```matlab
clear all;
close all;
%m equally spaced points over [0,1]
m = 50; n=12;

% Vandermonde matrix t
t = zeros(m,n);
for i = 1:n
    for j = 1:m
        t(j,i) = ((j-1)/(m-1))^(n-i);
    end
end

%fliping the vandermonde matrix t to form A
A = fliplr(t);

%fuction f
tj = zeros(m,1);
for j = 1:m
    tj(j) = (j-1)/(m-1);
end

f = cos(4*tj);

format long
%(a). normal equations
x = (A'*A)\(A'*f);

%(b). QR decomposition using CGS
[q_c,r_c] = CGS(A); xc = r_c\(q_c'*f);

%(c). QR decomposition using MGS
[q_m,r_m] = MGS(A); xm = r_m\(q_m'*f);

%(d). QR decomposition using Householder
[v_h,r_h] = house(A); q_h = house2q(v_h);
x_h = r_h\(q_h'*f);

%(e). QR decomposition using inbuilt Householder
[q,r] = qr(A); xh = r\(q'*f);

%(f). QR decomposition using inbuilt svd
[u,s,v] = svd(A); xs = (u*s*v')\f;

Table = table(x,xc,xm,x_h,xh,xs, 'VariableNames',{'Normal equation','CGS','MGS','Householder','Builtin function','SVD'})

%Differences and Similarities
fprintf('The Normal equation and the MGS, slightly give the same results different from SVD, CGS, built in function and the Householder, however the S
%Plot the difference between AX - b
%a) the Equations method
plot(tj,(f - A*x),'-*')
hold on
%e) the Inbulit in Householder
plot(tj,(f - A*xh),'-o')
title('Ax - f against t')
xlabel('tj');ylabel('Ax - f')
legend('Equations method','Householder')
```

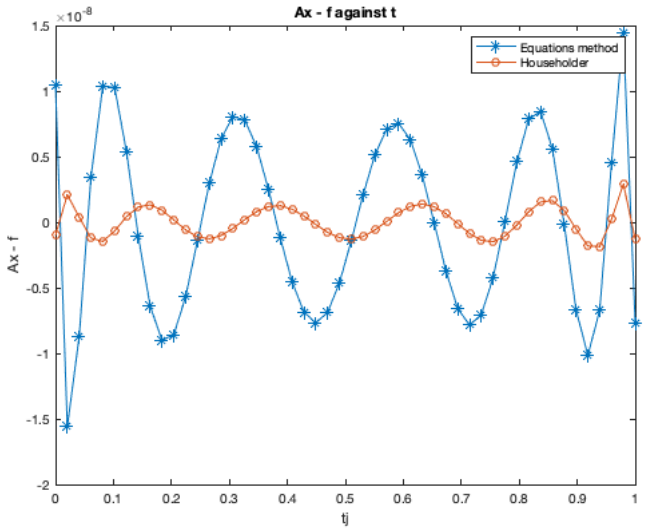
```
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate.
RCOND =  2.800825e-17.

Table =

  12×6 table
```

Normal equation	CGS	MGS	Householder	Builtin function	SVD
0.999999989587329	1.00001318251953	0.999999998520677	1.0000000009966	1.00000000099661	1.0000000009966
2.84029396133336e-06	-0.00225720796774053	3.05080727773958e-07	-4.22742880142516e-07	-4.22742915903599e-07	-4.22742687968714e-07
-8.00010214560535	-7.93913160486272	-8.00000853723409	-7.99998123568728	-7.99998123568936	-7.99998123569402
0.00144399781030622	-0.651916745057654	8.30962169927592e-05	-0.00031876322646563	-0.000318763182123933	-0.000318763136786353
10.6560552366266	14.2711955211007	10.6663571718914	10.6694307959049	10.6694307955344	10.6694307952905
0.0460832179149034	-11.5678311875708	3.8863814958323e-05	-0.0138202880901764	-0.0138202863975713	-0.0138202856094021
-5.81579888120301	17.0680866167968	-5.68634045840887	-5.64707562703058	-5.64707563175731	-5.64707563334524
0.231892082482534	-27.8571950090876	-0.0034568433400209	-0.0753160248519546	-0.0753160164200601	-0.0753160144223081
1.33247545357655	22.3656313402359	1.60875341462289	1.69360696399754	1.69360695433438	1.69360695282722
0.270659249202885	-8.65775021730327	0.0684591563300498	0.00603210846945386	0.00603211536110353	0.00603211596325072
-0.484158233866101	1.28940347151745	-0.400264201000408	-0.374241703362034	-0.374241706147935	-0.374241706226963
0.107803579981325	0.0280984905476861	0.0927344155691747	0.0880405760611674	0.0880405765490434	0.0880405765380861

The Normal equation and the MGS, slightly give the same results different from SVD, CGS, built in function and the Householder, however the SVD, built in function and the Householder matrix give almost similar results different from CSG.



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