

Homework-1. Due 30 Sep.

Given an n-abstract simplicial complex S, write an algorithm to write the p-boundary matrix of S for $0 \leq p \leq n$.

Details :

- The input file will be a matrix of oriented simplices, for instance :

$$\begin{bmatrix} 0 & 1 & 3 \\ 1 & 2 & 3 \\ 2 & 4 & 3 \end{bmatrix}$$

-You should be able to extract the vertices, edges and faces (and higher simplices) from the given file and arrange the following matrices :

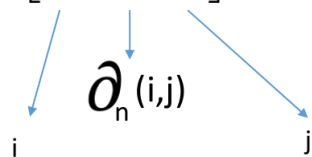
$$\partial_0 = \begin{matrix} & [0] & [1] & [2] & [3] & [4] \\ \begin{bmatrix} \end{bmatrix} & \begin{bmatrix} 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 0 \\ 0 \end{bmatrix} & \begin{bmatrix} 0 \\ 0 \end{bmatrix} \end{matrix}$$

$$\partial_1 = \begin{matrix} & [0\ 1] & [0\ 3] & [1\ 2] & [1\ 3] & [2\ 3] & [2\ 4] & [3\ 4] \\ \begin{matrix} [0] \\ [1] \\ [2] \\ [3] \\ [4] \end{matrix} & \begin{bmatrix} -1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & -1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & -1 & -1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 \end{bmatrix} \end{matrix}$$

$$\partial_2 = \begin{matrix} & \begin{matrix} [0\ 1\ 3] & [1\ 2\ 3] & [2\ 3\ 4] \end{matrix} \\ \begin{matrix} [0\ 1] \\ [0\ 3] \\ [1\ 2] \\ [1\ 3] \\ [2\ 3] \\ [2\ 4] \\ [3\ 4] \end{matrix} & \begin{bmatrix} 1 & 0 & 0 \\ -1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \\ 0 & 0 & -1 \end{bmatrix} \end{matrix}$$

-It is recommended that you write the matrix in a sparse matrix format. For instance in the previous example ∂_2 can be written as follows :

$$\begin{bmatrix} 3 & 1 & 0 \\ 4 & 1 & 1 \\ 6 & -1 & 2 \\ 1 & -1 & 0 \\ 1 & -1 & 1 \\ 3 & 1 & 2 \\ 5 & 1 & 0 \\ 2 & 1 & 1 \\ 4 & -1 & 2 \end{bmatrix}$$


 $\partial_n(i,j)$