CAC User Guide

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Introduction

The acronym 'CAC' stands for Computer-Aided Composition. The software can generate music using a repertoire of controllable automatic functions. Such music can then be played and displayed as notation, and saved in the fashion of a sequencer.

CAC was created especially for composers interested in making music 'in the gaps between the notes' both in terms of pitch and rhythm. Thus pitches are available at increments of one hundreth of a semitone (a "cent") and sounds can occur at any points in continuous time (which can be "quantized" into, if need be complex, rhythmic notation if required).

The background of the inception of the programme was in the early 1990's at a time when the Acorn Archimedes (the first computer running Sibelius software) provided an IT-illiterate composer to learn and write software in a user-friendly computer language (BBC BASIC) for a machine with some native sound capability. As a result the program which may be ambitious mathematically is necessarily basic in terms of its sound production: although an unlimited simultaneous musical parts may be composed, the actual performance of a maximum of 8 polyphonic voices, with limited synthesised or sampled sounds, is possible (although the voices can be over-dubbed indefinitely using an audio editing application).

Conventions

Any reference to the keys of the keyboard are printed in bold, e.g. 'press **L**'.

To hold down the key **Shift** before pressing a key is notated as, for example, **^L**.

Any reference to text within the programme are notated as bold, for example, **Define a group of values**.

Installing the software

The BBC BASIC file 'CAC_xxx' has to live in a new directory you have created named 'CAC' immediately inside the root directory. So in the case of the computer Raspberry Pi the pathway of the programme file would be 'SDFS::RISCOSpi.$.CAC.CAC_xxx'.

You should then create three sub-directories inside 'CAC', namely 'CACvar', 'Files' and 'Printing'

Starting a new file

How many bars, how many notes, how many voices

Double-click on the CAC icon. In answer to the question which appears press **N**.

Estimate the number of bars your piece will have, then add on plenty of contingency extras (type the number and press **Enter**).

A busy piece with an average of 16 notes per bar in each part, or a slow piece with only say 4? Type the number you first thought.

A 'voice' is a central concept in CAC. It is the same as a musician or musicians who can perform one note at a time with no chords or harmony, just like a singer or a flautist or a violin section with no *divisi*. So if you want a 3-note chord, such as played by, say, 3 flutes or the right hand of the pianist, the 3 notes should be given in CAC to 3 separate voices. Bear this in mind when typing the answer to the question 'How many voices?' (there is no maximum!).

If you want to define the voices, you will have to take the trouble here to give each one a name, a clef and how many staves – if so press **Y**. However, pressing **D** gives you default voices which are all given no name, a treble clef and a single stave – easier for now, and can be changed later, so for this press **D**.

Macro-beats and micro-beats

The next question refers to the upper number of a time signature, or measure. If you want 4/4, say, type 4. And the final question refers to the lower number of the time signature. So type 4 again.

You see CAC's display, showing the top 3 voices out of how many you previously chose, and the meter shown as 4/4. Press the keys **O** followed by **T** to display the positions of the 4 beats of each bar.

In CAC you are stuck with this meter throughout this file. However, the upside of this inflexibility is to allow *greater* flexibility of the rhythms created within them.

How? If the 4 beats of the time signature can be called macro-beats, to locate sounds *other* than on the macro-beats, CAC also understands micro-beats of which each bar consists of 960. This fine gradation allows you to position sounds effectively in continuous time, just as CAC allows you also to position sounds effectively in continuous pitch.

Getting started

Your first note

To make a note, press **Menu/Add one note fully defined** (the keys **M** then **O**). You will remember that you previously told CAC how many voices you needed, and the first 3 of them are displayed on the screen. Let's have voice 2, so type **2** and press **Enter**.

Then type **2** for bar number 2, and then type **2** for the beat number – beat numbers start with 0, not 1, so this is the middle beat of the bar.

What pitch shall we choose for our note (I condescendingly ask)? What about middle C? So type the pitch name **C** (no need to press **Enter** this time) and then…er, how do we say an accidental called 'natural'? You will need constantly to have this information, so I may as well give you now the full Monty: the number keys allow you to signify accidentals in terms of eighth-tones, ascending steadily upwards from a flat to a sharp:

    1 = ½-tone flat

    2 = ⅜-tone flat

    3 = ¼-tone flat

    4 = ⅛-tone flat

    5 = natural

    6 = ⅛-tone sharp

    7 = ¼-tone sharp

    8 = ⅜-tone sharp

    9 = ½-tone sharp

After pressing **5** and be told you have just been given a natural, then press octave **4** (as you probably know – you will patronisingly be told - middle C is the lowest note of the octave numbered as '4' in musical convention).

We have now got on to the question of Duration. Duration always indicates the time a note sounds for until either it stops or it is followed by another note in the same voice. Duration *never* indicates the distance between the attacks of (beginnings of) adjacent notes. Let's type **1** for bars (then **Enter**) and then **1** for beats.

We are not even going to *think* about a note's 'Envelope/glissando' or its number of phases, so here type **0**.

'Amplitude' is what an acoustician calls 'dynamics' – the loudness of a note. CAC provides a range of amplitudes from *ppp* up to *fff*. Let's be a nuisance for others nearby and type **fff**.

If you are in to micotonality, this is your chance to show off. You can give our note a certain number of cents 'flat' or 'sharp' by typing a minus or a positive figure. But let's be boring and just type **0**.

Our first note is born! It is a middle C and it is half way through bar 2. We have already called up the **Display Menu** previously by pressing **O**. Do this again, and in the lower part of the menu, under **Remove:** you see items which will disappear or reappear each time you press the letter opposite them. Here press **D** opposite **durations**. Now a horizontal line extends rightwards from our note's notehead to the point signifying its duration, which you will remember was asked for as 1 bar and 1 beat – as you see, the duration line extends for the space of 1 and a quarter bars to the right of the note.

Since our note is half way through the bar, you will work out that it is on the micro-beat 480 (half of the bar's total micro-beats of 960). Press **Display Menu** (O) and choose **beat numbers** (O). Your maths was right!

Play the music

Press **Menu** (M) – the usual starting move for most things – then press **Play** (P). Type in the bar and beat to start, and ending at bar 3. One voice will be sufficient, and it should be voice number 2. Sit back and enjoy your composition.

You will increasingly use keyboard shortcuts to speed things up. The list of shortcuts can be viewed by pressing **K**. You will see that the shortcut **P** should activate **Quickplay top *x* voices**. But you will want to play voice 2 (again and again!). The list informs you that the two keys on your keyboard just below **P** are the ones you will need to start playing voices 2 or 3 respectively. Remove the shortcuts list by pressing a key, and try pressing the key for a colon or semicolon.

The music plays again – but wait: it keeps on and on playing empty bars without stopping. What you need here is the key of choice when anything puzzling happens – the key **Esc**.

<u>Navigation</u>

Pressing **Esc** thankfully escaped that playing silence. But how can you get back to bar 2?

Navigation basics are thus:

       To display one bar further forwards press **>** and backwards press **<**.

       To go downwards through the voices press **v**, upwards **^** (all lower case).

       To display half the number of bars press **–** or for double press **+**.

       Or press **D** to display a certain number of bars or **B** to select a bar.

Basic techniques

Define a group of values: starting with attacks

Now, we are going to gravitate from a single note to a group of notes.

IMPORTANT – usually go to **Define a group of values** (M/G) as the first stop whenever you want to create anything.

Having 'defined' that something, CAC takes you automatically into the **Add the group of values** stage. (The latter appears as a separate Menu option so that you can add your defined group again elsewhere, as if it were stored on a 'clipboard').

Having selected **Define a group of values** you will see that you have to select one of various options next. The first option you *must* select is **attacks** if you are creating something new – this follows the concept that you first have to make an initial rhythmic passage as a 'skeleton' before going back to its other parameters, such as its pitches, amplitudes and durations, which can be applied later.

So having chosen **Define a group of values/attacks**, then press **R** to signify you want to input the attacks as a series of **Raw beat numbers**. Let's have 4 attacks, after which you are asked whether the intervals (of time) are the same. Note the use of the word 'interval' to indicate the distance between the attacks of the notes, so as to reserve the word 'duration' for its own meaning.

A minimalist here would probably answer 'Yes', but we will be sufficiently complex to say 'No' the intervals between the attacks are *not* the same. Shall we have an interval between attacks one and two maybe 0 bars and 3 beats, the next one 0 bars and 1 beats, and the final interval 0 bars and 2 beats? (Alternatively you could use the micro-beats notation, which would be 0 bars 720 beats, 0 bars 240 beats and 0 bars 480 beats).

This 'group of values' (i.e. attacks) can be placed wherever you wish – what about typing **0** to signify the first bar displayed? Actually, pressing **Enter** is the same as inputting the figure '0' – getting used to this shortcut will save a considerable amount of time when aggregated over a long day's work! To practice this, press **Enter** again in reply to the question **beat**, and you have again input the answer **0** with a single key-stroke instead of two.

Finally, it must be decided which voice is to be given this rhythmic treasure. What about pressing **Enter** again and give it to voice 1 – that's what **0 = top** means (note that pressing **Enter** twice in quick succession selects the second stave from the top displayed, and three times quickly selects the bottom stave).

Another way of creating a group of attacks

I have previously told you how to define a group of attacks. But this time type **M/G/A** to get a group of attacks again. But then press **A** for **already rhythmicized**. Press **G** for **group**, then bar 2, beat 3. Then ending at bar 3 beat 0.

For divisions type **3** (a triplet), how many attacks type **2** (one of the triplets will be a rest). **Attack 1** will be on division number 2, and **attack 2** on division 3. Then press **F** for **finished**. Select voice 2 and the triplet with the first attack as a rest should appear.

The principle of the program is to request notes as either with rhythmic notation – such as the one you've just created – or without notation, like the first note you created. Using without notation, attacks can appear on any of the 960 microbeats you like. You have already pressed **O** twice to display the microbeat of the first attack in each voice. The attack placed on beat 2 is half way through the bar, and thus on beat 480. If you press **O** twice again, the beat numbers for every attack are displayed.

Typically in my own case I would create music first without notation, then re-copy a voice asking for the rhythm to be **rhythmicized**. The music would then be 'quantized' using notation as complex as you wished. For instance, tuplets ('irrational' rhythms) more complex than triplets could go up to divisions of 5, 6, 7, 8 and so on indefinitely – you can stipulate the number you require. You can also stipulate how long tuplets can be, and on which beats of the bar they can begin.

To rhythmicize the attacks

We are going to create in voice 3 the same triplet you have made in voice 2, but now *without* the rhythmic notation. To create rhythms without these press **M/G/A** then **R** for raw. So ask for 2 attacks, the interval between them being 0 bars, 80 beats (a triplet), starting at bar 2, beat 800. The triplet appears on voice 3 but without rhythmic notation, that is, just noteheads and stems.

Navigate down to see both voices 3 and 4 (the program invariably displays only a maximum of 3 voices). Then press **M/V** (**Various**) then **D** (**Display options**). Then press **H** (**Rhythmicize attacks**). You are then returned to the display.

You are now going to copy voice 3 to voice 4, but this time you will be asked whether you wish to re-define your rhythmicization criteria.

So press **M/C/C**. For which voice type 3. For note numbers type from 1 to 2 (you don't need to press **Enter** – the program waits until you've *not* typed a double number). To use the same bar and beat just type **0** (or just **Enter**), then **0** to confirm bar 2 beat 640.

You will be asked whether you want the group to be rhythmicized. Press **Y**, then **D** for default criteria (later in the manual we will experiment to re-defining them), then voice 4. Your triplet is now copied onto voice 4 with rhythmic notation added.

Deleting notes

Press **Menu/Delete** notes (M/X). To delete notes leaving the rhythmic notation may be useful if you don't want to re-rhythmicize a passage, but maybe re-arrange the odd note – or when the passage is in its initial pre-rhythmicized form, i.e. just noteheads and stems without any rhythmic notation.

To quickly delete single notes, use the keys **^O**, **^K** and **^M** to delete the first note on the top, middle or bottom staves. If you quickly press a number key after this, other corresponding notes will be deleted. For example, if you press **^M2** the third note on the bottom stave will be deleted.

Defining a group of values other than attacks

Parameters such as pitch, duration, amplitudes and so on can only be added to *existing* attacks, which, when first created, are given default parameters. If desired these defaults can be edited per voice (**Menu\Various\Display options\Define parameter values** – M/V/D/P).

Pitches   This process should already be clear.

Amplitudes and Amplitude gradations   An amplitude of a note can be defined as *ppp, pp, p, mp, mf, f, ff, ff* or *fff*. But if you want a finer gradation between these loudnesses, it is possible by selecting **Menu/Define a group of values/amplitude gradation** (M/G/G).

Inputting your gradations of amplitude is not a triumph of elegance. They are instructed as if they are envelopes with 4 phases, which is bit tricksy on CAC because the maximum of envelope's phases is 3.

Any road up, type in here the number of gradations you want *as if* they are envelopes/glissandos, let's say **1**. Remembering that you have to pretend the number of phases is 4, so type in that. Now, for the amplitude type *mf*. And then you can select your gradation between 1 and 9 (these numbers gradually increase the ampltude from *mf* upto almost *f*). After instructing which voice and which note-number the group is to be added, you will see the gradation below the amplitude of each note.

(By the way, if you can't see things you are supposed to see, it probably means they need to be switched on in **Display Menu**, so to switch on **amplitdes** press O/M – this toggles with each press between 'off', 'on in a line', and 'stepped').

Envelope/glissandos   An envelope describes the *crescendi* and *diminuendi* applied to the dynamics (amplitudes) of a note, often called 'hairpins'.

Note: unfortunately this section is addressed only to users of RISC OS 4 and backwards, i.e. typically users of the emulator VirtualRiscPC running on a Mac or PC, but not users of a Raspberry Pi or other machines running RISC OS 5. This is because envelopes only work with certain sounds loaded from the Creations 'sampled' waveforms, a commercially-available product sold by EMR (ElectoMusic Research) who made software to run on Acorn machines in the 1980's and 1990's. Annoyingly its products report an error "not 32-bit compatible" on RISC OS 5.

Make sure you are displaying a note with a long 'duration' line to the right of the notehead. Press **Menu/Define a group of values/Envelopes/glissandos** (M/G/E). Let's just have **1**.

What is a 'phase' of an envelope? If the envelope has a single crescendo or diminuendo for its full duration, then it has 1 phase. But if it has a crescendo followed by a diminuendo, or a diminuendo followed by a crescendo, it has two phases. And if the duration divides into three crescendos or diminuendos it has three phases – the maximum.

If the note has no crescendos or diminuendos, it has no phases.

Let's go for 2 phases. Starting amplitude? – type **p**. Phase 1 is going to be a crescendo up to f. But before typing **f** we can decide at which *point* along the duration will this 'f' arrive. 50% is implied by a simple 'two hairpins', but you can choose any other percentage – but let's type 50% anyway.

The first phase arrives at 'f' – its 'destination' amplitude, so type **f**.

Glissandi if required should be added at this point. Any upward or downward glissando must coincide with one of the envelope phases applied to amplitude. If there is going to be no crescendo or diminuendo during the glissando just make the destination the same as the starting amplitude. Downward glissandos are given by minus numbers, in terms of eighth-tones. Type **-8**.

The second phase's destination amplitude is right at the end of the note's duration – let make it **ppp**, and the glissando **8**, and apply to the note with a long duration line you had in mind. Hey presto!

Editing existing envelopes   If you wish to alter one of your envelopes – maybe its amplitudes or its horizontal position of its middle amplitude(s) – it is not necessary to start again. If you press **K** to look at the keyboard shortcuts, half way down the right-hand side you will see **Edit envelopes….** To edit the top voice, note 1 it say you should press **^Q** (i.e. hold down **Shift** and press **Q**). So first get rid of the shortcuts page, make sure the first note in the top voice has an envelope, then press **Q** after holding down the **Shift**.

The principle here is first to press which key signifies your choice of option – let's say **E** for **move 1st envelope point** – and then use the **Shift** in conjunction with the **<** or **>** keys to edit the envelope. So press **E**, hold down **Shift**, and press **>** key repeatedly. You will notice that the envelope point move rightwards. (To additionally see what percentage the envelope point represents, press **M/V/D/L**).

You may experiment on the other options for **Editing envelopes** should you wish.

Envelope points   If you are interested enough to control the precise horizontal points your envelopes 'peak' or 'trough' you probably want to notate this point rhythmically for the benefit of your performer. We have the science! Press **Menu/Define a group of values/envelope points** (M/G/R), stipulate which voice and which of its note(s), then in answer to the question 'the passage is to be copied/moved to bar…' press **Enter** to signify 'for the same position', then **Enter** again to confirm that position displayed in red. Then either choose the voice having the envelope, or another voice.

Two new notes appear showing the positions of the middle amplitude of the envelope and the end of its duration. Of course, this facility would be essential also for notes without any envelopes, so that you can notate precisely its rhythmic value (i.e. its duration).

Durations   Defining a group of durations is self-explanatory. The dialogue box offers you the possibility to define durations which 'fill gaps between attacks', or 'half-fill' them. These options represent making the passage *legato* (no gaps between notes) or *mezzo staccato* (notes notated with dots and short horizontal 'tenuto' lines) respectively.

Microtonal inflections   Press Menu/Define a group of values/microtinal inflections (M/G/M). Before typing in your data, the dialogue box presents a reminder of useful stuff about microtones, namely how many cents equal the various microtones and the tuning of the partials of the harmonic series.

Having digested and memorised this data, you can type the number of notes required to be 'inflected' microtonally – let's say one – and then how many cents upwards or downwards (type a positive or negative number).

The inflection appears above the note you chose, and will be played accurately by CAC.

Copy/move notes

'Copying' means making a copy of a note or passage when the original being copied remains intact and 'moving' means making a copy when the original note or passage is deleted.

Everyone of the many users of CAC ('nerds') will be spending a lot of time copying and moving notes, so, as well as the 'long way round' (**Menu/Copy/move notes/Copy one note** or **a Copy passage** and so on) some shortcuts are provided: the key **X** is for copying a passage, **Z** is for copying a single note, \ is for moving a passage, and the same key with **Shift** applied is for moving a single note (see keyboard shortcuts, key **K**).

Extracting notes   This copies only notes with designated attributes, for exampe, certain pitches and so on. If you press **Menu/Copy/move notes/Extract** (M/C/E) you will then be confronted by the demand **Copy-extract or move-extract?**. The former leaves the extracted passage intact in the original voice, while the latter deletes it.

Having pressed **C** or **M** and selected a passage you are now faced with another tricky decision. If you want to **exact notes with certain pitches** press **P**.

If you want to **extract notes within a designated band of pitches** press **B**.

If you want to **extract notes which are distant from the following notes by a certain amount of time** press **A**.

If you want to **extract notes by random numbers** press **R**. If you answer the following question 'at a distance between 6 and 9' the program will randomly choose an extracted note between 6 notes and 9 notes from the last note exracted.

If you want to **repeat your mode of extracting** press **L**.

Copying a rhythm   Useful if you wanted to copy a voice's rhythmic notation only.

Save and import   This refers to saving a passage in a single voice, or the entire music of that voice, to your hard disc, in order to move it from one file to another one. So it should *not* be used for performing the usual job of saving the file.

Quickly copying single notes   To quickly copy a single note from the top stave to the next stave at the same place press **^1**, **^2** etc. To copy the note to a lower stave press a number key immediately afterwards. For example, to copy the third note on the top stave to the same place two staves lower quickly press **^3** then **2**.

Parenthetically   A very useful coding in CAC allows music to be copied *on top* of existing music, producing a passage in that voice which is composed of the two passages combined. This process can be repeated endlessly.

Display

In the 'longscore' mode CAC displays 3 voices. Use **Menu/Display** (M/D) to choose which bars and which voices to be displayed. To display all voices press the **=** key with **Shift** applied.

To see your music in 'shortscore' (i.e. all voices chosen to be displayed appearing on 2 systems of a 'piano reduction') press **Display Menu/Longscore-Shortscore** (O/L) – all the options toggle between states.

Display shortcuts   For number of bars displayed press **D**.

To go to a bar press **B**.

To double the bars displayed press **+** or to halve the bars press **-**.

Use **<** or **>** to move left or right – one stroke for a single bar, double strokes for a screen-full of bars, or the key followed by a number to move for that amount of bars.

Use **^** or **v** to move up or down – single stroke for up or down by one voice, double strokes for up or down by 3 voices, a stroke followed by a number to move up or down by that number of voices, or a stroke followed by **0** to move up or down by 50 voices.

Pressing **Q** brings up **Quickdisplay**, a quicker route to display the voices you want. After using Quickdisplay you can then use **W** - the first press of **W** calls back any previous Quickdisplay asked for, the next press calls the present Quickdisplay, and the next press after that calls back the original Display asked for.

The many and various

If you press **Menu** and then choose **Various** (M/V) a whole list of exciting possibilities become available.

Load waveforms

Note: You can load waveforms only if you are running CAC on RISC OS 4 and backwards (see **Envelopes/glissandos**) and have acquired EMR's Creations samped waveforms.

Press **Menu/Various/Load waveforms**. If you have previously loaded waveforms for the present file (and saved it) you are offered to reload them or choose new ones.

If you choose **New Waveforms**, you are then offered to load waveforms individually or from lists. If you choose lists, you can choose between **Sustaining instruments** or **Percussion instruments** of two types.

Assign waveforms to voices

Each voice is assigned a waveform which will be its timbre when it is played. New files are assigned WaveSynth-Beep as their waveforms by default.

The options are:

Keep the assignations   Er, self-explanatory

Reassign   Users who do not have Creations waveforms can reassign to a voice any of the 8 possibilities available with RISC OS other than WaveSynth-Beep. They are:

      StringLib-Soft

      StringLib-Pluck

      StringLib-Steel

StringLib-Hard

Percussion-Soft

Percussion-Medium

Percussion-Snare

Percussion-Noise

Use WaveSynth-Beep defaults   get back to assigning WaveSynth-Beep defaults, which seem generally preferable

Randomly assign sustaining/dry instruments/drums   available for Creations waveforms users

Assign in groups   assign the same waveform to groups of voices

Set tempo

Tempo can be re-set at any bars you want. Note that the MM figure given is for the bar, not for beats. Thus a tempo of crotchet = 60 BPM should be set in a 2/4 bar at MM.30, or in a ¾ at MM.20, or in a 4/4 at MM.15 etc.

Set l.v.

When playing music, each voice to be played is allotted to one of 8 sound 'channels' available in RISC OS. Because each channel is monophonic, every voice's successive note cancels the playing of its predecessor, should their durations overlap.

The depressing of the piano's right-most 'sustaining' pedal effectively gives a duration to every note lasting until the pedal is released. This is an effect emulated by **Set l.v.** ('l.v.' is used in music to stand for *laissez vibrer* – 'let ring') by automatically distributing a voice's notes across any spare channels, to prolong their durations maximally.

So before trying **Set l.v.** you should give the notes to be given 'l.v.' very long durations, let's say durations of 10 bars.

To start, decide how many voices are to be played and then deduct that total from 8 – this gives you the number of spare channels available to be used by **Set l.v.**

Example 1   If you want to play a single voice and you want it to be played l.v. then you have 7 (i.e. 8 minus 1) spare channels to recruit to emulate l.v. So press **Menu/Various/Set l.v.** and type the number of sound channels to generate lv as **1**, how many other channels as **7**, and then which channels they are – given that channel 1 will be allotted the main voice, the others will be channel 2, channel 3, channel 4, channel 5, channel 6, channel 7 and channel 8.

To **play** this, it helps to distinguish *voices* from *channels*. You are going to use all of the 8 channels. So when you give the number of voices as 8, RISC OS waits to be told which voice is to be allotted to each of the channels 1 to 8 in order.

If our voice with the l.v. is, say, voice 2, then press **Menu/Play** and type the number of voices as **8**, and their numbers as 2,2,2,2,2,2,2,2. (This makes sure that the 'spare' channels nos. 2-8 are given the same timbre as voice 2. If you play it again immediately, you can just play voice 2).

Example 2   If you want to play 2 voices – let's say voices 2 and 3 - but you want only voice 2 to have l.v. then you have 6 (i.e. 8 minus 2) spare channels to recruit. So in **Set l.v.** give the number of sound channels to generate lv as 1, how many other channels as 6, and then which channels they are – given that voices 2 and 3 take up the first two channels, that means the channels to be used are channel 3, channel 4, channel 5, channel 6, channel 7 and channel 8.

To **play** this, press **Menu/Play** and type the number of voices as 8 again. Then always follow the rule of giving the 8 voice numbers as (i) the lv generating voices (ii) the non-lv voices and (iii) the voices recruited by the lv voices. So in this case give their voice numbers as 2,3,2,2,2,2,2,2.

Example 3   This time we will have three voices, voices 2 and 3 will be lv and voice 4 will not be. There will be 5 (i.e. 8 minus 3) spare channels available for recruiting as lv voices. Let's say two of them will be helping voice 2 and three will be helping voice 3. In **Set l.v.** the number of sound channels to generate l.v. is 2. The first of these channels uses the other channels 4 and 5, and the other one uses the channels 6, 7 and 8.

To **play** this, ask for 8 voices and, following the rule, give them as 2,3,4,2,2,3,3,3. That is, the first l.v. voices (2 and 3), then the non-l.v. voices (4) and finally, in order, the voice numbers allotted to the remaining five channels (2,2,3,3,3).

Example 4   This time no voices are to use lv. In **Set l.v.** simple type the number of sound channels generating l.v. as **0**.

Beats input

By default, if you ask for a note to be placed on 0, 1, 2, or 3 beats (if your time signature is 4/4) CAC understands that you are intending to refer to the macro-beats. But what if you wanted to place a note, or anything, on the micro-beat 1, 2 or 3? Just press **–** signifying **should be read as micro-beats**.

Memory setup

A reminder of how many bars, how many notes and how many voices you have configured.

Display pitches in colours

You can configure also your pitches to be displayed in different colours. (The GCOL colours in the code need to be re-programmed for RISC OS 5).

Display options

When you discover this page a daunting list confronts you (believe me, bednight reading was not the intention).

Here you can switch on or switch off (i.e. 'toggle') options which you may or (more likely) may not find useful. Here is a summary of what they do:

See graph during accel/rit The first **Funtion** (M/F) calls itself **Accel/rit** (described elsewhere). It plots coordinates of a user-defined graph to generate rhythms of either accelerating or decelerating attacks. Whilst using this **Function** you can see how this graph works, or not.

See info on attacks When attacks are created or copied, this option gives a full list of the locations, intervals between them and ratios between adjacent intervals.

Get printout of info on attacks When **See info on attacks** is on, select this option to print out the information instead. Make sure you have allocated some memory for System sprites in RISC OS Tasks and double-clicked on !Paint in Apps. The printout(s) should appear as numbered sprite files inside the folder 'Printing'.

Re-order attacks When attacks are created, copied or moved, this option give you the opportunity to re-order the intervals between them, either randomly or determinedly. If randomly, you can re-order all the intervals (inconsistently called "durations") or just a group of them, and you can also determine the chance of duplicating the original as a percentage, in other words if you selected 100% then randomness would be abolished, but if you selected 0% then you would have maximized randomness. This is useful if you wished to nuance

how much random re-ordering will occur. For instance, you could randomly re-order an accelerating attacks created by the **Accel/rit** function but with a chance of 50%, which would mean that 50% on average of the intervals of acceleration would remain intact.

Re-order attacks during accel/rit only   This saves you being quizzed about re-ordering *unless* you are using **Accel/rit**.

Equalize attacks   The unequal intervals between notes can be equalized when created (perhaps a segment of an acceleration or ritardation), copied or moved.

Equalize attacks during accel/rit only   Again, this only applies when using **Accel/rit**.

Rhythmicize attacks   Allows **rhythmicization** (see 'Advanced rhythmicize').

Re-order pitches using M/A/P   Allows you to randomly re-order pitches, restricting re-ordering not to occur beyond defined batches if you wish, during copying pitches from one passage to another (to do this see the tip **Copying single parameters**).

Query before adding new values to array Turn off if you are irritated by CAC always asking you 'Do you want to add this group to the array?'.

Define parameter values during input   When a group of attacks is created, CAC gives them default parameter values (default pitch, amplitude etc). If you wanted different values to be used, press this on to edit them when the attacks are created, then off again to use those defaults subsequently.

Accel/rit by total durat, endpoints or first two notes displayed   Different ways to locate **Accel/rit**. Fully explained here in 'Accel/rit.' in the 'Summary of Functions' section.

Accel/rit by start/finish durats or not   Two different modes of creating an **Accel/rit**. Fully explained here in 'Accel/rit.' in the 'Summary of Functions' section.

See duration upto last displayed bar   See your composition's duration.

Quick copy   On by default, to copy a passage by notes on the screen. When off copying is by bars and beats.

See durations in micro-beats or macro-beats   Displays the durations in exact numerical values as well as graphically by horizontal 'duration' lines. You can choose between micro-beats or macro-beats.

Voice numbers by 1/2/3 on screen   Instead of selecting a voice by its voice number, you can alternatively press 1, 2 or 3 signifying the voices displayed on the screen. Also pressing **Enter** once, twice or three times quickly does the same job (as it does also when selecting by voice numbers).

Use advanced amplitudes options   If this option is on you can create a group of amplitudes which can be (i) a recycling sample which can be randomly re-ordered, (ii) groups manipulated according to their rhythms or (iii) by their number of notes elapsed. These groups can be subsequently edited, saved or re-loaded. (The 2nd and 3rd options here need checking!).

Double v/^ moves down/up by 3/10 staves   When navigating by pressing **v** or **^** twice quickly, the screen can be scrolled down or up by groups of 3 staves or 10 staves.

1,2 = A/R start/quickdisplay/play vces   The number keys can be pressed *before* using **Menu** to control various things. This option allows you to choose *which* area the keys control. Toggle the options by pressing **J** each time (which area selected is shown in brackets).

If you have selected **A/R** the keys control the starting note used in **Accel/rit** when itself has been told to use the 'adjacent notes' method. In other words, if you first press **F** to select 'adjacent notes', then press, say, **3** then subsequently using **Accel/rit** will create an accelerating or decelerating attacks between notes 3 and 4.

If you have selected **quick** the keys tell **quickdisplay** how many voices you want to display.

If you have selected **play** the keys tell **quickplay** how many voices downwards from the top of the screen to play when pressing **P**. This is a shortcut useful if you are repeatedly changing the setting using **Menu/Various/Quickplay options** (M/V/Q).

See envelope %'s/indicators/neither   If you want to alter the positions of 'apexes' and 'troughs' of an envelope (see 'Editing existing envelopes') this option allows you to see whereabouts along the note's duration they occur as a percentage. Or as an alternative you can see apexes' absolute position in time regardless of its duration as an 'indicator'. This is useful if you wanted to synchronize the apexes of two or more notes with different attacks or durations.

Query if pitches all the same   When inputting a group which repeats the same pitch, when this option is switched on you will be asked firstly if they are the same pitch, which saves you inputting them individually.

Group of pitches fills bottom stave   If switched on, an inputted pitch appears on all the notes displayed on the bottom stave. Useful for obscure reasons.

Copy from next vces/to section   This toggles the key **S** between **Copy from next voices** and **Go to section** (showing in brackets as **next** or **sect**). When set as **Copy from next voices**, if you first press **S** you can copy a voice as normal, but the next time you copy or move CAC suggests the next voice displayed on the screen, which you can accept by pressing **Enter**. This is just a time-saving option useful when you are copying many voices. Each time the dialogue appears suggesting the next voice, you can cancel the facility instead.

When set as **Go to section**, pressing **S** invites you to go to a particular section. 'Sections' should be displayed using **Remarks** as 'SECTION 1' etc. to be picked up by this facility.

Shift+Y = Add pitches/edit envelope   This toggles the key **Y** when **Shift** is applied. When set as **pitch** the key is a shortcut for **Add the group of pitches** (**M/A/P** – *not* **M/G/P** which is **Define a group of pitches**). When set as **env** the key functions like the other keys pressed with **Shift**, to edit the envelope of note number 6 of the top voice displayed.

[ ] keys = move remarks/add to copydown   This toggles the **[** and **]** keys. If set as **remarks** the keys move the upper remarks left or right by one bar. If set to **copy +** then the number keys which copy single notes from the top stave downwards if **Shift** is applied, can indicate note numbers 11 – 20 by pressing the key **]** or 21 – 30 by pressing the key **'** or returned to the default 1 – 10 by pressing the key **[**.

Accel/rit asks for starting attack   If switched on, then **Accel/rit** when using the 'between adjacent notes' method will ask which starting note it should use. If switched off, then **Accel/rit** when using the same method will not ask about the starting note, but will use the first two notes by default - although pressing a **number key** beforehand will make **Accel/rit** use *that* number as the starting note (assuming the option **1,2 = A/R start** is selected in **Display Options**).

Reset no.staves ^/v moves up/down by   By default pressing **^** or **v** navigates up or down by 1 stave. This option allows you to reset that number to whatever you like.

Y = single/multiple pitch entry   The shortcut **Y** sends you to **Define a group of pitches** and by default asks you how many pitches you want to define. But if you invariably want to define one, press this option to **single** to prevent always being asked this.

^V = rename/delete batch of voice names   This lets you pressing **V** with **Shift** applied either to rename a voice or to delete a batch of voice names

Play with beep or assigned voices   Toggle between playing voices with the waveforms actively assigned to them or assign them with a default WaveSynth-Beep waveform.

Display only voices with content   If you are working with a great many voices, it is useful to ellliminate from the display those yet to be given with content. This quickly displays only voices *with* content throughout the file.

Show list of voices with content   It is also useful when working with an orchestra-like array of voices to see a list of those with content *during the bars currently displayed*. If it is a very long list it may be useful to compress it vertically to be able to see it on one screen, and also useful to see the Quickdisplay dialogue on the same screen to be able to then select which voices you want to display for the time being.

Allow copying to last note   Toggle the ability during the selection of a voice's passage to quickly select up to their last note. A useful facility, but when over-used breeds the tendency to mis-select *all* the voice's content rather than just part of it – hence being able to switch off the facility.

Pause for querying stave   [?]

Pause for previous position   [?]

Debugging mode   Switch this on to see error reports from the programme rather than errors simply reverting to the display – the latter prevents you seeing the 'Error at line' report every time you pressed **Esc** to aborting any operation, or reports when non-fatal crashes occur.

Remarks

Brief text can be annotated to your work attaching to a particular bar. Two remarks are permitted per bar, appearing in an upper or lower line.

Rename staves

You can type a name for, or rename, any voice.

Change a stave's clef

You can give a clef to any voice. There are four clefs – Piccolo clef (sounds an octave higher), Treble clef, Bass clef and Doublebass clef (sounds an octave lower).

Additionally, any voice can have a pair of staves rather then just one. This is useful for a keyboard instrument **but** remember that each voice is only monophonic, so a keyboard instrument with multiple 'real' parts should be given that number of voices.

Quickplay options

Quickplay allows you by default to use the key **P** and the two keys below it to quickly play either the top voice, the middle voice or the bottom one (with **Shift** activated to play that screenful only). But you can play multiple number of voices downwards from the top voice using **P** using this option.

Set stereo positions

RISC OS can play its voices stereophonically. Each of its maximum of 8 simultaneous voices can be given a value between 1 – 7 to pinpoint it along the stereo spectrum.

Set key response speeds

Key strokes used for, for example, two-digit numbers can have their delay configured, in one-hundredths of a second.

Tutorial

A so-far incipient Help section.

Re-set parameter defaults

This is an extension of the ability to re-set a voice's other default parameters when creating a passage of attacks (see the Display Option **Define parameter values during input** – M/V/D/P). Here you can re-set parameter defaults in different batches (so far only functional for amplitudes).

Saving and opening files

When you create a new file, you can give it a name and save it by pressing **Menu/Save** (M/S). Then the next time you load CAC and select **Open an existing file** the name will appear in a list of the last 9 recently-saved files. To open another file not listed here press **0** and type in its name.

All files are kept in the folder 'Files' which is a sub-folder inside the folder 'CAC' which was created when installing CAC. You can create your own further sub-folders inside 'Files' to which you can save a new file. The pathway of folders use the RISC OS convention of 'dots' (full stops) to separate the folder names. For example if you created the folder 'Works_1' inside 'Files' you can then save a new file named 'Bill' as 'Works_1.Bill'.

(Occasionally BBC BASIC refuses to save a file which is 'open'. Fix this by Quitting then accessing the Command Line **(F12)** and type **close* and then press **Enter).**

Printing files

The unsophisticated method of printing single hardcopies of one screenful of CAC's display creates sprites files which can be opened by !Paint, and then printed using !Printers. Software is available to then convert sprites into PDF's.

A folder called 'Printing' should be created inside 'CAC' in advance.

To print to a sprite make sure in advance that System sprites have sufficient memory in RISC OS's Tasks and that !Paint has been double-clicked. Within your file press **H** for hardcopy and the sprite will appear inside 'Printing'.

Summary of Functions

Accel/rit

Generates a string of attacks which gradually accelerates or decelerates. When creating an acceleration CAC refers to the opening interval between the first two attacks as its **slow end** and the culminating interval between the final two attacks as the **quick end**. Naturally this is reversed in the case of a ritardation (deceleration).

Accel/rit does its job in two different modes. In the first mode the speeds at the quickend and the slowend as well as the length of the string are defined. The actual number of attacks is then determined by the function. In the second mode a **rate** and a **bias** are given by the user as well as the number of attacks and the length of the string. The function then returns its acceleration or deceleration with the number of attacks, a 'steepness' (given by the **rate**) and a 'curve' of the incline (given by the **bias**) determined.

In both modes there are three options to begin an acceleration/ritardation – either start by giving the **total duration** of the accel/rit, or determine the **start-point** and the **end-point**, or 'fit' the accel/rit between outer attacks which you have originally created. These options are found within **Diplay Options** (M/V/D) or you can use the shortcuts **T**, **E** or **F**.

Example of the first mode: press **M/F/A** and give the total duration of 5 bar 0 beats. For the **quick end duration** give 0 bars and 120 beats. For the **slow end** give 1 bar and 0 beats. For the **bias** press **Enter** (equivalent of **0**) to select the default of 3.7 – different values would give different "curves" of the accelerating process.

Give an estimated number of attack, say 10. Unless the perfect solution is achieved, a dialogue describes the two closest solutions. Press **A** then **B** to select the second solution.

Then press **A** for **accel**. Then determine which bar and beat you want to start the string (something already on the screen!) and the voice. The accel appear over 5 bars, moving from the slow end of about 1 bar to a quick end of about 120 beats.

To examine the properties, press **D** then **6** to display 6 bars. Press **O** four times to reveal the beat positions within each bar for each attack. To display the attacks' intervals instead of their positions, press **O** then **I**. The intervals are shown between 947 beats to 116 beats – the closest the program could achieve for your original requests.

To play the result press **^P** if it is on the top voice, or **^:** below P if on the second voice, or **^?** below that for the third one (pressing **Shift** with these keystrokes plays the screenful only).

Example of the second mode: press **M/V/D** (Display options) then press **S** to switch off **Accel/rit by start and finish durations**. When you press **M/F/A** the value given to **rate** controls how 'steep' the acceleration or deceleration will be – a value of 1 gives nil steepness (periodic) while a value of 9 or greater will give a very steep one.

Before doing the **Accel/rit** you can press **T** for **Accel/rit by total duration**, or **E** for **Accel/rit by start/end points**, or **F** for **Accel/rit between adjacent notes**, that is, the first two notes on the screen for the voice you have chosen.

To see how the technique creating the accel/rit's work, press **M/V/D** then **G** to see the graph during creating an accel/rit. The technique draws a curved line which is a graph of a mathematical function. Equidistant lines representing the attacks are plotted horizintally until touching the curve and then plotted vertically to the axis representing time, thus generating the attack-points of an accel/rit.

(If you press **C** the hyper-esoteric **Increment calculator** appears. It is prefaced by an explanation in the unlikely event anyone cares).

Layered attacks

This generates a single string of attacks made by randomly selecting from a pre-defined repertoire of rhythmic intervals ('layers'), each interval repeated in a pre-defined number of times. For instance you could ask for a string with three layers being (i) an interval of 960 microbeats happening once (ii) an interval of 480 beats repeated three times and (iii) an interval of 240 beats repeated randomly between one to five times.

The string starts by randomly selecting (i), (ii) or (iii) followed immediately by one of the other two layers, and so on, for as long as you ask it for. If you wanted the string to divide into phrases with gaps, just make one of the layers to use an interval long enough to make a gap. Various refinements are possible during the course of the dialogue.

Pitch string 1

Produces a random string of pitches (which are then applied to already created attacks) with certain properties. For example the string derives from a given 'sample' of pitches, repeated as many times as you wish, with the given pitches randomly occuring in defined possible octaves and ordered according to a given plan of contours.

For instance, the sample could have three notes, C natural, D natural and E natural. This would be recycled throughout, with the C randomly in octaves 4, 5 or 6, the D in randomly octave 3 and 5, and the E always in octave 5. Once it has determined the octaves for the three notes, one of the contours originally determined by the user is randomly selected to place the three notes in order.

Contours available are shown below, together with their codes which should be used in **Pitch string 1**.

The string can be split into sections of contrasting octave occurrence for each pitch-class. And there are possible sections of transposition level and contour sequences available also.

Pitches can be in a semitone, quartertone or eighth-tone mode.

Pitch string 2 – 6

Explanations preface each one chosen.

Interval string

Returns a string of random pitches within a defined tessitura removing banned pitch-classes and intervals. Multiple controls can be explored.

Distort

One of my favourite functions. 'Distort' means editing values randomly between defined degrees. For instance, a passage could have its attacks distorted, changing the intervals between its attacks randomly between, say, 80% of the original to 120% of the original. If a string of periodic attacks were to be distorted like this, a series of intervals between 80% - 120% of the original periodicity would result.

Like all functions, the distorted version of the passage can be 'copied' to another voice, retaining the original, or 'moving' which deletes the original.

Distortion of the other parameters – pitch, amplitude, envelope etc – behaves similarly.

Uses of Distort

As well as generating strings of randomly 'distorted' parameters, the function can be used simply to transpose pitches or the duration intervals of rhythm. For instance, pitches can be distorted between '6 semitones higher' to '6 semitones higher' thus transposing the pitches up by a tritone. Or attacks can be distorted between 150% to 150% thus stretching the rhythms by a half.

Slave voice & Double-stop

Esoteric functions meaningful only to the present writer. Explanations can be found when looking at their dialogues within the programme.

Advanced rhythmicize

Introduction

The **Rhythmicize** facilty lets you control the complexity of your rhythmic notation. At the *least* complex, all rhythms would sub-divide the beats by a ratio of 1:2, in other words it would position the attacks on one or other crotchets, quavers, semiquavers and so on.

Slightly more complex rhythms would entertain simple irrational groups ('tuplets') such as '3 quavers in the time of 2' or '3 crotchets in the time of 2'. In the terms of CAC, the **complexity** here would be 3, the irrational groups would have **lengths** of between 1 beat (crotchet) - 2 beats (minim), and the **locations** of groups would be on a division of the bar up to a maximum of 4 (a crotchet, assuming a meter of 4/4).

At the New Complexity stage **complexity** might be set as, say, 17 'in the time of…', group **lengths** set as between ¼ of a beat – 2 bars, and the **locations** set as divisions of the bar into a minimum of 1/16 (that is, starting on any semiquaver). If the **shortest duration** is set down to the speed of a hemidemisemiquaver/a sixty-fourth note (15 micro-beats in a meter of 4/4) then this would allow rhythms such as '17 hemidemisemiquavers in the time of 14 starting on any semiquaver of the bar'.

Of course, the irrational groups could contain rests as well as attacks. So two extra criteria are included – **fallback locations** as well as **groups locations** (the latter begins with an attack, while the former begins or ends with a rest) and **default divisions beyond a certain point** (which reduces rhythmic complexity at the cost of accuracy).

Before running through an example, a reminder: terminology in the **rhythmicize** dialogues does not include macro-beats. The system of 960-micro-beats-to-the-bar is the only system used for the sake of simplicity. (However, you can still use macro-beats when inputing data – unless you want a fraction of a macro-beat, which, of course, you can indicate in micro-beats).

Example

Having switched on **Rhythmicize attacks** in **Display options** (M/V/D/H) you will need to create some attacks or copy them or move them to be then invited to **rhythmicize** them.

Having created a suitably complex passage (maybe using **Accel/rit** or **Distort attacks**) reply **Y** to the question **Do you want this group to be rhythmicized?**

The next screen gives you a generic three-way choice about irrational groups: re-define the criteria, keep the criteria you have already defined during this session, or use the CAC's defaults.

To help you, there follows a reminder of the criteria, which if this is the first occasion this session you have used **rhythmicize** will be CAC's defaults. Upper case letters draw your attention to the six categories of criteria described in the above **Introduction** – GROUP LENGTHS, GROUP LOCATIONS, FALLBACK LOCATIONS, SHORTEST DURATION, COMPLEXITY and DEFAULT DIVISIONS. Press **Y** to re-define these criteria.

You will immediately be asked to give criteria about the irrational **group lengths**, namely the shortest and the longest. Bear in mind CAC's invariance of fixed bars each consisting of 960 micro-beats. Given this, various meters would pan out as:

      meter 4/4   micro-beats per macro-beat (crotchet) – 240

      meter 2/4   micro-beats per macro-beat (crotchet) – 480

      meter 3/4   micro-beats per macro-beat (crotchet) – 320

      meter 5/4   micro-beats per macro-beat (crotchet) – 192

      meter 4/8   micro-beats per macro-beat (quaver) – 240

Let's choose a shortest group length of one crotchet (in a meter of 4/4 type 0 bars 240 beats, or 0 bars 1 beat). For a longest group length let's have a minim (0 bars 2 beats).

Choose a **group location** which is acceptable for the shortest group. You probably want the crotchet groups to occur on any crotchet of the bar, so type 4 for ¼ of the bar.

The **fallback locations** might be the same as group locations, or possibly in certain contexts acceptable only on less frequent beats. Here type 4 again for ¼ of the bar.

An updated account of your criteria now appears, followed by a question about the shortest allowable duration. The shorter the duration allowed, the finer the temporal 'grid', and therefore the greater accuracy achieved by **rhythmicize**. But this can go too far. For example, if in order to render the position of an attack precisely would require the division of a crotchet into 16 or more parts (hemidemisemiquavers or 1/64-notes) then it might be considered preferable to simplify the notation at the expense of inaccuracy (unperceivable, let alone unperformable, anyway). That would insist on a shortest duration of a demisemiquaver (1/32-note) or even a semiquaver (1/16-note). In 4/4 that would a shortest duration of 30 micro-beats or 60 micro-beats respectively.

Let's keep it simple and pick 60 beats.

The next question asks about **complexity**. This is straightforward – use the first number of the formula '*x* in the time *x*'. CAC will then use that number, and lesser than it, in its irrationals. So giving the value **4** would include '4 in the time of 3' and '3 in the time of 2'. The value **5** would include those plus '5 in the time of 4' and '5 in the time of 3'.

The final question regarding **default divisions** will be illustrated by three alternative criteria:
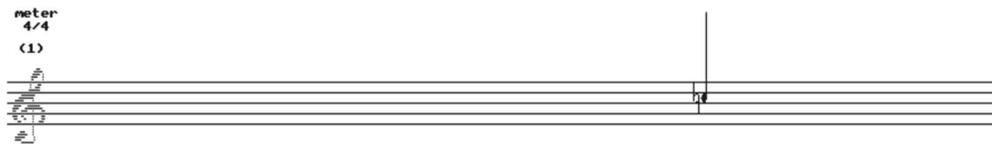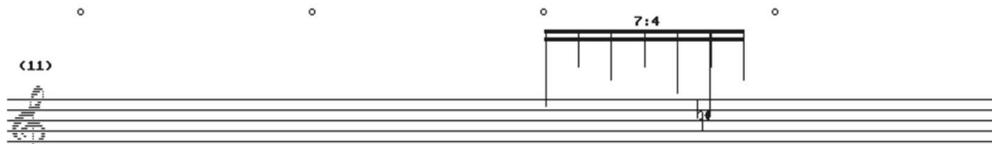
Stave '1' contains a single attack on bar 4 beat 647 before rhythmicization.

The following three staves rhythmicize stave 1 progressively more accurate – they place the attack on beats 640, 651 and 648 – inaccurate by a distance of repectively 7, 4 and 1 beats.

This progressively accuracy entails however progressively more complexity of its irrational notation.

The criteria instructed for the three staves are given below:

	group lengths	group locations	fallback locations	shortest duration	complexity	default divisions
stave 10	480 – 480	½	½	60	9	8
stave 11	240 – 240	¼	¼	30	9	32
stave 12	240 – 240	¼	¼	15	9	64

Stave 10's **lengths** and **locations** determines its irrational length as 480 (a minim) and located on any ½ of a bar

Stave 11 and 12's **lengths** and **locations** determines its irrational length as 240 (a crotchet) and located on any ¼ of a bar (includes ½!)

However the salient criteria are **shortest duration** and **default divisions**.

Stave 10's shortest duration of **60 beats** permits only irrational notation using semiquavers and slower. And its default divisions of **8** prefers irrationals using no more than 8 divisions of the bar (a quaver) if possible.

Stave 11's shortest duration of 30 beats permits notation using demisemiquavers and slower and a default division of 32, in other words a division of a crotchet into 8 - criteria which allows the septuplet semiquavers here.

Stave 12's shortest duration of 15 allows speeds down to hemidemisemiquavers and slower, and with its default divisions of 64 allows the crotchet to be divided into 16, which permits the use of the quintuplet demisemiquavers here, which divide the crotchet into10.

Conclusion

This example of rhythmicizing the only single attack in a bar may seem pedantic with its possibilities. However it will be found in contexts of music with rapid non-periodic rhythms, generated maybe by automatic funcions such as **Accel/rit**, **Layered attacks** or **Distort attacks**, then it is very useful to arrive quickly at rhythmicized notation with your own preferences of degree of complexity and rhythmic 'style'.

It has found useful to experiment with the criteria in order to arrive at the best solution. Especially altering the value given to **default divisions** can sometimes throw up a simpler rhythmicization of a passage, avoiding anomalies sometimes produced by more complex solutions – trying settings here of 24 or 36 or 48 should give a clearly preferable solution.

Tips

Cancelling menus via Escape

If you have arrived at some or other menu or sub-menu and do not wish to proceed, or for any reason at all you want to get back to 'square 1', just press **Esc**.

Undo the last operation

And if you don't like something you have just done, click **Undo** (M/Z).

Quickly select a voice

Often menus ask **Which voice?** followed by **(0 = top)** in brackets. If the voice you want to choose is displayed on the screen and is at the top of the three on the screen, just press **Enter** – pressing **Enter** is the equivalent of entering the digit **0**. To select the second voice on the screen, press **Enter** twice in quick succession. And for the third press it three times.

Copying single parameters

You may wish to copy, say, the pitches of a passage to another passage without disturbing its other parameters (attacks, amplitudes etc.) This can be done by, first, copying or moving the original to itself, which places all its parameters on the clipboard, then press **Menu/Add the group of values/Pitches** (M/A/P) and select which voice the pitches are to be copied *to* and which note they are to begin. The pitches you previously copied to itself in the original are then duplicated here. All other parameter except attacks can be copied in the same way.

Quickly playing things

The keys **P** and the two keys below it are shortcuts to play the top voice displayed or the middle voice or the bottom voice.

Holding down **Shift** before pressing the keys plays the voice only for the screen display.

Any number of voices can be played downwards from the top voice dispayed by pressing **Quickplay options** (M/V/Q).

Press **R** to replay.

Menus large or little

Press @ to contract menus so as to obscure music minimally.

Quick navigation

< one bar left   **>** one bar right

<< a screenful left   **>>** a screenful right

< then a number key that number of bars left   **> then a number key** that number of bars right

^ one stave up   **v** one stave down

^^ three staves up   **vv** three staves down

^ then a number key that number of staves up   **v then a number key** that number of staves down

^ then **0** fifty staves up   **v** then **0** fifty staves down

¬ type a number to display from which voice down

Desparate for a quick random number

Press **N** to satisfy your addiction. But beware, unless you are happy with the same 'random' numbers produced each time you use CAC (BBC BASIC always uses the same chart of random numbers every time) hold down **R** to re-run it multiple times to 'randomize' the use of the chart. For true random number try www.random.org.