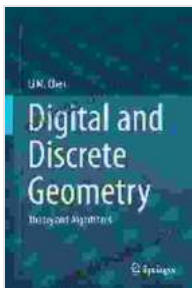


Digital and Discrete Geometry: Theory and Algorithms

Digital and Discrete Geometry is a rapidly growing branch of mathematics that has applications in many areas of computer science, including computer graphics, image processing, and computer-aided design. Digital geometry is concerned with the properties of digital objects, such as points, lines, and polygons, that are defined by their pixels. Discrete geometry is concerned with the properties of discrete objects, such as graphs and polyhedra, that are defined by their vertices and edges.

Basic Concepts

The basic concepts of digital and discrete geometry include:



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by Li M. Chen

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- **Pixels:** Pixels are the basic building blocks of digital images. They are defined by their position and their color or intensity.

- **Lines and polygons:** Lines and polygons are defined by the pixels that they contain. A line is defined by two pixels, while a polygon is defined by three or more pixels.
- **Graphs:** Graphs are defined by their vertices and edges. A vertex is a point, while an edge is a line that connects two vertices.
- **Polyhedra:** Polyhedra are defined by their vertices and faces. A vertex is a point, while a face is a polygon.

Applications

Digital and discrete geometry has applications in many areas of computer science, including:

- **Computer graphics:** Digital geometry is used to create and render 3D models, animations, and special effects.
- **Image processing:** Digital geometry is used to process and analyze images, such as by detecting edges, removing noise, and compressing images.
- **Computer-aided design:** Digital geometry is used to create and modify 3D models of objects, such as for use in engineering and architecture.
- **Computational topology:** Discrete geometry is used to study the properties of topological spaces, such as their connectivity and homology.

Algorithms

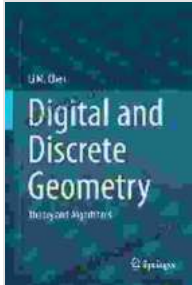
There are many algorithms for digital and discrete geometry, including:

- **Bresenham's algorithm:** Bresenham's algorithm is a simple and efficient algorithm for drawing lines.
- **Polygon scan conversion:** Polygon scan conversion is a technique for filling in polygons with color.
- **Graph traversal algorithms:** Graph traversal algorithms are used to visit all of the vertices and edges in a graph.
- **Polyhedral mesh generation algorithms:** Polyhedral mesh generation algorithms are used to create 3D meshes of objects.

Theory

The theory of digital and discrete geometry is based on the mathematics of set theory, topology, and algebra. Set theory is used to define the basic concepts of digital and discrete geometry, such as pixels, lines, and polygons. Topology is used to study the properties of topological spaces, such as their connectivity and homology. Algebra is used to study the properties of algebraic structures, such as groups and rings.

Digital and discrete geometry is a rapidly growing branch of mathematics that has applications in many areas of computer science. The basic concepts of digital and discrete geometry include pixels, lines, polygons, graphs, and polyhedra. The applications of digital and discrete geometry include computer graphics, image processing, computer-aided design, and computational topology. The algorithms for digital and discrete geometry include Bresenham's algorithm, polygon scan conversion, graph traversal algorithms, and polyhedral mesh generation algorithms. The theory of digital and discrete geometry is based on the mathematics of set theory, topology, and algebra.



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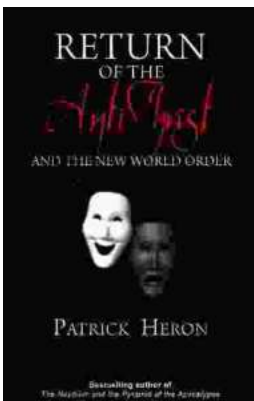
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