

¹ `ggpedigree`: Visualizing Pedigrees with ‘`ggplot2`’ and ² ‘`plotly`’

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⁵ Summary

Pedigree diagrams underpin research and practice across genetics, animal breeding, genealogy, forensics, and counseling. They help medical geneticists trace the inheritance of Mendelian diseases and identify at-risk relatives; enable dairy breeders to plan matings that improve milk yield; support genealogists in reconstructing ancestry; assist forensic scientists in establishing familial connections in criminal investigations; and facilitate family therapists and counselors in understanding their clients' relationships (McGoldrick, Gerson, & Petry, 2020). Early R tools such as `kinship2` (Sinnwell, Therneau, & Schaid, 2014) plot simple nuclear families effectively, but they do not scale to today's pedigrees that can exceed 1,000s of individuals. As datasets have grown, researchers now work with increasingly complex family structures, including large-scale plant breeding pedigrees (Shaw, Graham, Kennedy, Milne, & Marshall, 2014), web-based pedigree management systems (Ranaweera, Makalic, Hopper, & Bickerstaffe, 2018), interactive pedigree editors (Carver et al., 2018), and behavior genetic studies of extended family structures (Garrison et al., 2023; Hunter, Garrison, Burt, & Rodgers, 2021). That complexity exposes the limitations of existing tools, which often struggle with large and complex datasets. `ggpedigree` addresses this need by combining a vectorised layout algorithm, `ggplot2` output, and optional `plotly` interactivity.

²² Statement of need

Pedigree visualization has traditionally relied on proprietary software (e.g., Progeny, GenoPro, Pedigree Viewer) or R packages like `kinship2` (Sinnwell et al., 2014), `pedtools` (Vigeland, 2021a), or `pedtricks` (J. Martin, Wolak, Johnston, & Morrissey, 2025). While these tools are functional for many use cases, their limitations become pronounced when working with complex, modern pedigree datasets or when more detailed customization is required. Most R packages focus on base graphics or simple `ggplot2` implementations.

Existing R solutions face three main challenges. First, current solutions are often poorly integrated with tidyverse workflows and do not expose the full theming and layering capabilities familiar to `ggplot2` users (Wickham, 2016). In animal-focused workflows, rapid rendering seems to takes precedence over aesthetic flexibility. I suspect that this is because users tend to work with more uniform data and fewer phenotypes. By contrast, human-focused workflows—particularly in behavior genetics and genetic epidemiology (Garrison et al., 2023; Lyu et al., 2025; McArdle & McDonald, 1984)—require closer integration with tidyverse pipelines and more flexible plotting systems to accommodate complex pedigree structures and harmonization of phenotypes across data sources. In other words, the needs are different.

Second, most R-based tools offer no interactivity. Static graphics are often sufficient for publication, but interactivity improves exploration and communication during model development or data cleaning. A notable exception is `pedtools` (Vigeland, 2021b), which offers a sister shiny

41 app, QuickPed ([Vigeland, 2022](#)). While the R ecosystem includes libraries, like `plotly`, that
42 support interactive plotting, these features have yet to be integrated into pedigree functions.

43 Third, scalability and extensibility remain limited across existing tools. Several R packages
44 attempt to address these challenges with built-in pedigree plotting functions. `kinship2`
45 ([Sinnwell et al., 2014](#)) remains widely used but produces static base graphics and relies on non-
46 vectorized recursive layout functions that do not scale well to large families. A partial `ggplot2`
47 implementation exists in a modernized `kinship2` (called `Pedixplorer`, [Le Nézet, Sinnwell,
48 Letko, André, & Quignon, 2025](#)), but is non-vectorized and incompatible with other `ggplot2`
49 layers. `pedtricks`, a revival of `pedantics` ([Morrissey & Wilson, 2010](#)), provides a `ggplot2`-
50 based implementation for large animal pedigrees but lacks extensibility and interactivity. The
51 `geneHapR` ([Zhang, Jia, & Diao, 2023](#)) package focuses on haplotype visualization rather than
52 general pedigree structure. The `pedgene` package ([Schaid & Sinnwell, 2024](#)) offers some
53 plotting functions but is primarily designed for association testing. The `pedigreejs` package
54 ([Carver et al., 2018](#)) provides an interactive pedigree editor but does not integrate with R or
55 `ggplot2`, limiting its utility for R users.

56 None of these packages offers the combination of modern `ggplot2` integration, interactive
57 capabilities, and extensibility that `ggpeditree` provides. `ggpeditree` addresses these limitations
58 by providing a comprehensive visualization framework built on modern R graphics infrastructure.
59 It leverages the extensive customization capabilities of `ggplot2` while adding specialized
60 functionality for pedigree-specific visualization challenges.

61 Software Architecture

62 `ggpeditree` is built on a modular architecture that separates data processing, layout calculation,
63 and visualization layers. The core workflow involves: (1) data standardization and family
64 structure analysis using `BGmisc` functions, (2) coordinate calculation using algorithms adapted
65 from `kinship2`, (3) relationship connection mapping, and (4) layer-based plot construction
66 using `ggplot2` geometry functions. This design allows users to customize any aspect of the
67 visualization while maintaining computational efficiency for large pedigrees. The package
68 integrates tightly with the broader R ecosystem, particularly the `tidyverse` ([Wickham et al.,
69 2019](#)) and `BGmisc` ([Garrison, S. M., Hunter, Michael D., Lyu, X., Trattner, J. D., & Burt,
70 S. A., 2024](#)). All functions return standard R objects (`ggplot` or `plotly`) that can be further
71 customized.

72 Features

73 I describe the main features of the `ggpeditree` package below. More detailed descriptions of
74 features and usage is available in the [package vignettes](#), including examples of how to create
75 static and interactive pedigree plots, customize aesthetics, and visualize relatedness matrices.
76 Additional example data include squirrel data from the Kluane Red Squirrel Project ([McFarlane
77 et al., 2014, 2015](#)) and Targaryen family data from the Song of Ice and Fire universe ([G. R. R.
78 Martin, 1997, 2018](#)).

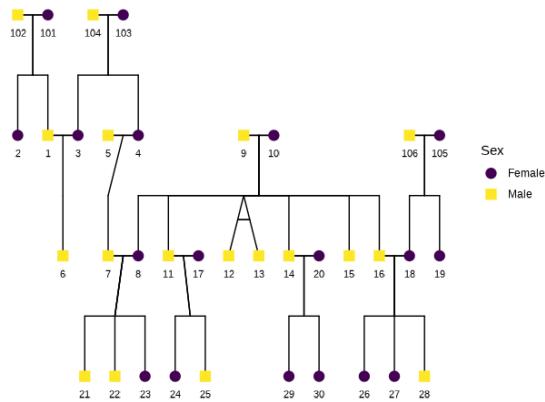
- 79 ▪ Data Standardization and Family Structure Analysis: `ggPedigree()` integrates with
80 `BGmisc` functions like `ped2fam()` to organize individuals by family, `recodeSex()` to
81 standardize sex coding, and `checkParentIDs()` to validate pedigree structures. The
82 function handles consanguineous relationships and individuals appearing in multiple
83 pedigree positions.
- 84 ▪ Coordinate Calculation: `calculateCoordinates()` computes optimal positioning for indi-
85 viduals using algorithms adapted from `kinship2::align_pedigree`, with enhancements
86 for large multi-generational pedigrees and complex family structures. These steps are
87 vectorized as much as possible to ensure computational efficiency and compatibility with
88 `ggplot2`.

- Relationship Connection Mapping: `calculateConnections()` generates connection paths between family members, mapping parent-child, sibling, spousal, and twin relationships. The function determines midpoints for line intersections and handles overlapping connections with specialized curved segments. These calculations are optimized for large datasets by using vectorized operations rather than the loop-based approaches used in `kinship2`.
- Layer-based Plot Construction: `ggPedigree()` constructs plots using `ggplot2` geometry functions, returning standard `ggplot2` objects that integrate with existing R workflows. `ggPedigreeInteractive()` extends plots into interactive `plotly` widgets. A config system allows customization of over 100 aesthetic and layout parameters.
- Individual Highlighting: Advanced functionality to highlight specific individuals and their relatives based on additive genetic, mitochondrial, or other relationship matrices.
- Specific Visualization Functions: `ggPedigree()` creates static pedigree plots using `ggplot2`. `ggPedigreeInteractive()` generates interactive pedigree plots using `plotly`. `ggRelatednessMatrix()` creates customizable heatmaps for relatedness matrices with support for hierarchical clustering, and seamless integration with `BGmisc` relatedness calculations. `ggPhenotypeByDegree()` visualizes phenotypic correlations as a function of genetic relatedness, including confidence intervals and statistical summaries for quantitative genetic analysis.

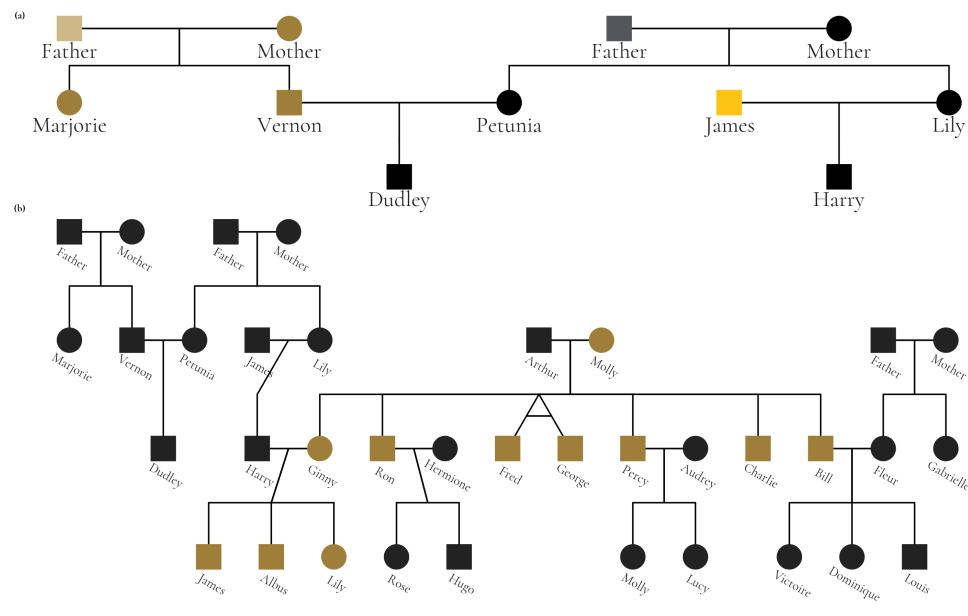
108 Code example

109 This example shows how to use `ggpedigree` to visualize a pedigree. The `potter` dataset
 110 includes several wizarding families from the Harry Potter series.

```
111    ggPedigree(potter,
  112      famID = "famID",
  113      personID = "personID"
  114     )
```



111
 112 I demonstrate several advanced features by restyling the figure from ([Hunter et al., 2025](#)), to
 113 follow the Wake Forest brand identity guidelines; source code is in the appendix.



114

115 I have combined two figures using patchwork (Pedersen, 2025): panel (a) highlights unique
 116 mitochondrial lines in the Dursley and Evans families, while panel (b) shows the full pedigree
 117 with Molly Weasley's mitochondrial descendants in gold.

118 Collectively, these tools provide a valuable resource for behavior geneticists and others who
 119 work with extended family data. They were developed as part of a grant and have been used
 120 in several ongoing projects, presentations (Garrison, 2024; Hunter, Garrison, Lyu, Good, &
 121 Burt, 2024), and forthcoming papers (Burt et al., 2025; Hunter et al., 2025; Lyu et al., 2025).

122 Availability

123 The `ggpedigree` package is open-source and available on both GitHub at <https://github.com/R-Computing-Lab/ggpedigree> and the Comprehensive R Archive Network (CRAN) at
 124 <https://cran.r-project.org/package=ggpedigree>. It is licensed under the GNU General Public
 125 License.
 126

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 130 package.

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