Visualizing Graphs as Maps with Contiguous Regions

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The Problem

BubbleSets
[Collins et al., 2009]

LineSets
[Alper et al., 2011]

GMap
[Hu et al., 2010]

Unnecessary overlap
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Disconnected regions

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The Two Approaches

Embedding-based
- Preserves embedding
- Recomputes clusters

Original graph

Cluster-based
- Preserves clusters
- Adjusts embedding
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]
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
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

- **Timing:** Relatively slow
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Original vs CBA
Conclusions and System

- **Conclusions**
  - Two approaches for contiguous, non-overlapping drawings with existing techniques
  - Different application scenarios
    - Characteristics to preserve
    - Time

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

- **Future work**
  - Fragmentation can be meaningful
  - Effect of cluster and embedding quality on understanding

GMap

gmap.cs.arizona.edu