IPSep-CoLa: An Incremental Procedure for Separation-Constraint Layout of Graphs

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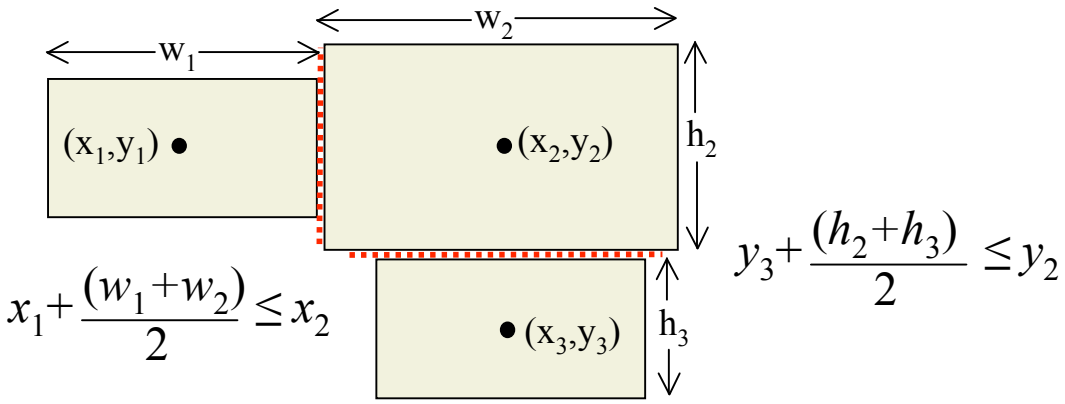
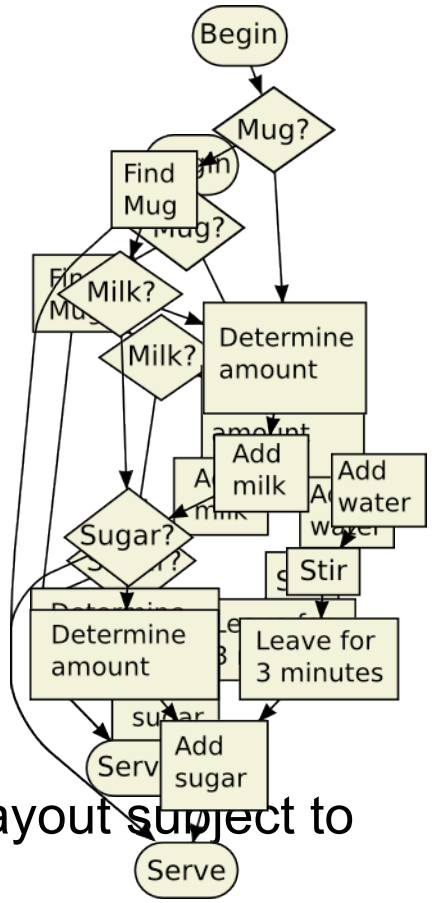
Constraint-based Graph Layout

- Separation constraints: $x_1+d \le x_2$, $y_1+d \le y_2$ can be used with *force-directed layout* to impose certain spacing requirements

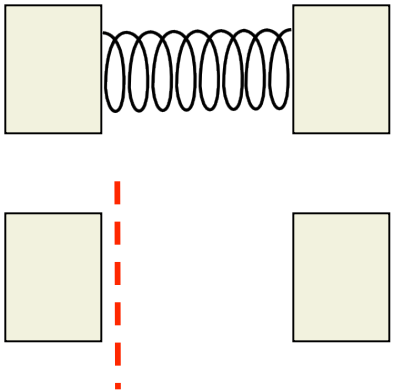


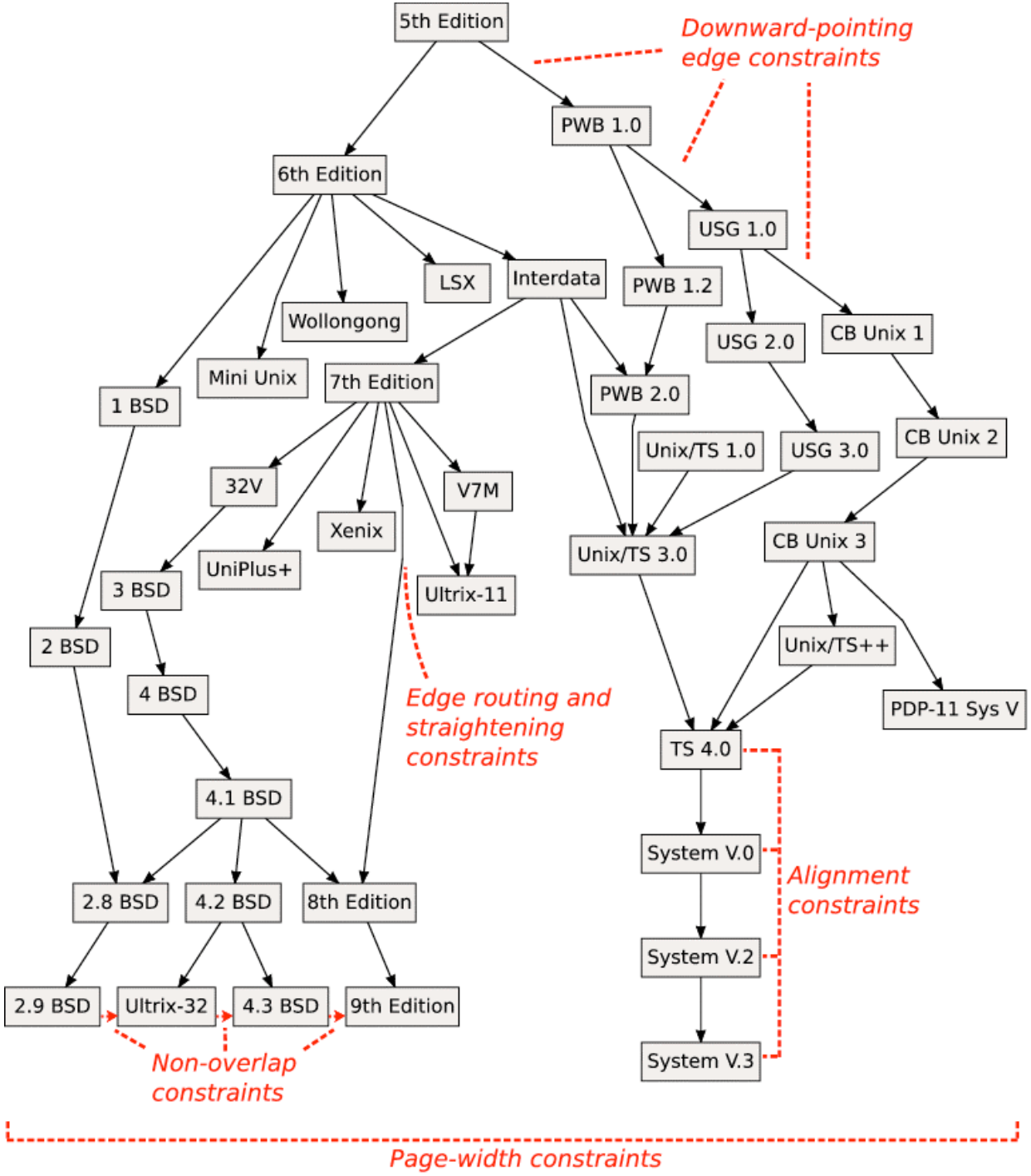


- In this talk we present:
  - A fast algorithm to perform *stress-majorization* layout subject to separation constraints
  - Applications of constrained graph layout

Constraint-based Graph Layout

- Constraints are not springies, they must be satisfied
- Springies are a modification of the goal function
- Constraints (in the OR sense) are separate (in)equalities subject to which the original goal function is optimised
- Springies:
  - Sugiyama and Misue (1995), Ryal et al. (1997), etc…
- Constraints:
  - He and Marriott (1998); Dwyer and Koren (2005); Dwyer, Koren and Marriott (2006)

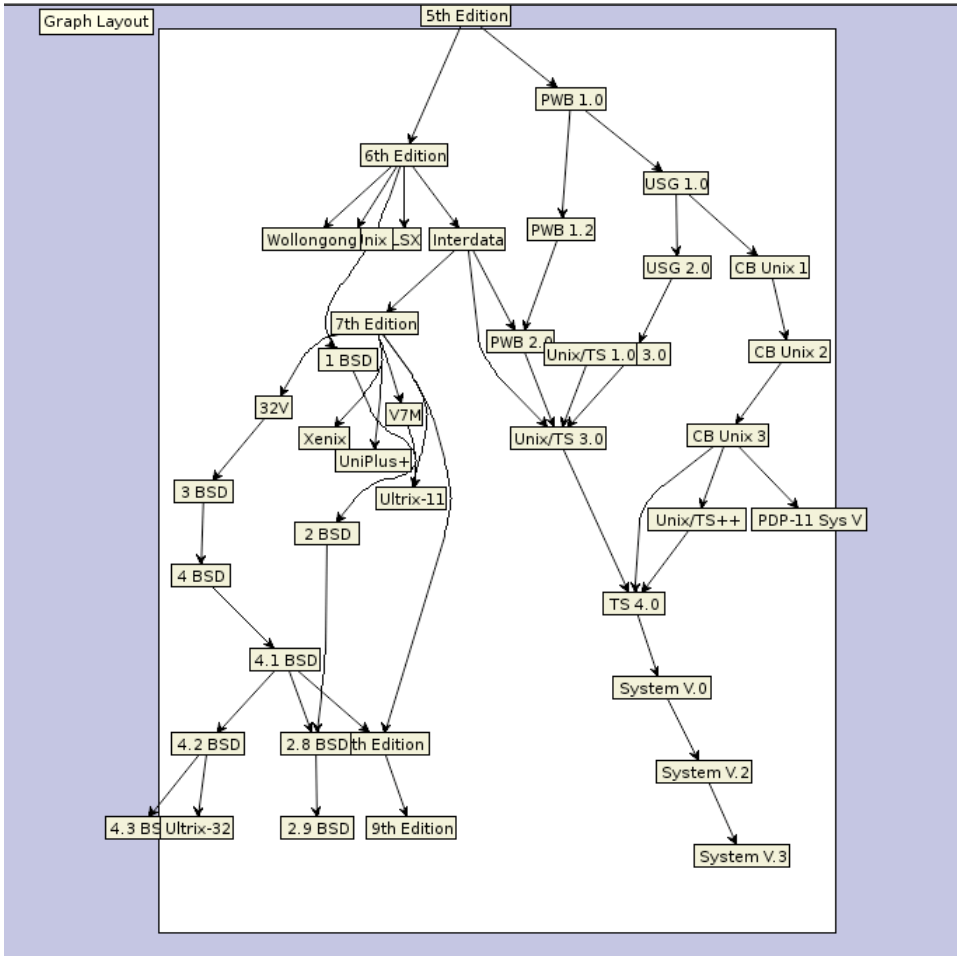




“Unix” Graph data From www.graphviz.org

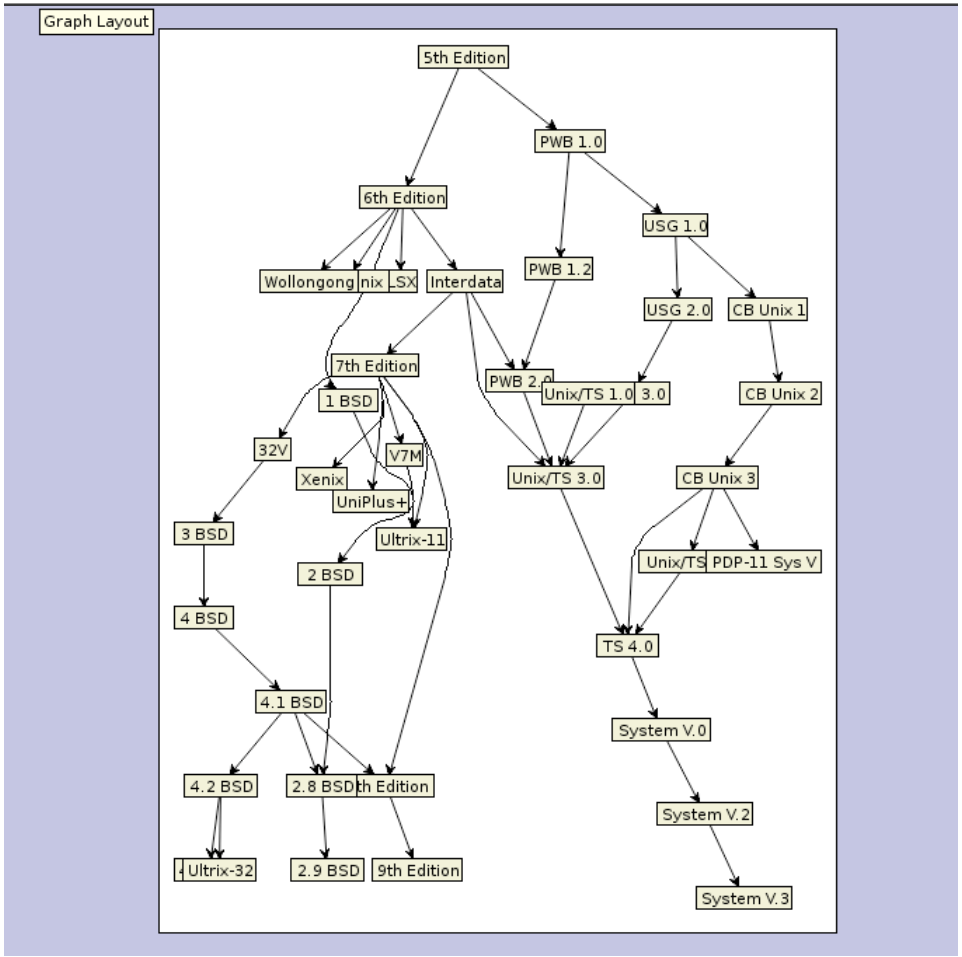
Constraint-layout in an interactive system

Downward-pointing edge constraints



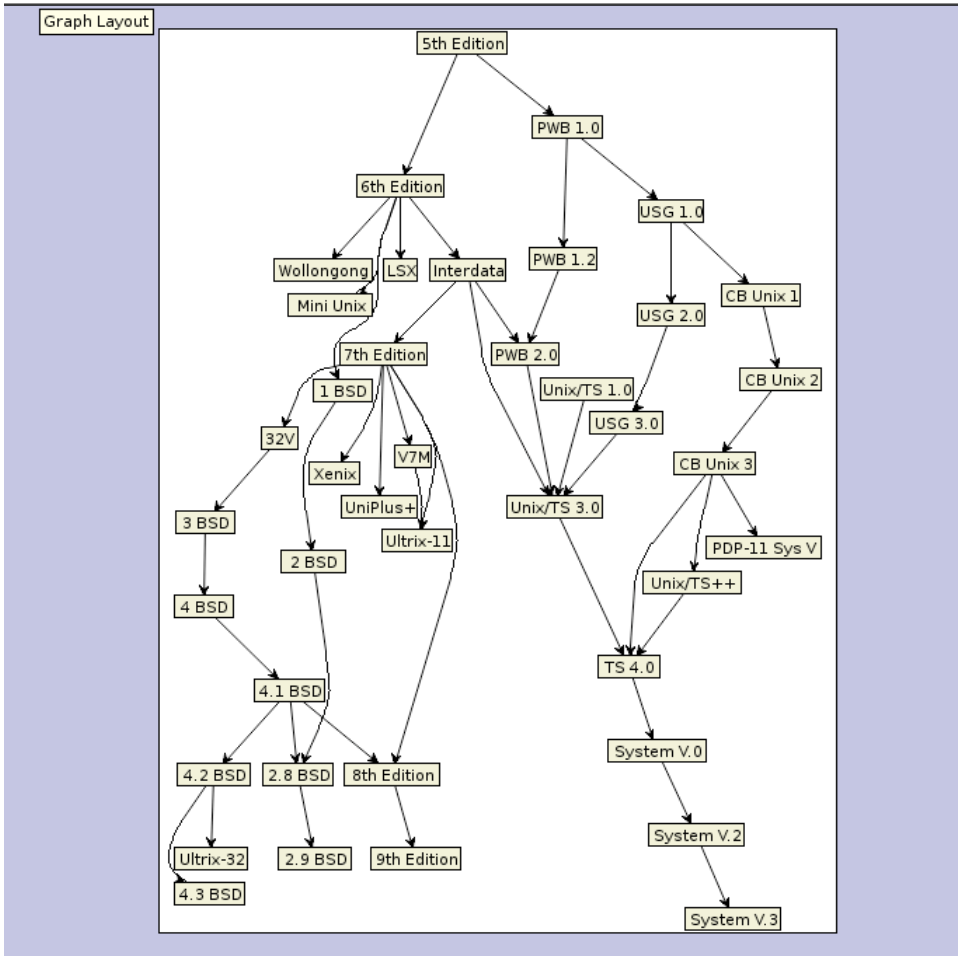
Constraint-layout in an interactive system

Page-boundary constraints



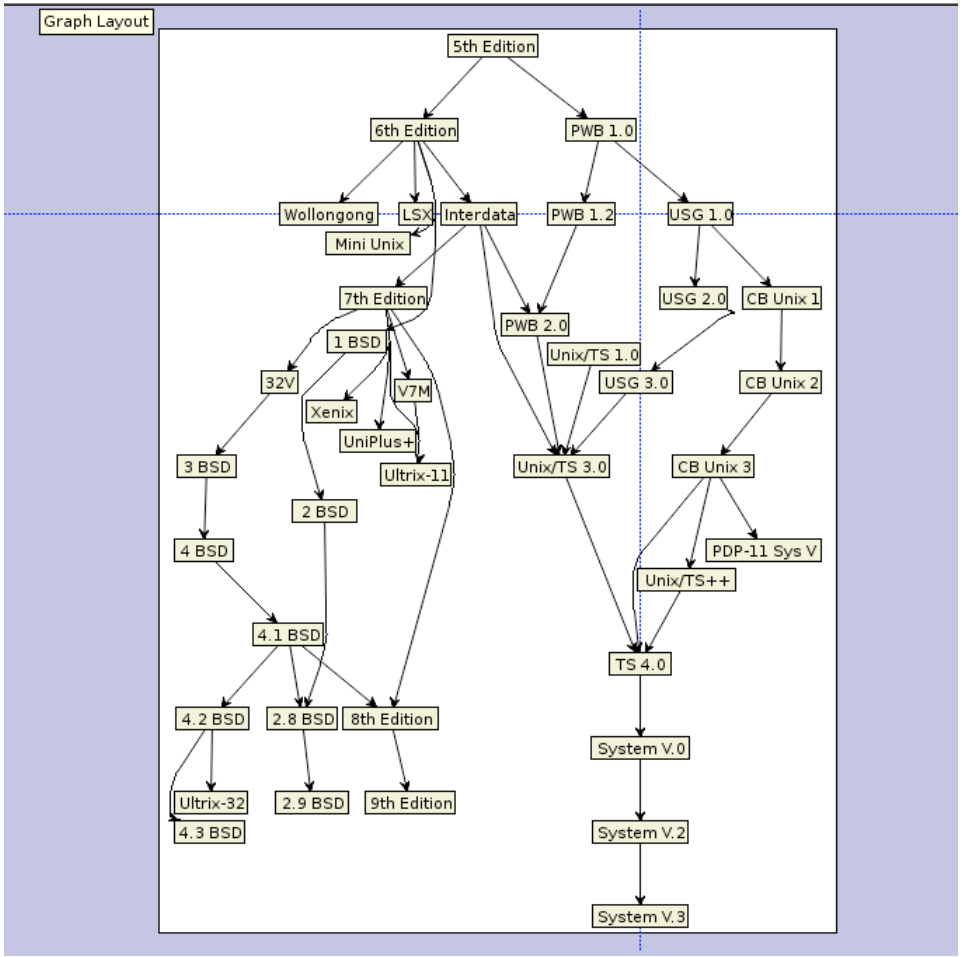
Constraint-layout in an interactive system

Non-overlap constraints

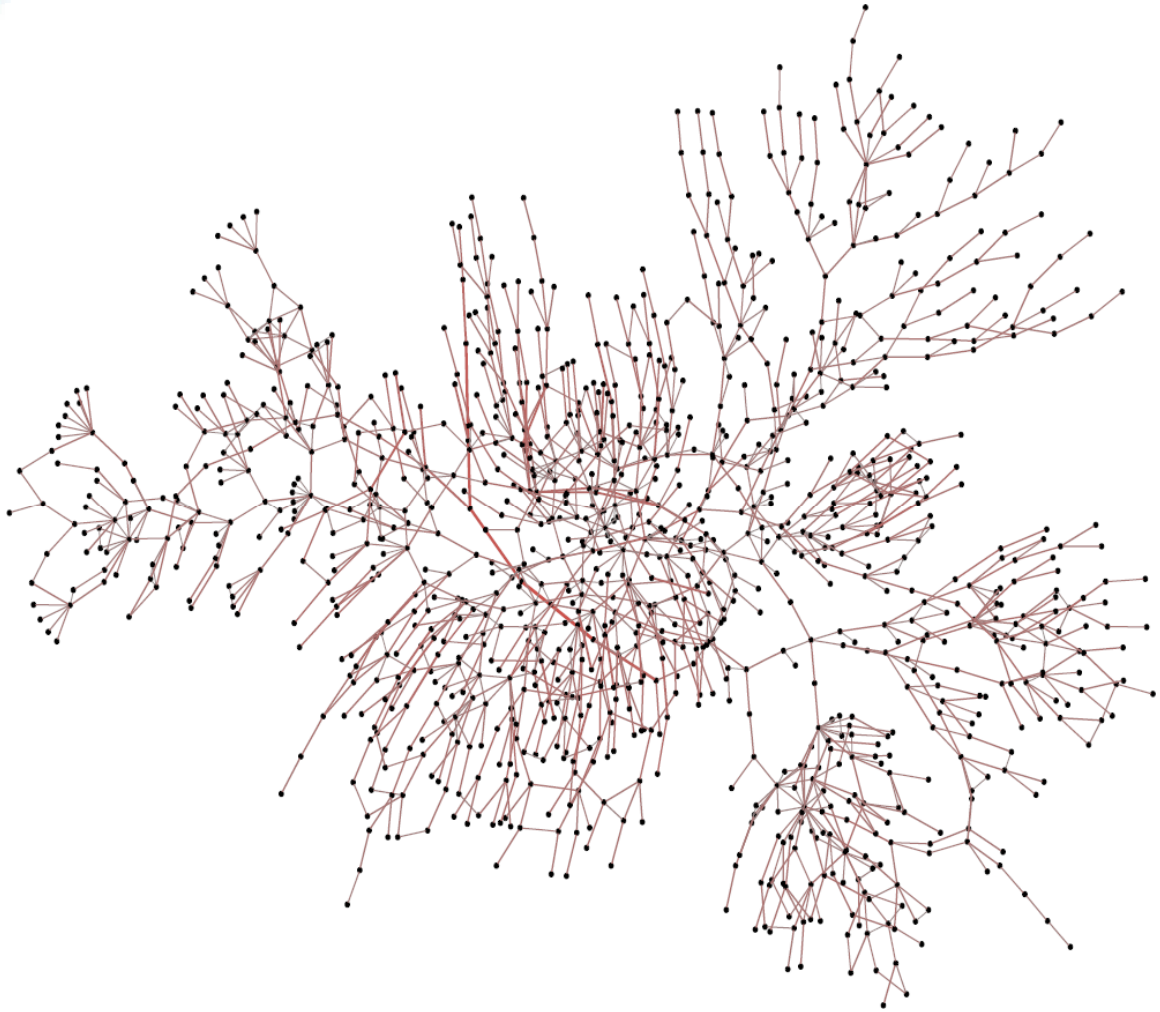


Constraint-layout in an interactive system

Alignment constraints



Drawing large directed graphs

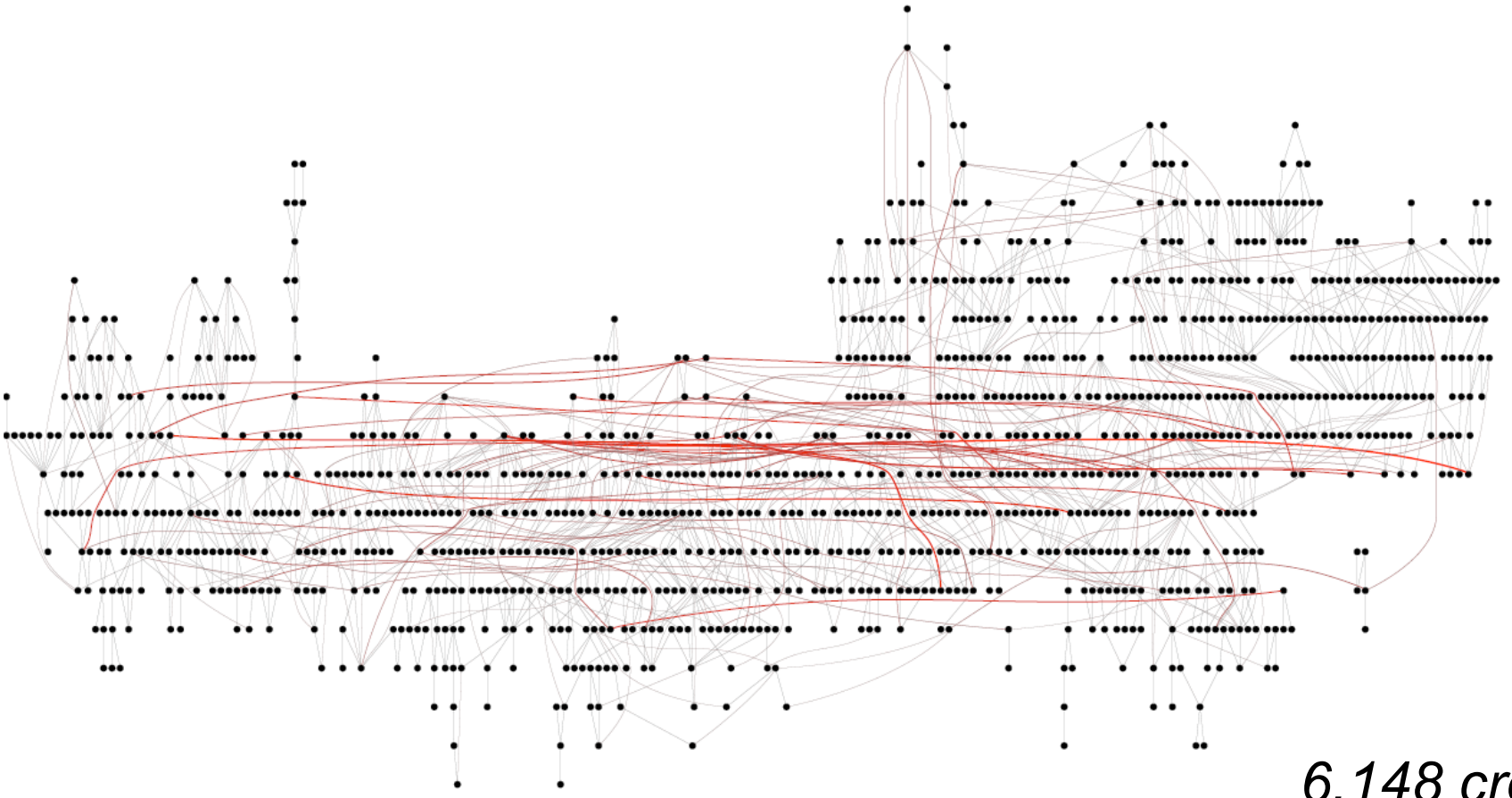


Unconstrained layout

1,142 crossings
Stress=39,954

Drawing large directed graphs

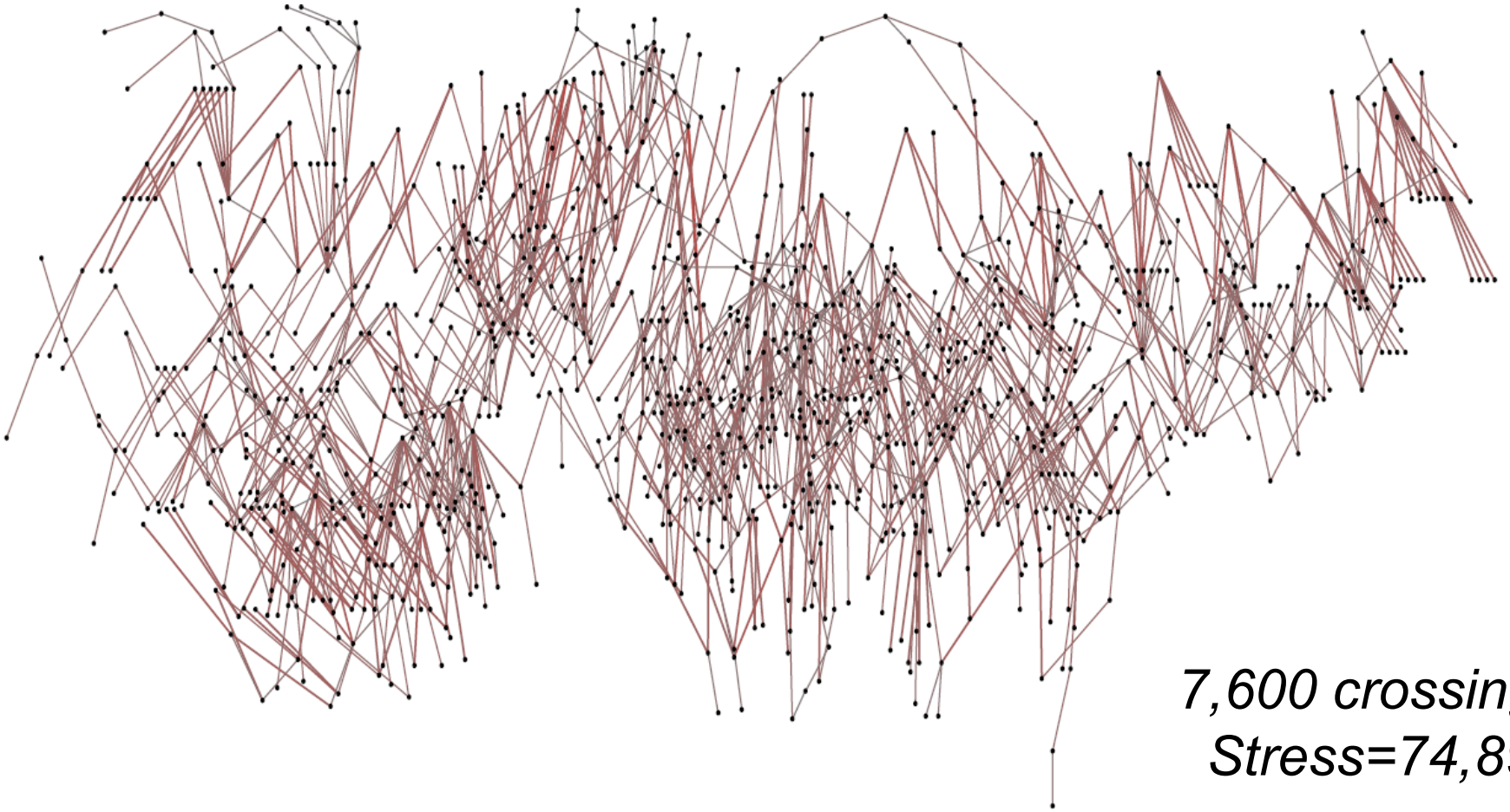
Sugiyama-style layout



6,148 crossings

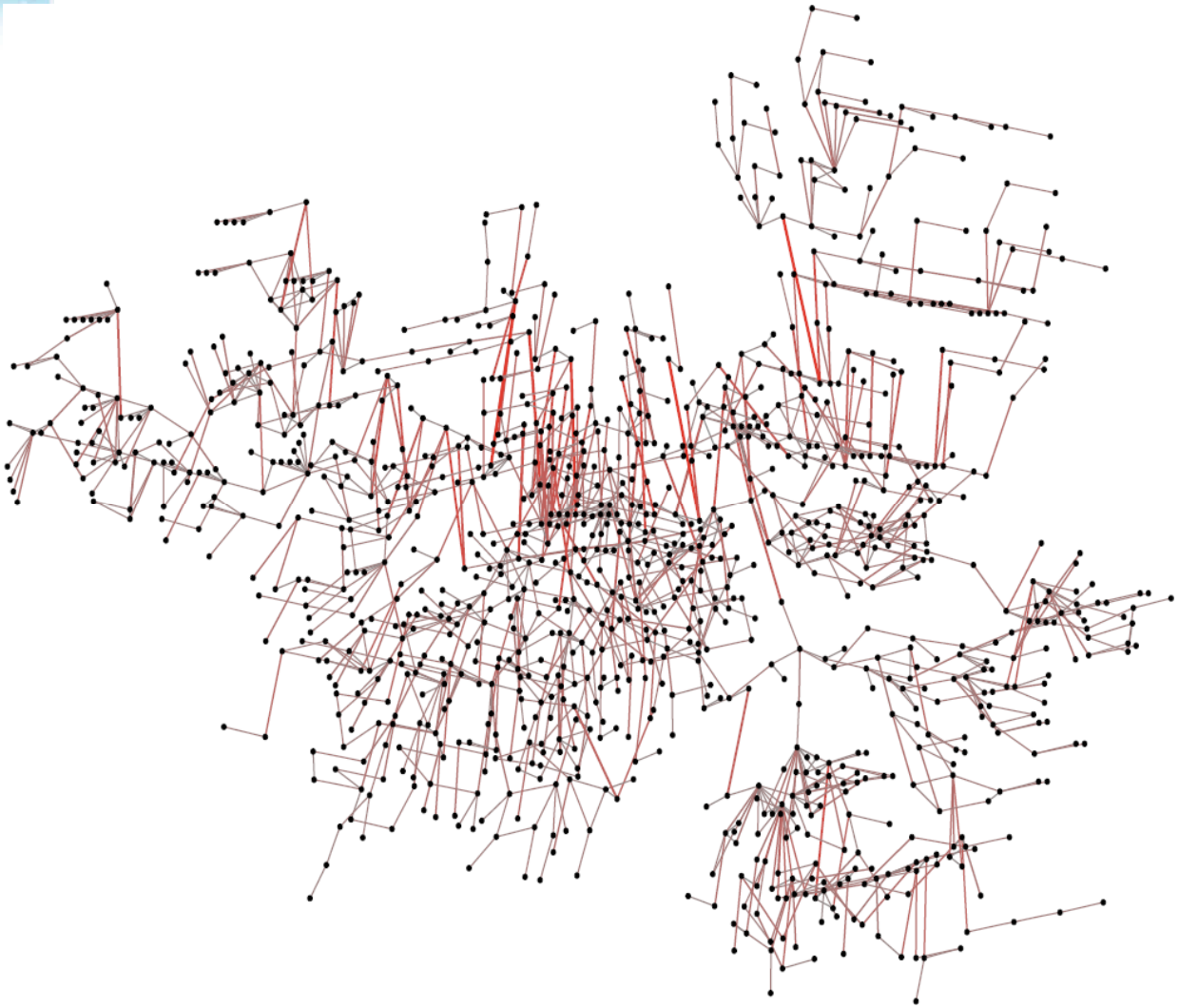
Drawing large directed graphs

DiG-CoLa



7,600 crossings
Stress=74,894

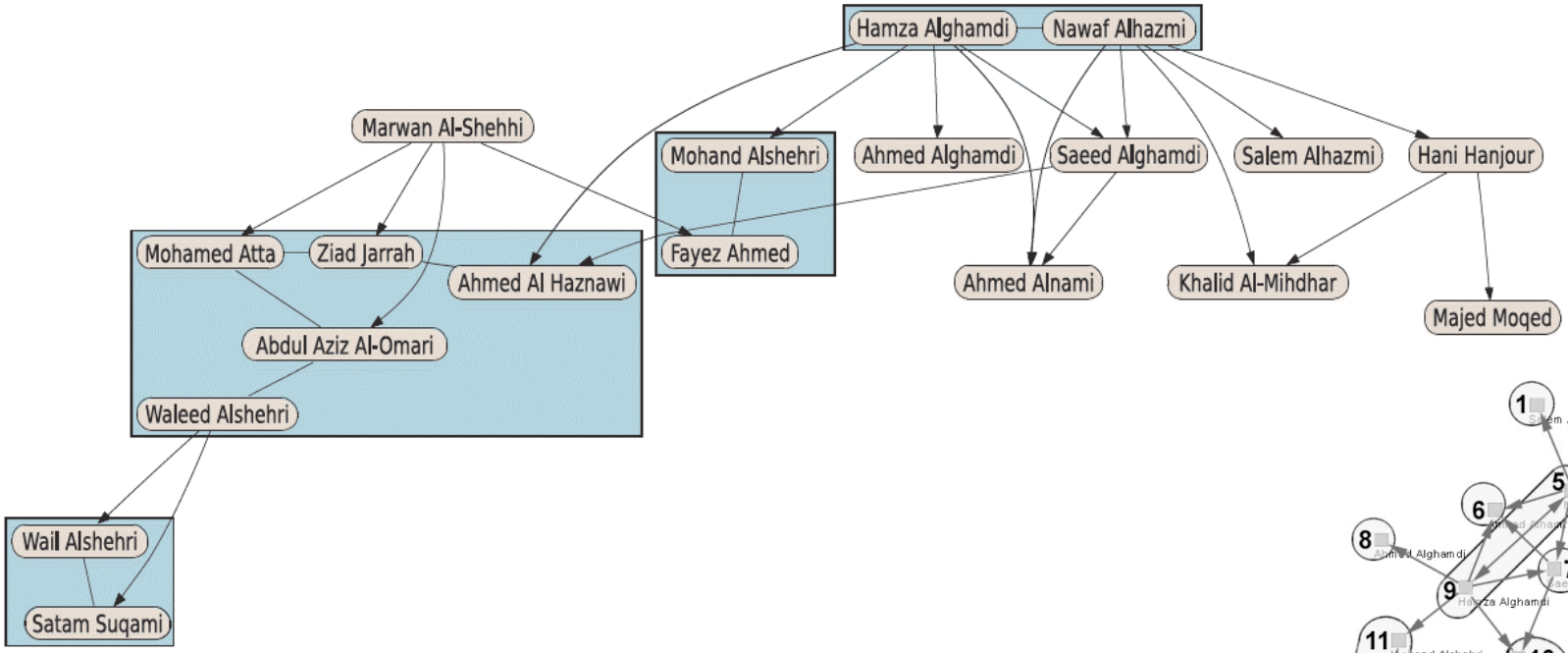
Drawing large directed graphs

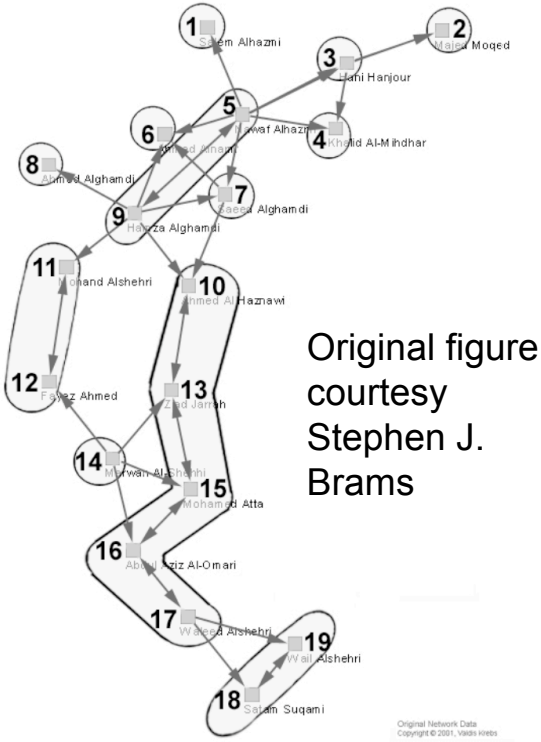


IPSep-CoLa

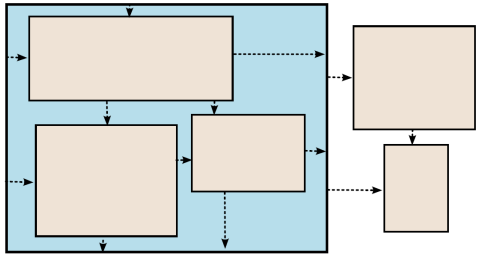
3,617 crossings
Stress=49,035

More applications



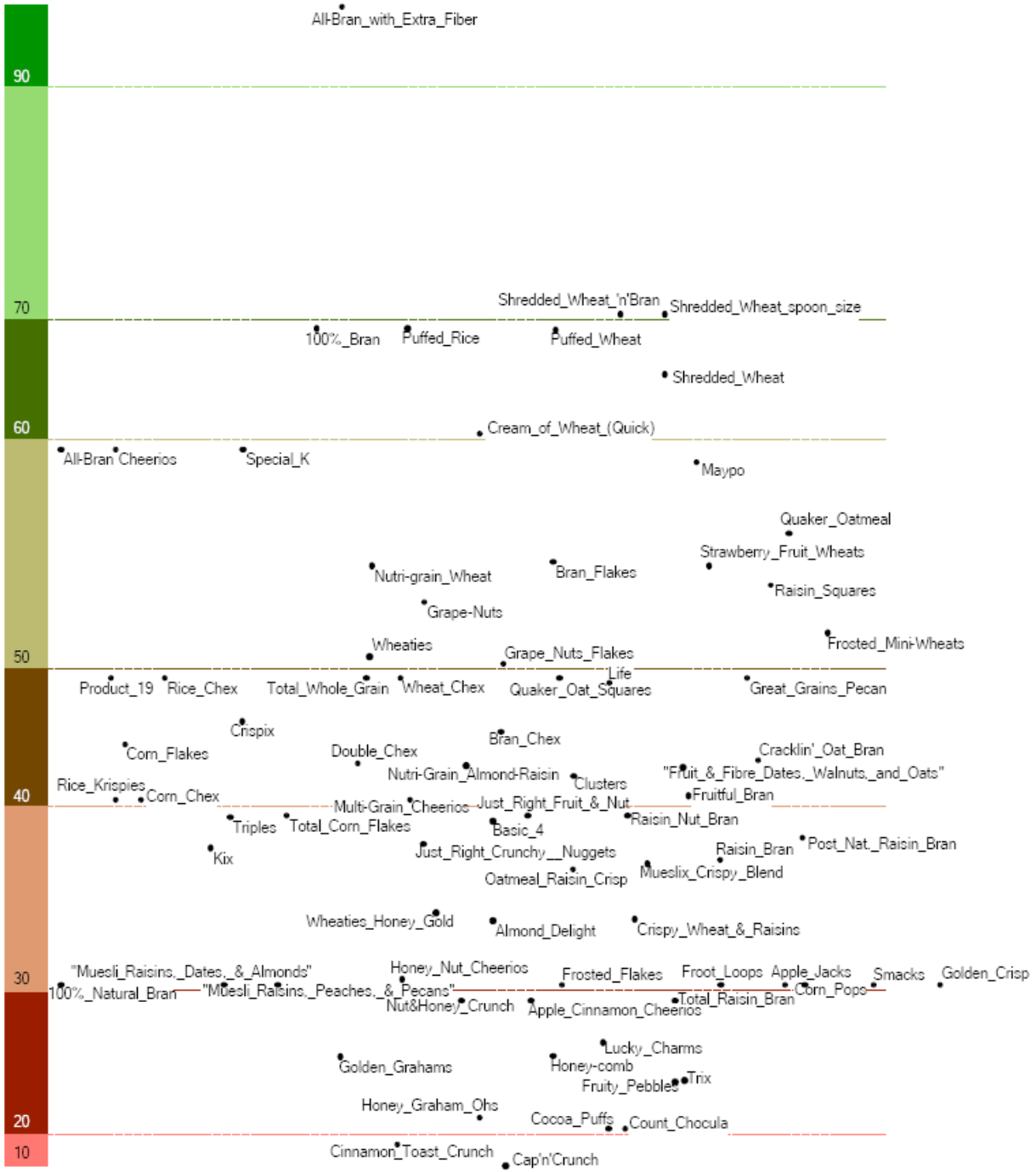


Original figure, courtesy Stephen J. Brams

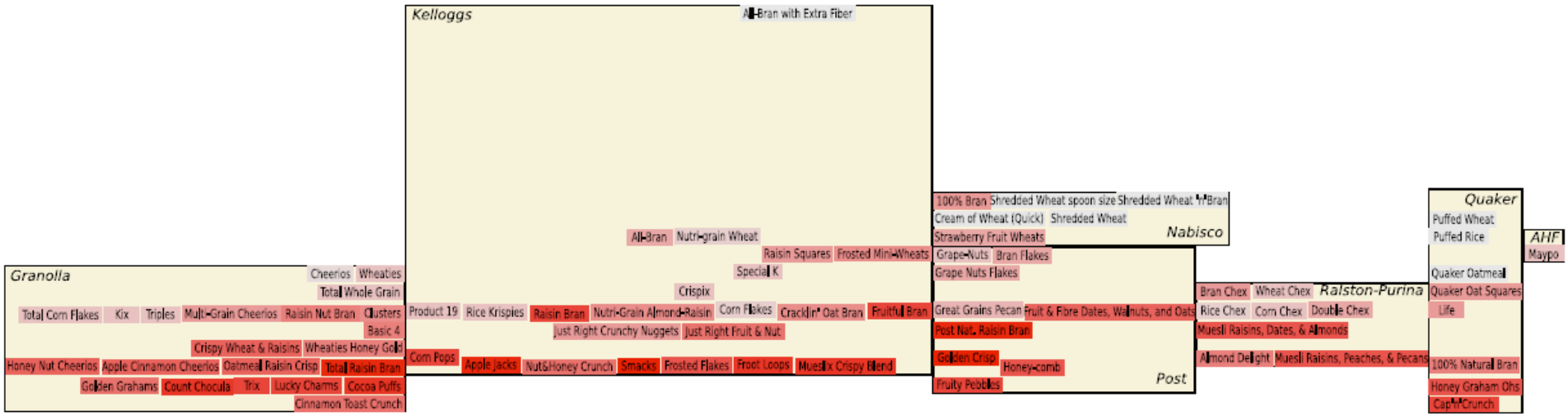


Non-overlapping clusters

Prevent overlaps between labels in MDS plots (DMDS)



Multi-dimensional scaling with clusters



Conclusion

- Separation constraints allow us to impose application specific requirements on stress-majorization layout
- We can do a lot of new things that previously could only be approximated with potentially unstable springies
- You can download an LGPLed C++ library implementation (adaptagrams.sf.net), or play with it in neato (www.graphviz.org) or Inkscape (www.inkscape.org)
- We'd love to collaborate with you to find more applications
  - contact: Tim.Dwyer@infotech.monash.edu.au