Appendix - codes

Ferris Wheel

1.

```
% initialize data set
xs = [];
ys = [];
zs = [];

xs2 = [];
ys2 = [];
zs2 = [];

% create 10X10 square
initDistance = 0.2;
index = 1;
j = 1;
k = 1;
while j < 11
    index = index + 1;
    xs2(index) = -1;
    ys2(index) = -1.2 + 0.2 * j;
    zs2(index) = 0;
    while k < 10
        index = index + 1;
        xs2(index) = xs2(index-1) + initDistance;
        ys2(index) = j*initDistance - 1-initDistance;
        zs2(index) = 0;
        k = k + 1;
    end
    k = 1;
    j = j + 1;
end

distance = 0.1532;
number = 100;
varT = (2*pi)/number;
theta = 0;
varX1 = theta;
varX2 = theta;
i = 1;
r = ((number-1)*distance)/2*pi;
x = 0;
y = 20;
while theta < pi
        varX1 = r*cos(theta);
        varX2 = r*cos(theta+varT);
        theta = theta + varT;
        ys(i) = (0.5*sqrt(r*r - varX1*varX1))*(1/sqrt(2));
        xs(i) = varX1+x;
        zs(i) = (0.5*sqrt(r*r - varX1*varX1))*((1/sqrt(2)))+y;
        i = i + 1;
        ys(i) = -(0.5*sqrt(r*r - varX2*varX2))*(1/sqrt(2));
        xs(i) = varX2+x;
        zs(i) = -(0.5*sqrt(r*r - varX2*varX2))*((1/sqrt(2)))+y;

        i = i + 1;
end
```

```
xs2([1]) = [];
ys2([1]) = [];
zs2([1]) = [];

length(xs)

hold on
xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
scatter3(xs,ys,zs);
scatter3(xs2,ys2,zs2);
axis([-40 40 -40 40 0 40])
hold off


sepResult = [];
i = 1;
j = 1;
index = 1;
hold on
xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
scatter3(xs,ys,zs);
scatter3(xs2,ys2,zs2);
axis([-40 40 -40 40 0 40])
while i <= 25
    j = 1;
    while j <= 25
        if (i ~= 1) && sepResult(j) == 40
            j = j + 1;
        else
            sepResult(j) = sqrt((-(xsSepInit(i)) + (xsSepEnd(j))));
            j = j + 1;
        end
    end
    [maxr,index] = min(sepResult);
    plot3([xsSepInit(i) xsSepEnd(index)],[ysSepInit(i) ysSepEnd(index)],[zsSepInit(i) zsSe
    sepResult(index) = 40;
    i = i + 1;
end
hold off
```

2.

```
    % initialize data set
xs = [];
ys = [];
zs = [];

xs2 = [];
ys2 = [];
zs2 = [];

% create 10X10 square
initDistance = 0.2;
index = 1;
j = 1;
k = 1;
while j < 11
    index = index + 1;
    xs2(index) = -1;
    ys2(index) = -1.2 + 0.2 * j;
    zs2(index) = 0;
    while k < 10
```

```
        index = index + 1;
        xs2(index) = xs2(index-1) + initDistance;
        ys2(index) = j*initDistance - 1-initDistance;
        zs2(index) = 0;
        k = k + 1;
    end
    k = 1;
    j = j + 1;
end

distance = 0.1532;
number = 100;
varT = (2*pi)/number;
theta = 0;
varX1 = theta;
varX2 = theta;
i = 1;
r = ((number)*distance)/2*pi;
x = 0;
y = 20;
while theta < pi
        varX1 = r*cos(theta);
        varX2 = r*cos(theta+varT);
        theta = theta + varT;
        ys(i) = (sqrt(r*r - varX1*varX1))*(1/sqrt(2));
        xs(i) = varX1+x;
        zs(i) = (sqrt(r*r - varX1*varX1))*((1/sqrt(2)))+y;
        i = i + 1;
        ys(i) = -(sqrt(r*r - varX2*varX2))*(1/sqrt(2));
        xs(i) = varX2+x;
        zs(i) = -(sqrt(r*r - varX2*varX2))*((1/sqrt(2)))+y;

        i = i + 1;
end

xsL = [0];
ysL = [0];
zsL = [20];
varX = 0.5;
i = 1;
while i <= 50
    xsL(i) = varX*0.5;
    ysL(i) = -sqrt(3)*varX*((1/sqrt(2)));
    zsL(i) = -sqrt(3)*varX*((1/sqrt(2)))+y;
    varX = varX + 0.5;
    i = i + 1;
end

xsL2 = [0];
ysL2 = [0];
zsL2 = [20];
varX = 0.5;
i = 1;
while i <= 50
    xsL2(i) = -varX*0.5;
    ysL2(i) = -sqrt(3)*varX*((1/sqrt(2)));
    zsL2(i) = -sqrt(3)*varX*((1/sqrt(2)))+y;
    varX = varX + 0.5;
    i = i + 1;
end




xs2([1]) = [];
ys2([1]) = [];
zs2([1]) = [];
```

```
distance = 0.1532;
number = 25;
varT = (2*pi)/number;
theta = 0;
varX1 = theta;
varX2 = theta;
i = 1;
r = ((number)*distance)/2*pi;
x = 0;
y = 20;
while theta < pi
        varX1 = r*cos(theta);
        varX2 = r*cos(theta+varT);
        theta = theta + varT;
        ysS(i) = (sqrt(r*r - varX1*varX1))*(1/sqrt(2));
        xsS(i) = varX1+x;
        zsS(i) = (sqrt(r*r - varX1*varX1))*((1/sqrt(2)))+y;
        i = i + 1;
        ysS(i) = -(sqrt(r*r - varX2*varX2))*(1/sqrt(2));
        xsS(i) = varX2+x;
        zsS(i) = -(sqrt(r*r - varX2*varX2))*((1/sqrt(2)))+y;

        i = i + 1;
end


xsSepInit1 = [];
ysSepInit1 = [];
zsSepInit1 = [];
i = 5;
j = 1;
while j <= 25
    xsSepInit1(j) = xs2(i);
    ysSepInit1(j) = ys2(i);
    zsSepInit1(j) = zs2(i);
    if mod(j,5) == 0
        i = i + 15;
    end
    i = i - 1;
    j = j + 1;

end


xsSepEnd1 = [];
ysSepEnd1 = [];
zsSepEnd1 = [];
i = 1;
j = 1;
while i <= 100
    if ys(i) < 0 && xs(i) < 0
        xsSepEnd1(j) = xs(i);
        ysSepEnd1(j) = ys(i);
        zsSepEnd1(j) = zs(i);
        j = j + 1;
    end
    i = i + 1;
end

sepResult = [];
i = 1;
j = 1;
index = 1;
hold on
grid on
xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
```

```
scatter3(xs,ys,zs);
scatter3(xs2,ys2,zs2);
scatter3(xsS,ysS,zsS);
scatter3(xsL,ysL,zsL);
scatter3(xsL2,ysL2,zsL2);
axis([-40 40 -40 40 0 40])
while i <= 25
    j = 1;
    while j <= 25
        if (i ~= 1) && sepResult(j) == 40
            j = j + 1;
        else
            sepResult(j) = sqrt((-(xsSepInit1(i)) + (xsSepEnd1(j))));
            j = j + 1;
        end
    end
    [maxr,index] = min(sepResult);
%      plot3([xsSepInit1(i) xsSepEnd1(index)],[ysSepInit1(i) ysSepEnd1(index)],[zsSepInit1
    sepResult(index) = 40;
    i = i + 1;
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

xsSepInit2 = [];
ysSepInit2 = [];
zsSepInit2 = [];
i = 6;
j = 1;
while j <= 25
    xsSepInit2(j) = xs2(i);
    ysSepInit2(j) = ys2(i);
    zsSepInit2(j) = zs2(i);
    if mod(j,5) == 0
        i = i + 5;
    end
    i = i + 1;
    j = j + 1;

end



xsSepEnd2 = [];
ysSepEnd2 = [];
zsSepEnd2 = [];
i = 1;
j = 1;
while i <= 100
    if ys(i) <= 0 && xs(i) > 0
        xsSepEnd2(j) = xs(i);
        ysSepEnd2(j) = ys(i);
        zsSepEnd2(j) = zs(i);
        j = j + 1;
    end
    i = i + 1;
end



sepResult2 = [];
i = 1;
j = 1;
index = 1;

while i <= 25
    j = 1;
    while j <= 25
        if (i ~= 1) && sepResult2(j) == 40
```

```
            j = j + 1;
        else
            sepResult2(j) = sqrt((-(xsSepInit2(i)) + (xsSepEnd2(j))));
            j = j + 1;
        end
    end
    [maxr,index] = min(sepResult2);
%     plot3([xsSepInit2(i) xsSepEnd2(index)],[ysSepInit2(i) ysSepEnd2(index)],[zsSepInit2(
    sepResult2(index) = 40;
    i = i + 1;
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

xsSepInit3 = [];
ysSepInit3 = [];
zsSepInit3 = [];
i = 95;
j = 1;
while j <= 25
    xsSepInit3(j) = xs2(i);
    ysSepInit3(j) = ys2(i);
    zsSepInit3(j) = zs2(i);
    if mod(j,5) == 0
        i = i - 5;
    end
    i = i - 1;
    j = j + 1;

end



xsSepEnd3 = [];
ysSepEnd3 = [];
zsSepEnd3 = [];
i = 1;
j = 1;
while i <= 100
    if ys(i) > 0 && xs(i) < 0
        xsSepEnd3(j) = xs(i);
        ysSepEnd3(j) = ys(i);
        zsSepEnd3(j) = zs(i);
        j = j + 1;
    end
    i = i + 1;
end



sepResult3 = [];
i = 1;
j = 1;
index = 1;

while i <= 25
    j = 1;
    while j <= 25
        if (i ~= 1) && sepResult3(j) == 40
            j = j + 1;
        else
            sepResult3(j) = sqrt((-(xsSepInit3(i)) + (xsSepEnd3(j))));
            j = j + 1;
        end
    end
    [maxr,index] = min(sepResult3);
%     plot3([xsSepInit3(i) xsSepEnd3(index)],[ysSepInit3(i) ysSepEnd3(index)],[zsSepInit3
    sepResult3(index) = 40;
    i = i + 1;
```

```
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

xsSepInit4 = [];
ysSepInit4 = [];
zsSepInit4 = [];
i = 96;
j = 1;
while j <= 25
    xsSepInit4(j) = xs2(i);
    ysSepInit4(j) = ys2(i);
    zsSepInit4(j) = zs2(i);
    if mod(j,5) == 0
        i = i - 15;
    end
    i = i + 1;
    j = j + 1;

end



xsSepEnd4 = [];
ysSepEnd4 = [];
zsSepEnd4 = [];
i = 1;
j = 1;
while i <= 100
    if ys(i) >= 0 && xs(i) > 0
        xsSepEnd4(j) = xs(i);
        ysSepEnd4(j) = ys(i);
        zsSepEnd4(j) = zs(i);
        j = j + 1;
    end
    i = i + 1;
end

length(xsSepEnd4)


sepResult4 = [];
i = 1;
j = 1;
index = 1;

while i <= 25
    j = 1;
    while j <= 25
        if (i ~= 1) && sepResult4(j) == 40
            j = j + 1;
        else
            sepResult4(j) = sqrt((-(xsSepInit4(i)) + (xsSepEnd4(j))));
            j = j + 1;
        end
    end
    [maxr,index] = min(sepResult4);
%     plot3([xsSepInit4(i) xsSepEnd4(index)],[ysSepInit4(i) ysSepEnd4(index)],[zsSepInit4(
    sepResult4(index) = 40;
    i = i + 1;
end



hold off
```

Dragon

1.

```
    clear all;
clc;

b = 1;
hold on
i = 1;
while i < 8
t = (5/12)*(3/2).^i*(-(1/3)*(-1).^i - (5/3)):0.0001:(5/12)*(3/2).^i*(-(1/3)*(-1).^i + (5/3
x = t;
y = sqrt(-(24/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
z = -sqrt((1/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
plot3(x,y,z);
i = i + 1;
t = (5/12)*(3/2).^i*(-(1/3)*(-1).^i - (5/3)):0.0001:(5/12)*(3/2).^i*(-(1/3)*(-1).^i + (5/3
x = t;
y = -sqrt(-(24/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
z = -sqrt((1/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
i = i + 1;
plot3(x,y,z);
grid on;
end
hold off
```

2.

```
    clear all;
clc;


b = 1;
height = 10;
hold on
xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')

recX = [];
recY = [];
recZ = [];

initDistance = 0.15;
index = 1;
j = 1;
k = 1;
while j <= 10

    recX(index) = -3;
    y = -4 + 0.2 * j;
    recY(index) = -4 + 0.2 * j;
    recZ(index) = -20;
    while k < 5
        index = index + 1;
        recX(index) = recX(index-1) + initDistance;
        recY(index) = y;
        recZ(index) = -20;
        k = k + 1;
    end
    index = index + 1;
    k = 1;
    j = j + 1;
end
```

```
i = 1;
while i < 6
t = (5/12)*(3/2).^i*(-(1/3)*(-1).^i - (5/3)):0.0001:(5/12)*(3/2).^i*(-(1/3)*(-1).^i + (5/3
x = t;
y = sqrt(-(24/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
z = -sqrt((1/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
plot3(x,y,z);
i = i + 1;
t = (5/12)*(3/2).^i*(-(1/3)*(-1).^i - (5/3)):0.0001:(5/12)*(3/2).^i*(-(1/3)*(-1).^i + (5/3
x = t;
y = -sqrt(-(24/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
z = -sqrt((1/25)*(t.^2) - (4/15)*(((-(3/2)).^i)*b*t) + (4/9)*(3/2).^(2*i));
i = i + 1;
plot3(x,y,z);
grid on;
end
```

```
k = 1;
i = 1;
zz = 1;
xsC = [];
ysC = [];
zsC = [];
total = 50;
distance = 0.3;
totalDistance = 0;
j = (5/12)*(3/2)^i*(-(1/3)*(-1)^i - (5/3));

xs = [j];
ys = [sqrt(-(24/25)*(j^2) - (4/15)*(((-(3/2))^i)*b*j) + (4/9)*(3/2)^(2*i))];
zs = [-sqrt((1/25)*(j^2) - (4/15)*(((-(3/2))^i)*b*j) + (4/9)*(3/2)^(2*i))];
xsC(1) = xs(1);
ysC(1) = ys(1);
zsC(1) = zs(1);

while j < (5/12)*(3/2)^i*(-(1/3)*(-1)^i + (5/3))
    j = j + 0.0001;
    x = j;
    y = sqrt(-(24/25)*(j^2) - (4/15)*(((-(3/2))^i)*b*j) + (4/9)*(3/2)^(2*i));
    z = -sqrt((1/25)*(j^2) - (4/15)*(((-(3/2))^i)*b*j) + (4/9)*(3/2)^(2*i));
    DT = sqrt((x - xs(k))^2 + (y - ys(k))^2 + (z - zs(k))^2);
    D = sqrt((x - xsC(zz))^2 + (y - ysC(zz))^2 + (z - zsC(zz))^2);
    zz = zz + 1;
    xsC(zz) = x;
    ysC(zz) = y;
    zsC(zz) = z;
    totalDistance = totalDistance + D;
    if distance <= DT
        k = k + 1;
        xs(k) = x;
        ys(k) = y;
        zs(k) = z;
    end
end

real(totalDistance)
24.84 + 16.5653 + 11.0436 + 7.3624 + 4.9082 + 3.2722

fXsInit = [];
fYsInit = [];
fZsInit = [];
i = 50;
j = 1;
while i >= 1
```

```
    fXsInit(j) = recX(i);
    fYsInit(j) = recY(i);
    fZsInit(j) = recZ(i);
    i = i - 1;
    j = j + 1;
end

fXsInit2 = [];
fYsInit2 = [];
fZsInit2 = [];
i = 36;
j = 1;
while j <= 40
    fXsInit2(j) = recX(i);
    fYsInit2(j) = recY(i);
    fZsInit2(j) = recZ(i);
    if mod(j,5) == 0
        i = i - 10;
    end
    i = i + 1;
    j = j + 1;
end



i = 1;
while i <= 50;
    if i <= 10
    plot3([fXsInit(i) xs(i)],[fYsInit(i) ys(i)],[fZsInit(i) zs(i)]);
    else
    plot3([fXsInit2(i-10) xs(i)],[fYsInit2(i-10) ys(i)],[fZsInit2(i-10) zs(i)]);
    end
    i = i + 1;
end


scatter3(xs,ys,zs);
scatter3(recX,recY,recZ);
% scatter3(xs2,ys2,zs2);
hold off
```

Firework

1.

```
syms x y z;
A = [0.7,-0.7;0.7,0.7];
i = 1;
total = 16;
height = 0;
distance = 0.15;
l = 2.5;
L = 5;

xsInit = [];
ysInit = [];
zsInit = [];
xs = [];
ys = [];
zs = [];

hold on
```

```
while i <= total
z1 = height;
x1 = distance*(i-1);
% xsInit(i) = x1;
% ysInit(i) = 0;
% zsInit(i) = z1;
z = height + x1*0.7;
x = x1*0.7;
y = 0;
xs(i) = x;
ys(i) = y;
zs(i) = z;
% plot3([xsInit(i) xs(i)],[ysInit(i) ys(i)],[zsInit(i) zs(i)]);
i = i + 1;
end


xs2 = [];
ys2 = [];
zs2 = [];
i = 0;
m = 100;
% t = 2;
while i < 8
    co = [rand,rand,rand];
    ys2(i+1) = ys(2*i+1) + cos(0.25*pi*i)*L;
    xs2(i+1) = 0.7*xs(2*i+1)-0.7*zs(2*i+1)-0.7*sin(0.25*pi*i)*L;
    zs2(i+1) = 0.7*xs(2*i+1)+0.7*zs(2*i+1)+0.7*sin(0.25*pi*i)*L;
    t = 0:0.01:5;
        xF = xs2(i+1)+(-0.3*xs(2*i+1)-0.7*zs(2*i+1)-0.7*sin(0.25*pi*i)*L) * (1*t);
        yF = ys2(i+1)+(cos(0.25*pi*i)*L) * (1*t);
        zF = zs2(i+1)+(0.7*xs(2*i+1)-0.3*zs(2*i+1)+0.7*sin(0.25*pi*i)*L) * (1*t) - 0.5*0.9
         plot3(xF,yF,zF,'color',co);
        grid on


 plot3([xs(2*i + 1) xs2(i+1)],[ys(2*i + 1) ys2(i+1)],[zs(2*i + 1) zs2(i+1)],'color',co);
    i = i+1;
end


xs3 = [];
ys3 = [];
zs3 = [];
i = 1;
while i <= 8
    co = [rand,rand,rand];
    xs3(i) = 0.7*xs(2*i) - 0.7*zs(2*i) - 0.7*sin(0.125*pi + 0.25*pi*i)*l;
    ys3(i) = ys(2*i) + cos(0.125*pi + 0.25*pi*i)*l;
    zs3(i) = 0.7*xs(2*i)+0.7*zs(2*i)+0.7*sin(0.125*pi + 0.25*pi*i)*l;
        t = 0:0.01:5;
        xF = xs3(i)+(-0.3*xs(2*i)-0.7*zs(2*i)-0.7*sin(0.25*pi*i)*L) * (1*t);
        yF = ys3(i)+(cos(0.25*pi*i)*L) * (1*t);
        zF = zs3(i)+(0.7*xs(2*i)-0.3*zs(2*i)+0.7*sin(0.25*pi*i)*L) * (1*t) - 0.5*0.98*m*(t
         plot3(xF,yF,zF,'color',co);
        grid on
      plot3([xs(2*i) xs3(i)],[ys(2*i) ys3(i)],[zs(2*i) zs3(i)],'color',co)
    i = i+1;
end



xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
% scatter3(xsInit,ysInit,zsInit);
scatter3(xs,ys,zs)
scatter3(xs2,ys2,zs2)
```

```
% scatter3(xs3,ys3,zs3)
axis([-8 8 -8 8 -8 8])
hold off
```

2.

```
    syms x y z;
A = [0.7,-0.7;0.7,0.7];
i = 1;
total = 16;
height = 10;
radius = height*sqrt(2);
minusX = radius*cos(0.25*pi);
minusZ = radius*sin(0.25*pi);
distance = 0.15;
l = 2.5;
L = 5;

xsInit = [];
ysInit = [];
zsInit = [];
xs = [];
ys = [];
zs = [];

hold on
radius = height*sqrt(2);
distance = 0.15;

i = 0;
while i < total

theta = 0:0.001:0.25*pi;
xT = radius*cos(theta) - height;
yT = 0*theta;
zT = radius*sin(theta) - height;
xsInit(i+1) = radius*cos(0) - height;
ysInit(i+1) = 0;
zsInit(i+1) = radius*sin(0) - height;
plot3(xT,yT,zT);
radius = radius + distance;
i = i + 1;
end

i = 1;
while i <= total
z1 = 0;
x1 = distance*(i-1);
z = 0 + x1*0.7;
x = x1*0.7;
y = 0;
xs(i) = x;
ys(i) = y;
zs(i) = z;
% plot3([xsInit(i) xs(i)],[ysInit(i) ys(i)],[zsInit(i) zs(i)]);
i = i + 1;
end


xs2 = [];
ys2 = [];
zs2 = [];
i = 0;
m = 100;
% t = 2;
```

```
while i < 8
    co = [rand,rand,rand];
    ys2(i+1) = ys(2*i+1) + cos(0.25*pi*i)*L;
    xs2(i+1) = 0.7*xs(2*i+1)-0.7*zs(2*i+1)-0.7*sin(0.25*pi*i)*L;
    zs2(i+1) = 0.7*xs(2*i+1)+0.7*zs(2*i+1)+0.7*sin(0.25*pi*i)*L;
    t = 0:0.01:5;
        xF = xs2(i+1)+(-0.3*xs(2*i+1)-0.7*zs(2*i+1)-0.7*sin(0.25*pi*i)*L) * (1*t);
        yF = ys2(i+1)+(cos(0.25*pi*i)*L) * (1*t);
        zF = zs2(i+1)+(0.7*xs(2*i+1)-0.3*zs(2*i+1)+0.7*sin(0.25*pi*i)*L) * (1*t) - 0.5*0.9
%          plot3(xF,yF,zF,'color',co);
        grid on


%  plot3([xs(2*i + 1) xs2(i+1)],[ys(2*i + 1) ys2(i+1)],[zs(2*i + 1) zs2(i+1)],'color',co);
    i = i+1;
end


xs3 = [];
ys3 = [];
zs3 = [];
i = 1;
while i <= 8
    co = [rand,rand,rand];
    xs3(i) = 0.7*xs(2*i) - 0.7*zs(2*i) - 0.7*sin(0.125*pi + 0.25*pi*i)*l;
    ys3(i) = ys(2*i) + cos(0.125*pi + 0.25*pi*i)*l;
    zs3(i) = 0.7*xs(2*i)+0.7*zs(2*i)+0.7*sin(0.125*pi + 0.25*pi*i)*l;
        t = 0:0.01:5;
        xF = xs3(i)+(-0.3*xs(2*i)-0.7*zs(2*i)-0.7*sin(0.25*pi*i)*L) * (1*t);
        yF = ys3(i)+(cos(0.25*pi*i)*L) * (1*t);
        zF = zs3(i)+(0.7*xs(2*i)-0.3*zs(2*i)+0.7*sin(0.25*pi*i)*L) * (1*t) - 0.5*0.98*m*(t
%          plot3(xF,yF,zF,'color',co);
        grid on
%       plot3([xs(2*i) xs3(i)],[ys(2*i) ys3(i)],[zs(2*i) zs3(i)],'color',co)
    i = i+1;
end



xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
scatter3(xsInit,ysInit,zsInit);
scatter3(xs,ys,zs)
% scatter3(xs2,ys2,zs2)
% scatter3(xs3,ys3,zs3)
axis([-10 10 -10 10 -10 10])
hold off
```

3.

```
    syms x y z;
A = [(1/sqrt(2)),-(1/sqrt(2));(1/sqrt(2)),(1/sqrt(2))];
i = 1;
total = 16;
height = 10;
radius = height*sqrt(2);
minusX = radius*cos(0.25*pi);
minusZ = radius*sin(0.25*pi);
distance = 0.15;
l = 2.5;
L = 5;

xsInit = [];
ysInit = [];
```

```
zsInit = [];
xs = [];
ys = [];
zs = [];

hold on



radius = height*sqrt(2);
distance = 0.15;

i = 0;
while i < total

theta = 0:0.001:0.25*pi;
xT = radius*cos(theta) - height;
yT = 0*theta;
zT = radius*sin(theta) - height;
xsInit(i+1) = radius*cos(0) - height;
ysInit(i+1) = 0;
zsInit(i+1) = radius*sin(0) - height;
 plot3(xT,yT,zT);
radius = radius + distance;
i = i + 1;
end

i = 1;
while i <= total
z1 = 0;
x1 = distance*(i-1);
z = 0 + x1*(1/sqrt(2));
x = x1*(1/sqrt(2));
y = 0;
xs(i) = x;
ys(i) = y;
zs(i) = z;
% plot3([xsInit(i) xs(i)],[ysInit(i) ys(i)],[zsInit(i) zs(i)]);
i = i + 1;
end


xs2 = [];
ys2 = [];
zs2 = [];
i = 0;
m = 100;
% t = 2;
while i < 8
    co = [rand,rand,rand];
    ys2(i+1) = ys(2*i+1) + cos(0.25*pi*i)*L;
    xs2(i+1) = (1/sqrt(2))*xs(2*i+1)-(1/sqrt(2))*zs(2*i+1)-(1/sqrt(2))*sin(0.25*pi*i)*L;
    zs2(i+1) = (1/sqrt(2))*xs(2*i+1)+(1/sqrt(2))*zs(2*i+1)+(1/sqrt(2))*sin(0.25*pi*i)*L;
    t = 0:0.01:5;
        xF = xs2(i+1)+(-0.3*xs(2*i+1)-(1/sqrt(2))*zs(2*i+1)-(1/sqrt(2))*sin(0.25*pi*i)*L)
        yF = ys2(i+1)+(cos(0.25*pi*i)*L) * (1*t);
        zF = zs2(i+1)+((1/sqrt(2))*xs(2*i+1)-0.3*zs(2*i+1)+(1/sqrt(2))*sin(0.25*pi*i)*L) *
          plot3(xF,yF,zF,'color',co);
        grid on


  plot3([xs(2*i + 1) xs2(i+1)],[ys(2*i + 1) ys2(i+1)],[zs(2*i + 1) zs2(i+1)],'color',co);
    i = i+1;
end


xs3 = [];
ys3 = [];
```

```
zs3 = [];
i = 1;
while i <= 8
    co = [rand,rand,rand];
    xs3(i) = (1/sqrt(2))*xs(2*i) - (1/sqrt(2))*zs(2*i) - (1/sqrt(2))*sin(0.125*pi + 0.25*p
    ys3(i) = ys(2*i) + cos(0.125*pi + 0.25*pi*i)*l;
    zs3(i) = (1/sqrt(2))*xs(2*i)+(1/sqrt(2))*zs(2*i)+(1/sqrt(2))*sin(0.125*pi + 0.25*pi*i)
        t = 0:0.01:5;
        xF = xs3(i)+(-0.3*xs(2*i)-(1/sqrt(2))*zs(2*i)-(1/sqrt(2))*sin(0.125*pi + 0.25*pi*i
        yF = ys3(i)+(cos(0.125*pi + 0.25*pi*i)*l) * (1*t);
        zF = zs3(i)+((1/sqrt(2))*xs(2*i)-0.3*zs(2*i)+(1/sqrt(2))*sin(0.125*pi + 0.25*pi*i)
          plot3(xF,yF,zF,'color',co);
        grid on
       plot3([xs(2*i) xs3(i)],[ys(2*i) ys3(i)],[zs(2*i) zs3(i)],'color',co)
    i = i+1;
end



xlabel('x(10m)')
ylabel('y(10m)')
zlabel('z(10m)')
scatter3(xsInit,ysInit,zsInit);
scatter3(xs,ys,zs)
 scatter3(xs2,ys2,zs2)
 scatter3(xs3,ys3,zs3)
axis([-10 10 -10 10 -10 10])
hold off
```

Python

```
import math
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
xs = []
ys = []
zs = []
i = 0
while i < 20:
    xs.append(i)
    ys.append(i)
    zs.append(i*i)
def three_d_circle(x,y,r):
    i = 0
    first = -r
    while first < r:
        ys.append(0)
        xs.append(first+x)
        zs.append(math.sqrt(r*r - first*first)+y)
        ys.append(0)
        xs.append(first+x)
        zs.append(-math.sqrt(r*r - first*first)+y)
        first = first + 0.2

three_d_circle(0,0,10)
three_d_circle(0,0,8)
three_d_circle(0,0,2)

ax = plt.figure().add_subplot(111, projection = '3d')
ax.scatter(xs, ys, zs, c = 'r', marker = '^') #points are triangle

ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
ax.set_zlabel('Z Label')
```

```
#plot now
plt.show()
```