Introduction to SMath

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Menu Panel: *File, Edit, View, **Insert**, **Calculation**, Tools, Pages, Help*
Toolbars (Side Panels):
1.1. Arithmetic
1.2. Matrices
1.3. Boolean
1.4. Functions
1.5. Plot
1.6. Programming
1.7. Symbols (α - ω)
1.8. Symbols (A - Ω)

2. Symbolic (analytical) *vs* numerical solution:

-	$\frac{15}{35} \to \frac{3}{7}$	$\frac{1}{4}+\frac{7}{67} \to \frac{95}{268}$	$\frac{\sin(x)}{\cos(x)} = \mathrm{tg}(x)$
$\int_{-2}^{2} \frac{x^2}{2}\,dx = 2.6667$	$\frac{15}{35} = 0.429$	$\frac{1}{4}+\frac{7}{67} = 0.354$	x:=0 $\frac{\sin(x)}{\cos(x)} = 0$

3. Solving equations & simplifying formulas:

$\mathrm{solve}(2\cdot x = 7, x) = 3.5$
$\mathrm{solve}\left(x^2+2\cdot x-8 = 0, x\right) = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$
$simplify\left(x^2+2\cdot x-8\right) = simplify\left(2\cdot(-4+x)+x^2\right)$

4. Searching the help: *Examples*

5. Creating functions: $f(x):=x^2+2\cdot x+4$

6. Using the built-in functions: *Insert* → *Function*

7. Arrays: create an array. Use built-in functions: *stack*, *augment*, *submatrix*.

8. Reading in from a file, writing to a file: *Insert → Function → File*

9. Using the *Programming* tools:
   9.1. ***Add Line*** – create the programmable part, also used as the operation brackets
   9.2. **:=** - assign a value
   9.3. ***If; otherwise*** - conditional
   9.4. ***For; while*** -loops
   9.5. ***Break*** – break of the loop; ***Continue*** – move to the beginning of the loop, the loop index is increased.
   9.6. ***Try*** – error trapping.

10. Practical exercises:
   10.1. Compute ***z*** for given values of ***a,b,c***:
      1) $z = 4(a+b)^{1/2}/(ab-c)$, a = 0.317, b = 3.27, c = 4.7561 [change of precision may be needed]
      2) $z = \ln[(b+c)/(b-ac)]$, a = 0,0399, b = 4,83 c = 0,0721
   10.2. Modify 10.1. such that ***a,b,c*** are given as the vector $A = \begin{pmatrix} a \\ b \\ c \end{pmatrix}$.
   10.3. Using *Plot toolbar*, plot:
      1) $y = 2\cdot\sin^2(x/2) - x^{1/2}$
      2) Plot an array of data points $[x_i;y_i]$
      3) Plot $\begin{cases} y1 = 2\cdot\sin(x/2) - x^{1/2} \\ y2 = 4\cdot\sin^2(x/2) - x \end{cases}$
      4) Create a 3D-plot.
      5) * Create a parametric plot.
      6) * Plot using polar coordinates r = 2*φ for φ* [0; 6pi]
      7) * Animate a plot.
   10.4. Create a vector in which ***A[i] = i***.
   10.5. Create a matrix in which ***A[i,j] = i*j***.
   10.6. Using the *vector and matrix toolbar*, solve a system of linear equations.
   10.7. Using *Programming toolbar* create a vector in which ***A[i] = i*** for odd ***i***, and ***A[i] = i^2*** for even ***i.***

11. Solving practical problems using the *Programming* toolbar:
   11.1. Isolate the roots graphically or analytically, and solve by implementing the root-finding algorithms:
      1) $x = (x+1)^3$ using *bisectional* method & *Newton's* method;
      2) $(x-1)^2 = 1/x$ using *fixed point* method & *secant* method;
      3) $x^3+4.5x-7 = 0$ using *false position* method & *fixed point* method;
      4) $x^4-9x+3 = 0$ using *combined tangent-and-secant* method.
   11.2. Find out the maximal speed which can be gained by a locomotive with the motive force of 25 ton *(1 ton of force = 9800 N*) if the total mass of the cars is 2000 tons? Consider the friction force noting that $F_{fr} = A\cdot v + B\cdot v^3$. Assume that $A = 10^4$ *kg/s*, and $B = 30$ *kg·s/m*^{2}. What power of the locomotive is? Find out how the speed would depend on the motive force and coefficients *A, B*?