When a computer records a sound, it merely samples what is going on at the microphone and stores the information in a file — several thousand times per second. Once the information is on the computer, you can edit it just as you edit other computer files. Read on for a taste of the digital recording and editing of sound files...

Purpose

• To learn to record and play sounds from a Terminal window.
• To understand what's in a sound file.
• To learn how to manipulate soundfiles using SoundEditor.

Materials you need

• **Earphones!**
• A cassette tape, if you want to have a recording of your sounds.

References

Required CheatSheets

• Preferences
• Sound
• UNIX
• SoundEditor

Helpful CheatSheets

• Storage
• rt.app
• SoundWorks

Online Help

• **Help** window (in the **Info** menu) for rt.app .
• **Help** window for SoundWorks.

Procedure

Setup

• Log in to a NeXT.

• Plug in your earphones in the back right of the monitor, under the picture of headphones. You might have to walk around to the back and look for the jack.

• Open up a Terminal window.

• Use the Preferences application to set the volume, and turn the mute on so the sound only comes through the headphones. Also, make sure you are in **UNIX Expert Mode** so you can view hidden files and directories such as **/tmp** .

• Finally, open up a WriteNow document and save it as **sndstuff.wn** . You'll use this to **Paste** in text to hand in. **Save it every once in a while** (this is always a good practice).

Playing sounds, recording your own

In general, sound files are HUGE. You'll probably run out of space if you try to store too many of them in your home directory — remember that you have a disk quota*. But... every UNIX machine has its own built-in disk drive called /**tmp** with lots of space available. In this lab, you'll save everything you do into /**tmp**, and copy the important things to your home directory when you're done (find out how to use the* `cp` *command in the UNIX CheatSheet).*

- `cd` to /**tmp** . If you want, you can use the `mkdir` command to make your own subdirectory in which to store your sounds.
- First you need a way to play sounds. On the NeXTs, there is a UNIX command called `sndplay` . To test it out, type

  ```
  sndplay ~cs111/Labs/5–Sound/hello.snd
  ```

  You should hear a short intro we prepared for you.
- Now you get to record your own sounds. The easiest way is to use the command `sndrecord` . Try it — type `sndrecord <filename>`, and follow the instructions that appear. If you don't end your filename with ".snd", it will be added for you (every NeXT sound must end in ".snd"). After you're done, the computer will report the amount of information it recorded.
- Play your sound, and don't forget the ".snd" at the end! If you don't like it, remove it with `rm` and give it another try.
- When you get a sound you like, rename it **snd1.snd** and save it into your home directory so you can submit it later. You can use the `mv` command to accomplish this (`mv <old filename> <new filename>`).

Getting information about your sounds

- You can get some interesting information about a sound using the `sndinfo` command. Type `sndinfo <filename>`, and five lines of information will pop up, like so:

  ```
  Filename: boxcars.snd
  Size: 22784 bytes, 22784 samples, 2.844 seconds
  Format: 8 bit muLaw
  SamplingRate: 8012.821 Hz
  Channels: 1
  ```

  The Size (number of bytes) can be thought of as the number of characters the computer stored on disk when it recorded your sound. Similarly, the number of samples is the number of times the computer saved information from the microphone.

  The Format shows the method the computer used to store the sound information. In this "muLaw" format, the computer stored each sample as an 8–bit number on a logarithmic scale.

  The number of Channels tells you whether the sound is stereo (two channels, *with different sounds for each ear) or monophonic (one channel, with the same sound played in each ear). Not surprisingly, stereo files take up twice as much space as mono files do.*

Finally, the SamplingRate is the number of times the computer saved information each second. Multiply the sampling rate by the number of seconds and POOF! *you get the total number of samples.*

Think about this for a moment: in the three seconds that the computer recorded information, it stored over twenty-two thousand characters. That's ten pages of text! Furthermore, this is the lowest quality sound on the NeXT. Recording CD-quality sound requires almost six times that much storage, because the computer records information almost six times as quickly. To record one minute of CD-quality stereo sound would require over two hundred pages of information. (ooh, aah!) Check out the Storage CheatSheet for more insight.

- Get information on your **snd1.snd** with `sndinfo`, and use Copy&Paste to transfer the output into **sndstuff.wn** . Also give a rough estimate of how many pages (at about 2200 characters per page) your sound would fill.

Playing with sounds in SoundEditor

- Launch the **SoundEditor** application, and open the sound you just created. (Use **Open...** from the **File** menu.)
- Reverse the sound to hear yourself played backwards.
- Reverse the sound again, back to its original state.
- Your assignment is to hack up this sound until it is unrecognizable. Deleting the whole thing doesn't count. :-) Look for tips in the SoundEditor CheatSheet.
- If you don't like what you have done, you can close the sound without saving it, and open up **snd1.snd** again. When you're done fiddling around, and you have a sound that you like, choose **Save As...** (not **Save**) from the **File** menu, and call your sound **snd2.snd** . Close up the editing window.
- That's all you have to do. But wait! Hopefully you have time left... find something fun to do from the **Above and Beyond** section, and after you do everything there :-) , find something in **For Further Exploration**. Enjoy!

What should be handed in

- **sndstuff.wn**, including the output from the `sndinfo` command and possibly short descriptions of your exploits in **Above and Beyond**.
- **snd1.snd** and **snd2.snd** .
- Any sounds you create in the **Above and Beyond** section.

Above and Beyond

Try anything you have time for, in any order.

Recording to and from the tape deck

To use the tape deck, you need to set up shop on the machine called ***page*** *(the first NeXT in the third row).*

...from the computer to a tape

- Press RECORD on the tape deck.
- Press the PLAY button to start recording, and play sounds on the computer as you normally would. The tape deck will record everything.

...from a tape to the computer

- Get to a Terminal window, and `cd` to the /**tmp** directory, so you have lots of space in which to record your sounds.
- Type `sndrecord -d <filename>`. The `-d` option tells the computer to record from the DSP port (see the Sound CheatSheet), where the computer gets information from the cassette deck.
- Follow the instructions for `sndrecord` as you normally would, except instead of speaking into the microphone, press PLAY (▷) on the tape deck.
- Just a note of caution: sounds recorded from the tape deck are saved in the highest-quality format with stereo. Use `sndinfo` to see how BIG they are. If you don't need your sound to be stereo, type

```
sndconvert -c 1 <filename>
```

  The `-c 1` tells the computer to convert the sound to one channel (monophonic). Saving the sound in monophonic format reduces your chances of running out of room on the disk.

/LocalLibrary/Sounds

- Check out this directory! In /**LocalLibrary/Sounds** there are over 300 sounds available for your listening pleasure.
- If you find a sound you like, you can save a copy into /**tmp** or your home directory and play around with it in SoundEditor, rt.app, or SoundWorks.

Mixing sounds with rt.app

Whether you're creating your own symphonic masterpiece or you just want to add your own voice to your favorite song, you will want to learn how to mix sounds. rt.app is the most powerful and fun mixing application around.

- You can record your own sounds to use, or you can use sounds from /**LocalLibrary/Sounds** .
- Read the rt.app CheatSheet, and make some wild sounds with `playnote`

commands. If something doesn't work, go back to the general procedure in the rt.app CheatSheet, or look in rt.app's **Help** screen.

- Save any interesting sounds with the **Write mix to disk...** item in the **Document** menu.

Mixing and altering sounds with SoundWorks

*Although SoundWorks is not as powerful as rt.app, it has a fantastic interface for simply mixing two sounds together and for playing with glissandos (sliding up or down the musical scale). To use this program, however, you must be working on the NeXT machine called **page**.*

- Read about mixing and the Effects Panel in the SoundWorks CheatSheet.
- Save some mixed sounds, and save some sounds which you changed with the Effects Panel.

Hidden messages

Recording artists have always had fun putting hidden messages in their work. The Beatles did it when they went on a "Paul is dead" kick. Here's an example from Queen's "Another One Bites the Dust." Make your own judgement on this one.

- In SoundEditor, open up ~**cs111/Labs/5-Sound/dust.snd** . Listen to it.
- **Reverse** it, and try to find the message (it's hard to understand).
- For a clearer, eerier example, get a copy of the Beatles' *The White Album* and reverse a chunk of "Revolution Number Nine." Turn me on, dead man.

Setting up a startup tune

*Everyone with a UNIX account has a file which runs a set of commands for every new Terminal window. It is called **.login** . Notice the "." in front... that just means it doesn't show up (for convenience) when you type `ls` to list the files in your home directory. To include "." files in a directory listing, type `ls -A` .*

- To add a sound to your startup routine, find **.login** in your home directory and open it up in Edit (see the Edit CheatSheet).
- Add in a `sndplay` statement at the end, and save the file. Now, whenever you open a new Terminal window, this sound will play.
- Take it out when it gets annoying.

For further exploration

- Check out **Sing** in **/Net/dobro/musr/Apps/SPASM1.06** . It... sings. Hint: find the switch that toggles between **Quiet** and **Sing**, and switch it to **Sing**.
- Record some good-quality music from the tape deck, and use rt.app to create a professional-sounding mix.