WILL TIRONE

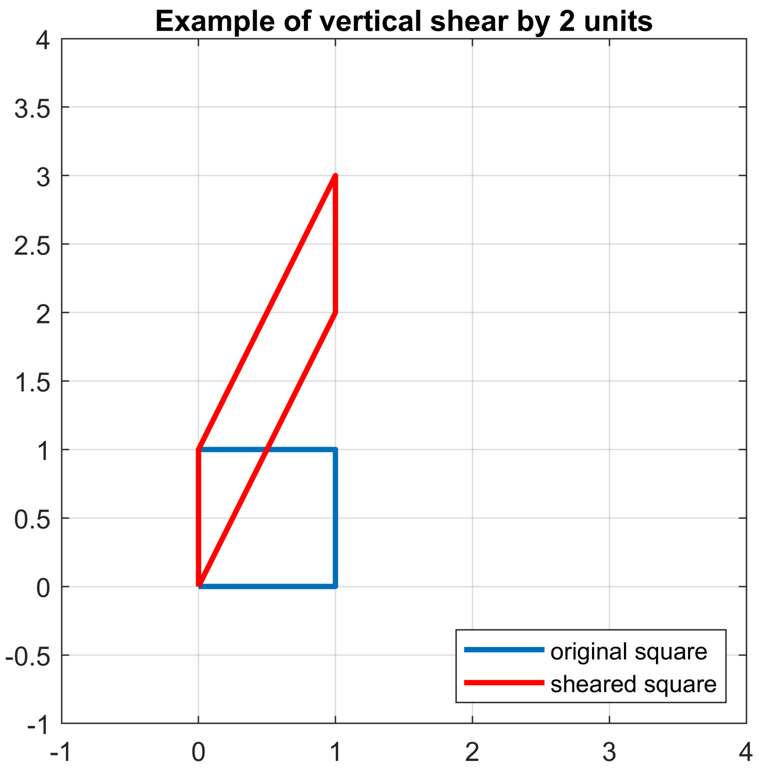
LAB 4 MAT 343

QUESTION 1

```
type VerticalShear.m
```

```
clf
S=[0,1,1,0,0;0,0,1,1,0];
plot(S(1,:),S(2,:),'linewidth',2)
hold on
T=[1,0;2,1];
TS=T*S;
plot(TS(1,:),TS(2,:),'-r','linewidth',2);
title('Example of vertical shear by 2 units')
legend('original square','sheared square','location','southeast')
axis equal,axis([-1,4,-1,4]); grid on
hold off
```

```
VerticalShear
```



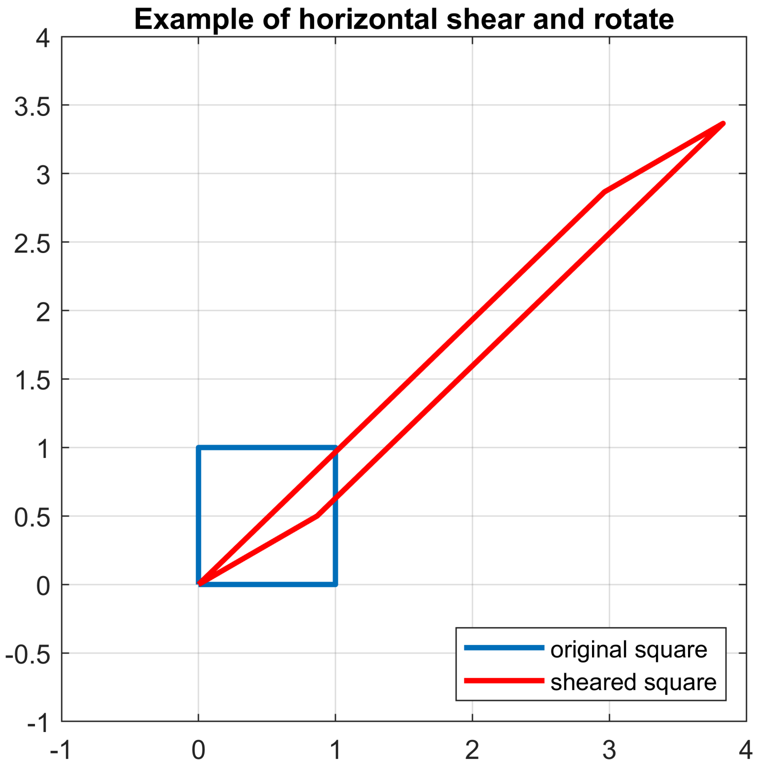
QUESTION 2

Are the results the same?Does the order of the transformations matter? No, the results are not the same and the order does matter. As displayed below, this is different than EXAMPLE 4 in the lab guide. In general, AB =/= BA in linear algebra and this makes sense below. If a sheared image is rotated, it will be different than rotating THEN shearing.

```
type ShearAndRotate.m
```

```
%apply the shear and then rotate

clf
S=[0,1,1,0,0;0,0,1,1,0];
plot(S(1,:),S(2,:),'linewidth',2)
hold on

theta = pi / 6;
Q=[ cos( theta ),-sin( theta ); sin( theta ),cos( theta )];
T =[1 ,4;0 ,1]; %shear matrix

QTS=Q*T*S;
plot(QTS(1,:),QTS(2,:),'-r','linewidth',2);

title('Example of horizontal shear and rotate')
legend('original square','sheared square','location','southeast')
axis equal,axis([-1,4,-1,4]); grid on
hold off
```

```
ShearAndRotate
```



QUESTION 3

```
type pi_over_eight_rotation.m
```

```
clf                                  % clear all settings for the plot
S=[0,1,1,0,0;0,0,1,1,0];
theta =pi /8; % define the angle
Q=[cos( theta ), -sin( theta ); sin( theta ), cos( theta)];
```

```
p = plot(S(1,:),S(2,:));          % plot the square
axis([-1,4,-1,4])                 % set size of the graph
axis square, grid on              % make the display square
hold on                           % hold the current graph
for i = 1:16
    S = Q*S;                               % dilate the square
    set(p,'xdata',S(1,:),'ydata',S(2,:));   % erase original figure and plot
                                            % the transformed figure
    pause(0.1)         % adjust this pause rate to suit your computer.
end

neg_Q=[cos(-theta ), -sin(-theta ); sin(-theta ), cos(-theta)];

for i = 1:16
    S = neg_Q*S;                               % contract the square
    set(p,'xdata',S(1,:),'ydata',S(2,:));   % erase original figure and plot
                                            % the transformed figure
    pause(0.1)         % adjust this pause rate to suit your computer.
end
hold off
```

QUESTION 4

```
type ExpandAndRotate.m
```

```
clf                               % clear all settings for the plot
S=[0,1,1,0,0;0,0,1,1,0];
D1 = 9/8* eye (2);
theta =pi /8; % define the angle
Q=[cos( theta ), -sin( theta ); sin( theta ), cos( theta)];
p = plot(S(1,:),S(2,:));          % plot the square
axis([-8,8,-8,8]);                % set size of the graph
axis square, grid on              % make the display square
hold on                           % hold the current graph

for i = 1:16
    S = D1*Q*S;                               % dilate the square
    set(p,'xdata',S(1,:),'ydata',S(2,:));   % erase original figure and plot
                                            % the transformed figure
    pause(0.1)         % adjust this pause rate to suit your computer.
end

neg_Q=[cos(-theta ), -sin(-theta ); sin(-theta ), cos(-theta)];
D2 = 8/9* eye (2);

for i = 1:16
    S = D2*neg_Q*S;                               % contract the square
    set(p,'xdata',S(1,:),'ydata',S(2,:));   % erase original figure and plot
                                            % the transformed figure
    pause(0.1)         % adjust this pause rate to suit your computer.
end
hold off
```

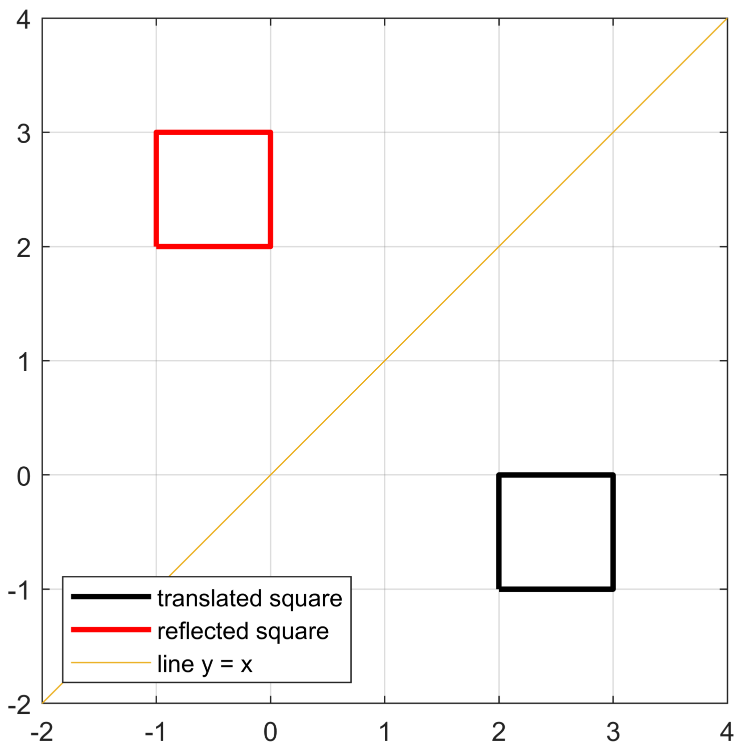
QUESTION 5

```
type TransateAndReflect.m
```

```
clf
S=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1];    % square in homogeneous coordinates
M=[1,0,2;0,1,-1;0,0,1];     % translation matrix
R=[0 1 0; 1 0 0; 0 0 1]; % reflection across 45 degrees
```

```
MS=M*S;
plot(MS(1,:),MS(2,:),'k','linewidth',2);
hold on

RS=R*MS;
plot(RS(1,:),RS(2,:),'r','linewidth',2);

plot([-2,4],[-2,4]);
legend('translated square','reflected square','line y = x','location','southwest');
axis equal, axis([-2,4,-2,4]), grid on    % adjust the axis
hold off
```

```
TransateAndReflect
```



QUESTION 6

```
type Example8Modified.m
```

```
clf
S=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1]; %  square in homogeneous coordinates

M1 = [1,0,0.4;0,1,0;0,0,1]; %  first translation matrix
M2 = [1,0,0;0,1,0.4;0,0,1]; %  the second translation matrix
M3 = [1 0 -0.4; 0 1 -0.4; 0 0 1];

p = plot(S(1,:),S(2,:)); % plot the original square
axis square, axis([-1,18,-1,18]), grid on

for i = 1:40
   S = M1*S; % compute the translated square
   set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
   pause(0.05)
end

for i = 1:40
   S=M2*S; % compute the translated square
   set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
   pause(0.05)
end

for i = 1:40
   S = M3*S; % compute the translated square
   set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
   pause(0.05)
end
```

QUESTION 7

```
type Example9Modified.m
```

```
clf
S=[0,1,1,0,0;0,0,1,1,0;1,1,1,1,1]; % square in homogeneous coordinates

M1 = [1,0,0.4;0,1,0;0,0,1]; % first translation matrix
M2 = [1,0,-0.4;0,1,0;0,0,1]; % second translation matrix

theta = pi/10;  % define the angle theta
second_theta = -pi/10;

Q=[cos(theta),-sin(theta),0;sin(theta),cos(theta),0;0,0,1]; % rotation matrix about (0,0)
QP=[1,0,17;0,1,0;0,0,1]*Q'*[1,0,-17;0,1,0;0,0,1];   % rotation matrix about (17,0)

second_Q = [cos(second_theta),-sin(second_theta),0;sin(second_theta),cos(second_theta),0;0,0,1];
second_QP = [1,0,1;0,1,0;0,0,1]*second_Q'*[1,0,-1;0,1,0;0,0,1];

p = plot(S(1,:),S(2,:)); % plot the original square
axis equal, axis([-0.5,19,-2,5]), grid on
for i = 1:40
    S = M1*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
    pause(0.05)
end
for i = 1:5
    S=QP*S; % compute the rotated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the rotated square
    pause(0.05)
end
for i = 1:40
    S = M2*S; % compute the translated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the translated square
    pause(0.05)
end
for i = 1:5
    S=second_QP*S; % compute the rotated square
    set(p,'xdata',S(1,:),'ydata',S(2,:)); % plot the rotated square
    pause(0.05)
end
```