Types of Sound and Music Programs

A. Sound programs

a. Sound players. All desktop computers now being sold include a sound player program (such as *Windows Media Player* or *Quicktime*) that is capable of playing back digitized sound files in all the common audio formats (WAV, AU, AIFF, MP3, WMA, and MIDI). For older computers that don't have their own sound players, you can use freeware sound players, such as *WinAmp* (for Windows) and *GrayAmp* (for Mac), in the Windows and Mac software folders.

b. Sound recorders. All desktop computers now being sold include a sound recorder program that can record sound from a microphone or other sound signal source connected to the sound input jack on the back of the computer. For example, Windows machines are supplied with the simple *Sound Recorder*. There are many third-party sound recorder programs with additional features: for example *Audacity* (for PC or Mac) can record sounds and then save them the compressed MP3 format. See handout **B1-2**.

c. Sound editors: Third-party sound editor programs (such as *Audacity*) perform sound recording and playback, and additionally allow you to edit the sound file - deleting parts you don't want, coping and pasting, adjusting volume, applying equalizers and filters, and adding various special effects. The best of these (like *Audacity*) handle multi-channel sound for recording, mixing, and arranging high-quality performances. See handout **B1-2**.

d. CD recorder ("ripper") programs, that automatically read an audio CD in your CD-ROM drive, convert its tracks into MP3 files, and save to your hard disk. *MusicMatch* and *Windows Media Player 10* combine the functions of a sound player, CD ripper, and CD-R burner, plus it looks up CDs in the on-line CD Data Base (CDDB) for album names and song titles. See handout **B6**.

e. Sound visualizers. These programs display the frequency components of sound files. *Audacity* includes a Spectrum display option for this purpose. *SoundView* (for Mac) and *SpectroGram* (for PC) work in real-time and are fun to watch. Useful for understanding the structure of complex sounds.

f. Synthesizer programs. These complex programs are intended to create interesting sounds, for sound effects or for creating original electronic musical instruments.

B. Music programs

a. **MIDI players.** A program for playing MIDI files (file extension ".MID"): The better ones let you change the tempo, key, instruments, and the volume of each instrument. See *Sweet MIDI Player* in handout **B7**.

b. MIDI sequencers. These programs act like a multi-track recorder for MIDI-capable musical instruments, e.g. electronic keyboards, drum pads, or other instruments that can hook up to the computer. They allow you to recored each track separately, then play them back all at once, adjusting the balance, tempo, key, and instrumentation as desired: a kind of electronic "one-man (or one-woman) band". Example: *PowerTracks* in the "Windows software" folder.

c. Music notation programs/Score editors: These are programs for writing (composing) music in Common Music Notation and printing out the sheet music. Most can save and play in MIDI format. One of the most famous is *Finale*. A demo version of a simpler program from the same company, *Finale Allegro*, is included in the Windows and Macintosh software folders.

d. Music accompaniment generators. These programs generate the sound of a "rhythm section" or "backup band" (e.g. piano, bass, drums, guitar) to accompany a solo performer or singer. You type in the chords to the song and choose from a list of hundreds of available styles (e.g. jazz, rock, pop, country, latin, reggae, swing, etc). Useful for for composing songs and practicing improvisation. Example: *Band in a Box* (in "Music accomp. program" in the Windows and Mac software folders).

e. Karaoke programs. A karaoke player program will read karaoke songs in .KAR format and display the lyrics synchronized with the music accompaniment. See "Computer Karaoke", handout **B7-8**.

Six different ways to represent 50 seconds of music as a computer file

(J. S. Bach's *Two Part Invention, #8*)

These files are stored in the "Sound file examples" folder on the Workshop CD-ROM

Formats based on sound waves:

TwoPartInvention.wav
8,685 KBytes (over 8 megabytes). A digital sound recording, in "Windows PCM (.wav)" format, digitized in stereo, 16 bits, 44 KHz sampling rate ("CD quality"). This is the largest file format. To listen to this file, just double-click on it; most modern computers have a sound player application that can handle this format. (File size calculation: 2 channels X 2 bytes/sample X 44,000 samples/sec X 50 sec. = 8600 kbytes).

TwoPartInvention.au
4,343 KBytes (over 4 megabytes). A digital sound recording, in ".au" format, digitized in stereo, 8 bits, 44 KHz sampling rate. This is about half the size of a 16-bit sound file (TwoPartInvention1.wav) but it sounds noisier because of the 8-bit digitization. To listen to this file, just double-click on it; most modern computers have a sound player application that can handle this format. (File size calculation: 2 channels X 1 byte/sample X 44,000 samples/sec X 50 sec. = 4300 kbytes)

TwoPartInvMono8bits11KHz.wav
546 KBytes. A digital sound recording, in "Windows PCM (.wav)" format, digitized in mono, 8 bits, 11 KHz sampling rate. This is an attempt to reduce the size of a WAV file by sacrificing audio quality. Note the poor sound quality, compared to the mp3 file (below) that is not much larger. To listen to this file, just double-click on it; most modern computers have a sound player application that can handle this format. (File size calculation: 1 channel X 1 byte/sample X 11,000 samples/sec X 50 sec. = 550 kbytes)

TwoPartInvention.mp3
789 KBytes. A digital sound recording, digitized in stereo, 16 bits, 44 KHz sampling rate ("CD quality") and converted into the highly-efficient "mp3" format. Note that this format preserves almost all of the quality of the original .wav file but is less than one-tenth the size. To listen to this file, just double-click on it; most modern computers have a sound player application that can handle this format. (The file size is about 1 MByte/minute). **TwoPartInventionReverb.mp3** is the same file with a reverberation effect added using *Audacity*.

Formats based on musical notes:

TwoPartInvention.mid
5 KBytes. A MIDI file contains only the notes used in this music; it does not record the actual sound of a particular performance. When the computer plays the file, it combines the musical note information in the MIDI file with the sounds of musical instruments stored in the sound card to produce a performance of that piece. Because the instrument sounds are not in the file, it is a very compact format (almost 2000 times smaller than a CD-quality digital sound recording of this piece in WAV format). To listen to this file, just double-click on it; modern computers have a sound card that can handle this format. "TwoPartInvention.mid" was created by typing in the notes into a score editor program and saving in MIDI format; "InventionLive.mid" is the same piece recorded live by a pianist playing on a MIDI-interfaced piano. Can you hear the difference?

TwoPartInvention.etf
124 KBytes. A score editor document created by entering the notes into the *Finale Allegro* score editor program and saving it as an ETF (Enigma Transportable Format) file. This is essentially the "sheet music" for this piece, including not only the notes themselves but also the staves, clefs, note stems, title, and other details of music typography. Note that it is larger than the MIDI file but much smaller than any of the digital sound recording formats. You won't be able to open up this file unless you have installed the *Finale Allegro* program (the installer is in "Finale Allegro score editor" in the "Windows software" folder). (Any computer can open up and print **TwoPartInvention.pdf**, the *Adobe Acrobat* version, but the computer can't play the PDF file.)

Sound and Music File Formats

A. Formats based on sound waveforms

These formats are essentially digital sound recordings - the digital equivalents of tape or disk recordings. You can easily make your own digital sound recordings using only a microphone and a sound recorder or editor program. A digital sound recording may be *mono* or *stereo*, have *8* or *16* bits, and may have any of several *sampling rates*. When you digitize your own sounds using a sound recorder program, you can choose these parameters. Each of these have an influence on the size of the resulting computer file and on the quality of the sound. Stereo recordings have two channels (left and right) and take up about twice the disk space of a mono (single channel) recording. A 16 bit recording takes about twice the disk space of an 8-bit recording, but the sound quality and dynamic range is better. The most common sampling rates are 11, 22, and 44 KHz; the larger the sampling rate, the larger the file size and the better the audio fidelity. For the best sound quality for music, use 16 bits and 44 KHz. Voice recordings can get by with 22 or even 11 KHz in order to produce smaller files.

Non-compressed formats: Some examples are WAV, AU, and AIFF. These files are often very large. A 3-minute song of CD-quality music (stereo, 16 bits, 44 KHz sampling rate) may take up 30 Megabytes. These file types can be played by virtually all current sound players. A sound editor program such as *Audacity* can read and write and convert between these formats.

MP3 (compressed) format: This format uses compression to reduce the file size of a digitized recording without degrading the audio quality. A 3-minute song song of CD-quality music (stereo, 16 bits, 44 KHz sampling rate) may be only about 3 Megabyte MP3 file. Some recorder programs that can record sound files directly in MP3 format or can convert non-compressed sound files into MP3. You can also use a CD-recorder program (such as *MusicMatch*) to automatically read an audio CD and convert its tracks into MP3 files and save them on your hard disk. MP3 files can be played by your computer's sound player or on portable MP3 players. *Audacity* can read and write MP3 format files.

B. Formats based on musical notes

These formats specify the music notes played in a musical performance. They are the digital equivalents of sheet music; they do not record the actual sound of a particular performance. These formats are used mainly for instrumental music.

MIDI format (file extension ".MID"): This is the most generic note-based format. It includes the notes, their duration and loudness, and the instruments used. MIDI files are very compact compared to the sound-based files of the same music - much smaller than any other format; a 3-minute song may be only a few Kbytes (v.s. a few Mbytes as an MP3 file). MIDI files can be played by most sound players of contemporary computers (e.g. MediaPlayer, Quicktime, WinAmp). The sound quality depends on the quality of the computer's sound card. Very old computers may not be able to play MIDI files. Some MIDI players allow you to change the tempo, musical key, and the instruments assigned to each part. To *record* a MIDI file, you need to have a MIDI-capable musical instrument, e.g. a keyboard, drum pad, or other instrument that can hook up to a computer running a MIDI sequencer program. With good-quality MIDI instruments, every nuance of a performace is recorded into the MIDI file: the exact phrasing, dynamics, and expression of each individual note, the action of the sustain pedals, pitch bends, etc.

Score editor formats: These are the proprietary formats of score-editor programs such as *Finale*. In addition to the notes and durations, these formats include the details of score typography (staves, clefs, stem directions, joined note tails, etc.). Using a score editor program, a musician can write music from scratch, then hear it played by the computer, print out the score parts, and save it as a MIDI file. However, a MIDI file created from a score will not have all the performance nuances of a live MIDI recording. For example, in the "Sound file examples" folder, compare "Moonlight1.mid", created from the score, to "Moonlight2.mid", created from a live recording on a MIDI piano. The notes and the tempo are exactly the same; can you hear a difference? Listen carefully - one sounds more mechanical and lifeless; the other sound more alive.

KAR format: A specialized format used for karaoke; it includes the song lyrics and the music accompaniment, often in MIDI format. A MIDI-karaoke player application (e.g. *WinKaraoke* in the "Windows software" folder) will read this format and display the lycics synchronized with the music accompaniment.

Setting up a home theater system for movies and music

The highest-quality movie viewing experience in the home is the DVD (Digital Video Disk). The picture and sound quality of a DVD movie is much better than a VCR tape and even better than most cable. DVD movies usually include interesting extra material that is not available anywhere else: "behind-the-scenes" documentaries, interviews with the actors and director, deleted scenes, etc. DVDs usually have easy-to-read subtitles in various languages and sometimes even audio tracks in other languages. In the last two years, the cost of DVD players have dropped dramatically.

1. DVD player. Most current DVD players now being sold will play DVD movies, audio CDs, and MP3 disks, and many models will also play disks with JPG photo files and homemade video disks in VDC and SVCD format. Some models are selling for as little as $30. Prices are dropping, so shop around. Look for models that play all the disk formats (DVD, DVD-R, DVD+R, audio CD, CD-R, MP3, VCD, SVCD, JPG), and that have "progressive scan" and (ideally) a volume control on the remote control. Combo DVD and VCR players are also sold.

A recent development is the introduction in 2006 of the first high-definition (HD) DVD players and the release of the first HD movie titles. These give much higher picture quality that standard DVD players when viewed on a high-definition TV set. However, there are two competing standards, *HD-DVD* and *Blue-Ray;* it is not clear yet which one will become the standard in the future. Wait for the dust to settle and for prices to come down.

2. Television: You can use any TV with an external video input. If your current TV has an extra video input that is not currently being used by your VCR player, you can use the unused input for a DVD player. (If your TV has no video inputs, you can buy a low-cost "RF modulator" that will allow you to connect a DVD player, but if your set is that old, you'll get a better picture if you buy a new set). Wide-screen flat-panel sets, both the LCD and plasma types, are getting cheaper all the time and are available is several sizes in the $1200-2000 range. A high-definition (HD) model is best, but you must also upgrade your cable TV service to HD, which will cost a few extra dollars per month. And remember that most DVD movies currently are not yet HD.

If an HD plasma screen is too much for your current needs, you can save a lot of money by buying a flat-*screen* (rather than a flat-*panel*) model - flat screen models look great and are *much* cheaper that flat-panel screens: 27" flat-screen sets go for about $250 -300 at any of the local consumer electronics stores (*Circuit City, Best Buys, Costco, Sam's Club*, etc). Make sure that you buy one with at least *two rear AV inputs* (for connecting the VCR and the DVD). (It's also nice to have a *front AV input*, for temporarily connecting a video or digital still camera to view on TV). New models are always coming out, and thankfully quality is going up and prices are going down all the time. Hint: *Ask the salesperson to show you how to switch between TV and the AV inputs*.

3. Speakers. For the best sound quality when playing DVD movies and music disks, add external speakers to your DVD player, rather than using the small speakers in the TV set itself. This also allows you to play audio CDs without turning on the TV. A good choice is a powered three-speaker system that has a "sub-woofer" (for bass sounds) in addition to small left and right side speakers. You can buy these at *Circuit City*, *Best Buys*, etc. *Altec Lansing* and other manufacturers make speaker sets that sound great and that cost only $20 - $40. Hook them up to the audio outputs on the back of the DVD player. You'll probably have to buy an adapter that will adapt the male 1/8" stereo phono plug on the speakers to the pair of female RCA jacks on the DVD player; you can get one at *Radio Shack* for about $5. (If you're planning to use external speakers hooked directly to your DVD player, choose a DVD player that has a volume control on the remote control, so that you will have a convenient way to control the volume when you are watching DVD movies or listening to audio CDs).

4. Hooking it up. Hooking it all up seems more complicated at first than it really is. There are three

ways to hook up a DVD to a TV. In the order of increasing video quality, they are:

a. Composite video. This is the simplest method. Most DVD players come with a cable that has a yellow male RCA plug at each end. You simply hook up this cable between the video output on the DVD player (usually colored yellow) and the video input on the TV (also usually colored yellow).

b. S-Video. If the DVD player has an S-Video output and your TV has an S-Video input, then you can get slightly better video quality by using an S-Video cable to connect these two rather than the composite video connection. You can buy as S-Video cable for about $10 at consumer electronics stores.

c. Component video. If the DVD player has component video outputs and your TV has component video inputs, then you can get even better video quality by using a component video cable to connect these two rather than composite or S-Video connection. A component video cable has three separate cables, each with a male RCA plug at each end. You can use three ordinary audio cables with RCA plugs. Make sure to match the inputs and outputs: connect the "Y" output to the "Y" input; "Pr" output to the "Pr" input, etc. Component video is required for high definition (HD).

d. Audio connections. No matter what video connection you use, you'll also have to connect the audio separately. On the back of the DVD player there will be two audio outputs: right channel (red) and left channel (white). Most DVD players come with an audio cable with color-coded RCA plugs for this connection. Use this cable to connect the DVDs audio outputs either to the TV's audio inputs (if you want to use the TVs little speakers) or to a set of external powered speakers, as described above in #3. For the best sound quality, use external speakers, and choose a DVD player that has a volume control on the remote control, so that you will have a convenient way to control the volume when you are watching DVD movies or listening to audio CDs.

5. Selecting the DVD player on the TV's remote control. Select the video input channel on your TV that corresponds to the input that the DVD player is plugged into. The procedure differs among TVs, but it is normally done by pressing the **VIDEO IN** or **INPUT** button on the TV's remote until you see the DVD player's picture appear on the screen. On some TVs this is done by pressing the channel change button to put the TV on the correct channel for the DVD player (often a channel below channel 2) or by pressing the video selection button on the TV set itself. Before you buy a TV set, it's good idea to ask the salesperson how to switch between regular TV and the external video inputs. If he has trouble with it, maybe you will to.

6. Surround Sound. For the ultimate listening experience when watching movies, add a surround-sound system to your DVD movie setup. These sell at consumer electronics stores for $100 - $500 under the name "Home Theater System" or "Surround Sound System". They consist of 5 or 6 speakers (center, left-front, right-front, left-rear, right-rear, and sub-woofer) and an amplifier that might contain also a DVD player. These are a bit time-consuming to install, because of all the speakers and wires that have to be placed around the room. For some people, this is overkill; the difference between a surround sound system and a simpler, cheaper external 3-speaker system is noticeable only on certain movies that make good use of the surround-sound capabilities.

Note: If your DVD movie skips, jumps, or breaks up, it might be dirty. Eject the disk and inspect it. If it looks dirty, clean it by washing it with clean water and drying it carefully with a clean dry soft towel. Wipe straight across the disk, not in a circle.