network *visualization*

introduction to *network science in Python* (*NetPy*)

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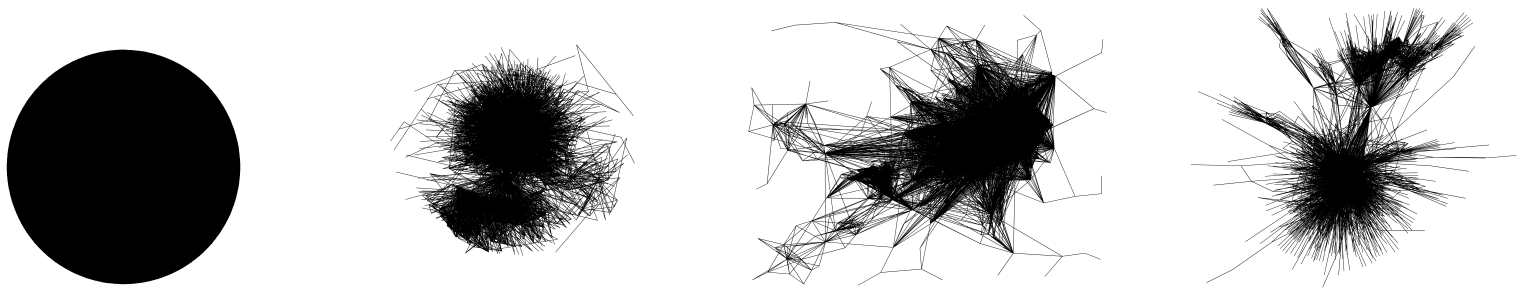
visualization *overview*

network *visualization* with *wiring diagram**

1st compute *network layout* as *node coordinates* Euclidean plane etc.

2nd *representation* of *network links*? strength, pattern, shape, color etc.

3rd *representation* of *network nodes*? size, shape, color, label etc.



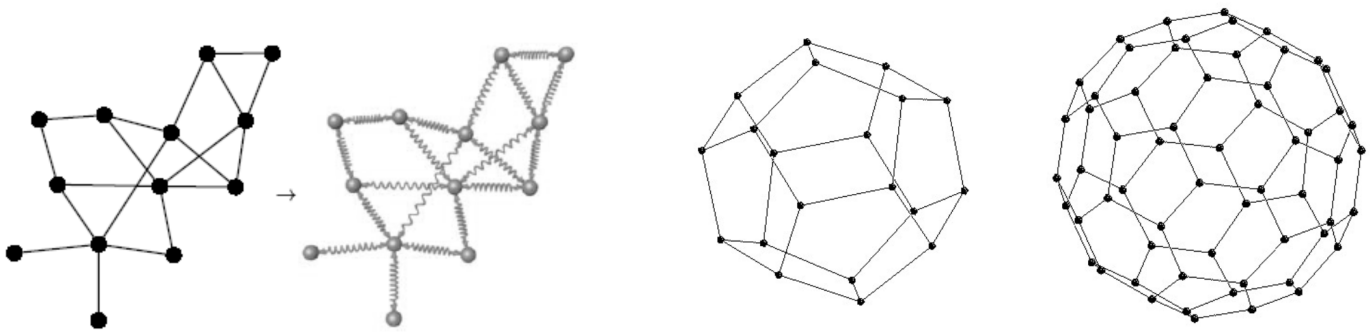
similar link lengths, no crossings, displays symmetry, even node distribution etc.

*small/dense graphs better visualized with block models

visualization *framework*

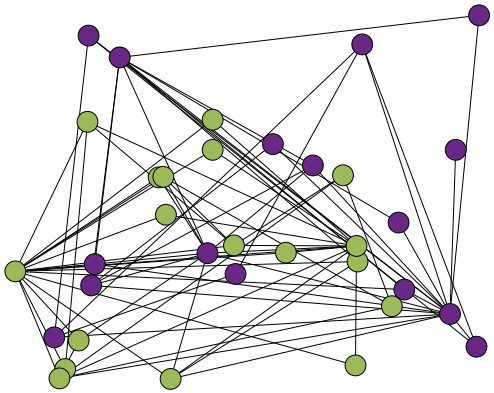
- Eades *spring embedded layout* [Ead84]
- Fruchterman-Reingold *force-directed layout* [FR91]
- Kamada-Kawai *graph theoretic layout* [KK89]

- *attractive forces* between *neighbors* using Hooke's law
- *repulsive forces* between *nodes* using Coulomb's law
- iteratively move nodes thus to *minimize layout energy*

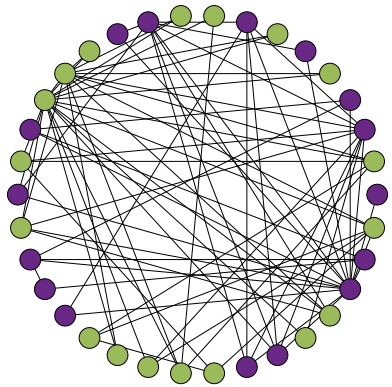


pleasing with similar link lengths, symmetry & even distribution

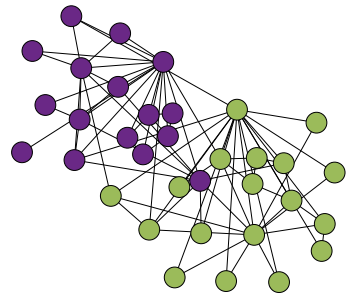
visualization *karate*



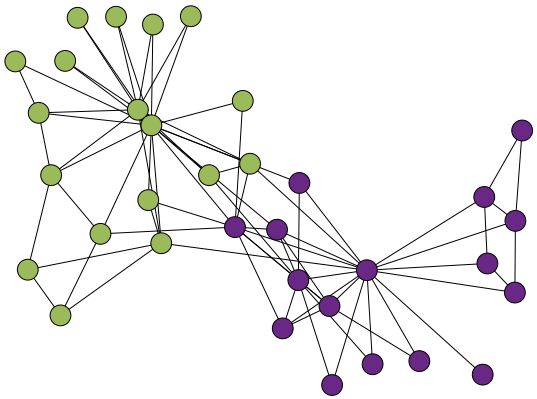
random layout



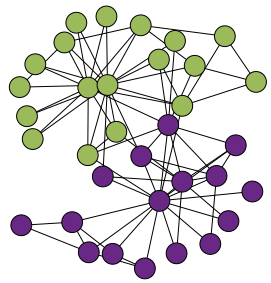
circular layout



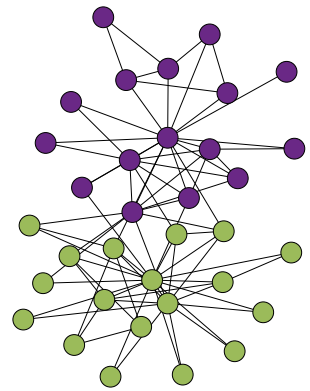
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]

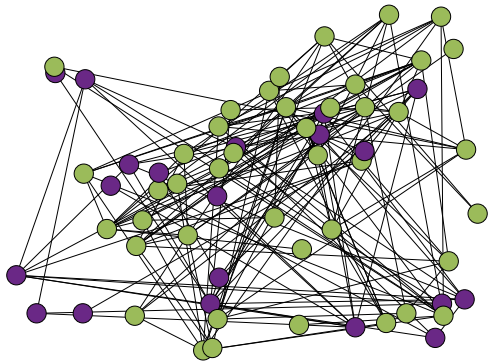


Kamada-Kawai layout [KK89]

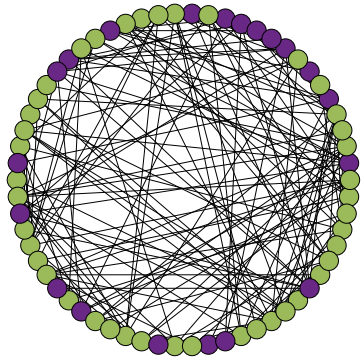


LGL layout [ADWM04]

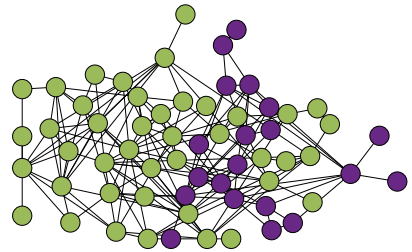
visualization *dolphins*



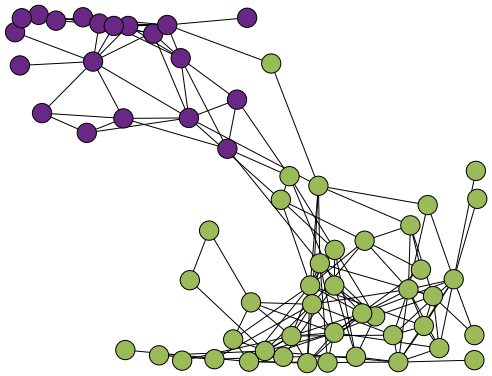
random layout



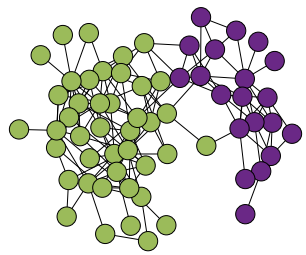
circular layout



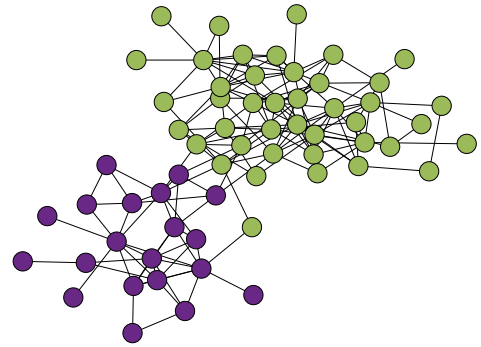
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]

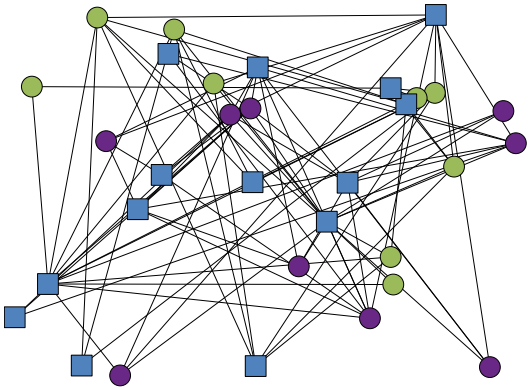


Kamada-Kawai layout [KK89]

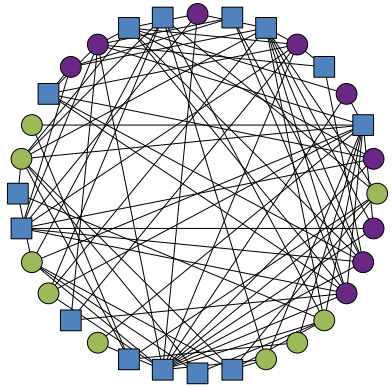


LGL layout [ADWM04]

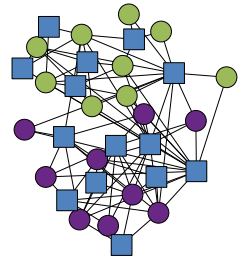
visualization *women*



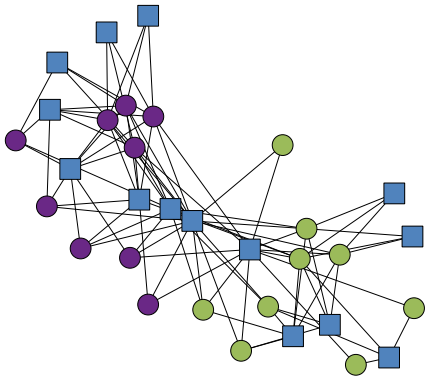
random layout



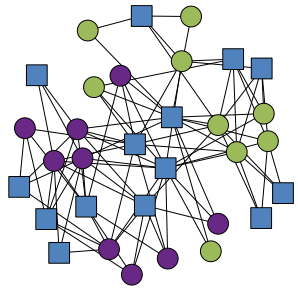
circular layout



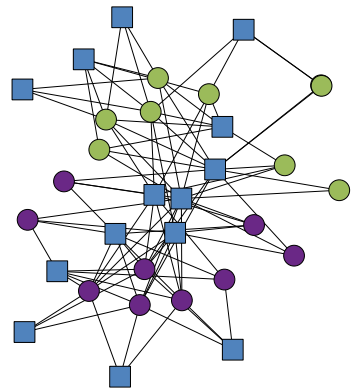
spring embedded layout [Ead84]



Fruchterman-Reingold layout [FR91]

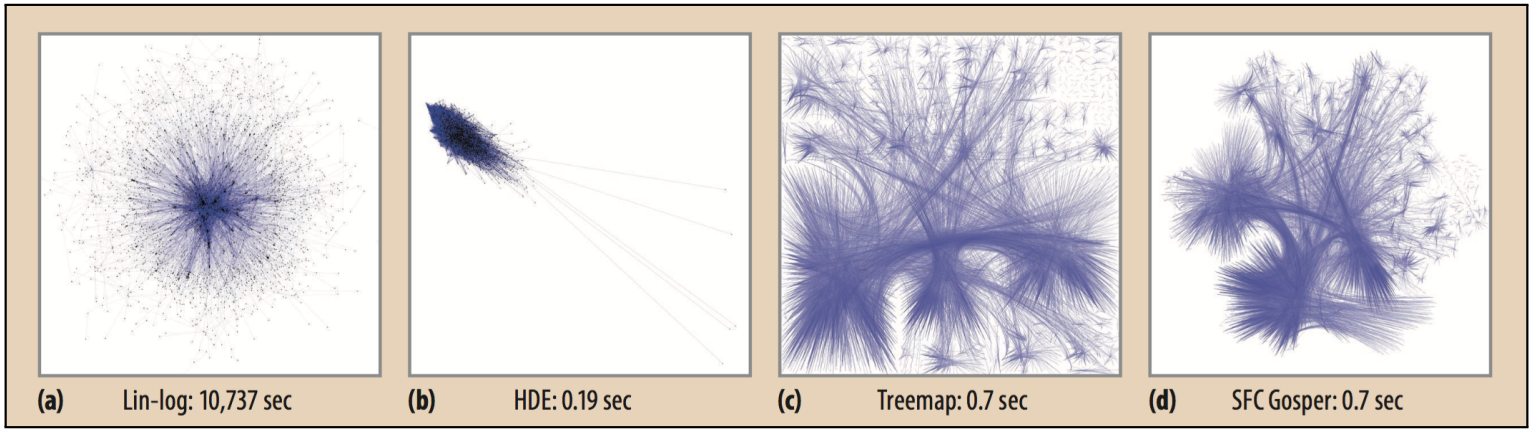


Kamada-Kawai layout [KK89]

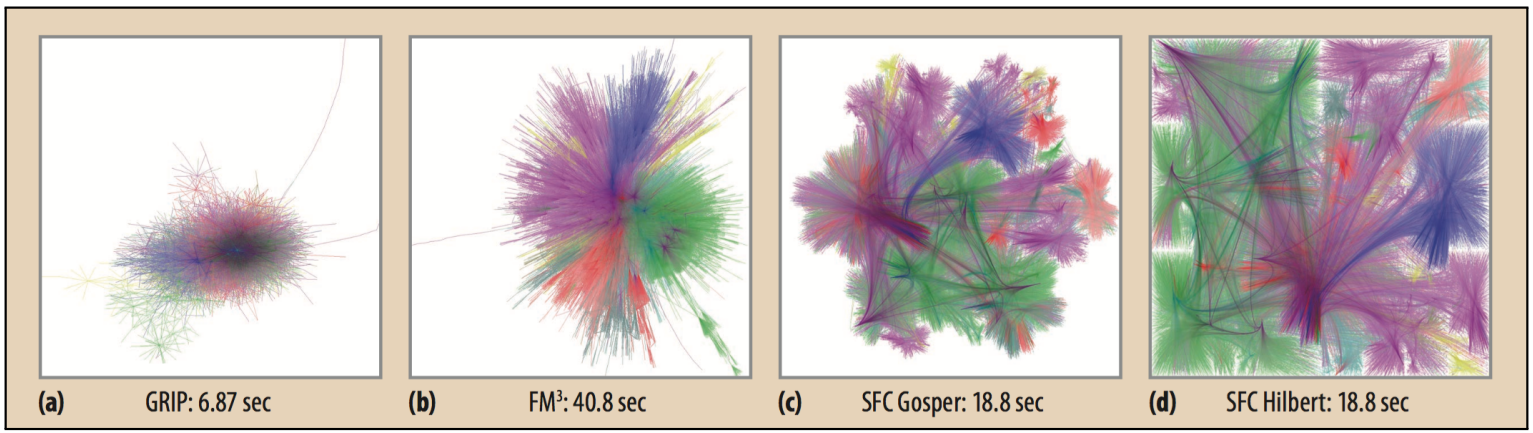


LGL layout [ADWM04]

visualization *static*

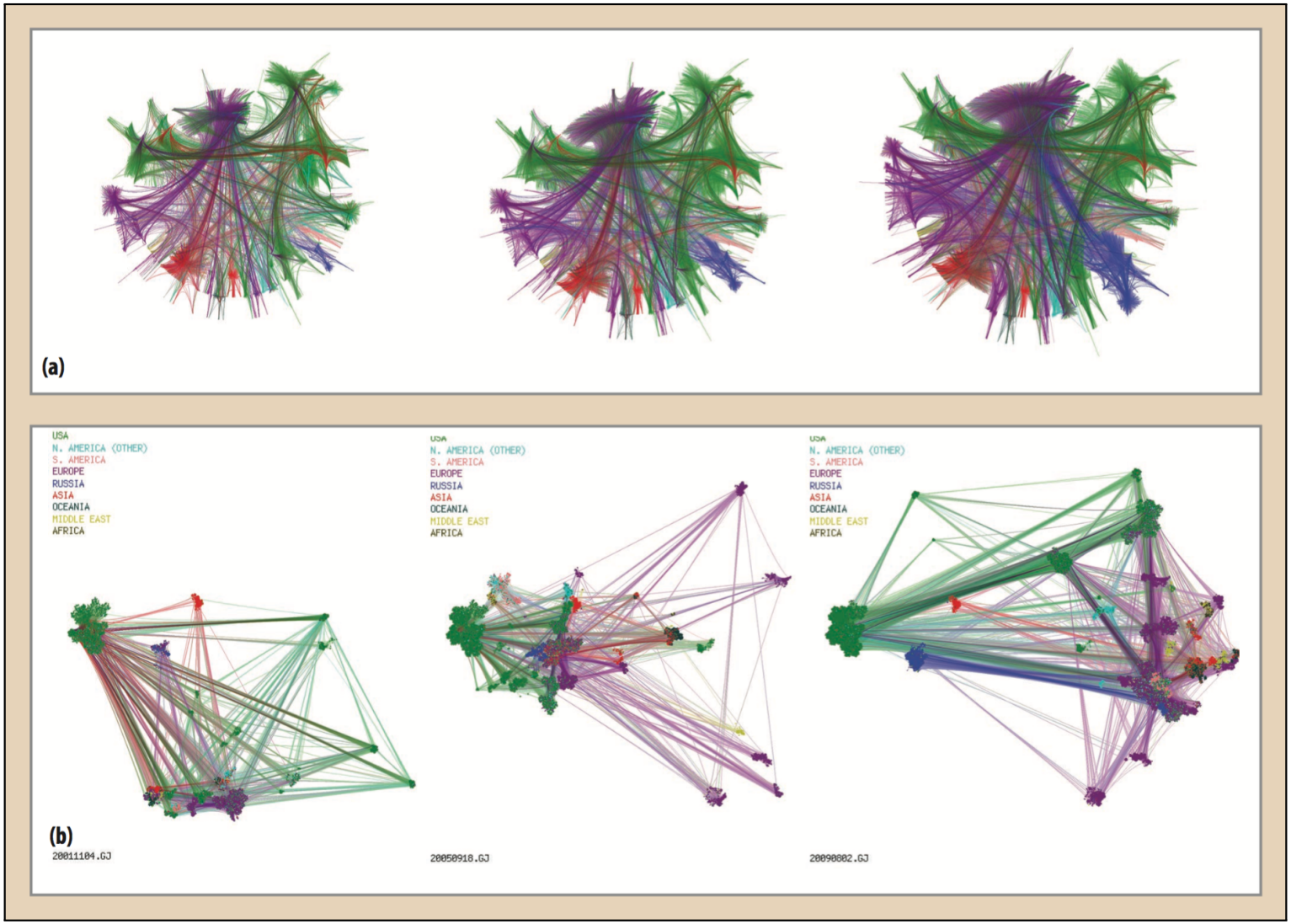


(*a*) *traditional* (*b*) *algebraic* (*c*) *hierarchical* and (*d*) *clustering-based force-directed layouts* of web graph



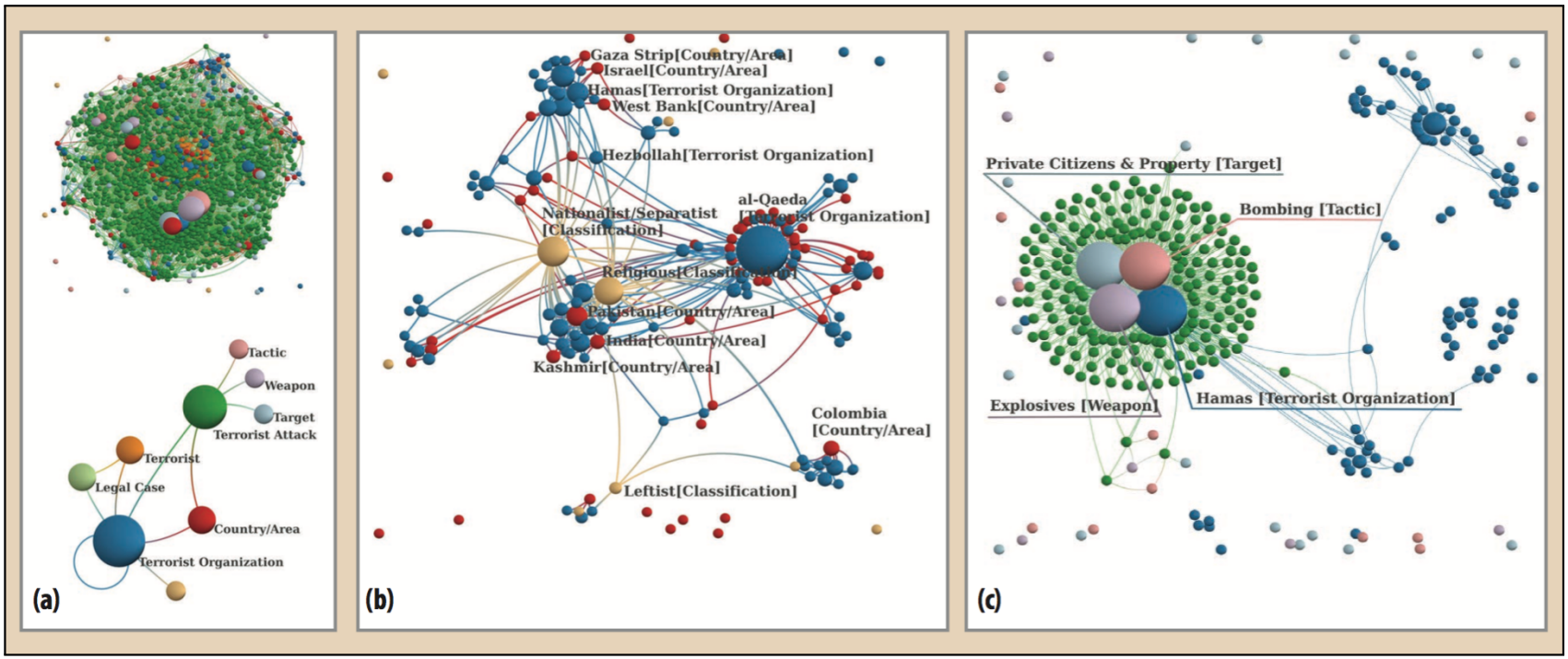
(*a*,*b*) *multilevel* and (*c*,*d*) *clustering-based force-directed layouts* of autonomous systems by continent

visualization *dynamic*



(*a*) *incremental* and (*b*) *global* clustering-based *force-directed layouts* of Internet by continent

visualization *heterogeneous*



terrorist network (*a*) *force-directed layout* with *semantic ontology* and (*b*) *active organizations* (*c*) *attack behaviour*

visualization *references*

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