Compact Drawing of Clustered Layered Graphs

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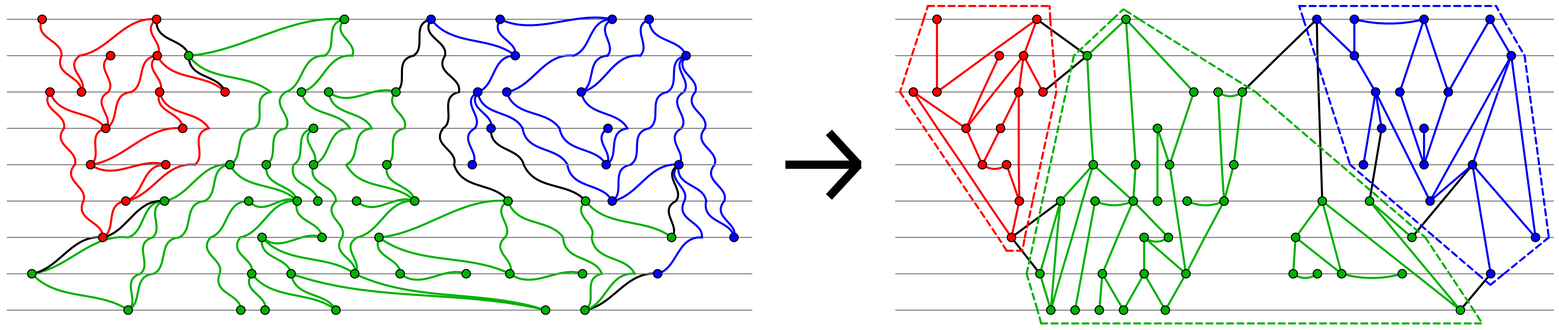
Problem

Input:

embedded graph $G(V, E)$ with disjoint clusters $C_1 \cup ... \cup C_m = V$ and layers $\lambda: V \rightarrow \{1, 2, ..., k\}$



Output:

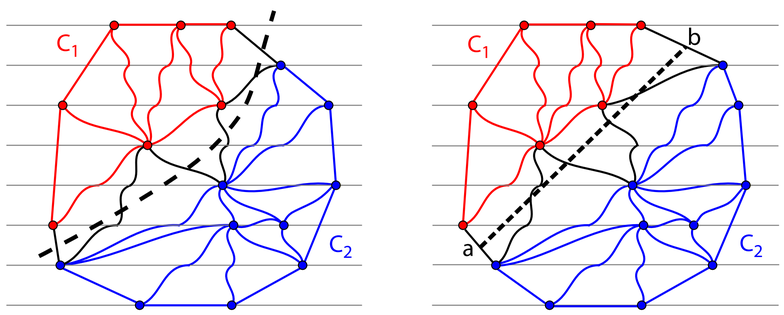
drawing with straight line edges and non-intersecting convex regions

Quick & Dirty: Linear-Time Recursion

Restriction

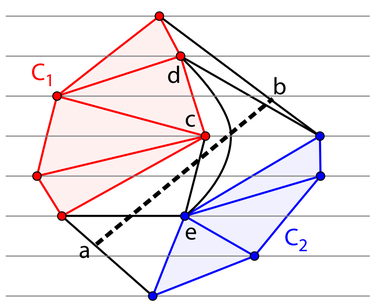
G must be triangulated and the *cluster graph* of G must be acyclic. This graph has an edge (C_i,C_j) if on some layer a vertex or edge of C_i lies to the left of a vertex or edge of C_j.

Approach



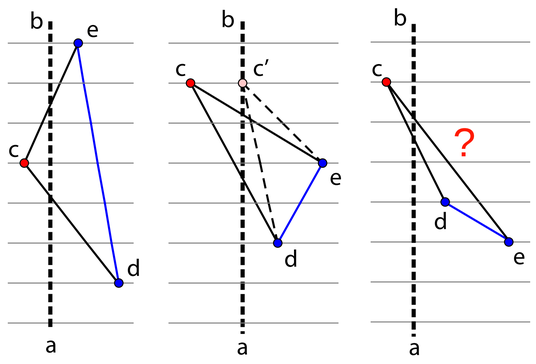
Recursively separate clusters by lines that divide the given convex boundary P of the outer face. Draw resulting subgraphs separately.

Problem



Edge *ed* cannot be straightened if C_1 and C_2 are drawn separately into polygon P.

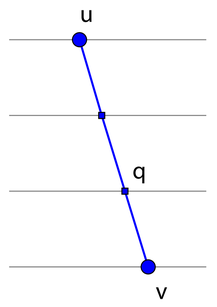
Solution



There are 3 cases when a face is split. Cases 1 & 2 are easy. Case 3 cannot occur since the cluster graph is acyclic!

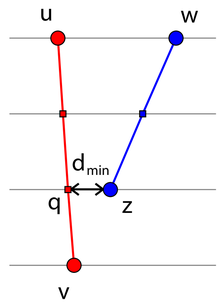
Slow & Nice: Linear Programming

$O(n)$ constraints



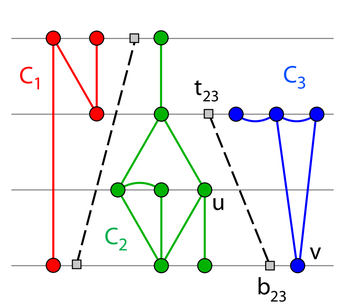
make edges straight

$$\text{RelPos}(q,u,v) = \begin{vmatrix} q_x & \lambda(q) & 1 \\ u_x & \lambda(u) & 1 \\ v_x & \lambda(v) & 1 \end{vmatrix} = 0$$



maintain original embedding

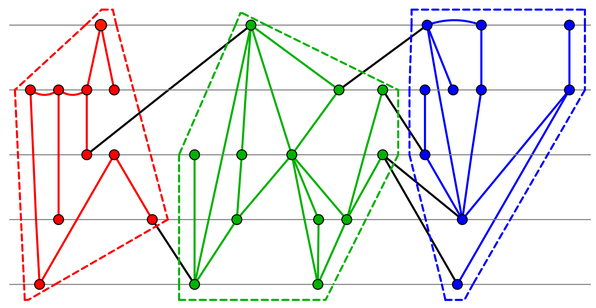
$$u_x + d_{\min} \le w_x$$
$$q_x + d_{\min} \le z_x$$



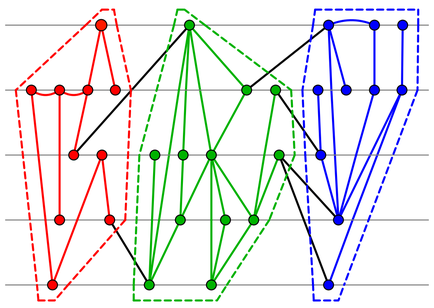
keep convex hulls disjoint

$$\text{RelPos}(u,b_{23},t_{23}) > 0$$
$$\text{RelPos}(v,b_{23},t_{23}) < 0$$

Objective functions



optimize for “nice” angles



optimize for small angles

Check our Java-Applet at: http://i11www.ira.uka.de/clusteredgraph

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