Assignment 4

Math for CS

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Challenge 1

(9, 18) (14, 22)

∆x = 14-9 = 5

∆y = 22-18 = 4

M = 4/5 = 0.8

Since 5 > 4 define steps |∆x|

|  |  |  |
| --- | --- | --- |
| Xp  yp | calculation | Draw |
| 9, 18 | 9+ 1 18+0.8 | (10, 19) |
| 10, 18.8 | 10+1 18.8+0.8 | (11, 20) |
| 11, 19.6 | 11+1 19.6 +0.8 | (12, 20) |
| 12, 20.4 | 12 +1 20.4 + 0.8 | (13, 21) |
| 13, 21.2 | 13 +1 21.2 +0.8 | (14, 22) |

Chart, scatter chart

Description automatically generated

Challenge 2

x0 y0

(9, 18) (14, 22)

∆x = 14-9 = 5

∆y = 22-18 = 4

Pk = 2(4) – 5 = 8 – 5= 3

Since Pk >= 0, we use Case 2

Pk + 1 = Pk + 2∆y Pk + 1 = 3+ 2(4) – 2(5)

|  |  |  |
| --- | --- | --- |
| Xp Yp Pk | method | draw |
| (9, 18) 3 | 9+1 18+1  3 + 2(4) – 2(5) | (10, 19) |
| (10, 19) 1 | 10+1 19 +1 1 + 2(4) – 2(5) | (11, 20) |
| (11, 20) -1 | 11 +1 20 -1 + 2(4) | (12, 20) |
| (12, 20) 7 | 12 + 1 20 + 1  7 +8 – 10 | (13, 21) |

A picture containing scatter chart

Description automatically generated

Challenge 3

One of the advantages of the Simple Bresenham Line Drawing Algorithm would be its efficiency. The Simple Bresenham uses integers, which can be computed faster and take up less memory, as opposed to DDA which uses floating point numbers and requires rounding. Therefore, Bresenham’s takes up less memory and can compute faster.

Challenge 4

A disadvantage of the Bresenham Line Drawing Algorithm is that the line it produces is not perfectly straight, which doesn’t seem to be a major issue since pixels are so tiny on a monitor you will see a straight line. If for some reason you had a monitor with massive pixels you would notice.  
  
  
  
Challenge 5  
For this assignment, the difficulties I encountered was with understanding how the Bresenham algorithm works. I initially thought that the two cases were mutually exclusive in the sense that once you were in a case you never left it, similar to how the DDA algorithm cases worked. I had lots of trouble understanding the role that Pk played in manipulating the points, as it initially looked independent. Once I realized that you must use Pk to determine which case to enter, it felt as though a lightbulb had turned on and it all made sense.

Reflection

Line drawing algorithms, such as Bresenham’s line algorithm, are used to rasterize what appear to be straight lines by colouring pixels on a monitor. This algorithm requires a start point and an endpoint to create an approximation. Line drawing algorithms are especially useful in the field of computer graphics.  
Computer graphics is a sub-field of computer science that specializes in creating images or objects digitally. Computer graphics has many applications in a variety of fields, such as architecture, CGI, medical imaging and so on. For example, computer graphics are especially important in the creation of video games. Different types of computer graphics in video games can range from 2D sprites made by colouring pixels on a bitmap, to more advanced 3D models involving complex shapes and polygons. Computer graphics artists will create models, typically starting with primitive shapes such as a cube, which they then manipulate. These manipulations become increasingly complex, as they create more vertices on the object giving it a more realistic form and creating a mesh to eventually shape into the complex character models we may see in-game. Computer graphics have come a long way since the 1970s game called Pong which consisted of rectangles and circles, now we have 4k resolution textures and models that are rendered in real-time, in what looks like immersive 3D worlds. Even though complex 3D shapes are used, what is rendered and displayed on the screen is still 2D just done in a way that gives it the illusion that it is 3D, similar to drawing a cube on a sheet of paper. Therefore, line drawing algorithms can be useful in the rendering of these images since they can calculate what pixels should be coloured. GPUs may contain these algorithms within their firmware, and ones like Bresenham’s which is rather efficient and fast since it only uses addition and subtraction with integers can be utilized without consuming excessive resources. While Bresenham’s algorithm is rather old, it isn’t obsolete due to its simplicity and efficiency. It is safe to assume that these simple line drawing algorithms helped pave the way for more advanced algorithms, such as ones that support anti-aliasing, which makes images appear less jagged and blocky. To summarize, line drawing algorithms have played an important role in the evolution of computer graphics, much so that simple ones such as Bresenham’s is still used to this day.

https://conceptartempire.com/what-is-3d-modeling/