

Processor (CPU)

- CPU computes data during almost every action you perform on your computer.
- When using a DAW a computer could need to natively process a large number of tasks simultaneously at any given time.
- A CPU with more cores and a higher processing rate (Hz) is better when using a DAW.

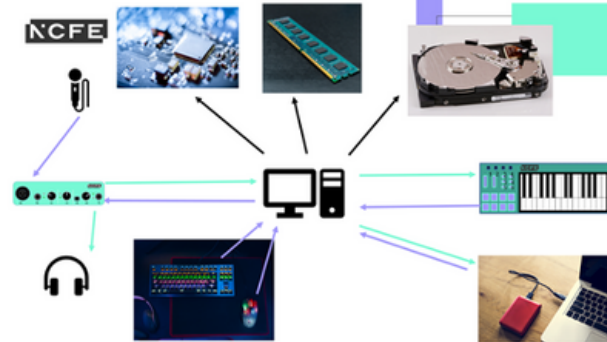
RAM

- RAM is essentially like a device's short term memory.
- It stops the CPU from using the slower hard drive to access files and run software.
- Temporarily stores information that software needs to instantly retrieve it when the CPU is told to execute a command, e.g. to playback an effects chain on a channel strip in a DAW.
- It is recommended to have at least 8GB of RAM installed when using a DAW.

Display Monitor

- The display monitor is an essential part of using a computer to run a DAW.
- It needs to be large enough to display enough tracks and plugin windows at once.
- Many DAW setups will include a second monitor to display plugins or the mix window.

Hardware Components & Peripherals



Hard Drives

- Hard drives store data.
- A minimum of 500GB hard drive is recommended when using a DAW.
- Two types of Hard Drive: HDD and SSD.
- HDDs have a spinning disc that data is written to which takes time.
- Solid state drives provide a much faster read and write speed than traditional HDDs.
- This is preferable when using a DAW

Peripherals

External Storage -

- USB stick, SSD, Cloud storage & Network drive can all be used to store data.

Data Input Devices -

- Keyboard shortcuts are vital for a fast workflow allowing users to be more efficient and accurate.
- Trackpads can be used instead of a mouse.
- These can perform multitouch gestures e.g. swiping between pages or a two finger click for a right click.
- Touchscreen technology has been integrated with DAWs.

Audio output -

- Open-backed Headphones are better for mixing and prolonged listening.
- Closed-backed Headphones are better for recording, as they reduce bleed into a microphone.
- Speakers provide a better listening experience.

Smart Devices -

- Smartphones and tablets can now be integrated to use with DAWs allowing you to control various functions.

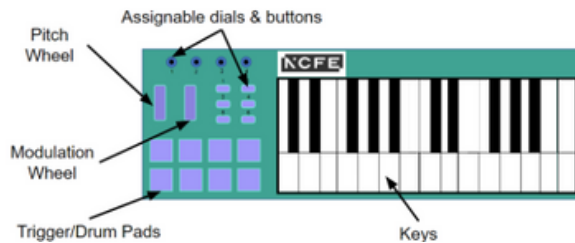
MIDI Keyboards

- A MIDI keyboard works by connecting via USB to a computer.
- It sends data (binary code) down the USB cable.
- When a key is pressed information is sent to the DAW about the:
 - Note pitch
 - Note velocity
 - Note duration
- The Modulation Wheel will normally have a default function within a software instrument but can be reassigned.
- The pitch bend wheel can be used to bend the pitch of a note up or down a fixed amount.

Other MIDI Controllers

- Designed for performance using MIDI rather than note input.
- Guitar Controllers are mostly designed to work in a similar way to a normal guitar outputting MIDI instead of audio.
- Pad controllers are designed for triggering drums. Some electronic drum kits also have MIDI capability.
- Wind Controllers are designed to work like a saxophone or clarinet but playing digital sounds.

MIDI Controllers & Audio Interfaces



MIDI Control Surfaces

- You can also have control surfaces that look like mini mixing desks.
- They have a mixture of faders and knobs/pots that can be assigned to control particular software functions in a DAW.
- DJs use specific software which can be controlled using specially designed MIDI controllers.



Gain Control

- When setting the gain level for recording the aim is to set the gain as high as you can without the signal distorting.
- You should leave headroom to allow the performer to get louder

Audio Interface

Component	Function
XLR Input	To connect microphones.
+48v Phantom Power	To power condenser microphones.
1/4" Jack Input	Used to connect instruments.
Gain Control	Controls the level of the signal being recorded.
Direct Monitoring	Controls the level of the signal being recorded.
1/4" Output	To connect a pair of headphones.
RCA Output	To connect speakers.
USB B Connection	To connect to the computer.

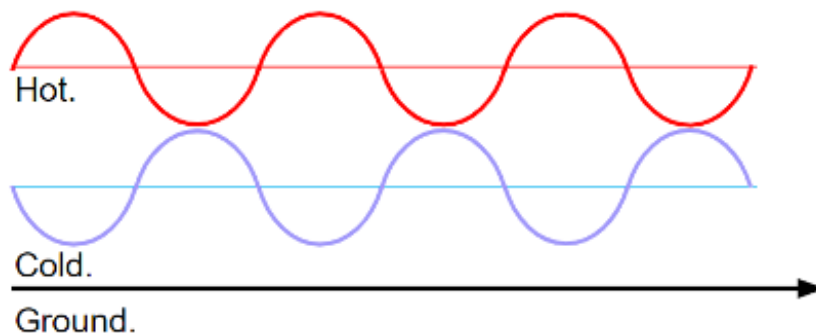
Audio Connections

Line & Instrument Level Inputs

- Line level inputs are used for equipment such as hardware synthesisers and drum machines.
- Instrument level inputs are used for instruments like electric or bass guitar. These are a lower voltage than line level.

Balanced vs Unbalanced Signals

- When recording audio, a balanced connection is preferable as they can remove noise from the signal.
- They have three wires running through them:
- Hot signal, Cold signal, Ground.
- The cold signal is inverted which removes any noise that is introduced to the cable when the signals are combined again.



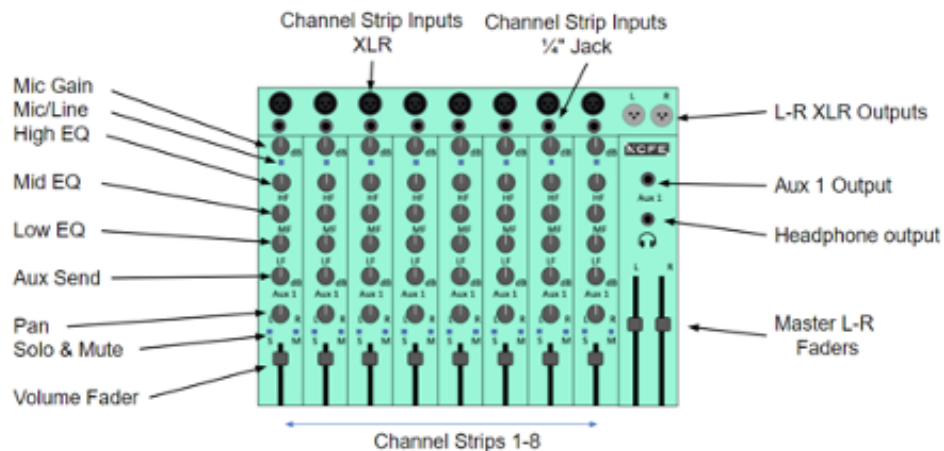
Audio Connections

Name	Function	Image
1/4" Jack Cable	<ul style="list-style-type: none"> • Mono (TR) carries unbalanced mono signals. Used for instruments. • Stereo (TRS) carries an unbalanced stereo signal or a balanced mono signal. Connect interfaces to speakers. 	<p>TS TRS</p>
XLR Cable	<ul style="list-style-type: none"> • Have 3 pins in the male end of the cable and 3 sockets in the female end. • Balanced connection type used for microphones most commonly. 	
RCA Cable	<ul style="list-style-type: none"> • Unbalanced connection type used to connect audio equipment e.g. interface to speakers. 	

Mixing Desks & DI

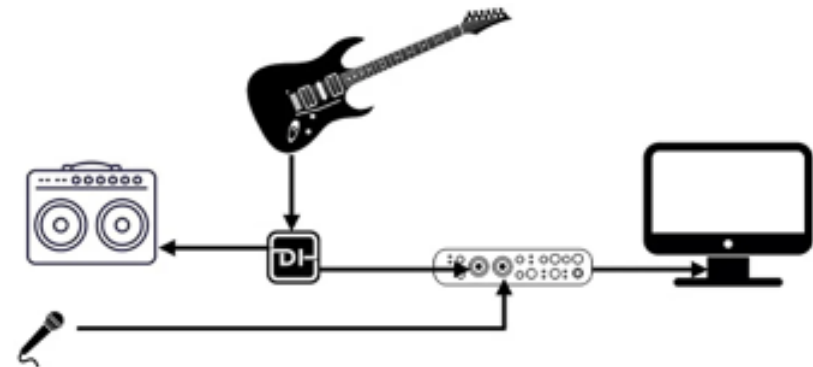
Mixing Desks

- Mixing desks are used for recording and live performance.
- An audio signal travels from the top of the strips then travels down the strip until it reaches the volume fader where it is sent to the master fader.
- The auxiliary send (Aux Send/Aux 1) creates a copy of the signal before the channel strip fader.
- This allows you to control the level being sent to a monitor feed for performers.
- Most mixing desks will include built in EQ and Pan on each channel strip allowing you to shape the tone of the incoming signal and create separation by using the stereo field.



Direct Input (DI)

- When recording using line or instrument level inputs you are recording using the technique known as direct input (DI).
- This gives a cleaner signal with less noise than recording using an amplifier and a microphone.



DAW Software & Configuring Projects

DAW Software

Type	Advantages	Disadvantages
Cloud-based	<ul style="list-style-type: none"> Projects stored and backed up remotely. Can access projects anywhere. Can easily collaborate with other musicians. Remote recording. Simple to use. 	<ul style="list-style-type: none"> Latency due to use of internet. Unable to record at higher quality. Have to have an internet connection to use. Does not have same feature set as desktop DAW. Fewer plugins available.
Desktop Application	<ul style="list-style-type: none"> Can record at higher quality. More power processing. Much lower latency (based on hardware available). Far more plugins and instruments to choose from. Does not require internet to work. Industry standard. 	<ul style="list-style-type: none"> Not automatically backed up remotely. Cannot access projects remotely. Harder to collaborate with other musicians. Can be more complex to use.

Buffer Size

- The amount of time allowed for your computer to process the audio of your audio interface.
- This setting can be found in your DAWs audio preferences menu.
- You will have different buffer size options.
- The lower the buffer size the less latency that there will be from your computer processing the input and output signals, good when recording.
- Higher buffer size is good when mixing as it will improve computer performance.

Tempo & Time Signature

- Most DAWs will default to a Tempo of 100 bpm or 120 bpm and a 4/4 time signature.
- Both of these settings can be changed according to the needs of your project.
- In Logic, these can be changed in the LCD display in the centre top of the window.

Bit Depth & Sample Rate

- Two settings we must consider when configuring a new project are: Bit depth and Sample rate.
- The minimum sample rate and bit depth for digital recording is 44.1kHz/16 bit.
- Bit depth affects the noise level and dynamic range available in a digital recording. Sample rate affects the range of frequencies captured.
- 16 bit 44.1kHz is known as CD quality, widely accepted as standard for digital recording.

Keyboard Shortcuts

- Keyboard shortcuts allow you to perform common DAW tasks more quickly.
- This allows you to speed up your workflow if you remember the main commands.

Software Instruments & Loops

Track Types

Audio -

- Audio Tracks handle audio files that are either recorded in or audio loops
- The input channel needs to be selected in the DAW which should correspond to the channel on the Audio Interface that the instrument/mic is plugged into.
- The Output is set to the Stereo Output by default but can be changed.

Software Instruments -

- Software Instrument tracks record MIDI data to be played back by a Software Instrument, either a sampler or a synthesiser.
- Most DAWs will come with a library of instrument sounds from which a range of instrument sounds can be chosen.

MIDI -

- MIDI Tracks also record MIDI data but are used to trigger external MIDI instruments rather than internal Software Instruments

Synthesisers

- These are the main parameters in a Synth:
 - Waveform (Sine, Square, Triangle, Sawtooth).
 - Pitch (octave of the waveform).
 - Filtering (HPF/LPF/Cutoff/Resonance).
 - ADSR (Attack, Decay, Sustain & Release - shape of the note).
- Software Synthesisers come with a range of presets that can offer useful starting points.
- These parameters can then be edited to modify the instrument's sound to something more unique.

Samplers

- Software Samplers cover a large number of acoustic instruments from pianos to violins to guitars and drums.
- They provide access to instrumental sounds users would otherwise not have access to or be able to play.
- Samplers can also be used to create new sounds by importing audio files and mapping them to the keyboard.
- Samplers also have controls in common with Synthesisers that can be edited such as Filter and ADSR Envelope.

Loops

- A loop is a premade piece of music that has been created using audio or MIDI.
- Loops are selected from a library and can be edited using plugins or editing tools.
- Loops are categorised by:
 - Loop Pack: Loops that belong to the same loop pack have been designed to work together.
 - Key, Tempo (BPM), Time Signature
 - Length
 - Instrument, Genre, Type (audio/MIDI)

Advantages

- Saves time.
- Can build a structure.
- Gives ideas for rhythms or chords.
- Something to write over the top of.
- Professional recordings.
- Instruments that you cannot play.

Disadvantages

- Can be unoriginal as available to everyone.
- Can be hard to fit loops together with minimal editing.

Editing Tools

MIDI Editing Tools

Velocity -

- Although velocity does affect the volume of an instrument, this is not the only thing that changes.
- The harder an instrument is struck or played, the tone will also change.
- Velocity control is essential to making a MIDI performance sound realistic.

Quantise -

- Quantise generally refers to snapping MIDI notes to a set note value. This is known as rhythmic or time quantise.
- Out of time performances can be snapped to the nearest note value on the piano roll grid.
- The strength of the quantise can also be adjusted. The lower the quantise strength, the more human the performance will be.

Swing -

- Quantise can also be used to create swung rhythms.
- You can set the amount of swing when quantising from 0 – 100%.
- You will need to make sure that you set the quantise to the smallest note value that appears in the MIDI file, otherwise it will change the rhythm of your recording.

Humanise -

- To make a MIDI part seem more like it has been played by a human and not by a computer, we need to edit two parameters: Note Position and Velocity.
- If a MIDI part is perfectly quantised and in time and all of the velocities are the same or very similar it will not sound realistic because humans are unable to play with 100% accuracy.
- This can either be done manually or by using the MIDI Transform tool to set ranges for the MIDI values.

Time Stretch -

- When using an analogue recording medium:
 - Speeding up the playback will raise the pitch.
 - Slowing down the playback will lower the pitch.
- In a DAW, we can change the speed of a file without affecting the pitch.
- This has limitations - the more you change the speed, the more artefacts will be introduced into the audio file.
- The benefit of this process in a DAW is that it is non-destructive, meaning that the process can be undone.

Pitch Shift -

- We can change the pitch of an audio file independently of the speed.
- It can also be done using a pitch shifting plugin.
- You can change the coarse (semitones) and fine tuning (cents) of an audio file

Reverse -

- We can use a DAW to reverse audio, using non-destructive editing.
- This is a common effect that is used to build tension and link sections.

Trimming -

- The trimming tool is used to change the length of a region.
- This is a non-destructive process.
- This means that you can undo this process at any point when editing.

Audio Editing Tools

Automation

- Automation can be used to control different parameters within our DAW.
- It is most commonly used to automate changes to volume and panning but can also be used to automate change to instrument parameters e.g. the cutoff of a filter.
- Plugin settings can also be automated such as creating a filter sweep using EQ by automating a change in the cutoff frequency of an HPF or LPF.
- Automation of effects and instruments helps to develop a piece of music to maintain interest and build tension.
- It can also be used to create interesting and unusual sounds for effects plugins.

Effects Plugins 1

Time-based Effects

Reverb

- How a sound wave interacts with its surroundings giving a sense of space.
- Digital Reverbs generate this artificially, through algorithms.
- **Size:** size of the space being created. The higher the setting the bigger the reverb.
- **Time:** This is the time (length or decay) that the reverb will last for.
- **Dry:** the amount of the original sound
- **Wet:** the amount of the reverb sound



Delay

- Digital delay is a delay generated artificially, through algorithms.
- **Note Value:** The time that the signal will be delayed by. It is measured in note values so that delays will synchronise with the BPM of the project. It can also be measured in milliseconds.
- **Feedback:** The amount that the delayed signal is sent back through the delay producing more repeats.

Modulation Effects

Chorus

- Chorus replicates the sound of multiple musicians playing the same thing together.
- It does this by modulating the frequency of the incoming signal, creating changes in pitch and time that mimic multiple musicians playing a part.
- **Rate:** the speed at which the plugin modulates the incoming signal.
- **Intensity:** the amount of modulation that will occur. Can create unusual, very detuned sounds.
- **Mix:** the mix between the original dry signal and the wet signal.

Flanger

- Flanging can be used to create a subtle double of an incoming signal or if used with extreme settings a metallic swooshing effect.
- **Rate, Mix, Intensity:** same as chorus
- **Feedback:** the amount of the affected signal that is sent back into the flanger.

Phaser

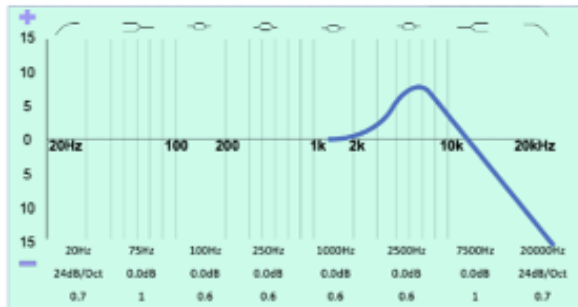
- Recreates the effect that phase cancellation has on an audio signal. It has a characteristic swooshing effect.
- **Stages:** This is the type of phasing that will take place.

Effects Plugins 2

Filter Effects

Wah Wah

- A Wah effect is created using a LPF with a high resonance boost.
- When the guitarist presses down on the pedal, the cut-off frequency rises.
- This movement creates the Wah filtering sound.



Filter Sweeps

- HPF and LPFs in an EQ are often automated to create filtering effects in a range of styles. although most commonly heard in Electronic Dance Music.
- These filtering effects are called filter sweeps.
- The cut-off frequency is automated to rise or fall.
- Filter sweeps also occur on synthesisers using a high resonance and automating or modulating the cutoff frequency.

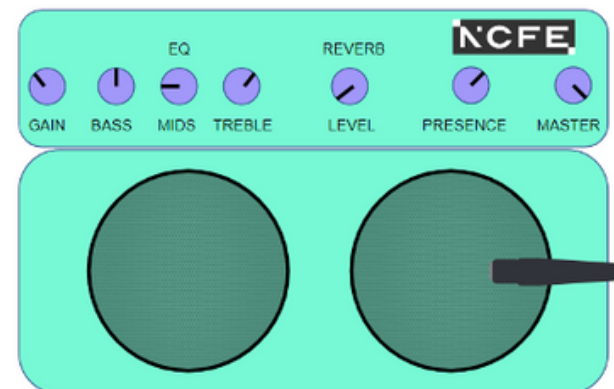
Distortion Effects

Overdrive

- Overdrive is a form of medium or mild distortion
- It is most commonly used with electric guitars in Rock music.
- Tone: Low Pass Filter on the overdriven signal.
- Level/Output: Output volume of the overdriven signal.
- Drive/Gain: Amount that the input signal is turned up.

Amp Simulation

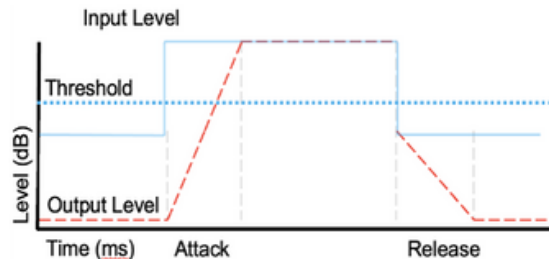
- This plugin simulates the sound of a real amplifier using software processing.
- The image below shows a typical layout of the common controls for an amp sim.
- When the input gain is turned up, it starts to distort.



Effects Plugins 3

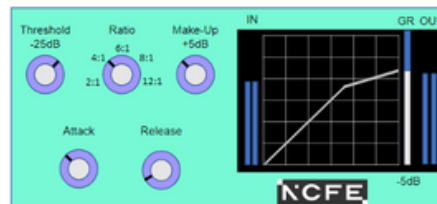
Noise Gate

- A noise gate is designed to remove unwanted noise or sound from an audio signal such as:
 - Gaps in vocal phrases.
 - Breaths.
 - String buzz.
 - Bleed from other instruments.
- Reduction:** This is the amount (dB) that the noise gate will turn down the incoming signal once it falls below the threshold.
- Threshold:** the level (dB) at which the compressor will start to turn down the input signal.
- Attack:** The speed at which the compressor will start to turn down a signal once it has passed the set threshold.
- Release:** The speed at which the compressor will start to let go of the incoming signal once it falls back below the threshold.



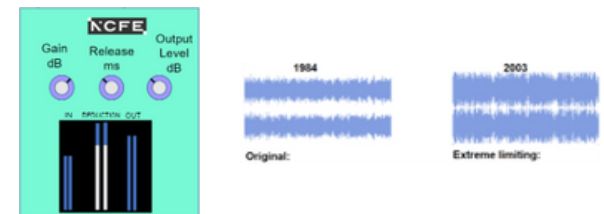
Dynamic Compression

- Its primary function is to turn down the loudest parts of an audio signal to even out dynamic range.
- The settings will need to be tweaked, depending on what is being played.
- Threshold:** the level (dB) at which the compressor will start to turn down the input signal.
- Ratio:** how much the compressor will turn down the incoming signal.
- Attack:** The speed at which the compressor will start to turn down a signal once it has passed the set threshold.
- Release:** The speed at which the compressor will start to let go of the incoming signal once it falls back below the threshold.
- Make-up gain:** Turns up the compressed signal as the compression will have made the overall signal quieter.



Limiter

- A limiter is an extreme form of compression with a fixed high ratio.
- Limiters are used in modern music to increase the average volume of a mix ready to be played on the radio, in clubs and streamed online.
- Increased volume comes at the cost of reduced dynamic range, so limiting should be applied with caution as too much can ruin a great sounding mix.
- Input:** level of signal going into the limiter.
- Reduction:** amount the signal is being turned down.
- Output:** level of signal going out of the limiter.
- Gain:** controls the level at which the input signal goes into the limiter. The more gain that is added, the more compression will take place.
- Output level:** Output volume after the limiting has taken place. The limiter will not let the signal go above this level, it will limit it from doing so.



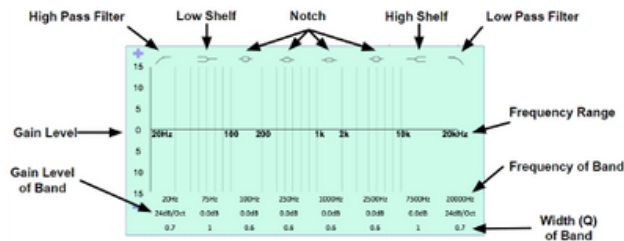
EQ

EQ

- Equalisation is the process of turning up or down the level of specific frequencies.
- There are four main reasons why you would want to use an EQ.
 - To remove (cut) unwanted frequencies.
 - To increase (boost) important frequencies.
 - To change the tonal balance of sound.
 - For a creative effect.

Parametric EQ

- This graph represents the most common type of stock EQ found in a DAW. This is known as a parametric EQ.



Advantages

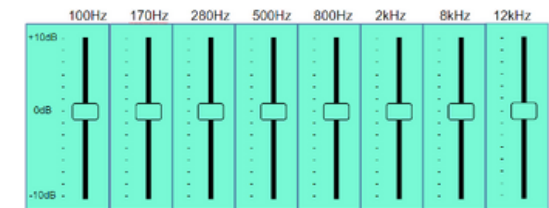
- Full control over frequency of bands
- Full control over shape of bands (Q)
- You know what the type of filters are
- Provides a visual reference

Disadvantages

- Offers too much choice which could lead to unmusical tone shaping.
- Visual reference can cause you to mix with your eyes and not your ears

Graphic EQ

- Graphic EQs can achieve the same outcome as parametric although they work in a different way.
- They are split into set bands. You can change the balance of these frequency bands to change the tone of an audio file.
- Below is an 8 band graphic EQ. This allows for greater control when recording and mixing a piece of music.



Advantages

- Set bands are the most common required frequencies.
- Faster workflow as there is less choice.
- Easier to use.

Disadvantages

- Set frequency bands may not always be what you want to change.
- You do not necessarily know what the shape of the band is.
- Can only turn up or down – less control

Using Software Functions

Audio Capture

- Audio is captured in Audio Tracks.
- Audio inputs are selected via the Software Preferences.
- The input device will usually be either an Audio Interface or a Mixing Desk.
- The correct input channel needs to be selected on the Audio Track in the DAW. This should correspond to the channel on the Audio Interface or Mixing Desk that the instrument or mic is plugged into.
- When setting the gain level for recording the aim is to set the gain as high as you can without the signal distorting.

MIDI Capture - Piano Roll/Step Input

- These methods use the pointer or pencil tool in your DAW to physically draw the notes.
- You use a pencil tool to draw the note pitch and length directly onto the piano roll.
- Step Sequencers are similar to the MIDI Sequencers we looked at in Content Area 1.

Advantages	Disadvantages
<ul style="list-style-type: none">• You can accurately input notes of different pitches and note lengths.• Your performance will be perfectly in time as it will be snapped to the grid.	<ul style="list-style-type: none">• Using this method can be far more time consuming.• It is much harder to make it sound realistic as the velocities have to be controlled manually.

MIDI Capture - Keyboard

- The main way of recording MIDI data into our DAW is by using a MIDI Keyboard.
- When you play live, the velocities and subtle timing differences will be captured.
- As the computer has to process the information, there will always be a small time delay called latency.

Advantages	Disadvantages
<ul style="list-style-type: none">• Captures realistic/human performance.• Change edit the performance after recording.	<ul style="list-style-type: none">• Will often contain timing errors• Have to be able to play the keyboard.

Controller Data

- When you record using a MIDI Keyboard, you can also send other data than just the note pitch, duration and velocity.
- e.g. if you used the pitch bend wheel, this data would be recorded into the MIDI file.
- Most DAWs will display the controller data using lines over the MIDI file.
- The Modulation Wheel can also be used to record controller data as can a foot pedal.

Exporting Audio

Exporting to Audio Files

- DAWs can export either the whole project as Audio files or just individual tracks, sometimes called bouncing.
- DAWs will also offer the option to turn MIDI files into Audio files, called rendering.

MP3

- One of the simplest digital audio file formats.
- WAV and AIFF (Apple version) files are known as uncompressed file formats
- They work by taking an audio signal and converting it to binary data.
- When exporting to an uncompressed file format you should keep the Bit depth & Sample rate at the same level that you recorded the project at.

Advantages	Disadvantages
<ul style="list-style-type: none">• Small file format• Little noticeable difference in quality• Easy to share.	<ul style="list-style-type: none">• Some loss of quality.• Not suitable for pro work.

.WAV

- One of the simplest digital audio file formats.
- WAV and AIFF (Apple version) files are known as uncompressed file formats
- They work by taking an audio signal and converting it to binary data.
- When exporting to an uncompressed file format you should keep the Bit depth & Sample rate at the same level that you recorded the project at.

Advantages	Disadvantages
<ul style="list-style-type: none">• WAVs are lossless• Simple format so easy to process.• Industry standard for pro audio	<ul style="list-style-type: none">• Large file size• Long upload time• Cannot be emailed

Health & Safety

Risk Assessment

- The process of evaluating the potential risks that may be involved in a future activity.
- 5 steps: Identify hazards; decide who could be harmed & how; evaluate the risks & decide on control measures; record your findings; review the assessment.

Reporting of Accidents

- All accidents must be reported in a workplace to ensure that steps are taken to minimise the risk of the accident happening again.
- Details of the accident are recorded and reviewed by the designated health and safety representative.

Identification of Hazards

By identifying the hazards associated with a task, it is then possible to put in control measures to reduce the risks associated with the task.

Hazard	Risk	Control Measures
Exposure to noise	<ul style="list-style-type: none">• The associated risk is hearing loss.• When producing music, you can be exposed to loud noise for extended periods of time.• Headphones are far more fatiguing on our ears because of their proximity to them so far more likely to develop hearing loss from listening to loud music on headphones.• Likely to lead to incorrect mix decisions.	<ul style="list-style-type: none">• Listen to music at a volume that you do not have to raise your voice to talk over.• The safe recommended decibel listening level is between 50 - 80dB.• Regular listening breaks should be taken.
Computer Display	<ul style="list-style-type: none">• The risk associated with this hazard is eye strain.• Looking at a screen for extended periods will cause your eyes to strain, leading to vision problems as well as headaches.• This could seriously affect your ability to work.	<ul style="list-style-type: none">• Take regular breaks.• Setting the display brightness at an appropriate level for the room.• Using a blue light filter.
Workstation Desk	<ul style="list-style-type: none">• The associated risk with the workstation desk is back strain.• When working at a DAW you will mostly be sitting down so you can have the best listening spot from the speakers.• However, sitting down for an extended period of time can cause back strain.	<ul style="list-style-type: none">• Have the desk and chair at the correct height.• Use an ergonomic keyboard/mouse.• Use an ergonomic chair.
Tripping: Cables & Wires	<ul style="list-style-type: none">• The associated risk with cables and wires is sprains and breaks.• When using recording hardware, there will often be a number of cables required to operate the equipment.• These are often very long and can become easily tangled creating a tripping hazard	<ul style="list-style-type: none">• Have a cable tie system for storing cables.• When using external equipment do not overstretch cables.
Electrical equipment	<ul style="list-style-type: none">• The main risk associated with electrical equipment is electrocution.• As there is a lot of electrical equipment associated with a DAW set up, there is always a risk of malfunction or faulty equipment that could cause electrocution.• This equipment could also overheat, which would create a risk of fire.	<ul style="list-style-type: none">• Ensure equipment is safe to use (P.A.T/E.E.T).• Allow for adequate airflow between equipment so it does not overheat.