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1 % Javier Salazar 1001144647
2 clc
3 clear all
4 %-----parameters-----
5 a = -1;
6 b = 1;
7 n = 11;
8 fun = @(x) abs(x);
9 %-----main function-----
10 %-----equally spaced points-----
11 x_points = linspace(a, b, n);
12 y_points = fun(x_points);
13 a_coeff = coefficients(n, x_points, y_points);
14 t = linspace(a, b, 41);
15 interpValues = evaluate(n, x_points, a_coeff, t);
16 y_new = abs(t);
17 %-----chevyshev-----
18 x_points_cheby = cheby(a, b, n);
19 y_points_cheby = fun(x_points_cheby);
20 a_coeff_cheby = coefficients(n, x_points_cheby, y_points_cheby);
21 interpValues_cheby = evaluate(n, x_points_cheby, a_coeff_cheby, t);
22 y_new_cheby = abs(t);
23 %-----plotting-----
24 figure
25 plot(t, y_new, 'Marker', 'o');
26 hold on
27 plot(t, interpValues, 'Marker', '+');
28 hold on
29 plot(t, interpValues_cheby, 'Marker', '*');
30 hold off
31 title('Evenly spaced points vs. Chebyshev nodes interpolation functions', 'FontSize', 20);
32 xlabel('X Value', 'FontSize', 20);
33 ylabel('Y Value', 'FontSize', 20);
34 legend({'Analytic Function', 'Evenly spaced Interpolation', 'Chebyshev Interpolation'}, 'FontSize', 20);
35
36 figure
37 plot(t, abs(y_new-interpValues), 'Marker', 'o');
38 hold on
39 plot(t, abs(y_new-interpValues_cheby), 'Marker', '+');
40 hold off
41 legend({'Evenly spaced Interpolation', 'Chebyshev Interpolation'}, 'FontSize', 20);
42 title('Error Comparison - Evenly Spaced Points vs Chebyshev Points - Interpolation', 'FontSize', 20);
43 xlabel('X Value', 'FontSize', 20);
44 ylabel('Y Diff. Value', 'FontSize', 20);
45 %-----cheby points-----
46 function points = cheby(a, b, n)
47 points = zeros(1,n);
48 for i = 0:n-1

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49     points(i+1) = 0.5*(a+b) + 0.5*(b-a)*cos(pi*((2*i+1)/(2*n+2)));
50 end
51 end
52 %-----a vector function-----
53 function a = coefficients(n, x, y)
54 a = y;
55 for j = 1:n
56     for i = n:-1:j+1
57         a(i) = (a(i)-a(i-1))/(x(i)-x(i-j));
58     end
59 end
60 end
61 %-----evaluate p(x) function-----
62 function values = evaluate(n, x, a, t)
63 numberPoints = length(t);
64 values = ones(1, numberPoints)*a(n);
65 for k = 1:numberPoints
66     for i = n-1:-1:1
67         values(k) = values(k)*(t(k)-x(i))+a(i);
68     end
69 end
70 end
71
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