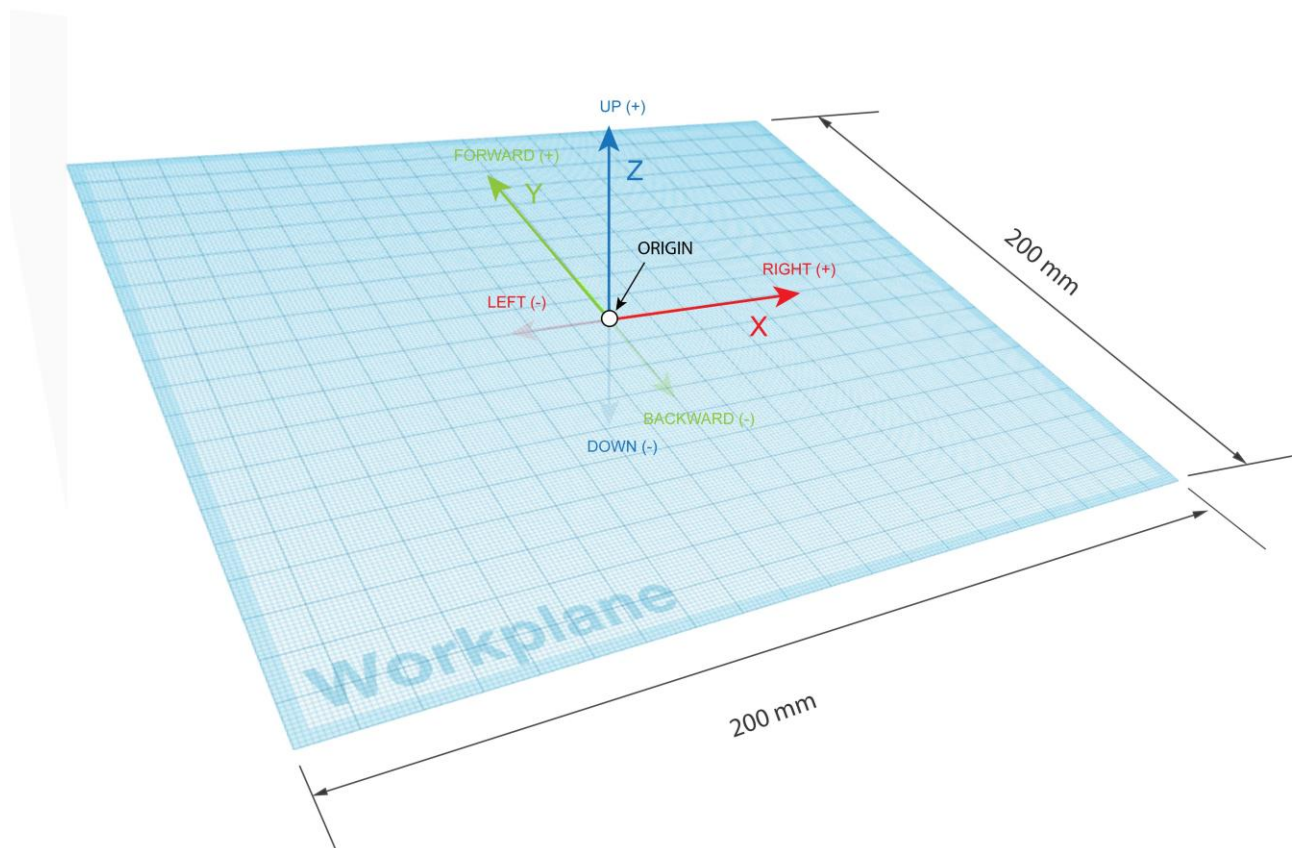


Fractions Coding Guide

In this activity, we will be looking at code that allows us to ‘cut’ a 3D shape into pieces.

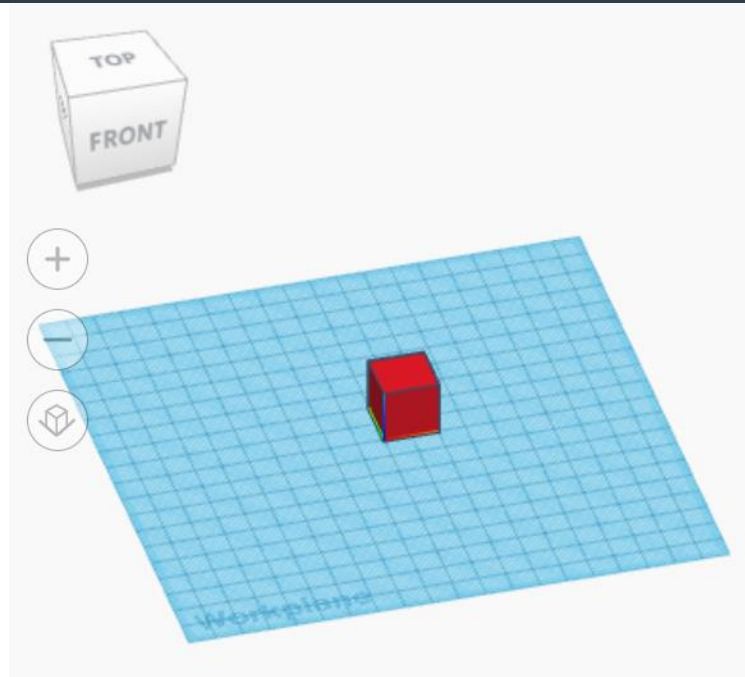
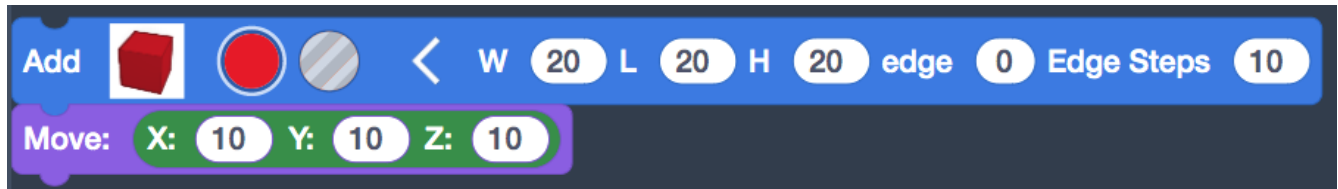
Before beginning the code, it is useful to look at and understand the Workplane and its origin. The origin is the centre point of the Workplane where $x=0$, $y=0$ and $z=0$. The Workplane measures 200mm x 200mm. The X direction corresponds to left/right movement. The Y direction corresponds to forward/backward movement. The Z direction corresponds to up/down movement.



Experiment by dragging codeblocks into the code space to see how the shapes then populate into the Workplane. You'll notice that shapes populate with their centre at the origin. We can use Move blocks to reposition the shapes. Change the values in the X, Y and Z boxes. Try both positive and negative numbers.



Try to set a rectangle shape so that it moves its corner to the origin.



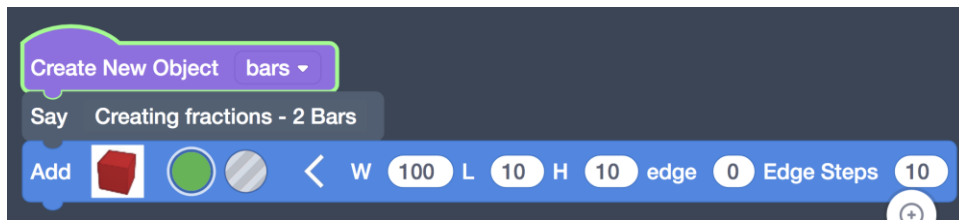
A convenient way to do that is to move the object by half its size in the X, Y, and or Z direction. In the example above, the object is 20 x 20 x 20. In this case, in order to shift it to the origin, we move half of 20, so 10, in X, Y and Z direction.

Next, we want to create an object that will span the width of the Workplane. Since it measures 200mm, we will choose the width to be 200. We will then move the block to the back of the Workplane.

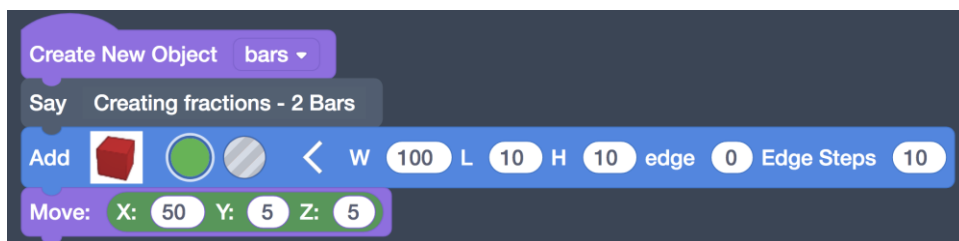


After this step, we will look at creating a rectangle that is divided into halves. In order to create the shape, we will need know how wide it should be. This is as simple as dividing the width of the Workplane by 2, the number of fractions we want. Each half of the larger bar will measure 100mm. We will need to create two 100mm wide shapes and place them beside each other in the Workplane.

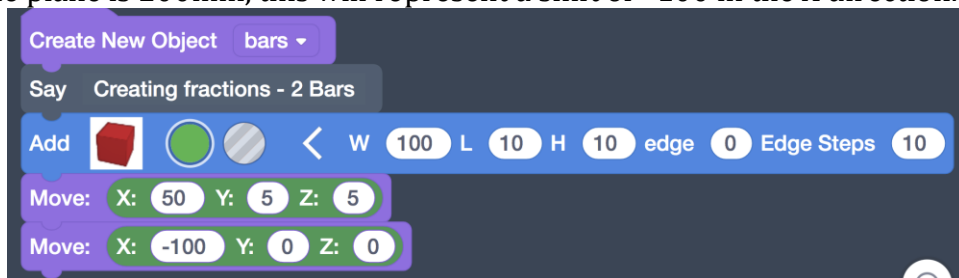
Let's create a new object for the halves bar. Now that we know how wide (200/2) the shapes will be, we can indicate this value within the block. We can select a different colour to differentiate this new bar from the last one.



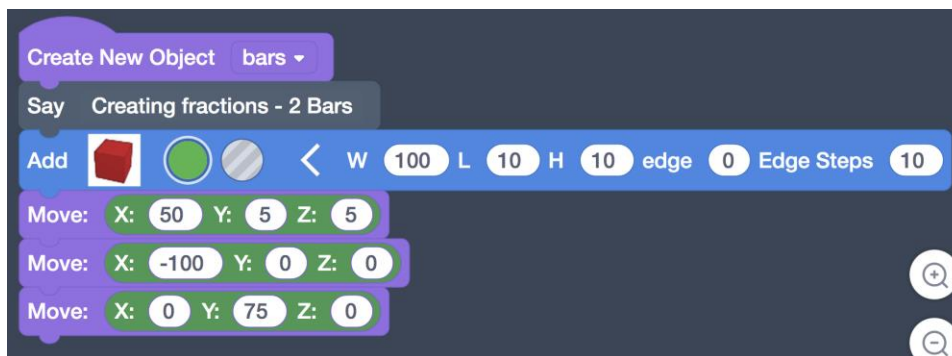
Next, we will need to move the shape to the appropriate position. Let's move the rectangle with its corner to the origin as we did before by moving half its size in all directions.



We'll then shift the shape all the way to the leftmost side of the Workplane. If the origin is in the centre and the plane is 200mm, this will represent a shift of -100 in the X direction.



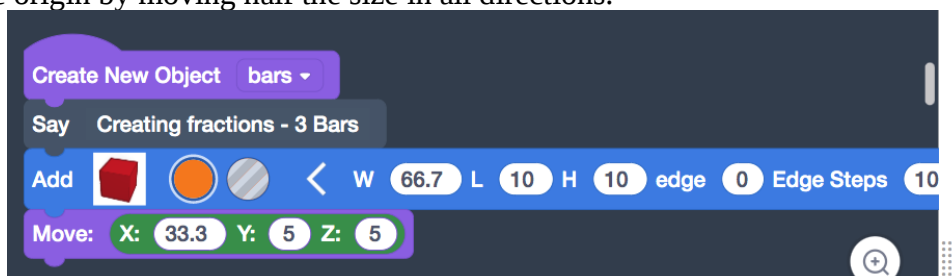
Finally, we can add 1 more Move to the back of the Workplane. The first full bar will occupy the last 10 steps of the Workplane from 100 to 90. We want our new half bar in front of the full bar to have a space before it begins so let's add another 5 steps or mm. So far, we want to move 15 steps from the back of the Workplane but we also need to consider the length of the shape. This will add 10 more steps for a total of 25. 100 steps to the back of the plane and then 25 forward so our shapes don't overlap. This makes Y=75 for the last step.



This completes the first half of the bar. We'll need to add the second half. We can add the same sized shape since we figured out how wide the halves need to be. The first 2 moves also remain the same since they move the shape to the origin and then the left of the plane. The last move will need to be adjusted in the X direction. The Y will stay the same since we want both halves in the same row. We want the 2nd half to be placed beside the first. This will require a shift in the X direction that is the same width as the piece itself, here, 100.

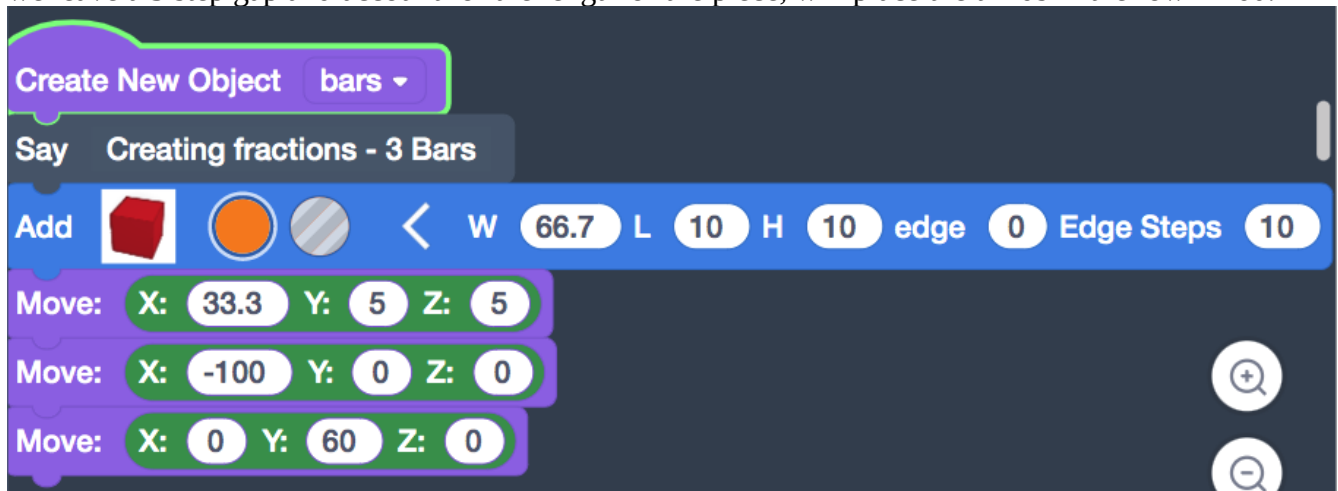


Let's continue the exploration with thirds. We will create a new object that includes 3 bars to complete the row. We'll need to know how wide the bars will be again. Remember, this is as simple as dividing the width of the Workplane by 3, the number of fractions we want. We'll also add the shift to the origin by moving half the size in all directions.

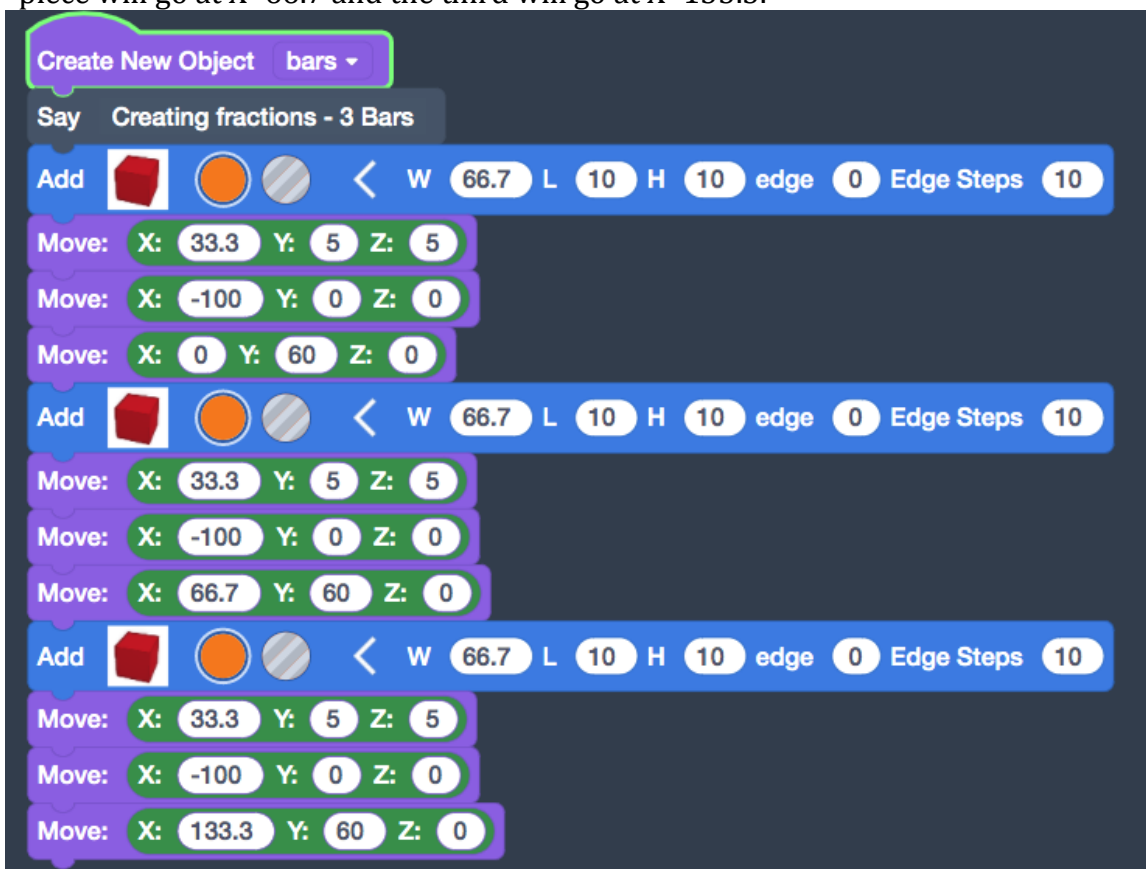


The next move will shift the pieces all the way to the left. The final move will shift the shape to the back of the plane. We want it to be placed next to the previous row. Remember, it is placed at Y=75. If

we leave a 5 step gap and account for the length of the piece, will place the thirds in the row Y=60.



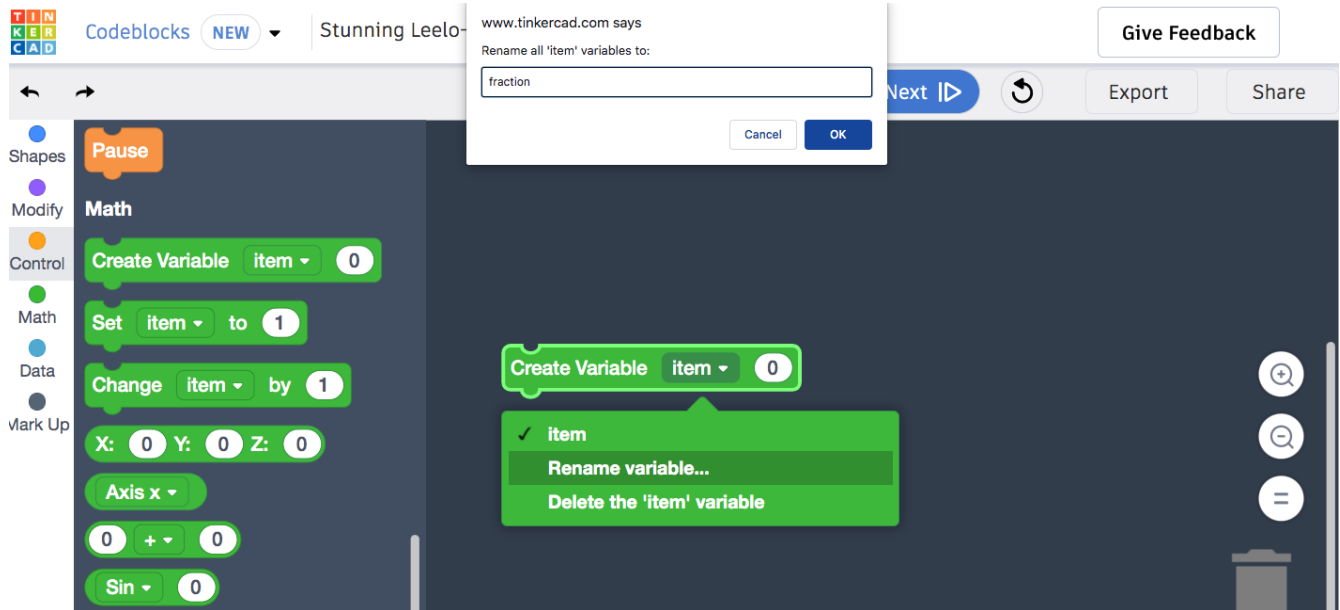
To complete a bar with thirds, we will need to repeat 2 more times. The only thing that will change is the last X-position move. We will need to account for placement beside the other pieces. Each following piece will be placed an extra width each time. Since the pieces are 66.7mm wide, the 2nd piece will go at X=66.7 and the third will go at X=133.3.



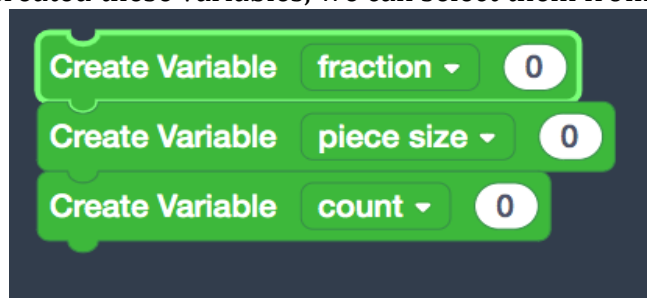
Do you notice any patterns emerging? We can see that within a given fraction row, the process will need to be repeated that number of times. For example, with thirds we created 3 shapes. If

we continue this process as it stands, we can see that it could get quite onerous to do tenths or twelfths. It might be a good time to introduce some variables to help clean up the code a little.

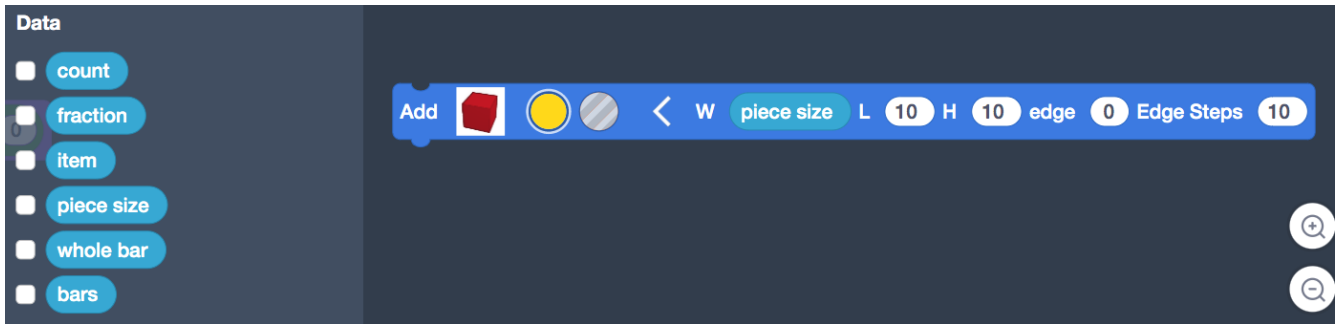
Let's continue with quarters! With quarters we will need 4 shapes. To determine the size of the piece we will need to divide the Workplane by 4. The fraction number that we are working with is important. We will create a variable called *fraction*. It represents the number of fractions that we want to divide the bar into.



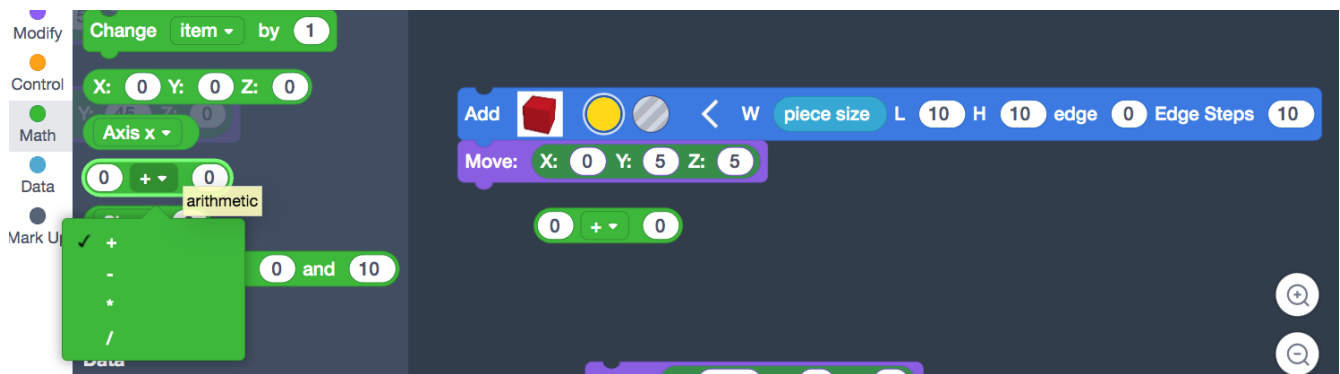
We'll create 2 more variables to help with our code. Since we use the piece size to determine positioning, we'll add a variable called *piece size*. It will represent the width of pieces based on the number of fractions we want. The last variable will be called *count*. We will be integrating a loop and need to keep track of how many times we've gone through the loop. We'll use the *count* variable. Once we have created these variables, we can select them from the Data menu.



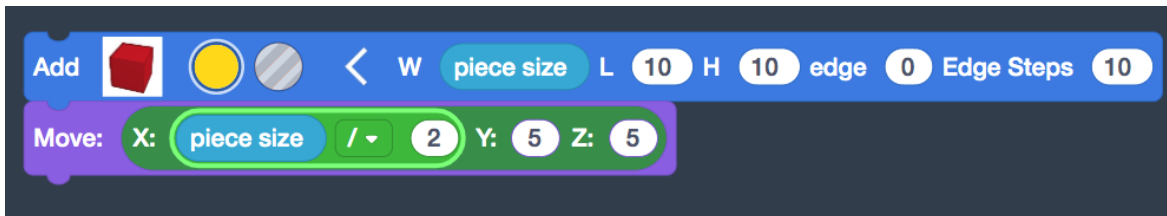
Let's start by building our loop based on the steps we did for halves and thirds. First we'll add the shape. Instead of entering the value that we determine for the width of quarters, we'll enter our variable *piece size*.



The first move block from our previous sequences, moved the shape by half of each side. We can use our *piece size* variable again but first we'll need to divide it by 2. In the Math menu, we have blank operations to choose from.

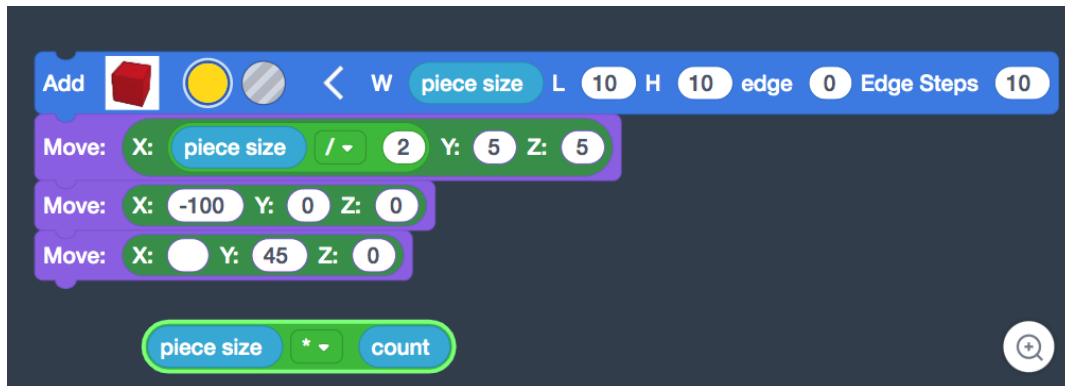


We can set the X move to $\text{piece size} / 2$ and place it into the Move block.

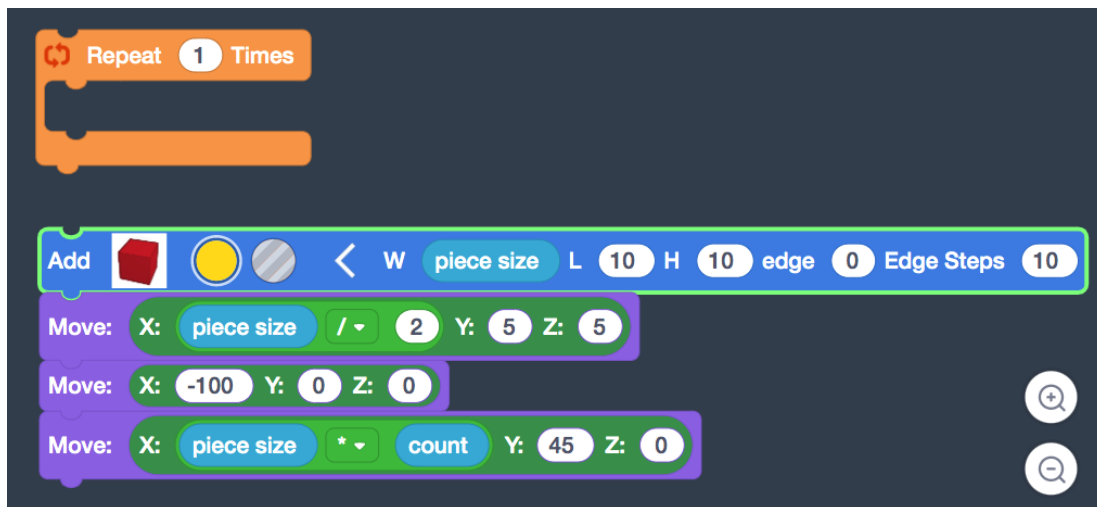


The next moved the block to the origin. It stayed the same each time. We'll add it as is.

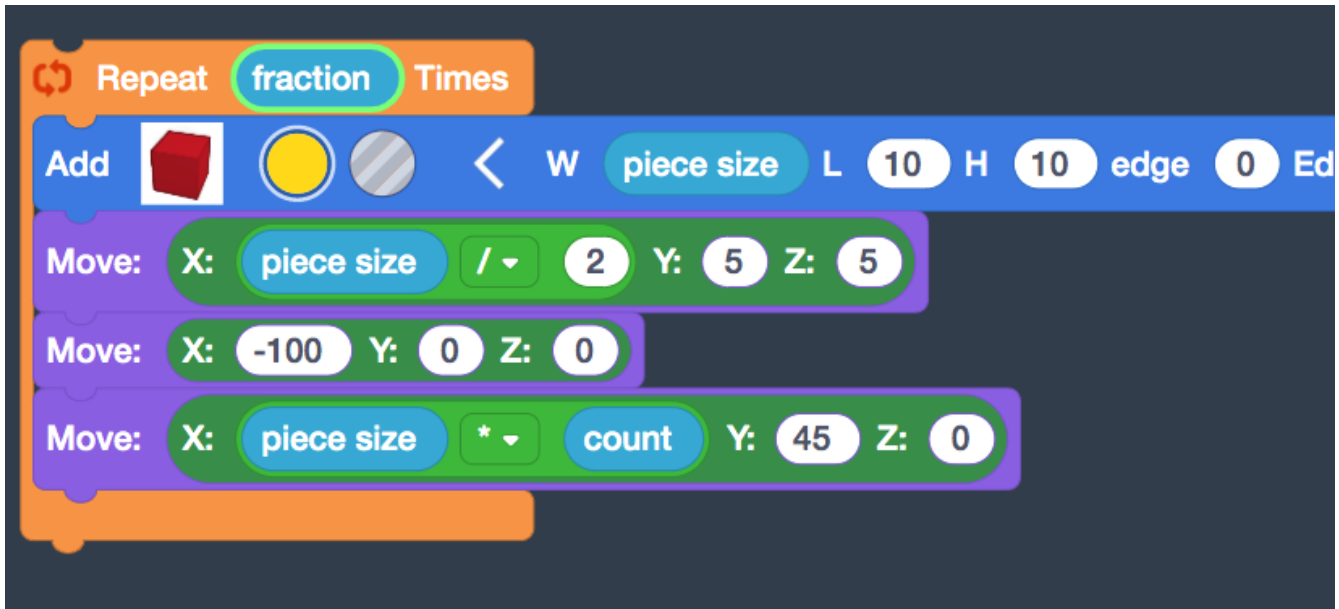
The last Move placed the block in the correct row and beside the other fractions that were already there. The first move starts at the edge and shifts to the correct row. In the subsequent pieces, we need to shift them by a *piece size* each time. We'll use another math operator in this move. We want to have the X increase by an extra piece size each time. We can accomplish this with a multiplication. This is where we will use the count variable. It will keep track of which fraction we are at. The last bit of info we need for the quarters is which row we will be placing it in. Remember the thirds are at Y=60. If we account for our 5 step gap and length of the piece, the quarters will be placed at Y=45.



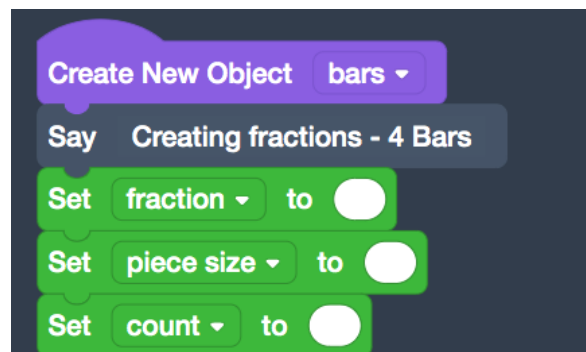
This is the set of blocks being repeated within our fraction code. Let's insert them into a loop from the Control Menu.



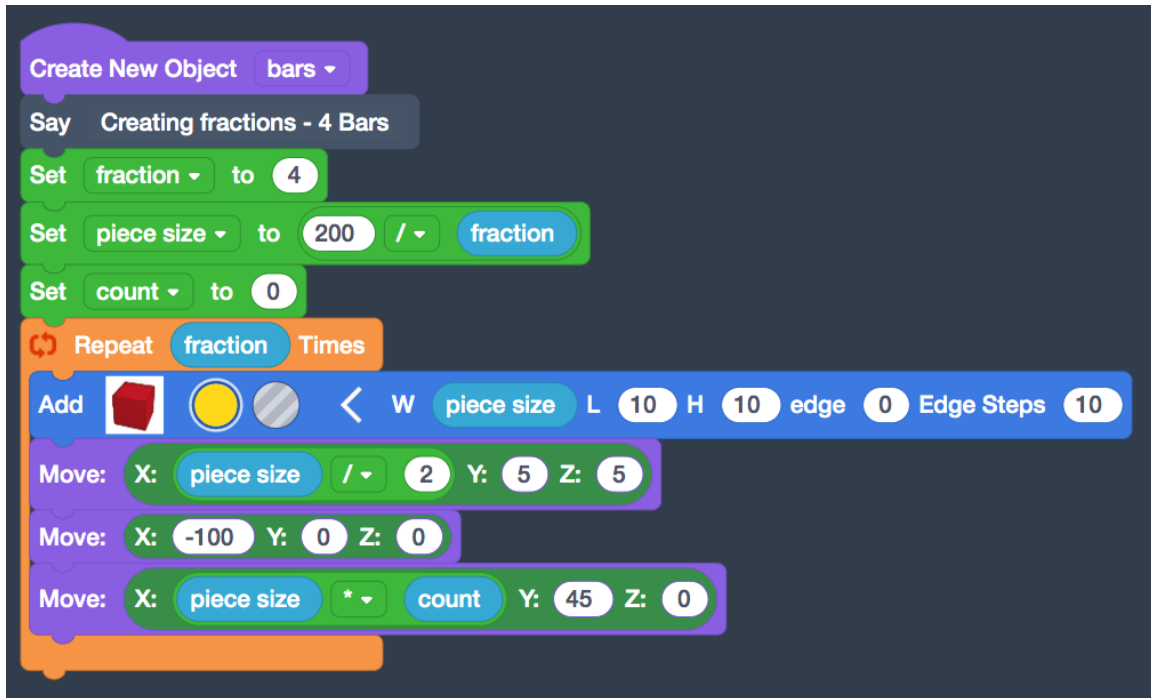
How many times do we want the loop to repeat? For quarters, it will be 4. Instead of the number 4, we will use the variable we called *fraction* so we can easily change it for subsequent fractions.



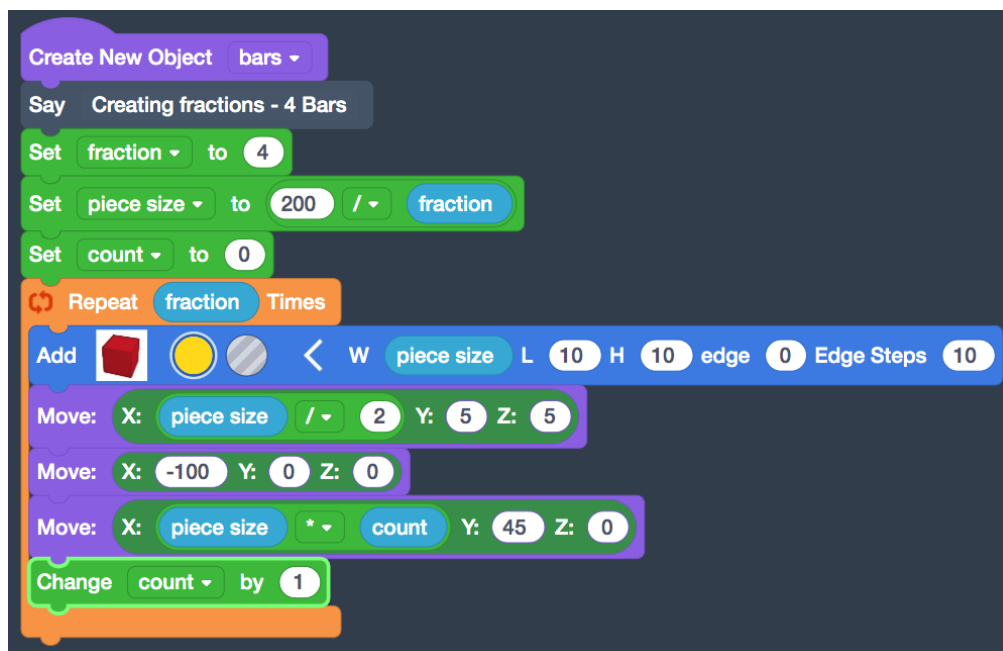
Before we start the loop though, we will need to set our variables.



The *fraction* gets set to the number of fractions we want. The *piece size* gets set to the Workplane(200mm) divided by the number of fractions we want, so *fraction*. We'll use another Math operator here too. We'll also set the count variable. It will start at 0 so that the first piece of each row is placed at the leftmost side of the plane.

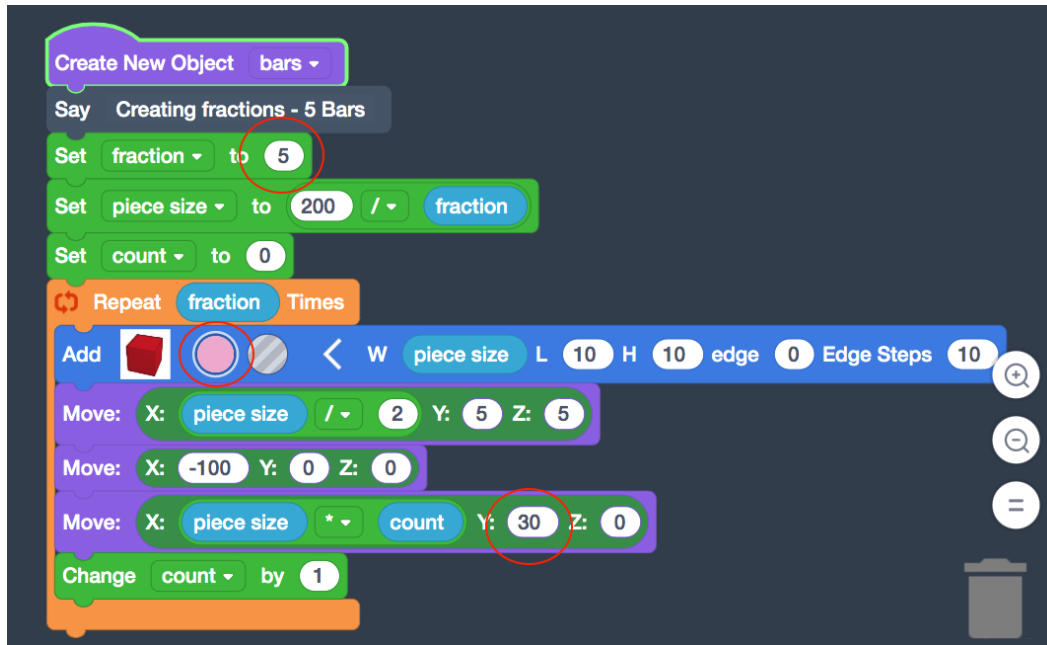


Almost done (for quarters)! If we run the code as is, all the fraction pieces will stack on top of each other because the count is set to 0. It stays unchanged in the loops because we haven't accounted for the *count* variable yet. In the Math menu, we can select a Change item by block, and set *item* to *count*. This will add 1 to the count at the end of each loop.

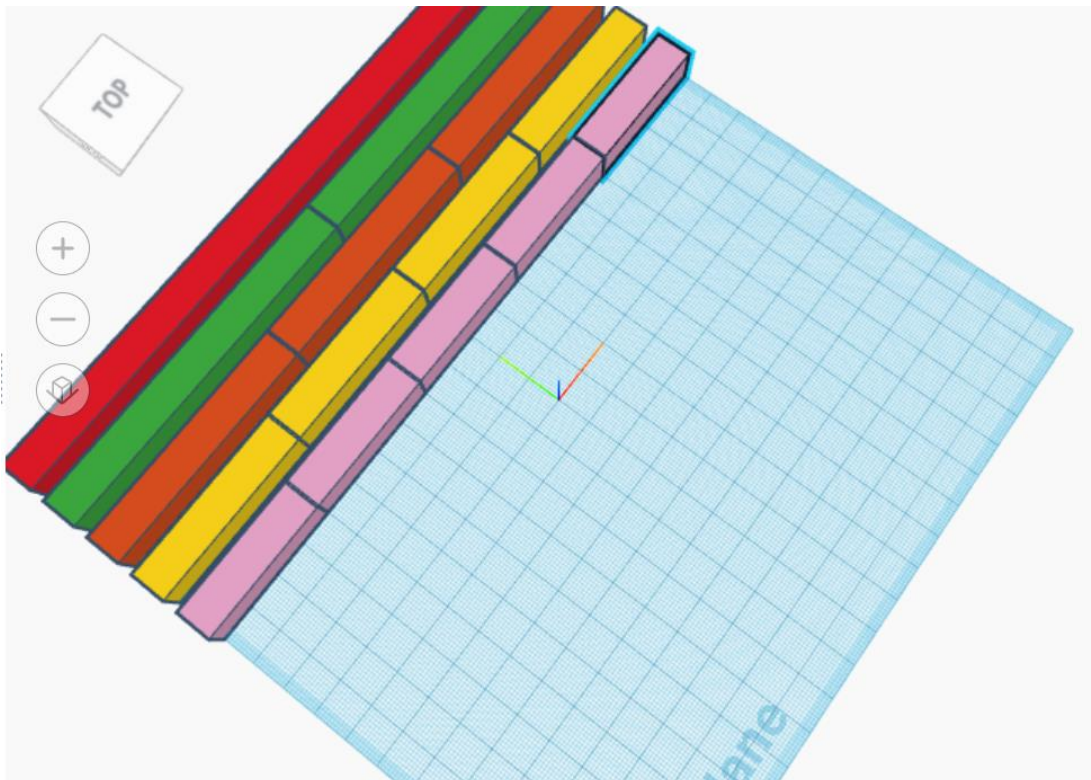


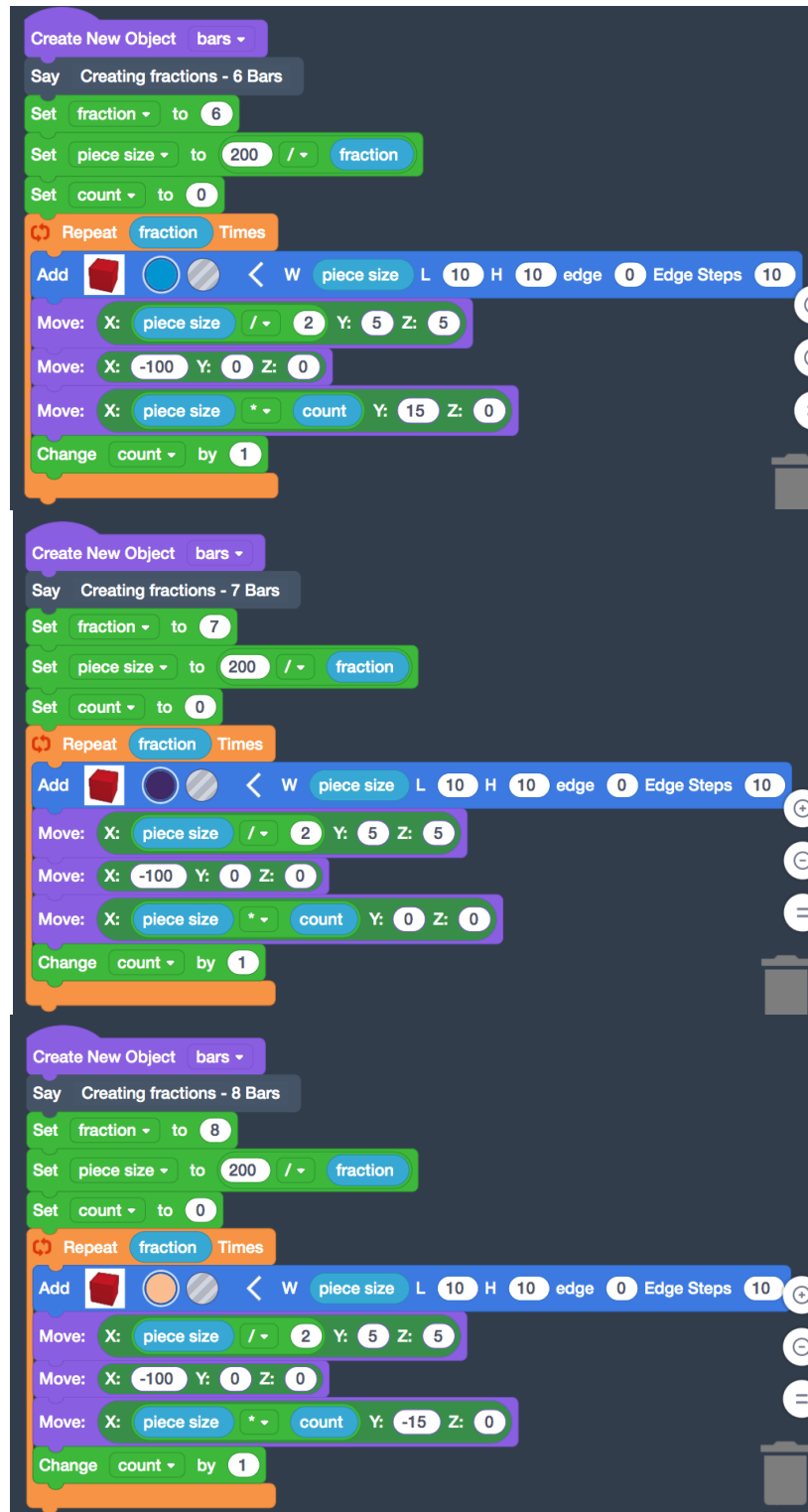
Now the code is complete! When adding more rows of fractions, we will simply need to Duplicate this whole block of code and set the *fraction* variable to the number we want. The last thing that

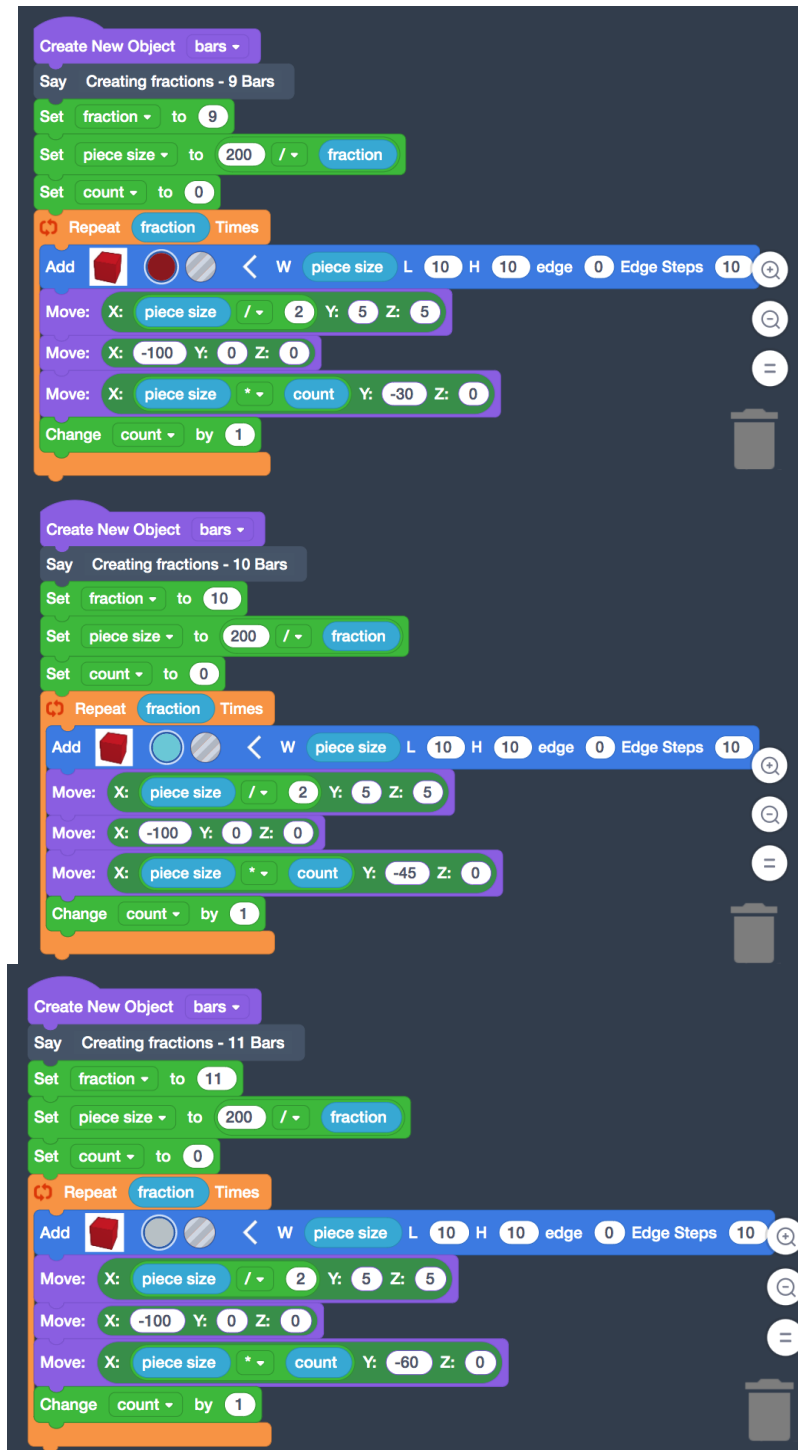
we will need to do 'manually' is select the colour and set the Y positioning of the row. Let's try for fifths.



Let's see what our code does up until now and then complete the exercise all the way to twelfths. We can only imagine at this point how much time we'll be saving by creating these loops instead of repeating code for each fraction.

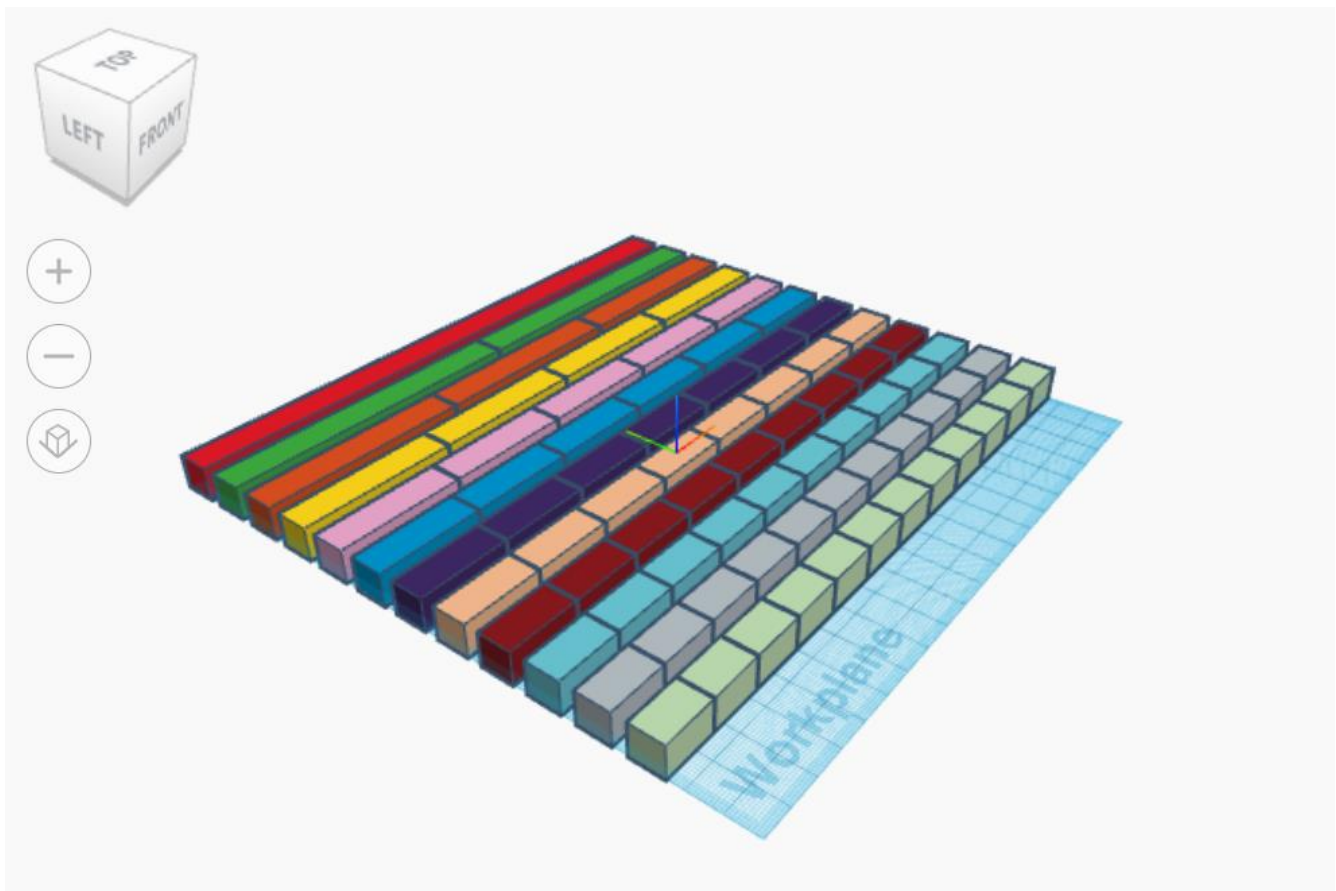




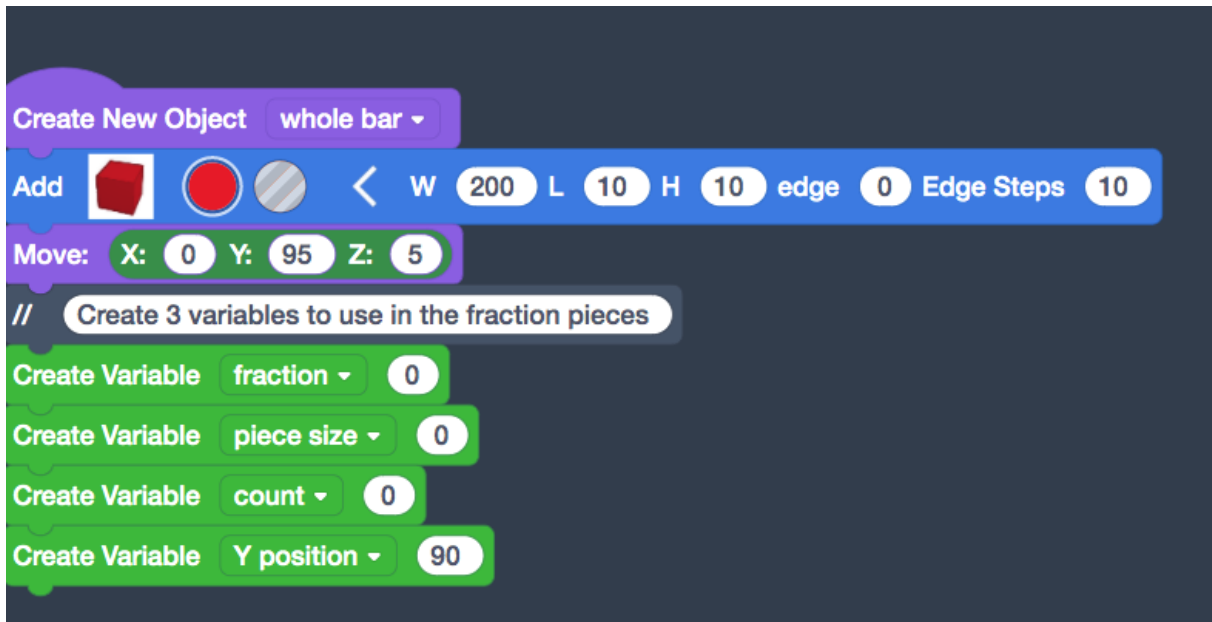




Below is our completed code with fractions up to twelfths.



Extension: Can you alter the code to integrate a variable for the Y position? If this is achieved successfully, the only things you'd need to set for a new row of fractions are the fraction number itself and the colour.



We can start the Y variable at 90 since that is the row for the first full bar. Each row after that subtracts 15. We'll need to Set a new Y position only after each full set of fractions so we have to take care that the Set is not inside the loop or we will subtract 15 from the position a *fraction* number of times when our intent is to do it once.

