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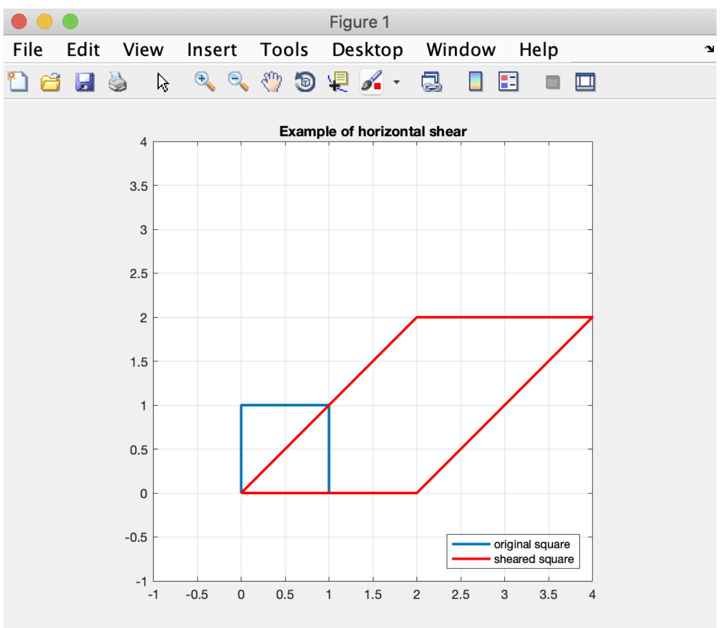
MAT 343 LAB

MAT 343 Laboratory 4

Exercise 1)

```
clf
S=[0,1,1,0,0;0,0,1,1,0];
plot(S(1,:),S(2,:),'linewidth',2)
hold on
T=[2,2;0,2]; % shear transformation matrix
TS=T*S;
plot(TS(1,:),TS(2,:),'-r','linewidth',2);
title('Example of horizontal shear')
legend('original square','sheared square','location','southeast')
axis equal,axis([-1,4,-1,4]); grid on %adjust the axis and the window
hold off
```



shearing transformation matrix that shears 2 units in the vertical direction

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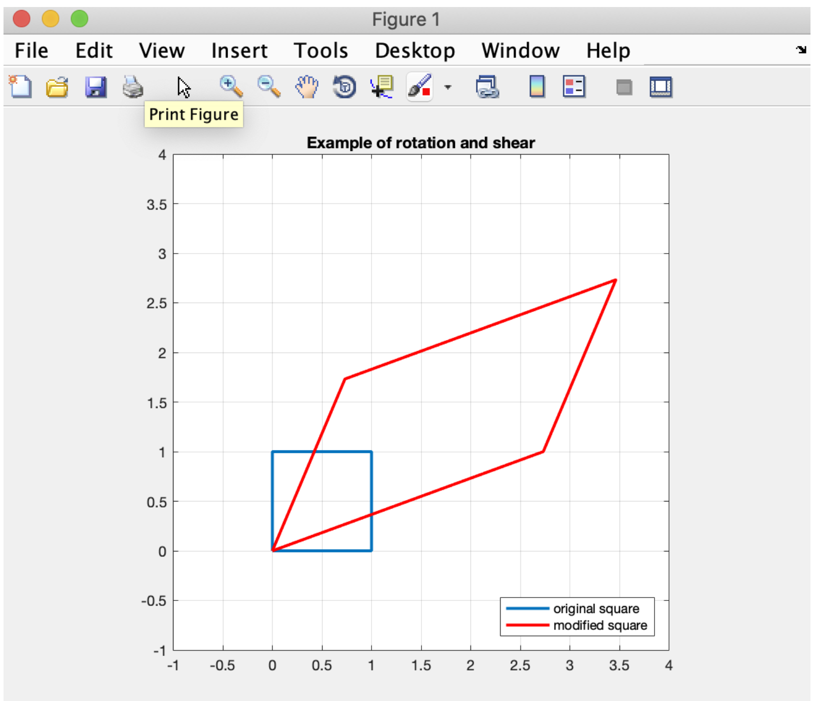
Exercise 2)

```
clf
S=[0,1,1,0,0;0,0,1,1,0];
plot(S(1,:),S(2,:),'linewidth',2)
hold on
theta=pi/6; % define the angle
Q=[cos(theta), -sin(theta); sin(theta), cos(theta)];
T=[2,2;0,2]; % shear transformation matrix
TQS=T*Q*S;
plot(TQS(1,:),TQS(2,:),'-r','linewidth',2);
title('Example of rotation and shear')
legend('original square','modified square','location','southeast')
axis equal , axis([-1,4,-1,4]);
grid on % adjust the axis and the
hold off
```



shearing transformation matrix that shears 2 units in the vertical direction then rotate the square 30◦ counterclockwise.

1. compare with the plot in Example 5. Are the results the same? Does the order of the transformations matter?

   The results are similar. The only difference is that the vertical shears are 2 units instead of 1 unit. The order of transformation does matter.

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Question 3)

```
clf
S=[0,1,1,0,0;0,0,1,1,0];
T=[0,1,1,0,0;0,0,1,1,0];

p = plot(S(1,:),S(2,:));
axis([-2,2,-2,2])
axis square, grid on
hold on
theta1= pi/5; % define the angle
Q=[cos(theta1) -sin(theta1); sin(theta1) cos(theta1)];
for i = 1:1:ceil(2*pi/theta1)
    S = Q*S;
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % erase original figure and plot
    pause(0.1)
end

theta2 = pi/5;
Q2=[cos(theta2) sin(theta2); -sin(theta2) cos(theta2)];
for i = 1:ceil(2*pi/theata1)
    S = Q2*S;
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % erase original figure and plot
    pause(0.1)
end
hold off
```

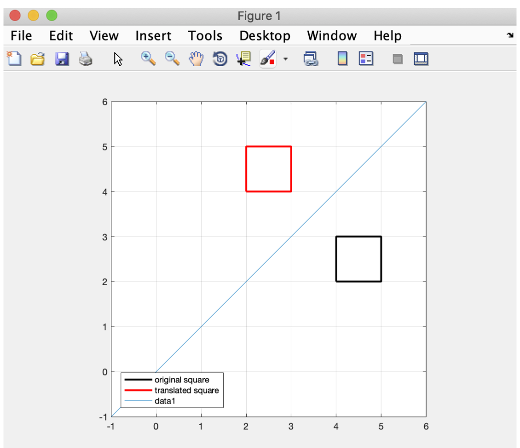
Question 4)

```
clf
S=[0,1,1,0,0;0,0,1,1,0];
T=[0,1,1,0,0;0,0,1,1,0];

%D1 = pi/5;
D1 = 6/5 * eye (2);
p = plot(S(1,:),S(2,:));
axis([-7,7,-7,7])
axis square, grid on
hold on
theta1= pi/5; % define the angle
Q=[cos(theta1) -sin(theta1); sin(theta1) cos(theta1)];
for i = 1:1:ceil(2*pi/theta1)
    S = D1*Q*S;
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % erase original figure and plot
    pause(0.25)
end

theta2 = pi/5;
Q2=[cos(theta2) sin(theta2); -sin(theta2) cos(theta2)];
D2 = 5/6 * eye (2);
for i = 1:ceil(2*pi/theta2)
    S = D2*Q2*S;
```

```
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % erase original figure and plot
    pause(0.25)
end
hold off
```

Example 5)

```
clf
S=[4,5,5,4,4;2,2,3,3,2;1,1,1,1,1]; % square in homogeneous coordinates
M=[1,0,-2;0,1,2;0,0,1]; % translation matrix
MS=M*S; % apply the translation to the square
plot(S(1,:),S(2,:),'k','linewidth',2); % plot the original square in black
hold on
plot(MS(1,:),MS(2,:),'r','linewidth',2); % plot the translated square in red
legend('original square','translated square','location','southwest');
axis equal, axis([-1,6,-1,6]);
plot([-1,6],[-1,6]);
grid on % adjust the axis
hold off
```



Example 6)

```
clf
S=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1]; % square in homogeneous coordinates
%S2=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1]; % square in homogeneous coordinates
M1 = [1 ,0 ,0.2;0 ,1 ,0;0 ,0 ,1]; % first translation matrix
M2 = [1 ,0 ,0;0 ,1 ,0.2;0 ,0 ,1]; % the second translation matrix
p = plot(S(1,:),S(2,:)); % plot the original square axis square ,
axis([-1,8,-1,8]), grid on
for i = 1:30
    S = M1*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); %
pause (0.1)
end
for i = 1:30
    S=M2*S; % compute the translated square
```

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```
    set(p,'xdata',S(1,:),'ydata',S(2,:)); %
pause (0.1)
end
M1 = [1 ,0 ,-0.2;0 ,1 ,0;0 ,0 ,1]; % first translation matrix
M2 = [1 ,0 ,0;0 ,1 ,-0.2;0 ,0 ,1]; % the second translation matrix
for i = 1:30
    S=  M2*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); %
    S=  M1*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); %
pause (0.1)
end
plot the translated square
plot the translated square
```

Example 7)

```
clf
S=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1]; % square in homogeneous coordinates
M1 = [1 ,0 ,0.2;0 ,1 ,0;0 ,0 ,1]; % first translation matrix
theta = pi/12; % define the angle theta
Q=[cos(theta),-sin(theta),0;sin(theta),cos(theta),0;0,0,1]; % rotation matrix
about (0,0)
QP=[1,0,7;0,1,0;0,0,1]*Q'*[1,0,-7;0,1,0;0,0,1]; % rotation matrix about (7,0)
p = plot(S(1,:),S(2,:)); % plot the original square
axis equal , axis ([ -0.5 ,9 , -2 ,5]) , grid on
for i = 1:30
    S = M1*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
    pause (0.1)
end
for i = 1:6
    S=QP*S; % compute the rotated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the rotated square
    pause (0.1)
end
M1 = [1 ,0 ,-0.2;0 ,1 ,0;0 ,0 ,1]; % first translation matrix
for i = 1:30
    S = M1*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
    pause (0.1)
end
theta = pi/2; % define the angle theta
Q=[cos(theta),sin(theta),0;-sin(theta),cos(theta),0;0,0,1]; % rotation matrix
about (0,0)
QP=[1,0,1;0,1,0;0,0,1]*Q'*[1,0,-1;0,1,0;0,0,1]; % rotation matrix about (7,0)
for i = 1:6
    S=QP*S; % compute the rotated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the rotated square
    pause (0.1)
end
```