

# *tanggle*: an R package for visualization of phylogenetic networks in a *ggplot2* framework

- [1. Introduction](#)
- [2. List of functions](#)
- [3. Getting started](#)
- [4. Split Networks](#)
- [5. Summary](#)
- [6. Session info](#)
- [7. References](#)



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# 1. Introduction

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**tanggle** extends the *ggtree* R package (Yu et al. 2017) to allow for the visualization of several types of phylogenetic networks using the *ggplot2* (Wickham 2016) syntax. More specifically, *tanggle* contains functions to allow the user to effectively plot: (1) split (i.e. implicit) networks (unrooted, undirected) and (2) explicit networks (rooted, directed) with reticulations. It offers an alternative to the plot functions already available in *ape* (Paradis and Schliep 2018) and *phangorn* (Schliep 2011).

XXX Add another paragraph or expand on the previous one

# 2. List of functions

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Function name	Brief description
<code>geom_splitnet</code>	XXX description of this function and what it does
<code>ggsevonet</code>	XXX description of this function and what it does
<code>ggsplitnet</code>	XXX description of this function and what it does
<code>minimize_overlap</code>	XXX description of this function and what it does
<code>node.depth.evonet</code>	XXX description of this function and what it does
<code>reexports</code>	XXX description of this function and what it does

# 3. Getting started

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Load the necessary libraries:

```
packages_needed <- c("ggplot2", "ggtree", "phangorn")
packages_to_install <- packages_needed[!(packages_needed %in% installed.packages()[,"Package"])]
if(length(packages_to_install)) install.packages(packages_to_install)
```

If you need to install *ggtree* from github:

```
library(devtools)
install_github("YuLab-SMU/ggtree")
```

Install *tanggle* from the github repository:

```
library(devtools)
install_github("KlausVigo/tanggle")
```

And load all the libraries:

```
library(devtools)
library(tanggle, quietly=T)
library(phangorn, quietly=T)
library(ggtree, quietly=T)
```

---

## 4. Split Networks

Split networks are data-display objects which allow for the definition of 2 (or more) options for non-compatible splits. Split networks are most often used to visualize consensus networks (Holland et al. 2004) or neighbor-nets (Bryant and Moulton 2004). This can be done either by using the `consensusNet` or `neighbor-net` functions in *phangorn* (Schliep 2011) or by importing nexus files from SplitsTree (Huson and Bryant 2006).

### 4.1. Data Types

*tanggle* accepts three forms of input data for split networks. The following input options all generate a *networkx* object for plotting.

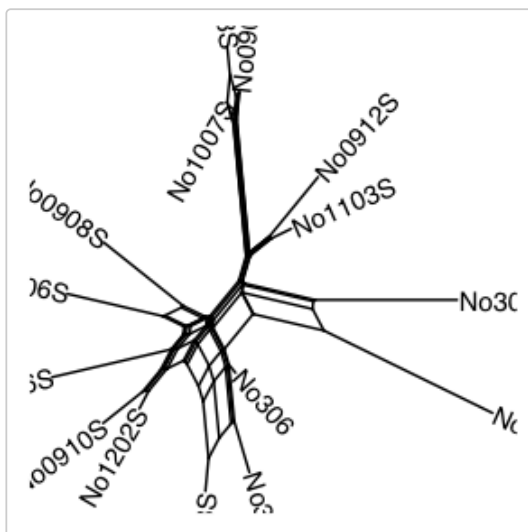
- Nexus file created with SplitsTree (Huson and Bryant 2006) and read with the `read.nexus.network` function in *phangorn* (Schliep 2011).
- Read in a split network in nexus format:

```
fdir <- system.file("extdata/trees", package = "phangorn")
Nnet <- phangorn::read.nexus.networkx(file.path(fdir, "woodmouse.nxs"))
```

2. A collection of gene trees (e.g.~from RAxML (Stamatakis 2014)) in one of the following formats:
  - Nexus file read with the function `read.nexus`
  - Text file in Newick format (one gene tree per line) read with the function `read.tree` A consensus split network is then computed using the function `consensusNet` in *phangorn* (Schliep 2011).
- Sequences in nexus, fasta or phylip format, read with the function `read.phyDat` in *phangorn* (Schliep 2011) or the function `read.dna` in *ape* (Paradis and Schliep 2018). Distances matrices are then computed for specific models of evolution using the function `dist.ml` in *phangorn* (Schliep 2011) or `dist.dna` in *ape* (Paradis and Schliep 2018). From the distance matrix, a split network is reconstructed using the function `neighborNet` in *phangorn* (Schliep 2011). **Optional:** branch lengths may be estimated using the function `splitsNetworks` in *phangorn* (Schliep 2011).

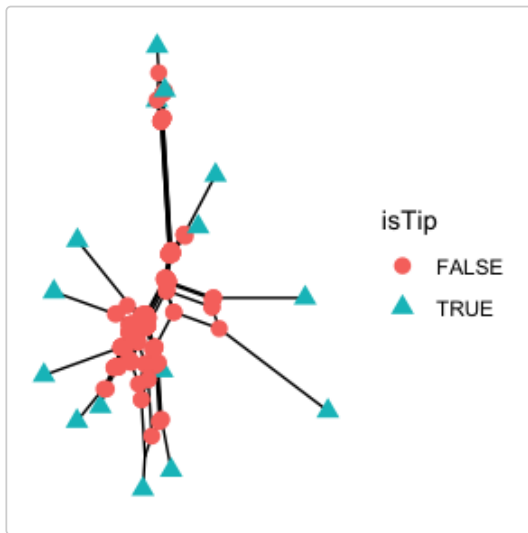
### 4.2. Plotting a Split Network:

```
ggsplitnet(Nnet) + geom_tiplab2()
```



Nodes can be annotated with `geom_point`.

```
ggsplitnet(Nnet) + geom_point(aes(shape=isTip, color=isTip), size=3)
```



### 4.3. Plotting Explicit Networks

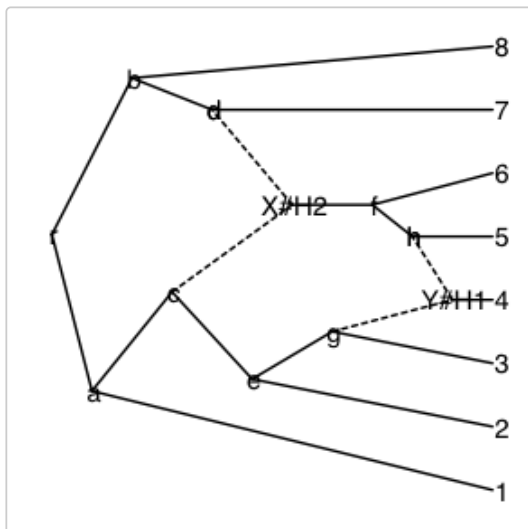
The function `ggevonet` plots explicit networks (phylogenetic trees with reticulations). A recent addition to *ape* (Paradis and Schliep 2018) made it possible to read in trees in extended newick format (Cardona, Rosselló, and Valiente 2008).

Read in an explicit network (example from Fig. 2 in Cardona et al. 2008):

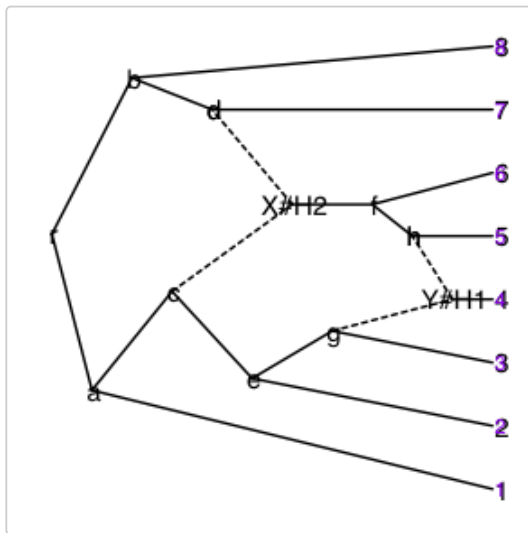
```
z <- read.evonet(text = "((1,((2,(3,(4)Y#H1)g)e,(((Y#H1,5)h,6)f)X#H2)c)a,
((X#H2,7)d,8)b)r;")
```

Plot an explicit network:

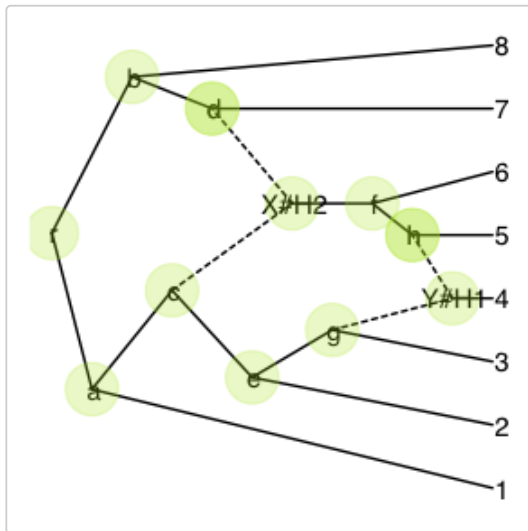
```
ggevonet(z) + geom_tiplab() + geom_nodelab()
```



```
p <- ggevonet(z, layout = "slanted") + geom_tiplab() + geom_nodelab()
p + geom_tiplab(size=3, color="purple")
```



```
p + geom_nodepoint(color="#b5e521", alpha=1/4, size=10)
```



## 5. Summary

The split network plots should take most of the functions compatible with unrooted trees in ggtree. The explicit network plots are phylogram or slanted. Not all options may work as intended yet. -> perhaps get rid of this?

## 6. Session info

```
sessionInfo()
#> R version 3.6.3 (2020-02-29)
#> Platform: x86_64-apple-darwin15.6.0 (64-bit)
#> Running under: macOS Catalina 10.15.5
#>
#> Matrix products: default
#> BLAS:
#> /System/Library/Frameworks/Accelerate.framework/Versions/A/Frameworks/vecLib.framework/Versions/A/LibBLAS.
#> LAPACK: /Library/Frameworks/R.framework/Versions/3.6/Resources/Lib/LibLapack.dylib
#>
#> Locale:
#> [1] en_AU.UTF-8/en_AU.UTF-8/en_AU.UTF-8/C/en_AU.UTF-8/en_AU.UTF-8
#>
#> attached base packages:
#> [1] stats      graphics  grDevices  utils      datasets  methods   base
#>
#> other attached packages:
#> [1] pagedown_0.11      rmarkdown_2.3      BiocManager_1.30.10 tanggle_0.99.0      ggplot2_3.3.2
#> [6] phangorn_2.5.5      ape_5.4-1           ggtree_2.3.5.993    BiocStyle_2.14.4    devtools_2.3.2
#> [11] usethis_1.6.3       tinytex_0.26        knitr_1.30
#>
#> Loaded via a namespace (and not attached):
#> [1] pkgload_1.1.0      tidyr_1.1.2        jsonlite_1.7.1      assertthat_0.2.1    rvcheck_0.1.8
#> [6] yaml_2.2.1         remotes_2.2.0      sessioninfo_1.1.1   pillar_1.4.6        backports_1.1.10
#> [11] lattice_0.20-41    glue_1.4.2         quadprog_1.5-8      digest_0.6.25       promises_1.1.1
#> [16] colorspace_1.4-1   websocket_1.3.1     httools_0.5.0       httpuv_1.5.4        Matrix_1.2-18
#> [21] pkgconfig_2.0.3    servr_0.18         purrr_0.3.4         patchwork_1.0.1     tidytree_0.3.3
#> [26] scales_1.1.1       processx_3.4.4     whisker_0.4         later_1.1.0.1        git2r_0.27.1
#> [31] tibble_3.0.3       farver_2.0.3       generics_0.0.2      ellipsis_0.3.1      withr_2.3.0
#> [36] lazyeval_0.2.2     cli_2.0.2          mime_0.9            magrittr_1.5         crayon_1.3.4
#> [41] memoise_1.1.0      evaluate_0.14      ps_1.3.4            fs_1.5.0            fansi_0.4.1
#> [46] nlme_3.1-149       pkgbuild_1.1.0     tools_3.6.3         prettyunits_1.1.1   lifecycle_0.2.0
#> [51] stringr_1.4.0      aplot_0.0.6        munsell_0.5.0       callr_3.4.4          compiler_3.6.3
#> [56] rlang_0.4.7        grid_3.6.3         rstudioapi_0.11     igraph_1.2.5         labeling_0.3
#> [61] testthat_2.3.2     gtable_0.3.0       curl_4.3            R6_2.4.1            dplyr_1.0.2
#> [66] fastmatch_1.1-0    rprojroot_1.3-2    treeio_1.13.1       desc_1.2.0           stringi_1.5.3
#> [71] parallel_3.6.3     Rcpp_1.0.5         vctrs_0.3.4         tidyselect_1.1.0    xfun_0.17
```

## 7. References

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Schliep, Klaus Peter. 2011. "Phangorn: Phylogenetic Analysis in R." *Bioinformatics* 27 (4): 592–93.  
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Stamatakis, A. 2014. "raxml Version 8: A Tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies." *Bioinformatics* 30 (9): 1312–3.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York.  
<http://ggplot2.org>.

Yu, Guangchuang, David Smith, Huachen Zhu, Yi Guan, and Tommy Tsan-Yuk Lam. 2017. "Ggtree: An R Package for Visualization and Annotation of Phylogenetic Trees with Their Covariates and Other Associated Data." *Methods in Ecology and Evolution* 8 (1): 28–36. <https://doi.org/10.1111/2041-210X.12628>.

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