Computing homology generators with `chom`

Program commands:

The two and three-dimensional commands are `chom2` and `chom3` respectively.
The program `chom` can be compiled using any dimension; no details will be provided here.

Preparing an input file:

The filename `in.dat` is the default input file.
The command line argument `-i FILENAME` overrides this default.

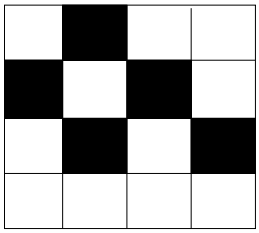
The main input is a list of bitcodes – strings of 0's and 1's separated by spaces.
Each line has $n \cdot d$ bits, where d is the dimension and n is the number of subdivisions in each coordinate direction.

The bitcodes are separated into groups of d bits which indicate which side of the bisecting line the cube falls in each dimension: a 0 indicates the lower half and a 1 the upper half. In the example below, consider the bitcode 0 0 1 1. The 0 0 corresponds to the left lower quadrant of the large cube and then 0 0 1 1 indicates the right upper quadrant of the left lower subcube. Since there are only two subdivisions in each direction, this identifies a specific highest (2) dimensional cube.

The bitcodes **must be sorted** in lexicographical order. To do this simply type the unix command:
`sort FILENAME > NEWFILENAME`

After sorting, a three line header must be added to the beginning of the file.
The first line specifies the dimension, the second line is $n \cdot d =$ number of 0's and 1's per line, and the third line contains the total number of bitcodes of input.

For example, consider the following complex and corresponding input file:



```
2
4
5
0 0 1 1
0 1 0 0
0 1 1 1
1 0 1 1
1 1 0 0
```

Output:

The default setting is to report only the Betti numbers to the display screen.
The command line argument to output generator information for a particular dimension is `-g DIM` where `DIM` represents the dimension. This argument can be invoked multiple times to output generator information for several dimensions from the same computation.

The filename `gen.dat` is the default output file.
The command line argument `-o FILENAME` overrides this default.

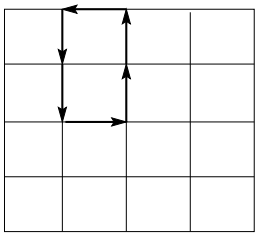
The generator information is output as lines in the following format:

```
x1 x2 ...  xd y1 y2 ...  yd I J D
```

where $(x_1, \ldots, x_d)$ and $(y_1, \ldots, y_d)$ are the coordinates of the diagonal of the D-cell which has incidence number I in the Jth D-dimensional generator.

For example, the output of the previous example is generated by the command:
`chom2 -i myinputfilename -o myoutputfilename -g 1`

The output is:



```
1 2 2 2 1 1 1
1 2 1 3 -1 1 1
1 4 2 4 -1 1 1
1 3 1 4 -1 1 1
2 3 2 4 1 1 1
2 2 2 3 1 1 1
```

Viewing 2d and 3d complexes and generators in `MATLAB`:

The `MATLAB` functions `imageplot2d.m` and `imageplot3d.m` display two and three-dimensional complexes in `MATLAB`. The commands `chco2` and `chco3` read the input file `in.dat` (this cannot be overridden currently) to generate a file `co.dat`. The following matlab commands then display the complex:

```
≫ load co.dat
≫ imageplot2d(n,co)
```

where n is the number of subdivisions in each coordinate direction.

The MATLAB functions `generator1d2d.m`, `generator1d3d.m`, and `generator2d3d.m` display generators. For example, the following MATLAB commands display the generator in the previous example:

```
≫ load gen.dat
≫ generator1d2d(n,gen)
```

where n is the number of subdivisions in each coordinate direction. Note that "gen" can be replaced by other filenames. The data file should only contain data from generators of the same dimension.