

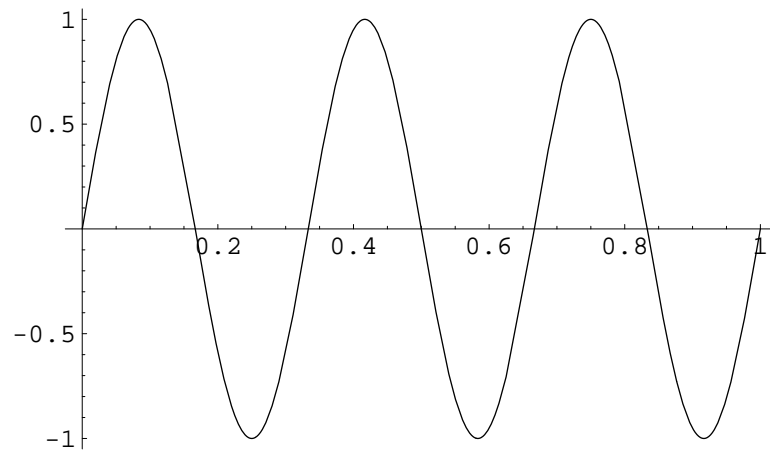
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## Setup and definitions:

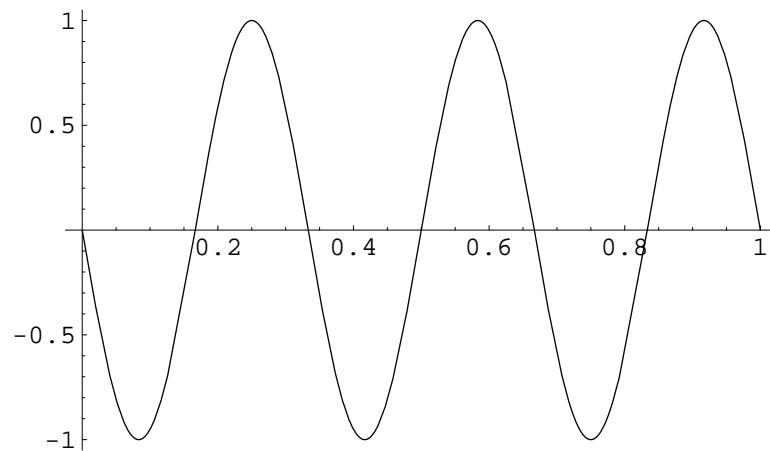
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### Out of phase waves

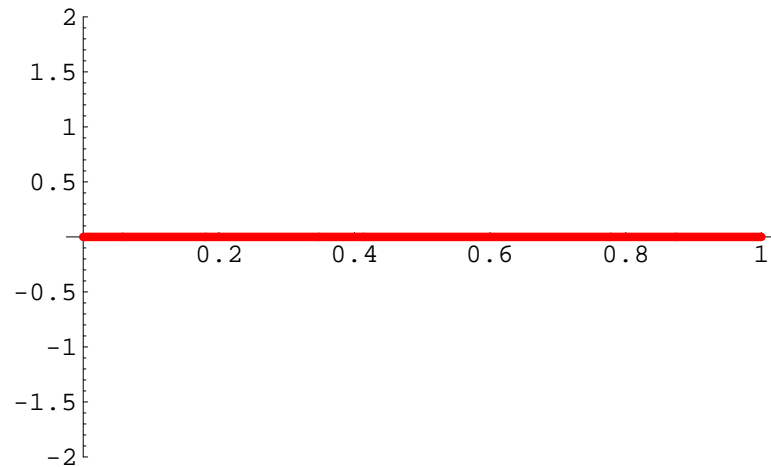
```
f = 3; (* Frequency *)  
phase = 0;  
Plot[Sin[2  $\pi$  f t + phase], {t, 0, 1}];
```



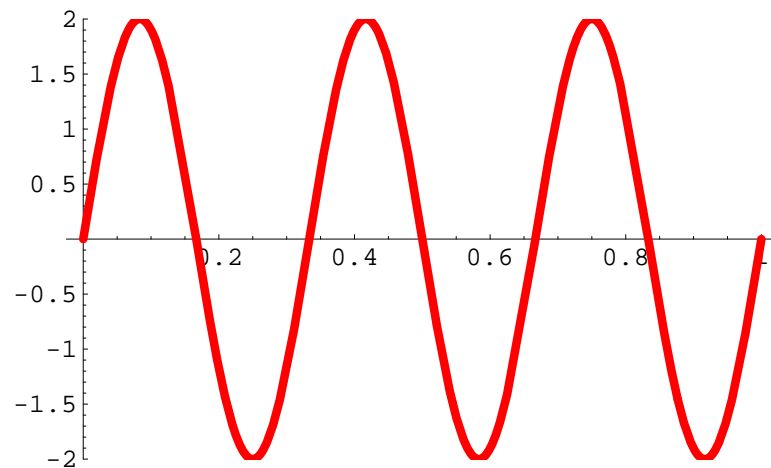
```
f = 3; (* Frequency *)  
phase =  $\pi$ ;  
Plot[Sin[2  $\pi$  f t + phase], {t, 0, 1}];
```



```
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}  
  ];
```

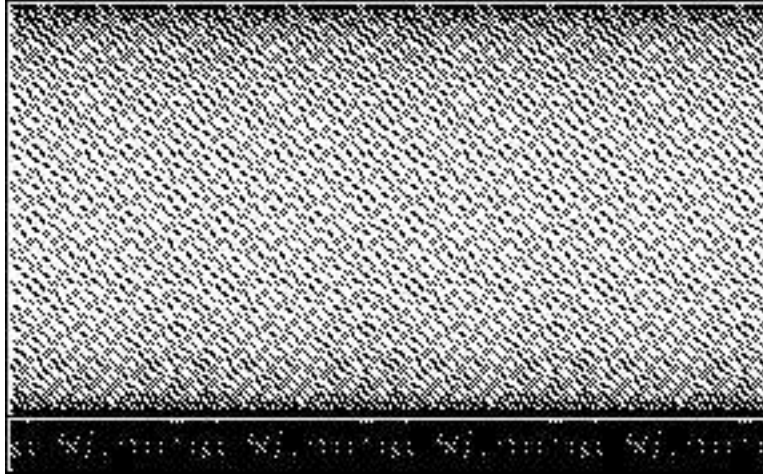


```
f = 3; (* Frequency *)  
Plot[Sin[2 π f t + 0] + Sin[2 π f t + 0]  
  , {t, 0, 1}  
  , PlotRange -> {-2, 2}  
  , PlotStyle -> {Thickness[0.012], red}  
  ];
```

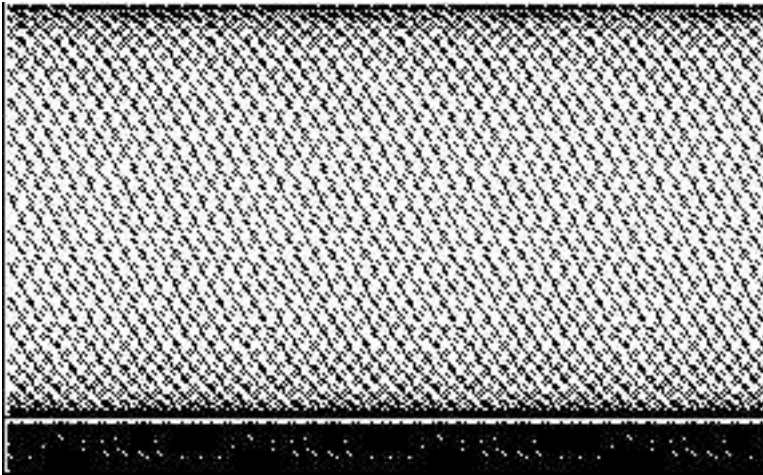


## Listen Interference and Beats

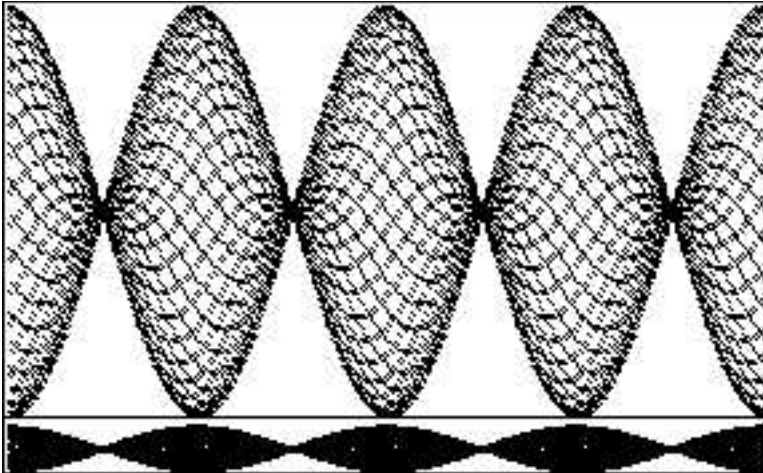
```
Play[Sin[2 π 440 t], {t, 0, 1}];
```



```
Play[Sin[2 π 444 t], {t, 0, 1}];
```

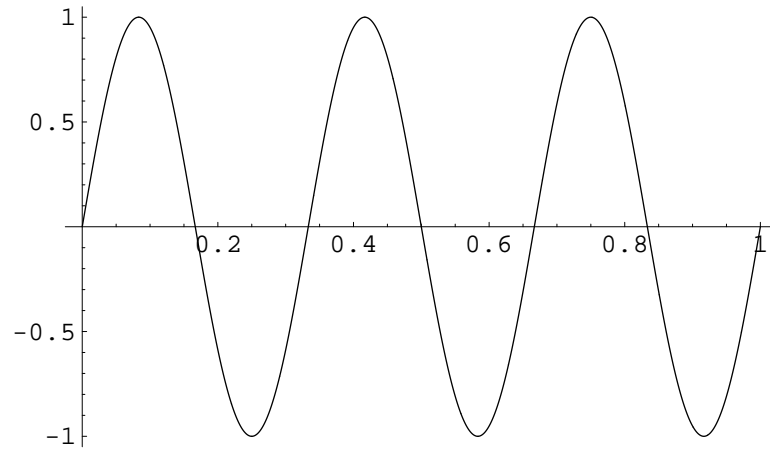


```
Play[Sin[2 π 440 t] + Sin[2 π 444 t], {t, 0, 1}];
```

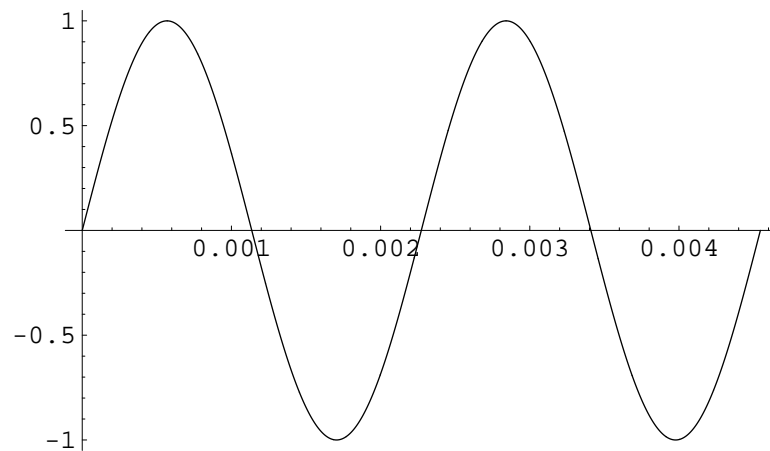


## View Interference and Beats

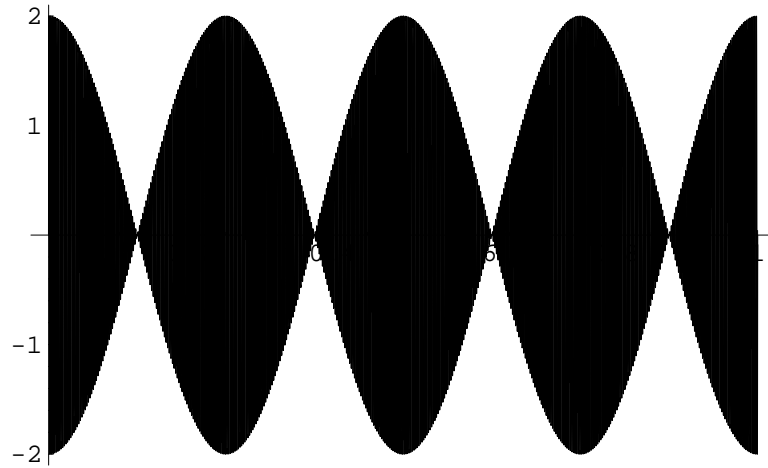
```
f = 3;  
Plot[Sin[ 2 π f t], {t, 0, 1}, PlotPoints -> 1000];
```



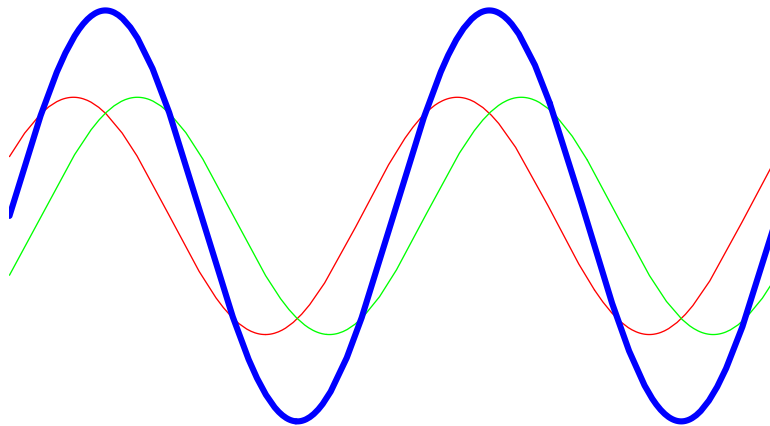
```
Plot[Sin[ 2 π 440 t], {t, 0, 2 / 440}, PlotPoints -> 1000];
```



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



## Animate Standing Waves:



```

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}}
    ]
, {x, 0, 1 - 1 / frames, 1 / frames}]

```

## Instrument Comparison:

```

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

```

```

f0 = 220;
trumpetList = {1, 1/2, 1/3, 1/4, 1/5};
clarinetList = {1, 0, 1/3, 0, 1/5};

```

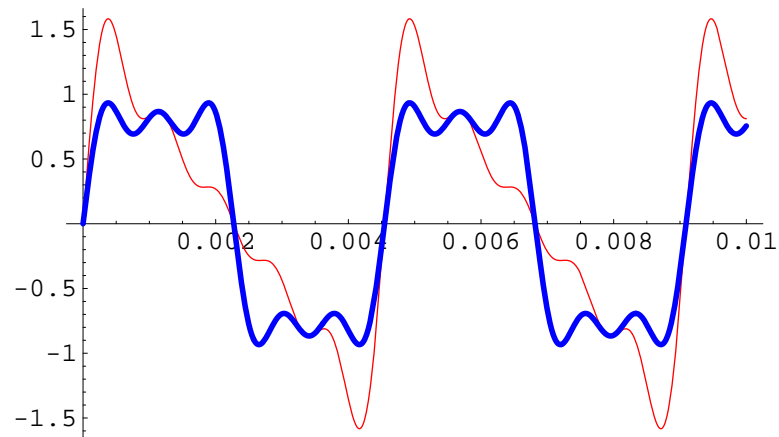
```
trumpet = f[trumpetList]
```

$$\sin[440 \pi t] + \frac{1}{2} \sin[880 \pi t] + \frac{1}{3} \sin[1320 \pi t] + \frac{1}{4} \sin[1760 \pi t] + \frac{1}{5} \sin[2200 \pi t]$$

```
clarinet = f[clarinetList]
```

$$\sin[440 \pi t] + \frac{1}{3} \sin[1320 \pi t] + \frac{1}{5} \sin[2200 \pi t]$$

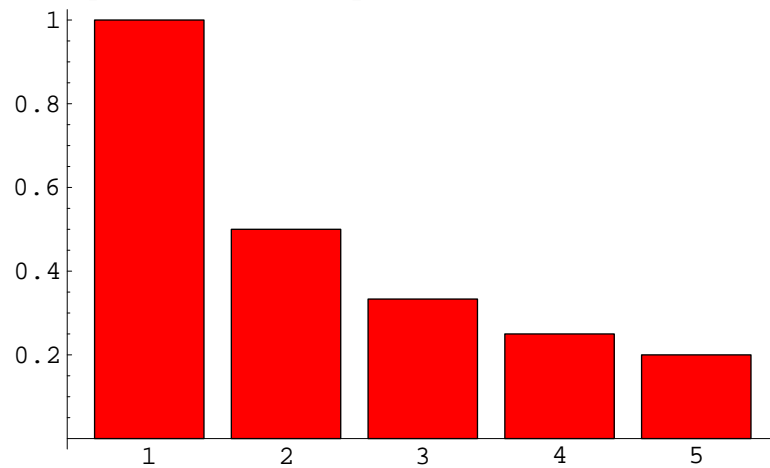
```
Plot[{trumpet, clarinet}, {t, 0, 0.01},  
PlotStyle -> {red, {Thickness[0.008], blue}}];
```



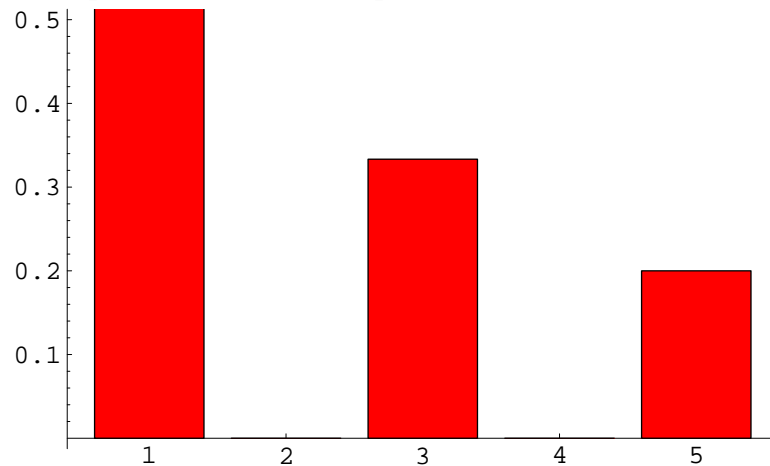
### ? BarChart

BarChart[list1, list2, ...] generates a bar chart of the data in the lists.

```
BarChart[trumpetList];
```

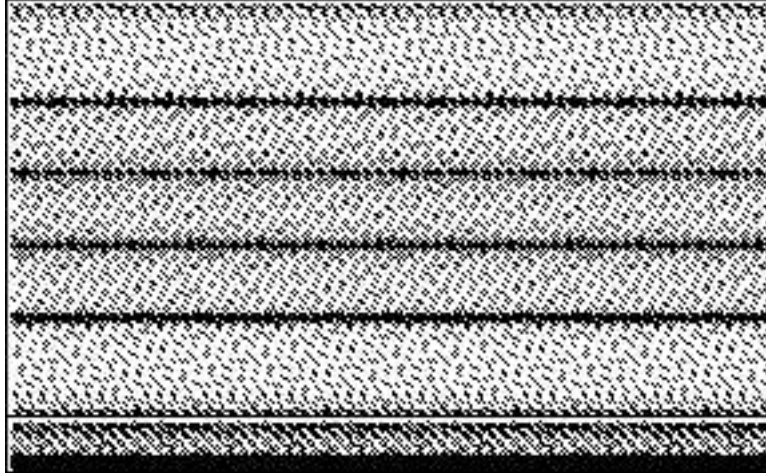


```
BarChart[clarinetList];
```

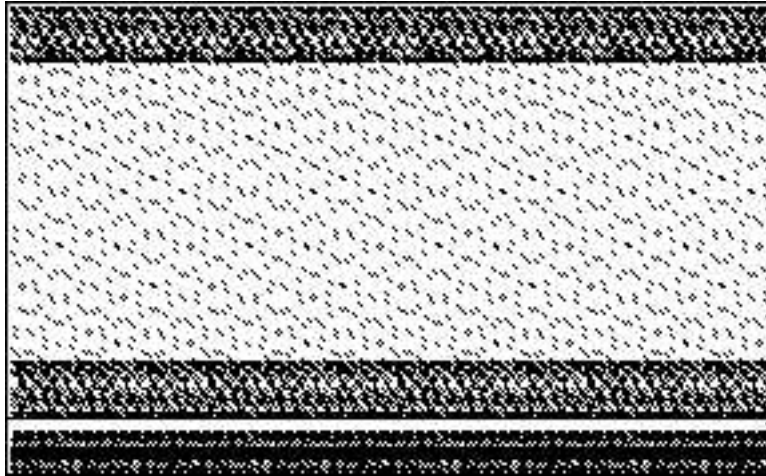




```
Play[trumpet, {t, 0, 1}];
```



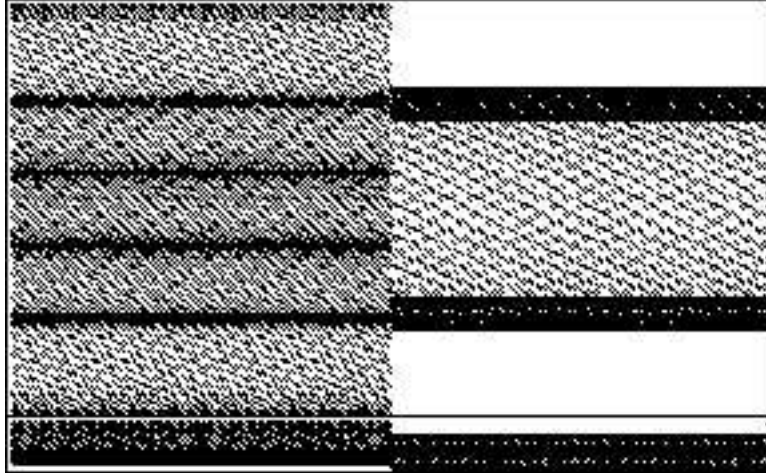
```
Play[clarinet, {t, 0, 1}];
```



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



```
Play[g[t], {t, 0, 2}];
```



---

## 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)

```
Plot[f[{1, 2, 3, 4, 5}], {t, 0, 0.01}];
```

```
Plot[f[{1, 2, 3, 4, 5}], {t, 0, 0.01}];
```