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Scottish Environment Protection Agency

Building GUIs in MATLAB

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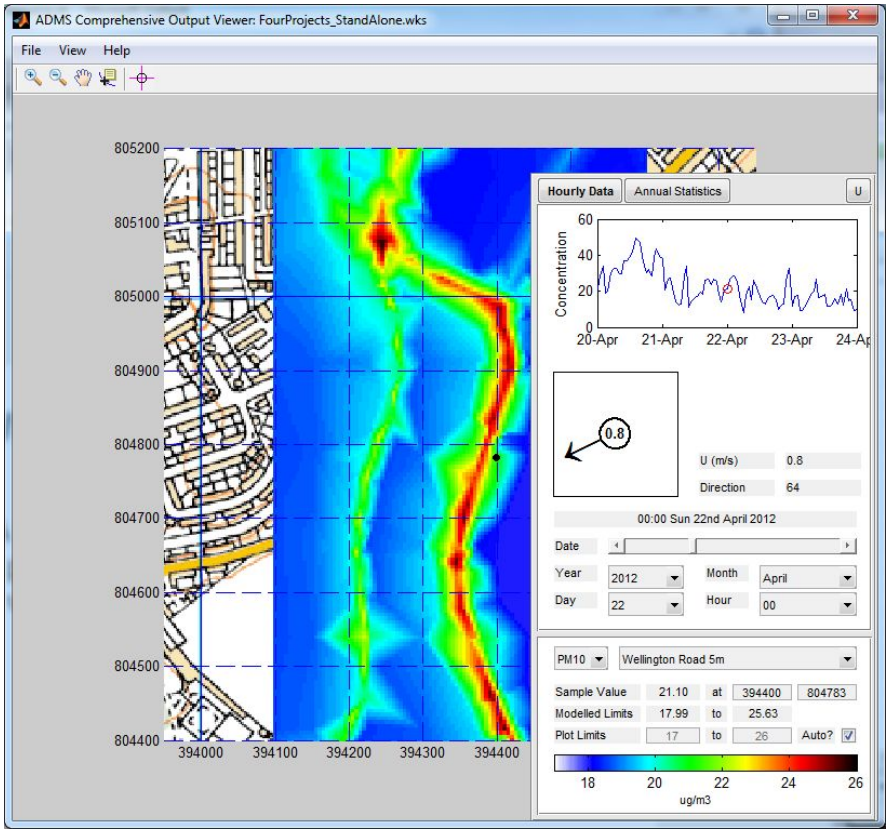
- Why use GUIs?
- Object Oriented Programming
- An example GUI Class
  - Constructor
  - Callbacks
  - In Actions.

Why GUIs?

A well designed Graphical User Interface (GUI) provides an intuitive way for a user to interact with a complex computer programme.

Stand by for a MATLAB GUI demonstration...



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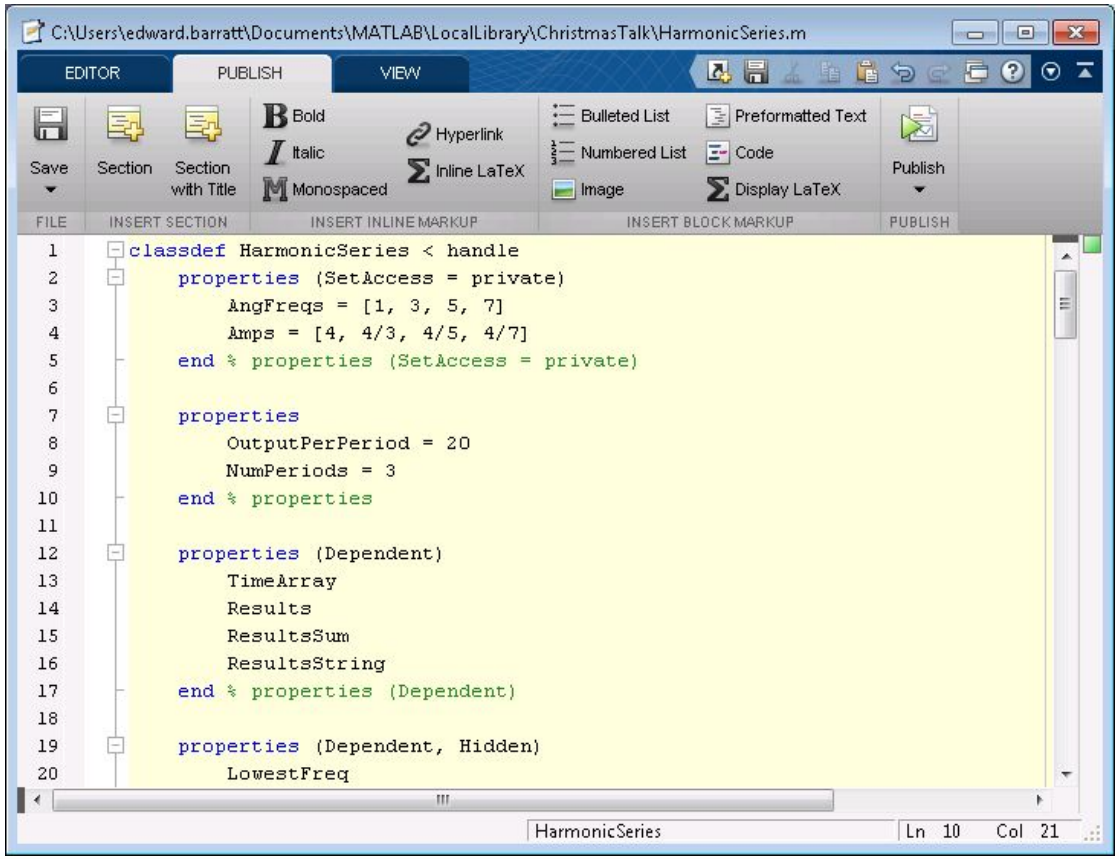
Object Oriented Programming

- Why GUIs?
- **Object Oriented**
- A GUI Class
- Constructor
- Callbacks
- In Action

Object Oriented programming involves creating classes that contain properties and methods related to the objects they represent.



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Object Oriented Programming

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Watch as I code...

```
>> HS = HarmonicSeries

HS =

  HarmonicSeries with properties:

          AngFreqs: [1 3 5 7]
              Amps: [4 1.3333 0.8000
0.5714]
    OutputPerPeriod: 20
         NumPeriods: 3
          TimeArray: [1x421 double]
            Results: [4x421 double]
         ResultsSum: [4x421 double]
      ResultsString: [1x59 char]

>> HS = HarmonicSeries([1,2,3])

HS =

  HarmonicSeries with properties:

          AngFreqs: [1 2 3]
              Amps: [1 1 1]
    OutputPerPeriod: 20
         NumPeriods: 3
          TimeArray: [1x181 double]
            Results: [3x181 double]
         ResultsSum: [3x181 double]
      ResultsString: 'y = 1sin(1x) +
1sin(2x) + 1sin(3x)'
```

```
>> HS = HarmonicSeries([1,2,3], [4, 2, 4])

HS =

  HarmonicSeries with properties:

          AngFreqs: [1 2 3]
              Amps: [4 2 4]
    OutputPerPeriod: 20
         NumPeriods: 3
          TimeArray: [1x181 double]
            Results: [3x181 double]
         ResultsSum: [3x181 double]
      ResultsString: 'y = 4sin(1x) + 4sin(3x) +
2sin(2x)'

>> HS.AngFreqs = [23, 45]
You cannot set the read-only property 'AngFreqs'
of HarmonicSeries.

>> HS.SetFreqsAndAmps([23, 45], [5, 6])
>> HS

HS =

  HarmonicSeries with properties:

          AngFreqs: [23 45]
              Amps: [5 6]
    OutputPerPeriod: 20
         NumPeriods: 3
          TimeArray: [1x118 double]
            Results: [2x118 double]
         ResultsSum: [2x118 double]
      ResultsString: 'y = 6sin(45x) + 5sin(23x)'
```

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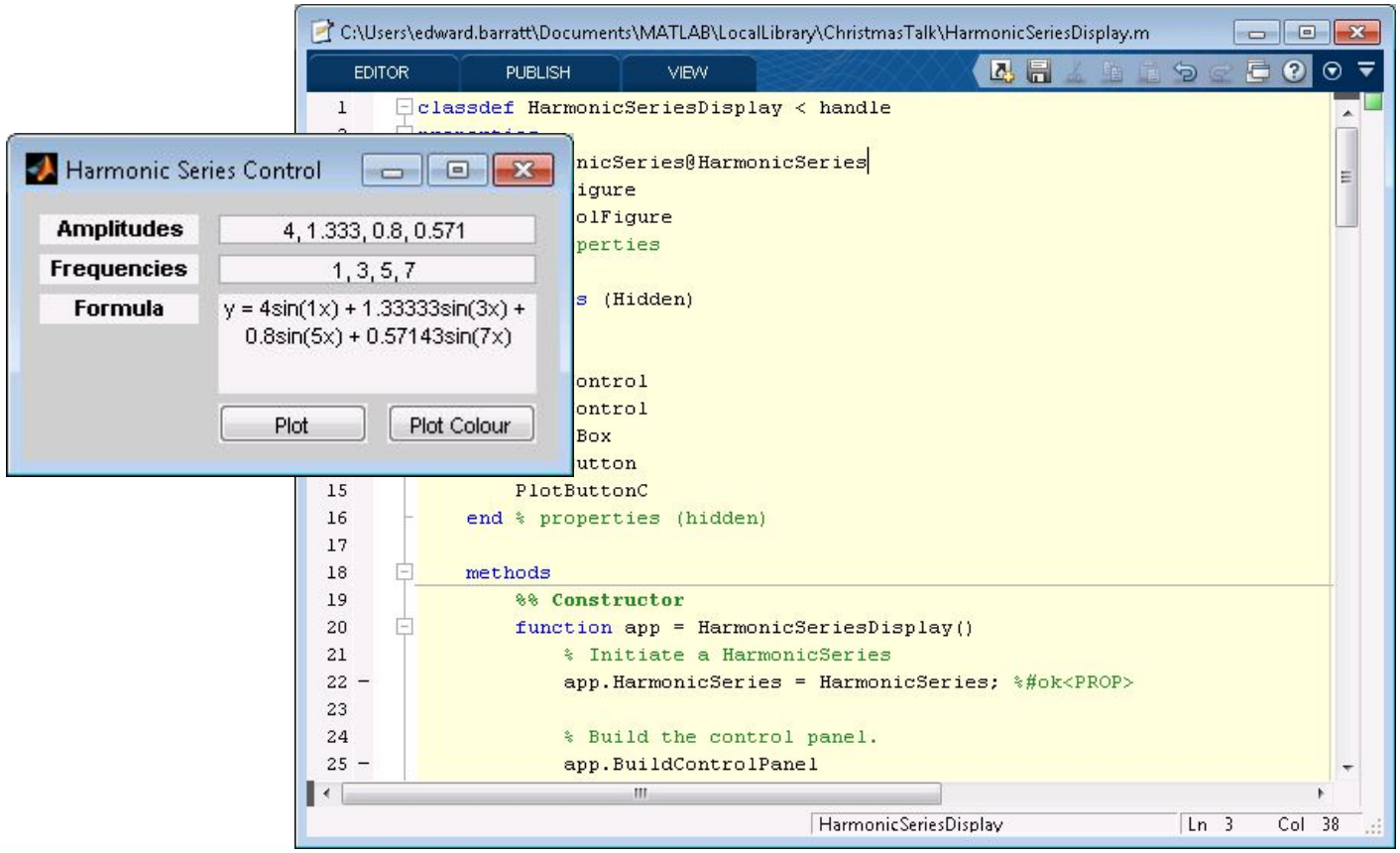
Object Oriented Programming

- Classes are self contained objects with properties and methods.
- Classes can be called by other programmes, or stand alone.

A GUI Class

- Classes can raise, control, and be controlled by figures.



A GUI Class

Constructor

- Why GUIs?
- Object Oriented
- A GUI Class
- **Constructor**
- Callbacks
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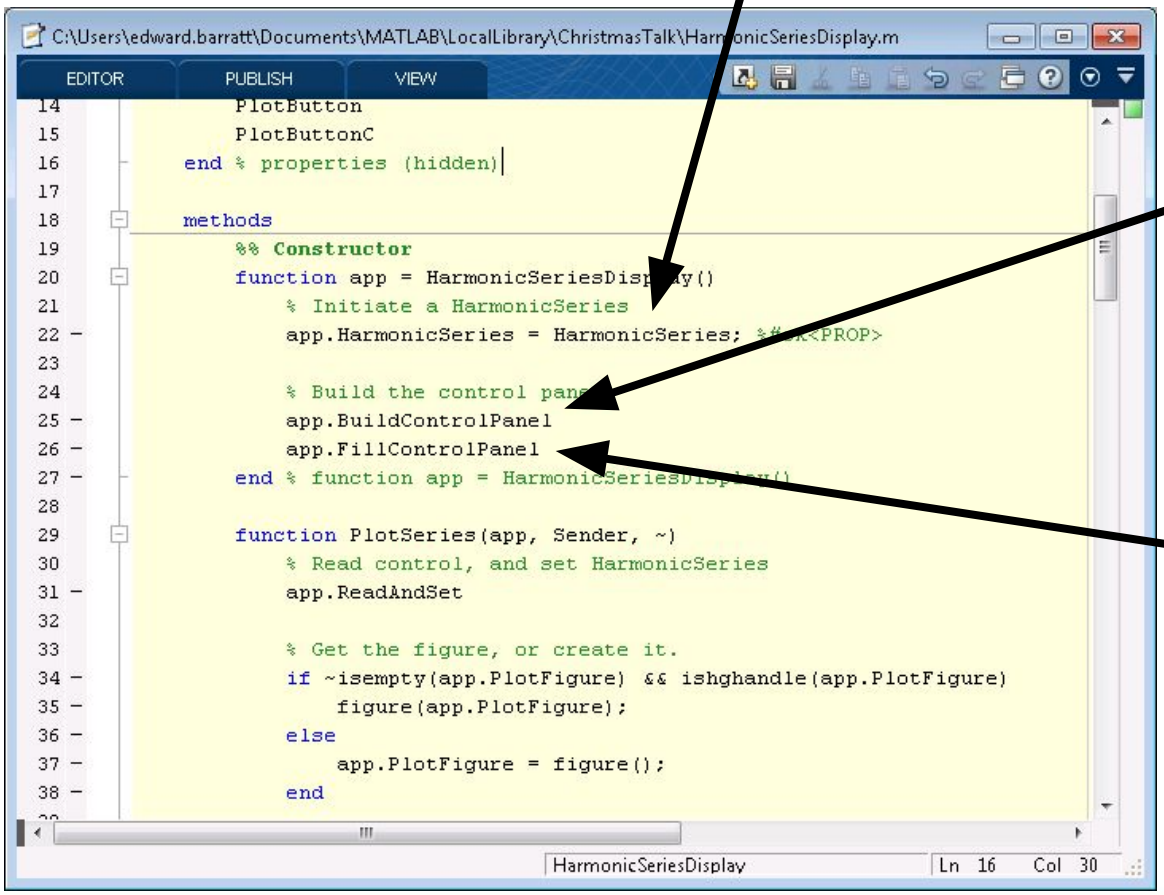
Constructor defines the "HarmonicSeries" property by initialising a HarmonicSeries object.



Then it calls the "BuildControlPanel" method

Followed by the "FillControlPanel" method

A GUI Class - uicontrol

BuildControlPanel method

- Why GUIs?
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Define the ControlFigure property, which is a MATLAB figure object.

Define various User Interface Controls and place them within the figure.

```
66        function BuildControlPanel(app)
67
68 -          app.ControlFigure = figure('Visible', 'off', ...
69              'Position', [100, 100, 270, 135], ...
70              'MenuBar', 'none', ...
71              'Name', 'Harmonic Series Control', ...
72              'NumberTitle', 'off');
73 -          movegui(app.ControlFigure, 'center')
74
75          % Amplitudes
76 -          uicontrol('style', 'text', ...
77              'Position', [10, 110, 80, 15], ...
78              'String', 'Amplitudes', ...
79              'FontWeight', 'bold')
80 -          app.AmpsControl = uicontrol('style', 'edit', ...
81              'Position', [100, 110, 160, 15], ...
82              'String', '-----');
83
84          % Frequencies
85 -          uicontrol('style', 'text', ...
86              'Position', [10, 90, 80, 15], ...
87              'String', 'Frequencies', ...
88              'FontWeight', 'bold')
89 -          app.FreqControl = uicontrol('style', 'edit', ...
90              'Position', [100, 90, 160, 15], ...
```

A GUI Class - uicontrol

BuildControlPanel method

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Define the ControlFigure property, which is a MATLAB figure object.


```
66        function BuildControlPanel(app)
67
68            app.ControlFigure = figure('Vis
69                'Position', [100, 100, 270,
70                'MenuBar', 'none', ...
71                'Name', 'Harmonic Series Co
72                'NumberTitle', 'off');
73            movegui(app.ControlFigure, 'cen
74
75            % Amplitudes
76            uicontrol('style', 'text', ...
77                'Position', [10, 110, 80, 15], ...
78                'String', 'Amplitudes', ...
79                'FontWeight', 'bold')
80            app.AmpsControl = uicontrol('style', 'edit', ...
81                'Position', [100, 110, 160, 15], ...
82                'String', '-----');
83
84            % Frequencies
85            uicontrol('style', 'text', ...
86                'Position', [10, 90, 80, 15], ...
87                'String', 'Frequencies', ...
88                'FontWeight', 'bold')
89            app.FreqControl = uicontrol('style', 'edit', ...
90                'Position', [100, 90, 160, 15], ...
```

and place them within the figure.

A GUI Class - uicontrol

FillControlPanel method

Use the values from the HarmonicSeries object to define strings.

And set the 'String' properties of the uicontrol objects.

C:\Users\edward.barratt\Documents\MATLAB\LocalLibrary\ChristmasTalk\HarmonicSeriesDisplay.m

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```
114
115     function FillControlPanel(app)
116         % Amplitudes
117 -       Str = '';
118 -       for A = app.HarmonicSeries.Amps
119 -           Str = [Str, sprintf('%.*f, ', DecPlaces(A, 3), A)]; %#ok<AGRO
120 -       end
121 -       Str = Str(1:end-2);
122 -       set(app.AmpsControl, 'String', Str, 'TooltipString', Str)
123
124         % Frequencies
125 -       Str = '';
126 -       for A = app.HarmonicSeries.AngFreqs
127 -           Str = [Str, sprintf('%.*f, ', DecPlaces(A, 3), A)]; %#ok<AGRO
128 -       end
129 -       Str = Str(1:end-2);
130 -       set(app.FreqControl, 'String', Str, 'TooltipString', Str)
131
132         % Formula
133 -       Str = app.HarmonicSeries.ResultsString;
134 -       set(app.DescrBox, 'String', Str)
135 -   end % function FillControlPanel(app)
136
```

HarmonicSeriesDisplay / FillControlPanel | Ln 116 Col 25

A GUI Class - uicontrol

FillControlPanel method

- Why GUIs?
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- **Constructor**
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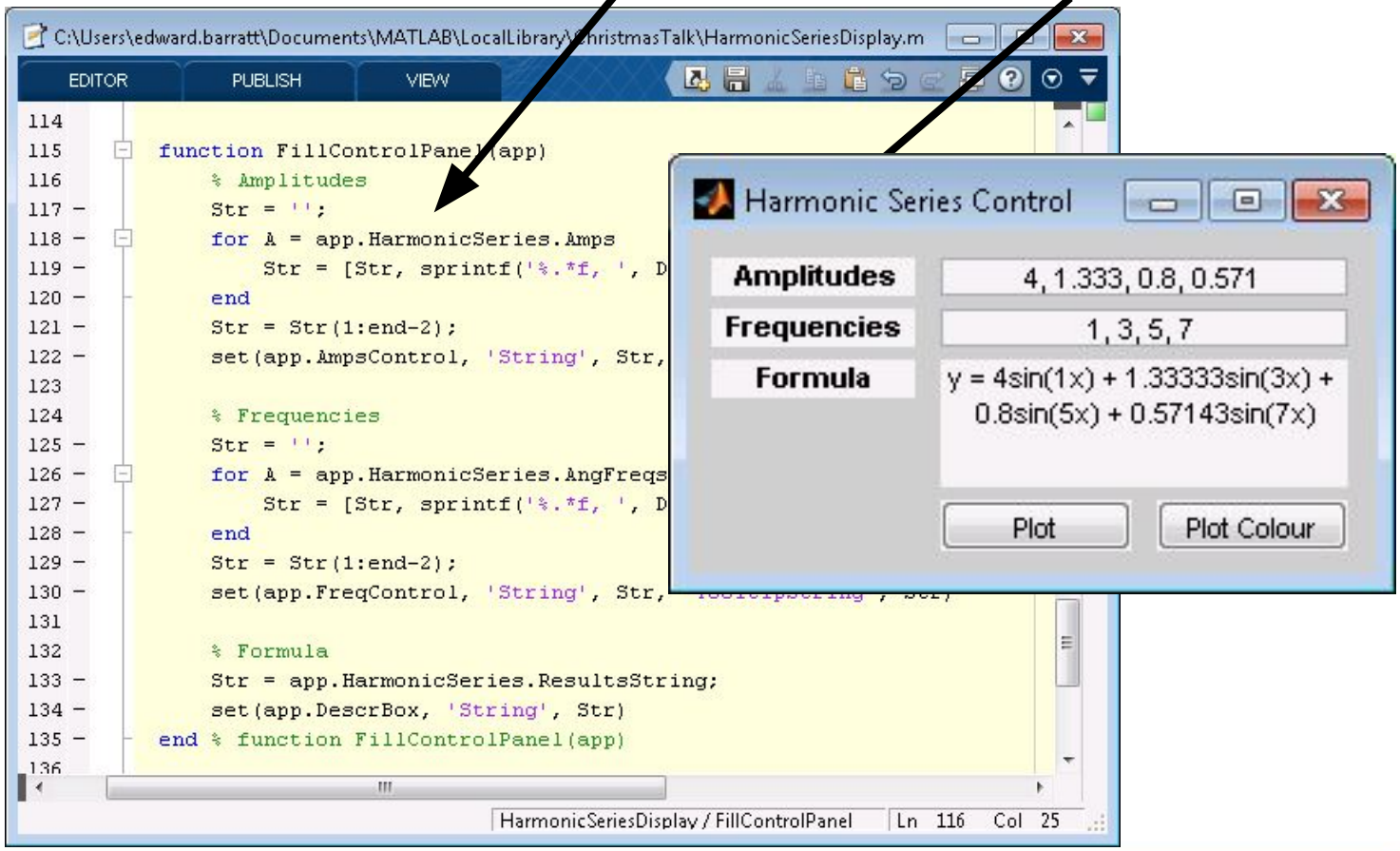
Use the values from the HarmonicSeries object to define strings.

And set the 'String' properties of the uicontrol objects.



A GUI Class - callbacks

BuildControlPanel method

- Why GUIs?
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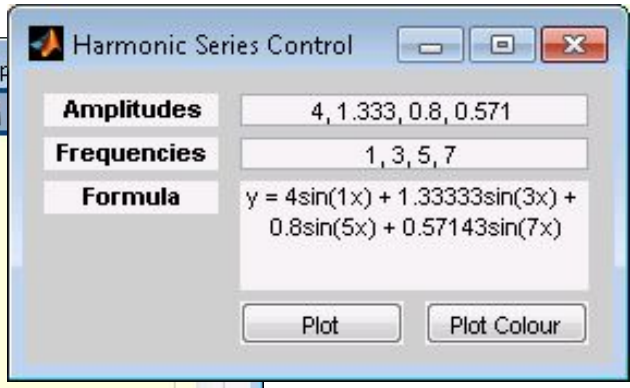
Two different 'pushbutton' uicontrols to plot the harmonic series.




```
92
93          % Description
94 -        uicontrol('style', 'text', ...
95              'Position', [10, 70, 80, 15], ...
96              'String', 'Formula', ...
97              'FontWeight', 'bold')
98 -        app.DescrBox = uicontrol('style', 'text', ...
99              'Position', [100, 35, 160, 50], ...
100             'String', '-----');
101
102         % Plot Buttons
103 -       app.PlotButton = uicontrol('style', 'pushbutton', ...
104             'Position', [100, 10, 75, 20], ...
105             'String', 'Plot', ...
106             'Callback', @app.PlotSeries);
107 -       app.PlotButtonC = uicontrol('style', 'pushbutton', ...
108             'Position', [185, 10, 75, 20], ...
109             'String', 'Plot Colour', ...
110             'Callback', @app.PlotSeries);
111
112 -       set(app.ControlFigure, 'Visible', 'on')
113 -   end % function BuildControlPanel(app)
114
```

Both calling the same 'PlotSeries' method.

A GUI Class - callbacks

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C:\Users\edward.barratt\Documents\MATLAB\LocalLibrary\ChristmasTalk\HarmonicSeriesDisplay.m

PlotSeries method

```
28
29        function PlotSeries(app, Sender, ~)
30            % Read control, and set HarmonicSeries
31 -          try
32 -              app.ReadAndSet
33 -          catch err
34 -              msgbox(err.message)
35 -              app.FillControlPanel
36 -              return
37 -          end
38
39            % Get the figure, or create it.
40 -          if ~isempty(app.PlotFigure) && ishghandle(app.PlotFigure)
41 -              figure(app.PlotFigure);
42 -          else
43 -              app.PlotFigure = figure();
44 -          end
45
46 -          app.Plt = plot(app.HarmonicSeries.TimeArrayPi, app.HarmonicSeries.ResultsSum);
47 -          NumLines = numel(app.Plt);
48 -          Shades = linspace(0.5, 0.1, NumLines-1);
49 -          Colors = {'m', 'r', 'g', 'c', 'b'};
50 -          ci = 0;
51 -          for linei = 1:NumLines
52 -              line = app.Plt(linei);
53 -              ci = ci + 1;
54 -              if ci > NumLines
55 -                  ci = 1;
56 -              end
57 -              if linei ~= NumLines
58 -                  switch Sender
59 -                      case app.PlotButton
60 -                          set(line, 'Color', Shades(linei)*[1,1,1], 'linewidth', 1)
61 -                      otherwise
62 -                          set(line, 'Color', Colors{ci} , 'linewidth', 1)
63 -                  end
64 -              else
65 -                  set(line, 'Color', 'k', 'linewidth', 2)
66 -              end
67 -          end
68 -          xlabel('x')
69 -          ylabel('y')
70 -      end % function PlotSeries(app)
```

HarmonicSeriesDisplay / PlotSeries Ln 36 Col 23

Read the contents of the GUI and set the HarmonicSeries object to take the appropriate values.

Open a figure, or get it if it's already been opened.

Plot the lines.

The "Sender" argument is used to control the line colours

A GUI Class - In Action

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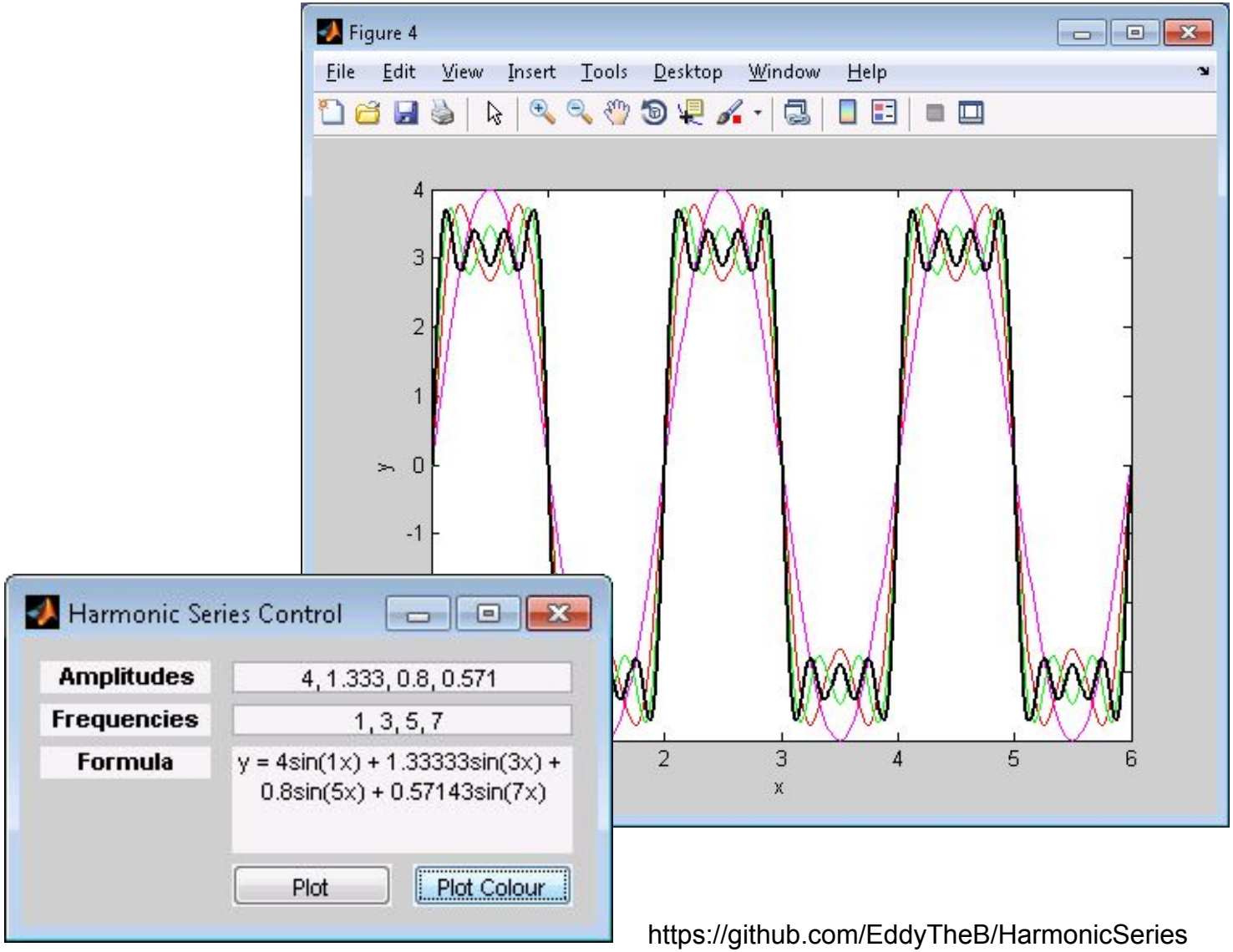

https://github.com/EddyTheB/HarmonicSeries