

$$V - E + F = 6757 - 13086 + 6331 = 2$$

January 3, 2017

```
[2681,2677,-4299,-2678]
[-2677,2679,-2682,4302]
[2678,2673,-4297,-2674,4298,-6532]
[-2673,2675,-2679,-4301,6535]
[2674,2670,-6530,-2671]
[-2670,2672,-2676,-12524]
[2671,2667,-6529,-2668]
[-2667,2669,-2672,9470]
[2668,2665,6529,-2666,6531,-4298,3933,-3932,4297,4299,-8943,5803,2741,-2740,5804,-2743,
-12509,-3971,-10971,-10968,3970,3965,-10965,-3967,10967,3964,-10964,3959,-10806,-3960,
-6032,6033,11280,-10960,5202,3950,10962,1847,12960,1844,-13048,-1846,-12949,-4992,12948,
-4993,-7395,7394,3938,3934,11870,-3935,-12714,-7437,-9727,-9725,10566,-5141,5408,5139,
5406,5142,5404,5401,12212,-5403,12213,-11614,5400,5396,-11612,4398,-11609,-4399,11610,
10379,12940,10378,12942,10376,-1537,1536,-10377,1539,7184,-7183,-2362,-2358,-11590,2359,
-11591,5159,-11592,-5158,12765,-5156,12207,-4794,508,-507,-4790,-3322,4791,-3324,-5153,
-5150,5962,5152,-5960,-5964,-5149,5148,2321,2316,-9381,2314,9380,2312,9383,-2313,9385,
-5204,9387,9531,9946,-6247,-9945,6245,-10250,6248,10490,6250,-10491,-6733,10489,6734,
10486,2553,-10700,-2552,-10697,-9527,10698,9587,-11579,9585,-529,528,-9586,11545,
11578,5347,-12232,-5344,-11171,-5349,-8997,-8994,359,-358,-8992,-361,8993,-5350,-11520,
8064,11522,7742,-10485,-7743,-5542,-5540,3442,3439,-5537,-3441,5539,8056,-10959,8053,
10958,-8054,-9989,6976,9990,-6975,-1678,1679,-6978,-8824,-9101,-8826,9100,-8829,-9750,
9749,-11536,9753,8834,-8832,-9755,-8835,-8851,-8849,3678,-3677,-4716,-4713,43,-42,-1638,
-45,-1635,1637,-9686,4145,-9330,4143,-9326,4140,-9324,-4142,9325,-1535,11008,1534,
-11009,9428,5058,-5057,-6030,-5059,6031,-5061,10230,-5065,-9925,-8561,12422,8560,-12421,
-9920,10882,9922,-10881,-10884,12386,-10886,-6612,6611,10259,-10260,-4643,4641,8047,4644]
[42,-43,46]
[45,-44,-7324,-49]
[44,-46,48,-3676,3677]
[-48,47,-3679,50,-3682,54,4356]
....

[-56,55,4358,59,3684,2662,-2664,-2661]
[-55,57,-58,6615]
[58,-59,7325,7327,-11319,-5477,4518,4514,-5472,-4516,5474]
[358,-359,362]
```

Figure 1: A portion of the computed list of 2-cells of Figure 2, each one described by an array of signed indices of edges. Each one correspond to a column of the signed boundary matrix  $\partial_2$ , with elements in  $\{-1, 0, 1\}$ . The matrix  $\partial_2$  is  $13086 \times 6331$ , and contains 82,847,466 elements, including 26,172 non-zeros, with a filling ratio equal to 0.03159%. The size of the representation is exactly  $2E$ .

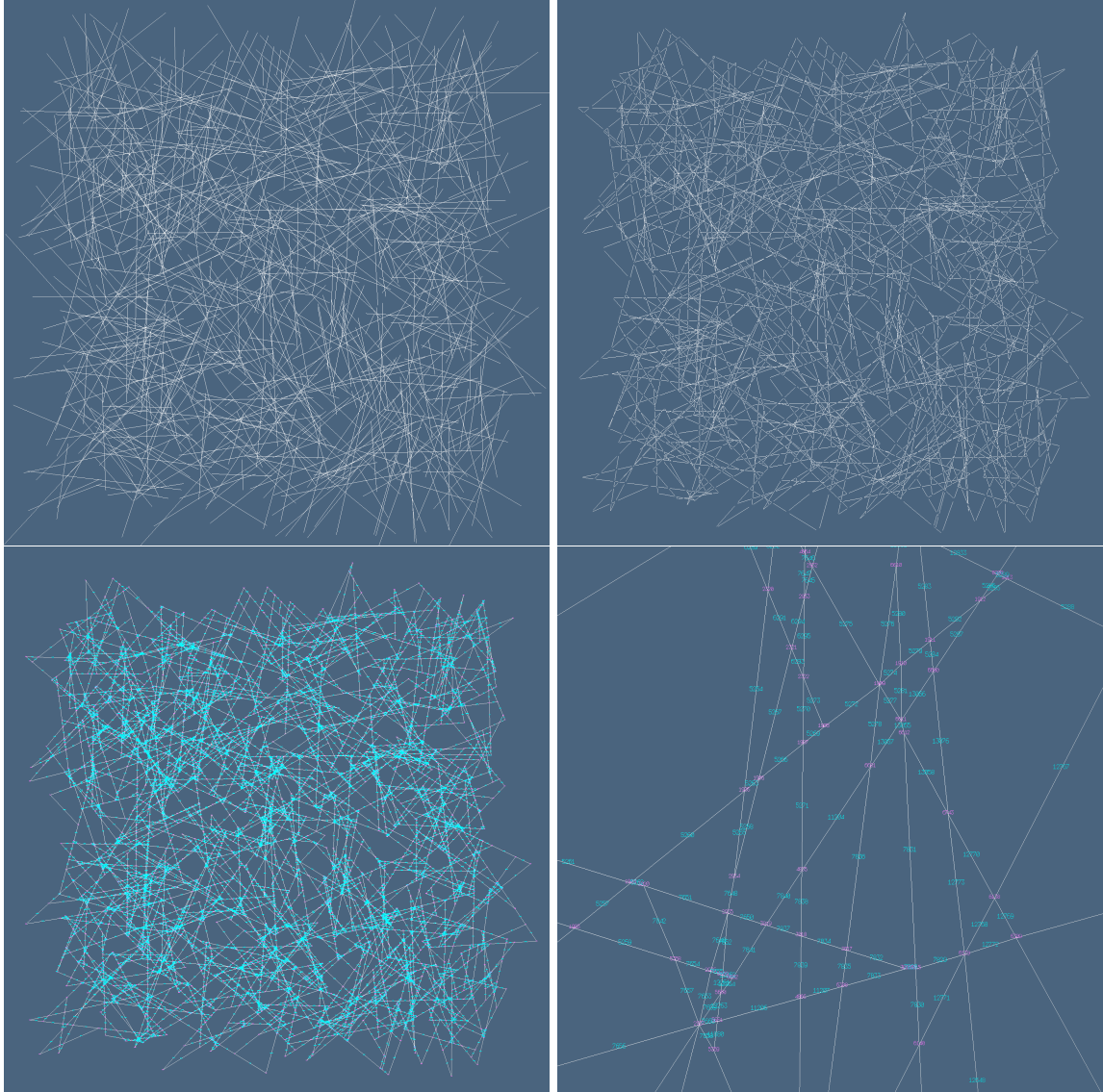


Figure 2: The 2D regular(ized) complex generated by a random arrangement of lines: (a) the arrangement of lines; (b) the 2-connected subgraph of the divided lines; (c) the numbering of vertices and edges; (d) a close view of an arrangement portion.

# 1 Planimetric 2-complex

Here it is shown both the input and the output of the simplest example of architectural data. The same approach would hold for cartographics applications at any scale (see Figures 4 and 5).

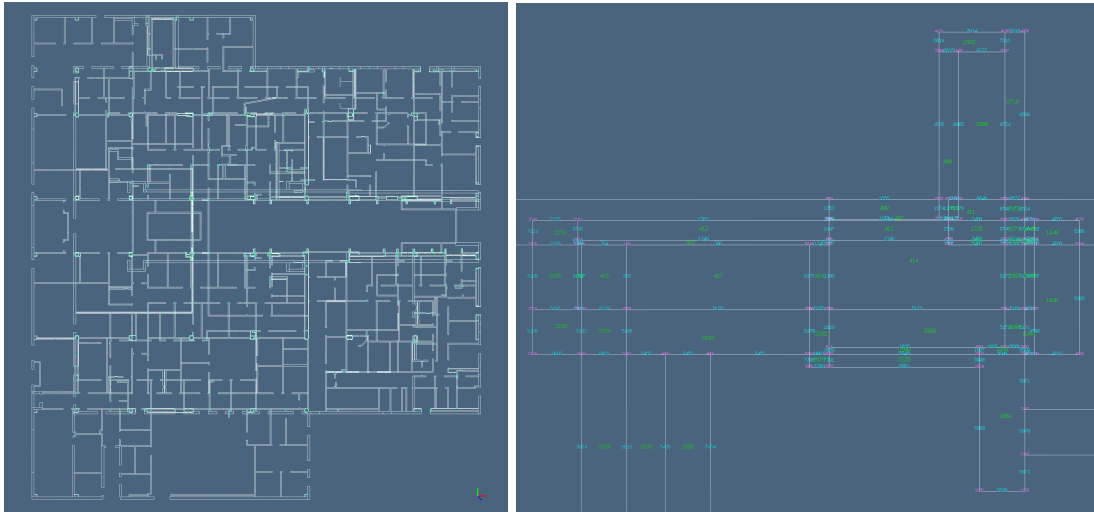


Figure 3: .

## 1.1 Input data

The input

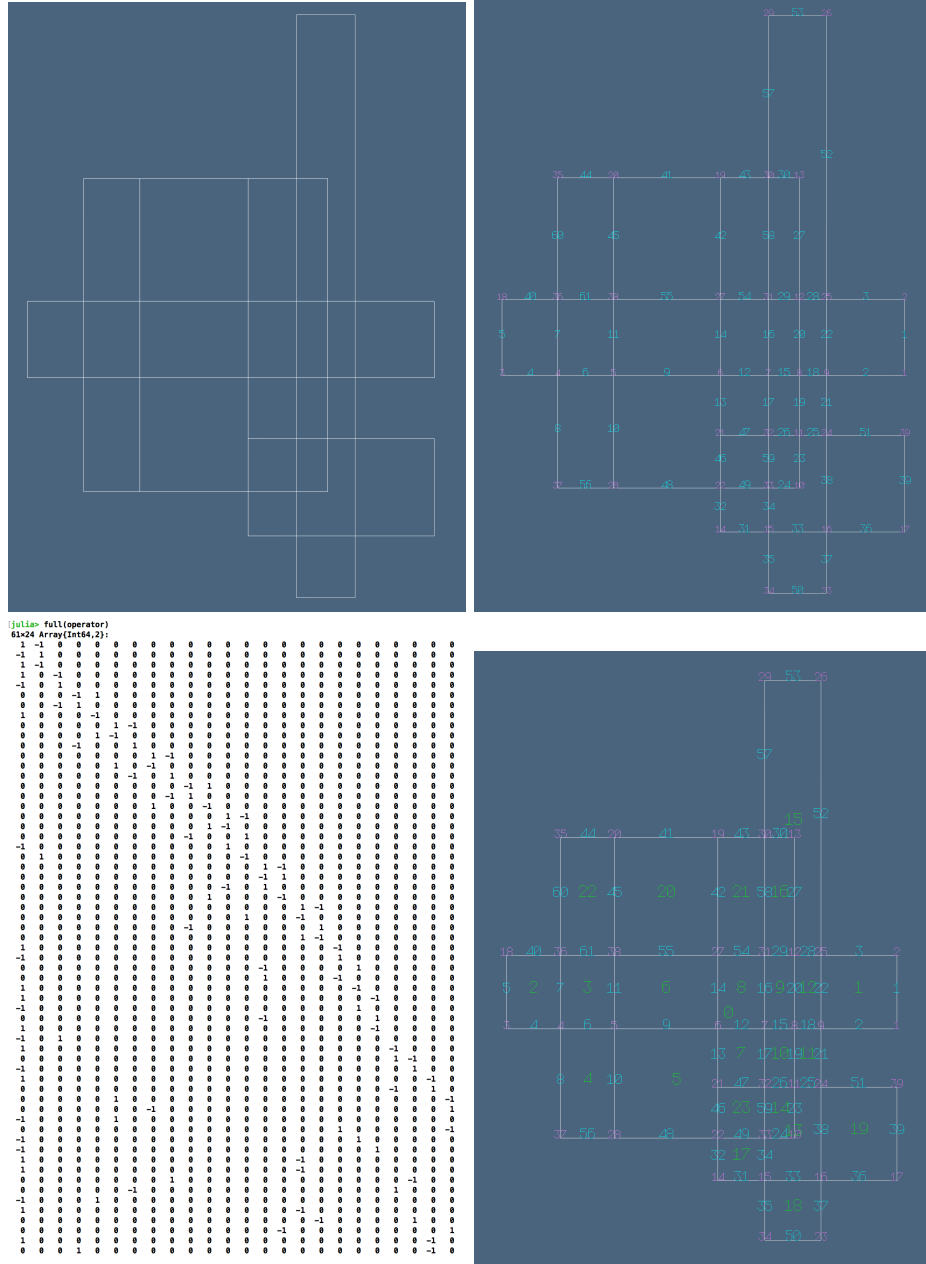


Figure 4: Cellular 2-complex built starting from a set of lines. (a) the input data, i.e. partially or totally superimposed lines; (b) 1-complex after line intersections; (c) matrix of  $\partial_2$  operator; (d) 2-complex produced by LAR calculi.

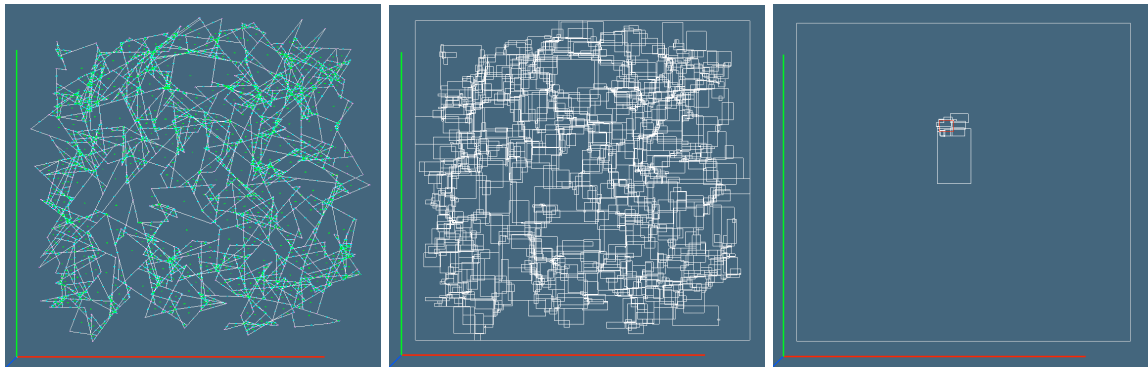


Figure 5: Fast intersection query of containment boxes of 2-cells using Interval Trees: (a) a random 2D decomposition generated by an arrangement of lines; (b) the containment boxes of all 2-cells; (c) the result of an intersection query with the red box.