Computational Thinking with Adinkra

What is Computer Programming?

Whenever you use a computer for email, games, calculating, etc., you are using a computer program that someone wrote. A computer program or "software application" is just a list of instructions telling the computer what to do. It is first written in a language such as Java or C++, so that humans can read it, and then "compiled" or "interpreted" into the code that only computers can read. When that code is "executed" you see it working as a game or other application.

CSnap is a visual programming environment. CSnap Users are able to write programs to create animations, graphic designs, games, music, and other media. The advantage of using CSnap is that you simply drag and drop code blocks which snap together like Legos. Programming in a language like Java or C++ requires that you follow complicated syntax rules, so that merely misplacing a single comma can cause the program to fail. The blocks in CSnap only require that you stack them in the order you want them to execute.

What is Adinkra Computing?

Adinkra Computing brings computer programming concepts together with Adinkra symbol carving and design. The discipline of ethnocomputing is used across different cultural contexts to reveal that present day computing concepts are embedded in local designs and artifacts. These designs and artifacts often have cultural and/or religious significance to groups of people in specific geographical locations. Adinkra symbols, being indigenous to Ghana, are examples of where computing and culture intersect.

Since Adinkra symbols have concepts with computational significance embedded in them, learning to program different Adinkra symbols using CSnap introduces students to deep connections between computing and their heritage/culture. Adinkra Computing helps students to learn computational thinking by drawing on local Ghanaian design knowledge.

Computational Thinking and Adinkra

The real value in using CSnap to simulate Adinkra symbols is that students learn computational thinking. By computational thinking, we mean that students learn to recognize problems that they want to solve (problem recognition), define how to solve the problem (problem definition), and then break their solution down into manageable pieces (decomposition). We call this computational thinking or algorithmic thinking.

Like the algorithms that make up a computer program, the carving of Adinkra designs also results from specific step-by-step solutions. After determining what symbol will be carved, the Adinkra craftsman must evaluate their chosen algorithms of the symbol and decide the order of operation to create the design. In a very real way this process involves computational thinking.

Computer Science Topics Taught Through CSnap Adinkra Computing Tool:

Agile Software Design - In agile software design, programmers concentrate on getting part of a working solution built as soon as possible, and then work on refining their solution to solve all aspects of the problem.

Flow of Control - The flow of control a CSnap program starts with the "Flag When Clicked" block, with each code block attached being executed in turn from top to bottom. Flow of control can be altered by using repeat blocks that repeat code more than once, or conditionally executed when a condition is met.

Looping- Looping alters the flow of control to repeat small sections of program code.

Variables- A variable is a storage location in memory, used during a code execution to reference an established value. In CSnap students can define both local variables for individual Sprites as well as global variables accessible by all Sprites. The scope of a variable refers to when a value stored in a variable is available for use.

Conditionals - Conditionals alters the flow of control to execute a group of code blocks only when an expression evaluates to true.

Exemplary Symbols

Akoma

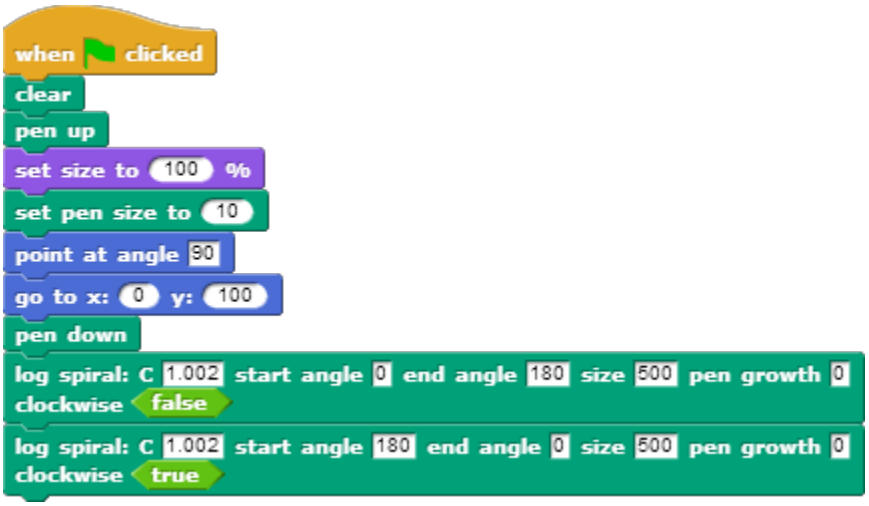
Meaning:

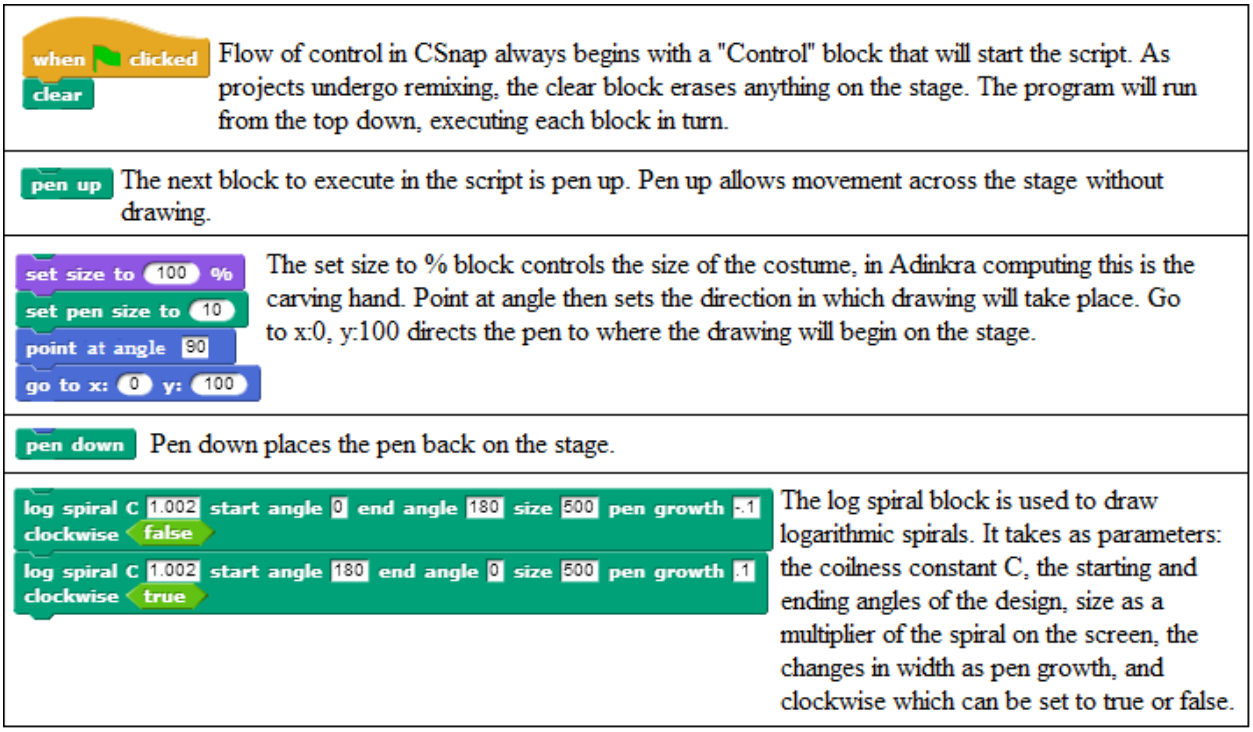
Akoma, translated in Akan to “heart”, is suggestive of the spiritual heart, not the physical heart. This symbol represents love, goodwill, patience, faithfulness, and fondness.

Applicable Computer Science Topics:

Flow of Control- The flow of control in a CSnap program starts with the “Flag When Clicked” block, with each code block attached being executed in turn from top to bottom.

CSnap Script to create Akoma:





Adinkrahene

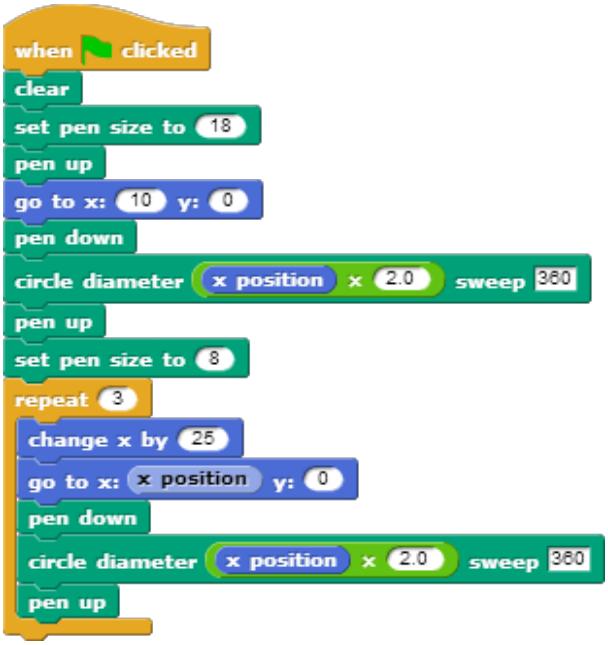
Meaning:

Adinkrahene, "Chief of the Adinkra symbols", represents greatness and leadership. The symbol of concentric circles was originally on gold medallions worn by "soul washers", officials who performed religious rituals for the chief, such as bathing ceremonial swords. The circles are said to resemble the expanding ripples from a pebble tossed into a pool of water, just as a great leader's influence can ripple across the nation.

Applicable Computer Science Topics:

Looping- Looping alters the flow of control to repeat small sections of program code.

CSnap Script to create Adinkrahene:



when clicked	Establishes an action to execute the code
clear	Clears the screen
set pen size to 18	Using a large pen size here helps to fill in the inner circle
pen up	Pen must be up to execute the next block without drawing a line
go to x: 10 y: 0	Moves the pen to a now defined x and y position
pen down	The pen is put down to begin "drawing" the symbol
circle diameter x position x 2.0 sweep 360	This block draws the first circle. When setting the circle diamter, it must be twice the circle radius. Therefore, we use the operator x where the x position has already been defined as the circle radius in the 5th block.
pen up	The pen is lifted up here to prepare for the first translation which will occur at the beginning of the loop
set pen size to 8	A smaller pen size is set to prepare for the three outter circles, which are thinner than the inner circle
repeat 3	A loop is introduced here, which is a way to make a computer do the same thing, or a very similar thing, over and over again. We repeat this loop three times beacuse Adinkrahene has three outer circles.
change x by 25	The first action in the loop is to change the x position, which is set at 10, by a positive 25. This will put the first outer circle 25 units away from the original x position. After this first loop is completed the new x position will change by 25 units again. When the loop repeats three times there will be three x positions: 35, 60, and 85.
go to x: x position y: 0	After a new x position has been established, this block will move the pen to the desired x position, which is the radius of the new circle
pen down	Because the pen is up last in the sequencing, it must be put down before a circle can be drawn
circle diameter x position x 2.0 sweep 360	This block draws each of the three outer circles. As done earlier, the circle diameter is set as twice the radius using an operator block to multiply the x position by two.
pen up	At the end of the loop, the pen must be lifted up before going to the new x and y position

Akokonan

Meaning:

Akokonan translates as "hen's foot," and it resembles one. The saying that comes with the symbol is "The hen treads on her chicks, but she does not kill them". Thus, it represents the idea of "tough love", the combination of care and responsibility that we see in good leadership from our own parents or government institutions.

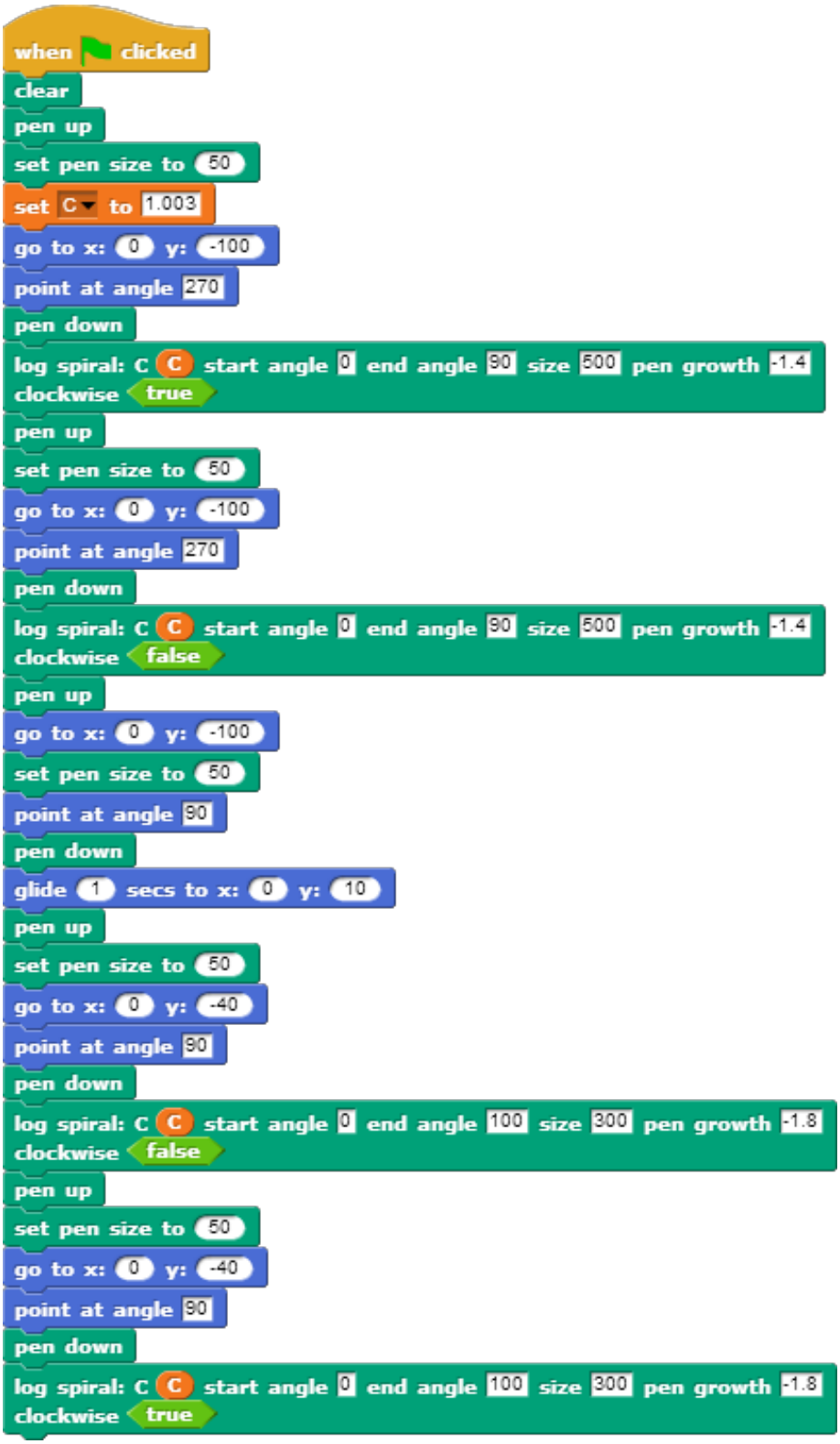
Applicable Computer Science Topics:

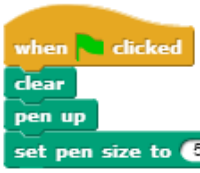
Variables- A variable is a storage location in memory, used during a code execution to reference an established value. In CSnap students can define both local variables for individual Sprites as well as global variables accessible by all Sprites. The scope of a variable refers to when a value stored in a variable is available for use.

Conditionals - Conditionals alter the flow of control to execute a group of code blocks only when an expression evaluates to true.

In addition to variables in Akokonan, conditional control structures can be examined as they are used in the log spiral block to draw Akokonan. The code for the log spiral block can be manipulated to see how conditionals are implemented for clockwise and anticlockwise spiral drawings. To do this, right click on the log spiral block and choose 'Edit'. A block editor window will open, showing the block definition below. Scroll to the bottom of the block definition window and notice how the 'if' control blocks use Boolean logic operators 'true' and 'false' to determine whether or not the code in the 'if' control block should execute.

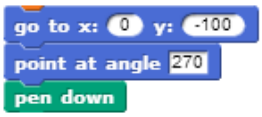
CSnap Script to create Akokonan:





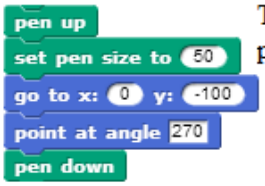
Here the script begins. Clear erases everything previously on the stage. Pen up, like the name, allows movement around the screen without leaving traces. Alas the pen size is set.

The variable C is assigned the value 1.003



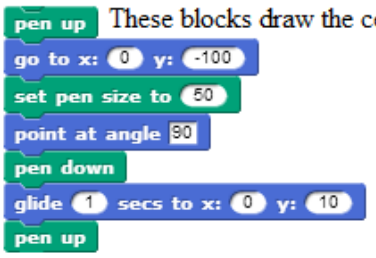
The pen is moved to x=0, y=-100 and the drawing angle is set to 270 degrees. The pen is now ready to draw and thus put down.

The log spiral block uses the variable assignement for C as the input for the C parameter

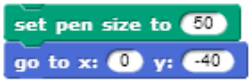


This code lifts the pen, restores the pensize to 50, moves the pen to x=0, y=-100, points the drawing angle to 270 degrees and puts the pen down ready to draw.

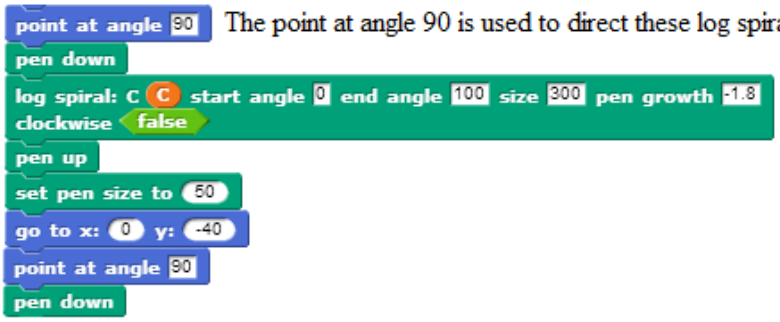
Again the log spiral block uses the variable assignment for C as the input for the C parameter.



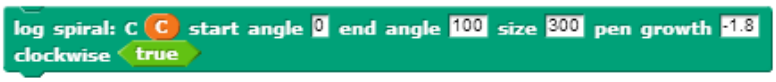
These blocks draw the center line in Akokonan



This process should now be familiar and is very similar to the first half of this script.



The point at angle 90 is used to direct these log spirals opposite the first two



Come the last log spiral one should hopefully see the benefit of using C as a variable. Changing this one variable easily manipulates the overall size of the Akokonan.

Editing the Log Spiral Block: