APPENDIX

HW 1, problem 3, computational part. math 228A UC davis fall 2010

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This is the code used to generate the plots and tables used in HW1

define local error function

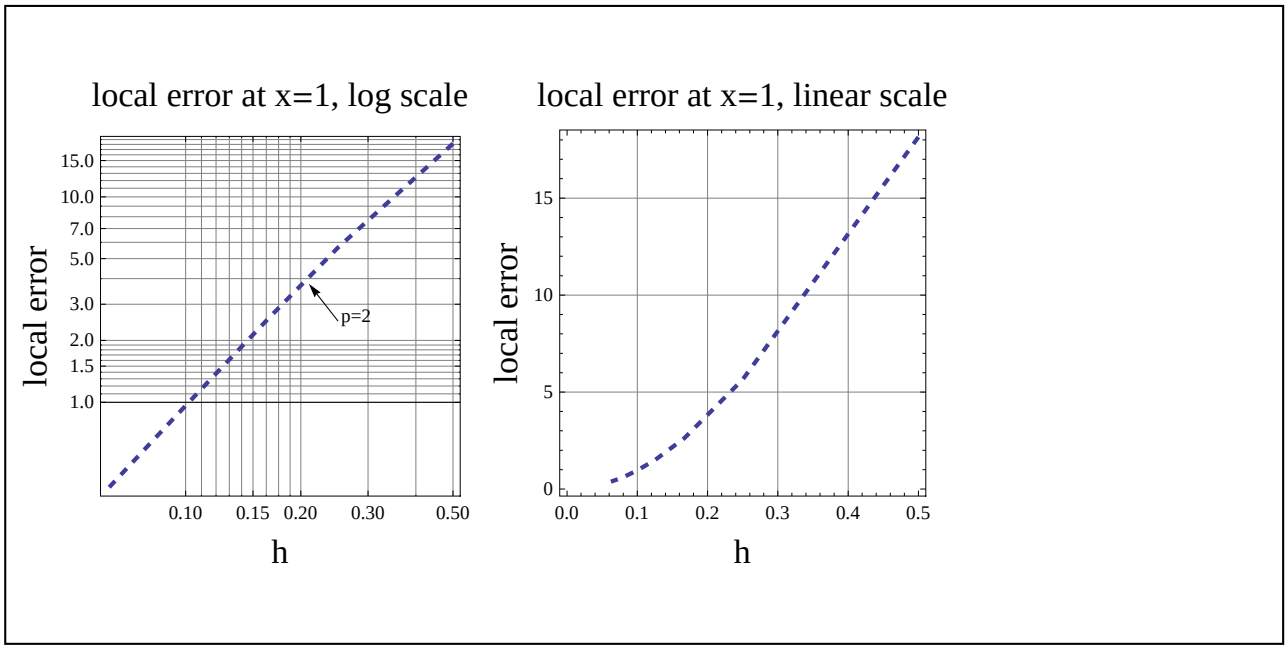
```
localError[h_, x_] :=
  Module[{}, 8/(3 h^2) Cos[2 π x - π h] - 4/h^2 Cos[2 π x] + 4/(3 h^2) Cos[2 π x + 2 π h]] + (2 π)^2 Cos[2 π x];
```

define a function to make the plots

```
makePlot[x_, s_, title_, xlabel_, ylabel_, f_] := Module[{data, n = 8},
  data = Table[{ 1 / (2^i), Abs@localError[1 / (2^i), x] }, {i, 1, n}];
  f[data, Joined → True, AxesOrigin → {0, 0},
   GridLines → Automatic, AspectRatio → 1, Frame → True, PlotRange → All,
   FrameLabel → {{ylabel, None}, {xlabel, title}}, PlotStyle → s, ImageSize → Full]
 ]
```

make plot for problem 3, part b

```
title = Style["local error at x=1, log scale", 16];
xlabel = Style["h", 16]; ylabel = Style["local error", 16];
p1 = makePlot[1, {Thick, Dashed}, title, xlabel, ylabel, ListLogLogPlot];
title = Style["local error at x=1, linear scale", 16];
p2 = makePlot[1, {Thick, Dashed}, title, xlabel, ylabel, ListPlot];
Framed[Grid[{{p1, p2}}], ImageSize → {600, 300}]
```



Generate error table, problem 3, part b

```
n = 14;
x = 1;
data = Table[{ 1 / (2^i), Abs@localError[1 / (2^i), x] }, {i, 1, n}];
data = Table[{ data[[i, 1]], data[[i, 2]], If[i == 1, 0, data[[i - 1, 2]] / data[[i, 2]]] }, {i, 1, n}];
t = TableForm[N[data, $MachinePrecision], TableHeadings →
    {None, {"h", "local error τ", "ratio"}}, TableSpacing → {1, 6}, TableAlignments → Left];
Labeled[Framed@ScientificForm[t, {8, 6}, NumberFormat → (Row[{#1, "e", #3}] &),
   NumberPadding → {"", "0"}], Style["local error as function of h at x=1", 14], Top]
```

local error as function of h at x=1

h	local error τ	ratio
5.000000e-1	1.814508e1	0.000000e
2.500000e-1	5.648307e	3.212482e
1.250000e-1	1.493636e	3.781581e
6.250000e-2	3.787161e-1	3.943947e
3.125000e-2	9.501408e-2	3.985895e
1.562500e-2	2.377451e-2	3.996468e
7.812500e-3	5.944941e-3	3.999117e
3.906250e-3	1.486317e-3	3.999779e
1.953125e-3	3.715845e-4	3.999945e
9.765625e-4	9.289644e-5	3.999986e
4.882812e-4	2.322413e-5	3.999997e
2.441406e-4	5.806034e-6	3.999999e
1.220703e-4	1.451509e-6	4.000000e
6.103516e-5	3.628771e-7	4.000000e

Generate table for problem 3, part (c)

```
n = 14;
x = 0.2;
data = Table[{ 1 / (2^i), Abs@localError[1 / (2^i), x] }, {i, 1, n}];
data = Table[{ data[[i, 1]], data[[i, 2]], If[i == 1, 0, data[[i - 1, 2]] / data[[i, 2]]] }, {i, 1, n}];
t = TableForm[N[data, $MachinePrecision], TableHeadings →
    {None, {"h", "local error τ", "ratio"}}, TableSpacing → {1, 6}, TableAlignments → Left];
Labeled[Framed@ScientificForm[t, {8, 6}, NumberFormat → (Row[{#1, "e", #3}] &),
   NumberPadding → {"", "0"}], Style["local error as function of h at x=0.2", 14], Top]
```

local error as function of h at x=0.2

h	local error τ	ratio
5.000000e-1	1.575174e1	0.000000e
2.500000e-1	1.014949e1	1.551974e
1.250000e-1	5.189762e	1.955675e
6.250000e-2	2.550829e	2.034539e
3.125000e-2	1.255100e	2.032371e
1.562500e-2	6.213251e-1	2.020037e
7.812500e-3	3.089650e-1	2.010989e
3.906250e-3	1.540406e-1	2.005737e
1.953125e-3	7.690765e-2	2.002930e
9.765625e-4	3.842539e-2	2.001480e
4.882812e-4	1.920555e-2	2.000744e
2.441406e-4	9.600990e-3	2.000372e
1.220703e-4	4.800048e-3	2.000186e
6.103516e-5	2.399851e-3	2.000144e

Generate plot for part (C)

```
title = Style["local error at different x locations, log scale", 16];
xlabel = Style["h", 16]; ylabel = Style["local error", 16];
p1 = makePlot[1, {Thick, Dashed}, title, xlabel, ylabel, ListLogLogPlot];
p2 = makePlot[0.2, {Thick, Black}, title, xlabel, ylabel, ListLogLogPlot];
Show[{p1, p2}, ImageSize → 500]
```