CS142 *Practice* Problems for Final Exam

Spring 2007

The exam will be closed book. No calculators are to be used.

1. Suppose you want to define a spline curve in Povray as follows:

```
spline {
    linear_spline
    0, point1
    t, point2
    1, point2
  }
```

   where you want your curve to begin at the origin, move 10 units along x, and continue by moving 20 units parallel to the z axis.

   a. What should the values of the points be?

      point1 = < , , >

      point2 = < , , >

      point3 = < , , >

   b. What should t (approximately) be if you want the movement along the spline to be very fast as it moves along x and slow as it moves parallel to z?

      t = _____

2. A Linear Bezier Curve simply interpolates along a line that connects two points P_0 and P_1. The points are called control points.

   a. What is the equation of a Linear Bezier Curve in terms of P_0, P_1, and the parameter t?

   b. If P_0=<1,0,1> and P_1=< 0, 2, 3 >, what is the value along the curve for t = ½?

3. In computer graphics, one may define a curve by specifying a set of vertices and edges or by using a mathematical equation (e.g. spline). What might be an advantage or disadvantage of each approach? (hint: think about creating your lathe object with just points and edges vs a quadratic spline).

4. Image Filtering:
    a. Explain how the threshold function works?

    b. Given the convolution filter on the left and the image in the center, what will be the value of the pixels at positions R1 and R2 in the filtered image on the right?

filter

-1	-1	-1
-1	8	-1
-1	-1	-1

orginal image

255	255	255	255	0
255	255	255	0	0
255	255	0	0	0
255	0	0	0	0
0	0	0	0	0

convolved image

	R_2			
			R_1	

5. Turtle Graphics and Recursion:
    a. Assume a turtle is positioned at (0,0,0) and is looking along the direction of the positive x axis (y is up). If the turtle is given the following sequence of instructions with d=2, draw the path that the turtle follows.

```
turtleMove(distance d) {
        move d
        turn 45
        move d
        turn -45
        move d
        turn 45
        move d
}
```

    b. What sequence of moves will get the turtle back to where he started (i.e. to the same position and direction)?
    c. Suppose we had the following set of instructions instead:

```
turtleMove(distance d, level L) {
    if (L=0) do nothing
    else {
        turtleMove(d/2,L-1)
        turn 45
        turtleMove(d/2,L-1)
        turn -45
        turtleMove(d/2,L-1)
        turn 45
        turtleMove(d/2,L-1)
}
```

    What do we get if we run:
        i. turtleMove(2,0)?
        ii. turtleMove(2,1)?
        iii. turtleMove(2,2)?

6. Describe at least one of the “principles of animation”.

7. Complex Numbers: Given the complex numbers

   $Z_1 = 2 - 5\,i$

   $Z_2 = -2 + 3\,i$

   $Z_3 = 1 + 2\,i$

   Compute the following:

   a. $Z_1 + Z_2$
   b. $Z_1 * Z_3$
   c. $Z_3 - i * Z_2$
   d. $| Z_3 |$

8. Fractals: The Julia set is defined as follows: Fix a value of C. For each point W in the complex plane, iterate: $z(t+1) = z^2(t) + C$, where $z(0) = W$. For the point W = i, Compute the first 3 iterations given that C = .5 + i.

   z(0) =

   z(1) =

   z(2) =

9. What does we mean when we say fractals exhibit self-similarity?

Note: you should also review the practice problems from the midterm as well as the midterm itself.