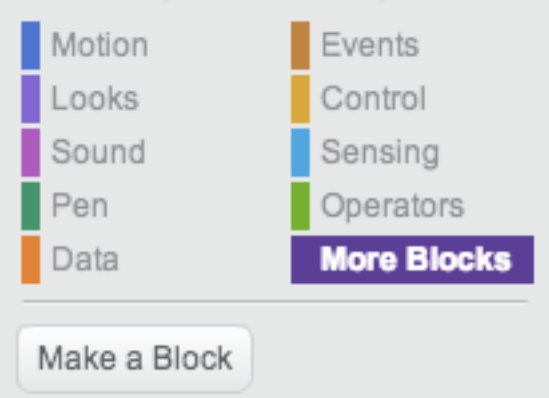
LESSON 6: Jan 18 due Jan 31 (this is our final lesson)

First Topic

We are going to learn about BYOB in this lesson.
This acronym stands for Build Your Own Blocks.

If you look at the bottom right of the Scratch color choices, you will see it say MORE BLOCKS in Purple.



When you make a new block, you are adding a new word to the Scratch language or defining a new procedure where some work is going to happen.

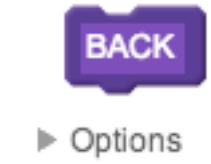
HW 6.0A So I can make a block to build a square of any specified size.
In this first required 4 min video at http://youtu.be/P05EMU9sqSk I am building a block called SQUARE and using it to achieve Spinning Squares.

Or I can make a block to create a new command. Or I can make a block that handles the question/answer dialogue with the student in a quiz program.

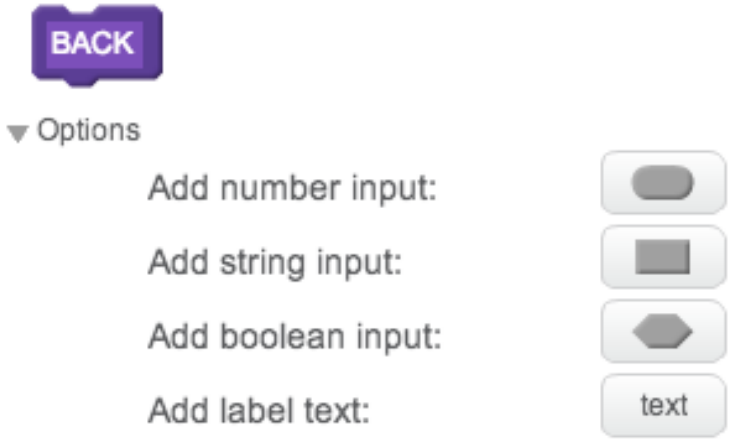
Once again, the BYOB feature of Scratch makes it into a real computer language.

For example, we have the MOTION command

that we have used since our first lesson, but we do not have one that GOES BACKWARD 10 STEPS. So we use MORE BLOCKS to create one, even though we could put a negative number in front of “steps.” When it says MAKE A BLOCK, we choose BACK and then notice there are OPTIONS below.



When we click on OPTIONS, we get several choices, each with a purpose



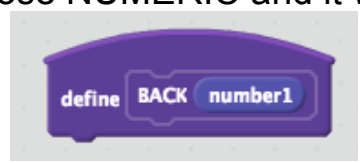
The first 3 are called INPUTS and they allow us to "pass info" to the new block called BACK. For our purposes now, we want the first type (numeric) so that we can issue commands like BACK 30 or BACK 140. Yes, I know we can MOVE -30 or -140 but I want to pretend we cannot and want to create this NEW command called BACK. HW 6.OB This optional 7 minute video at http://youtu.be/4pNpcn2R1Ck takes you through building the new COMMAND called BACK. It also has a section on the BACKPACK feature for those of you whom I have not yet shown via screenshare.

Or we might one day create a block called REVERSE that would take a string and reverse the order when we type the command REVERSE (any word).

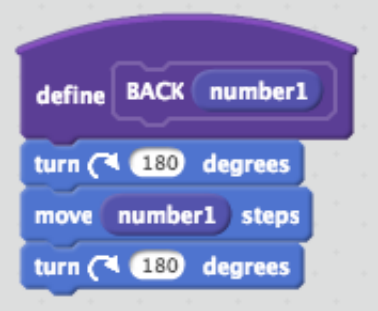
Boolean refers to True or False and that is yet another input, e.g. we could say RESPOND (X>Y) where X>Y is either true or false.

And LABEL TEXT allows you as programmer to put some comments or notes about this block for your future reference or that of someone else if you are on a programming team.

So for our BACK block, we choose NUMERIC and it would look like this:



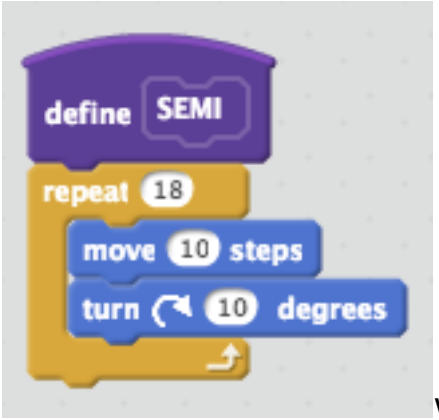
We now put in the script for this command -- turning 180 degrees, moving the specified number of steps and then turning again.



and we now can go back to our main program and issue commands like

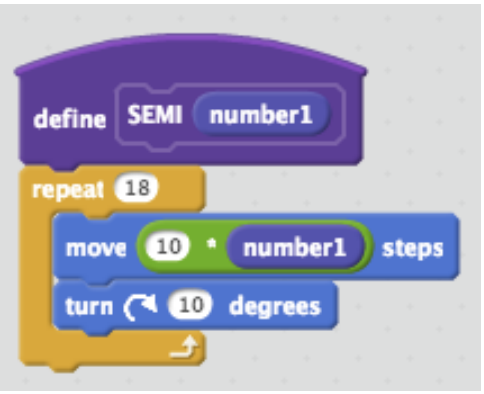
and everything acts as if Scratch has a new command!

How about a block that draws a SEMICIRCLE which can be useful when drawing letters of the alphabet like "S" or "C" or "G"



which results in

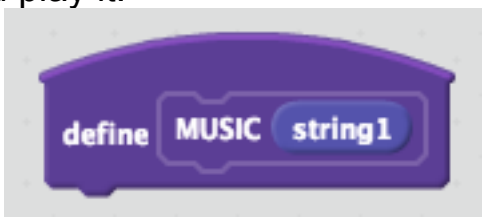
Want to make the SEMI block fancier?
How about a numeric input that specifies whether the semicircle is bigger or smaller than one we just drew? We can EDIT the BLOCK called SEMI to have a numeric input and then use NUMBER1 as a multiplier for the number of steps.



so SEMI .5 is  and SEMI 1.5 is 

The fact that both BACK and SEMI use the variable NUMBER1 which was made by the system is not a problem, since it is a "local variable" used internally when the programmer issues the command.

For another example of a BLOCK with a STRING INPUT, consider how useful it would be to have a BLOCK called MUSIC so that you could type in the first few notes of a song and it would play it!

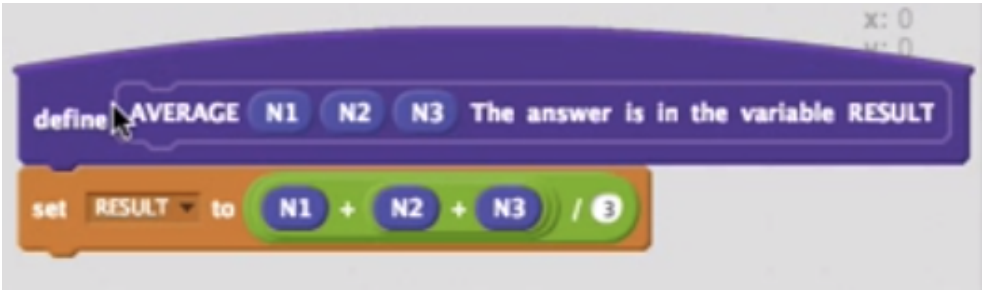


If you had this block working (not impossible to write) then you could put in your program

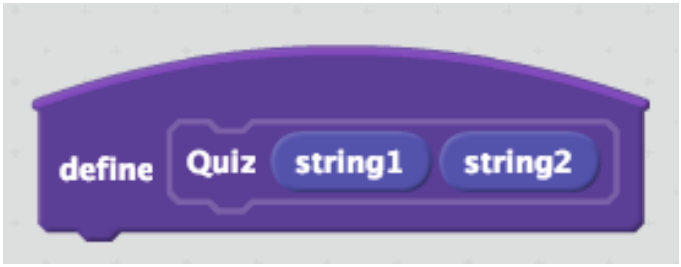
and it would play the first 7 notes of *Doe A Deer*, one of the few songs I remember from my piano playing days as a teenager ;-)

Or you could have a VOWELS block that would count the number of vowels in a string.

Or you could have an AVERAGE BLOCK that automatically finds the average of several numbers. HW 6.0C Here is a required 5.5. minute video on building the block called AVERAGE -- http://youtu.be/l4Qzw3j_TqE -- using three numeric parameters. Hopefully this video will solidify your awareness of BYOB.

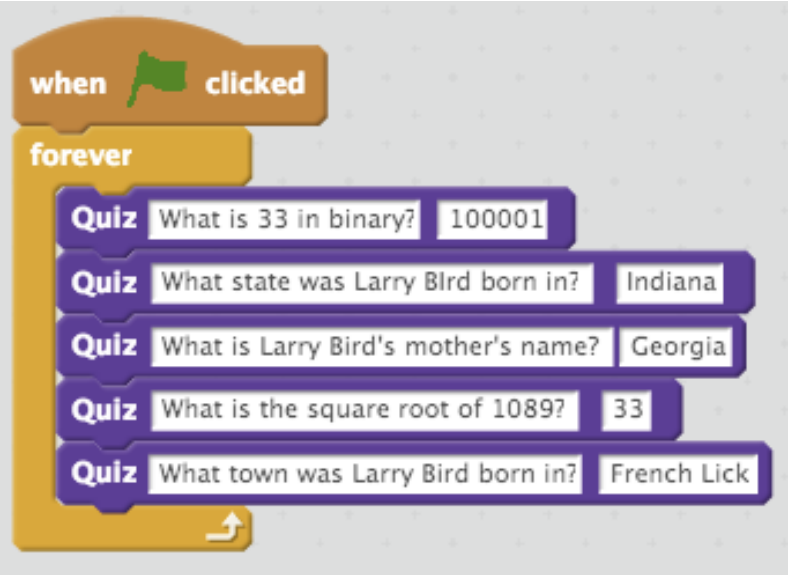


Here is one last example that you will weave into your 6.1 HW so it is the most important example. I am going to use the BYOB feature to create a quiz game that will ask a bunch of questions of the user.



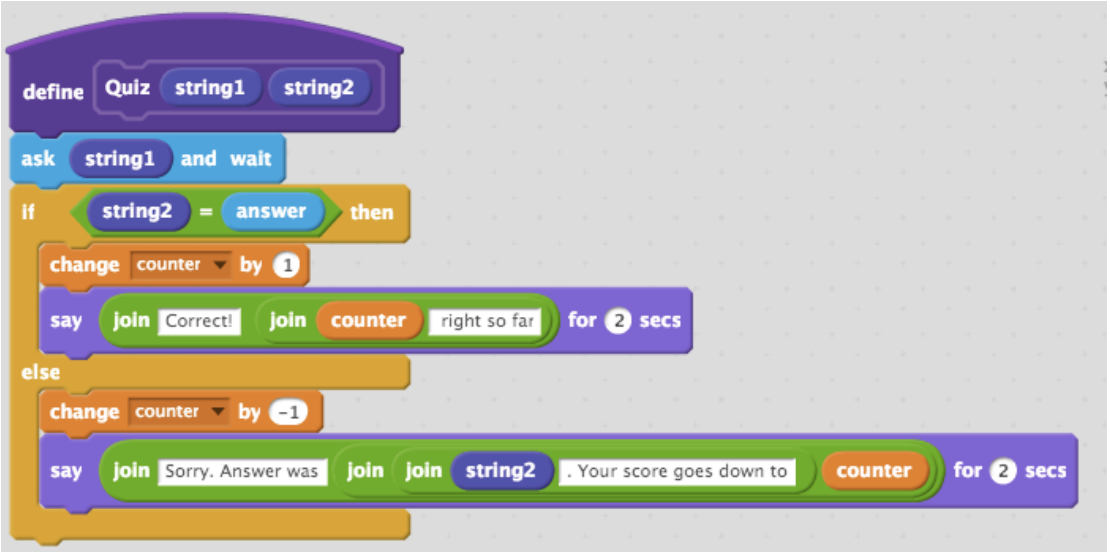
The two variables STRING1 and STRING2 are called PARAMETERS. We are passing these parameters from the main program to the BLOCK and saying “hey Block, please take charge of asking the question called STRING1 to the user and evaluate what he or she responds based on the answer I am giving you in STRING2."

One more point of advocacy regarding BLOCKS. It allows you as the programmer to keep your code shorter and more efficient. The code I have written for my quiz program would have to be replicated 5 times in my main program if I did not have blocks. Just imagine if you were charged $1 per line of code! Efficiency in coding is a plus.



Instead, this is my main program where I have my five questions. The block called QUIZ takes care of all the work. In other computer languages, what we call blocks in Scratch might be called SUBROUTINES or PROCEDURES.

Here are the details of what goes on within the block called QUIZ.



Notice how the computer asks the question called STRING1 of the user and then evaluates whether STRING2 matches ANSWER, either adding or subtracting a point from the user's score via the variable COUNTER. Now using the COUNTER, you

can do what you want on your screen. I have chosen to program a basketball to start bouncing and eventually reach Tom Brady on this screen.

The script for the ball is based on the script that one of Jeff's students (from Houston) used. Even though I can't say I understand it 100%, I can now use it effectively and want you to do the same. I have programmed the use of the COUNTER to make the ball bounce a little higher each time you get one quiz question correct. I want you to do something similar in the context of your 4.1 program, bouncing a fish, a volleyball or an object from Downton Abbey.

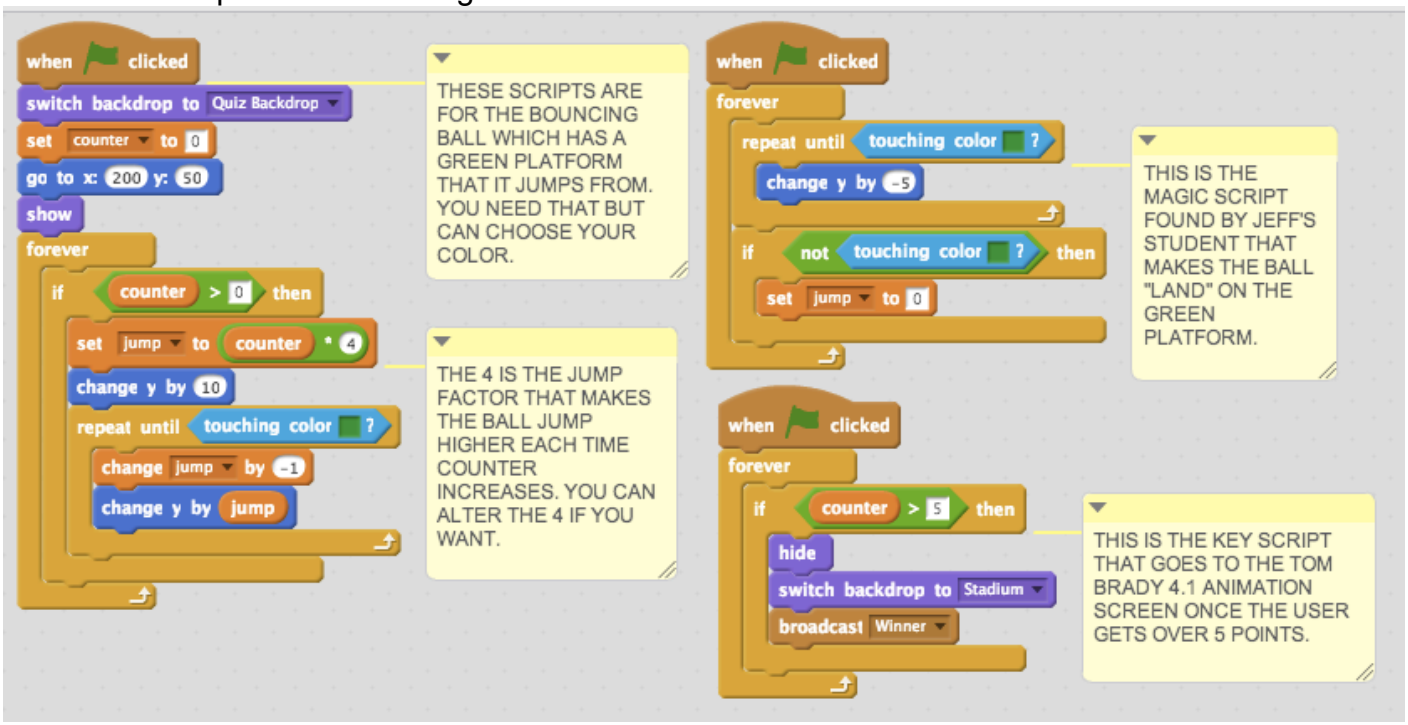
In my program called HW 6.1 Adding a Quiz to your 4.1 Screen Chase, you will see all of these elements. You can remix the program and use your backpack and move any scripts you want into your own 4.1 Creation (which now was enhanced several times in lesson 5). The URL is http://scratch.mit.edu/projects/17847231

So your HW 6.1 is an enhancement to your evolving 4.1 project
When done, I want you to have your 6.1 include
• a bouncing ball or bouncing anything
• a quiz program that keeps track of points using BLOCKS
• the reward of seeing your 4.1 Screen Chase animation happen after a certain number of points are scored using BROADCAST

Please send an email to your teammate(s) and me when you are ready for us to see your 6.1 creation.

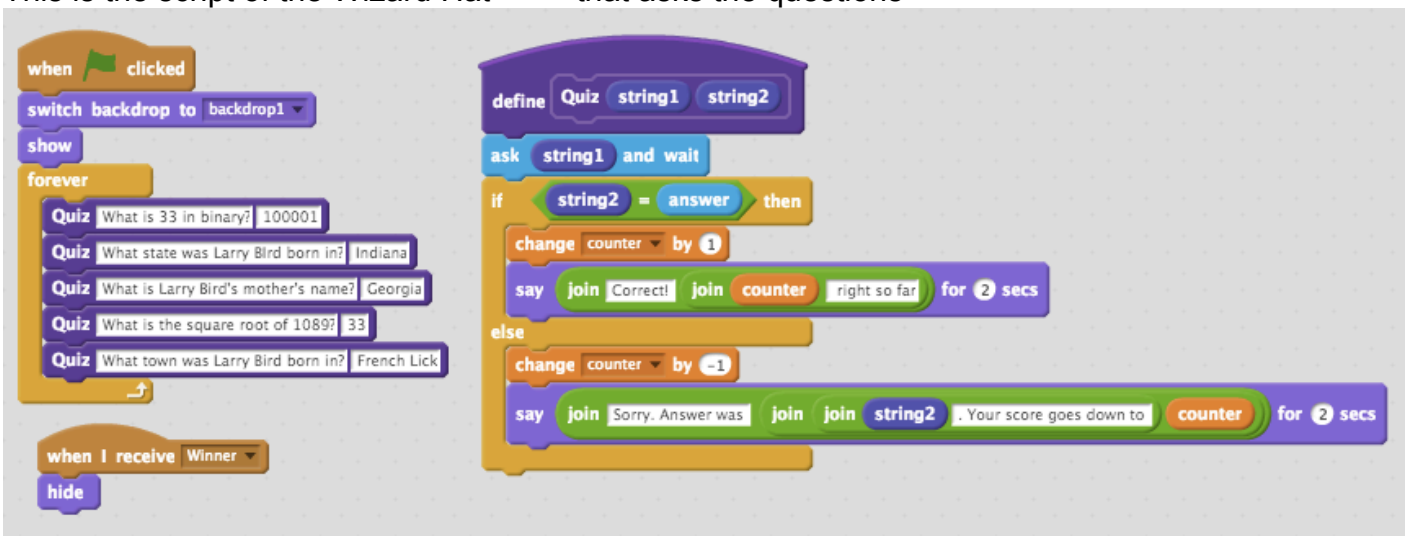
On the next two pages – to help you – I am including the scripts of the bouncing ball and wizards hat from my 6.1. Please make this program your own by doing your own thing with these techniques in your own creative way!

Here is the script of the Bouncing Ball  Sprite1 that animates more and more based on the counter.



Try your best to understand the script on the left. Pretend that COUNTER = 2. This makes JUMP start out as 10. So in the bottom REPEAT loop, it changes Y by 9, then 8 then 7 until 1 which is why the ball GOES UP. Then JUMP is -1 so it descends 1 pixel in the first nanosecond, then descends 2 pixels in the second nanosecond, then 3, then 4 which means it speeds up until it touches "and lands" on the green. I am in awe of whomever was this clever to first program this!

This is the script of the Wizard Hat  Wizard Hat that asks the questions



Required HW 6.5 Teammate (s) assignment (due by end of January when our course ends) You and your teammate(s) need to look through the Video Library of Colleen Lewis and choose one of the videos and learn a new Scratch trick that you then explain to the whole class on our collaborative doc. Your explanation goes on the shared doc at http://tinyurl.com/scratchjan2016 that you all can access.

That's it folks! Be well everyone and hope you stay in touch. Teaching you and 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 on January 31, 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

p.s. for any ambitious types, here is an OPTIONAL bonus topic for lesson 6. The topic -- FRACTALS -- makes for a great one-on-one lesson during our final half hour conversation. I love fractals and love the fact that I can make one using Scratch. You will feel the same way (I think) if you work at it!

Optional Bonus

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!

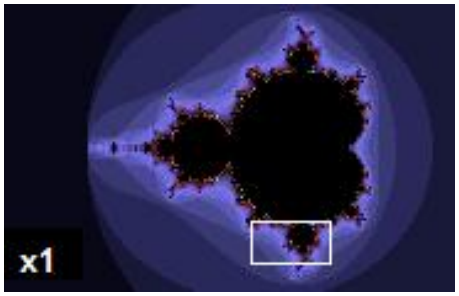
Recursion and Fractals -- Exciting & Empowering

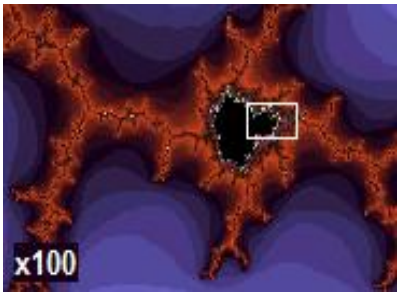
Here is the easiest definition I could find from the website of http://www.techterms.com/definition/recursivefunction
If you look up *Recursion Computer Programming* on Google, you get so much amazing complexity.

"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.



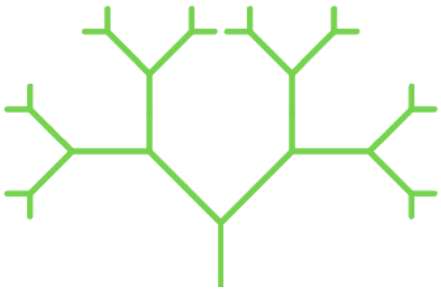


This paragraph from http://en.wikipedia.org/wiki/Fractal may be of help:

"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.



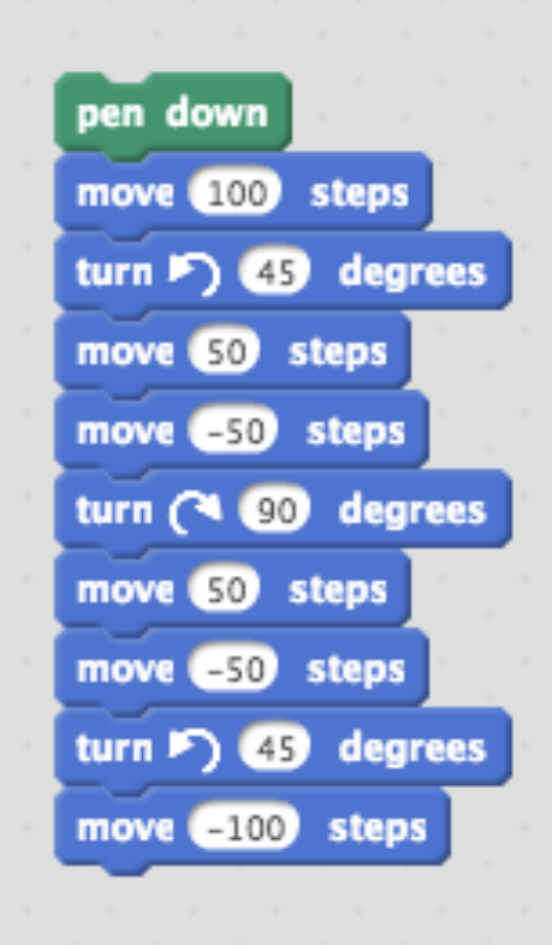
Video Part 1 (5 min) http://youtu.be/WQfEd5AcnVY
This gives you the orientation to what a fractal is and an overview of the one we are going to code from scratch using Scratch.

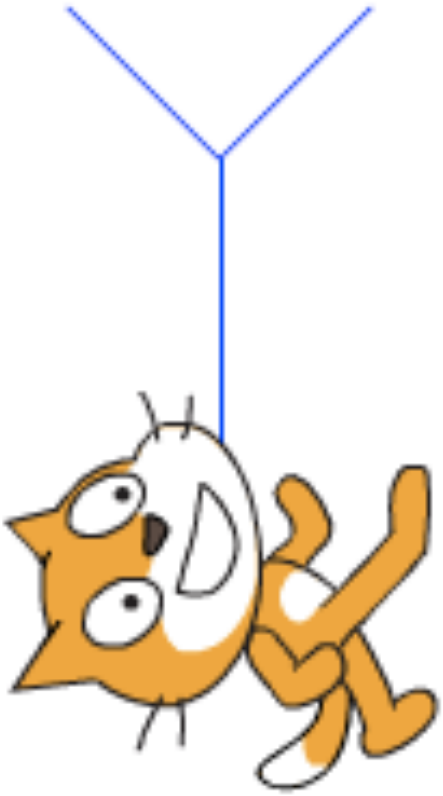
VideoLesson Fractals Part 2 (18 min) http://youtu.be/LKkVzmBB5Zs
This takes you through the nitty gritty programming for creating a tree fractal. This is a tough challenging topic yet needs to be an important part of any coding course. I wish I could teach this to someone in 33 seconds but I can't!

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)

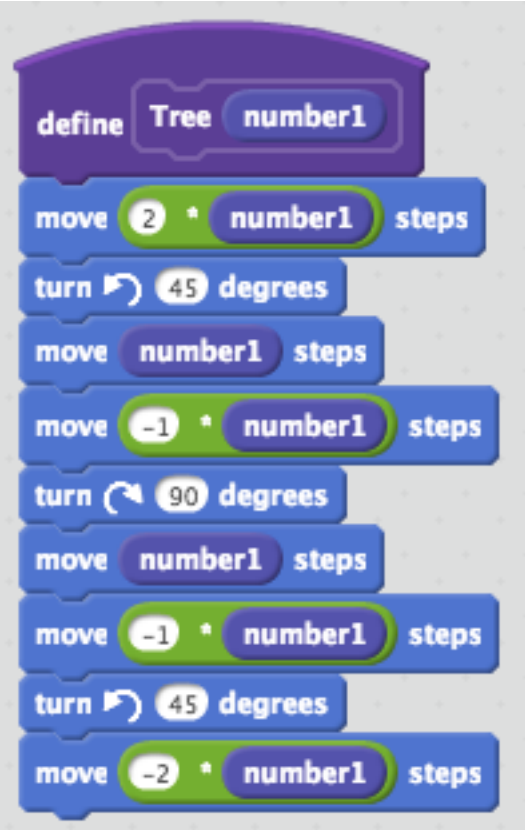
STEP 1
We begin by making an uppercase Y with each "limb" equal to half of the main trunk. Observe that the cat comes back to the starting spot (very important).

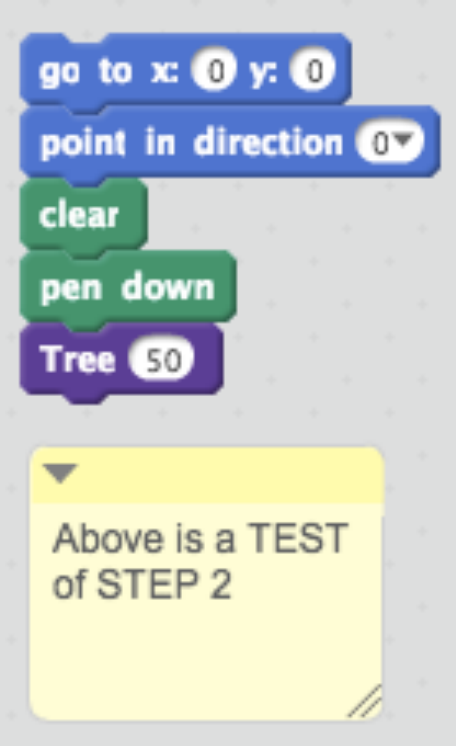

pen down
move 100 steps
turn 45 degrees
move 50 steps
move -50 steps
turn 90 degrees
move 50 steps
move -50 steps
turn 45 degrees
move -100 steps



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.

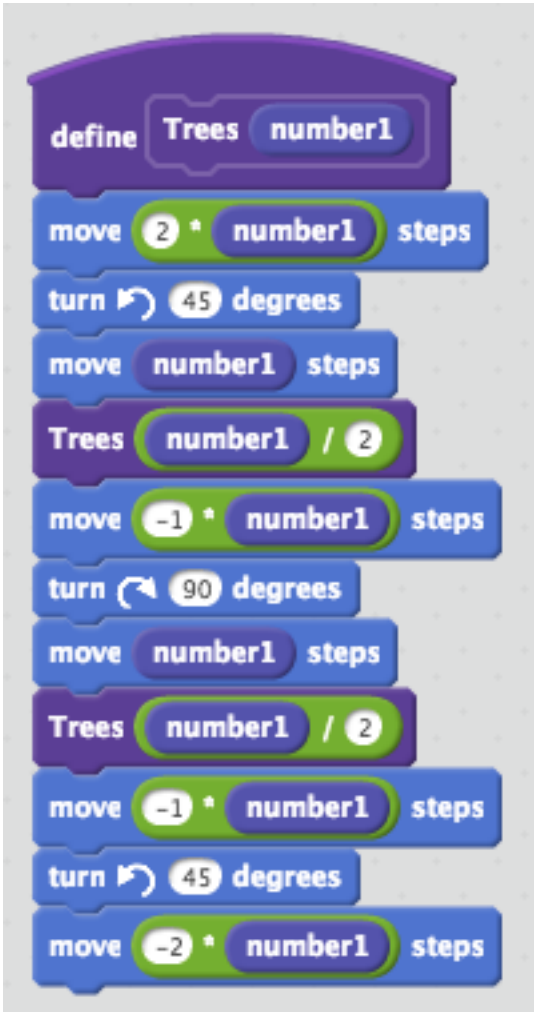
Make sure you test STEP 2 to get the same Y as you had in STEP 1.





STEP 3

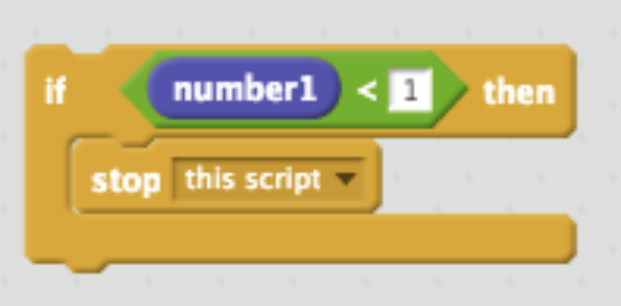
Below is STEP 3 where in my demo I modified the TREE block, calling it TREES just so I can show you both STEP 2 and STEP 3. You do NOT need to have both the TREE and the TREES blocks. You can succeed with one block that is like TREE modified in step 3 and step 4.

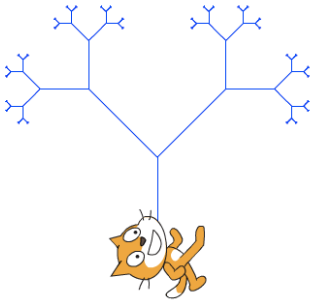


This STEP 3 is very important even though it is a failure. You can see that the computer is trying to make the "Y" but it never finishes. At the top LEFT of each subsequent "Y" it tries to make another "Y" that is smaller. But it never finishes so what we have in STEP 3 is a series of "left sides of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

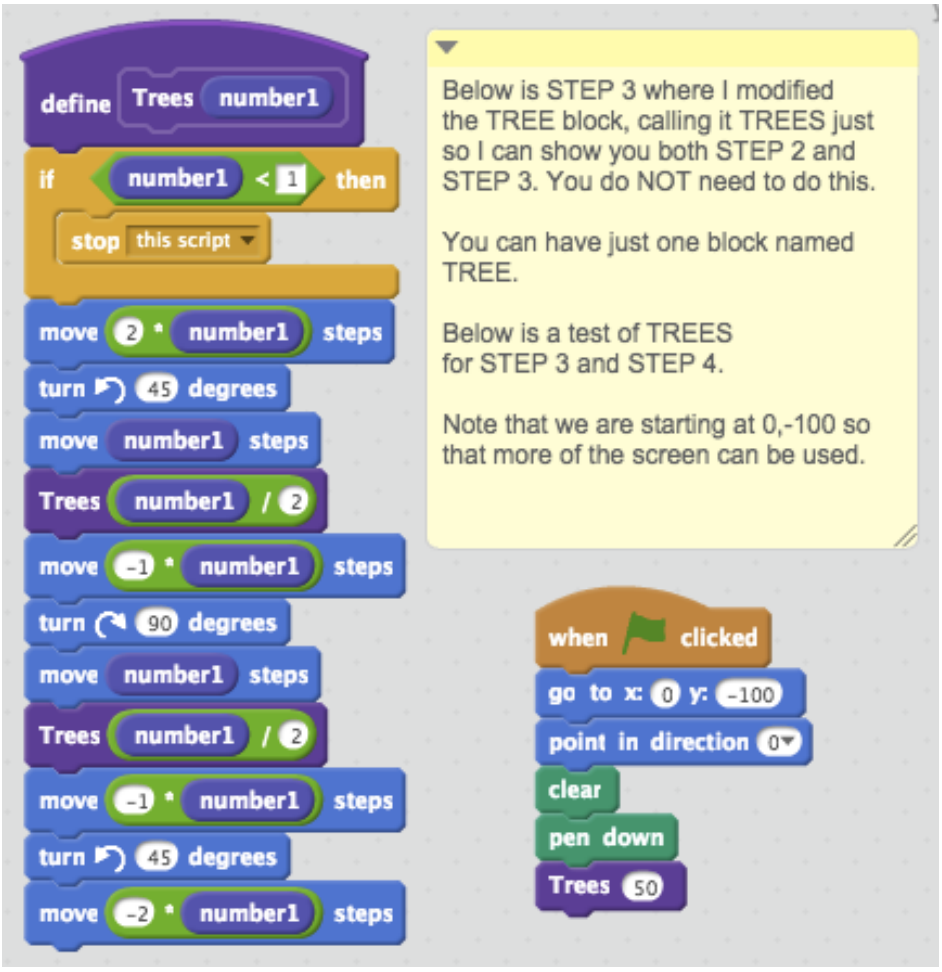
STEP 4: We are so close to success. We need just ONE IF STATEMENT to STOP the recursion when number 1 gets "too small" which you are welcome to define.

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.

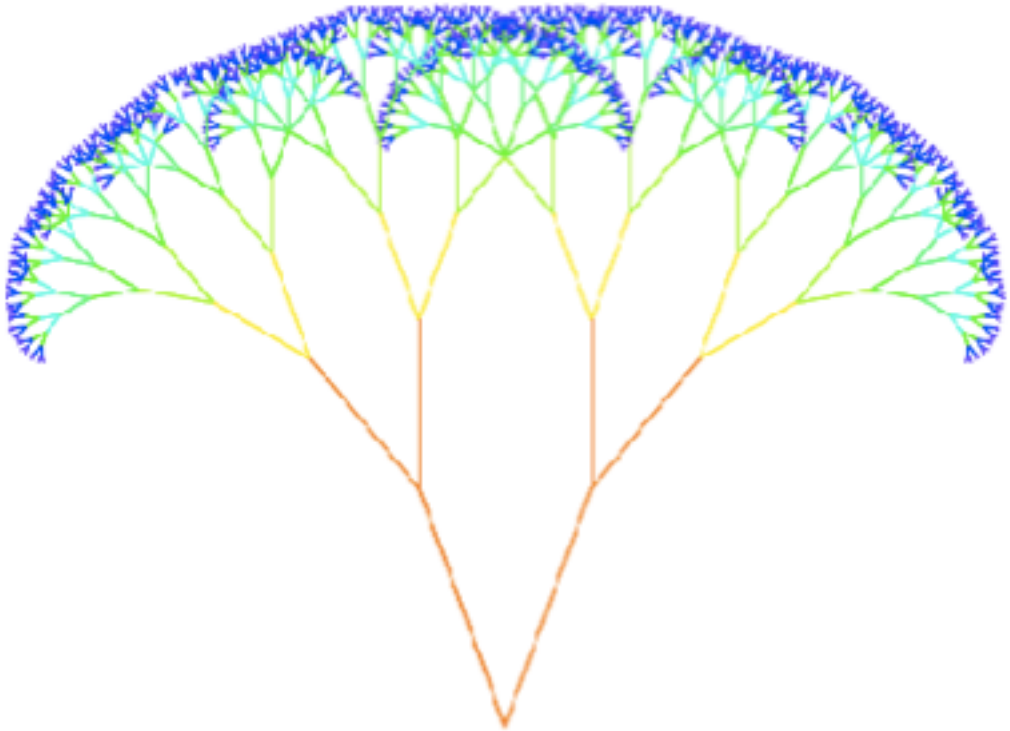


Optional HW 6.2
Study, study, study!
Practice, practice, practice!
Consider this your final exam.

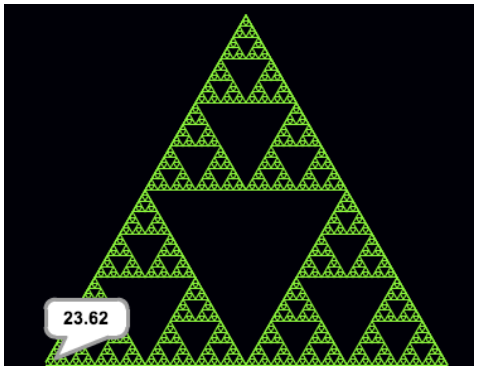
Then wake up the next day and create the fractal from scratch without notes!
If you succeed, buy a drink and charge it to me!
If you don't succeed and have to look at notes, then try it again the next day.

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.

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/



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

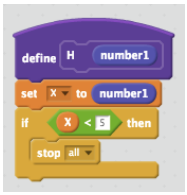
How does fit into education, particularly lower school? Kids can and should learn about these graphics and they can identify and see real world examples such as rivers, trees, leaves and snowflakes. Creating connections between computers, mathematics and nature is part of developing in children an enthusiasm 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 & Middle School Students*

Optional: A Really Cool Fractal Scratch Program by a Programmer named **Lataliat**
https://scratch.mit.edu/projects/86938742

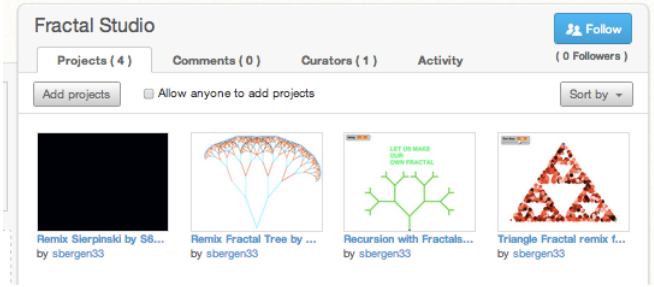
Next Optional Item
Make your own fractal using one of the block letters you created of variable size in a previous lesson.

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.
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/

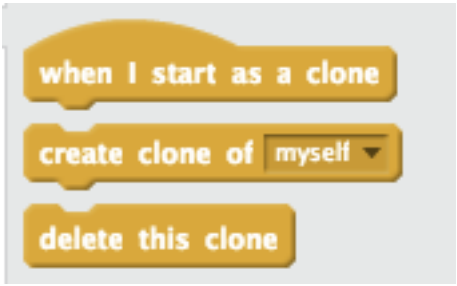
INDEX of HIGHLIGHTS can be found on page 18

☑HW 6.0A Watch the required video on BYOB (p1)
☑HW 6.0B Watch optional video on the BACK command (p3)
☑HW 6.0C Watch the required video on BYOB with AVERAGE (p5)
☑HW 6.1 Enhance your evolving 4.1 project to include the bouncing ball, a quiz sequence on any topic and the reward of seeing the Screen Chase scene after the user achieves a number of points. Send to your teammate(s) and me. (p7)
☑HW 6.2 Optional Bonus: Read about Fractals and then create your first fractal either following directions or with me at our final screenshare (pages 10-18)
☑HW 6.3 Optional Bonus: Read about Cloning and then try to make your own variation of one of the cloning examples (pp 19-23)
☑HW 6.4 Optional Bonus: Read about Using Mount-Pointer to Create a Draw Program and then try to make your own (p24)
☑Required HW 6.5 Teammate(s) assignment -- Library of Colleen Lewis and choose one and explain on the shared doc at http://tinyurl.com/scratchjan2016 (p9)

OPTIONAL UNIT 6.3 on Three CLONING COMMANDS

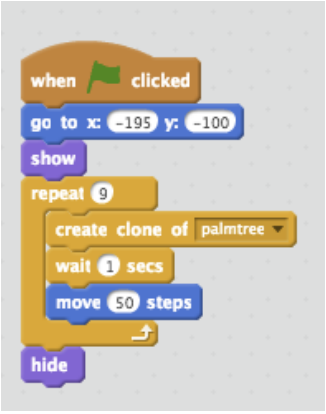
(thanks to Craig from MD for this suggestion)

The project at https://scratch.mit.edu/projects/10003371 is part of a CLONING STUDIO and will serve as our entry into this world of cloning. The CLONE commands were added to SCRATCH in 2013-2014. You can read about these commands on the Scratch Wiki at http://wiki.scratch.mit.edu/wiki/Cloning if interested. You can find the 3 CLONE commands at the bottom of the CONTROL section.



The program below consists of two Sprites
The first one is SCRATCH CAT that goes to bottom left of stage, then shows the sprite, then 9 times CREATES a clone of the other sprite called PALMTREE. So without knowing any more, you can say that there will be 9 palm trees, each one is created with a second delay and 50 steps further along.

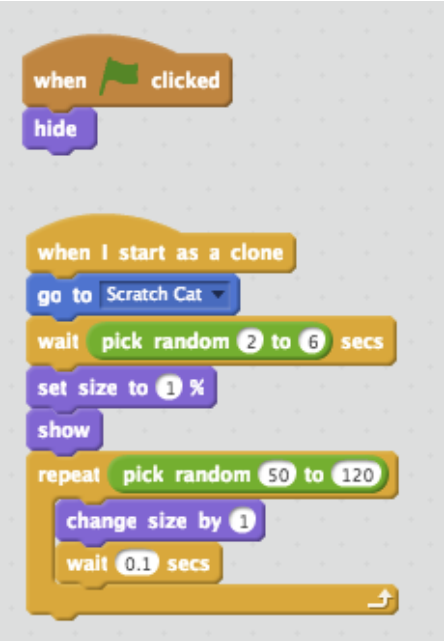
The one new command below is CREATE CLONE.



The second sprite is PALM TREE. It begins by hiding and then comes our second new command called WHEN I START AS A CLONE. Here we have the program ("the recipe") that tells any new clone what to do when it is created. The first thing to do (hidden since we do not SHOW yet) is GO TO wherever the SCRATCH CAT is. Then we wait a random number of seconds and SET SIZE to be 1% -- is a very

small palm tree. Then we SHOW and now REPEAT a random number of times between 50 and 120 the following two steps:

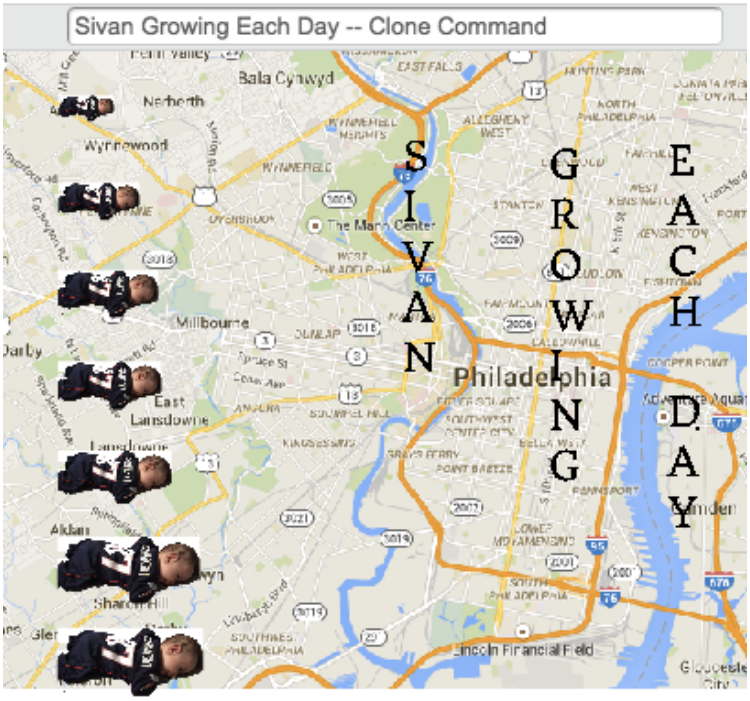
CHANGE SIZE by 1
WAIT .1 SECONDS



Got it? Very clever program. Very short program. Each time we get 9 palm trees of variable size.
Here is one outcome.

Optional HW Challenge 6.3 to help solidify these commands in your skill set. Instead of the CAT walking and 9 PALM TREES growing find another character to walk and something else that grows. Change the spacing, the time, the number of objects.

To give you an example, I chose to take a picture of my new granddaughter Sivan and have her grow horizontally on a map of Philadelphia where she lives. I ended up incorporating a LIST and the STAMP command as well.

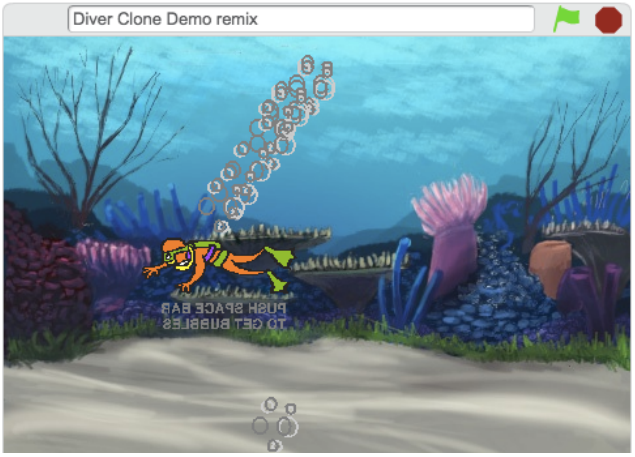


You can find many examples of using the three clone commands at https://scratch.mit.edu/studios/201437/
The palm tree example appears to be submitted by Mitch Resnick -- famous professor at MIT (Scratch name "mres") and creator of Scratch. He has a powerful Ted talk on Scratch at http://www.ted.com/talks/mitch_resnick_let_s_teach_kids_to_code

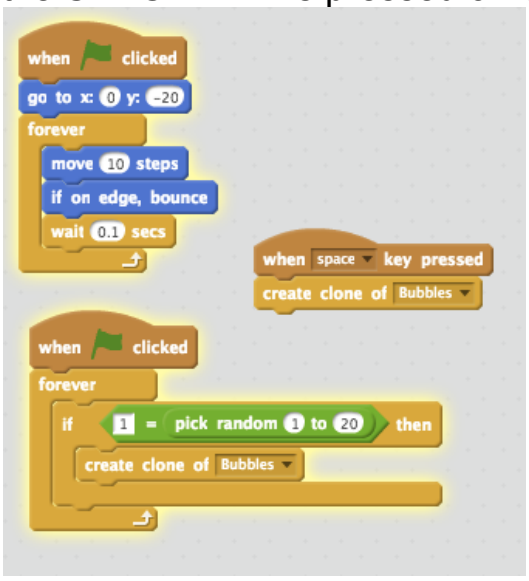
Here is another example from this site that uses one more CLONE command -- the DELETE CLONE command. I have modified it to be a bit more teachable friendly. It is based on https://scratch.mit.edu/projects/11583247/ by a programmer named JohnM

My remix is at https://scratch.mit.edu/projects/60091118

The program lets a diver bounce around on the screen and produces bubbles randomly or when the user pushes SPACE BAR.



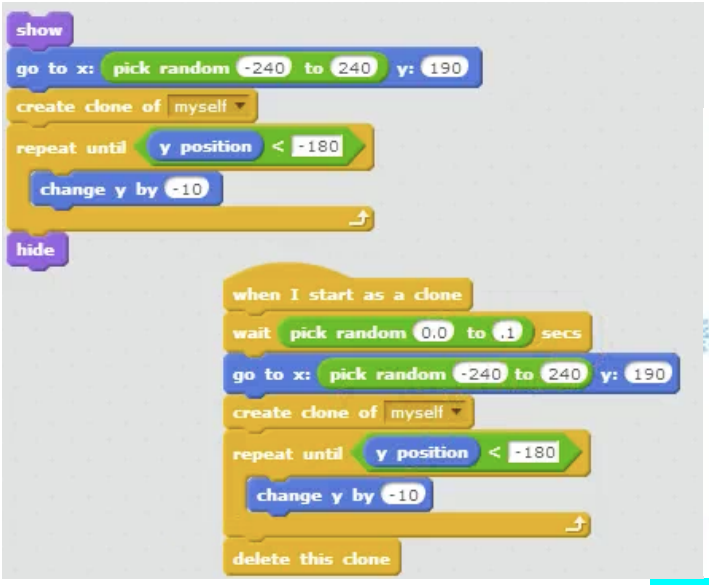
The script for the diver is very short. The diver moves to a starting point and forever moves 10 steps, pausing briefly in the forever loop. Notice the powerful use of IF ON EDGE, BOUNCE to make the diver go back and forth over and over again -- very short and efficient programming! Next we see that a CLONE of BUBBLES (the other sprite) occurs when either the SPACE BAR is pressed or randomly.



So the main program has just one use of a CLONE command -- the implementation to CREATE A CLONE. Let us now look at the BUBBLES program to see what happens when a clone is created.

Here we see the steps each time a clone is made, whether by randomness or via the space bar. The first thing is that the sprite goes to the position of the diver since that is where the BUBBLES will begin their journey. Then repeatedly, the BUBBLES go up by 4. If they hit the edge then the clone is deleted. This is so simple, so efficient and so powerful. Finally, here is a program that Craig -- in our course -- created, using a sample by Colleen Lewis (creator of that Scratch site from Lesson 5).

CODE ON LEFT



OUTPUT ON RIGHT

Video of the program (made by Craig) at http://youtu.be/ZjHGI_Pif4k

Link to the actual program: https://scratch.mit.edu/projects/59828714

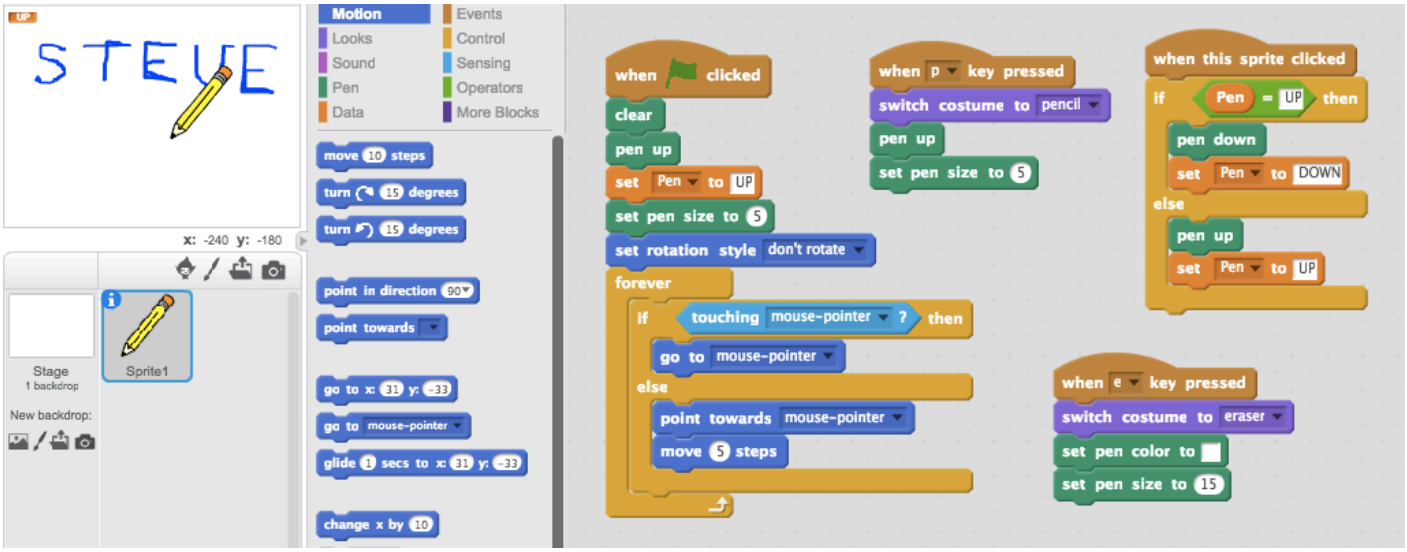
6.4 Optional -- Using Mount-Pointer to Create a Draw Program

This is a very short lesson on using the commands that contain Mouse-Pointer.

The one on the left is a SENSING command that detects if the current sprite is touching the place where your mouse arrow is located.

The one the right is a MOTION command that makes the sprite point towards the place where your mouse arrow is located.

Here is the code



Sample program is at
https://scratch.mit.edu/projects/86912718/

Enjoy! This is a very cool technique to add to your repertoire. It took me a while to understand it. I learned it from a 12 year old from GA in my Online Scratch Course 4 Kids who used it in one of his programs! Serious!