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qualpal: qualitative color palettes for everyone

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Summary

qualpal is a C++ library for generating qualitative color palettes with maximum perceptual distinctiveness, designed for scientific data visualization and accessibility. It supports flexible palette generation via multiple input formats (RGB, HSL and LCHab (HCL) colorspaces, built-in palettes) and can adapt palettes to color vision deficiencies (CVD) of the full dichromacy spectrum (protanopia, deuteranopia, tritanopia) with any choice of severity. The

color vision deficiency simulation, and perceptual color difference metrics. The library uses fast algorithms and perceptually uniform color spaces (DIN99d, CIEDE2000) to select colors that are maximally distinct, ensuring accessibility for users with color vision deficiencies.

Statement of need

Effective visualization of categorical data requires color palettes where colors are easily distinguishable, including for users with color vision deficiencies (CVD). Standard palettes are often optimized for a fixed number of colors and may not be perceptually distinct or accessible. qualpal addresses this gap by providing an automated, reproducible method for generating and improving color palettes, supporting accessibility and flexible input. It is useful for researchers, data scientists, and developers who need high-quality, accessible color palettes for figures, charts, and interfaces. To support the large community of R users in scientific visualization, qualpalr provides bindings to the C++ library, allowing palette generation directly from R and integration with R plotting packages.

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References