

Bipartite Networks

Structural Analyses

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Bipartite Networks

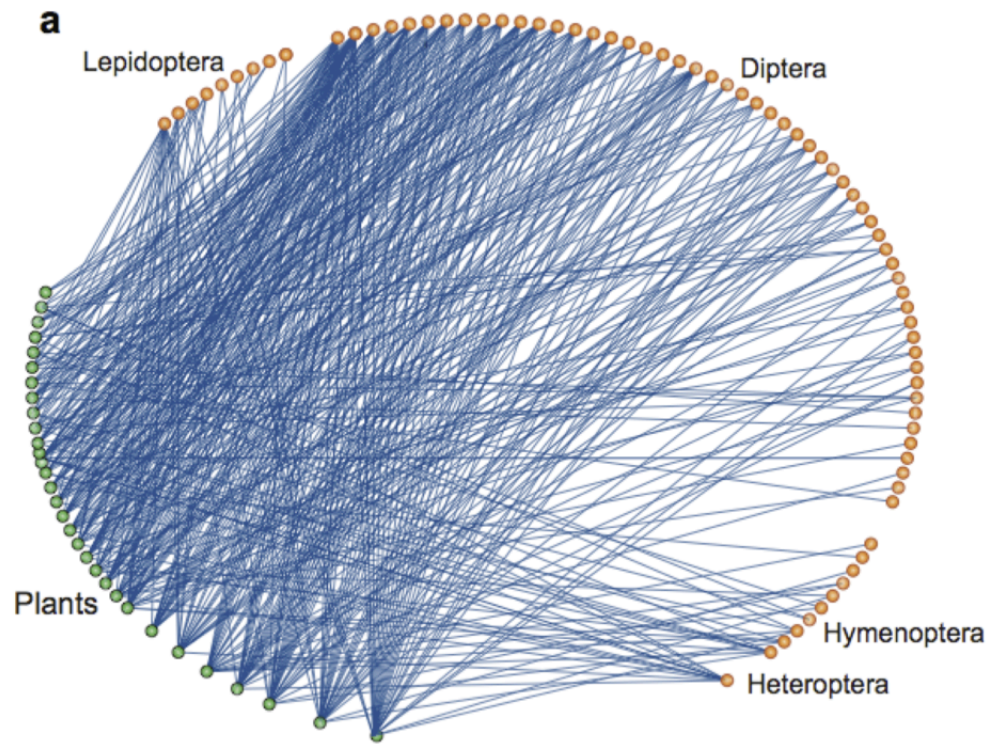
- What are they?
- What are they good for?
- How do I use them?

Bipartite Networks: What are they?

Definition: a network in which has two sets of nodes with edges between and not within sets.

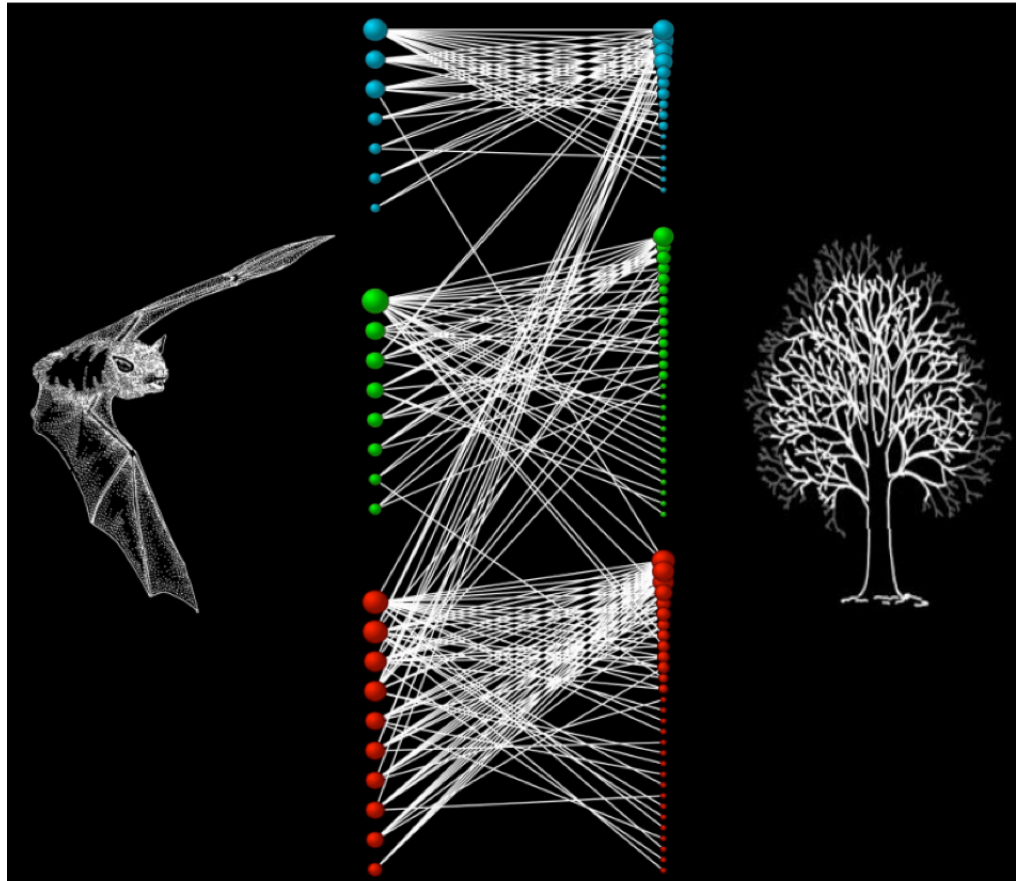
Bipartite Networks: What are they?

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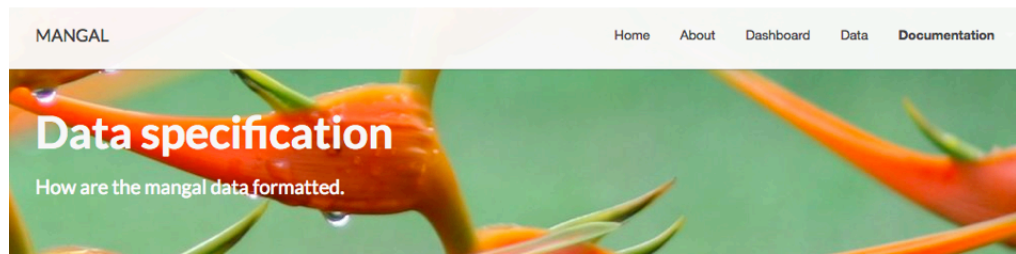


Bipartite Networks: What are they?

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mangal



General informations

The data specification is implemented as a collection of JSON schemes, that can be downloaded from the [GitHub repository](#) of the project.

For each object, the name of the fields, the type of the field, and additional informations are given. When using the `rmangal` package, the same information can be viewed using:

```
api = mangalapi()
whatIs(api, 'taxa')
```

Note also that when data are uploaded through the R package, (i) the `owner` field is *always* set automatically, and (ii) instead of giving URI of the resources, users should give the `id`, or the list representation of the object directly.

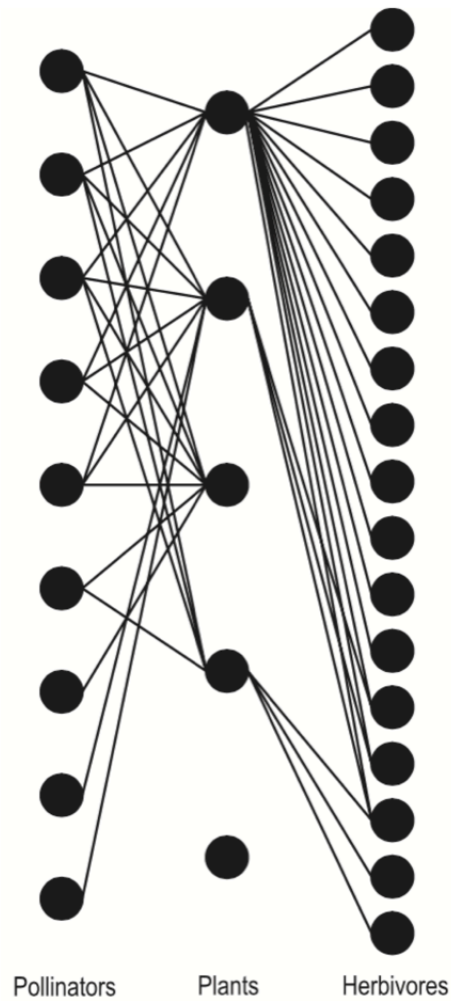
⚠ All fields whose `type` is `related` are references to other objects in the database. When listing or getting data, these fields will be exposed as their `id`, primarily because it is a more compact notation for end-users (i.e. `/api/v1/taxa/1` will simply be `1`). However (expect when using the R package), when *adding* data, these fields should contain the `URI` of the resource being linked to.

<http://mangal.uqar.ca/doc/spec/>

Bipartite Networks: What are they good for?

- Simplification (= ignore interactions within sets)
- Stability Theory
- Limitations

Bipartite Networks: Limitations



Bipartite Networks: How do I use them?

Can you represent your network as two distinct sets?

Bipartite Networks: How do I use them?

"Hello, R!"

- Open-source
- Free!
- "Easy/Lazy" programming language

"Hello, R!"

- Packages
- CRAN
- GitHub

"Hello, R!"

2+2

```
## [1] 4
```

"Hello, R!"

```
four = 2 + 2
```


"Hello, R!"

```
four = 2 + 2
```

```
print(four)
```

```
## [1] 4
```

"Hello, bipartite!"

```
library(bipartite)
```

bipartite: models

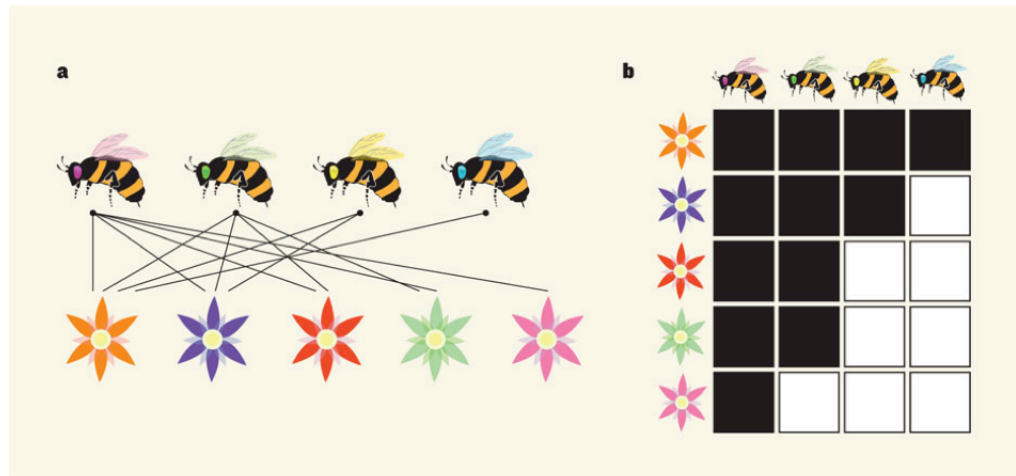
Import/Load models using read.csv

people.fas.harvard.edu/~matthewklau/bipmodel.csv

bipartite: models

```
our.binet <- read.csv('../data/bipmodel.csv')
```

bipartite: nestedness



bipartite: nestedness

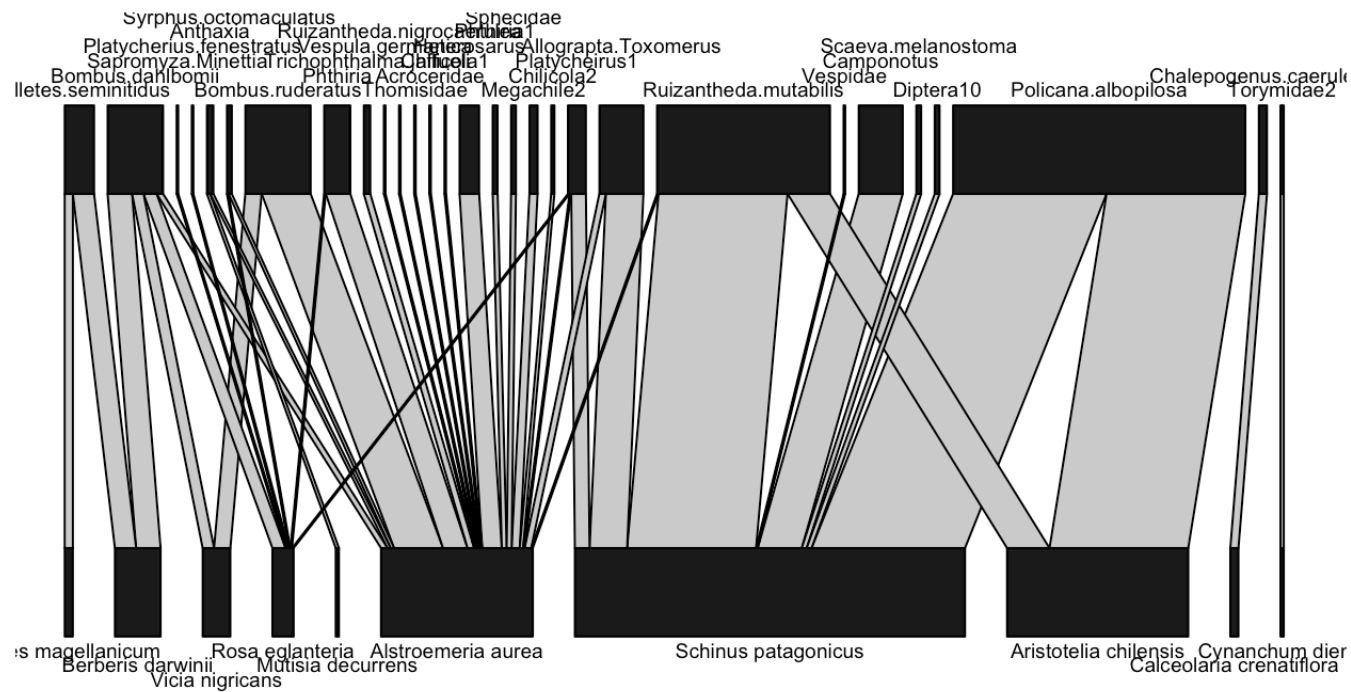
```
binet.nest <- nestedness(our.binet,null.models=FALSE)  
names(binet.nest)  
binet.nest$temperature
```

bipartite: nestedness

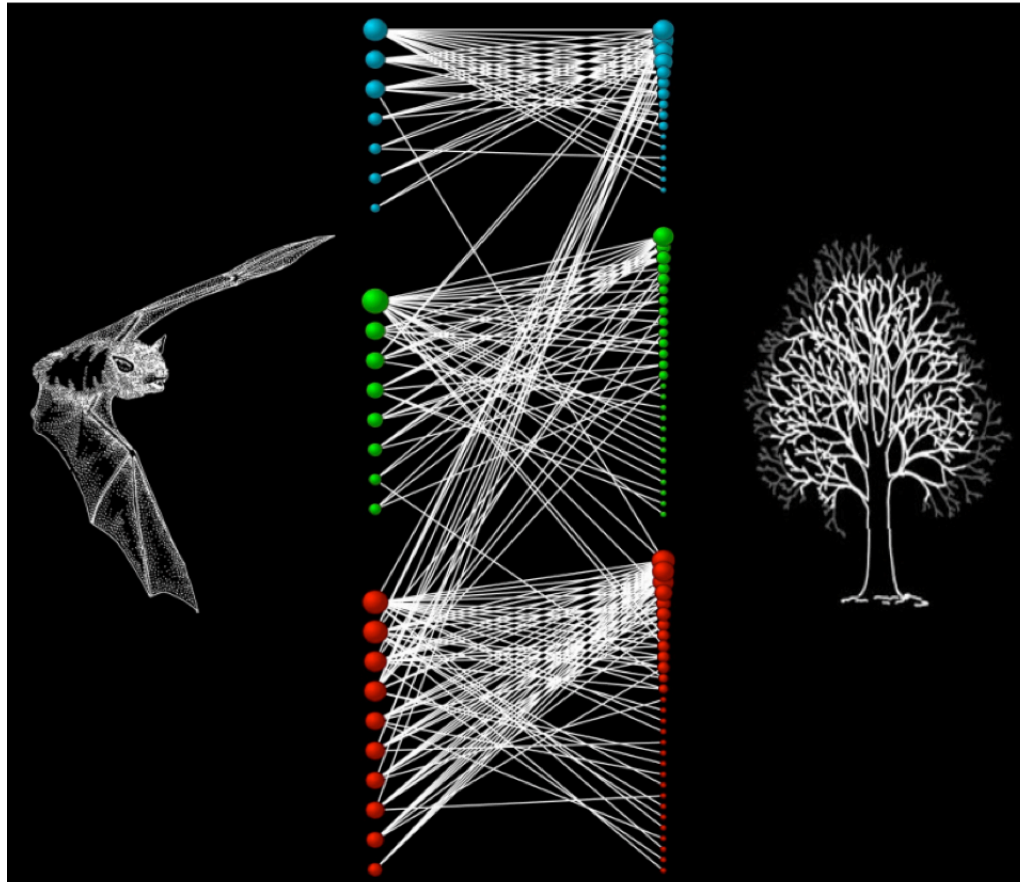
```
binet.nest <- nestedness(our.binet,null.models=TRUE,n.nulls=10)
```

bipartite: nestedness

```
plotweb(our.binet)
```



bipartite: modularity



bipartite: modularity

```
binet.mods <- computeModules(our.binet)
```

```
binet.mods
```

```
plotModuleWeb(binet.mods)
```

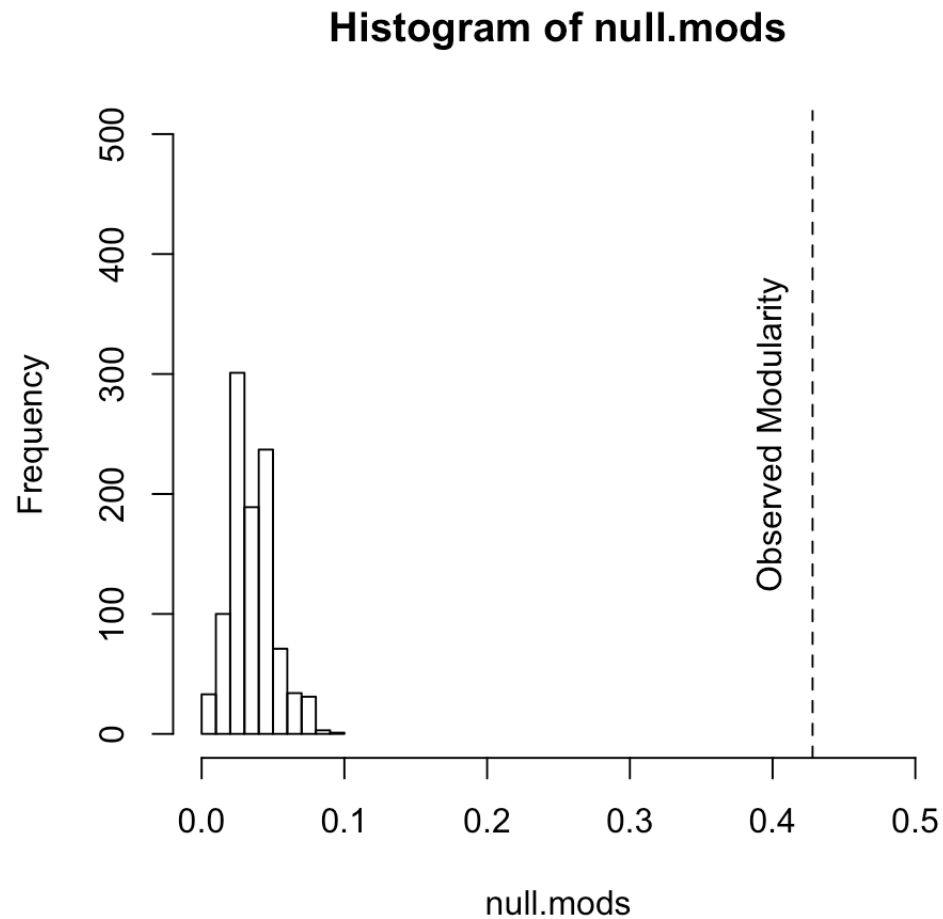
bipartite: modularity

```
null.nets <- nullmodel(our.binet, N=1000, method="r2d")
```

```
null.mods <- lapply(null.nets, computeModules)
```

```
null.mods <- lapply(null.mods, slot, name='likelihood')
```

bipartite: modularity



bipartite: modularity

Calculate z-value and p-value for right-tailed test:

```
obs.mods <- slot(obs.mods, name='likelihood')
```

```
null.mods <- unlist(null.mods)
```

```
z.val <- (obs.mods - mean(null.mods)) / sd(null.mods)  
z.val
```

```
## [1] 24.52201
```

```
p.val <- length(null.mods[null.mods >= obs.mods]) / length(null.mods)  
p.val
```

```
## [1] 0
```

What does it all mean?

- Structural analysis with dynamic implications
- Nestedness minimizes competition and facilitates diversity
- Modularity stabilizes through compartmentalization

What does it all mean?

Bascompte J. and Jordano P. 2014. [Mutualistic networks](#). Princeton University Press.

Fortuna M.A. et al. 2010. [Nestedness versus modularity in ecological networks: two sides of the same coin?](#). J. Anim. Ecol., 7:811-817.

Gotelli N.J. and Ellison A.M. 2013. [Primer of Ecological Statistics](#). Sinauer Associates, Inc.

Bluthgen N. et al. 2008. [What do interaction network metrics tell us about specialization and biological traits?](#). Ecology, 89: 3387-3399.

Fontaine et al. 2011. [Stability of ecological communities and the architecture of mutualistic and trophic networks](#). Ecol. Lett., 14: 1170-1181.

Connect: The R network world

Other Network Packages

- *sna*
- *network*
- *statnet*
- *igraph*
- *Rgraphviz*
- *vegan*

Connect: enaR to EcoNet

This function will right a network class model to a text file formatted for *EcoNet*.

```
data(oyster)
write.EcoNet(oyster, file='./oyster.txt', mn='ena_model_oyster')
```