Patterns and Factoring

1. Patterns and Factoring

Point arrangements can represent patterns. For example, a square has points at four corners. A cube has points at eight corners. A circle has a center and evenly spaced points around circumference. A sphere has a center and evenly spaced points around surface. A leaf has points at stem beginning and end, leaf tips and indentations, and along veins.

2. Point Figures

Patterns have a center point. Patterns have points at salient features, such as corners, borders, and contrasts.

3. Relative Point Distances

Pattern points have relative distances. A cube differs from a rectangle by having points with different relative distances. However, patterns differing only in size are the same pattern, because relative distances are the same for patterns of the same shape.

4. Features

Point combinations and their relative distances make features. Two points make a line segment. Three points make a triangle. Four points make a square, diamond, rectangle, T, or pyramid.

5. Pattern Representation

A unique pattern representation can use a pattern center, vectors, and pairwise relations between points. The first two points have distance one unit.

5.1. Pattern Center

Using Cartesian coordinates, pattern center is at three-dimensional coordinate origin and one distance unit along fourth dimension (0,0,0,1). The extra dimension avoids false equivalences that can happen if pattern center lies near a point.

5.2. Vectors

Vectors go from pattern center to pattern points. Pattern points have 0 for fourth dimension (x,y,z,0). Different points have different vectors.

5.3. Vector Pairs

To represent relation between two points, from their two vectors, calculate their vector cross product and square to use only positive numbers. Different pairs have unique cross products.

5.4. Multiply Factors

After finding cross product for all vector pairs, multiply all cross products. Same-shape patterns have the same unique pattern representation.

5.5. Colors or Point Types

Points can have different colors and/or types by adding a fifth dimension (x,y,z,0,n).

6. Patterns and Factors

Patterns are multiples of pattern features. Removing a point factors out its pairwise factors and leaves the remaining pattern features. Adding a point adds pairwise features and keeps previous features.

Pairwise features already account for all triple-point, quadruple-point, and higher features.

Pattern translation, reflection, rotation, and inversion have same pattern representation, so orientation and position do not matter.
