**CSC418 A1**

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Part A:

1. x(t) = 4 cos(2πt) + 1/16 \* cos(32πt)

x(t) = 4 cos(2πt) + 1/16 \* cos(32πt) = -2π(4sin(2πt) + sin(32πt))

y(t) = 2 sin(2πt) + 1/16 \* sin(32πt) = 2 π (2 cos (2 π t) + cos (32 π t))

So, the tangent vector is (-2π(4sin(2πt) + sin(32πt)), 2 π (2 cos (2 π t) + cos (32 π t)))

The normal vector is (2 π (2 cos (2 π t) + cos (32 π t)), 2π(4sin(2πt) + sin(32πt))

2) the curve is symmetric around the X-axis

Since cos is even, so x(t) is even.

Since sin is odd, so y(t) is odd

Let a = -t, then x(a) = x(t) and y(a) = -y(t)

We can see that the curve is symmetric around the X-axis

The curve is not symmetric around Y-axis

Counter Example:

Let = 1, = 1.5

Y() = 0 and y() = 0

However, x() = 4 + 1/16, and x() = -3 – 15/16.

Obviously, x() -x()

We can see that the curve is not symmetric around Y-axis.

3)

Formula of the length of the perimeter should be

,

Since the curve above x-axis are the opposite direction of the curve under x-axis. We only need to calculate the curve above x-axis and multiply it by 2

So, L =2\*

4)

suppose there exits t\* such that [0, t\*] determined ¼ of the curve.

Then the ¼ curve length should be

The perimeter should be 4\*

2.

1) The area should be

2) The number can be 0 or 1 or 2 or 3 or 4

3) When a line intersects with a circle, we can get the equation such that

= or =

=

=

- = 0

since

for larger circle is

for larger circle is

if < 0, we can get that there is no solution for this equation, there is no intersection

if = 0, we can get that there is one solution for this equation, there is one intersection

if > 0, we can get that there are two solutions for this equation, there are two intersection points.

So,

if < 0, there is no intersection point

if = 0, there is only one intersection point

point p =

if < 0 and , then there are two intersection points

p =

if = 0 and , then there are three intersection points

p =

=

if > 0 and , then there are three intersection points

p =

p =

4)

If the line and donut are both transformed by a non-uniform scale () around the origin, the location will transformed by (), and the number of intersections will not change.

5)

we can first apply the scale on the donut, it becomes an ellipse, then we can use the method in 3), and get the location and the number of the intersections

both of them will change.

3.

a) Not commute

Counter Example:

Let uniform scaling matrix be S =

Let translate matrix be T =

ST = TS =

We can see that STTS, So, translate and uniform scaling are not equal

b) Not commute

Counter Example:

Let non-uniform scaling matrix be S =

Let translate matrix be T =

ST = TS =

We can see that STTS, So, translate and non-uniform scaling are not equal

c) there exists 2 cases:

1) uniform scaling: commute

Let uniform scaling matrix be S =

Let rotation matrix be R =

SR = RS =

We can see that SR = RS, so scaling and rotation, both having the same fixed points are commute when it is uniform scaling

2) non-uniform scaling: not commute

Let non-uniform scaling matrix be S =

Let rotation matrix be R =

SR = RS =

We can see that whatever is, , then SR RS. So scaling and rotation, both having the same fixed points(0,0) are not commute when it is non-uniform scaling

d) not commute

counter example:

Let the different fixed points be (1,0) and (0,1)

Let the scale matrix = = =

Let the scale matrix = = =

= =

We can see that , so, scaling and scaling with different fixed point are not commute.

e) not commute

counter example:

Let translate matrix be T =

Let shear matrix be S =

ST = TS =

We can see that STTS, so translation and shearing are not commute

4.

a) choose a point q, if q satisfied three conditions:

1. the distance from to q is less than the distance from to

2. the distance from to q is less than the distance from to

3. the distance from to q is less than the distance from to

then q should inside the triangle

if q satisfied three conditions:

1. the segment from to q has intersection point with the segment from to

OR

2. the segment from to q has intersection point with the segment from to

OR

3. the segment from to q has intersection point with the segment from to

Then q is outside the triangle

b)

based on part a, if q satisfied:

1. (the distance from q to plus the distance from q to equals to the length of )

OR

2. (the distance from q to plus the distance from q to equals to the length of )

OR

3. (the distance from q to plus the distance from q to equals to the length of )

Then q should on the edge of triangle

c)

choose any two non-adjacent vertexes, connect them with each other, there exists two conditions:

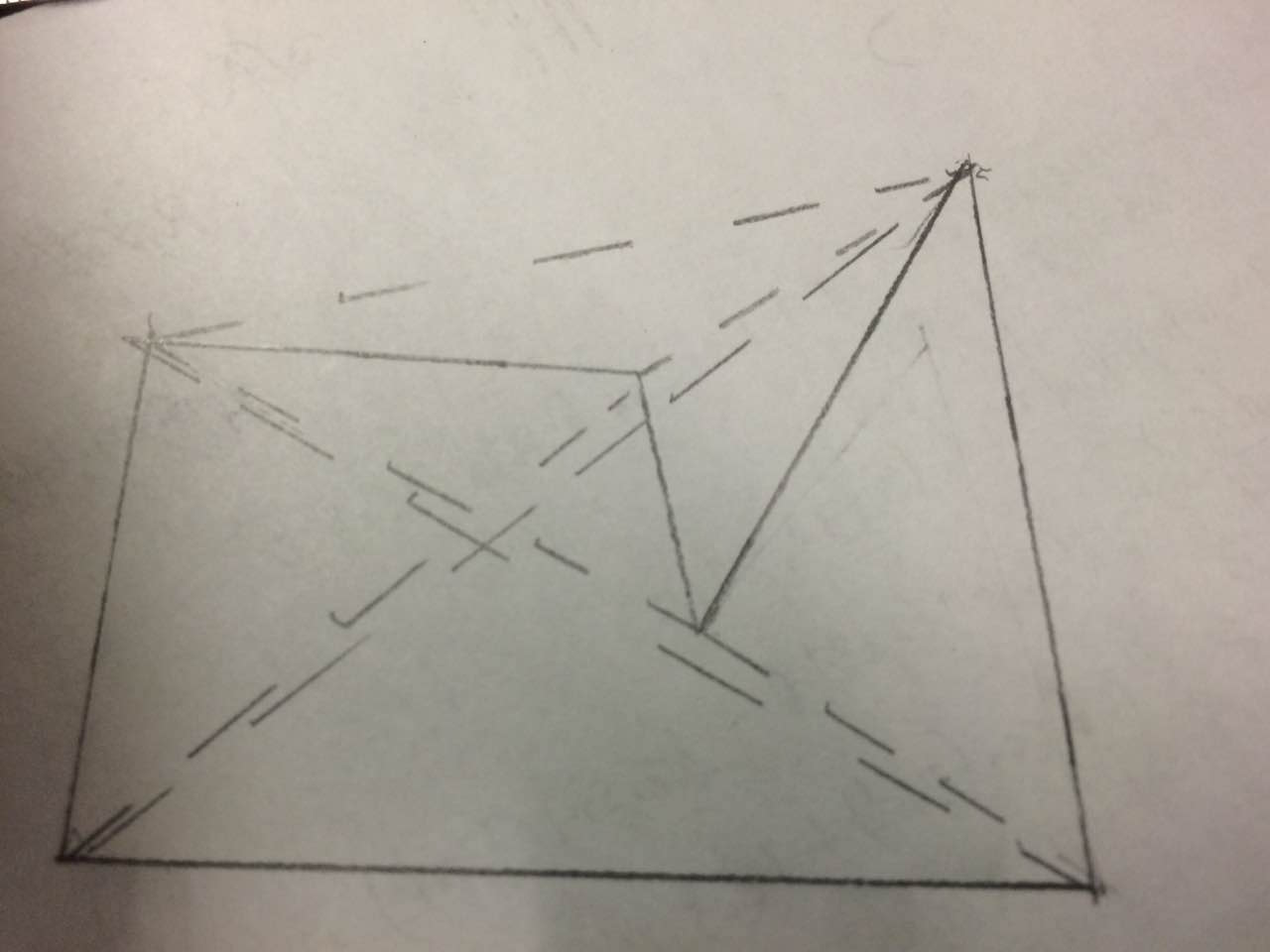
1. if the new line is outside the quadrilateral, reject it.

2. if the new line is inside the quadrilateral, then we can see that the quadrilateral is combine of two triangles.

d)

for any vertex v, connect v with any other non-adjacent vertexes, then we can see that the polygon is combine of many triangles

e)



we can see that the method in d will failed, since many lines will appear outside, and the polygon cannot be triangular.

f)

Outside:

for segment between any two adjacent vertexes, if there exists a segment between q and other vertexes that intersects , then q is outside of the polygon.

In:

For any two adjacent vertexes and , if the distance from to q plus the distance form to q equals to the distance from to , then q is on triangle

Inside:

Suppose for any , , they are adjacent vertexes.

Set means the distance from vertex to segment

Let = {, ,…….. , ,…... }

Choose a point q, if q satisfied all the conditions:

1. for (the distance from to q), max() >

2. for (the distance from to q), max() >

3. for (the distance from to q), max() >

.

.

.

n. for (the distance from to q), max() >