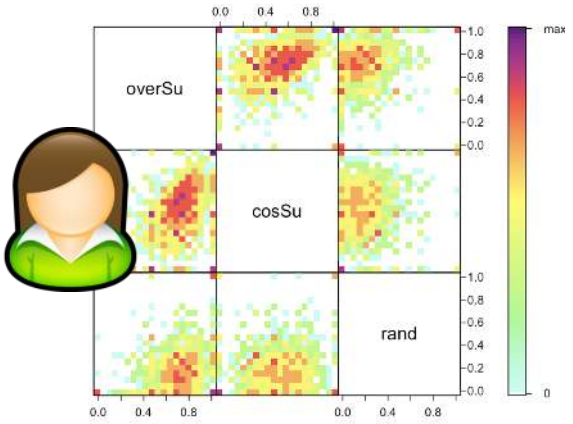
Constellation: Programming decentralised social networks

Anne-Marie Kermarrec, François Taïani

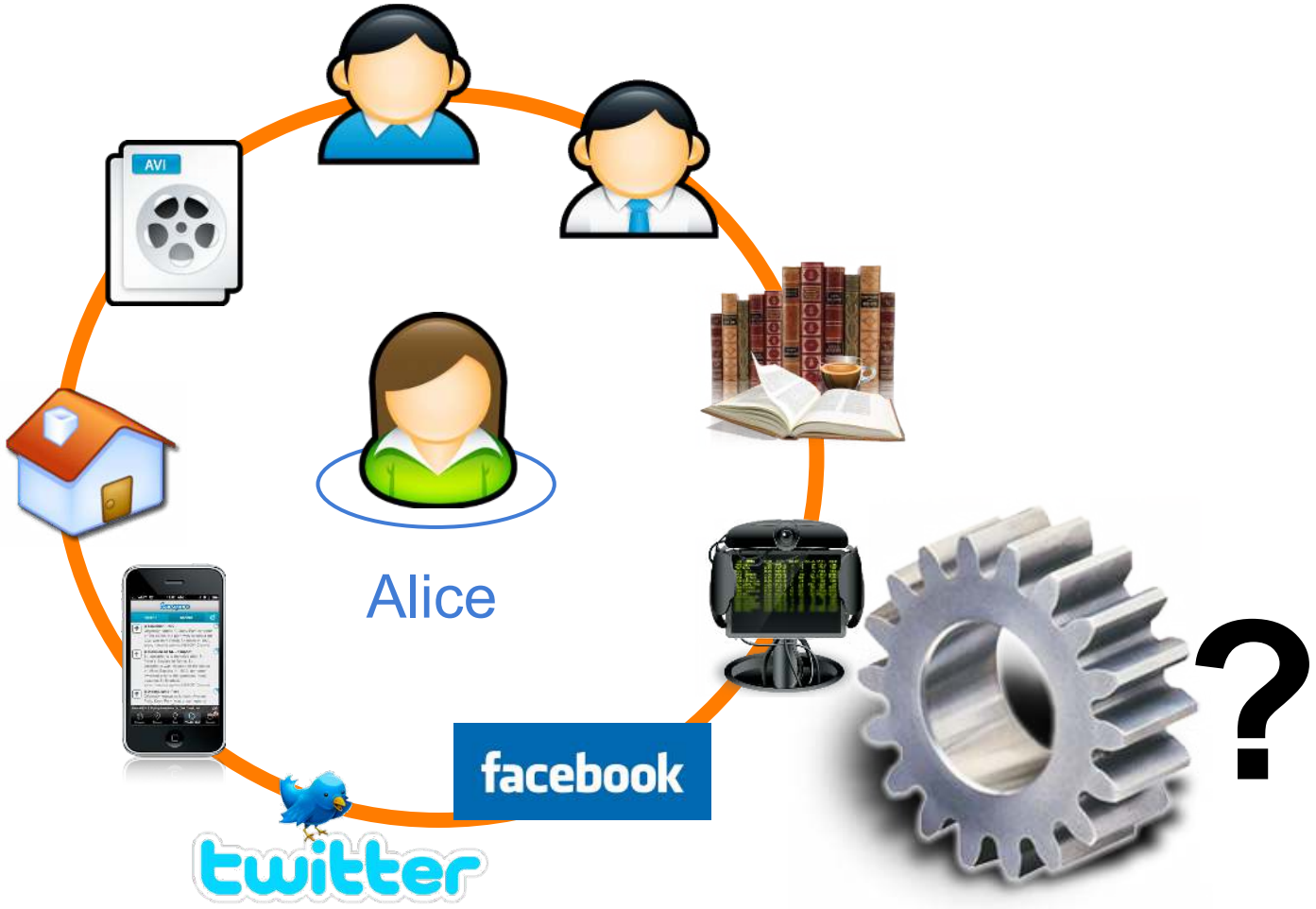
Summary

- **Constellation**: DSL for self-organising social networks
  - ➔ **Rapid** experimentation
  - ➔ **Composable**, recursive
  - ➔ Still under development



- Benefits
  - ➔ Not much in terms of language research (?)
  - ➔ Dist. Sys. : organise **design space**, help **exploration**
  - ➔ Not limited to social networks (embryomorphic eng.)

Towards a User-Centred Web

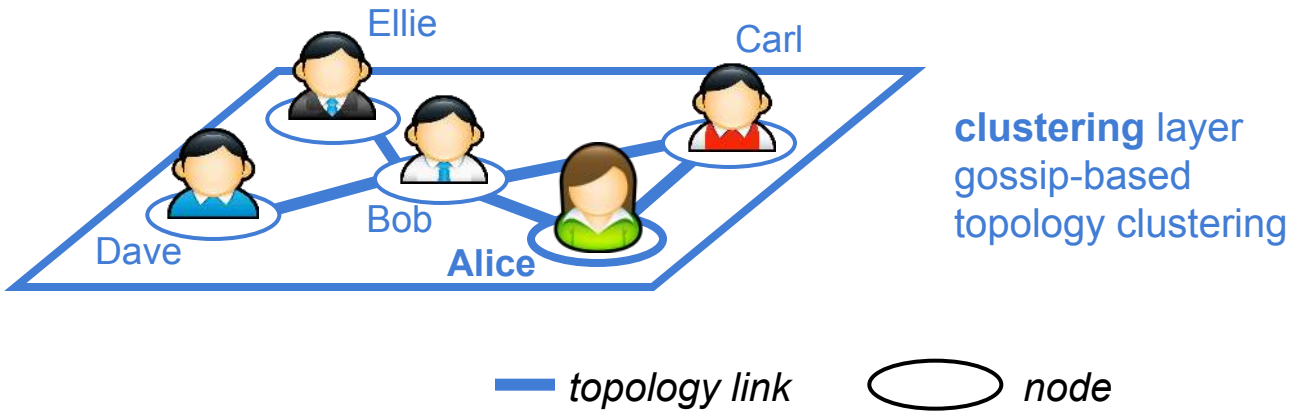


- Privacy + Personalisation ➔ Decentralisation

Gossip-based Social Networks

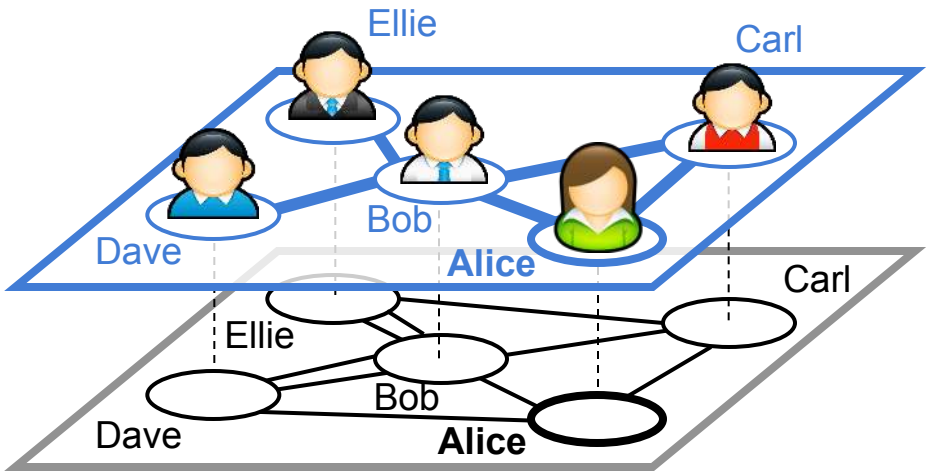
Builds on T-Man [JMB09], Vicinity [VS05]

- Each users = 1 node = a profile + a set of neighbours
- Metrics: “similarity” measure between nodes
- Goal: find *n* closest neighbours (decentralised)



Gossip-based Social Networks

- Uses randomising layer (RPS, Cyclon)
- Periodically: each node **n**
  - ➔ **merges** RPS neighbours with clustering neighbours
  - ➔ **sorts** nodes in list based on similarity
  - ➔ **keeps** k closest neighbours



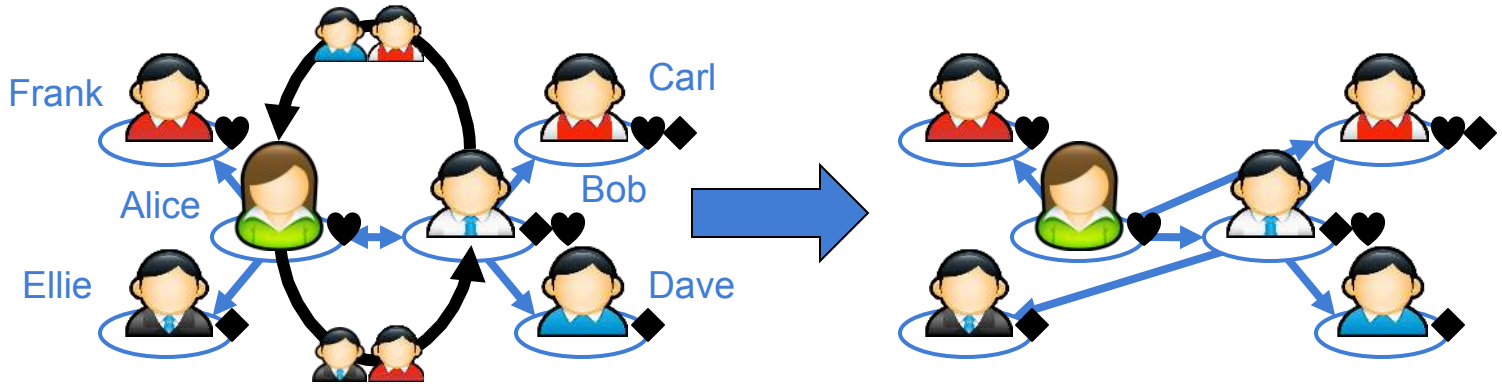
clustering layer
gossip-based
topology clustering

RPS layer providing
random sampling

random link *topology link* *node*

Example: Overlap Metrics

- User profile: list of shapes
  - ➔ Alice loves heart, Bob prefers diamonds over hearts

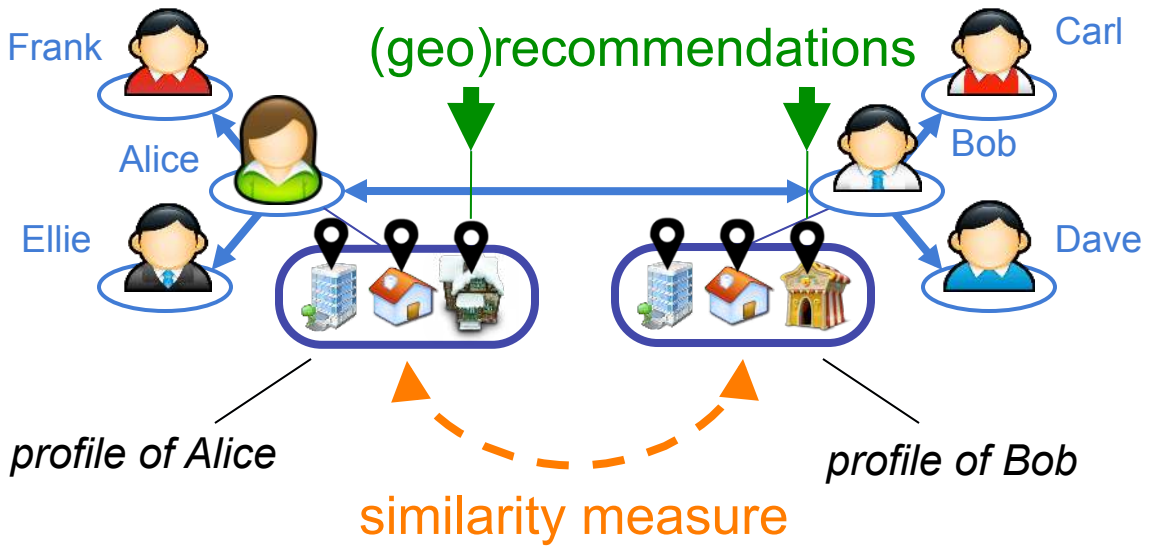


❶ exchange of neighbors lists

❷ neighborhood optimization

Exploitation: recommendation

- E.g. (geo)recommendations



- Other uses: search, query extension, news filtering

Can we build a (simple, elegant) language to rapidly experiment with these self-stabilising social networks?

Challenges

- Large design space (profile, metrics)
- Recursive behaviours (neighbourhood comp)
- Monolithic approaches / low reuse

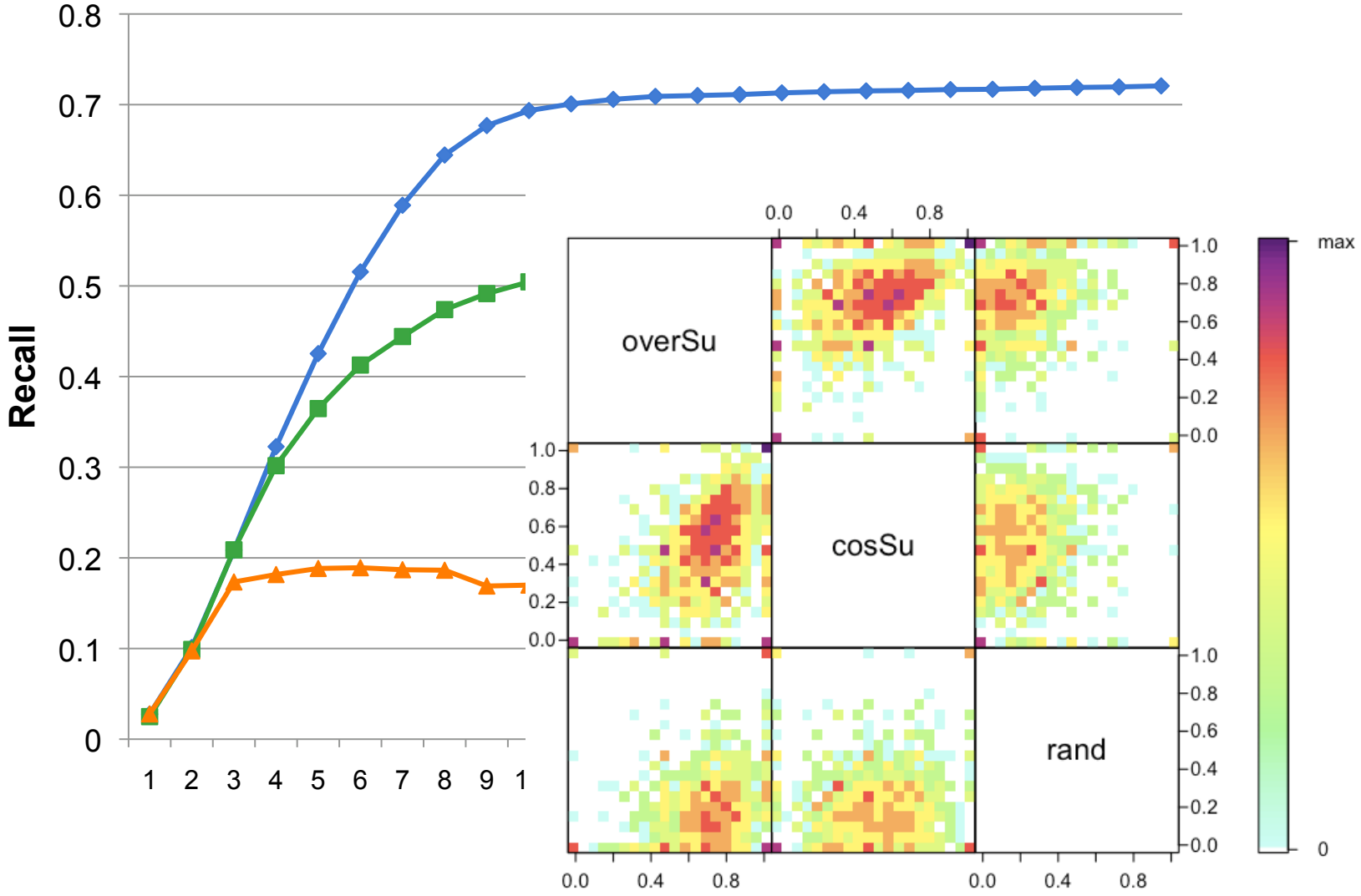
Our Take: Constellation

- Simple, declarative, (composable)
- Predicting twitter subscriptions using past subs (:s)

```
node User {
  data :name
  data :s
  clusters :cosSu  {|u|  cos_sim(self->:s, u->:s) }
  clusters :overSu {|u|  overlap(self->:s, u->:s) }
  clusters :rand   {|u|  rand }
}
```

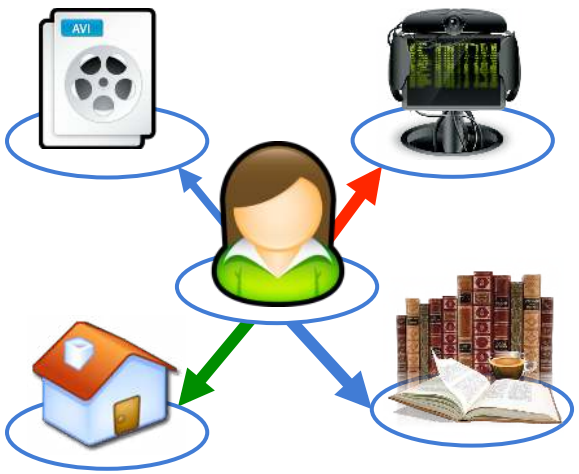
- Ruby-based prototype
- 2446 users crawled from twitter

Results


Recall
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 1
overSu
cosSu
rand
0.0 0.4 0.8
1.0 0.8 0.6 0.4 0.2 0.0
max
0

Tackling more: Heterogeneity

- Different types of nodes, asymmetric similarities (*)

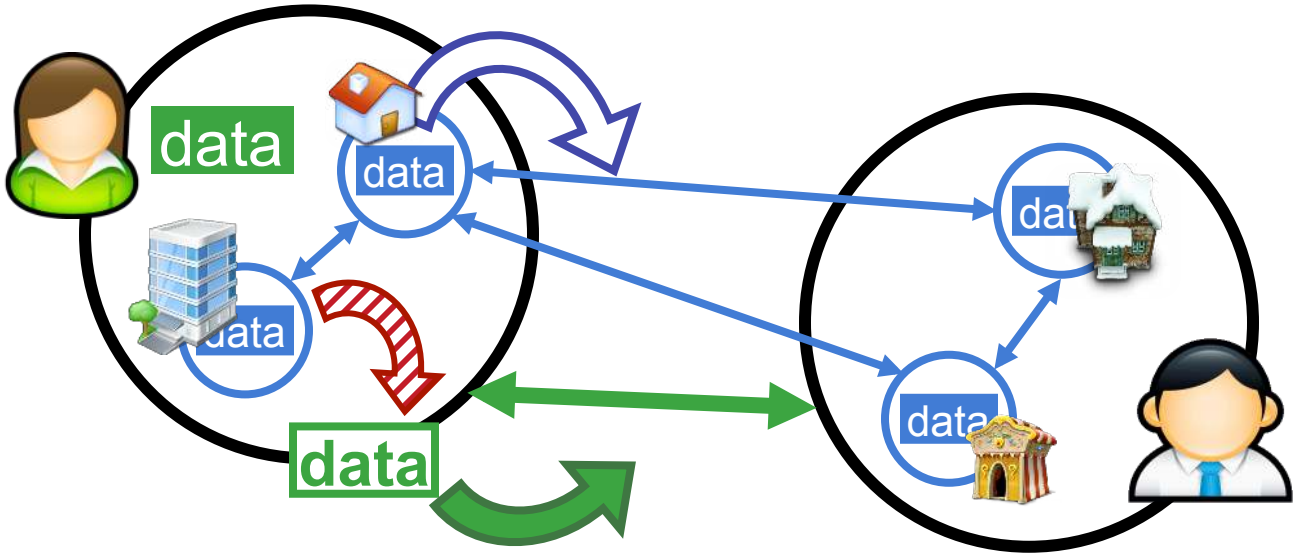



```
node Website { data :k }
node User    {
  data :i
  ..
  clusters :sites with Website {
    |s| cos_sim( this->:i, s->:k ) }
  ..
}
```

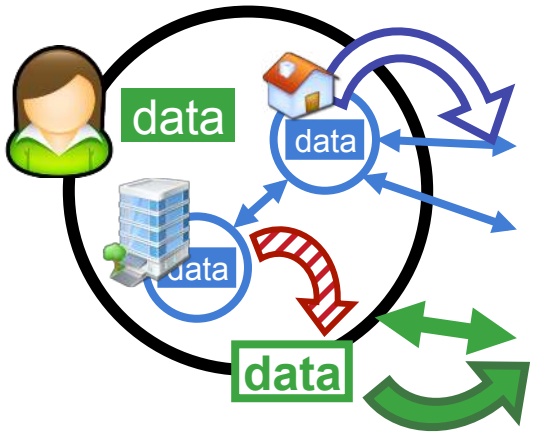
(*) under development

Tackling more: Recursion

- Recursive clustering [BBGKL10, BFGKL10]
  - ➔ containment relationships
  - ➔ clustering applied to containee
  - ➔ neighbourhood computation



Tackling more: Recursion




```
node Checkin {
  data :t
  clusters :similarSites { |c|
    overlap(this->:t,c->:t) }
}
node User {
  contains Checkin :c
  clusters :similarUsers { |u|
    overlap(this->:c->:t,u->:c->:t) }
  set_scope :similarUsers for :c
}
```

(under development)

Summary

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[Doursat, R. (2008)]

- Benefits
  - ➔ Not much in terms of language research?
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Doursat, R. (2008). Programmable architectures that are complex and self-organized: from morphogenesis to engineering. (ALIFE XI)

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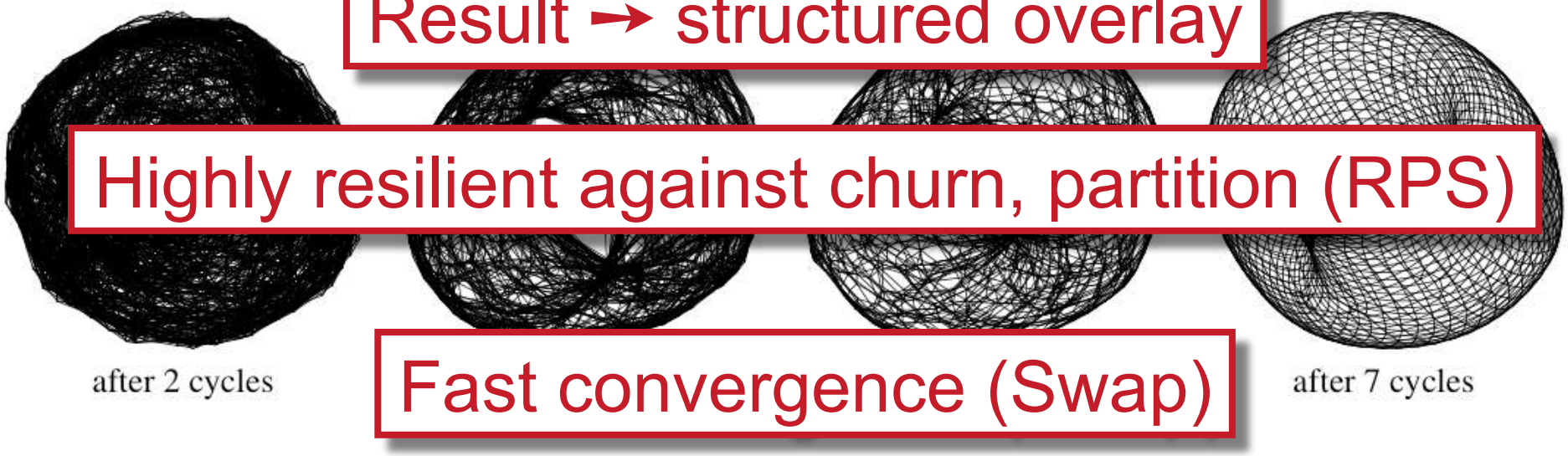
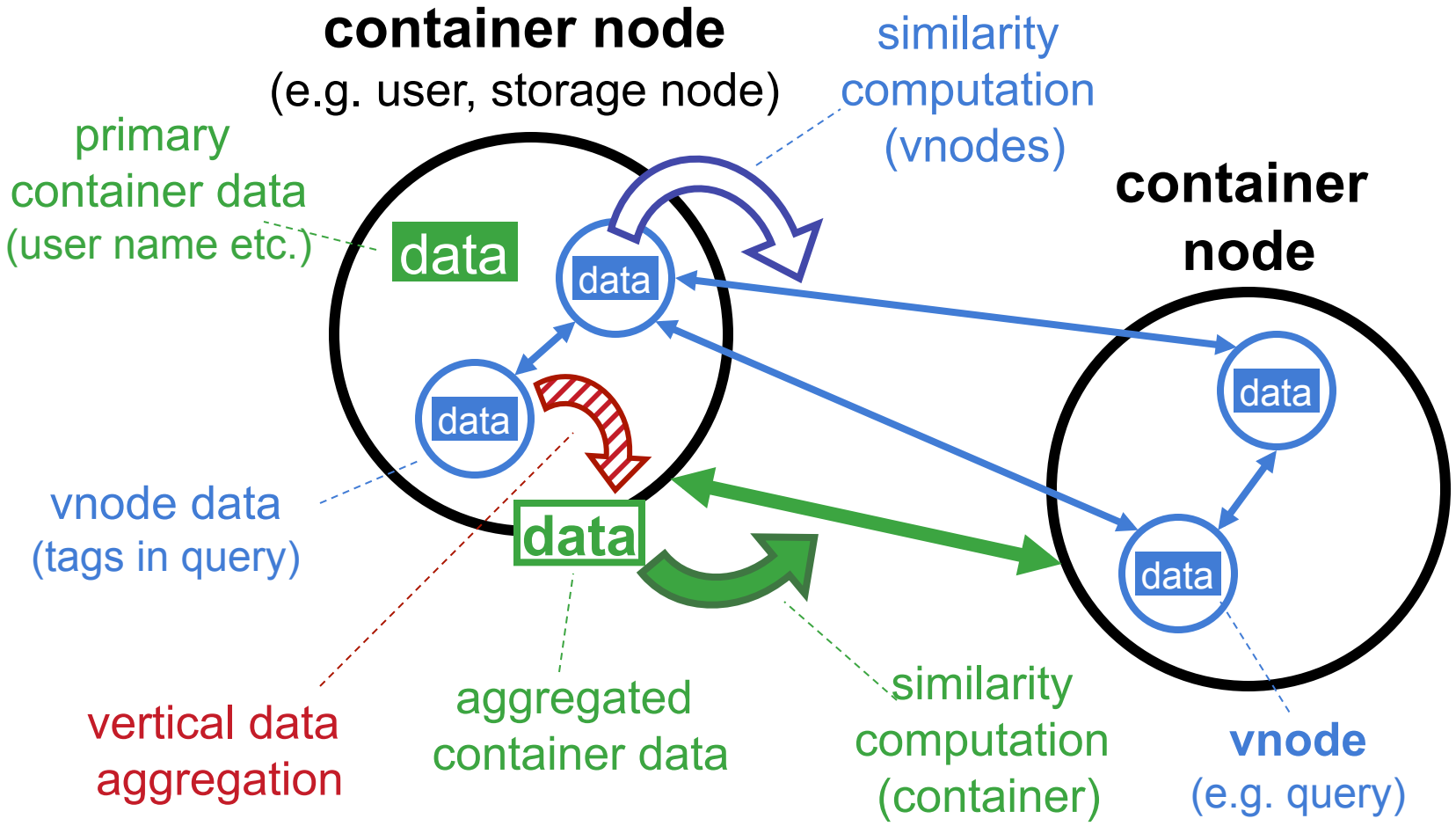
T-Man in Action

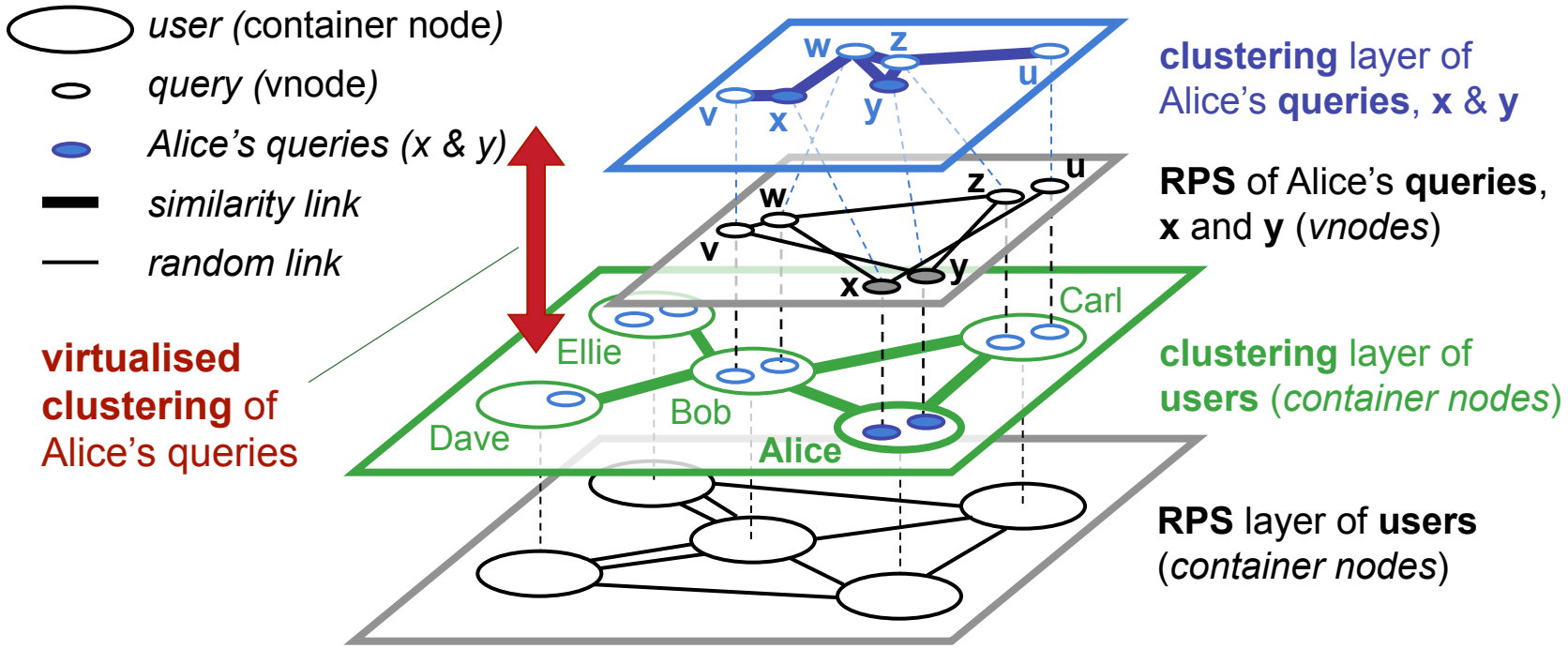
- (taken from [JMB09])



Capturing Neighbourhood Comp



Capturing neighbourhood Comp



Self-organising networks

- To speed convergence each node **n**
  - ➔ picks one neighbour **i** in clustering layer
  - ➔ sends own list of neighbours, receives that of **i**
  - ➔ **i** and **n** merge, **sort**, keep k closest neighbours