Coding

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summercore

Lesson 7 page 1

My studio for this course
http://scratch.mit.edu/studios/531413

LESSON 7: Nov 10 - Nov 17 ("we officially end 11/17")

Hi everyone in the Coding course! This is our final lesson and final week. I know many of you are "playing catchup" so I am going to feature one main required topic and everything else is optional **Yes, Monday 11/17 is the last day for any phone call or screenshare appointment.**

Let us begin with an explanation of recursion -- an important part of computer science and computer programming theory. Please stay with me on this journey! This is a great way to end the course if you can create your own **Fisher-Price First Fractal** that uses variables, blocks and recursion. Stay on the journey! Persevere!

Recursion and Fractals -- Exciting & Empowering

Here is the easiest definition I could find from the website of
http://www.techterms.com/definition/recursivefunction
If you look up *Recursion Computer Programming* on Google, you get so much amazing complexity.

"A recursive function is a function that calls itself during its execution. This enables the function to repeat itself several times, outputting the result and the end of each iteration. Recursive functions are common in computer science because they allow programmers to write efficient programs using a minimal amount of code. The downside is that they can cause infinite loops and other unexpected results if not written properly. For example, the function may be terminated if the number is 0 or less or greater than 9. If proper cases are not included in the function to stop the execution, the recursion will repeat forever, causing the program to crash, or worse yet, hang the entire computer system."

Here is my 3 minute video -- http://youtu.be/r40MHcsWxqI -- hopefully humorous but informative attempt to explain with my Larry Bird doll what recursion is and why it is different from repetition using the REPEAT command.

Starting in the 1970s, computer programmers were able to use the techniques of recursion to create fractals. You may have heard of the Mandelbrot fractal below on the next page. When you zoom in to this fractal on the left you get the graphic in the middle and then when you zoom in again, you get the graphic on the right. Each "zoom" yields a shape that is proportional (similar) to the original one.
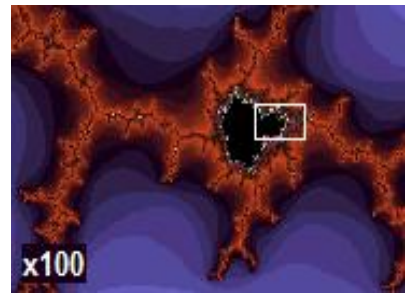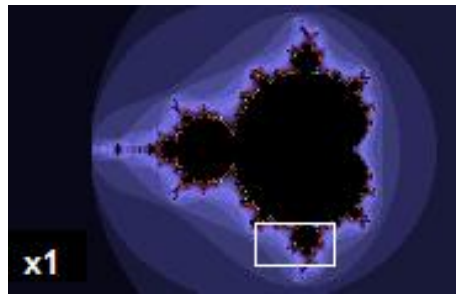
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x1   x6   x100

This paragraph from http://en.wikipedia.org/wiki/Fractal may be of help:

"The mathematical roots of the idea of fractals have been traced through a formal path of published works, starting in the 17th century with notions of recursion, then moving through increasingly rigorous mathematical treatment of the concept to the study of continuous but not differentiable functions in the 19th century, and on to the coining of the word fractal in the 20th century with a subsequent burgeoning of interest in fractals and computer-based modelling in the 21st century. **The term "fractal" was first used by mathematician Benoît Mandelbrot in 1975.** Mandelbrot based it on the Latin frāctus meaning "broken" or "fractured", and used it to extend the concept of theoretical fractional dimensions to geometric patterns in nature."

So our journey today is to make our own fractal.
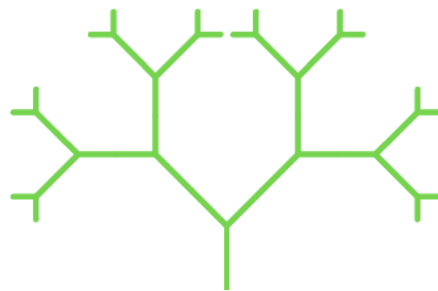
Video Part 1 (5 min) http://youtu.be/WQfEd5AcnVY
This gives you the orientation to what a fractal is and an overview of the one we are going to code from scratch using Scratch.

VideoLesson Fractals Part 2 (18 min)   http://youtu.be/LKkVzmBB5Zs
This takes you through the nitty gritty programming for creating a tree fractal. This is a tough challenging topic yet needs to be an important part of any coding course. I wish I could teach this to someone in 33 seconds but I can't!

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The above two videos will show you how to make this primitive "tree fractal" which of course I have shared with you in my Scratch library/studio
http://scratch.mit.edu/projects/13740603/
program name: Recursion with Fractals (Make Your Own Fractal 2013)

Here is a better step-by-step presentation of creating your first fractal that has simpler and more efficient code that corresponds to below.
http://scratch.mit.edu/projects/32791442
program name: My First Fractal (step by step 2014)

STEP 1
We begin by making an uppercase Y with each "limb" equal to half of the main trunk. Observe that the cat comes back to the starting spot (very important).
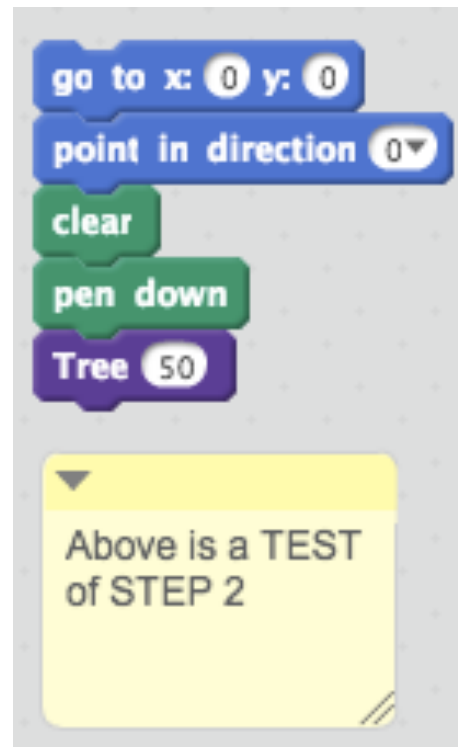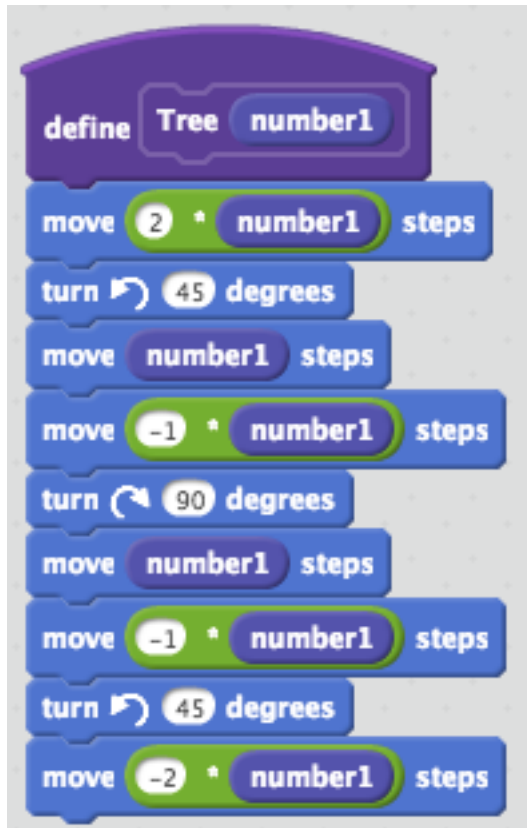
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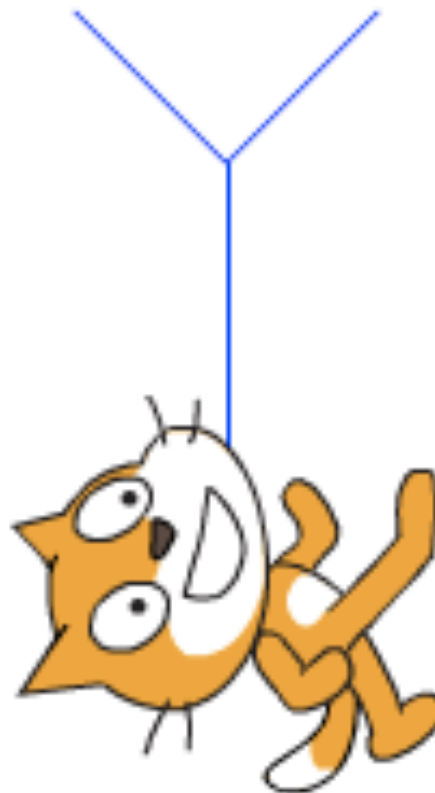
Lesson 7 page 4

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http://scratch.mit.edu/studios/53141:

STEP 2

We now turn this into a new block called TREE that makes a variable sized "Y" where in this example NUMBER1 is taking on the value of 50 as in the STEP 1 example.

Make sure you test STEP 2 to get the same Y as you had in STEP 1.

```
define Tree number1
move 2 * number1 steps
turn 45 degrees
move number1 steps
move -1 * number1 steps
turn 90 degrees
move number1 steps
move -1 * number1 steps
turn 45 degrees
move -2 * number1 steps
```

```
go to x: 0 y: 0
point in direction 0
clear
pen down
Tree 50
```

Above is a TEST of STEP 2

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STEP 3
Below is STEP 3 where in my demo I modified the TREE block, calling it TREES just so I can show you both STEP 2 and STEP 3. You do NOT need to have both the TREE and the TREES blocks. You can succeed with one block that is like TREE modified in step 3 and step 4.

This STEP 3 is very important even though it is a failure. You can see that the computer is trying to make the "Y" but it never finishes. At the top LEFT of each subsequent "Y" it tries to make another "Y" that is smaller. But it never finishes so what we have in STEP 3 is a series of "left sides of each Y."

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STEP 4: We are so close to success. We need just ONE IF STATEMENT to STOP the recursion when number 1 gets "too small" which you are welcome to define.

We add this one statement to our loop
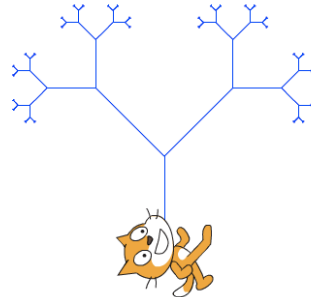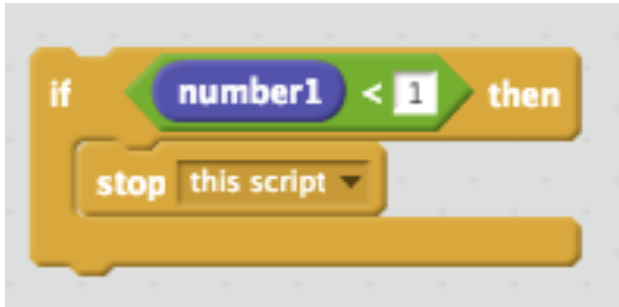
and now we have it since now each subsequent and smaller "Y" is done until the variable is less than 1.

Below is STEP 3 where I modified the TREE block, calling it TREES just so I can show you both STEP 2 and STEP 3. You do NOT need to do this.

You can have just one block named TREE.

Below is a test of TREES for STEP 3 and STEP 4.

Note that we are starting at 0,-100 so that more of the screen can be used.

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Required HW 7.1
Study, study, study!
Practice, practice, practice!
Consider this your final exam.

Then wake up the next day and create the fractal from scratch without notes!
If you succeed, buy a drink and charge it to me!
If you don't succeed and have to look at notes, then try it again the next day.

Modify your first fractal (or mine) to have colors. Modify your first fractal to have thicker lines. Modify your first fractal so that the left branches of the tree are not symmetric with the right branches in terms of thickness, angle or color.

That's it folks! Share your fractal and send a note to me and your partners.

Be well everyone and hope you stay in touch. Teaching you and getting to know all of you has been fun. I wish you the best of success with your computer usage and your careers. Even though our 30 minute phone sessions/teaching sessions end this Monday 11/17, if I can help you at some point in the next 33 years by email or a 10-15 minute phone call, I would be glad to! Be well, everyone! Steve

p.s. in a week or so, I will send you an optional end of course survey along with an optional procedure for a certificate for PD hours

OPTIONAL ITEMS BELOW
(hopefully you will peruse in the future when you have time)

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First Optional Item

optional: Here are several articles and videos on coding and Scratch

Article: Tips to get your Kids Excited about Coding
http://thejournal.com/articles/2013/10/23/6-tips-to-get-your-kids-excited-about-coding.aspx?=THE21

Video: Code, The New Literacy
http://www.youtube.com/watch?v=MwLXrN0Yguk

Video: What Most Schools Don't Teach
http://www.youtube.com/watch?v=nKIu9yen5nc

Learn Scratch Website http://learnscratch.org/

Scratch Curriculum Cards you can print out
http://scratch.mit.edu/help/cards/

Textbook
http://www.nostarch.com/learnscratch
Someone told me about this book which I have NOT seen yet -- Steve
TABLE OF CONTENTS -- http://www.nostarch.com/download/samples/LTPWS_DTOC.pdf

Chapter 1: Getting Started
Chapter 2: Motion and Drawing
Chapter 3: Looks and Sound
Chapter 4: Procedures
Chapter 5: Variables
Chapter 6: Making Decisions
Chapter 7: Repetition: Definite and Indefinite Loops
Chapter 8: String Processing
Chapter 9: Lists

Learn to Program with Scratch

LEARN TO PROGRAM WITH SCRATCH
A VISUAL INTRODUCTION TO PROGRAMMING
WITH GAMES, ART, SCIENCE, AND MATH

A Visual Introduction to Programming with Games, Art, Science, and Math
by Majed Marji

February 2014, 288 pp.
ISBN: 978-1-59327-543-3
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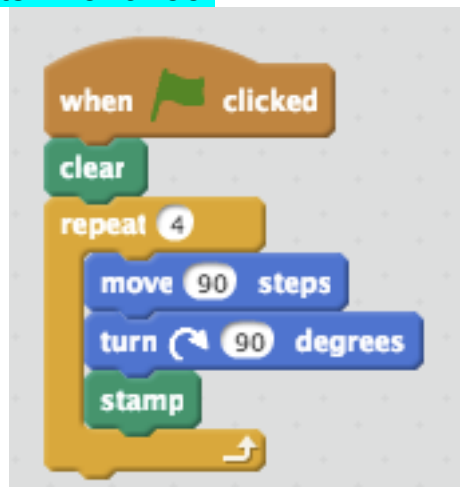My studio for this course
http://scratch.mit.edu/studios/53141

Next Optional Item

The fascinating STAMP command

Let us talk about the STAMP command that a few of you have seen but up until now it has not served any real purpose. What STAMP does is to take the current costume at that moment and paints it onto screen at that position.

So consider this program called **Using the Stamp Command**
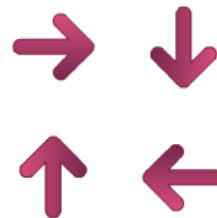http://scratch.mit.edu/projects/14349753/

What does it do? Yes, it draws a square but it "stamps the costume" once at each corner.
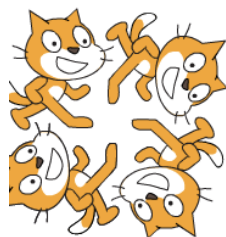
If the Sprite is a cat, then I get this:

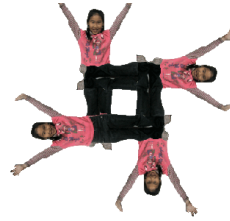While if the Sprite is an arrow, then I get this:

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My studio for this course
http://scratch.mit.edu/studios/53141[

Or if the cursor is a person, then I get this:

Got it?

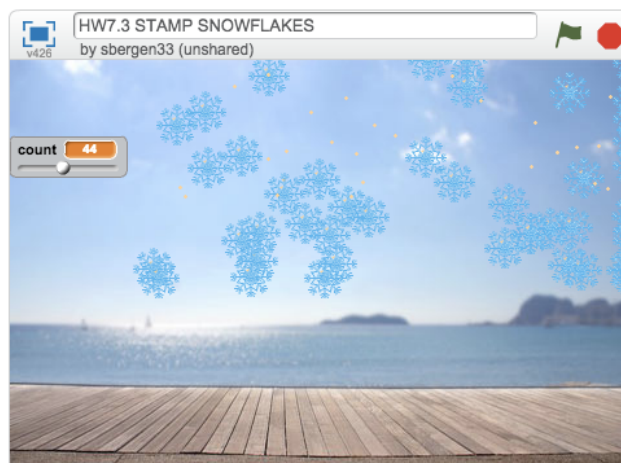**stamp** just takes the current costume and "stamps it" on the screen.
Note that STAMP is a PEN command (dark green).

What you have to remember is that the STAMP command takes the current costume and then puts it onto the screen at that location as if it were a "stamper."

optional HW 7.5a
Use the snowflake costume found in the Holiday section of the standard Scratch

library   and write a program that randomly draws snowflakes on the screen using one of the backdrops from the Scratch library. Make sure you SHRINK the snowflake so it is smaller. You can shrink using the command or via vector mode in the graphics screen. Add a counter to keep track of how many snowflakes. When your program runs, it should look like this.

HW7.3 STAMP SNOWFLAKES
by sbergen33 (unshared)

count   44

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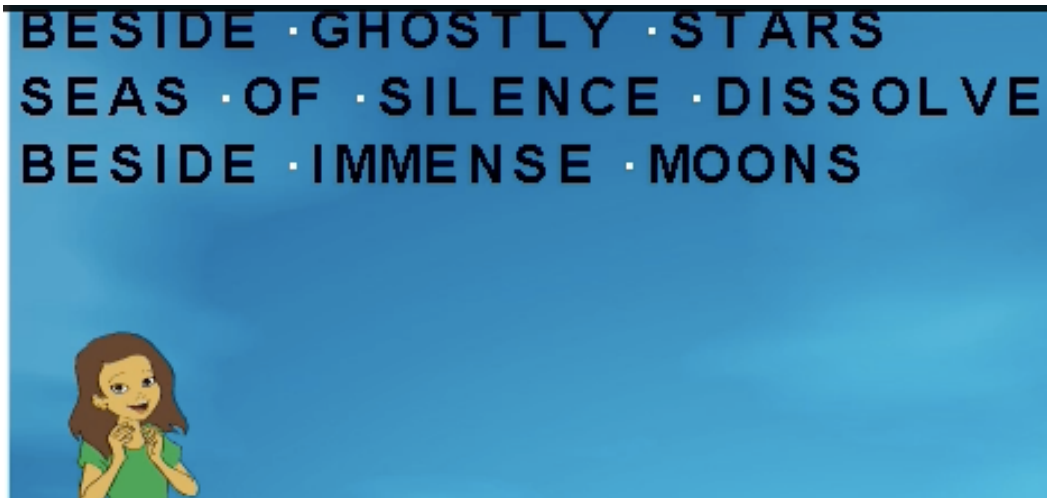My studio for this course
http://scratch.mit.edu/studios/53141:

Use the balloon found in the Holiday section of the standard Scratch library and write a program that draws exactly 10 balloons on the screen. Now have your program switch back to the cat and allow the cat to "walk around the screen with the 4 direction arrows. Program the cat so that when it lands on a balloon (the color purple) it STAMPS itself over the balloon. When done, your program should look like this
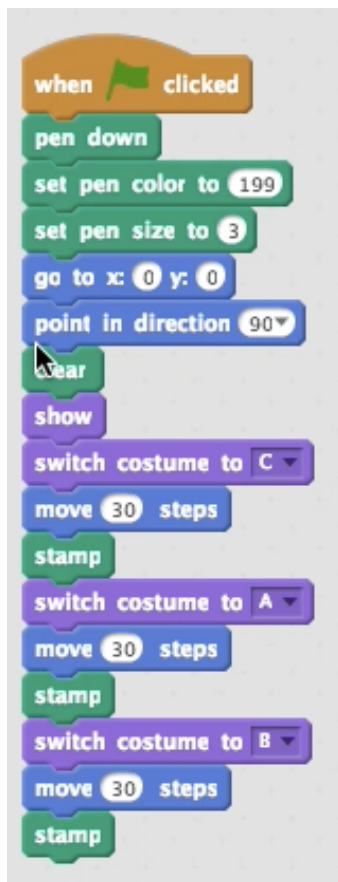

OPTIONAL but REALLY SPECIAL (at the very least, please read)
This leads us to the very clever program written by one Scratch programmer who uses STAMP to accomplish something I have been wanting to do for months -- write text onto the background! Here is the 25 minute video lesson that takes you thoroughly through all the steps -- http://youtu.be/FpeB5O7UjWU -- it does take a lot of time to dissect and explain the code in a program.

I have used the Haiku program by one former student (Fall 2013) as the demo model to work with. I hope you will find it as cool as I do that you can now write on the screen and achieve this. The programmer who created this code is named Megadrats and he or she uses 26 costumes and the STAMP command so that the poem is *stamped* onto the screen!

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My studio for this course

http://scratch.mit.edu/studios/53141

BESIDE ·GHOSTLY ·STARS
SEAS ·OF ·SILENCE ·DISSOLVE
BESIDE ·IMMENSE ·MOONS

Check out this intro program that I wrote; it is much more basic than the one from megadrats -- Putting A,B,C or D onto the Background -- but easier to understand. It lets you stamp words on the screen that contain the first 4 letters of the alphabet.

when 🏴 clicked
pen down
set pen color to 199
set pen size to 3
go to x: 0 y: 0
point in direction 90▾
clear
show
switch costume to C ▾

← the C costume is just the letter C which we then STAMP onto the screen!

move 30 steps
stamp

← We then MOVE 30 pixels and then STAMP an A

switch costume to A ▾
move 30 steps
stamp
switch costume to B ▾

Then we STAMP a B and so it looks like CAB to the user!

move 30 steps
stamp

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My studio for this course
http://scratch.mit.edu/studios/531413

This is a fascinating topic that allows you to put large text on the screen. In other words, I can type END OF OUR COURSE into my script and I will get this message stamped onto the screen. For example, using this script
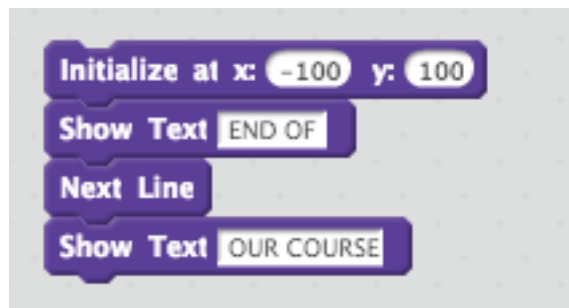
I achieved this

Interested? Read on and watch the videos!

We begin the STAMP command that a few of you have seen but up until now it has not served any real purpose. What STAMP does is to take the current costume at that moment and paints it onto screen at that position.

So consider this shared program called **Using the Stamp Command**
http://scratch.mit.edu/projects/14349753/
Got it?

    just takes the current costume and "stamps it" on the screen.

Note that the costumes for this script are just single letters on each costume.
The beauty of this approach (thanks, Megadrats) is using the STAMP command!
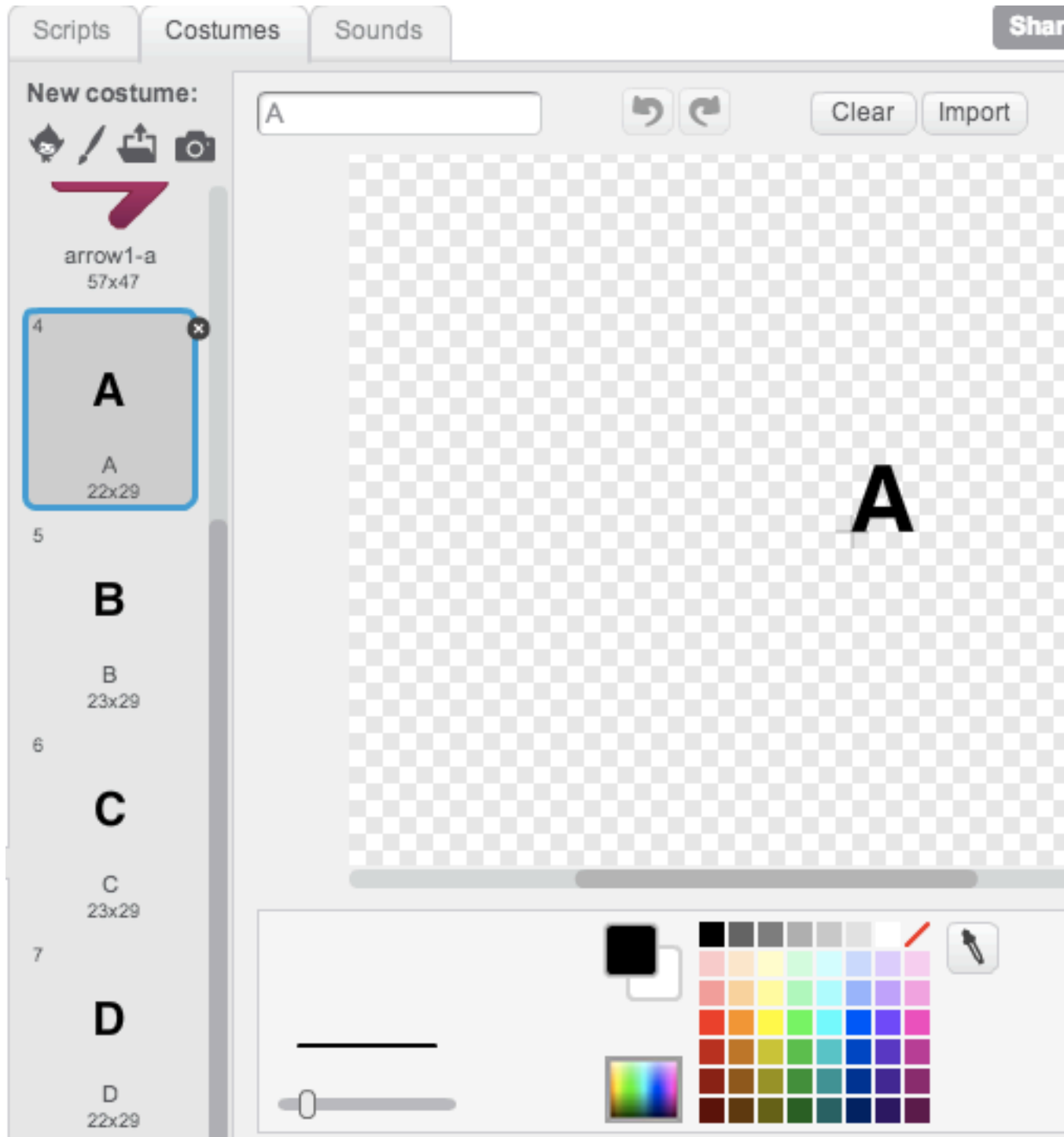
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Scripts | Costumes | Sounds

Shar

New costume:

A

Clear | Import

arrow1-a
57x47

4
A
A
22x29

5
B
B
23x29

6
C
C
23x29

7
D
D
22x29

A

Here are the two Sprites used in this program:
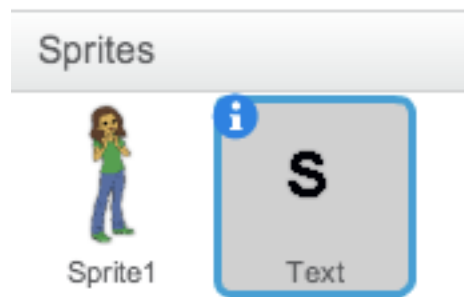**Haiku Poem (Jessica) with Stamping Text by Megadrats**

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My studio for this course
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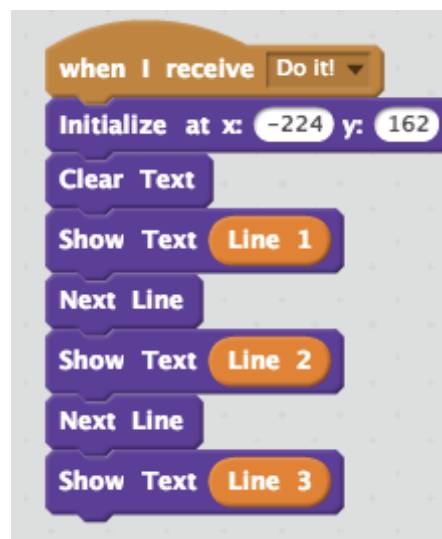summercore

Sprites

Sprite1   Text

Sprite1 is Jessica's Haiku program but it ends with the BROADCAST command that
I added called Do It!

broadcast Do it!

This corresponds to a script in the "S" Sprite program below. This program uses the
construction of Megadrats who makes the work available to all of us and encourages
us to use it. The video will show you step by step exactly how the BLOCKS called
NEXT LINE (go to next line) and SHOW TEXT (type this line onto the background)
work.

```
when I receive Do it!
Initialize at x: -224 y: 162
Clear Text
Show Text Line 1
Next Line
Show Text Line 2
Next Line
Show Text Line 3
```

The INITIALIZE block by Megadrats specifies the location to begin the typing.

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Here is the most important script from Megadrafts. The variable TEXT is the stuff to be printed on the screen. Notice the purple command to SWITCH THE COSTUME. What is it switching to? If the word TEXT is CAB, then it switches to Costume C and stamps, then it switches to Costume A and stamps and so on.
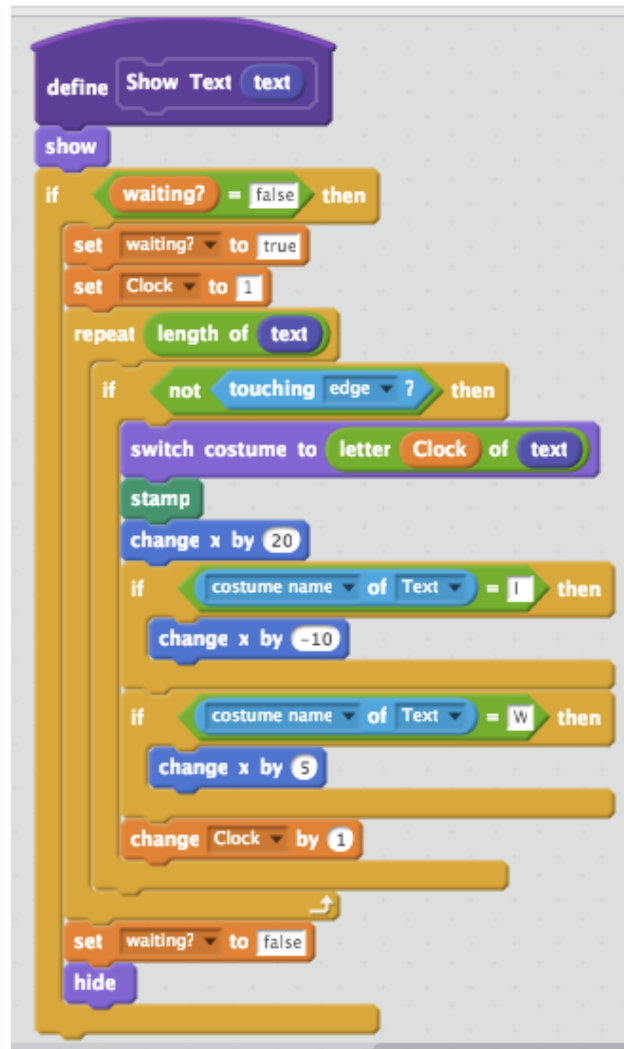

I was unable to figure out the significance of the flag called WAITING? Maybe you can help me make sense of that one. However, the reason for the IF THEN statements has to do with the width of l (narrow letter) and W (wide letter) so Megadrats is adjusting the spacing accordingly. The program from Megadrats is now in my library as **Make Text in your Games! (Custom Blocks) remix**. Take it and put it in your library and in your backpack. As an optional assignment if you want one, it would be to use the Megadrats program as part of one of your programs to add large text.

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My studio for this course
http://scratch.mit.edu/studios/53141:

Next Optional Item

A Better Tree Fractal by someone else on Scratch
This fractal tree from the library of NGMR is much nicer. I have remixed it for you
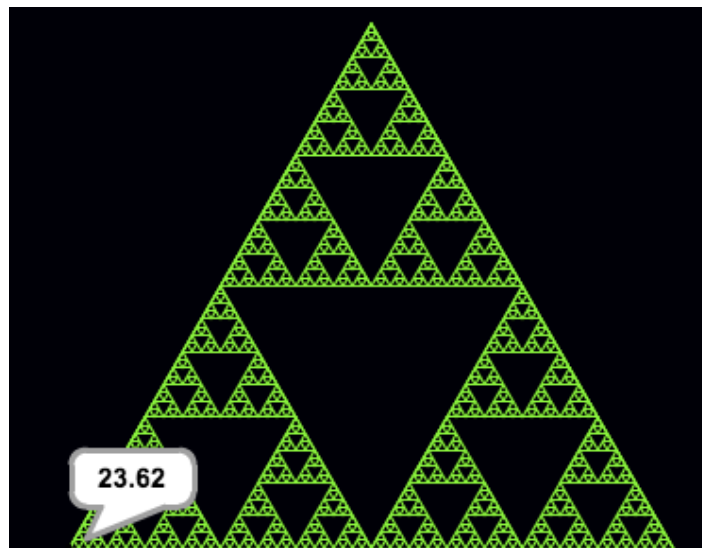and it is called Remix Fractal Tree by NGMR
http://scratch.mit.edu/projects/13941742/
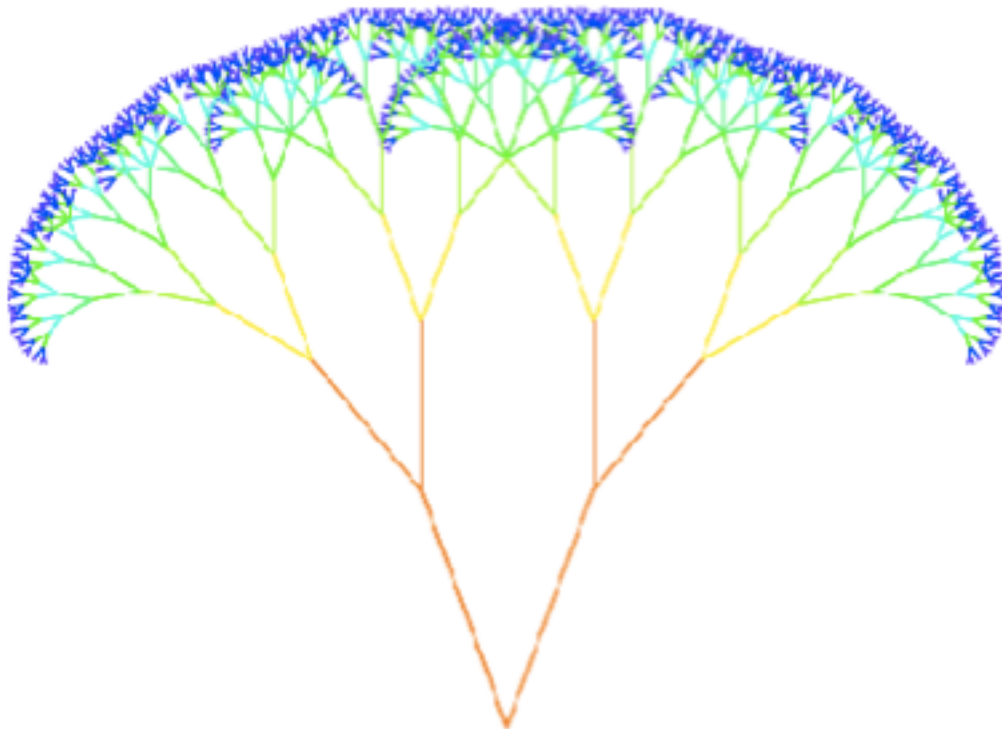
A Different Type of Fractal called The Sierpinksi Triangle
I have also remixed for you a famous fractal called the Sierpinksi Triangle
and it is called Remix Sierpinski by S65 and Cyclone103
http://scratch.mit.edu/projects/13941868/

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I hope you see the way that each of these graphics is a fractal in that the big picture is proportional and similar to any magnified portion.

Connections to Education and Our Kids

How does fit into education, particularly lower school? Kids can and should learn about these graphics and they can identify and see real world examples such as rivers, trees, leaves and snowflakes. Creating connections between computers, mathematics and nature is part of developing in children an enthusiasm for what is now being packaged as STEM in our schools -- Science, Technology, Engineering and Mathematics.

See http://fractalfoundation.org/2009/02/fractals-on-the-earth/
Fractals on the Earth

or see http://math.rice.edu/~lanius/frac/
A Fractals Unit for Elementary and Middle School Students

Next Optional Item
Make your own fractal using one of the block letters you created of variable size in a previous lesson.

Let's say you made a H of variable size.
Then you can make a fractal by adding the H command at each corner of the H.
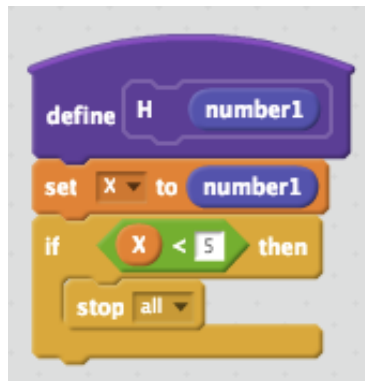
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Here is the big picture:

then do the steps for an H of variable size and at each corner of the H you include

Get the logic? It will draw an H of specified size NUMBER1 which then goes into X. As long as X stays above 5 then all is good. At each "corner" of the H, it will do a smaller H of one third size. If you succeed with your H fractal, you can then sing the song from West Side Story "Recursion, recursion, I just wrote a program with recursion." Let me know and I will add it to my new fractal studio.

URL of my fractal studio? http://scratch.mit.edu/studios/358166/
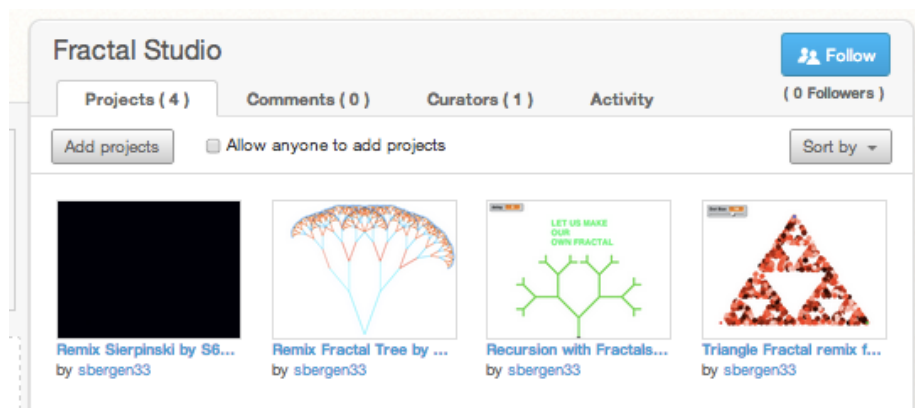
Next Optional Item
Watch this 10 minute video on using the Broadcast command
-- http://tinyurl.com/broadcast33 -- åπthat corresponds to the program at
 http://scratch.mit.edu/projects/33581732 on Scratch.
Thanks to Majken from Hawaii for letting me use her Wizard Girl Soccer Ball program.