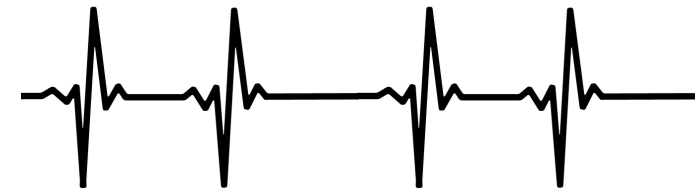


Don't touch
yet!
;-)

Making star music with coding, ...

... a computer and SONIC PI



*Collegio Pio X
Treviso
Italy*

Instructions

Stars make sound

... but we cannot hear them because they are too far from us and because there is no air in space.
Yet, we can recreate those sounds just like the *university's astroseismologists*.

HOW?

On Earth, a speaker can vibrate our air to hear sound.
A star can get bigger and smaller. This makes her seem to vibrate slightly.
To hear a star, we convert the vibration of its light into sound.

5. Name your star and your code now

Come up with a title for your star yourself and complete it with your name.

In Sonic Pi, you can write text as long as you **use the #** character.

Type e.g.

```
# TREVISIO MAXIMUS Marcello and Leana  
F1=hz_to_midi 300  
F2=hz_to_midi 180  
play F1, sustain: 30  
play F2, sustain: 30, amp: 0.5
```

Save your code as both text and sound.
Follow your teacher's instructions.

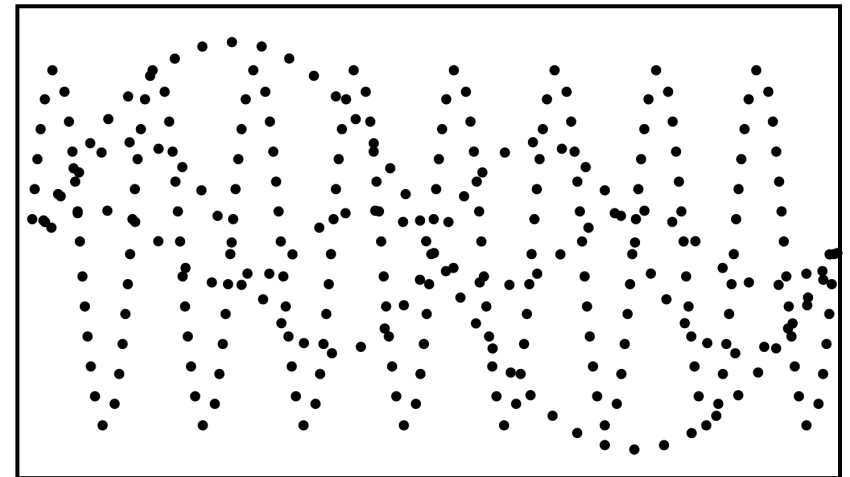
4. Fill in the sheet and program the sound of your star.

Star Music

LIGHT <i>this is how we see the star</i>				
Our star is	Huge	Large	Small	Very small
Our star vibrates... So she sounds...	Very slowly Very low	slowly Low	fast high	Very fast Very high
Sound <i>Our star sounds...</i>				
	Choose a frequency between 50 & 150 <i>(Hz_to_midi)</i>	Choose a frequency between 150 & 300 <i>(Hz_to_midi)</i>	Choose a frequency between 300 & 600 <i>(Hz_to_midi)</i>	Choose a frequency between 600 & 1800 <i>(Hz_to_midi)</i>
Main vibration (F1) is				
F2				
F3				
F4				
F5				
F6				
F7				
F8				
F9				
F10				

With telescopes on Earth and in space, one looks at a star that 'vibrates,' and the computer measures the moments when the star **gives little and much light**.

THE INFORMATION FROM THE TELESCOPE LOOKS VERY RANDOM.



This looks pretty confusing, but with a computer, we can search precisely for the different vibrations because we know that the star shrinks and expands again (*a sine wave movement*).

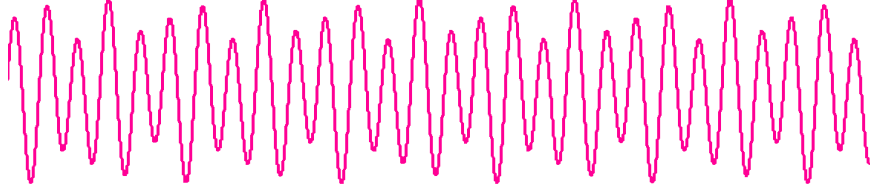
3. Exercise: Amplitudes (louder and quieter)

Because we know that the primary vibration is louder than the other frequencies, we have to make the second vibration less loud. You can do this with the 'amp:' instruction. If we only want F2 half as loud as F1, then you type:

```
F1=hz_to_midi 300  
F2=hz_to_midi 180
```

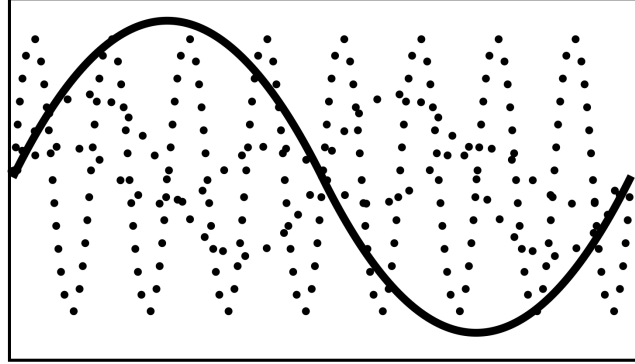
```
play F1, sustain: 5  
play F2, sustain: 5, amp: 0.5
```

On the 'scope,' you can see how the different vibrations influence each other. In this way, the tones reinforce each other, but sometimes they weaken each other:



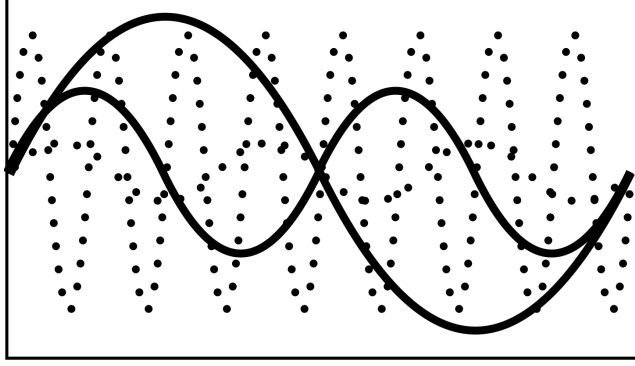
We first look for the primary vibration (F1) ...

A COMPUTER CAN LOOK FOR THE MOST IMPORTANT VIBRATION.



... now we are looking for other vibrations (F2)

THE COMPUTER IDENTIFIES THE SECOND VIBRATION (F2).
THIS ONE IS FASTER (HIGHER) BUT WEAKER THAN F1.



2. Exercise: Variables

When you code, it's easier to work with *variables*. This way, you only have to *give a number once* instead of constantly adjusting it throughout your code.

We will change our variables F1, F2, F3, ... just like the number of vibrations of a star.

As an exercise, type:

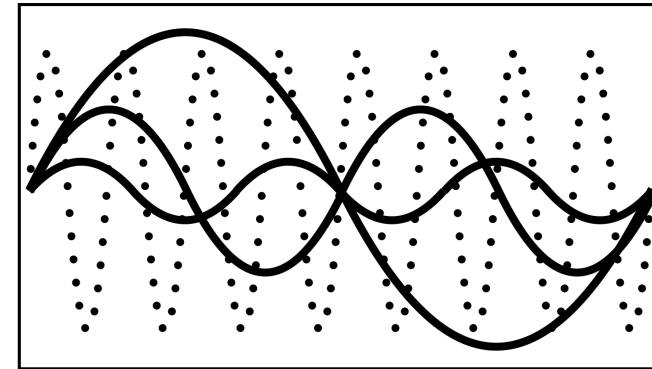
```
F1=hz_to_midi 300  
F2=hz_to_midi 180
```

```
play F1, sustain: 5  
play F2, sustain: 5
```

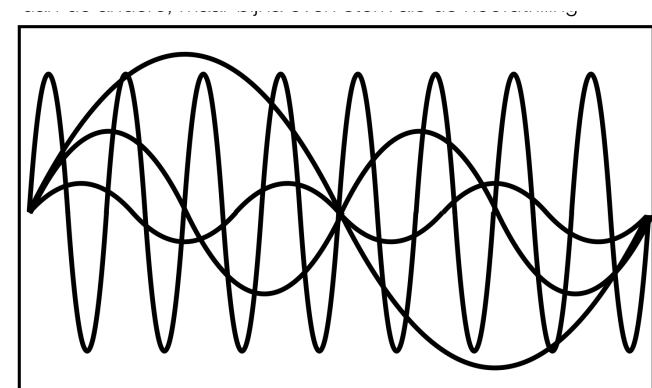
Press the RUN button and look at the 'scope.'

You can work with more variables if your star has more vibrations.

THE COMPUTER IDENTIFIES A THIRD VIBRATION (F3).
THIS ONE IS FASTER (HIGHER) BUT WEAKER THAN F1 AND F2.



THE COMPUTER IDENTIFIES A FOURTH VIBRATION (F4).
THIS ONE IS EVEN FASTER (HIGHER) AND ALMOST AS STRONG THAN F1



The speed of vibration is called frequency.
So this star vibrates at four frequencies: F1, F2, F3, and F4.

We can convert these frequencies into sound.

1. Exercise: Encoding a frequency

Let's make a small star with one vibration.

We express the number of vibrations per second in

hertz (Hz)

As an exercise, type:

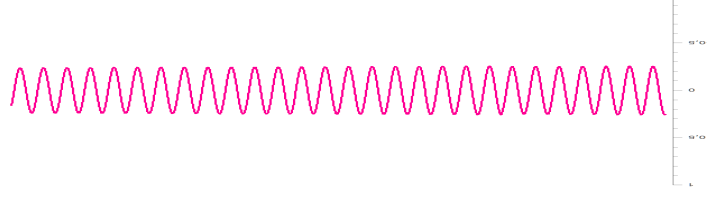
`play hz_to_midi(300)`

Press the RUN button or press ALT+R

You hear a sinewave tone of 300hz (300 vibrations per second)

Click the SCOPE icon and press RUN again

Now you can also see the sinewave tone of 300Hz:



Because the tone keeps stopping, type:

`play hz_to_midi(300), sustain: 5`

Press RUN, and the tone will play for 5 seconds

Beware!



BECAUSE WE ARE GOING TO
WORK WITH PURE TONES, IT
BECOMES VERY DANGEROUS
TO DAMAGE YOUR HEARING.

**THEREFORE, CHECK NOW
THAT THE VOLUME OF YOUR
COMPUTER IS NOT HIGHER
THAN '50'**

ONCE YOU'VE CHECKED THIS,
PUT YOUR HAND IN THE AIR