Lab 01   Introduction to Scratch Programming

General Information

What you should do
• You should follow the instructions step by step especially if this is your first programming course.
• You should try to come up with the code yourself as much as possible. Do not be afraid of making mistakes, since debugging (finding out where your code goes wrong and fixing it) is part of the learning process.
• We do not give out model programs to the exercises. There can be multiple ways to write the code that solves the same problem. It is important that you build up the program logic yourself instead of merely looking at some code that you do not understand. At any time if you are lost or if you have any questions, feel free to ask the instructor, tutor, or teaching assistant and we will be very happy to help you.

Self-Discovery
• Most lab tasks are designed to be relatively simple such that you can take the time to think about the related underlying concepts. Besides, we also encourage you to discover things on your own which may not be specified in the tasks.

Scratch Introduction

Scratch is a programming language developed by the MIT Media Lab for the purpose of teaching programming to teens and other first-time programmers. It supports the development of computer games, interactive stories, graphic artwork and computer animation, and all sorts of other multimedia projects.
Scratch allows programmers to snap blocks together to create programs where each block represents a different command or action that tells the application how to execute. It is a dynamic programming language that allows changes to be made to application projects even while the projects are executing. Scratch programmers can experiment by making application changes on the fly in order to see what type of effect the changes may have on the application's execution.

Task 1.1 Sign up a Scratch Account

Make sure that your notebook is connected to the Internet. The current version of Scratch is Scratch 3.0 which can be run online with a web browser: (1) Chrome (63+); (2) Edge (15+); (3) Firefox (57+); (4) Safari (11+). Note that Internet Explorer is NOT supported.

Start the Chrome browser on your notebook and go to the webpage https://scratch.mit.edu/.

Click on the button "Join Scratch" to sign up an account.
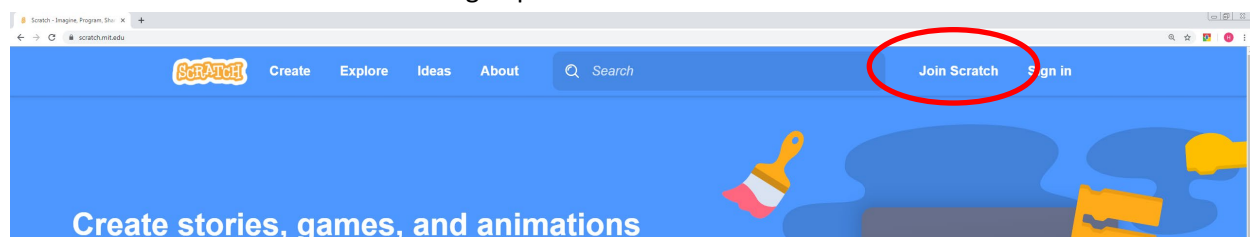
Note: In case you do not see the "Join Scratch" button on the right, try the webpage https://scratch.mit.edu/help/ and see if the "Join Scratch" button is there.

Follow the instructions to sign up a Scratch account. Remember your username and password.

Click on the "Create" button on top to create a new project.
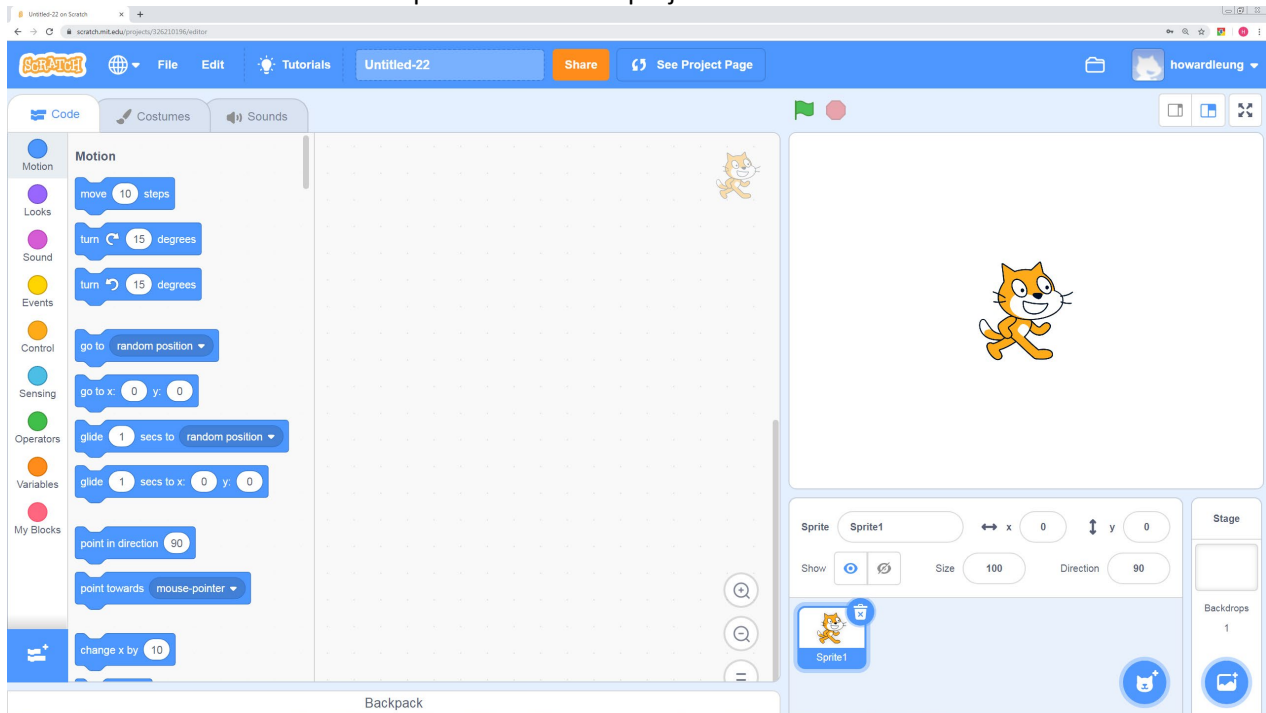
If the language is not in English, click on the "world" icon on top to change the language setting to English.
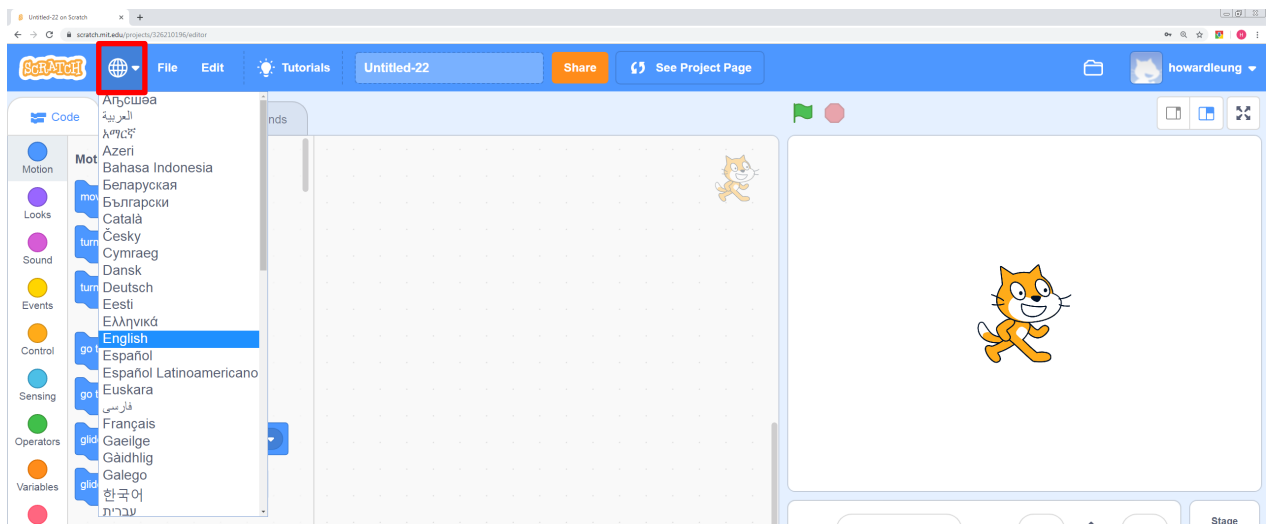

Task 1.2 Understand the Scratch development environment

Note that the Scratch development environment contains different regions (refer to the figure at the top of next page):

- Stage - where a Scratch project is physically run
- Block palette – where different blocks are located under each block category
- Scripts area – where scripts can be assembled

Scratch application projects are made up of objects called sprites. A sprite is a 2D bitmap image drawn on a transparent background. Sprites can be moved around and made to interact with one another. The Scratch Cat is the default sprite when you create a new project.
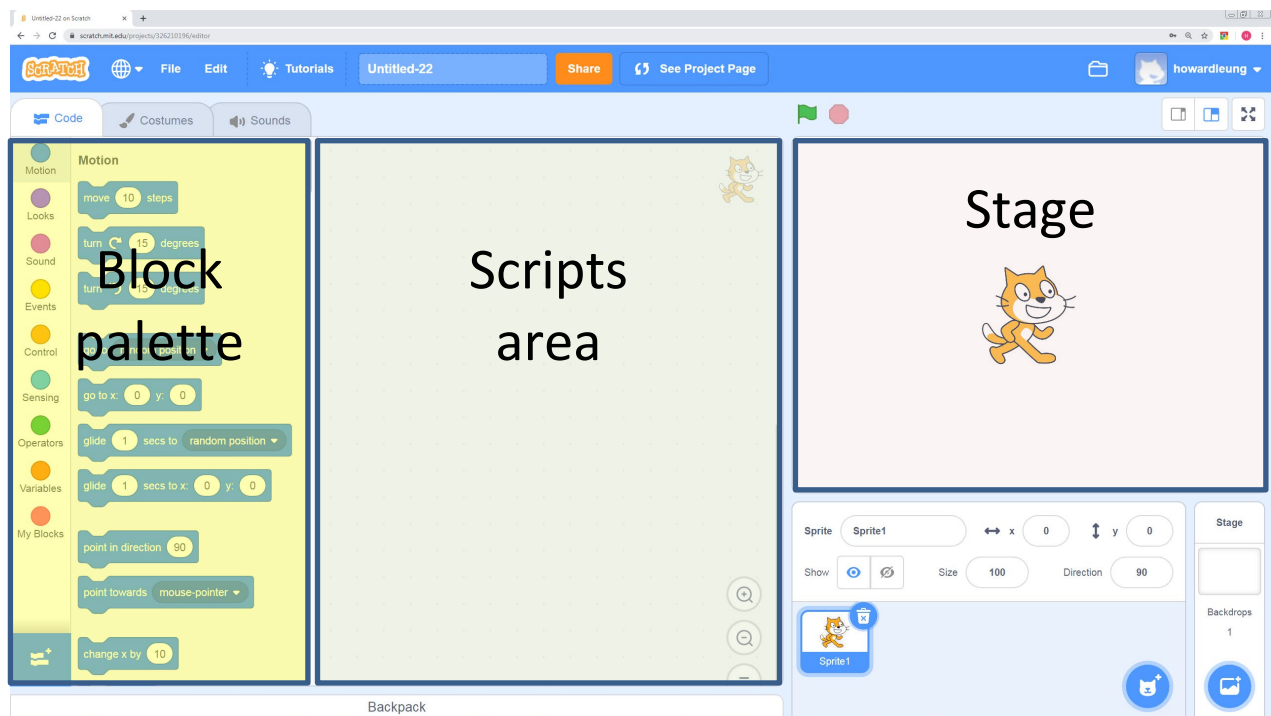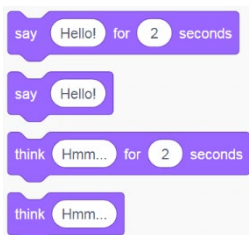
You can double click on a block under Block palette and see the corresponding action on Stage. Try the followings:
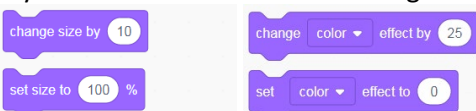
1) Under the Motion block category, double click on each of the following blocks and see what happens:

2) Under the Looks block category, double click on each of the following blocks and see what happens:

Try different values in the following blocks to understand what each block does:

To reset the sprite to its original size, click this block (make sure that the value is 100%).

To reset the color/graphic effect to its original appearance, click this block .

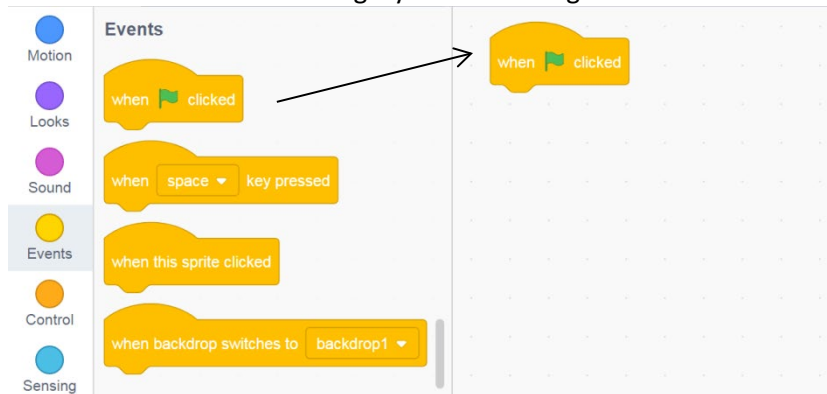3) Under the Sound block category, double click on following block and see what happens (make sure that your sound is on):
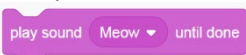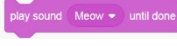
Task 1.3 Your First Scratch Project
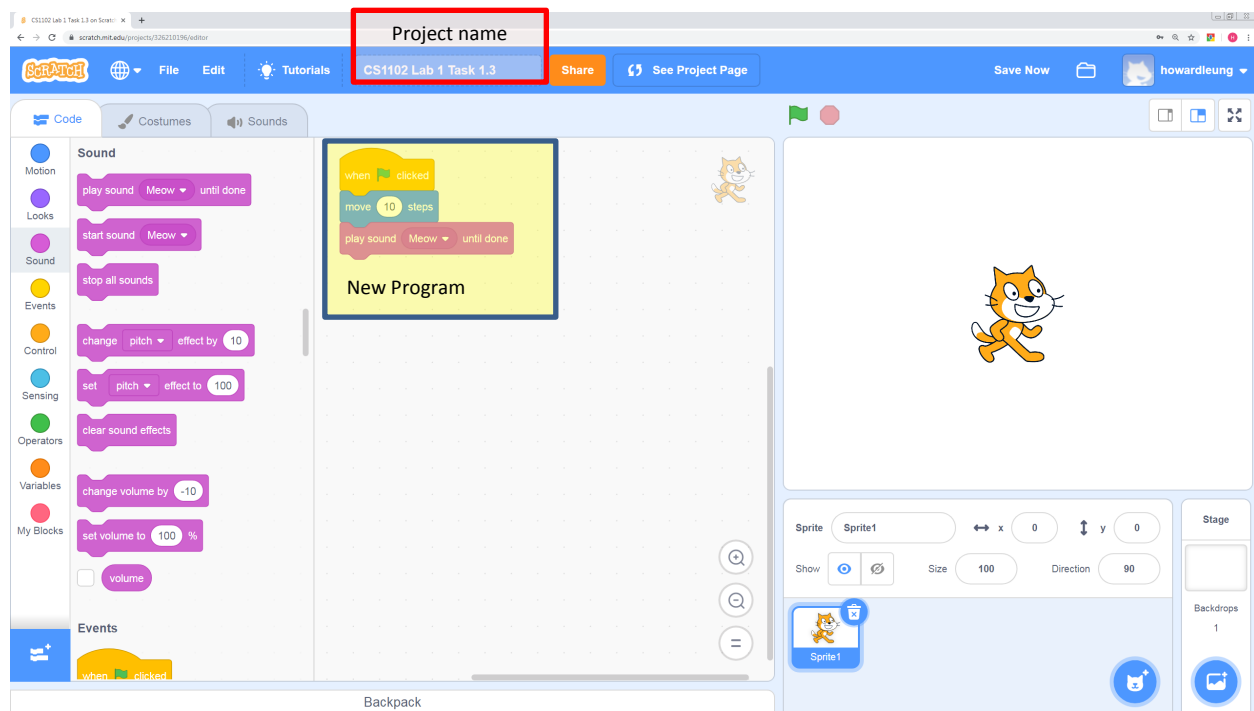
Let's start your first Scratch project:

1) Enter "CS1102 Lab 1 Task 1.3" as the project name shown in the above figure

2) Click on the Events block category and then drag the block [when clicked] to the Scripts area

3) Click on the Motion block category and then drag the block [move 10 steps] to the Scripts area and stack it below the block [when clicked]
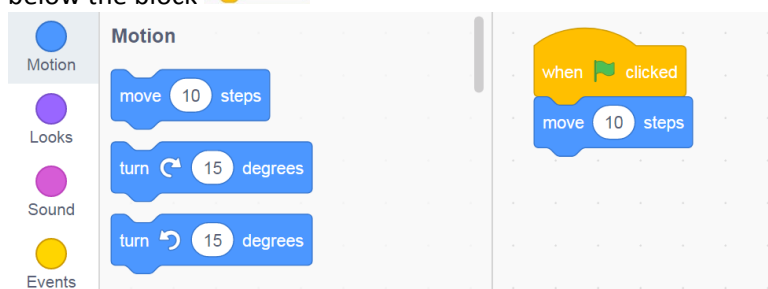

4) Click on the Sound block category and then drag the block [play sound Meow until done] to the Scripts area and stack it below the block [move 10 steps]. Now the new program consists of 3 blocks in the Scripts area as shown in the illustration from the previous page.

5) Now you can execute your new program by clicking on the button 🚩 located above the stage area
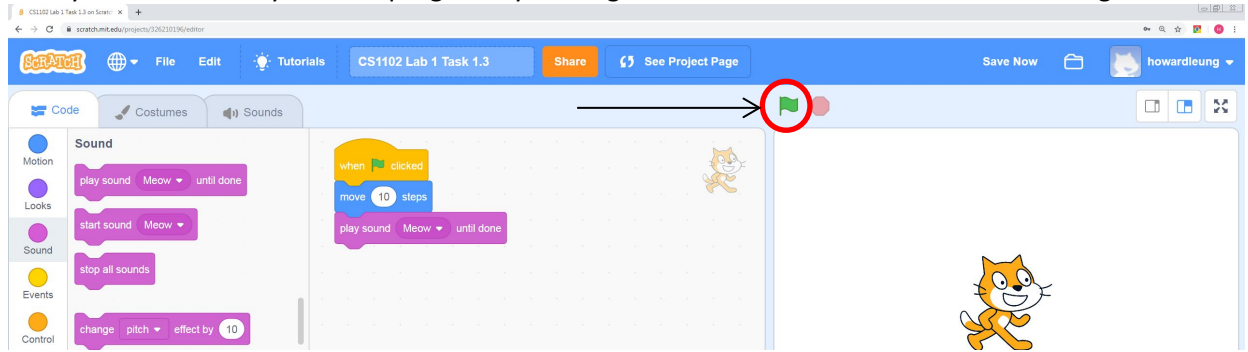
6) Alternatively, you can also execute your new program by double clicking on the block
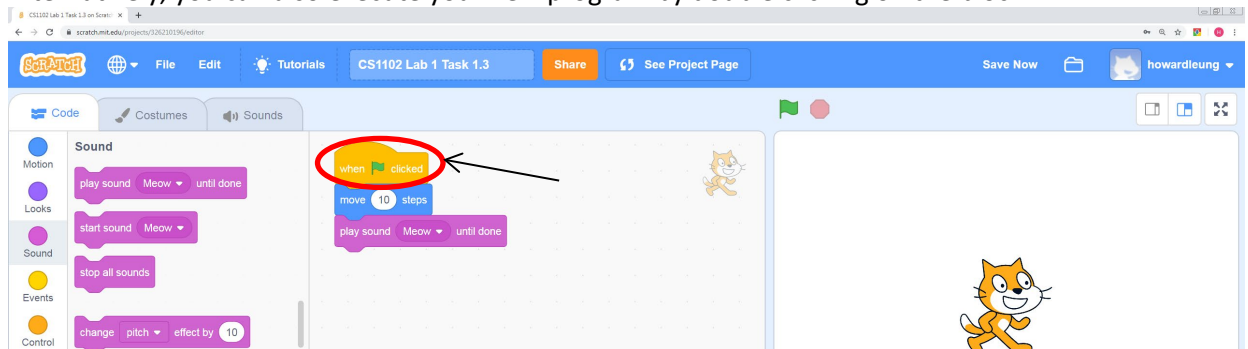
7) Now change the program as follows (you can first click on the blue block to move it away from the stack, then click on the purple block and restack it under the brown block. Finally move the blue block back to stack it at the bottom):
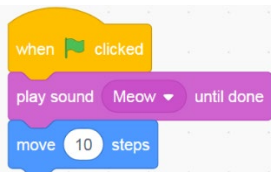

Note that these are the exact same blocks as shown in the previous step. Do you expect this program to run with exactly the same outcome as the program in the previous step? Verify your expectation by executing the program.

Task 1.4 Leaving a Trail

In this task, we would like the Scrath Cat to leave a trail as it moves as shown below:
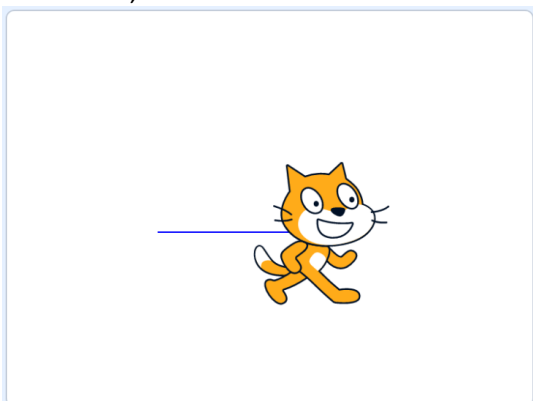
This would require the Pen block category. However, at a first glance, you would not find this block category from the Scratch interface. In fact, you need to add it from the Extension by clicking the button as shown below:
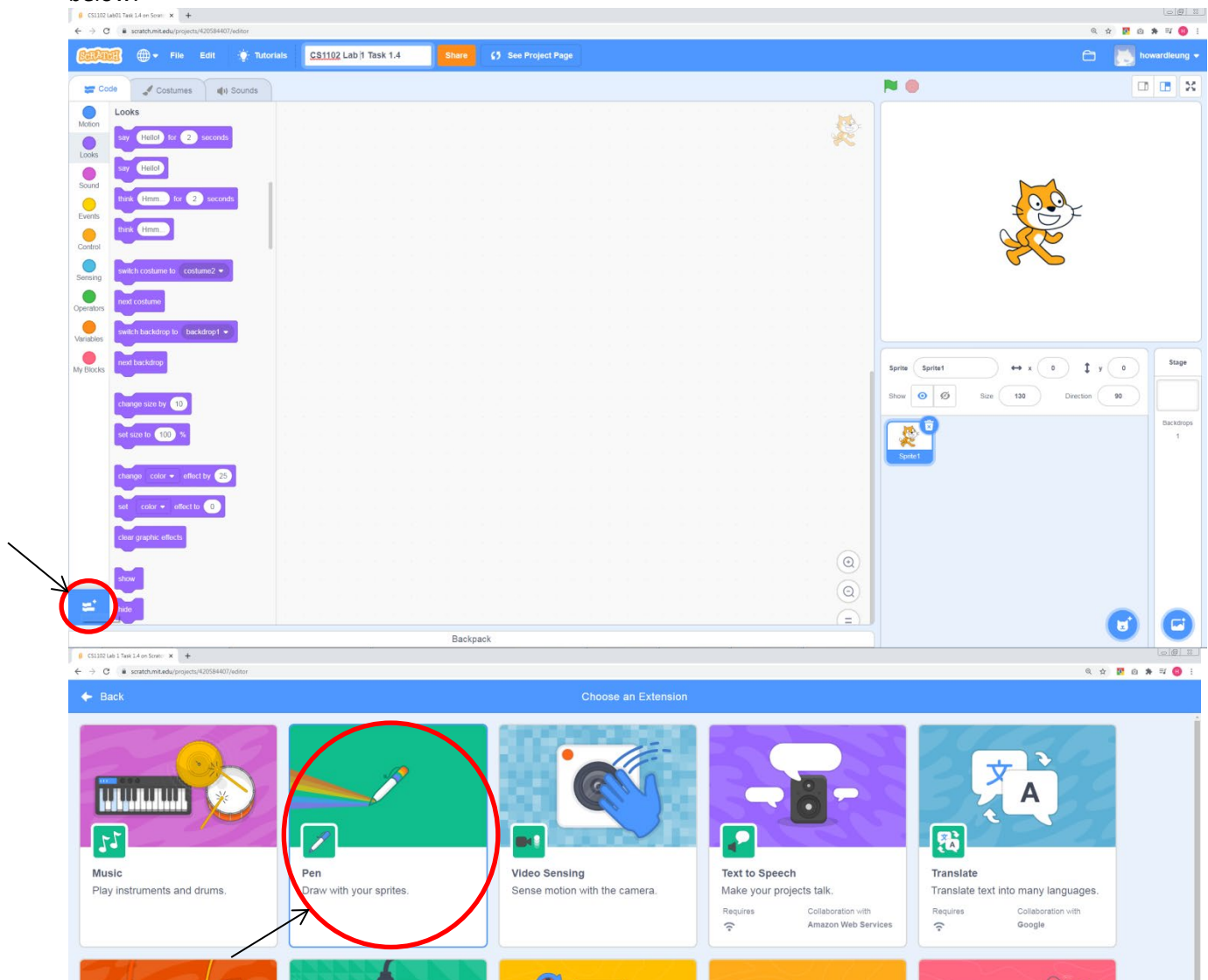
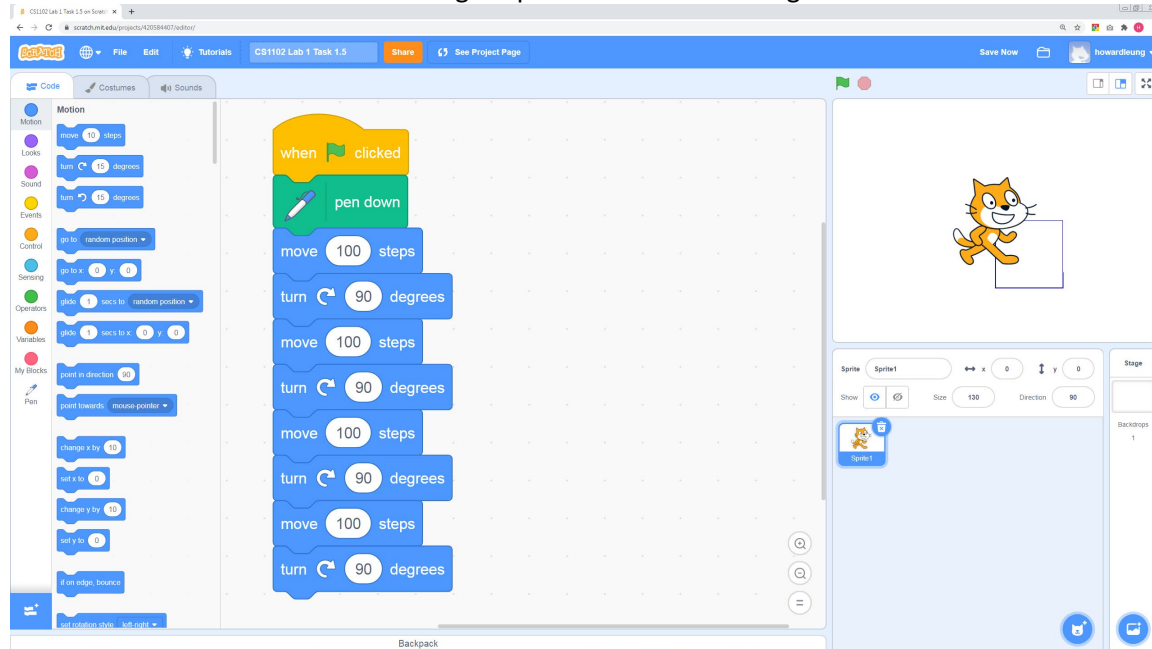Now you would see a new Pen block category in the Scratch interface:
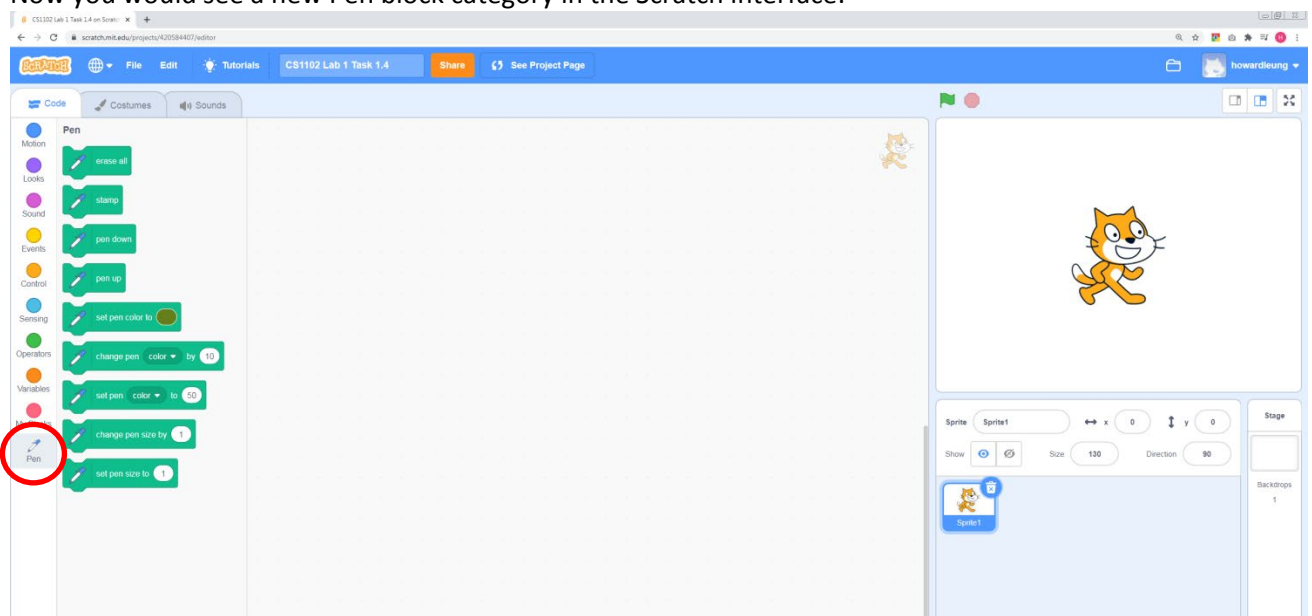
You can form the following blocks in order to leave a trail as the Scratch Cat moves:
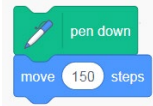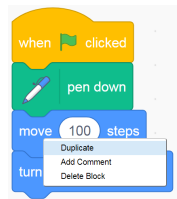

You can use this block to clear all trails.

## Task 1.5 Moving along a Square

We can let the Scratch Cat move along a square with the following blocks:

Hint: You can observe that the above 8 blue blocks consist of 2 blue blocks repeated 4 times. You can first form the 2 blue blocks, then right click on it and select Duplicate.

You can use the following blocks to let the Scratch Cat return to the original position and orientation:
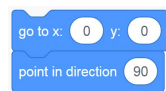
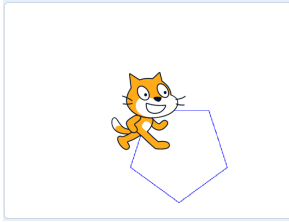Note that the following blocks can achieve the same function as the above:

The above blocks contain a loop which is used to carry out repeated task. We will learn about loop in more details in later lab sessions.
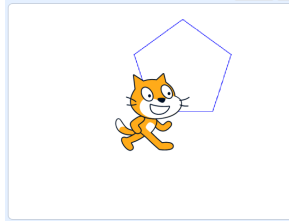
Exercise 1.5: Try to write the code for the Scratch Cat to leave a trail according to the pattern shown in each of the following illustrations:
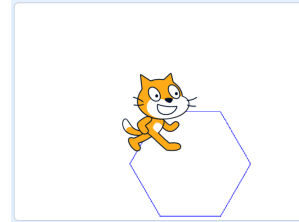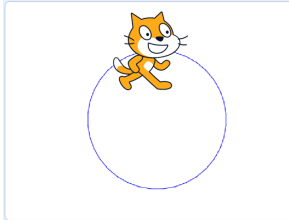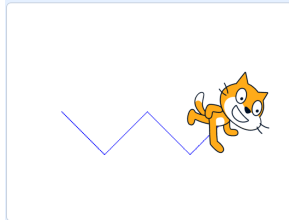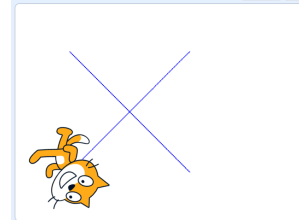
Pattern A:

Pattern B:
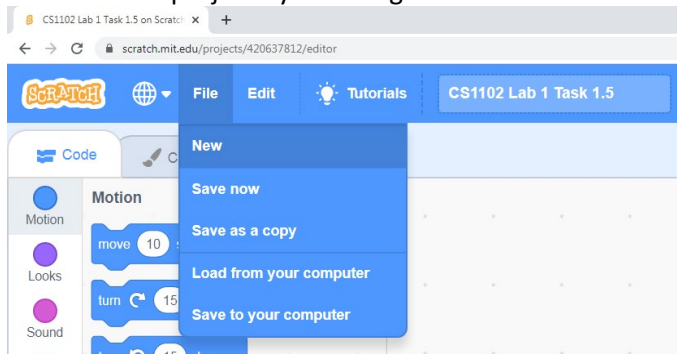
Pattern C:

Pattern D:

Pattern E:

Pattern F:

(require other blocks)

Task 1.6 Cat catches mouse

Create a new project by selecting File > New from the menu:

Note: each time when you are working on a different task, you should create a new project and assign a meaningful project name. If you simply rename the project without opening a new one, your old project would be overwritten by any changes you apply on the current project.

In this task, we will create the code with the following basic specifications:
   a) When the program starts, the Scratch Cat will appear in a random position
   b) When the program starts, another sprite Mouse will appear in a random position
   c) If the Scratch Cat catches (by touching) the Mouse, the Scratch Cat says "Meow"

You can let the Scratch Cat move to a random position by using the following blocks:
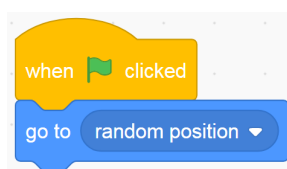
Verify that your program is working by clicking on the button 🚩 a few times and see the Scratch Cat appears in random positions.

Now we will add another sprite Mouse to the project. Click on the cat icon at the bottom right as shown in the following illustration.

A dialog box will pop up which will show a number of existing sprites in the library that you can add to your project (as shown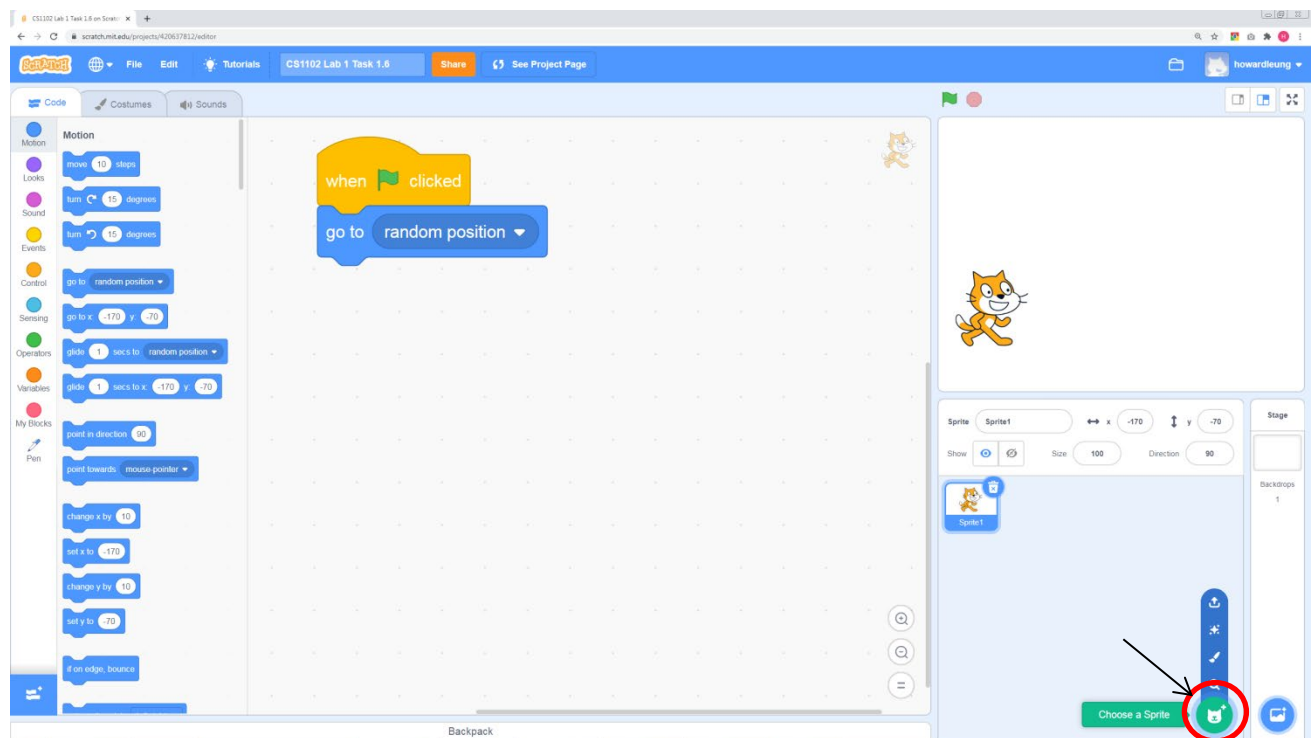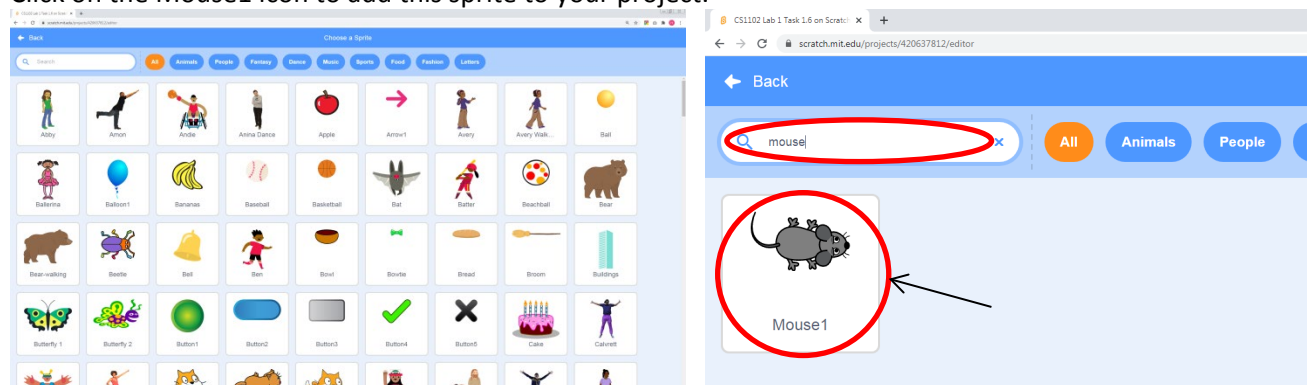 in the following illustration on the left). Type the word "mouse" on the search box to quickly find all sprites labelled as mouse in the library (as shown in the following illustration on the right). Click on the Mouse1 icon to add this sprite to your project.

Now you should see that this Mouse1 sprite has been added to your project as illustrated below (on the left). You may observe that the code that you created earlier seems to disappear, which is because the code was associated with the Scratch Cat sprite. If you click on this sprite (Sprite1) again, then it will show up again in the Script area (illustrated below on the right).
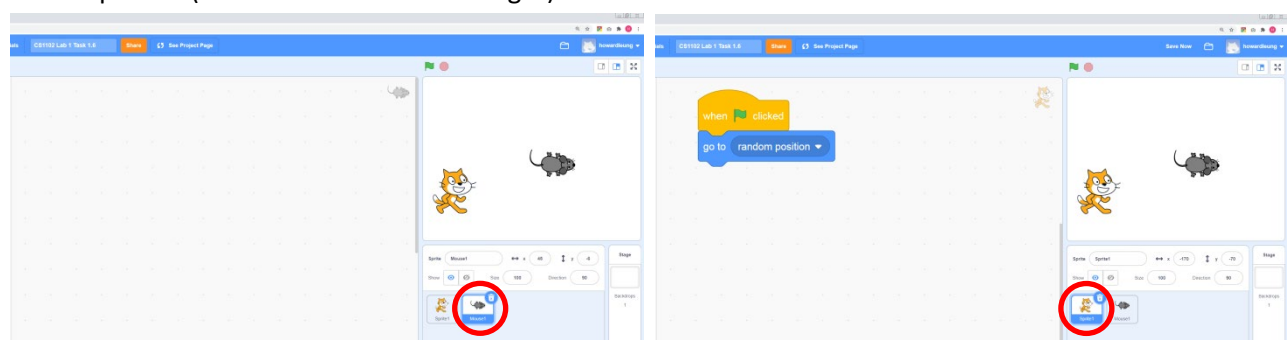
Right now the Scratch Cat sprite is shown as Sprite1 and the Mouse sprite is shown as Mouse1. You can rename a sprite to have a more meaningful name. Make sure that the Scratch Cat sprite is selected and then change its name from Sprite1 to Cat, as illustrated as follows:
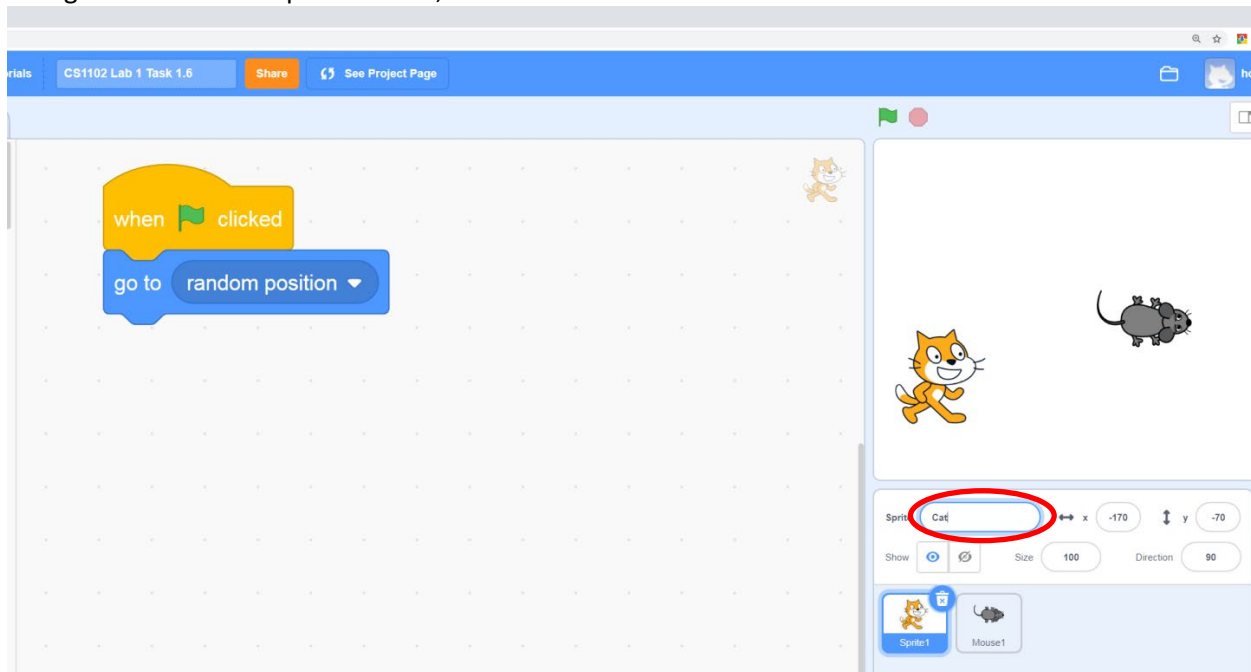
Now we want to make the Mouse move to a random position as the program starts just as the Cat does. As a result, you can add the exact same code to the Mouse sprite. You can first click on the Mouse sprite, and then drag the same blocks from the Block Palette to form the same code as what you did for the Cat sprite earlier. Alternatively, you could just copy the same code from the Cat sprite to the Mouse sprite using drag and drop. Drag the code block from the Cat sprite to the Mouse sprite and **make sure that the cursor stays inside the Mouse sprite icon**. When you see that the **==Mouse sprite icon wiggles==**, then you can drop it. Afterwards, when you click on the Mouse sprite, you should see the same code appears in the Script area. The steps are shown as follows:

Verify that your program is working by clicking on the button 🚩 a few times and see the Cat and the Mouse both appear in random positions.
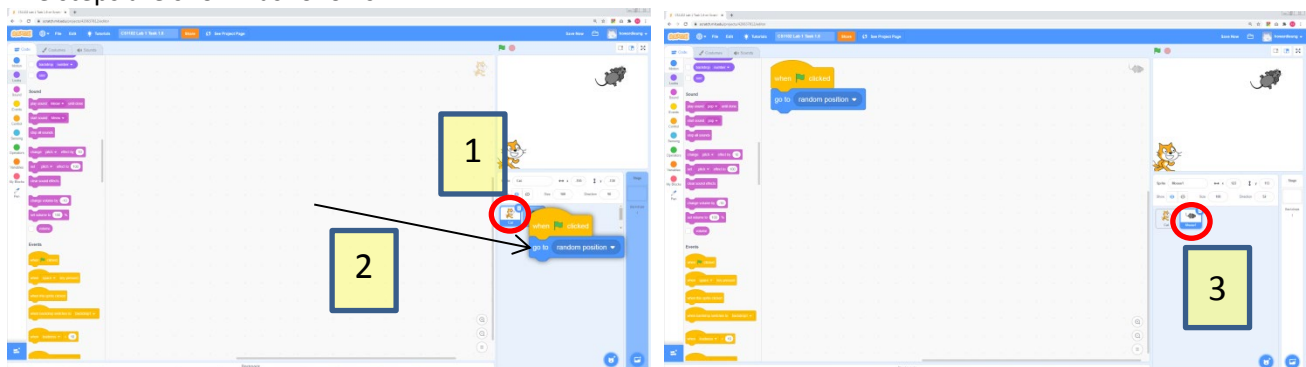
For the last part, we would like to let the Cat says Meow when it touches the Mouse. Compose the following code and attach it to the end of the existing code in the Cat sprite:

The code (play "Meow" sound) inside the if-block will only run under a given condition (when it is touching the Mouse sprite). This is one type of conditional statement and we will learn about conditionals in more details in later lab sessions.

Your code for the Cat sprite should appear as follows:
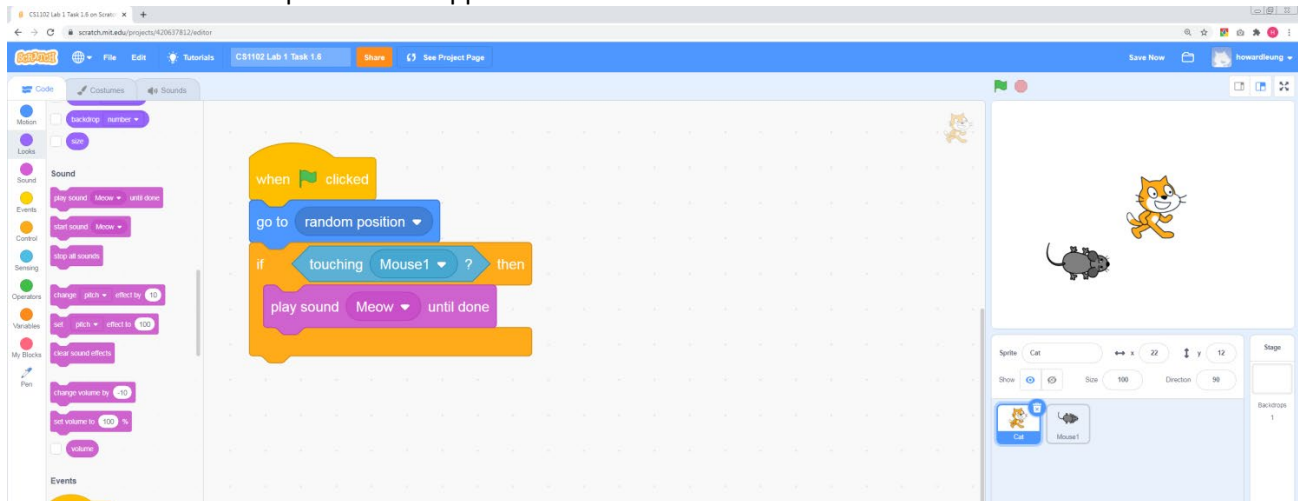
Verify that your program is working by clicking on the button 🚩 a few times and hear the "Meow" sound when the Cat touches the Mouse. If you find that after many trials the Cat still does not touch the Mouse because they are too small, then use the following block to increase the size of both the Cat and the Mouse sprites (click on the Cat sprite, click on the following block directly from the Block palette after modifying the value from 100 to 200; then click on the Mouse sprite, click on the following block again from the Block palette):
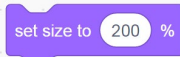
Now it should be much easier for the Cat to touch the Mouse as they are much bigger!
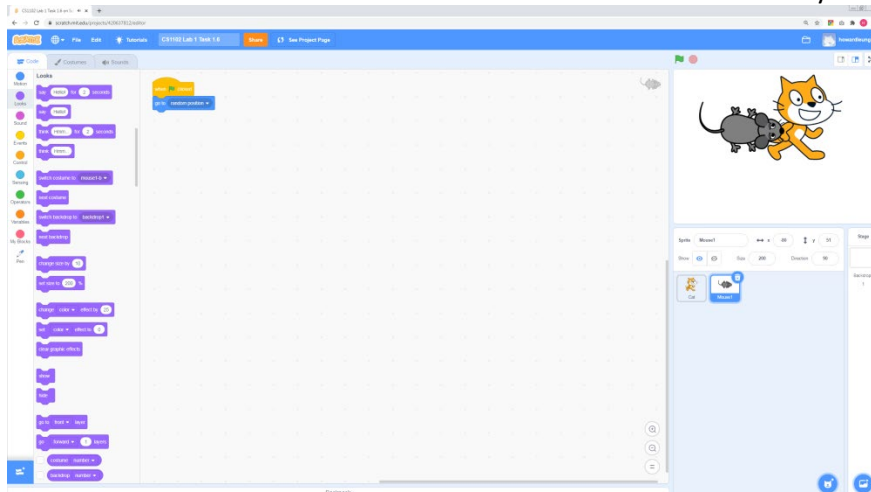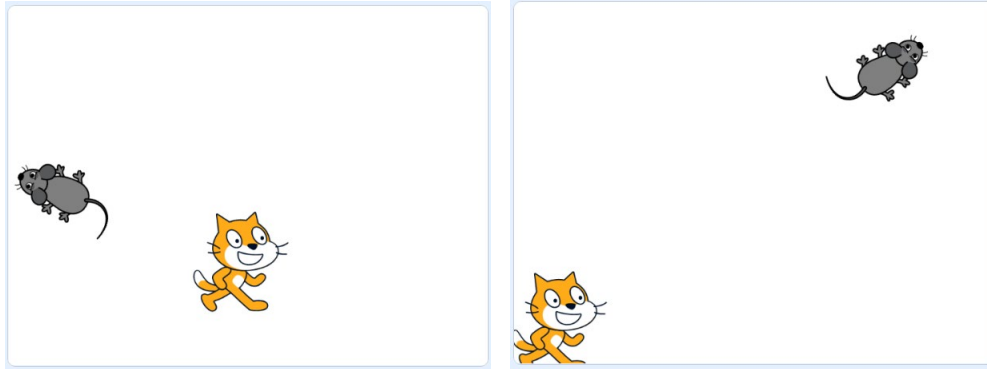

Exercise 1.6: Try to add more code to your program so that it will work according to the following specifications. Verify that your program works under each specification before moving on to the next one:
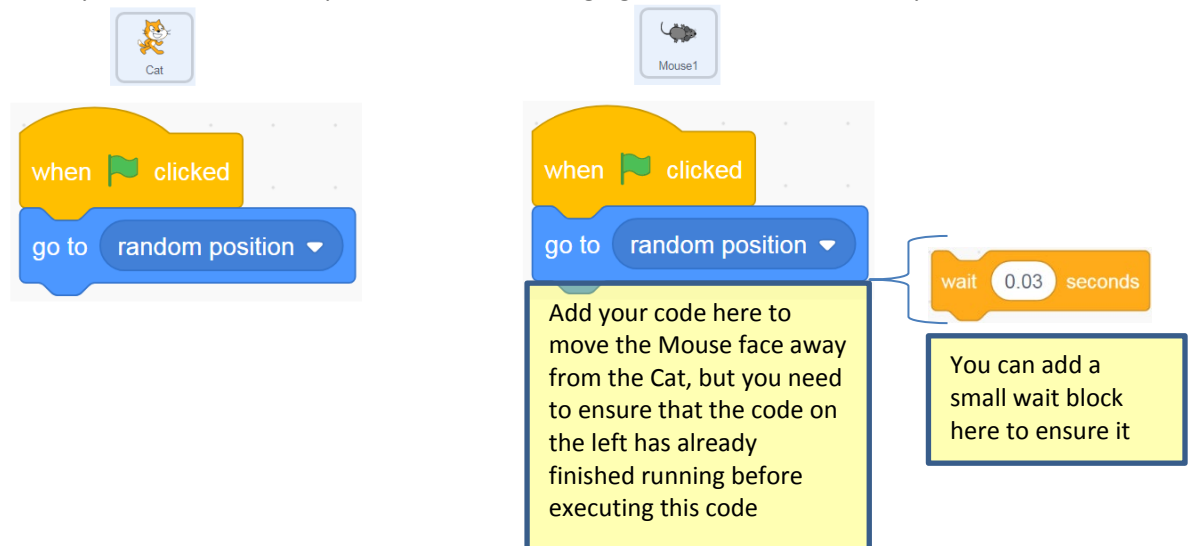
d) Reset the size of the Cat and the Mouse back to 100%

e)   The Mouse is always facing away from the Cat, e.g. as shown below:

Note: As the code block from each sprite runs concurrently, you need to make sure that both sprites have already moved to the new positions before changing the Mouse to face away from the Cat

when 🚩 **clicked**

go to   random position ▼

when 🚩 **clicked**

go to   random position ▼

wait   0.03   seconds

Add your code here to move the Mouse face away from the Cat, but you need to ensure that the code on the left has already finished running before executing this code
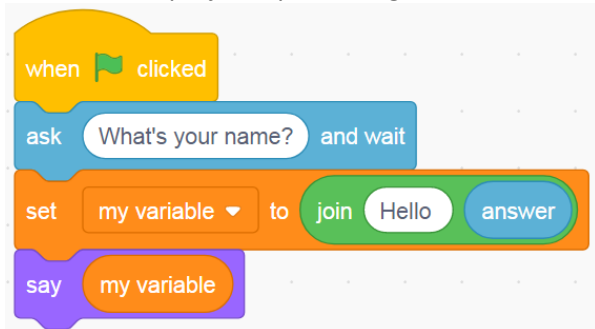
You can add a small wait block here to ensure it

f)   Add a Dog2 sprite that will also appear in a random position each time when the program starts. When the Dog touches the Cat, it will play "dog1" sound.

Sprite	Dog2	↔ x	191	↕ y	103
Show	◉ ⦰	Size	100	Direction	90
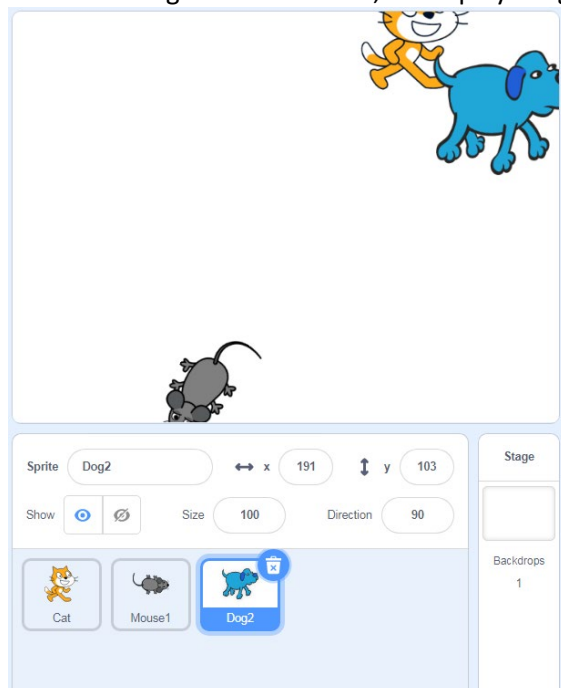
Task 1.7 Input-Process-Output

Create a new project by selecting File > New from the menu. Compose your program as shown below:

Note that the ask block gets input from the user which is stored in the answer block. The user can input a string which is a text consisted of a sequence of characters. A character can be alphanumeric (e.g., A-z, 0-9) or a symbol (?, , *, &, etc.). The join block concatenates the 2 strings ("Hello" and the answer block) together to form a single string and this concatenated string is stored in a variable "my variable" in the orange block. The say block returns the output back to the user.

Run your program to make sure that you understand exactly how the program works.

To do:

1) Write a program to ask the user to input his/her favorite color. Then output a message "[color] is your favorite color" where [color] denotes the actual color the user has input. For example, the Scratch Cat asks "What is your favorite color" and the user enters "Red". Then the Scratch Cat will say "Red is your favorite color" (Make sure that there is a space between "Red" and "is")
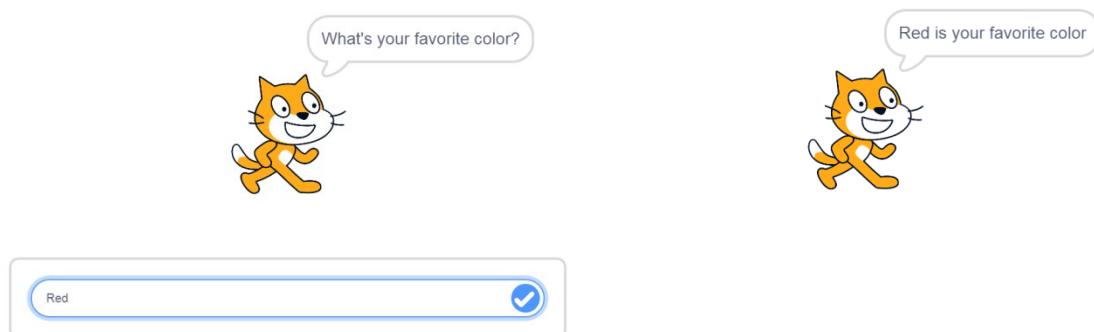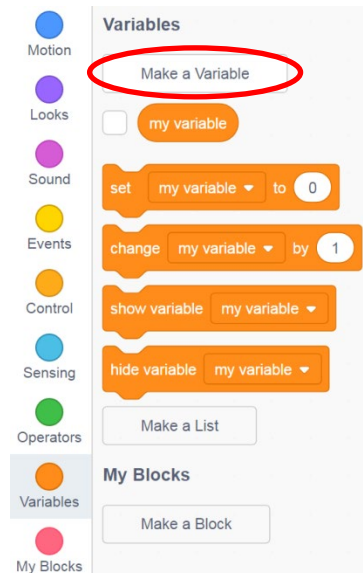

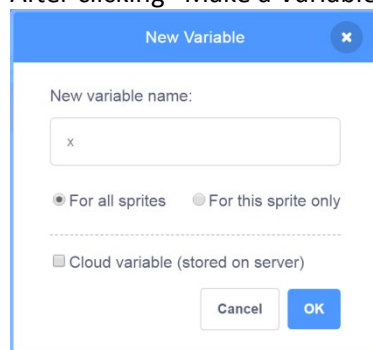2) Modify your program from 1) such that it will output the message "I learn that [color] is your favorite color"
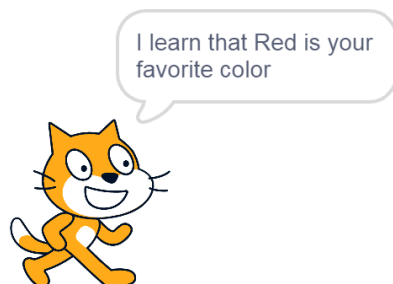
Hint: use 2 join blocks.
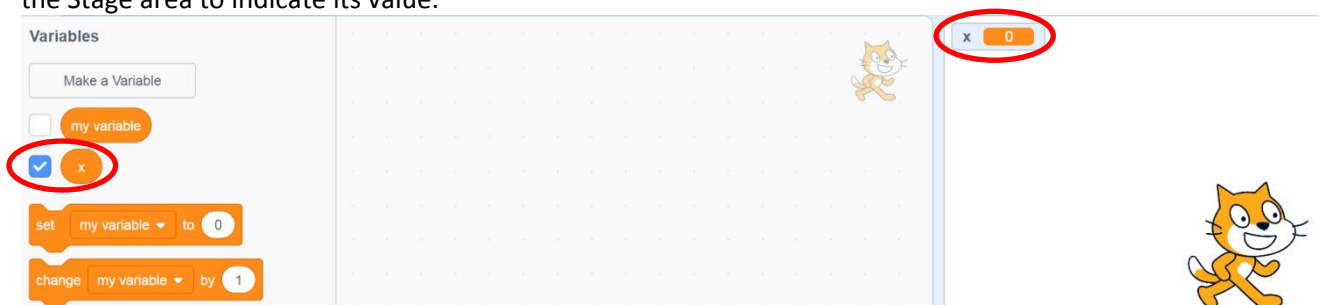
Task 1.8 Variables and numbers

You can create variables under Variables block category:

After clicking "Make a Variable" button, a window will pop up. Enter x as the new variable name and click OK.

Now you would see this variable x as a block that you can drag to use it and the variable display is shown on the Stage area to indicate its value.

The Operators block category provides some blocks for mathematical operations such as addition, subtraction, multiplication and division.
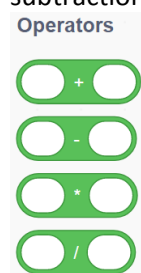
Exercise 1.8:

1) Other than x, create 5 more variables y, z, i, j, k
2) Construct the following code blocks. Observe the initial variables on the variable display. After clicking on each code block, observe the final values of these variables.

```
set  i ▼  to  0
set  j ▼  to  ( i  +  1 )
set  k ▼  to  ( j  /  4 )
```

x	0
y	0
z	0
i	0
j	0
k	0

```
set  x ▼  to  2.4
set  y ▼  to  ( 0.8  *  x )
set  z ▼  to  ( y  -  x )
```

x	2.4
y	1.92
z	-0.48
i	0
j	1
k	0.25

3) After running the following code block, what will be the values of i,j,k? First try to trace the code line by line and determine the expected value of each variable after each line (without using the computer). Then verify your answer by constructing the code block in Scratch and observe the output in the variable displays.

```
set  k ▼  to  2
set  k ▼  to  ( k  *  k )
set  i ▼  to  ( k  *  k )
set  j ▼  to  ( i  /  k )
```

Task 2   Challenge your classmates

You can first reflect on what you have learnt in this lab, and then come up with problems to challenge your classmates. You can post your problem on the Canvas course page, under this [Discussion page](#). One should be able to solve your problem by using what he/she learns in Lab 01. You will not get extra marks by posting a challenging problem or solving a challenging problem posted by another student, but you will earn your fame so that you can impress the course leader, the lab tutors, and your classmates.