Homework 12

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```matlab
n = 10;

% X values where x0 = 0, and xn = 1 where n=10
xf = [0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1];

% calculate yf values using x values with function: f(x) = e^-x
yf = [];
for i=1:n
    yf_value = exp(-xf(i));
    yf = [yf yf_value];
end

% calculating h values

hf = [];
for i=1:n
    hf_value = xf(i + 1) - xf(i);
    hf = [hf hf_value];
end

% matrix A

A = zeros(8, 8);
for row=1:n-2
    for col=1:n-2
        if row==col
            A(row, col) = 2 * (hf(row + 2) + hf(row + 1));
        elseif col==row+1
            A(row, col) = hf(row + 2);
        elseif col == row-1
            A(row, col) = hf(row + 1);
        end
    end
end

% print matrix A and F
fprintf("Matrix A: ")
A

fprintf("Vector F: ")
F = yf(1, 1:8).'

% calc matrix Z
fprintf("Vector Z: ")
z = A\F;
```

```matlab
z = [0, z.', 0];
z

% Calculate interpolation to plug in
Sf = [];
syms x
for i=1:n-1
    Sf_value = ((( z(i)/( 6*hf(i) ) )*(xf(i+1) - x)^3));
    Sf_value1 = ((( z(i+1)/( 6*hf(i) ) )*( x - xf(i))^3));
    Sf_value2 = (((yf(i + 1)/hf(i)) - ((z(i+1)*hf(i))/6))*(x - xf(i)));
    Sf_value3 =  (( yf(i)/hf(i) ) -  ((z(i)*hf(i))/6)*(xf(i+1) - x));
    Sf = [Sf Sf_value+Sf_value1+Sf_value2+Sf_value3];
end

Sf

hold on
fplot(Sf(1),[0, 0.1]);
fplot(Sf(2),[0.1, 0.2]);
fplot(Sf(3),[0.2, 0.3]);
fplot(Sf(4),[0.3, 0.4]);
fplot(Sf(5),[0.4, 0.5]);
fplot(Sf(6),[0.5, 0.6]);
fplot(Sf(7),[0.6, 0.7]);
fplot(Sf(8),[0.7, 0.8]);
fplot(Sf(9),[0.8, 0.9]);
hold off
```

Output

```
Matrix A:
A =

    0.4000    0.1000         0         0         0         0         0         0
    0.1000    0.4000    0.1000         0         0         0         0         0
         0    0.1000    0.4000    0.1000         0         0         0         0
         0         0    0.1000    0.4000    0.1000         0         0         0
         0         0         0    0.1000    0.4000    0.1000         0         0
         0         0         0         0    0.1000    0.4000    0.1000         0
         0         0         0         0         0    0.1000    0.4000    0.1000
         0         0         0         0         0         0    0.1000    0.4000

Vector F:
F =

    1.0000
    0.9048
    0.8187
```

```
        0.7408
        0.6703
        0.6065
        0.5488
        0.4966

Vector Z:
z =

         0    2.1566    1.3736    1.3974    1.2242    1.1140    1.0229    0.8597
    1.0265         0


Sf =

[(8093720221926357*x^3)/2251799813685248 + (1268386880704305*x)/140737488355328 +
10, (11817960713330726117*x)/144115188075855872 - (8093720221926357*(x -
1/5)^3)/2251799813685248 + (2577558003524349*(x - 1/10)^3)/1125899906842624 +
5926552707779826587/720575940379279360, (2135148910174403197*x)/288230376151711744
+ (5244361239025749*(x - 1/5)^3)/2251799813685248 - (1288779001762175*(x -
3/10)^3)/562949953421312 + 19321410923826271113/2882303761517117440,
(30201530287081203*x)/4503599627370496 - (5244361239025747*(x -
2/5)^3)/2251799813685248 + (4594401657504675*(x - 3/10)^3)/2251799813685248 +
60731347043780399/11258999068426240, (1748734835891309665*x)/288230376151711744 -
(2297200828752339*(x - 1/2)^3)/1125899906842624 + (2090468826358853*(x -
2/5)^3)/1125899906842624 + 2463967944680332959/576460752303423488,
(1582279578342027909*x)/288230376151711744 + (7677913955667005*(x -
1/2)^3)/4503599627370496 - (2090468826358853*(x - 3/5)^3)/1125899906842624 +
4782653263873103217/1441151880758558720,
(1432093853852960385*x)/288230376151711744 + (3226328211536589*(x -
3/5)^3)/2251799813685248 - (7677913955667005*(x - 7/10)^3)/4503599627370496 +
7220941442732373369/2882303761517117440,
(2588601796402296297*x)/576460752303423488 - (6452656423073171*(x -
4/5)^3)/4503599627370496 + (3852629174433885*(x - 7/10)^3)/2251799813685248 +
1312215225700546071/720575940379279360, (73549289058271191*x)/18014398509481984 -
(3852629174433889*(x - 9/10)^3)/2251799813685248 +
220736579345911921/180143985094819840]

>>
```

Name: plot_cubic_spline.fig