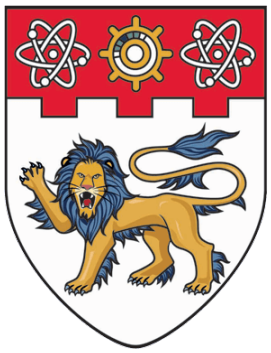

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

CZ2003 Computer Graphics and Visualisation

Experiment 2: Parametric Curves

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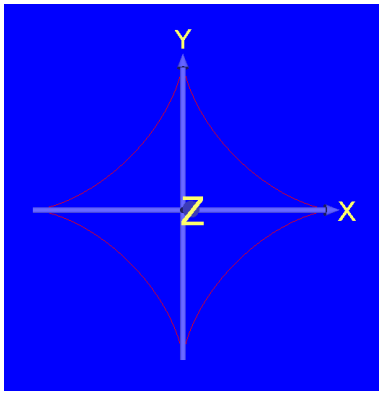
Matriculation Number: XXXXXXXXX

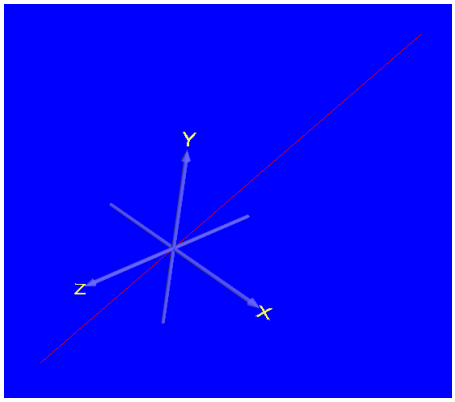
Lab Group: XXX

Exercise 1



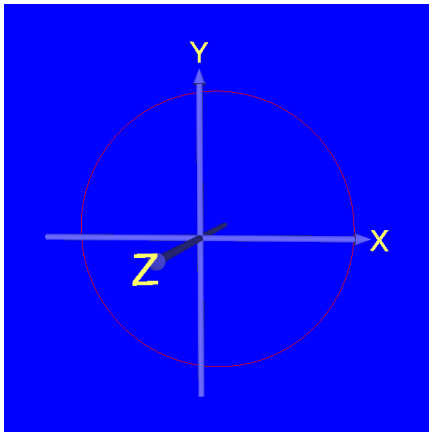
Exercise 2

1. **Straight Line Segment**



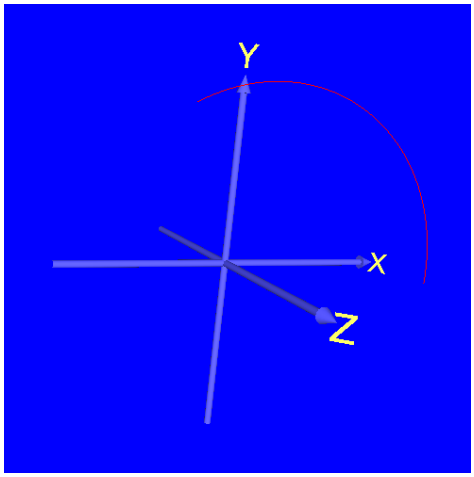
- defines a red straight line segment
    - starts from (-1, -2, 1) and ends at (1, 2, -1)

2.
    a. **Circle**



- defines a red circle parallel to the x-y plane
    - with radius of 1 unit and centre at (0, 0, -0.5)

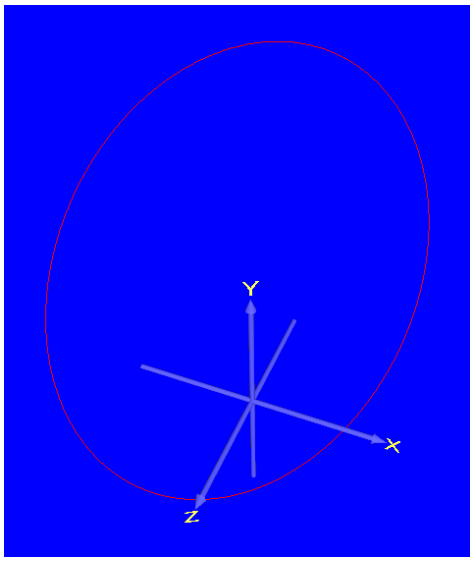
b. Arc of Circle



- defines an arc of a circle
    - almost the same equations as above, except that
        - only 1/3 of the circle is drawn (2*π*u/3)
        - centre is at (0, 0, 0.5)

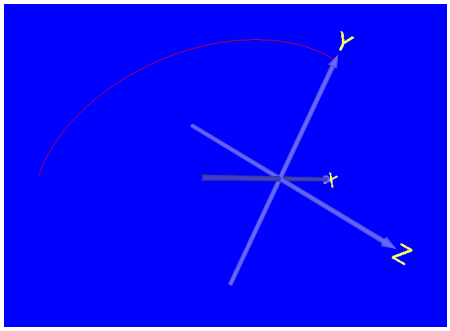
3.

a. Ellipse



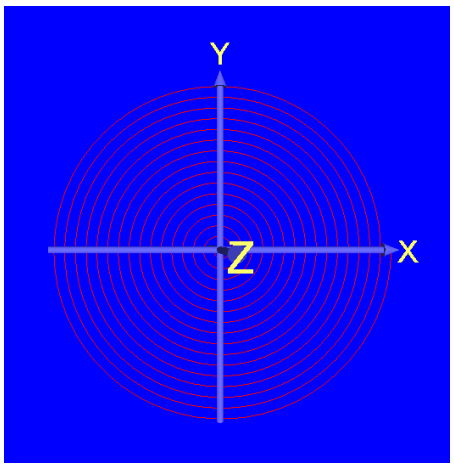
- start with a circle (radius = 1, centre (0,0)) in the x-y plane
  - x = 1 * cos(2*π*u)
  - y = 1 * sin(2*π*u)
  - z = 0
- scale circle in the y-direction by 2 to get an ellipse
  - x = 1 * cos(2*π*u)
  - y = 2 * sin(2*π*u)
  - z = 0
- translate ellipse by π/4 in the positive y-direction
  - x = 1 * cos(2*π*u)
  - y = 2 * sin(2*π*u) + π/4
  - z = 0
- rotate ellipse about y-axis
  - x = 1*cos(2*π*u)
  - y = 2*sin(2*π*u) + π/4
  - z = 1*cos(2*π*u)
- rotate ellipse about y-axis in the opposite direction (final ellipse)
  - x = 1*cos(2*π*u)
  - y = 2*sin(2*π*u) + π/4
  - z = -1*cos(2*π*u)

b. Arc of Ellipse



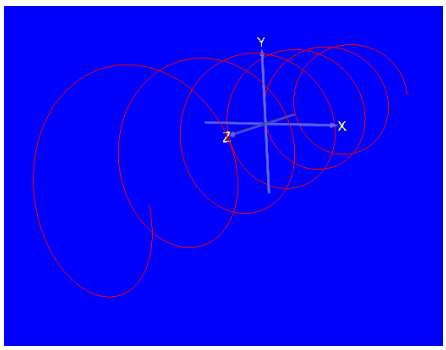
- start with a circle (radius = 1, centre (0,0)) in the x-y plane
  - x = 1 * cos(2*π*u)
  - y = 1 * sin(2*π*u)
  - z = 0
- scale circle in the x-direction by 2 to get an ellipse
  - x = 2 * cos(2*π*u)
  - y = 1 * sin(2*π*u)
  - z = 0
- draw 1/4 of an ellipse to get an arc
  - x = 2 * cos(2*π*u/4)
  - y = 1 * sin(2*π*u/4)
  - z = 0
- start drawing the arc from π /2 instead of 0 radians (final arc)
  - x = 2 * cos(2*π*u/4 + π /2)
  - y = 1 * sin(2*π*u/4 + π /2)
  - z = 0

4. 2D Spiral



- start with a circle (radius = 1, centre (0,0)) in the x-y plane
  - x = 1 * cos(2*π*u)
  - y = 1 * sin(2*π*u)
  - z = 0
- let radius scale based on parameter u
  - x = u * cos(2*π*u)
  - y = u * sin(2*π*u)
  - z = 0
- make the spiral go through 16 revolutions, along with changing resolution to 1000 (final spiral)
  - x = u * cos(2*π*u)
  - y = u * sin(2*π*u)
  - z = 0

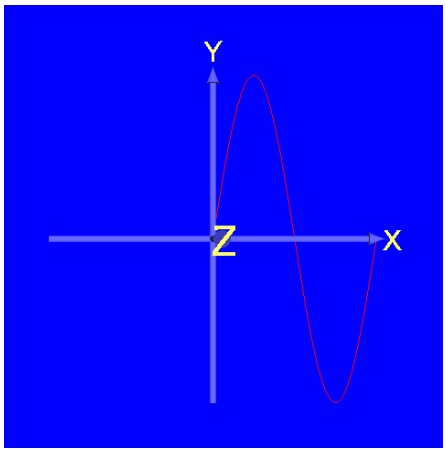
5. 3D Helix



- start with a circle (radius = 1, centre (0,0)) in the x-y plane
    - x = 1 * cos(2*π*u)
    - y = 1 * sin(2*π*u)
    - z = 0
- make the circle grow from z = -4 to z = 4
    - x = 1 * cos(2*π*u)
    - y = 1 * sin(2*π*u)
    - z = 8*u – 4
- make the helix do 6 revolutions (final helix)
    - x = 1 * cos(6*2*π*u)
    - y = 1 * sin(6*2*π*u)
    - z = 8*u – 4

Exercise 3

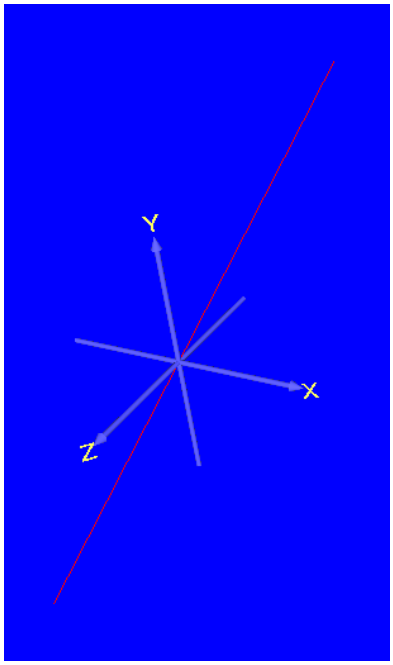
Sine Curve



- explicit to parametric: let x = u
- standard sine curve
    - x = u
    - y = sin(2*π*u)
    - z = 0
    - domain: 0 to 2π

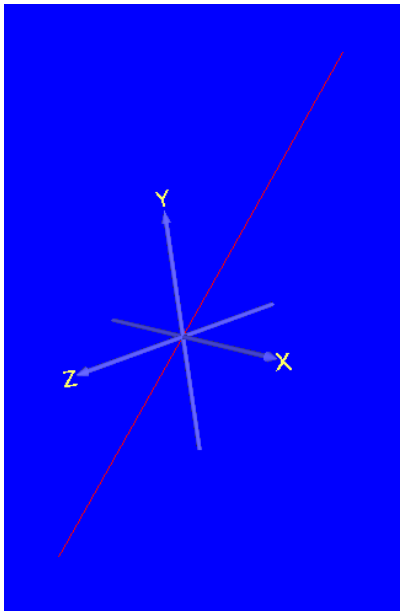
Exercise 4

1. **Straight Line Segment**
    a. resolution of 20:



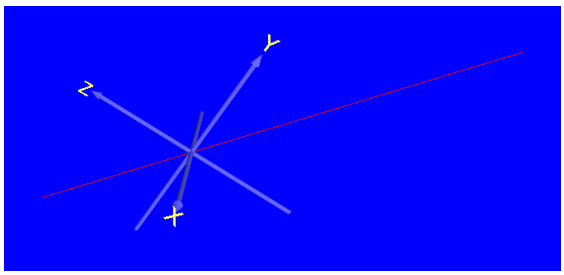
- looks just like resolution of 100
    - all points lie on the same line segment

    b. resolution of 5:



- looks just like resolution of 100 and 20
    - all points lie on the same line segment

c. resolution of 2:

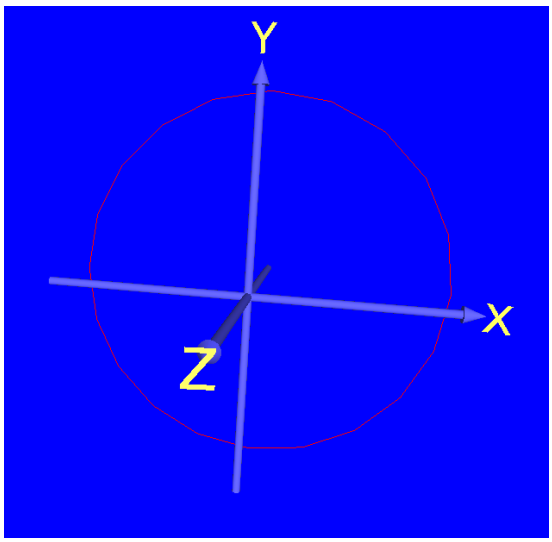


- looks just like resolution of 100, 20 and 5
  - all points lie on the same line segment

2.

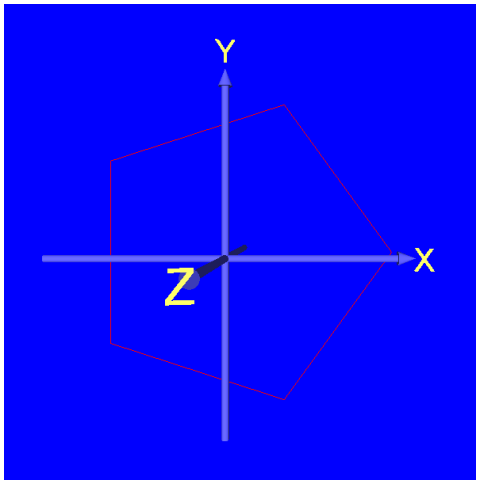
a. Circle

i. resolution of 20:



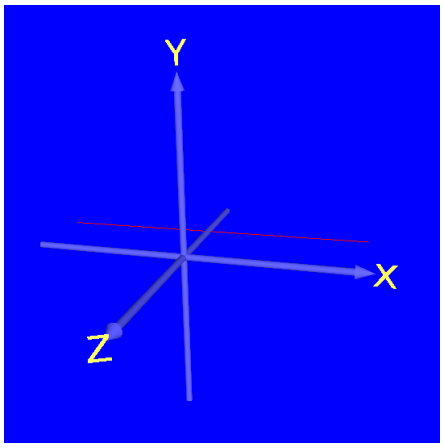
- it is possible to see 20 straight line segments that interpolate from point to point

ii. resolution of 5:



- linear interpolation between 5 points result in a pentagon

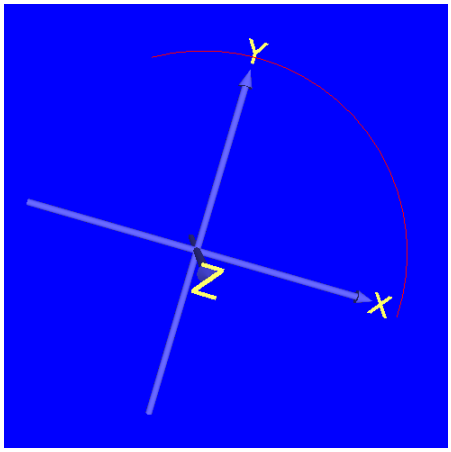
iii. resolution of 2



- linear interpolation between 2 points result in a straight line segment

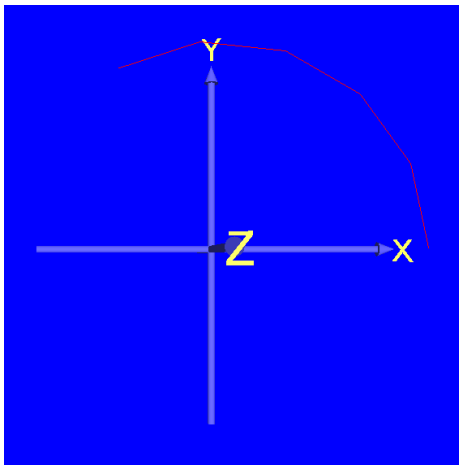
b. Arc of Circle

i. resolution of 20:



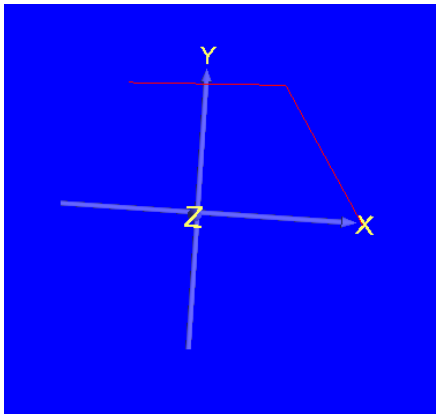
- looks just like resolution of 100
  - 20 points are enough to make this arc looks smooth

ii. resolution of 5:



- possible to see 5 line segments

iii. resolution of 2:

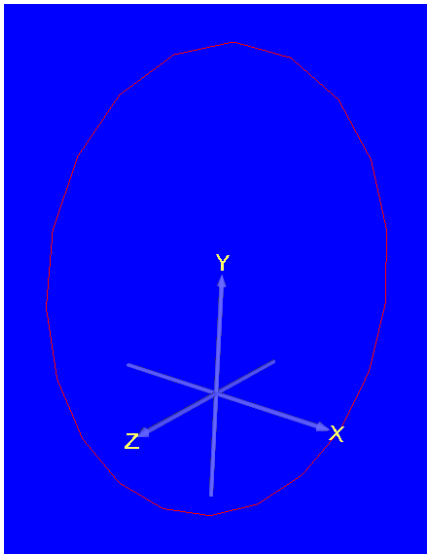


- 2 line segments

3.

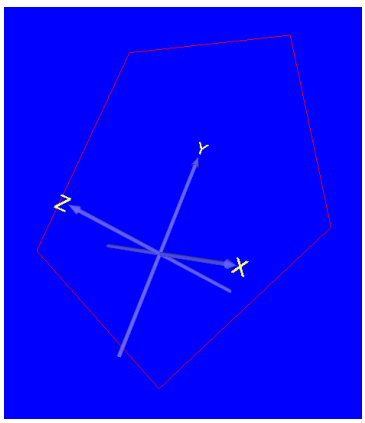
a. Ellipse

i. resolution of 20:



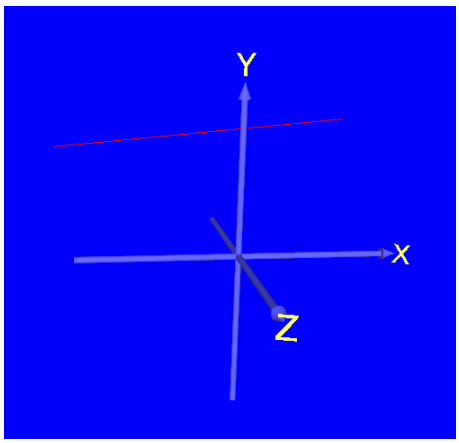
- a not-so-smooth ellipse

ii. resolution of 5:



- a deformed pentagon

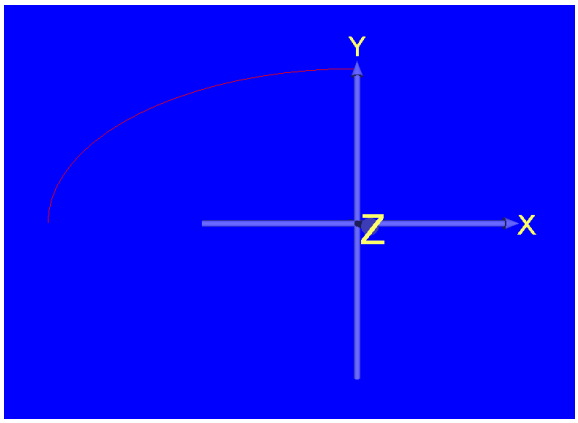
iii. resolution of 2:



- a straight line segment

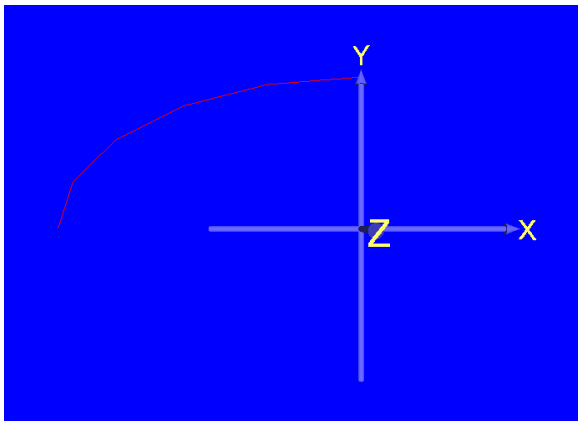
b. Arc of Ellipse

i. resolution of 20:



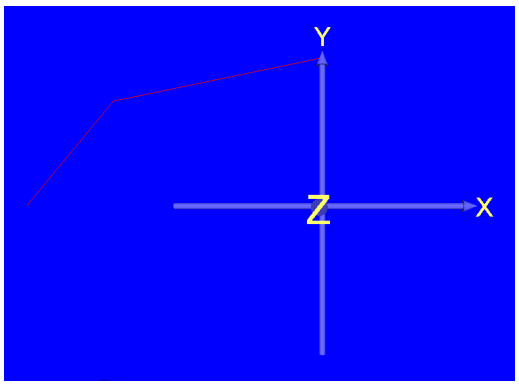
- arc looks smooth enough with 20 line segments

ii. resolution of 5:



- 5 line segments which follow the general shape of the arc

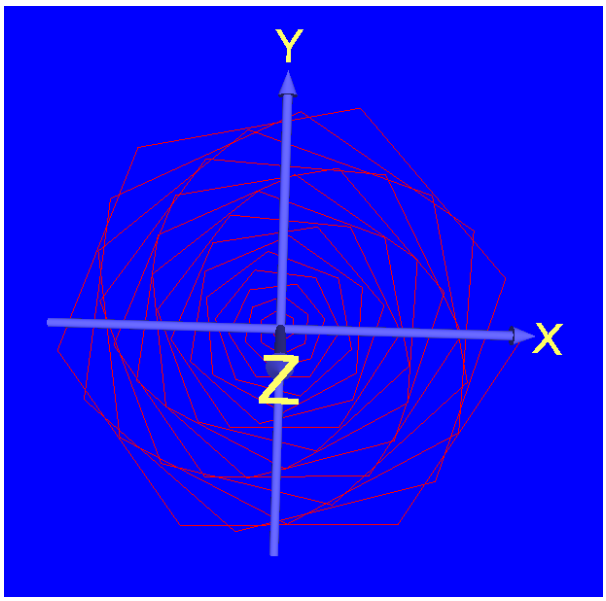
iii. resolution of 2:



- 2 line segments that follow the general shape of the arc

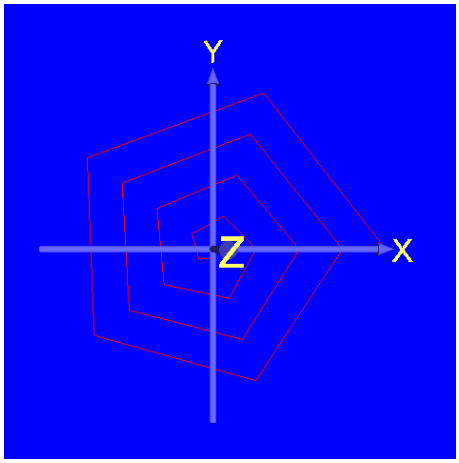
4. 2D Spiral

a. resolution of 100:



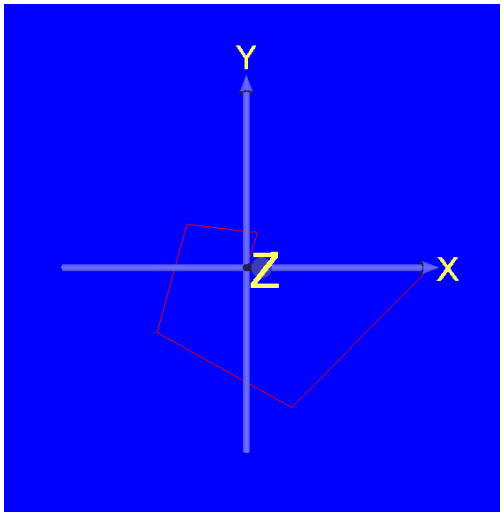
- cool-looking shape

b. resolution of 20:

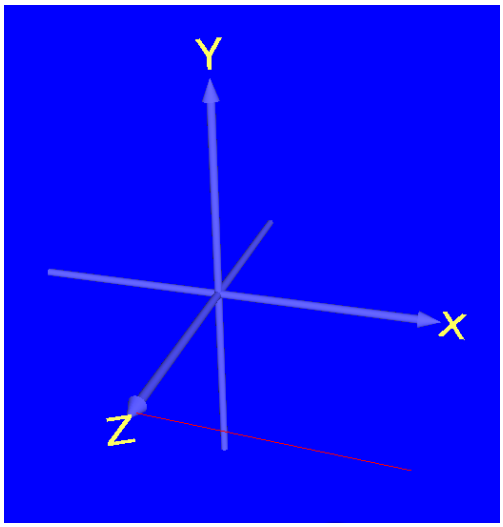


- looks neater with 20 edges

c. resolution of 5:

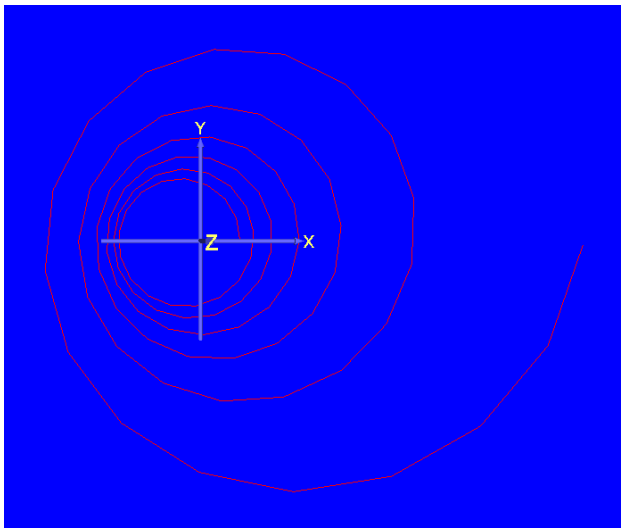


d. resolution of 2 (added offset of 1 unit in z-direction):

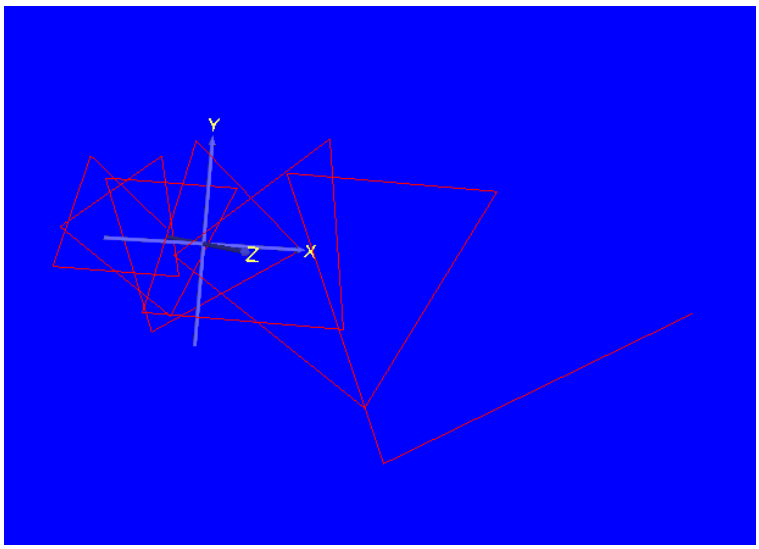


5. 3D Helix

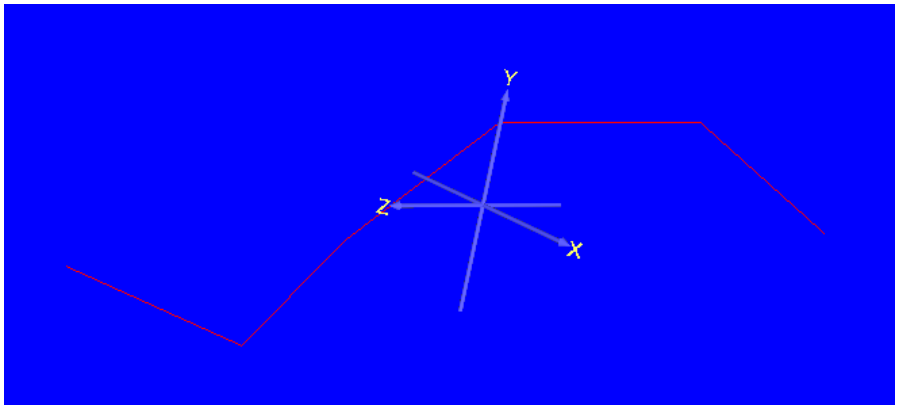
a. resolution of 100:



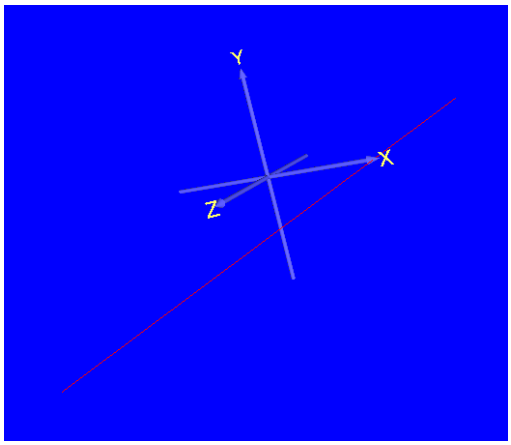
b. resolution of 20:



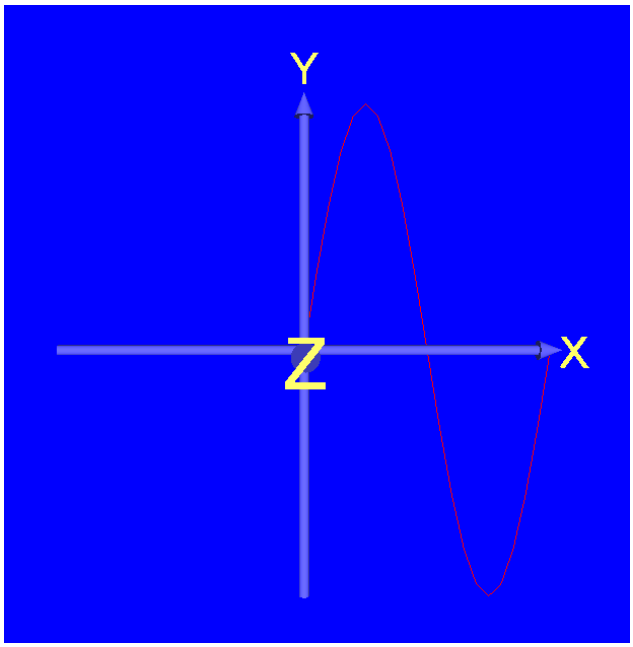
c. resolution of 5:



d. resolution of 2:

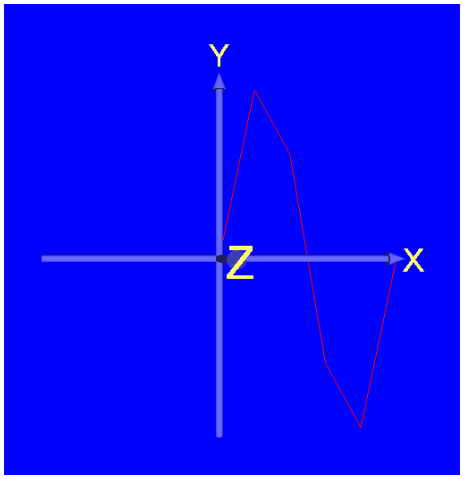


6. **Sine Curve**
    a. resolution of 20:

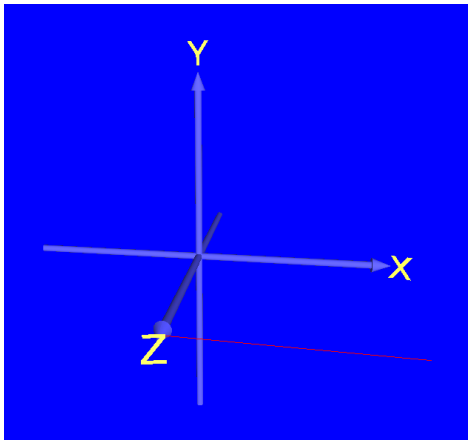


- it is possible to see the line segments at maximum amplitude of the sine curve

    b. resolution of 5:



    c. resolution of 2 (added offset of 1 unit in z-direction):

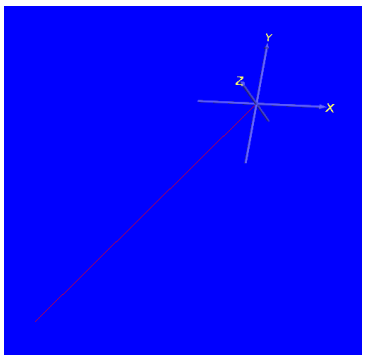


Exercise 5

- general note: BS Contact crashes if domain is from a larger value to a smaller value

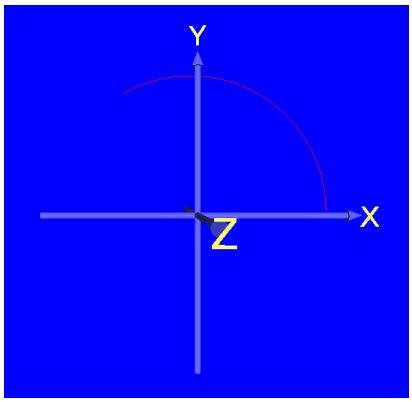
1. **Straight Line Segment**

u ∈ [-2, 0]:



2.
    a. **Circle**

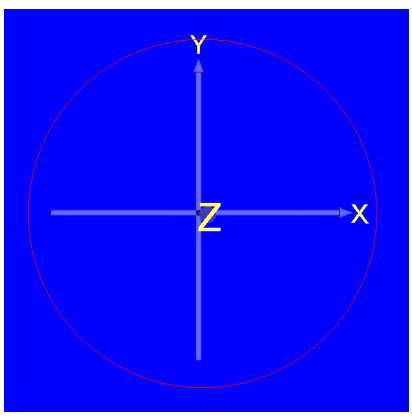
u ∈ [0, 0.333]:



- approximately the original arc of circle

    b. **Arc of Circle**

u ∈ [0, 3]:

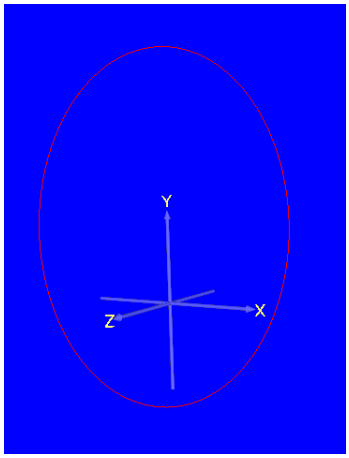


- just like the original circle

3.

a. **Ellipse**

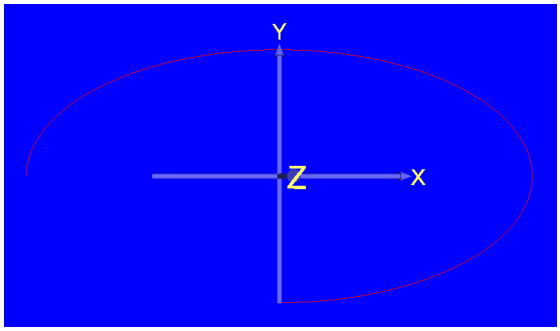
u ∈ [-1, 0]:



- just like the original ellipse

b. Arc of Ellipse

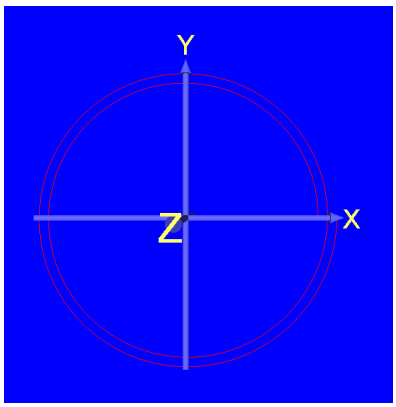
u ∈ [-2, 1]:



- starts from angle α = -π and ends at angle α = -π/2 if the rotational offset of π/2 is not considered

4. 2D Spiral

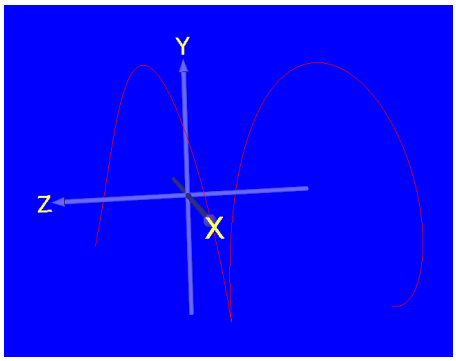
u ∈ [0.875, 1]:



- outermost 2 revolutions of the spiral
  - 1 – 2/16 = 0.875

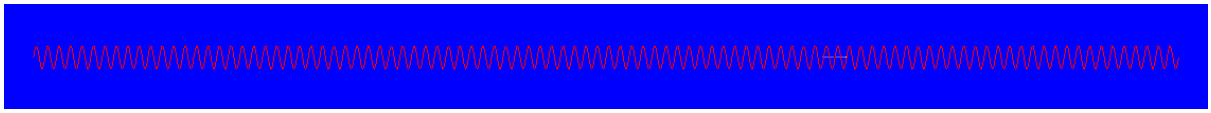
5. 3D Helix

u ∈ [0.3, 0.6]:



6. Sine Curve

u ∈ [-70, 30]:



Exercise 6

- refer to the folder “Created_Shapes”

Exercise 7

- refer to this report