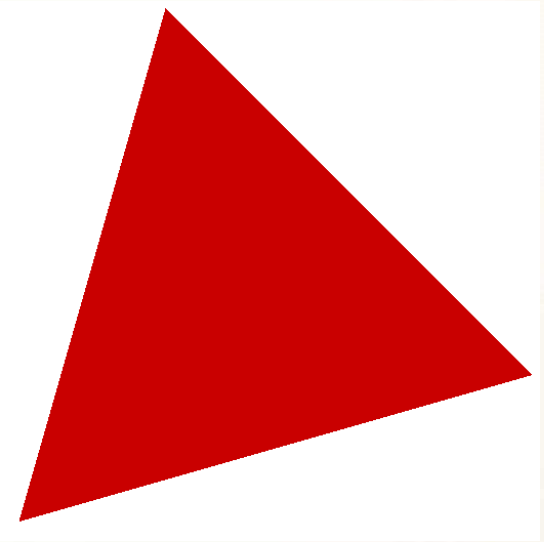


```
1  import add
2  add.cone([0,-0.5,0],[0,0.5,0],0.5,20,[255,0,0])
3  add.cone2([0,-0.5,1],[0,0.5,1],0.5,20,[0,0,255])
4  add.off('cones.off')
```

def newface(A,RGB)

A – 3D taškų seka,

RGB – sienos spalva.



```
1  import add
2  add.newface([[1,0,0],[0,1,0],[0,0,1]],[255,0,0])
3  add.off('trikampis.off')
```

Pastaba: gali būti nebūtinai trikampis.

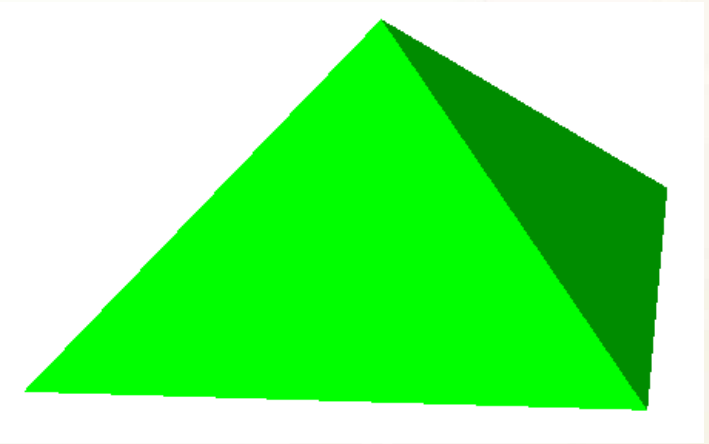
def pyramid(c,e,h,RGB)

c – kvadrato centro 3D koordinatės,

e – pagrindo (kvadrato) briaunos ilgis,

h – piramidės aukštis,

RGB – piramidės spalva.



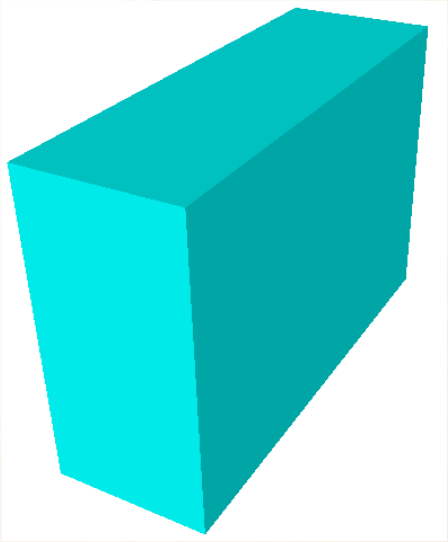
```
1 import add
2 add.pyramid([0,0,0],1,0.5,[0,255,0])
3 add.off('pyramid.off')
```

def rectangle3D(c,e,RGB)

c – centro 3D koordinatės,

e – stačiakampio gretasienio briaunų ilgių seka (atitinkamai X, Y ir Z ašių atžvilgiu),

RGB – stačiakampio gretasienio spalva.



```
1  import add
2  add.rectangle3D([0,0,0],[1,2,3],[0,255,255])
3  add.off('plyta.off')
```

def circle(A,B,r,k,RGB)

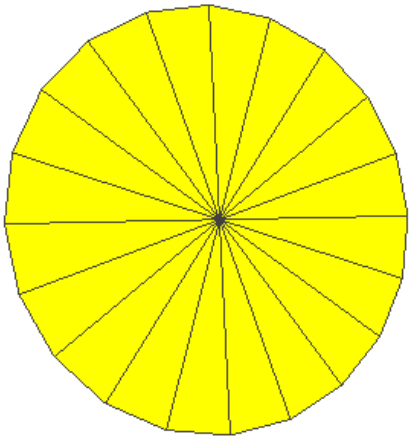
A – vektoriaus AB pradžios taškas,

B – vektoriaus AB pabaigos taškas,

r – apskritimo spindulys,

k – detalumo parametras,

RGB – apskritimo spalva.

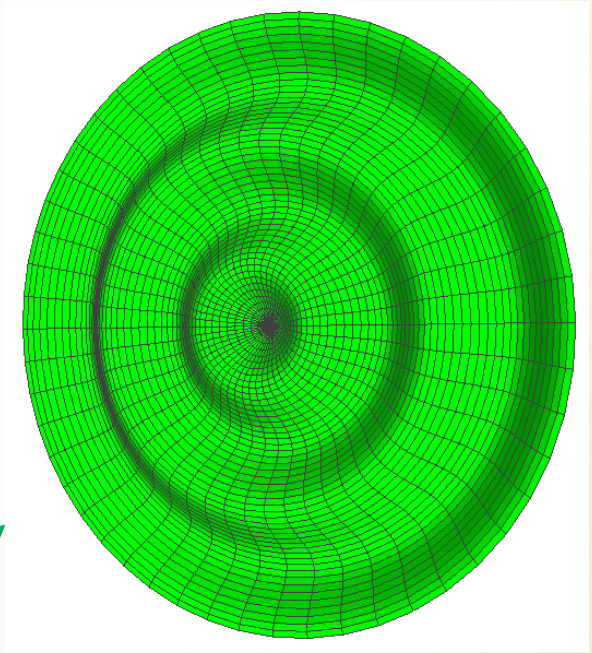


```
1  import add
2  add.circle([0,0,0],[1,1,1],1,20,[255,255,0])
3  add.off('apskritimas.off')
```

Pastaba: vektorius AB statmenas apskritimui, kur A – apskritimo centras.

def spin3D(A,B,S,min_t,max_t,grid_t,k,RGB)

A – vektoriaus AB pradžios taškas,
B – vektoriaus AB pabaigos taškas,
S – parametrinė kreivė,
min_t, max_t – parametrinės kreivės t parametro intervalas,
grid_t – t parametro detalumas,
k – sukinio detalumas,
RGB – sukinio spalva.



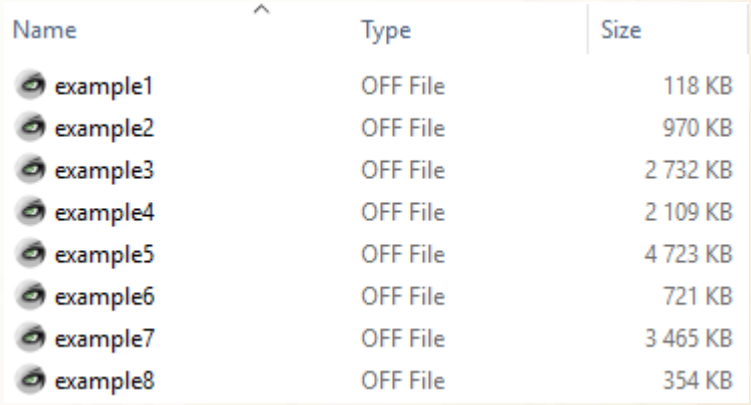
```
1 import add
2 import math
3 def curve(t):
4   x = t
5   y = math.cos(t)
6   return ([x, y])
7 add.spin3D([0,0,0],[-1,1,3],curve,0,10*math.pi/2,50,50,[0,255,0])
8 add.off('sukinys.off')
```

Pastaba: kreivė sukama apie vektorių AB, kur A – naujos koordinačių pradžios taškas.

*Modulio **add.py*** 3D modelių pavyzdžiai

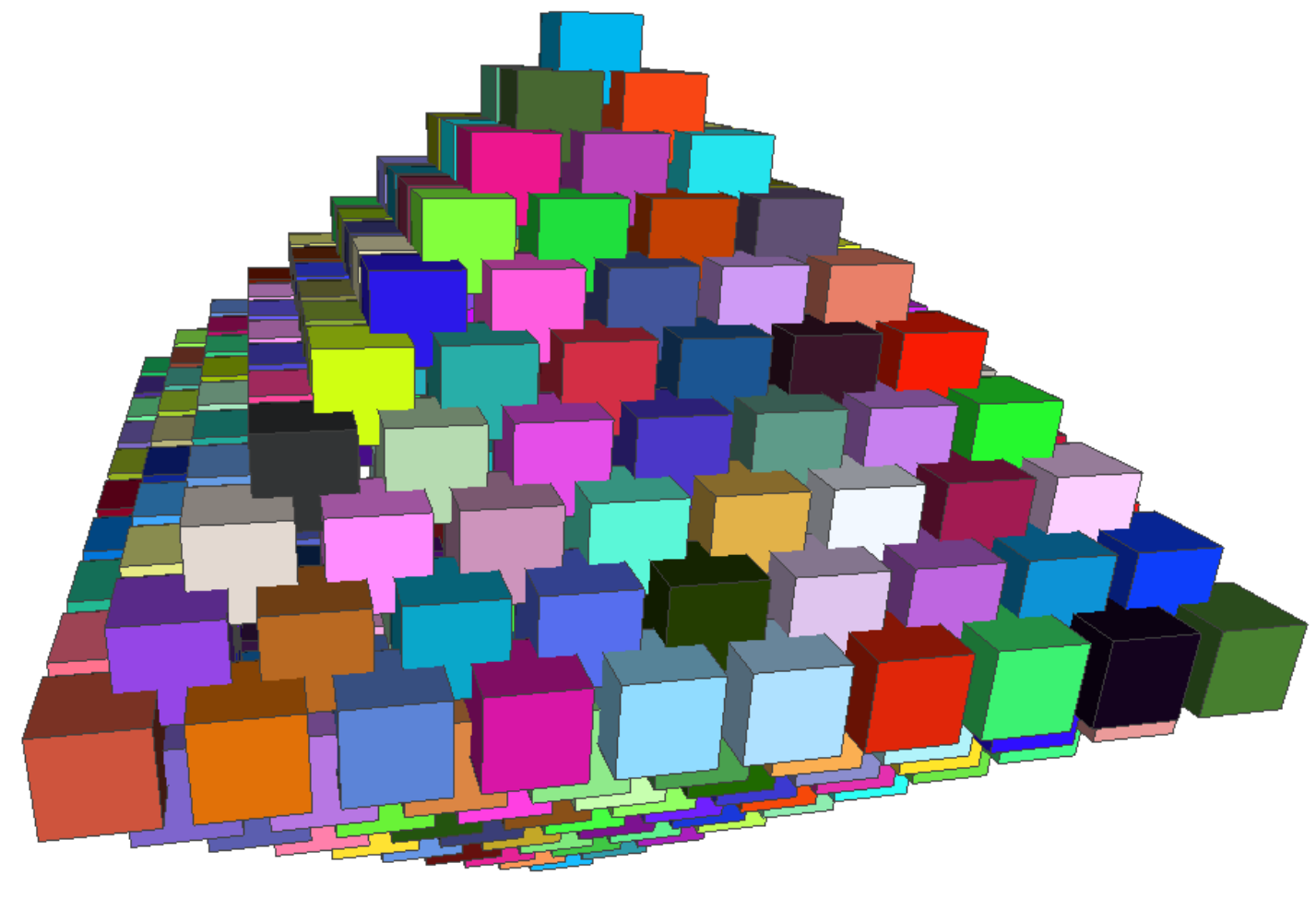
examples.py failas:

```
1  import add
2  add.example1()
3  add.example2()
4  add.example3()
5  add.example4()
6  add.example5()
7  add.example6()
8  add.example7()
9  add.example8()
```

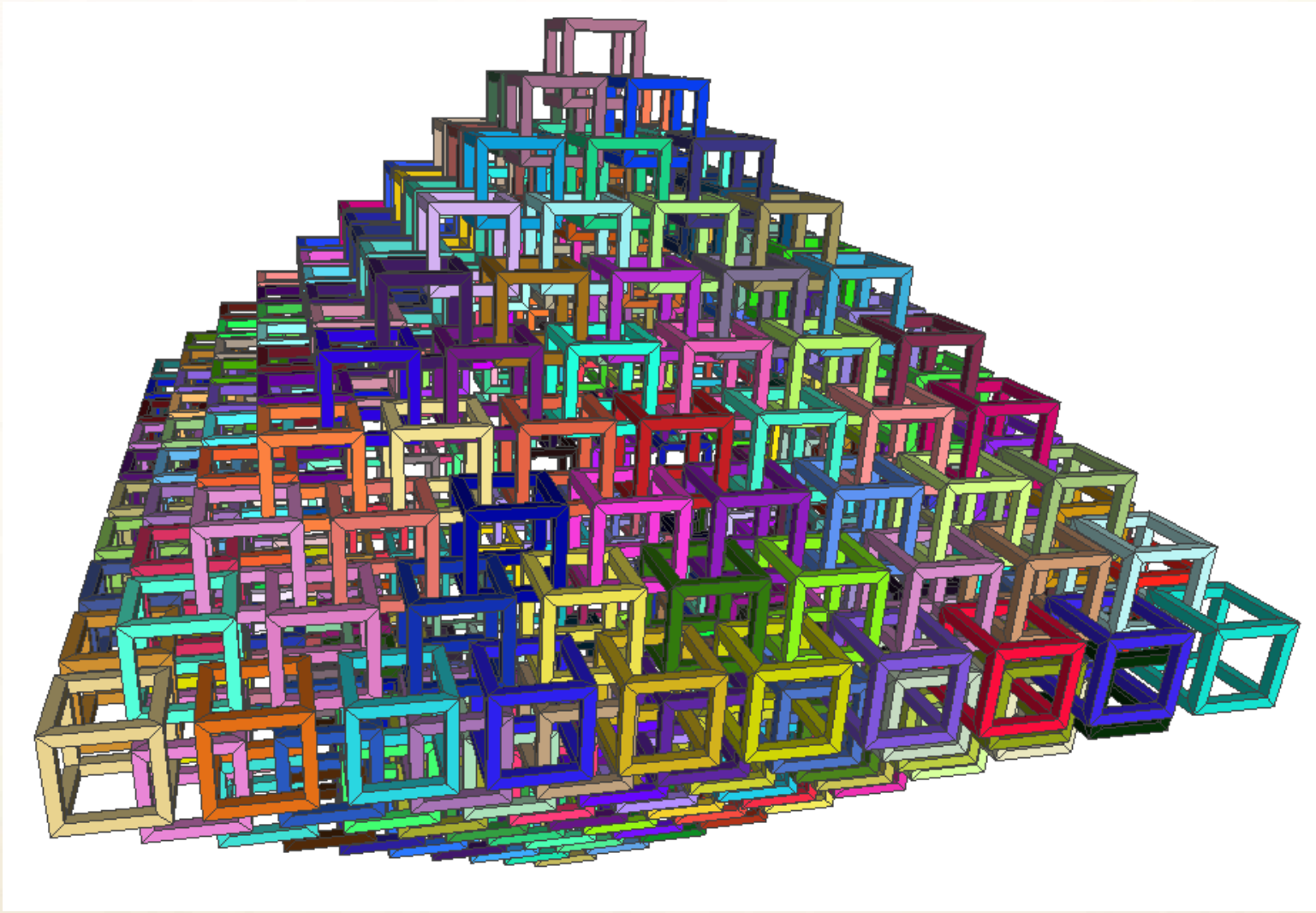


Name	Type	Size
example1	OFF File	118 KB
example2	OFF File	970 KB
example3	OFF File	2 732 KB
example4	OFF File	2 109 KB
example5	OFF File	4 723 KB
example6	OFF File	721 KB
example7	OFF File	3 465 KB
example8	OFF File	354 KB

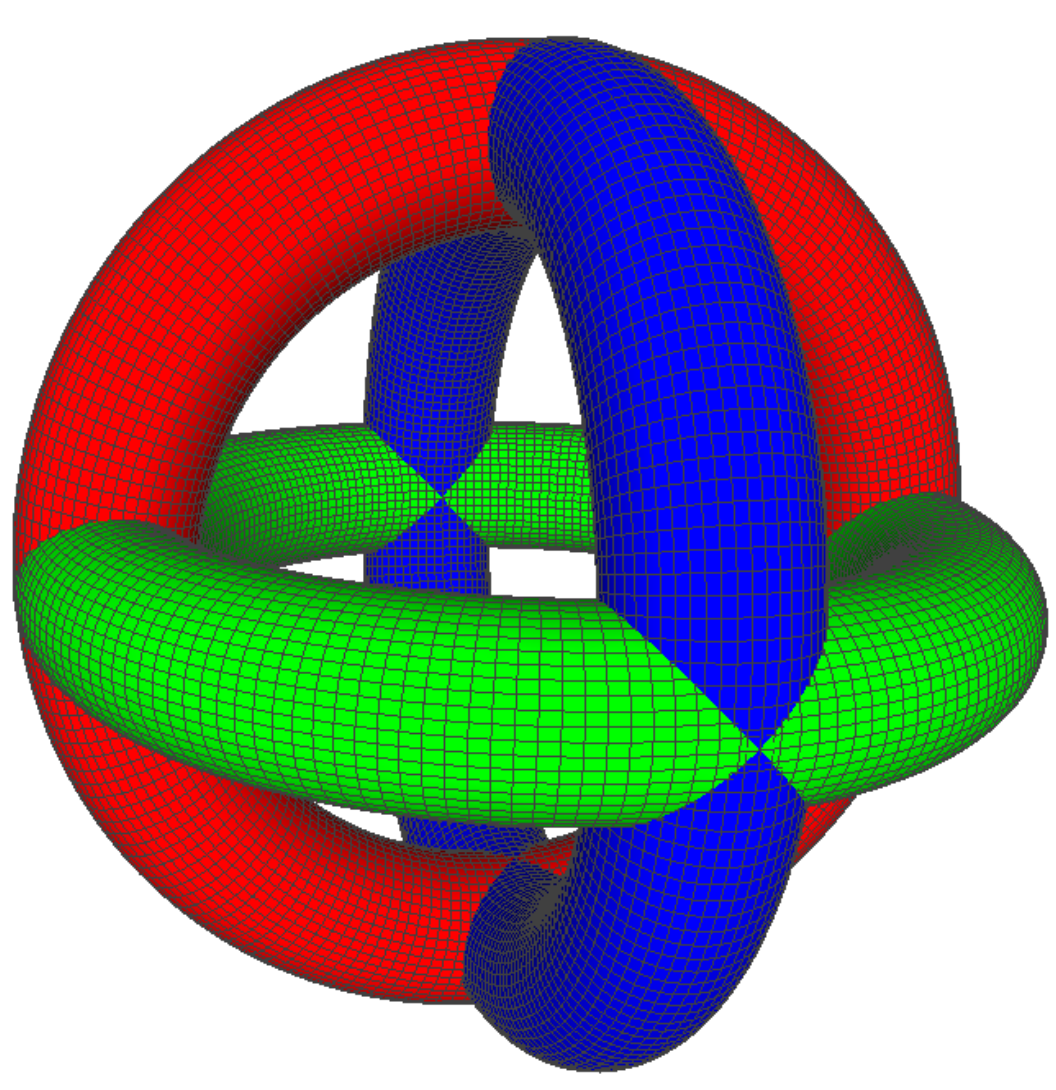
example1.off



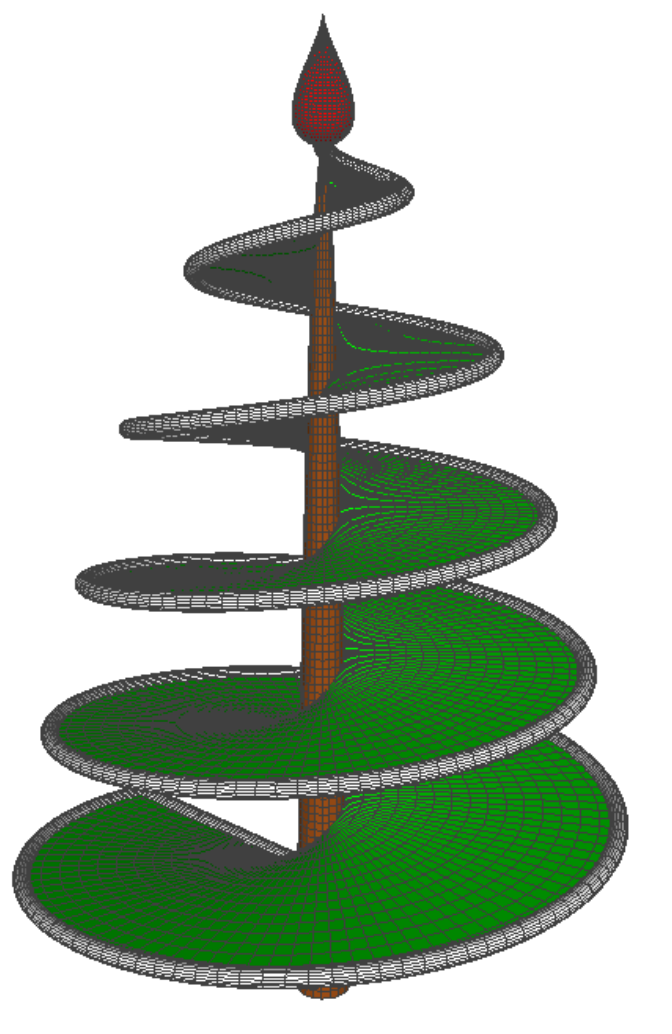
example2.off



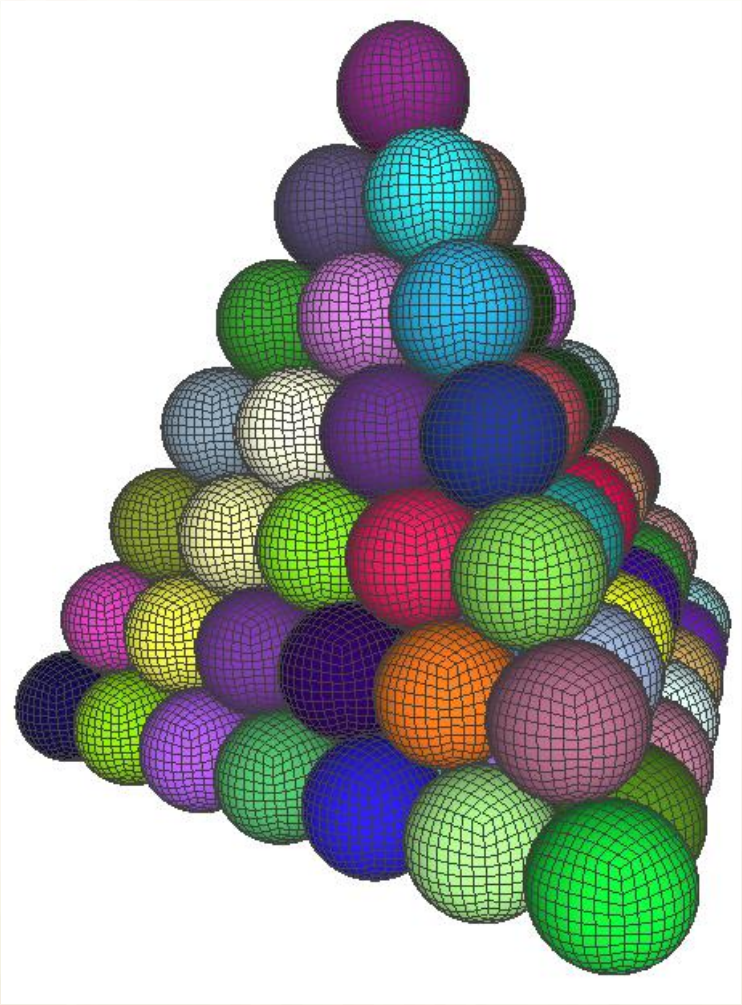
example3.off



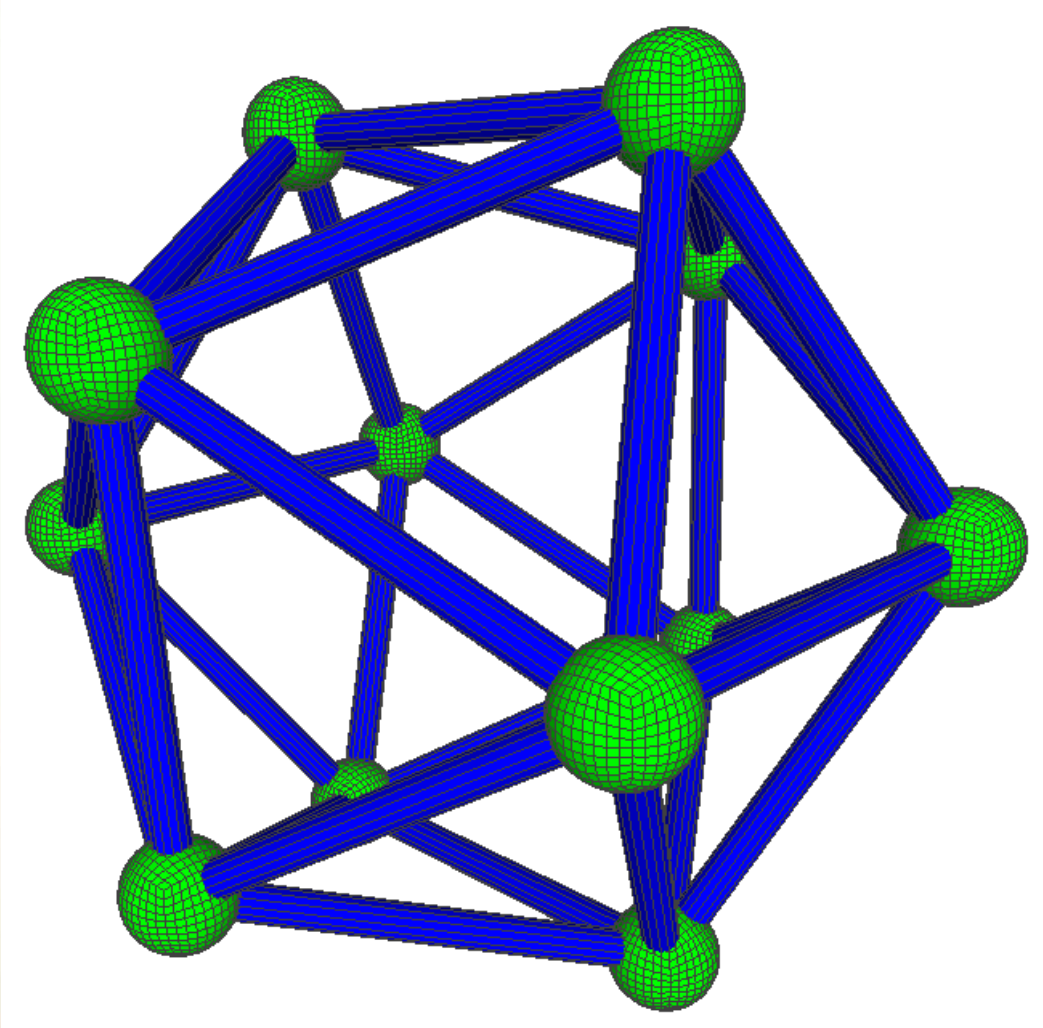
example4.off



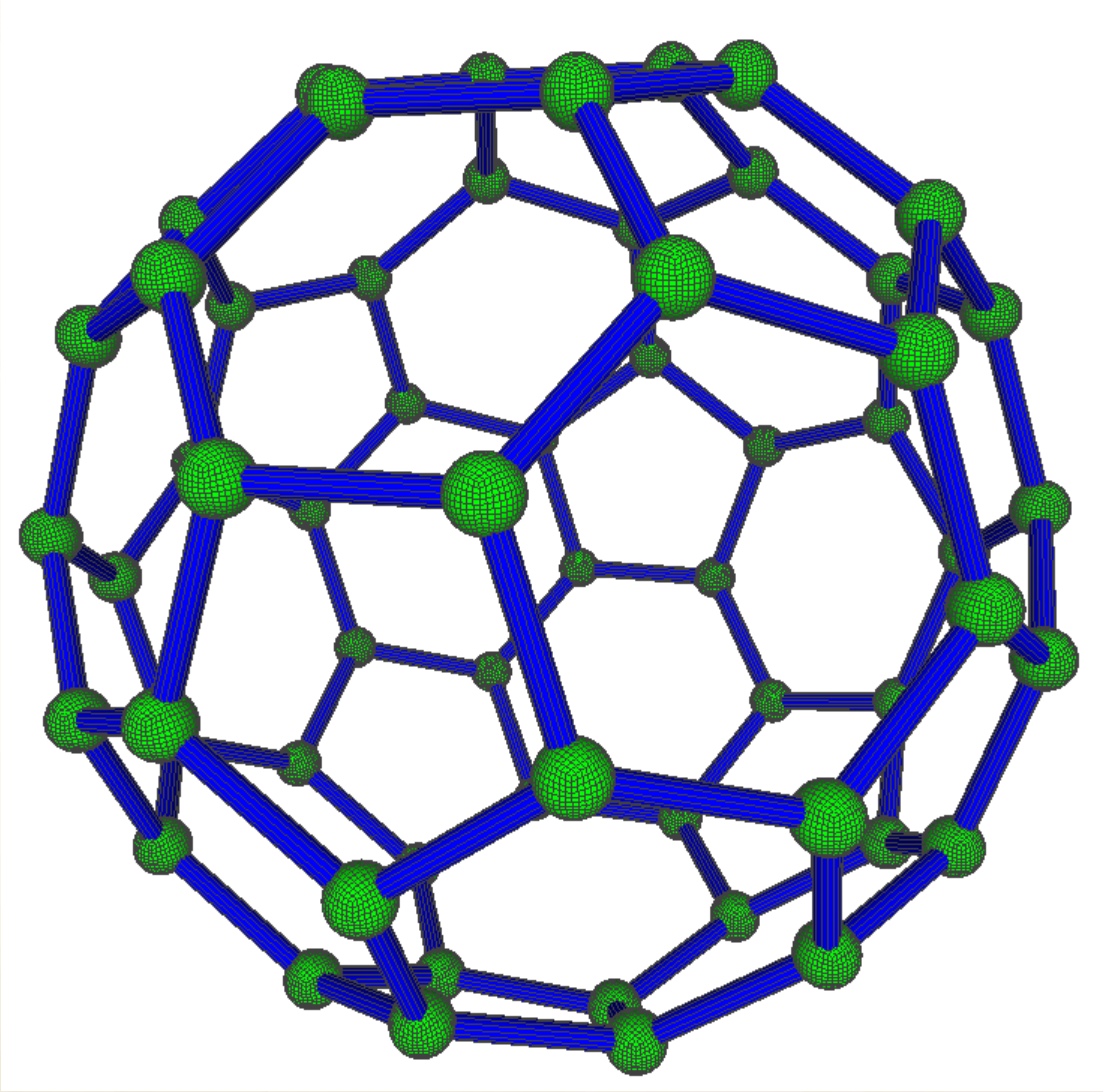
example5.off



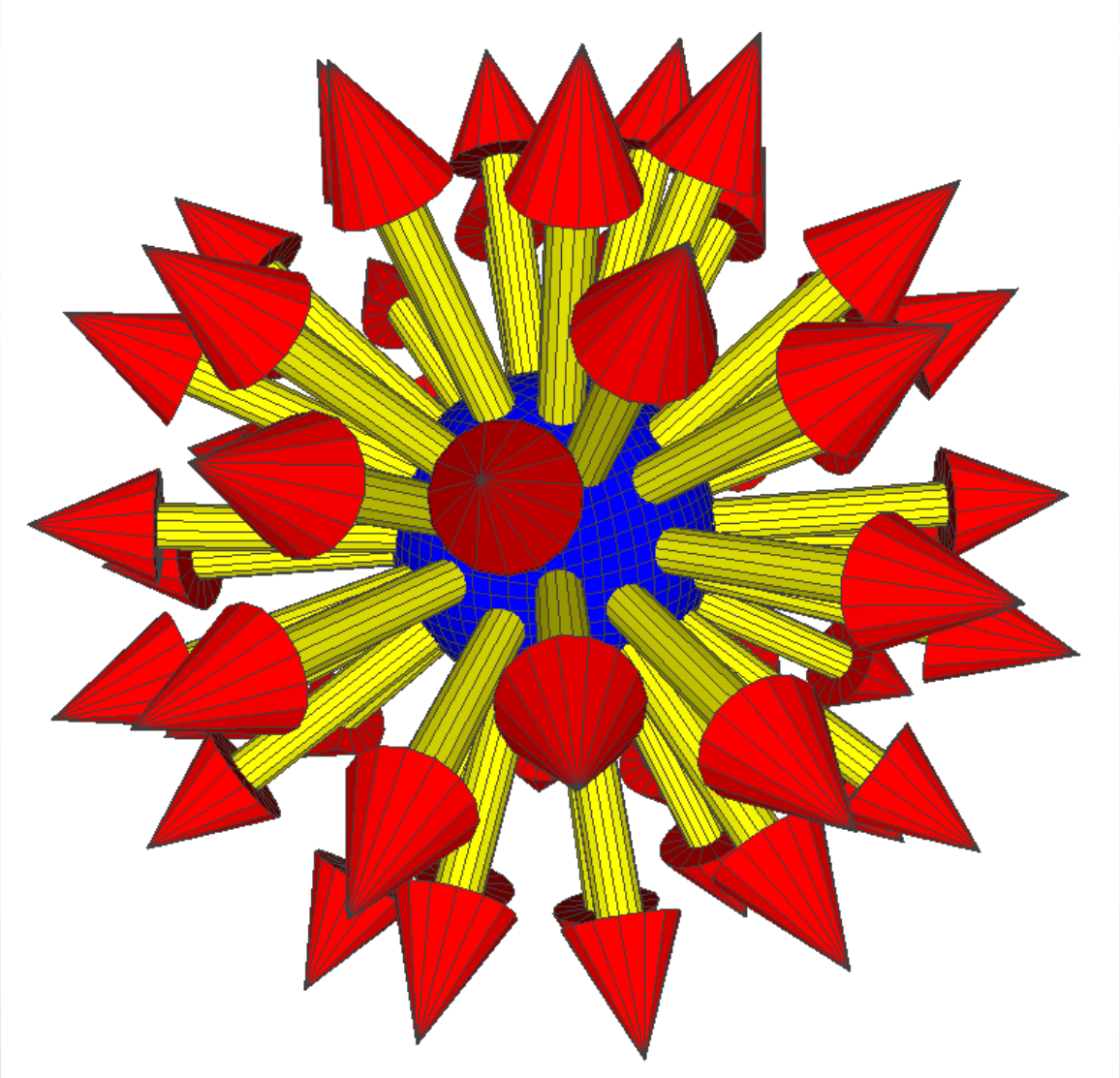
example6.off



example7.off

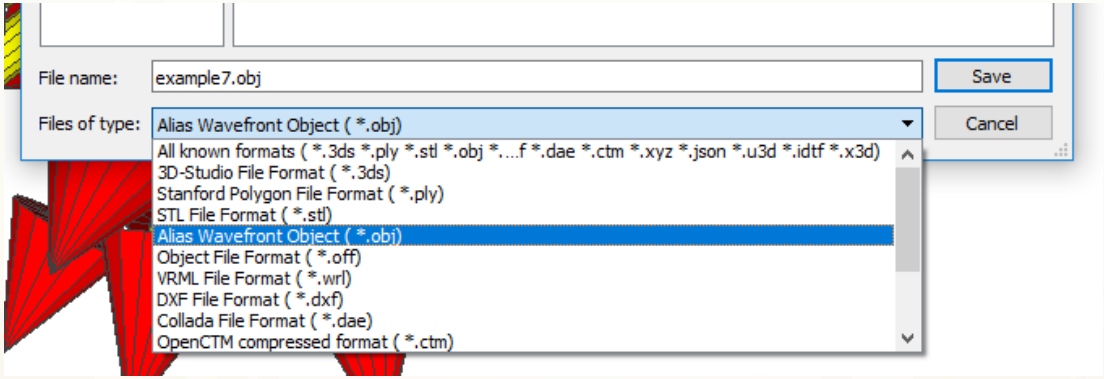


example8.off



3D modelio viešinimas https://sketchfab.com svetainėje

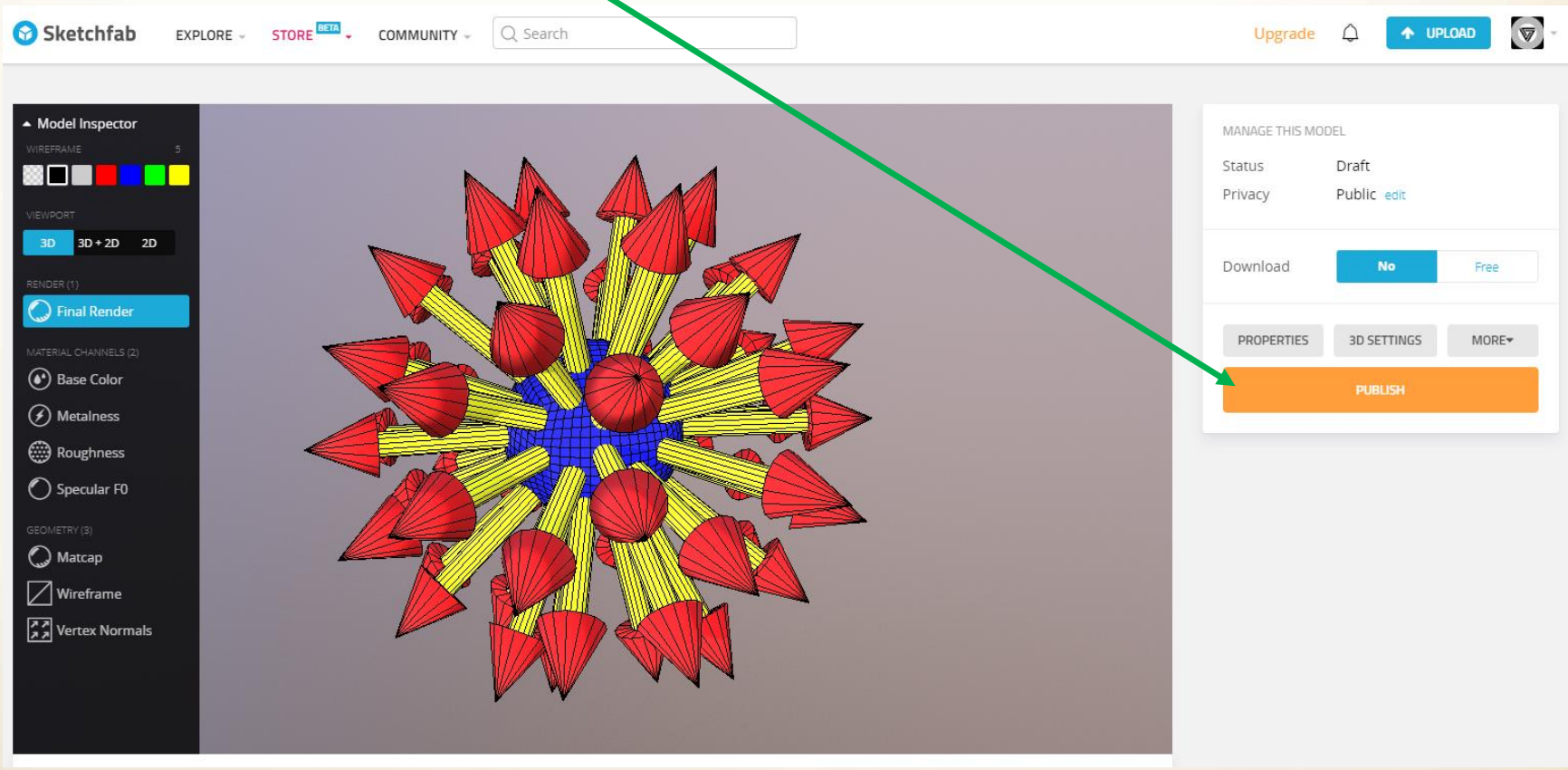
- Naudojant *MeshLab* programą 3D modelį reikia konvertuoti iš OFF formato į OBJ formatą:
  1) File → Export Mesh As...
  2) Pasirinkti *.obj formatą:



  3) Išsaugojus bus gauti 2 failai: *.obj ir *.mtl.
  4) Susikūrus nemokamą paskyrą sketchfab sistemoje, abu šiuos failus reikia įkelti vienu metu.

3D modelio viešinimas https://sketchfab.com svetainėje

Nustačius režimą „Public“, 3D modelis tampa viešai prieinamas, juo galima dalintis nuoroda.



Ačiū už dėmesį.