The Kontakt Script Language

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Please note:

When viewing this manual with Acrobat Reader, the underscore ("_") may not be visible.

It is recommended to view this manual at a higher zoom factor and/or to print it out, since the underscore is a very important character in the programming language.

Also, we included a copy of this manual as a raw text file, since when copying and pasting portions of this text (e.g. code examples) you might loose line breaks which results in incorrect code. Please use the raw text file for copying and pasting the script examples.

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Introduction

Welcome to KSP – the Kontakt Script Processor.

The Kontakt Script Processor is a unique feature in Kontakt 2. You can use it as an effect or composition tool, you can build custom instruments with intelligent processing through algorithms, create sequencers, exotic tunings and much more. But the best part of it is, you can program script modules yourself, share them with others, or modify and personalize existing scripts. This manual describes the usage of the script processor and the programming of scripts in the Kontakt Script language.

A programming language? But I'm a musician and not a computer geek!

Don't be afraid of such terms as "programming language" or "scripting"; this manual will give you a step by step approach, even (or especially) for the novices in computer programming. In fact you don't need to know anything about programming languages in order to benefit from KSP; even if you don't want to program yourself, you'll get an insight into the structure of KSP and can modify certain scripts to fulfill your needs.

As a serious musician, you will find yourself in situations where you need to solve a problem in a very specific way, whether you're a performer, composer or producer. A "problem" is anything where your imagination and creativity are restricted by the boundaries of a specific music program. With KSP, you can extend the already numerous possibilities in Kontakt2 and tailor your own modules.

But I AM a computer geek – do I need to read the whole manual?

If you do have experience in programming languages or in a programming environment like Reaktor, you'll probably want to step through the whole manual as fast as possible and start scripting. That's fine but please remember that certain commands are unique to KSP; you might want to have a quick look at the Reference and then read the chapters which look unfamiliar to you.

So I'm ready to start – what else do I need besides this manual?

Of course, you must have Kontakt2 installed on your computer, together with the proper Audio/Midi configuration. There's really nothing else you need, but you might find it convenient to use an external text editor to type in your scripts. This of course can also be done in Kontakt (and is much faster for small scripts), but for larger scripts we recommend using a text editor, e.g. BBEdit on OS X or Ultraedit on Windows.

Getting Started - the Kontakt Script Processor

To begin with, we should clarify a couple of things so you know exactly what you're dealing with.

So what is the Kontakt Script Processor anyway?

The Kontakt Script Processor is one part of the architecture of Kontakt, i.e. it constitutes one element in the signal flow. As you'll recall from the Kontakt manual, from the point of hitting a key on the keyboard to actually hearing the sound, the audio signal goes through various stages (this is somewhat simplified):

Play a note → Source (sample is triggered) → Group FX → Amplifier → Instrument FX → Output

KSP is situated between the incoming midi information and the source:

Play a note → **KSP** → Source (sample is triggered) → Group FX → Amplifier → Instrument FX → Output

However, KSP is not a simple MIDI processor which takes in MIDI, processes it and spits it out again; if that were the case, you could use any MIDI processing utility and patch it between your keyboard and Kontakt. KSP, on the other hand, is able to retrieve Kontakt-specific parameters like the naming of the groups in an instrument, for example. It also can pass Kontakt-specific parameters to the source module, like the tuning of the triggered zone.

Please note: the KSP operates on the instrument level of a Kontakt instrument, just like the instrument send and instrument insert effects.

Don't worry if think you're already lost - you'll grasp the principle quite soon.

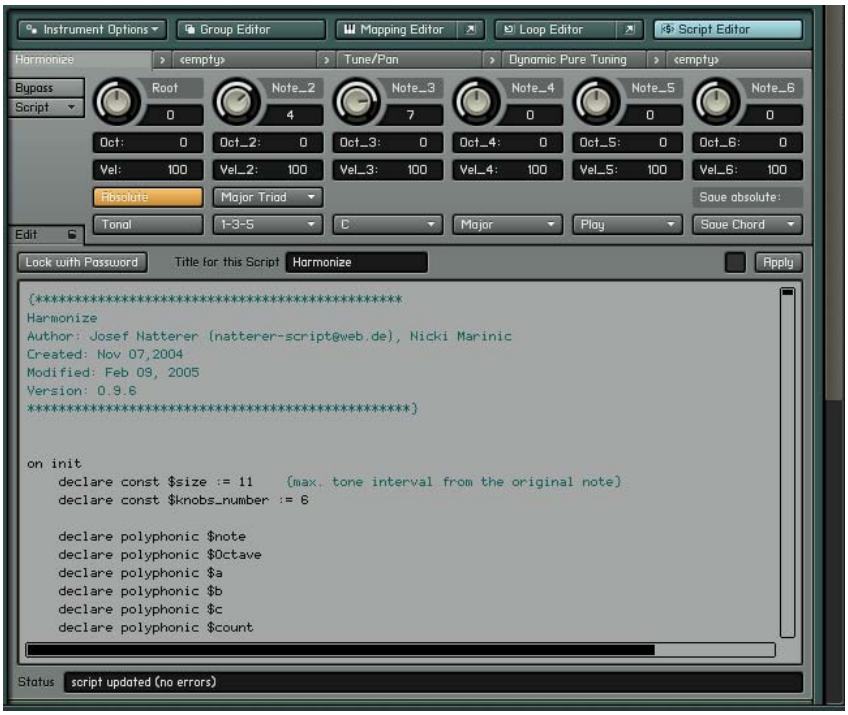
So what about the Kontakt Script Language?

Not so fast...in order for KSP to do anything, a module must be plugged in (just like if you want to have a delay effect on your audio, you must plug in the delay effect in the effect chain). We refer to such a module as a **script**, and a script is a program written in the Kontakt Script Language.

Let's illustrate this in Kontakt:

- Open Kontakt, load an instrument, and click the wrench icon to access the edit mode
- Click on the **Script Editor** tab in the top area to open the script module pane
- Click on the **Script** icon. A pop up menu appears
- Click on **Harmonization/Harmonize**
- The module appears in the script module pane:

Now click on the **Edit** button in the bottom left corner of the module:



Magic, huh?

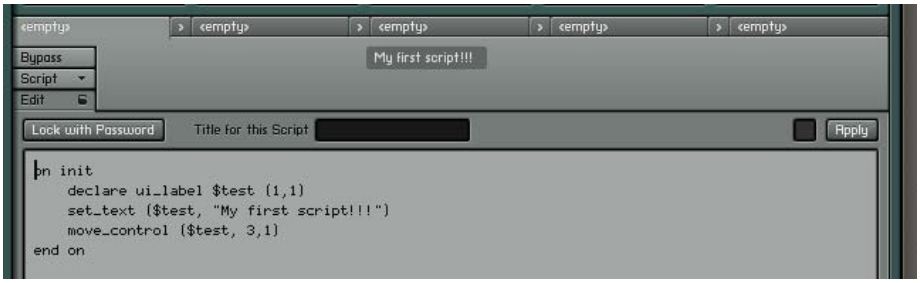
What you see is the actual code of the module. If you keep on reading this manual soon you'll be able to read and access the code, modify it to make it suitable for your own genius musical style, copy parts of it to use in your own scripts and so forth.

Let's move on:

- Click the **Edit** button to close the edit area
- Click on the **Script** icon and choose **- Empty -** from the pop up menu. This removes the script from the module pane.
- Select the following text and copy it to the clipboard:

```
on init
  declare ui_label $test (1,1)
  set_text ($test, "My first script!!!")
  move_control ($test, 3,1)
end on
```

- In Kontakt, click the **Edit** button to access the script edit area. You'll see a blinking cursor waiting for your masterpiece.
- Paste the text from the clipboard into the script edit area. Notice how the LED next to the "Apply" button turns orange, indicating that you've done something to the script.
- Click on "Apply". You should end up with the following:



Congratulations! You have taken the first step in becoming a programming geek!

But our work of art is not finished yet; let's be thorough and bring it to an end:

- Next to where it says **Title for this script** enter a nice, descriptive and boring title like **My first script** and hit Return.
- Click on **Edit** to close the edit area and select **save preset...** from the **Script** pop-up menu. A standard **Save** dialog box appears.
- Type in a name for the file (be sure to keep the extension .nkp) and save it.
- Assume we want to finish our session for today, so close the instrument and quit Kontakt (no need to save anything).
- Assume we've changed our mind, so open up Kontakt, load an instrument and bring the script module pane to the front (you should know by know how that works).
- From the **Script** pop up menu, select your script and voilá: you brought your masterpiece back.

At this point, you've basically already learned all the necessary steps in script production (well, all except for actually writing the scripts yourself, but we'll deal with that).

Let's recap:

- The **Kontakt Script Processor** (KSP) is an element in Kontakt's flowchart.
- In order for KSP to do anything, a **module** has to be loaded.
- We refer to such a module as a **script**.
- A script is a small **program**, which is executed by KSP.
- This program is basically nothing more than pure text, written in the **Kontakt Script Language**.

Here's what the normal workflow looks like:

- Write some code, either in an external text editor or in the script edit area.
- If you've written the code in an external text editor, copy it to the script edit area.
- Click on “Apply” to initialize the script.
- Save the script. It now becomes an encoded file with the extension .nkp (like all Kontakt presets).

The scripts are stored on your hard drive in the Kontakt application folder:
Kontakt 2/presets/scripts/

This concludes our getting started session. Next we'll learn a little bit more about the general user interface of KSP before we finally start to write our own scripts.

In case you're wondering...the script you saved a couple of minutes ago does not do anything glorious. Actually, it does nothing; but don't worry, this will change.

Working with KSP and Scripts

Let's have a look at the general user interface elements of KSP:

Script module: This area is similar to a normal Kontakt module. At the top you'll find five tabs to switch from one script to the other (you can load up to five script modules per instrument). A script module need not necessarily contain any GUI elements; a script can have a specific function and have a blank interface. Later you'll learn how to create UI elements.

Bypass: Activates/deactivates the script
Script: Use this pop-up menu to load and save scripts.
Edit: Click this button to open the script edit area. The lock indicates if the script is editable or not (see below).

Script edit area: This area opens up if you click on **Edit** in the script module. Here you can write, paste and view the actual code of the script.

Only have the script edit area open if you need to view or edit the code, otherwise keep it closed to conserve CPU power.

Lock with Password: Click this button to type in a password in order to prevent others from viewing or changing your scripts.

Title for this Script: You can enter a title for the script in this field. The title will then appear in the tab. Note that scripts can have different names for titles and file names.

Apply: Click on "Apply" to activate the script. KSP checks the syntax of the code, and if there are no error messages you're ready to go. The LED left of the "Apply" button turns orange whenever you make changes to a script and the script is not yet activated.

Script status line: If you've made a mistake while typing a script, KSP will output an error message in this line and highlight the incorrect line in the edit area.

Kontakt status line: This line will output all script messages generated from a message() function as well as errors which occur during playback of a script. Don't know what a function is? Don't worry, you'll see.

Basic Scripting Tutorial

Generating MIDI notes: a simple accompanist

Now we're ready to jump right into programming. This chapter will introduce you to the most basic (yet very important) procedures while programming. Also, you will get an insight into many topics which will be covered later in this manual.

We'll start with a simple script demonstrating one important and powerful feature of the script engine: the ability to generate "artificial" MIDI events. So let's get started!

Open Kontakt, load an instrument of your choice, open the script editor and copy the following text into the script editor:

```
on note
  play_note(60,120,0,-1)
end on
```

After pressing "Apply" the script is analyzed and (if you did not make any mistakes while copying...) ready to use. Play some notes on your keyboard; each played note will be accompanied by the note C3 with a velocity of 120.

Cool! I ALWAYS wanted every note that I play to be accompanied by C3...

Yeah, I know, maybe you think it's silly but let's stick to this example and really see what's going on.

So how does it work?

Whenever you play a note, KSP processes a specific part of the script. These parts are called **callbacks**. What you've written above is a so-called **note callback**. A note callback is a section in the script which is executed whenever you play a note. "Executed" means that each and every line is interpreted by KSP from top to bottom.

So let's analyze what we've done line by line:

`on note`: this marks the beginning of a note callback, i.e. it tells KSP to interpret the following lines of code whenever a note is played.

`play_note(60,120,0,-1)`: this is the first command KSP executes (it's also the only one in this case). We'll refer to such a command as a **function**. This function generates midi notes. In this case it generates a C3 (note number 60) with a velocity of 120. See below for a complete definition of this function.

`end on`: this marks the end of the callback.

Again, keep in mind that this callback is only triggered by notes (since it's a note callback), so it will not generate any notes when you move the mod wheel for example. KSP recognizes more than this type of callback of course. You'll learn one more in this chapter and the remaining in the section labeled "Callbacks".

You'll probably have understood everything except for the those fancy numbers in the `play_note()` statement. These numbers are called **parameters** and each function needs parameters to work properly. Functions can have one, two, three or more parameters. In this case `play_note()` has four parameters and it always needs four parameters to work with.

Here's a complete definition of the `play_note()` function (you'll come across many definitions of functions in this manual so we'll introduce you also to the general format of such a definition):

play note(<note-number>,<velocity>,<sample-offset>,<duration>)	
play a note, i.e. generate a note on message followed by a note off message	
<note-number>	the note number to be generated (0 -127)
<velocity>	velocity of the generated note (1 -127)
<sample-offset>	this parameter specifies an offset in the sample in microseconds **Please note**: this parameter does not work in DFD mode - only in sampler mode!
<duration>	specifies the length of the generated note in microseconds this parameter also accepts two special values: -1: releasing the note which started the callback stops the sample 0: the entire sample is played

Now we can fully understand what our script does:

- it plays a note with note number 60: `play_note(`**`60`**`,120,0,-1)`
- with a velocity of 120: `play_note(60,`**`120`**`,0,-1)`
- the sample will be played from the beginning: `play_note(60,120,`**`0`**`,-1)`
- and the sample will have the same duration as the note which triggered the callback: `play_note(60,120,0,`**`-1`**`)`

Maybe now it is a good time to take a break and play around with what you've learned so far; explore the `play_note()` function by entering other values, or even adding more `play_note()` functions to the script.
Don't forget: it's wise to read the manual but as with any programming language...learning by doing is the key to success!

Summary

The statement "`on note`" marks the beginning of a **note callback**. A callback is a section within a script that is being "called back" (i.e. executed) at certain times. In our example, the callback is executed whenever the program receives a note-on message, since it's a note callback. The script processor then interprets each line of the script from top to bottom until it reaches the "`end on`" statement, which defines the end of the callback. The function `play_note()` generates artificial MIDI notes.

Built-in variables: Building a simple Octaver

If you've played around with the script mentioned above you will have noticed that you can enter various numbers for the note and velocity of the MIDI note to be generated, but it's always static - the script always generates the same notes.

Now, this really should change, right?

Please input the following script:

```
on note
  play_note($EVENT_NOTE - 12,$EVENT_VELOCITY,0,-1)
end on
```

Play some notes on the keyboard, every note you play will be accompanied by the octave below with the same velocity of the original note; you've just built a simple octaver!

So how did we do that?

This little script introduces you to two new elements: **variables** and **operators**.
You will find detailed information about these two concepts later in this manual, for now let's stick to the following:

`$EVENT_NOTE` is a **built-in variable**, it carries the note number of the original played note. So when you play C3 (60) on your keyboard, `$EVENT_NOTE` will be 60.

`$EVENT_VELOCITY` is also a **built-in variable**, it carries the velocity number of the original played note. So when you play a note with a velocity of 110, `$EVENT_VELOCITY` will be 110.

You'll also find the operator "-". And yes, it performs exactly as you would expect: it subtracts a value. So the first parameter in the `play_note function()` – which denotes the note number of the generated note – is: `$EVENT_NOTE - 12`; so when you play C3 (60), the script will output C2 (48) (since 60 - 12 = 48) with the same velocity as the note you played!

Again, it's time to experiment: fool around with different transpositions (i.e. other numbers instead of 12), alter the velocity of the generated note (e.g. `$EVENT_VELOCITY - 20`), use more than one `play_note()` function; you'll get the idea.

Summary

Built-in variables are very important and powerful things. They cannot be declared, but "are always there". We looked at two important built-in variables here: `$EVENT_NOTE` and `$EVENT_VELOCITY`. KSP provides many different built-in variables. A complete list of all built-in variables can be found in the reference section of this document.

UI Control variables and the init callback: Creating a simple Harmonizer

Now let's extend our little script:

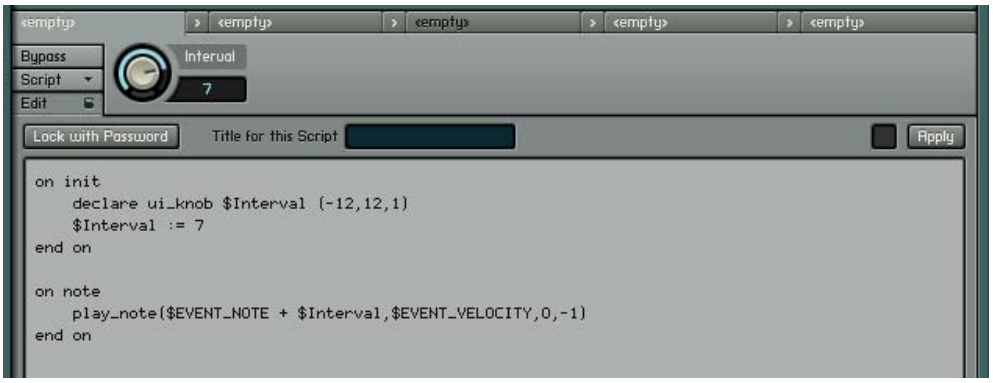
Wouldn't it be great if you had some sort of knob with which you could specify the distance between the generated note and the original note; maybe a knob labeled "Interval"?

Please input the following script:

```
on init
  declare ui_knob $Interval (-12,12,1)
  $Interval := 7
end on

on note
  play_note($EVENT_NOTE + $Interval,$EVENT_VELOCITY,0,-1)
end on
```

Play a few notes, each note will be accompanied a fifth above, perfect for scoring a Ben Hur-like movie...

But something else happened, take a look at the script module area:



A cute knob appeared, labeled "Interval". Now play a few notes and set the knob to different values: you can now specify the amount of transposition yourself, so you've changed your octaver into a simple harmonizer!

But how did we do that?

To put it in a simplified manner, we declared a GUI element (in this case a knob), we told KSP that this knob has a range from -12 to 12 and that its initial value should be 7, and finally we told KSP that it should add this number to the note number we play and generate a new note.

This script introduces you to three new elements: the **init callback**, the **declaration of UI control variables** and the **assignment of values to variables**.

Let's dig into it:

```
on init ... end on
```

initial callback, executed when the script was successfully analyzed

The **init callback** is a callback which is executed when you click on "Apply". It contains all initializations, variable declarations, UI elements and much more. The **init callback** is thus interpreted only once, whereas the note callback is interpreted whenever you play note. It's obvious that when you want to have a GUI element like a knob in your module, this knob needs to be created, but it needs to be created only once. That's why all GUI elements, for example, can only be declared ("created") in the init callback. The beginning of an init callback is marked with `on init` and its end is marked with `end on` (like the note callback).

A **UI control variable** is a type of **user defined variable**. The Kontakt Script Language distinguishes between **built-in variables** and **user defined** variables.

In our example we created a knob which in principle is a user defined variable, where you can change the value of the variable by changing the knob in the script module area.

Here's how we define a UI element like a knob:

```
declare ui_knob $<variable-name> (<min>,<max>,<display-ratio>)
```

create a user interface knob

Don't worry about the various parameters for now. You'll learn them later.

So in our script we've created a knob and given it the name `Interval`. What's missing in our discussion is the third line:

```
    $Interval := 7
```

":=" denotes an assignment. In our example it says "Assign the value 7 to the variable called Interval".

So when the init callback is executed (upon clicking on "Apply"), a knob is created and the knob initializes itself to 7. When you play a note, this value is then added to the note number you've played, so when you set Interval to -12 and play C3 (60), the accompanying note will be C2 (48) since `$EVENT_NOTE + $Interval` equals 60 + (-12) equals 48!

We finish with a subtle variation. By now you should have the chops to understand what it's doing:

```
on init
  declare ui_knob $Interval (-12,12,1)
  $Interval := 7
  declare ui_knob $Velocity (1,127,1)
  $Velocity := 60

end on

on note
  play_note($EVENT_NOTE + $Interval,$Velocity,0,-1)
end on
```

Summary

The **init callback** is called as soon as the script is successfully analyzed. That happens exactly when you press the "Apply" button in the script editor window.
A knob is a UI Control variable which is a type of user defined variable. UI elements are created in the init callback.
":=" marks an assignment, the value at the right gets assigned to the variable at the left of this sign.

Debugging and customizing: finishing your script

In this last part of the chapter we'll begin with a slight variation on the preceding script:

```
on init
  declare ui_knob $Interval (-12,12,1)
  declare ui_knob $Velocity (-64,64,1)

  $Interval := 7
  $Velocity := 20

end on

on note
  play_note($EVENT_NOTE+$Interval,$EVENT_VELOCITY+$VELOCITY,0,-1)
end on
```

With the knob labeled **Velocity** you can now modify the velocity of the generated note; if set to -10 for example, when you play a note with a velocity of 100 the generated note will have a velocity of 90.

No big deal, why don't we just go on with something new?

Now, you think we're done with our little script. Alas, we're not...

Try this: set **Velocity** to the maximum value of 64 and play a note on your keyboard as loud as possible. Then take a look at the status of Kontakt (in the lower left corner of the Kontakt window):

Oops, we have a problem. What happened?

Well, probably you've played a note with a velocity of 100 or more, the **Velocity** knob value of 64 got added to this velocity and you end up with a velocity value well beyond 127 which does not exist in MIDI. So KSP is so friendly to remind you that it was told to play a note with a velocity that is simply not possible. In this case, KSP will process the `play_note()` function with a velocity of 127 and output an error message.

An error message does not necessarily lead to a catastrophe; in our script we actually could live with such an error message since the harmonizer does its job. However, make it a habit to watch out for those messages and program your scripts in such a way that no errors are produced.

Take a look at the following:

```
on init
  declare ui knob $Interval (-12,12,1)
  declare ui_knob $Velocity (-64,64,1)

  $Interval := 7
  $Velocity := 20

  message ("")

end on

on note
  if ($EVENT_VELOCITY+$VELOCITY > 127)
     play note($EVENT NOTE+$Interval,127,0,-1)
  else
     play_note($EVENT_NOTE+$Interval,$EVENT_VELOCITY+$VELOCITY,0,-1)
  end if
end on
```

Again, set the **Velocity** knob to 64 and play a loud note; no error message will be produced.

So let's go through this script. It contains two new elements: the `message()` function and the `if…else…end if` control statement.

The message function writes text into the Kontakt status line. Here's the complete definition.

`message(<number,variable or text>)`	
display numbers, variable values and text in the status line in Kontakt	
`<number>`	display single numbers: `message(2)`, `message(128)`
`<variable>`	display the value of a variable: `message($EVENT_VELOCITY)`
`<text>`	display text: `message("script info")` – you must put the text string in quotation marks
Remarks	you can also use combinations of the above: `message("Velocity: " & $EVENT_VELOCITY)` you must use the `&` operator in order to concatenate elements

The `message()` function can be extremely helpful in scripts when you run into problems and need to retrieve specific information. Please note that only one message can be displayed in the Kontakt status line, so you will always see the last output of `message()`.

If you want to output a message to the user, please do not use the `message()` function.

There is a GUI label (explained later), which is more useful for those purposes.
Imagine having 16 instruments loaded, each with 5 scripts: if every scripts outputs messages (something like: this script was created by xxx, master of scripting!), it can get VERY annoying.

In our example we wrote: `message("")` (i.e. nothing) in the init callback; this is helpful if you want to clear previous error messages.

Make it a habit to write `message("")` in the init callback. You can then be sure that all previous messages (by the script or by the system) are deleted and you see only new messages.

The next new element is the `if…else…end if` control statement.

If the condition `$EVENT_VELOCITY + $Velocity > 127` is **true** (i.e. the sum is larger than 127), the script will output:

```
play_note($EVENT_NOTE+$Interval,127,0,-1)
```

If **not** (i.e. the sum is equal or less 127), the script will output:

```
play_note($EVENT_NOTE + $Interval, $EVENT_VELOCITY+$VELOCITY,0,-1)
```

An `if` statement is closed by the term `end if`.

So now we can be sure that the `play_note()` function will always process correct velocity values (i.e. in the range of 1 - 127).

Cool...enough smart talk. Are we finally finished now?

No.

Are you really sure this script will not produce any error messages? We were talking about velocities exceeding 127, but did we talk about velocities below 1, which are also not possible?

Right, turn the **Velocity** knob to -40 and play a soft note, you will get the same error message since the velocity in the `play_note()` function was below 1.

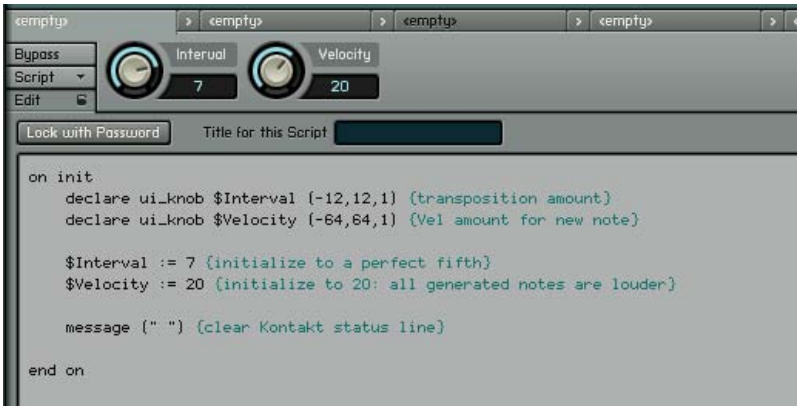
Without any further comments, take a look at the following script:

```
on init
  declare ui knob $Interval (-12,12,1) {transposition amount}
  declare ui_knob $Velocity (-64,64,1) {Vel amount for new note}

  $Interval := 7 {initialize to a perfect fifth}
  $Velocity := 20 {initialize to 20: all generated notes are louder}

  message (" ") {clear Kontakt status line}

end on

on note
  {check if Vel is higher than 127}
  if ($EVENT VELOCITY+$VELOCITY > 127)
     play_note($EVENT_NOTE+$Interval,127,0,-1)
  else
     {check if Velocity is lower than 1}
     if ($EVENT_VELOCITY+$VELOCITY < 1)
        play_note($EVENT_NOTE+$Interval,1,0,-1)
     else
        play_note($EVENT_NOTE+$Interval,$EVENT_VELOCITY+$VELOCITY,0,-1)
     end if
  end if
end on
```

Now your script should work as expected and will not produce any error messages.

By the way, the above announcement "*Without any further comments*" is not quite true. In fact, our script now has many comments indeed...

Take a look at the script editor:



Everything you write between curly brackets: { . . . . . } is a comment; it is not interpreted by KSP (in the script editor, comments are highlighted). The purpose of comments is just to help you structure your code so at every point you're know what you're doing.

Be smart, use comments!

You might find it silly to comment every command of code, but when working on larger scripts this might become extremely helpful. Let's say you work on a larger script, take a break for a couple of weeks and then come back to your script; without comments it is very hard to "get back into the code".

Also, do not expect anybody to help you with your scripts when you encounter problems if your script has no comments; it is just too difficult to look at 500 lines of code from somebody else without any comments.

So my script is up and running. Anything else?

Yep, one more thing and we're done for today.

Load the script and find a nice combination of **Interval** and **Velocity** for your upcoming musical masterpiece. Save the patch (or your project if you're working in a host sequencer) and reopen it: all your settings in the script module are lost!

How come?

Whenever you load a script or a patch that contains a script, the init callback is executed. Thus all variables (in our script the two knobs) are reset to their initial value (i.e. the values they were assigned to in the init callback).

Now that's just great – no total recall with scripts at all?

You're right. It would be pretty useless to load a script into a patch, tweak it, save the patch and lose your settings. The only workaround would be to always write the parameter values into the init callback, but that's not really how a musician works.

Therefore it is possible to make variables **persistent.** Try this script:

```
on init
  {----- GUI elements -----}
  declare ui_knob $Interval (-12,12,1) {transposition amount}
  declare ui_knob $Velocity (-64,64,1) {Vel amount for new note}

  {----- Inits -----}
  $Interval := 7 {initialize to a perfect fifth}
  $Velocity := 20 {initialize to 20: all generated notes are louder}

  {----- Recall -----}
  make_persistent ($Interval) {save the state of the knob Interval}
  make_persistent ($Velocity) {save the state of the knob Velocity}

  message ("") {clear Kontakt status line}
end on

on note
  {check if Vel is higher than 127}
  if ($EVENT_VELOCITY+$VELOCITY > 127)
     play note($EVENT NOTE+$Interval,127,0,-1)
  else
     {check if Velocity is lower than 1}
     if ($EVENT_VELOCITY+$VELOCITY < 1)
        play_note($EVENT_NOTE+$Interval,1,0,-1)
     else
        play note($EVENT NOTE+$Interval,$EVENT VELOCITY+$VELOCITY,0,-1)
     end if
  end if
end on
```

Load the script, make some changes to it, save the patch and reload the patch: everything in its right place!

This is achieved by using the function `make_persistent()`; this function has to be written in the init callback and must contain the variable name.

`make_persistent(<variable-name>)`

retain the value of a variable when a patch is loaded

All variable types (e.g. arrays, user defined variables) can be made persistent, not just UI control variables.

So that's it - the script is finally complete. Congratulations!

Now give it a nice title, save it, and…most important of all…make music with it!

Summary

You can execute commands under certain conditions with `if…else…end if`. By using the `message()` function, you can display numbers, variable values or text in the Kontakt status line. If you want all variables (e.g. knobs) to be saved with the patch, use the `make_persistent()` function.

Comments are written in curly brackets: `{this is a comment}`. They are an immeasurable help for you and others in understanding the code.

This concludes our little **Basic Scripting** chapter. From now on, we'll move on at a slightly faster pace with more complete definitions. Be sure to always play around with everything as you learn it. This is the only way to really grasp the full potential of the Kontakt Script Language. Don't be afraid to make mistakes. You cannot ruin Kontakt with any script...

Fundamentals

General rules concerning the syntax

Let's start by laying down some basic rules about the syntax of the script language (e.g. the way scripts have to be written in order to be properly executed):

- each command has to be written in one line
- there can be an infinite number of spaces between the command lines
- there can be an infinite number of spaces between single words
- the script language is case sensitive, so the command `play_note()` would not be recognized when spelled `Play_Note()`
- if one command line is too long and therefore is difficult to read, you can break it by typing ". . . "at the end of the line. Since a script statement must always be contained within a single line, we need a special mechanism to tell the processor that our line is not yet finished, should we want to break it.

So the following two scripts are identical:

```
on note
  if($EVENT_VELOCITY > 100)
        message ("Script message: key struck HARD")
  else
        message("Script message: key struck SOFT")
  end if
end on
```

is the same as

```
on note
  if(    $EVENT_VELOCITY    > 100)

        message(...
  "Script message: key struck HARD")
  else
        message("Script message: key struck SOFT")
  end...
 if
            end on
```

- syntax errors are reported in the script status line. The line containing the error is marked in red.
- errors during a running script are reported in the Kontakt status line below Kontakt's browser.

Callbacks

Callbacks are programs which are executed at certain times. If you press and hold a note, the note callback is executed, but releasing the note triggers the release callback and so forth.

There are five different types of callbacks:

`on init ... end on`
initial callback, executed when the script was successfully analyzed

`on note ... end on`
note callback, executed whenever a note on message is received

`on release ... end on`
release callback, executed whenever a note off message is received

`on ui_control (<variable-name>) ... end on`
ui callback, executed whenever the user changes the respective UI element

`on controller ... end on`
controller callback, executed whenever a cc or pitch bend message is received

(actually there's two more callbacks used for rpn/nrpn messages, but those two callbacks can be seen as "special" controller callbacks).

You can stop a callback with the statement `exit`:

`exit`
immediately stops a callback

Variables

Let's go back to our first script:

```
on note
  play_note(60,120,0,-1)
end on
```

As we said – having each note accompanied by middle C3 is not very spectacular. So if we want each played note to be accompanied by a newly generated note which has the same velocity and sounds an octave higher we write:

```
on note
  play note($EVENT NOTE + 12,$EVENT VELOCITY,0,-1)
end on
```

Instead of a specific note number we write `$EVENT_NOTE + 12`, instead of specifying a velocity we type `$EVENT_VELOCITY`. `$EVENT_NOTE` and `$EVENT_VELOCITY` are so-called **built-in variables**; they contain the note number and the velocity of the note which triggered the callback.

Variables are the most important part of the script language. Speaking in computer terms, they are named storage spaces for numbers. We have several types of variables which we'll discuss in a moment, but for now it's important that we distinguish between **user-defined variables** and **built-in variables**.

Both user-defined and built-in variables can have two states:

- normal variables, marked by a dollar sign (`$my_variable` or `$EVENT_VELOCITY`) or an "at" sign (`@my_text`)
- array variables, marked by a percent sign (`%my_array[]` or `%KEY_DOWN[<note-number>]`) or an exclamation mark (`!my_text_array[]`)

A normal variable can store a single integer value or a text string. An array variable is similar to a normal one, but it can store several values/text strings at once. An array is an indexed list of numbers, similar to a table with each index x pointing to an address y. An array can have 1 to 512 indices.

Declaration of variables

All user-defined variables must be declared. Declaring a variable means that its name is registered for subsequent use and its value is initialized to a certain value. Let's look at some examples of variable declarations:

```
on init
  declare $first_variable
  declare $second_variable := 12
  declare const $third_variable := 24
  declare %first_array[4]
  declare %second_array[3] := (3,7,2)
end on
```

So what does this script do?

- The first line marks the beginning of an init callback (you'll recall that an init callback is executed immediately after the script has been successfully analyzed).
- In the second line, a normal variable called first_variable is declared by using the statement declare. It has no value assigned to it by the user so it is initialized to zero.
- The third line declares a normal variable called second_variable and assigns it the value 12 with the operator `:=`
- The fourth line declares a special normal variable: a constant called third_variable. A constant is pretty much the same thing as a normal variable, except that its value cannot be changed and it's a little more efficient (since it need not be evaluated at runtime).
- The fifth line declares an array called first_array with four elements, all initialized to zero.
- The sixth line declares an array called second_array with three elements, which are initialized to 3, 7 and 2.
- The seventh line marks the end of the init callback.

We can see that variables have certain naming conventions: non-array variables must start with a dollar sign, whereas arrays must start with a percent sign. The syntax is always the same as in the example; constant declarations must always include the initial value, which gets assigned by the `:=` operator.

Now we'll take the script from above (which does not do anything yet) and try to extend it.

Working with variables

Copy the following script and play a note on the keyboard:

```
on init
  declare $first_variable
  declare $second_variable := 12
  declare const $third_variable := 24
  declare %first_array[4]
  declare %second_array[3] := (3,7,2)
end on

on note
  play_note ($second_variable + 48,$third_variable + 96,...
             %first_array[2] + $first_variable,%second_array[0] - 4)
end on
```

This (rather useless) script generates the same note as our very first script: each played note will be accompanied by the note C3 with a velocity of 120...

Its purpose is to show an extremely basic idea of manipulating variables. The above `play_note()` function is identical to `play_note (60, 120, 0, -1)`:

- `$second_variable + 48` equals 60
- `$third_variable + 96` equals 120
- `%first_array[2]` equals 0 since index number 2 points to the value 0
- `%second_array[0] - 4` equals -1, since index number value points to value 3 which is subtracted by 4

The built-in variables are very important and powerful things. They cannot be declared but "are always there". We take a look at two important built-in variables here (a complete list of all built-in variables can be found in the appendix of this document):

$EVENT_NOTE
note number of the event which triggered the callback

$EVENT_VELOCITY
velocity of the note which triggered the callback

`$EVENT_NOTE` contains the note value of the MIDI event that triggered the containing callback and `$EVENT_VELOCITY` is its corresponding velocity. It's pretty obvious that both variables may not be used within an init callback (since the init callback doesn't get triggered by a key and thus has no note or velocity value!).

Valid note values go from 0 – 127 which correspond to C-2 – G8 obviously. `$EVENT_VELOCITY` can contain values from 1 to 127. As you can see, built-in variables are spelled with capitals, so it's a good idea if you stick to small letters for your own variables.

Let's look at some examples that contain both types of variables.

```
on init
  declare $new_note
end on

on note
  $new_note := $EVENT_NOTE + 12
  play_note($new_note,$EVENT_VELOCITY,0,-1)
end on
```

And again, this script accompanies each and every note you play with C3 and a velocity of 120...

The variable `$new_note` is declared and has the value zero, since it was not assigned to a value. By hitting a note, the note callback is processed, where the value of `$new_note` is replaced by the expression `$EVENT_NOTE+12`. (remember: by using the operator `:=` the value of the left variable is replaced by the value of the right variable).

Can we PLEASE make a script that does not accompany each note I play with C?

Sure we can. Check out the following:

```
on init
  declare %addNote[12] := (4, 6, 3, 6, 3, 4, 6, 4, 6, 3, 6, 3)
  declare $keyClass
end on

on note
  $keyClass := $EVENT_NOTE mod 12
  play note($EVENT NOTE + %addNote[$keyClass],$EVENT VELOCITY,0,-1)
end on
```

Play a few notes – magic, huh? Each note you play will be accompanied by note which really fits well in the key of C major...

Before we start analyzing this script, let's first direct our attention to the modulo operator `mod`. A modulo operator divides two numbers and outputs the remainder of the division, so for example 14 mod 12 equals 2, 128 mod 10 equals 8 and so on.

In our example we can see a very common use for the modulo operator: by writing `$EVENT_NOTE mod 12` we can retrieve the pitch class (i.e. the pitch independent of the octave) of the played note. So whenever you hit any D, `$keyClass` will always be 2.

Let's assume you've played D3 (62): now this variable is used as an index in the array `%addNote[12]` which results in the new note number 62 + 3 = 65, which equals F3.

String Variables

There are two variable types which store text strings instead of integers:

- string variables, which are declared with a @ prefix
- string arrays, which are declared with a ! prefix

See the following script for a simple example:

```
on init
  declare @text
  @text := "note played: "

  declare !list[12]
  !list[0] := "C"
  !list[1] := "C#"
  !list[2] := "D"
  !list[3] := "D#"
  !list[4] := "E"
  !list[5] := "F"
  !list[6] := "F#"
  !list[7] := "G"
  !list[8] := "G#"
  !list[9] := "A"
  !list[10] := "A#"
  !list[11] := "B"
end on
on note
  message(@text & !list[$EVENT_NOTE mod 12])
end on
```

Persistent variables

In the Basic Scripting chapter, the command `make_persistent()` was already introduced:

`make_persistent(<variable-name>)`

retain the value of a variable when a patch is loaded

Whenever you load a patch or a script, the init callback is processed and the persistent variables are set to their saved state. Additionally, the value of persistent variables is also saved when clicking on Apply. So when you load for example the Arpeggiator, make some changes to the rhythm in the gui and then decide to edit the code of this particular script, you will not loose the changes you've made before.

Please note: if you load a script from the script menu, the value of persistent variables is NOT buffered. This is necessary, since for example you could have more than one script with the same variable name.

So if you load a script which contains the variable name `$Time` (say for example a delay script), make some changes and then load a different script which contains the same variable name (say for example sequencing script), you would not want the changes of the first script to be applied to the second script.

Script Call Order

There are five scripts that are called in ascending order. The first script receives MIDI signals from the keyboard or a sequencer, while the other scripts receive the MIDI signals from the script preceding them.

If one event is ignored in script 1, it will then not appear in the following scripts. If for example you generate notes in script 1, script 2 will receive these notes as if they were being played on the keyboard.

Variables are only valid in the script in which they appear, so you could for example use the variable `$tune_amount` independently in different scripts. That's why you can safely insert scripts after each other, for example:

Midi Latch -> Harmonize -> Arpeggiator -> Microtuning

Take a look at the patch **Ambient Harmonization.nki** which is part of the Kontakt 2 library. The patch can be found at:

Kontakt 2 Library/02 - KSP Instruments/06 - Harmonizer/Ambient Harmonization.nki.

- The first script latches incoming MIDI notes.
- The second script retriggers these notes at a specific rate.
- The third script creates chords out of the repeating notes.
- The fourth script constrains these chords to a specific scale.

Tempo- and time-based scripting

The wait() function

So far, all artificially generated notes have been played together with the played note. But what if we want to delay that generated note - for example, in a delay or arpeggiator situation?

It's time to say hello to a very important statement in the script engine: the `wait()` function.

wait(<wait-time>)	
pauses the callback for the specified time	
`<wait-time>`	wait time in microseconds

`wait()` stops the callback at the position in the script for the specified time. In other words, it freezes the callback (although other callbacks can be accessed or processed). After the specified time period the callback continues.

All timing information (except `$ENGINE_UPTIME`) in the Kontakt Script Language is measured in microseconds (µsec), so 1000000 µsec equal 1 sec.

Let's see `wait()` in action:

```
on init
  declare %addNote[12] := (4, 6, 3, 6, 3, 4, 6, 4, 6, 3, 6, 3)
  declare $keyClass
end on

on note
  $keyClass := $EVENT_NOTE mod 12
  wait(500000)
  play_note($EVENT_NOTE + %addNote[$keyClass],$EVENT_VELOCITY,0,-1)
  wait(500000)
  play_note($EVENT_NOTE + 12,$EVENT_VELOCITY,0,-1)
end on
```

Play C3 and hold the note. After 0.5 seconds you'll hear E3, followed by C4 0.5 seconds later. Because of the `wait()` function, the callback is not processed right away but within the time period of one second (two `wait()` functions, each is 0.5 seconds long).

Now release C3 and play and hold E3. You'll hear a similar result, G3 and E4 are being played. So far, everything is fine.

But now hit both keys, C3 and E3 together. The result is... well it's not the same as before when we played the notes one after the other.

What happened?

First of all, we need to know that since each callback lasts one second, a second note played shortly after (< 1 sec) will produce a second callback, which is running parallel to the first callback! In this case, the two callbacks are running simultaneously, one after the other. The second callback (triggered by E3) will assign a new value to `$keyClass`, but this variable is also needed by the first callback (triggered by C3) resulting in a wrong `$keyClass` variable for the first callback. So what we need is a variable for every note, which brings us to a new variable type: the **polyphonic variable**.

Polyphonic Variables

Try the following:

```
on init
  declare %addNote[12] := (4, 6, 3, 6, 3, 4, 6, 4, 6, 3, 6, 3)
  declare polyphonic $keyClass
end on

on note
  $keyClass := $EVENT_NOTE mod 12
  wait(500000)
  play_note($EVENT_NOTE + %addNote[$keyClass],$EVENT_VELOCITY,0,-1)
  wait(500000)
  play note($EVENT NOTE + 12,$EVENT VELOCITY,0,-1)
end on
```

Now `$keyClass` is a polyphonic variable. If you want to declare a polyphonic variable, you must write `polyphonic` between `declare` and the variable name.

```
declare polyphonic $<variable-name>
```

declare a user -defined polyphonic variable to store a single integer value

Play C3 and E3 together. You should hear a more "correct" arpeggio. This is because each callback has its own `$keyClass` variable. Please note that these variables need more memory (4 KB per instance) and can only be used in note and release callbacks.

A polyphonic variable retains its value in the release callback of the corresponding note.

Control Statements

A lot of times, we (or, better said, KSP) need to make decisions based on certain conditions. KSP knows three types of control statements: `if`, `select` and `while`.

if...else...end

The `if…else…end` control in the next example is quite easy to grasp:

```
on note
  if($EVENT_VELOCITY > 80)
        play_note($EVENT_NOTE+12,$EVENT_VELOCITY,0,-1)
        message("loud " & $EVENT_VELOCITY)
  else
        message("soft " & $EVENT_VELOCITY)
  end if
end on
```

If the condition `$EVENT_VELOCITY > 80` is true, the script processes the `if` branch; if the condition is false the `else` branch is processed. The `else` branch is optional - it may also be omitted.

An `if()` statement is closed by the term `end if`.

---

select()

`select` is an elaborated version of `if..else..end`:

```
on note
  select($EVENT_VELOCITY)
        case 1 to 40
              message("Script message: key struck SOFT")
        case 41 to 100
              message("Script message: key struck MEDIUM")
        case 101 to 126
              message("Script message: key struck HARD")
        case 127
              message("Script message: key struck BRUTAL")
  end select
end on
```

The `select` statement is similar to the `if` statement, except that it has an arbitrary number of branches. The expression after the `select` keyword is evaluated and matched against the single `case` branches. The first `case` branch that matches is executed. The `case` branches may consist of either a single constant number or a number range (expressed by the term "`x to y`").

A `select()` statement is closed by the term `end select`.

---

while()

In principle, `while` is a continuous `if` statement. Therefore it can be referred to as **while loop**. In the next example we make use of the `while` statement to simulate a mandolin tremolo.

```
on note
  wait(70000)
  while($NOTE_HELD = 1)
        play note($EVENT NOTE,$EVENT VELOCITY,0,70000)
        wait(70000)
  end while
end on
```

The built-in variable `$NOTE_HELD` is 1 if the key which triggered the callback is still pressed. Otherwise it is 0. As long as you hold a note, KSP will run through the `while` loop, meaning it will play a note, wait, play a note and so forth.

When you release the key, the `while` condition is not true anymore since `$NOTE_HELD` will output 0, so everything inside `while` will be ignored and the callback comes to an end.

A `while()` statement is closed by the term `end while`.

Operators

Boolean Operators

Boolean operators are used in `if` and `while` statements, since they return if the condition is either true or false. Below is a list of all Boolean operators. x, y and z denote numerals, a and b stand for Boolean values.

Boolean Operators	
`x > y`	greater than
`x > y`	less than
`x >= y`	greater than or equal
`x <= y`	less than or equal
`x = y`	equal
`x # y`	not equal
`in range(x,y,z)`	true if x is between y and z
`not a`	true if a is false and vice versa
`a and b`	true if a is true and b is true
`a or b`	true if a is true or b is true

Arithmetic Operators

The following arithmetic operators can be used in the script language:

Arithmetic operators	
`x + y`	addition
`x - y`	subtraction
`x * y`	multiplication
`x / y`	division
`x mod y`	modulo
`-x`	negative value
`abs(<expression>)`	returns the absolute value of an expression
`inc(>expression>)`	increments an expression by 1
`dec(<expression>)`	decrements an expression by 1

Bit Operators

The following bit operators can be used:

Bit operators	
x .and. y	bitwise and
x .or. y	bitwise or
.not. x	bitwise negation
sh_left(<expression>,<shift-bits>)	shifts the bits in <expression> by the amount of <shift-bits> to the left
sh_right(<expression>,<shift-bits>)	shifts the bits in <expression> by the amount of <shift-bits> to the right

Array Functions

To facilitate the usage of arrays, the following functions can be used:

sort(<array-variable>,<direction>)
sort an array in ascending or descending order: With direction = 0, this function sorts in ascending order, with a value other than 0, it sorts in descending order

num_elements(<array-variable>)
returns the number of elements in an array With this function you can, e.g., check how many groups are affected by the current event by using num_elements(%GROUPS_AFFECTED) .

search(<array-variable>,<value>)
searches the specified array for the specified value and returns the index Example: $a := search(%array, 10) searches the array for the value 10 and return the first position of that value to $a. If the value is not found, the function returns -1.

array_equal(<array1-variable>,<array2-variable>)
check the values of two arrays, true if values are equal

Random Generator

Finally there is the random() function, which generates random numbers between <min-value> and <max-value>:

random(<min>,<max>)
generate a random number

Group Management

If there are multiple groups in one instrument, it is possible to access them in the script engine by using the following four functions:

`disallow_group(<group-index>)`
turn off the specified group, i.e. make it unavailable for playback

`allow_group(<group-index>)`
turn on the specified group, i.e. make it available for playback

`find_group(<group-name>)`
returns the group-index for the specified group

`group_name(<group-index>)`
returns the group-name for the specified group

Each group has an index number assigned to it. The indices are numbered from 0 to the number of groups minus 1. If you don't know the index of a group, you can recall it by using `find_group()`. Just type the name of the group in quotation marks and the index will be returned. The function `group_name()` works the opposite way.

By default, all groups are allowed (they all play back). If you want to allow only one group, it's best to disallow all groups by using `disallow_group($ALL_GROUPS)`. `$ALL_GROUPS` is a built-in variable that addresses all groups. As soon as all groups are disallowed you can, for example, allow the first group by typing `allow_group(0)`.

`$ALL_GROUPS`
addresses all groups in a `disallow_group()` and `allow_group()` function

```
on note
  disallow_group($ALL_GROUPS)
  allow_group(find_group("piano_1"))
end on
```

The groups can only be changed if the voice is not running.

Another helpful built-in array is `%GROUPS_AFFECTED`:

`%GROUPS_AFFECTED`
an array with the group indexes of those groups that are affected by the current Note On or Note Off events

With this function you can, e.g., check how many groups are affected by the current event by using `num_elements(%GROUPS_AFFECTED)`.

And yet another helpful built-in variable is $NUM_GROUPS:

$NUM_GROUPS
total amount of groups in an instrument

This built-in variable returns the amount of groups in an instrument. It is very useful when declaring a generic drop-down menu with all group names:

```
on init
  declare $count
  declare ui_menu $group_menu
  while ($count < $NUM_GROUPS)
        add_menu_item ($group_menu,group_name($count),$count)
        inc($count)
  end while
end on
```

Of course, if you make any changes to the amount of groups in your instrument, or if you change the names of the groups in your instrument, the changes to the menu are not reflected right away. Either click on apply again, or save and reload the instrument (remember, the init callback is processed when you click on Apply, or open a script from the Script menu, or when you load an instrument).

Event Management

Events and Note ID's

Each note is an event, regardless of whether the note comes from outside (keyboard, sequencer) or from the script engine itself. For as long as the note decays after the note-off, this event is existent, which means that most of the time many events exist simultaneously. In order to access them, each event gets a unique number.

It's important to note that a callback and an event are two different things. A callback is a program which is being interpreted by the computer, while an event could be seen as a virtual voice.

The ID number of the note which started the callback is stored in the built-in variable `$EVENT_ID`. The ID number of artificially generated notes can be accessed through `play_note()`:

```
on init
  message ("")
  declare  $new_note_id
  declare  $original note id
end on

on note
  $original_note_id := $EVENT_ID
  wait(500000)
  note off($original note id)
  $new_note_id := play_note($EVENT_NOTE + 12,$EVENT_VELOCITY,0,500000)
  wait(500000)
  note_off($new_note_id)
end on

on release
  if ($EVENT_ID = $new_note_id)
        message("note off new note")
        wait (200000)
        message ("")
  end if
  if ($EVENT ID = $original note id)
        message("note off original note")
        wait(200000)
        message ("")
  end if
end on
```

By pressing a key the note callback is executed once. The release callback, however, is executed twice as you can see in the Kontakt status line.

Why?

The `play_note()` function can be thought of as a virtual finger pressing a key, and since every key has to be released sometime this artificial note-on generates a note-off, which then triggers a release callback.

Actually, play_note() should also execute a note callback in theory. However, this is not the case, since one would get an infinite loop. So a play_note() function never executes a note callback, even if started from a different callback.

Related to play_note() is note_off(), since this command also generates a note-off:

note_off(<ID-number>)
note_off() has the same impact on an event as releasing the note. note_off() will always trigger a release callback

Actually the duration parameter in play_note() could be replaced by a combination of wait() and note_off(). But since play_note() is used a lot, the duration parameter is available in play_note().

And finally, if you want to get rid of an event altogether, use ignore_event()

```
on note
  ignore_event($EVENT_ID)
  play_note($EVENT_NOTE,$EVENT_VELOCITY,400000,-1)
end on
```

The original note which triggered the callback is available, as if the key were never pressed. The note number and velocity however can still be used in the callback. play_note() plays back the note, but the sample has an offset of 400 msec. A release callback can also be ignored with ignore_event.

ignore_event(<ID-number>)
ignore an event in a callback

Changing Events

The values of $EVENT_NOTE und $EVENT_VELOCITY can be changed by using the following functions:

change_note(<ID-number>,<new-note-number>)
change the note value of a specific note event

change_velo(<ID-number>,<new-velocity-number>)
change the velocity value of a specific note event

If the two functions are applied before the first wait(), the change occurs for the sounding voice. If the voice is already running, only the value of the variable changes.

Until now, it was only possible to simulate MIDI signals (play_note() and note_off()), or to ignore them (ignore_event()) or to change their value (change_note() and change_velo()). With the following commands you can also alter the sample:

change_pan(<ID-number>,<panorama>,<relative-bit>)	
change the pan position of a specific note event	
<ID-number>	the ID number of the event to be changed
<panorama>	pan position, values go from -1000 (left) to 1000 (right)
<relative-bit>	If the relative bit is set to 0, the change occurs relative to the start value of the event. If it is set to 1, it occurs relative to the actual pan value. The different implications are only relevant when there is more than one change_pan() statement applied to the same event.

change_vol(<ID-number>,<volume>,<relative-bit>)	
change the volume of the sample of a specific note event in millidecibels	
<ID-number>	the ID number of the event to be changed
<volume>	volume change in millidecibels
<relative-bit>	If the relative bit is set to 0, the change occurs relative to the start value of the event. If it is set to 1, it occurs relative to the actual volume value. The different implications are only relevant when there is more than one change_vol() statement applied to the same event.

change_tune(<ID-number>,<tune-amount>,<relative-bit>)	
change the tuning of the sample of a specific note event in Millicents	
<ID-number>	the ID number of the event to be changed
<tune-amount>	amount in Millicents, so 100000 equals one half tone
<relative-bit>	If the relative bit is set to 0, the change occurs relative to the start value of the event. If it is set to 1, it occurs relative to the actual tune value. The different implications are only relevant when there is more than one change_tune() statement applied to the same event.

fade_in(<ID-number>,<fade-time>)	
perform a fade-in of a specific note event	
<ID-number>	the ID number of the event to be changed
<fade-time>	fade-in time in microseconds

fade_out(<ID-number>,<fade-time>,<stop-voice>)	
perform a fade-out of a specific note event	
<ID-number>	the ID number of the event to be changed
<fade-time>	fade-out time in microseconds
<stop-voice>	indicate if the voice is stopped after it has been faded (1) the voice is faded out and kept silence, but is still running (0)

Grouping Events

Sometimes it is impractical to address each event separately. Therefore one has the option of creating groups by assigning a mark to an event:

set_event_mark(<ID-number>,<bit-mark>)	
assign the specified event to a specified event group	
<ID-number>	the ID number of the event to be grouped
<bit-mark>	here you can enter one of 28 marks from $MARK_1 to $MARK_28 which is addressed to the event. You can also address more than one mark to a single event, either by typing the command or by using the operator +.

So instead of the individual ID you can use marks by typing by_marks(<bit-mark>) in place of the ID (the program needs to know that you want to address marks and not ID's). Let's look at the following example to illustrate this:

```
on init
  declare $new_id
end on

on note
  set_event_mark($EVENT_ID,$MARK_1)
  $new_id := play_note($EVENT_NOTE + 12,120,0,-1)
  set_event_mark($new_id,$MARK_1 + $MARK_2)

  change_tune(by_marks($MARK_1),50000,0)
        {Both notes are set 50 cent higher}


  change_vol(by_marks($MARK_2),-6000,0)
        {only the volume of the new note changes -6dB}
end on
```

by_marks(<bit-mark>)
address all events of the specified event group

Assigning Event Parameters

It is possible assign up to four parameters to an event. As you know by now, each event has certain parameters, which are bound to that event like an id number (`$EVENT_ID`), a note number (`$EVENT_NOTE`) and velocity number (`$EVENT_VELOCITY`).

You can assign up to four parameters to an event by using

set_event_par(<ID-number>,<index>,<value>)	
assign a parameter to an event	
`<ID-number>`	the ID number of the associated event
`<index>`	the index (0 – 3) of the assigned parameter
`<value>`	the value of the assigned parameter

The four parameters reside in the array `%EVENT_PAR[]`, which consists of four elements (`$EVENT_PAR[0]` – `$EVENT_PAR[3]`).

Here's an example for a usage of `set_event_par()`:

This script resides in slot 1 and tunes each note 50 cent up (this simple script just demonstrates the principle, it could stand for example for scripts like Microtuning):

```
on note
   change_tune($EVENT_ID,50000,1)
   set_event_par($EVENT_ID,0,50000)
end on
```

In slot 2, an artificial note is created. Since the original event is ignored, the tuning information (i.e. the 50 cent) is lost. By using `set_event_par` in the first slot and `%EVENT_PAR[]` in the second slot, you can retrieve this tuning information:

```
on init
   declare $art_id
   declare ui_button $On_Off
end on

on note
   ignore_event($EVENT_ID)
   $art_id := play_note($EVENT_NOTE+2,$EVENT_VELOCITY,0,-1)
   if ($On_Off = 1)
       change_tune($art_id,%EVENT_PAR[0],1)
   end if
end on
```

User Interface Controls

The script engine is capable of generating user interface modules to facilitate the usage of the script and to give the user hands-on control over the variables. The user interface controls have to be declared in the init callback, just like the other variables. A UI control is basically a variable that can be controlled by the user from the Kontakt interface. The UI controls appear in a separate module in Kontakt. Here are all the available UI controls:

Buttons

```
declare ui_button $<variable-name>
```

create a user interface button

```
on init
  declare ui_button $mybutton
end on
```

A button is a variable that can have the value 0 (not active/pressed) or 1 (active/pressed). If you click on the button, the variable and the button toggle between the two states.

Knobs

```
declare ui_knob $<variable-name> (<min>,<max>,<display-ratio>)
```

create a user interface knob

```
on init
 declare ui_knob $myknob (1,100,1)
  $myKnob := 50
end on
```

The variable of the knob can hold integers from `<min>` (when the knob is turned left-most) to `<max>` (when the knob is turned right-most). The default value when initializing is `<min>`. In our example patch above however, we have assigned the value 50 to the variable `$myknob` which defaults the knob to that value when initializing the script. The name of the variable will also be displayed right of the knob, so choose your variable name wisely.

`<display-ratio>` is a little tricky to understand: it means the ratio of displayed vs. internal value. That can be of advantage for example if you want to adjust a time parameter, which needs to be in microseconds, but you want to show seconds to the user.

Let's assume you need a knob with values going from 0 to 1000000, since you want the user to choose a time between 0 and 1 second (remember, 1 million microseconds equals one second). Then you'd supply the knob with a scale of 1000000. This way, you get the values you need internally and the user sees something he can deal with. Furthermore, the knob knows that it's required to display fractional values, since the internal resolution is higher than the displayed one.

Supplying zero for the scale parameter is the same as supplying 1 and means that the internal and the displayed ranges match each other.

Menus

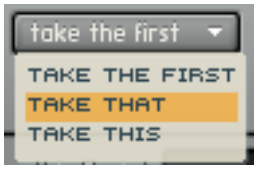
`declare ui_menu $<variable-name>`

create a user interface menu

`add_menu_item (<variable>,<text>,<number>)`

add text to a user interface menu

```
on init
  declare ui menu $myMenu
  add_menu_item($myMenu,"take the first",0)
  add_menu_item($myMenu,"take that",1)
  add_menu_item($myMenu,"take this",2)
end on
```



The line `declare ui_menu $myMenu` declares a UI control variable and creates a menu for it. The new menu will initially be empty, so we must fill it with something sensible. The `add_menu_item` statement takes three parameters: first comes the menu variable, then comes the text showing up in the menu, and finally comes the value the variable will have when the particular menu item is selected.

Text Labels

`declare ui_label $<variable-name> (<width>,<height>)`

create a user interface text label

`set_text (<variable>,<text>)`

when applied to a text label: delete the text currently visible in the specified label and add new text

`add_text_line (<variable>,<text>)`

add a new text line in the specified label without erasing existing text

```
on init
  declare ui_label $myText(<width>,<height>)

  set_text(<label_variable>,<text>)
  add_text_line(<label_variable>,<text>)
end on
```

This creates a text field in which you can write text. You have to supply values for width and height of the text field. The width is measured in columns and the height in lines, with a maximum of six columns and six lines.

`set_text()` deletes text currently visible and adds new text, whereas `add_text_line()` adds a new line and therefore can be used for logging.

Value Edit

`declare ui_value_edit $<variable>(<min>,<max>,<display-ratio>)`

create a user interface number box

```
on init
  declare ui_value_edit $myEdit (0, 1000,10)
  $myEdit := 166
end on
```

This control behaves exactly like a knob, with the difference that the user can enter a value by double clicking.

Table

```
declare ui_table %<array-name>[columns](<width>,<height>,
<range>)
```
create a user interface table

```
on init
  declare ui_table %table[32](2,2,128)
end on
```

This control creates a table that can be edited by the user. The number of columns is indicated in brackets (the number of indices or "x" values) and is limited to a maximum of 128. `<width>` and `<height>` work as in the text label. The `<range>` in the example above is from 0 to 127, positive values for the range create a unipolar table while negative values create a bipolar table. This means we get a table with steps from -100 to 100 if `<range>` is set to -100.

Positioning of ui elements

A script can appear with one, two or three height units. One height unit equals two lines, so six lines is the maximum a script module can have. The number of columns is always six.

By using the command

```
move_control (<variable>,<x position>, <y position>)
```
move a UI element to a specific place

you can move a UI control around. You can do this not only in the init callback, but in all callbacks; thus allowing ui elements to appear dynamically at any position. Here's an example:

```
on init
  declare ui_label $label (1,1)
  set_text ($label,"Move the wheel!")
  move_control ($label,3,6)
end on
on controller
  if ($CC_NUM = 1)
        move control ($label,3,(%CC[1] * (-5) / (127)) + 6 )
  end if
end on
```

(don't worry about the `on controller` callback, this will be covered later).

Hiding GUI elements

You can hide GUI elements like buttons, knobs etc. Just move the control to the position 0 - 0 and the control is invisible. `move_control(<variable>,0,0)` can be used in all callbacks and can be applied to more than one GUI element:

```
on init
  declare ui_button $Bingo
  $Bingo := 1
  move_control ($Bingo,0,0)
end on
on note
  move_control ($Bingo,3,6)
end on
on release
  move_control ($Bingo,0,0)
end on
```

UI Callbacks

You can create a callback for each UI control, which is triggered when the user changes the respective control. The example below creates a button which plays a note when it's being pressed.

```
on ui_control (<variable-name>) ... end on
```

UI callback, executed whenever the user changes the respective UI element

```
on init
  declare ui_button $play
  $play := 0
end on

on ui_control ($play)
  play_note(60,120,0,1000000)
  wait (1000000)
  $play := 0
end on
```

The variable name of the UI control has to be indicated in the callback. Otherwise, these callbacks behave like the other ones.

Naming of GUI elements

It is possible to label GUI elements like knobs, buttons and value edits with text strings. The command is the same as for GUI labels:
This command can be used in all callbacks:

```
set_text (<variable>,<text>)
```

when applied to a label: delete the text currently visible in the specified label and add new text
when applied to knobs, buttons and value edits: set the name of the ui element

Here's a simple example for this:

```
on init
  declare ui_button $Toggle
  $Toggle := 0
  set_text ($Toggle,"Off")
end on
on ui_control ($Toggle)
  select ($Toggle)
        case 0
              set_text ($Toggle,"Off")
        case 1
              set_text ($Toggle,"On")
  end select
end on
```

Performance View

By using the command:

make_perfview
activates the performance view for the respective script

in the init callback, you can the GUI of the script will appear as the performance view.

So, when this script is used in an iinstrument:

```
on init
  declare ui_knob $A (0,127,1)
  declare ui_knob $B (0,127,1)
  declare ui_knob $C (0,127,1)
  declare ui_knob $D (0,127,1)
  declare ui knob $E (0,127,1)
  declare ui_knob $F (0,127,1)

  make_perfview
end on
```

the instrument's performance view looks like this:

Usage of Midi Controllers

The Controller Callback

The last callback type we haven't handled so far is the controller callback. It gets called every time a controller value changes:

on controller ... end on
controller callback, executed whenever a cc or pitch bend message is received

The controller callback must be used with care, since controllers tend to produce quite a large number of events. Reacting to those events with complicated scripts means using a lot of CPU and that might produce unwanted artifacts and compromise playback.

```
on controller
  message ("You've changed a controller!")
  wait (1000000)
  message ("")
end on
```

Similar to the note and release callbacks there is an ignore function:

ignore_controller
ignore a controller event in a controller callback

This function has no parameters.

Controller variables and arrays

You can access the controller number which started the callback with the built-in variable `$CC_NUM`:

$CC_NUM
controller number of the controller which triggered the callback

By using the array `%CC[<controller number>]` you can access the specific controller values which go from 0 to 127:

%CC[<controller-number>]
current controller value for the specified controller (CC# 128 = pitch bend)

Pitch bend values can be retrieved by using the built-in variable $VCC_PITCH_BEND: pitch bend values go from –8192 to +8191:

$VCC_PITCH_BEND
the value of the virtual cc controller for pitch bend

So by writing

```
on controller
  message(%CC[$VCC PITCH BEND])
end on
```

the pitch bend values from –8192 to +8191 are displayed on incoming pitch bend messages.

Another array is `%CC_TOUCHED[<controller-number>]`:

`%CC_TOUCHED[<controller-number>]`
1 if a controller value has changed, 0 otherwise

This array will contain a "1" for each controller that has been changed since the last visit to the controller callback and a zero for all others. It's important to know if a certain controller of interest has changed, since the callback gets executed for every controller.

```
on controller
  if (%CC_TOUCHED[1] = 1)
        message ("You've changed the mod wheel!")
        wait (1000000)
        message ("")
  end if
  if (%CC_TOUCHED[$VCC_PITCH_BEND] = 1)
        message ("You've changed the pitch bend wheel!")
        wait (1000000)
        message ("")
  end if
end on
```

A function related to controllers is `set_controller()`:

`set_controller(<controller-number>,<controller-value>)`
send a MIDI CC value of a specific controller

This function is available in all callbacks. With it you can assign controller values to controllers. By modulating parameters in Kontakt through MIDI CC's, you can basically access all parameters in Kontakt through the script engine.

Working with RPN and NRPN messages

There are two other callback types available, which are called whenever a rpn or nrpn message is received:

on rpn ... end on
rpn callback, executed whenever a rpn (registered parameter number) message is received

on nrpn ... end on
nrpn callback, executed whenever a nrpn (non-registered parameter number) message is received

To make use of these two callbacks, the following two built-in variables are of importance:

$RPN_ADDRESS
the parameter number of a received rpn/nrpn message (0 – 16383). Can only be used in an rpn/nrpn callback.

$RPN_VALUE
the value of a received rpn/nrpn message (0 – 16383). Can only be used in rpn/nrpn callback.

The variables can be used both in an rpn and nrpn callback. The following simple script looks for three common rpn types:

```
on rpn
  if ($RPN_ADDRESS <= 2)
        select ($RPN_ADDRESS)
              case 0
                    message("Pitch Bend Sensitivity")
              case 1
                    message("Channel Fine Tuning")
              case 2
                    message("Channel Coarse Tuning")
        end select
  else
        message ("Not specified")
  end if
end on
```

Any (n)rpn message uses two bytes to represent the parameter number, for example in the case of rpn messages CC 101 represents the MSB (most significant byte) and CC100 the LSB (least significant byte).
Also, two bytes are used to represent the value (CC 6 for MSB and CC 38 for LSB). It is possible to retrieve the MSB or LSB portion of a message by using the following functions:

msb(<built-in variable>)
returns the MSB portion of a rpn/nrpn address or value.

lsb(<built-in variable>)
returns the LSB portion of a rpn/nrpn address or value.

And finally there are two commands, with which you can create rpn and nrpn messages (similar to `set_controller`). These commands can be used in all callbacks:

`set_rpn(<address>,<value>)`

send a rpn message

`set_nrpn(<address>,<value>)`

send a nrpn message

Advanced Concepts

Preprocessor

A preprocessor is used to exclude code elements from interpretation. Here's how it works:

```
USE_CODE_IF(<condition>)
...
END_USE_CODE
```

or

```
USE_CODE_IF_NOT(<condition>)
...
END_USE_CODE
```

`<condition>` refers to a symbolic name which consists of alphanumeric symbols, preceded by a letter. You could write for example:

```
on note
  {do something general}
  $var := 5

  {do some conditional code}
USE_CODE_IF_NOT(dont_do_sequencer)
  while ($count > 0)
        play_note()
  end while
END_USE_CODE
end on
```

What's happening here?
Only if the symbol `dont_do_sequencer` is not defined, the code between `USE_` and `END_USE` will be processed. If the symbol were to be found, the code would not be passed on to the parser; it is as if the code was never written (therefore it does not utilize any CPU power).

You can define symbols with

```
SET_CONDITION(<condition symbol>)
```

and delete the definition with

```
RESET_CONDITION(<condition symbol>)
```

All commands will be interpreted **before** the script is running, i.e. by using `USE_CODE_` the code might get stalled before it is passed to the script engine. That means, `SET_CONDITION` and `RESET_CONDITION` are actually not true commands: they cannot be utilized in `if()...end if` statements; also a `wait()` statement before those commands is useless. Each `SET_CONDITION` and `RESET_CONDITION` will be executed before something else happens.
All defined symbols are passed on to following scripts, i.e. if script 3 contains conditional code, you can turn it on or off in script 1 or 2.

You can use conditional code to bypass system scripts. There are two built-in symbols:

```
NO_SYS_SCRIPT_PEDAL
NO_SYS_SCRIPT_RLS_TRIG
```

If you define one of those symbols with `SET_CONDITION()`, the corresponding part of the system scripts will be bypassed. For clarity reasons, those definitions should always take place in the `init` callback.

```
on init
  {we want to do our own release triggering}
  SET_CONDITION(NO_SYS_SCRIPT_RLS_TRIG)
end on

on release
  {do something custom here}
end on
```

Engine Parameter

General Syntax

It is possible to control all automatable Kontakt parameters with a KSP. The general syntax is the following:

_set_engine_par(<parameter>,<value>,<group>,<slot>,<generic>)	
control any automatable Kontakt parameter from KSP	
<parameter>	here you specify the parameter to be controlled with a built-in variable. All of those built-in variables start with $ENGINE_PAR_ , e.g. $ENGINE_PAR_VOLUME $ENGINE_PAR_TUNE $ENGINE_PAR_CUTOFF You can find a list of all Kontakt parameters in the appendix of this manual.
<value>	The value to which the specified parameter is set. The range of values is always 0 to 1000000.
<group>	the index (zero based) of the group in which the specified parameter resides. If the specified parameter resides on an Instrument level, enter -1.
<slot>	the slot index (zero based) of the specified parameter, applies only Group Effects, Instrument Insert and Send Effects and Modulators. For Group/Instrument effects, this parameter specifies the slot in which the effect resides (zero-based). For internal modulators, this parameters specifies the modulation assignment, based on the order of creation. For external modulators, this parameter specifies the modulation module. For all other applications, set this parameter to -1.
<generic>	this parameter applies to Instrument Effects (Send/Insert) and to internal modulators. For Instrument Effects, this parameter distinguishes between 1: Insert Effect 0: Send Effect For internal modulators, this parameter specifies the actual modulation assignment. For all other applications, set this parameter to -1.

One word of caution before we delve into this: this command is only applicable for Kontakt parameters which are available for automation, i.e. knobs and sliders. Additionally, the Bypass knob of all filters and effects is available as an engine parameter.

Another word of caution: since this command is nothing else then remote controlling the parameter, just like automation. This also means, that changing values can be CPU intensive (just like automation).

We can basically strip down the Kontakt parameters into four groups:

- "Basic" parameters, i.e. parameters that are available for every instrument (instrument tune, pan and volume; group tune, pan and volume)
- Group and Instrument Effects
- External Modulators
- Internal Modulators

In the next four chapters, we'll demonstrate each scenario with some example scripts.

For the sake of simplicity, you don't have to use `_set_engine_par` to control parameters, since MIDI events generated by `set_controller` can also be used to automate parameters.

Basic Procedure

The following script simply creates a knob which controls the instrument volume; no more, no less:

```
on init
  declare ui_knob $Volume (0,1000000,1000000)
end on
on ui_control ($Volume)
  _set_engine_par($ENGINE_PAR_VOLUME,$Volume,-1,-1,-1)
end on
```

It's important to memorize the order of the last three parameters: group/slot/generic.
In our example above,

- the `group` parameter is set to **-1** since we address something on **instrument** level
- the `slot` parameter is set to **-1** since it has no function here
- the `generic` parameter is set to **-1** since it has no function here

If we want to control group volume instead, we write:

```
on init
  declare ui_knob $Volume (0,1000000,1000000)
end on
on ui_control ($Volume)
  _set_engine_par($ENGINE_PAR_VOLUME,$Volume,0,-1,-1)
end on
```

Now, the knob controls the volume of the first group, because the `group` parameter has been set to 0: `_set_engine_par($ENGINE_PAR_VOLUME,$Volume,0,-1,-1)`
However, the knob will always only control the volume of the first group, regardless of the amount of groups in the instrument.

Check out the following example:

```
on init
  declare $count
  declare ui_menu $group_menu
  while ($count < $NUM_GROUPS)
        add_menu_item ($group_menu,group_name($count),$count)
        inc($count)
  end while
  declare ui_knob $Pan (0,1000000, 1000000)
end on
on ui_control ($Pan)
  _set_engine_par($ENGINE_PAR_PAN,$Pan,$group_menu,-1,-1)
end on
```

Here, a drop down menu is created in the init callback with the group names of all groups in the instrument. If you change the knob, the pan position of the chosen group will be changed.

Of course, if you make any changes to the amount of groups in your instrument, or if you change the names of the groups in your instrument, the changes to the menu are not reflected right away. Either click on apply again, or save and reload the instrument (remember, the init callback is processed when you click on Apply, or open a script from the Script menu, or when you load an instrument).

Working with Group/Instrument Effects

Now, let's control the cutoff frequency of a filter which is applied as a Group Insert FX (we'll leave out the generic group menu from above to save space and apply everything to the first group). First, create an empty instrument and insert a filter into the third slot, then enter the following script:

```
on init
  declare ui knob $Freq (0,1000000,1000000)
end on
on ui_control ($Freq)
  _set_engine_par($ENGINE_PAR_CUTOFF,$Freq,0,2,-1)
end on
```

Now, the knob controls the cutoff frequency of a filter in the **third** slot in the **first** group, simply because:

- the `group` parameter is set to **0** since we address the first group
- the `slot` parameter is set to **2** since we look for an effect in the third slot
- the `generic` parameter is set to **-1** since it has no function here

Two minor remarks:

- the built-in variable `$ENGINE_PAR_CUTOFF` is valid for all filter types
- if there is no filter in the specified slot, the knob will simply don't do anything.

Let's finish this little script by adding a Bypass button:

```
on init
  declare ui_knob $Freq (0,1000000,1000000)
  declare ui_button $Bypass
end on
on ui_control ($Freq)
  _set_engine_par($ENGINE_PAR_CUTOFF,$Freq,0,2,-1)
end on
on ui_control ($Bypass)
  _set_engine_par($ENGINE_PAR_EFFECT_BYPASS,$Bypass,0,2,-1)
end on
```

Working with external modulators

Now we'll go one step further: let's suppose, we have a simple patch with a filter as a Group Insert Effect. The Cutoff Frequency is being modulated by velocity and we want to control the modulation amount with the `_set_engine_par` command. Since Velocity is an external modulator, we use the built-in variable: `$ENGINE_PAR_EXTMOD_INTENSITY`

Create a new instrument, put a filter in the first Group Insert FX slot and assign velocity to modulate the filter cutoff frequency. Then enter the following script:

```
on init
  declare ui_knob $Mod (0,1000000,1000000)
end on
on ui_control ($Mod)
  _set_engine_par($ENGINE_PAR_EXTMOD_INTENSITY,$Mod,0,2,-1)
end on
```

The script *should* now control the modulation slider, but not necessarily...

In our script, we've given the slot index (the fourth parameter) the value 2. The slot index determines, which of the modulation assignments is being addressed. The internal numbering of the slot indices is determined by their order of creation. So when you have three external mod assignments (e.g. velocity → amp, pitch bend → pitch, velocity → cutoff), the slot index of the respective assignments depends on when those assignments where created.

Let's take a look at the instrument:

When you create a new instrument, usually velocity → volume and pitch bend → pitch are already assigned, thus the slot indices 0 and 1 are already occupied. If your default instrument however has already more assignments, you need to experiment to find the correct slot index.

The slot indices are not changed when deleting a module! Also, when deleting an assignment an re-entering the same assignment, the slot index will be the same!

So in the above example, let's assume the velocity → volume assignment has the slot index 0. If you delete the assignment, and later on assign velocity to control volume, this assignment again will have the slot index 0.

Working with internal modulators

Internal modulators are envelopes (AHDSR, DBD, flexible) and LFO's. Like external mod assignments, the slot index is a crucial factor and behaves similar. However, the `<generic>` parameter (the fifth parameter) comes into play too, so please memorize the following when working with internal modulators:

The `<slot>` parameter specifies the modulation module.
The `<generic>` parameter specifies the actual modulation assignment.

Kinda hard to grasp, so let's go easy and first write a script to control the attack time of a volume envelope:

```
on init
  declare ui_knob $Attack (0,1000000,1000000)
end on
on ui_control ($Attack)
  _set_engine_par($ENGINE_PAR_ATTACK,$Attack,0,0,-1)
end on
```

Again, the slot index determines which internal modulator is addressed.
In our default instrument:

there's only one internal modulator (which probably was created first), so we address it with a slot index of 0.

Now one step further, we want to control the mod intensity of this envelope (ok, it does not make much sense to control the intensity of a volume envelope, but it serves the purpose of our explanation).

Notice the use of the <generic> parameter:

```
on init
  declare ui_knob $Mod (0,1000000,1000000)
end on
on ui control ($Mod)
  _set_engine_par($ENGINE_PAR_INTMOD_INTENSITY,$Mod,0,0,0)
end on
```

Now the script knob controls the mod intensity:

Now consider the following: the above envelope does not only modulate volume but also filter cutoff (a combined volume/filter envelope). Create a filter and assign the existing envelope to modulate the cutoff frequency. Now we want to control the env → cutoff with a script knob:

```
on init
  declare ui_knob $Mod (0,1000000,1000000)
end on
on ui_control ($Mod)
  _set_engine_par($ENGINE_PAR_INTMOD_INTENSITY,$Mod,0,0,1)
end on
```

The <generic> parameter has been set to 1, to distinguish between the env → volume and env → cutoff assignment:

Receiving parameter values (a.k.a. what goes up, must come down)

It's not only possible, to send specific values to automatable Kontakt parameters from KSP, you can also retrieve those values. The basic syntax is as following:

```
_get_engine_par(<parameter>,<group>,<slot>,<generic>)
```

returns the value of any automatable Kontakt parameter from KSP

So let's get back to the very first script we wrote using _set_engine_par. We can use the above command to retrieve the knob setting in the init callback:

```
on init
  declare ui_knob $Volume (0,1000000,1000000)
  $Volume := _get_engine_par($ENGINE_PAR_VOLUME,-1,-1,-1)
end on
on ui_control ($Volume)
  _set_engine_par($ENGINE_PAR_VOLUME,$Volume,-1,-1,-1)
end on
```

Now, whenever the init callback is processed, the knob resets itself to the correct instrument volume level.

Here's a real-life-scenario script:

```
on init
   declare ui_label $label (1,1)
   set_text ($label,"Select Group:")

   declare $count
   declare ui_menu $group_menu
   while ($count < $NUM_GROUPS)
          add menu item ($group_menu,group_name($count),$count)
          inc($count)
   end while

   declare ui_knob $Volume (0, 100, 1)
   declare ui_knob $Pan (-100, 100, 1)
   declare ui_knob $Tune (-1200, 1200, 100)

   $Volume :=  get_engine_par($ENGINE_PAR_VOLUME,0,0,1) / 10000
   $Pan :=  get_engine_par($ENGINE_PAR_PAN,0,0,1) / 5000 -100
   $Tune :=  get_engine_par($ENGINE_PAR_TUNE,$group_menu,0,1)*24/10000-1200

   move_control ($label,1,1)
   move_control ($group_menu,1,2)
   move_control ($Volume,2,1)
   move_control ($Pan,3,1)
   move_control ($Tune,4,1)

   make_perfview
end on
on ui_control ($Volume)
   set_engine_par($ENGINE_PAR_VOLUME,$Volume * 10000,$group_menu,0,-1)
end on
on ui_control ($Pan)
    set_engine_par($ENGINE_PAR_PAN,($Pan+100) * 5000,$group_menu,0,-1)
end on
on ui_control ($Tune)
   set_engine_par($ENGINE_PAR_TUNE,($Tune + 1200)*100000/240,$group_menu,0,-1)
end on
on ui_control ($group_menu)
   $Volume :=  get_engine_par($ENGINE_PAR_VOLUME,$group_menu,0,1) / 10000
   $Pan :=  get_engine_par($ENGINE_PAR_PAN,$group_menu,0,1) / 5000 -100
   $Tune :=  get_engine_par($ENGINE_PAR_TUNE,$group_menu,0,1)*24/10000-1200
end on
```

You'll end up with a nice and simple performance view, with three basic parameters available for tweaking:

Module status retrieval

By combining the command _get_engine_par and the following five built-in variables:

```
$ENGINE_PAR_EFFECT_TYPE
$ENGINE_PAR_EFFECT_SUBTYPE
$ENGINE_PAR_SEND_EFFECT_TYPE
$ENGINE_PAR_INTMOD_TYPE
$ENGINE_PAR_INTMOD_SUBTYPE
```

you can retrieve information about which module is used in which slot. This is basically an advanced tool to create generic menus, based on the composition of the Kontakt instrument.

There are built-in variables for any effect type, like $EFFECT_TYPE_FILTER or $EFFECT_TYPE_REVERB, please check the appendix for a complete listing.

The usage of this command can be best explained with the following little scripts.

This script looks if a filter is used as a group insert effect in the second slot of the first group:

```
on init
   if (_get_engine_par($ENGINE_PAR_EFFECT_TYPE,0,1,-1) = $EFFECT_TYPE_FILTER)
      message ("There's a filter in the second slot of the first group, hooray!")
   else
      message ("There's no filter in the second slot of the first group, boooo!")
   end if
end on
```

The statement _get_engine_par($ENGINE_PAR_EFFECT_TYPE,0,1,-1) returns the effect type of the second slot (slot index = 1; third parameter) of the first group (group index = 0; second parameter). The generic parameter has been set to -1 since it has no meaning here.

The above mentioned statement actually returns an integer, from zero to 20 (the built-in variable $EFFECT_TYPE_FILTER has the value 7).

By using the following string array:

```
declare !effect_name[21]
   !effect_name[0] := "None"
   !effect_name[2] := "Compressor"
   !effect_name[3] := "Limiter"
   !effect_name[4] := "Inverter"
   !effect_name[5] := "Surround Panner"
   !effect_name[6] := "Saturation"
   !effect_name[7] := "Filter"
   !effect_name[8] := "Lo-Fi"
   !effect_name[9] := "Stereo Modeller"
   !effect_name[10] := "Distortion"
   !effect_name[11] := "Send Levels"
   !effect_name[14] := "Phaser"
   !effect_name[15] := "Flanger"
   !effect_name[16] := "Chorus"
   !effect_name[17] := "Reverb"
   !effect_name[18] := "Delay"
   !effect_name[19] := "Convolution"
   !effect_name[20] := "Gainer"
```

you can easily retrieve the name of any effect. So let's rewrite the above script to the following:

```
on init
   declare !effect_name[21]
          !effect_name[0] := "None"
          !effect_name[2] := "Compressor"
          !effect_name[3] := "Limiter"
          !effect_name[4] := "Inverter"
          !effect_name[5] := "Surround Panner"
          !effect_name[6] := "Saturation"
          !effect_name[7] := "Filter"
          !effect_name[8] := "Lo-Fi"
          !effect_name[9] := "Stereo Modeller"
          !effect_name[10] := "Distortion"
          !effect_name[11] := "Send Levels"
          !effect_name[14] := "Phaser"
          !effect_name[15] := "Flanger"
          !effect_name[16] := "Chorus"
          !effect_name[17] := "Reverb"
          !effect_name[18] := "Delay"
          !effect_name[19] := "Convolution"
          !effect_name[20] := "Gainer"

   message (!effect_name[_get_engine_par($ENGINE_PAR_EFFECT_TYPE,0,1,-1)])
end on
```

This script will now output the name of the effect of the **second** slot of the **first** group. If you'd like to retrieve information about the instrument insert effects, the last command would have to be rewritten to

```
message (!effect_name[_get_engine_par($ENGINE_PAR_EFFECT_TYPE,-1,1,1)])
```

since:

- the second parameter specifies the instrument level (-1)
- the third parameter specifies the second slot (1)
- the fourth parameter specifies the insert effect (1)

There are times when you need information about which filter is used, so let's suppose you know that you have a filter in the first slot of the first group. By using `$EFFECT_SUBTYPE` you can retrieve the type of the filter:

```
on init
   declare !filter name[25]
   !filter_name[2] := "1-pole LP"
   !filter_name[3] := "1-pole HP"
   !filter name[4] := "2-pole BP"
   !filter name[6] := "2-pole LP"
   !filter_name[7] := "2-pole HP"
   !filter name[8] := "4-pole LP"
   !filter name[9] := "4-pole HP"
   !filter name[10] := "4-pole BP"
   !filter name[11] := "4-pole BR"
   !filter name[12] := "6-pole LP"
   !filter_name[13] := "Phaser"
   !filter name[14] := "Vowel A"
   !filter name[15] := "Vowel B"
   !filter name[16] := "Pro 53"
   !filter name[17] := "4-stage ladder"
   !filter name[19] := "3x2"
   !filter_name[22] := "1-band EQ"
   !filter name[23] := "2-band EQ"
   !filter name[24] := "3-band EQ"

   message (!filter name[ get engine par($ENGINE PAR EFFECT SUBTYPE,0,0,-1)])
end on
```

Now let's do the same with instrument send effects; here we use the built-in variable `$ENGINE_PAR_SEND_EFFECT_TYPE`, so if we want to know, which effect reside in the first send effect slot we write:

```
on init
   declare !effect name[21]
   !effect name[0] := "None"
          !effect name[14] := "Phaser"
          !effect name[15] := "Flanger"
          !effect name[16] := "Chorus"
          !effect name[17] := "Reverb"
          !effect name[18] := "Delay"
          !effect name[19] := "Convolution"
          !effect name[20] := "Gainer"

   message (!effect name[ get engine par($ENGINE PAR SEND EFFECT TYPE,-1,0,-1)])
end on
```

Loading IR Samples

It is possible to load impulse response samples into the convolution effect with the following command:

load ir sample(<file name>,<slot>,<generic>)	
load an impulse response sample into Kontakt's convolution effect	
<file name>	the file name of the sample. A relative path has to be used.
<slot>	the slot index of the convolution effect (zero-based)
<generic>	specifies if the convolution effect is used as an Insert Effect (1) Send Effect (0)

The problematic issue here is the correct path to the sample. To ensure cross platform compatibility, always use a relative path with help of this command:

get folder(<path variable>)
returns the path specified with the built-in path variable

and these three built-in path variables:

$GET_FOLDER_INSTALL_DIR
the installation directory of Kontakt 2

$GET_FOLDER_LIBRARY_DIR
the library directory (set in Options/Load-Import)

$GET_FOLDER_PATCH_DIR
the directory in which the patch was saved. If the patch was not saved before, an empty string is returned.

So let's assume we have an impulse response sample called "Super Hall.wav" and it resides in the installation directory of Kontakt. By using a script such as:

```
on init
  declare ui_button $Load
end on
on ui_control ($Load)
```

```
        _load_ir_sample(_get_folder($GET_FOLDER_INSTALL_DIR) ...
        & "Super Hall.wav",0,1)
        $Load := 0
end on
```

the sample is loaded into the convolution effect (which itself is specified to reside in the insert chain in the first slot) whenever the button is pressed.
Of course, there must be a sample called "Super Hall.wav" in the installation directory of Kontakt 2, otherwise you'll get a warning message.

Since Kontakt 2 comes with a number of convolution presets and samples, here's the example from above, pointing to the sample "warm room.wav" which is located here:

Kontakt 2/presets/effects/convolution/06 Medium Rooms/IR Samples/warm room.wav

So the correct command would be

```
 load ir sample( get folder($GET FOLDER INSTALL DIR) ...
& "presets/effects/convolution/06 Medium Rooms/IR Samples/warm room.wav",0,1)
```

Specifying when persistent variables are read

It is possible to specify the exact moment when persistent variables are read out:

`_read_persistent_var(<variable>)`

reads the value of the specified persistent variable in the init callback

Usually, all persistent variables are set AFTER the init callback. With `_read_persistent_var()`, persistent variables can be retained at any spot in the init callback. If a value is read with `_read_persistent_var()`, the value is of course not read out again after the init callback.

This command is very useful if certain gui elements can be made visible or invisible by the user and the loaded patch should recall the last gui state. See the following script:

```
on init
  declare ui button $Sync

  declare ui_menu $time
  add_menu_item ($time,"16th",0)
  add_menu_item ($time,"8th",1)

  $Sync := 0

  {sync is off by default, so hide menu}
  move_control ($time,0,0)

  move_control ($Sync,1,1)

  make_persistent ($Sync)
  make_persistent ($time)

  _read_persistent_var ($Sync)
  if ($Sync = 1)
        move control ($time,2,1)
  else
        move_control ($time,0,0)
  end if
end on
on ui_control ($Sync)
  if ($Sync = 1)
        move_control ($time,2,1)
  else
        move_control ($time,0,0)
  end if
end on
```

Depending on the state of the button, a menu is shown or not. By using `_read_persistent_var ($Sync)`, you can retrieve the last saved state of the button and therefore decide to show or hide the menu.

Reference

1. Callback types

```
on init ... end on
```
initial callback, executed when the script was successfully analyzed

```
on note ... end on
```
note callback, executed whenever a note on message is received

```
on release ... end on
```
release callback, executed whenever a note off message is received

```
on ui_control (<variable-name>) ... end on
```
UI callback, executed whenever the user changes the respective UI element

```
on controller ... end on
```
controller callback, executed whenever a cc or pitch bend message is received

```
on rpn ... end on
```
rpn callback, executed whenever a rpn (registered parameter number) message is received

```
on nrpn ... end on
```
nrpn callback, executed whenever a nrpn (non-registered parameter number) message is received

2. Declaration of variables and ui elements

```
declare $<variable-name>
```
declare a user-defined normal variable to store a single integer value

```
declare const $<variable-name>
```
declare a user-defined constant variable to store a single integer value

```
declare polyphonic $<variable-name>
```
declare a user-defined polyphonic variable to store a single integer value

```
declare %<array-name>[<number-of-elements]
```
declare a user-defined array to store single integer values at specific indices

```
declare ui_button $<variable-name>
```
create a user interface button

```
declare ui_knob $<variable-name> (<min>,<max>,<display-ratio>)
```
create a user interface knob

`declare ui_menu $<variable-name>`

create a user interface menu

`add_menu_item (<variable>,<text>,<number>)`

add text to a user interface menu

`declare ui_label $<variable-name> (<width>,<height>)`

create a user interface text label

`set_text (<variable>,<text>)`

when applied to a label: delete the text currently visible in the specified label and add new text
when applied to knobs, buttons and value edits: set the name of the ui element

`add_text_line (<variable>,<text>)`

add a new text line in the specified label without erasing existing text

`declare ui_value_edit $<variable>(<min>,<max>,<display-ratio>)`

create a user interface number box

`declare ui_table %<array>[columns](<width>,<height>, <range>)`

create a user interface table

`move_control (<variable>,<x position>, <y position>)`

move a UI element to a specific place. Moving a UI element to the position 0,0 hides the element

`make_perfview`

activates the performance view for the respective script

3. Functions

`abs(<expression>)`
return the absolute value of an expression

`by_marks(<bit-mark>)`
address all events of the specified event group

`change_note(<ID-number>,<new-note-number>)`
change the note value of a specific note event

`change_pan(<ID-number>,<panorama>,<relative-bit>)`
change the pan position of a specific note event

`change_time_with_pitch(<ID-number>,<time>)`
returns the expression <time> scaled by the actual tune amount

`change_tune(<ID-number>,<tune-amount>,<relative-bit>)`
change the tuning of the sample of a specific note event in Millicents

`change_velo(<ID-number>,<new-velocity-number>)`
change the velocity value of a specific note event

`change_vol(<ID-number>,<volume>,<relative-bit>)`
change the volume of the sample of a specific note event in millidecibels

`dec(<expression>)`
decrement an expression by 1

`exit`
immediately stops a callback

`fade_in(<ID-number>,<fade-time>)`
perform a fade-in of a specific note event

`fade_out(<ID-number>,<fade-time>,<stop-voice>)`
perform a fade-out of a specific note event

`ignore_controller`
ignore a controller event in a controller callback

`ignore_event(<ID-number>)`
ignore an event in a callback

`inc(<expression>)`

increment an expression by 1

`lsb(<built-in variable>)`

returns the LSB portion of a rpn/nrpn address or value.

`make_persistent(<variable-name>)`

retain the value of a variable when a patch is saved

`message(<number,variable or text>)`

display text in the status line in Kontakt

`msb(<built-in variable>)`

returns the MSB portion of a rpn/nrpn address or value.

`note_off(<ID-number>)`

send a note off message to a specific note event and triggers the release callback

`play_note(<note-number>,<velocity>,<sample-offset>,<duration>)`

play a note, i.e. generate a note on message followed by a note off message

`random(<min>,<max>)`

generate a random number

`_read_persistent_var(<variable>)`

reads the value of the specified persistent variable in the init callback

`_reset_rls_trig_counter(<note>)`

resets the release trigger counter (used by the release trigger system script)

`set_controller(<controller-number>,<controller-value>)`

send a MIDI CC value of a specific controller

`set_event_mark(<ID-number>,<bit-mark>)`

assign the specified event to a specified event group

`set_event_par(<ID-number>,<index>,<value>)`

assign a parameter to an event

`set_nrpn(<address>,<value>)`

send a nrpn message

`set_rpn(<address>,<value>)`

send a rpn message

`sh_left(<expression>,<amount>)`

shift the bits in <expression> by the specified amount to the left

`sh_right(<expression>,<amount>)`

shift the bits in <expression> by the specified amount to the right

`wait(<wait-time>)`

pauses the callback for the specified time

`_will_never_terminate(<event-id>)`

tells the script engine that this event will never be finished (used by the release trigger system script)

4. Group and array functions

`disallow_group(<group-index>)`

turn off the specified group, i.e. make it unavailable for playback

`allow_group(<group-index>)`

turn on the specified group, i.e. make it available for playback

`find_group(<group-name>)`

returns the group-index for the specified group

`group_name(<group-index>)`

returns the group-name for the specified group

`sort(<array-variable>,<direction>)`

sort an array in ascending or descending order

With direction = 0, this function sorts in ascending order, with a value other than 0, it sorts in descending order.

`num_elements(<array-variable>)`

returns the number of elements of the specified array

`search(<array-variable>,<value>)`

searches the specified array for the specified value and returns the index.
If the value is not found, the function returns -1.

`array_equal(<array1-variable>,<array2-variable>)`

check the values of two arrays, true if values are equal

5. Built-in Variables

$ALL_GROUPS
addresses all groups in a `disallow_group()` and `allow_group()` function

$ALL_EVENTS
addresses all events in functions which deal with a ID-number

%CC[<controller-number>]
current controller value for the specified controller (CC# 128 = pitch bend)

$CC_NUM
controller number of the controller which triggered the callback

%CC_TOUCHED[<controller-number>]
1 if a controller value has changed, 0 otherwise

$DISTANCE_BAR_START
returns the time of a note on message in µsec from the beginning of the current bar with respect to the current tempo

$DURATION_BAR
returns the duration in µsec of one bar with respect to the current tempo

$DURATION_QUARTER
duration of a quarter note, with respect to the current tempo

$DURATION_EIGHTH
duration of an eighth note, with respect to the current tempo

$DURATION_SIXTEENTH
duration of a sixteenth note, with respect to the current tempo

$DURATION_QUARTER_TRIPLET
duration of a triplet quarter note, with respect to the current tempo

$DURATION_EIGHTH_TRIPLET
duration of a triplet eighth note, with respect to the current tempo

$DURATION_SIXTEENTH_TRIPLET
duration of a triplet sixteenth note, with respect to the current tempo

$ENGINE_UPTIME
Returns the time period in milliseconds (not microseconds) that has passed since the start of the script

$EVENT_ID
unique ID number of the event which triggered the callback

$EVENT_NOTE
note number of the event which triggered the callback

%EVENT_PAR[]
event parameter of an event, which was set with set_event_par

$EVENT_VELOCITY
velocity of the note which triggered the callback

%GROUPS_AFFECTED
an array with the group indexes of those groups that are affected by the current Note On or Note Off events

%KEY_DOWN[<note-number>]
array which contains the current state of all keys. 1 if the key is held, 0 otherwise

%KEY_DOWN_OCT[<octave-number>]
1 if a note independently of the octave is held, 0 otherwise

$MARK_<number>
bit mark of an event group

%NOTE_DURATION[<note-number>]
note length since note-start in µsec for each key

$NOTE_HELD
1 if the key which triggered the callback is still held, 0 otherwise

$NUM_GROUPS
total amount of groups in an instrument

$NUM_ZONES
total amount of zones in an instrument

$PLAYED_VOICES_INST
the amount of played voices of the respective instrument

$PLAYED_VOICES_TOTAL
the amount of played voices all instruments

$RPN_ADDRESS
the parameter number of a received rpn/nrpn message (0 – 16383). Can only be used in an rpn/nrpn

callback.

$RPN_VALUE
the value of a received rpn/nrpn message (0 – 16383). Can only be used in rpn/nrpn callback.

$SIGNATURE_NUM
nominator of the current time signature

$SIGNATURE_DENOM
denominator of the current time signature

$VCC_PITCH_BEND
the value of the virtual cc controller for pitch bend

6. Slice functions

`_num_slices(<group-index>)`

returns the number of slices in the specified group

`_slice_length(<group-index>,<slice-index>)`

return the length of the specified slice in the specified group with respect to the current tempo

`_slice_start(<group-index>,<slice-index>)`

return the absolute start point of the specified slice, independent of the current tempo

`_slice_idx_loop_start(<group-index>,<loop-index>)`

return the index number of the slice at the loop start

`_slice_idx_loop_end(<group-index>,<loop-index>)`

return the index number of the slice at the loop end

`_slice_loop_count(<group-index>,<loop-index>)`

return the loop count of the specified loop

`dont_use_machine_mode(<ID-number>)`

play the specified event in sampler mode

7. Preprocessor

```
SET_CONDITION(<condition-symbol>)
```

define a symbol to be used as a condition

```
RESET_CONDITION(<condition-symbol>)
```

delete a definition

```
USE CODE IF(<condition-symbol>)
...
END_USE_CODE
```

interpret code when <condition> is defined

```
USE CODE IF NOT(<condition-symbol>)
...
END_USE_CODE
```

interpret code when <condition> is not defined

```
NO_SYS_SCRIPT_PEDAL
```

condition; if defined with SET_CONDITION(), the system script which sustains notes when CC# 64 is received will be bypassed

```
NO_SYS_SCRIPT_RLS_TRIG
```

condition; if defined with SET_CONDITION(), the system script which triggers samples upon the release of a key is bypassed

8. Engine Parameters

General Syntax

`_set_engine_par(<parameter>,<value>,<group>,<slot>,<generic>)`

control any automatable Kontakt parameter from KSP

`_get_engine_par(<parameter>,<group>,<slot>,<generic>)`

returns the value of any automatable Kontakt parameter from KSP

General

`$ENGINE_PAR_VOLUME`

instrument volume

`$ENGINE_PAR_PAN`

instrument panorama

`$ENGINE_PAR_TUNE`

instrument tuning

Source Module

```
$ENGINE_PAR_Tune
$ENGINE_PAR_SMOOTH
$ENGINE_PAR_FORMANT
$ENGINE_PAR_SPEED
$ENGINE_PAR_GRAIN_LENGTH
$ENGINE_PAR_SLICE_ATTACK
$ENGINE_PAR_SLICE_RELEASE
$ENGINE_PAR_TRANSIENT_SIZE
```

Amp Module

```
$ENGINE_PAR_VOLUME
$ENGINE_PAR_PAN
```

Filter/EQ

$ENGINE_PAR_CUTOFF

cutoff frequency of all filters

$ENGINE_PAR_RESONANCE

resonance of all filters

$ENGINE_PAR_EFFECT_BYPASS

bypass button of all filters/eq

3x2 Versatile

```
$ENGINE_PAR_FILTER_SHIFTB
$ENGINE_PAR_FILTER_SHIFTC
$ENGINE_PAR_FILTER_RESB
$ENGINE_PAR_FILTER_RESC
$ENGINE_PAR_FILTER_TYPEA
$ENGINE_PAR_FILTER_TYPEB
$ENGINE_PAR_FILTER_TYPEC
$ENGINE_PAR_FILTER_BYPA
$ENGINE_PAR_FILTER_BYPB
$ENGINE_PAR_FILTER_BYPC
$ENGINE_PAR_FILTER_GAIN
```

EQ

```
$ENGINE_PAR_FREQ1
$ENGINE_PAR_BW1
$ENGINE_PAR_GAIN1
$ENGINE_PAR_FREQ2
$ENGINE_PAR_BW2
$ENGINE_PAR_GAIN2
$ENGINE_PAR_FREQ3
$ENGINE_PAR_BW3
$ENGINE_PAR_GAIN3
```

Insert Effects

$ENGINE_PAR_EFFECT_BYPASS

bypass button of all insert effects

$ENGINE_PAR_INSERT_EFFECT_OUTPUT_GAIN

output gain of all insert effects

Compressor

```
$ENGINE_PAR_THRESHOLD
$ENGINE_PAR_RATIO
$ENGINE_PAR_COMP_ATTACK
$ENGINE_PAR_COMP_DECAY
```

Limiter

```
$ENGINE_PAR_LIM_IN_GAIN
$ENGINE_PAR_LIM_RELEASE
```

Surround Panner

```
$ENGINE_PAR_SP_OFFSET_DISTANCE
$ENGINE_PAR_SP_OFFSET_AZIMUTH
$ENGINE_PAR_SP_OFFSET_X
$ENGINE_PAR_SP_OFFSET_Y
$ENGINE_PAR_SP_LFE_VOLUME
$ENGINE_PAR_SP_SIZE
$ENGINE PAR SP DIVERGENCE
```

Saturation

```
$ENGINE_PAR_SHAPE
```

Lo-Fi

```
$ENGINE_PAR_BITS
$ENGINE PAR FREQUENCY
$ENGINE_PAR_NOISELEVEL
$ENGINE_PAR_NOISECOLOR
```

Stereo Modeller

```
$ENGINE_PAR_STEREO
$ENGINE PAR STEREO PAN
```

Distortion

```
$ENGINE_PAR_DRIVE
$ENGINE_PAR_DAMPING
```

Send Levels

```
$ENGINE PAR SENDLEVEL 0
$ENGINE PAR SENDLEVEL 1
$ENGINE_PAR_SENDLEVEL_2
$ENGINE PAR SENDLEVEL 3
$ENGINE_PAR_SENDLEVEL_4
$ENGINE PAR SENDLEVEL 5
$ENGINE PAR SENDLEVEL 6
$ENGINE PAR SENDLEVEL 7
```

Send Effects

$ENGINE_PAR_SEND_EFFECT_BYPASS

bypass button of all send effects

$ENGINE_PAR_SEND_EFFECT_DRY_LEVEL

dry amount of send effects when used in an insert chain

$ENGINE_PAR_SEND_EFFECT_OUTPUT_GAIN

when used with send effects, this controls either:
- **wet** amount of send effects when used in an **insert** chain
- **return** amount of send effects when used in a **send** chain

Phaser

$ENGINE_PAR_PH_DEPTH
$ENGINE_PAR_PH_SPEED
$ENGINE_PAR_PH_PHASE
$ENGINE_PAR_PH_FEEDBACK

Flanger

$ENGINE_PAR_FL_DEPTH
$ENGINE_PAR_FL_SPEED
$ENGINE_PAR_FL_PHASE
$ENGINE_PAR_FL_FEEDBACK
$ENGINE_PAR_FL_COLOR

Chorus

$ENGINE_PAR_CH_DEPTH
$ENGINE_PAR_CH_SPEED
$ENGINE_PAR_CH_PHASE

Reverb

$ENGINE_PAR_RV_PREDELAY
$ENGINE_PAR_RV_SIZE
$ENGINE_PAR_RV_COLOUR
$ENGINE_PAR_RV_STEREO
$ENGINE_PAR_RV_DAMPING

Delay

$ENGINE_PAR_DL_TIME
$ENGINE_PAR_DL_DAMPING
$ENGINE_PAR_DL_PAN
$ENGINE_PAR_DL_FEEDBACK

Convolution

$ENGINE_PAR_IRC_PREDELAY
$ENGINE_PAR_IRC_LENGTH_RATIO_ER
$ENGINE_PAR_IRC_FREQ_LOWPASS_ER
$ENGINE_PAR_IRC_FREQ_HIGHPASS_ER
$ENGINE_PAR_IRC_LENGTH_RATIO_LR
$ENGINE_PAR_IRC_FREQ_LOWPASS_LR
$ENGINE_PAR_IRC_FREQ_HIGHPASS_LR

Gainer

$ENGINE_PAR_GN_GAIN

Modulation

$ENGINE_PAR_EXTMOD_INTENSITY
the intensity slider of an external modulation assignment (e.g. velocity, pitch bend, aftertouch, midi CC)

$ENGINE_PAR_INTMOD_INTENSITY
the intensity slider of an internal modulation assignment (e.g. AHDSR envelope, LFO)

$ENGINE_PAR_INTMOD_BYPASS
the bypass button of an internal modulation assignment (e.g. AHDSR envelope, LFO)

Envelopes:

AHDSR
$ENGINE_PAR_ATK_CURVE $ENGINE_PAR_ATTACK $ENGINE_PAR_HOLD $ENGINE_PAR_DECAY $ENGINE_PAR_SUSTAIN $ENGINE_PAR_RELEASE

DBD
$ENGINE_PAR_DECAY1 $ENGINE_PAR_BREAK $ENGINE_PAR_DECAY2

LFO:

LFO
For all LFOs: $ENGINE_PAR_INTMOD_FREQUENCY $ENGINE_PAR_LFO_DELAY For Rectangle: $ENGINE_PAR_INTMOD_PULSEWIDTH For Multi: $ENGINE_PAR_LFO_SINE $ENGINE_PAR_LFO_RECT $ENGINE_PAR_LFO_TRI $ENGINE_PAR_LFO_SAW $ENGINE_PAR_LFO_RAND

Module status retrieval

$ENGINE_PAR_EFFECT_TYPE

used to query the type of a group insert or instrument insert effect, can be any of the following:

```
$EFFECT_TYPE_FILTER
$EFFECT_TYPE_COMPRESSOR
$EFFECT TYPE LIMITER
$EFFECT_TYPE_INVERTER
$EFFECT_TYPE_SURROUND_PANNER
$EFFECT_TYPE_SHAPER (Saturation)
$EFFECT_TYPE_LOFI
$EFFECT_TYPE_STEREO (Stereo Modeller)
$EFFECT TYPE DISTORTION
$EFFECT_TYPE_SEND_LEVELS
$EFFECT_TYPE_PHASER
$EFFECT_TYPE_CHORUS
$EFFECT_TYPE_FLANGER
$EFFECT_TYPE_REVERB
$EFFECT TYPE DELAY
$EFFECT_TYPE_IRC (Convolution)
$EFFECT_TYPE_GAINER

$EFFECT_TYPE_NONE (empty slot)
```

you can use this string array to query the names:

```
declare !effect_name[21]
      !effect_name[0] := "None"
      !effect_name[2] := "Compressor"
      !effect_name[3] := "Limiter"
      !effect_name[4] := "Inverter"
      !effect_name[5] := "Surround Panner"
      !effect_name[6] := "Saturation"
      !effect_name[7] := "Filter"
      !effect_name[8] := "Lo-Fi"
      !effect_name[9] := "Stereo Modeller"
      !effect_name[10] := "Distortion"
      !effect_name[11] := "Send Levels"
      !effect_name[14] := "Phaser"
      !effect_name[15] := "Flanger"
      !effect_name[16] := "Chorus"
      !effect_name[17] := "Reverb"
      !effect_name[18] := "Delay"
      !effect_name[19] := "Convolution"
      !effect_name[20] := "Gainer"
```

$ENGINE_PAR_SEND_EFFECT_TYPE

used to query the type of a send effect, can be any of the following:

```
$EFFECT_TYPE_PHASER
$EFFECT_TYPE_CHORUS
$EFFECT_TYPE_FLANGER
$EFFECT_TYPE_REVERB
$EFFECT_TYPE_DELAY
$EFFECT_TYPE_IRC (Convolution)
$EFFECT_TYPE_GAINER
```

$EFFECT_TYPE_NONE (empty slot)

$ENGINE_PAR_EFFECT_SUBTYPE

used to query the type of filter/EQ, can be any of the following:

```
$FILTER_TYPE_LP1POLE
$FILTER_TYPE_HP1POLE
$FILTER_TYPE_BP2POLE
$FILTER_TYPE_LP2POLE
$FILTER_TYPE_HP2POLE
$FILTER TYPE LP4POLE
$FILTER_TYPE_HP4POLE
$FILTER_TYPE_BP4POLE
$FILTER_TYPE_BR4POLE
$FILTER_TYPE_LP6POLE
$FILTER_TYPE_PHASER
$FILTER TYPE VOWELA
$FILTER_TYPE_VOWELB
$FILTER_TYPE_PRO52
$FILTER_TYPE_LADDER
$FILTER_TYPE_VERSATILE
$FILTER_TYPE_EQ1BAND
$FILTER TYPE EQ2BAND
$FILTER_TYPE_EQ3BAND
```

you can use this string array to query the names:

```
declare !filter_name[25]
      !filter_name[2] := "1-pole LP"
      !filter_name[3] := "1-pole HP"
      !filter_name[4] := "2-pole BP"
      !filter_name[6] := "2-pole LP"
      !filter_name[7] := "2-pole HP"
      !filter_name[8] := "4-pole LP"
      !filter_name[9] := "4-pole HP"
      !filter_name[10] := "4-pole BP"
      !filter_name[11] := "4-pole BR"
      !filter_name[12] := "6-pole LP"
      !filter_name[13] := "Phaser"
      !filter_name[14] := "Vowel A"
      !filter_name[15] := "Vowel B"
      !filter_name[16] := "Pro 53"
      !filter_name[17] := "4-stage ladder"
      !filter_name[19] := "3x2"
      !filter_name[22] := "1-band EQ"
      !filter_name[23] := "2-band EQ"
      !filter_name[24] := "3-band EQ"
```

What's new in Kontakt 2.2 – KSP

Last changed: October 13, 2006

Introduction

This short document covers all changes related to KSP and the included script modules. The documents "Kontakt Script Language Manual.pdf" and the "Kontakt 2 Script Library.pdf" have been updated to reflect all changes. For most applications, it is sufficient to read though this document; where stated, you should consult the Kontakt Script Language Manual for a complete description.

Table of Content

KSP changes in Kontakt 2.2

New callback type: on ui_update

There is a new callback type: `on ui_update`. This callback is executed whenever you change something in the Kontakt GUI, like selecting a different group, changing knobs etc. If for example you want to exactly mirror one particular knob of Kontakt in the script, you could write:

```
on init
   declare ui_knob $Volume (0,1000000,1)
   set_knob_unit ($Volume,$KNOB_UNIT_DB)
   set_knob_defval ($Volume,630859)
   $Volume := _get_engine_par ($ENGINE_PAR_VOLUME,0,-1,-1)
   set_knob_label ($Volume,_get_engine_par_disp($ENGINE_PAR_VOLUME,0,-1,-1))
end on

on ui_update
   $Volume := _get_engine_par ($ENGINE_PAR_VOLUME,0,-1,-1)
   set_knob_label($Volume,_get_engine_par_disp($ENGINE_PAR_VOLUME,0,-1,-1))
end on

on ui_control ($Volume)
   _set_engine_par($ENGINE_PAR_VOLUME,$Volume,0,-1,-1)
   set_knob_label ($Volume,_get_engine_par_disp($ENGINE_PAR_VOLUME,0,-1,-1))
end on
```

This script will create a script knob which mirrors the volume knob in the amp module of the first group.

Caution: This callback should be used with care, since knob movements create many events which in turn always execute this callback.

New built-in variables for group based scripting

There are two new built-in variables to facilitate group based scripting:

$REF_GROUP_IDX
group index number of the currently viewed group

%GROUPS_SELECTED
initial callback, executed when the script was successfully analyzed

`$REF_GROUP_IDX` contains the index of the currently visible group (i.e. the group whose group name's text appears inverted in the group editor). In the following screenshot for example, the third group (Rock Organ) is currently visible:

Obviously, only one group can be visible at a time.

Now insert the following script into an instrument with more than one group:

```
on init
  declare ui_label $group_name_label (1,1)
  set_text ($group_name_label,group_name($REF_GROUP_IDX))
end on

on ui_update
  set_text ($group_name_label,group_name($REF_GROUP_IDX))
end on
```

and click on various group names in the group editor to see the effect.

`%GROUPS_SELECTED` is an array with each array index pointing to the group with the same index. In other words, `num_elements(%GROUPS_SELECTED)` equals `$NUM_GROUPS`.

If a group is selected for editing (i.e. it has a checkmark to the left of the group name in the group editor), the corresponding array index contains a 1, otherwise 0. In the following screenshot, the first and third group are selected for editing, i.e. if you create a group insert effect in the second slot, the effect will be created in the group "Digital Rhodes" and in the group "Rock Organ":

Insert the following script into an instrument with more than one group:

```
on init
  declare ui_label $label (3,4)
  set_text ($label,"Selected Groups for editing:")
  declare $count
  while ($count < $NUM_GROUPS)
        if (%GROUPS_SELECTED[$count] = 1)
              add_text_line ($label,group_name($count))
        end if
        inc ($count)
  end while
end on
on ui_update
  set_text($label,"Selected Groups for editing:")
  $count := 0
  while ($count < $NUM_GROUPS)
        if (%GROUPS_SELECTED[$count] = 1)
              add_text_line ($label,group_name($count))
        end if
        inc ($count)
  end while
end on
```

and click on various checkboxes in the group editor to see the effect.

Creating custom group start options

By defining the condition

NO_SYS_SCRIPT_GROUP_START
condition; if defined with SET_CONDITION(), the system script which handles all group start options will be bypassed

with SET_CONDITION(), you can disable all group start options.

By using the following engine parameter variables, you can retrieve the status of the group start options for each key:

Group Start Options – List of built-in variables

```
$ENGINE_PAR_START_CRITERIA_MODE
$ENGINE_PAR_START_CRITERIA_KEY_MIN
$ENGINE_PAR_START_CRITERIA_KEY_MAX
$ENGINE_PAR_START_CRITERIA_CONTROLLER
$ENGINE_PAR_START_CRITERIA_CC_MIN
$ENGINE_PAR_START_CRITERIA_CC_MAX
$ENGINE_PAR_START_CRITERIA_CYCLE_CLASS
$ENGINE_PAR_START_CRITERIA_ZONE_IDX
$ENGINE_PAR_START_CRITERIA_SLICE_IDX
$ENGINE_PAR_START_CRITERIA_SEQ_ONLY
$ENGINE_PAR_START_CRITERIA_NEXT_CRIT

$ENGINE_PAR_START_CRITERIA_MODE can return one of the following values:

$START_CRITERIA_NONE
$START_CRITERIA_ON_KEY
$START_CRITERIA_ON_CONTROLLER
$START_CRITERIA_CYCLE_ROUND_ROBIN
$START_CRITERIA_CYCLE_RANDOM
$START_CRITERIA_SLICE_TRIGGER

$ENGINE_PAR_START_CRITERIA_NEXT_CRIT can return one of the following values:

$START_CRITERIA_AND_NEXT
$START_CRITERIA_AND_NOT_NEXT
$START_CRITERIA_OR_NEXT
```

With these commands it is possible to create custom group start options, while giving the user the opportunity to use the commands found in the group start options tab in the group editor.

Retrieving the Release Trigger state of a group

There is a new engine parameter variable which can be used to retrieve the state of the Release Trigger button in the source module:

$ENGINE_PAR_RELEASE_TRIGGER
engine parameter variable; 1 if the Release Trigger button in the source module is activated, 0 otherwise

Default values for knobs

By using the command

```
set_knob_defval(<knob-variable>,<value>)
```

assign a default value to a knob

you can set a default value for a knob, to which the knob is reset when Cmd-clicking the knob.

KSP changes in Kontakt 2.1.1

Assigning unit marks to knobs

By using the command

```
set_knob_unit(<knob-variable>,<unit>)
```

assign a unit mark to a knob

you can set a unit mark next to the numerical display of knobs. To choose a unit mark, use any of the following built-in variables:

Built-in variables for knob unit marks
$KNOB_UNIT_NONE
$KNOB_UNIT_DB
$KNOB_UNIT_HZ
$KNOB_UNIT_PERCENT
$KNOB_UNIT_MS
$KNOB_UNIT_OCT

Assigning text strings to knobs

By using the command:

```
set_knob_label(<knob-variable>,<text>)
```

assign a text string to a knob

you can assign a text string to a knob variable. You could for example create a knob which controls some kind of rate, and set the knob to display values like 1/4, 1/8, 1/16 etc.

Retrieving knob values

If you control knobs by using `_set_engine_par()`, you can now retrieve the displayed knob value by using the command:

```
_get_engine_par_disp(<parameter>,<group>,<slot>,<generic>)
```

retrieve the displayed knob values from the specified knob

What's new in Kontakt 3 – KSP

Last changed: October 8, 2007

Performance View Handling

It is now possible to have more than one script as the performance view script – all five scripts can be brought to the front by using the `make_persistent` command.

By using the new command

`_set_skin_offset(<offset in pixel>)`
offsets the chosen background tga file by the specified number of pixels

If a background tga graphic file has been selected in the instrument options and this file is larger than the maximum height of the performance view, you can use this command to offset the background graphic, thus creating separate backgrounds for each of the script slots.

Inter-Script Communication: PGS

It is now possible to send and receive values from one script to another, discarding the usual left-to-right order by using the new Program Global Storage (PGS) commands. PGS is a dynamic memory which can be read/written by any script. Here are the commands:

PGS commands
`_pgs_create_key(<key-id>,<size>)`
`_pgs_key_exists(<key-id>)`
`_pgs_set_key_val(<key-id>,<index>,<value>)`
`_pgs_get_key_val(<key-id>,<index>)`

`<key-id>` is something similar to a variable name, it can only contain letters and numbers and must start with a number. It might be a good idea to always write them in capitals to emphasize their unique status.

Here's an example, insert this script into any slot:

```
on init
   _pgs_create_key(FIRST_KEY, 1) {defines a key with 1 element}
   _pgs_create_key(NEXT_KEY, 128) {defines a key with 128 elements}
   declare ui_button $Just_Do_It
end on

on ui_control($Just_Do_It)

   {writes 70 into the first and only memory location of FIRST_KEY}
   _pgs_set_key_val(FIRST_KEY, 0, 70)


   {writes 50 into the first and 60 into the last memory location of NEXT_KEY}
   _pgs_set_key_val(NEXT_KEY, 0, 50)
   _pgs_set_key_val(NEXT_KEY, 127, 60)
end on
```

and insert the following script into any other slot:

```
on init
  declare ui_knob $First (0,100,1)
  declare ui_table %Next[128] (5,2,100)
end on
on _pgs_changed

  {checks if FIRST_KEY and NEXT_KEY have been declared}
  if(_pgs_key_exists(FIRST_KEY) and _pgs_key_exists(NEXT_KEY))
        $First := _pgs_get_key_val(FIRST_KEY,0) {in this case 70}
        %Next[0] := _pgs_get_key_val(NEXT_KEY,0) {in this case 50}
        %Next[127] := _pgs_get_key_val(NEXT_KEY,127) {in this case 60}
  end if
end on
```

As illustrated above, there is also a new callback type which is executed whenever a set_key command has been executed:

`on _pgs_changed`
callback type, executed whenever any `_pgs_set_key_val()` is executed in any script

It is possible to have as many keys as you want, however each key can only have up to 256 elements.

Addressing modulators by name

It is now possible to address modulators and modulation intensities by a using the name of a modulator or modulation assignment. This text string can be pre-defined or manually altered.

The two new commands are

`find_mod(<group-idx>,<mod-name>)`
returns the index of a modulator

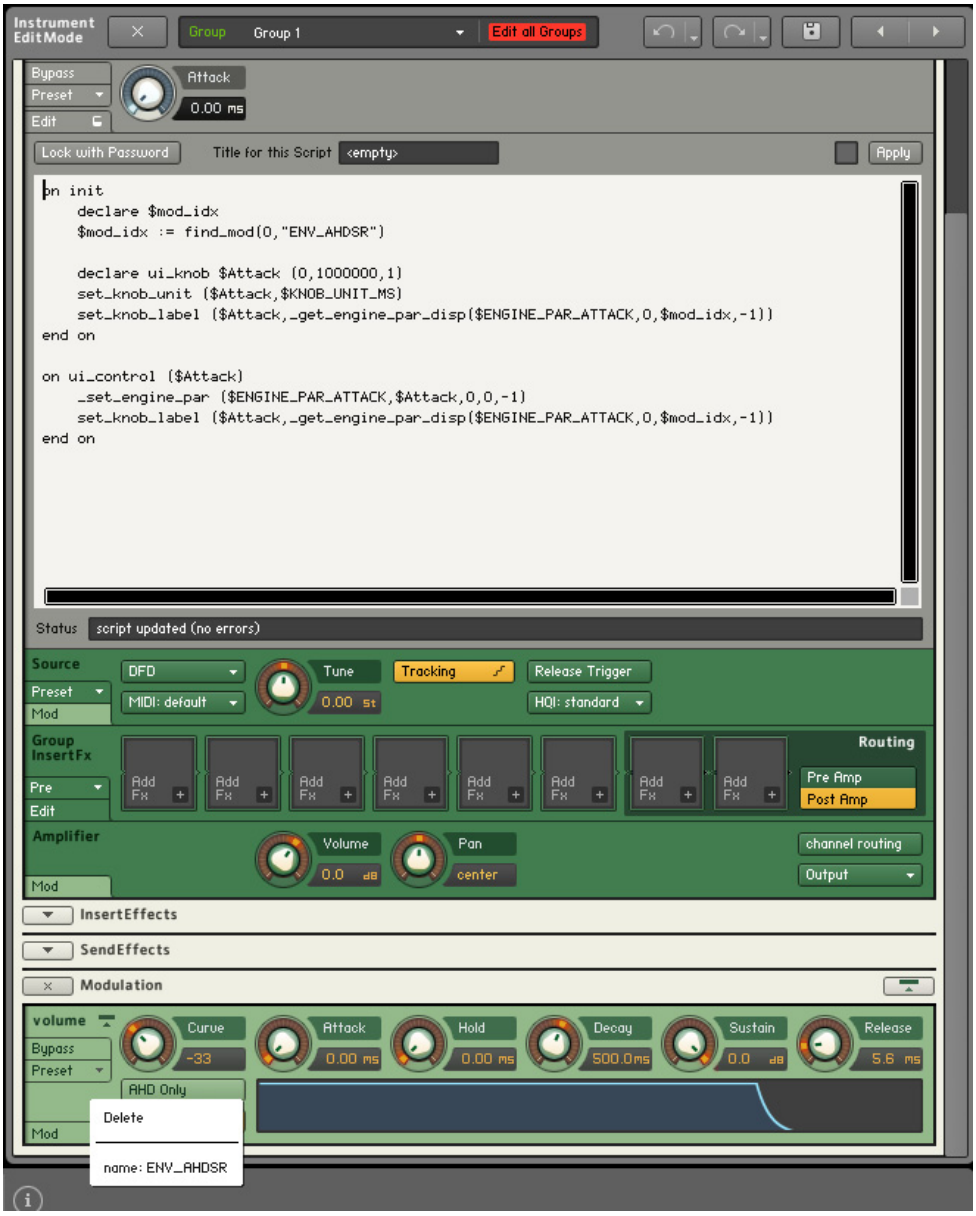
and

`find_target(<group-idx>, <mod-idx>, <target-name>)`
returns the index of a modulation assignment

Let's see how these commands can be used in real life. Let's say we want to control the attack time of the volume envelope of the first group in an instrument. We can simply write:

```
on init
  declare $mod_idx
  $mod_idx := find_mod(0,"ENV_AHDSR")

  declare ui_knob $Attack (0,1000000,1)
  set_knob_unit ($Attack,$KNOB_UNIT_MS)
  set_knob_label ($Attack,_get_engine_par_disp($ENGINE_PAR_ATTACK,0,$mod_idx,-1))
end on

on ui_control ($Attack)
  _set_engine_par ($ENGINE_PAR_ATTACK,$Attack,0,0,-1)
  set_knob_label ($Attack,_get_engine_par_disp($ENGINE_PAR_ATTACK,0,$mod_idx,-1))
end on
```

But why do we write "ENV_AHDSR"? Because this is the default name of any ahdsr envelope. You can view and change the name while the script editor is open and right clicking on the module:



This means, you could rename an existing modulator, for example if you have to envelopes (one for volume , one for filter).

Now, controlling the velocity to volume modulation is just as easy, just write this:

```
on init
   declare $mod_idx
   $mod_idx := find_mod(0,"VEL_VOLUME")
   declare ui_knob $Velocity (0,1000000,1)
   set_knob_label...
   ($Velocity,_get_engine_par_disp($ENGINE_PAR_MOD_TARGET_INTENSITY,0,$mod_idx,-1))
end on

on ui_control ($Velocity)
   _set_engine_par($ENGINE_PAR_MOD_TARGET_INTENSITY,$Velocity,0,$mod_idx,-1)
   set_knob_label...
   ($Velocity,_get_engine_par_disp($ENGINE_PAR_MOD_TARGET_INTENSITY,0,$mod_idx,-1))
end on
```

Here, we change the value of the modulation slider (the velocity to volume modulation). Since we're addressing an external modulator, we can also use the find_mod command.

If you want to control the modulation intensity of e.g. the filter envelope, check this out:

```
on init
  declare $mod_idx
  $mod_idx := find_mod(0,"FILTER_ENV")

  declare $target_idx
  $target_idx := find_target(0,$mod_idx,"ENV_AHDSR_CUTOFF")

  declare ui_knob $Knob (-100,100,1)
  $Knob := 0
  set_text ($Knob, "FLT Env")
end on

on ui_control ($Knob)
  if ($Knob < 0)
     _set_engine_par ($MOD_TARGET_INVERT_SOURCE,1,0,$mod_idx,$target_idx)
  else
     _set_engine_par ($MOD_TARGET_INVERT_SOURCE,0,0,$mod_idx,$target_idx)
  end if
 _set_engine_par($ENGINE_PAR_MOD_TARGET_INTENSITY,abs($Knob*10000),0,$mod_idx,$target_idx)
end on
```

Note that we have manually renamed the ahdsr envelope to "FILTER_ENV".

Other changes/improvements

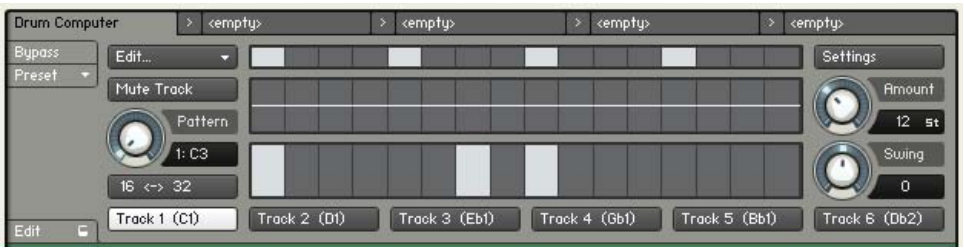
UI Table changes

You can now change the number of displayed columns in an ui table:

`set_table_steps_shown(<ui-table-variable>,<num-steps>)`

changes the number of displayed columns in an ui table

Further, it is now also possible to declare tables with a height of 1. This could e.g. be useful for displaying steps in a sequencing module:



Info Tags for UI elements

By using the following command:

set_control_help(<control-id>,<text-string>)
assigns a text string to be displayed when hovering the ui element

You can create help texts which appear when hovering the ui element with the mouse (make sure Kontakt's Info Pane is visible). Just try it:

```
on init
  declare ui_knob $Knob(0,100,1)
  set_control_help($Knob, "Hello, I'm the only knob, folks")
end on
```

Knob Unit Mark for Semitone

$KNOB_UNIT_ST
displays "ST" (semitone) as a knob unit mark

New Engine Parameter Variables

Below is a list of all new Engine Parameter variables for the new effects in Kontakt 3:

Skreamer
$ENGINE_PAR_SK_TONE $ENGINE_PAR_SK_DRIVE $ENGINE_PAR_SK_BASS $ENGINE_PAR_SK_BRIGHT $ENGINE_PAR_SK_MIX

Rotator
$ENGINE_PAR_RT_SPEED $ENGINE_PAR_RT_BALANCE $ENGINE_PAR_RT_ACCEL_HI $ENGINE_PAR_RT_ACCEL_LO $ENGINE_PAR_RT_DISTANCE $ENGINE_PAR_RT_MIX

Twang
$ENGINE_PAR_TW_VOLUME $ENGINE_PAR_TW_TREBLE $ENGINE_PAR_TW_MID $ENGINE_PAR_TW_BASS

Cabinet
$ENGINE_PAR_CB_SIZE $ENGINE_PAR_CB_AIR $ENGINE_PAR_CB_TREBLE $ENGINE_PAR_CB_BASS $ENGINE_PAR_CABINET_TYPE