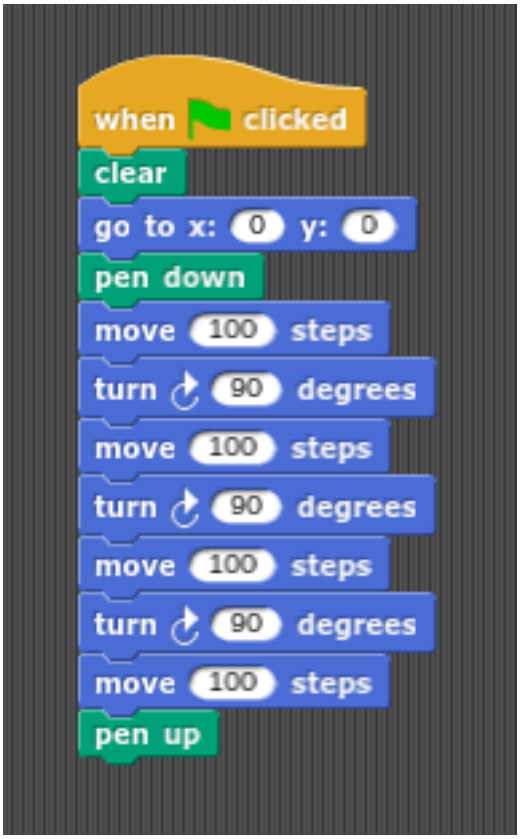
An introduction to programming

To save time learning syntax we are going to look at a *block programming language* where the commands appear as block. Some of you will have seen block programming before, in which case this is a reminder, for some others this will be new. When you get used to a programming language typing is, of course, quicker than moving blocks around, but block programming languages are very convenient; this programming environment is hosted online which is even more convenient since it means we don't have to install anything. The site an be found at `snap.berkeley.edu`. The notes guide you through some example, the exercises are bulletpointed along the way.

Basic example

Here is a simple programme for drawing a square; we will start with this and try to make more complicated drawings.



Enter this and make sure it draws a square! One thing about this program is that after it draws the square the arrow ends up pointing a different direction to the direction it started in.

- Can you fix this?

A loop

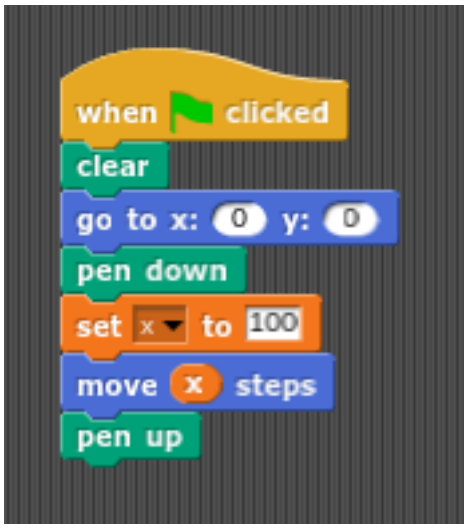
Now, the annoying thing about this programme is having to move over the same two commands again and again; this isn't just a problem because it is boring, it also disguises the main point

of the program, doing the same thing four times. Programmes are best when they are easy to interpret, so here we can make the programme simpler using a repeat:

- Can you use that to make the square drawing programme more succinct and readable?
- Can you make a programme to draw something that looks like a circle but going forward a tiny bit and turning again and again?

Variables

Now, look at this programme

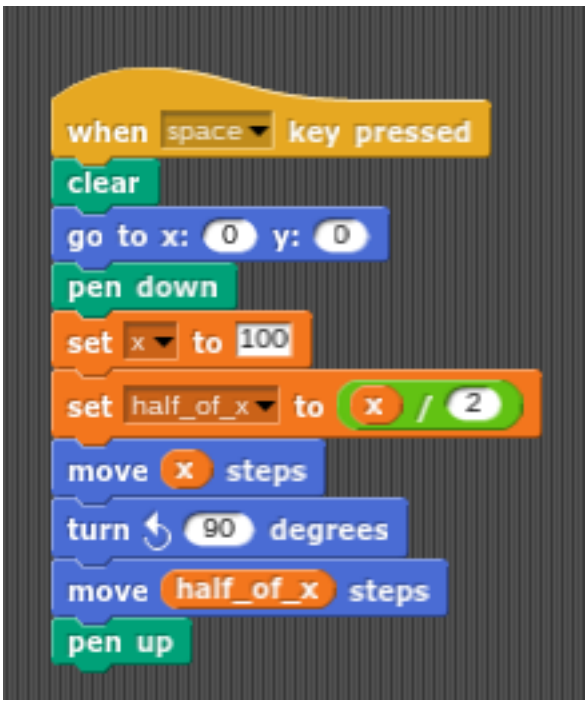


Instead of writing directly that it is to go 100 steps and make a *variable* called `x` and tell it to go `x` steps. This is kind of pointless in this short program but we will see soon how useful variables are.

- Do the same to your square programme!

You will need to click the 'Make a variable' button to add a variable; add it for all sprites, we'll only be using one sprite at a time in this class.

This programme does something slighly more useful with a variable, it goes forward a certain number steps, turns, then goes forward half as far as before. Now, rather than having to put in the number of steps, then work out half and put that in, it uses a variable for the number of steps and another one to calculate half the number.

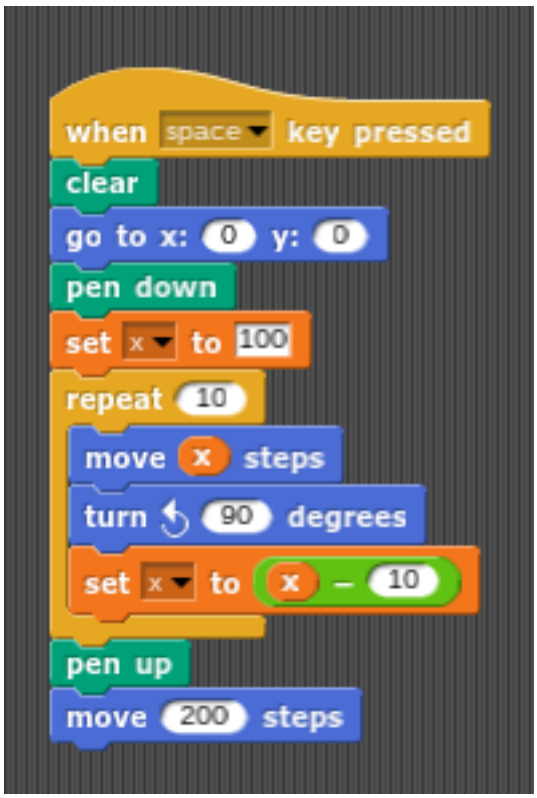


- Try modifying your programme in a similar way so that it draws an n-gon, notice that turning 90 degrees each time won't give an n-gon, so you'll need to use a variable to instruct it to turn

$$\theta = \frac{360}{n}$$

  degrees each time.

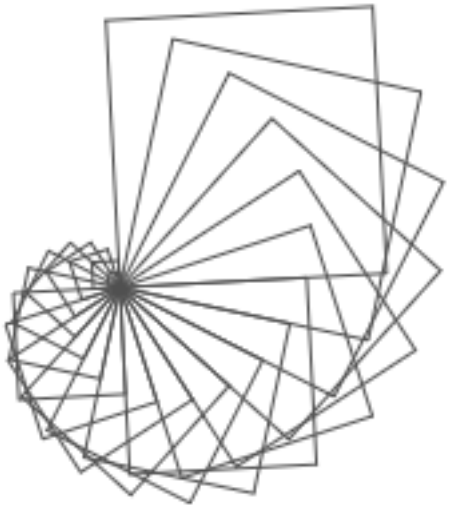
In this programme the variable is changed in the *loop* so the line is shorter each time:



giving a spiral

- Try modifying your programme in the same way so that you get smaller and smaller squares retreating into one corner, like this

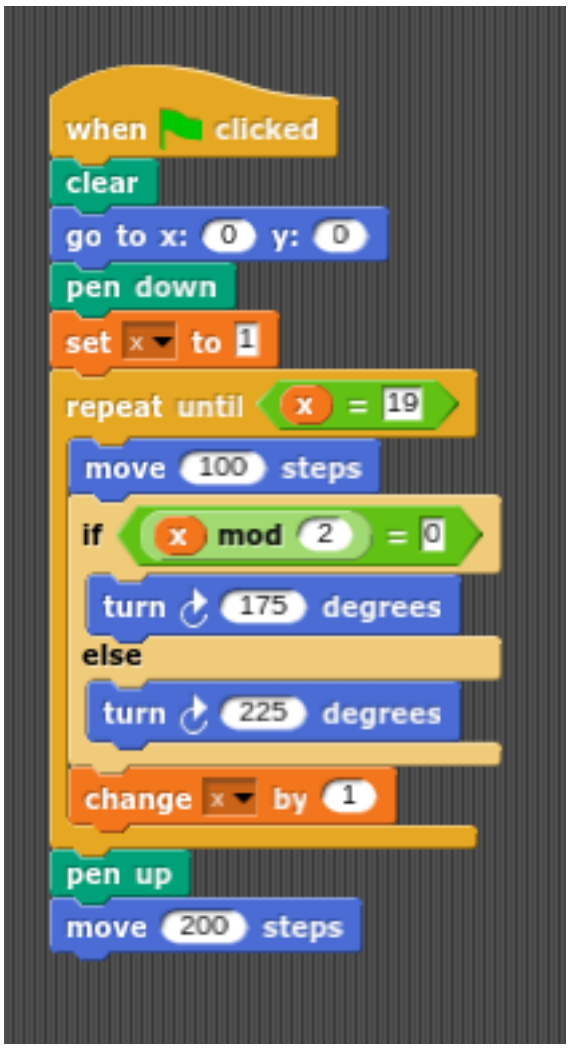
- If you want to you can try playing with you programme a bit to give other patterns, like this



- Try modifying your circle programme to draw a round spiral.

If

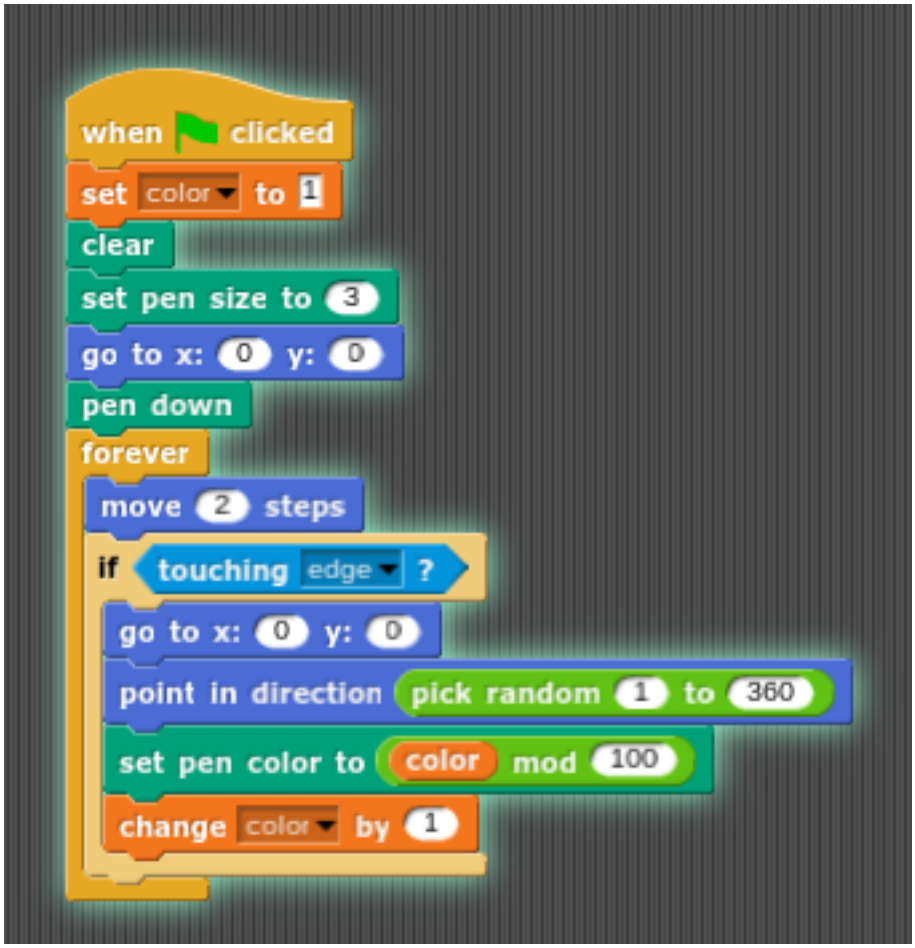
This next programme draws a star



Input it and have a look and then try to understand it; it is intended to illustrate the idea of conditional statements. There are two, first the *repeat until*. This is similar to the repeat we used before, but now, instead of repeating a set number of times, every time it repeats it checks a condition, in this case `x=19`; if the condition is true, it stops, otherwise it keeps repeating. In our case one gets added to `x` each time, so eventually it will stop. The other conditional statement is the `if . . . else` statement. Because the star has two different angles we need two different sorts of turns, in the if statement it does the first possibility, turning 175 degrees if `x mod 2 = 0` and the other otherwise. The meaning of *mod* is that it gies the remainder after dividing, so `x mod 2` means the remainder after dividing `x` by 2; this will be zero if `x` is even, odd otherwise.

- You can mess with programme a bit, maybe changing the angles or putting the whole thing in a loop to give something like this

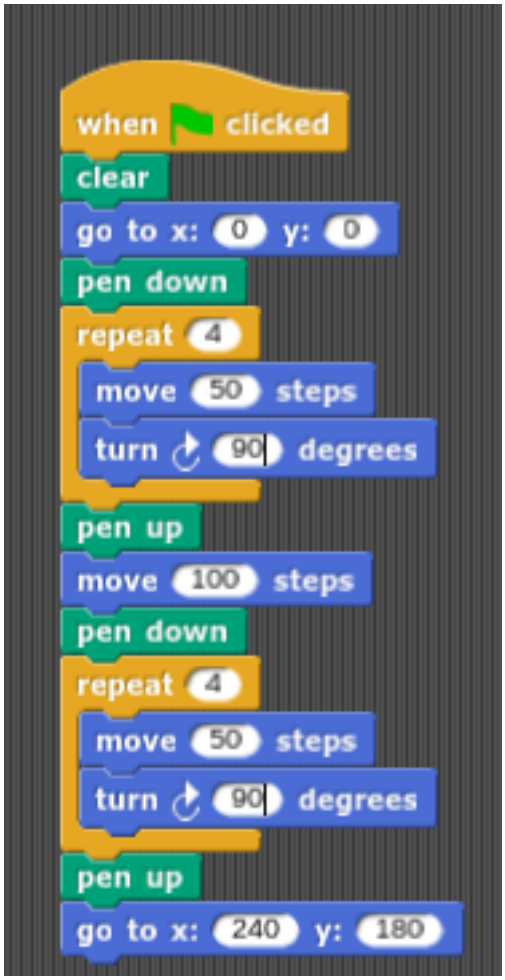
Next have a look at this programme:



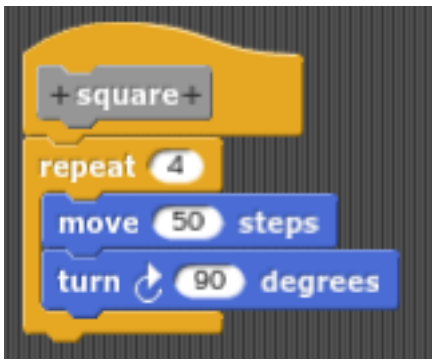
It also has a conditional statement, but the condition is something outside the programme, in this case touching the edge.

blocks

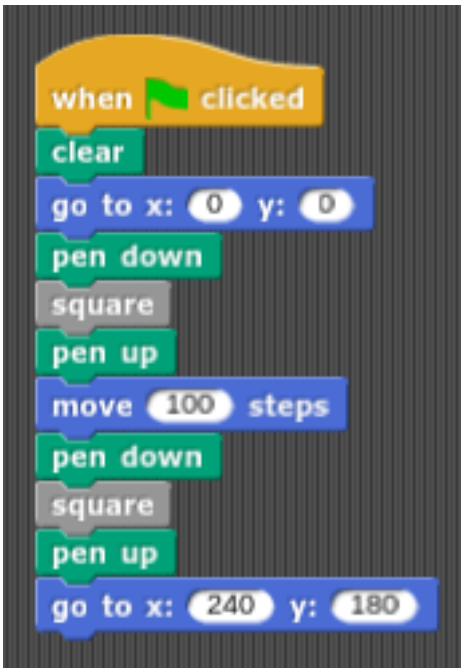
Imagine you want to use the same commands a few times; in this programme for example we draw a square, move over a bit and draw another:



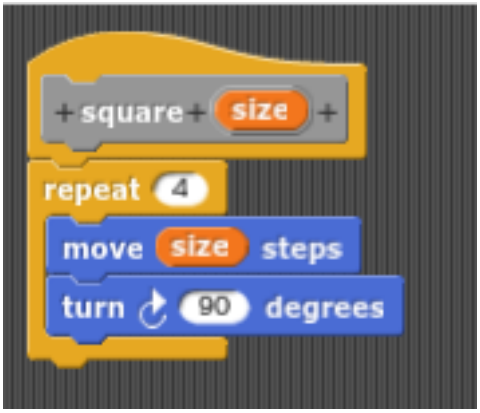
This is annoying, again, the extra typing, but also, as we discussed before, it isn't as readable as it could be; each time you get to the square drawing piece you need to work out what it is. Most programming languages get around this with *functions* and the block programming language we are using here has functions, it calls them *blocks*. A block is a piece of code with a name. Here we will make a block called square that draws a square: the block commands are at the bottom of the variable menu:



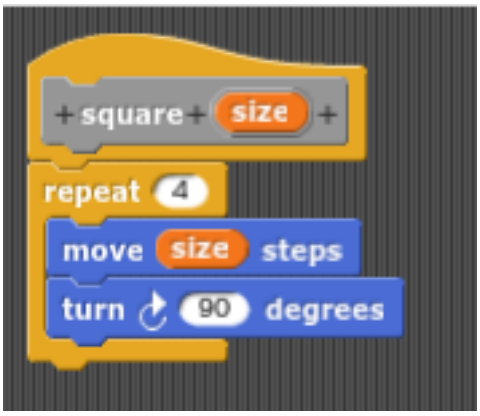
This block draws a square, so our two square code becomes a bit neater, quicker to input and easier to read:



You can make your blocks more flexible by adding *arguments*; these are variables that work inside the block that you can send from the main programme, you make them by clicking the plus by the block name.



and



draws the two squares different sizes.

- Try writing a block to make a circle with the radius as the argument, remembering that:

$$\text{circumference} = 2\pi\text{radiu}$$

- Can you improve your circle block so that you also send the x and y location of the center of the circle?
- Draw a snowman with a top hat and a carrot nose.