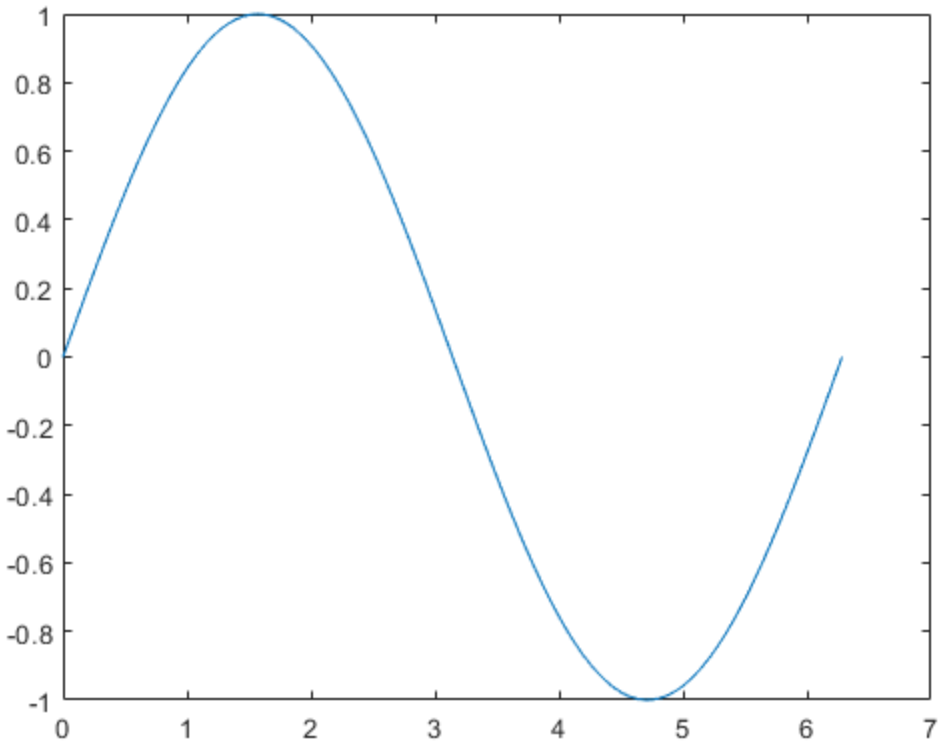
Table of Contents

Demonstrates the parent-children relationship among graphic objects

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x = linspace(0,2*pi);
y = sin(x);
hCurve = plot(x,y);
hCurve.Parent % .Parent##plot#info
hAxes = hCurve.Parent;
hAxes.Parent
hFigure = hAxes.Parent;
hFigure.Parent
hRoot = hFigure.Parent;
hRoot.Parent
hRoot.Children
hFigure.Children
hAxes.Children
hCurve.Children
% delete(hCurve) % delete : ######
% delete(hAxes)
% delete(hFigure)


ans =

  Axes with properties:

            XLim: [0 7]
            YLim: [-1 1]
          XScale: 'linear'
          YScale: 'linear'
```

```
    GridLineStyle: '-'
         Position: [0.1300 0.1100 0.7750 0.8150]
            Units: 'normalized'

  Use GET to show all properties


ans =

  Figure (1) with properties:

      Number: 1
        Name: ''
       Color: [0.9400 0.9400 0.9400]
    Position: [680 558 560 420]
       Units: 'pixels'

  Use GET to show all properties


ans =

  Graphics Root with properties:

          CurrentFigure: [1×1 Figure]
    ScreenPixelsPerInch: 96
             ScreenSize: [1 1 1920 1080]
       MonitorPositions: [2×4 double]
                  Units: 'pixels'

  Use GET to show all properties


ans =

  0×0 empty GraphicsPlaceholder array.


ans =

  Figure (1) with properties:

      Number: 1
        Name: ''
       Color: [0.9400 0.9400 0.9400]
    Position: [680 558 560 420]
       Units: 'pixels'

  Use GET to show all properties


ans =

  Axes with properties:
```

```
            XLim: [0 7]
            YLim: [-1 1]
          XScale: 'linear'
          YScale: 'linear'
    GridLineStyle: '-'
         Position: [0.1300 0.1100 0.7750 0.8150]
            Units: 'normalized'

  Use GET to show all properties


ans =

  Line with properties:

              Color: [0 0.4470 0.7410]
          LineStyle: '-'
          LineWidth: 0.5000
             Marker: 'none'
         MarkerSize: 6
    MarkerFaceColor: 'none'
              XData: [1×100 double]
              YData: [1×100 double]
              ZData: [1×0 double]

  Use GET to show all properties


ans =

  0×0 empty GraphicsPlaceholder array.
```

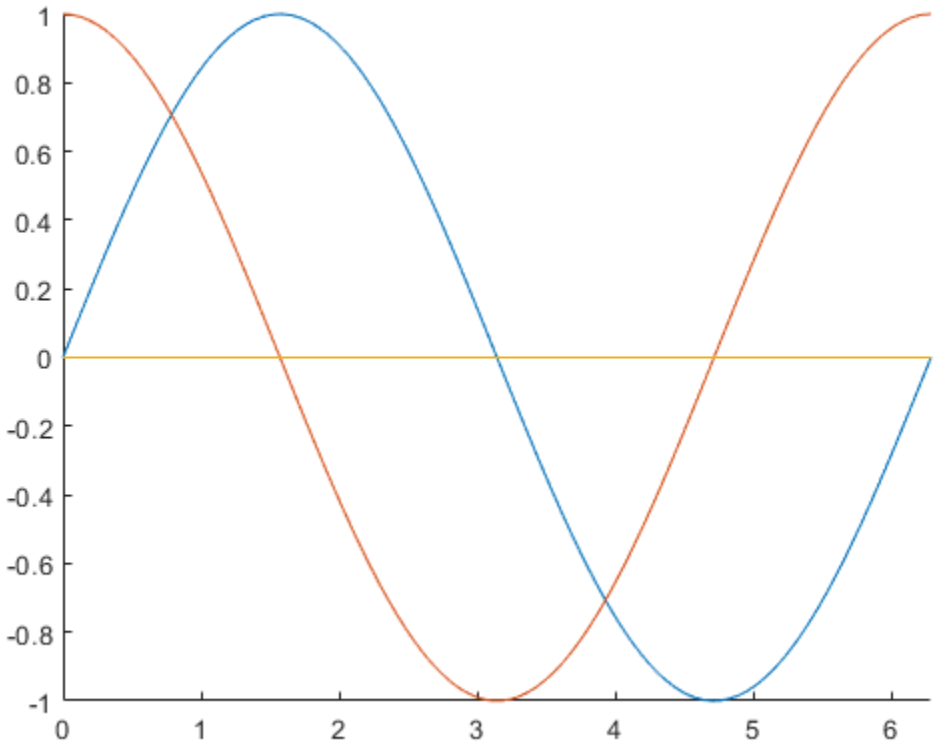


Demonstrates the parent-children relationship among graphic objects.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x = linspace(0,2*pi);
figure
axes('XLim', [0,2*pi], 'YLim', [-1,1])
hold on
plot(x, sin(x), x, cos(x))
plot([0,2*pi],[0,0])
hAxes = gca; % gca : #########
hCurve = hAxes.Children % ####axes#######
% delete(hCurve(1))
% delete(hCurve(2))
% delete(hAxes)
% delete(gcf)
```

```
hCurve =

  3×1 Line array:
```

```
Line
Line
Line
```



Demonstrates the getting/setting of object properties.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x = linspace(0,2*pi);
hCurve = plot(x, sin(x));
get(hCurve, 'LineWidth') % ##hCurve#LineWidth##
% set(hCurve, 'LineWidth', 2) % LineWidth####2
hCurve.LineWidth = 2 % LineWidth####2(##)
inspect(hCurve) % inspect#######
propedit % propedit#######
get(hCurve)
get(gcf)
get(gca)


ans =
```

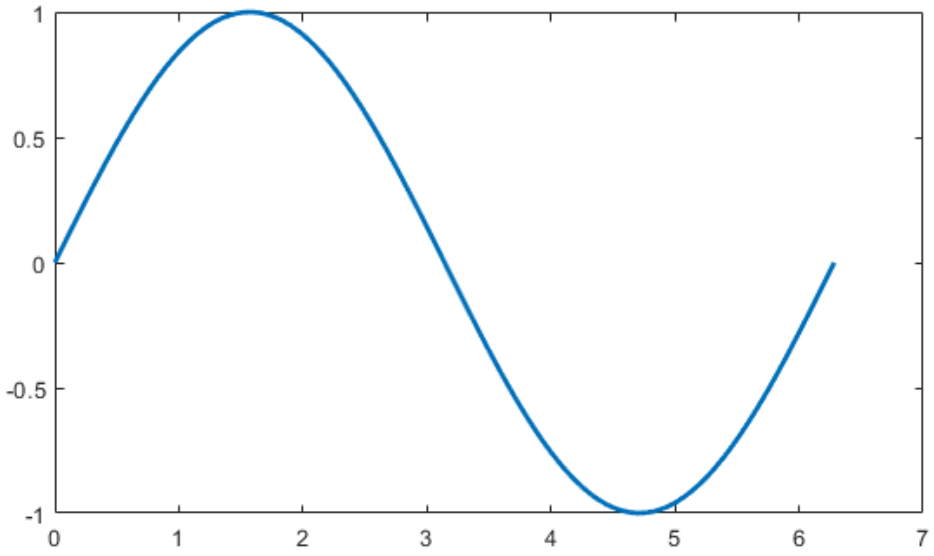
```
    0.5000


hCurve =

  Line with properties:

              Color: [0 0.4470 0.7410]
          LineStyle: '-'
          LineWidth: 2
             Marker: 'none'
         MarkerSize: 6
    MarkerFaceColor: 'none'
              XData: [1×100 double]
              YData: [1×100 double]
              ZData: [1×0 double]

  Use GET to show all properties

    AlignVertexCenters: 'off'
            Annotation: [1×1 matlab.graphics.eventdata.Annotation]
          BeingDeleted: 'off'
            BusyAction: 'queue'
         ButtonDownFcn: ''
              Children: [0×0 GraphicsPlaceholder]
              Clipping: 'on'
                 Color: [0 0.4470 0.7410]
             CreateFcn: ''
             DeleteFcn: ''
           DisplayName: ''
      HandleVisibility: 'on'
               HitTest: 'on'
          Interruptible: 'on'
              LineJoin: 'round'
             LineStyle: '-'
             LineWidth: 2
                Marker: 'none'
       MarkerEdgeColor: 'auto'
       MarkerFaceColor: 'none'
         MarkerIndices: [1×100 uint64]
            MarkerSize: 6
                Parent: [1×1 Axes]
          PickableParts: 'visible'
              Selected: 'off'
    SelectionHighlight: 'on'
                   Tag: ''
                  Type: 'line'
          UIContextMenu: [0×0 GraphicsPlaceholder]
              UserData: []
               Visible: 'on'
                 XData: [1×100 double]
             XDataMode: 'manual'
           XDataSource: ''
```

```
            YData: [1×100 double]
      YDataSource: ''
            ZData: [1×0 double]
      ZDataSource: ''

            Alphamap: [1×64 double]
        BeingDeleted: 'off'
          BusyAction: 'queue'
       ButtonDownFcn: ''
            Children: [1×1 Axes]
            Clipping: 'on'
      CloseRequestFcn: ''
               Color: [0.9400 0.9400 0.9400]
            Colormap: [64×3 double]
          CreateFcn: ''
         CurrentAxes: [1×1 Axes]
    CurrentCharacter: ''
       CurrentObject: [1×1 Figure]
        CurrentPoint: [0 0]
           DeleteFcn: ''
        DockControls: 'on'
            FileName: ''
  GraphicsSmoothing: 'on'
   HandleVisibility: 'on'
       InnerPosition: [680 558 560 420]
       IntegerHandle: 'on'
       Interruptible: 'on'
      InvertHardcopy: 'on'
         KeyPressFcn: {3×1 cell}
       KeyReleaseFcn: ''
             MenuBar: 'figure'
                Name: ''
            NextPlot: 'add'
              Number: 1
         NumberTitle: 'on'
       OuterPosition: [672 550 576 514]
    PaperOrientation: 'portrait'
       PaperPosition: [3.0917 9.2937 14.8167 11.1125]
  PaperPositionMode: 'auto'
           PaperSize: [21.0000 29.7000]
           PaperType: 'A4'
          PaperUnits: 'centimeters'
              Parent: [1×1 Root]
             Pointer: 'arrow'
  PointerShapeCData: [16×16 double]
PointerShapeHotSpot: [1 1]
            Position: [680 558 560 420]
            Renderer: 'opengl'
        RendererMode: 'auto'
              Resize: 'on'
       SelectionType: 'normal'
      SizeChangedFcn: ''
                 Tag: ''
             ToolBar: 'auto'
```

```
                    Type: 'figure'
          UIContextMenu: [0×0 GraphicsPlaceholder]
                  Units: 'pixels'
               UserData: []
                Visible: 'on'
    WindowButtonDownFcn: {3×1 cell}
  WindowButtonMotionFcn: ''
      WindowButtonUpFcn: {3×1 cell}
      WindowKeyPressFcn: {3×1 cell}
    WindowKeyReleaseFcn: {3×1 cell}
   WindowScrollWheelFcn: ''
            WindowState: 'normal'
            WindowStyle: 'docked'

                   ALim: [0 1]
                ALimMode: 'auto'
  ActivePositionProperty: 'outerposition'
             AlphaScale: 'linear'
               Alphamap: [1×64 double]
      AmbientLightColor: [1 1 1]
           BeingDeleted: 'off'
                    Box: 'on'
                BoxStyle: 'back'
             BusyAction: 'queue'
          ButtonDownFcn: ''
                   CLim: [0 1]
                CLimMode: 'auto'
          CameraPosition: [3.5000 0 17.3205]
      CameraPositionMode: 'auto'
            CameraTarget: [3.5000 0 0]
        CameraTargetMode: 'auto'
          CameraUpVector: [0 1 0]
      CameraUpVectorMode: 'auto'
         CameraViewAngle: 6.6086
     CameraViewAngleMode: 'auto'
                Children: [1×1 Line]
                Clipping: 'on'
           ClippingStyle: '3dbox'
                   Color: [1 1 1]
              ColorOrder: [7×3 double]
         ColorOrderIndex: 2
              ColorScale: 'linear'
                Colormap: [64×3 double]
              CreateFcn: ''
           CurrentPoint: [2×3 double]
       DataAspectRatio: [3.5000 1 1]
    DataAspectRatioMode: 'auto'
              DeleteFcn: ''
              FontAngle: 'normal'
               FontName: 'Helvetica'
               FontSize: 10
           FontSizeMode: 'auto'
         FontSmoothing: 'on'
              FontUnits: 'points'
```

```
              FontWeight: 'normal'
               GridAlpha: 0.1500
           GridAlphaMode: 'auto'
               GridColor: [0.1500 0.1500 0.1500]
           GridColorMode: 'auto'
           GridLineStyle: '-'
        HandleVisibility: 'on'
                 HitTest: 'on'
           Interruptible: 'on'
LabelFontSizeMultiplier: 1.1000
                   Layer: 'bottom'
                  Legend: [0×0 GraphicsPlaceholder]
          LineStyleOrder: '-'
     LineStyleOrderIndex: 1
               LineWidth: 0.5000
          MinorGridAlpha: 0.2500
      MinorGridAlphaMode: 'auto'
          MinorGridColor: [0.1000 0.1000 0.1000]
      MinorGridColorMode: 'auto'
      MinorGridLineStyle: ':'
                 NextPlot: 'replace'
           OuterPosition: [0 0 1 1]
                  Parent: [1×1 Figure]
           PickableParts: 'visible'
      PlotBoxAspectRatio: [1 0.7903 0.7903]
  PlotBoxAspectRatioMode: 'auto'
                Position: [0.1300 0.1100 0.7750 0.8150]
              Projection: 'orthographic'
                Selected: 'off'
     SelectionHighlight: 'on'
              SortMethod: 'childorder'
                     Tag: ''
                 TickDir: 'in'
             TickDirMode: 'auto'
    TickLabelInterpreter: 'tex'
              TickLength: [0.0100 0.0250]
              TightInset: [0.0506 0.0532 0.0071 0.0202]
                   Title: [1×1 Text]
TitleFontSizeMultiplier: 1.1000
         TitleFontWeight: 'bold'
                 Toolbar: [1×1 AxesToolbar]
                    Type: 'axes'
          UIContextMenu: [0×0 GraphicsPlaceholder]
                   Units: 'normalized'
                UserData: []
                    View: [0 90]
                 Visible: 'on'
                    XAxis: [1×1 NumericRuler]
           XAxisLocation: 'bottom'
                  XColor: [0.1500 0.1500 0.1500]
             XColorMode: 'auto'
                    XDir: 'normal'
                   XGrid: 'off'
                  XLabel: [1×1 Text]
```

```
                XLim: [0 7]
           XLimMode: 'auto'
         XMinorGrid: 'off'
         XMinorTick: 'off'
             XScale: 'linear'
              XTick: [0 1 2 3 4 5 6 7]
         XTickLabel: {8×1 cell}
     XTickLabelMode: 'auto'
 XTickLabelRotation: 0
          XTickMode: 'auto'
              YAxis: [1×1 NumericRuler]
      YAxisLocation: 'left'
             YColor: [0.1500 0.1500 0.1500]
         YColorMode: 'auto'
               YDir: 'normal'
              YGrid: 'off'
             YLabel: [1×1 Text]
               YLim: [-1 1]
           YLimMode: 'auto'
         YMinorGrid: 'off'
         YMinorTick: 'off'
             YScale: 'linear'
              YTick: [1×11 double]
         YTickLabel: {11×1 cell}
     YTickLabelMode: 'auto'
 YTickLabelRotation: 0
          YTickMode: 'auto'
              ZAxis: [1×1 NumericRuler]
             ZColor: [0.1500 0.1500 0.1500]
         ZColorMode: 'auto'
               ZDir: 'normal'
              ZGrid: 'off'
             ZLabel: [1×1 Text]
               ZLim: [-1 1]
           ZLimMode: 'auto'
         ZMinorGrid: 'off'
         ZMinorTick: 'off'
             ZScale: 'linear'
              ZTick: [-1 0 1]
         ZTickLabel: ''
     ZTickLabelMode: 'auto'
 ZTickLabelRotation: 0
          ZTickMode: 'auto'
```



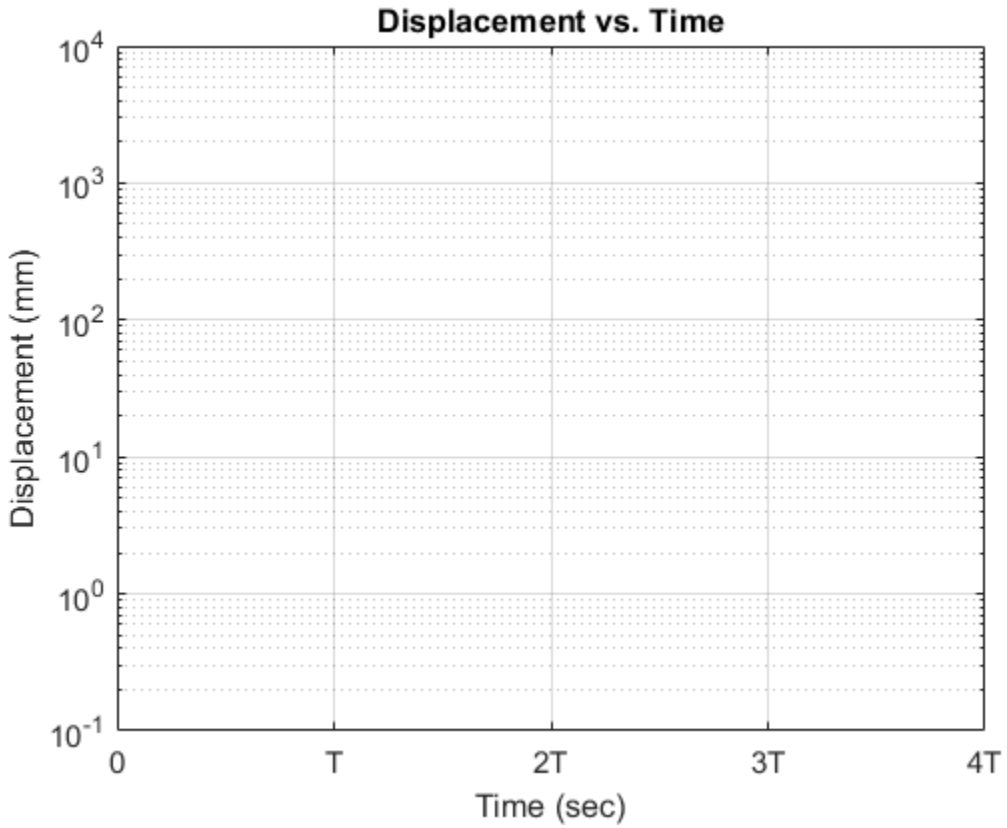
Demonstrates some properties of Figure objects.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

scrsz = get(groot, 'ScreenSize');
h1 = figure;
    h1.Position = [20, 60, scrsz(3)/5, scrsz(4)/4];
    h1.Name = 'Bottom-left Figure Window';
h2 = figure;
    h2.Visible = 'off';
    h2.Units = 'normalized';
    h2.Position = [0.1, 0.2, 0.3, 0.4];
    h2.Visible = 'on';
    h2.Color = [0.8, 0.8, 0.8];
    h2.Name = 'A Window of Gray Background';
    h2.NumberTitle = 'off';
    h2.ToolBar = 'none';
    h2.MenuBar = 'none';
% delete(h1)
% delete(h2)
```

Demonstrates some properties of Axes objects

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

h = axes;
    xlabel('Time (sec)');
```

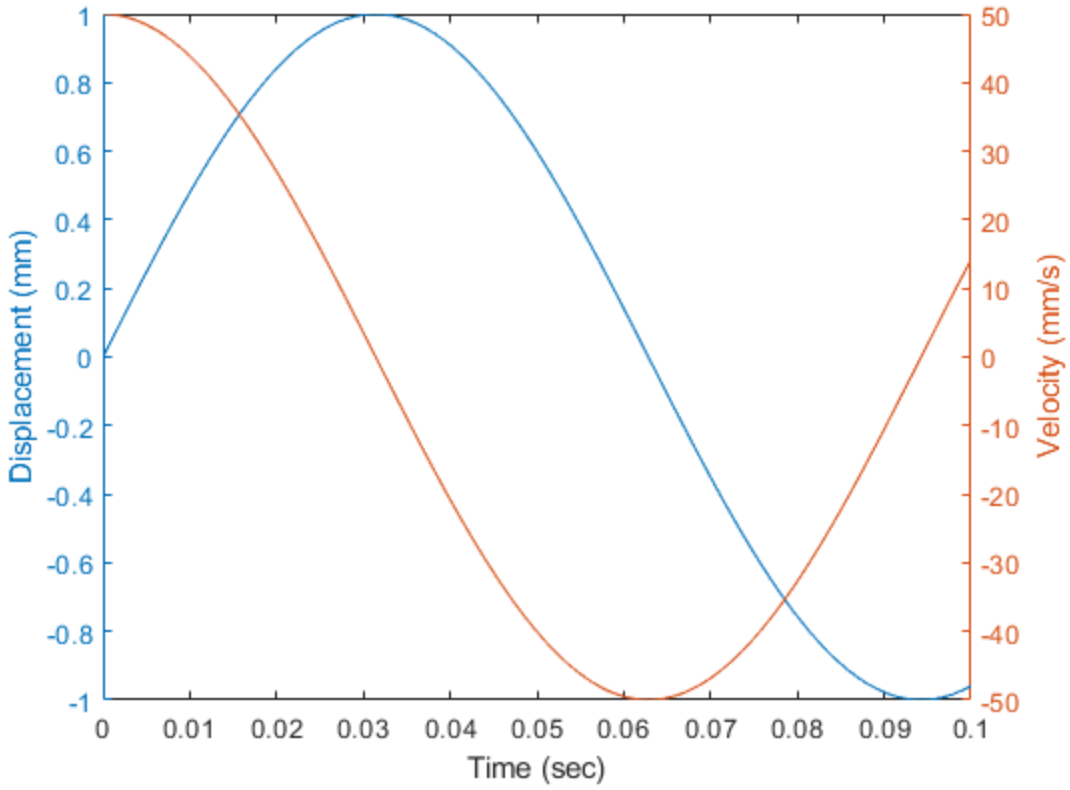
```
    ylabel('Displacement (mm)');
    title('Displacement vs. Time');
    axis([0, 20, 0, 10000]);
    grid on
    h.Box = 'on';
    h.YScale = 'log'; % #log###
    h.XTick = [0, 5, 10, 15, 20];
    h.XTickLabel = {'0', 'T', '2T', '3T', '4T'}; %####Label
    h.FontSize = 11;
% delete(h)
% delete(gcf)
```



Demonstrates multiple Axes in a Figure. (pratice)

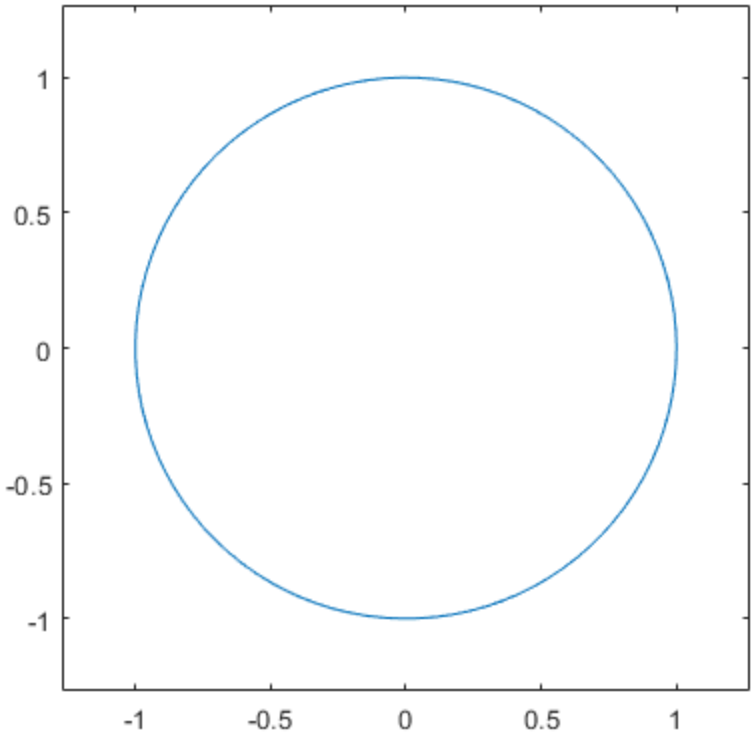
```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

t = linspace(0,0.1); w = 50;
y = sin(w*t);
v = w*cos(w*t);
yyaxis left % ####y####yyaxis left
hLine1 = plot(t, y);
xlabel('Time (sec)')
```

```
ylabel('Displacement (mm)')
yyaxis right % ####y####yyaxis right
hLine2 = plot(t, v);
ylabel('Velocity (mm/s)')
% delete(hLine2)
% delete(hLine1)
% delete(gca)
% delete(gcf)
```



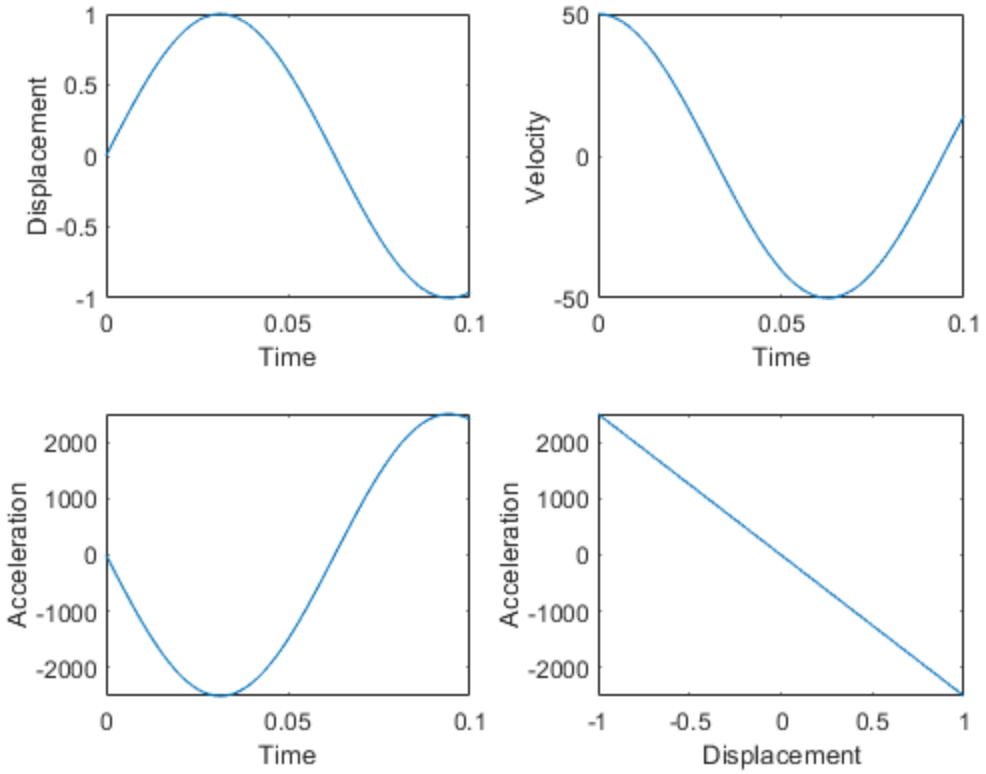
Demonstrates the scaling of Axes.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

t = linspace(0,2*pi);
plot(cos(t), sin(t))
axis equal
limits = axis;
axis square
axis([limits(1),limits(2),limits(1), limits(2)])
% delete(gca)
% delete(gcf)
```



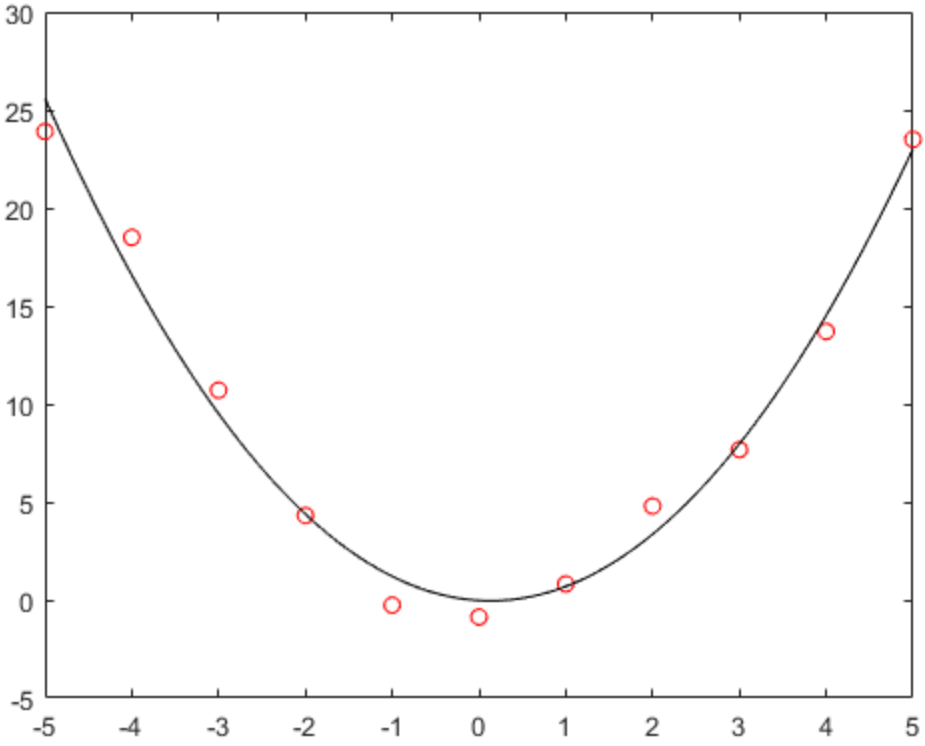
Demonstrates multiple plots (subplots) in a Figure (pratice sin,cos,tan, sinh.cosh,tanh)

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

t = linspace(0,0.1); w = 50;
y = sin(w*t);
v = w*cos(w*t);
a = -w*w*sin(w*t);
h1 = subplot(2,2,1);
plot(t,y), xlabel('Time'), ylabel('Displacement')
h2 = subplot(2,2,2);
plot(t,v), xlabel('Time'), ylabel('Velocity')
h3 = subplot(2,2,3);
plot(t,a), xlabel('Time'), ylabel('Acceleration')
h4 = subplot(2,2,4);
plot(y,a), xlabel('Displacement'), ylabel('Acceleration')
% delete(h1)
% delete(h2)
% delete(h3)
% delete(h4)
% delete(gcf)
```



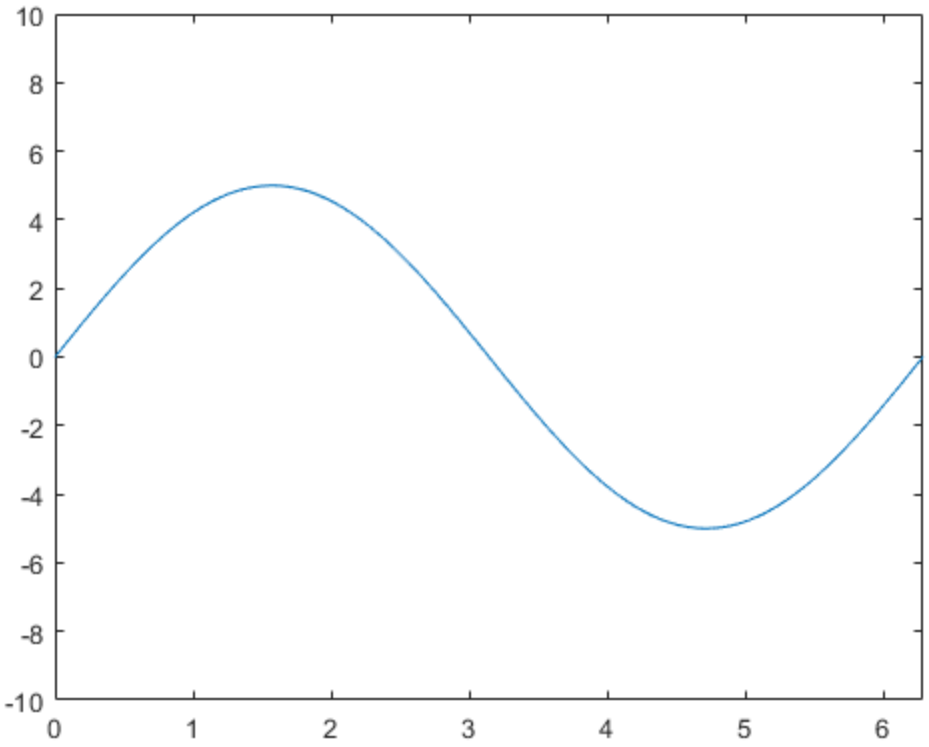
Demonstrates the use of line styles, colors, and marker types. (pratice #####)

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x1 = [-5 -4 -3 -2 -1 0 1 2 3 4 5];
y1 = [23.9, 18.5, 10.7, 4.31, -0.26, -0.87, 0.82, 4.79, 7.67, 13.7,
 23.5];
p = polyfit(x1, y1, 2)
% polyfit : ################ ########n###########p#########S#####
x2 = linspace(-5,5);
y2 = polyval(p, x2);
% polyval########
h = plot(x1, y1, 'or', x2, y2, '-k');
% delete(h(1))
% delete(h(2))
% delete(gca)
% delete(gcf)


p =

    0.9731   -0.2568   -0.0252
```



Demonstrates additional line properties. (update 5*y) pratice

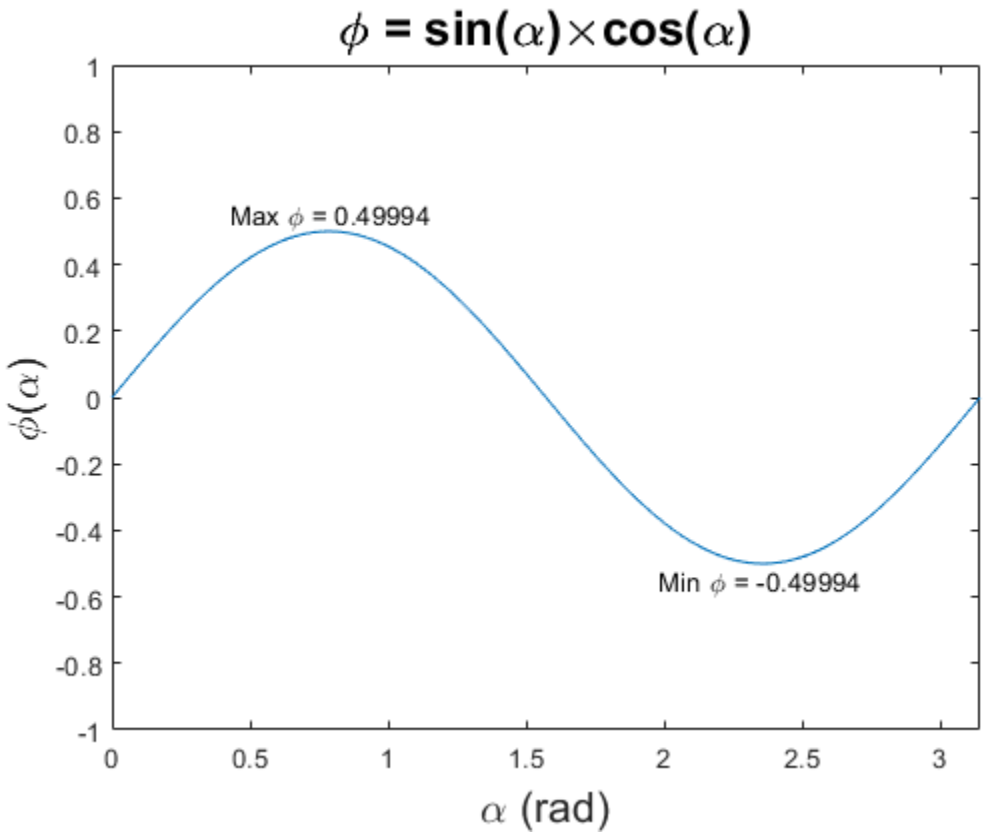
```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x = linspace(0,2*pi);
y = sin(x);
h = plot(x, y);
axis([0, 2*pi, -10, 10])
h.YData = 5*y;
% h.YData = 10*sin(x);
```



Demonstrates some Text properties.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

alpha = linspace(0, pi);
phi = sin(alpha).*cos(alpha);
plot(alpha, phi)
axis([0, pi, -1, 1])
hx = xlabel('\alpha (rad)');
hy = ylabel('\phi(\alpha)');
ht = title('\phi = sin(\alpha)\timescos(\alpha)');
    hx.FontSize = 16;
    hy.FontSize = 16;
    ht.FontSize = 18;
[value, index] = max(phi); % ##phi####value#index
hmax = text(alpha(index), value, ['Max \phi = ', num2str(value)]);
    hmax.HorizontalAlignment = 'center';
    hmax.VerticalAlignment = 'bottom';
[value, index] = min(phi); % ##phi####value#index
hmin = text(alpha(index), value, ['Min \phi = ', num2str(value)]);
    hmin.HorizontalAlignment = 'center';
    hmin.VerticalAlignment = 'top';
% delete(hx)
```

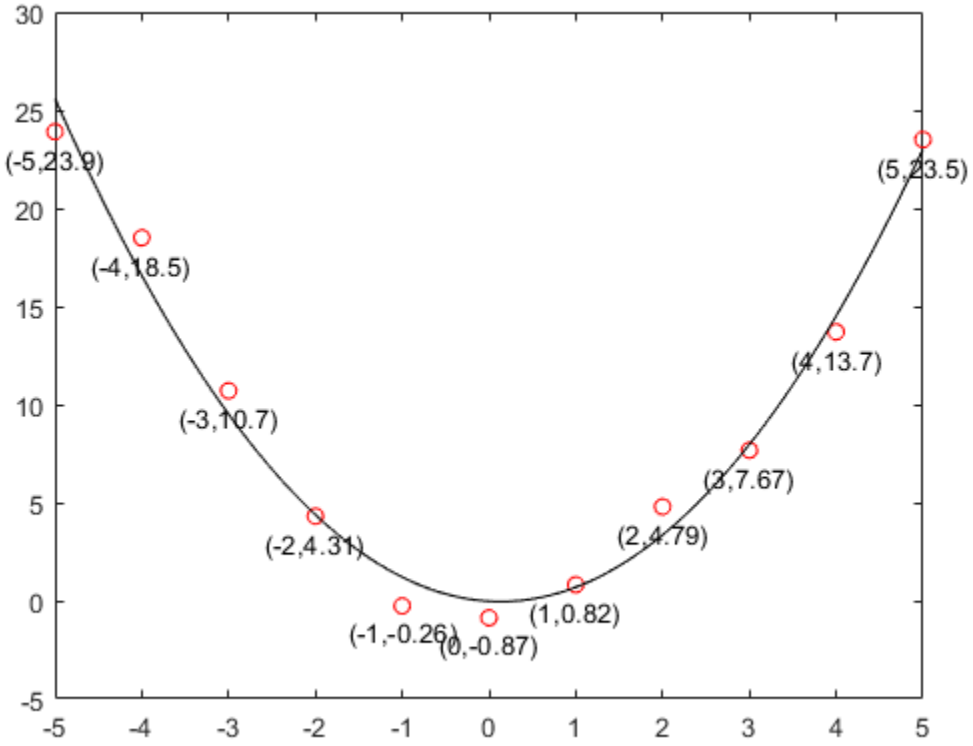
```
% delete(hy)
% delete(ht)
% delete(hmax)
% delete(hmin)
% delete(gcf)
```



Demonstrates more Text properties.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x1 = [-5 -4 -3 -2 -1 0 1 2 3 4 5];
y1 = [23.9, 18.5, 10.7, 4.31, -0.26, -0.87, 0.82, 4.79, 7.67, 13.7,
 23.5];
p = polyfit(x1, y1, 2)
x2 = linspace(-5,5);
y2 = polyval(p, x2);
h = plot(x1, y1, 'or', x2, y2, '-k');
for k = 1:length(x1)
    txt{k} = sprintf('(%g,%g)', x1(k), y1(k)); % ############
end
text(x1, y1-0.5, txt, ...
    'HorizontalAlignment', 'center', 'VerticalAlignment', 'top')
```

```
p =

    0.9731   -0.2568   -0.0252
```

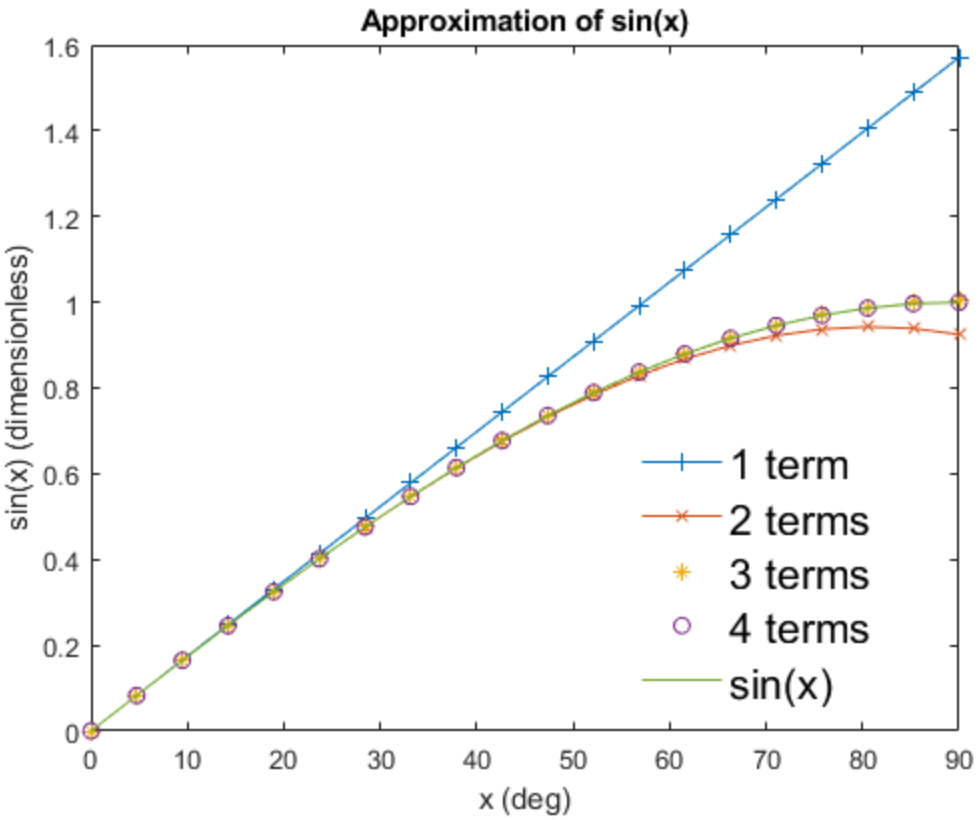


Modifies Example02_12e to include a Legend in the Figure.

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

x = linspace(0,pi/2,20);
n = 4;
k = (1:n);
[X, K] = meshgrid(x, k);
sinx =cumsum(((-1).^(K-1)).*(X .^ (2*K-1))./factorial(2*K-1)) % cumsum
###################
plot(x*180/pi, sinx(1,:), '+-', ...
     x*180/pi, sinx(2,:), 'x-', ...
     x*180/pi, sinx(3,:), '*', ...
     x*180/pi, sinx(4,:), 'o', ...
     x*180/pi, sin(x))
title('Approximation of sin(x)')
xlabel('x (deg)')
```

```
ylabel('sin(x) (dimensionless)')
h = legend('1 term', '2 terms', '3 terms', '4 terms', 'Exact');
    h.Position = [0.6, 0.2, 0.25, 0.2];
    h.FontSize = 16;
    h.String{5} = 'sin(x)';
    h.Box = 'off';
```

```
sinx =

  Columns 1 through 7

         0    0.0827    0.1653    0.2480    0.3307    0.4134    0.4960
         0    0.0826    0.1646    0.2455    0.3247    0.4016    0.4757
         0    0.0826    0.1646    0.2455    0.3247    0.4017    0.4759
         0    0.0826    0.1646    0.2455    0.3247    0.4017    0.4759

  Columns 8 through 14

    0.5787    0.6614    0.7441    0.8267    0.9094    0.9921    1.0748
    0.5464    0.6132    0.6754    0.7326    0.7841    0.8293    0.8678
    0.5470    0.6142    0.6773    0.7358    0.7892    0.8374    0.8798
    0.5469    0.6142    0.6773    0.7357    0.7891    0.8372    0.8795

  Columns 15 through 20

    1.1574    1.2401    1.3228    1.4054    1.4881    1.5708
    0.8990    0.9223    0.9370    0.9428    0.9389    0.9248
    0.9163    0.9467    0.9708    0.9885    0.9997    1.0045
    0.9158    0.9458    0.9694    0.9863    0.9965    0.9998
```



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