

Transcoding

Transcoding is the conversion of one digital data format into another digital format. Most of the time, transcoding is an attempt to convert the source material into a smaller material by means of compression. Transcoding is the science that observes and analyses the different actors involved in transcoding. A sub-discipline of transcoding is compressology. Anyway, lets have a look into the world of transcoding.

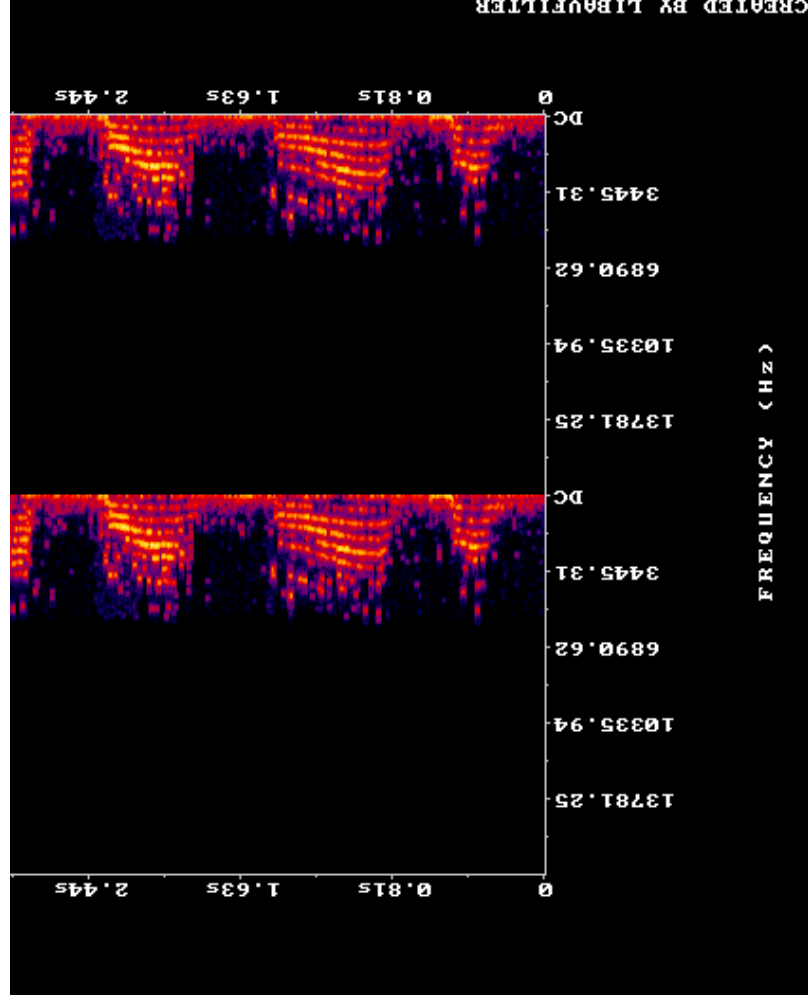
For our experiment today, we need a high-quality source material. Therefore, we are now looking for a good cat meow in the [freesound](#) library. freesound is a community-run sound library with [more than 500k Creative Commons sounds](#).

Because of the licence used in the freesound library, we don't have to worry about copyright infringements in this transcology exercise *wink smiley*
Alright, the [cat meowing](#) uploaded by the user [nekoninja](#) in very good quality (wav-format, samplerate 44100.0 Hz, bitdepth 16 bit, channels stereo) is our selected source material. The user nekoninja mentions in the description that the cats name is sushi. Thank you sushi and nekoninja!

Lets see what info we can get about the file (called "cat-meowing-original.wav" with the following command:

```
In [1]: !ffprobe -hide_banner cat-meowing-original.wav
```

Out[62]:



```
In [60]: from IPython.display import Audio  
Audio('test/400.mp3', autoplay=True)
```

Out[60]: Your browser does not support the audio element.

From nowadays perspective mp3 could be considered as old and outdated. A current state of the art compression is called [sndo](#)

In []:

```
Input #0, wav, from 'cat-meowing-original.wav':
  Metadata:
    encoder      : Coderium SoundEngine 5.21
  Duration: 00:00:10.18, bitrate: 1411 kb/s
  Stream #0:0: Audio: pcm_s16le ([1][0][0][0] /
0x00001), 44100 Hz, 2 channels, s16, 1411 kb/s
```

And we listen to the sound file with the following command:

```
In [40]: from IPython.display import Audio
         Audio('cat-meowing-original.wav',
              autoplay=True)
```

Out[40]: Your browser does not support the audio element.

Now we are going to create a spectrogram of the file with the following ffmpeg-command:

```
In... ! ffmpeg -hide_banner -i cat-meowing-original.wav -
lavfi showspectrumpic=s=1000x400:mode=separate
meowing-original-spectrogram.png -y
```

```
In... ! ffmpeg -hide_banner -i test/400.mp3 -lavfi
showspectrumpic=s=1000x400:mode=separate:legend=disabl
test/meowing-400times-spectrogram.png -y
```

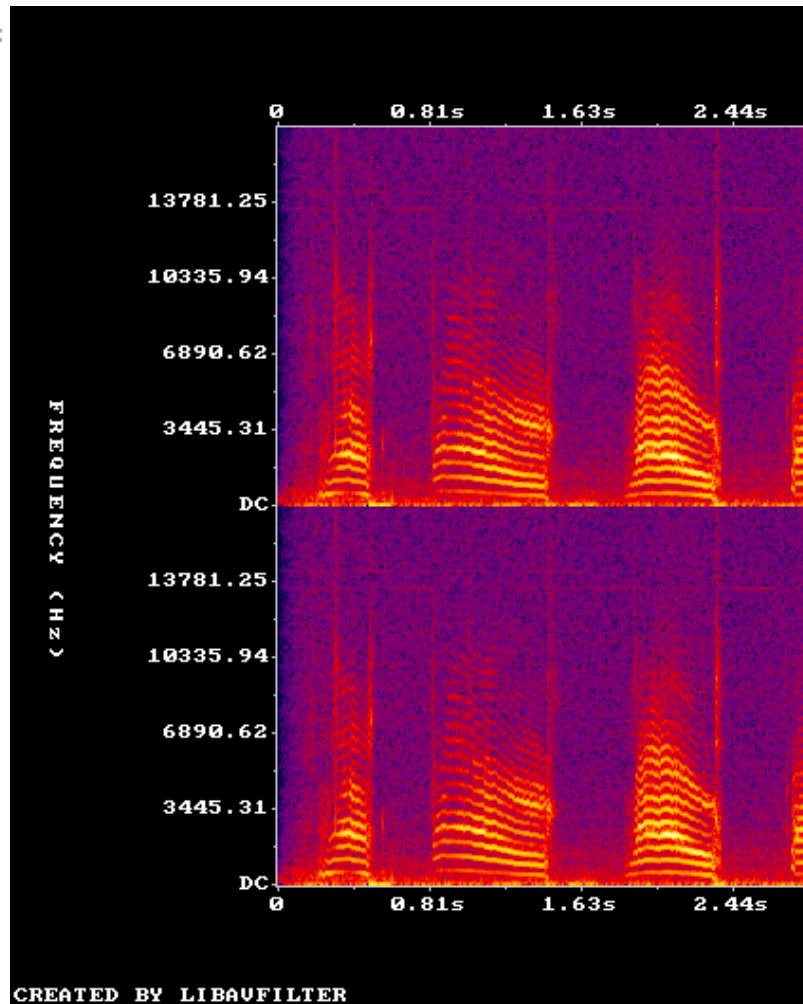
```
Input #0, mp3, from 'test/400.mp3':
  Metadata:
    encoder      : Lavf58.20.100
  Duration: 00:00:10.21, start: 0.025057, bitrate: 32
kb/s
  Stream #0:0: Audio: mp3, 44100 Hz, stereo, fltp, 32
kb/s
  Metadata:
    encoder      : Lavc58.35
Stream mapping:
  Stream #0:0 (mp3float) -> showspectrumpic
  showspectrumpic -> Stream #0:0 (png)
Press [q] to stop, [?] for help
Output #0, image2, to 'test/meowing-400times-
spectrogram.png':
  Metadata:
    encoder      : Lavf58.20.100
  Stream #0:0: Video: png, rgb24, 1282x528 [SAR 1:1
DAR 641:264], q=2-31, 200 kb/s, 86.13 fps, 86.13 tbn,
86.13 tbc
  Metadata:
    encoder      : Lavc58.35.100 png
frame=    1 fps=0.0 q=-0.0 Lsize=N/A time=00:00:00.01
bitrate=N/A speed=0.026x
video:196kB audio:0kB subtitle:0kB other streams:0kB
global headers:0kB muxing overhead: unknown
```

```
In [62]: from IPython.display import Image
         Image('test/meowing-400times-spectrogram.png')
```

```
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Finished
```

```
Gessed Channel Layout for Input Stream #0.0 : stereo
Input #0, wav, from 'cat-meowing-original.wav':
  Metadata:
    encoder : Coderium SoundEngine 5.21
    Duration: 00:00:10.18, bitrate: 1411 kb/s
    Stream #0:0: Audio: pcm_s16le ([1][0][0][0] /
    0x0001), 44100 Hz, stereo, s16, 1411 kb/s
  Stream mapping:
    Stream #0:0 (pcm_s16le) -> showspectrum
    Stream #0:0 (png) -> Stream #0:0 (png)
    Press [q] to stop, [?] for help
    Output #0, image2, to 'meowing-original-
    spectrum.png':
      Metadata:
        encoder : Lavf58.20.100
      Stream #0:0: Video: png, rgb24, 1282x528 [SAR 1:1
      DAR 641:264], q=2-31, 200 kb/s, 86.13 fps, 86.13 tbn,
      86.13 tbc
      Metadata:
        encoder : Lavc58.35.100 png
        frame= 1 fps=0.0 q=-0.0 Lsize=N/A time=00:00:00.01
        bitrate=N/A speed=0.0167x
        video:580kB audio:0kB subtitle:0kB other streams:0kB
        global headers:0kB muxing overhead: unknown
In [64]: from IPython.display import Image
Image('meowing-original-spectrum.png')
```

Out[64]:



In the next to steps we will transcode the original wav-file to a high quality mp3-file and a low quality mp3-file!

First the compression into a high quality mp3-file with 128kbps:

```
In [... ! ffmpeg -hide_banner -i cat-meowing-original.wav  
-b:a 128k cat-meowing-128k.mp3 -y
```

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Gussed Channel Layout for Input Stream #0.0 : stereo

```
Input #0, wav, from 'cat-meowing-original.wav':  
  Metadata:  
    encoder : Coderium SoundEngine 5.21  
    Duration: 00:00:10.18, bitrate: 1411 kb/s  
    Stream #0:0: Audio: pcm_s16le ([1][0][0][0] /  
    0x0001), 44100 Hz, stereo, s16, 1411 kb/s  
    Stream mapping:  
      Stream #0:0 (-> #0:0 (pcm_s16le (native) -> mp3  
    (libmp3lame))  
    Press [q] to stop, [?] for help  
    Output #0, mp3, to 'cat-meowing-128k.mp3':  
    Metadata:  
      TSSE : Lavf58.20.100  
      Stream #0:0: Audio: mp3 (libmp3lame), 44100 Hz,  
      stereo, s16p, 128 kb/s  
    Metadata:  
      encoder : Lavc58.35.100 libmp3lame  
      size= 160kB time=00:00:10.18 bitrate= 128.7kbits/s  
      speed=19.9x  
      video:0kB audio:160kB subtitle:0kB other streams:0kB  
      global headers:0kB muxing overhead: 0.282704%  
In [44]: from IPython.display import Audio  
         Audio('cat-meowing-128k.mp3', autoplay=True)  
Out[44]: Your browser does not support the audio element.  
And now the spectrogram of it:  
In [44]: !ffmpeg -hide_banner -i cat-meowing-128k.mp3 -lavfi  
         showspectrumpic=s=1000x400:mode=separate:legend=disabl  
         meowing-128k-spectrogram.png -y
```

```
Input #0, mp3, from 'cat-meowing-128k.mp3':
  Metadata:
    encoder          : Lavf58.20.100
  Duration: 00:00:10.21, start: 0.025057, bitrate: 128
kb/s
  Stream #0:0: Audio: mp3, 44100 Hz, stereo, fltp,
128 kb/s
  Metadata:
    encoder          : Lavc58.35
Stream mapping:
  Stream #0:0 (mp3float) -> showspectrumpic
  showspectrumpic -> Stream #0:0 (png)
Press [q] to stop, [?] for help
Output #0, image2, to 'meowing-128k-spectrogram.png':
  Metadata:
    encoder          : Lavf58.20.100
  Stream #0:0: Video: png, rgb24, 1000x400 [SAR 1:1
DAR 5:2], q=2-31, 200 kb/s, 86.13 fps, 86.13 tbn, 86.13
tbc
  Metadata:
    encoder          : Lavc58.35.100 png
frame= 1 fps=0.0 q=-0.0 Lsize=N/A time=00:00:00.01
bitrate=N/A speed=0.016x
video:544kB audio:0kB subtitle:0kB other streams:0kB
global headers:0kB muxing overhead: unknown
```

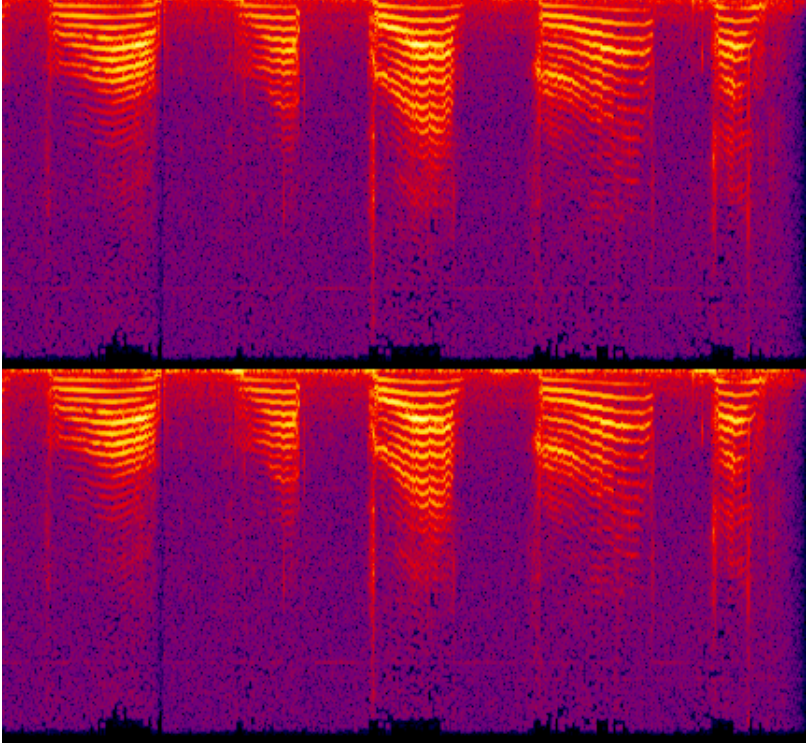
```
In [46]: from IPython.display import Image
Image('meowing-128k-spectrogram.png')
```

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```

Out[46]:



Lets make a really low compression of the original file:

```
In [ ... ]: fmp3eg -hide_banner -i cat-meowing-original.wav
            -b:a 8k cat-meowing-8k.mp3 -y
```

Guessed Channel Layout for Input Stream #0.0 : stereo

Input #0, wav, from 'cat-meowing-original.wav':

Metadata:

encoder : Coderium SoundEngine 5.21

Duration: 00:00:10.18, bitrate: 1411 kb/s

Stream #0:0: Audio: pcm_s16le ([1][0][0][0] / 0x0001), 44100 Hz, stereo, s16, 1411 kb/s

Stream mapping:

Stream #0:0 -> #0:0 (pcm_s16le (native) -> mp3 (libmp3lame))

Press [q] to stop, [?] for help

Output #0, mp3, to 'cat-meowing-8k.mp3':

Metadata:

TSSE : Lavf58.20.100

Stream #0:0: Audio: mp3 (libmp3lame), 44100 Hz, stereo, s16p, 8 kb/s

Metadata:

encoder : Lavc58.35.100 libmp3lame

size= 40kB time=00:00:10.18 bitrate= 32.3kb/s

speed=22.2x

video:0kB audio:40kB subtitle:0kB other streams:0kB

global headers:0kB muxing overhead: 0.619248%

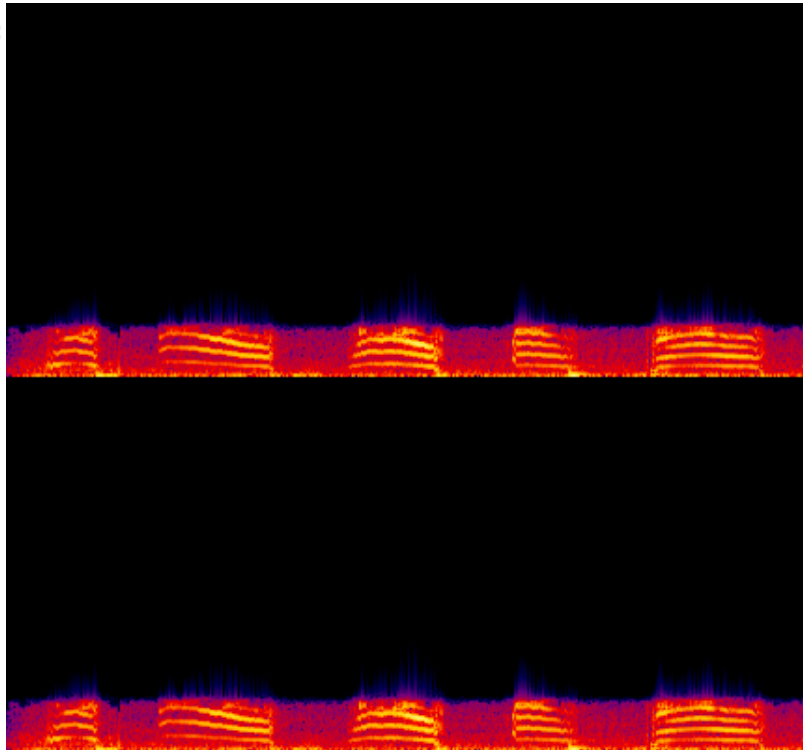
In... ! **ffmpeg -hide_banner -i cat-meowing-8k.mp3 -lavfi showspectrumpic=s=1000x400:mode=separate:legend=disabl meowing-8k-spectrogram.png -y**

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```
Input #0, mp3, from 'cat-meowing-8k.mp3':  
  Metadata:  
    encoder : Lavf58.20.100  
  Duration: 00:00:10.21, start: 0.025057, bitrate: 32  
  kb/s  
  Stream #0:0: Audio: mp3, 44100 Hz, stereo, fltp, 32  
  kb/s  
  Metadata:  
    encoder : Lavc58.35  
  Stream mapping:  
    Stream #0:0 (mp3float) -> showspectrumpic  
    showspectrumpic -> Stream #0:0 (png)  
  Press [q] to stop, [?] for help  
  Output #0, image2, to 'meowing-8k-spectrogram.png':  
  Metadata:  
    encoder : Lavf58.20.100  
  Stream #0:0: Video: png, rgb24, 1000x400 [SAR 1:1  
  DAR 5:2], q=2-31, 200 kb/s, 86.13 fps, 86.13 tbn, 86.13  
  tbc  
  Metadata:  
    encoder : Lavc58.35.100 png  
  frame= 1 fps=0.0 q=-0.0 Lsize=N/A time=00:00:00.01  
  bitrate=N/A speed=0.0313x  
  video:113kB audio:0kB subtitle:0kB other streams:0kB  
  global headers:0kB muxing overhead: unknown  
In [49]: from IPython.display import Image  
Image('meowing-8k-spectrogram.png')
```

Out[49]:



```
In [50]: from IPython.display import Audio
         Audio('cat-meowing-8k.mp3', autoplay=True)
```

Out[50]: Your browser does not support the audio element.

What we can see from the image and hear from the audio is that the mp3 compression cuts already a lot of the high frequencies! Lets compare the file sizes of the three different files:

```
In [32]: ! ls -al *.wav *.mp3
```

```
-rw-rw-r--+ 1 joak joak 163675 Apr 19 07:45 cat-
meowing-128k.mp3
-rw-rw-r--+ 1 joak joak  41109 Apr 19 08:06 cat-
meowing-8k.mp3
-rw-rw-r--+ 1 joak joak 1796250 Apr 18 23:00 cat-
meowing-original.wav
```

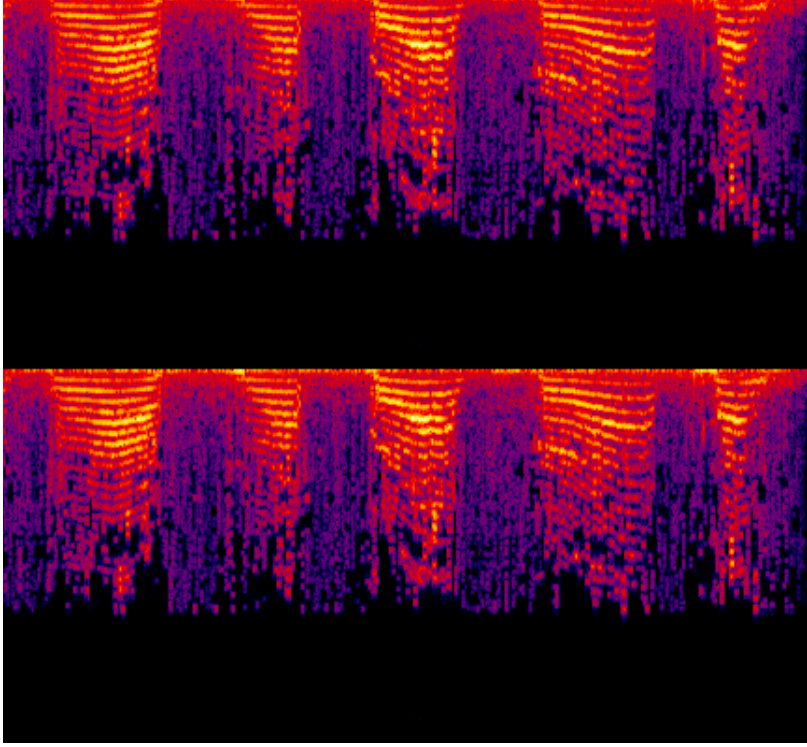
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Now the script is at step 85 of 399
Now the script is at step 86 of 399
Now the script is at step 87 of 399

```
I... import os

In the next step we will transcode the 'cat-
meowing-128k.mp3'-file 100 times and listen what kind of
glitches will appear: D

os.system("cp -f cat-meowing-128k.mp3 test/0.mp3")
#copy the mp3 to the test folder
for i in range(0,100):
    os.system("ffmpeg -loglevel quiet -hide_banner -
i test/"+str(i)+"mp3 test/"+str(i)+"wav -y")
#convert from mp3 to wav
os.system("ffmpeg -loglevel quiet -hide_banner -
i test/"+str(i)+"wav -b:a 32k -filter:a
'volume=1.05' test/"+str(i+1)+"mp3 -y") #convert
from wav to mp3
print("Now the script is at step "+str(i)+" of
99")
print("Finished")
```

Alright that goes into a good direction and even the spectrogram looks good. Lets try it now with 400 times :D

```
I... import os

os.system("cp -f cat-meowing-128k.mpeg test/0.mpeg")
#copy the mp3 to the test folder
for i in range(0,400):
os.system("ffmpeg -loglevel quiet -hide_banner -i test/"+str(i)+".mp3 test/"+str(i)+".wav -y")
#convert from mp3 to wav
os.system("ffmpeg -loglevel quiet -hide_banner -i test/"+str(i)+".wav -y")
#convert from mp3 to mp3
os.system("cp -f cat-meowing-128k.mpeg test/0.mpeg")
print("Now the script is at step "+str(i)+" of 399")
print("..Finished")
```

```
Now the script is at step 44 of 99
Now the script is at step 45 of 99
Now the script is at step 46 of 99
Now the script is at step 47 of 99
Now the script is at step 48 of 99
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Now the script is at step 81 of 99
Now the script is at step 82 of 99
Now the script is at step 83 of 99
Now the script is at step 84 of 99
Now the script is at step 85 of 99
Now the script is at step 86 of 99
Now the script is at step 87 of 99
```



```
Now the script is at step 88 of 99
Now the script is at step 89 of 99
Now the script is at step 90 of 99
Now the script is at step 91 of 99
Now the script is at step 92 of 99
Now the script is at step 93 of 99
Now the script is at step 94 of 99
Now the script is at step 95 of 99
Now the script is at step 96 of 99
Now the script is at step 97 of 99
Now the script is at step 98 of 99
Now the script is at step 99 of 99
Finished
```

```
In [54]: from IPython.display import Audio  
Audio('test/100.mp3', autoplay=True)
```

```
Out[54]: Your browser does not support the audio element.
```

```
In... ! ffmpeg -hide_banner -i test/100.mp3 -lavfi  
showspectrumpic=s=1000x400:mode=separate:legend=disabl  
test/meowing-100times-spectrogram.png -y
```

```
Input #0, mp3, from 'test/100.mp3':  
  Metadata:  
    encoder           : Lavf58.20.100  
  Duration: 00:00:10.21, start: 0.025057, bitrate: 32  
  kb/s  
    Stream #0:0: Audio: mp3, 44100 Hz, stereo, fltp, 32  
  kb/s  
    Metadata:  
      encoder         : Lavc58.35  
  Stream mapping:  
    Stream #0:0 (mp3float) -> showspectrumpic  
    showspectrumpic -> Stream #0:0 (png)  
  Press [q] to stop, [?] for help  
  Output #0, image2, to 'test/meowing-100times-  
  spectrogram.png':  
    Metadata:  
      encoder         : Lavf58.20.100  
    Stream #0:0: Video: png, rgb24, 1000x400 [SAR 1:1  
  DAR 5:2], q=2-31, 200 kb/s, 86.13 fps, 86.13 tbn, 86.13  
  tbc  
    Metadata:  
      encoder         : Lavc58.35.100 png  
  frame=    1 fps=0.0 q=-0.0 Lsize=N/A time=00:00:00.01  
  bitrate=N/A speed=0.0272x  
  video:186kB audio:0kB subtitle:0kB other streams:0kB  
  global headers:0kB muxing overhead: unknown
```

```
In [31]: from IPython.display import Image  
Image('test/meowing-100times-spectrogram.png')
```