# CATO-ANDROID: THE GUIDED USER INTERFACE FOR CAS ON ANDROID SMARTPHONES

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*CATO is the self-explanatory user interface for several CAS on Windows, Linux/Unix and Mac/Ox. The principles of CATO are for example: packages realized as selection menus for the commands and extra windows for the input of multi-parameter commands.*

*The author has developed an application, CATO-Android, with the principles of CATO for smartphones with the operating system android. It is a user interface for guided input for CAS, at the moment only for Symja.*

*In the article below, the author describes this app and how he realized the principles of guided input.*

*Keywords: GUI, CAS, android, smartphone, small display*

## THE REASONS FOR A GOOD USER INTERFACE

The demand for better designs of user interfaces for computer algebra systems is almost as old as the systems themselves. Kajler has described and developed his ideas for a perfect user interface in various works (Kajler, 1992) and (Kajler, 1993). He has postulated that well-designed computer algebra interfaces should afford intuitive access. As such, users should be able to enter commands with more than one parameter in a two-dimensional fashion. This prevents syntactic and structural errors. In addition, all templates and masks should follow the convention of operating from left to right.

Many of his reflections and wishes are not realized by the computer algebra systems running on Windows, Linus or MacOSx. So the author has developed the GUI CATO, (Janetzko, 2015) for intuitive usage of CAS. CATO aims at users who want to use the CAS only sporadically, e.g., one, two or three times a week.

The author believes the usage of a CAS on a smartphone (Fujimoto, 2014) will be sporadically, too. Therefore, a guided input is very important.

## THE PRINCIPLES OF CATO

CATO, the **C**omputer **A**lgebra **T**aschenrechner (calculator) **O**berfläche (surface), is a realization of some principles for a guided input: The commands of CATO are structured into packages in the usual mathematical kind: "analysis I, analysis II, linear algebra, numeric, …". Alternatively, the names of the packages clearly identify the content: "solving equations, trigonometric functions, integral transformations, …". Because there are only twenty-seven packages in CATO, some packages will have sub-packages. The user can select a package with a drop-down menu and then the correct command (or the sub-package) in a second one, commands of a sub-packages in a third one. The menus are collocated from left to right. All multi-parameter commands have their own input window with one input row for each parameter and a short description for it. Consequently, the windows of the multi-parameter commands are uniform, independent of the CAS. Furthermore,

the absence of abbreviations is very crucial for an effective sporadic usage of CAS and consequently, CATO does not abbreviate commands.

Other possibilities of CATO reflect state-of-the-art settings of other CAS: the kind of output, numerical or accurate, is a global option, also the user defined precision of numeric output. The design guidelines of CATO are thoroughly maintained as for example options can be selected and set like commands. Furthermore, there exists the package "chronicle", which collects all used commands (if they are selected by a menu). Additionally, another global option is the choice of the selected CAS. CATO provides a log for the re-usage of recent inputs.

**Figure 1. The graphical user interface on Android.**

## THE APP CATO-ANDROID

Starting the app, see Figure 1, two text areas, reserved for input and output, several buttons and six menus for selecting, spinners, are visible. To use CATO, the user should first select at the head of the app the computer algebra system of his choice; at the moment only Symja is available. CATO-Android then instantiates a connection to the chosen computer algebra system. Now the user can

select commands. For example, for calculating "sin(3.4)", he has to select in the menu "Pakete" (packages) "Analysis I" (analysis I), see Figure 2.



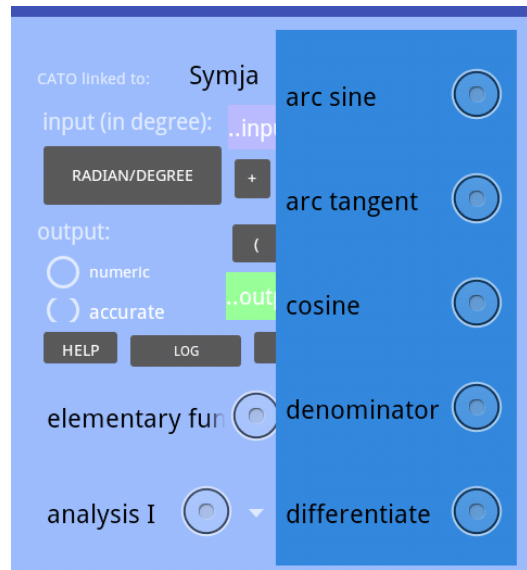**Fig. 2: Selecting Analysis I in the spinner packages.**



**Fig. 3: Selecting a command in the spinner right next.**

In the menu right next, the commands of this package are now available. The user can select the command he wants, see Figure 3. In the input text area he reads "Sinus(" and he can use the buttons of the app for the remaining part of the input.

For the input of more complicated terms he gets with the button "tastatur" (keyboard) a window with several buttons for many signs.

## THE EXTRA WINDOWS FOR MULTI-PARAMETER COMMANDS

The user can also select a command with more than one input, for example "differentiate". He selects at first "analysis I" in the menu "packages" and the command itself in the menu right next. The extra window will appear, see figure 4. The user can see at first the name of the command, then a short description of it, and two input rows for the parameters with a short description "fonction" (function) and "variable". Like in the Desktop version of CATO, the user does not need to know the right order of the parameters, the correct brackets or separators. But it is an android window for dialog, so the user can not apply the functionality of the CATO-Android surface itself: Therefore several buttons of the surface are part of this window useable for the input, also the button "tastatur" ("clavier") for a keyboard. For the same reason the selecting menus spinner can not be part of this window. The author has solved this problem with the application of scrollviews, vertical tables of buttons. The user can use them like the spinners for selecting packages and commands.

Also the log of the version 1.1 is an android window for dialog, where the user can select an old input by typing its number in a field for input.

**Figure 4: The extra window of the command "differentiate".**

**OUTLOCK**

English and French versions of CATO-Android like the English or French versions of CATO are published. Also the connection of CATO-Android with Symja will be a first step, other computer algebra systems will follow.

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