IPSep-CoLa: The Incremental Procedure for Separation-Constraint Layout of graphs

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Constraint-based Graph Layout

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

\[
x_1 + \frac{(w_1 + w_2)}{2} \leq x_2 \\
y_3 + \frac{(h_2 + h_3)}{2} \leq y_2
\]

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

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
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