n = 6;

f[t\_] := 1 / (1 + 4t);

Do[x[k] = k/2,

{k, 0, n}];

Do[diff[k, 1] = f[x[k]],

{k, 0, n}];

Do[

Do[diff[k, j] = (diff[k + 1, j - 1] - diff[k, j - 1] )/ (x[k + j - 1] - x[k]),

{k, 0, n + 1 - j}],

{j, 2, n + 1}];

P[t\_] :=

(s = 0; w = 1;

Do[(s += diff[0, k] \* w; w \*= t - x[k - 1]), {k, 1, n + 1}];

s);

a = Expand[P[t]]

Plot[Abs[f[t]-a],{t,0,3}, PlotRange  All]

Plot[{f[t], P[t]}, {t, 0, 3}]

n = 4;

f[t\_] := E ^ (-t);

Do[x[k] = 0,

{k, 0, 2}];

Do[x[k] = 1,

{k, 3, n}];

Do[diff[k, 1] = f[x[k]],

{k, 0, n}];

Do[

Do[If[x[k]== x[k + j - 1],

diff[k, j] = Derivative[j-1][f][x[k]]/ Factorial[j-1],

diff[k, j] = (diff[k + 1, j - 1] - diff[k, j - 1] )/ (x[k + j - 1] - x[k])],

{k, 0, n + 1 - j}],

{j, 2, n + 1}];

P[t\_] :=

(s = 0; w = 1;

Do[(s += diff[0, k] \* w; w \*= t - x[k - 1]), {k, 1, n + 1}];

s);

a = Expand[P[t]]

Plot[Abs[f[t]-a],{t,0,1}, PlotRange  All]

Plot[{f[t], P[t]}, {t, 0, 1}]

(\* for checking  Expand[InterpolatingPolynomial[{{0,1,-1, 1}, {1, 1/E,-1/E}}, x]] \*)