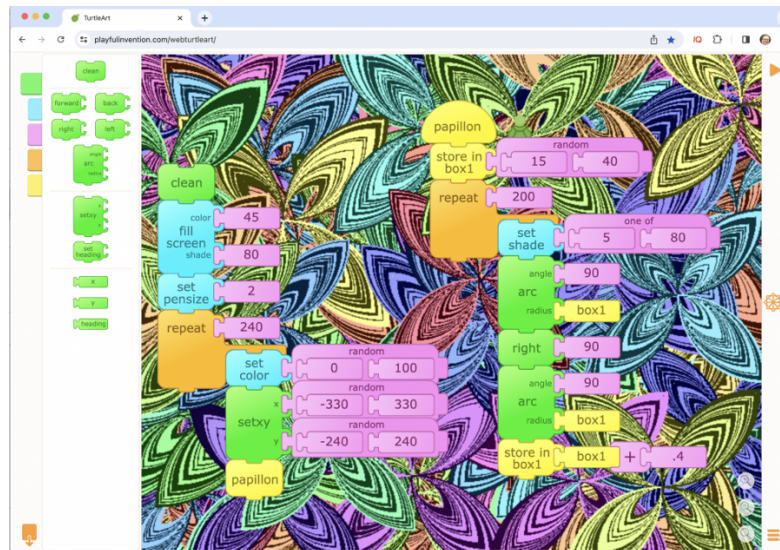


Getting Started with Turtle Art

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Using Turtle Art

1. Run Turtle Art in a browser by going to playfulinvention.com/webturtleart/ or
2. Purchasing the Turtle Art app from the iOS App Store for the iPad

Turtle Art Help

Help is built-into Turtle Art. Just click and hold a block and useful information will popup!

Saving Turtle Art Projects

Save often by clicking the down arrow button in the bottom left-hand corner of the Turtle Art Screen. For example, if you save or download the samples found on the turtleart.org site, you can a program into Turtle Art and remix them.



Opening a Turtle Art Project

You can open any PNG file created by Turtle Art, found on the Web or on your hard drive by dragging that file into Turtle Art. This maneuver requires overlapping windows and basic trackpad/mouse skills.

Other Software to Consider

- Scratch (Mac & PC)
- Octostudio (Android/iOS phones & tablets)
- The Logical Journey of the Zoombinis (iPad, Mac, Windows)
- Lynxcoding.club (Mac & PC)
- Microsoft MakeCode
- Snap! (Mac & PC)



Lots of
Turtle Art Resources

Turtle Art - Playing with Arithmetic

Problem 1

Create the following program:



Can you predict what it will do before you run it?

What does it do?

What happens if you change the number 1 to another number?

What happens if you change the **X** to +, - or / ?

Problem 2

Create the following program:



Can you predict what it will do before you run this program?

How does it work?

What happens if you replace the 1 with a larger number, say 10?

When you increase the pen color by 1, does the color get lighter or darker?

What happens if you place a repeat block at the top of the program?

Problem 3

Here's a crazy idea!

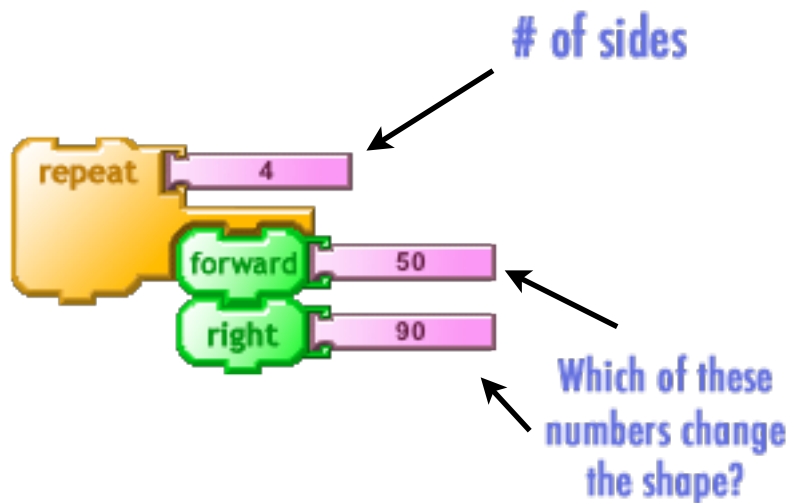
What do you predict will happen if you combine program 1 and program 2? Snap them together and fine out!

Making Polygons

Super Dooper Really Really Really Hard Challenge

Name	# of sides	amount of turn
Triangle	3	
Square	4	90
Pentagon	5	
	6	
	7	
Octagon	8	
	9	
	10	36
	11	
	12	

Change the number of sides and and amount of the turn to create the polygons.



4th Grade Clever Computing for Kids
Session #2

Me: Have the turtle draw a triangle with equal sides

Student:

```
FORWARD 100  
FORWARD 100
```

```
RIGHT 100  
RIGHT 100
```

“Now run RIGHT 100 RIGHT 100 again”

“and again”

“Then FORWARD 100 FORWARD 100 again”

```
RIGHT 100  
RIGHT 100
```

“three times”

```
FORWARD 100  
FORWARD 100
```

```
RIGHT 100  
RIGHT 100
```

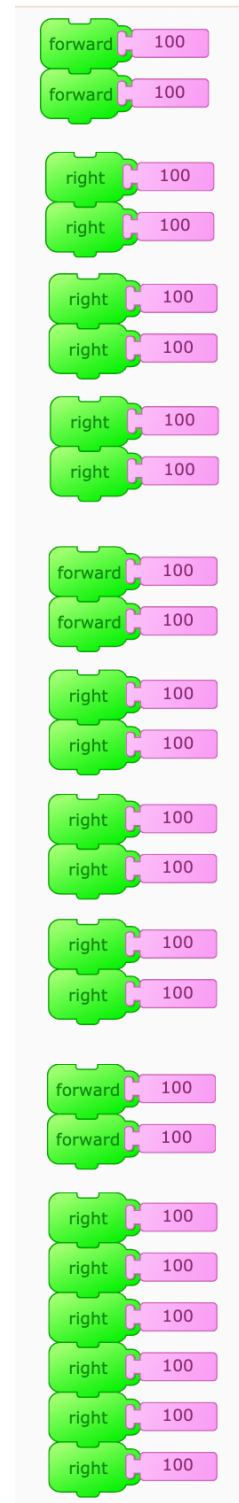
```
RIGHT 100  
RIGHT 100
```

```
RIGHT 100  
RIGHT 100
```

Thoughts

She is not yet thinking at the pattern or procedural level and is using a lot of repeated addition. The instructions for each of the triangle’s sides were conceptually grouped by the time she shared her approach with the class.

With a little coaxing from me, the student began seeing that FORWARD 100 FORWARD 100 could be simplified as FORWARD 200.



Seeing `RIGHT 100 RIGHT 100` three times was more difficult.

A nice feature of the Web-based version of Turtle Art is that you can see the silly turtle turning a lot and tiring itself out.

Other students could see a pattern that led to the creation of

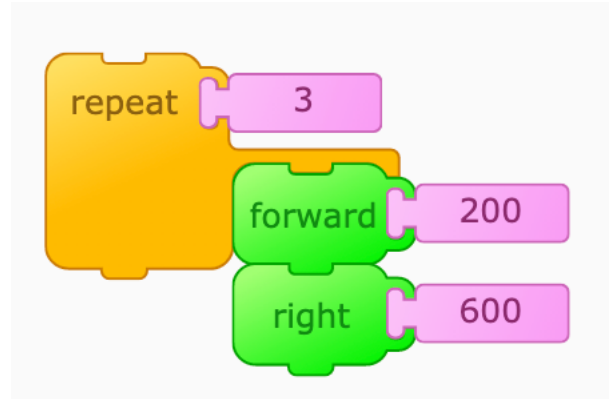
```
REPEAT 3 [FORWARD 100 RIGHT 600]
```

The use of `RIGHT 600` was *after* I asked students “Should the turtle turn less than or more than 90?”

Eventually, there was a tepid consensus that the turn should be greater than that for a square.

Then I asked, “What number do you think the turn will then be less than?”

A few students reported, “180,” because that’s a U-Turn.



I suspect that a turn of 600 being a multiple of 120, greater than 360 (a full rotation) is a concept that will remain elusive for some time.

Note: Despite turning the turtle right, the repeated turns cause the triangle to draw to the left of the initial starting position and orientation. This requires further exploration with the students.

Multiplication and Turtle Art

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You can use Turtle Art to explore multiplication, multiples, or even fractions.

Remember that you change a value (input) in Turtle Art by clicking on the input bar and typing.

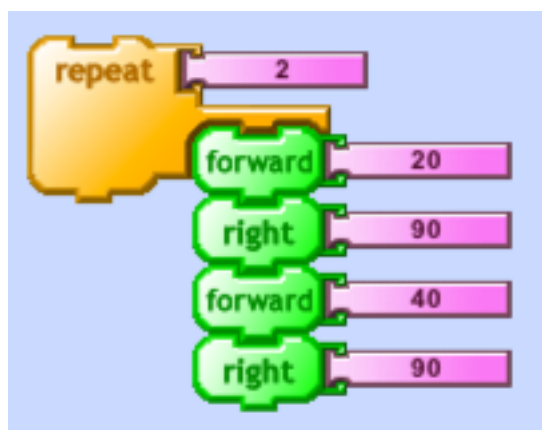
Provide the kids with a procedure, such as the following:



Ask kids the following questions:

- Can you change the procedure to make your shape 2, 3, or 4 times bigger. Which of the two numbers needs to be changed? Do both?
- Can you make it half as large?
- Are there ways to enlarge the shape between 2 and 3 times?
 - How would you do that?

Can you do the same for this procedure?



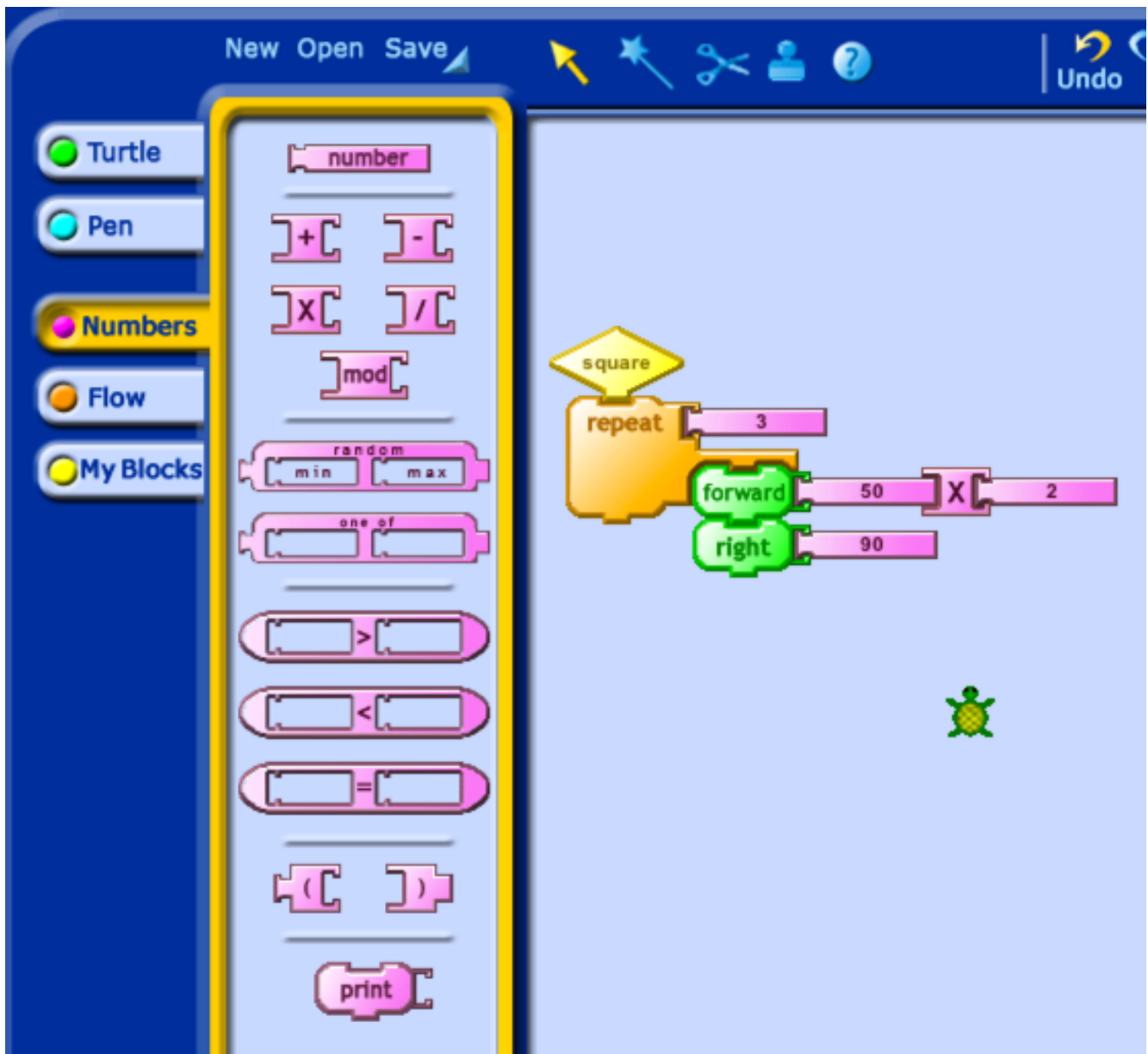
What about this program?



Can you enlarge and shrink a design of your own?

The computer can also help with multiplication and other operations even when you find those calculations hard or tedious. Computing is what makes a computer a computer.

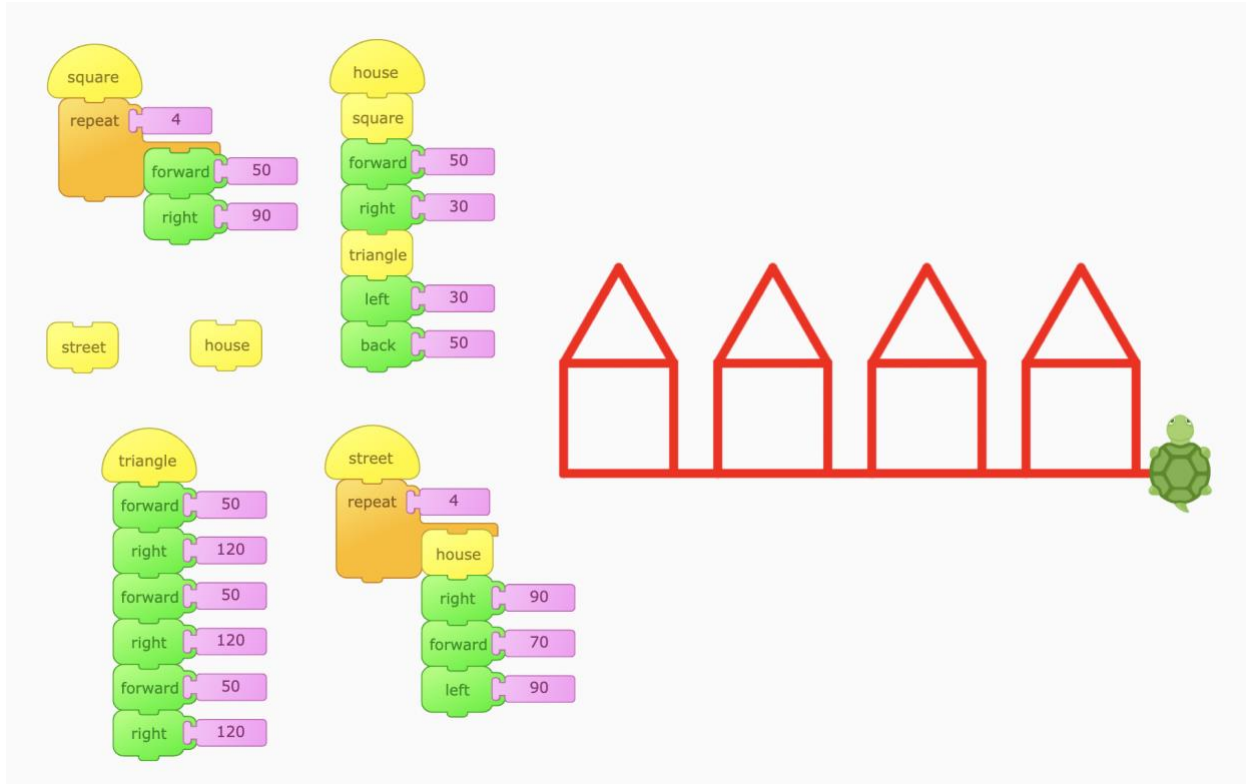
In this case, you can use an operations block (under the Numbers tab) to have the computer do the multiplication for you and the turtle! You may also use the other operations.



Houses Galore

Review

We created new blocks (also called “procedures”) to assemble a house and then create a row of them to make a street. The code is below.



Challenge #1

Modify the street procedure so that each house is a different color. (Hint: Blue tab collection of blocks)

You may either specify specific colors for each house, add a value to each color to choose the next color, or perhaps even use randomness. If you can't figure out a mathematical way of generating lots of color, we'll discuss it next time we meet.

Challenge #2

Can you modify the house procedure to draw a window, door, or window and door on a house?



Remember, it's always a good idea to return to where you start!

Looking forward...

What does the `setxy` block do?



Tip #1

You can get *help* for a block by long clicking on it.

Tip #2

Copy a block and any blocks attached to it by shift-click dragging it.



Turtle Art Jack 'O Lantern Project

Gary S. Stager, Ph.D.
The Willows Community School

October 2015

Objectives:

- Use turtle geometry to assemble procedures to make a coherent picture
- Understand procedurality, pen up, and pen down
- Develop spatial reasoning, including angle, rotation, movement
- Parts and wholes

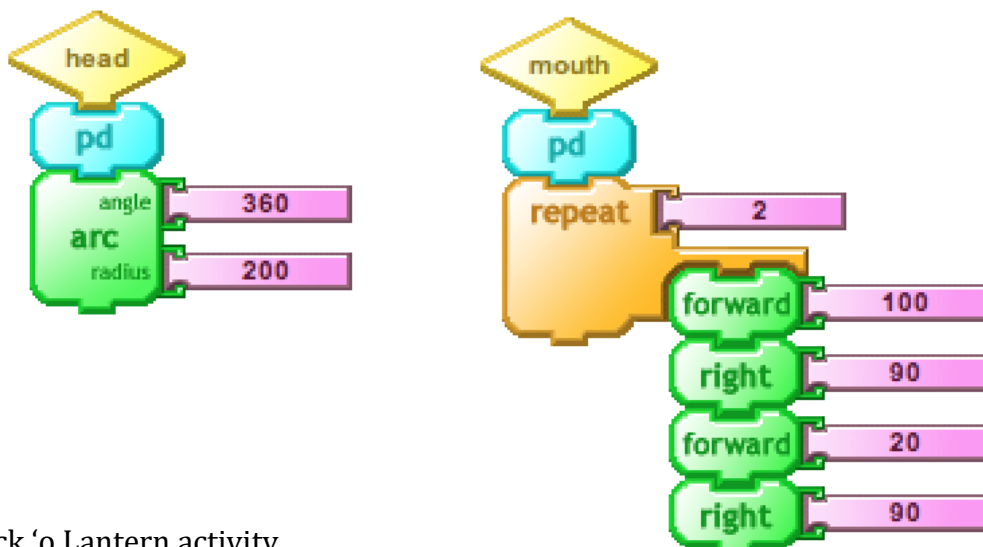
Goal:

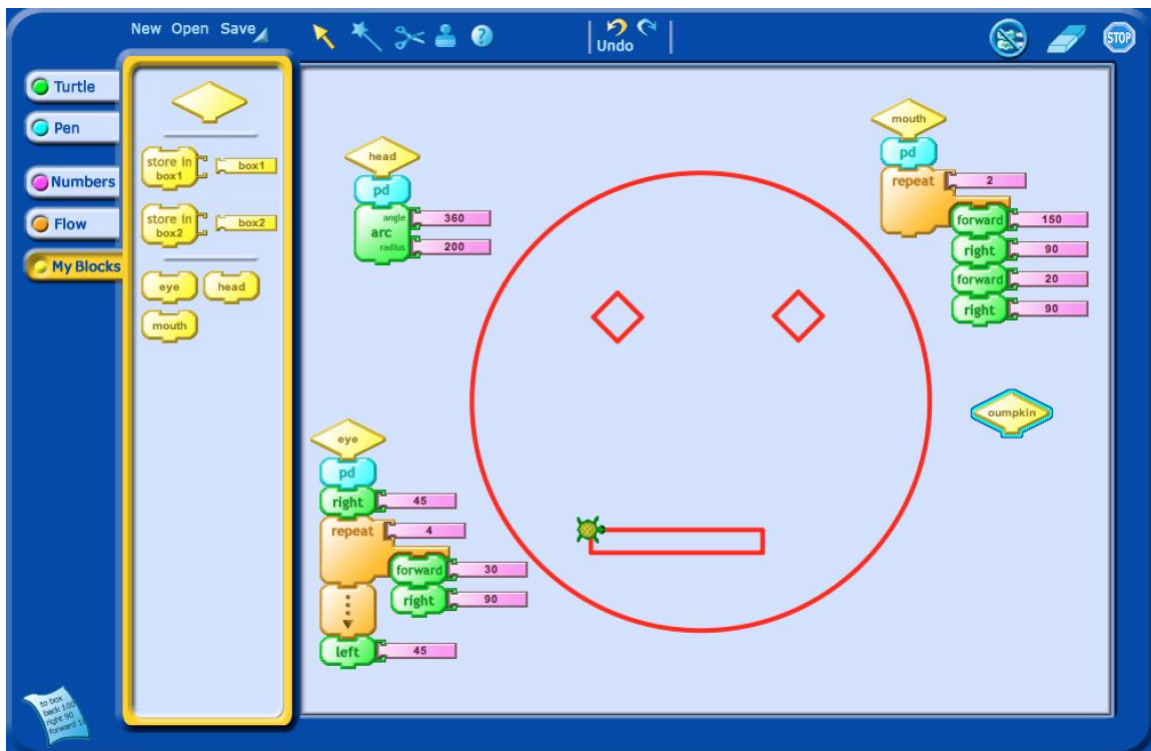
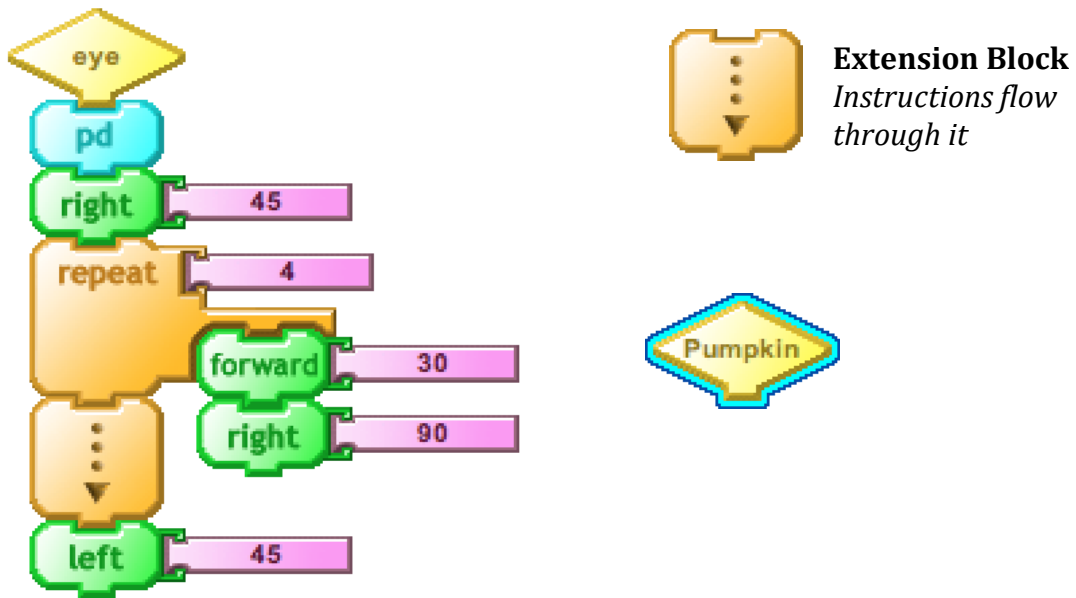
Assemble the building block procedures below in a new procedure that will put the shapes together as a jack 'o lantern.

Procedures:

In Turtle Art and other dialects, including Lynx, MicroWorlds, or Snap!, procedures are simply a list of instructions with a name attached. That name may then be used to run the list of instructions in other contexts. A procedure is like a building block.

I created three building block procedures that will help you build your jack 'o lantern. The yellow "hat" block allows you to create a new procedure in Turtle Art. Any instructions attached to that hat become associated with one name you type into the hat itself.





Can you complete the Pumpkin procedure (stack) by using the other procedures, forward, back, right, left, pen down, and pen up?

Thinking About ~~cheating at~~ Tricky Pattern Blocks in Turtle Art

Goal

Write a Turtle Art procedure to draw each of the shapes in a set of pattern blocks! In other words, teach the turtle to draw all of the shapes in a set of pattern blocks.

Suggested Strategies

Think about the shape you want the turtle to draw

How many sides are there? Is there a mirror image?

Look for patterns

Are any of the turns/corners ones you have seen before?

Are all of the sides equal? Are some longer than others? If so, by how much?

Try numbers you know

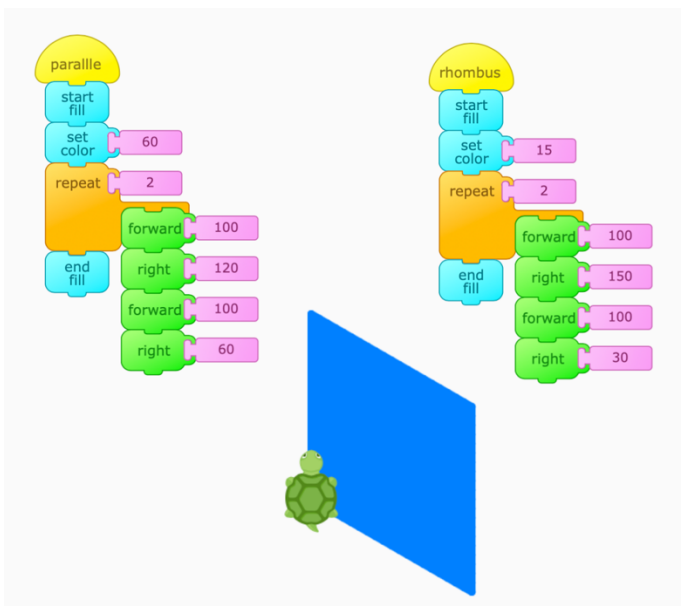
Start with simple numbers for right or left turns. Numbers ending in 0 or 5 often do the trick (those are multiples of 5 or 10). For example, 90, 120, 30, 150, 60, 45 are some of the numbers we have used to turn the turtle.

Hide the turtle to see if the shape is drawn perfectly

You should not see overlapping lines or gaps in the shape.

I really like when the turtle returns to where it started drawing a shape and pointed in its original direction. That's why I use FORWARD RIGHT or FORWARD LEFT instead of RIGHT FORWARD or LEFT FORWARD.

Here are two of the shapes we figured out together. Do you see any patterns?

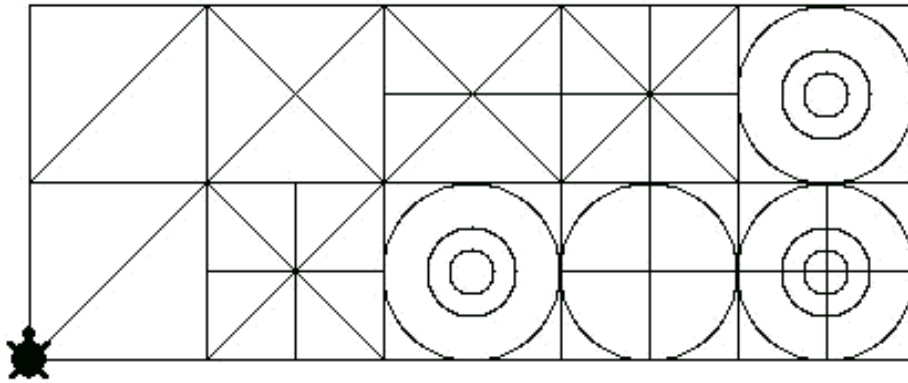


Challenge

Figure out a way to use the shapes you created to make patterns on the computer screen with your new procedures. You might even think of this as creating art software for little kids to play with.

Turtle Art Quilt Project

An adventure in creativity



Yours will be much prettier of course!

Goal

Design one or more quilt patches that may be combined with classmates or used to create your own screen quilts in [Turtle Art](#).

Instructions

Start with blocks like these. Everyone needs to use the same `frame` instructions as a starting point.

Each quilt project needs the fundamental building block, `frame`. `Quilt` puts everything together.

Design a procedure named `patch1` to draw a design completely within the frame and be sure that the turtle returns to where it begins with the same orientation as when the procedure started. The frame is a square with sides of `150` turtle steps.

Extra credit

If you are satisfied with `patch1`, design procedures for new and different quilt patches. Name them `patch2`, `patch3`, etc...

Each patch needs to begin with *frame*.

Extreme Arts and Crafts Challenge

Create a *quilt* procedure that assembles one or more of your patches into a beautiful quilt design. You are of course free to repeat the use of a patch or use a variety of them.

Note: color -9999 is black in Turtle Art

Remember

- Save often!
- Each patch needs to begin with *frame*.



Export for 3D printing or vinyl cutters

- Click on the menu in the bottom right-hand corner of the Turtle Art screen
- Save as SVG

Where to get Turtle Art & Resources

- [iPad App](https://apps.apple.com/us/app/turtleart-make-art-with-code/id1041064776) (\$10) - <https://apps.apple.com/us/app/turtleart-make-art-with-code/id1041064776>
- [Web-based Turtle Art software](https://playfulinvention.com/webturtleart) – playfulinvention.com/webturtleart
- New [Turtle Art cards](https://constructingmodernknowledge.com/new-turtle-art-cards/) featuring project ideas - constructingmodernknowledge.com/new-turtle-art-cards/
- [Turtle Art files](https://turtleart.org) for remixing and tutorial information – turtleart.org
- [Free Turtle Art Tiles Project Guide](https://constructingmodernknowledge.com/tatpg5/) - constructingmodernknowledge.com/tatpg5/
- [Getting Started with Turtle Art](https://playfulinvention.com/webturtleart/webhelp/samples.html) - playfulinvention.com/webturtleart/webhelp/samples.html
- [Logo Resources](https://dailypapert.com/logo) • Logo is the language Turtle Art derives from – dailypapert.com/logo
- [Logothings](https://logothings.github.io/logothings/) is a website about Logo maintained by Cynthia Solomon. It includes a section with [turtle geometry projects](https://logothings.github.io/logothings/). - logothings.github.io/logothings/
- [History of Logo](https://cynthiasolomon.com/history-of-logo) by Cynthia Solomon, et. al.
- [Classic Logo books](https://dailypapert.com/logo), including *Turtle Speaks Arithmetic* and *Teaching with Logo* – dailypapert.com/logo
- [Download Gary Stager's Early Turtle Art activities for classrooms](https://dailypapert.com/logo)
- [New programming environments for learning, including the web-based Turtle Art \(Fall 2020\)](https://dailypapert.com/logo)
- Learn more about why software like Turtle Art is a terrific way to learn coding in our book – [Invent to Learn: Making, Tinkering, and Engineering in the Classroom](https://inventtolearn.com).



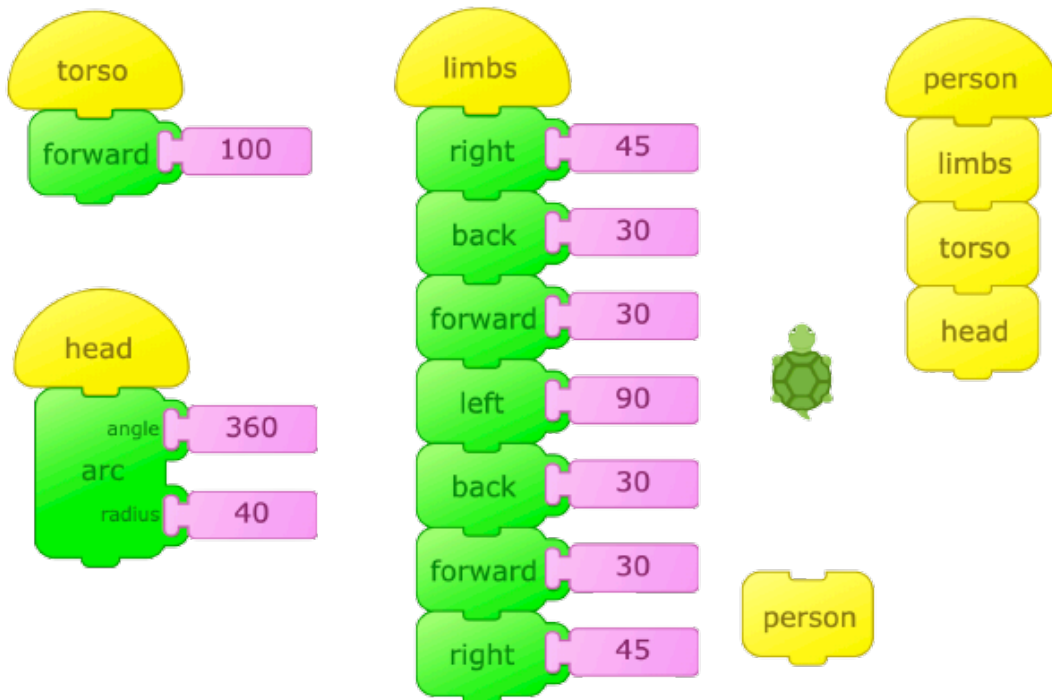
Turtle Art Resources

Scribble your name here


The turtle needs your help!


Please put Mr. Nobody together again.

1) Create the following procedures in Turtle Art.



2) Run the  block. Does the turtle draw a stick figure (person) correctly?

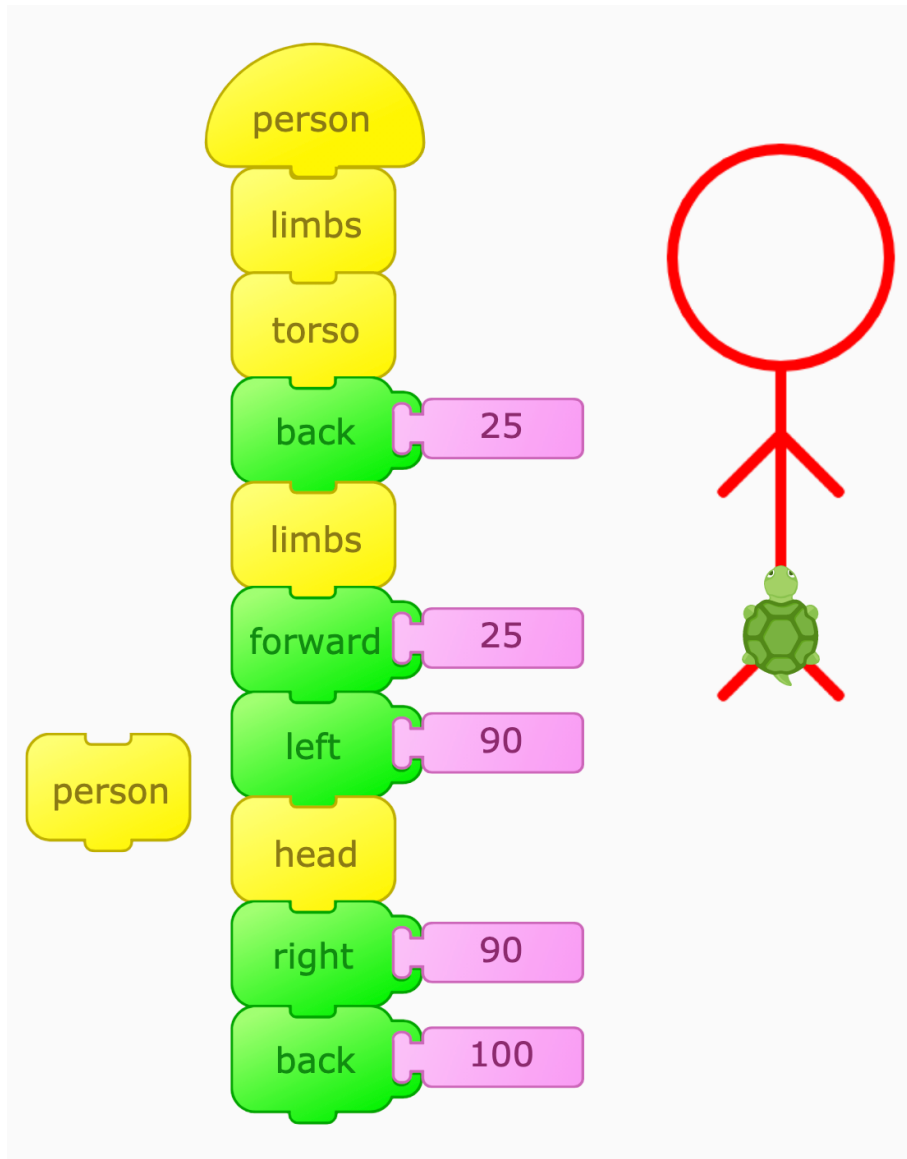
3) Change the order of the blocks in the  procedure and add any commands you need to put Mr. Nobody back together again. This person needs to include arms, legs, a body, and one head. Use FORWARD, BACK, RIGHT, or LEFT blocks as necessary.

4) The turtle needs to return to where it began! So, use any extra blocks you need in .

5) Be sure to save your project!

The challenge should you choose to accept it: Add instructions or new blocks to the person procedure to give your person a face, hair, or clothes. Use color to add personality.

Mr. Nobody Sample Answer Key



Teachers should observe if a kid can:

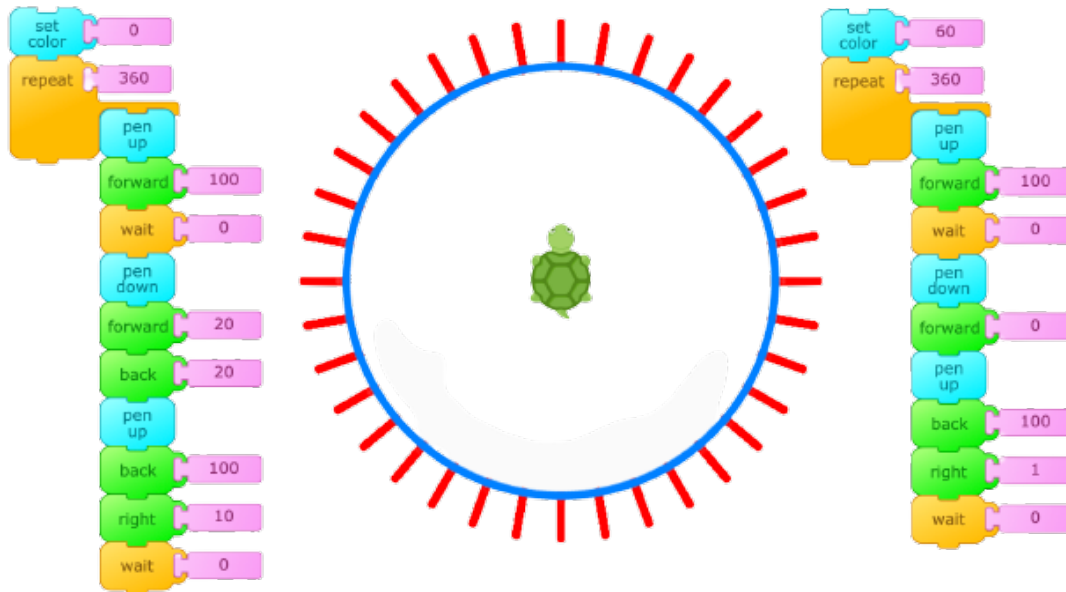
1. Program Turtle Art so that running the `person` block draws a stick figure containing arms, legs, body, and head
2. Return the turtle to where the figure began drawing
3. Tackled any of the extra credit successfully

The only data I require is percentages for successful completion of each of the three objectives above. #1 is most important since it demonstrates understanding of procedurality and simple turtle geometry.

Some Silly Turtle Art Challenges for Vacation Week, plus a top secret extra sneaky spy mission

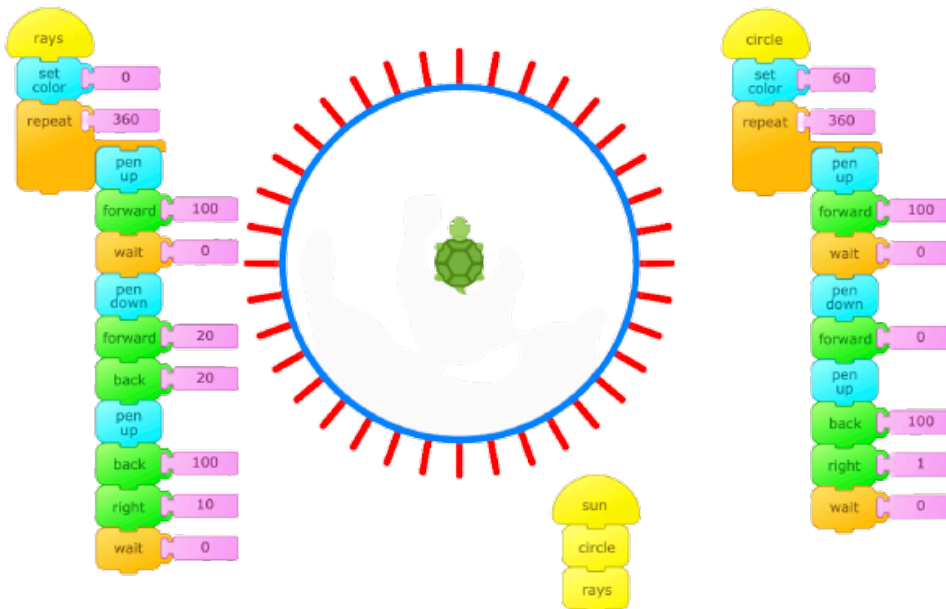
(if you get a chance or have the time)

1) Experiment with these two procedures I showed at the end of class.



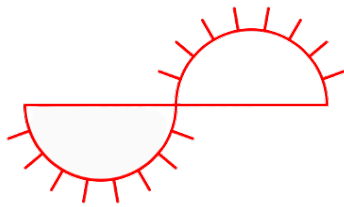
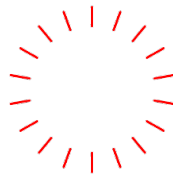
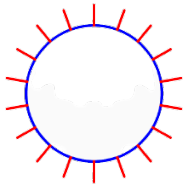
- Try changing the `right 10` in the first procedure (on the left) to a different number. What happens?

2) In this version, I named the procedures and then used those blocks to make the sun.



- What else can you do or add to the sun procedure to make the shape fancier?

3) Here are a few other shapes to figure out how to teach the turtle to draw! Good luck!



If you are super curious and adventurous, there is a programming environment similar to Turtle Art, called Scratch. It is used by millions of kids for creating interactive stories, animation, and games. Scratch has an unlimited number of turtles, called sprites, that can wear any costume you wish.

If you want to start playing with Scratch ahead of the class, go to <http://scratch.mit.edu> and click the *Start Creating* button. There are built-in tutorials and millions of other kids' projects to look at. You can even borrow code from their programs to use in your own!

Ask your grownups to help you setup an account if you want to save and share your Scratch projects.

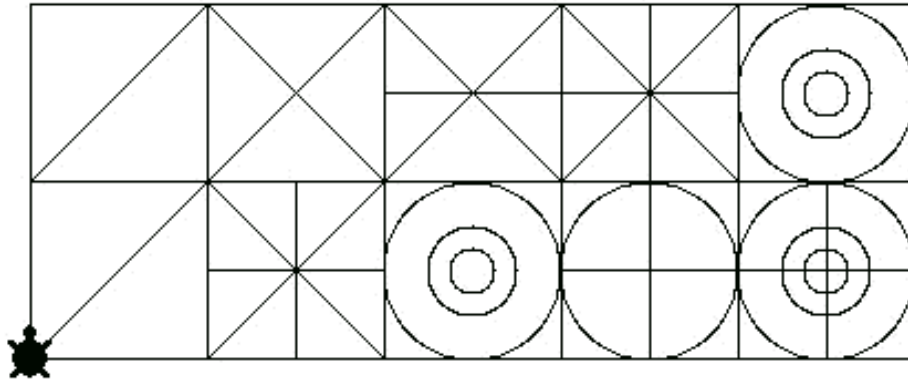
I look forward to seeing what you learn without me.

Have a super fun vacation,

Gary

Turtle Art Quilt Project

An adventure in creativity



Yours will be much prettier of course!

Goal

Design one or more quilt patches that may be combined with classmates or used to create your own screen quilts in [Turtle Art](#).

Instructions

Start with these blocks. Everyone needs to use these instructions as a common starting place.

Each quilt project needs these fundamental building blocks

Design a procedure named *patch1* to draw a design completely within the frame and be sure that the turtle returns to where it begins with the same orientation as when the procedure started. The frame is a square with sides of *150* turtle steps.

Extra credit

If you are satisfied with *patch1*, design procedures for new and different quilt patches. Name them *patch2*, *patch3*, etc...

Each patch needs to begin with *frame*.

Extreme Arts and Crafts Challenge

Create a *quilt* procedure that assembles one or more of your patches into a beautiful quilt design. You are of course free to repeat the use of a patch or use a variety of them.

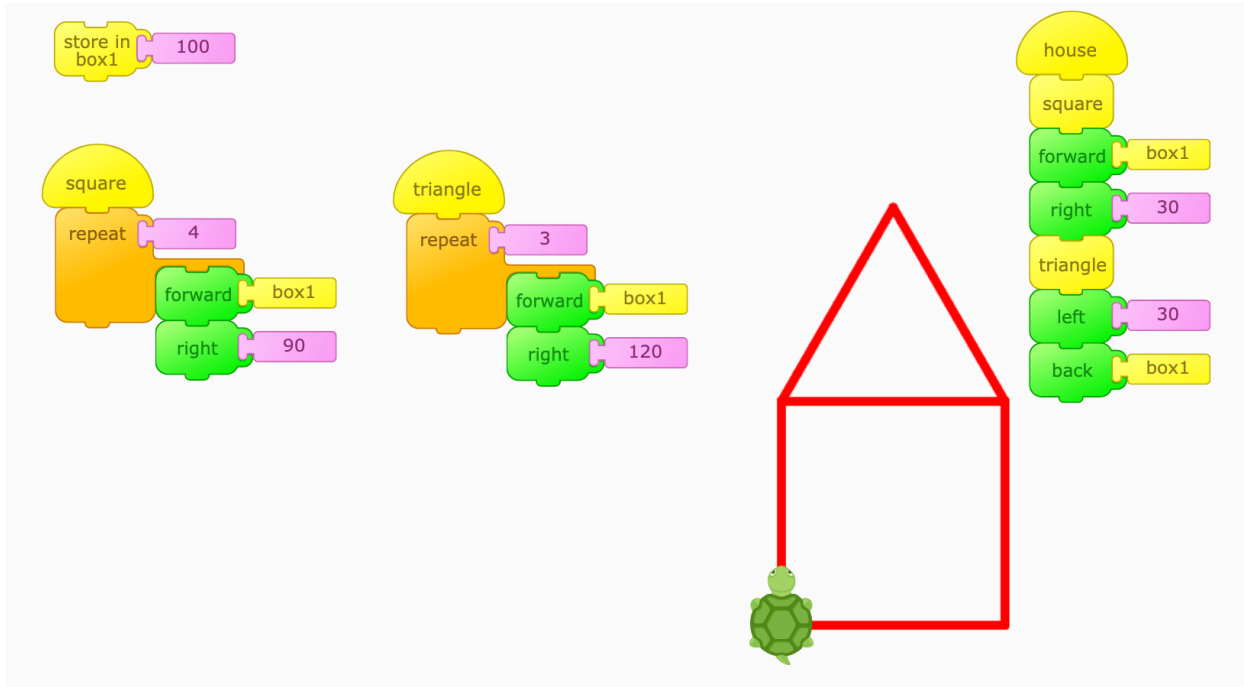
Note: color *-9999* is black in Turtle Art

Remember

- Save often!
- Each patch needs to begin with *frame*.

Variables and Scale in Turtle Art Global Version

1. Create the following program in Turtle Art.
2. Type a value into the store in box1 block and click on that block to run it.
3. Click on the house block and see what happens.
4. Change the value stored in box1, click on the store in box1 block, and then make a new house.
5. Repeat steps 3 & 4 a few times.



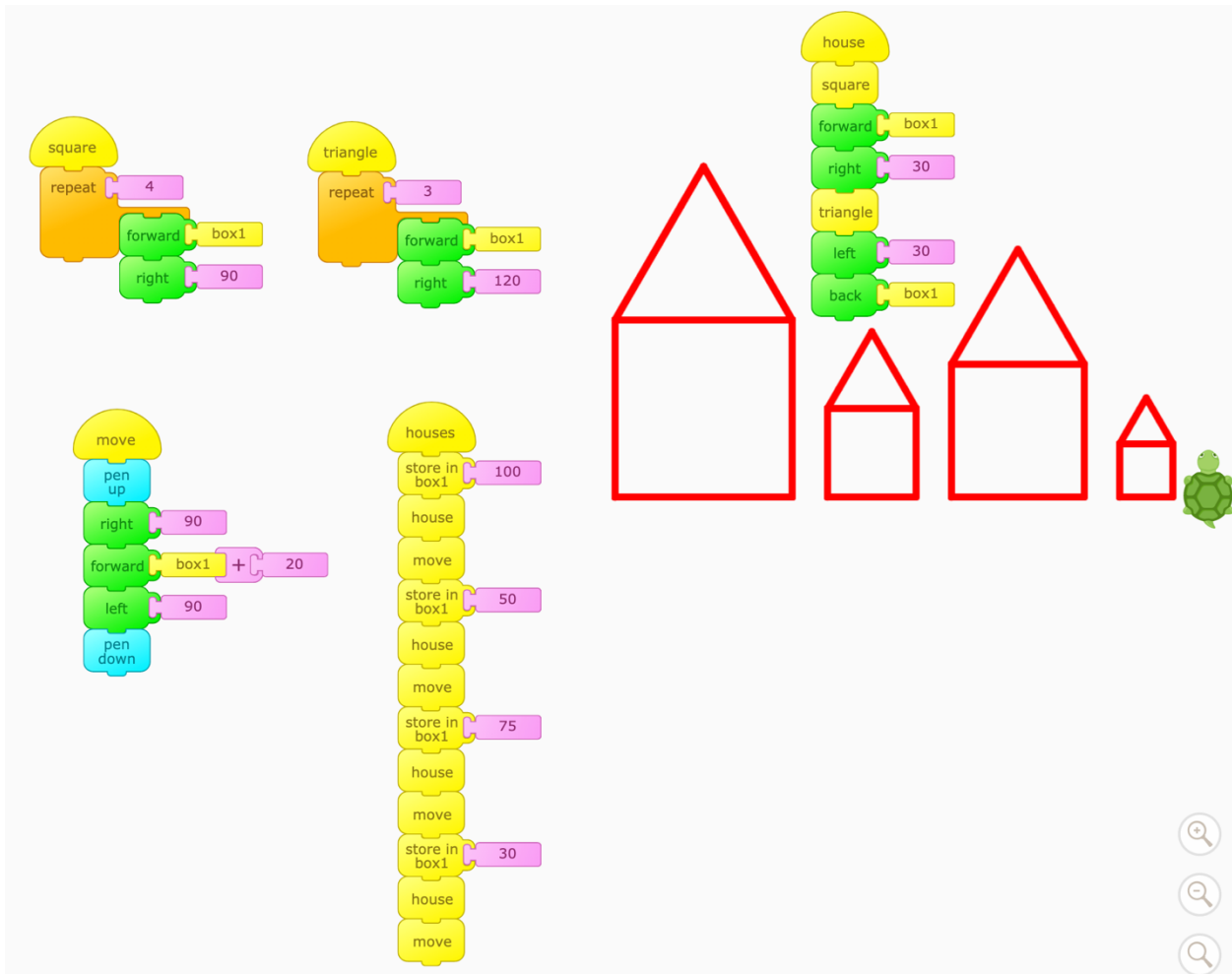
Questions

- What does store in box1 do?
- What does box1 do?
- How does this vary the size of your house?

Varying procedures and subprocedures

In this version of the Turtle Art program, changing the value of the thing inside box1 allows you to not only vary the size houses, but create equally spaced neighborhoods.

1. Create the following procedures in a new project or by modifying the procedures used above.
2. Read the code and try to understand what it does.
3. Click on the blocks for square, triangle, house, move, and houses to make sure that each work properly.



We don't need to set the value of box1 separately from running the houses superprocedure. Its value is changed multiple times in houses, prior to each house being drawn.

The move procedure causes the turtle to slide "down the road" with equal spacing between each house.

Challenges

- Add additional houses to the houses procedure.
- Start houses on the left-hand side of the screen in order to accommodate a larger neighborhood.
- Write a neighborhood procedure that uses the other blocks created, but draws houses of random size
- Change the color of the houses.
- Change the color of the houses randomly.
- Make roofs and houses contrasting colors manually or randomly.

Scale

In this version of the Turtle Art program, we will add a second *variable*, `box2`. This value will represent the scale of the images drawn by the turtle

1. Create the following procedures in a new project or by modifying the houses procedures from the previous activity.
2. Read the code and try to predict what it does.
3. Run the houses block.
4. Change the number stored in `box2` in houses. Then run houses again. What happened? Try different numbers stored in `box2`. What happens to your neighborhood? What is scale?

The image shows a Scratch workspace with several code blocks and a drawing of four houses of different sizes. The code blocks are as follows:

- square procedure:** A yellow 'square' block containing an orange 'repeat' block with the number 4, a green 'forward' block with 'box1', and a green 'right' block with 90.
- triangle procedure:** A yellow 'triangle' block containing an orange 'repeat' block with the number 3, a green 'forward' block with 'box1', and a green 'right' block with 120.
- houses procedure:** A yellow 'houses' block containing:
 - store in box2: 1
 - store in box1: 100 X box2
 - house
 - move
 - store in box1: 50 X box2
 - house
 - move
 - store in box1: 75 X box2
 - house
 - move
 - store in box1: 30 X box2
 - house
 - move
- move procedure:** A yellow 'move' block containing:
 - pen up
 - right: 90
 - forward: box1 + 20
 - left: 90
 - pen down

The drawing shows four houses of different sizes, each with a square base and a triangular roof. The houses are drawn in red. A small green turtle is positioned in the center of the workspace. A yellow 'houses' block is also visible on the workspace.

Challenge

- Your move procedure now needs to be debugged to deal with the issue of scale. A little bit of math should do the trick! Can you fix it?
- Embrace some of the challenges listed in the previous activity.

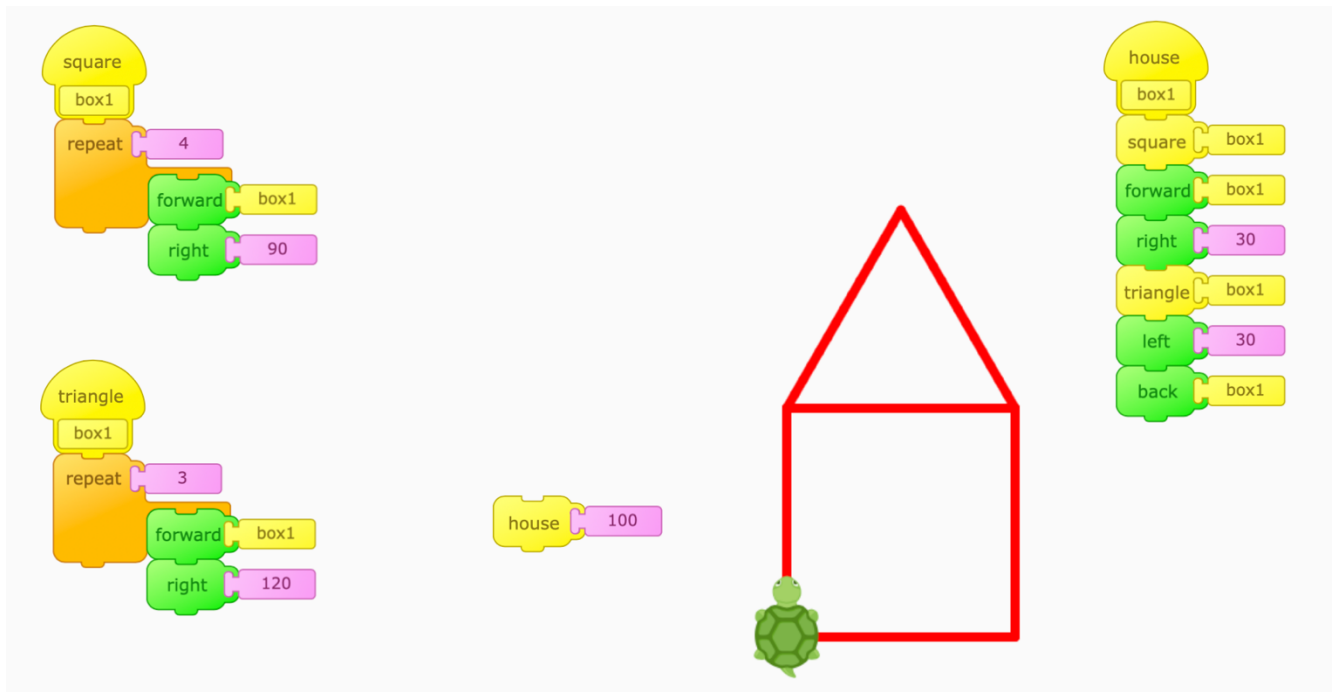
Variables and Scale in Turtle Art Local Version

In this version of the project, we will create procedures with inputs. These *local variables* are a more flexible efficient way of changing values in a computer program.

1. Create the following program in Turtle Art.
2. Once you create a stack of blocks, including the “hat,” and name that *procedure*.
3. Drag a box 1 block into the hat and you will see the input added to the top of the procedure.
4. Notice how a new block is created with an open jaw for a variable value.

This process creates a new block that requires an input, just like `forward`. Procedures and subprocedures may now pass values to each other.

5. Run the house block, change the value input to house and run the house block again.



Do you understand how house and its subprocedures work now?

A New Neighborhood

Create the following program and run it by clicking on the houses block.

The Scratch program consists of the following blocks:

- square** block: box1, repeat 4, forward box1, right 90.
- triangle** block: box1, repeat 3, forward box1, right 120.
- move** block: box1, pen up, right 90, forward box1 + 20, left 90, pen down.
- houses** block: house 100, move 100, house 60, move 60, house 80, move 80, house 40, move 40.
- house** block: box1, square box1, forward box1, right 30, triangle box1, left 30, back box1.
- houses** block: houses.

The visual output shows four houses of different sizes and orientations, drawn in red lines on a white background.

A More Elegant Version of the Previous Program

Modify the house and houses blocks in the program, as follows. What is the advantage of this new version?

The modified Scratch program consists of the following blocks:

- square** block: box1, repeat 4, forward box1, right 90.
- triangle** block: box1, repeat 3, forward box1, right 120.
- move** block: box1, pen up, right 90, forward box1 + 20, left 90, pen down.
- house** block: box1, square box1, forward box1, right 30, triangle box1, left 30, back box1, move box1.
- houses** block: house 100, house 60, house 80, house 40.
- houses** block: houses.

The visual output shows four houses of different sizes and orientations, drawn in red lines on a white background.

Turtle Art "Cheat Sheet"

The cheat sheet is organized into two columns of blocks, each associated with a specific color from a vertical bar on the left.

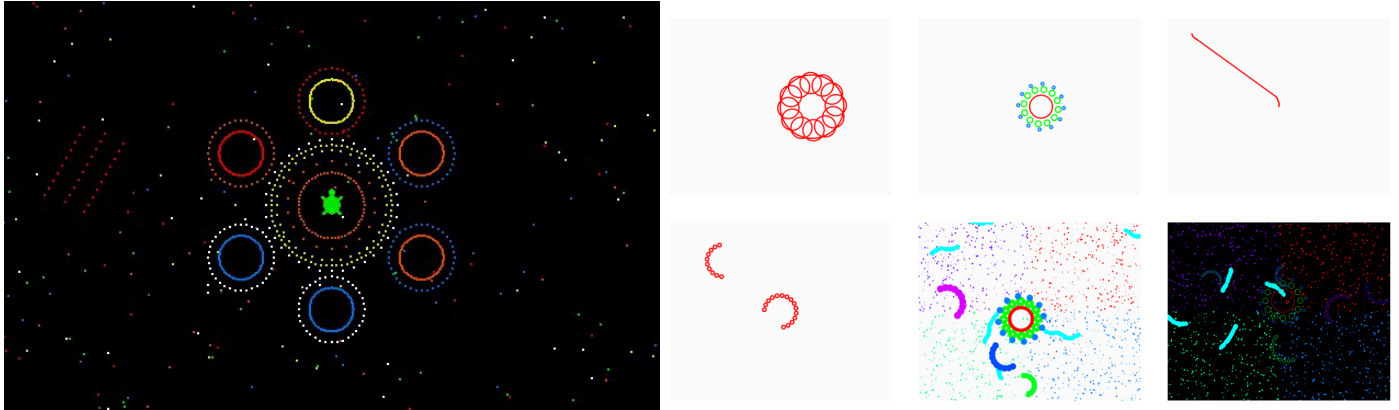
Left Column (Movement and Drawing):

- Green:** clean
- Light Blue:** forward, back
- Purple:** right, left
- Orange:** arc (with sub-slots for angle, radius)
- Yellow:** setxy (with sub-slots for x, y), set heading
- Light Green:** pen up, pen down
- Light Blue:** set pensize, set color, set shade
- Orange:** start fill, end fill
- Yellow:** fill screen (with sub-slots for color, shade)
- Green:** 0
- Light Blue:** +, -, x, /
- Purple:** %
- Orange:** random (with two input slots)
- Yellow:** one of (with two input slots)

Right Column (Control and Storage):

- Green:** repeat
- Light Blue:** if
- Purple:** stop
- Orange:** forever
- Yellow:** (empty block)
- Light Green:** (empty block)
- Light Blue:** store in box1 (with sub-slot box1)
- Purple:** store in box2 (with sub-slot box2)
- Orange:** store in box3 (with sub-slot box3)
- Yellow:** (empty block)

Creating Dreamtime Designs with Logo



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About the Project

The indigenous people of Australia, the original landowners, have expressed themselves through a form of geometric painting for thousands of years. These paintings tell the stories of dreamtime—myths of spirituality, community, and survival. The geometry and symbolism of dreamtime painting create an excellent opportunity for combining art, mathematics, language arts, multiculturalism, and social studies in a creative context. The simple geometric symbols found in this art tell stories of hunting, dreaming, and community. The procedureality of Logo is particularly well suited to these sorts of projects.

[Lynx](#) (software) offers a terrific canvas for expressing the dreamtime designs of you and your students. Lynx is a modern web-based version of the [Logo programming language](#)—visit [Lynxcoding.club](#) to use Lynx or learn more. [Turtle Art](#) is an online, block-based, turtle geometry microworld in which formal mathematical and computational ideas are turned into beautiful images in a fashion immediately accessible to learners of all ages.

The Art

Take a look at the following websites to learn more about aboriginal art. Perhaps you will be inspired to create your own masterpiece!

- <http://www.aboriginalart.com.au>
- <http://www.ozemail.com.au/~aaia/invest.htm>
- <http://www.aboriginalartprints.com.au>

The Toolkit

The procedureality of Lynx allows users to create tools for creating their art. You might think of these procedures as a collection of different paintbrushes. Each procedure creates a different type of geometric figure. The use of numerical variables/inputs allows the user to paint with number.

Dot Procedures

```
to dot
pd fd 0 pu
end
```

```
to dot
setsh
"theshapenameofyourchoice
pd stamp pu
end
```

```
to dot
setpensize 2
pd fd 0 pu
end
```

Line Procedure

```
to l :length :spacing
repeat :length / :spacing
[dot pu fd :spacing]
end
```

Circle Procedure

```
to c :radius :spacing
repeat 360 / :spacing [fd
:radius dot pu bk :radius rt
:spacing]
end
```

Concentric Circles Example

```
to circles
setc "red c 100 10 setc "blue
c 50 20 setc "green c 25 5
end
```

What happens when you create concentric circles with different spacing between the dots?

The Challenge

Seek inspiration from the galleries of aboriginal art listed above. Can you recreate some of the patterns you see with Lynx? Use the provided procedures and your own variations to create a dreamtime design that tells a story. Share that graphic story with your colleagues.

Right-Click (Windows) or CTRL-Click (Mac) to copy or save the graphic you create. Be sure to hide the turtle before doing so. Now, you can use your dreamtime design in other applications or print it. Are there other types of art made of dots? Can you point to some examples on the web?

Creating such designs in Turtle Art

Although [Turtle Art](#) does not feature turtle costumes to be stamped, its ease-of-use and powerful turtle geometry features make it an excellent choice for creating the sort of geometric art found in a wide variety of cultures.

Imagine that you can quickly figure out how to use Turtle Art in such a project. Here are some quick ‘scribblings’ suggesting possibilities.