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Line vector computer definition

On-Line Geometric Modeling Notes Points and Vectors The basic 3-dimensional space objects that form the basis of all operations in computer graphics are the point, and the vector (sometimes called a free vector). These objects are often confused when studying the field, and often students learn that points and vectors are essentially the same. But they are very different. Namely, A Point has position in the room. The only property that separates one point from another is its position. A vector has both size and direction, but no fixed position in the room. For a postscript version of these notes see here. Geometrically, we draw points such as dots and vectors as line segments with arrows. We will usually draw vectors by attaching them to a certain point, but it should be emphasized that any vector is positionless. We will denote points with uppercase bold letters such as and , and will designate vectors as lowercase letters with an arrow above as and . In computer graphics, we use an affin space. This space consists of a set of points and a vector area. The points and vectors of this room are related in a fixed but simple way by the following axioms. We illustrate the axioms by harnessing the affine space to two-dimensional points and vectors. In this example, we represent points component-wise by using parentheses (e.g.) and vectors using parentheses (e.g. <u,v,w>). There are several axioms that relate the points and vectors in an affine room. In general, the points are thought to play the primary role in space, while the vectors are used to move around the room from point to point. The general axioms are as follows. For each pair of points and , there is a unique vector so that this axiom says, in the case of affine space at 2-dimensional points and vectors, this that there is a direction and size between two points of space. The figure below illustrates this axiom. For each point and vector, there is a unique point, so this axiom says, in the case of affine space at 2-dimensional points and vectors, as given a point, if we move from this point a distance in the direction of , we should find a point defined there. The point is often written as , and the vector is often written as . Given three points, and , these points satisfy this is usually called "head-to-tail" axiom and is illustrated for affine space of 2-dimensional points and vectors in the following figure. From the three axioms we can deduce that affine areas have the following characteristics. This is an immediate feature of head-to-tail axiom with . We note that both the left and right sides of this equation are vectors. This therefore says that the additive inverse of the vector is . We note that both the left and right sides of this equation </u,v,w>Vectors. This axiom is illustrated in the affine room of two-dimensional points and vectors in the following figure. We note that both the left and right sides of this equation are vectors. The axiom is illustrated for the affine room of two-dimensional points and vectors in the following figure. It should also be noted in this case that the vectors are free and positionless. The two resulting vectors have the same direction and size, and are therefore similar. We note that both the left and right sides of this equation are points. This is only a direct result of the definition of the vector . We note that the left and right sides of this equation are vectors. This axiom is illustrated for the affine room of two-dimensional points and vectors in the following figure. We note that these axioms show that points and vectors are two different units. In particular, vectors can be added, but points can not. Vectors can also be scaled, while points can not. Many see points such as playing the primary role in geometry, while the role of vectors is to allow movement from point to point. There are operations at points that are fundamental to the content of the data graphic field. These operations are affin combinations that arise from the following operation: Leave and be points in our affin space. Think of the expression This formula is meaningful, which is a vector, and thus is . Therefore, the sum of a point and a vector is a valid operation. This point represents, in the affine room for two-dimensional points and vectors, a point on the line that passes through and . We note that if then is somewhere on the line segment join and . This expression allows us to define a basic operation at points. We use the following notation to mean that it is the point defined by we can then define an affin combination of two points and to be there. The form is displayed to be an affine transformation by specifying . We can generalize this to define an affin combination of an arbitrary number of points. If are points and are scalaars so that, then is defined to be the point of constructing an excellent example of an affin combination consider three points, and . A point defined by where , gives a point in the triangle. We note that the definition of affin combination defines this point to be the following illustration shows the point generated when and . In fact, it can easily appear that if then the point will be within (or at the limit) of the triangle. If someone is less than zero or greater than one, the point will be outside the triangle. If someone is zero, the point will be on the border of the triangle. This document is maintained by Ken Joy Comments to author All Content Copyright (c) 1996, 1997 Computer Science Department, University of California, Davis All Rights Reserved. Ken Joy Mon January 6 PST 1997 Computer graphics images defined by points, lines, and curves This article is about computer illustration. For other uses, see Vector graphics (disambiguation). Example showing the effect of vector graphics versus raster graphics Vector graphics are computer graphics images defined in the form of points on a Chartesian plane, which are associated with lines and curves to form polygons and other shapes. Vector graphics have the unique advantage over raster graphics in that the points, lines, and curves can be scaled up or down to a resolution without equalization. The points determine the direction of the vector path; each path can have different properties, including border color, shape, curve, thickness, and fill values. [1] Instead of removing a large area of data memory and assigning that to the display device, vector display devices use a variable number of lines to create images — hence the term vector graphics. Since vector screen units can define a line by handling only two points (that is, the coordinates of each end of the line), the device can reduce the total amount of data it must handle by organizing the image in terms of pairs of points. [3] Vector graphics are typically found today in SVG, EPS, PDF, or AI file formats, and are inherently different from the most common raster graphics file formats such as JPEG, PNG, APNG, GIF, and MPEG4. Overview A free software Asteroids-like video game played on a vector monitor Vector graphic screens was first used in 1958 by the U.S. SAGE air defense system. [4] Vector graphics systems were retired from the United States on the way to air traffic control in 1999. [citation needed] Vector graphics were also used on TX-2 at the MIT Lincoln Laboratory by computer graphics pioneer Ivan Sutherland to run his sketchpad program in 1963. [5] Subsequent vector graphics systems, most of which iterated through dynamically modifiable stored lists of drawing instructions, include IBM 2250, Imlac PDS-1 and GT DEC40. It was a video game console that used vector graphics called Vectrex, as well as various arcade games such as Asteroids, Space Wars and many cinematronics titles such as Rip-Off and Tail Gunner using vector screens. [6] Storage scope images, such as Tektronix 4014, can display vector images but not change them without first deleting the screen. Modern vector graphics displays can sometimes be found at laser light shows, where two fast X-Y mirrors place the beam to quickly draw shapes and text as straight and curved strokes on a screen. Vector graphics can be created in a shape using a pen plotter, a special type of printer that uses a series of bullet point and marker pens on a servo-driven mount that moves horizontally over the paper, with the plotter moving the paper back and forth through the vertical motion paper path. Although a plot can easily require a few thousand paper movements, back and forth, the paper does not slide. In a small roll-fed plotter made by the Alps of Japan, teeth on thin gears yanked the paper near the edges of the first pass and maintained registration on subsequent passes. Some Hewlett-Packard pen plotters had two-axis pen carriers and stationery (plot size was limited). However, the moving H-P plotters had gravel wheels (related to machine workshop grinding wheels) which at first pass indented the paper surface and collectively maintained the registration. Today's vector files, such as technical drawings, are usually printed as bitmaps, after conversion from vector to raster. The term vector graphics is mainly used today in the context of two-dimensional computer graphics. It's one of several modes an artist can use to create an image on a raster screen. Vector graphics can be uploaded to online databases for other designers to download and manipulate, faster the creative process. Other modes include text, multimedia, and 3D rendering. Almost all modern 3D renderings are made using extensions of 2D vector graphics techniques. Plotters used in technical drawing still draw vectors directly to paper. This vector-based image of a round four-color vortex shows several unique features of vector graphics versus raster graphics: There is no aliasing along the rounded edge resulting in digital artifacts, the color gradients are all smooth, and the user can resize the image infinitely without losing any quality. The Standards World Wide Web Consortium (W3C) standard for vector graphics is scalable vector graphics (SVG). The standard is complex and has been relatively slow to be established at least in part because of commercial interests. Many browsers now have some support for rendering SVG data, but full implementation of the standard is still relatively rare. In recent years, SVG has become a significant format that is completely independent of the resolution of the rendering device, usually a printer or screen display. SVG files are essentially printable text that describes both straight and curved paths, as well as other attributes. Wikipedia prefers SVG for images such as simple maps, line illustrations, coats of arms and flags, which are usually not like photographs or other continuous tone images. Rendering SVG requires conversion to raster format at a resolution suitable for the current task. SVG is also a format for animated graphics. There is also a version of SVG for mobile phones. Specifically, it is called the specific format for mobile phones SVGT (SVG Tiny version). These images can count links and also utilize leveling. They can also appear as wallpaper. Conversion The list of image file formats covers proprietary and public vector formats. Original reference image before vectorization can be added or removed from vector graphics. For raster Main articles: Rasterization, Raster image processor and Render output device Modern monitors and printers are raster devices; vector formats must be converted to raster format (bitmap - pixel arrays) before they can be rendered (displayed or printed). [7] The size of the bitmap/raster format file generated by the conversion depends on the resolution required, but the size of the vector file that generates the bitmap/raster file will always remain the same. Thus, it is easy to convert from a vector file to a variety of bitmap/raster file formats, but it is much harder to go in the opposite direction, especially if subsequent editing of the vector image is required. Saving an image created from a vector source file as a bitmap/raster format may be advantageous, because different systems have different (and incompatible) vector formats, and some may not support vector graphics at all. However, once a file is converted from the vector format, it is likely to be larger, and it loses the benefit of scalability without loss of resolution. It will also no longer be possible to edit certain parts of the image as discrete objects. The file size of a vector graphic image depends on the number of graphic elements it contains; there is a list of descriptions. From raster Main Articles: Vectorization (image tracking) and comparison of raster-to-vector conversion software This section is empty. You can help by adding it. In 2018, there were 100,000 people who were written in 201 Printing Vector art is ideal for printing since the art is made of a variety of mathematical curves, it will be printed very sharply even when resized. [8] For example, you can print a vector logo on a small sheet of copy paper, then enlarge the same vector logo to billboard size and retain the same sharp quality. A low-resolution raster graphic would make it pixelated or pixelated too much if it was magnified from business card size to billboard size. (The exact resolution of a raster graphic required for high-quality results depends on the display distance, for example, a billboard may still appear to be of high quality even at low resolution if the display distance is large enough.) [9] If we consider typographical characters as images, the same considerations we have made for graphics apply even to the composition of written text for printing (betting). Older character sets were saved as bitmaps. Therefore, to achieve maximum print quality, they had to be used only with a given resolution; These font formats are said to be non-scalable. High-quality typography is today based on character drawings (fonts) that are usually stored as vector graphics and can be scaled to any size. Examples of these vector formats for are Postscript fonts and TrueType fonts. Operation Advantages of this style of drawing over raster graphics: Because vector vector consists of coordinates with lines/curves between them, the size of the representation does not depend on the dimensions of the object. This minimal amount of information translates into a much smaller file size compared to large raster images defined pixel by pixel. This said, a vector graphic with a small file size is often said to lack detail compared to a real image. Similarly, one can infinitely zoom in on eg, a circular arc, and it remains smooth. On the other hand, a polygon representing a curve will reveal not to be truly curved. When you zoom in, lines and curves don't have to be wider proportionally. Often the width is either not increased or less than proportional. On the other hand, irregular curves represented by simple geometric shapes can be made proportionally wider when zooming in, to keep them smooth and not like these geometric shapes. The parameters for objects are saved and can later be changed. This means that moving, scaling, rotating, filling etc. does not degrade the quality of a drawing. Moreover, it is common to specify the dimensions of device-independent units, resulting in the best possible rasterization on raster units. From a 3D perspective, rendering shadows is also much more realistic with vector graphics, as shadows can be abstracted into the light beams from which they are formed. This allows for photorealistic images and renderings. For example, considering a circle of radius r.[10] The most important parts of the information an application needs to draw this circle is an indication that what should be drawn is a circle radius is the position of the center point in the circular stroke line style and color (possibly transparent) fill style and color (possibly transparent) Vector formats are not always appropriate in graphics work and also have many drawbacks. [11] For example, devices such as cameras and scanners produce essentially continuous tone raster graphics that are impractical to convert to vectors, and so for this type of work, an image editor will operate on the pixels instead of on drawn objects defined by mathematical expressions. Comprehensive graphics tools will combine images from vector and raster sources, and can provide editing tools for both, since some parts of an image may come from a camera source, and others could have been drawn using vector tools. Some writers have criticized the concept of vector graphics as confusing. [12] [13] In particular, vector graphics not only refer to graphics described by Euclidean vectors. [14] Some authors have suggested using object-oriented graphics instead. [12] [15] [16] But this term can also be confusing as it can be read as any kind of graphics implemented using object-oriented programming. [12] Typical primitive objects A specific vector file format supports only some types of primitive objects. All vector file formats support simple and fast rendering primitive objects: Lines, polylines and polygons Bézier curves and bezigons circles and ellipses Most vector file formats support: Text (in data font formats such as TrueType where each letter is created from Bézier curves) or quadratics. Color gradients Often a bitmap image is considered a primitive object. From conceptual view, it behaves like a rectangle. Some vector file formats support more complex objects such as primitives: Many computer-assisted design applications support splines and other curves, such as: Catmull-Rom splines NURBS iterated function systems superellipses and superellipsoids metaballs If an image stored in one vector file format is converted to another file format that supports all primitive objects used in that image, the conversion may be lossless. Vector operations Vector graphics editors usually allow translation, rotation, mirroring, stretching, bias, affine transformations, change of z-order (solved, what is ahead of what) and combination of primitives into more complex objects. [quote required] More sophisticated transformations include set operations on closed forms (union, difference, intersection, etc.). [17] Vector graphics are ideal for simple or composite drawings that must be device independent,[18] or do not need to achieve photorealism. For example, the languages for Description of the PostScript and PDF page use a vector graphics model. See also Animation Anti-Grain Geometry Cairo (graphics) Comparison of vector graphics editors Comparison of graphics file formats Computer-assisted design Direct2D Illustration Javascript graphics library Raster to vector Raster graphics Resolution Independence Turtle graphics Vector graphics file formats Vector monitor Vector packages Vexel Wire frame model 3D modeling Notes ^ Arie Kaufman (1993). Rendering, visualization, and rasterization hardware. Springer Science & Business Media. In 1999, 100,000 people were booked in 1988. In 1978 he became 1,000,000,000