MAT 2170: Laboratory 7

Key Concepts

1. Writing and using methods

Instructions

- As usual, create these projects in a `lab7` directory
- Use `dialog` programs.
- Just to shake things up a bit, don't sit next to anyone you sat next to in Lab 6.
- Come to lab with a **written plan** for each exercise, noting the required inputs, a few test cases, and an algorithm for each. Do **not** come in "cold," expecting to start from scratch and finish the lab.

Exercises

1. (Page 172, Exercise 4) Your program, `TestDigits`, is to include and utilize a `countDigits()` method.

2. (Page 175, Exercise 12) Include and utilize an `isPerfect()` predicate method in your program `TestPerfect`. Extend the program to ask the user for a range, `[low, high]`, and find all the perfect numbers in that range (not just between 1 an 9,999).

3. *The Ant Dance.* Four ants—A_1, A_2, A_3, and A_4—are positioned at the vertices of a square, as shown in Figure 1. These ants have a well-developed sense of distance, in that any ant can determine its distance to any other ant.

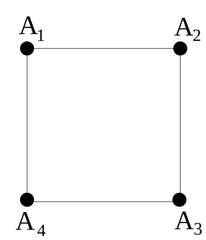

Figure 1. Four ants positioned at the vertices of a square.

Each ant is attracted to exactly one other ant in a counter-clockwise fashion: A_1 is attracted to A_4, A_2 to A_1, A_3 to A_2, and A_4 to A_3. The ants carry out a dance by moving toward each other in a carefully orchestrated sequence of steps: first A_1 moves, followed by A_2, then A_3 and finally A_4. After each of the four ants has moved, the process is repeated.

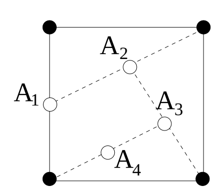

Figure 2. Each of the four ants has moved one half the distance to its neighboring ant ($r = 0.5$). The open circles show the new positions. Ants move sequentially, A_1 through A_4.

When an ant moves, it moves directly toward the ant to which it is attracted. If the distance between the ants is D, it moves a fraction of the distance, rD, where $0 < r < 1$. Figure 2 shows how each of the four ants move when $r = 0.5$.

Program Requirements

Your dual slider program should perform the following actions:

- Set the window size to 700×700.
- Set slider `RangeA` to [50..100], the number of snapshots, or steps, in the dance.
- Set slider `RangeB` to [5..50], the percent of the distance moved toward each other, where $5 =$ 5% or 0.05, and $50 =$ 50% or 0.5.
- set the margin size to 50. Choose the smaller of the window width or height, minus the margins, as the size of the background square. Center this square in the window. (A black background makes colorful ants show up nicely.)
- Determine the coordinates of the four ants, which should correspond to the vertices of the background square.
- Each ant will be circular and 20 pixels in diameter. Use a different color for each ant.
- Use a loop to generate the snapshots. After the ants are drawn, the coordinates of each of the four circles should be translated in preparation for the next pass through the loop.
- You must use the `createFilledCircle()` method, given in the textbook and this week's slides. You must also create and utilize the method `translate()` which determines the change in the x or y coordinate of an ant as it moves towards another ant.
- Use a short pause to animate the dance.

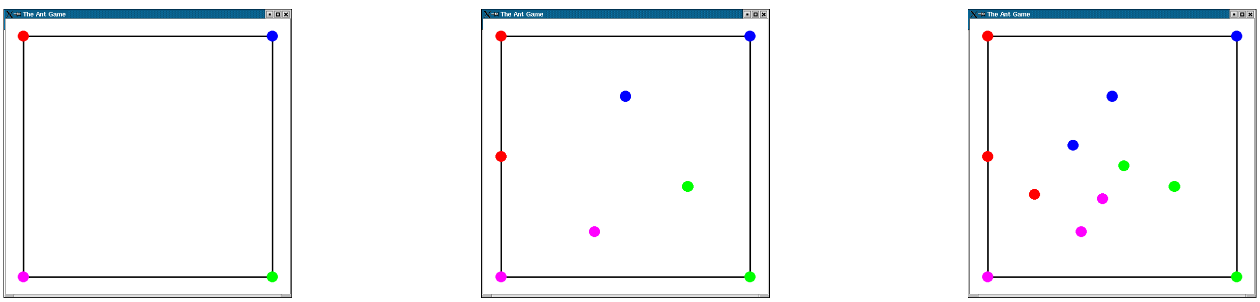

Figure 3. Three frames, showing one, two, and three steps of the ants' dance. In this example, $r = 0.5$, so each ant moves half the distance to its neighbor.

Hint

Let P be the point (x_1, y_1), Q be the point (x_2, y_2) and suppose the distance between these points is D. If P moves toward Q a distance rD, it stops at the point $(x_1 + r(x_2 - x_1), y_1 + r(y_2 - y_1))$. It is the product of r and the difference of the coordinates that the `translate()` method should calculate.

Finishing Up

Publish the programs to your web site and submit an electronic copy by the beginning of Lab 8.