The basics of set theory – some new possibilities with ClassPad

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Abstract:

The basics of set theory consists in sets, elements, lists, set-builder notation, subsets, equal sets, the empty set, union, intersection, difference, symmetric difference and Cartesian product.
Sets are one of the most fundamental concepts in mathematics but we can not calculate with set operations and set relations on the ClassPad. On the other hand we can write in the text mode with special symbols of the set theory in the ClassPad, e.g. $\in$, $\notin$, $\cup$, $\cap$, \, $\subset$, $\subseteq$, $\neq$, …

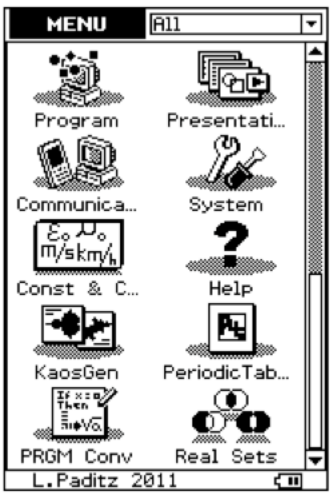
Thus some students of informatics tried to introduce the set theory in the operating system version 3.05 (published 2010). They followed two ways of solution:
1. Create a so called Add-In for ClassPad to calculate with sets of real numbers.
2. Create a Basic-program for ClassPad to calculate with finite sets of numbers or words.

In the first case we use the set-builder notation {x|…}, e.g. {x|a<x<b} or {x|x≥c} or {x|2,3,5}. In the other case we use the notation "{2,3,5}" or "{x1,x2,x3}" or "{(a,b),(a,c),(2,c),(d,4)}" or"{Anna, Alan, Max, Marc, Tanja}" to fulfil set theory operations. Here we work with strings. Thus we get no problems with system variables x1, x2, x3 or Max.

During the workshop the participants could download the new programs to their own calculators or notebooks and check the new possibilities or they follow a demonstration with the ClassPad Manager software.

1. The Add-In "Real Sets"

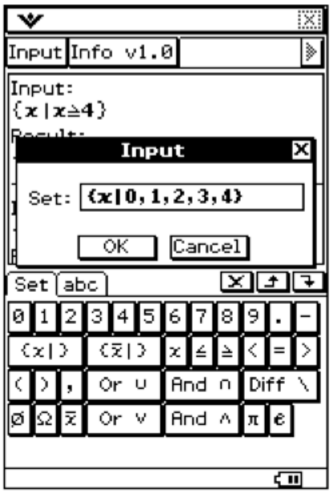
The students wrote a program in C^{++} and used than the CASIO-SDK (software development kid) to compile the source program into a ClassPad Add-In. The Add-In can be installed in a handheld calculator but not in the PC-manager-software. Thus the students compiled their program additional in an exe-file, which runs on a Windows-PC (**Real_Sets.exe**). Here we need additional a special library, the **ClassPadDLLgcc.dll**, in the exe-file folder.

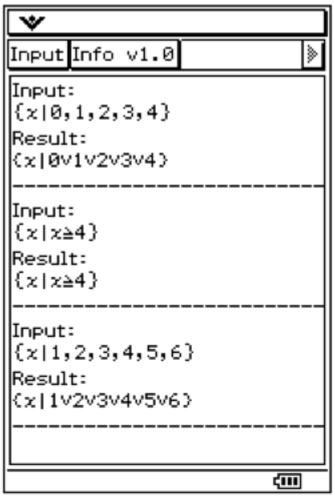


The new **Real Sets**-Icon in the menu

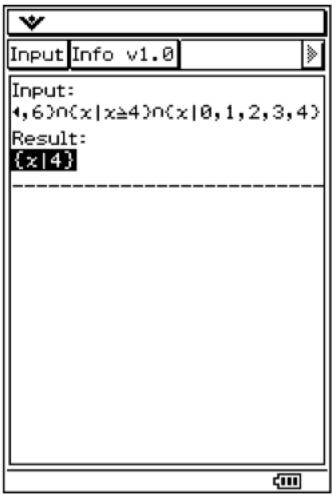
The students created a special keyboard for the set theory!

Now let us calculate some examples:
Let be A = {x| 1,2,3,4,5,6}, B = {x| x≥4} and C = {x| 0,1,2,3,4}

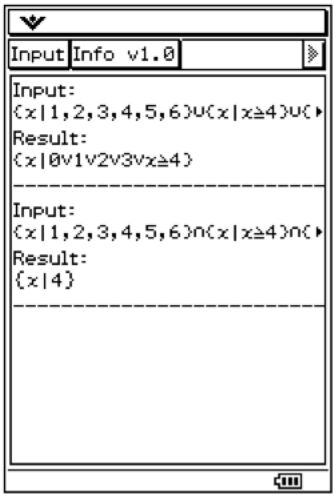


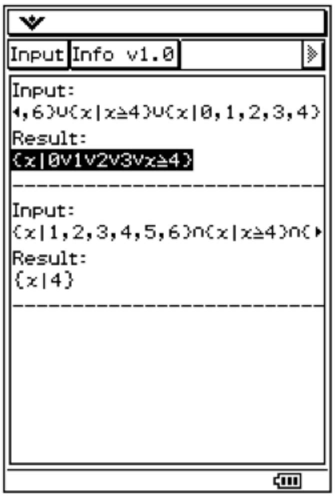


The output-window shows 3 results



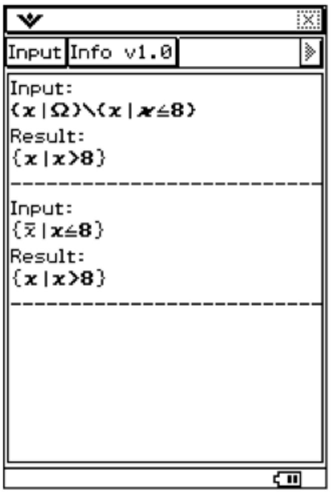
A∩B∩C



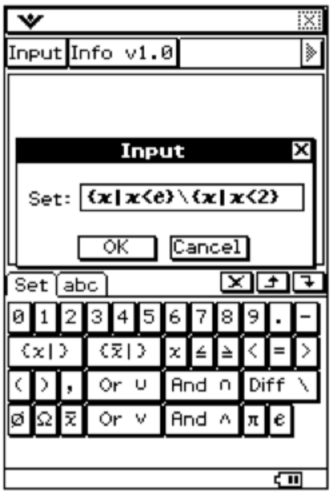


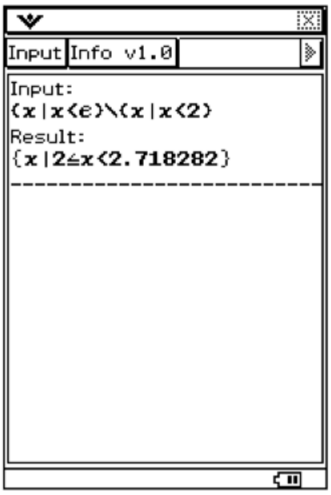
A∪B∪C

For the empty set here we have the symbol Ø and the full set (all real numbers) is Ω.
Additionally we can calculate the complementary set in Ω by the help of the x-bar notation.
We can use brackets (…) for multiple operations, e.g. A∩(B∪C).

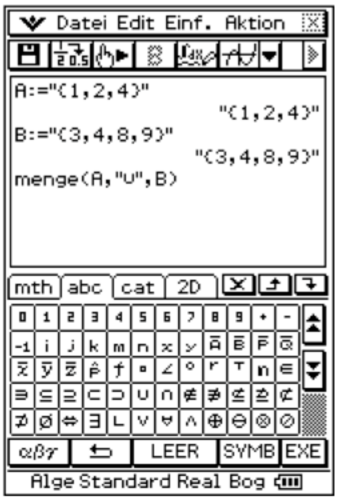


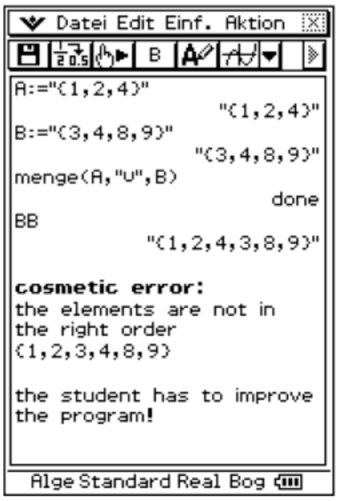
Sometimes we get an error message (we forgot x after |).

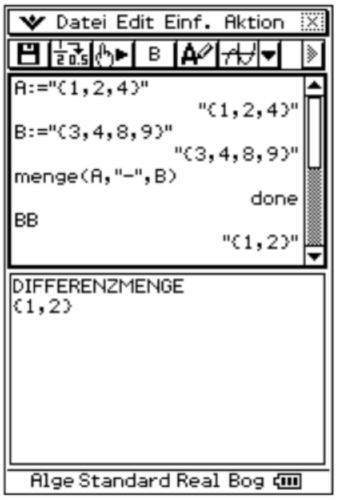


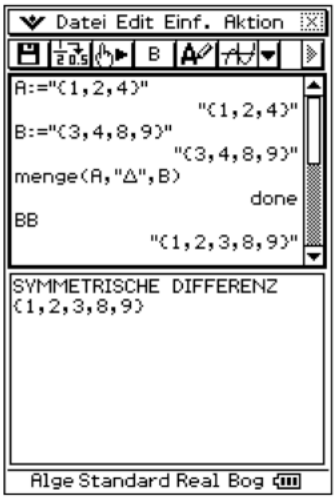


2. The program "menge" (see SA2011-workshop-Paditz.vcp)
After download the program in the library-folder of the ClassPad we can use it e.g. in the eActivity-menu. The function menge has the syntax **menge("A","operation","B")** or **menge("A","relation","B")**. The result is stored in the variable BB and appears in a separate window. At first have a look in the source text (Beta version 0.9).

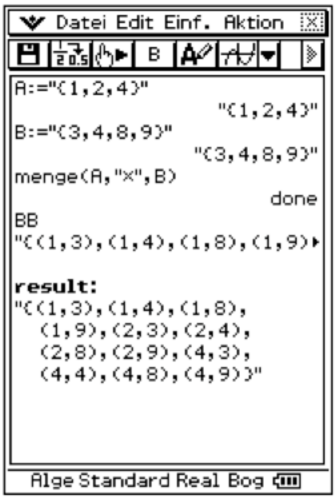






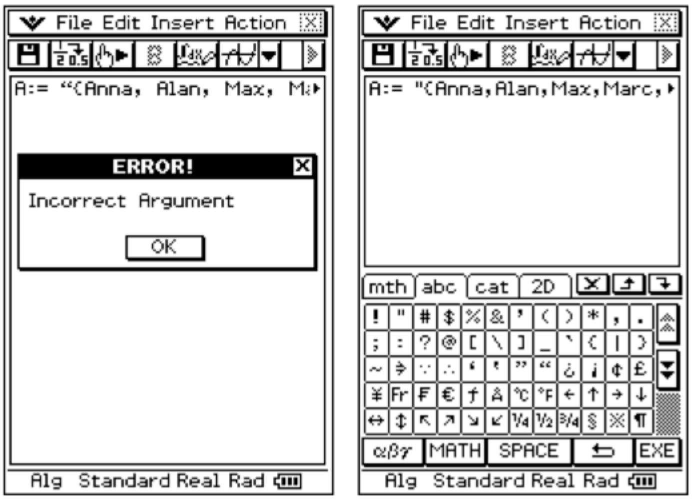


the result window is not optimal

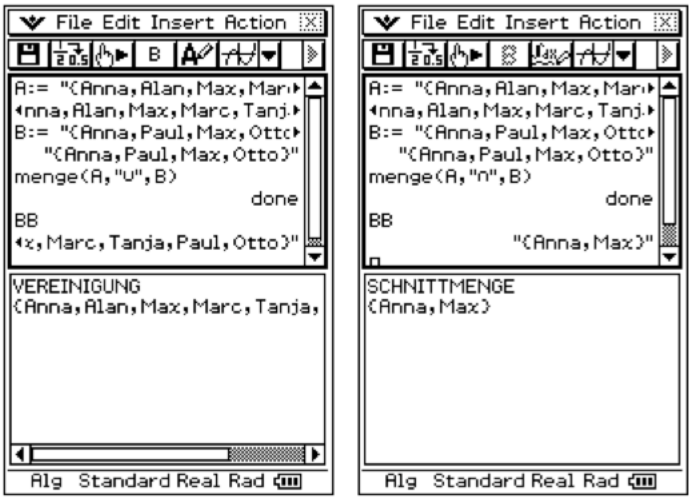


Now we can work with names:

Let be A:= "{Anna, Alan, Max, Marc, Tanja}" and B:= "{Anna, Paul, Max, Otto}"

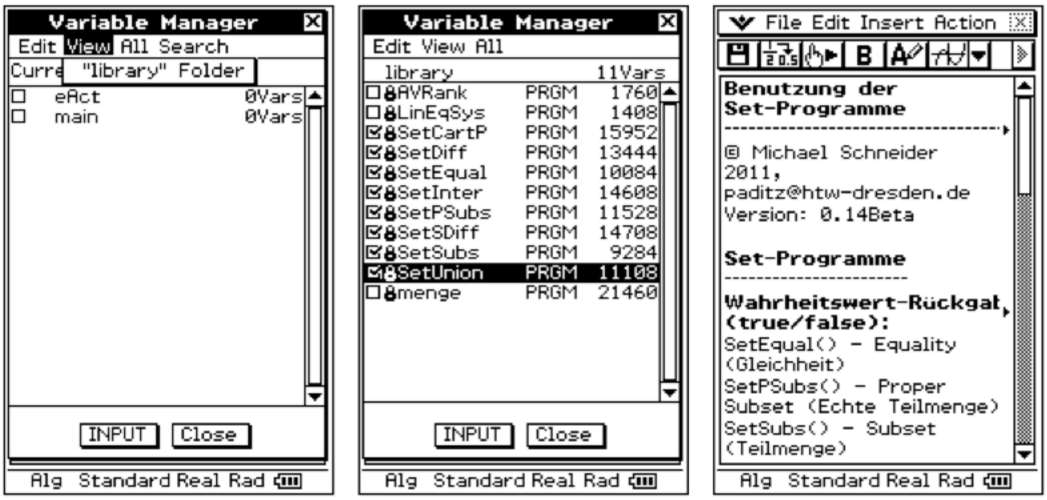


use the correct strings “…”



and so on.

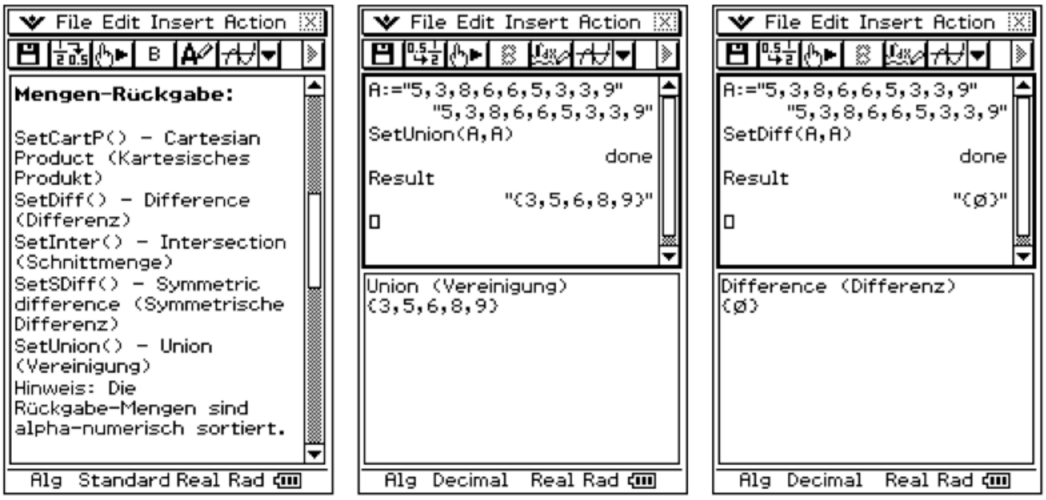
3. The individual programs for one task (see SA2011-workshop-Paditz.vcp)
Another student has created 8 several single programs for one operation or relation.

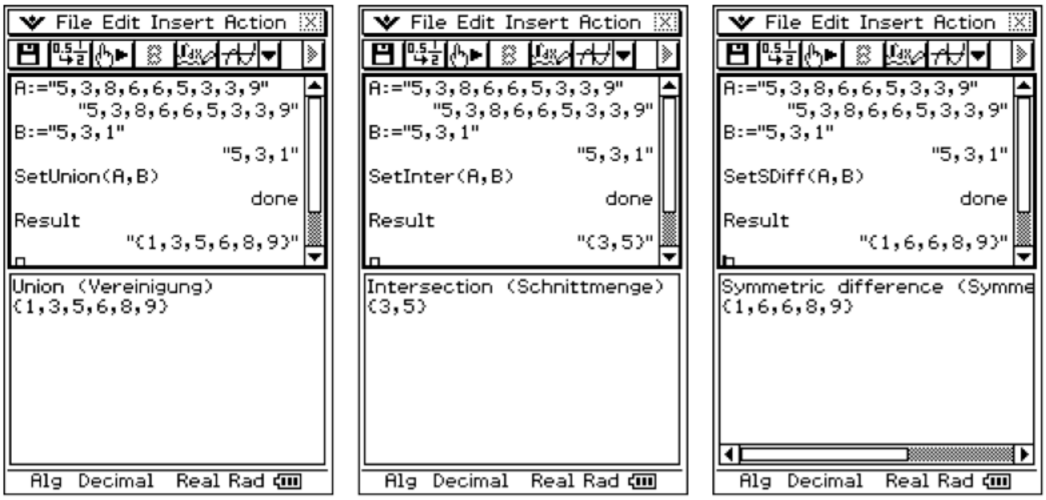


The programs have English names: SetUnion (for ∪), SetInter (for ∩), SetDiff (for \ ), SetSDiff (for Δ), SetCartP (for ×), SetSubs (for ⊆), SetPSubs (for ⊂), SetEqual(for =).

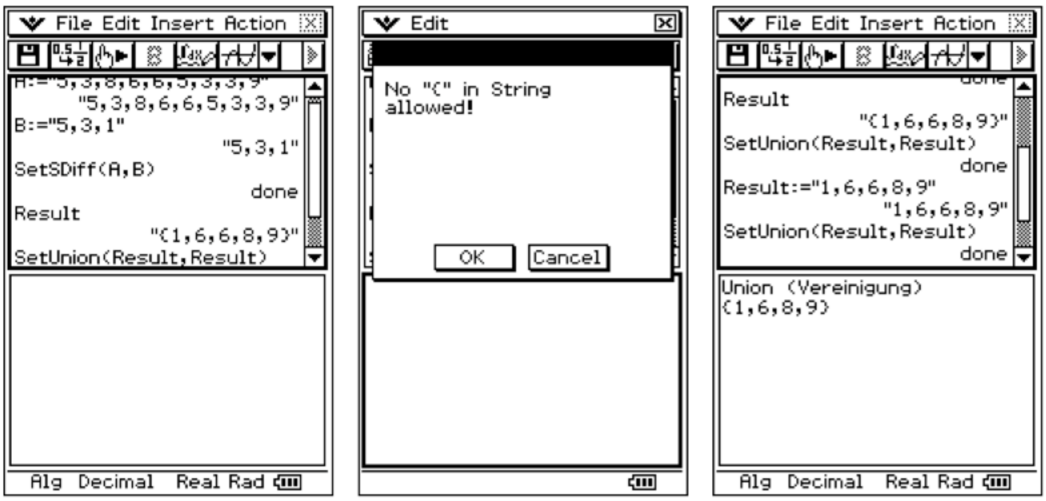
Let us check these programs. We idn't need any operation or relation symbol. The syntax is as follows: Set…(A,B), where the sets are given in strings “ “ but without brackets { and } .

The result is stored in the variable **Result**, the elements are in alpha-numerical order (sorted by their ASCII-codes)

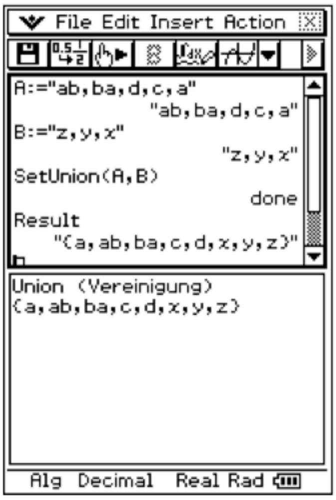




In the last result is a cosmetic error: double 6, better {1,6,8,9}. The student has to improve his program. To simplify the result we use SetUnion(Result,Result) = Result. At first we get an error message.



Here we remark, that the input is without brackets { and }, but the result variable has brackets!



4. Final remarks

During the learning process our students have good ideas to solve several problems in development new programs. The final step is to check the new programs and improve the errors, which appear during the first check of the new created programs. Here we have the Add-In in the final version 1.0 but the other programs in a Beta version 0.9 and 0.14 respectively. Later we will publish some updates.

For the HP 50g calculator you can find set programs here (by Clemens Heuson)
http://www.heuson-software.de/heusoneng.htm

In the internet we have a nice symbolic and numeric calculator:
http://www.tusanga.com/
Here we can do set theory calculations too.

A next step could be to create a program for drawing Venn diagrams, cp.
http://en.wikipedia.org/wiki/Set_%28mathematics%29

Download:
http://www.informatik.htw-dresden.de/~paditz/Set-Theory-SA2011.zip

The Set-Theory-SA2011.zip contains following parts:
- the **Real_Sets.exe** together with **ClassPadDLLgcc.dll** for a Windows-PC
- the CASIO ClassPad Add-in application: **Real Sets.cpa**
- the CASIO ClassPad Manager Virtual ClassPad File: **SA2011-workshop-Paditz.vcp**