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Computer Science Department

CS 375 – Fall 2021 – Watts Score: / 100

Midterm Exam

Date due: Monday 18 October 2021, 11:59 pm

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| 1. | Explain the relationship between the Cartesian Coordinate Plane and a computer graphics canvas. On the 200x200 canvas below, indicate approximate locations of the following points. Label each point with its corresponding letter.  a. 100, 150  b. 100, 75  c. 100, 300 |
| Answer | A Cartesian Coordinate Plane is a coordinate plane system that specifies each point by numerical coordinates on either a two-dimensional or three-dimensional space. A computer graphics canvas is a container that holds drawing elements such as lines or shapes. The computer graphic canvas can be using the width and height in pixels. Just like a Cartesian Coordinate Plane, a computer graphics canvas uses points called pixels. Computer Graphics uses a bitmap which is an image file format used to store digital images. A bitmap is essentially just a spatially map of an array of bits. Each point can only have two possible values so they can be stored in one bit. Input is created through the keyboard or file, then a C++ program calls the bitmap, and then the bitmap image is outputted. The diagram below shows an approximate position of the three points and as you can see, the third point’s y value is outside the bounds of the 200x200 canvas so it is outside of the canvas. |
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| 2. | What is the “Graphics Pipeline”? What are the part of the modified pipeline we have been using so far this semester? |
| Answer | A graphics pipeline is a conceptual model that describes the steps that a graphics system needs to output a graphics screen. Typically, The modified graphics pipeline that we have been using includes getting an input from keyboard or a file, sending that input to a c++ program with a bitmap call, and then outputs a bitmap image. We have been using our html viewer folder that send this bitmap image to our blue website to view our bitmap image. |
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| 3. | The following segment of C++ code is designed to draw a solid line between 2 points on the graphics coordinate plane.  float m = (y1 - y2) / (x1 - x2);  float b = y1 - m \* x1;  for (int x = x1; x <= x2; x++)  {  float y = m \* x + b;  bmp.set\_pixel (x, y, 0, 0, 0);  }  For each of the following pairs of points, will this code be successful or will it fail? If it fails, why?  a. x1 = 100, y1 = 100, x2 = 500, y2 = 500  b. x1 = 500, y1 = 100, x2 = 100, y2 = 500  c. x1 = 300, y1 = 100, x2 = 300, y2 = 500  d. x1 = 100, y1 = 500, x2 = 500, y2 = 100  e. x1 = 100, y1 = 100, x2 = 200, y2 = 500 |
| Answer | To preface, I tested these points by inputting these points for the start and end value manually.   1. This will work. 2. This will not work. This is because the x2 value is smaller than the x1 value. Since we are starting at x1=500 and x2=100, x will continue to grow instead of decrease since we are using x++. Therefore, it will never reach the x2 value. 3. This will not work. This is because the x1 and x2 values are the same which means it is a vertical line. In order to make this work, you would have to draw the line setting a pixel while increasing or decreasing (depending if the y1 or y2 value is greater) toward one y value to the next. You can’t use the X values like this code uses in the for loop. 4. This will work. 5. This will work. |
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| 4. | The following segment of C++ code is designed to draw a solid circle centered at cx with radius r on the graphics coordinate plane.  for (float a = 0; a < 2\*PI; a += 0.1)  {  float x = r \* cos (a) + cx;  float y = r \* sin (a) + cy;  set\_pixel (x, y, 0, 0, 0);  }  While it works well for small circles, when r gets larger, it just creates a series of dots.  a. How would you modify this code to create a complete circle for all values of r?  b. How would you modify this code to draw an ellipse with horizontal radius rx and vertical radius ry? |
| Answer | 1. I would modify this code by using the DrawLine function. I would create two more variables that will represent the previous x and y values and draw a line from the current x and y values to the previous. This will create a solid circle and fill in the gaps. 2. I would modify this code by first using the ellipse equation to find x and y. I would use float y = (radiusY \* sqrt((radiusX + x)\*(radiusX - x))) / radiusX; for example. I would also do the same modification as I did in a. This will avoid gaps between the points. I will also make the same modifications to the equation for float y to float x as well. This equation would be |
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| 5. | page10image1786144Given the following control points for a Bezier curve,  700,100  900, 500  500,900  100, 500  300,100  If 10 line segments (parts) are used to render the curve, the first point will be located at 700,100. Where will the 5th point be located? Explain your answer. |
| Answer | When trying to solve this problem, I used the formula of Xa = x1 + (x2-x1)/10 and Ya = y1 + (y2-y1) / 10. I used 10 since the problem says there are 10 line segments. I was not successful on solving this problem since after just doing the first two points with this formula, I got a X value of 90 and a Y value of 50, which is too small. I tried to continue to do this and finding Xb and Yb getting the coordinates of (50,90) which was also too small. I then used those two values to try to find the Bezier point and got (5,9), which is again too small. If I had continued to do this and multiplied the values in the parenthesis by 2, 3, and so forth, I would eventually end of getting negative numbers, which would also not be correct for this problem. |
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| 6. | a. What is a Color Model?  b. What is the CMYK Color Model?  c. What is the RGB Color Model?  d. How is black encoded in the RGB model?  e. How is white encoded in the RGB model?  f. How is yellow encoded in the RGB model?  g. How might you create a medium gray in the RGB model? |
| Answer | 1. A color model is a model that represents colors as tuples of numbers. An Example of a color model would be the RGB color model that uses different combinations of the primary colors of red, green, and blue to make a unique color. 2. The CMYK color model is a color model that uses these four colors: cyan, magenta, yellow, and key(black). This is how it got it’s name. It works by masking colors on a usually white background. It is a subtractive because inks subtract the primary colors red, green, and blue from white light. 3. The RGB color model is an additive color model. IT uses red, green, and blue in various ways to create a broad array of colors. The name comes from red, green, and blue. 4. Black is represented in RGB as RGB(0,0,0). This is because the RGB color model is additive. This means that colors are made by adding colors so the absent of color (black) would be (0,0,0) and white would be the maximum of 255 in all components. 5. Yellow is encoded in the RGB color model by adding red to green. 6. Gray is created in the RGB color model when the red, green, and blue values are all equal. A medium gray would be around (120,120,120) |
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| 7. | How do Vector and Raster graphics differ? What are the benefits of each? What are the drawbacks of each? |
| Answer | Vector graphics (SVG) consist of anchored dots connected by lines and curves. They are indefinitely scalable and don’t loose quality based on their size. The size of the files are usually relatively small. Vector graphics however are difficult if not impossible to create a true-to-life representation. They are great for creating precise paths but not for detailed editing. Vector graphics are difficult to blend colors.  Raster graphics are made of pixels so they can only contain a fixed number of pixels which also determines the quality of the image. The more pixels there are, the better the quality. Raster graphics are great for making true-to-life graphics. They do require larger file sizes. Raster graphics are great for detailed editing and capable of complex color blends. |
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| 8. | The following SVG Polygon command is designed to draw a regular hexagon with sides of length 100 and a top vertex at the point 200, 100. What additional values need to be entered into the points string? Explain your calculations.<polygon points="200,100" stroke="black" fill="none" /> |
| Answer | The following points should be added: (300, 100)  I added 100 to the X value to get this other top vertex. |
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| 9. | In certain cases, the following recursive implementation of the flood fill algorithm is crashing.  void Fill (bitmap\_image & bmp, int X, int Y, int R, int G, int B)  {  unsigned char r, g, b;  bmp.get\_pixel (X, Y, r, g, b);  if (r != R || g != G || b != B)  {  bmp.set\_pixel (X, Y, R, G, B);  Fill (bmp, X+1, Y, R, G, B);  Fill (bmp, X-1, Y, R, G, B);  Fill (bmp, X, Y+1, R, G, B);  Fill (bmp, X, Y-1, R, G, B);  }  }  a. Why might it be crashing?  b. What modifications would you make to prevent it from crashing? |
| Answer | 1. This code may be crashing because r, g, and b are set as unsigned chars and you are comparing integers to chars in the if statement and the if statement uses or instead of and. 2. I would modify the code to assign r, g, and b as integers and I would change the if statement to && instead of ||. |
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| 10. | The following SVG image contains 2 rectangles. <svg width="400" height="400"  xmlns="http://www.w3.org/2000/svg" >  <rect x="125" y="100" height="200" width="150"  stroke="black" fill="none" />  <rect x="125" y="100" height="200" width="150"  transform="rotate(45,200,200)"  stroke="red" fill="none" /> </svg>a. Starting with the top left vertex, and moving in a clockwise direction, what are the coordinates of the vertices of the black rectangle?b. Starting with the topmost vertex, and moving in a clockwise direction, what are the coordinates of the vertices of the red rectangle? Explain your calculations. |
| Answer | 1. (125, 100) (275, 100) (275, 300) (125, 300) 2. (150.7,53.9) I found the X value by taking the cosine and sin of 45 and multiplying the cosine by X and adding the sin times Y. I found the Y value by multiplying the sin and X and adding that to cosine times Y. |
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