
Problem 2 Code

```
clear
close all

% Define points as matrix of vectors in homogeneous coordinates
shape0 = [4 6 6 10 10 12 12 11 11 10 10 6 6 5 5 4 4;
          8 6 5 5 6 8 9 9 10 10 11 11 10 10 9 9 8;
          ones(1,17)];
x_0 = 8;
y_0 = 8;

T_f = [1 0 -x_0;
       0 1 -y_0;
       0 0 1]; % homogeneous forward translation matrix
shape1 = T_f*shape0;

s_x = 1.5;
s_y = 1.5;
S = [s_x 0 0;
     0 s_y 0;
     0 0 1]; % homogenous scaling matrix
shape2 = S*shape1;

theta = -45;
R = [cosd(theta) -sind(theta) 0;
     sind(theta) cosd(theta) 0;
     0 0 1]; % homogeneous rotation matrix
shape3 = R*shape2;

T_b = [1 0 x_0;
       0 1 y_0;
       0 0 1]; % homogeneous backward translation matrix
shape4 = T_b*shape3;

% Plotting
linewidth = 2;
plot([x_0 0],[y_0 0],'k.','MarkerSize',10)
hold on
plot(shape0(1,:),shape0(2:3,:),'LineWidth',linewidth)
plot(shape1(1,:),shape1(2:3,:),'LineWidth',linewidth)
plot(shape2(1,:),shape2(2:3,:),'LineWidth',linewidth)
plot(shape3(1,:),shape3(2:3,:),'LineWidth',linewidth)
plot(shape4(1,:),shape4(2:3,:),'LineWidth',linewidth)
hold off
title('CAD Operations')
xlabel('X')
ylabel('Y')
legend('Reference point','Original','Translated forward','Scaled by 1.5x','Rotated 45 deg CW.','Translated backward','Position',[0.6,0.2,0.28214,0.24405])
grid on
```

```
axis equal
axis([-10 18 -10 18])
xticks(-10:2:18)
yticks(-10:2:18)
set(gca,'FontSize',14)

% Print matrices
fprintf('Forward translation matrix:\n')
T_f
fprintf('Scaling matrix:\n')
S
fprintf('Rotation matrix:\n')
R
fprintf('Backward translation matrix:\n')
T_b
fprintf('Overall transformation matrix:\n')
M = T_b*R*S*T_f
```

Published with MATLAB® R2023a