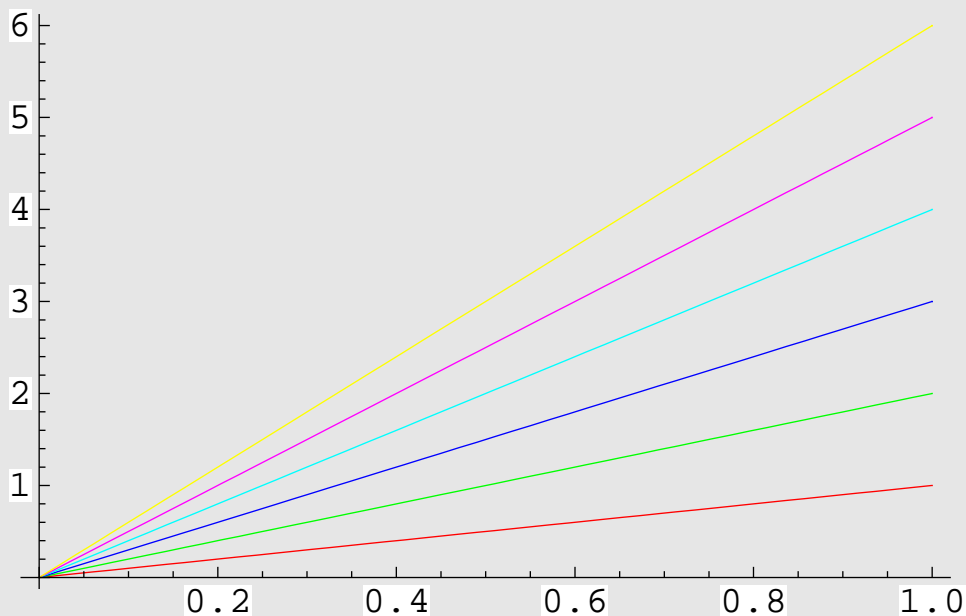# Setup and definitions:

In[4]:=
```
Needs["BarCharts`"];
Needs["Histograms`"]; Needs["PieCharts`"]
```
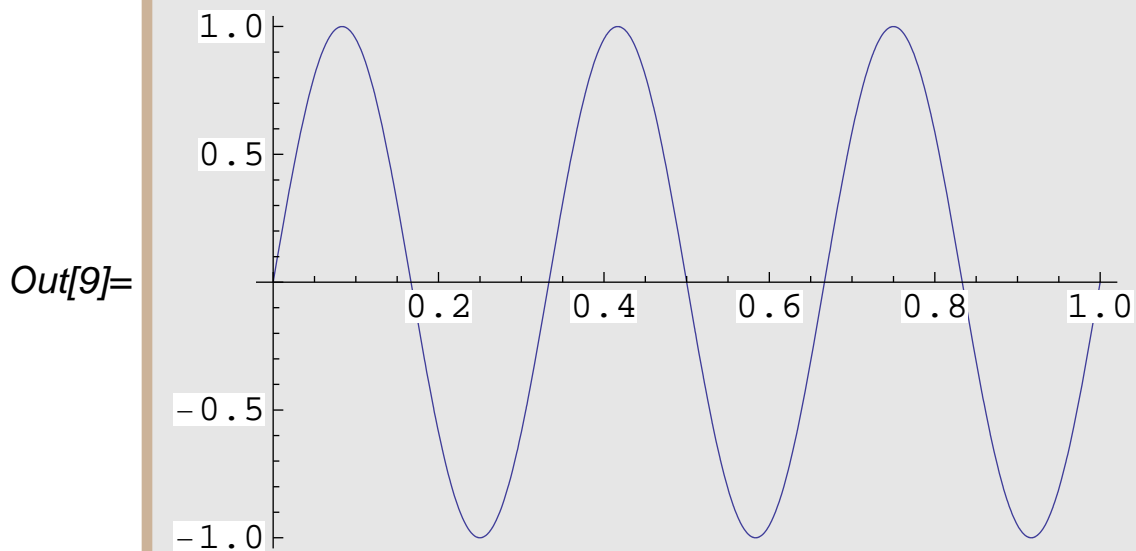
In[5]:=
```
colors = {red, green, blue, cyan, magenta, yellow} =
    {RGBColor[1, 0, 0]
    , RGBColor[0, 1, 0]
    , RGBColor[0, 0, 1]
    , RGBColor[0, 1, 1]
    , RGBColor[1, 0, 1]
    , RGBColor[1, 1, 0]
    };
Plot[ Table[i x, {i, 1, 6}] // Evaluate,
  {x, 0, 1}, PlotStyle -> colors]
```
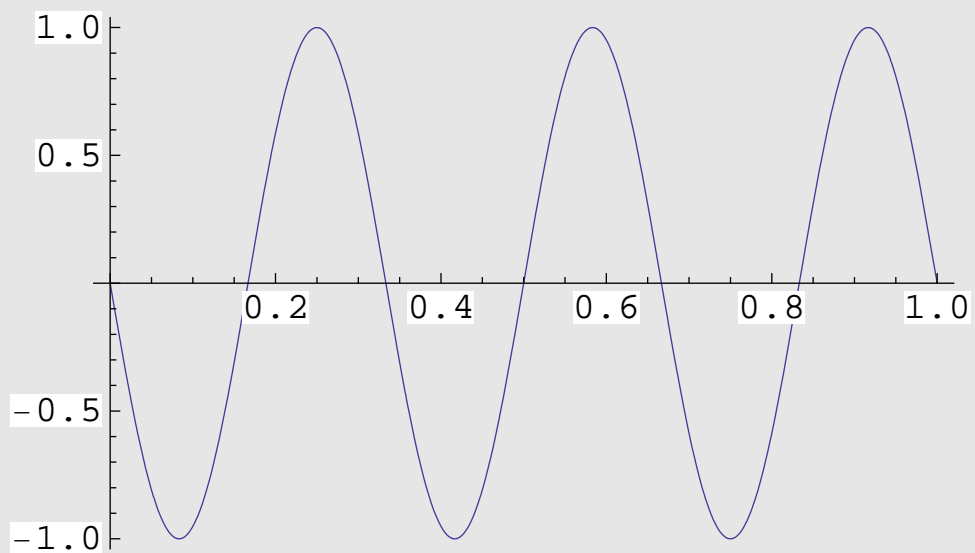
Out[6]=

Out of phase waves

In[7]:=
```
f = 3;(* Frequency *)
phase = 0;
Plot[Sin[ 2 π f t + phase], {t, 0, 1}]
```
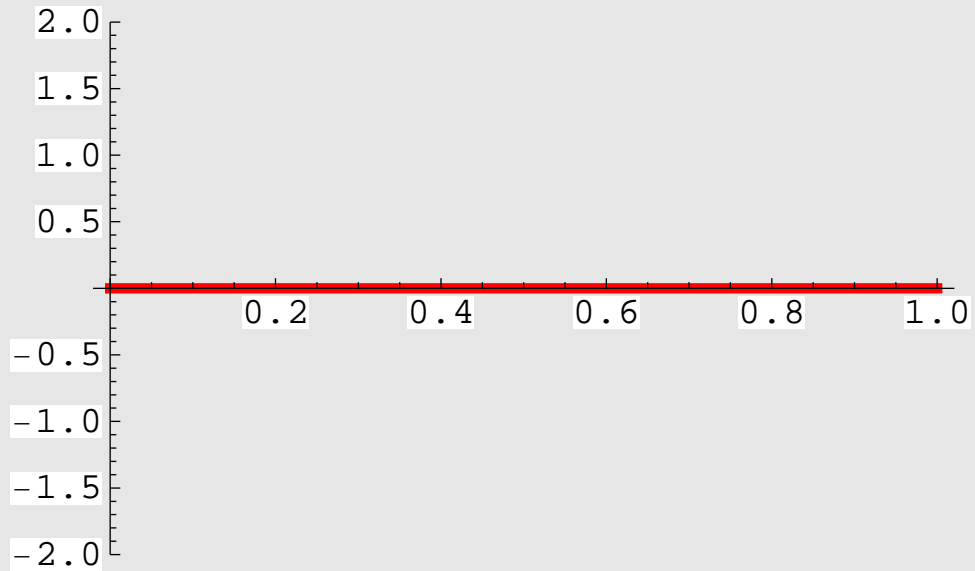
Out[9]=

In[10]:=
```
f = 3; (* Frequency *)
phase = π;
Plot[Sin[ 2 π f t + phase], {t, 0, 1}]
```

Out[12]=

In[13]:=
```
f = 3; (* Frequency *)
Plot[Sin[ 2 π f t + 0] + Sin[ 2 π f t + π]
    , {t, 0, 1}
  , PlotRange -> {-2, 2}
    , PlotStyle -> {Thickness[0.012], red}
    ]
```
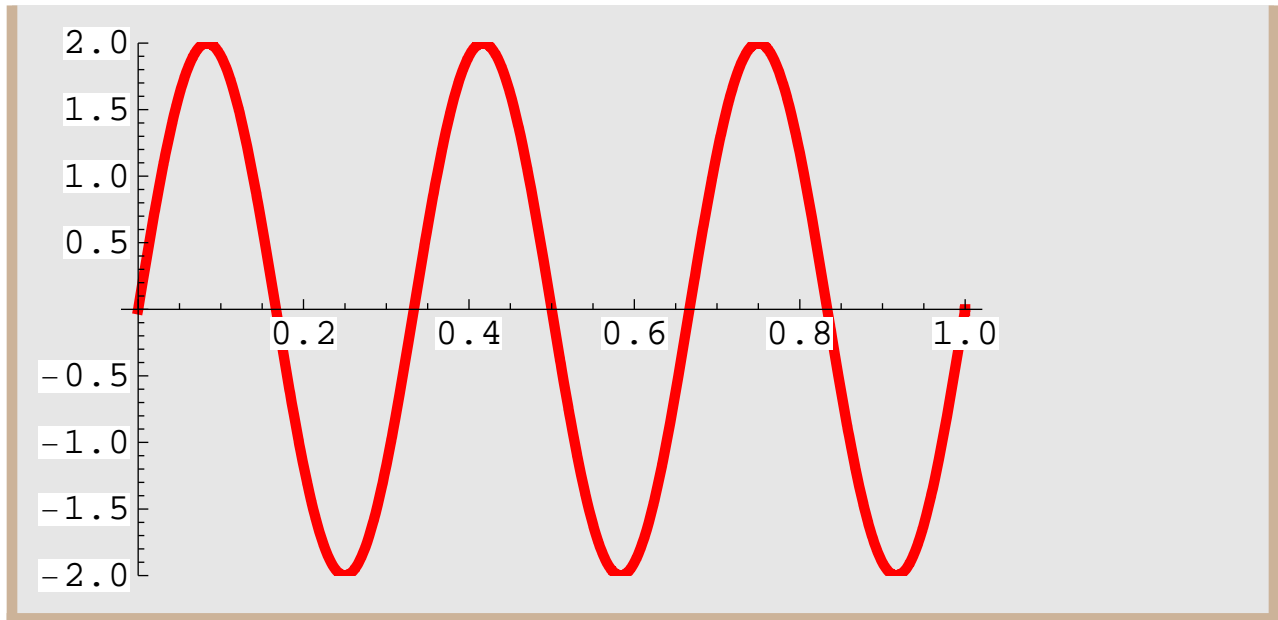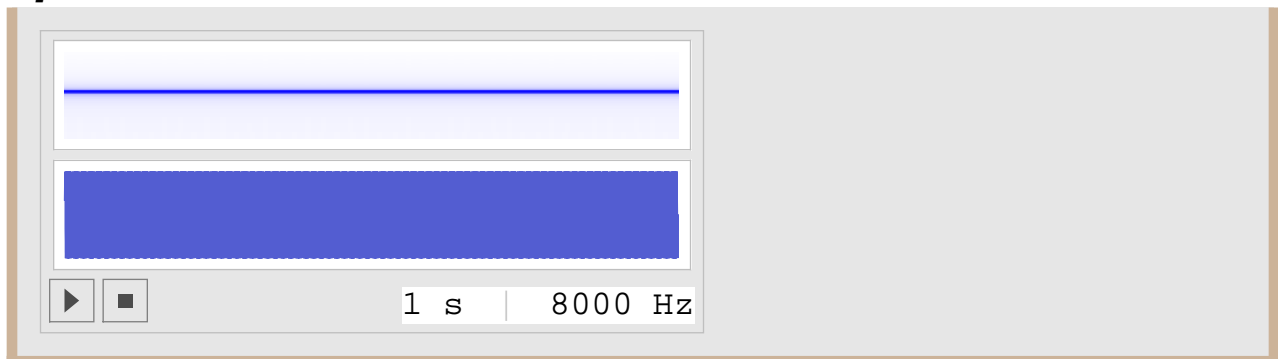
Out[14]=

```
In[15]:= f = 3;(* Frequency *)
        Plot[Sin[ 2 π f t + 0] + Sin[ 2 π f t + 0]
             , {t, 0, 1}
           , PlotRange -> {-2, 2}
             , PlotStyle -> {Thickness[0.012], red}
             ]
```
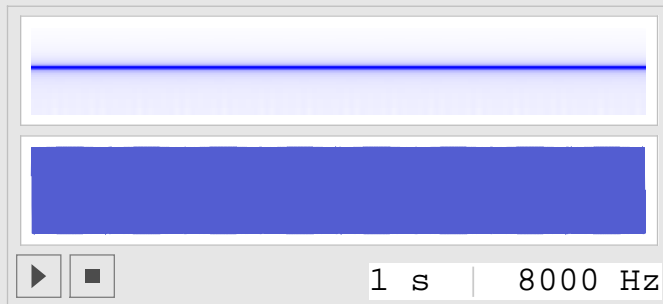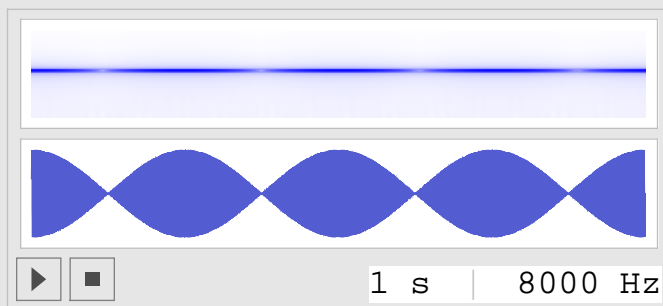
Out[16]=

Listen Interference and Beats

```
In[47]:= Play[Sin[ 2 π 440 t], {t, 0, 1}]
```
Out[47]=
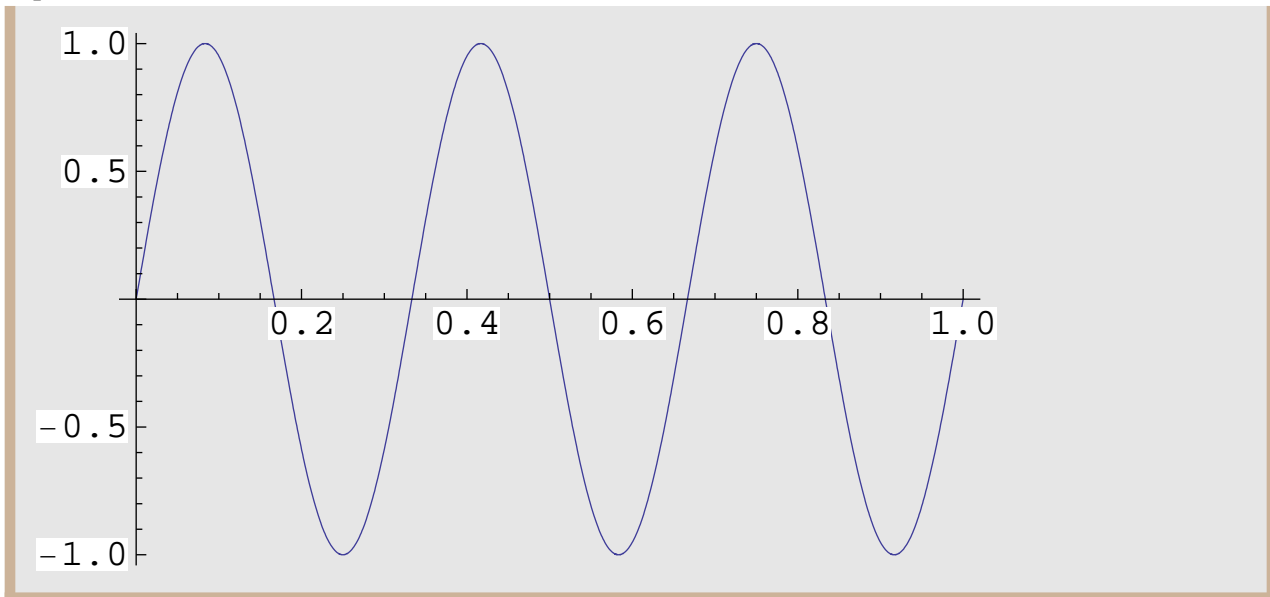
In[49]:= `Play[Sin[ 2 π 444 t], {t, 0, 1}]`

Out[49]=

| ▶ | ■ | | 1 s | 8000 Hz |

In[50]:= `Play[Sin[ 2 π 440 t] + Sin[ 2 π 444 t], {t, 0, 1}]`

Out[50]=
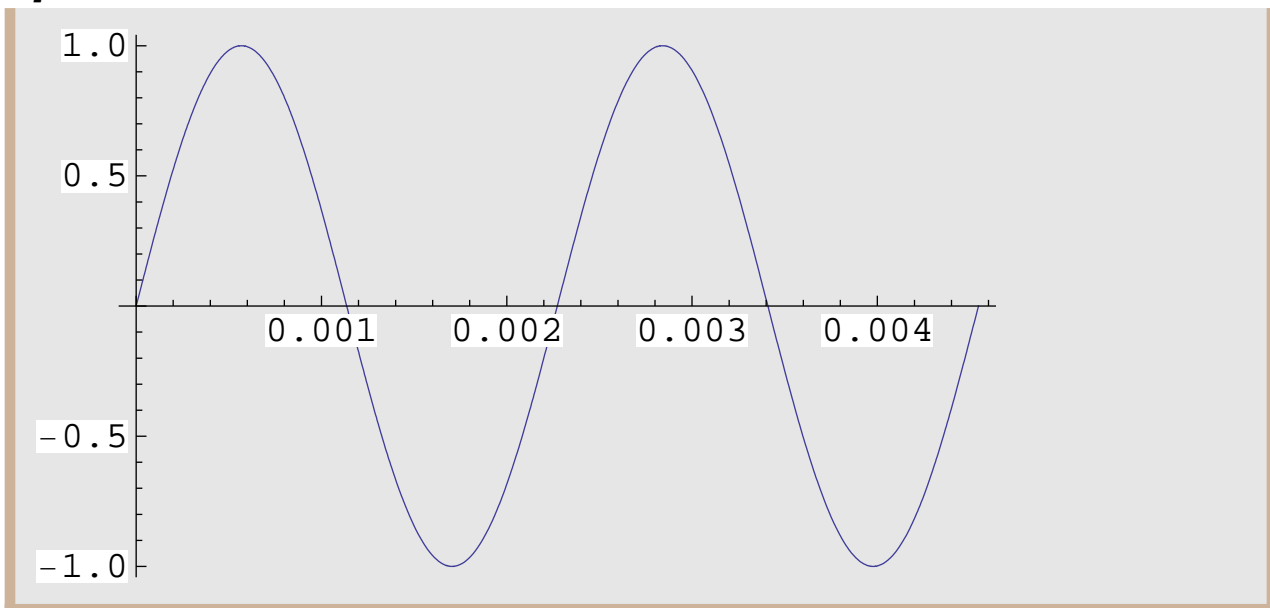

| ▶ | ■ | | 1 s | 8000 Hz |

View Interference and Beats

In[20]:=
```
f = 3;
Plot[Sin[ 2 π f t], {t, 0, 1}, PlotPoints -> 1000]
```
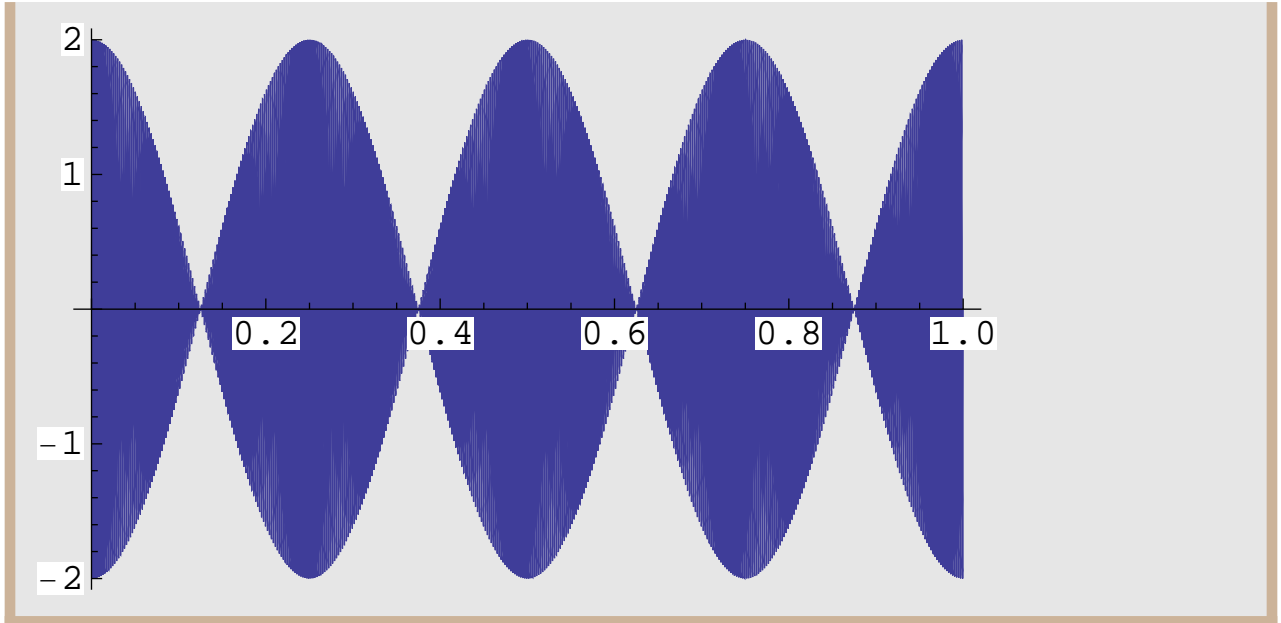*Out[21]=*

In[22]:=
```
Plot[Sin[ 2 π 440 t], {t, 0, 2 / 440}, PlotPoints -> 1000]
```
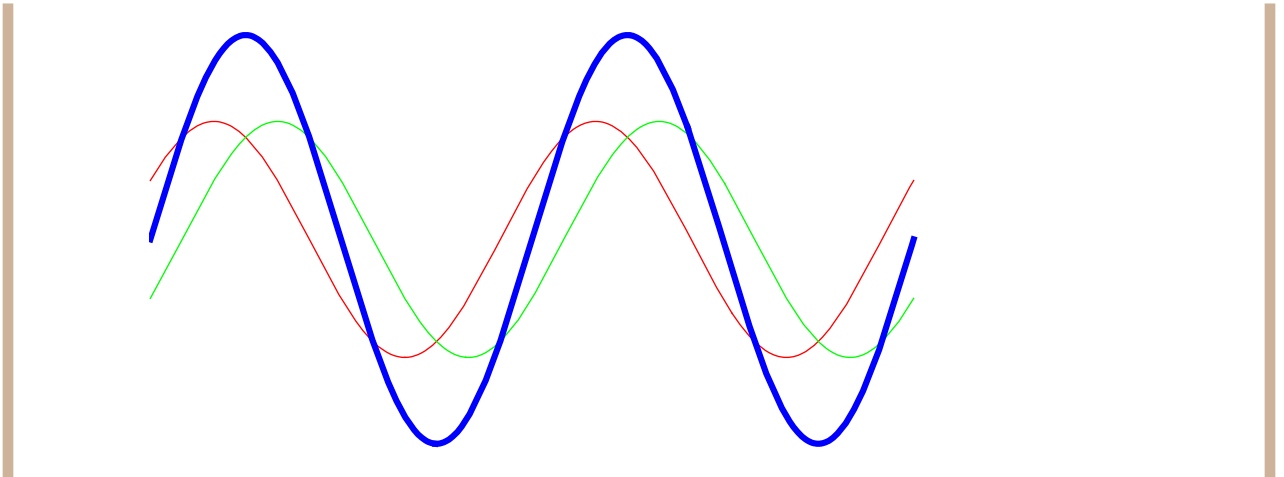*Out[22]=*

In[23]:=
```
Plot[
     + Sin[ 2 π 440 t]
  + Sin[ 2 π 444 t]
     , {t, 0, 1}, PlotPoints -> 1000]
```

Out[23]=

Animate Standing Waves:

In[24]:=
```
f = 2;
v = 1;
k = π / λ;
λ = v / f;
frames = 24;
Do[
Plot[
        {Sin[ 2 π f t + k x]
        , Sin[ 2 π f t - k x]
        , Sin[ 2 π f t + k x] + Sin[ 2 π f t - k x]
        }
    , {t, 0, 1}
    ,
    PlotStyle -> {red, green, {Thickness[0.008], blue}}
        , Axes -> False
        , PlotRange -> {{0, 1}, {-2, 2}}
        ] // Print
, {x, 0, 1 - 1 / frames, 1 / frames}]
```

Instrument Comparison:

In[30]:=
```
Clear[f, f0];
f[list_List] :=
 Sum[ list[[n]] Sin[2 π f0 t n], {n, 1, Length[list]}]
```

In[32]:=
```
f0 = 220;
trumpetList  = {1, 1 / 2, 1 / 3, 1 / 4, 1 / 5};
clarinetList = {1,    0, 1 / 3,    0, 1 / 5};
```

In[35]:= `trumpet = f[trumpetList]`

Out[35]=

$$\text{Sin}[440 \pi t] + \frac{1}{2} \text{Sin}[880 \pi t] +$$

$$\frac{1}{3} \text{Sin}[1320 \pi t] + \frac{1}{4} \text{Sin}[1760 \pi t] + \frac{1}{5} \text{Sin}[2200 \pi t]$$

In[36]:= `clarinet = f[clarinetList]`

Out[36]=

$$\text{Sin}[440 \pi t] + \frac{1}{3} \text{Sin}[1320 \pi t] + \frac{1}{5} \text{Sin}[2200 \pi t]$$
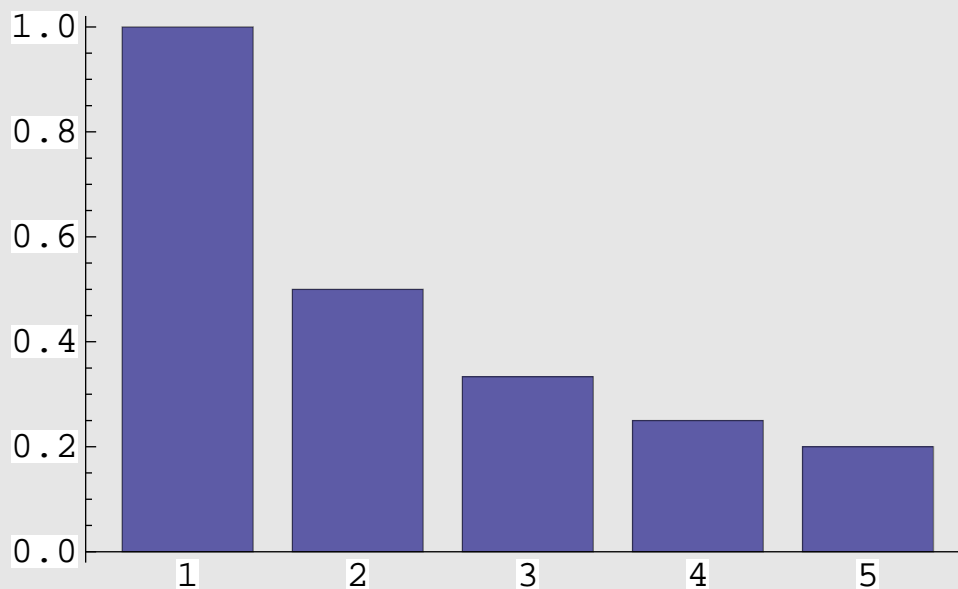
In[51]:= `Plot[{trumpet, clarinet}, {t, 0, 0.01},`
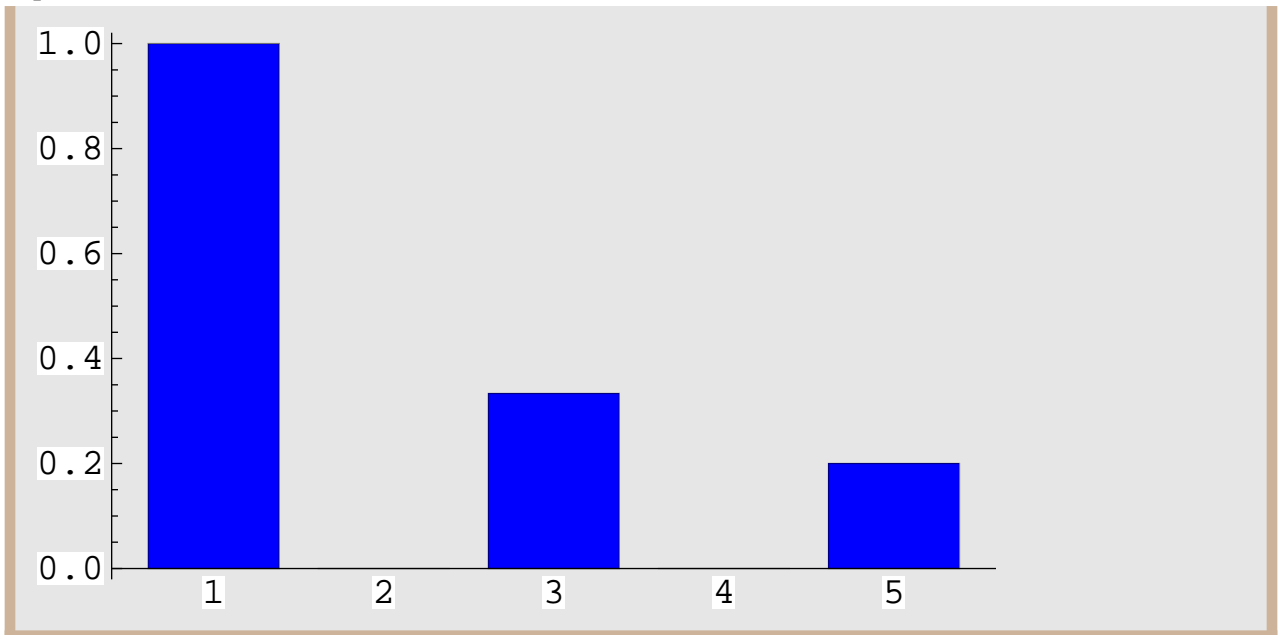`  PlotStyle -> {Red, {Thickness[0.008], Blue}}]`

Out[51]=
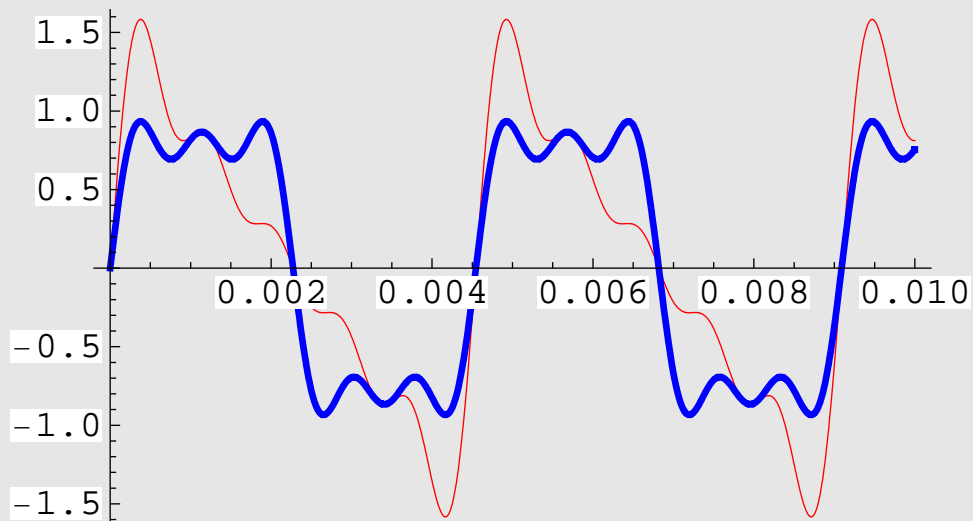
In[38]:= `? BarChart`

BarChart$[\{y_1, y_2, ...\}]$ generates a bar chart of the values $y_1, y_2, ...$.
BarChart$[\{list_1, list_2, ...\}]$ generates
    a bar chart of the data in the lists. ≫

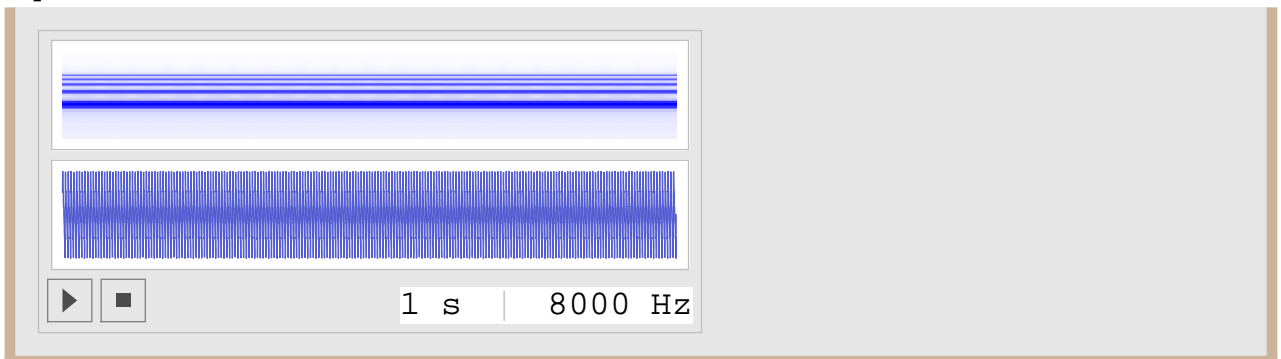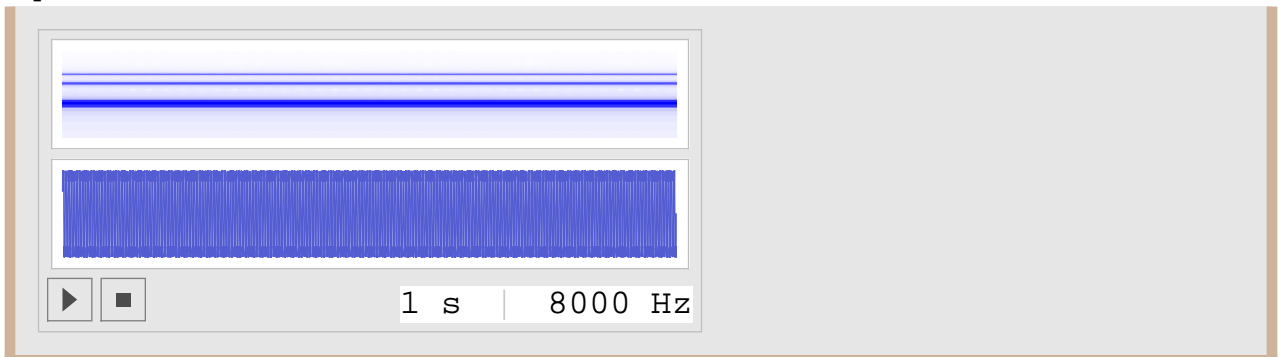*In[39]:=* `BarChart[trumpetList]`

Out[39]=

In[40]:= **BarChart[clarinetList, BarStyle → {blue}]**
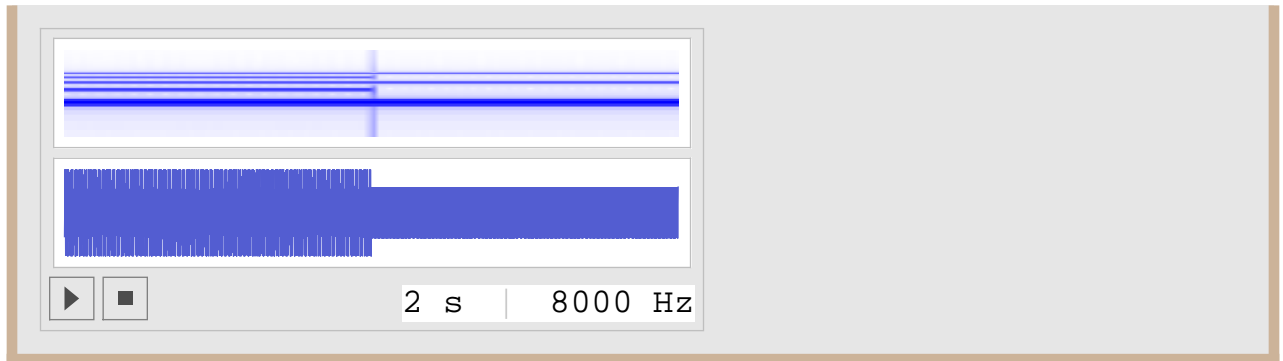*Out[40]=*

In[52]:= **Play[trumpet, {t, 0, 1}]**
Out[52]=

1 s | 8000 Hz

In[53]:= **Play[clarinet, {t, 0, 1}]**
Out[53]=

1 s | 8000 Hz

```
In[54]:= g[t_] := If[t <= 1, trumpet, clarinet]
```

In[55]:= `Play[g[t], {t, 0, 2}]`
  Out[55]=


```
                        2  s  |  8000  Hz
```

Make your own shapes:

Make your own shapes by replacing the numbers {1,2,3,4,5} below with numbers of your choice.

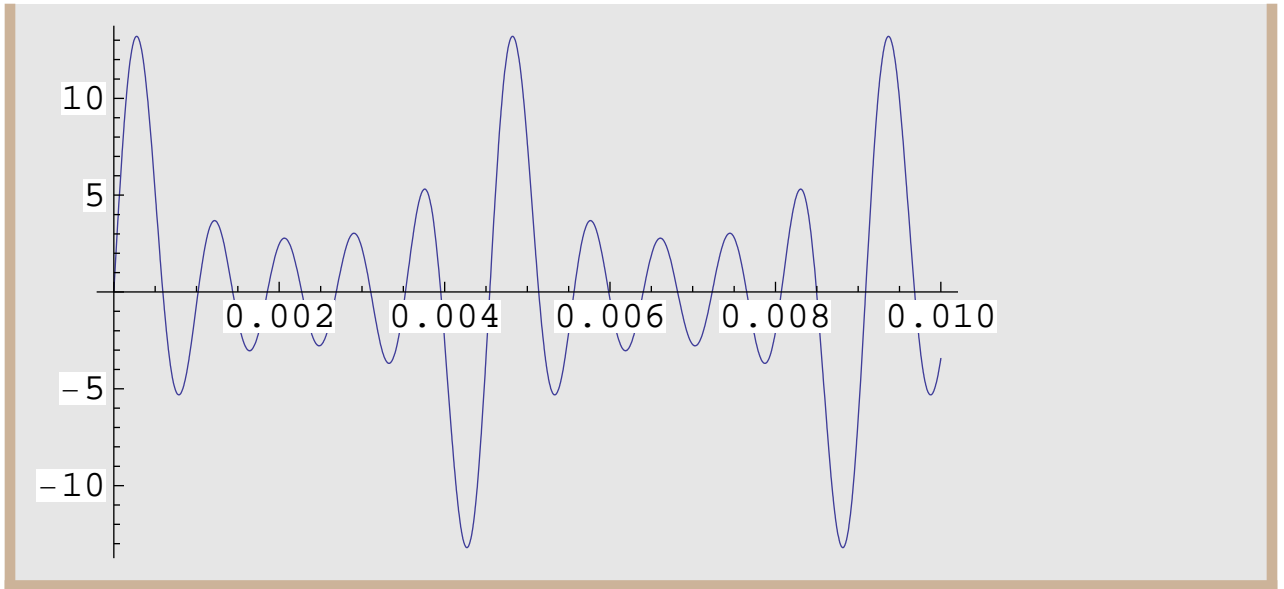When you get the strangest pattern, print it out, and turn it in with your name(s) on it.

Please print out only this part of the notebook by first selecting the relevant cells, and then

use the "Print Selection" command from the "File" menu.

Name:____ (enter your name(s) here)

In[45]:= `Plot[f[{1, 2, 3, 4, 5}] , {t, 0, 0.01}]`

Out[45]=

In[46]:= `Plot[f[{1, 2, 3, 4, 5}] , {t, 0, 0.01}]`

Out[46]=