24-681 COMPUTER-AIDED DESIGN Spring 2016

Carnegie Mellon University

PROBLEM SET 3

Due: **2/4/2016 (Thu) 3:00PM @ DH A302**
Issued: 1/26/2015 (Tue)
Weight: 3% of total grade
Note: * **Attach the last page of the problem set as the cover page of your paper.**

PS3-1 Calculation of the area of a 2D polygon

Write a computer program that reads a 2D polygon file and calculates the area of the polygon.

Your program should read a 2D polygon file, count the number of vertices, and compute the area of the polygon. The output of your program should look like the following:

```
Problem Set 3-1
Kenji Shimada
File Name:  ___
# of vertices:  ___
Area : ___
```

Apply your program to two 2D polygon files, "mouse.txt" and "bird.txt."

Each of the 2D polygon files consists of a sequence of points (in counter clockwise).

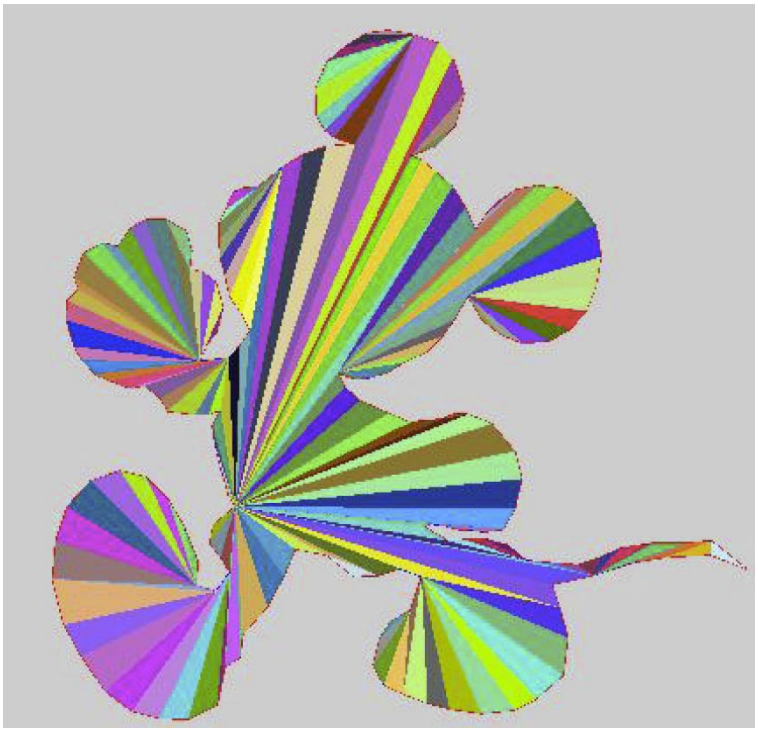
Before you start writing your program, make a pseudocode that describes the outline of the process that your program will perform.

In your hand-in directory on AFS, make a new directory called ps3-1 (in lower case), and hand in:

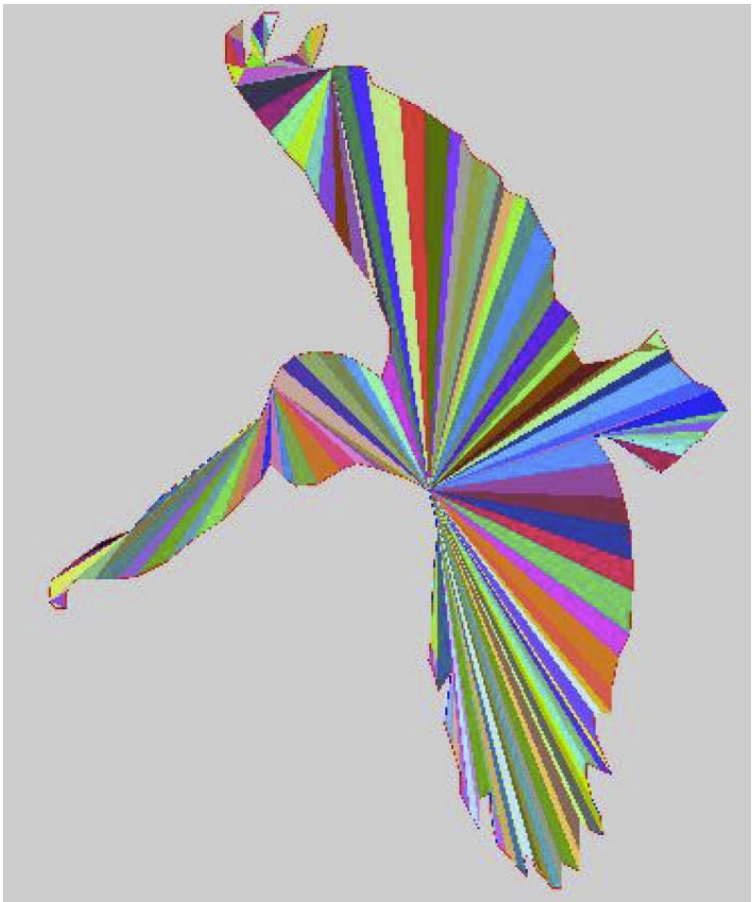
- source code
- "readme" file that explains what programming language, operating system, and compiler/interpreter you used.

Also hand in a printout of the following:

- pseudocode
- source code
- output from your program
- readme file



mouse.txt



Bird.txt

PS3-2 Calculation of the surface area and the volume of a polyhedron

Write a computer program that reads a polygonal mesh file and calculates the surface area and the volume of a polyhedron.

Your program should read a polygonal mesh file, count the number of vertices, count the number of faces, and compute the area and the volume of the polyhedron. The output of your program should look like the following:

```
Problem Set 3-2
Kenji Shimada
File Name:  ___
# of vertices:  ___
# of faces:  ___
Area : ___
Volume: ___
```

Apply your program to two polygonal mesh files, shape.dat and triceratops.dat. Each of the polygon mesh files consists of:

(1) an ordered list of the coordinate values of all the vertices, and
(2) an ordered list of the boundary vertices of all the polygons

Before you start writing your program, make a pseudocode that describes the outline of the process that your program will perform.

In your hand-in directory on AFS, make a new directory called ps3-2 (in lower case), and hand in:

- source code
- "readme" file that explains what programming language, operating system, and compiler/interpreter you used.

Also hand in a printout of the following:

- pseudocode
- source code
- output from your program
- readme file

```
v    0.000292319 -0.0268846 0.07
v    0.0237904 -0.0302096 0.0405772
v    0.0244004 -0.0295996 0.0416753
v    -0.00105749 -0.0280107 0.07
v    0.003 0.019 0.07
...
..
.
f    4  31  7
f    7  31  23
f    7  23  27
f    9  16  9
...
..
.
```

Figure 1. Polygonal mesh data file, "shape.dat"

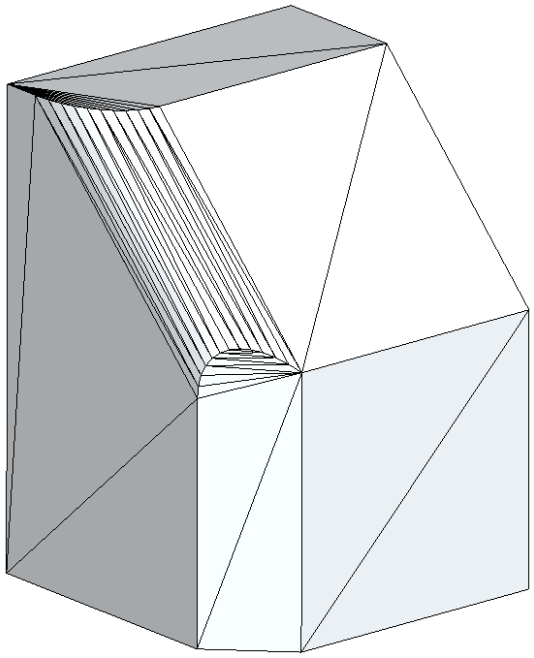


Figure 2. "shape.dat" geometry

```
v  3.66093  0.002173  -0.738231
v  3.71948  0.346536  -0.832918
v  3.97733  0.310855  -0.725284
v  4.07667  0.138582  -0.653713
v  4.14038  0.040489  -0.561284
...
..
.
f  2805  2809  2814  2820
f  2796  2800  2810  2804
f  2788  2792  2801  2795
f  2782  2793  2787
...
..
.
```

Figure 3. Polygonal mesh data file, "triceratops.dat"

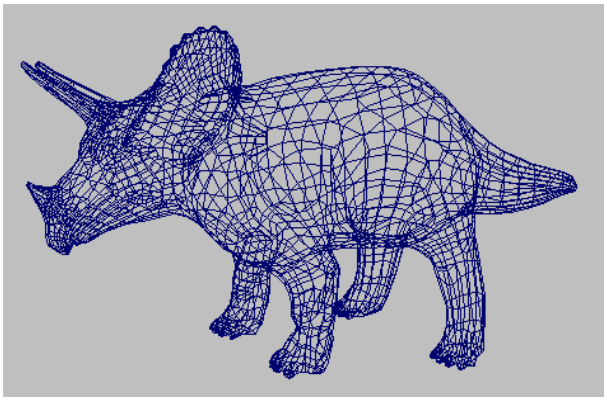
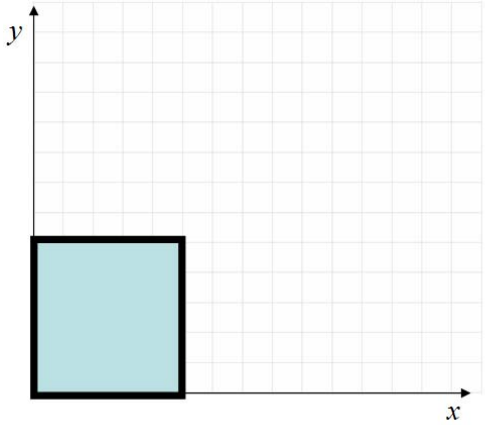


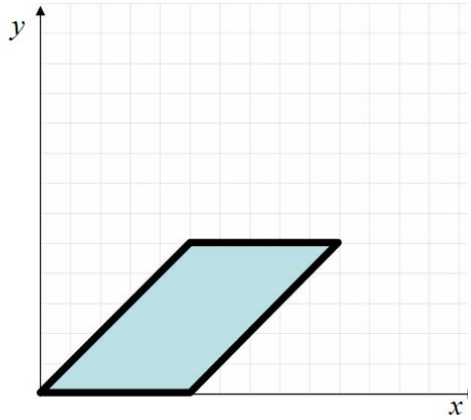
Figure 4. "triceratops.dat" geometry

PS3-3 Homogeneous 2D geometric transformation

(1) Find the 3 x 3 homogeneous geometric transformation matrix that performs the two-dimensional skewing shown in the figure on the right.

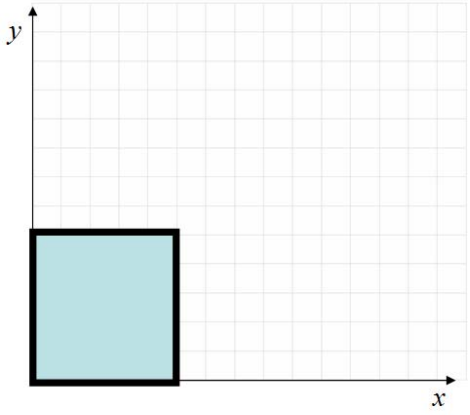


Before geometric transformation

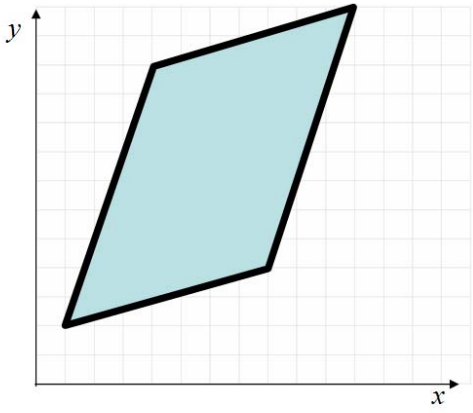


After geometric transformation

(2) Find the 3 x 3 homogeneous geometric transformation matrix that performs the combination of two-dimensional skewing, scaling and translation shown in the figure on the right.

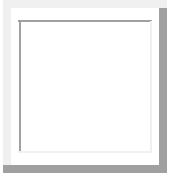


Before geometric transformation



After geometric transformation

PS3



The first letter of your LAST name _____ First Name _____ Last Name

How many hours did you spend to complete this problem set?

_____ Hour(s)

How many no-penalty late days do you want to use for this problem set?

_____ Day(s)

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