

Workshop: Digitising Analogue Audio Recordings

LPs & more to CD & more using freely available software, including “Audacity”

Presented by Basil McMillan

Introduction

- **Goal** is to **convert analogue audio to** modern **digital** form - for listening (in CD, MP3, ...) and/or archival.
- **Hows & Whys** of Hardware, Software & Organising
- A “Workshop” format - I am not an expert
 - Digitised some of my own records, so I’ve some skills to share.
- Effort – result tradeoff. YOU decide.
- Much to cover, so keep questions to a minimum
 - 3 dozen slides + demos to fit into 75 minutes!
- Audacity software
 - freely available for download (next slide)
 - Beta version is quite OK for this work.

http://audacity.sourceforge.net/

http://audacity.sourceforge.com/net



Google Search

this site Wiki/Forum/Team site Web



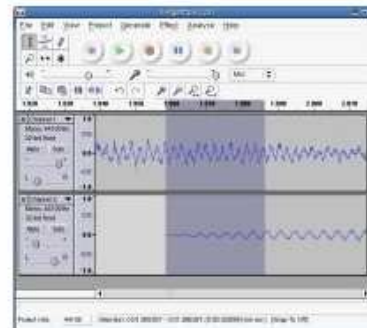
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The Free, Cross-Platform Sound Editor

Audacity is free, open source software for recording and editing sounds. It is available for Mac OS X, Microsoft Windows, GNU/Linux, and other operating systems. [Learn more about Audacity...](#) Also check our [Wiki](#) and [Forum](#) for more information.

The latest release of Audacity is [1.3.4 \(beta\)](#). Because it is a work in progress and does not yet come with complete documentation or translations into foreign languages, it is recommended for more advanced users. See [New Features in 1.3](#) for more information about the 1.3.x beta series.

For all users, [Audacity 1.2.6](#) is a stable release, complete and fully documented. You can have both Audacity 1.2.6 and 1.3.3 installed simultaneously.



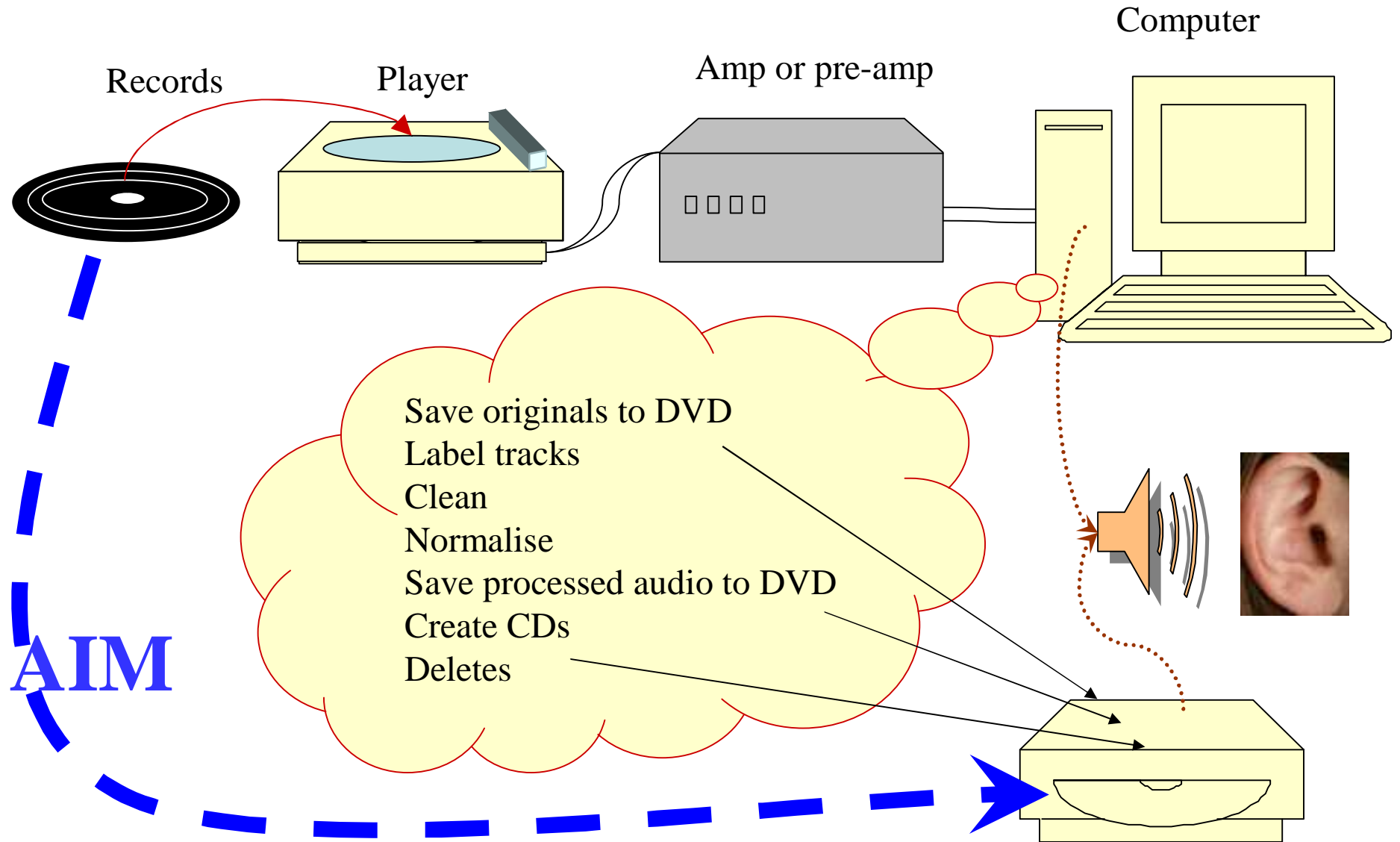
[Download Audacity 1.2.6](#)

for Microsoft Windows

[Download Audacity 1.3.4 \(Beta\)](#)

...Introduction...

System

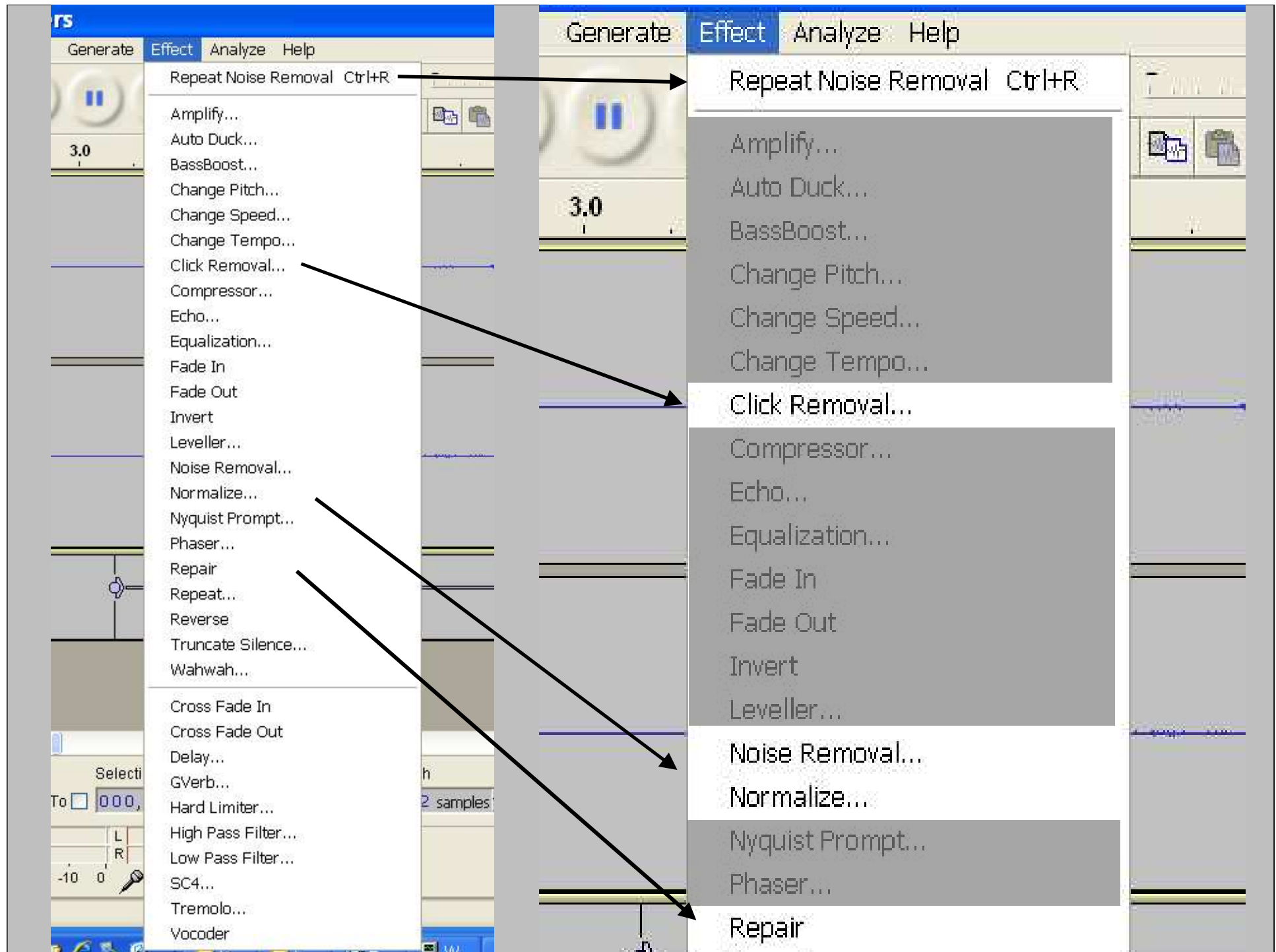


... Introduction ...

Audacity Demo & Some Remarks

- audio waveform
- noise removal
- noise sources, types & treatment
- Digital audio standards - CD & capture
- Hardware issues
- Organising the work & workflow
- More Audacity features
- The Final Product – CD & MP3
- Web Sites List

Audacity Demo



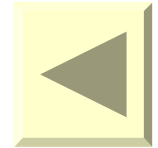
Audio Problems

- Improvements in Audio possible

- System noise – mains hum, fans, bearings.
- Surface noise
 - Characteristics depend on medium and surface speed
 - Varies from outermost to innermost track
- Dirt, scratches
 - Clicks & pops
 - Other

- Would require much effort

- Wear & distortion
- Speed Variation



Managing Audio Problems

- Trade-offs
 - Reduce magnitude (eliminate often not possible) - can generate artifacts
 - Effort v Result
- Automated methods in “Effect” menu
 - Noise Removal
 - Identify a noise sample
 - Decrease noise levels
 - Click & pop removal
- Manual – residual clicks, pops, scratches, etc
 - Identify problem area then:
 - “Effect” menu, repair (small samples – up to 127 data points = 3ms)
 - Edit audio data directly
 - Cut and paste
- Normalise – adjust amplitude so maximum is as set (I use -3dB)
 - Alternate method, can also adjust L-R balance

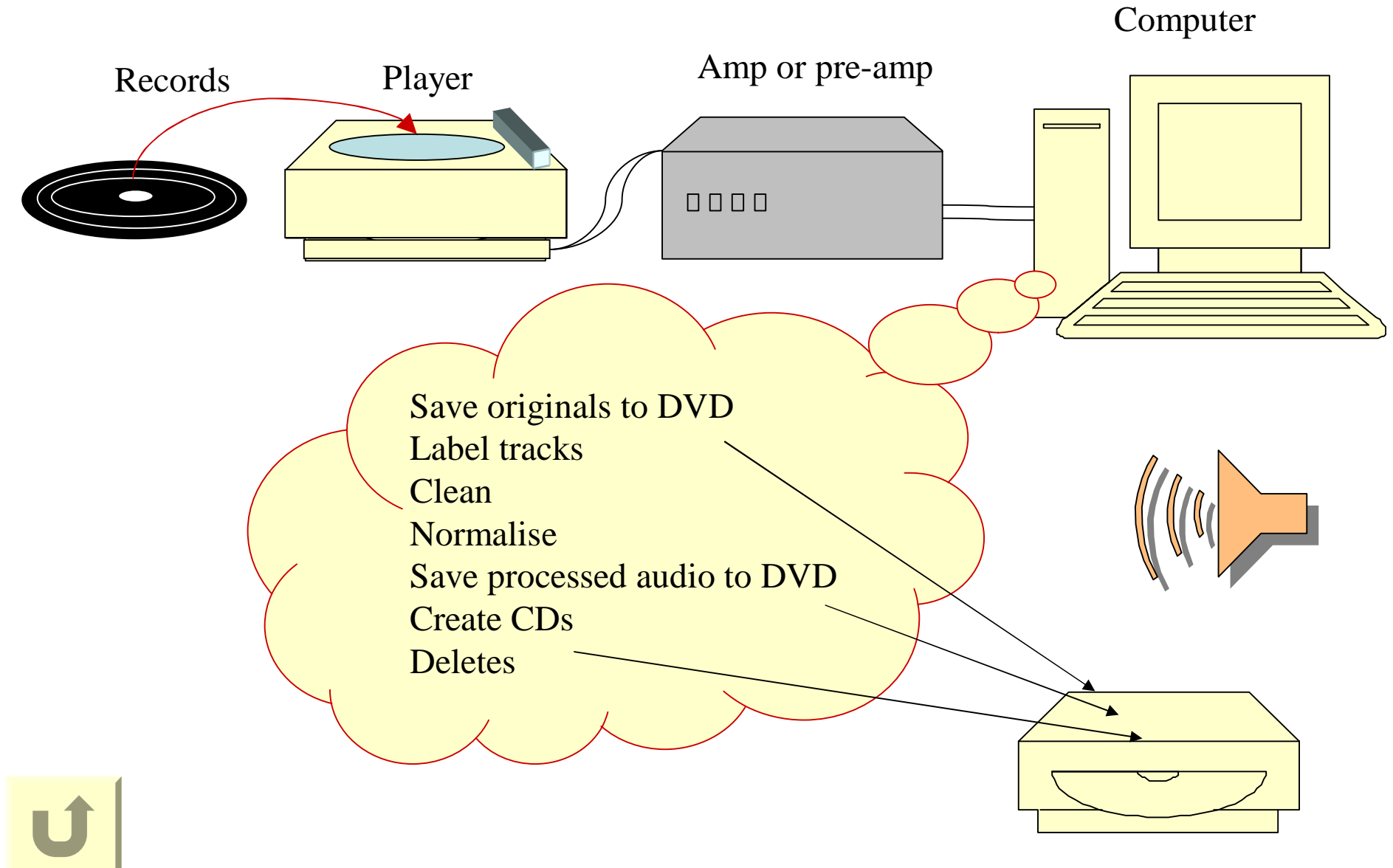
Digital audio standards

- A desirable end result is a CD you can play
- CD standard is 44,000 samples/second & 16 bits/sample
 - **Softest to loudest:**
 - One bit for the sign, so $\sim 2^{15}$ - ~ 32000 , or
 - 90dB ... less up to 20dB for technical reasons
 - Human hearing is up to 100dB, LPs are up to 110dB
 - **Real issue is fidelity in quiet passages (say -20 to -40 dB)**
 - -36dB means at least the top 6 bits are 0
 - leaves 9 bits for small changes in level – ie steps of 1/512th.
- Lose bits when recording and editing – eg 2-6
 - **Can record in “32 bit float”**
 - ie allows loss of 16 bits before CD standard reached
 - **Save CD result as 16 bit .WAV (PCs) or .AIFF (MACs)**

Hardware Issues

- Noise & fidelity
 - Electronic
 - Turntable bearings etc
 - Needle & Cartridge
 - Record
 - Speakers
- Electronics
 - Amplification
 - pre-amp and correction
 - Signal to sound card (clipping)
 - Sound card
- Record Player adjustments

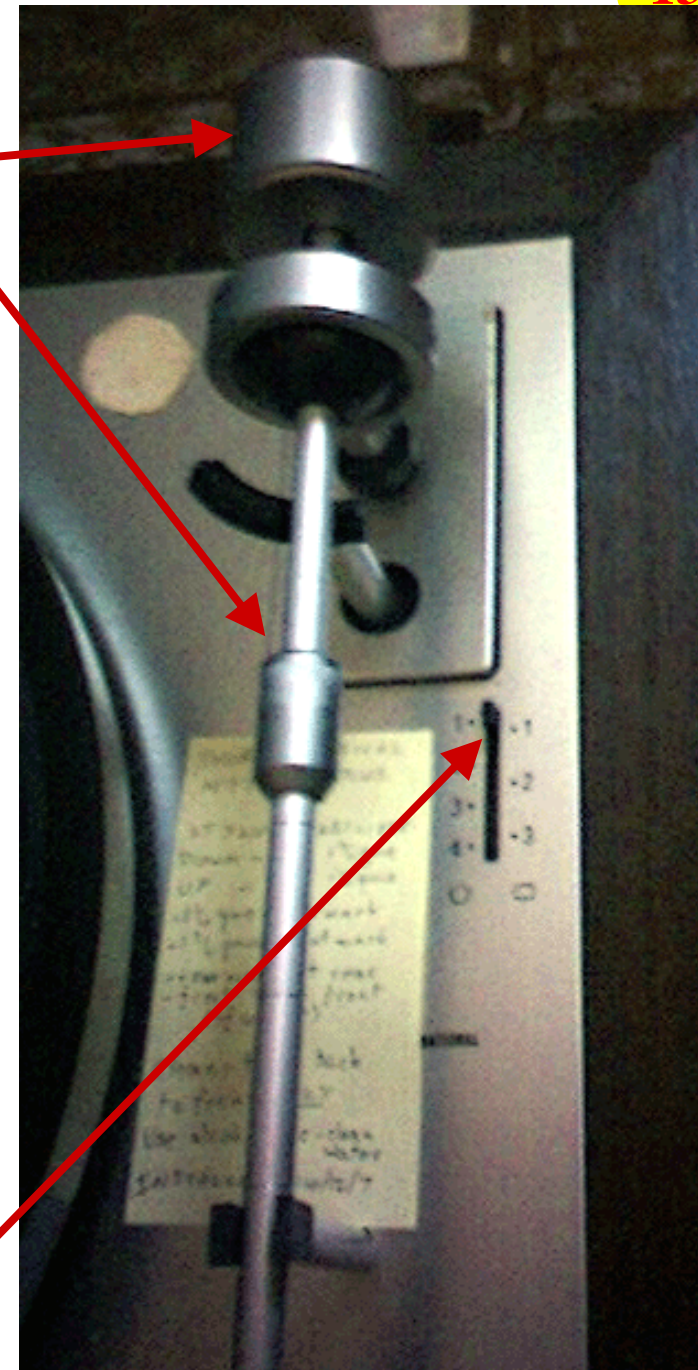
System



Turntable & Tone-Arm

Counter-weight

Adjusting weight



Side force

Another Turntable

Only weight adjustment available
Side force = adjustment weight

Speed check disk

Counter-weight



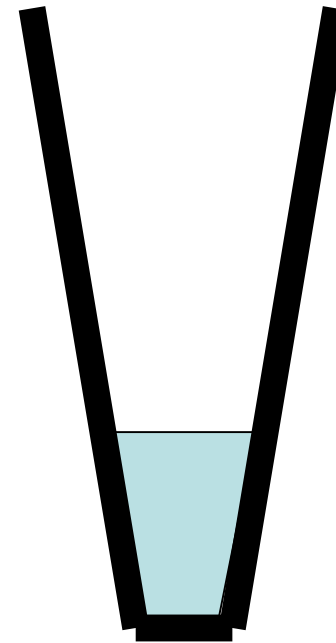
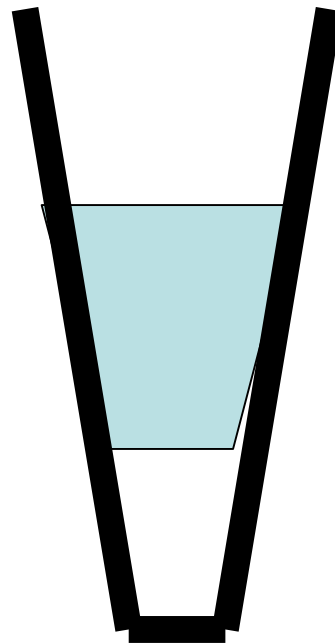
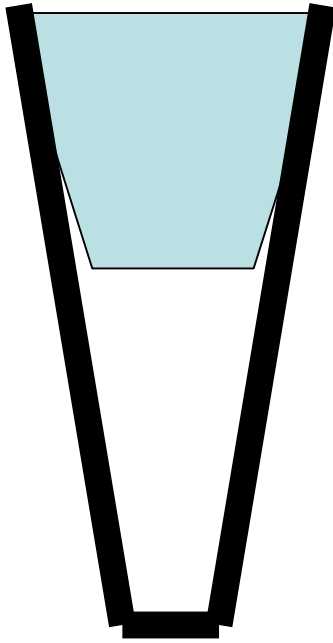
Speed Check Disk



Records

- Cleaning
 - Soak in warm water and CHEAP (unscented) washing up liquid, & dry with microfibre cloth
 - Can use iso-propyl alcohol – NOT ON SHELLAC (78s)
 - Play record when dry, but while residual dirt is still soft
 - Static – carbon fibre brushes
- Grooves
 - Standards include: Early (78s, 45s) & Microgroove (45s, 33s)
- Require different needles
 - If needle too small, it will bottom in the groove
 - may read dirt, detritus, and unwritten surface
 - May rattle from side to side
- Modern needles sit lower in the groove
 - More likely to find un-damaged/un-worn surfaces

Needle Positions

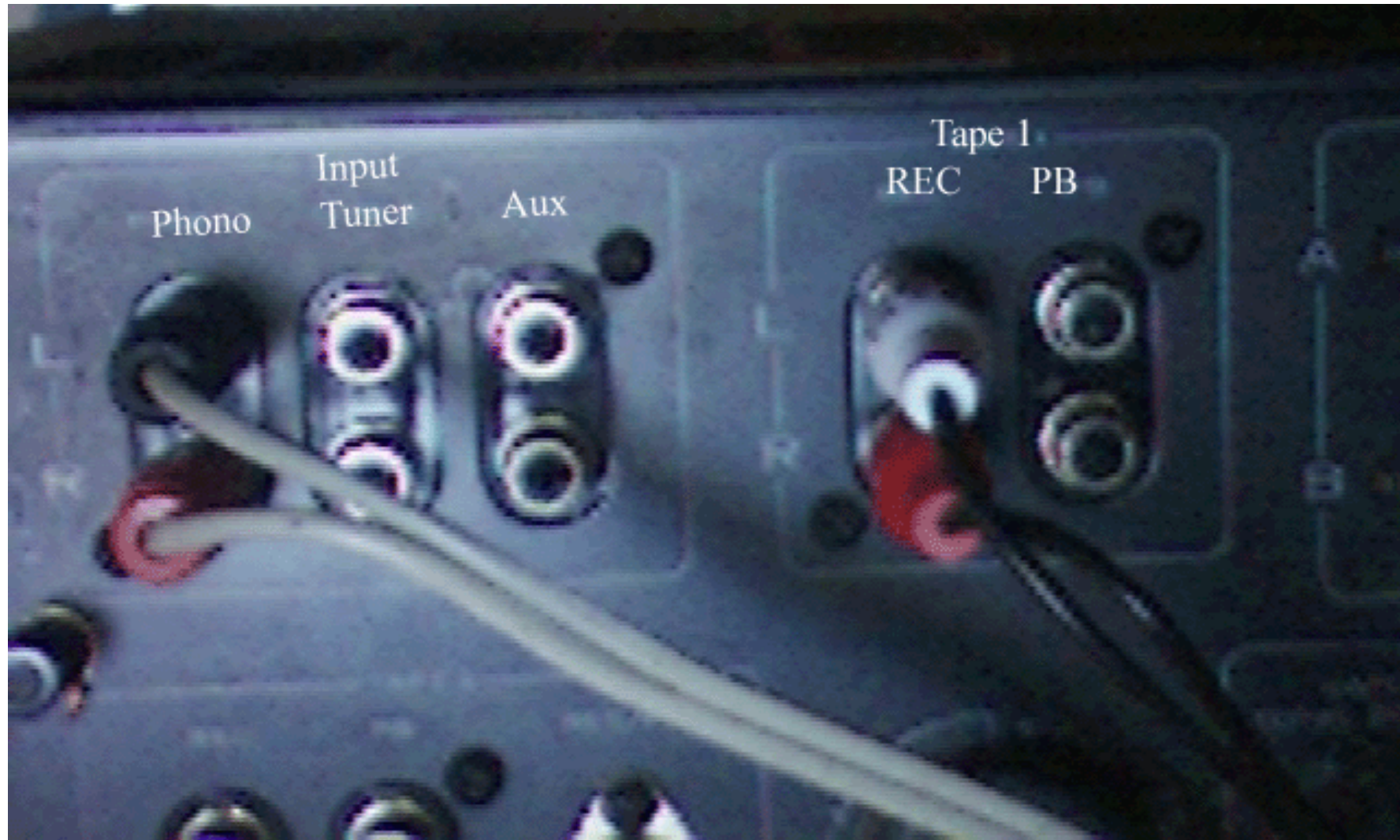


...Hardware Issues - Electronics...

Interconnections

- Connecting the player to the amplifier
 - Use the record or phono input
 - Signal voltage, bias correction
 - May be separate input, and/or a switch setting, espec if choice of moving magnet or coil cartridge
- Connecting the amplifier to the sound card – use:
 - amplifier Playback output (eg “to tape” or “REC”); or
 - if signal level is too high use headphone jack & reduce volume
- Reduce electronic noise with earthed shielded wire and battery powered devices
 - But consider if it is worth the effort!

Amplifier Connections



PC Connections



...Hardware Issues...

Digital Media

- Reliability & lifetime
 - Cheaper can be poorer
 - Even high cost not good for indefinite storage
 - Technological evolution
 - Floppies, CDs (500x), DVDs(8x), Blu-ray(8x), ...(20x), ...
- Leads to:
 - Strategy for back-up/archive/redundancy
 - Expect to migrate material again in the future
 - (Useful for software evolution too!)

...Hardware Issues...

Electronics

- Sound card
 - Functions available in:
 - Motherboard chipset ... often inadequate
 - Add-on Video board ... good
 - Add-on sound card ... very good
 - Offboard ... excellent
 - Issues:
 - A-D conversion (& D-A)
 - Bit depth – 32 bit
 - Noise

Organising the work, & workflow

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- Groups
 - 5-6 LPs – fit on a DVD
- CDs – 1 or 2 LPs each
- Disk space
 - 32 bit audio file typically fills 20Mbytes/minute
 - LPs often 30-45 mins (2 sides) – 600-900Mb
 - Original + cleaned + CD versions – to 2.2GB, + zips

 - Large files are created, moved & deleted, so De-fragment from time to time
 - My computer;R click relevant drive;properties;tools;de-frag

Time taken for one LP:

<u>Activity</u>	<u>Approximate Time</u> <u>(mins)</u>
Clean record (I spread this over hours)	10
Read in (both sides)	30-45
Enter labels	5
Clean using automatic processes	40
Manual clean	15-50-...
Saves	10
Write to CD, and produce cover	10-20+
Other	10
Total	130-180+ -...

Based on an AMD XP1400+, 1GB RAM, 7500 rpm ATA disk (80Mb/s), and my standards etc

...Organising...

“Paperwork”

- I use Access, but Excel should also be OK
- List your records
 - Title, genre, genre characteristics
 - Other characteristics – speed, mono/stereo/...
 - Group, CD no
- Progress
 - Playable, Cleaned, Digitised, (...from table)

Directory Structures

- My Documents

- My Music

- Records

- Group #

- ... working area – all ongoing
Audacity files

- » Originals

- ... 32 bit wav storage until the group
is finished

- » CD #

- ... 16 bit wav & cover storage until
the CD is finished

- » DVD ready

- ... Audacity & cover storage until
the group is finished

- » Ready to Delete

- ... storage until the group is finished

- Group xxx ...

...Organising...

Compressing

- Wav files compress well – to 30-40%
- Audacity files poorly – to perhaps 85%
 - Data held in subdirectories with files of 1KB
 - Benefits primarily lie in ability to organise, move and access material easily
- 7z provides good visual access and adjustable packing

More Audacity Features

- Speed control
- Fades, envelopes
- Labels (more slides later)
 - Splitting a recording – find silence
 - Import/Export
 - Saving as multiple wav files
- Selection blocks & units
- Preferences
- Input options

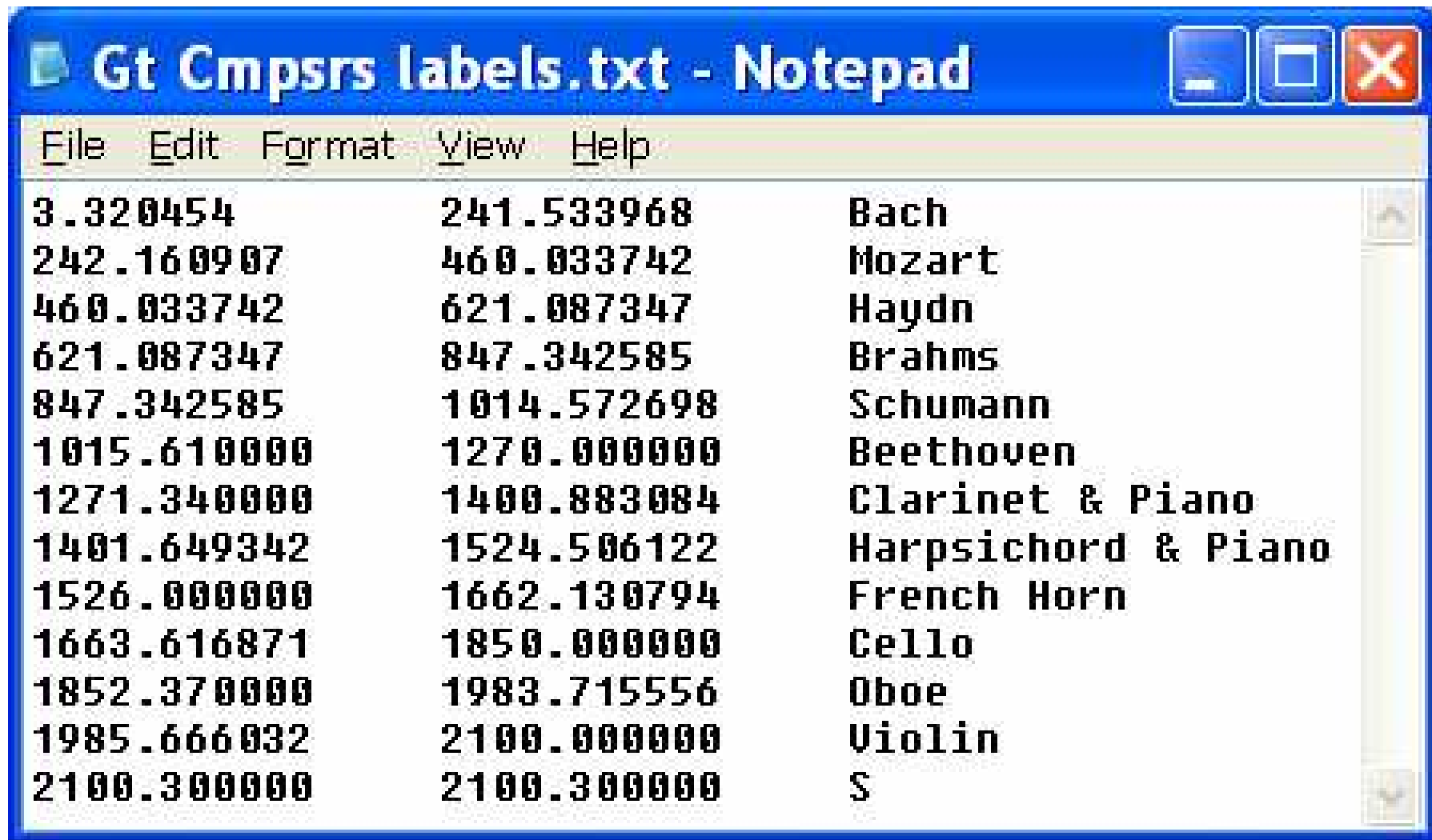
More Audacity Features

DON'Ts

- DON'T
 - Use “view all” with a full LP
 - Gobbles up time
 - View much more than “normal” (full LP)
 - Expect to work well on concurrently open pieces

...Audacity...

Exported Labels



```
Gt Cmpsr labels.txt - Notepad
File Edit Format View Help
3.320454      241.533968      Bach
242.160907    460.033742      Mozart
460.033742    621.087347      Haydn
621.087347    847.342585      Brahms
847.342585    1014.572698     Schumann
1015.610000   1270.000000     Beethoven
1271.340000   1400.883084     Clarinet & Piano
1401.649342   1524.506122     Harpsichord & Piano
1526.000000   1662.130794     French Horn
1663.616871   1850.000000     Cello
1852.370000   1983.715556     Oboe
1985.666032   2100.000000     Violin
2100.300000   2100.300000     S
```

Create labels using Excel

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C
1	Start	Finish	Title
2			
3	=B2		
4	=B3		
5	=B4		

The formula bar at the top shows the active cell is A1, containing the text "Start". The "Formula Auditing" task pane is open at the bottom, showing the text "Formula Auditing".

Writing to CD or MP3

- Proprietary burners
 - Nero
 - B's clip
 - ...
- Media player
- Cover material
- BonkEnc (MP3 encoder)
 - One of many ... chosen at random

B's Recorder GOLD - New Project

File Edit View Disc Record Tools Help



B's Recorder
GOLD
BASIC

Folders

- Desktop
- My Documents
- My Computer
- My Network Places
- Recycle Bin
- A-D Wedd
- Briefcase-I
- Dont work
- Handy bits
- IPAQ
- MS trash

- Archive
- Records
- MP3
- Sample Playlists
- My Playlists
- CDI list.mdb
- Music

B's Recorder GOLD BASIC

Welcome to B's Recorder GOLD!

Click one of the buttons below.
An explanation appears when you move the cursor over the button.

Data Audio CD VideoCD Copy Rip

Display wizard at startup. Options Close

Type: Blank
Used: 0.00

Track Type

For Help, press F1.

(E:) HL-DT-ST DVD-RAM GSA-4081B A100

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Cover Creation from Labels

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	A	B	C	D	E
1		<u>A Tribute to Glen</u>	<u>The Very Thought</u>		
2		<u>Miller</u>	<u>of You</u>		
3					
4	1.	Anvil Chorus	11.	You & The Night &	
5	2.	Greensleeves		The Music	
6	3.	Habanera	12.	Night & Day	
7	4.	Goin' Home	13.	The Very Thought of You	
8	5.	Anitra's Dance	14.	Autumn In New York	
9	6.	Londonderry Air	15.	Blues In The Night	
10	7.	Piano Concerto	16.	Clair de Lune	
11	8.	Jeannie With The Light	17.	La Mer	
12		Brown Hair	18.	Autumn Leaves	
13	9.	The Volga Boatmen	19.	Love Look Away	
14	10.	Battle Hymn of the Republic	20.	Vocalise	
15					
16					
17					

Cover

A Tribute to Glen Miller

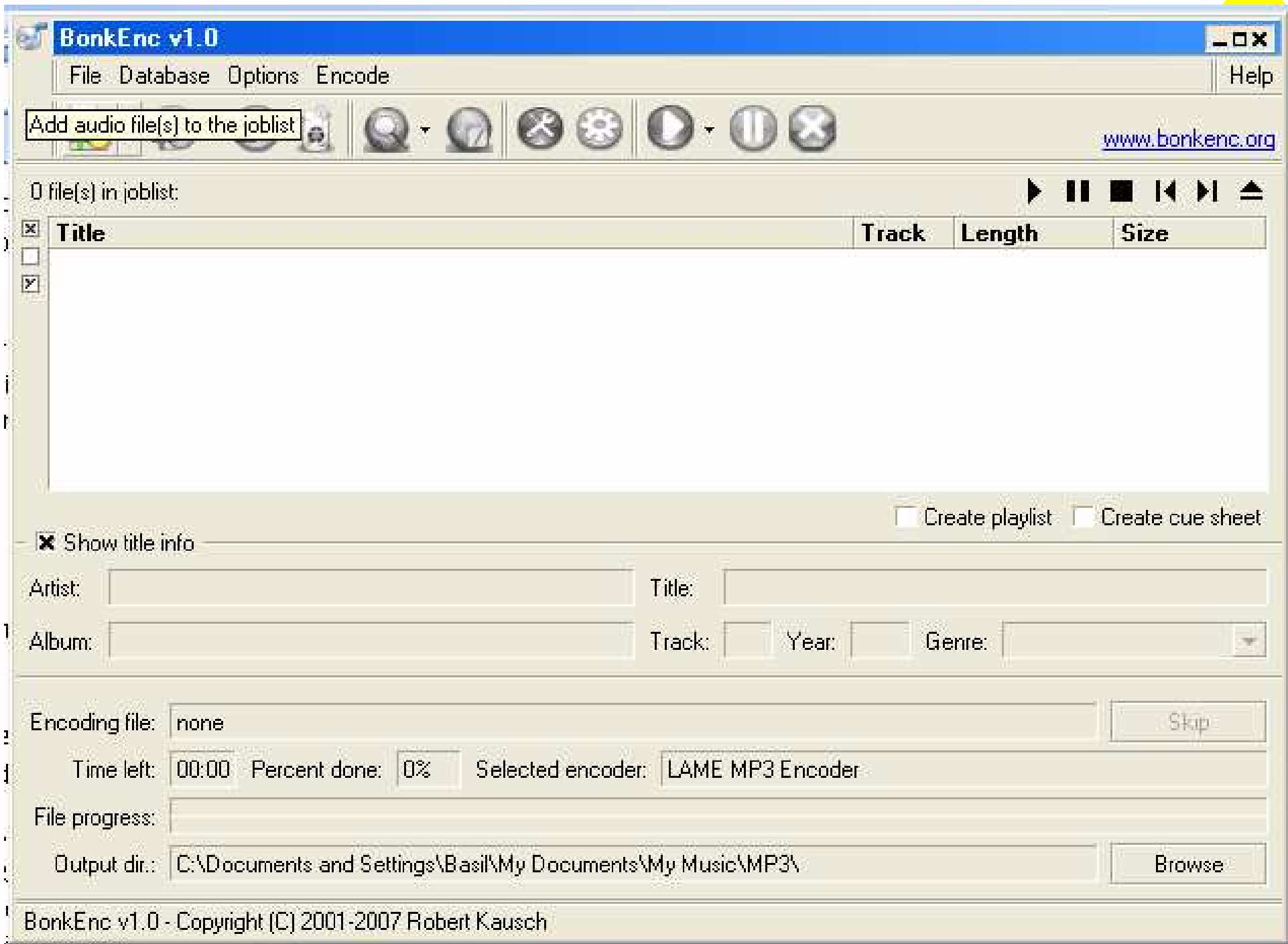
1. Anvil Chorus
2. Greensleeves
3. Habanera
4. Goin' Home
5. Anitra's Dance
6. Londonderry Air
7. Piano Concerto
8. Jeannie With The Light
Brown Hair
9. The Volga Boatmen
10. Battle Hymn of the Republic

The Very Thought of You

11. You & The Night &
The Music
12. Night & Day
13. The Very Thought of You
14. Autumn In New York
15. Blues In The Night
16. Clair de Lune
17. La Mer
18. Autumn Leaves
19. Love Look Away
20. Vocalise

Covers etc

- Other options include
 - scanning the record label to print on CD
 - Photographing sleeve and printing it
 - On cover
 - Directly
 - as backdrop
 - as multi-page
 - ...



BonkEnc v1.0

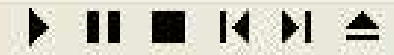
File Database Options Encode

Help

Add audio file(s) to the joblist

www.bonkenc.org

0 file(s) in joblist:



<input checked="" type="checkbox"/>	Title	Track	Length	Size
<input type="checkbox"/>				
<input checked="" type="checkbox"/>				

Create playlist Create cue sheet

Show title info

Artist: Title:

Album: Track: Year: Genre:

Encoding file:

Time left: Percent done: Selected encoder:

File progress:

Output dir.:

Some Web Sites

- <http://audacity.sourceforge.com/net>
- <http://www.wikihow.com/Change-Your-Records-Into-CDs>
 - Good comprehensive Wikipedia article
- http://www.delback.co.uk/lp-cdr.htm#record_play
 - Excellent article. Wider & deeper than most
- <http://www.restoring78s.co.uk/Index.htm>
 - Good for 78s in particular, but has general info too.
- <http://www.jacksmusicfactory.com/default.asp?aid=39>
 - “The Book of Shure Needles” - Hints on Tone-arm, Stylus, etc
- <http://www.shure.com/PersonalAudio/Products/Phono/HowPhonoCartridgesWork/index.htm>
 - How cartridges work
- <http://members.ozemail.com.au/~mawd/TVS-1.htm>
 - Spruiks a cleaning solution that I’ve been told is quite good
- <http://www.sourceforge.net/projects/bonkenc>
 - MP3 encoder