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Imagespace: a graphical method to visualise large numbers of discrete character combinations

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Morphospaces allow the forms of different organisms to be quantitatively compared. Researchers have generally adopted two approaches to morphospace development. The first involves using a generative model to produce theoretical morphologies that can be compared with forms that exist in the real world. The second involves representing the forms of organisms by a number of discrete characters, and using multivariate ordination to create a morphospace of reduced dimensions. In addition to these two approaches there are also raw morphospaces, which are formulated in terms of observed morphological variation but prior to any multivariate ordination. Raw morphospaces capture form by the enumeration of discrete characters and can represent both theoretical morphologies and forms that are realised in nature. Raw morphospaces are useful tools in the investigation of organic form because they facilitate the study of the evolution of the actual within the realm of the possible. However, a primary obstacle to their use in studies of the evolution of biological form is the visualisation of large numbers of discrete character combinations. I have taken a computer graphics approach to this problem, and have developed tools using the Python programming language that allow collections of morphologies to be visualised as images. In these imagespaces each pixel represents a unique combination of discrete characters. I use this approach to study the morphology of angiosperm (flowering plant) pollen from tropical rain forests, and compare these imagespaces with other ways of visualising large numbers of discrete character combinations.