Layouts for GD00 Graph-Drawing Competition

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All work was done using our program package Pajek, which is freely available at:
`http://vlado.fmf.uni-lj.si/pub/networks/pajek/`

All layouts in EPS and SVG format and the complete report in PDF are also available at:
`http://mrvar.fdv.uni-lj.si/pub/gd/gd00`

How layouts of graphs were obtained

Graph B (A and B) by Brandes

The essential part of both graphs A and B are the green vertices. But there are to many arcs among them to produce a clear picture.

We first tried with circular presentation. To reveal internal structure of green subgraph and to determine the ordering of vertices on the circle we computed d_2 on the green subgraph and applied TSP (Travelling Salesman Problem) algorithm on this matrix.

$$d_2(u, v) = \frac{|N(u) \oplus N(v)|}{|N(u) \cup N(v)|} \qquad (1)$$

$N(v)$ is the *neighborhood* of vertex $v \in V$:

$$N(v) = \{u \in V : (v : u) \in E\}$$

($\oplus$ denotes the symmetric difference, $\cup$ denotes union)

Since there can exist different clusters inside the green set of vertices we extended the d_2 matrix with some additional vertices with equal distance to all green vertices. Some vertices were repositioned manually according to connections to yellow and blue vertices on the circular net. From obtained pictures we can see that neighbouring vertices have similar patterns of arcs (see Figures 1 and 2 – a_circle.eps and b_circle.eps). Vertices having loops are drawn as boxes (vertices 5 and 11 in graph A) other as circles. Different gray colors are used to show the frequency of contact:

- Black: 1 - weekly
- 75% Gray: 2 - biweekly
- 50% Gray: 3 - monthly
- 25% Gray: 4 - quarterly

The ordering of green vertices obtained by TSP algorithm we used also in matrix representation of graphs A and B. It seems that the matrix representation is more appropriate for dense (parts of) graphs (see Figures 3, 4, 5 and 6 – a_mat.eps and b_mat.eps). In the matrix representation the same shadowing is used as in the graph layout.

Graph A by Himsolt

First we found out that graph consists of 26 weakly connected components. After removing loops from the graph we got acyclic graph. On the acyclic graph we used standard algorithms to compute layers and position vertices into layers in order to minimize total length of lines. Some manual repositioning of vertices was used to avoid some line crossings. Vertices having loops are drawn as ellipses other as rectangles. The complete layout is presented in Figure 7 (passau1.eps). Since graph consists of several components and labels are very small, some additional layouts of parts of network (top, middle and bottom) containing some components are shown in Figures 8, 9 and 10 (passau2.eps, passau3.eps and passau4.eps).

We also produce pictures of this graph in Scalable Vector Graphics (SVG) format besides EPS pictures. Pictures passau1.svg, passau2.svg, passau3.svg, and passau4.svg can be found on the Web page with GD99 report:

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http://mrvar.fdv.uni-lj.si/pub/gd/gd00
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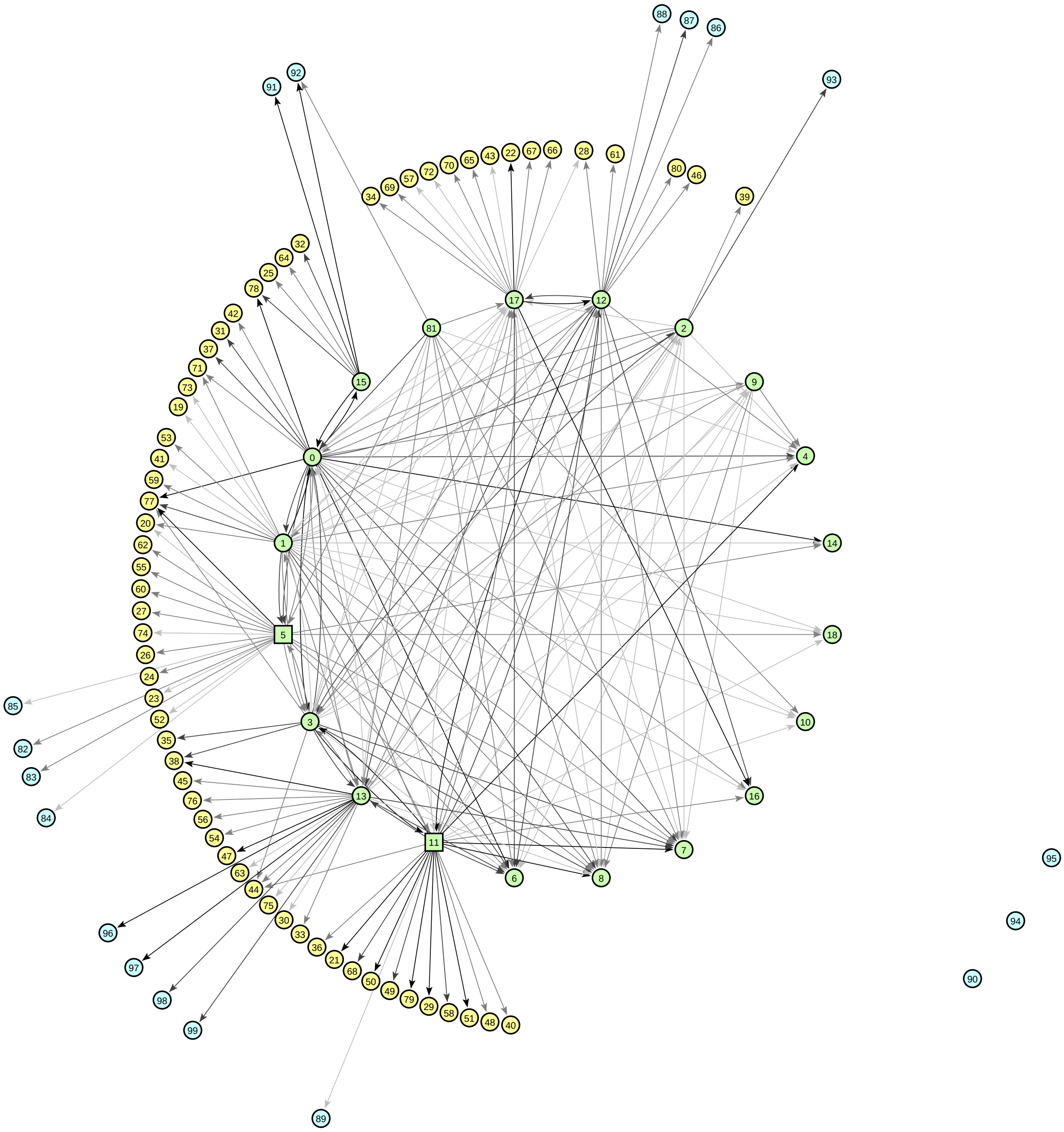

Figure 1: Graph A - circular layout.

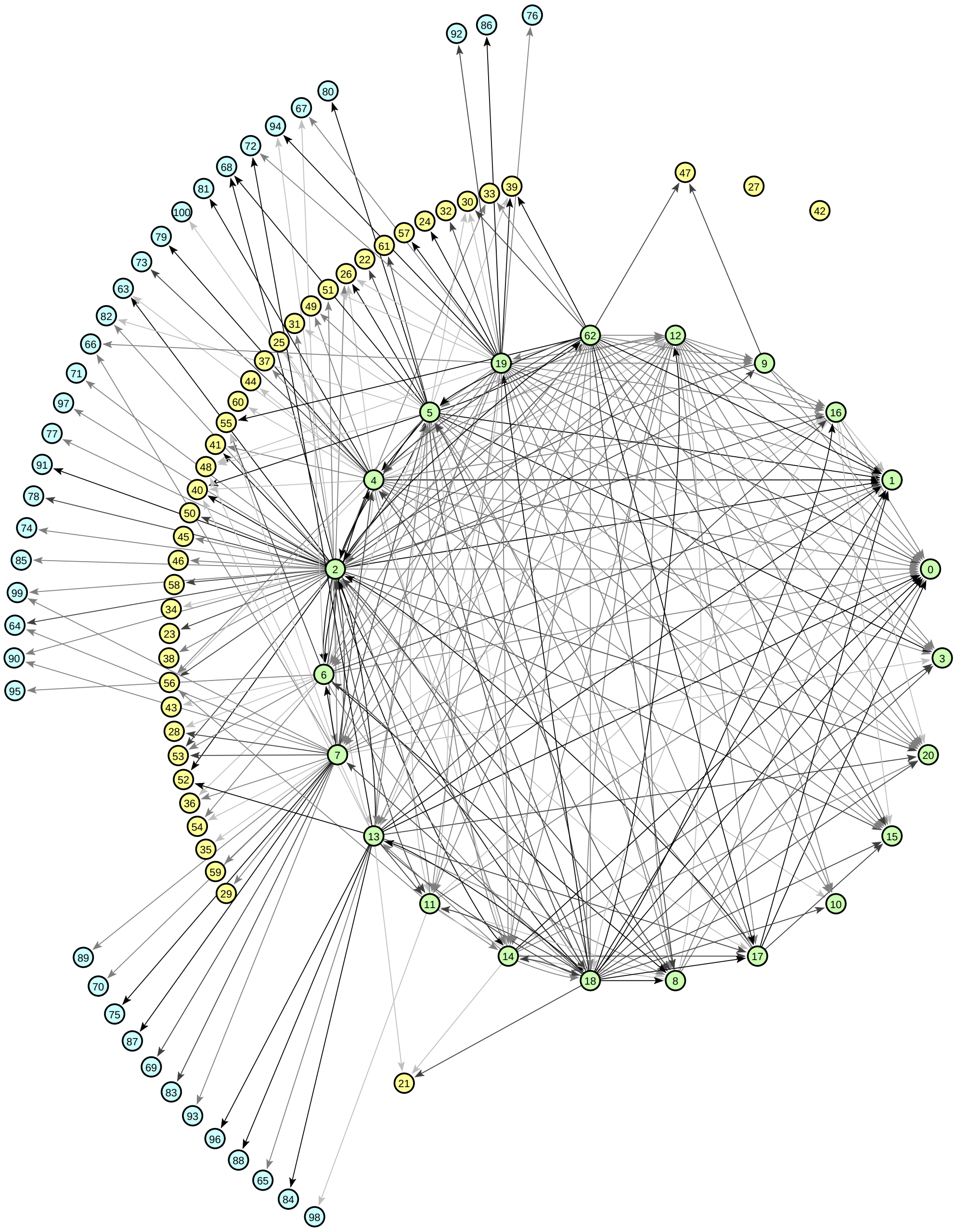

Figure 2: Graph B - circular layout.

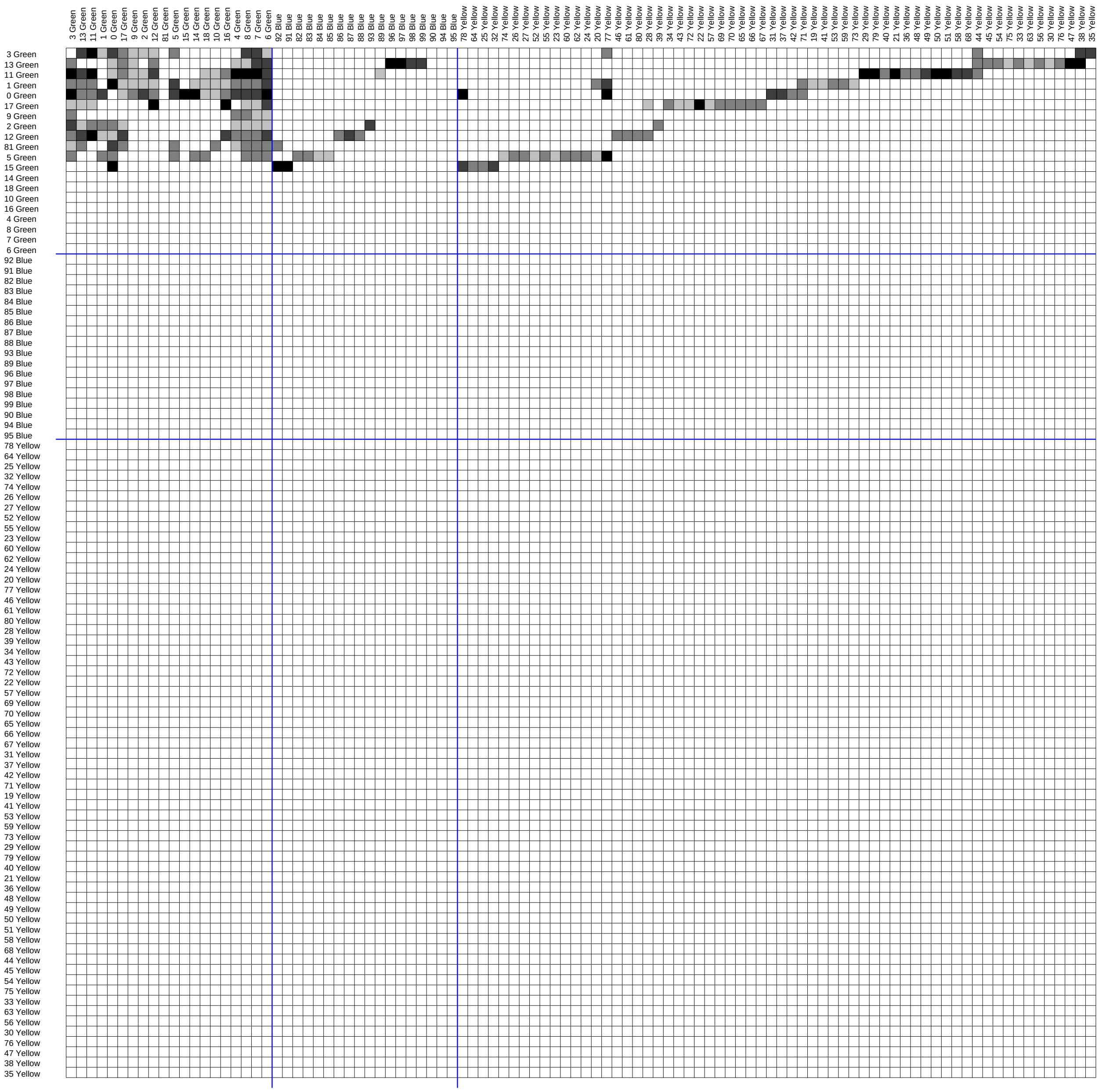

Figure 3: Matrix representation of graph A.

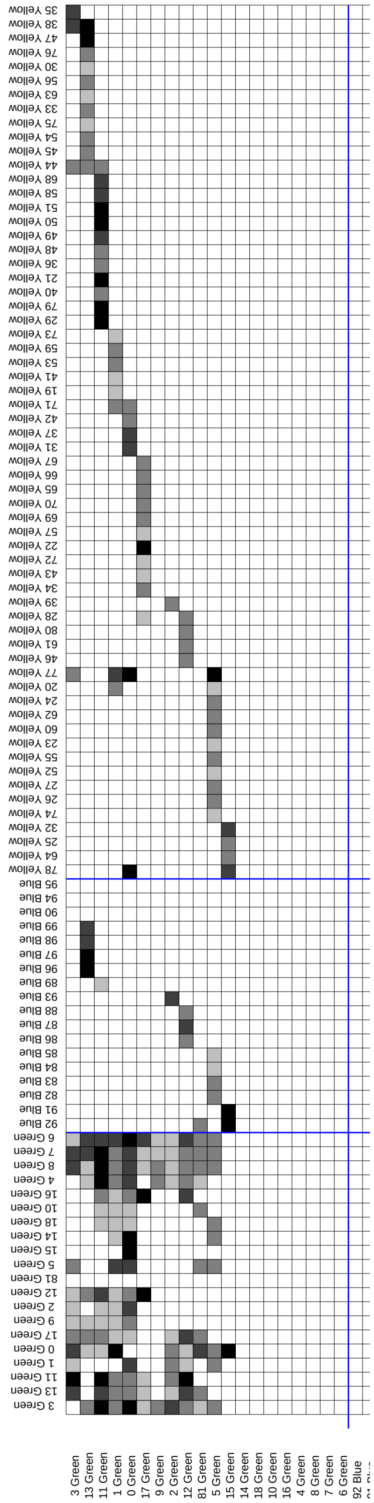

Figure 4: Matrix representation of non empty part of graph A.

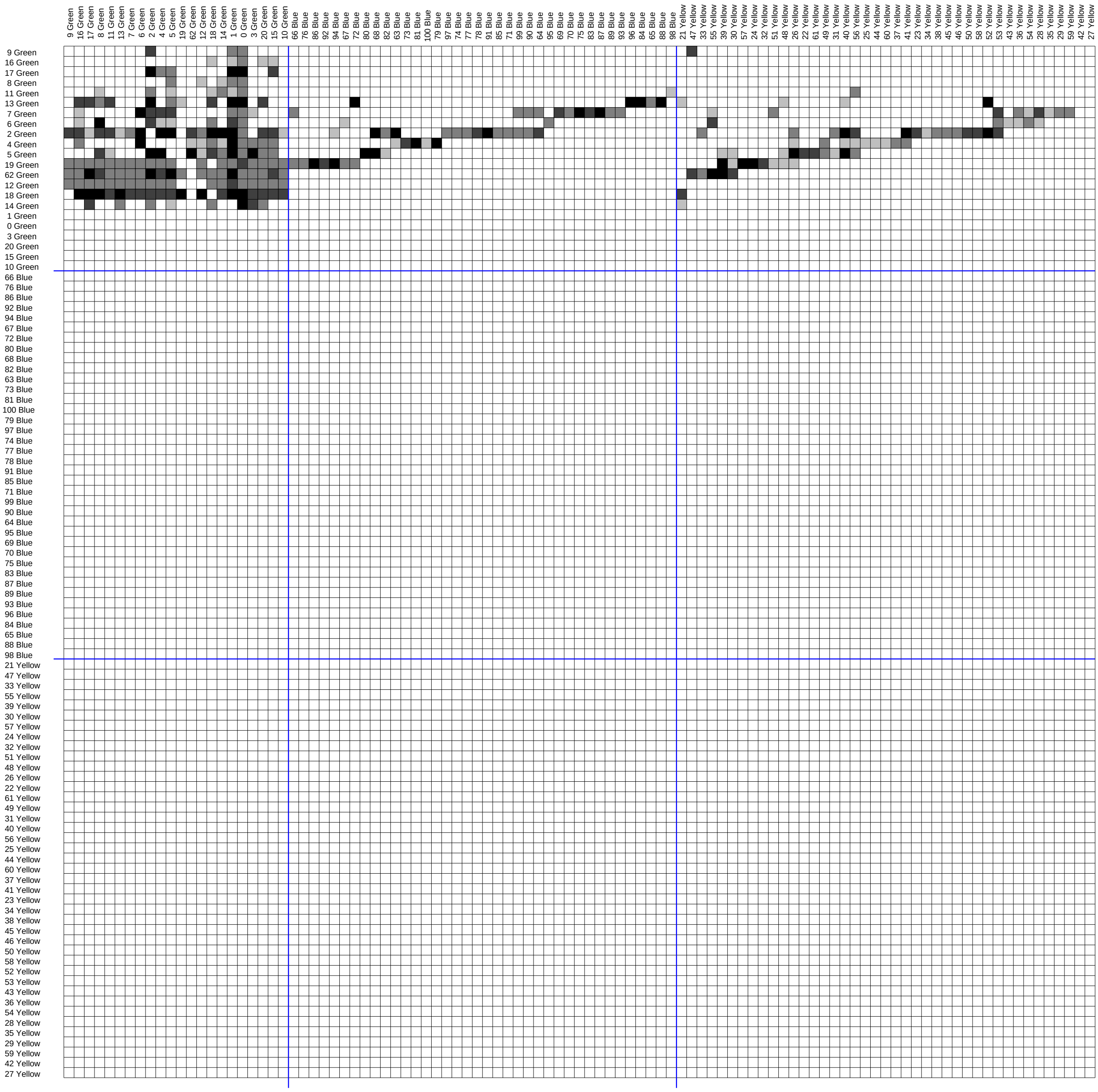

Figure 5: Matrix representation of graph B.

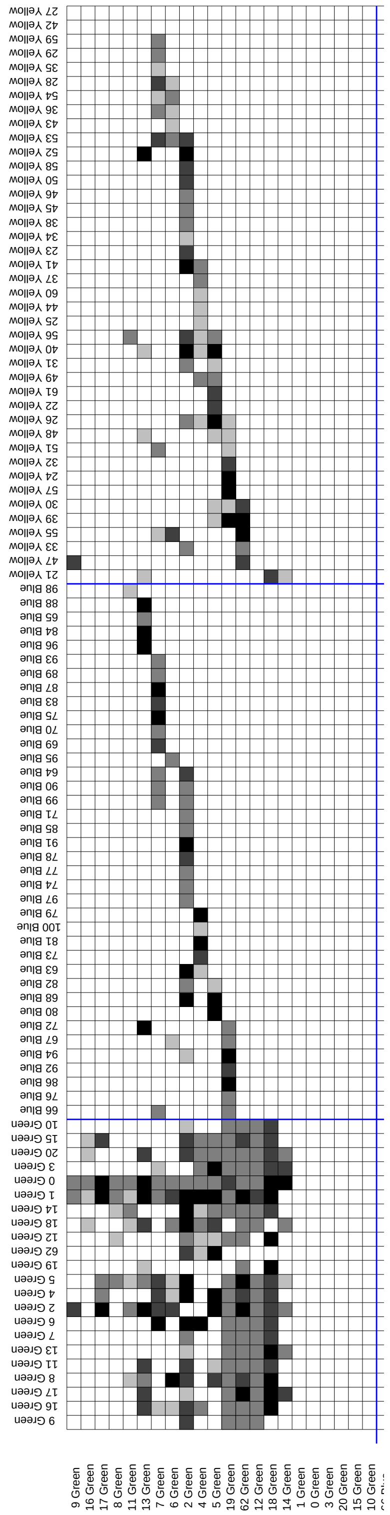

Figure 6: Matrix representation of non empty part of graph B.

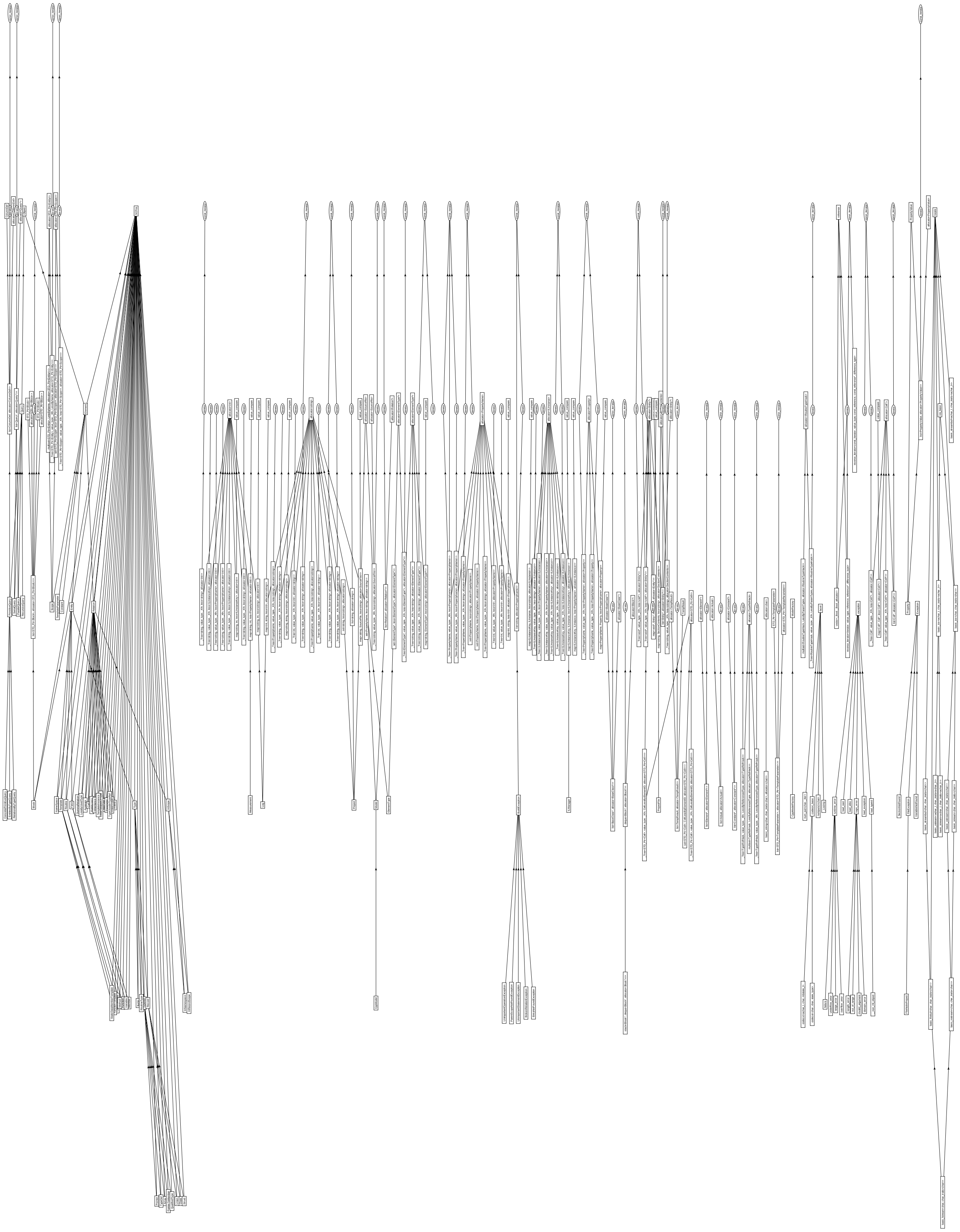

Figure 7: Complete layout of Himsolt graph A.

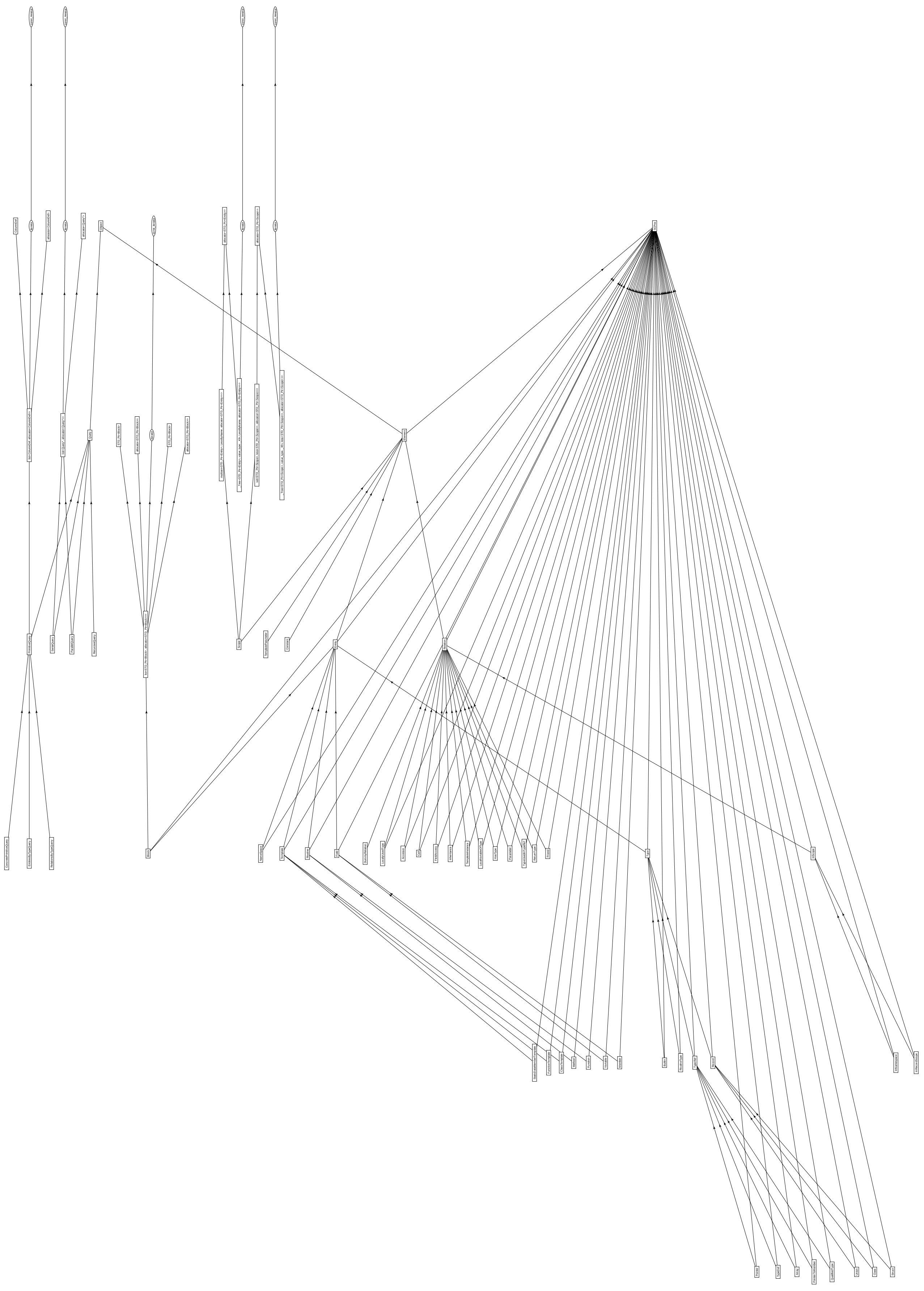

Figure 8: Upper part of Himsolt graph A.

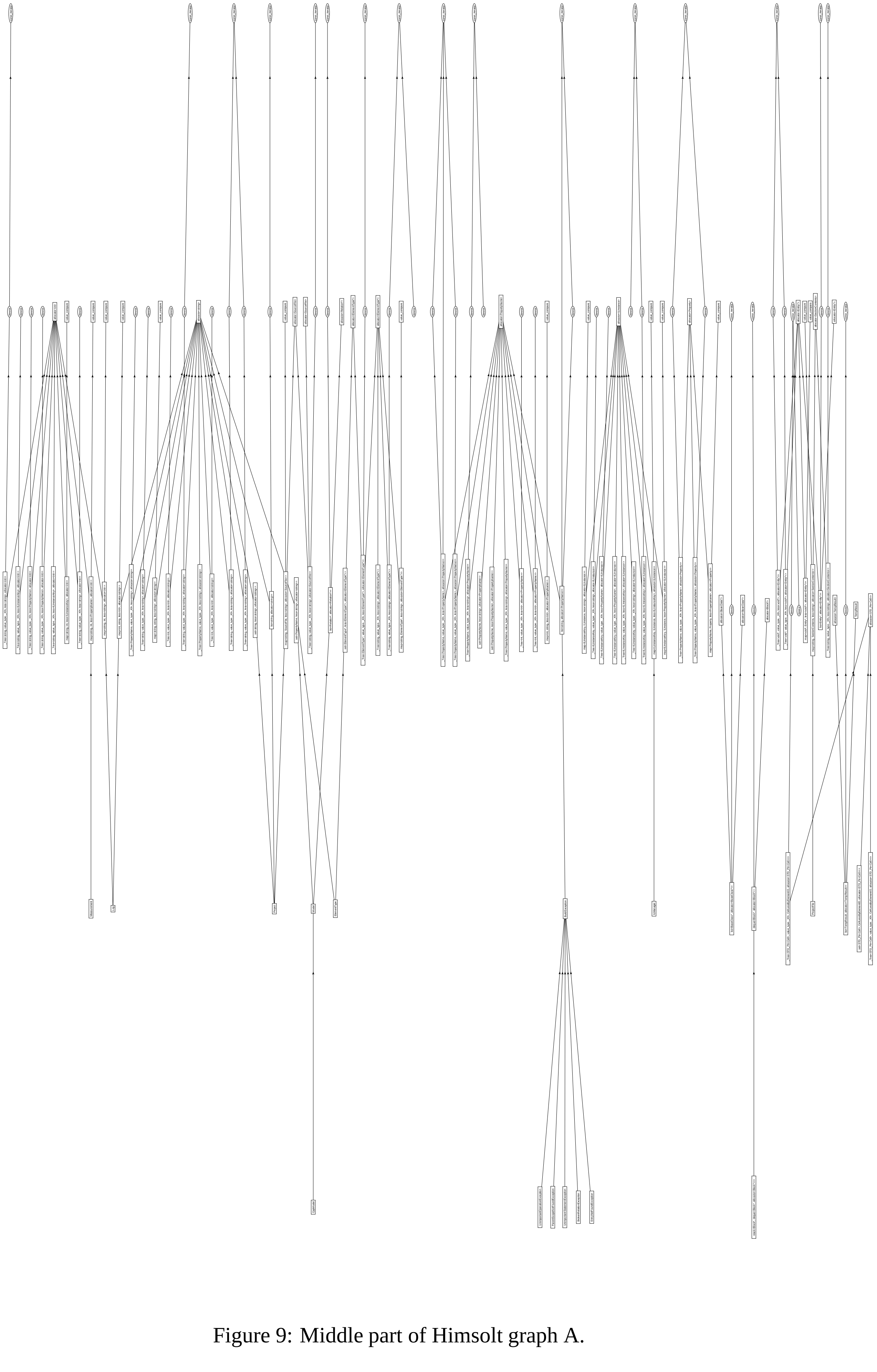

Figure 9: Middle part of Himsolt graph A.

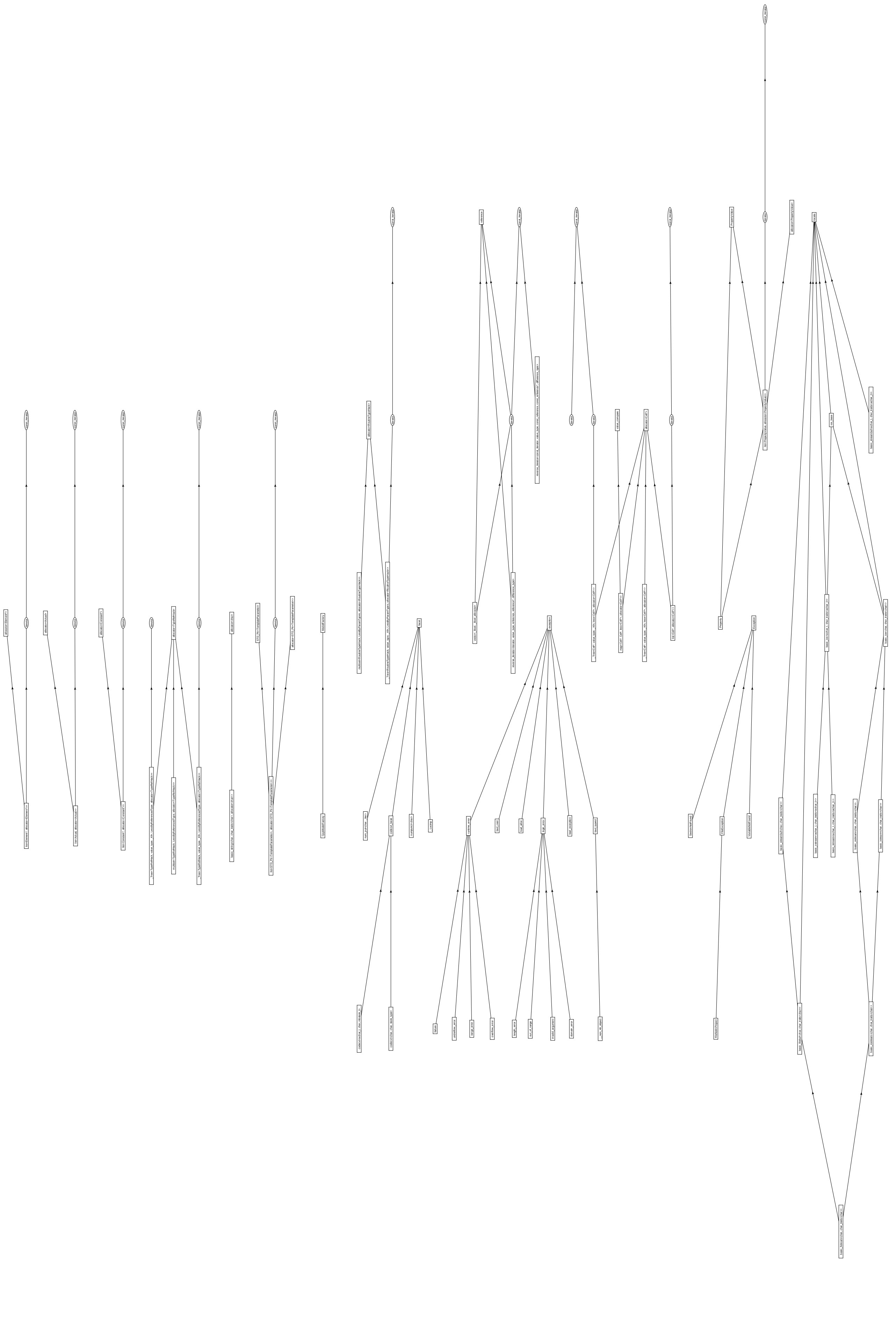

Figure 10: Bottom part of Himsolt graph A.