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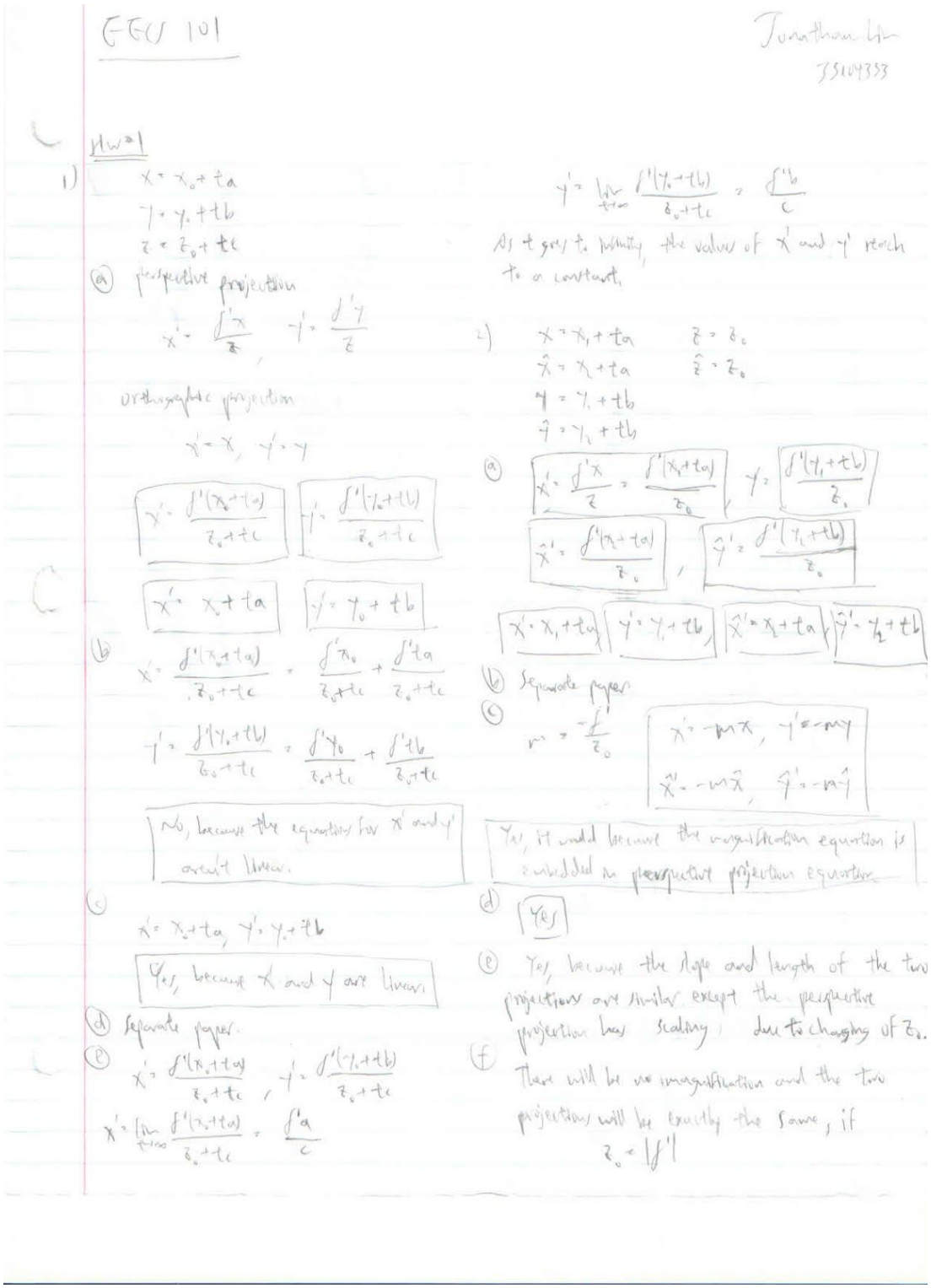
HW #1



CEE 101

Jonathan Lim
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HW #1

1) $x = x_0 + ta$
$y = y_0 + tb$
$z = z_0 + tc$

(a) perspective projection
$x' = \frac{f'x}{z}$, $y' = \frac{f'y}{z}$

orthographic projection
$x' = x$, $y' = y$

$x' = \frac{f'(x_0+ta)}{z_0+tc}$ $y' = \frac{f'(y_0+tb)}{z_0+tc}$

$x' = x_0 + ta$ $y' = y_0 + tb$

(b) $x' = \frac{f'(x_0+ta)}{z_0+tc} = \frac{f'x_0}{z_0+tc} + \frac{f'ta}{z_0+tc}$

$y' = \frac{f'(y_0+tb)}{z_0+tc} = \frac{f'y_0}{z_0+tc} + \frac{f'tb}{z_0+tc}$

No, because the equations for x' and y' aren't linear.

(c) $x' = x_0 + ta$, $y' = y_0 + tb$

Yes, because x' and y' are linear.

(d) Separate paper.

(e) $x' = \frac{f'(x_0+ta)}{z_0+tc}$, $y' = \frac{f'(y_0+tb)}{z_0+tc}$

$x' = \lim_{t\to\infty} \frac{f'(x_0+ta)}{z_0+tc} = \frac{f'a}{c}$

$y' = \lim_{t\to\infty} \frac{f'(y_0+tb)}{z_0+tc} = \frac{f'b}{c}$

As t goes to infinity, the values of x' and y' reach to a constant.

2) $x = x_1 + ta$ $z = z_0$
$\hat{x} = x_2 + ta$ $\hat{z} = z_0$
$y = y_1 + tb$
$\hat{y} = y_2 + tb$

(a) $x' = \frac{f'x}{z} = \frac{f'(x_1+ta)}{z_0}$ $y' = \frac{f'(y_1+tb)}{z_0}$

$\hat{x}' = \frac{f'(x_2+ta)}{z_0}$, $\hat{y}' = \frac{f'(y_2+tb)}{z_0}$

$x' = x_1 + ta$ $y' = y_1 + tb$ $\hat{x}' = x_2 + ta$ $\hat{y}' = y_2 + tb$

(b) Separate paper

(c) $m = \frac{-f'}{z_0}$

$x' = -mx$, $y' = -my$

$\hat{x}' = -m\hat{x}$, $\hat{y}' = -m\hat{y}$

Yes, it would because the magnification equation is embedded in perspective projection equation.

(d) Yes

(e) Yes, because the slope and length of the two projections are similar except the perspective projection has scaling due to changing of z_0.

(f) There will be no magnification and the two projections will be exactly the same, if
$z_0 = |f'|$

3) $x = x_1$

$\hat{x} = x_2$

$y = y_0 + tb$

$\hat{y} = y_0 + tb$

$z = z_0 + tc$

$\hat{z} = z_0 + tc$

(a) $x' = \frac{f'x}{z} = \boxed{\frac{f'x_1}{z_0+tc}}$

$y' = \frac{f'y}{z} = \boxed{\frac{f'(y_0+tb)}{z_0+tc}}$

$\hat{x}' = \frac{f'\hat{x}}{\hat{z}} = \boxed{\frac{f'x_2}{z_0+tc}}$

$\hat{y}' = \frac{f'\hat{y}}{\hat{z}} = \boxed{\frac{f'(y_0+tb)}{z_0+tc}}$

$\boxed{x' = x_1}$ $\boxed{\hat{x}' = x_2}$ $\boxed{y' = \hat{y}' = y_0 + tb}$

(b) Separate paper.

(c) $m = \frac{-f'}{z_0}$

Not parallel, because m cannot fit into the x', $\hat{x}'$, y', and $\hat{y}'$ equations.

(d) No, because the answer from part (c) won't provide images that are parallel to the images generated

(e) No, because the projections have different equations and look totally different

(f) $x' = \frac{f'x_1}{z_0+tc}$, $y' = \frac{f'(y_0+tb)}{z_0+tc}$

$\hat{x}' = \frac{f'x_2}{z_0+tc}$, $\hat{y}' = \frac{f'(y_0+tb)}{z_0+tc}$

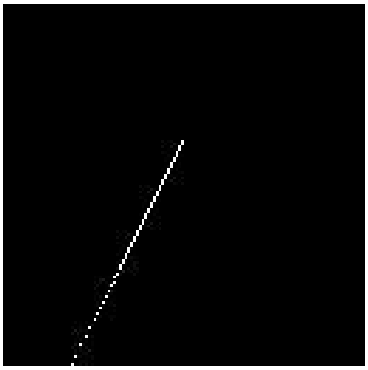
$\boxed{x' = \hat{x}' = 0}$ $\boxed{y' = \hat{y}' = \frac{f'b}{c}}$

Yes, because x converges to zero while y converges at a constant

1.

Perspective Projection:

Image:



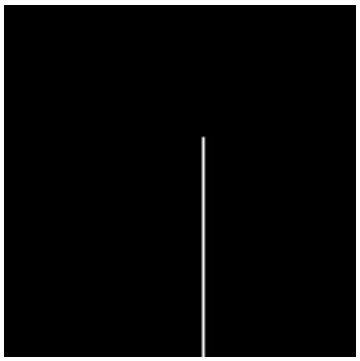
Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float a = 0.0;
    float b = 1.0;
    float c = -1.0;
    float x0 = 0.5;
    float y0 = -1.0;
    float z0 = 0.0;
    float fprime = 1.0;
    x = x0 + t*a;
    y = y0 + t*b;
    z = z0 + t*c;

    /* Modify these according to the projection */
    xprime = fprime*x/z;
    yprime = fprime*y/z;
    plot_logical_point(xprime, yprime, image);
}
```

Orthographic Projection:

Image:



Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float a = 0.0;
    float b = 1.0;
    float c = -1.0;
    float x0 = 0.5;
    float y0 = -1.0;
    float z0 = 0.0;
    float fprime = 1.0;
    x = x0 + t*a;
    y = y0 + t*b;
    z = z0 + t*c;

    /* Modify these according to the projection */
    xprime = x;
    yprime = y;
    plot_logical_point(xprime, yprime, image);
}
```

2.

<u>Perspective Projection:</u>

$$z_0 = -1$$

Image:

Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float a = 1.0;
    float b = 1.0;
    float x1 = 0.5;
    float x2 = -0.5;
    float y1 = -1.0;
    float y2 = -1.0;
    float z0 = -1.0; /*z0 = -1, -2, -3*/
    float fprime = 1.0;
    x = x1 + t*a;
    float x_hat = x2 + t*a;
    y = y1 + t*b;
    float y_hat = y2 + t*b;
    z = z0;

    /* Modify these according to the projection */
    xprime = fprime*x/z;
    yprime = fprime*y/z;
    float xprime_hat = fprime*x_hat/z;
    float yprime_hat = fprime*y_hat/z;
    plot_logical_point(xprime, yprime, image);
    plot_logical_point(xprime_hat, yprime_hat, image);
}
```

$z_0 = -2$

Image:

Code Snippet:

Change value of z_0 to -2.

$z_0 = -3$

Image:

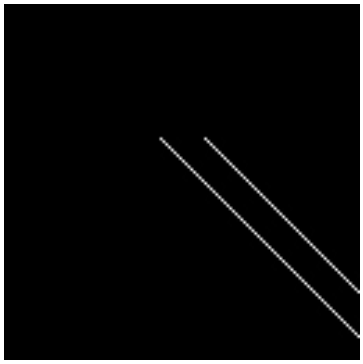
Code Snippet:

Change the value of z_0 to -3.

Orthographic Projection:

z_0 = -1, -2, -3

Image:



Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float a = 1.0;
    float b = 1.0;
    float x1 = 0.5;
    float x2 = -0.5;
    float y1 = -1.0;
    float y2 = -1.0;
    float z0 = -1.0; /*z0 = -1, -2, -3*/
    float fprime = 1.0;
    x = x1 + t*a;
    float x_hat = x2 + t*a;
    y = y1 + t*b;
    float y_hat = y2 + t*b;
    z = z0;

    /* Modify these according to the projection */
    xprime = x;
    yprime = y;
    float xprime_hat = x_hat;
    float yprime_hat = y_hat;
    plot_logical_point(xprime, yprime, image);
    plot_logical_point(xprime_hat, yprime_hat, image);
}
```

3.

Perspective Projection:

b = 0, c = 1

Image:

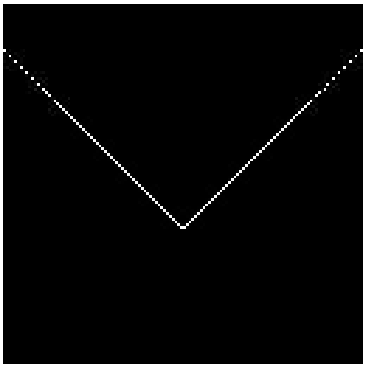
Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float b = 0; /*b = 0, 1, -1*/
    float c = 1.0; /*c = 1, -1*/
    float x1 = -1.0;
    float x2 = 1.0;
    float y0 = -1.0;
    float z0 = 0.0;
    float fprime = 1.0;
    x = x1;
    float x_hat = x2;
    y = y0 + t*b;
    float y_hat = y0 + t*b;
    z = z0 + t*c;
    float z_hat = z0 + t*c;

    /* Modify these according to the projection */
    xprime = fprime*x/z;
    yprime = fprime*y/z;
    float xprime_hat = fprime*x_hat/z;
    float yprime_hat = fprime*y_hat/z_hat;
    plot_logical_point(xprime, yprime, image);
    plot_logical_point(xprime_hat, yprime_hat, image);
}
```

b = 1, c = 1

Image:



b = -1, c = 1

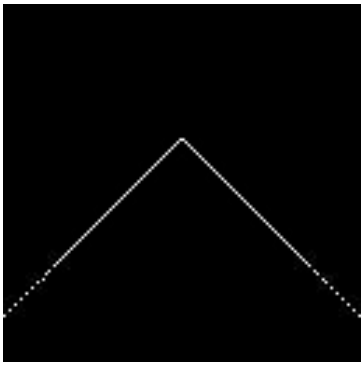
Image:

b = 0, c = -1

Image:

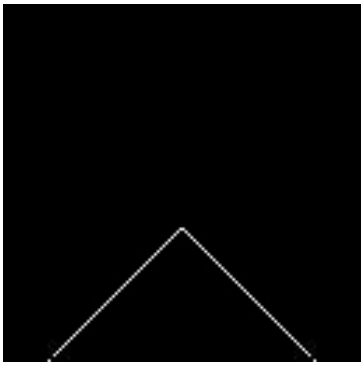
b = 1, c = -1

Image:



b = -1, c = -1

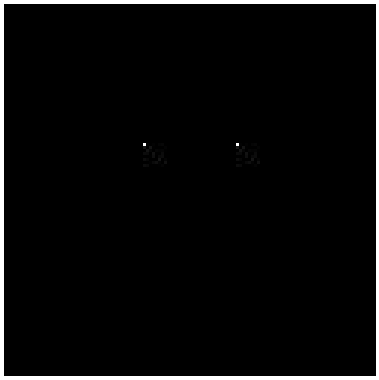
Image:



<u>Orthographic Projection:</u>

b = 0

Image:



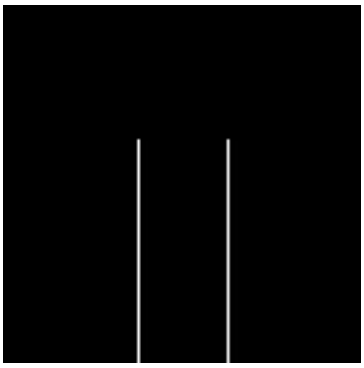
Code Snippet:

```
for (t = 0.01; t < 10000.01; t += .01)  //change the t range
{
    /*Modify the coefficiences according to questions*/
    float b = 0; /*b = 0, 1, -1*/
    float c = 1.0; /*c = 1, -1*/
    float x1 = -1.0;
    float x2 = 1.0;
    float y0 = -1.0;
    float z0 = 0.0;
    float fprime = 1.0;
    x = x1;
    float x_hat = x2;
    y = y0 + t*b;
    float y_hat = y0 + t*b;
    z = z0 + t*c;
    float z_hat = z0 + t*c;

    /* Modify these according to the projection */
    xprime = x;
    yprime = y;
    float xprime_hat = x_hat;
    float yprime_hat = y_hat;
    plot_logical_point(xprime, yprime, image);
    plot_logical_point(xprime_hat, yprime_hat, image);
}
```

b = 1

Image:



b = -1

Image: