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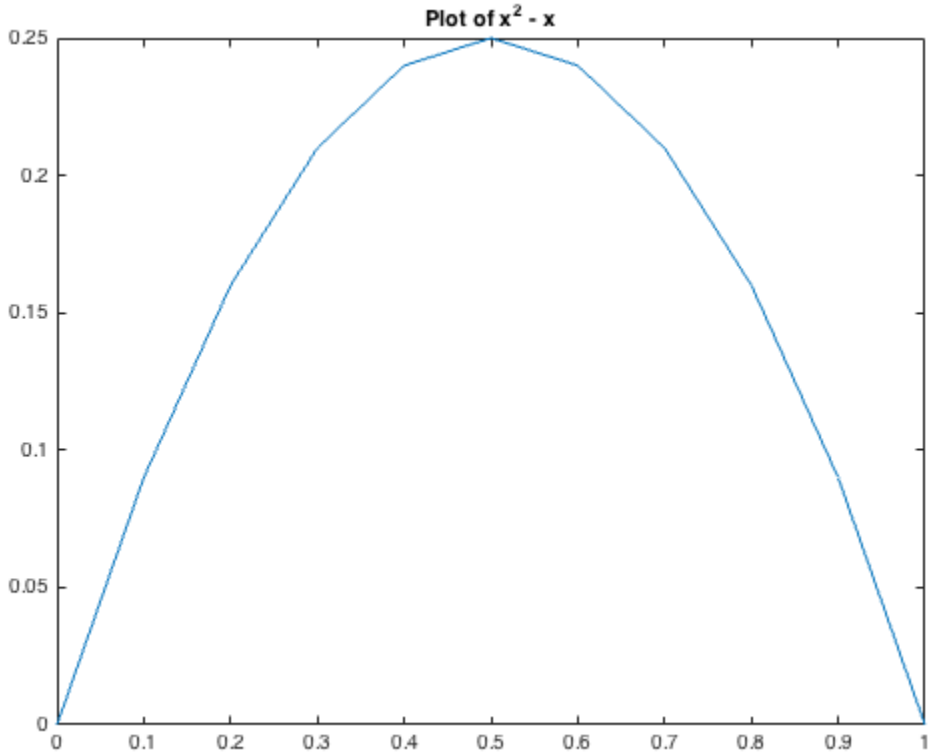
```
clear all
close all
```

Morgan Yost, MATH 502 HW 1

Problem 3

```
x = 0:.1:1;
figure(1)
plot(x, abs(x.^2-x))
title('Plot of x^2 - x')
```



Problem 4

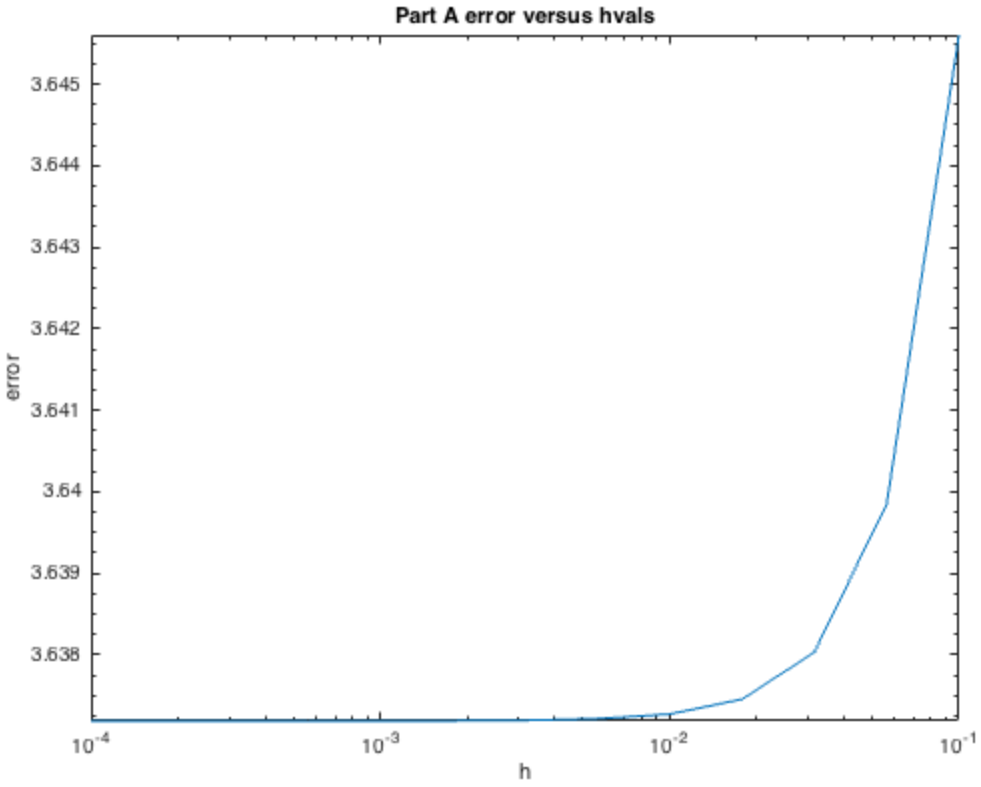
```
x = [.2 .4 .6 .8 1];
h = .2;
U = x.^2-x;
%Part a
U_inf = max(abs(U));
%Part b
U_1 = h*sum(abs(U));
%Part c
U_2 = sqrt(h*sum(U.^2));
```

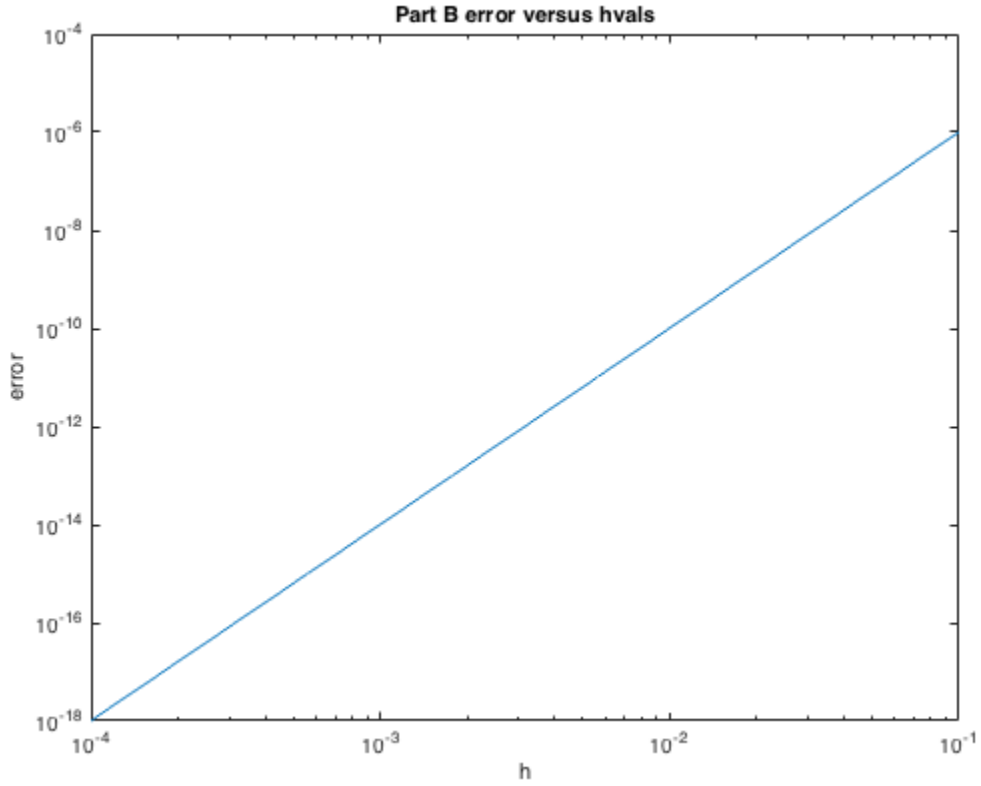
Exercise 1.2

```
%Part a
u = [1 1 1 1 1;
     -2 -1 0 1 2;
     2 .5 0 .5 2;
     -4/3 -1/6 0 1/6 4/3;
     2/3 1/24 0 1/24 2/3];
v = [0; 0; 1; 0; 0];
C = inv(u)*v;
fprintf('Using the method of undetermined coefficients, \n')
fprintf('I found the coeffiecients to be:\n')
fprintf('%f \n\n', C);
%Part b
fprintf('Using fdstencil:\n')
[c, err0, err1] = fdstencil(2, -2:2);
if(u*c' ~= v)
    fprintf('Error: mismatched results \n')
else
    fprintf('Sucessful Match!\n\n')
end
%Part c
x0 = ones(length(c),1);
hCoeff = [-2 -1 0 1 2]';
hvals = logspace(-1, -4, 13);
count = 1;
for h = hvals
    result(count) = sum(c'.*sin(x0+h.*hCoeff));
    err(count) = abs(4*sin(2)-result(count));
    exptError(count) = abs(err0*h^3*cos(2) + err1*h^4*sin(2));
    count = count+1;
end

%plots
figure(2)
loglog(hvals, err)
title('Part A error versus hvals')
xlabel('h')
ylabel('error')
figure(3)
```

```
loglog(hvals, exptError)
title('Part B error versus hvals')
xlabel('h')
ylabel('error')

%make table for latex
fprintf('Error table:')
for i = 1:length(hvals)
    fprintf('%.16f & %.16f & %.18f \\\\ \n', hvals(i), err(i),
 exptError(i));
end
```

```
Using the method of undetermined coefficients,
I found the coeffiecients to be:
-0.083333

1.333333

-2.500000

1.333333

-0.083333

Using fdstencil:

The derivative u^(2) of u at x0 is approximated by

          1/h^2 * [
                     -8.333333333333333e-02 * u(x0-2*h) +
                      1.333333333333333e+00 * u(x0-1*h) +
                     -2.500000000000000e+00 * u(x0) +
                      1.333333333333333e+00 * u(x0+1*h) +
                     -8.333333333333333e-02 * u(x0+2*h) ]

For smooth u,
       Error = 0 * h^3*u^(5) + -0.0111111 * h^4*u^(6) + ...

Sucessful Match!

Error table:0.1000000000000000 & 3.6456044078094720 &
 0.000001010330474251 \\
0.0562341325190349 & 3.6398506719040853 & 0.000001010330474251 \\
0.0316227766016838 & 3.6380311782781858 & 0.000001010330474251 \\
0.0177827941003892 & 3.6374558037921250 & 0.000001010330474251 \\
0.0100000000000000 & 3.6372738544011982 & 0.000001010330474251 \\
0.0056234132519035 & 3.6372163169516960 & 0.000001010330474251 \\
0.0031622776601684 & 3.6371981220125749 & 0.000001010330474251 \\
0.0017782794100389 & 3.6371923682676237 & 0.000001010330474251 \\
0.0010000000000000 & 3.6371905487737117 & 0.000001010330474251 \\
0.0005623413251903 & 3.6371899733992166 & 0.000001010330474251 \\
0.0003162277660168 & 3.6371897914498255 & 0.000001010330474251 \\
0.0001778279410039 & 3.6371897339123755 & 0.000001010330474251 \\
0.0001000000000000 & 3.6371897157174367 & 0.000001010330474251 \\
```


Part A error versus hvals
3.645
3.644
3.643
3.642
3.641
3.64
3.639
3.638
error
10^-4
10^-3
10^-2
10^-1
h


Part B error versus hvals
10^-4
10^-6
10^-8
10^-10
10^-12
10^-14
10^-16
10^-18
error
10^-4
10^-3
10^-2
10^-1
h

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