CSC4140 Assignment I

Computer Graphics

February 14, 2022

Learn to use VirtualBox and Mathematic Review

This assignment is 5% of the total mark.

Strict Due Date: 11:59PM, Feb 14^{th}, 2022

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This assignment represents my own work in accordance with University regulations.

Signature: JINGYU LI

1 Question 2.1

2.1.1

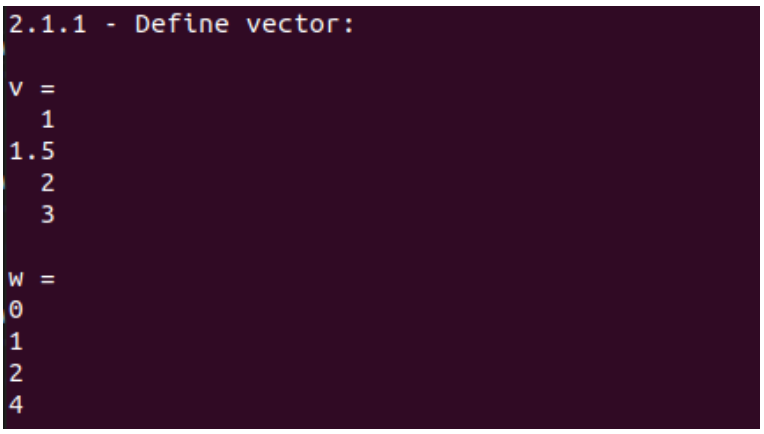

Figure 1: Vector Definition

2.1.2

To perform vector add, the homogeneous coordinates are required to transform to Cartesian coordinates (3-dimension) to calculate. The method is to divide first three coordinates by the fourth value w.

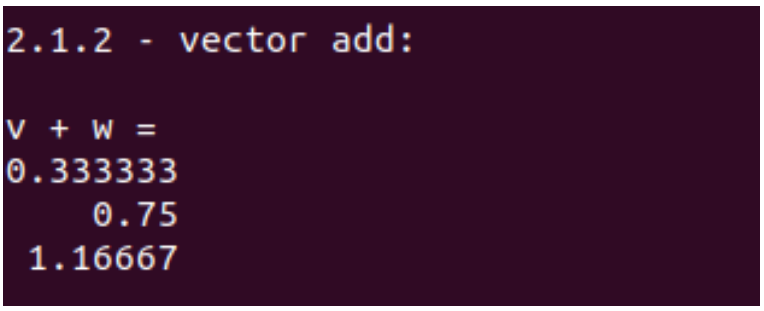

Figure 2: Vector Add

2.1.3

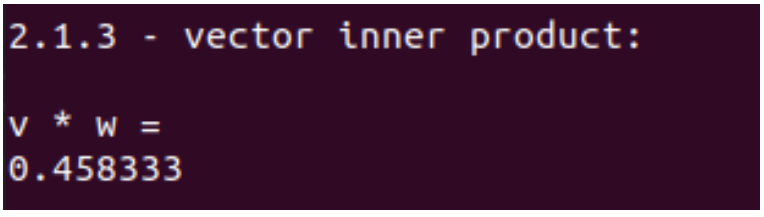

Figure 3: Vector Inner Product

2.1.4

Vector cross product makes sense when the vectors are in 3-dim. As a result, the homogeneous coordinates needs to be changed to Cartesian coordinates.

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2.1.4 - vector cross product:

v x w =
0.0833333
-0.166667
0.0833333
```

Figure 4: Vector Cross Product

2 Question 2.2

2.2.1

```
2.2.1 - Define matrix:

i =
 1  2  3  4
 5  6  7  8
 9 10 11 12
13 14 15 16

j =
 4  3  2  1
 8  7  6  5
12 11 10  9
16 15 14 13
```

Figure 5: Matrix Definition

2.2.2

```
2.2.2 - matrix add:

i + j =
 5  5  5  5
13 13 13 13
21 21 21 21
29 29 29 29
```

Figure 6: Matrix Add

2.2.3

```
2.2.3 - matrix multiply:

i * j =
120 110 100  90
280 254 228 202
440 398 356 314
600 542 484 426
```

Figure 7: Matrix Multiply

2.2.4

```
2.2.4 - matrix multiply vector

i * v =
 22
 52
 82
112
```

Figure 8: Matrix Multiply Vector

3 Question 2.3

2.3.1

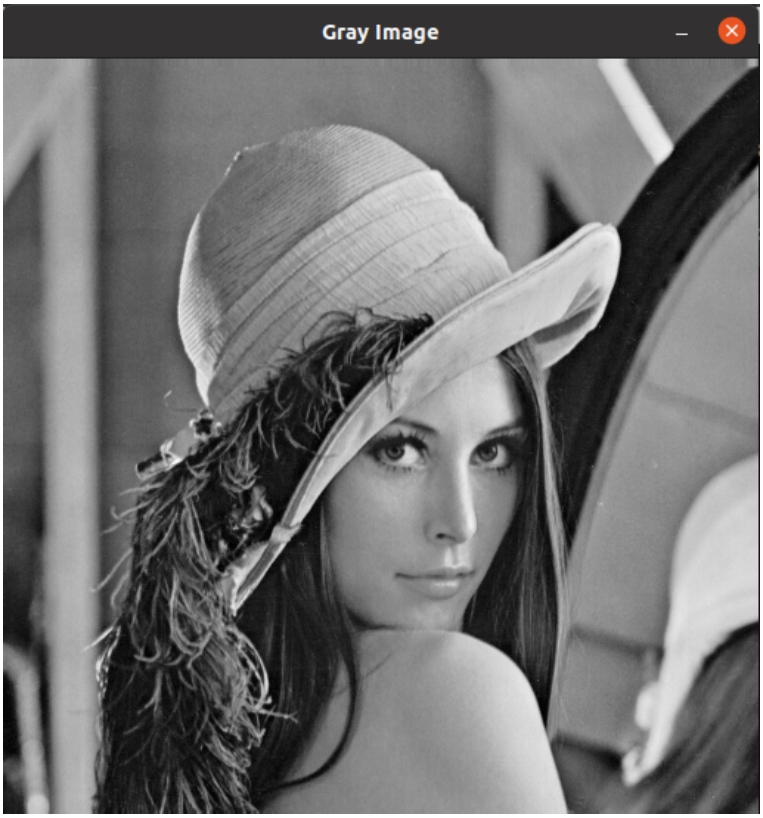

Figure 9: Gray Image

2.3.3

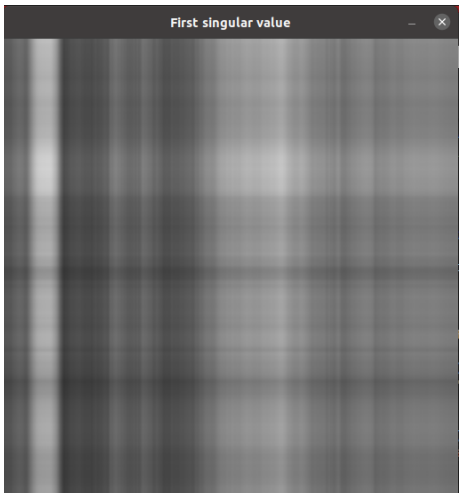

Figure 10: First Singular

2.3.4

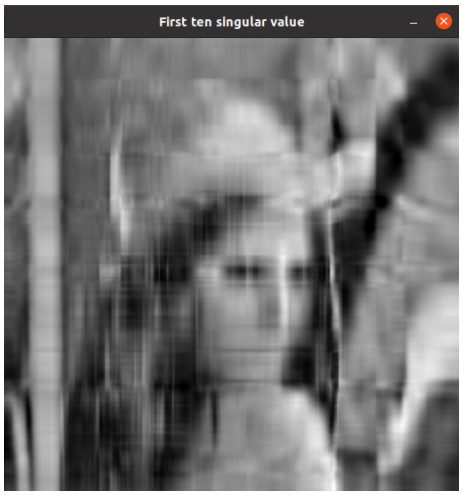

Figure 11: First ten Singular

2.3.5

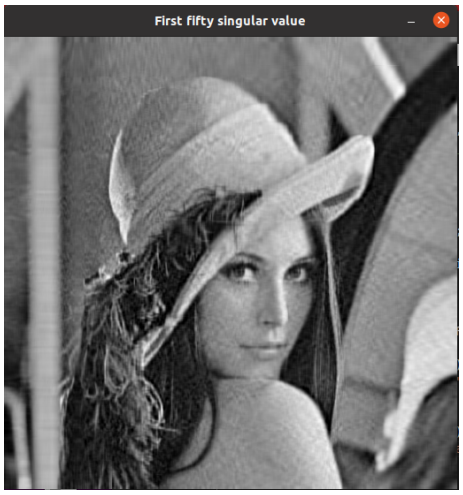

Figure 12: First fifty Singular

2.3.6

For the feature map of the first singular value, the image is blurry and can hardly recognize the figure; In the first ten singular value one can recognize the portrait but still not clear; As the feature map increases to fifty, the image becomes clear and easy to recognize. The higher the feature map of S and V, the clearer and more recognizable the image is, that is, the closer to the origin picture. The feature map can provide more information if the singular value is larger.

4 Question 2.4

To rotate a point A around another point B, first translate the point A according to B's coordinates so that A can rotate around the origin and apply 3 axis's rotation matrix. After matrix multiplication, translate back.

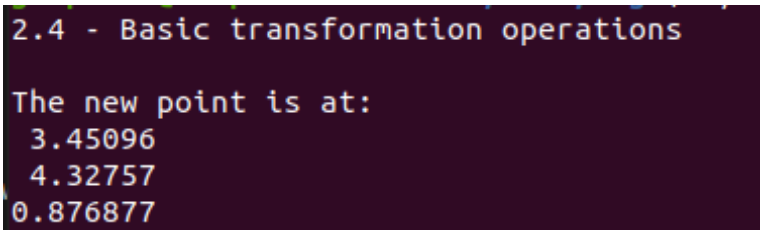

Figure 13: Rotation