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EECS 101

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Homework 1

1a. Write expressions for the image coordinates x' and y' in terms of these constants and f' and t for both the perspective and orthographic projection of the line.

orthographic:

```
float x0 = 0.5;
float y0 = -1.0;
float z0 = 0.0;
float a = 0.0;
float b = 1.0;
float c = -1.0;
float fprime = 1.0;

for (t = 0.01; t < 10000.01; t += .01) //change the t range
{

    /*Modify the coefficients according to questions*/
    x = 0.5 + t * 0.0;
    y = -1.0 + t;
    z = -t;

    /* Modify these according to the projection */
    xprime = x0 + t * a;          /* this is an example of orth */
    yprime = y0 + t * b;
```

perspective:

```
float x0 = 0.5;
float y0 = -1.0;
float z0 = 0.0;
float a = 0.0;
float b = 1.0;
float c = -1.0;
float fprime = 1.0;

for (t = 0.01; t < 10000.01; t += .01) //change the
{

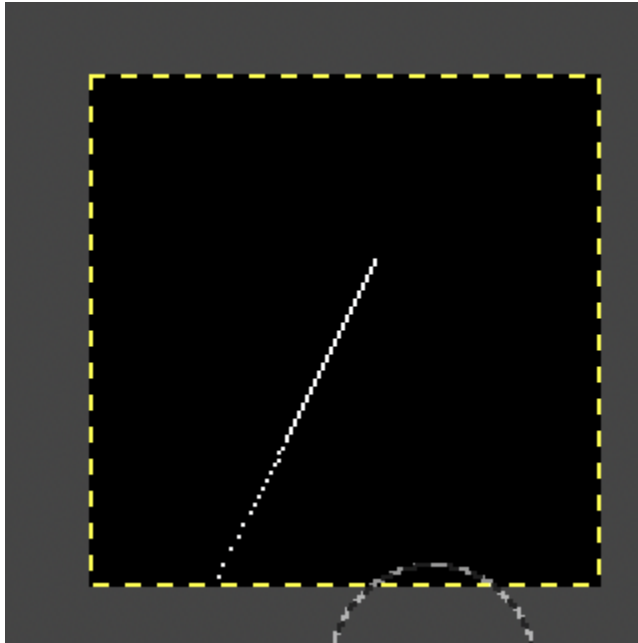
    /*Modify the coefficients according to question
    x = 0.5 + t * 0.0;
    y = -1.0 + t;
    z = -t;

    /* Modify these according to the projection */
    xprime = (fprime * (x0 + t * a))/(z0 + t * c);
    yprime = (fprime * (y0 + t * b))/(z0 + t * c);
```

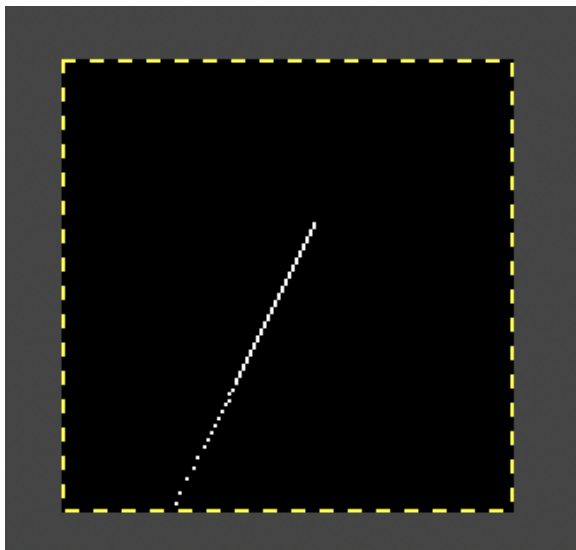
1e. The situation that occurs when the perspective projection case as t goes to infinity is that the line will be projected to a point in infinity. This happens because in the perspective projection

equations, the denominator will approach zero while the numerator will stay the same. This is consistent with the image my program generates as after trying out larger and larger values, I find this to be the case as the line points to a point in infinity.

Orthographic:



Perspective:



2a.

orthographic

```
for (t = 0.01; t < 10000.01; t += .01) //change th
{

    /*Modify the coefficients according to questio
    x = x1 + t * a;
    y = y1 + t * b;
    z = z0;

    float xm = x2 + t * a;
    float ym = y2 + t * b;
    float zm = z0;

    /* Modify these according to the projection */
    xprime = x1 + t * a;          /* this is an e
    yprime = y1 + t * b;

    float xmprime = x2 + t * a;
    float ymprime = y2 + t * b;

    plot_logical_point(xprime, yprime, image);
}
```

Perspective:

```

for (t = 0.01; t < 10000.01; t += .01) //change the t r
{

    /*Modify the coefficiences according to questions*/
    x = x1 + t * a;
    y = y1 + t * b;
    z = z0;

    float xm = x2 + t * a;
    float ym = y2 + t * b;
    float zm = z0;

    /* Modify these according float t projection */
    xprime = (fprime * (x1 + t * a)) / z0; // t
    yprime = (fprime * (y1 + t * b)) / z0;

    float xmprime = (fprime * (x2 + t * a)) / z0;
    float ymprime = (fprime * (y2 + t * b)) / z0;

    plot_logical_point(xprime, yprime, image);
}

```

2c. The projections of the lines in the image will be parallel for orthographic projection but not for parallel projection.

i) The lines on the perspective projection will not be parallel as with the lines moving farther away, the lines will at some point cross and direct towards each other to a single point that leads to the lines being distorted. This is due to the fprime and z0 values in the orthographic line equations.

ii) The lines will be parallel for orthographic projection since orthographic projection maintains the parallelism since there is no f' or z_0 value involved to distort the parallelism of the lines.

The value of the x and y of the line will be maintained on the image plane.

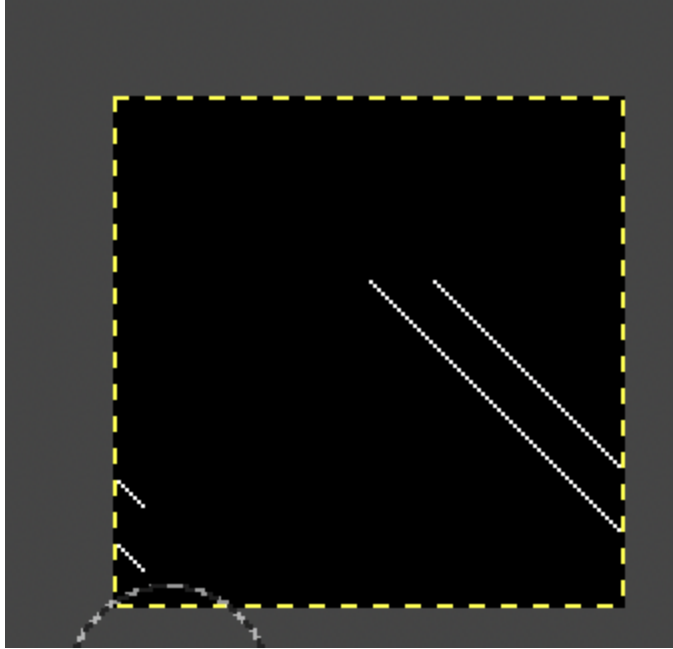
2d) My answer for part c is consistent with the images that my program generates as for the orthographic pictures, the lines are parallel. For the perspective projected pictures, the images appear to be converging (although it is quite hard to see)

2e) Orthographic projection is a good way to approximate compared to perspective projection in terms of this problem since the lines are parallel and the value for z is a constant value. In addition, with orthographic projection, it still shows the parallel lines whereas with a perspective projection, the distorted lines may not be the best case to show the geometry of the lines by producing something inaccurate.

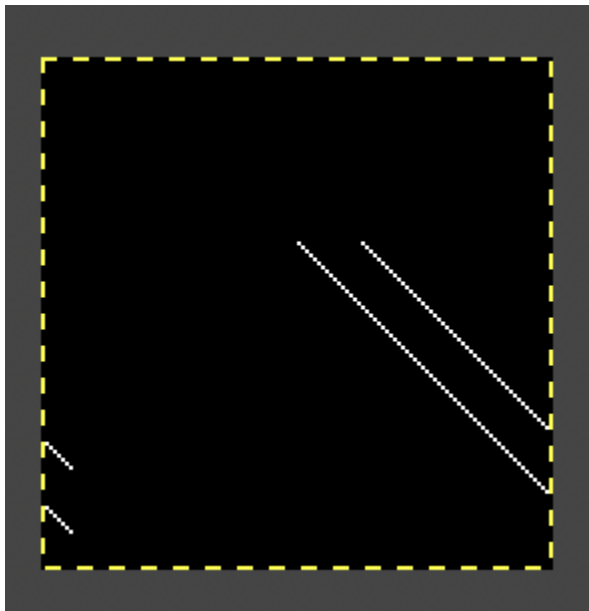
2f) When $z_0 = |f'|$, what happens is that the lines projected will be parallel in both orthographic and perspective projections since the z value is constant and the absolute value modifies the value of the f' .

Orthographic:

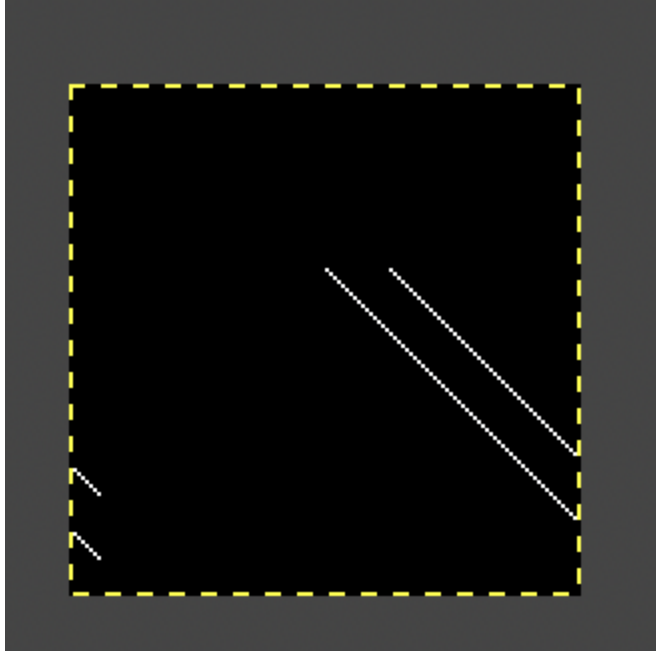
$z_0 = -1$:



$Z_0 = -2$:

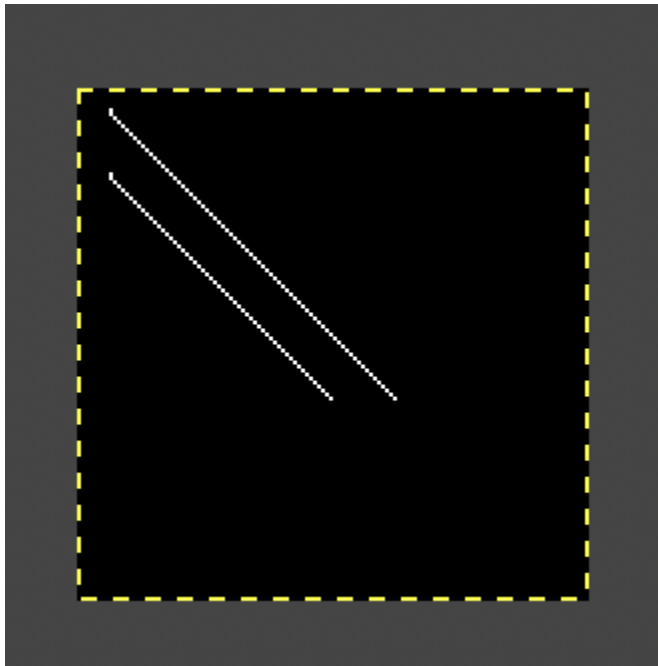


$Z_0 = -3$:

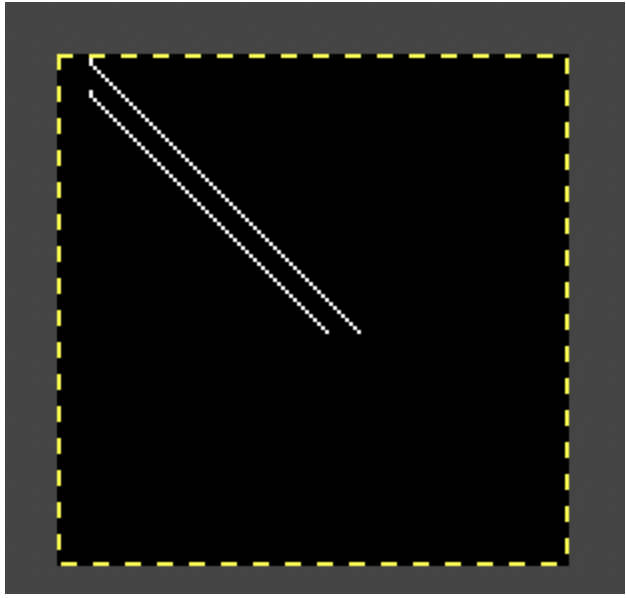


Perspective:

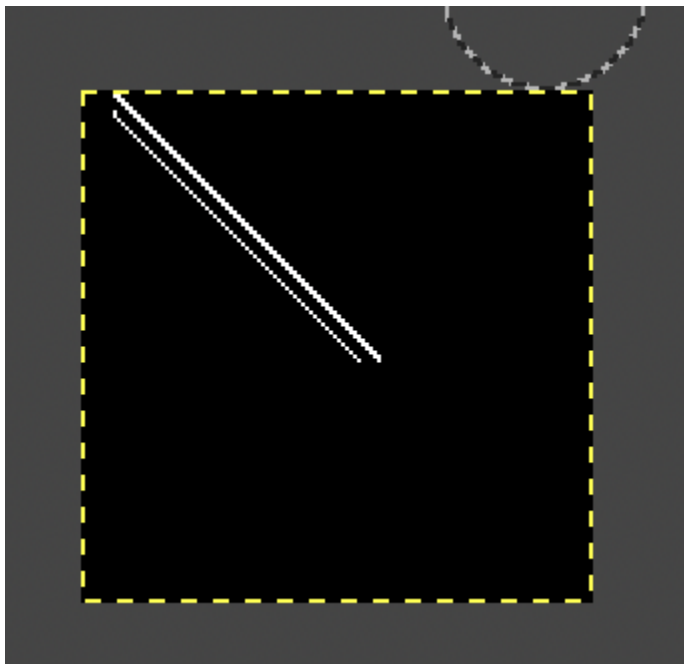
$Z_0 = -1$:



$Z_0 = -2$:



$Z_0 = -3$:



3a.

Perspective

```
//perspective projection expressions
xprime = (fprime * x1) / (z0 + t * c);
yprime = (fprime * (y0 + t * b)) / (z0 + t * c);

xprime2 = (fprime * x2) / (z0 + t * c);
yprime2 = (fprime * (y0 + t * b)) / (z0 + t * c);
```

Orthographic:

```
//orthographic projection expressions
xprime = x1;
yprime = y0 + t * b;
xprime2 = x2;
yprime2 = y0 + t * b;
```

3c. The projections of the parallel lines will be parallel in the orthographic projection but not for the perspective projection. For the perspective projection, it distorts the parallel lines causing them to cross into each other. For the orthographic, despite the image plane not being parallel to the plane that contains the parallel lines, the lines will still be parallel as there is no change in how the lines are being reshaped / distorted.

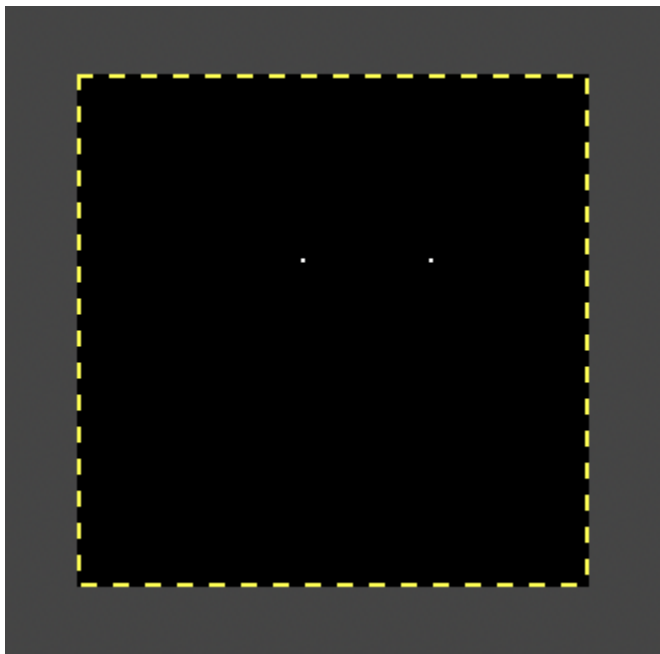
3d. My answers for part c are consistent with the images that my program generates as the lines are parallel for the orthographic projection and are not parallel for the perspective projection

3e. Orthographic is not a great approximation to perspective projection in this case since the given lines lie on an image plane that is not parallel to the actual lines. It won't accurately portray the lines.

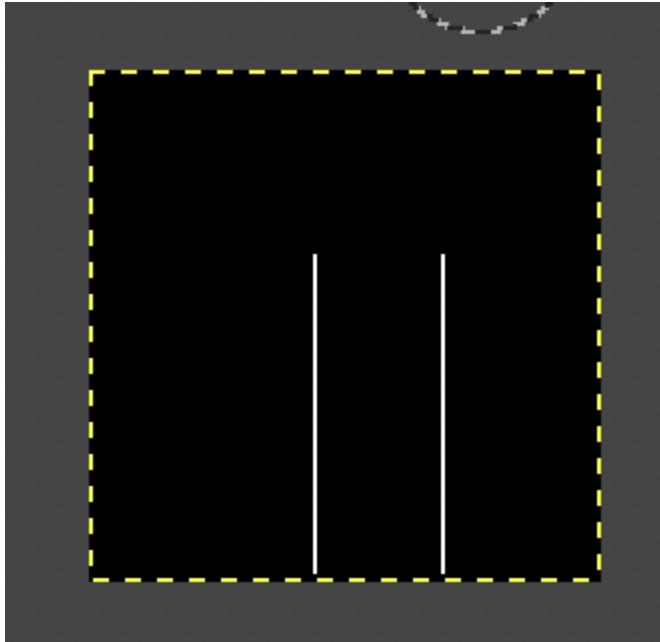
3f. In this case, when the value goes to infinity in the perspective projection, it will continue to converge until at some point in infinity.

Orthographic:

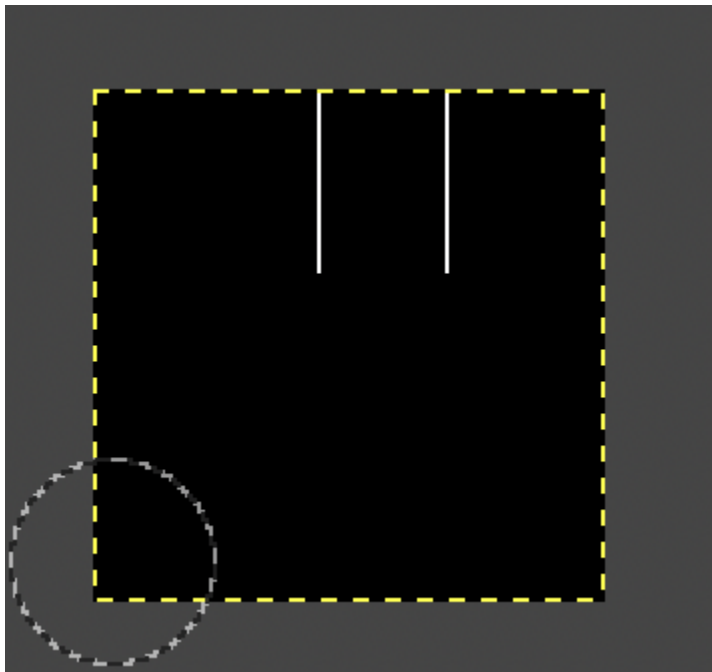
$B = 0, C = 1$:



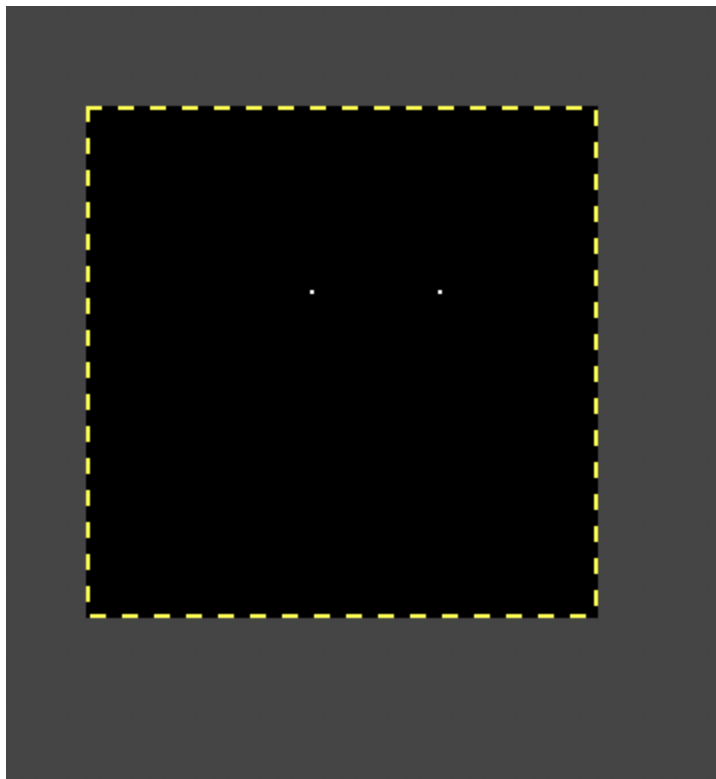
$B = 1, C = 1$:



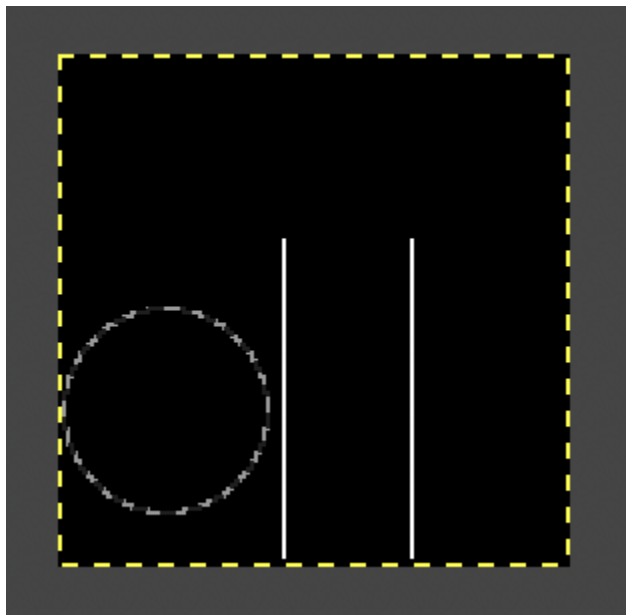
$B = -1, C = 1:$



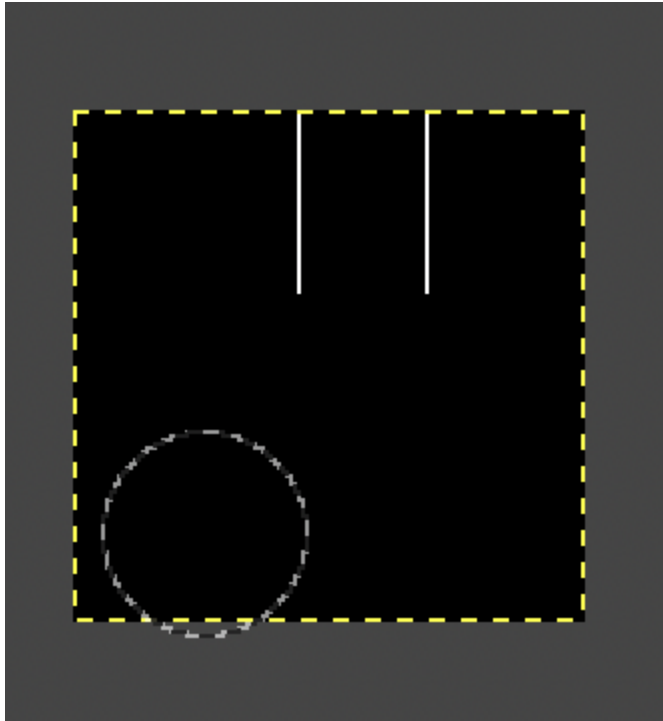
$B = 0, C = -1:$



$B = 1, C = -1$:

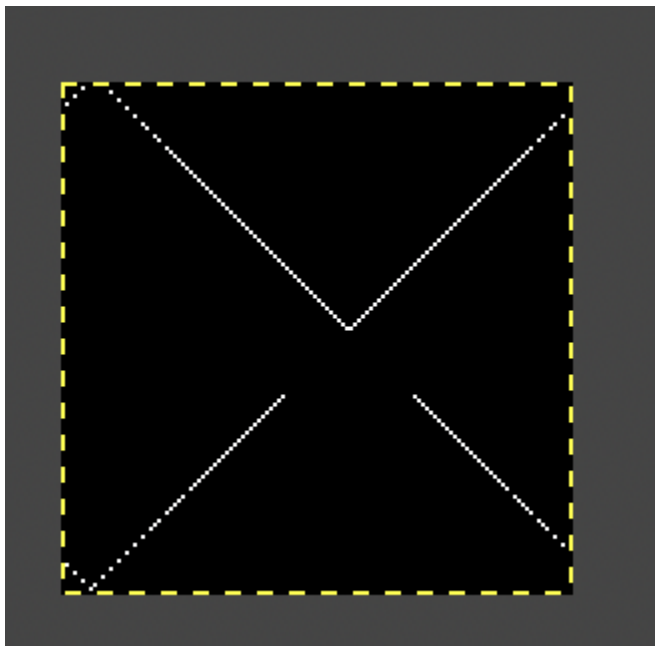


$B = -1, C = -1$:

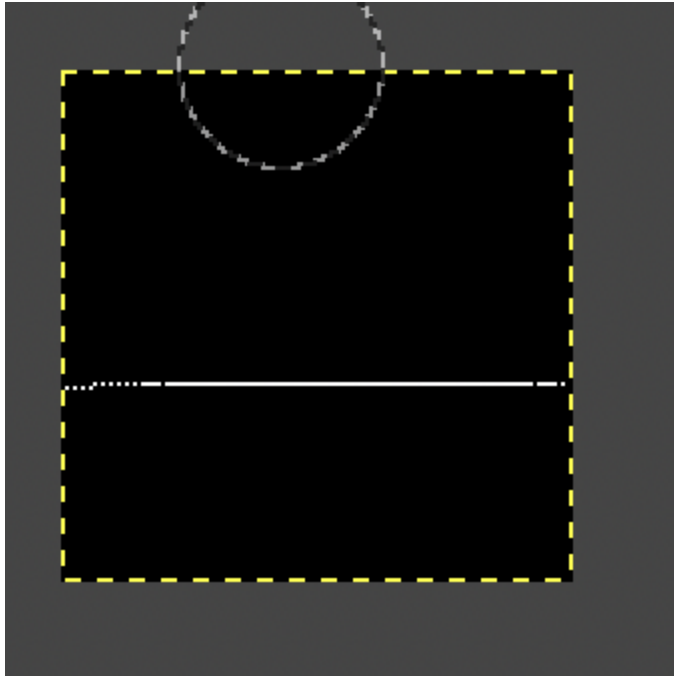


Perspective:

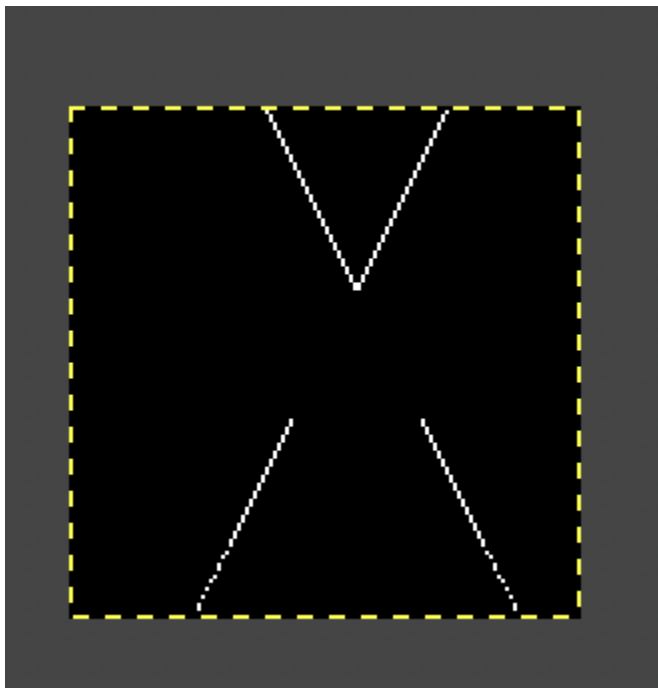
$B = 0, C = 1$:



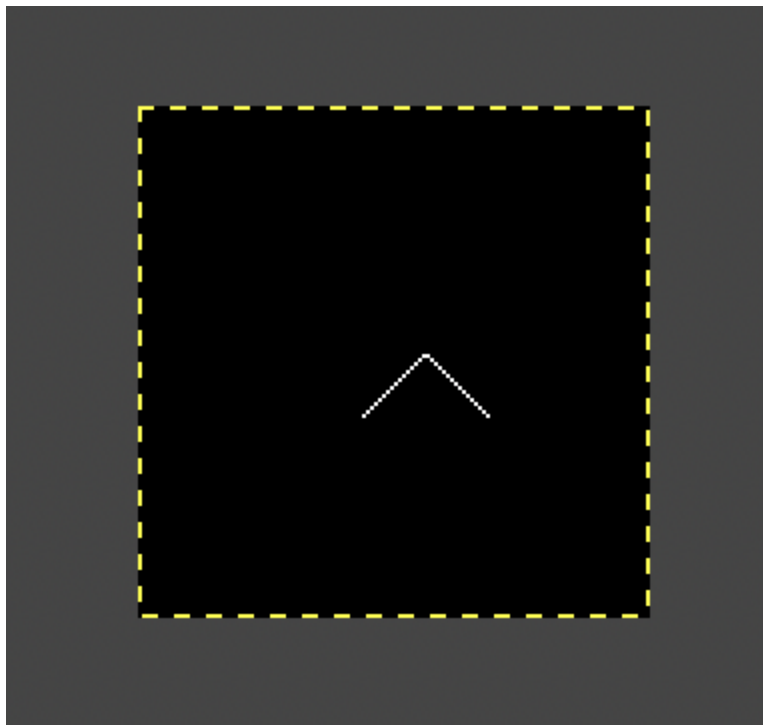
$B = 1, C = 1$:



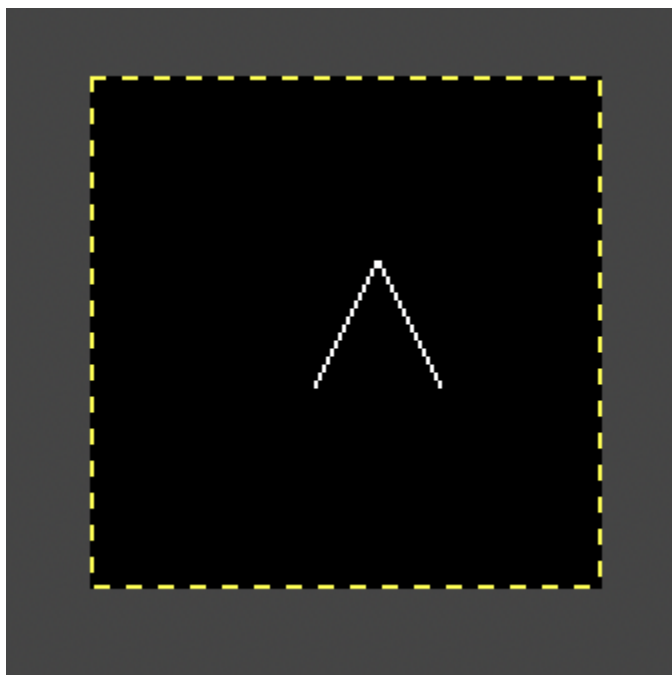
$B = -1, C = 1:$



$B = 0, C = -1:$



$B = 1, C = -1:$



$B = -1, C = -1:$

