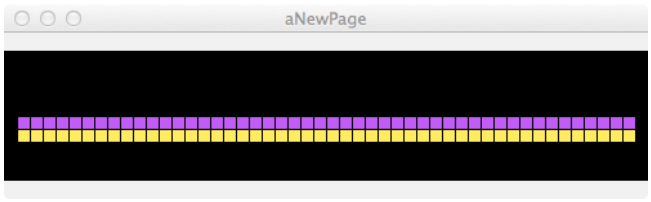
Lab Exercise 7: Recursion

Goal

The objective is to understand how recursion works. The programming in this exercise is easy. The goal is to imagine how the computer follows the instructions.

Warm Up

In lecture we wrote a small recursive function husky( ) to draw purple and gold boxes using the "draw one, and if space remains, do it again" technique. Use that same idea to draw this sequence of 10x10 box pairs, leaving 10 pixels at each side of the window. Check the lecture if you have questions.



Overview

You are given a recursive program that produces the following (Figure 1)

and you will improve it so that it produces the following (Figure 2).

Then, you will explain in your own words what's happening.

Step 1: Start. Grab the Recursive Code posted with this lab page. Also, open a word processing document.

Step 2: Color the boxes. The first step is to modify the paint( ) function so that it colors each level differently. You choose the colors, but they must all be different, and consistent by level – no random colors this time! The paint( ) function, which takes one argument, will be just a series of if-statements, like we've seen in the keyPressed( ) function. For example, it uses

```
if (level == 0) {
  return color(0);
}
```

and a separate if-statement for each level (up to, say, 7). Remember, copy/paste are your friends for programming similar sequences of code. *Check that each level has one color.*

Change A. Next, **replace** the //Change A goes here line in the box( ) function with the following code

```
 else {
    stroke(0);
    line(xdist-5, 200, xdist-5,250);
    noStroke( );
}
```

This will draw vertical lines. *Check your code and notice where the lines are drawn.*

In your document write a sentence or two to finish "The vertical line drawn in Change A indicates visually the point in the recursive code where …" The sentences are to say what's happening in the code.

Change B. Next, "comment out" the first call to the box( ), and run the program. What you see is a diagonal row of colored boxes. This change neutralizes the tree-drawing ability of the recursive function; notice how the original box( ) works: For a tree of x levels, it draws a tree of x-1 levels, draws the root of the tree, and then draws another x-1 level tree. The two shorter trees are created recursively by the same logic.

Analysis. Using your knowledge of recursion, and your observations/information from the two changes above, answer these questions: [Give answers in your document.]

1. The Processing program that drew the gray diagram (Figure 1) calls the box( ) function how many times in total? _____
2. What does the basis case do in the revised program?
3. The box pointed at by the arrow is what color in the colored picture? _____
4. If the box pointed at by the arrow was drawn as a result of the call, box(*level*), what was the value of *level* in the call?_____
5. Referring to the function that made the call of question 3, what color box did *it* draw (as shown in the colored picture)? _____
6. Referring to the function that made the call of question 3, which of the two box( ) calls was it? _____
7. As explained in the lecture, functions are often suspended in recursive programs while they perform recursive calls. At the moment that the rect( ) function was called to draw the rectangle referred to in question 2, what box( ) functions (if any) were suspended besides box(6)? _____

Wrap Up: You have taken a simple recursive program, and by adding lines and colors, you have tagged so that you can follow its behavior. This allows you to see how the recursive function works.

Turn In: Paste your .pde code for husky( ) and paint( ) into your document, save it and submit it to the class dropbox.