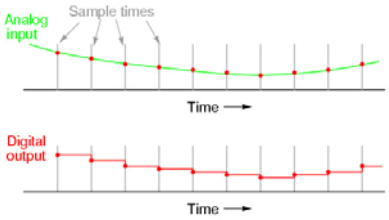
- Previous class:
  - Color vectors – RGB
  - 1-dimensional array – vector
- Now:
  - Play with sound files
  - (more vectors!)

Computing with sound requires digitization

- Sound is continuous; capture its essence by sampling
- Digitized sound is a vector of numbers



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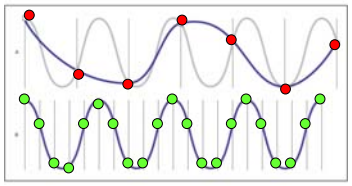
Sampling rate affects the quality

If sampling is not frequent enough, then the discretized sound will not capture the essence of the continuous sound…



Too slow

OK

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Sampling Rate

Given human perception, 20000 samples/second is pretty good (20000Hz or 20kHz)

8,000 Hz	required for speech over the telephone
44,100 Hz	required for audio CD
192,400 Hz	required for HD-DVD audio tracks

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Resolution also affects the quality

Typically, each sampled value is encoded as an 8-bit integer in the .wav file.

Possible values: -128, -127,…,-1,0,1,…,127

Loud: -120, 90, 122, etc.

Quiet: 3, 10, -5

Magnitude
determines loudness

16-bit used when very high quality is required.

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Reading and playing `.wav` files

```
[y,rate,nBits] = wavread('austin.wav')
sound(y,rate)
```

A wav file is for the computer to process—software is required to play the sound.

Computing with sound in Matlab requires that we first convert the wav format data into simple numeric data—the job of **`wavread`**.

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wavread converts the 8-bit values to floating point values between -1 and 1

```
[y,rate,nBits]= wavread('austin.wav')
```

```
    0.4609
    0.3516
    0.2734
    0.2891
    0.2500
    0.1484
    0.1094
    0.1641
    0.1484
    0.0000
   -0.1641
   -0.2734
   -0.3281
```

← y(50000:50012)

wavread

```
[y,rate,nBits]= wavread('austin.wav');
n = length(y);

n =
       54453
rate =
       11025
nBits =
        8
```

austin.wav encoded the sound with 54,453 8-bit numbers that were gathered over a span of about 54453/11025 secs

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wavread

Name of the source file

```
[data,rate,nBits]= wavread('austin.wav')
```

The vector of sampled sound values is assigned to this variable

The sampling rate is assigned to this variable

The resolution is assigned to this variable

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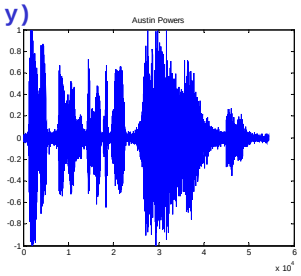
Hearing and "seeing" the sound

```
[y,rate]=  wavread('austin');
sound(y, rate)
plot(1:length(y), y)
```

Usually playback at a rate equal to the sampling rate



Subvectors

- Can access just part of a vector, or subvector
- Suppose you have a vector v:
  - v(1) - value in 1st cell
  - v(k) - value in kth cell for valid k
  - v(2:5) - the 2nd thru 5th values in v, as a vector
  - length(v) - how many cells in vector v
  - v(1:length(v)) - all the values in v

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Building a vector

Concatenate two vectors to make one…

```
v= ones(1,3);  % a row of length 3
w= [4; 7];     % a column of length 2
x= [w; v'];    % a column of length 5
```

Concatenate vectors repeatedly…

```
a= [];
for k= 1:4
   a= [a ones(1,2)];
end
% What is a?
```

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