Vectors and matrix - data manipulation

In this document we will walk through the set of matrix and data functions that are designed to make data manipulation easier, to create a good and secure basis for the implementation of your projects and ideas and to grant you the power to work with matrices and vectors in MatDeck without any restrictions whatsoever.

To extract a single value from a vector or matrix use the function, **value at()**

$$\text{value at}\left(\begin{bmatrix}1 & 2 & 3 & 4\end{bmatrix}, 0, 2\right) = 3$$

$$\text{value at}\left(\begin{bmatrix}1\\2\\3\end{bmatrix}, 1, 0\right) = 2$$

Function value at()

$$\text{value at}\left(\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix}, 1, 2\right) = 6$$

To set or change a specific value in a vector or matrix use the function, **set value at()**

$$\text{set value at}\left(\begin{bmatrix}1 & 2 & 3 & 4\end{bmatrix}, -5, 0, 2\right) = \begin{bmatrix}1 & 2 & -5 & 4\end{bmatrix}$$

$$\text{set value at}\left(\begin{bmatrix}1\\2\\3\end{bmatrix}, 6.35, 1, 0\right) = \begin{bmatrix}1\\6.35\\3\end{bmatrix}$$

Function set value at()

$$\text{set value at}\left(\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix}, 0, 1, 1\right) = \begin{bmatrix}1 & 2 & 3\\4 & 0 & 6\\7 & 8 & 9\end{bmatrix}$$

If there is a need to shift the vector elements or matrix rows and columns circularly, use the functions, **row shift()** and **col shift()**

$$\text{row shift}\left(\begin{bmatrix}1 & 2 & 3\end{bmatrix}, 1\right) = \begin{bmatrix}3 & 1 & 2\end{bmatrix}$$

$$\text{row shift}\left(\begin{bmatrix}1&2&3\\4&5&6\\7&8&9\end{bmatrix},2\right)=\begin{bmatrix}4&5&6\\7&8&9\\1&2&3\end{bmatrix}$$

$$\text{col shift}\left(\begin{bmatrix}1\\2\\3\end{bmatrix},1\right)=\begin{bmatrix}3\\1\\2\end{bmatrix}$$

Functions row shift() and column shift()

$$\text{col shift}\left(\begin{bmatrix}1&2&3\\4&5&6\\7&8&9\end{bmatrix},2\right)=\begin{bmatrix}2&3&1\\5&6&4\\8&9&7\end{bmatrix}$$

To delete a value or a position in a vector or to delete a row or column inside a matrix, use the functions, **row delete()** and **column delete().**

$$\text{row delete}\left(\begin{bmatrix}1\\2\\3\end{bmatrix},1\right)=\begin{bmatrix}1\\3\end{bmatrix}$$

$$\text{col delete}\left(\begin{bmatrix}1&2&3\end{bmatrix},2\right)=\begin{bmatrix}1&2\end{bmatrix}$$

Functions row delete() and column delete()

$$\text{row delete}\left(\begin{bmatrix}1&2&3\\4&5&6\\7&8&9\end{bmatrix},0\right)=\begin{bmatrix}4&5&6\\7&8&9\end{bmatrix}$$

$$\text{col delete}\left(\begin{bmatrix}1&2&3\\4&5&6\\7&8&9\end{bmatrix},0\right)=\begin{bmatrix}2&3\\5&6\\8&9\end{bmatrix}$$

To return the largest and the smallest element in each matrix row or column utilize the functions, **rows max()**, **rows min()**, **cols max()** and **cols min()**. For the largest and the smallest element of the whole matrix or vector use the functions, **mat max()** and **mat min()**.

$$\text{rows max}\left(\begin{bmatrix}1&2&3\\4&6&5\\9&8&7\end{bmatrix}\right)=\begin{bmatrix}3\\6\\9\end{bmatrix}$$

$$\text{rows min}\left(\begin{bmatrix}1 & 2 & 3\\ 4 & 6 & 5\\ 9 & 8 & 7\end{bmatrix}\right)=\begin{bmatrix}1\\ 4\\ 7\end{bmatrix}$$

$$\text{cols min}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}\right)=\begin{bmatrix}1 & 2 & 3\end{bmatrix}$$

Functions rows max(), rows min(), cols max(), cols min(), mat max() and mat min()

$$\text{cols max}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}\right)=\begin{bmatrix}9 & 8 & 7\end{bmatrix}$$

$$\text{mat max}\left(\begin{bmatrix}4 & -8 & 3.6\end{bmatrix}\right)=4$$

$$\text{mat max}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}\right)=9$$

$$\text{mat min}\left(\begin{bmatrix}4 & -8 & 3.6\end{bmatrix}\right)=-8$$

$$\text{mat min}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}\right)=1$$

To sort the elements of a vector use the function, **sort()** but to sort the rows and columns of a matrix in ascending or descending order use the functions, **rows sort()** and **cols sort()**.

$$\text{rows sort}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix},\text{"a"}\right)=\begin{bmatrix}1 & 2 & 7\\ 4 & 5 & 8\\ 3 & 6 & 9\end{bmatrix}$$

$$\text{rows sort}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix},\text{"d"}\right)=\begin{bmatrix}7 & 2 & 1\\ 8 & 5 & 4\\ 9 & 6 & 3\end{bmatrix}$$

$$\text{cols sort}\left(\begin{bmatrix}1&2&7\\4&8&5\\9&6&3\end{bmatrix},\text{"a"}\right)=\begin{bmatrix}1&2&3\\4&6&5\\9&8&7\end{bmatrix}$$

$$\text{cols sort}\left(\begin{bmatrix}1&2&7\\4&8&5\\9&6&3\end{bmatrix},\text{"d"}\right)=\begin{bmatrix}9&8&7\\4&6&5\\1&2&3\end{bmatrix}$$

Functions rows sort(), cols sort() and sort()

$$\text{sort}\left(\begin{bmatrix}3&1&2\end{bmatrix},\text{"a"}\right)=\begin{bmatrix}1&2&3\end{bmatrix}$$

$$\text{sort}\left(\begin{bmatrix}3&1&2\end{bmatrix},\text{"d"}\right)=\begin{bmatrix}3&2&1\end{bmatrix}$$

$$\text{sort}\left(\begin{bmatrix}3\\2\\1\end{bmatrix},\text{"a"}\right)=\begin{bmatrix}1\\2\\3\end{bmatrix}$$

$$\text{sort}\left(\begin{bmatrix}3\\2\\1\end{bmatrix},\text{"d"}\right)=\begin{bmatrix}3\\2\\1\end{bmatrix}$$

To return the elements in the reversed order use function, **flip()**.

$$\text{flip}\left(\begin{bmatrix}1&2&3\end{bmatrix},1\right)=\begin{bmatrix}1&2&3\end{bmatrix}$$

$$\text{flip}\left(\begin{bmatrix}1&2&3\end{bmatrix},2\right)=\begin{bmatrix}3&2&1\end{bmatrix}$$

$$\text{flip}\left(\begin{bmatrix}1\\2\end{bmatrix},1\right)=\begin{bmatrix}2\\1\end{bmatrix}$$

$$\text{flip}\left(\begin{bmatrix}1\\2\end{bmatrix},2\right)=\begin{bmatrix}1\\2\end{bmatrix}$$

Function flip()

$$\text{flip}\left(\begin{bmatrix}1&2&7\\4&8&5\\9&6&3\end{bmatrix},1\right)=\begin{bmatrix}9&6&3\\4&8&5\\1&2&7\end{bmatrix}$$

$$\text{flip}\left(\begin{bmatrix}1&2&7\\4&8&5\\9&6&3\end{bmatrix},2\right)=\begin{bmatrix}7&2&1\\5&8&4\\3&6&9\end{bmatrix}$$

You can join the row vectors and column vectors in a matrix by utilizing the functions, **join mat rows**() and **join mat cols()**. You can even join two matrices together.

$$\text{join mat rows}\left(\begin{bmatrix}1 & 2\end{bmatrix}, \begin{bmatrix}3 & 4\end{bmatrix}\right) = \begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$$

$$\text{join mat rows}\left(\begin{bmatrix}1\\ 2\end{bmatrix}, \begin{bmatrix}3\\ 4\end{bmatrix}\right) = \begin{bmatrix}1\\ 2\\ 3\\ 4\end{bmatrix}$$

$$\text{join mat rows}\left(\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}, \begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}\right) = \begin{bmatrix}1 & 2\\ 3 & 4\\ 1 & 2\\ 3 & 4\end{bmatrix}$$

Functions join mat rows(), join mat cols()

$$\text{join mat cols}\left(\begin{bmatrix}1 & 2\end{bmatrix}, \begin{bmatrix}3 & 4\end{bmatrix}\right) = \begin{bmatrix}1 & 2 & 3 & 4\end{bmatrix}$$

$$\text{join mat cols}\left(\begin{bmatrix}1\\ 2\end{bmatrix}, \begin{bmatrix}3\\ 4\end{bmatrix}\right) = \begin{bmatrix}1 & 3\\ 2 & 4\end{bmatrix}$$

$$\text{join mat cols}\left(\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}, \begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}\right) = \begin{bmatrix}1 & 2 & 1 & 2\\ 3 & 4 & 3 & 4\end{bmatrix}$$

To extract a row or column from a matrix use the functions, **row2vec()** and **col2vec()**.

$$\text{row2vec}\left(\begin{bmatrix}1\\ 2\\ 3\end{bmatrix}, 1\right) = \begin{bmatrix}2\end{bmatrix}$$

$$\text{row2vec}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, 2\right) = \begin{bmatrix}9 & 6 & 3\end{bmatrix}$$

Functions row2vec(), col2vec()

$$\text{col2vec}\left(\begin{bmatrix}1 & 2 & 3\end{bmatrix}, 0\right) = \begin{bmatrix}1\end{bmatrix}$$

$$\text{col2vec}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, 2\right) = \begin{bmatrix}7\\ 5\\ 3\end{bmatrix}$$

To repeat a inserted vector or matrix and to create n times larger object use the function, **matrep()**.

$$\text{matrep}\left(\begin{bmatrix}1 & 2\end{bmatrix}, 2, 3\right) = \begin{bmatrix}1 & 2 & 1 & 2 & 1 & 2\\ 1 & 2 & 1 & 2 & 1 & 2\end{bmatrix}$$

$$\text{matrep}\left(\begin{bmatrix}1\\ 2\end{bmatrix}, 1, 2\right) = \begin{bmatrix}1 & 1\\ 2 & 2\end{bmatrix}$$

Function matrep()

$$\text{matrep}\left(\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}, 2, 2\right) = \begin{bmatrix}1 & 2 & 1 & 2\\ 3 & 4 & 3 & 4\\ 1 & 2 & 1 & 2\\ 3 & 4 & 3 & 4\end{bmatrix}$$

You can replace a row or column in a matrix by using the functions, **row replace()** and **col replace()**.

$$\text{row replace}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, \begin{bmatrix}-7 & -8 & 0\end{bmatrix}, 1\right) = \begin{bmatrix}1 & 2 & 7\\ -7 & -8 & 0\\ 9 & 6 & 3\end{bmatrix}$$

$$\text{col replace}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, \begin{bmatrix}-7\\ -8\\ 0\end{bmatrix}, 1\right) = \begin{bmatrix}1 & -7 & 7\\ 4 & -8 & 5\\ 9 & 0 & 3\end{bmatrix}$$

Functions row replace() and col replace()

To re-sort a vector's or matrix's elements in a different way and to change the starting object size use the function, **mat reshape()**.

$$\text{mat reshape}\left(\begin{bmatrix}1 & 2 & 3 & 4\end{bmatrix}, \begin{bmatrix}2 & 2\end{bmatrix}\right) = \begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$$

$$\text{mat reshape}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\\ 0 & -1 & 2\end{bmatrix}, \begin{bmatrix}3 & 4\end{bmatrix}\right) = \begin{bmatrix}1 & 2 & 7 & 4\\ 8 & 5 & 9 & 6\\ 3 & 0 & -1 & 2\end{bmatrix}$$

Function mat reshape()

You can extract or set a vector or matrix as a subset of another vector or matrix by using the functions, **subset()** and **set subset()**.

$$\text{subset}\left(\begin{bmatrix}1 & 2 & 3 & 4\end{bmatrix}, 0, 1, 0, 2\right) = \begin{bmatrix}2 & 3\end{bmatrix}$$

$$\text{subset}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, 1, 1, 2, 2\right) = \begin{bmatrix}8 & 5\\ 6 & 3\end{bmatrix}$$

Function subset(), with last four arguments choose starting and ending row and column position

$$\text{set subset}\left(\begin{bmatrix}1 & 2 & 7\\ 4 & 8 & 5\\ 9 & 6 & 3\end{bmatrix}, 1, 1, \begin{bmatrix}0 & 0\\ 0 & 0\end{bmatrix}\right) = \begin{bmatrix}1 & 2 & 7\\ 4 & 0 & 0\\ 9 & 0 & 0\end{bmatrix}$$

Function set subset(), with second and third argument choose starting row and column position

To set all a vector's or matrix's elements smaller by the absolute value than suggested threshold to zero. Use the functions, **threshold()**, **row threshold()** and **col threshold()**.

$$\text{threshold}\left(\begin{bmatrix}0.1 & -0.2 & 0.3 & 0.4\end{bmatrix}, 0.25\right) = \begin{bmatrix}0 & 0 & 0.3 & 0.4\end{bmatrix}$$

$$\text{threshold}\left(\begin{bmatrix}0.1 & -0.2 & 0.7\\ -0.4 & 0.8 & -0.5\\ 0.9 & -0.6 & 0.3\end{bmatrix}, 0.45\right) = \begin{bmatrix}0 & 0 & 0.7\\ 0 & 0.8 & -0.5\\ 0.9 & -0.6 & 0\end{bmatrix}$$

$$\text{row threshold}\left(\begin{bmatrix}0.1 & -0.2 & 0.3 & 0.4\end{bmatrix}, 0.25, 0\right) = \begin{bmatrix}0 & 0 & 0.3 & 0.4\end{bmatrix}$$

$$\text{row threshold}\left(\begin{bmatrix}0.1 & -0.2 & 0.7\\ -0.4 & 0.8 & -0.5\\ 0.9 & -0.6 & 0.3\end{bmatrix}, 0.45, 1\right) = \begin{bmatrix}0.1 & -0.2 & 0.7\\ 0 & 0.8 & -0.5\\ 0.9 & -0.6 & 0.3\end{bmatrix}$$

$$\text{col threshold}\left(\begin{bmatrix}0.1\\ -0.09\\ 0.2\end{bmatrix}, 0.1, 0\right) = \begin{bmatrix}0.1\\ 0\\ 0.2\end{bmatrix}$$

Functions threshold(), row threshold() and col threshold()

$$\text{col threshold}\left(\begin{bmatrix}0.1 & -0.2 & 0.7\\ -0.4 & 0.8 & -0.5\\ 0.9 & -0.6 & 0.3\end{bmatrix}, 0.45, 1\right) = \begin{bmatrix}0.1 & 0 & 0.7\\ -0.4 & 0.8 & -0.5\\ 0.9 & -0.6 & 0.3\end{bmatrix}$$

You can perform vector orientation by utilizing the functions, **to row vec()** and **to col vec()**.

$$\text{to row vec}\left(\begin{bmatrix}1\\2\\3\end{bmatrix}\right) = \begin{bmatrix}1 & 2 & 3\end{bmatrix}$$

$$\text{to col vec}\left(\begin{bmatrix}1 & 2 & 3\end{bmatrix}\right) = \begin{bmatrix}1\\2\\3\end{bmatrix}$$

Functions to row vec(), to col vec()

We have presented in short, some of the endless possibilities of MatDeck's software capabilities especially dealing with data manipulation in vectors and matrices.