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

December 13, 2016

```
[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, each described by an array of signed indices of edges. Each one correspond to a column of the signed buondary matrix ∂_2, with elements in $\{-1, 0, 1\}$. The matrix ∂_2 is 13086×6331, 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 $2E$.
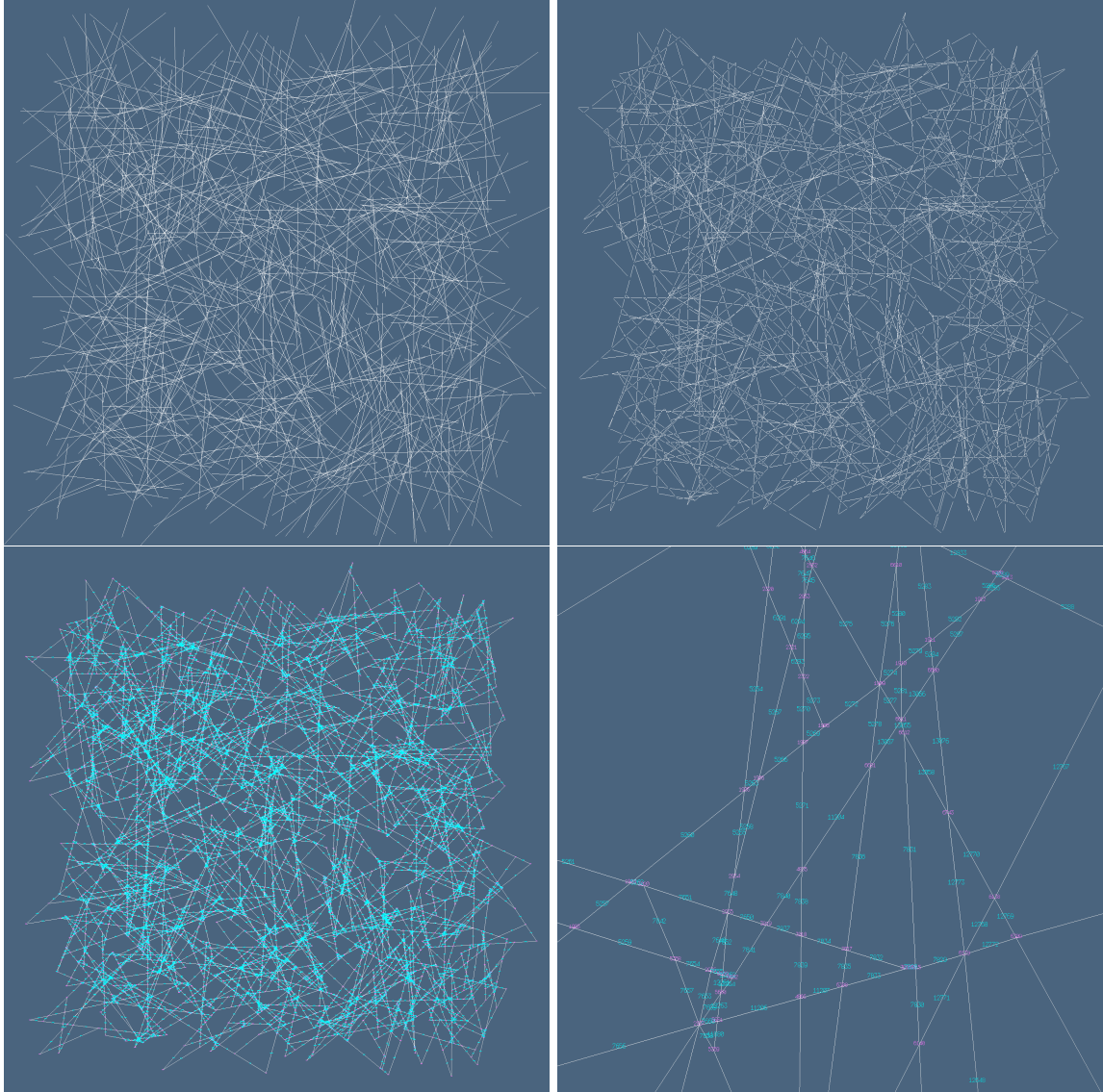
Figure 2: The 2D regular(ized) complex generated by a random arrangement of lines: (a) the arrangement of lines; (b) the 2-connected subgraph of the divided lines; (c) the numbering of vertices and edges; (d) a close view of an arrangment portion.