```
In[1]:= (* MA39110 / Assignment 2.2 / 16MA20053 / NER ROHIT *)
ClearAll["Global`*"];

In[2]:= Thomas[a_, b_, c_, d_] :=
  Module[{c1 = Range[Length[c]], d1 = Range[Length[d]], x = Range[Length[b]]},
   c1[[1]] = c[[1]] / b[[1]]; d1[[1]] = d[[1]] / b[[1]];
   Do[
    If[i ≠ Length[d], c1[[i]] = c[[i]] / (b[[i]] - a[[i - 1]] * c1[[i - 1]])];
    d1[[i]] = (d[[i]] - a[[i - 1]] * d1[[i - 1]]) / (b[[i]] - a[[i - 1]] * c1[[i - 1]]);
    , {i, 2, Length[d]}];
   x[[Length[b]]] = d1[[Length[b]]];
   Do[
    x[[i]] = d1[[i]] - c1[[i]] * x[[i + 1]];
    , {i, Length[b] - 1, 1, -1}];
   x];
Model[n0_] := Module[{n = n0},
   x0 = 0; xf = 1; h = (xf - x0) / n;
   A = Table[0, {x, 1, n - 1}, {y, 1, n - 1}];
   X = Table[x0 + x * h, {x, 1, n - 1}];
   B = Table[-4 * (x0 + x * h), {x, 1, n - 1}];
   For[i = 1, i < n, i++,
    {
     A[[i, i]] = -(2 + (2 / (h^2)));
     If[i ≠ 1, A[[i, i - 1]] = (1 / h^2) + X[[i]] / h];
     If[i ≠ n - 1, A[[i, i + 1]] = (1 / h^2) - X[[i]] / h];
    }];
   A[[1, 1]] = A[[1, 1]] + ((1 / h^2) + X[[1]] / h) * (4 / (2 * h + 3));
   A[[1, 2]] = A[[1, 2]] - ((1 / h^2) + X[[1]] / h) * (1 / (2 * h + 3));
   A[[n - 1, n - 1]] = A[[n - 1, n - 1]] + ((1 / h^2) - X[[n - 1]] / h) * (-4 / (4 * h - 3));
   A[[n - 1, n - 2]] = A[[n - 1, n - 2]] + ((1 / h^2) - X[[n - 1]] / h) * (1 / (4 * h - 3));
   B[[n - 1]] = B[[n - 1]] - (1 / h^2 - X[[n - 1]] / h) * (2 * h / (4 * h - 3));
   Thomas[Diagonal[A, -1], Diagonal[A], Diagonal[A, 1], B]];
```

In[4]:=
```
sol = Model[10];
solt = DSolve[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
   y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[x], x]
err1 = Abs[DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
      y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol];
perr1 = ListPlot[Transpose[{X, err1}], PlotStyle → Red];
N[Max[err1]]
p1 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Red]}];
```

Out[5]= $\{\{y[x] \to e^{x^2} + x\}\}$

Out[8]= 0.748796

In[10]:=
```
sol = Model[50];
err2 = Abs[DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
      y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol];
perr2 = ListPlot[Transpose[{X, err2}], PlotStyle → Blue];
N[Max[err2]]
p2 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1/5", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Blue]}];
```

Out[13]= 0.0328078

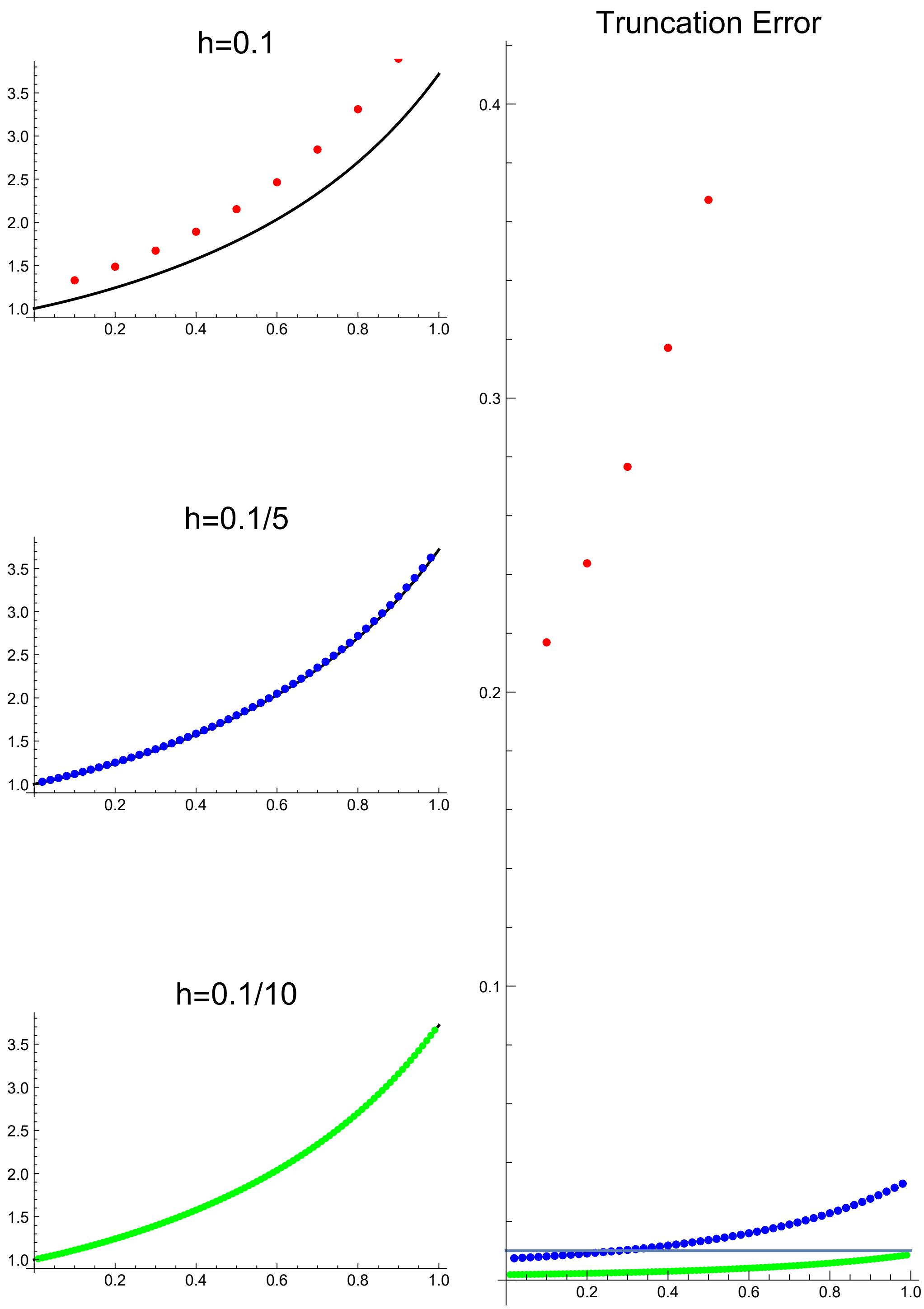
In[15]:=
```
sol = Model[100];
err3 = Abs[DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
      y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol];
perr3 = ListPlot[Transpose[{X, err3}], PlotStyle → Green];
N[Max[err3]]
p3 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1/10", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Green]}];
```

Out[18]= 0.00853588

In[20]:=
```
p4 = Show[{perr1}, {perr2}, {perr3}, {Plot[y[x] = 10^-2, {x, 0, 1}]},
   PlotLabel → Style["Truncation Error", FontSize → 18],
   PlotRange → {{0, 1}, {0, 0.4}}, AspectRatio → 3];
N[sol[[-1]]]
GraphicsGrid[{{p1, p4}, {p2, SpanFromAbove}, {p3, SpanFromAbove}}]
```

Out[21]= 3.66326

Out[22]=


h=0.1
3.5
3.0
2.5
2.0
1.5
1.0
0.2
0.4
0.6
0.8
1.0
h=0.1/5
3.5
3.0
2.5
2.0
1.5
1.0
0.2
0.4
0.6
0.8
1.0
h=0.1/10
3.5
3.0
2.5
2.0
1.5
1.0
0.2
0.4
0.6
0.8
1.0
Truncation Error
0.4
0.3
0.2
0.1
0.2
0.4
0.6
0.8
1.0