Visualizing Graphs as Maps with Contiguous Regions

Stephen G. Kobourov

Sergey Pupyrev

Paolo Simonetto





The Problem



Unnecessary overlap

Unnecessary overlap

Disconnected regions



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Contiguity



- Theoretically, no instance is discontiguous
- Pratically, most instances are difficult to draw

Aim:

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convert the input into configurations easy to draw

Drawback: the input changes



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The Two Approaches

Embedding-based

- Preserves embedding
- Recomputes clusters

2

6

5

3



1

Cluster-based

- Preserves clusters
- Adjusts embedding





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Embedding Based Approach



- Preserve node positions
- Recompute clusters
 - Compute *k*-means [Lloyd, 1982]
 - Refine clusters by pulling-in connected nodes
- How to choose k
 - Use same *k* of existing clustering
 - Provide it as a parameter
 - Compute a suitable value
 [Sugar *et al.*, 2003]



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Clustering Based Approach



- Preserve clusters

Adjust node positions

- Compute barycenter graph
- Remove overlaps [Dwyer *et al.*, 2007]
- Bound countries and scale nodes in
- Run FDA that keeps nodes in countries
- ImPrEd [Simonetto *et al.*, 2011]
 - Boundaries are uncrossable and flexible
 - Additional force: attraction to original node positions



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Analysis

EBA effect on clustering

- Metrics

- Modularity [Brandes *et al.*, 2003]
- Coverage [Schaeffer, 2007]
- Conductance [Brandes et al., 2003]

Results

- On average, 20% reduction in cluster quality
- Better results for small graphs
- Timing: Very fast

CBA effect on embedding

- Metrics

- Stress [Gansner et al., 2004]
- Distortion
- Neighborhood preservation
 [Venna *et al.*, 2010]
- Results
 - On average, 10% reduction in embedding quality
- Timimg: Relatively slow



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Original vs EBA







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Original vs CBA





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Conclusions and System

- Conclusions
 - Two approaches for contiguous, non-overlapping drawings with existing techniques
 - Different application scenarios
 - Characteristics to preserve
 - Time
- Future work
 - Fragmentation can be meaningful
 - Effect of cluster and embedding quality on understanding

- System
 - On-line implementation
 - Source code available
 - Gmap, EBA, CBA, and more



gmap.cs.arizona.edu



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