The Sparse Matrix File Formats

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1 Matrix Format

The following format are used to store generator matrices in sparse form in files. We use the following assumptions. For an n-dimensional matrix, indices run from 0 through $n-1$. We define generator matrices such that the row sum is zero. This is common in literature on Markov models [1] but differs from the notation in other branches of numerical analysis where matrices with column sum 0 are considered. The matrix file contains only the non-zero elements of a matrix plus some additional information according to the matrix structure. Matrices are potentially block structured such that different submatrices can be defined according to a partition of the state space. If $\mathcal{S} = \{0, \ldots, n-1\}$ is the state space, then a partition may be defined by combining consecutive states in subsets. I.e., $\mathcal{S} = \cup_{j=0}^{J} \mathcal{S}_j$, $\mathcal{S}_j = \{n_j, \ldots, n_{j+1} - 1\}$ where $n_0 = 0$, $n_j < n_{j+1}$ and $n_J = n$.

Then we use the following format to store matrices. In the format all lines starting with # are interpreted as comments.

```
Number of matrices (usually one)
Number of partition blocks
first state in the first block (must be 0!)
...
last state in the last block (must be n)

For each row of the matrix
Number of non-zero elements
Diagonal Element

For each non-zero element
destination state
value
```

2 Example

As an example we consider the following matrix:

$$\left(\begin{array}{ccc|c} -4 & 2 & 1 & 1 \\ 2 & -3 & 1 & 0 \\ 1 & 0 & -2 & 1 \\ \hline 1 & 0 & 0 & -1 \end{array}\right)$$

which is defined by the following specification:

```
# number of matrices
1
# partition groups
2
# boundaries of the partition groups
0
3
```

```
4
# number of non-zero entries and diagonal element of row 0
3 -4.00e+00
# non-zero entries destination state and value for row 0
1 2.00e+00
2 1.00e+00
3 1.00e+00
# number of non-zero entries and diagonal element of row 1
2 -3.00e+00
# non-zero entries destination state and value for row 1
0 2.00e+00
2 1.00e+00
# number of non-zero entries and diagonal element of row 2
2 -2.00e+00
# non-zero entries destination state and value for row 2
0 1.00e+00
3 1.00e+00
# number of non-zero entries and diagonal element of row 3
1 -1.00e+00
# non-zero entries destination state and value for row 3
0 1.00e+00
```

References

[1] W. J. Stewart. *Introduction to the numerical solution of Markov chains.* Princeton University Press, 1994.