



Technology Institute for Music Educators

TI:ME COURSE 2A Advanced Sequencing

Syllabus, Workbook, and Appendices
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TI:ME 2B Advanced Sequencing – Syllabus

By Don Muro & Bill Purse

Objective:

The objective of Advanced Sequencing is to impart practical skills and knowledge to *In-Service Teachers* (ISTs) to allow them to integrate MIDI and digital audio sequencing effectively into teaching and learning. The course covers in-depth skills in sequencing, and ISTs will learn both MIDI theory and digital audio theory pertaining to sequence recording, editing, and playback. ISTs will leave with the necessary knowledge to make critical judgments about the appropriateness of selected music software and hardware for particular educational applications and various computer platforms. The format of the course alternates presentations with class activities, many of which serve to assess student progress. Satisfactory participation in class activities and successful completion of multiple final projects are required for certification. The prerequisite for this course is basic computer skills including using a computer keyboard, and using a mouse for pointing, clicking, dragging, and some exposure and experience in the use of any sequencing software. TI:ME Course 1A Electronic Instruments, MIDI Sequencing and Notation is strongly recommended as preparation for this course.

Additional Information:

Advanced Sequencing is offered as either a two-credit or three-credit graduate course. Topics in ALL CAPS within topics need not be included in the course when it is offered for two graduate credits only. The instructor of the course must be approved by TI:ME and an expert in teaching music sequencing to in-service music teachers. It is strongly recommended that the class size be limited to allow for one IST per computer and no more than 16 ISTs per instructor. Additional ISTs may be accommodated if computer workstations and assistants are available. Each IST will need approximately 20 hours working alone on a workstation in order to complete the final projects and class activities and communication.

Hardware Requirements:

A computer lab/classroom consisting of multimedia computers connected to MIDI keyboards is the standard recommended configuration. Printers must be available for output of projects. The teacher's station should have a projection device and sound system to allow the instructor's screen to be viewed by the entire class. A minimum of 4 workstations must have multimedia capabilities and digital audio recording capabilities. When possible, a sound system connecting all MIDI devices in the room should be used to allow for class activities. One station (teacher's minimum) must be able to do hard disk recording and a audio mixer, 2 microphones, necessary cables and powered monitors. IST stations must be able to import and playback digital audio. Digital video capabilities are necessary for the three-credit course offering.

Software Requirements:

Sequencing software designed for professional musicians and educators should be used. The sequencer software used for projects must allow the recording and importation of digital audio. If the course is offered for three credits the software must also import digital video. Demonstration versions of low-end software packages designed for young students or amateurs should be used only in presentations to demonstrate software choices that are available in Appendix A.

Please Note: The activities in this syllabus often specify the use of specific scores and sequences that are provided in the course materials. Instructors may substitute other similar pieces for these activities.

Text:

The instructor may specify appropriate required text(s) in addition to the supplied TI:ME course resources.

Required

- Instructor specified sequencing text.
- *Technology Strategies for Music Education* by Thomas Rudolph, Floyd Richmond, David Mash, and David Williams; Published by Technology Institute for Music Education 305 Maple Ave. Wyncote, PA 19095 www.ti-me.org

Recommended Texts

The Art of Sequencing by Don Muro; Warner Bros. Publications U.S. Inc Miami (MMBK0029)

Quick Start Series, Home Recording by Bill Purse Warner Bros. Publications U.S. Inc Miami ISBN 0-7692-8617-8

Prerequisites: TI:ME Level One Certification, or completed a minimum of 2 courses in music technology, or comparable experience using music sequencing software with a Macintosh or Windows PC. TI:ME Course 1A Electronic Instruments, MIDI Sequencing and Notation is strongly recommended. This course is designed for the experienced computer user.

The outline is designed for 25-hour units on advanced sequencing within a 2-credit graduate workshop. Items in UPPERCASE can be added if the course is offered for 3 graduate credits.

Introduction: The primary objective of TI:ME 2A Advanced Sequencing is to impart practical skills and knowledge to in-service teachers (ISTs) to allow them to integrate MIDI/digital audio sequencing effectively into teaching and learning. The purpose of this course is to instruct ISTs in basic skills in using a high-end sequencing program. The instructor will also provide ISTs with the information they need to make critical judgments about the appropriateness of selected sequencing programs for particular educational applications. The format of this course alternates presentations with class activities, many of which serve to assess the participant's progress. In addition to satisfactory participation in class activities, final projects in sequencing are required for certification.

Objectives:

Procedural Knowledge:

(assessed via class activities, lesson plans and a final paper)

Final Sequences will be a minimum of thirty-two measures and at least six tracks.

- The IST creates two finished sequences. One sequence should be a transcription or an arrangement of a classical work. (See Appendix G for a list of suggested works.) The other sequence should be in a contemporary style using contemporary sounds and drum parts. This sequence could be a popular song from a show or performing group. One sequence project of your choice must include at least two tracks of digital audio in addition to a minimum of six MIDI tracks. (Sample audio files of public domain songs are available from the TI:ME web site.) The IST may sequence the included Star Spangled Banner as a song to add digital audio tracks [voice(s) and or acoustic instrument(s)].

Each sequence should include a brief journal (See Appendix M for content suggestions--two page minimum) containing a brief description of the sequence and the IST's artistic goals, specific problems and solutions, musical decisions regarding timbres, effects, etc.)

Two Lesson Plans

- The IST describes several ways to use sequencing software to enhance teaching and learning. This description will be in the form of two lesson plans that incorporate the MENC National Standards for music. (Appendix L includes a sample lesson planer.)

Declarative Knowledge

The IST demonstrates skills in using a MIDI/digital audio sequencing program to create dynamic, musical sequences in any musical style. The skills to be acquired include the following:

- Introduction to Advanced Sequencing
- History of Music Sequencing
- 1. Review of Basic MIDI Concepts
 - MIDI IN/OUT/THRU ports
 - MIDI channels
 - Channel voice messages (note on/off, pitch bend, aftertouch, program change, volume, pan, sustain)
 - Miscellaneous information – keyboards (multi-timbral capability, polyphony), MIDI interfaces (simple MIDI interfaces, multi-port interfaces, USB, etc.)
 - General MIDI
- 2. Review of Basic Sequencing Concepts
 - Types of sequencers (hardware, software, integrated)
 - Sequencer tracks and MIDI channels
 - SMFs
 - Loading song files into the sequencer
 - Transport controls (play, stop, pause, record, go to, loop, etc.)
 - Track parameters (volume, mute, solo, pan, transpose, and program)
 - Record modes (record, overdub, loop, punch-in, step time)
 - Sequencer display views (standard music notation, piano-roll, graphic, event list)
- 3. Review of Corrective Editing Techniques
 - Correcting wrong notes
 - Correcting rhythmic errors
 - Correcting dynamics
- 4. Creative Editing Techniques
 - Manipulating data on individual tracks (volume, velocity level, pan, brightness, vibrato, and pitch bend)
- 5. Using Quantization Effectively
- 6. Copying/pasting MIDI data
- 7. Adding Effects to MIDI Tracks (Definition and common uses of reverberation and chorus)
- 8. Creating a Balanced Stereo Image
- 9. Creating/Editing/Importing Drum Parts
- 10. Creating Tempo Maps (conductor tracks)
- 11. Creating a Notated Musical Score of a Sequence
- 12. Review of basic digital audio concepts
- 13. Adding Digital Audio to MIDI Sequences
- 14. Adding Effects to Digital Audio (basic types, outboard vs. Plug-ins)
- 15. Creating the Master Copy (CD, cassette; equipment needed, connections, etc.)
- 16. REVIEW OF BASIC DIGITAL VIDEO CONCEPTS (3 CREDIT COURSE)
- 17. INTEGRATING MIDI SEQUENCES WITH DIGITAL VIDEO
- 18. Sequencer Applications in the Curriculum & Classroom (composition, improvisation, arranging/orchestration, listening skills). Performance (accompaniments, practice tapes)

Introduction

The prediction of today's art of electronic music and sequencing dates back to 1624 when Francis Bacon, in his book New Atlantis, wrote . . .

“We have also sound-houses, where we practice and demonstrate all sounds, and their generation. We have harmonies, which you have not, of quarter-sounds, and lesser slides of sound. Diverse instruments of music likewise to you unknown, some sweeter than any you have; together with bells and rings that are dainty and sweet. We represent small sounds as great and deep; like- wise great sounds extenuate and sharp; we make diverse tremblings and warblings of sounds, which in their original are entire.”

“We represent and imitate all articulate sounds and letters, and the voices and notes of beasts and birds. We have certain helps which set to the ear do further the hearing greatly. We have also diverse strange and artificial echoes, reflecting the voice many times, and as it were tossing it: and some that give back the voice louder than it came; some shriller, and some deeper; yes, some rendering the voice differing in the letters or articulate sound from that they receive. We have also means to convey sounds in trunks and pipe, in strange lines and distance.”

Overview of Music Sequencing

A sequencer is a device that records the details or parameters of a musical performance as MIDI data and not as actual sound. These parameters can include the notes that were played, their dynamics and a general tempo. On playback, a sequencer will feed its stored MIDI information into an instrument capable of translating this information into a musical duplicate of the original performance. If you think of a player piano's use of the paper roll to store a musical performance, you can see how a sequencer uses its computer memory to store a musical performance. A sequencer also provides easy and extensive options for editing the recorded MIDI data such as transposition, quantization, surgical editing of note data without re-recording the source.

There are three basic types of sequencers, each with pros and cons:

- Software
 - Pros* – Easily to update, many edit and performance functions displayed simultaneously on a large computer screen, other software can be run on the computer
 - Cons* – need a computer to operate the sequencer
- Hardware
 - Pros* – easy to transport from classroom to classroom, rather inexpensive
 - Cons* – small display for edit and performance functions, may have limited space for storing sequences, need to use multiple disks for storage
- Integrated (MIDI Workstation)
 - Pros* – all in one, Keyboard, Drum Machine, Synthesizer Sounds, and Sequencer, transportable
 - Cons* - small display for edit and performance functions, limited song storage, generally a lower quantization level than software based

Introduction ii

Historical Developments in Music Sequencing

Table - 1

2nd Century, BC.	Greek Aeolian Harp was first automatic instrument. It was named for Aeoles, the Greek god of the wind. The instrument had two bridges over which the strings passed. The instrument was placed in a window where air current would pass, and the wind current activated the strings. The strings were all the same length and tuned to the same pitch the different string thickness, produced varying pitches.
1400s	Development of an organ-grinder-like instrument called the hurdy-gurdy,
1600	Athanasius Kircher, described in his book, Musurgia Universalis (1600), a mechanical device that composed music. He used number and arithmetic-number relationships to represent scale, rhythm, and tempo relations, called the Arca Musarithmica.
1700's	Hand-cranked street organs began life in the eighteenth century as little tiny hand-cranked table organ that were called serinettes (French for bird). They were designed to teach song birds how to sing lovely little songs.
1738	Mechanical singing birds and barrels organs popular, which had music composed by Mozart.
1796	Carillons invented that used slivers of steel, shaped, polished, tempered and then secured into a position where projections on a rotating cylinder could pluck at their free extremity,
1804	Panharmonium designed by Maelzel. Driven by air pressure and reproduced the timbres of traditional instruments. Beethoven wrote Battle of Vittoira for the Panharmonium, unfortunately it was not performed due to various technical problems.
1895	Boch and Wachter developed the calliope that used metal disks with holes punched into it to represent music.
1897	E.S. Votey invented the Pianola, an instrument that used a pre-punched, perforated paper roll moved over a capillary bridge. The holes in the paper corresponded to 88 keys of the piano. Openings in the paper roll sounded a note.
1920's	Givelet and Coupleux's Pipeless Organ. One of the first programmable analog music synthesizers. Seeburg, Wurlitzer and others were building the first electronic jukeboxes.
	Conlon Nancarrow – used the player piano as a medium for original composition. He laboriously punched out rolls by hand.
1951-53	Eimert and Beyer (b. 1901) produced the first compositions using electronically-generated pitches. The pieces used a mechanized device that produced melodies based on Markov analysis of Stephen Foster tunes.
1950's	MUSICOMP composition language developed for Lejaren Hiller and Leonard Isaacson's IBM Illiac 7090 computer at the University of Illinois – first significant work was a string quartet called the Illiac Suite. In addition

	the RCA Mark II Synthesizer used operating codes punched on cards or paper tape.
1956	Martin Klein and Douglas Bolitho used a Datatron computer called Push-Button Bertha to compose music. This computer was used to compose popular tunes; the tunes were derived from random numerical data that was sieved, or mapped, into a preset tonal scheme.
1960's	The transistor helps Don Buchla create an analog synthesizer with the first built-in sequencer.
Late 1960's	The Sal-Mar Construction was built. This instrument was named for composer Salvatore Martirano and designed by him. The Sal-Mar Construction weighed over fifteen hundred pounds and consisted of "analog circuits controlled by internal digital circuits controlled by the composer/performer via a touch-control keyboard with 291 touch-sensitive keys.
1970's	Analog and digital synthesizers featured built in real time sequencing capabilities (Fairlight, Synclavier, Linn Drum Machine, and Prophet). Roland produced the first digital sequencing device under control of a microprocessor.
1980's	Birth of MIDI implementation and growth of the personal computer. Yamaha DX-7 and Roland Jupiter 6 were two of the first synths to embrace MIDI. The birth of the MIDI workstation (sequencer, synth voices, drum sounds and a keyboard). Computers began to have sound cards and software control.
1986	Jam Factory written by programmer David Zicarelli. He was trying to create a program that would listen to MIDI input and 'improvise' immediately at some level of proficiency, while allowing (Zicarelli) to improve its ability.
Late 1980's	Music Mouse, written by Laurie Spiegel, was designed to be a stand-alone performance system. It may be used as a MIDI controller or as a performance station using the Macintosh internal sound. Unlike other programs for the Macintosh environment, Music Mouse was not intended to be used as a recorder/player program. Instead, the program enables the programmer to "play" the computer.
1990's	Sequencing is welcomed into the recording industry and performance side (especially pop music). Sequencers are refined as music notation, digital audio and video become integrated.

Historical Developments in Music Sequencing compiled in part from the books Experiencing Music Technology by David Williams and Peter Webster p351-352 (see bibliography) and Electronic and Experimental Music by Thomas B. Holmes p. 89-93

Class Activities

The instructor will briefly discuss the historical development of conventional music notation and notation technology.
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TOPIC #1 - Review of Basic MIDI Concepts

IST Objectives:

- 1) To understand that MIDI cannot transmit sound; why audio and MIDI cables are separate
- 2) To understand the functions of MIDI IN/OUT/THRU ports
- 2) To understand how MIDI channels operate
- 3) To understand the terms voice, polyphony, multi-timbral, and multi-port interface
- 4) To understand the MIDI channel voice messages most often used in sequencing.
- 5) To understand the General MIDI (GM) specifications.

Procedures:

1A) Review the definition of MIDI – a digital communication system that MIDI-equipped instruments and devices use to communicate with each other.

1B) Review the function of the MIDI ports: IN (receiver), OUT (transmitter), and THRU (exact MIDI data replication of In port data without any of the MIDI data generated by your instrument)

1) Review MIDI channels – 16 separate electronic pipelines that can transmit or receive different MIDI data streams simultaneously. A MIDI device set to a specific channel number will only execute MIDI data sent on a the same MIDI channel.

2) Review the following terms:

Voice – defines a complete sound programmed into an electronic instrument. This would normally include the sound timbre (oscillator), filters (see EQ glossary) and sound modifiers (LFO for vibrato or pitch modulation) in addition each voice can sound a variable amount of notes (this amount cannot exceed the total polyphony of the instrument). For example, a six-string acoustic guitar is a six-voice instrument; it can play up to six notes at once. An acoustic piano is an eighty-eight-voice instrument. The first synthesizers were one-voice (monophonic) instruments; only one key could be played at a time on a keyboard. As technology advanced, synthesizers with increased polyphonic capabilities were introduced: 4-voice instruments, 8 voice, and then 16, 32, and 64 voices. Most instruments manufactured today have at least 32 voices, this means that you can hear up to 32 different pitches at once.

Polyphony – the total number of voices (or individual notes) that an instrument can play at the same time.

Multi-timbral – an instrument or tone generator that can simultaneously play several programs (or sounds) on separate MIDI channels.

Multi-port MIDI interface – two or more separate sets of MIDI In and OUT parts. A 6x6 multi-port interface will allow up to six MIDI instruments to be connected to a computer, with all 16 channels available on each instrument (for a total of 96 MIDI channels). (Review various connection methods for MIDI interfaces – modem, printer, serial, parallel, USB, etc.)

3) Review the MIDI channel voice messages most often used in sequencing:
Note on/off – note names (usually C-1 to G8, where piano middle C is C3).

Also includes note on velocity ranging from 1-127. In sequencer edit mode, most note events contain five parameters: position within the song, note name, length (in ticks or pulses per quarter note), velocity and MIDI channel.

- *Program change* – a command that sets up a specific sound on a specific MIDI channel (review the two program numbering systems – 1-128 and 0 –127.)
- *Pitch bend* – a continuous controller that allows you to bend a note up or down. The most common range of pitch bend is +2 or - 2 semitones. Pitch bend messages offer 16384 possible settings within the pitch bend range. For example, if the pitch bend range is set to +/-2 semitones, then a value of “-8192” would produce a pitch change two semitones down. A value of “4096” would produce a pitch change of one semitone up.
- *Aftertouch* – aftertouch information is generated on many electronic keyboards by applying additional pressure to a key after it is depressed. As the key is pressed harder, more and more information is transmitted. (0-127). This information is commonly used to increase the brightness of a sound or to increase the amount of vibrato.
- *Modulation* (Continuous Controller #1) the modulation controller most often used to add vibrato to a sound. The control range is from 0 – 127.
- *Volume* (Continuous controller #7) the control range for volume (also called Main Volume) is from 0 – 127.
- *Pan* (Continuous controller #10) “Pan” is short for “panpot” which is short for “panoramic potentiometer”. The pan controller makes it possible to assign sounds to different positions in a stereo mix. The control range is 0 –127 where 0 is hard left, 64 is center and 127 is hard right.
- *Sustain footswitch* (controller #64) this controller is a switch controller – a value of 0 is off, and a value of 127 is on. (Some sequences may interpret any value between 1 and 63 as off, and any value between 64 and 126 as on.)

4) Review the following information about General MIDI (GM):

Why and how it was developed

Specifications (minimum)

- a) 24 voice polyphony
- b) 16 part multi-timbral capability (with dynamic voice allocation)
- c) 128 instrumental sounds and one drum kit (47 drum sounds)

General MIDI groups sounds into sixteen families, with eight instruments in each family) sometimes called octal mode.

Prog# Instrument**(1-8 PIANO)**

- 1 Acoustic Grand
- 2 Bright Acoustic
- 3 Electric Grand
- 4 Honky-Tonk
- 5 Electric Piano 1
- 6 Electric Piano 2
- 7 Harpsichord
- 8 Clav

(17-24 ORGAN)

- 17 Drawbar Organ
- 18 Percussive Organ
- 19 Rock Organ
- 20 Church Organ
- 21 Reed Organ
- 22 Accoridan
- 23 Harmonica
- 24 Tango Accordion

(33-40 BASS)

- 33 Acoustic Bass
- 34 Electric Bass(finger)
- 35 Electric Bass(pick)
- 36 Fretless Bass
- 37 Slap Bass 1
- 38 Slap Bass 2
- 39 Synth Bass 1
- 40 Synth Bass 2

(49-56 ENSEMBLE)

- 49 String Ensemble 1
- 50 String Ensemble 2
- 51 SynthStrings 1
- 52 SynthStrings 2
- 53 Choir Aahs
- 54 Voice Oohs
- 55 Synth Voice
- 56 Orchestra Hit

Prog# Instrument**(9-16 CHROM PERCUSSION)**

- 9 Celesta
- 10 Glockenspiel
- 11 Music Box
- 12 Vibraphone
- 13 Marimba
- 14 Xylophone
- 15 Tubular Bells
- 16 Dulcimer

(25-32 GUITAR)

- 25 Acoustic Guitar(nylon)
- 26 Acoustic Guitar(steel)
- 27 Electric Guitar(jazz)
- 28 Electric Guitar(clean)
- 29 Electric Guitar(muted)
- 30 Overdriven Guitar
- 31 Distortion Guitar
- 32 Guitar Harmonics

(41-48 STRINGS)

- 41 Violin
- 42 Viola
- 43 Cello
- 44 Contrabass
- 45 Tremolo Strings
- 46 Pizzicato Strings
- 47 Orchestral Strings
- 48 Timpani

(57-64 BRASS)

- 57 Trumpet
- 58 Trombone
- 59 Tuba
- 60 Muted Trumpet
- 61 French Horn
- 62 Brass Section
- 63 SynthBrass 1
- 64 SynthBrass 2

(65-72 REED)

65	Soprano Sax
66	Alto Sax
67	Tenor Sax
68	Baritone Sax
69	Oboe
70	English Horn
71	Bassoon
72	Clarinet

(73-80 PIPE)

73	Piccolo
74	Flute
75	Recorder
76	Pan Flute
77	Blown Bottle
78	Skakuhachi
79	Whistle
80	Ocarina

(81-88 SYNTH LEAD)

81	Lead 1 (square)
82	Lead 2 (sawtooth)
83	Lead 3 (calliope)
84	Lead 4 (chiff)
85	Lead 5 (charang)
86	Lead 6 (voice)
87	Lead 7 (fifths)
88	Lead 8 (bass+lead)

(89-96 SYNTH PAD)

89	Pad 1 (new age)
90	Pad 2 (warm)
91	Pad 3 (polysynth)
92	Pad 4 (choir)
93	Pad 5 (bowed)
94	Pad 6 (metallic)
95	Pad 7 (halo)
96	Pad 8 (sweep)

(97-104 SYNTH EFFECTS)

97	FX 1 (rain)
98	FX 2 (soundtrack)
99	FX 3 (crystal)
100	FX 4 (atmosphere)
101	FX 5 (brightness)
102	FX 6 (goblins)
103	FX 7 (echoes)
104	FX 8 (sci-fi)

(105-112 ETHNIC)

105	Sitar
106	Banjo
107	Shamisen
108	Koto
109	Kalimba
110	Bagpipe
111	Fiddle
112	Shanai

(113-120 PERCUSSIVE)

113	Tinkle Bell
114	Agogo
115	Steel Drums
116	Woodblock
117	Taiko Drum
118	Melodic Tom
119	Synth Drum
120	Reverse Cymbal

(121-128 SOUND EFFECTS)

121	Guitar Fret Noise
122	Breath Noise
123	Seashore
124	Bird Tweet
125	Telephone Ring
126	Helicopter
127	Applause
128	Gunshot

d) Channel 10 assigned to drums & percussion

General MIDI Percussion Key Map

MIDI Key	Drum Sound	MIDI Key	Drum Sound
35	Acoustic Bass Drum	59	Ride Cymbal 2
36	Bass Drum 1	60	Hi Bongo
37	Side Stick	61	Low Bongo
38	Acoustic Snare	62	Mute Hi Conga
39	Hand Clap	63	Open Hi Conga
40	Electric Snare	64	Low Conga
41	Low Floor Tom	65	High Timbale
42	Closed Hi-Hat	66	Low Timbale
43	High Floor Tom	67	High Agogo
44	Pedal Hi-Hat	68	Low Agogo
45	Low Tom	69	Cabasa
46	Open Hi-Hat	70	Maracas
47	Low-Mid Tom	71	Short Whistle
48	Hi-Mid Tom	72	Long Whistle
49	Crash Cymbal 1	73	Short Guiro
50	High Tom	74	Long Guiro
51	Ride Cymbal 1	75	Claves
52	Chinese Cymbal	76	Hi Wood Block
53	Ride Bell	77	Low Wood Block
54	Tambourine	78	Mute Cuica
55	Splash Cymbal	79	Open Cuica
56	Cowbell	80	Mute Triangle
57	Crash Cymbal 2	81	Open Triangle
58	Vibraslap		

e) Reverb and chorus effects (described in detail later)

f) Standardized use of controllers: 1 (Modulation), 7 (Volume), 10 (Pan), 11 (Expression), 64 (Sustain), 121 (Reset All Controllers), and 123 (All

Notes Off). The default settings for all 16 channels in GM mode are as follows:

Pitch Bend = 0

Pitch Bend Sensitivity = +/- 2 semitones

Channel Pressure (Aftertouch) = 0

Modulation = 0

Pan = 64 (center)

Expression = 127

Sustain = 0 (off)

Copies of the Level 1 Specification documents for General MIDI are available from the International MIDI Association, 5316 West 57th Street Los Angeles, CA 90056, (213) 649-6434.

Review the basic differences between GM, GM Level 2, GS, and XG

General MIDI Level 2 Specification

Introduction

General MIDI System Level 1 made great strides in the music industry by providing a platform for compatibility between device manufacturers and content providers. Still, many manufacturers felt there needed to be additional functionality. General MIDI Level 2 is a group of extensions made to General MIDI Level 1, which increases both the number of available sounds and the amount of control available for sound editing and musical performance. All GM2 devices are also fully compatible with General MIDI Level 1.

Portions of the MIDI Specification which have been enhanced include MIDI Tuning, Controllers, RPNs, and Universal System Exclusive Messages. Of particular significance are the new Universal System Exclusive Messages, including Controller Destination Setting, Key-Based Instrument Controllers, Global Parameter Control, and Master Fine/Coarse Tuning.

Summary of GM2 Requirements

GENERAL REQUIREMENTS

Number of Notes: 32 simultaneous notes

MIDI Channels: 16

- Simultaneous Melodic Instruments = up to 16 (all Channels)
- Simultaneous Percussion Kits = up to 2 (Channel 10/11)

SUPPORTED CONTROL CHANGE MESSAGES (Some Optional)

- Bank Select (cc#0/32)
- Modulation Depth (cc#1)
- Portamento Time (cc#5)
- Channel Volume (cc#7)
- Pan (cc#10)
- Expression (cc#11)
- Hold1 (Damper) (cc#64)
- Portamento ON/OFF (cc#65)
- Sostenuto (cc#66)
- Soft (cc#67)
- Filter Resonance (Timbre/Harmonic Intensity) (cc#71)
- Release Time (cc#72)
- Attack time (cc#73)
- Brightness (cc#74)
- Decay Time (cc#75)
- Vibrato Rate (cc#76)
- Vibrato Depth (cc#77)
- Vibrato Delay (cc#78)
- Reverb Send Level (cc#91)
- Chorus Send Level (cc#93)
- Data Entry (cc#6/38)
- RPN LSB/MSB (cc#100/101)

SUPPORTED RPNs (Registered Parameter Numbers)

- Pitch Bend Sensitivity
- Channel Fine Tune
- Channel Coarse Tune
- New! Modulation Depth Range (Vibrato Depth Range)

- RPN NULL

SUPPORTED UNIVERSAL SYSTEM EXCLUSIVE MESSAGES

- Master Volume
- New! Master Fine Tuning
- New! Master Coarse Tuning
- New! Reverb Type
- New! Reverb Time
- New! Chorus Type
- New! Chorus Mod Rate
- New! Chorus Mod Depth
- New! Chorus Feedback
- New! Chorus Send to Reverb
- New! Controller Destination Setting
- New! Scale/Octave Tuning Adjust
- New! Key-Based Instrument Controllers
- New! GM2 System On

GM 2 INSTRUMENT SOUND SET GM 2 PERCUSSION SOUND SET

GS – Extension of GM protocol developed by Roland. Important features:

- a) At least 226 instrumental sounds (can accommodate up to 16,384 sounds)
- b) More controllers available for greater control of sounds.

XG – Extension of GM protocol developed by Yamaha. XG features include:

- a) A minimum of 480 instrumental sounds
- b) A minimum of nine drum kits (each with up to 72 sounds) and two sound-effects kits
- c) Use of up to three simultaneous drumkits
- d) 32 voice polyphony
- e) 3 effects processors
- f) the capability of adding one or two audio signals.

Although the **GS** and **XG** supersets are more powerful than the original **GM** specification, they are not as widely available. The **GM** format should be used to guarantee maximum compatibility with other tone modules.

Follow-up

ISTs should be encouraged to ask questions about the material in this topic. It is important that they understand this material before advancing to other topics. Have the Ists visit the website Electronic Music Interactive (nmc.uoregon.edu/emi) for an overview of MIDI and the basics of MIDI systems.

TOPIC #2: REVIEW OF BASIC SEQUENCING CONCEPTS

IST Objectives:

- 1) To review the basic concepts of sequencing input
 - Real Time Recording
When recording difficult music passages tempos can be decreased for recording and then increased for playback.
 - Loop Recording
Especially useful for doing drum tracks.
Usually uses overdub mode that does not replace earlier recorded MIDI data as the loop repeats.
 - Step Time Recording
Recording advances when specified by the user one note or chord at a time. Note durations are preset then a MIDI note played to specify pitch and velocity data. Good for complicated rhythms and long passages in repetitive note values. All recording techniques can be used in a single sequence.
- 2) To review the three types of sequencers
 - Software
 - Hardware
 - Integrated -- MIDI Workstation (Controller Keyboard or Other, Drum Sounds, Sequencer, and Synthesizer Sounds)
- 3) To review the concept of sequencer tracks
- 4) To understand the purpose of the Standard MIDI File (SMF) format
- 5) To be able to load an SMF into a sequencer and to use the basic transport controls
- 6) To be able to adjust various track parameters
- 7) To be able to access different views of track data

Procedures:

- 1) Review the basic concepts of sequencing
 - a. Sequencer – a device that can record, edit, store and playback digital data, which represent a musical performance. (The term “digital” can include MIDI data as well as digitized audio).
 - b. Advantages of sequencing over to tape recording:
 - i. Independent tempo/key variables
 - ii. Easier recording techniques (recording at a slow tempo, step entry)
 - iii. Extensive non-destructive editing capabilities (easily modify a sound; pitch, start time, duration, volume level, and timbre)
- 2) Review the three types of sequences:
 - a. *Hardware* – a discrete component, which, in some cases, contains internal sound generating capabilities.
Pros: portability, price
Cons: small screen size
 - b. *Software* – a computer program, which enables a computer to function as a sequencer.
Pros: least expensive; greatest variety of features; uses computer monitor for large, color screen displays
 - c. *Integrated* – sequencers built into electronic instruments.
Pros: portability, convenience (both the sequencer and the tone module

are in the same product.)

Cons: relatively small viewing area; very few integrated sequences can record digital audio.

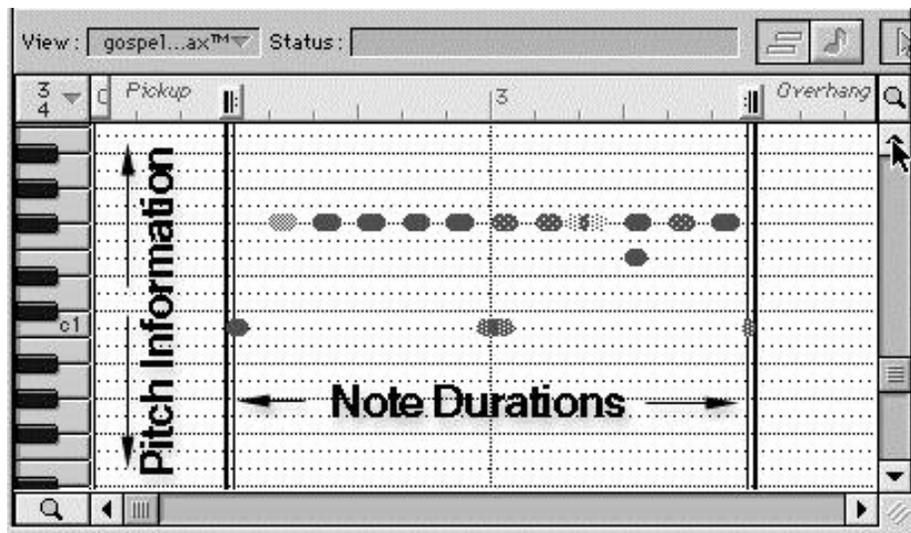
3) Review sequencer tracks

Compare sequencer tracks to tracks on a standard cassette tape. Cassette tapes are divided into four tracks or separate horizontal areas. Two tracks are for the stereo program on side 1, and the remaining two tracks are for the stereo program on side two. (The term “side” is a misnomer – only one side of the tape is used for recording and playback.) A track on a cassette tape is an area of the tape used to store specific audio information. (In this case, the information would be one of four possibilities: either the right channel information for side 1 or side 2, or the left channel information for side 1 or side 2.)

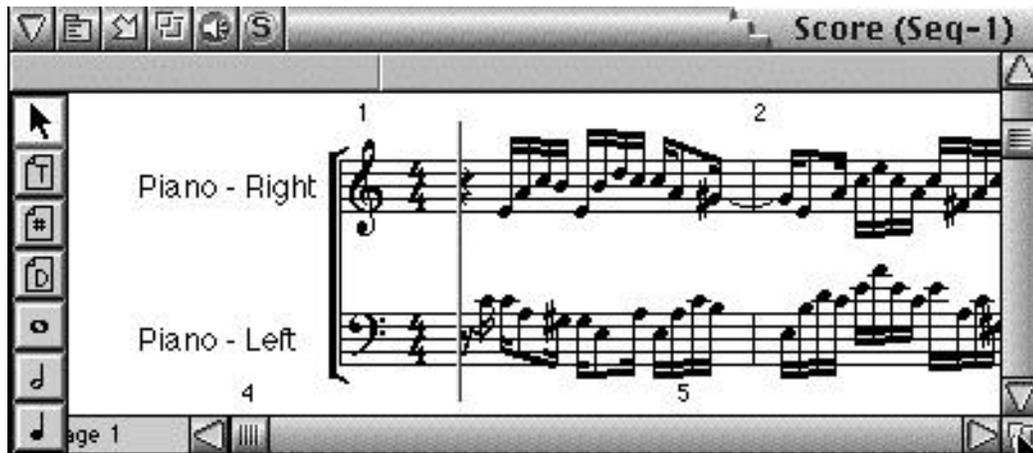
A sequencer track is an area of computer memory used to store specific information. When you record a MIDI track using a synthesizer bass sound, the MIDI data generated by your performance is stored in a specific memory address in the computer’s memory. The large amount of memory found in most computers allows most sequencing programs to have an unlimited track capability.

The MIDI data can be viewed in a sequencer in three distinct ways.

A). As a graphic representation (pitch on the vertical axis & duration on the horizontal axis)



B). As notation



C). As an event list (note on time in Measure/ Beat / Tick Pitch information in Octaves C3=middle C, Note On Velocity and Duration in Quarter note and Tick addition)

Measure/Beat/Tick	Pitch (Octaves)	Note On Velocity	Duration (Quarter note and Tick addition)
1 1 000	A Minor		
4/4	click		
1 2 000	E3	172	0 119
1 2 120	A3	168	0 119
1 2 240	C4	172	0 118
1 2 360	B3	170	0 121
1 3 000	E3	170	0 120
1 3 120	B3	168	0 120
1 3 240	D4	174	0 120

The instructor will provide a brief overview of MIDI data contained in an events list, and in addition discuss and demonstrate how to:

- Insert MIDI data in an events list
- Edit MIDI data in an events list
- Understand time stamping of data in an event list and the Pulse Per Quarternote or (PPQ) (PPQN) principle used by all sequencers. (*Topic #3 covers PPQ or PPQN in depth*)

There are three types of SMF formats. Each format saves the same data in a different way.

Type 0 – the original SMF format. MIDI data on all tracks are combined into a single multi-channel track. This is the recommended format for GM files.

Type 1 – This format retains the original multi-track setup.

Type 2 – This format contains individual track information (as does Type 1), but it also saves pattern data for each track when the file was created on a pattern-based sequencer. This format is generally not used.

Some sequencers can "explode" or "optimize" a Type 0 file by assigning specific channel information to separate tracks.

The following list shows the recommended track assignment for the SMF format.

Recommended SMF format Track Layout

MIDI Channel Recommended Instrumentation

1	Piano Solo (Left & Right Hand)
2	Bass Instrument
3	Primary Accompaniment (or for Left-hand part when using split Piano parts)
4	Primary Melodic Instrument* (or for Right-hand part when using split Piano parts)
5	Secondary Accompaniment
6	Secondary Melodic Instrument
7	Alternative 1
8	Alternative 2
9	Alternative 3
10	Drums & Percussion
11	--Available--
12	--Available--
13	--Available--
14	--Available--
15	--Available--
14	--Available--

Song Tempo should remain within the range of 30-240bpm.

The timebase is usually 96 – 480 PPQN.

*Lyrics should be placed on Channel 4

5) ISTs are introduced to the sequencing program used for the course.

The instructor will demonstrate the following procedures:

- a. Configuring the instrument for GM mode
- b. Booting the sequencing software
- c. Loading or importing an SMF
- d. Using the transport controls (Play, Stop, Pause, Go to, Loop)
- e. Experimenting with track parameters (volume, pan, mute, solo, transpose, program)
- f. Locating and selecting various record modes (overwrite, overdub, punch-in, step)
- g. Selecting display views (standard music notation, piano-roll, graphic, event list)

Follow up:

ISTs should have a generous amount of hands-on time in order to become familiar with the software to be used for the class. ISTs can download and experiment with SMFs from the Internet. <http://midiworld.com/classic.htm> Classical MIDI Files at MIDIWORLD
Classical music in General MIDI file format at MIDIWORLD.

TOPIC #3: REVIEW OF CORRECTIVE EDITING TECHNIQUES

IST Objective:

To become familiar with the editing procedure on the software used in the course.

Procedures:

- 1) Correcting wrong notes

ISTs should become familiar with various techniques for correcting wrong notes: re-recording, punch-in, note-dragging, event edit. This section should include a review of MIDI note numbers.

- 2) Correcting rhythmic errors

ISTs should become familiar with various techniques for correcting wrong rhythms: re-recording (at a slower tempo), punch-in, note dragging, event edit, and quantization. This section should include a review of sequencer timing resolution (PPQN or PPQ). The following list shows the note values for a sequencer using resolutions of 96, 192, 240, 384 and 480 PPQN or PPQ.

96 PPQN or PPQ		
Whole = 384	Dotted Whole = 576	Whole Triplet = 256
Half = 192	Dotted Half = 288	Half Triplet = 128
Quarter = 96	Dotted Quarter = 144	Quarter Triplet = 64
Eight = 48	Dotted Eight = 72	Eight Triplet = 32
Sixteenth = 24	Dotted Sixteenth = 36	Sixteenth Triplet = 16
Thirty-second = 12	Dotted Thirty-second = 18	Thirty-second Triplet = 8
Sixty-fourth = 6	Dotted Sixty-fourth = 9	Sixty-fourth Triplet = 4
128 th = 3	Dotted 128 th --	128 th Triplet = 2

192 PPQN or PPQ		
Whole 768	Dotted Whole 1152	Whole Triplet 512
Half 384	Dotted Half 576	Half Triplet 256
Quarter 192	Dotted Quarter 288	Quarter Triplet 128
Eight 96	Dotted Eight 144	Eight Triplet 62
Sixteenth 48	Dotted Sixteenth 72	Sixteenth Triplet 32
Thirty-second 24	Dotted Thirty-second 36	Thirty-second Triplet 16
Sixty-fourth 12	Dotted Sixty-fourth 18	Sixty-fourth Triplet 8
128 th 6	Dotted 128 th 9	128 th Triplet 4

240 PPQN or PPQ		
Whole = 960	Dotted Whole = 1440	Whole Triplet = 640
Half = 480	Dotted Half = 720	Half Triplet = 320
Quarter = 240	Dotted Quarter = 360	Quarter Triplet = 160
Eight = 120	Dotted Eight = 180	Eight Triplet = 80
Sixteenth = 60	Dotted Sixteenth = 90	Sixteenth Triplet = 40
Thirty-second = 30	Dotted Thirty-second = 45	Thirty-second Triplet = 20
Sixty-fourth = 15	Dotted Sixty-fourth --	Sixty-fourth Triplet = 10
128 th --	Dotted 128 th --	128 th Triplet = 5

384 PPQN or PPQ		
Whole = 1536	Dotted Whole = 2304	Whole Triplet = 1024
Half = 768	Dotted Half = 1152	Half Triplet = 512
Quarter = 384	Dotted Quarter = 576	Quarter Triplet = 256
Eight = 192	Dotted Eight = 288	Eight Triplet = 128
Sixteenth = 96	Dotted Sixteenth = 144	Sixteenth Triplet = 64
Thirty-second = 48	Dotted Thirty-second = 72	Thirty-second Triplet = 32
Sixty-fourth = 24	Dotted Sixty-fourth = 36	Sixty-fourth Triplet = 16
128 th = 12	Dotted 128 th = 18	128 th Triplet = 8

480 PPQN or PPQ		
Whole = 1920	Dotted Whole = 2880	Whole Triplet = 1280
Half = 960	Dotted Half = 1440	Half Triplet = 640
Quarter = 480	Dotted Quarter = 720	Quarter Triplet = 320
Eight = 240	Dotted Eight = 360	Eight Triplet = 160
Sixteenth = 120	Dotted Sixteenth = 180	Sixteenth Triplet = 80
Thirty-second = 60	Dotted Thirty-second = 90	Thirty-second Triplet = 40
Sixty-fourth = 30	Dotted Sixty-fourth = 45	Sixty-fourth Triplet = 20
128 th = 15	Dotted 128 th = 22	128 th Triplet = 10

Modern software sequencers provide the user a selectable PPQN or PPQ resolution. A good rule to working with PPQN or PPQ is the greater the number the more human and less rigid sequencer tracks will sound when recorded.

3) Correcting dynamics

ISTs should be able to find and to edit note velocities, CC#7 data (volume), and CC#11 data (expression).

Follow-up:

Exercise: Give ISTs a sequence containing mistakes in pitch, rhythm and dynamics and let them make the corrections using editing techniques of their choice.

TOPIC #4: CREATIVE EDITING TECHNIQUES

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

ISTs will open the SMF titled “Demo1”. They should perform the following steps to improve the sound of the sequence.

- *Create a stereo image* – use the Pan control to experiment with different stereo placements. In this type of piece, two placement setups would work equally well. One setup is similar to the setup used most often for string quartets: Track 1 – 20 (CC#10 value), Track 2 – 50, Track 3 – 80, and Track 4 – 110. The other setup places the top and bottom parts in the center, with the inner parts panned left and right: Track 1 – 64, Track 2 – 30, Track 3 – 100, and Track 4 – 64. Spreading sounds between the left and right speakers is an easy way to create a bigger sounding mix. The music feels “wider”, and it becomes much easier to hear inner parts.
- *Add vibrato to sustained notes* – use the modulation controller to add vibrato. In this example, vibrato should be added to notes with durations of at least 1.5 beats. Adding vibrato to specific notes is a great way to add expression to a melodic line. Vibrato can also be used as a way of emphasizing specific notes in a phrase.
- *Create a decrescendo effect in the final two measures* – use a graphic display to draw a volume curve from 100 (the track volume level) down to 60. Changes in volume levels (and velocity levels) help to make sequences sound more dynamic.

• *Add reverberation to the tracks* – insert a value of 100 for CC#91 at the beginning of each track. Reverberation helps to create a larger soundscape by creating the illusion of depth.

Follow-up:

Give ISTs the opportunity to experiment with these techniques.

TOPIC #5: CREATIVE EDITING TECHNIQUES (Part 2)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Dynamics)

Record the following music into the sequencer using program GM51 (Analog Pad). On many instruments, the Analog Pad sound is very velocity sensitive. As a result, some notes may be much louder or softer than others. Correct the balance of individual notes by editing the velocity levels. When you have done this, save your sequence as “Mystring1”.

1. Create a crescendo effect over the four measures by creating a velocity curve. Listen to the effect. How does it sound? (The crescendo effect with velocity is note dependent – a new note must be played in order to increase the velocity level. The crescendo effect can be improved by adding a volume curve. Unlike velocity levels, volume changes can take place over the duration of a note.)
2. Create a volume curve over the four measures. Listen to the effect. (Note that the crescendo effect can be made even smoother by utilizing cc#74 – brightness. This controller makes it possible to change a sustained note’s brightness. Create a brightness curve for the music. Experiment with the brightness settings – a small change in this parameter can go a long way.)
3. Save the sequence as “Mystring2”.

Follow-up:

Review the methods of producing crescendo and decrescendo effects – velocity levels, volume curves and brightness curves.

Exercise: Record the following music using GM#57. Execute the dynamic markings.

TOPIC #6: CREATIVE EDITING TECHNIQUES (Part 3)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Pitch - Octave Doubling)

Open your file “Mystring1”.

1. Transpose Track 1 down one octave below concert pitch and listen. Describe the difference in the sound. (Darker, richer, fuller)
2. Transpose Track 1 one octave above concert pitch and listen. Describe the difference in the sound. (Brighter, smaller). One of the easiest ways to maintain interest in an arrangement is to vary the octave placement of sounds.
3. Transpose the track back to concert pitch. Copy Track 1 to Track 2 and assign the same program (GM51) to Track 2. Transpose Track 2 one octave above concert pitch and listen. Describe the difference in the sound.
4. Transpose Track 2 one octave below concert pitch and listen. Describe the difference in sound.
5. Mute Track 2.
6. Assign the same sound (GM51) to Track 3 and record the soprano line. Play the part one octave higher than written. Compare this sound to the sound produced in Step 3. (The sound produced in Step 6 is cleaner and lighter, because only the top line is doubled at the octave. This version adds brightness without thickening the sound through the doubling of inner voices.)
7. Assign the same sound (GM51) to Track 4 and record the soprano line again, this time two octaves higher than written. Describe the difference in the sound. (This extra octave gives the sound even more brightness and feelings of height.)
8. Mute Track 3 and listen to the example. Describe the difference in sound. (The removal of the lower octave creates a greater sense of space and width between the parts.)
9. Un-mute Track 3, then assign the same sound (GM51) to Track 5. Record the bass line one octave lower than written. Describe the difference in sound. (The music has the warm bottom heard in Step 2 but without the thickening produced by doubling all of the voices at the lower octave.)
10. Assign the same sound (GM51) to Track 6. Record the bass line two octaves lower than written. Describe the difference in sound. (The music has a very deep, heavy feeling to it.)

Save this sequence as "Mystring3".

Follow-up:

Review the difference between doubling all voices and doubling only the outer voices of a chordal section. Let the ISTs experiment with different textures by muting selected tracks.

EXERCISE: Arrange the music on the next page for strings. Start softly and gradually build the sound by adding octaves to the parts. Save your work as "Mystring4".

TOPIC #7: CREATIVE EDITING TECHNIQUES (Part 4)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Stereo Placement)

1. Open your file “Mystring3”.
2. Mute all tracks except for Tracks 1, 3, and 5. Listen to the sequence.
3. Set the Pan controls as follows: Track 1 – 64 (center), Track 3 – 30 (left side), Track 5 – 100 (right side). Listen to the track. You should perceive a wider sound.
4. Un-mute Tracks 4 and 6. Assign the Pan control for Track 4 to 10; assign the Pan control for Track 6 to 120. Listen to the sequence. You should perceive a “larger-than-life” spread of sound. The music sounds much bigger because it uses a greater frequency range, and it spreads the range across the left and right speakers. Note that doubling the outer voices and then panning them to opposite sides is a quick way to create a stereo image from a chordal part.

There are two ways to create a stereo image from Track 1. Here is method 1:

1. Mute all of the tracks except for Tracks 1 and 2.
2. Be sure that Track 2 plays in the same octave as Track 1.
3. Set the Pan controls to the following values: Track 1 – 10; Track 2 – 117. Listen to the sequence. The music is thicker and has a sense of stereo. The illusion is the sound of two string sections – one on the right side and the other on the left side.
4. Save this as “Mystring4”.

The other method of creating a stereo image from a chordal part takes longer to create, but produces a more realistic effect. Here is method 2:

1. Mute all of the tracks except for Track 1.
2. View Track 1 in notation mode, and highlight the soprano notes.
3. Select the copy function, then paste the soprano notes into Track 7. Select sound GM51 for Track 7.
4. Go back to the notation view of Track 1 and highlight the alto notes.
5. Copy the alto notes, then paste them into Track 8. Select sound GM51 for this track.
6. Go back to the notation view of Track 1, highlight the tenor notes, copy them then paste them into Track 9. Select sound GM51 for this track.
7. Repeat the process for the bass notes, pasting them into Track 10. Select the sound

GM51 for Track 10.

8. Set the Pan controls as follows: Track 7 – 25; Track 8 – 50; Track 9 – 80; Track 10 – 100.

Listen to the sequence. This placement of tracks is the most common placement for string sections. The tracks sound bigger without changing volume levels, and it becomes much easier to hear inner voices.

Save this sequences as “Mystring6”.

Follow-up:

Review the methods for creating a stereo image from a chordal part.

Exercise: Open “Mystring4” and adjust the pan controls for a wide stereo image.

TOPIC #8: CREATIVE EDITING TECHNIQUES (Part 5)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Detuning)

1. Load “Mystring4” into the sequencer. Listen to the sequence.
2. Detune Track 2 [18 cents sharp]. Listen to the track. It should sound thicker. Detuning is an easy way to create thicker textures without doubling octaves or layering sounds.

Here is another example.

1. Load "Mystring3" into the sequencer.
2. Mute Tracks 2, 4, and 6.
3. Detune Track 3 (melody double) 18 cents sharp (D=18). Listen to the music. The music should have more of an edge to it – sensitive ears might hear it as higher or brighter.
4. Detune Track 5 (bass double) 10 cents flat (D-10). Listen to the sequence. The music should sound thicker or rounder.

Here is one more example.

1. Load “Mystring6” into the sequencer.
2. Mute Tracks 1-6.
3. Listen to the sequence.
4. Detune the tracks as follows: Track 7 – 12 cents sharp; Track 8 – 3 cents sharp; Track 9 – no detune; Track 10 – 6 cents flat. Listen to the sequence. It should sound much thicker.

Experiment with different detunings and notice the effect.

Note that the detune effect is static – the amount of detune remains the same for the entire sequence. Here is a way to vary the amount of detune.

Record the following music on Track 1 of a new song using program GM26 (acoustic guitar).

1. Copy Track 1 to Track 2 and assign program GM26 to Track 2.
2. Put Track 2 into OVERDUB record mode. While recording, use the pitch bender to raise the pitch during measure 1-2 and 5-6, and to lower the pitch in measures 3-4 and 7-8. Be sure to move the bender only slightly - if it sounds badly out of tune, you've probably moved the pitch bender too far.
3. Save this exercise as "Guitar1".

You should hear a variable detuning effect. This effect can be used to thicken a sound. (Sensitive ears may hear a difference between the sharp detune effect and the flat detune effect.) The soundfield of the guitar can be broadened by moving the sounds father apart –assign a pan value of 30 to Track 1, then assign a pan value of 100 to Track 2. Listen to the difference in the sound.

Detuning is an easy way to produce thicker textures. There are no strict rules concerning the amount of detuning for sounds – the right amount of detuning is determined by the sound's volume level, timbre, octave, musical function, and other factors. The ear is the bottom line.

Follow-up:

ISTs should be given ample time to experiment with detuning effects. If possible, introduce them to the use of random detuning and alternate tuning systems.

TOPIC #9: CREATIVE EDITING TECHNIQUES (Part 6)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Adding expression to individual instruments)

Exercise 1

1. Open the file "Grace1" and listen to it. You should hear a very dull realization. Explain why it sounds dull – constant velocity and loudness, no tempo change, every note equal.
2. Now open the file "Grace2" and listen to it. Note the differences in the performances.
3. Go back to "Grace1" and edit the track so that it sounds like "Grace2". You will need to access the following MIDI data: velocity, volume (cc7), modulation (cc1), brightness (cc74), note durations.

Exercise 2

1. Open the file "Trpt1" and listen to it.
2. Open the file "Trpt2" and listen to it. Note the differences between the two

realizations.

3. Open “Trpt1” again and edit the track so that it sounds like “Trpt2”.

Follow-up:

Give ISTs the opportunity to experiment with these important techniques.

TOPIC #10: CREATIVE EDITING TECHNIQUES (Part 7)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Layering)

1. Open “Guitar1” and assign program GM73 (Piccolo) to Track 3. Record the following melody along with the guitar tracks.
2. Notice how the melody stands out against the accompaniment – it is higher in pitch and its sustaining notes contrast the shorter, percussive notes of the guitar part.
3. Copy Track 3 to Track 4 and assign Track 4 to program GM71 (Bassoon). Transpose the track one octave down. Listen to the sequence and notice how the bassoon doubling fills out the melodic line, making it easier to hear.
4. Transpose Track 4 another octave down and listen. Notice how a sense of space is created by the two-octave spread between the two melody instruments.
5. Copy Track 1 to Track 5 and assign program GM93 (Bowed Glass). Listen to the sequence. Notice that the arrangement sounds fuller, because we have added a harmonic pad to the mix. A pad is a soft, sustained sound that fills in the gaps in an arrangement. It provides a harmonic bed for the rest of the arrangement. Quite often a pad can be so soft that we don’t consciously hear it, but we would notice instantly if it were removed. This pad adds warmth, but it also gives a little more weight to the accompaniment. To offset this, we’ll create the opposite effect with the melody – double it with a percussive sound in order to give the notes more definition.
6. Copy Track 3 to Track 6 and assign Track 6 to program GM47 (Harp). Listen to the sequence. The harp sound is dark in tone quality, but it provides a clear attack for each note, adding a kind of sparkle. We can increase this effect by changing the sound to program GM10 (Glockenspiel). The volume level may have to be lowered on some instruments – the glockenspiel sound is much brighter than the harp. To create even more of a shimmer effect, transpose this track up one octave and lower the volume a little more. Now both elements of the piece (melody and accompaniment) contain sustained and percussive sounds, but the sounds are offset by pitch, timbre and volume level. This arrangement is much thicker than the original arrangement, but the basic feel of the piece is still intact.
7. Save this as “Myguit2”.

8. To make the piece a little more delicate, mute Track 4 (the bassoons track). This will give the melody a much lighter feeling.

9. To create a sense of evolution in this arrangement, un-mute Track 4 and erase measures 1-4 from Tracks 4 and 6.

Follow-up:

There should be ample time for ISTs to try these techniques on other music. Although the instrumentation will vary from one song to another, the concepts demonstrated in this topic can be applied very successfully.

TOPIC #11: CREATIVE EDITING TECHNIQUES (Part 8)

IST Objective:

To learn how to improve the sound of sequences.

Procedure:

Arranging Techniques (Effects)

1. Record a two octave ascending C Major scale (quarter notes) using an acoustic piano sound. Set all note velocities to a value of 85.
2. Create a volume curve starting at a value of 100 at the beginning of measure 1 and ending at a value of 20 at the end of measure 4. Listen to the sequence. The addition of this controller curve to the track will make the track begin loudly and slowly fade away. We might perceive this as a movement in the location of the sound; as the sound becomes softer, it creates the illusion of moving away from us.
3. Create a pan curve starting at a value of 0 (hard left in measure 1 and ending at a value of 127 (hard right) at the end of measure.
4. Listen to the track – you should now perceive the music as moving across and away from us.
5. Create a reverberation curve by using MIDI controller 91 – reverberation amount. Start at a value of 0 and end with a value of 127. Listen to the sequence. The increase in reverberation intensifies the illusion of the sound moving away from us into the distance. Adding reverb to selected MIDI tracks can be a great help in adding warmth and depth to the sound.
6. Open “Myguit2”. Set the reverberation amount to 127 for the piccolo, bassoon and glockenspiel tracks. Listen to the sequence and notice how the melody gains a sense of spatial depth and richness.
7. The other GM effect is chorus, which makes sounds thicker. Add a small amount of chorus (GM controller 93) to the glockenspiel track. This should give the track some animation.
8. Add full chorus (127) to Track 5 starting at measure 5. This will not be a major change in the sound, but it will thicken the sound and give it a stereo spread.
9. Copy measures 9-10 from Track 1 to an empty track and assign program GM103(Echoes) to the track. Reduce the track volume to 30, insert a controller 91 value of 127 and a controller 93 value of 127 at the end of measure 8, and listen. You should hear a soft blurring sound at the end of the piece.

Follow-up:

ISTs will open other instructor provided files and add effects to the tracks. The difference in sound can be great. Add small amounts of chorus to string tracks, add reverb to string pads and high parts, add chorus to fretless bass parts, add reverb to guitar parts – again, the ear is the final judge on the appropriate use of these two effects.

TOPIC #12: CREATIVE EDITING TECHNIQUES (Part 9)

IST Objective:

To learn how to improve the sound of sequences.

Background

Tempo Control Techniques

Early sequencers could only maintain an original tempo during playback from the beginning to the end of a song. If the performer wanted to create a *rallentando* or *accelerando* a tempo knob had to be physically moved for tempo variance. Today all sequencers allow multiple user programmed tempos. Many sequencers accomplish tempo changes in a separate track usually called a *conductor track* or *tempo map*. A new tempo can be entered into this track and the sequence will change to this tempo at the point it is inserted in the sequence. Multiple continuous tempos can be inserted to create a *ritard* or *accelerando*.

Procedure:

The IST will open a MIDI sequence provided by the instructor and create tempo changes continuously in a conductor track with the instructor's help.

The instructor will discuss the difference between a linear tempo transition and one that speeds up more quickly at the beginning or end of a region that is to be effected.

TOPIC #13: ADDING DIGITAL AUDIO TO MIDI SEQUENCES

IST Objective:

To gain an overview of the basics of digital audio recording and how to integrate digital audio into MIDI sequences.

Procedure:

The instructor will have the IST read all the following background materials and associated appendices as a prerequisite to actual digital audio integration with the sequencer software.

Background: DAW (Digital Audio Workstation) Sequencer Integration

Today even entry-level sequencer software is available with digital audio recording capabilities. It is important to keep in mind that digital audio software's functions and controls mirror their analog counterpart the multi-track tape recorder. Therefore,

understanding the basic recording procedures and equipment operation is an essential bridge to effective work in the digital domain.

The entire recording process is similar to building a house. Virtual MIDI sequencer tracks and digital audio tracks establish the foundation, stereo mixdown places rooms on this foundation, and mastering completes the project by placing the roof on top. A *stereo mixdown* is composed of any number of digital audio and MIDI instrument tracks that are mixed (combined) and modified into a final stereo mixdown recording.

Digital Primer

In digital recording the original analog sound source is encoded into a stream of numerical data, which is then processed, stored, and distributed as a representation of a sound waveform. The reverse process converts numerical data back to an analog signal that only occurs for playback. This process generates lots of numbers that represents a sound and also requires lots of memory space to store each one of these numbers. On the other hand, digital systems have a unique feature called *random access memory* that provides instant access and editing of any specific location of recorded materials.

Digital audio is stored and played back as a series of zeros and ones. Zeros and ones easily work with computers as an electrical state of either “on” or “off.” The greater the possible choices of numbers available to represent sound as digital audio, the clearer the resulting sound.

For example, let’s say you want to display a digital picture of your favorite dog. To represent the dog’s image, “zeros” will represent blank spaces on a screen and “ones” will be dots. If you only had 30 dots and spaces to create this illustration, it would not effectively convey the dog’s image! On the other hand, if you had 44,000 dots and spaces available, you can make a very clear representation of your four-legged friend.



Digital audio takes into account that the waveform’s shape equals timbre, its height equals amplitude, and its cycles per second equals pitch or frequency. By converting sound into evenly timed numbers or *samples* that represent a sound's momentary amplitude, you can connect these amplitude dots to recreate any complex waveform.

Bits

For digital audio, we use the term *bit* (an acronym created from two words: **binary** and **digit**). Bits function like little switches to represent zeros or ones in electronic computer circuits. Operating with two states, zeros and ones, reduces chances for errors. “Ones”

represent *on* a number value is present in a numeric column, with each column increasing by a power of two. “Zeros” represent a *off*, or no number present in a numerical column. Each of these bits will be used like a letter in the alphabet to make up a digital word that the computer will use to represent a sound’s amplitude.

The more bits that are in a digital word, the more values a digital system uses to represent audio waveforms, thus, the higher the sound quality.

Binary counting example—a one each of the bit columns means that a columns binary number will be added to the final decimal number. A zero in a column means columns bit number will not be added to the decimal total. This is very much like our decimal counting where each column represents a power of ten not two as in binary.

8 Bit Counting	<u>128</u>	<u>64</u>	<u>32</u>	<u>16</u>	<u>8</u>	<u>4</u>	<u>2</u>	<u>1</u>	Number in decimal
	0	0	0	0	1	0	0	0	= 8
	1	0	0	0	0	0	0	0	= 128
	0	0	0	0	0	0	1	1	= 3
	0	0	0	0	1	1	1	1	= 15

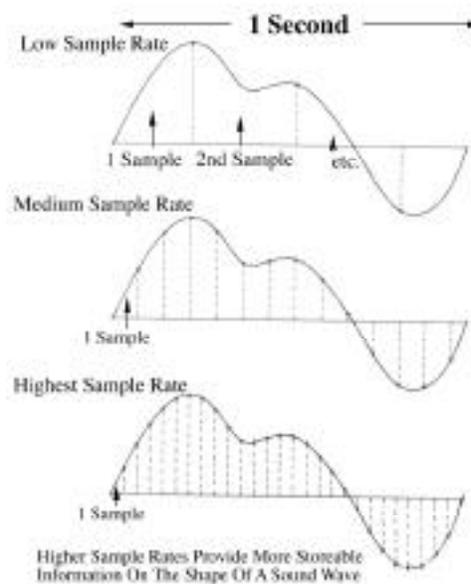
The instructor will make sure that the IST’s have a basic grasp of why bit depth is so important for digital audio recording.

When you record a digital audio track with a sequencer you will set up the bit depth for your project. How many bits the computer will use for each digital word, such as 8 bits for (lower sound multimedia quality), 16 bits (CD quality), or 20 bits (very high-end studio recording).

Sample Rates

The second component to digital sound is the *sample rate*. A sample rate represents how many times a second a digital word is recorded to represent a sound. The sample rate is very high when working with digital audio. The sample rate for CD quality sound is 44.1 thousand times per second.

You can draw an analogy between film and digital audio to better understand how the sample rate and bit depth work together to represent sound. The frames per second a film utilizes determines the whether we see individual pictures or a perception of motion (15 frames per second or FPS minimum for motion perception used in multimedia and animation) (24 frames per second for



film, and 30 FPS for television). The frames per second rate correspond to the sample rate of digital audio. The higher the sample rate the more closely the stored digital data will represent a sound.

Bit depth can be compared to the sharpness of the image in each frame. Higher bit depth would equal a sharper picture. With digital audio higher bit depth allows more numbers to be used to represent volume levels of the sound as data. Therefore if you had a fast frame per second rate but a very un-sharp picture (low bit resolution) you would not be happy with the results or a very sharp picture (high sample rate) and low frame rate per second (low bit resolution) you would also be unhappy. There are certain conventional rates that have developed over time and if you use these and understand their implication to sound quality and amount of data storage space you will be very successful.

<i>Settings</i>	<i>Sample Rate</i>	<i>Bit Depth</i>
Low Quality/ Old Mac	22254	8 Bit
Low Quality Multimedia/ PPC Mac or Windows	22050	8 Bit
CD Quality	44,100	16 Bit
DAT Quality	48,100	16 Bit
Best Studio Quality	96,000	24 Bit

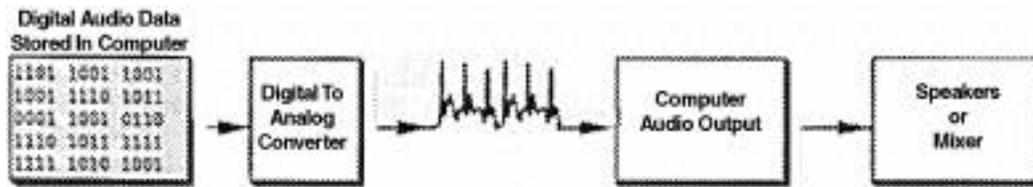
ADCs and DACs

A digital system uses two special converters to create and store sound. The first is an *analog-to-digital converter* or *ADC*. The ADC examines an analog audio signal at its input and generates a number value to represent the waveform's amplitude during each sample. The higher the sample rate, the greater the number of waveform samples will be encoded each second. The greater the digital word resolution of the ADC, the wider the range of amplitudes you can store and the higher the sound quality. A CD-quality ADC with a 16-bit word will allow one of 65,536 possible amplitude levels to be identified for each sample. The ADC will store these numbers to a personal computer, hard disk recorder, or digital audiotape for editing or playback.



The second converter in a digital recording system is the *digital-to-analog converter* or *DAC*. A DAC's sample rate and digital word resolution must perfectly match a system's ADC to read the stored digital audio information. A DAC uses the reverse process of an

ADC; it will read the stored waveform amplitudes for each sample and convert it into an electrical signal that can be replayed from each track of a digital audio sequencer track.



This data is stored on a hard disk storage medium known for high-density storage of data. A one or more gigabyte (1,000 megabytes) drives are common today and essential for recording digital audio. To record and reproduce digital audio, a hard drive must have a fast access time under 18 milliseconds to be useable. Most sequencers that have digital audio capability list specific manufactures of hard drives that will work; check the software's WWW site.

CD quality digital audio needs five megabytes for each minute of mono recording time, ten megabytes per minutes for stereo, and an additional five megabytes per minute for each additional multi-track.

MIDI Tracks (May Be Called Virtual Tracks in the Audio Field)

By taking advantage of MIDI sequencing with digital audio recording; the digital audio portion plays back acoustic sounds (such as vocals and guitar) while the MIDI's sequencer controls playback of MIDI (or Virtual MIDI Tracks) tracks of keyboards, samplers, drums, and sound modules. The MIDI portion of the sequence takes up very little storage memory compared to digital audio. Recorded MIDI information is not actual audio, but information about pitches, note duration, and volume.

MIDI devices must be plugged into a mixer to hear a sequencer's performance, but these additional virtual MIDI tracks do not consume much space on your hard drive. Both MIDI instrument audio output and digital audio tracks are combined in a mixer—*MIDI virtual tracks act like live performers playing along with your digital audio tracks.*

This technique provides first generation quality for synth parts at mixdown. Many of the computer-based digital audio programs combine both MIDI and digital audio into one powerful software package or a DAW. (See appendix A for a listing of these programs)

Digital Audio Formats

Most sequencers that offer digital audio recording can import prerecorded or downloaded digital audio file types such as:

WAV (primarily Windows)

AIF or AIFF

SDII (Sound Designer)

QuickTime safe cross platform format Mac & Windows

Many sequencers with digital audio capability require you to save your audio in one of these formats. If you will be sharing these files make sure that the other sequencer/digital audio program can read them.

Every digital audio format will allow you to set the sample rate and bit depth for storage.

The instructor will discuss appropriate uses of the different formats, their use with different computer platforms and way to convert different types.

Destructive and Non-Destructive Editing

Sequencers with digital audio capabilities have special editing functions similar to those of word processing software. Once you have experienced the freedom of cutting, copying, pasting, and merging words, sentences, and paragraphs with a word processor, you will have a hard time going back to a manual typewriter. The same is true with digital audio/sequencers that offers these kinds of editing capabilities.

There are two types of audio editing: *destructive* and *non-destructive*.

- Destructive editing permanently alters the original digital recording and replaces it with the edited version. It is a good idea to make a copy of the original when editing destructively so you can return to the original if necessary.
- Non-destructive editing allows you to change things without permanently altering or erasing the original track. With some software a single undo command or multiple levels of the undo command may be available to bring back an accidental erasure of an important take.

Sequencer software with digital audio recording capability has four distinct stages: sequencing, multi-track recording and stereo mixdown, and mastering.

FOUR STEPS NECESSARY FOR SEQUENCING AND DIGITAL AUDIO INTEGRATION

STEP 1 - MIDI Sequencing

Start and complete all virtual MIDI tracks.

If you know you will be working with virtual MIDI tracks and digital audio, it is much easier to complete your MIDI sequencing first, then track the audio.

STEP 2 – Record Multi-track Digital Audio (Digital Audio + Sequencer Tracks)

Multi-tracking records multiple microphone and/or line analog audio signals or imported pre-recorded digital audio into your computer. It then retrieves this stored digital audio

information for conversion to a mono or stereo signal for playback. Usually the software, computer processor speed, and or amount of RAM in your computer limits the amount of tracks that are available.

The software will provide a built in *mixer* to enable you to modify each digital audio track's individual volume, panning [placement of the audio signal anywhere between the two loudspeakers, from extreme left to extreme right (stereo imaging)], EQ, and routing to plug-in effects processors during mixdown.

STEP 3 - Stereo Mixdown

The stereo mixdown is what you present to your students or audience as the final step, whether for use in a multi-media presentation, or as part of a performance to be place on your World Wide Web page. The objective of a mixdown session is to create only two signals (stereo) for a left and right pair of loudspeakers. A *mixdown deck* is used to record the mixdown. If you are using virtual MIDI tracks you will need a stereo mixer to combine the digital audio and MIDI signals (virtual MIDI tracks) to either analog or digital medium for storage.

You can create and record many different mixes of the same song until you are happy with a final mix. You can use one of the following options as a mixdown choice: a digital audio tape recorder (DAT), a high-quality cassette deck, reel to reel tape recorder, Mini disk, your computer's hard disk, or a CD recorder.

You can create and record many different mixes of the same song until you are happy with a final mix. Music educators who are taking advantage of digital audio and sequencing can use one of the following as a mixdown deck: digital audio tape recorder (DAT), a high-quality cassette deck, hard disk recorder, CD burner, or a reel-to-reel tape recorder.

STEP 4 - Mastering

Mastering involves adjusting final equalization to the entire stereo mixdown, setting the arrangement of songs in order (also called *sequencing*), creation and design of the artwork, and duplication of the final project (multiple cassettes or CDs).

Sound will be determine by many factors. Think of who will be listening to it. Will it be an original song to a national performance or composition competition? Or will it provide extra income to your program through sales at live performances? These questions aid the mastering process also by making you think about how your audio project needs to sound.

The instructor can have IST's cover these steps more in-depth by using a supplemental audio reference (See appendix K bibliography)

Procedure:

The instructor will demonstrate the process of recording a digital audio track into a sequence and the different ways a mixdown can be created from the same MIDI and digital audio tracks.

Classroom Equipment

The instructor will demonstrate and lecture on all the necessary equipment for integrating digital audio into a sequence.

- Computer with MIDI sequencer software that provides digital audio recording.
 1. Computer has built in Audio Visual capabilities
 2. An additional sound card is attached to the computer
- A hardware mixer to mix the multi timbral synthesizer audio output with the computer audio output. This mixer will be used for recording tracks if the sound card or AV computer input does not accept microphones.
- A stereo DAT or cassette mixdown deck attached to the mixer to record the final mix.
- Monitors or headphones:
 1. Powered Monitors or Amplifier and Monitors (See Appendix I)
 2. Good Quality Headphones
- Microphone(s) & cables

Computer with MIDI Sequencer Software Mixer Background

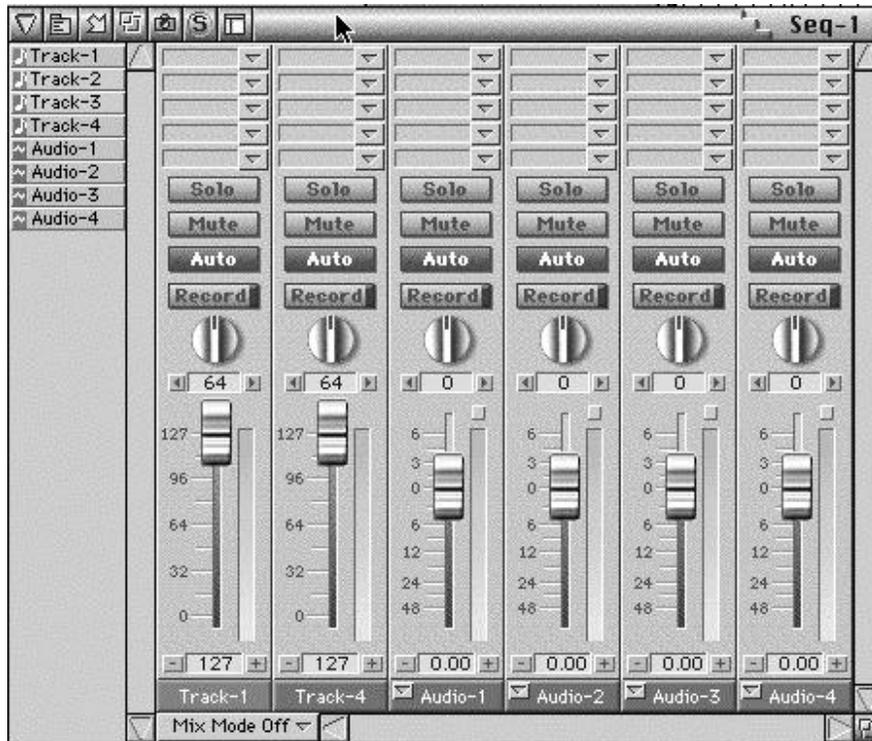
The computer used for digital recording must have either built-in audio capabilities or a PCI card dedicated to recording audio such as an Audiomeia III card. If your computer has a built-in microphone jack you can use this for recording audio. The small submini (1/8") jack (Appendix H cables) can be used and the computer set to accept line level or microphone.

The software used for digital recording will allow you to set the sample rate and bit depth. CD quality is 44.1k sample rate with a bit depth of 16. This setting will give great sound quality but you will need 5 megabytes of disk space for every minute of each audio track recorded. Therefore if you have 4 tracks of digital audio recorded you will need 20 megabytes of storage space. Another option is to record at a lower sample rate and bit depth such as 22K and an 8-bit depth. This will not yield as high a quality but will take up less disk space: 10 megabytes for one minute of four digital audio tracks. Always be clear as to the outcome use of your digital audio. A lower sample rate and bit depth will take up less storage space and will upload or stream at a much faster rate if you are going to place your project on the Internet.

Mixer

Mixers come in four basic types: *integrated*, *powered*, and *stand-alone*.

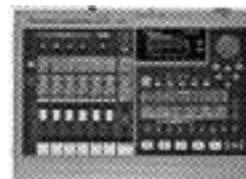
- The virtual mixer on a computer screen, comes built in with sequencer/digital audio software



- The stand-alone mixer needs more consideration since it will be purchased separately, and you will be making all of the connections.
- The powered mixer is just like the stand-alone mixer with the addition of a built-in amplifier. This type of mixer does not require a separate stereo amplifier; just plug in your studio monitors and you are ready to record, mix and play back.



Stand Alone Mixer



Integrated Mixer

- The integrated mixer is easy to use with its combined multi-track analog or digital recorder and has internally connections.

When recording tracks, the mixer routes signals to the computer's input.

When creating a stereo mixdown, the multiple audio channels are modified (volume, pan, eq) if necessary and then combined into a stereo mix that is recorded on a mixdown deck or bounced directly to the computer. This is similar fashion to the way the ISTs have edited MIDI data in a sequence.

A mixer's first job is to amplify a microphone's low electrical impulse to a useable level. It provides multiple input and level controls for audio signal blending (*mixing*) such as multiple microphones, electronic instruments, and recorded tracks.

A mixer also provides individual timbre (tone) modification called *equalization* or *EQ* for short. You can change the EQ of an input similarly to the way you set a stereo's tone controls to either cut or boost high (treble) and low (bass) frequencies for individual or multiple audio signals. *Adjustable filters* are used to modify equalization settings. A filter removes the certain frequencies from an audio signal similar to the way a filter works in a coffeepot. The filter lets the caffeinated water through, but not the grounds; in this case a mixer's EQ lets selected frequencies pass through. A mixer will often have several filters available for each audio input.

Output: A mixer provides several options for the output of audio signals to individual or multiple tracks of recording devices including your computer if it has multiple inputs. Other output routing possibilities may be available such as external or built-in signal modifiers (processors: echo, reverb and others). In addition, the output section may provide an audio signal to amplifier/speakers or headphones for listening (monitoring).

Audio signals are monitored during recording and mixing in order to ensure proper levels and to create a good balance of pre-recorded and newly recorded tracks. There may also be a metering system to show you the volume or signal strength of each track.

If you have good quality speakers attached to your computer, these can work as monitors.

Mixer Features A Music Educator Needs to Know

Mute Switch

A mixer's *mute switch* eliminates that channel from playback, turning the channel strip off when selected. Some mixers also have a helpful mute LED indicator that will light up or blink to let you know which channel strips are being muted.

The mute button is very helpful when doing stereo mixdown. It allows you to concentrate on a specific number of channel strips with a simple push of a button rather than adjusting faders across the mixer.

Solo Button

By pushing this button, the mixer will mute all other audio tracks and will allow you to listen only to the selected audio or a combination of other soloed tracks. There is usually a solo LED indicator that will light up or blink track or to let you know which channel strip(s) have been placed in this mode.

Pan Control

The *pan control* is a knob or slider that adjusts an audio signal's placement from left to right in a stereo mix.

This process is called *stereo imaging* and adds an important sense of realism to your mix. When the *pan-pot* (short for panoramic potentiometer) is set to the middle, there is equal signaling going to the left and right speakers. The direction in which you move the pan knob will direct the audio signal to appear to originate in that direction.

Volume Fader

A *fader* adjusts the volume for each individual audio track. These settings are the essence of creating a mix from the tracks of your multi-track recorder.

The instructor will discuss and demonstrate how a mixer is used to modify and mix multiple audio signals.

Stereo Mixdown Deck Background

Sequencer software that provides digital audio retrieves this stored digital audio information for conversion to speakers or a mixer for playback. This signal can also be sent to a *mixdown deck* to convert (records) the mixer's stereo audio signals to analog or digital information for storage. Some more advanced digital audio software does not need any outside equipment for creating a mixdown. This is all done inside the computer and your digital audio settings are bounced to a new file all nicely combined from your choices.

A *mixdown deck* converts (records) the mixer's stereo audio signals to analog or digital information for storage. You can create and record many different mixes of the same song until you are happy with a final mix. You can also create back-up final mixes in case your original copy is lost or destroyed. Most home recording engineers will use one of the following as a mixdown choice: digital audio tape recorder (DAT), a high-quality cassette deck, hard disk recorder, CD burner, or a reel-to-reel tape recorder.

Too much intense listening while mixing will result in ear fatigue; you don't have to do your listening and mixing at the same time. Wait a day or so to listen with fresh ears and make your final decisions.

Microphone and Line Signal Background

A *microphone* converts sound waves into electrical impulses. They are available in different sizes, shapes, and prices and have general to specialized applications such as the range of frequencies they record, sensitivity to loud and soft sound levels and so on. The art of proper microphone or mike selection is very broad in scope. Current advances in microphone technologies and manufacturing have created a new line of reasonably priced all-purpose microphones that work in multiple recording situations. (See Appendix G for descriptions and applications)

Line Level Signals

A line level signal differs from a microphone's signal in that it has a substantially larger level. Line level equipment are synthesizers, signal processors, tape recorders, CD players.

Plugging line-level gear into microphone input will overload the circuit and cause distortion. Most mixers have a switch that allows you to choose either line or microphone input option. Always ensure that this switch is set to match your audio source: microphone or line.

A guitar or electric bass is a low-level device whose output is closer to a microphone's level. You can set a mixer's input switch to microphone if plugging the output of a guitar or electric bass directly into a mixer or your computer. Adjust the input's trim pot or gain control to increase or decrease the guitar or electric bass' signal level. (See Appendix H for cables)

Microphone and Direct Recording Techniques for Educators

Achieving a good sound with a microphone is a direct product of two factors: microphone selection and positioning. Before you select a microphone, listen intently to what you are recording.

- Walk around the sound source while moving closer then farther away. Think about what you hear. Is there a sweet spot where the source sounds best? Begin by placing your mike right at this spot.
- Record a short passage of the sound source. Play it back and listen objectively to the recording. Does it sound as good as it did when you walked around?
- If not, it's time to experiment by moving the mike closer or farther away, or selecting another microphone.
- If you feel the sound needs EQing, use it, but as a last resort. Move your microphones, not your EQ controls.

Recording Direct Inject (DI)

Recording direct into your computer or mixer is a straightforward process where an electronic instrument simply plugs directly into an input. Synthesizers have a high enough output for DI recording. On the other hand, electric guitars, acoustic instrument pickups, and electric basses present a somewhat weaker signal without additional help. By adding a *direct box*, you can plug them into the mixer's microphone input and present a clean robust signal to your multi-track recorder.

Studio Monitors and Headphones Background

If any component in your classroom studio is going to have the final shaping of what your music project sounds like, it will be your studio monitors and headphones. (See appendix J for monitor components)

Important Recording Techniques for the Music Educator

The Click Track and Silent Count-Off

The first step for a digital audio session is establishing a performance tempo.

- One approach is to keep the tempo metronomic with a *click track* (a reference track that has only a metronome or drum machine recorded without any tempo fluctuation).
- A more organic approach is to record live without a click track. If you are not sure of the tempo for a song or arrangement, record it with several different tempos and decide at a later time.
- If you have completed MIDI tracks they will function as a click track when you add digital audio tracks to a sequence.

Overdubs

Overdubbing has many flavors; one of that is a *unison* or *doubled* performance that strengthens a solo instrument or a lead vocal's punch and density. This doubling technique uses the same vocalist, background singers, or soloist's to record an additional track of exactly the same performance. Microphone placement and mixer setting should be the same as the first track. What gives doubling such power is the fact that since no one can duplicate their performance perfectly, the minor discrepancies add a unique character to lead or background parts. If you know you are going to use doubling, it is easier to do so immediately after the first track. The idea is to not duplicate each track, but to add power and fullness via subtle differences.

The instructor will have the ISTs sing an overdub of a song. Record both a harmony track and unison with a MIDI sequence. Star Spangled banner may be used as a MIDI source. Use the mute button to compare the addition and removal of the unison track 's effect to the impact of the vocal.

Punch In and Punch Out

The *punch in* and *punch out* technique is used to fix small or large musical mistakes, or for cleaning up coughing sounds at the end of a take. Instead of re-recording an entire track, you can erase and record over the mistake. With most digital audio sequencers and multi-tracks, "record enabling" a track and playing it back allows you to replace the previously recorded material with punched-in material with the touch of a record button. When you touch the stop button, the recording stops and you would have executed a "punch out." To make this task easier for the solo engineer/artist, some sequencers allow you to do this with a foot switch or you can specify a certain point in the sequence where you want to directly into record (punch in) and a specific point in the sequence where you want the recording to stop (punch out). This is a wonderful way to use automation with your sequencer.

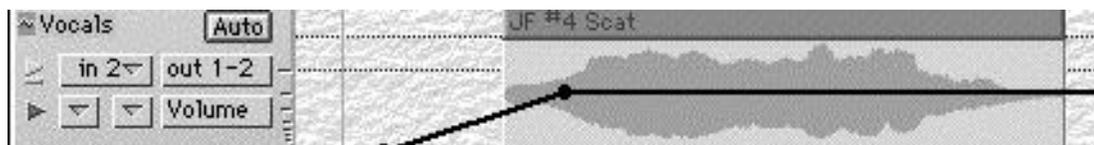
The instructor will demonstrate how to use punch in and the importance of pre-roll and post-roll when recording digital audio tracks. The IST should use this

principle when recording MIDI tracks also. Discuss the similarities between recording digital audio and virtual MIDI tracks with sequencing software.

Fade-Outs, Fade-Ins, And Cross-Fades

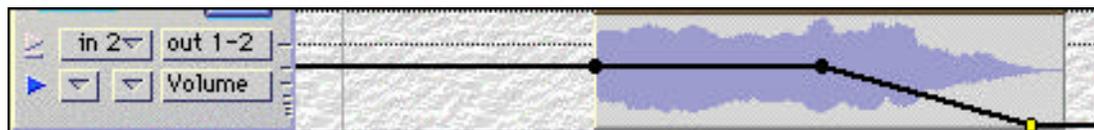
A fader controls audio levels and is usually in the form of a slider on a mixer instead of a rotary control. Faders are used to control all types of fades. Sequencers that incorporate digital audio often use a graphic concept for creating automated fades. A straight line is superimposed over a waveform representation of the track. You simply insert a break point in this line and drag the volume to a greater or lesser setting. If you don't like the fade reposition the break points. This technique is used over and over again in software that deals with audio (Premiere, Sound Edit 16, Sound Forge, and Peak).

Fade-in (volume fades in from silence to a set level over a specific period of time). Fade-ins usually occur at the beginning of a song, while fade-outs happen at the end. They both can also occur anywhere in a mix.



Many digital audio tracks use the rubber band principle where break points are placed on a line representing volume and either raised or lowered to modify the volume at output.

Fade-out (volume fades out completely over a specific period of time). If you are fading out a song, make sure that you have plenty of material tracked so you can experiment with different lengths of fade-out time.



Crossfades (two different tracks' volumes move smoothly in the opposite—direction one up from silence and one down to silence). Cross-fades are used to switch solo instruments or entire songs from one into another smoothly. If you are going to do a cross-fade, you must



have a certain period of time where the crossfading tracks are playing simultaneously.

All of the aforementioned fades are most effective when they match the tempo of the song or a subdivision of it. Linear fades and ones that move faster at the beginning or end are all possible. Experiment with your mix when executing a fade to find the right feel. Many of the new hard disk stand-alone multi-track recorders and all-digital audio software programs have automation for fades.

Procedure: (Class Projects)

Project 1

The instructor will have the IST sequence the Star Spangled Banner

- An audio track will be added
- The IST will record his or her voice onto a digital audio track additional overdubs will then be created
- Additional voice(s) or acoustical instruments are added to the sequence
- The IST will make a mistake and practice the technique of punch in and punch out to correct it
- Various mix downs will be created and saved, with at least one created by editing.

Project 2

- Open up the “SMF 12barblue.mid” sequence a simple 12-bar blues progression.
- Record a solo on a digital audio track, with an acoustic instrument or voice. Leave a lot of space between riffs. Practice replacing the recorded riffs with new ones by punching in and out.
- If you have automation, practice with it.
- Play back the sequence after each punch to evaluate your edit.
- Record new solo tracks and decrease the space between your solo riffs until you are using a continuous line for punch in/out practice.

Follow-up:

The instructor will provide recordings for the ISTs to analyze and critique for good and poorly recorded mixes of songs.

The instructor will provide recordings and sequences in a variety of styles and the ISTs will determine if there was a special way of mixing or re-mixing the instruments and voice (pop, classical, country, blues reggae, etc.).

TOPIC #14: ADDING EFFECTS TO DIGITAL AUDIO (basic types, outboard vs. Plug-ins)

IST Objective:

To learn how to integrate digital audio effects into MIDI sequences.

Many of today’s sequencers that incorporate digital audio have plug-in options available. A plug-in is either bundled with the software or an addition to the software that is usually purchased separately to add one or more effect such as echo, chorusing or reverb directly to

your digital audio while it is still in the computer. (See appendix K for a guide to signal processing) Most plug-ins utilize destructive editing with only one undo so you must be careful when using them. A plug-in can be applied to an entire audio track or only a small portion of one.

The instructor will discuss the importance of saving the original audio source as a back up so that you do not have to rerecord an audio track.

Adding effects to digital audio is a creative process that requires preplanning to avoid blindly mixing without an objective.

Procedure:

The instructor will demonstrate the use of various plug-in effects and also outboard gear that is used with a mixer. The gtrquic.mov file can be used.

The IST will apply digital signal processing to the digital audio track recorded in the Star Spangled Banner (reverb, echo, flanging).

Follow-up:

Through analytical listening try to determine the types of signal processing used in the mix of several contemporary songs provided by the instructor.

Can the ISTs find or discuss recorded or downloaded examples that have effective mixes and ones that ineffective unbalanced instrument levels and over the top effects?

Have the ISTs open other files and add effects to the tracks. The difference in sound can be great. Add small amounts of chorus to string tracks, add reverb to string pads and high parts, add chorus to fretless bas parts, add reverb to guitar parts – again, the ear is the final judge on the appropriate use of these two effects.

TOPIC #15: CRITICAL LISTENING & CREATING THE MASTER COPY (CD, cassette; equipment needed, connections)

IST Objective:

To learn how to master a finished project from a sequencer that has digital audio capabilities.

Procedure:

The instructor will discuss the importance of critical listening in recording with sequencers in two of the following distinct areas; technical and musical.

The art of critical listening is indispensable to the creation of a good recording. This skill is necessary for critical evaluation in two areas of the recording process: technical listening and musical listening.

Technical Listening

Technical listening focuses on the sound quality and design of audio information while it is being recorded or mixed. Has microphone selection and placement clearly captured or enhanced the instrument or voice? Are the noise levels of the recording acceptable? Does this recording need additional equalization for more punch or air? Sound design questions also come into play for a recording's ambiance. How much or little signal processing, reverb or echo will be effective in the final mix? Are there too many instruments panned to the left or right, making the mix lopsided? These technical questions are an important part of critical listening.

Musical Listening

Musical listening means asking yourself questions about your project, and objectively listening for answers. Was the performance just right for the digital audio recording? Should a track be re-recorded or could a simple punch-in strengthen the track? Contrasting musical elements can keep the listener's interest: vary the tempo, dynamics, instrumentation, harmonic elements, and so on.

It is important for you to develop and enhance this skill by listening closely to recordings at home and on the radio. Try to pick out successful production techniques that professionals use, then apply this skill to your student's classroom projects.

Creating a Master

The quantum leap in the quality of home digital recording equipment places a greater demand than ever on the mastering process. The *mastering* process is where you create

- A final mix and sequence of songs for distribution such as to a *mastering houses* (a company that masters and duplicates CDs and cassettes)
- Your own CD for use in the classroom or the creation of an audio cassette or sound file to be played on the internet

Personal computers now have software that allows you to make CDs one at a time at a very modest cost.

<p>THE INSTRUCTOR WILL DEMONSTRATE THESE PROGRAMS AND HOW YOU CAN MAKE YOUR OWN LABELS AND INSERTS WITH A PRINTER. (3 Credit Workshop)</p>
--

Points to consider when you send your work to a CD mastering house (Disk Makers, Digital Dynamic Audio Incorporated)

- If your ultimate goal is to produce a CD, make sure that the total time of all material is less than 74 minutes, the maximum time a CD is capable of playing back.
- Contact mastering facilities in which you are interested for pricing information. Make sure that they can handle your final mixdown master format without any problems. You

can shop around to find out prices for mastering, artwork development, and duplication from several mastering facilities. The more CDs you order, the lower the cost per unit. Orders are usually in lots of 500 to 1,000. If you need only a small order of CDs and you have a personal computer, a CD burner may be an inexpensive alternative.

- Include a complete and accurate time log with your master.

Procedure:

A mixdown will be created of the Star Spangled Banner using creative mixing techniques and digital signal processing.

The instructor will demonstrate a mastering program such as Sound Forge or Toast that allow you to burn your own CD. The instructor will provide other sound files to be included in a master list and the process of burning a CD completed with the class.

Follow-up:

The IST can search the Internet for mastering houses and other types of digital audio resources.

The instructor and IST will discuss the fundraising possibilities of creating master of performances or student projects and selling them at concerts or to parents.

TOPIC #16: INTEGRATING MIDI SEQUENCES WITH DIGITAL VIDEO SYNCHRONIZATION (3 Credit Workshop)

IST Objective:

To learn how to integrate and synchronize digital video into MIDI sequences.

Today students and teachers can move into a territory that was once only the domain of major television and motion picture industries. By adding a digital movie such as QuickTime or AVI to your sequence, you can synchronize original or arranged music, voice over, and special sound effects with the video image. Today many sequencer programs allow you to record and edit sequencer tracks while viewing digital video at the same time; this makes it easy to coordinate your music with a video file. You can even imitate the house organists and pianists of the silent movie days and record tracks while viewing the video file right in your sequencer program.

(Creating and capturing video is beyond the scope of this course but ISTs should have gained this information from T:ME 1B)

THE INSTRUCTOR WILL DEMONSTRATE AND LECTURE ON ALL THE NECESSARY SOFTWARE & EQUIPMENT FOR INTEGRATING DIGITAL VIDEO INTO A SEQUENCE. (3 credit Workshop)

Popular Video Formats

QuickTime – cross platform for Mac & windows that use the .mov file extension when saving for Windows

AVI – video for Windows that uses the .avi file extension when saving for Windows

MPEG (Music Picture Expert Group) .mpg file extension when saving for Windows – with DVD (Digital Versatile Disk) usually not used by sequencer applications.

Procedure:

THE INSTRUCTOR WILL PROVIDE THE IST WITH A SHORT VIDEO CLIP OR ANIMATION THAT THE IST WILL CREATE A BACKGROUND SOUND TRACK. THIS CLIP MAY COME FROM THE INSTRUCTOR OR BE DOWNLOADED FROM THE TI:ME WEB SITE.

THE INSTRUCTOR WILL DEMONSTRATE HOW TO IMPORT THE DIGITAL VIDEO INTO SEQUENCER SOFTWARE

- THE TECHNIQUE OF SPOTTING THE VIDEO TO TIME OUT REFERENCE POINTS WHERE SOUND EFFECTS WILL ENTER OR THE MUSIC STOP AND START.
- THE INSTRUCTOR WILL DISCUSS SMPTE (SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS) TIME CODE AND HOW TO VIEW TIME CODE IN A SEQUENCER..
- ONCE THE VIDEO IS SPOTTED (ANAYIZED FOR TIMING INFORMATION)
- THE INSTRUCTOR WILL DEMONSTRATE HOW TO ADD MARKERS TO THE SEQUENCE.
- A VOICE OVER OR DIALOGUE CAN BE CREATED IN A DIGITAL AUDIO TRACK
- ALL THE ELEMENTS ARE ENTERED INTO THE SEQUENCE AND EDITED FOR A FINAL PRESENTATION.

Follow-up:

The class can discuss the impact of musical underscore and sound design for video or movies. Soundtrack examples can be viewed and critiqued for their originality, impact on the plot or action.

The effect of orchestration and instruments, the tempo and rhythm and tonality (major minor, atonal) can be discussed. The role of sound in video games and commercials can be discussed.

TOPIC #17: SEQUENCER APPLICATIONS IN THE CURRICULUM

IST Objective:

To develop innovative ways to incorporate sequencer applications into the music curriculum.

Procedure:

The instructor will provide sequenced examples and facilitate discussion on student activities and teacher strategies that use the sequencer for curriculum development.

Student Activities--A student can:

- Record music in step time or real time with a MIDI sequencer
- Capture musical performances for self-evaluation or evaluation by the teacher via a MIDI sequencer
- Isolate individual parts for singing practice/rehearsal -- Practice singing one on a part using practice sequences.
- Change the timbres of one or more parts in a prerecorded MIDI sequence
- Record music in step time or real time with a MIDI sequencer
- Record and edit acoustic sounds using digital audio integrated with MIDI sequencers
- Capture musical performances for self-evaluation or evaluation by the teacher via a MIDI sequencer
- Search for MIDI Files on the internet

Teacher Strategies--A teacher can:

- Conduct a chorus or class using MIDI sequencer accompaniment
- Select appropriate MIDI accompaniment music for students to use in live performance
- Create multi-timbral music examples using a MIDI sequencer
- Create musically expressive MIDI sequences using appropriate MIDI controllers and Fx
- Edit and perform complex mixing processes, and integrate digital audio with MIDI sequencers
- Record and evaluates student performances using a MIDI sequencer

Follow-up:

Addition strategies should be developed and shared by the IST and instructor.

These can additional activities and strategies can be incorporated into the two lesson plans the IST will submit at the end of this workshop.

TOPIC #18: Classroom (composition, improvisation, arranging/orchestration, and listening skills)

Performance (accompaniments, practice tapes)

IST Objective:

To develop innovative ways to incorporate sequencer applications into the music curriculum that develop composition and improvisation skills for the student.

Procedure:

The instructor will provide sequencer examples and discussion on student activities that use the sequencer for composition and improvisation development.

Student Activities--A student can:

- Demonstrate the elements of music using a MIDI sequencer
- Compose pieces demonstrating the ranges of traditional instruments using a MIDI sequencer
- Create compositional forms using a MIDI sequencer. (Binary, Ternary, Blues, Rondo)
- Use a sequencer to develop an original or supplied compositional theme.

Compositional Development Technique	Sequencer Technique
Augmentation and Diminution of Melody	Scale Time 200% Aug. 50% Dim
Diatonic Inversion of Melody (reversal of intervals in diatonically)	Invert Pitch Option
Symmetrical or Exact Inversion of Melody (reversal of intervals symmetrically)	Invert Pitch or Transpose notes up or down in sequence
Use Different Rhythms for the Melody	Change the time signature but do not adjust the barlines and modify the note values
Retrograde melody (use the original melody played backwards)	A Retrograde Edit technique is sometimes available with a sequencer.
Retrograde Inversion of melody (use the original melody played backwards and invert)	Retrograde edit and Invert pitch
Parallel Transposition of melody	Copy and paste melody into a new track and transpose the counter melody either symmetrically or diatonically by an interval of 4 th , 5 th , 6 th or 3 rd
Modal Alterations	Apply a new key signature to the melody and hold the original notes to their original pitches except the ones affected by the key signature. Some sequencers have this option under their transposition command.
Octave Displacement (moving the melody notes to upper or lower octaves from the original)	Humanize – Many sequencers will have a pitch range that you can set for humanizing extend it to 5 or 6 octaves. Instant 20 th century composition technique.

- Record a MIDI sequence and synchronize it with a video clip or computer animation

Teacher Strategies--A teacher can:

- Create ostinatos and accompaniments for student improvisation using a MIDI sequencer
- Present the music of various cultures and historical periods using MIDI sequencers
- Create examples for students to listen to, analyze and describe using a MIDI sequencer

Follow-up:

Addition strategies should be developed and shared by the IST and instructor.

These additional activities and strategies can be incorporated into the two lesson plans the IST will submit at the end of this workshop.

TOPIC #19: COPYRIGHT AND SEQUENCER SOFTWARE

IST Objective:

To discuss copyright issues and Sequencer software.

Procedures:

The instructor and ISTs will discuss copyright and fair use for educators and look at the supplied list of public domain (PD) works in appendix F.

Public Domain Information Project (Visit this site)

<http://www.pdinfo.com/proof.htm>

Topic: - Copyright

Proof of Public Domain

You should use a public domain composition only if you have proof of public domain from a legitimate source. If you do not have a legitimate source in your possession, there is no way you can be certain that the music you use is in the public domain. A legitimate source is a tangible copy of the work with a copyright date old enough to be in the public domain. Sources are usually either an original or a copy of a book or sheet music. could result in your having to pay substantial royalties.

Simple Guide for Copyright Date Old Enough to be in the Public Domain

- United States and most countries - copyright notice of 1903 or earlier
- United States only - copyright notice between 1904 and 1922

Legitimate Sources - Sheet Music or Books

For sheet music, the copyright date is usually shown on the first page of the music notation. If you are obtaining copies of original sheet music as proof of PD, you should get a photocopy of the cover page as well as the actual pages of music notation. While getting a copy of the cover page may not be absolutely necessary, you may not be able to show whether the copy was made from sheet music or from a book of music without a copy of the cover page. It is always best to be able to absolutely identify your PD source.

Legitimate Sources for Proof of Public Domain

- Original Book with PD copyright date on the Title Page

- Original Book with PD copyright date for the individual composition
- Original Sheet Music with PD copyright date
- Photocopy of a Book or Sheet Music with PD copyright date which you photocopied yourself
- Notarized photocopy of a Book or Sheet Music with PD copyright date from a person or company you trust
- Photocopy of a Book or Sheet Music with PD copyright date from a person or company you trust
- Digital copy of a Book or Sheet Music with a PD copyright date printed on your printer from an internet web site you know to be reliable
- Digital copy of a Book or Sheet Music with a PD copyright date printed from a CD or DVD published by a person or company you trust

Invalid Sources for Proof of Public Domain

- Original or photocopy of a Book or Sheet Music with no copyright dates
- The name of the song on a list of public domain music
- An old-looking book with no title page and no copyright dates anywhere in the book
- An old-looking page of music with no copyright date ripped from an old-looking book
- Photocopy of a Book or Sheet Music when you do not know who made the photocopy
- An individual telling you that a song is PD, even if you know and trust the individual.
- An email from anyone telling you a song is PD

TOPIC # 20: THE WWW AND SEQUENCER SOFTWARE AND UPLOADABLE FILES

Procedures

Visit some of the WWW sites offered in *Appendix E* and discuss the use of the Internet as a way of searching for MIDI Files. Discuss how this will affect music education in the near future.

TOPIC # 21: EVALUATING SEQUENCER SOFTWARE AND HARDWARE

Download a demo version of music sequencing software that you are not using in the class and use the following criteria to create a comprehensive evaluation.

- How much does the software cost? Find out if there is an educational price.
- What is the learning curve for the software? Are there third party books, CD-ROMS, or videos that can shorten the learning curve?

- Does the software have a multiple ways to view MIDI, Video and Audio Data such as:
Graphic
Notation
Event List
Audio – Virtual Mixer and Waveform Editing
- How many tracks can you use or create? Are MIDI and Audio track sizes variable?
- What is the PPQ resolution of the sequencer? Is it variable?
- Can you create and play multiple songs like a MIDI jukebox?
- Can you export a sequence as a Standard MIDI File?
- How many music-input options does the software possess?
MIDI, Mouse, other SMF
Can you scroll during play back of a sequence? Are articulations, dynamics and expressions reflected in MIDI playback?
- Does the sequencer offer multiple levels of undo and redo.
- Are there any MIDI filters available for input or viewing data? (Aftertouch, patch change, pitchbend, controllers, etc.)
- Can you add plugins to use with digital audio? (Reverb, Chorus, Compressors, EQ, Echo etc.)
- Can you scrub the MIDI or digital audio data? Scrubbing produces sound when you drag over data both forward and backward to find a specific spot in your sequence.

Follow-up:

The instructor will have the ISTs go over the Glossary of Terminology in appendix D. Any topics that the ISTs do not understand can be discussed for clarification.

TOPIC # 22: COMPLETE THE FINAL PROJECTS FOR A SHOW AND TELL WITH SEQUENCING SOFTWARE

Final Projects

Final Sequences (min. 32 measures and at least 6 tracks)

The IST creates two finished sequences.

- One sequence should be a transcription or an arrangement of a classical work. (See Appendix F for a list of suggested works.)
- The other sequence should be in a contemporary style using electronic sounds and drum parts. This sequence could be a popular song from a performing group or from a show. This sequence should include at least two tracks of digital audio in addition to a minimum of six MIDI tracks. Digital audio can be of voices, sound effects, an acoustic instrument, or any combination.

An additional option for the second sequence project may be one that incorporates digital video and a synchronized score or sound design as digital audio.

(Sample audio files of public domain songs are available from the TI:ME web site.)

Each sequence should include a brief journal (two-page minimum) containing a brief description of the sequence (specific problems and solutions, musical decisions regarding timbres, effects, etc.)

Appendix A

Software Available for TI:ME 2A & Computer Music Sequencing

This is not an exhaustive list but one of popular computer sequencing software available. Keep in mind that there is no such thing as the “best” sequencer (hardware, integrated or software) with all having distinct pros and cons. This appendix is a starting point for available options and possible demonstration downloads. Most demos that are downloaded have all of the software’s features available but you can not save your work. Note that several manufacturers offer different versions or levels of a sequencer application. Therefore, you can start out with a basic version and upgrade to a more powerful version without having to learn a new interface. Also, many manufacturers offer the same software for both the Macintosh and Windows platforms. For a lab situation, you may want to investigate lab pack and site license pricing packages with the manufacturer.

The sequencer programs in the following table are divided into two categories basic and advanced. In general advanced programs have not only a greater number of features but also a greater level of control for all features. The following abbreviations DA and VID are used for advanced software that incorporates digital audio (DA) and video (VID) capabilities

Macintosh

Windows

Software Title	Company	Software Title	Company
FreeStyle (basic)	Mark Of The Unicorn	FreeStyle (basic)	Mark Of The Unicorn
Performer (advanced) VID	Mark Of The Unicorn	PowerTracks Pro (basic)	PG Music
Musicshop (basic)	Opcode	Musicshop (basic)	Opcode
Vision (advanced) DA	Opcode	Vision (advanced) DA	Opcode
Cubase Light (basic)	Steinberg	Cubase Light (basic)	Steinberg
Cubase (advanced) DA-VID	Steinberg	Cubase (advanced)	Steinberg
Mastertracks Pro (basic)	Passport Designs	Mastertracks Pro (basic)	Passport Designs)
Micro Logic (basic)	Emagic	Micro Logic (basic)	Emagic
		Cakewalk Home Studio (basic)	Cakewalk/Twelve Tone
		Cakewalk Pro (advanced) DA 4 tracks only	Cakewalk/Twelve Tone
		Jammer Pro (advanced)	Sound Trek

Sequencers with Audio Capabilities and other advanced features.

Macintosh

Windows

Software Title	Company	Software Title	Company
Digital Performer DA,VID	Mark Of The Unicorn	PowerTracks Pro Audio	PG Music
Cuebase Audio DA,VID	Steinberg	Cakewalk Pro Audio DA,VID	Cakewalk/Twelve Tone
Logic DA,VID	Emagic		
Pro Tools (limited sequencing but professional audio and video capabilities)	Digidesign	Pro Tools (limited sequencing but professional audio and video capabilities)	Digidesign

Manufacturer Addresses:

- **Cakewalk Music Software/Twelve Tone**, PO Box 760, Watertown, MA 02272; (800) 234-1171; www.cakewalk.com
- **Digidesign**, 3401-A Hillview Ave, Palo Alto, CA 94304; (650) 842-7900 (800) 333-2137; www.digidesign.com
- **Emagic**, 13348 Grass Valley Avenue, Building C, Suite 100, Grass Valley, CA 95945; (916) 477-1051; www.emagic.de
- **Mark of the Unicorn**, 1280 Massachusetts Avenue, Cambridge, MA 02138; (617) 576-2760; www.motu.com
- **Opcodes Systems Inc.**, 3950 Fabian Way, Suite 100, Palo Alto, CA 94303; (415) 369-8131; www.opcode.com
- **Passport Designs**, 12335 Santa Monica Blvd., #124, Los Angeles, CA 90025; (800) 777-8010
- **PG Music Inc.**, 29 Cadillac Ave., Victoria, BC V8Z1T3 Canada; (250) 475-2874 (800) 268-6272; www.pgmusic.com
- **Steinberg North America**, 9312 Derring Ave., Chatsworth, CA 91311 -5857; (818) 993-4161; www.steinberg-na.com
- **Sound Trek**, 30 Waverly Place, San Francisco, CA 94108; (415) 989-3922; NA

Appendix B

Step by Step Guide for Musical Sequencing Creation

Always analyze your music's form and melodic content to use accelerated music data entry techniques such as copy & paste to shorten the amount of time required for input. Whether you are working from a pre-existing musical score or new score one, number every measure lightly with a pencil (including repeats) as a reference.

- Layout your sequencer tracks - create and name the tracks that you will be using for the sequence. You can also open a template (a time saving prefabricated sequencer layout without any music data present; this is an easy way to get students started on a sequencer project). Select your initial tempo.
- Set up a click track or simple drum loop before recording note data.
- Develop a roughed out orchestration for the composition. Decide on the patch changes and set the multi-timbral synthesizer(s) to the patches or insert these default patches into the tracks themselves. Include MIDI information in your count off measure so that there is not an interruption of the first measure by patch changers or other types of MIDI data. A guide for MIDI data to include in this first measure would be:
 - Initial patch change
 - Volume settings (controller #7) try setting all the tracks to 100 so you have headroom to go up and down with the volume. After listening to all the tracks you can go back and edit the volume numbers for balance.
 - Pitch Bend --set to 0
 - Modulation set to 0 (controller # 1)
 - Reset to power up default mode (controller # 122)

This data can be incorporated in one track and copied and pasted to another.

- Enter notes. (Step Time and/or Real Time Entry). If the music is unfamiliar you can always record at a slower tempo and speed it up for playback. Always make sure you practice your part before recording.
- Playback; check and correct wrong note pitches or durations (quantize or edit manually).
- Add markers and/or location points into the sequence to help you navigate when editing or punching in.

Appendix C

Nine Suggestions for Improving Sequences

When I evaluate students' sequences, I often find that the students could have profited by utilizing one or more of the suggestions listed below. These suggestions are designed to make the process of sequencing more efficient and more musical.

Suggestion #1: Be familiar with the music to be sequenced.

A great deal of recording time and editing time can be saved by familiarizing yourself with the score and by slowly practicing each part before beginning to record. If possible, listen to a recorded version of the composition. Examine the frequency range, the dynamic range, and the timbral range of the score. Know where musical climaxes occur so that you will be able to adjust volume levels and sound combinations appropriately. Be aware of the articulation idiosyncrasies of each instrument you will be emulating. In other words, try to overcome the limitations of a keyboard and think like a violinist when recording a violin part; think like a clarinetist when recording a clarinet part.

Suggestion #2: Number the measures in the score.

Using a score with all of the measures numbered will make it easy to locate specific measures for re-recording, for editing and for playback. Be sure to number repeated measures correctly. For example, if the first sixteen measures of a piece repeat, measure 1 will also be measure 17, measure 2 will also be measure 18, and so on.

Suggestion #3: Identify layered or doubled programs in your instruments in order to conserve voice allocations.

Many of today's electronic instruments are programmed to produce thicker textures by using layered or doubled programs. In a layered or doubled program, two voices are used for each key played on the keyboard. This doubling technique produces a thicker texture, but it also halves the polyphonic resources of the instrument. For example, playing an eight-note chord using a doubled program would use 16 voices instead of eight voices.

By using doubled programs sparingly, you can increase the number of voices available for other sequencer tracks. On many instruments the only way to tell if a program is doubled is to go into program edit mode. You can make it easy to identify doubled programs by either adding an asterisk at the end of the names of doubled programs, or by putting the names of all doubled programs in upper case - for example, by changing the name "Layerpiano" to "LAYERPIANO".

Suggestion #4: Set the sequencer metronome at a comfortable tempo.

If you can't play the music at the indicated tempo, choose a slower tempo for the recording process. For example, suppose that the tempo indication for a difficult melody is 120 *bpm* (*beats per minute*). If you feel more comfortable playing the melody at a metronome marking of 80 *bpm*, set the tempo indicator to 80 *bpm* and record the melody at this tempo. After you finish recording, change the tempo indicator to 120 *bpm*, and the sequencer will play back at the correct tempo.

Suggestion #5: If your sequencer doesn't have a multiple level "Undo" function, always save your work before editing.

Some sequencers will only undo the most recent action performed. Always listen to any changes you make before you continue working. If you aren't satisfied with the change, you can restore the original data.

Suggestion #6: When recording a punch-in, start playing along with the music before the punch-in point, and continue to play after the punch-out point.

One of the audible signs of a punch-in is a sudden change in the phrasing of a musical line. Playing the part a little before the punch-in point and a little after the punch-out point will often make the punch-in less obvious by maintaining the flow of the musical line.

Suggestion #7: Match the dynamics of the punch-in music with the rest of the musical line.

Another audible sign of a punch-in is a sudden change in dynamics in the middle of a musical line. Be sure to match the dynamic level of the new musical material with the rest of the phrase.

Suggestion #8: Use quantization correctly and sparingly.

There are two points to consider before you use quantization. The first point to consider is that in quantizing a track, you might produce rhythms which sound unnatural or unmusical compared to unquantized parts of your music. It is important to understand that rhythmically perfect music is usually not a desired goal in musical performance. Sequences with every track quantized usually become rhythmically uninteresting; therefore, use quantization sparingly.

Second, quantization will work only if you have recorded your tracks by playing along with the sequencer's metronome. Quantizing a track which was not recorded with the metronome will produce unpredictable and, in most cases, disastrous musical results.

Suggestion #9: Understand the difference between velocity and MIDI volume.

It is important to understand the difference between controlling dynamics through velocity data and controlling dynamics through MIDI volume. When you lower the values of note velocities, in most cases you are lowering the volume level as well as making the tone quality darker. When you lower the MIDI volume, you are lowering only the volume level. This difference can be compared to a trumpet player who plays a melody very softly during a recording session, as opposed to a recording engineer who lowers the volume of a trumpet part after it has been recorded. When the trumpet player plays softly, the lower harmonics of the sound dominate, producing a darker tone quality. When the trumpet player plays loudly, the upper harmonics dominate, producing a brighter tone quality. Therefore, if the volume level of the recorded trumpet melody is lowered, the notes will be softer but the tone quality will not change. For this reason, the editing of dynamics through velocity values is usually used to control the dynamics of individual notes in a track; the editing of dynamics through MIDI volume is usually used to adjust the balance of one sequencer track with other tracks.

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Appendix D

Sequencing, Computer, & Music Technology Terminology

If this is your first experience with sequencing software or the dedicated sequencer and MIDI workstation, you should take some time to learn the basics from a guided tour for gaining security in working with a computer mouse. The following important computer and sequencing terms should be understood or assimilated, and will apply to all available computer software.

A/D Converter -- Analog to Digital converter; a device that encodes a continuously varying (analog) audio signal into a string of (digital) numeric values. Each of these numbers represents a measurement of the amplitude of the analog signal at a particular instant. A converter's resolution is specified in bits (binary digits), typically 8, 12 or 16. The greater the bit resolution the less distortion. The rate at which the analog signal is converted into is called the sample rate. Typical sample rates used in MIDI audio sequencers are 22 or 44.1 thousand times per second. The highest frequency a digital system can reproduce is equal to one half the sample rate of the A/D converter.

Aliasing -- A weird form of digital distortion that is highly audible. It is caused when an audio signal is introduced into a digital system (A/D converter) that is higher than one half the sample rate.

All Notes Off -- A MIDI message that turns all the notes off in a MIDI network. Helpful if you have a "stuck" MIDI note. These can occur when an instrument did not get a MIDI message to turn off the note when the unit was switched off.

Arpeggiator -- Some sequencers offer an arpeggiator feature that will randomly change the order of notes in a chord or sequencer track or arpeggiate to a preprogrammed order.

Typical arpeggiator modes up Down, Up/Down.

Autolocate -- Some sequencers allow you to locate and or set specific temporal locations and allow the user to instantly return to them.

Autocorrect -- all sequencers allow the user the ability to correct timing to a specified rhythmic value (i.e. eighth notes, sixteenth notes, eighth note triplets, etc.). This should be used sparingly as it makes sequencer tracks sound perfect or robotic in nature.

Channel -- A term applied to MIDI for one of its 16 available 'software transmission lines over which MIDI data can be sent or received.

Channelize -- A term used for assigning MIDI data to a particular MIDI channel.

Click Track -- A metronome track generated by the sequencer to which a performer may listen to as they record overdubs. This will help to maintain rhythmic cohesiveness during the course of recording a sequence.

Clock -- A master timing reference used by a sequencer

Contiguous -- items on a computer screen that is immediately next to each other. (See antonym Non-Contiguous)

Continue -- A MIDI message that tells a sequencer or drum machine to continue playing from the current location if they have been stopped previously by a MIDI Stop message.

Continuous Controller -- A MIDI generated signal that can express data over a wide range; as opposed to a switch controller that has only two possible states on or off.

Controller #7 -- The controller number assigned to affect MIDI volume changes.

DAC -- Digital to Analog Converter is a circuit that accepts a digital word that represents the amplitude of a sound wave and produces a corresponding analog voltage at its output that can be fed to a speaker or headphone system.

Default -- when several options are available with a computer program and you do not pick one, then one is automatically assigned by default. You can also design personal default setting for options when you launch a program.

Default Window -- A computer or user assigned window that appears when a program is launched.

Delete Key -- A computer keyboard key which will backspace, removing a single letter or setting in a dialog box field. If a handle is selected for a number or word in a field, the Delete Key will eliminate it from your score.

DeskTop -- consists of a white menu bar and the gray or colored desk surface. Objects can be placed on the desk surface, moved about and removed. It can be thought of as an actual desk.

Dialog Box -- a box on the screen requesting information, or a decision from you.

Digitize -- To convert an analog audio signal into a digital code that represents that signal. See A/D Converter.

Disable -- To turn off a function.

Disk Initialization or Formatting -- Before a computer can store data on a disk, the disk must be organized into a form that allows data to be stored and retrieved -- a type of indexing system. Formatting/initialization typically involves inserting a blank disk in a disk drive and running a formatting/initialization program. The disk drive will then magnetically mark the disk where data is to be stored.

Diskettes (Floppy Disks 3.5 Inch) -- Where information is stored; can be transported and backed-up. They should always be inserted into the disk drive with the topside (the side without the metal circle in the center) facing up. The edge of the rectangular metal bar should be inserted into the disk drive. If this is done properly, you will notice a small arrow indented into the plastic cover surface of the diskette. The arrow should point towards the Macintosh's disk drive.

Document -- the file you create and modify with an application. A collection of information on a disk or in memory, grouped together and called by one name.

Double-clicking -- positioning the pointer and then quickly pressing and releasing the button on the mouse twice.

EQ -- short for equalizer, a device or plug-in that allows attenuation or emphasis of frequencies in an audio signal. Bass and treble controls on a radio represent a simple form of EQ.

Field -- a box in a dialog box that you type information into such as word or numerical data.

Graphic Editing -- An editing option that shows and manipulates data pictorially, as opposed to using numbers or text.

Hard Disk Recording -- The process of recording digital audio signals directly on to the hard drive for storage. Since digitized audio signals takes up a great deal of memory (CD-quality stereo 10 Meg a minute) and a hard drive has lots of memory, this is a logical way to record digitally.

Humanize -- To add minute variations in a sequencer's data to gain a more natural sound.

Icon -- a graphic representation, that looks like what it represents.

Interface -- a device that allows for the transfer, input, or viewing of information. The computer screen is an interface that displays information. The way in which software is designed to accept data would be its interface.

Launch -- double clicking on a computer application's icon to start or launch the program.

Local Control -- A MIDI feature that determines whether a keyboard's voice generators are controlled by the unit's keyboard (Local On) or by the MIDI in port (Local Off).

Loop -- A portion of a music sequencer's tracks that repeat for a specified number of times or infinitely.

Macros -- a combination of commands that may be called up by one computer command or keystroke(s).

Menu -- a list of functions available in a computer program or part of a computer program.

Menu Bar -- A bar used to select an option or command from a menu. May have pull down options when a key word is selected with a mouse

MIDI Time Code -- a set of MIDI messages that allow MIDI gear to have events triggered according to times related to SMPTE time code.

Non-Contiguous -- items on a computer screen that are not next to each other. (See antonym Contiguous)

Pan -- A control that places the audio signal at a specific point within the stereo field of two speakers.

PPQ -- (Pulse Per Quarternote) The number of clock (sync) pulses a sequencer or drum machine subdivides a quarter note into for as a rhythmic reference. The higher the number the finer the resolution of the sequencer. This number must be divisible by three to allow triplets. Common numbers used for PPG 24, 48, 96, or 480.

PPQN -- See PPQ (Pulse Per Quarternote)

Preset -- A particular patch or program stored in a synthesizer that will be assigned to a specific MIDI program number.

Program Change -- A MIDI message that instructs the receiving MIDI device understanding the Program Change Command to jump the number specified by the command. MIDI channel specific.

Punch In -- To initiate recording at a specific point in a composition with a sequencer. Punching in will erase existing material recorded starting at the punch in point, or it can add new material on top of existing material (sound on sound).

Punch Out -- To exit the recording process after initiating a punch in.

Quantization -- A term used interchangeably with autocorrect.

RAM -- Random Access Memory is a computer memory location that can be used repeatedly to temporarily store data. Both computer applications and documents are placed into RAM as you work. You have to save your work from RAM to a floppy disk or hard drive since when you turn off your computer all data in RAM is erased. RAM is very important in that it allows computers to run an unlimited array of software.

Real Time Recording -- To record data into a sequencer's memory as it is being played on a keyboard or other controller. In early computer programs, a composition had to be entered one note at a time.

RTM -- Read The Manual

Scroll View -- the music is viewed as a continuous horizontal band on the computer screen. The computer redraws the screen quickly in Scroll View

Sampler -- A device that records and stores actual sounds into its digital memory to be played back from a keyboard or other type of MIDI controller or sequencer.

Sampling -- The act of recording sound into a sampler or computer memory.

Sampling Rate -- The rate at which a signal is digitized into samples. Reading back the samples at the same rate reproduces the original sound, at an altered higher or lower rate varies the pitch on playback.

SMPTE -- (Society of Motion Picture and Television Engineers) originated at NASA for logging telemetry data and later adopted and modified by the Society of Motion Picture and Television Engineers to label each frame of a video tape by recording a unique piece of digital data on that frame. For the American standard (NTSC) each second of SMPTE time code is divided into 30 frames. A complete time code address includes
hours:minutes:seconds:frames = 00:00:00:00.

Song Position Pointer -- A MIDI message that describes where a sequencer or drum machine is /or should locate to with respect to the beginning of the composition.

Song Select -- A MIDI message that instructs a sequencer or drum machine to select a particular song number that is stored in its memory.

Start -- A MIDI message that tells the sequencer or drum machine when to start and follow MIDI timing messages.

Status Byte -- A byte used in MIDI to identify the particular message type to which subsequent data bytes relate.

Step Time -- To enter notes into a sequencer or drum machine one note or chord at a time in a non-real time manner. Usually a note value resolution is selected beforehand and the pitch information is supplied by the controller or keyboard.

Stop -- A MIDI message that tells sequencer or drum machine when to stop playback.

Sub Menu -- a main menu item may contain a sub menu, which will allow several options which the user can select. You can tell if a menu item contains sub menus by the inclusion of an arrow to the right of the command. Access to the sub menu options can be selected by dragging the pointer to the right of the arrow and then releasing it on the sub menu pop-up command list.

System Exclusive Messages -- MIDI messages that are unique to a particular manufacturer. These messages allow the manufacturer to send data that relates to their specific products and models with in MIDI messages.

Sysex --Abbreviated term for System Exclusive Message

Template -- A file that does not contain any note data but is pre- formatted for special layouts, such as grand staff for piano, tablature and staff guitar, etc. You can design you own or use the pre-made templates that come with your software package as a time saver when you create a score.

Toggle -- a computer command option that allows you move between two possible states like a toggle switch. Ex. on or off, page view or scroll view etc.

Track Shift -- To shift or slide a sequencer track ahead or behind in time, usually in very small increments.

Appendix E

WWW Resources for Sequencing

Music Sequencing Sites:

University of Oregon's Electronic Music Interactive
nmc.uoregon.edu/emi

Easy to digest of interactive explanations of topics such as synthesis, sound waves, and MIDI systems. 80 diagrams, 50 animations, and a 150 term glossary.

Classical music in General MIDI file format at MIDIWORLD.

<http://midiworld.com/classic.htm>

Sequencer Manufacturer Addresses:

Cakewalk Music Software <http://www.cakewalk.com>

Digidesign; <http://www.digidesign.com>

Emagic; <http://www.emagic.de>

Mark of the Unicorn; <http://www.motu.com>

Opcode Systems Inc.; <http://www.opcode.com>

PG Music Inc.; <http://www.pgmusic.com>

Steinberg North America; <http://www.steinberg-na.com>

Magazines

Electronic Musician, www.emusician.com

Keyboard, www.keyboardmag.com

Music and Computers, www.musicand-computers.com

Net Directory (Music)

<http://www.excite.com/Subject/Entertainment/Music/s-index.h.html>

Music Publishers Association

<http://host.mpa.org/mpa/Welcome.html>

World Wide Music

<http://www.WorldWideMusic.com>

Public Domain Information Project

<http://www.pdinfo.com/proof.htm>

Appendix F

An Abridged Public Domain List from the Music in the Public Domain Site for Sequencing Source Materials

This list is intended only as help in researching public domain materials and is not sufficient documentation that music is in the public domain.

A

A-Hunting We Will Go - Trad
Adeste Fideles - 1782
Afternoon of a Faun - Debussy ©1895
Air for the G String - c1700
Alouette - ©1879
Amazing Grace - John Newton c1800
America, My Country 'Tis of Thee - tune 1744, wds Rev Samuel Francis Smith 1832
America the Beautiful - ©1895
Angels We Have Heard On High - 1800s

Arkansas Traveler © 1851
Ash Grove The trad Welsh
Assembly (bugle call) Trad.
Au Clair de la Lune 1811
Auld Lang Syne music 1687 words 1711 verses 2&3 Robert Burns
Aura Lee H - 1885 1861
Ave Maria Gounod 1859
Ave Maria Schubert 1826
Away in the Manger ©1887

B

Baa Baa Black Sheep 1765
Bach Johann Sebastian 1685-1750)*
Barbara Allen '1885 1666
Barber of Seville Rossini * 1813
Battle Hymn of the Republic Julia Ward Howe ©1862
Beautiful Dreamer Foster © 1864
Beethoven Ludwig v *1770-1827)*

Berlioz, Hector (1803-1869)*
Bill Bailey Won't You Please Come Home ©1902
Bizet, Georges (1838-1875)*
Blue Bells of Scotland The '1885
Borodin, Alexander (1834-1887)*
Brahms Johannes (1833-1897)*
Bridal Chorus Lohengrin '1885
British Grenadiers '1885 1750

C

Camptown Races Foster -©1850
Can Can Offenbach 1858

Careless Love (probably trad) c1895
Carnival of Venice Bellak ©1854
Chopin Frederic (1810-1849)*
Chopsticks ©1877
Clementine ©1884
Cockles and Mussels 1750
Columbia the Gem of the Ocean 1843
Come All Ye Faithful Reading 1885
Comin' Thru the Rye 1796
Concerto for Piano #2 Rachmaninoff ©1901
Couperin , Francois (1668-1733)*
Czerny, Carl (1791-1857)*

D

Dance Macabre Saint-Saens ©1872
Death and Transfiguration R Strauss ©1891
Deck the Halls 1784
Did you Ever See a Lassie
Down by the Riverside ©1865
Drink to Me Only with Thine Eyes tune 1780 words 1616
Drunken Sailor The ©1891
Dufay Guillaume (c1400-1474)*
Dunstable John (1370?-1453)*

E

East Side, West Side (see "Sidewalks of New York")
Entertainer The Joplin ©1902
Eroica Symphony Beethoven
España Tango Albeniz ©1890
Evening Hymn (canon) Tallis 1890
Eyes of Texas Are Upon You The ©1903

F

Fantasia Impromptu Chopin 1855
Farmer in the Dell ©1883
Fifteen Miles on the Erie Canal
First Call (bugle call)
First Nowel The 1833
Fisher's Hornpipe - 1849
Flight of the Bumble Bee Rimsky-Korsikov ©1900
Flying Dutchman Overture Wagner 1844
For He's a Jolly Good Fellow 1783
Frankie and Johnny c 1869
Frere Jacques 1811
Frog Went A'Courtin' 1580

From the New World Dvorak ©1893
Funeral March Chopin 1840
Funeral March of a Marionette Gounod ©1872
Für Elise Beethoven 1810
Fux Johann Joseph (1660-1741)*

G

Git Along Little Dogies ©1893
Give My Regards to Broadway ©1904

Go Tell Aunt Rhody 1844
Go Tell it on the Mountain ©1865
God Rest You Merry Gentlemen c 1770
Golden Slippers ©1879
Goober Peas 1864
Good King Wenceslas tune Swedish 1582 words ©1853-67
Good Morning to All (tune of Happy Birthday) ©1893
Goodnight Ladies 1853
Gottschalk, Louis Moreau (1829-1869)
Gounod, Charles Francis (1818-1893)
Grand March--Aida Verdi
Grande Valse Brillante Chopin 1834
Grandfather's Clock Henry C Work ©1876
Greensleeves 1580
Guido of Arezzo (d 1050 AD)
Gypsy Chorus --Carmen Bizet
Gypsy Music Liszt *

H

Habanera--Carmen Bizet
Hail to the Chief Scott 1812
Hallelujah Chorus 1767
Handel, George Frederick (1685-1759)
Happy Farmer The Schumann 1849
Hard Times Come Again No More Foster ©1855
Hark the Herald Angels Sing 1855
Haydn Franz Joseph 1732-1791)
Here We Go Round the Mulberry Bush 1857
Hey Diddle Diddle 1765
Hickory Dickory Dock 1765
Home on the Range c 1873
Humoresque Dvorak ©1894
Hungarian Dances Brahms * #5--1859 ©1869
Hungarian Rhapsodies Liszt *

I

I Gave My Love a Cherry 1850
I Saw Three Ships Come Sailing 1765
I'm a Yankee Doodle Dandy ©1904
I've Been Working on the Railroad ©1894
In the Good Old Summertime ©1902
Invitation to the Dance Weber * 1821
Irish Washerwoman 1792
It Came Upon a Midnight Clear 1850

J

Jingle Bells 1857
John Henry ©1873
Johnny Has Gone for a Soldier, Irish trad.
Joshua Fit the Battle of Jericho ©1865
Josquin Des Pres (c1450-1521)
Joy to the World Handel 1839

K

Kreutzer LM Kreutzer R-1890

L

La Boheme Puccini *
La Donna e Mobile--Rigolette Verdi
Largo--New World Symphony Dvorak
Liebestramme Liszt 1847
Liszt, Franz (1811-1886)
Little Boy Blue (Mother Goose) 1765
Little Brown Jug Joe Winner ©1869
Little Jack Horner 1765
London Bridge 1744
Londonderry Air 1855
Long Long Ago Bayly ©1843
Lord's Prayer The 1885
Lullabye, Brahms
Lully Jean Baptiste (1633-1687)

M

Man on the Flying Trapeze The ©1868
Maple Leaf Rag ©1899
March of the Toys The ©1903
March Slav Tchaikovsky ©1876
Marriage of Figaro The Mozart * 1786
Mary Had a Little Lamb Sarah Josepha Hale ©1866
Meet Me in St Louis, Louis ©1904
Mendelssohn-Bartholdy Felix (1809- 1847)
Messiah The Handel *
Michael Row the Boat Ashore 1867
Mighty Fortress Is Our God A 1529
Minuet in G Beethoven 1796
Monteverde Claudio (1568-1643)
Moonlight Sonata Beethoven 1802
More, Sir Thomas (1478-1535)
Morely, Thomas (1557-1602)
Mousorgsky, Modeste (1835-1881)
Mozart, Wolfgang A (1756-1791)
My Bonnie Lies Over the Ocean ©1881
My Old Kentucky Home Foster -©1853

N

New World Symphony Dvorak *
Night on Bald Mountain A Mussorgsky ©1887
Nocturne op 9 no 2 Chopin 1832
Norwegian Dance The Grieg ©1881
Now I Lay Me Down To Sleep ©1866
Nutcracker Suite The Tchaikovsky *

O

O Holy Night 1843
O Little Town of Bethlehem ©1868
O Tannenbaum Ernst Anschutz c 1824 trad tune

Obrecht Jacob (1430-1505)
Offenbach, Jacques (1819-1880)

Oh Susannah Foster -©1848
Oh Them Golden Slippers James A Bland ©1879
Old Folks at Home The Foster -©1851
Old MacDonald Had a Farm words 1706 tune 1859
Orpheus in the Underworld Offenbach *

P

Pat-a-Cake Mother Goose
Pathetique Sonata Beethoven 1799
Pavanne for a Dead Infanta Ravel ©1899
Peer Gynt Suite Grieg * ©1888
Peter and the Wolf Prokofiev*
Peter Peter Pumpkin Eater 1765
Piano Concerto #1 Tchaikovsky ©1875
Piano Concerto #2 Rachmaninoff
Piano Concerto Grieg ©1873
Pictures at an Exhibition Mussorgsky ©1887
Pirates of Penzance Gilbert & Sullivan*
Pizzicato Polka Strauss
Polly Wolly Doodle Foster 1885
Polonaise Militaire Chopin 1840
Polovetsian Dances Borodin ©1888
Pomp and Circumstance Elgar ©1902
Pop Goes the Weasel ©1853
Prelude in C# Minor Rachmaninoff ©1893
Prelude op 28 no 7 Chopin 1839
Purcell, Henry (1658-1695)

Q

Quantz, Johann Joachim (1697-1733)

R

Rameau, Jean Philippe (1683-1764)
Red River Valley The ©1896
Reverie Debussy ©1895
Riddle Song The 1850
Robert Burns *
Rock of Ages Hastings ©1832
Rock-a My Soul 1830
Romeo and Juliet Tchaikovsky* 1871
Rosini C M Rosini 1890
Rossini Gioacchino Antonio (1792-1868)
Rousseau, Jean Jacques (1712-1778)
Row Row Row Your Boat words 1852 music 1881
Rub-a-Dub-Dub Mother Goose

S

Sailing Sailing (Over the Bounding Main) ©1880
Sailor's Hornpipe 1795
St Matthew's Passion Bach *
Scarlatti, Alessandro (1659-1725)
Scarlatti, Domenico (1685-1757)
Scheherazade Rimsky-Korsikov ©1890
Schubert, Franz Peter (1797-1828)
Schumann, Clara Josephine Weick (1819-1896)
Schumann, Robert (1810-1856)
Semper Fidelis Sousa ©1888
Serenade Schubert 1824
She'll Be Comin' Round the Mountain ©1899
Shenandoah 1826
Shoo Fly Don't Bother Me ©1869
Silent Night Holy Night Josef Mohr M Franz Gruber 1818
Silver Moon 1849
Simple Simon 1765
Slavonic Dances Dvorak ©1887
Sleeping Beauty Waltz Tchaikovsky ©1890
Sonatas of III Parts Henry Purcell* 1683
Song of India Rimsky-Korsikov ©1897
Song of the Volga Boatman ©1867
Sorcerer's Apprentice The Dukas ©1897
Spring Song Mendelssohn 1844
Star Spangled Banner 1885 9/13/1812 at Ft McHenry
Stars and Stripes Forever March ©1897
Strauss, Joseph (1827-1870)
Streets of Laredo 1860
Summer is Icumen In 1226
Swan The Saint Saens ©1887
Swing Low Sweet Chariot 1872

T

Ta Ra Ra Boom De Ay ©1891
Tales from the Vienna Woods J Strauss ©1868
Tallis Thomas (1505-1585)

Taps
Tarantella (Italian trad)
Tchaikovsky Peter Illich (1840-1893)
Teleman Georg Philipp (1681-1767)
Tenting Tonight on the Old Camp Ground Kittredge -© 1864
There is a Tavern in the Town ©1883
There Was A Crooked Man (Mother Goose)
There Was an Old Woman Who Lived in a Shoe 1765
Three Blind Mice 1609
Till Eulenspiegel R Strauss ©1895
Toreador Song-Carmen Bizet ©1873
Toyland Herbert 1885 ©1903
Tramp!Tramp!Tramp! Root -© 1864
Trois Gymnopedies Satie
Turkey in de straw 1834
Twinkle Twinkle Little Star 1765

U

Unfinished Symphony Schubert

V

Verdi Giuseppe (1813-1901)
Vivaldi, Antonio (c 1680-1743)

W

Wagner, Wilhelm Richard (1813-1883)
Waltz of the Flowers- The Nutcracker Suite Tchaikovsky ©1891
Waltzing Matilda ©1903
We Three Kings of Orient Are - 1857
Weber Carl Marie von (1786-1826)
Wedding March A Midsummer Night's Dream Mendelssohn 1844
Wedding March - Lohengrin Wagner 1852
Wedding March Mendelssohn
Well-Tempered Clavier 1 Bach * 1722
When Johnny Comes Marching Home Lambert -© 1863
When the Saints Go Marching In ©1896
Wildwood Flower (I'll Twine Mid the Ringlets) Maude Irving & JD Webster©1860
William Tell Overture Rossini 1829
Wolf, Hugo (1860-1903)

X

No songs with X.

Y

Yankee Doodle c 1775 melody pub Glasgow 1782
Yellow Rose of Texas J K ©1853

Z

No songs with X.

Appendix G

Microphone Descriptions and Applications

There are two basic types of popular inexpensive microphones: *dynamic* and *condenser*. Dynamic microphones are very durable workhorse mics while condenser types need batteries or power from a mixer but have a greater sensitivity to sound and higher frequency range. Very small movements in the air from soundwaves are converted from physical motion into electrical energy, Similar to the way your eardrum converts sound waves to electrical nerve impulses.

Every microphone has a specialized or selectable pick-up pattern. Here are common pickup patterns for the microphones you will be using for class room hard disk recordings. Each pattern has one or more specialized applications that make microphone selection an important part of capturing the best audio quality possible.



Cardioid (Unidirectional)

The front part of the microphone picks up sound while the back of the microphone rejects sound. Usually dynamic microphones have a cardioid pick-up pattern. *Hyper cardioid* is shaped like the cardioid but has an even narrower pick-up pattern in front.

Cardioid Applications

These are great for vocal and instrumental situations where you want to reject other instruments or vocals. Hyper cardioid is useful for isolating an instrument or voice to prevent it from bleeding onto another instrument's tracks.

Omnidirectional

The omnidirectional pick-up pattern is a complete sphere and will sense sound from all directions equally well. Omnidirectional microphones sound very natural, usually have a very flat response, and are not susceptible to the proximity effect.

Omnidirectional Applications

These can be used to record a performance and total room ambiance simultaneously. Be careful when using the omnidirectional pattern in live applications as it is prone to feedback.

Bi-Directional (Figure Eight)

A bi-directional pick-up pattern responds to sound sources at the front and back of the microphone. Bi-directional patterns reject sounds at the sides of the microphone.

Bi-Directional Applications

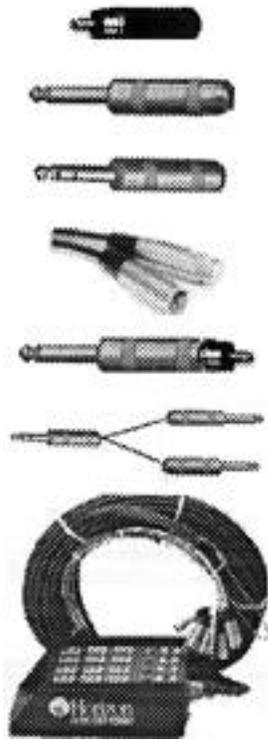
This is an excellent pattern choice for two singers facing each other or between two toms of a drum set. Picking up the audience and performer simultaneously is another popular use of this pattern.

Appendix H

An Educators Guide to Cables and Signal Strengths

Cables are a necessary part of any studio. It is helpful to remember the dimensions of your studio when determining the lengths of cable you will need to wire all components.

Diagram 2-6 lists and illustrates the most commonly used connections for audio cables.



1. *RCA (phono)*: usually on tape recorders, stereos and hi-fi gear, some mixers and multi-track recorders.
2. *1/4" Phono/Guitar & Speaker Cables* (tip, sleeve); have two conductors
3. *1/4" TRS* (tip, ring, sleeve): can be used for stereo signals or balanced operations (see low impedance previous section), also speaker connections.
4. *XLR*: used for microphone and pro audio equipment connections
5. *Adapters*: It is a good idea to purchase multiple adapters and create an adapter kit for your project studio. It can save time in a crisis. Adapters to include are RCA to 1/4", 1/4" phono to RCA, RCA female to RCA female, 1/4" female to 1/4-inch female.
6. *Insert Cables*: have a stereo TRS 1/4" phono on one end and two separate 1/4-inch phono cables on the other. The insert jack is an output/input option where the TRS 1/4" stereo phono plug inserts into the mixer's insert jack. The other two regular 1/4" phono plugs will go to an input and output of an audio device.
7. *Snakes*: groupings of cables that have been molded or bound together. These can help to tame the mountain of cables needed to organize a studio. Snakes can have similar or different connectors on both ends.

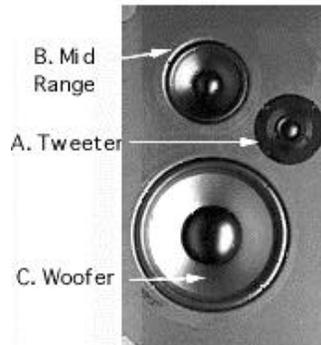
Lowest To Highest Audio Signal Levels:

Microphone - Electric Guitar or Bass - Line Level - Speaker

Appendix I

An Educators Guide to Studio Monitors

Loudspeakers: The principle behind a loudspeaker is very simple. Place a coil of wire in a magnetic field and electrify it with alternating electrical currents, and it will vibrate back and forth following the shape of the electrical signal. Attach a shallow cone to the coil to set the air in motion, and you have a dynamic loudspeaker. Most high-fidelity speaker systems use several dynamic loudspeaker drivers; each assigned to a specialized area of the audio frequency spectrum.



- *Studio monitors* are designed to be flat in frequency response. Their function is to provide accurate reproduction of the sound during all aspects of the recording process. *Near-field monitors* are small studio monitors designed for close placement to the listener (three to four feet). The object of near-field design is to hear the sound of the speaker with minimal room coloration and reflections of the sound. They are less expensive than their full-blown studio monitor relatives and should be positioned so that the sound goes directly into your ears.
- *Home stereo (hi fi) loud speakers* provide reasonable reproduction of recorded music in small rooms. These monitors are not ideal to use in a home studio since most are not flat in frequency response and tend to emphasize high or low frequencies.
- *Powered monitors* contain their own internal amplifier. These monitors range from very inexpensive models by Yamaha and Fostex to expensive Genelec studio monitors. An advantage of powered monitors is that the amplifier is custom-tailored to work efficiently with the speaker.

Appendix J

An Educators Guide to Signal Processing

The use of effects provides an ambiance for the voices and instruments in your mix. A signal without effects or signal processing is said to be *dry*, and a signal that has effects or processing applied to it is called *wet*. Effects provide a third dimension to a mix: dry to wet balances determine a sound's perceived proximity. Wetter sounds are perceived as more distant. Before applying any effects, always listen to your tracks dry first, and then decide if there is a spot in the mix where signal processing will provide a dramatic effect. Effects tend to disappear when instruments and vocals are combined in the mix. The preview and bypass switch on a plug-in effects processor is important in order to A/B the effect of signal processing and the unprocessed signal to determine if you are getting the desired effect and helps adjust the balance.

Echo

An *echo* is a discrete repeat or series of repeats from a digital delay (or built-in digital signal processing available with digital audio software and some hard-disk systems). In nature, a person shouting into a canyon creates an echo. The shouted words return as a series of discrete echoes that diminish in amplitude with each successive echo. There are many plug-ins that allow you to specify the amount of time until you hear an echo. Echo units and plug-ins have a control called *feedback* or *regeneration*, which controls the number of repeats. These are great effects to add to lead vocals or a solo instrument. An echo can thicken up a part when working with limited tracks. Echoes should be set to a rhythmic subdivision of the music; some digital delays have a tap tempo function to set the tempo quickly.

Delay-Based Effects

Chorus creates the impression of multiple instruments from a single instrument. A 30–40 millisecond delay is combined with the original signal and modulated (a modulator makes the input signal's pitch rise and fall at a particular speed and shape). Chorusing adds life to a sound. *Phasing* is created with a delay setting of 0.5 milliseconds. This short delay causes the frequencies of an instrument at input to be cut, and boosts frequencies when mixed at the output. It also adds modulation to the signal. Phasing creates a “whooshing” sound—something like a wah-wah pedal on a guitar. *Flanging* is created exactly the same way as phasing, but the delay time is greater—between 10–20 milliseconds. The name “flanger” came from the engineer holding a finger on one of two synchronized reel-to-reel tape's flanges with both playing the same material. Flanging is a very dramatic sound like a jet engine's “swhoosh.”

Appendix K

Bibliography for Further Study

Books and Videos on Sequencing

Muro, Don *Video -- The Art of Sequencing* • (VH0198) CPP Media VHS

Keyboard Magazine Editors *MIDI Sequencing for Musicians* (ISBN 0-88188-911-3) • GPI Publications • 138 pages • 1989

Allen, Corey *Arranging in the Digital World* (ISBN 0-634-00634-7) • Berklee Press distributed by Hal Leonard • 78pages and Standard MIDI files • 2000

Books and Videos on MIDI

Anderton, Craig, *Video – The Basics Of MIDI* • Alesis corporation VHS 1991

Buick, Peter & Lennard, Vic *Music Technology Reference Book* (ISBN 1-870775-34-1) • PC Publishing • 154 pages • 1995

Eiche, Jon F. *What's MIDI?* (ISBN 0-7935-0082-6) • Hal Leonard Publishing • 62 pages • 1991

Lehrman, Paul & Tully, Tim *MIDI for the Professional* (ISBN 0-8256-1374-4) Amsco Publications • 255 pages • 1993

Rothstein, Joseph *MIDI A Comprehensive Introduction* (ISBN 0-89579-285-3) • A-R Editions, Inc. • 226 pages • 1992

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Rudolph, E Thomas *Teaching Music with Technology* • (ISBN 094105092-0) • GIA Publications, Inc. Chicago, 316 pages • 1996.

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Anderton, Craig *The Electronic Musician's Dictionary* • (ISBN 0-8256-1125-3) • Amsco Publications, New York, NY, 119 pages • 1988.

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Lee, William *Music in the 21st Century: The New Language* • (ISBN 0-7604-0065-2) • CPP/Belwin, Inc., Miami Florida, 193 pages • 1994.

Tomlyn, Bo & Leonard, Steve *Electronic Music Dictionary: A glossary of specialized terms relating to the music and sound technology of today.* • (ISBN 0-88188-904-0) • Hal Leonard Books, Milwaukee, WI, 77 pages • 1988

Williams, David & Webster, Peter *Experiencing Music Technology:* • (ISBN 0-02-872914-5) • Schirmer Books, NY, NY, 594 pages & CD-ROM • 1996.

Holmes, Thomas B. *Electronic & Experimental Music* New York: Charles Scribner's Sons, 1985.

Periodicals The following periodicals are popular sources of information about current sequencer technology. These publications include product reviews, announcements of updates, and advertisements by leading hardware and software manufacturers.

- **Electronic Musician**, 6400 Hollis Street, Suite 12, Emeryville, CA 94608; (510)653-3307; www.emusiclan.com
- **Keyboard**, 411 Borel Ave., Suite 100, San Mateo, CA 94402; (415)358-9500; www.keyboardmag.com
- **Music and Computers**, Box 56220, Boulder, CO 80322-6220; (303)678-0439; www.musicand-computers.com

Appendix L

TI:ME 2A Advanced Sequencing Lesson Planer

Short Answer Worksheet for creating Computer Notation Software Lesson Plans

Sequencer Software and the MENC National Standards

- Which national standard(s) can be addressed using Sequencing Software?

- What specific ways could Sequencing be used to address these standards?

MENC Standards:

1. Singing, alone and with others, a varied repertoire of music.
2. Performing on instruments, alone and with others, a varied repertoire of music.
3. Improvising melodies, harmonies, and accompaniments.
 - Composing and Arranging Music within specified guidelines.
 - Reading and notating music.
 - Listening to, analyzing and describing music.
 - Evaluating music and music performances.
 - Understanding relationships between music, the other arts, and disciplines outside the arts.
 - Understanding Music in Relation to History and Culture

Now review the Teaching Strategies listed in the TI:ME technology strategies document.

See

Appendix A of the *Technology Strategies for Music Education (TI:ME pub.)*. Describe one or more ways to use Sequencing in your teaching situation:

TI:ME Tech. Strat.

Teaching Application

<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

List three ways that Sequencers can be used in your teaching:

Sample Lesson Planer

I. ADVANCE PLANNING

A. GRADE LEVEL AND SUBJECT

For what grade/age is the plan?

How long is the class?

Where are the students developmentally?

B. MATERIALS AND EQUIPMENT

Which books (page numbers) are needed for the plan?

Which song materials are needed?

Which visual aids (flashcards, photos, and charts) are needed?

Which aural aids (recordings, cassette tapes) Are needed?

Which instruments are needed? Do they need to be tuned?

Which equipment (chalkboard, chalk/ eraser, and sketchpad) is needed?

Is a filmstrip projector, tape recorder, or VCR/monitor needed?

Which props are needed?

Does the plan require open space for movement?

C. SPECIFIC PROGRAM OBJECTIVES

List here several objectives for the YEAR to meet in the activities of singing, playing, reading, moving, creating, or listening.

List here several objectives for the YEAR to meet teaching goals based on music elements (melody, rhythm, harmony, form, expression, and timbre).

D. LESSON OBJECTIVES

List here several specific music objectives for THIS particular class.

The objectives will answer, in sentence form: WHO, WHAT SPECIFIC ACTIVITY (ACTIVE VERB), WHAT MUSIC IS USED, HOW WELL THE GOAL IS ACCOMPLISHED.

II. THE LESSON

A. MOTIVATION

Give a brief sentence or two explaining how the teacher will get the students interested in the music lesson.

B. PROCEDURES

In complete sentences, describe the steps you (the teacher) will take to teach the music/songs, Lead the students to understand the music concepts, the types of questions you will ask, the activities that will take place, etc. Have you included at least three activities? singing, playing, moving, listening, creating, reading? Are you teaching music concepts? Have you planned enough activities to fill the time allotted? Have you built in procedures to evaluate the students' understanding? Have you allowed for individual modifications?

C. EVALUATION

Ask yourself questions about the objectives planned for the lesson.

III. FOLLOW-UP LESSONS

Include six or more ideas to expand or continue concepts/activities from this lesson into future classes, using music activities (singing, playing, moving, listening, creating, and reading) AND/OR music elements (melody, rhythm, harmony, form, expression, timbre). Where could the lesson go in the next class?

5 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

6 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

7 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

8 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

9 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

10 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

11 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

12 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

13 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

14 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

15 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

16 -- MIDI Channel # () Patch Change # and Names (List original 1st and all others sequentially) _____

Sequencer Digital Audio Track Sheet (Sample Rate _____ Bit Rate _____)

1 -- Name of Track and additional important information _____

2 -- Name of Track and additional important information _____

3 -- Name of Track and additional important information _____

4 -- Name of Track and additional important information _____

Digital Video Information (AVI – QuickTime) _____

Name of Video and additional important information _____