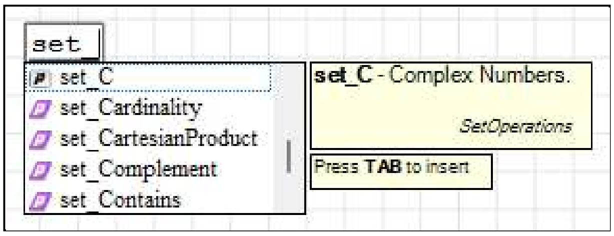
Set Operations plugin

SMath Studio "1.1.8763"

INTRODUCTION

All variables and functions have a **set_** prefix



A dedicated toolbox is available on the right hand side of the canvas

SETS

roster set a list of elements

$$A:=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix} \quad B:=\begin{bmatrix}5\\ 2\\ -23\end{bmatrix} \quad C:=\begin{bmatrix}3 & 0 & 1 & -1\end{bmatrix}$$

$$D:=\begin{bmatrix}3 & 2\end{bmatrix} \quad E:=\begin{bmatrix}3 & 2 & 4 & 1\end{bmatrix}$$

NOTE:
- any matrix can be used as a roster set;
- duplicate entries are allowed as input; however they are counted as single items in set operations;
- anything can be an element of a roster set (numbers, strings, variables, matrices, ...)

empty set a set without members $\mathrm{matrix}(0;\,0)=\mathrm{mat}(0;\,0)$

set-builder set definition by predicate $\left\{ variables \mid condition\_1 ;\, condition\_2 ;\, \blacksquare ;\, condition\_n \right\}$

if the first argument contains the membership operator $variable \in set$ *and a roster set is given, or if the variable given is a definet set itself, the set-builder will evaluate itself*

$$\left\{ x \in A \mid x>1 ;\, x \le 3 \right\} = \begin{bmatrix}2\\ 3\end{bmatrix}$$

$$\left\{ \begin{bmatrix}x & y\end{bmatrix} \in \begin{bmatrix}\begin{bmatrix}10 & -5\end{bmatrix}\\ \begin{bmatrix}-10 & 5\end{bmatrix}\\ \begin{bmatrix}4 & 2\end{bmatrix}\\ \begin{bmatrix}-4 & -2\end{bmatrix}\end{bmatrix} \middle| \; x>-5 ;\, y<0 \right\} = \begin{bmatrix}\begin{bmatrix}-4 & -2\end{bmatrix}\\ \begin{bmatrix}10 & -5\end{bmatrix}\end{bmatrix}$$

$$z:=\begin{bmatrix}-5\,..\,5\end{bmatrix} \qquad P(x):=|x|>4$$

$$\left\{ z \mid P(z) \right\} = \begin{bmatrix}-5\\ 5\end{bmatrix}$$

otherwise the set-builder won't evalute unless it is used in set membership/operations/subsets functions

$$\left\{ x \mid x>1 ;\, x \le 4 \right\} = \left\{ x \mid x>1 ;\, x \le 4 \right\}$$

$$\pi \in \left\{ x \mid x>1 ;\, x \le 4 \right\} = 1$$

$$5 \in \left\{ x \mid x>1 ;\, x \le 4 \right\} = 0$$

universe set	current universe	**set_Universe**

this set is required to be defined to evalute the set_Complement(1) function

$P(x) = |x| > 4$

$Q(x) := x > 3$

QUANTIFIERS

for all	$\forall \blacksquare \blacksquare$	$\forall z\ P(z) = 0$	$\forall x \in A\ Q(x) = 0$
there exists	$\exists \blacksquare \blacksquare$	$\exists z\ P(z) = 1$	$\exists x \in A\ Q(x) = 1$
does not exist	$\nexists \blacksquare \blacksquare$	$\nexists z\ P(z) = 0$	$\nexists x \in A\ Q(x) = 0$
there exists one and only one	$\exists! \blacksquare \blacksquare$	$\exists! z\ P(z) = 0$	$\exists! x \in A\ Q(x) = 1$

MEMBERSHIP

$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

$B = \begin{bmatrix} 5 \\ 2 \\ -23 \end{bmatrix}$

$D = \begin{bmatrix} 3 & 2 \end{bmatrix}$

$E = \begin{bmatrix} 3 & 2 & 4 & 1 \end{bmatrix}$

element of set	$\blacksquare \in \blacksquare$	$3 \in A = 1$	$3 \in B = 0$
set contains an element	$\blacksquare \ni \blacksquare$	$A \ni 3 = 1$	$B \ni 3 = 0$
not an element of set	$\blacksquare \notin \blacksquare$	$3 \notin A = 0$	$3 \notin B = 1$
set doesn't contains an element	$\blacksquare \not\ni \blacksquare$	$A \not\ni 3 = 0$	$B \not\ni 3 = 1$

SUBSETS

subset	$\blacksquare \subseteq \blacksquare$	$D \subseteq A = 1$	$A \subseteq E = 1$	$A \subseteq B = 0$
superset	$\blacksquare \supseteq \blacksquare$	$D \supseteq A = 0$	$A \supseteq E = 1$	$A \supseteq B = 0$
proper subset	$\blacksquare \subsetneq \blacksquare$	$D \subsetneq A = 1$	$A \subsetneq E = 0$	$A \subsetneq B = 0$
proper superset	$\blacksquare \supsetneq \blacksquare$	$D \supsetneq A = 0$	$A \supsetneq E = 0$	$A \supsetneq B = 0$
not subset	$\blacksquare \nsubseteq \blacksquare$	$D \nsubseteq A = 0$	$A \nsubseteq E = 0$	$A \nsubseteq B = 1$
not superset	$\blacksquare \nsupseteq \blacksquare$	$D \nsupseteq A = 1$	$A \nsupseteq E = 0$	$A \nsupseteq B = 1$

OPERATIONS

union	$\blacksquare \cup \blacksquare$	$\blacksquare \cup \blacksquare \cup \blacksquare$
intersection	$\blacksquare \cap \blacksquare$	$\blacksquare \cap \blacksquare \cap \blacksquare$
difference	$\blacksquare \setminus \blacksquare$	$\blacksquare \setminus \blacksquare \setminus \blacksquare$
symmetric difference	$\blacksquare \Delta \blacksquare$	$\blacksquare \Delta \blacksquare \Delta \blacksquare$
cartesian product	$\blacksquare \times \blacksquare$	$\blacksquare \times \blacksquare \times \blacksquare$
complement	$\blacksquare^{C}$	
power set	$\mathcal{P}(\blacksquare)$	
set cardinality	$\lvert \blacksquare \rvert$	

$$\mathcal{P}(B) = \begin{bmatrix} \mathrm{mat}(0;\ 0) \\ \begin{bmatrix} 5 \end{bmatrix} \\ \begin{bmatrix} 2 \end{bmatrix} \\ \begin{bmatrix} -23 \end{bmatrix} \\ \begin{bmatrix} 5 \\ 2 \end{bmatrix} \\ \begin{bmatrix} 5 \\ -23 \end{bmatrix} \\ \begin{bmatrix} 2 \\ -23 \end{bmatrix} \\ \begin{bmatrix} 5 \\ 2 \\ -23 \end{bmatrix} \end{bmatrix}$$

$$A \cup B = \begin{bmatrix} -23 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix}$$

$$A \setminus B = \begin{bmatrix} 1 \\ 3 \\ 4 \end{bmatrix}$$

$|A| = 4$

$$\left\| \begin{bmatrix} 2 & a \\ \sqrt{2} & \sqrt{4} \end{bmatrix} \right\| = 3 \qquad |A| = 4$$

$$A \cap B = \begin{bmatrix} 2 \end{bmatrix} \qquad A \,\Delta\, B = \begin{bmatrix} -23 \\ 1 \\ 3 \\ 4 \\ 5 \end{bmatrix} \qquad A \times B = \begin{bmatrix} \begin{bmatrix} 1 \\ 5 \end{bmatrix} \\ \begin{bmatrix} 1 \\ 2 \end{bmatrix} \\ \begin{bmatrix} 1 \\ -23 \end{bmatrix} \\ \begin{bmatrix} 2 \\ 5 \end{bmatrix} \\ \begin{bmatrix} 2 \\ 2 \end{bmatrix} \\ \begin{bmatrix} 2 \\ -23 \end{bmatrix} \\ \vdots \end{bmatrix}$$

$A^{C} = ▮$

lastError = "Set 'set_Universe' is not defined."

$$set\_Universe := \begin{bmatrix} 5 & 3 & 2 \\ 4 & 1 & 0 \end{bmatrix} \qquad A^{C} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

NUMBER SETS

Natural numbers — set of natural numbers — **set_N**

$2 \in \mathbf{set\_N} = 1$ $\quad -2 \in \mathbf{set\_N} = 0$ $\quad \pi \in \mathbf{set\_N} = 0$ $\quad \frac{5}{3} \in \mathbf{set\_N} = 0$

$2 + 3 \cdot i \in \mathbf{set\_N} = 0$ $\quad -5 \cdot i \in \mathbf{set\_N} = 0$ $\quad \infty \in \mathbf{set\_N} = 0$

Integrers — set of integers — **set_Z**

$2 \in \mathbf{set\_Z} = 1$ $\quad -2 \in \mathbf{set\_Z} = 1$ $\quad \pi \in \mathbf{set\_Z} = 0$ $\quad \frac{5}{3} \in \mathbf{set\_Z} = 0$

$2 + 3 \cdot i \in \mathbf{set\_Z} = 0$ $\quad -5 \cdot i \in \mathbf{set\_Z} = 0$ $\quad \infty \in \mathbf{set\_Z} = 0$

Rational numbers — set of rational numbers — **set_Q**

$2 \in \mathbf{set\_Q} = 1$ $\quad -2 \in \mathbf{set\_Q} = 1$ $\quad \pi \in \mathbf{set\_Q} = 0$ $\quad \frac{5}{3} \in \mathbf{set\_Q} = 1$

$2 + 3 \cdot i \in \mathbf{set\_Q} = 0$ $\quad -5 \cdot i \in \mathbf{set\_Q} = 0$ $\quad \infty \in \mathbf{set\_Q} = 0$

Real numbers — set of real numbers — **set_R**

$2 \in \mathbf{set\_R} = 1$ $\quad -2 \in \mathbf{set\_R} = 1$ $\quad \pi \in \mathbf{set\_R} = 1$ $\quad \frac{5}{3} \in \mathbf{set\_R} = 1$

$2 + 3 \cdot i \in \mathbf{set\_R} = 0$ $\quad -5 \cdot i \in \mathbf{set\_R} = 0$ $\quad \infty \in \mathbf{set\_R} = 0$

Complex numbers — set of complex numbers — **set_C**

$2 \in \mathbf{set\_C} = 1$ $\quad -2 \in \mathbf{set\_C} = 1$ $\quad \pi \in \mathbf{set\_C} = 1$ $\quad \frac{5}{3} \in \mathbf{set\_C} = 1$

$2 + 3 \cdot i \in \mathbf{set\_C} = 1$ $\quad -5 \cdot i \in \mathbf{set\_C} = 1$ $\quad \infty \in \mathbf{set\_C} = 0$

Imaginary numbers — set of imaginary numbers — **set_I**

$2 \in \mathbf{set\_I} = 0$ $\quad -2 \in \mathbf{set\_I} = 0$ $\quad \pi \in \mathbf{set\_I} = 0$ $\quad \frac{5}{3} \in \mathbf{set\_I} = 0$

$2 + 3 \cdot i \in \mathbf{set\_I} = 0$ $\quad -5 \cdot i \in \mathbf{set\_I} = 1$ $\quad \infty \in \mathbf{set\_I} = 0$