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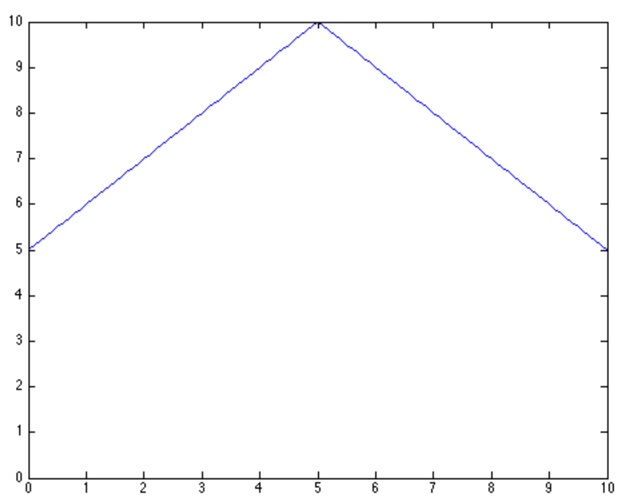
ISTA 352 HW 2

1)
To make creating a house easier, I created a function that created a matrix who's values represented points on a graph that would appear as a house:

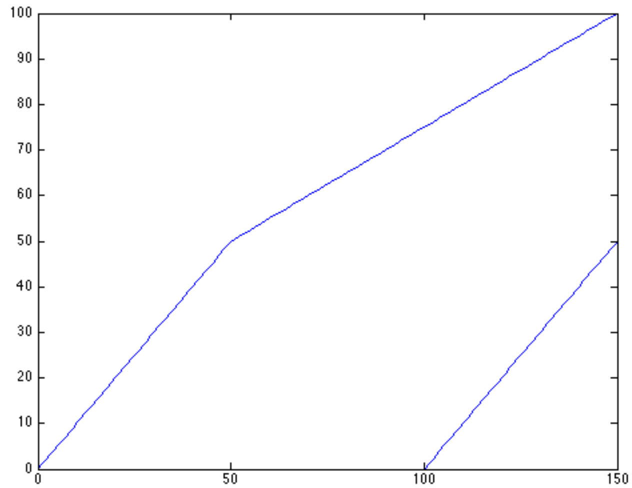
```
y = zeros(1,51);
x = [0:1:50];
h = [x',y'];

y = [0:1:50];
x = x + 50;
h = [h; [x',y']];

y = [50:1:100];
x = -x + 150;
h = [h; [x',y']];

y = 100 * ones(1,51);
x = [50:-1:0];
h = [h; [x',y']];

y = [100:-1:0];
x = zeros(1,101);
h = [h; [x',y']];
```



By multiplying this matrix by a sheer matrix

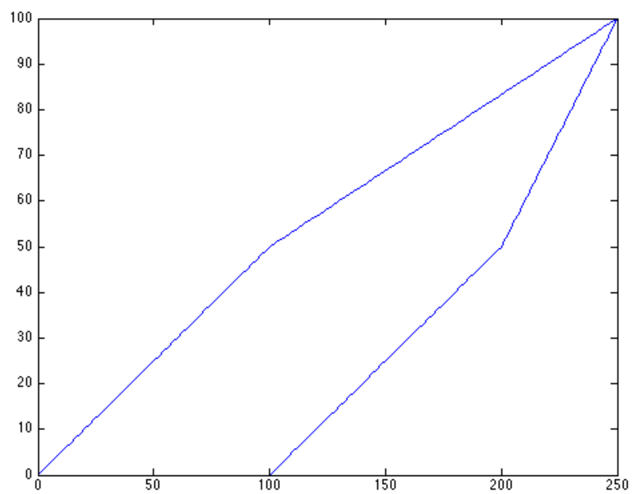
$$\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$$

we get a picture that looks like



Here we get an image that is stretched horizontally to the right, as we are now adding the x and y coordinates together. And finally if we multiply it by

$$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$$



Similar to the other image, only we have doubled the rate of horizontal stretch.

2)
The file created gives us matrix for positions:

$$\begin{pmatrix} 38 & -11 \\ -163 & -51 \\ 196 & -43 \\ -249 & -155 \\ 149 & 7 \\ -253 & 9 \\ -105 & 254 \\ 100 & 236 \\ 224 & 115 \\ -335 & -97 \\ 344 & 249 \\ 221 & 26 \end{pmatrix}$$

we can convert this to a homogeneous matrix by adding a column of 0's and transposing the matrix, such that it becomes

$$a3 = a2^T = \begin{pmatrix} 38 & -168 & 196 & -249 & 149 & -235 & -105 & 100 & 224 & -335 & 334 & 221 \\ -11 & -51 & -43 & -155 & 7 & 9 & 254 & 236 & 115 & -97 & 249 & 26 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

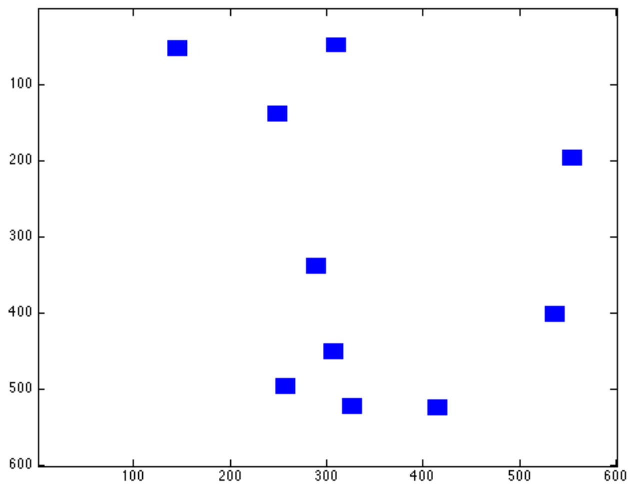
and a Homogenous transform matrix

$$HC = \begin{pmatrix} 1 & 0 & 300 \\ 0 & 1 & 300 \\ 0 & 0 & 1 \end{pmatrix}$$

By multiplying these matrices together we get

$$HC * a3 = \begin{pmatrix} 338 & 137 & ... \\ 289 & 249 & ... \\ 1 & 1 & ... \end{pmatrix}$$

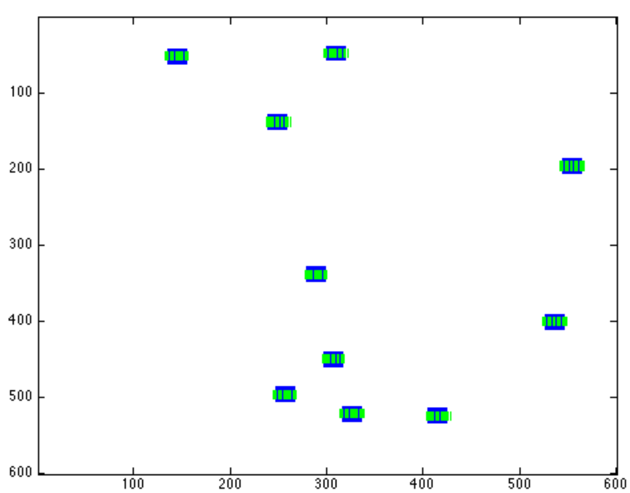
by transposing this matrix and removing the 3rd column, we have a matrix that can easily be fed into matlab to get an image such as:



3)
A matrix that homogeneous and scales the X direction by 3/5 and Y direction by 5/4 looks like

$$\begin{vmatrix} 3/5 & 0 & 0 \\ 0 & 5/4 & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

When this matrix is multiplied blocks that are graphed, you end up with a image that appears as



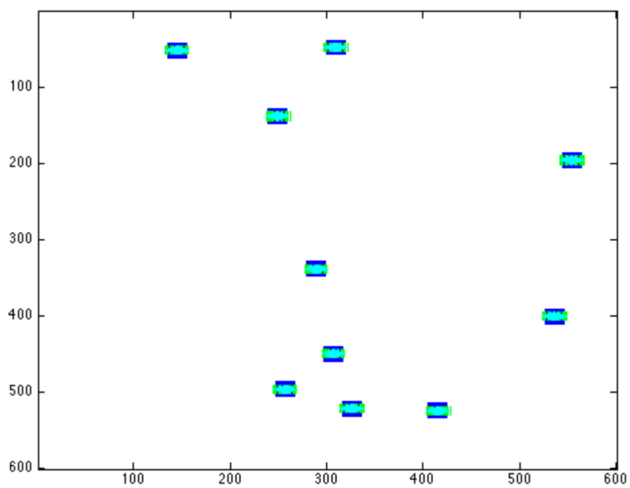
The next step requires to use of a rotation matrix which would appear as

$$\begin{pmatrix} sin(\theta) & sin(\theta) & 0 \\ -sin(\theta) & sin(\theta) & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

so in the case of rotating a matrix 30 degrees we end up with

$$\begin{pmatrix} sin(30) & sin(30) & 0 \\ -sin(30) & sin(30) & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} .5 & .5 & 0 \\ -.5 & .5 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

This matrix when multiplied against the previous matrix should result in an image as seen below.



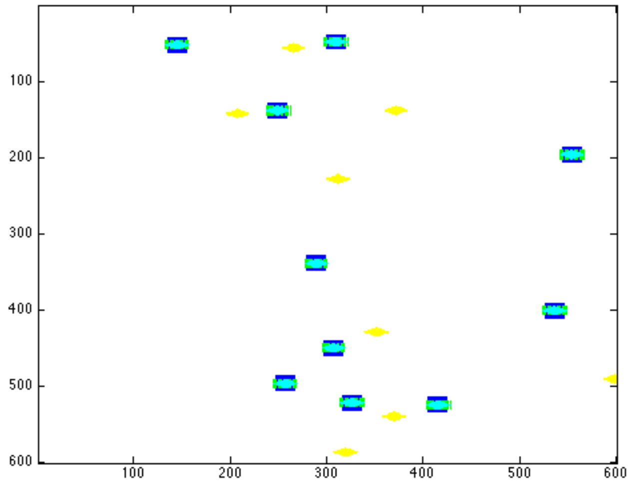
Finally a matrix to move each point (100,-200) looks like

$$\begin{pmatrix} 1 & 0 & 100 \\ 0 & 1 & -200 \\ 0 & 0 & 1 \end{pmatrix}$$

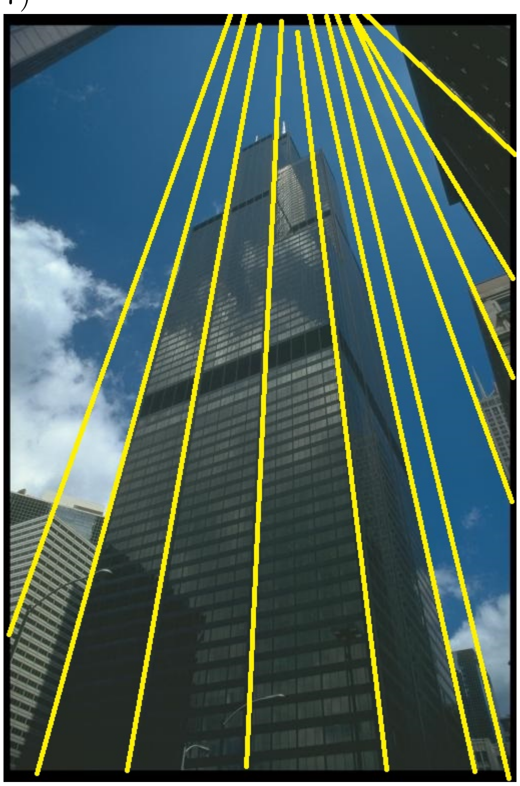
all together a matrix that would perform all those moves would look like

$$\begin{pmatrix} 0.3 & 0.3 & -30 \\ -0.6 & 6.3 & -1312.5 \\ 0 & 0 & 1 \end{pmatrix}$$

a composite image off all these steps is seen in the last image.



4)
5)
6)
7)

 For this image, you can basically see that the lines of the tower converge on a point somewhere high above is. This is corroborated with the fact that the buildings on the edge of the frame are

converging on the same focal point.

The difficulty with this image is that there is no hard line to infer a focal point. I attempted to gain understanding of the focal point by estimating the angle at which the flat surfaces on top of the chandelier. While it is not as concrete of a method as a straight line, with some calculation, we could figure out the angle at which this picture is taken to show a focal point.