# Computational Thinking and STEAM Activity in Game Development Makecode Arcade

# 運算思維/創客教育於遊戲設計

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2022

# STEAM & CT介紹

## STEAM，代表的是

- Science(科學)
- Technology(科技)
- Engineering(工程)
- Art藝術
- Math(數學)

目的

- 培養跨領域能力
- 培養問題解決能力
- 培養創造力

## 運算思維CT四個步驟

問題拆解(Decomposition)

模式辨別(Pattern Recognition)

抽象化(Abstraction)

演算法(Algorithm)

# STEM & CT 課程

教育者透過PPT和影片介紹軟體案硬體(設備、運作方式)

將重複的步驟和元素利用於硬體和軟體

分析重複的地方

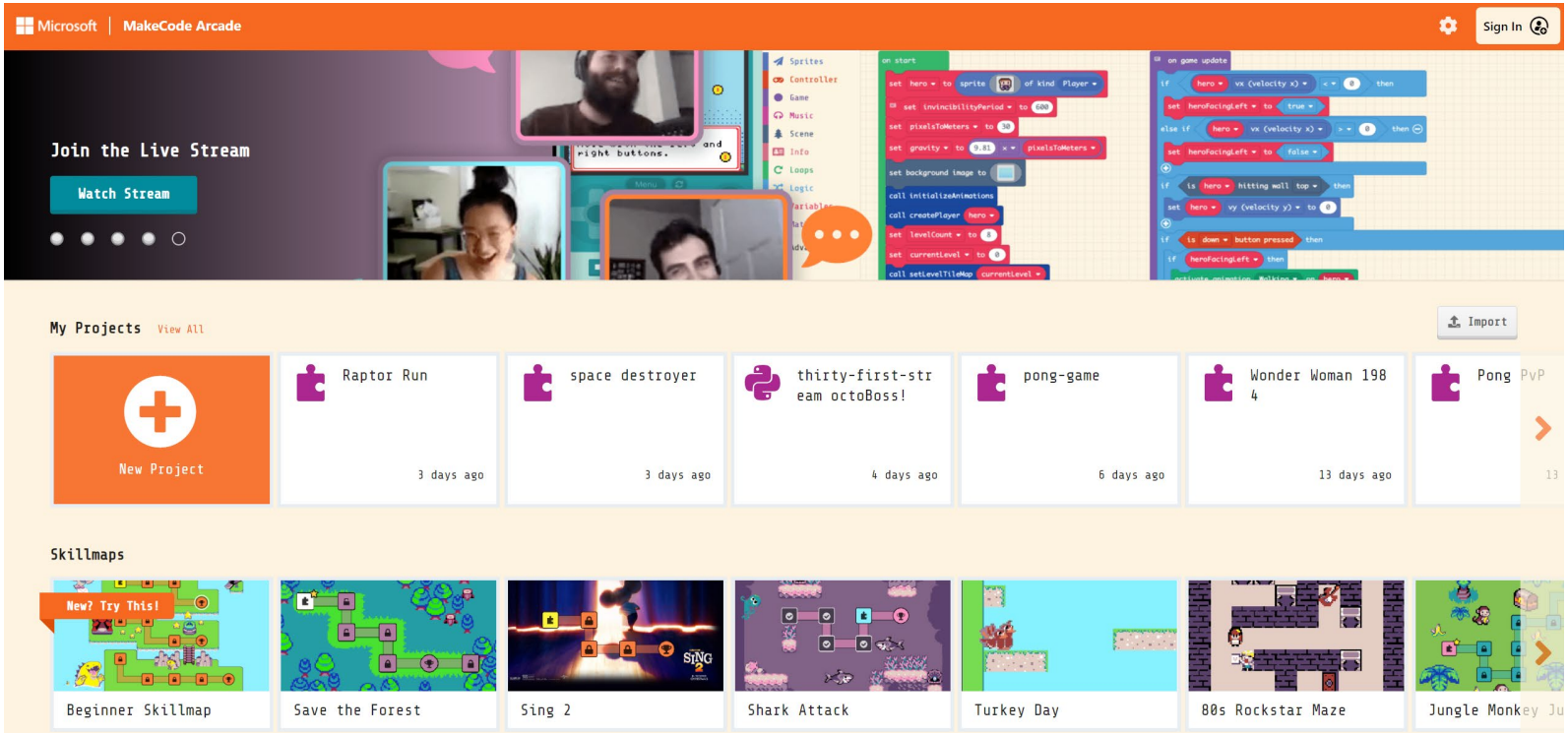
學生延伸作品

# STEAM Activity

本次學習活動包含以下STEAM跨領域學科主題

| 學科 | 涵蓋主題 |
| --- | --- |
| 科學 Science | 數位科技/物理速度、力量 |
| 科技 Technology | Makecode coding/Python/Javascript |
| 工程 Engineering | Meowbit 組裝安裝 |
| 藝術 Art | 圖樣設計/角色設計 |
| 數學 Math | 座標、向量、生命值計算、亂數 |

# Makecode
# https://arcade.makecode.com/



# What is Makecode

Microsoft MakeCode 是免費的開放原始碼平台，用於創造生動有趣的電腦科學學習體驗，並支援邁向真實世界程式設計之路。

# Makecode好處

## 什麼是 Microsoft MakeCode？

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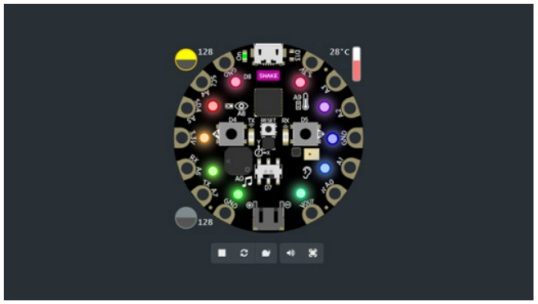
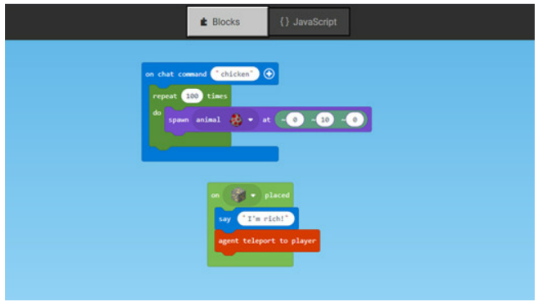


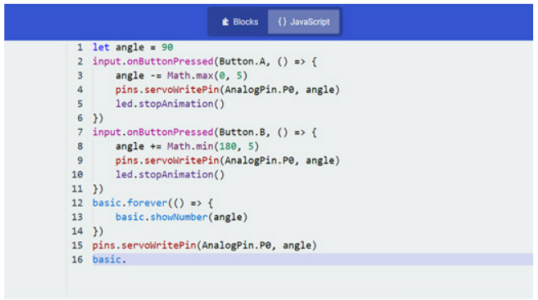
### 模擬器

互動式模擬器為學生的程式執行情況提供即時回饋，方便他們測試程式碼並進行偵錯。




### 積木編輯器

編碼初學者可以從彩色積木開始著手，將積木拖放至工作區來建構程式。

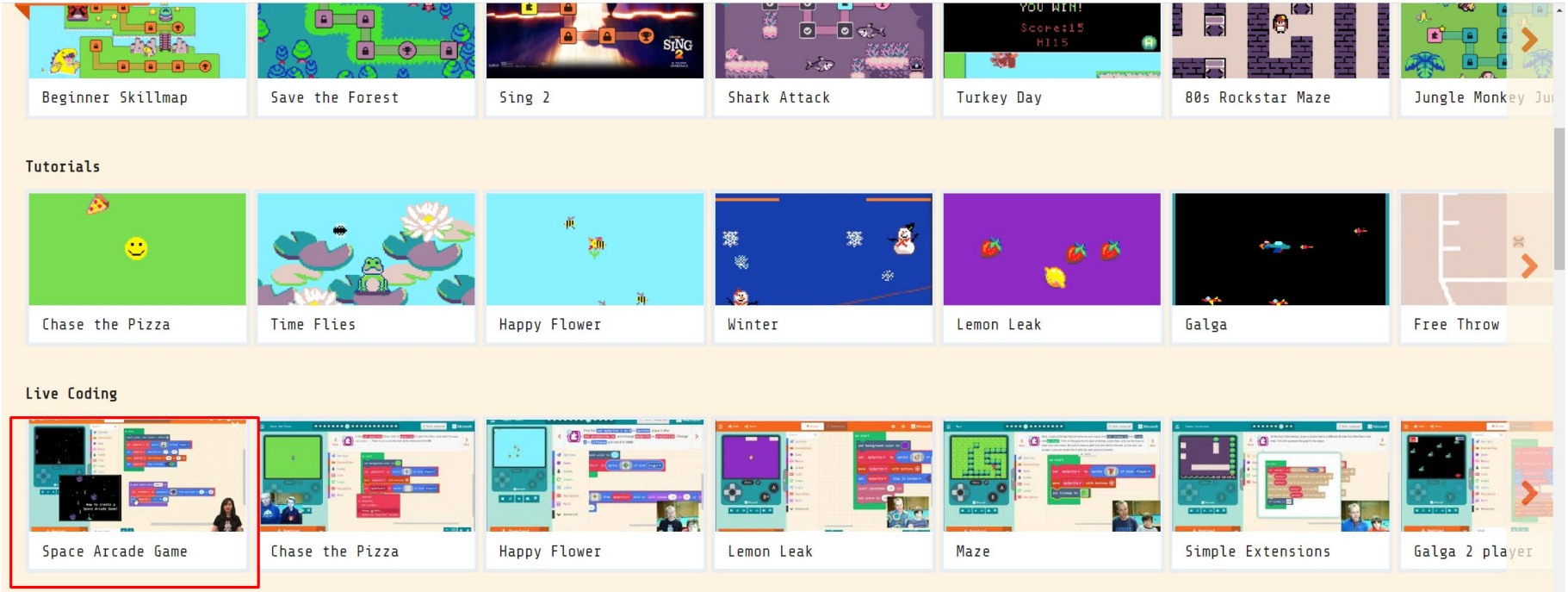



### JavaScript 編輯器

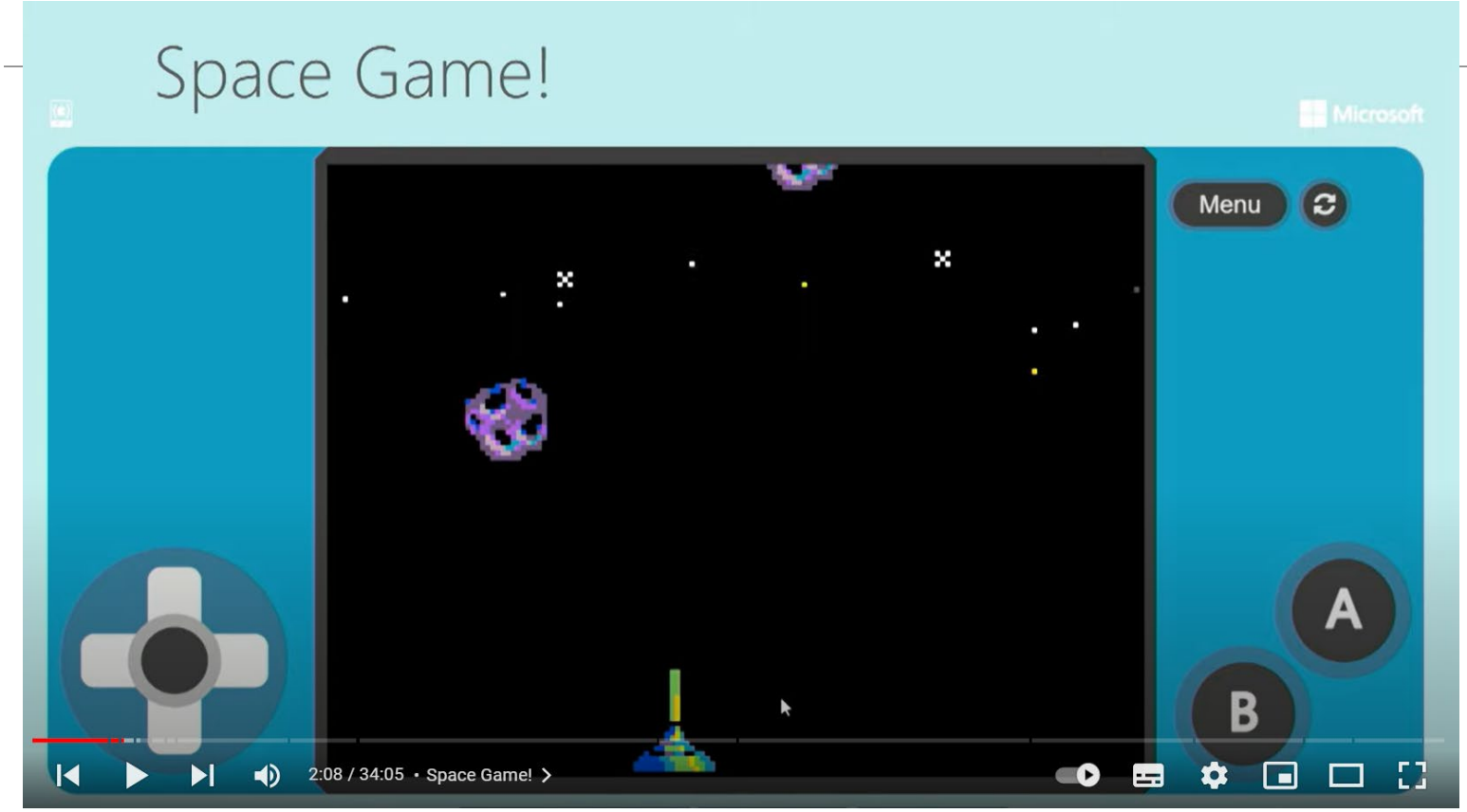
在準備就緒時，學生可以使用具備程式碼片段、工具提示和錯誤偵測、功能完整的 JavaScript 編輯器，協助他們寫程式。

# Space Destroy Game

# Live Coding
# Space Arcade Game



# 觀看線上教材&完成程式




https://www.youtube.com/watch?v=7pBGS_tKfmU&list=PLMMBk9hE-SepPgF7YE099S-VluvZmRkO0

# 導入Meowbit
# 實際上手玩玩看

# Meowbit

Meowbit是款具有1.8吋螢幕，並採用ARM Cortex M4微控制器的迷你電腦，使用者不但可以在上面執行遊戲，還可以利用6個可程式化按鍵、感應器，以及透過多個I/O端子連接各種周邊配備，將Meowbit改造為物聯網裝置，可以做為創客遊戲開發工具。

# Meowbit

Meowbit的螢幕尺寸與解析度分別為1.8吋、160 x 128。

# Meowbit

Meowbit 的 核 心 為 搭 載 Arm Cortex M4 微控制器的STMicro STM32F401RET6，並具有6個可程式化按鍵、光線感應器、溫 度 感 應 器 、 蜂 鳴 器 、 microSD讀卡機、Micro USB，以及多個I/O端子。使用者不但可以透過I/O端子串接2台主機進行多人遊戲，還可連接多種周邊配備以及micro:bit的擴充子板。

1. Charging/work indicator
2. Light sensor
3. Power switch
4. Programmable led x 2
5. Reset
6. DFU mode button
7. 160 x 128 TFT color screen
8. Temperature sensor
9. Direction button x 4
10. Buzzer
11. Button A/B
12. Compatible with micro:bit's 40 PINs Goldfinger
13. USB program download port / charging port
14. SD card slot (Use for store programs or extend wireless modules)
15. Multiplayer Connector
16. mp6050 gyroscope
17. 3.7V lithium battery package interface
18. MCU
19. 2MByte SPI-flash (default download Unicode character table)
20. Signature area

▲ Meowbit具有豐富的I/O端子，最下方匯流排為相容micro:bit的40個GPIO。

資料來源: https://www.techbang.com/posts/69473-meowbit-ultra-mini-earth-gun-game-console-can-also-be-used-as-a-development-board

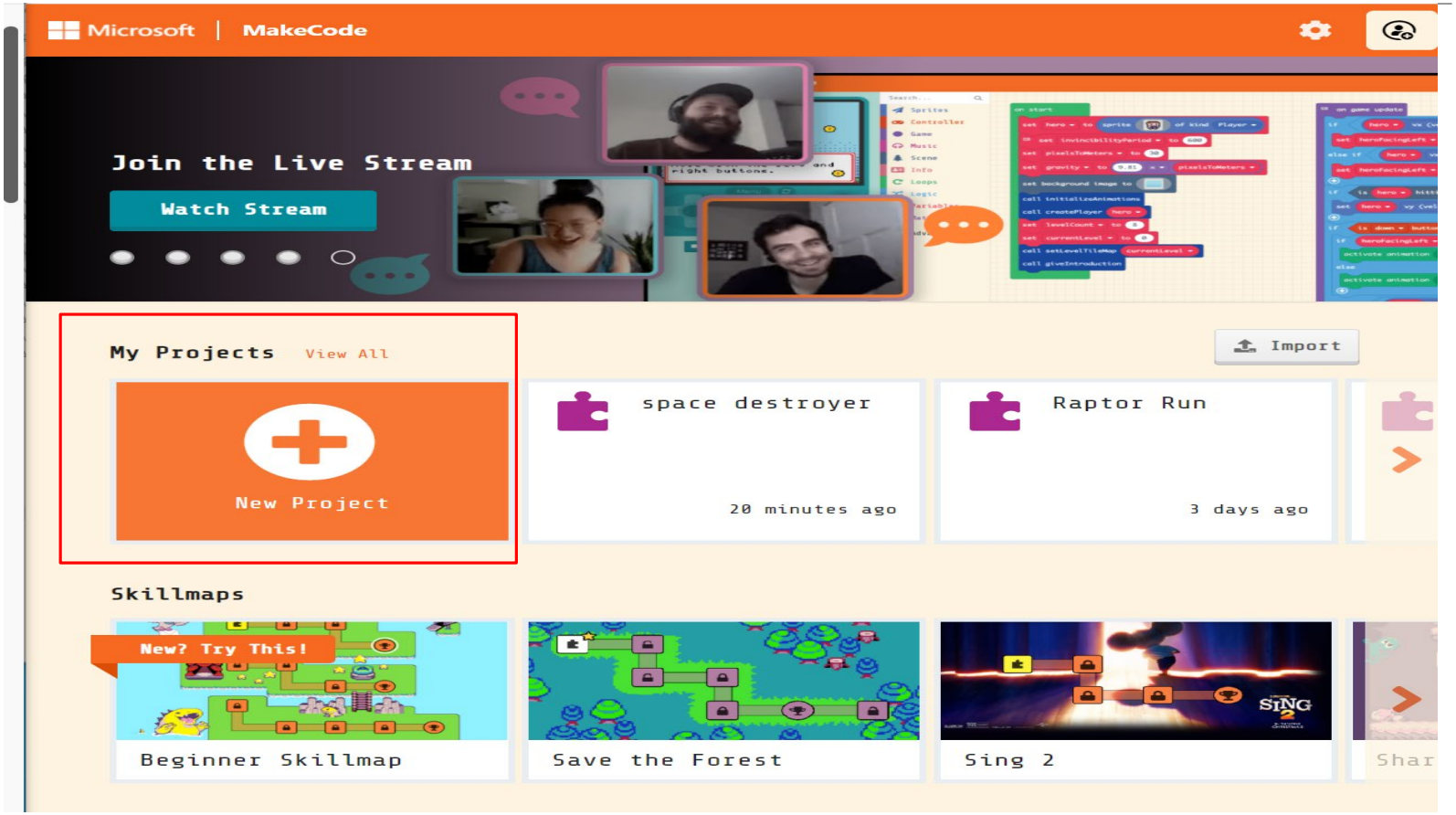
# 注意安裝方式如右

# 安裝鋰電池

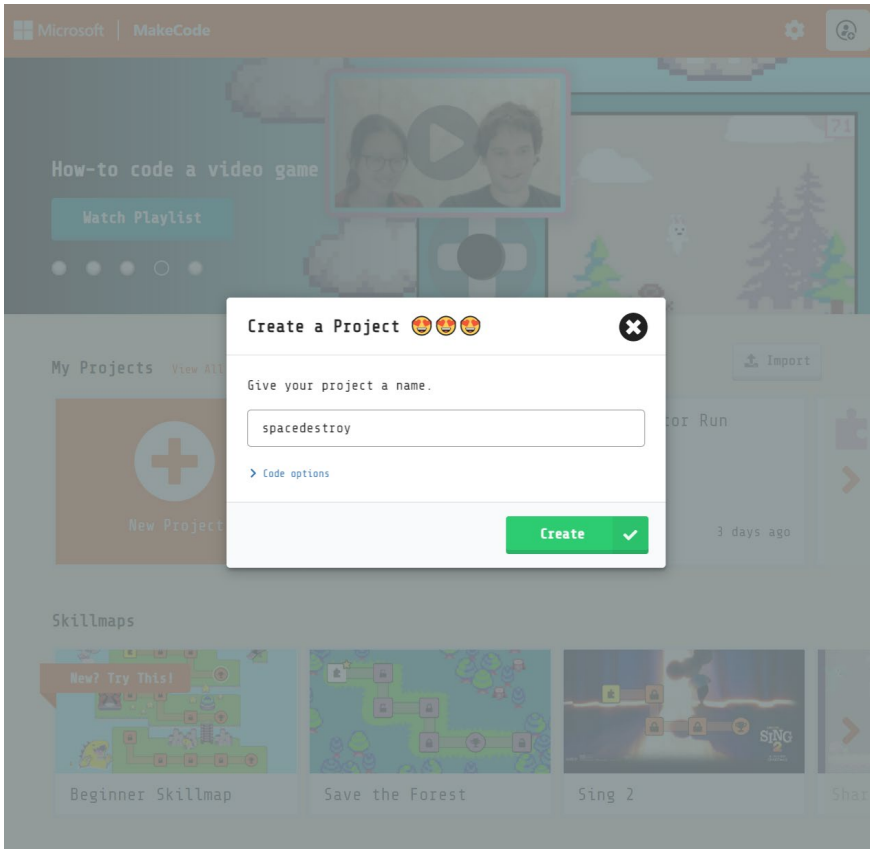
安裝完成

# 實作
# Space Destroy Game

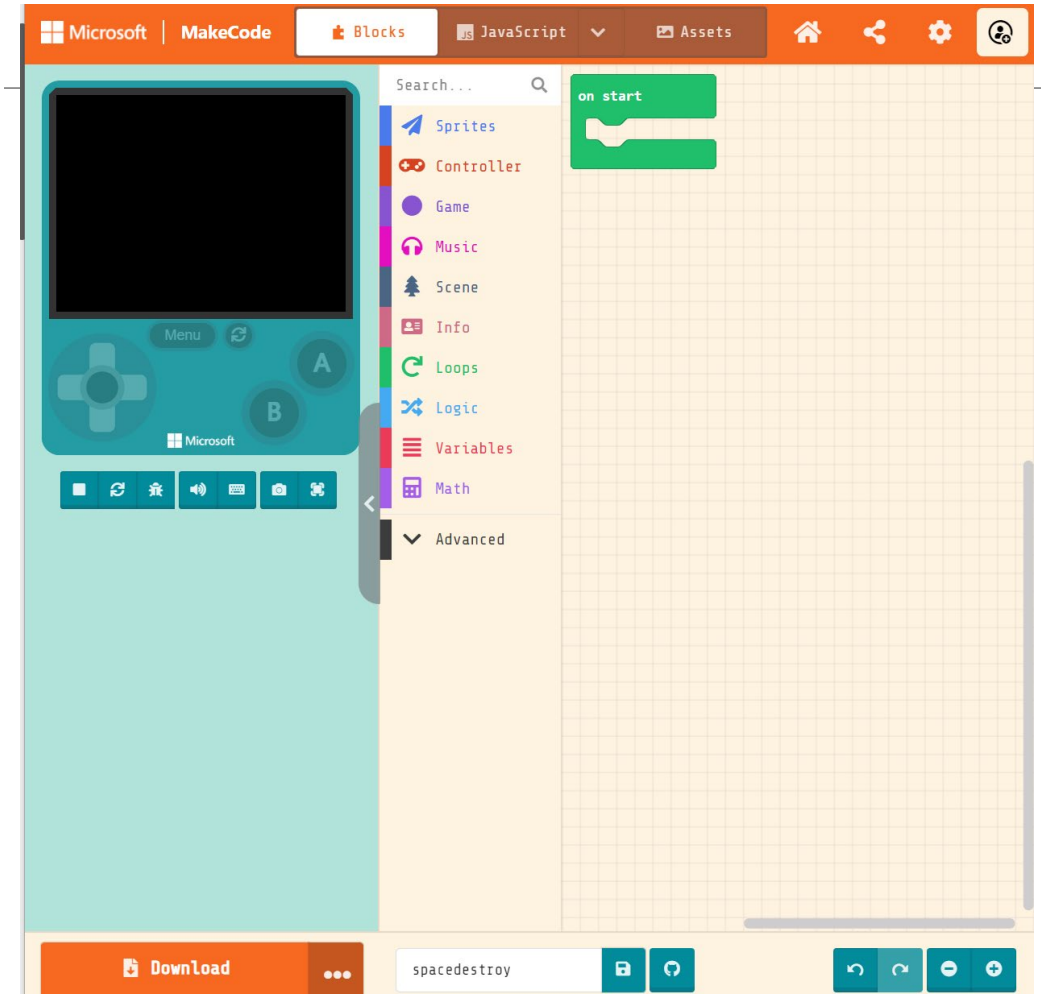
# New Project


Microsoft | MakeCode
Join the Live Stream
Watch Stream
My Projects
View All
Import
New Project
space destroyer
20 minutes ago
Raptor Run
3 days ago
Skillmaps
New? Try This!
Beginner Skillmap
Save the Forest
Sing 2

# Project name -> spacedestroy

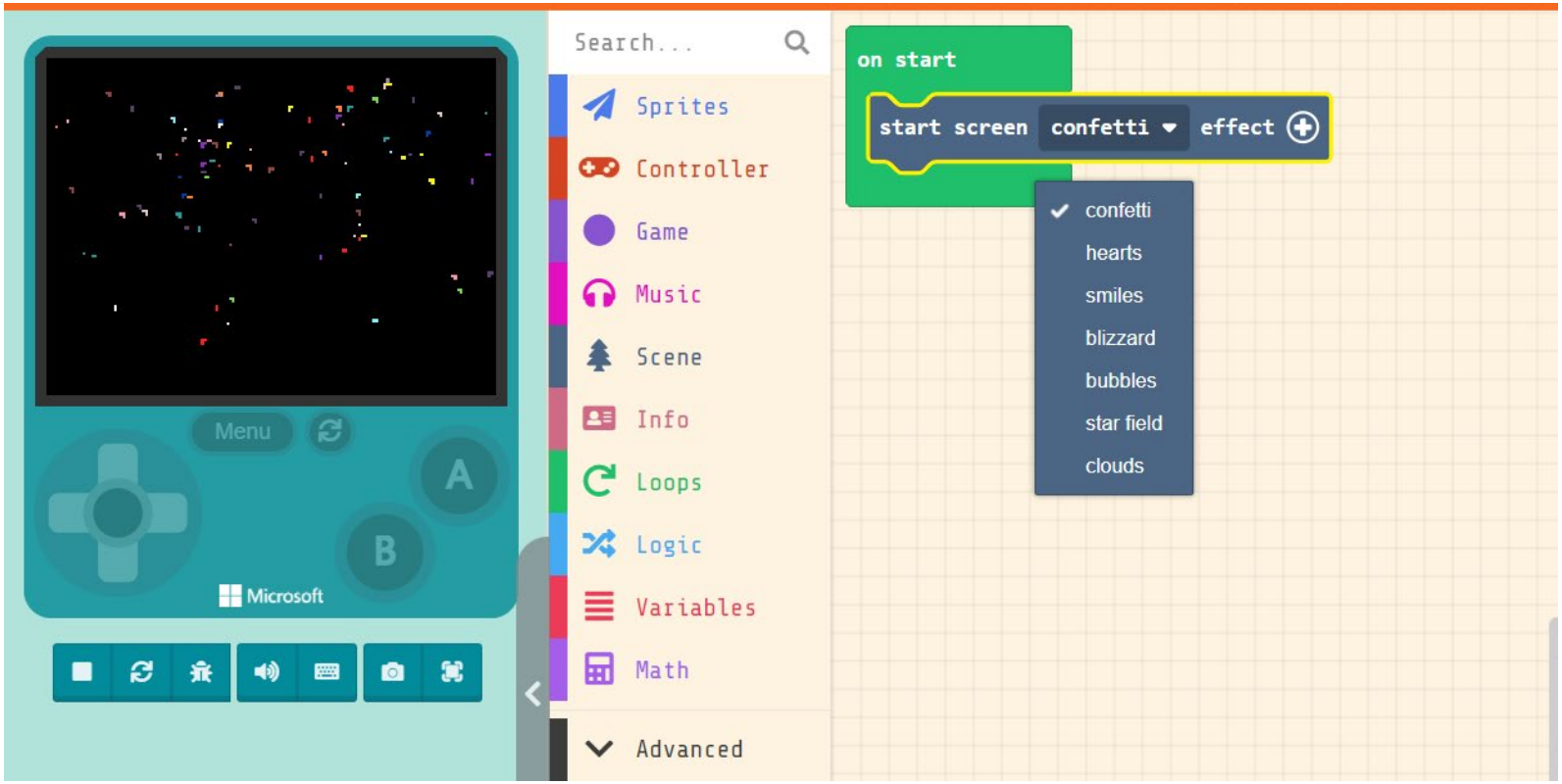


# Editor

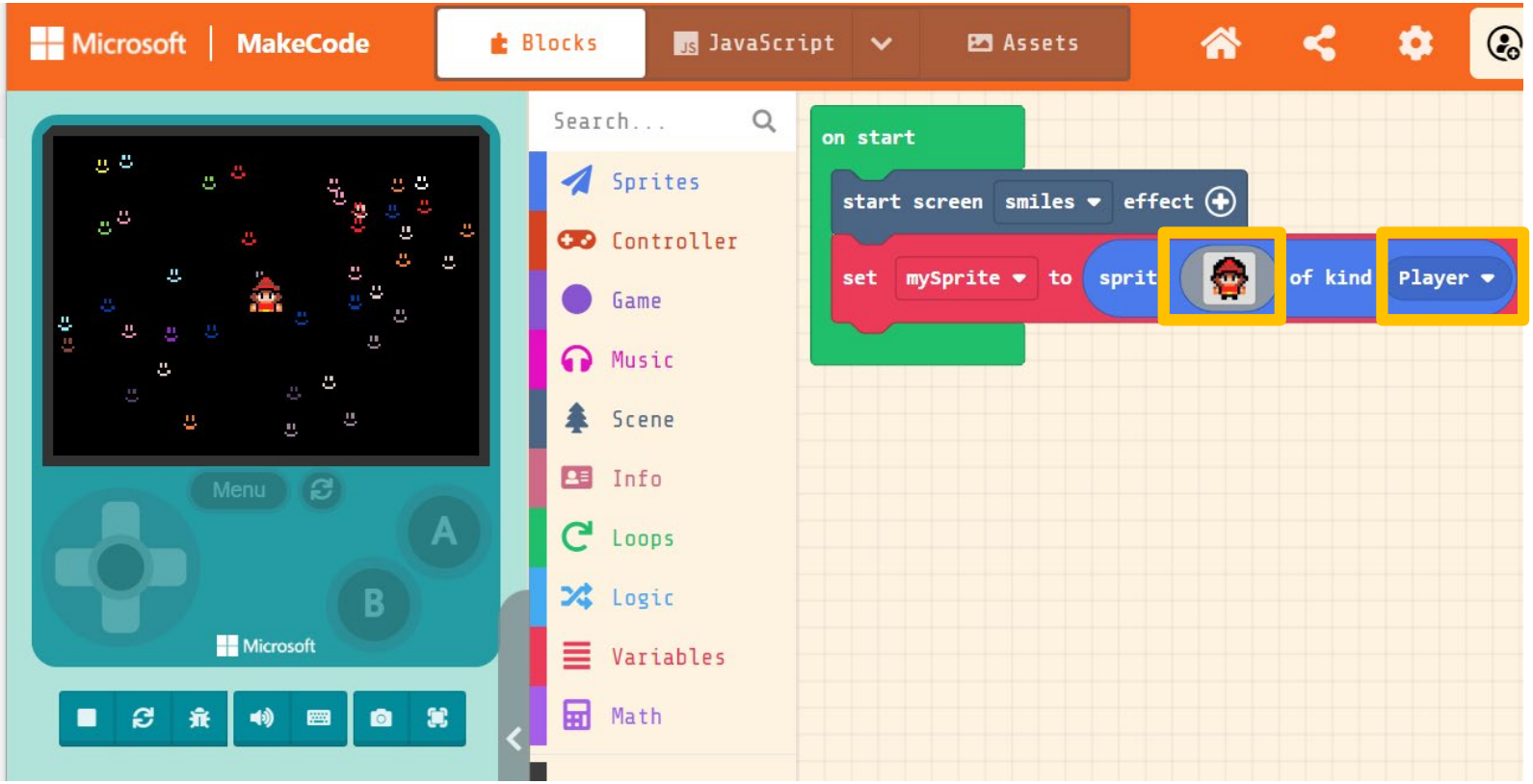

Microsoft
MakeCode
Blocks
JavaScript
Assets
Search...
Sprites
Controller
Game
Music
Scene
Info
Loops
Logic
Variables
Math
Advanced
on start
Menu
A
B
Microsoft
Download
spacedestroy

# Part I.
# Game start initialization

# 1. 設定背景效果

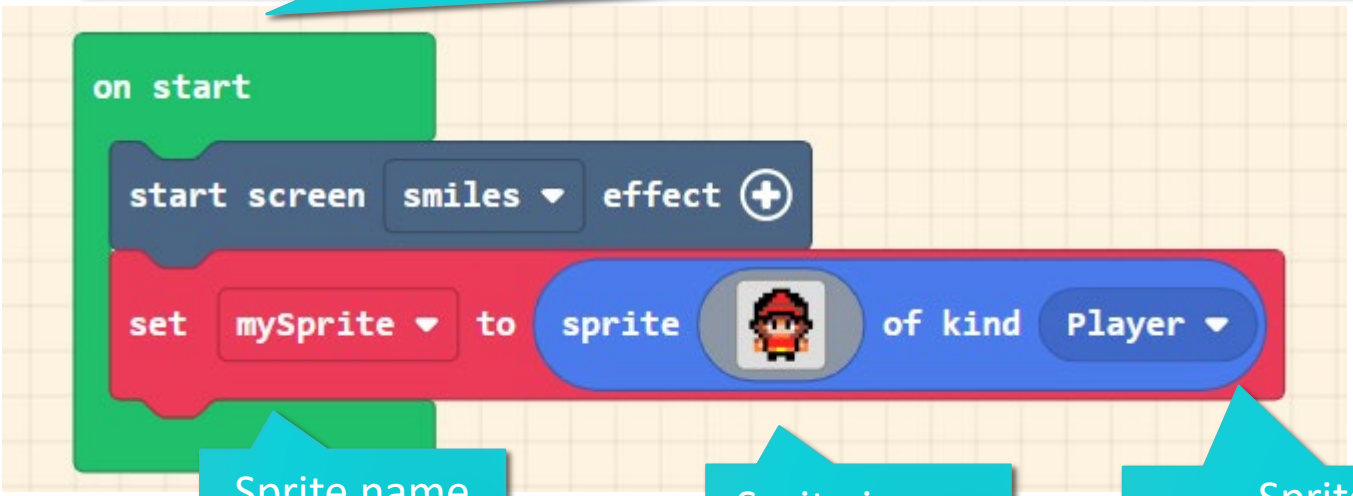

Menu
A
B
Microsoft
Search...
Sprites
Controller
Game
Music
Scene
Info
Loops
Logic
Variables
Math
Advanced
on start
start screen confetti effect
confetti
hearts
smiles
blizzard
bubbles
star field
clouds

# 2. Set/design & select your sprite type



# 2. Set/design & select your sprite type

The codes in On start block will run immediately when the game start.



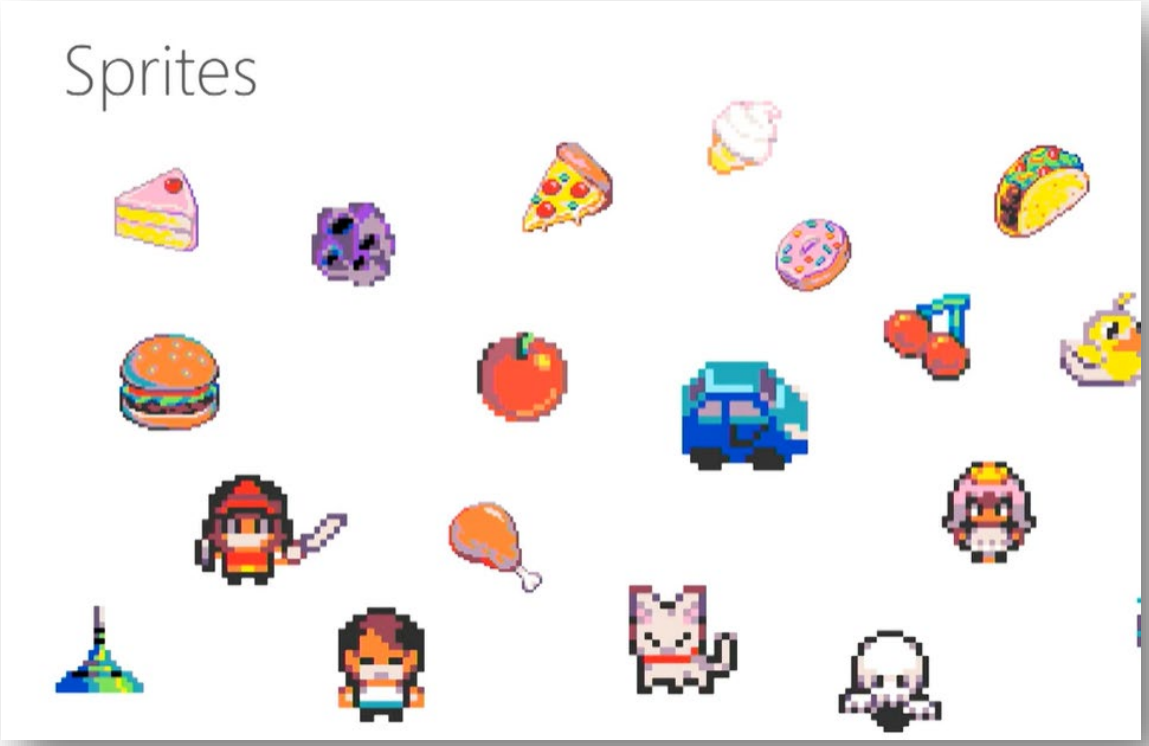

Sprite name

Sprite image

Sprite type
such as Player,
Enemy, ....

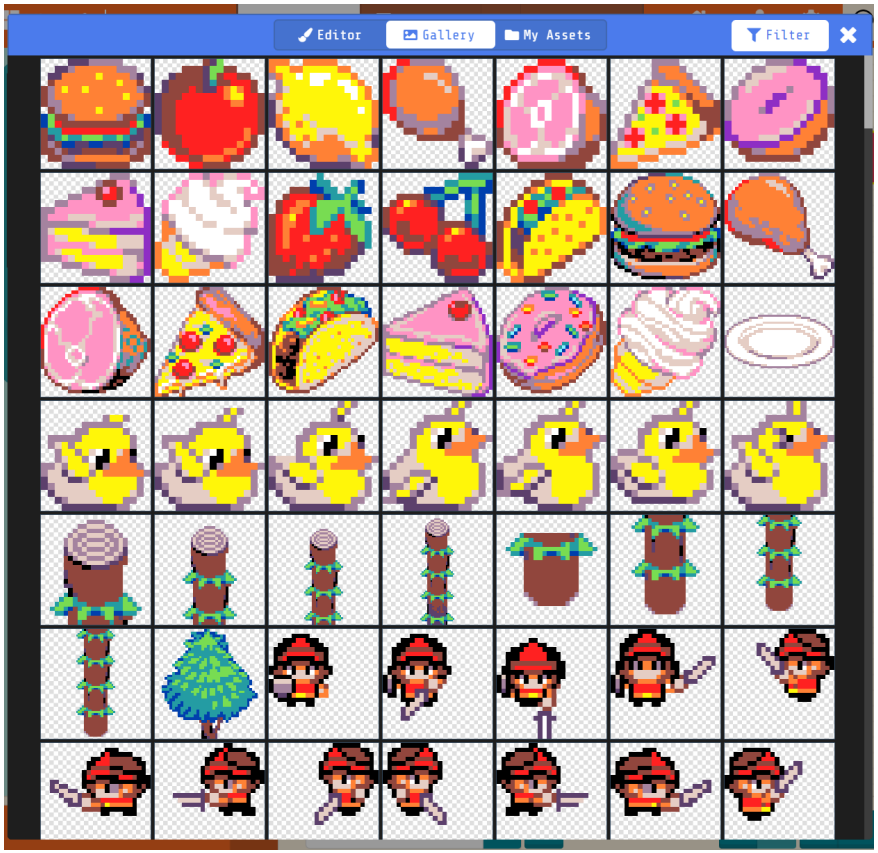
# What is sprite

The object in the game such as player, enemy.
遊戲裡面的物件，例如主角、敵人

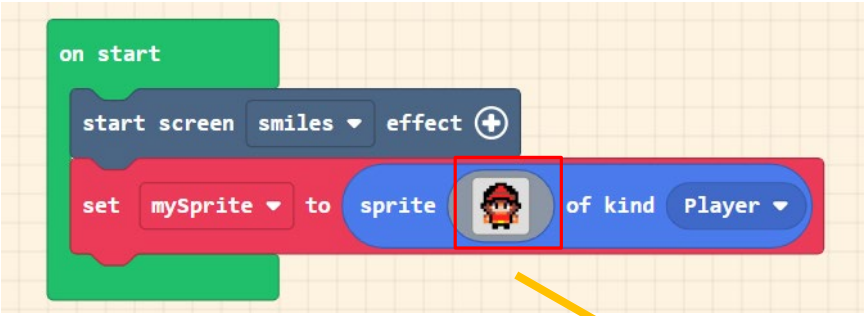


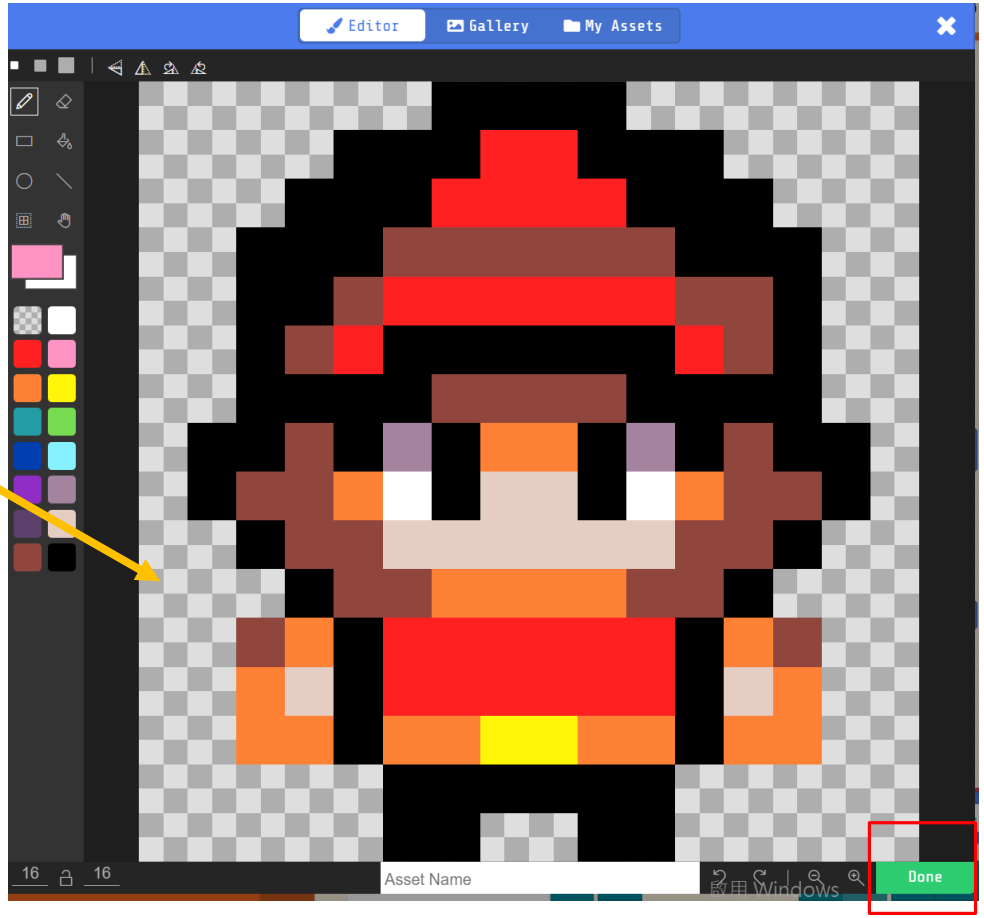

Build-in
Sprite image
In Makecode

# Build-in sprite (Gallery)

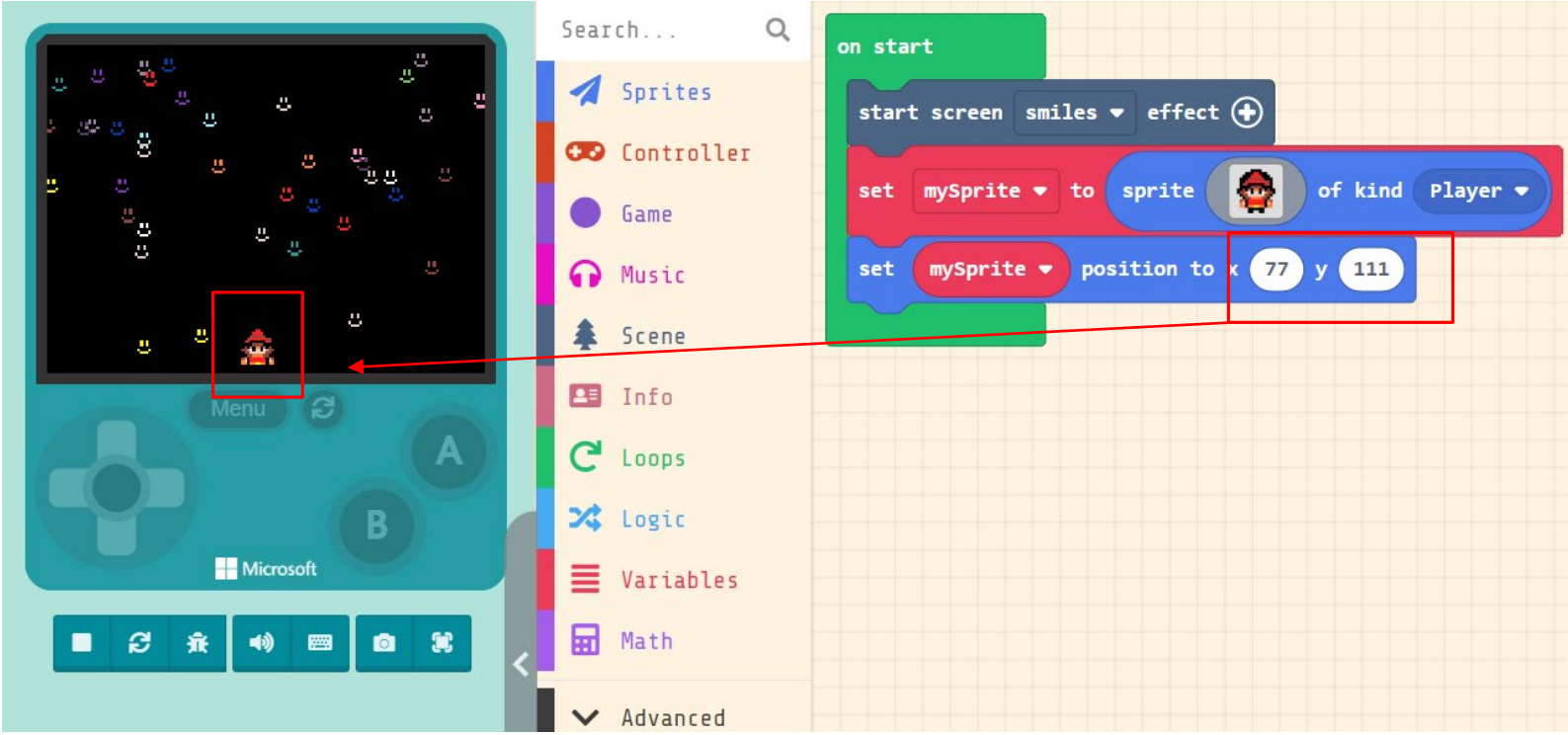


# Create/design your own Sprite



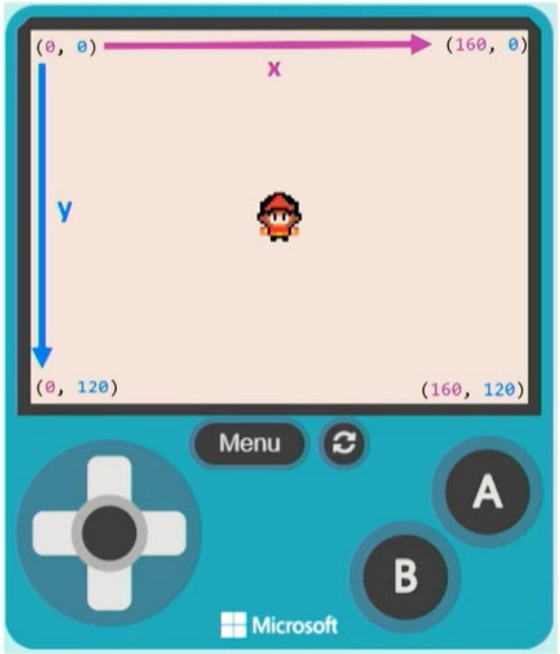
# 3. Set sprite position (x,y)->(77,111)



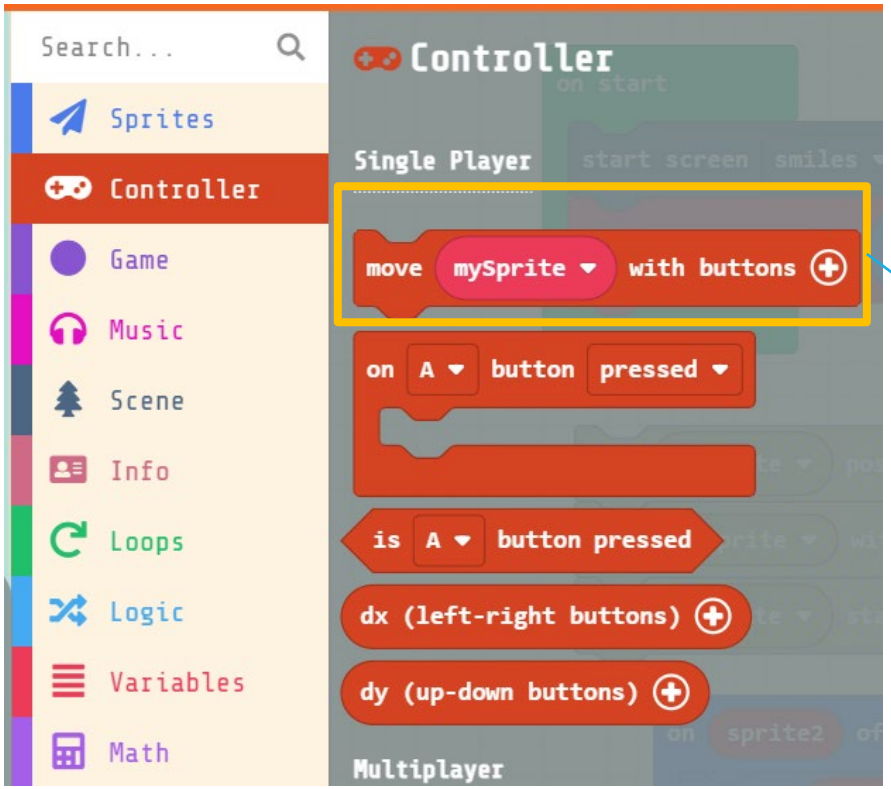
# Coordinates in Arcade (座標系統)

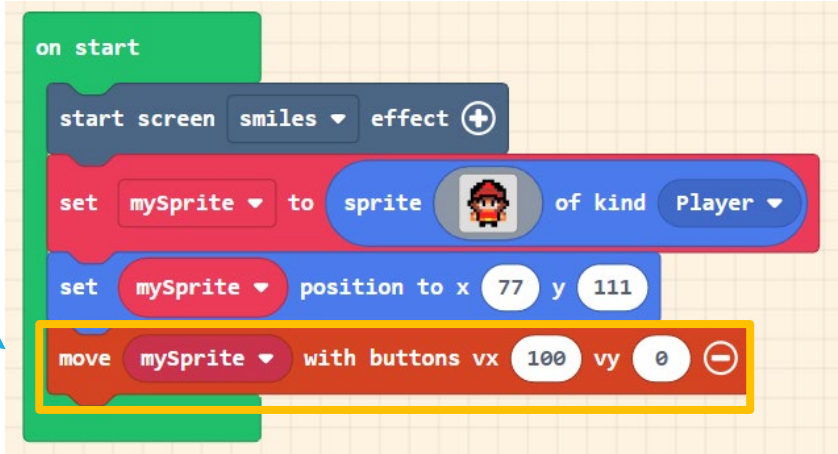
## Coordinates

The Arcade game screen dimensions are 160 width x 120 height

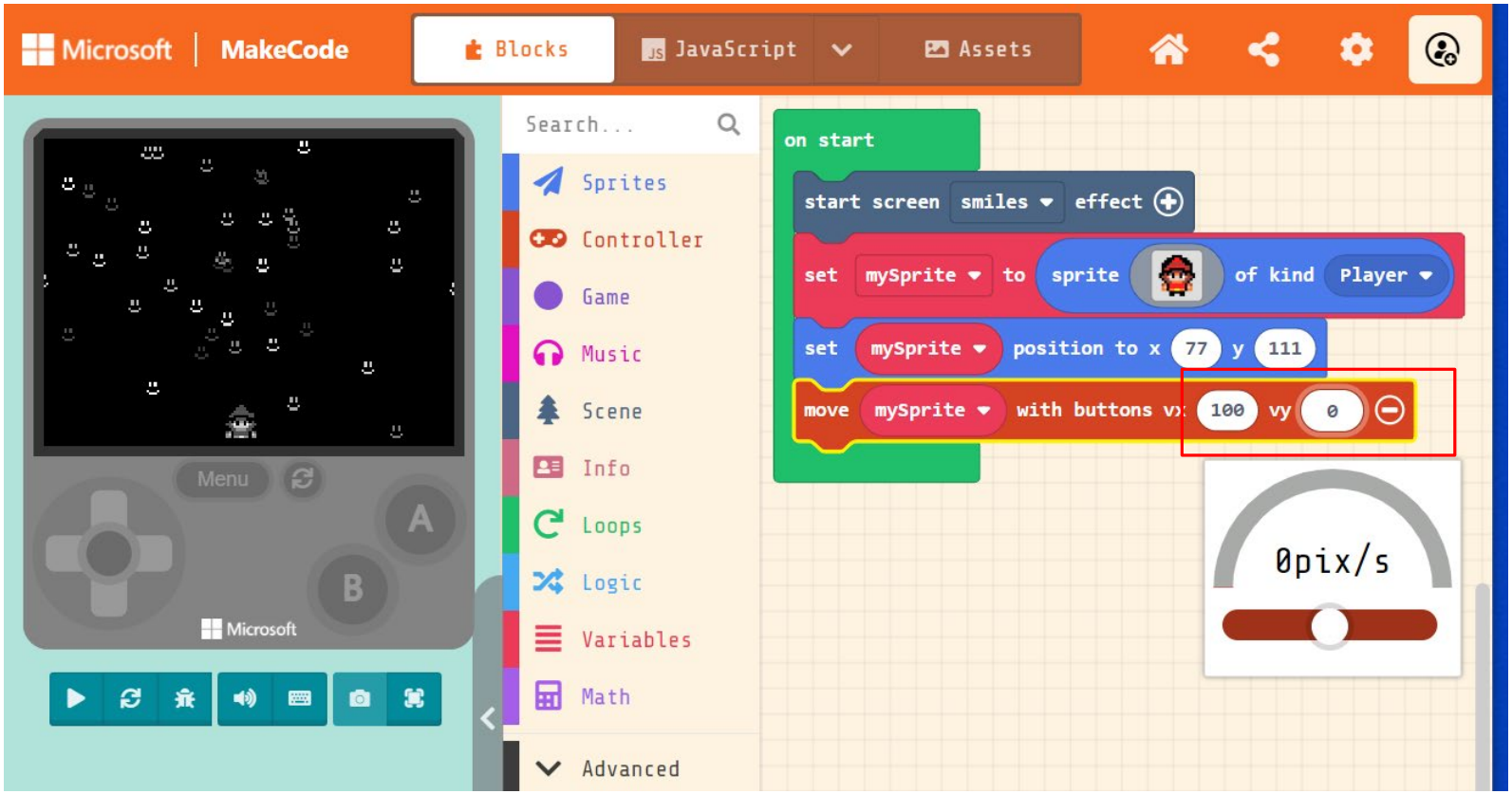


# 4. Control the movement of spaceship

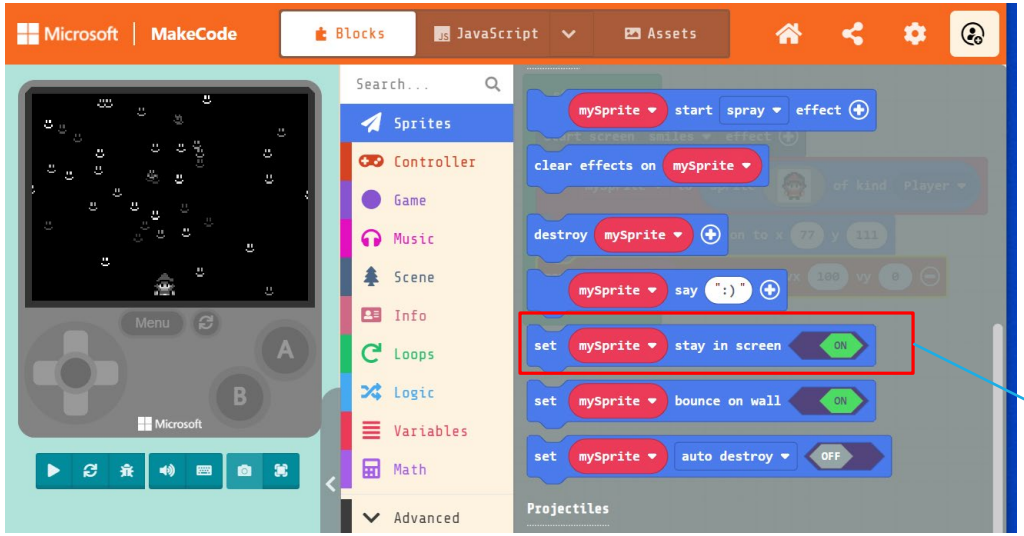


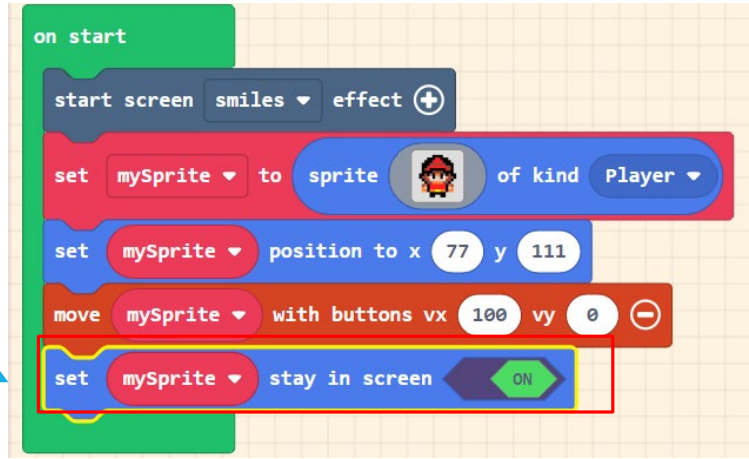



# 4. Set my sprite movement vx: 100, vy: 0

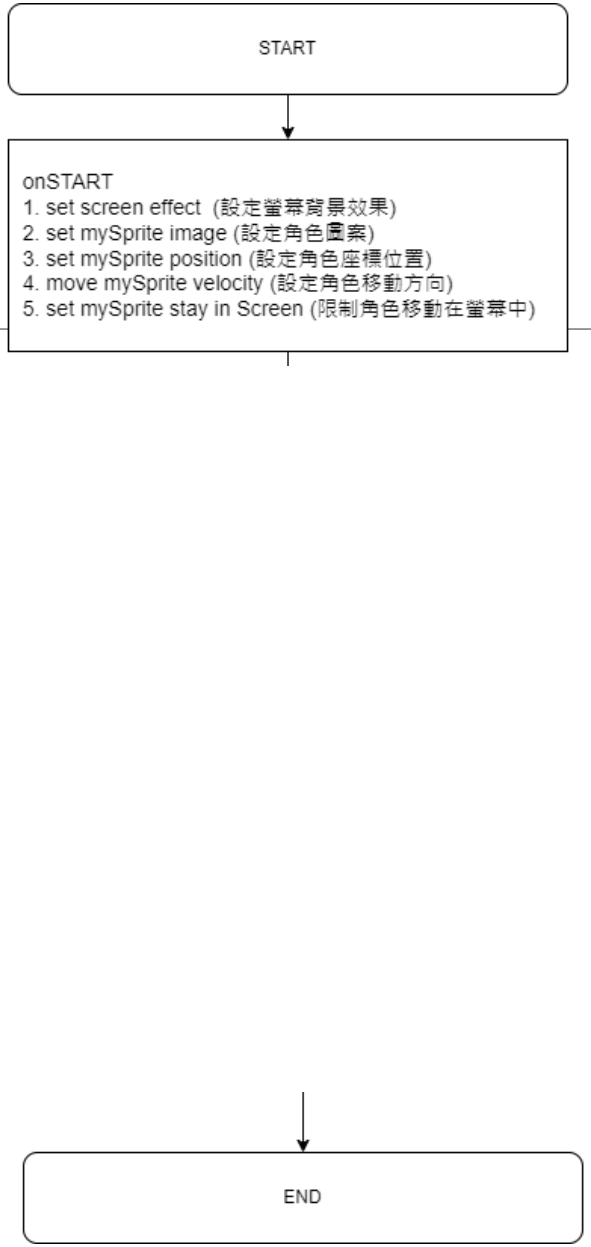


# 5. Keep your spaceship on the screen



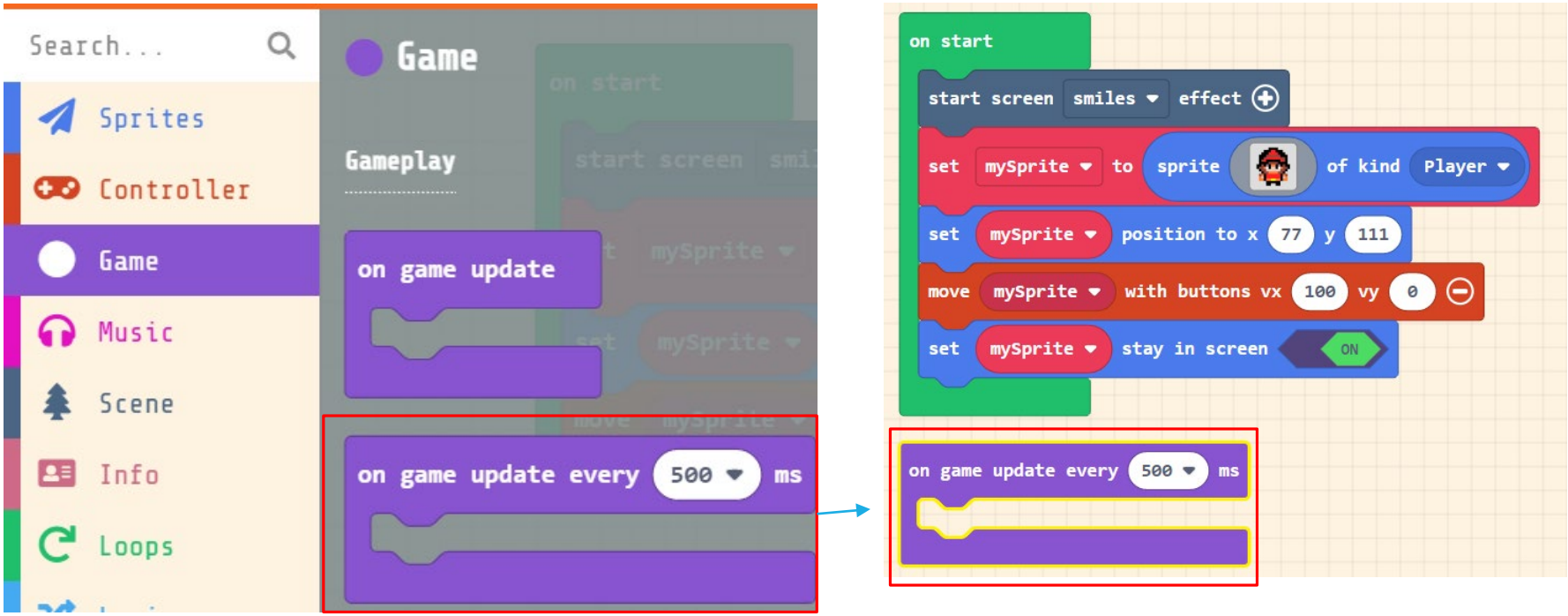



# flowchart


START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
END

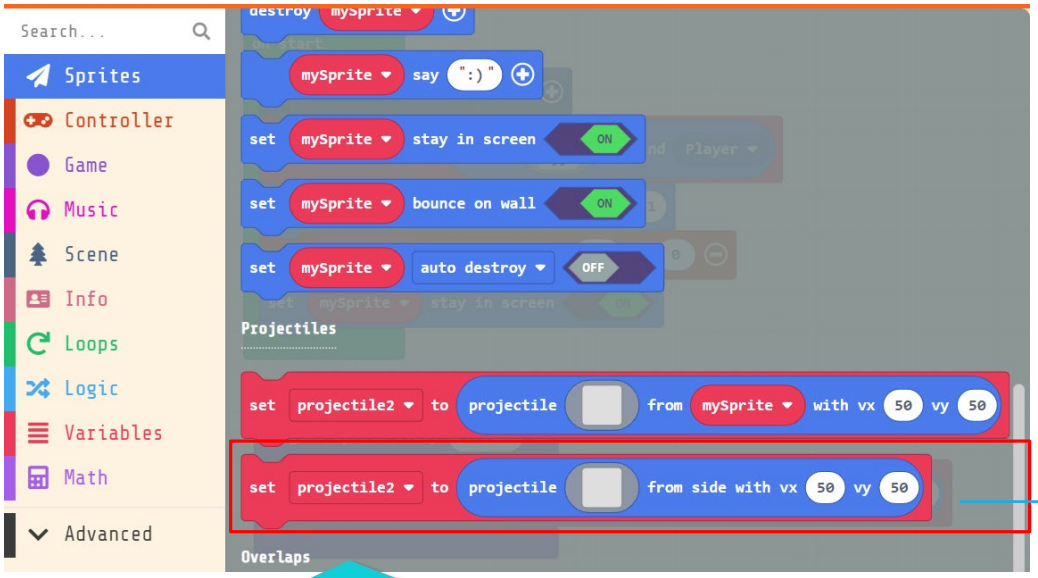
# Part II
# Game update event

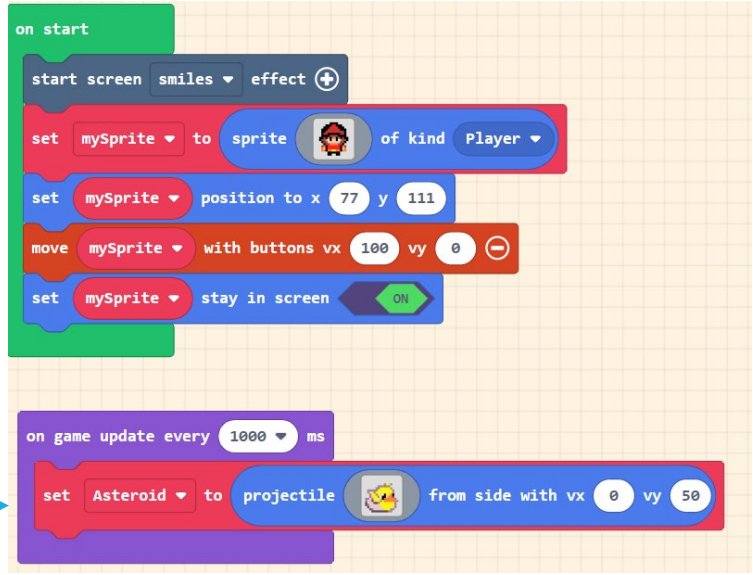
# 6. Make an Asteroid fall every 1 second



# 7. Set projectile

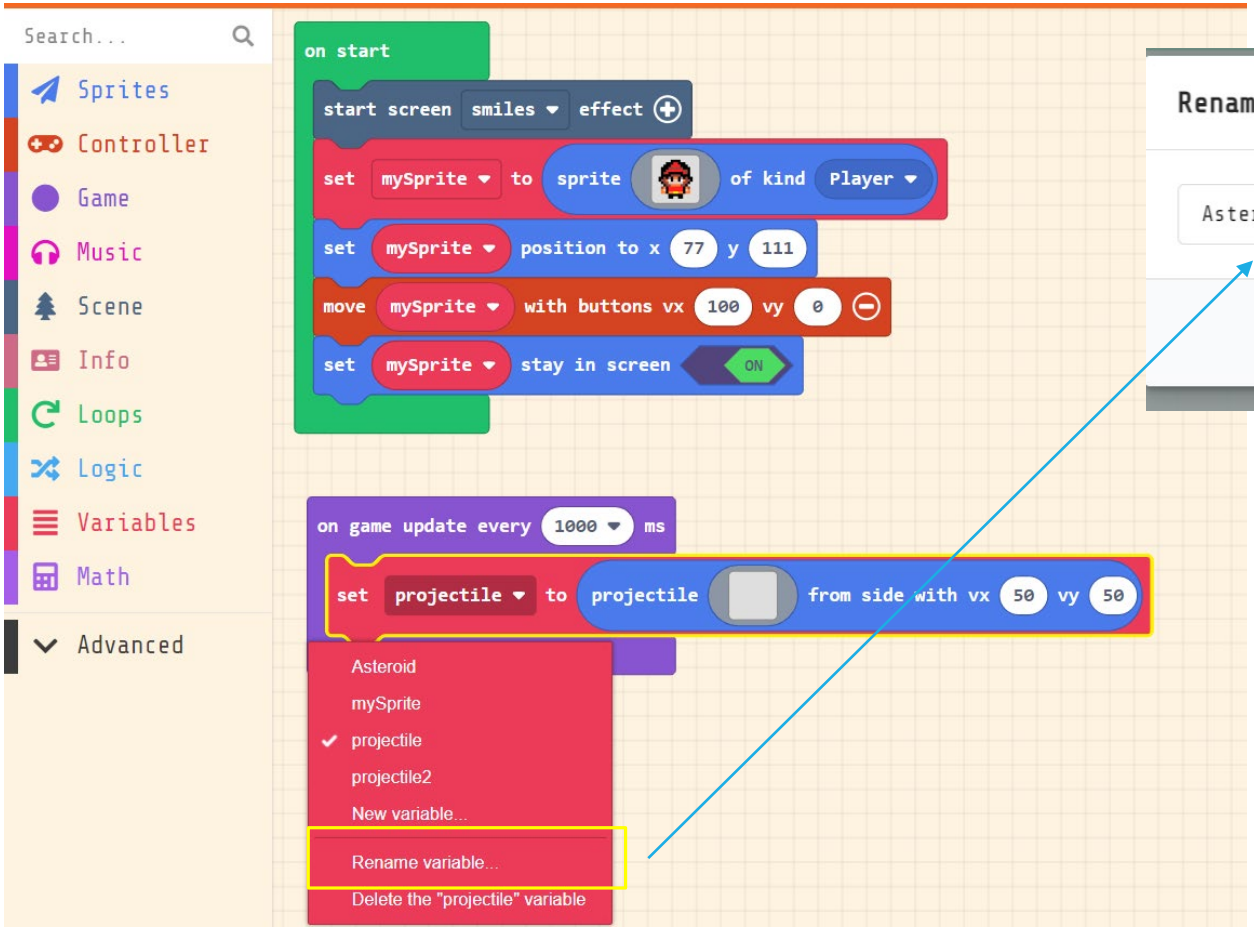
## Sprites->set projectile -> on game update block

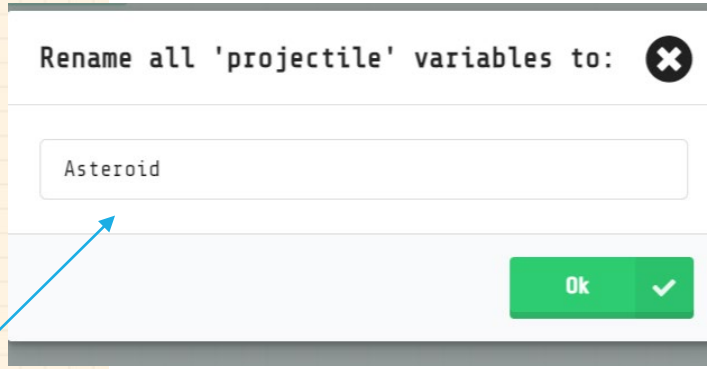


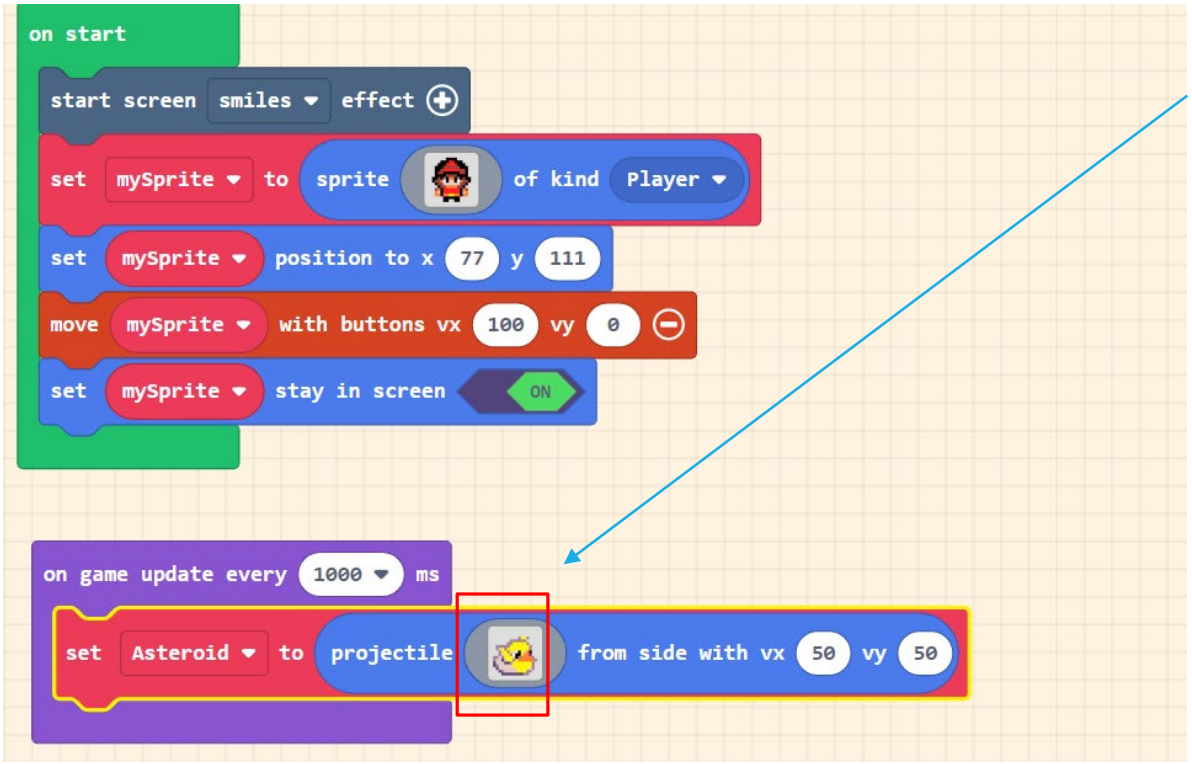

The projectile type is the object can move by itself such as 'Enemy' in the game.

# Set projectile & rename to ‘Asteroid’



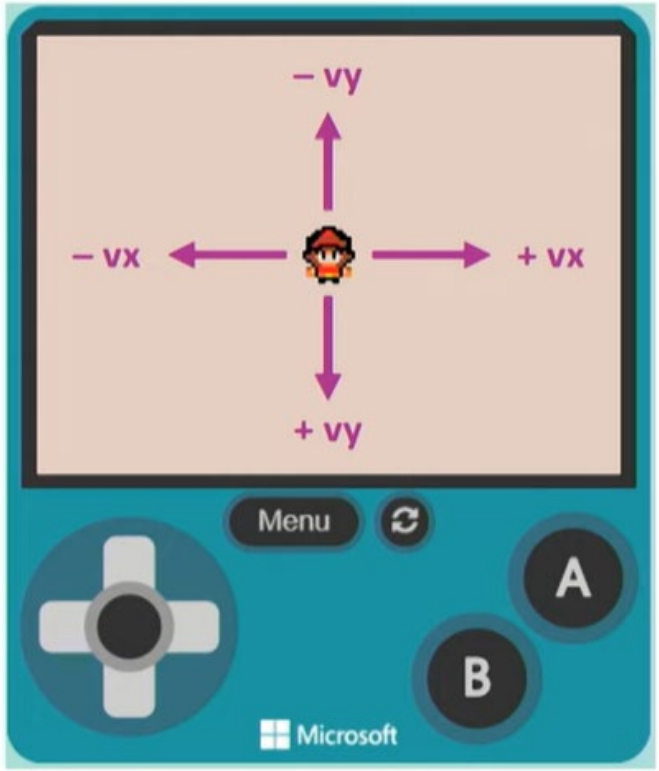



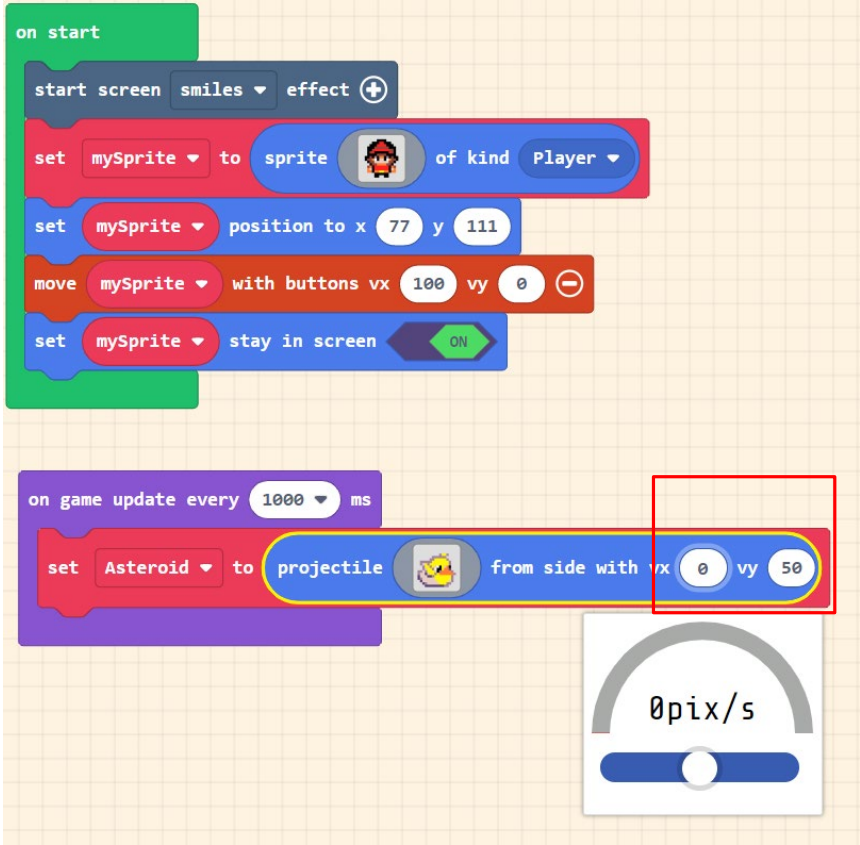
# Create your Asteroid Image



# Set Velocity = speed and direction

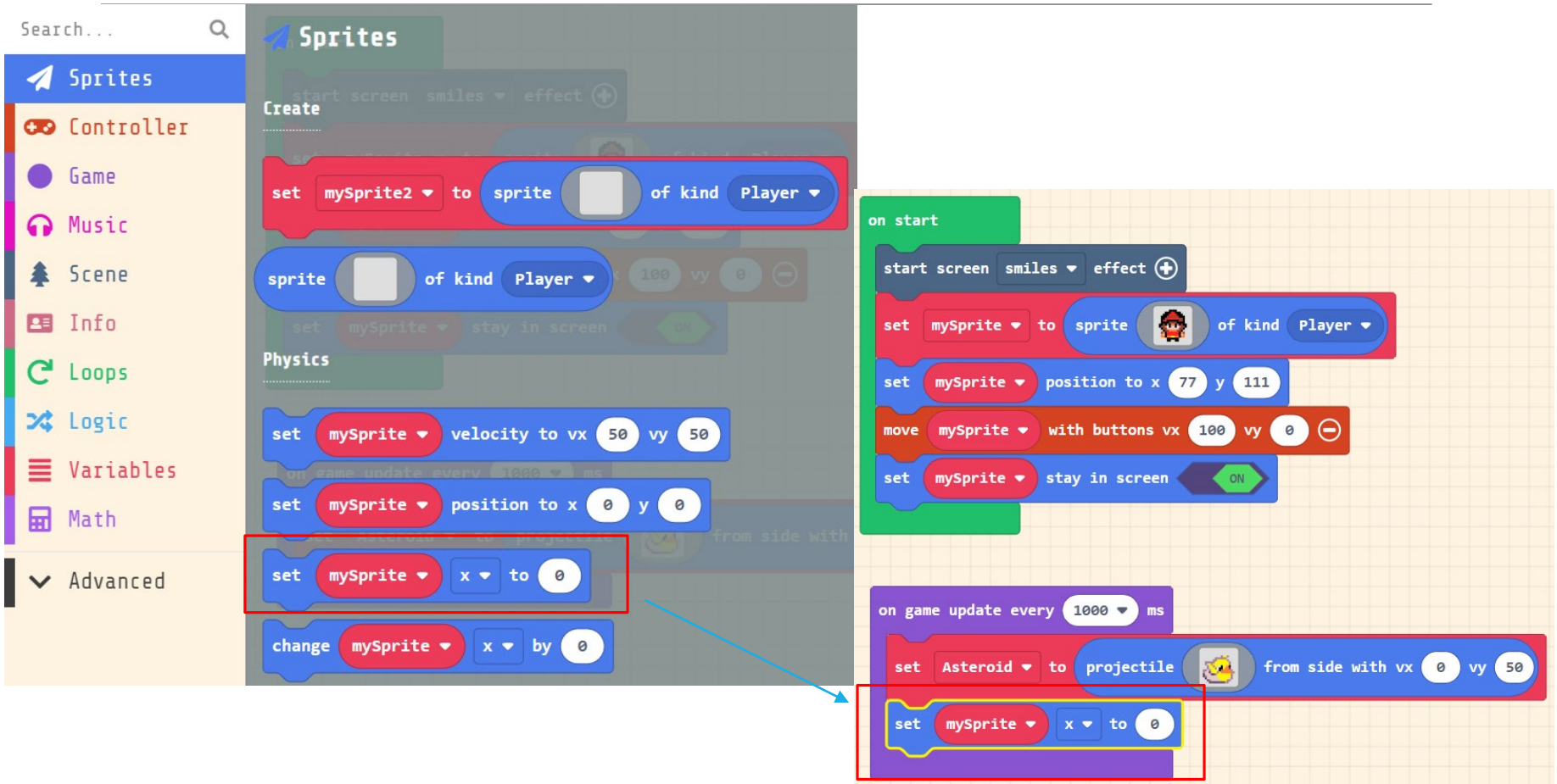
-vx: move to left + vx: move to right
-vy: move up + vy: move down



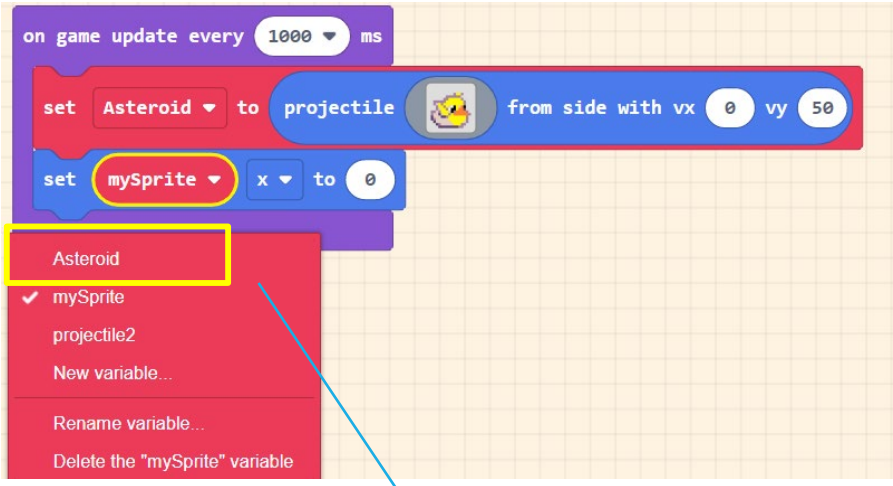



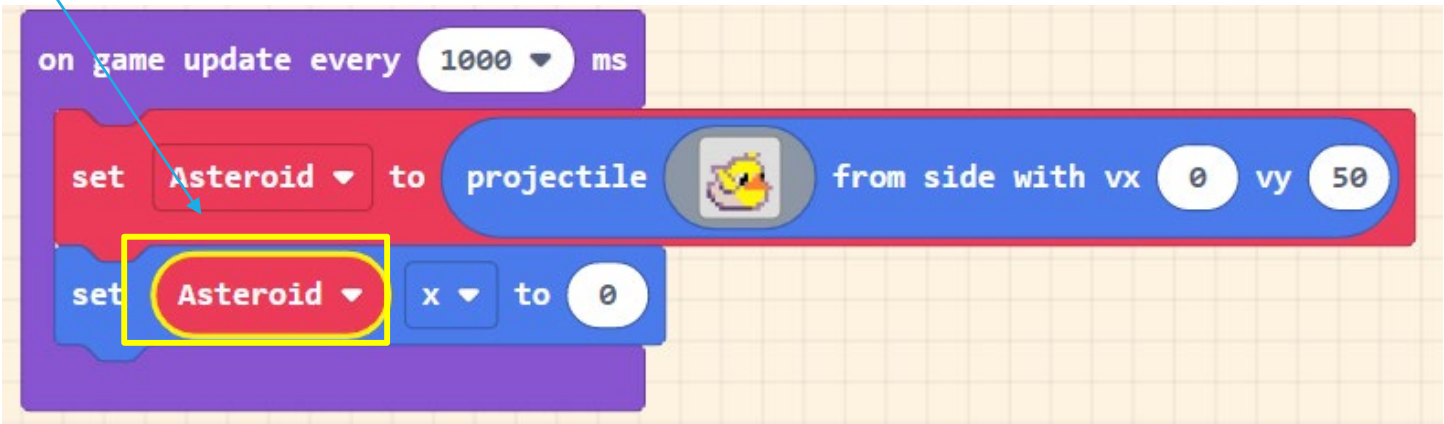
# Result: The projectile is always move down in the left side

# 8. Set the Asteroid to fall from random x locations

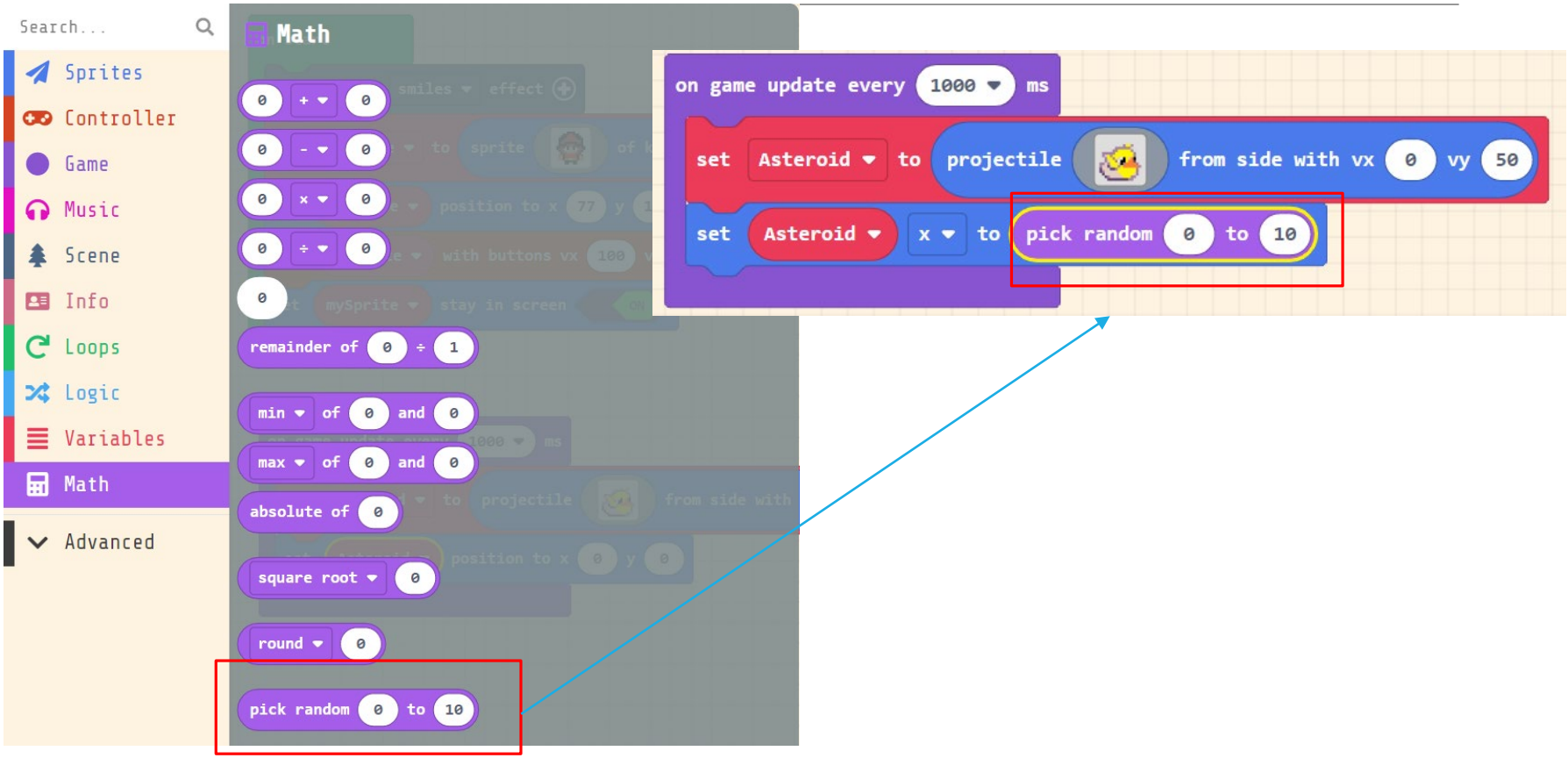


# 9. Select mySprite -> Asteroid

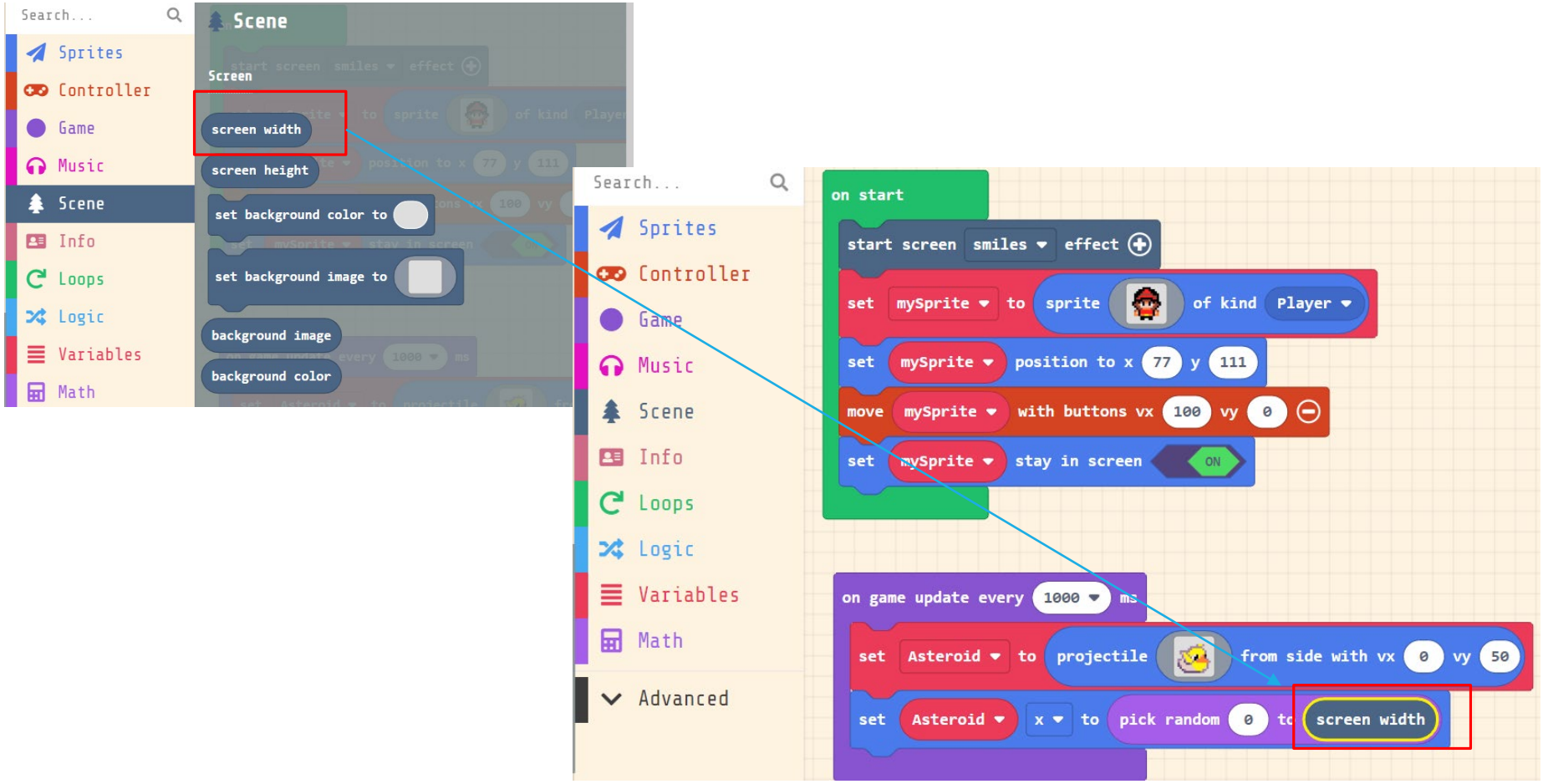


# 10. Set random x location Math ->

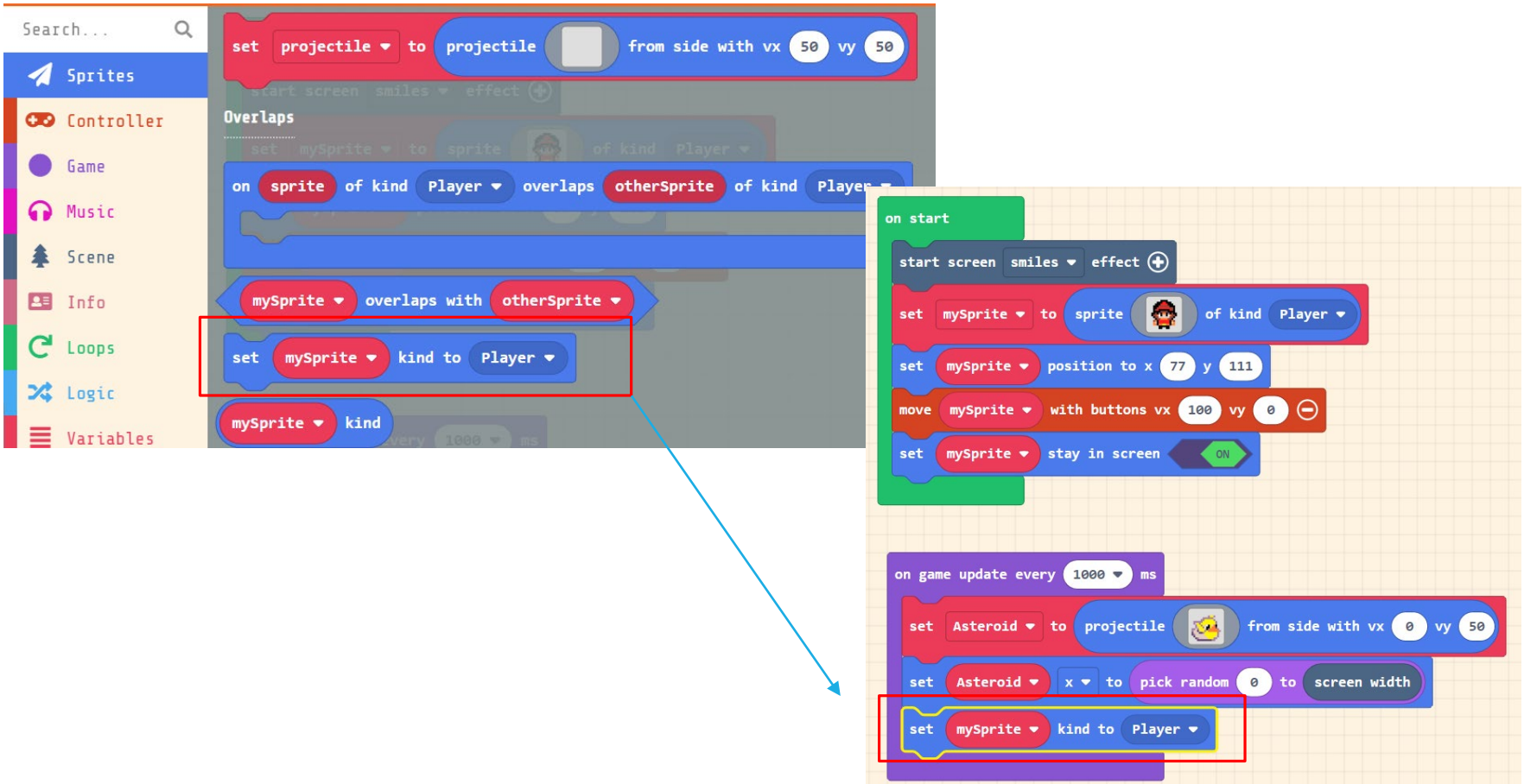


# Use screen width as maximum value of x

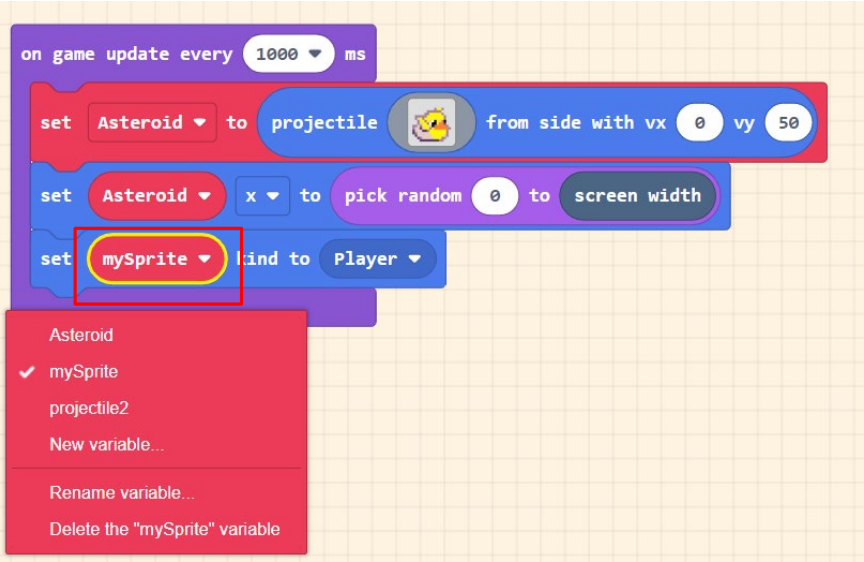


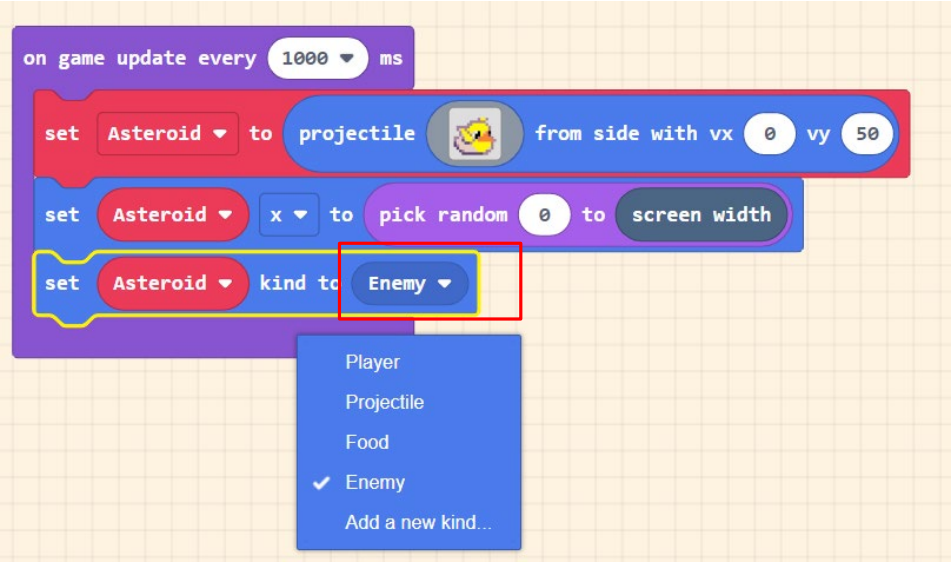
# Result:
# All projectiles are falling down randomly in x location every one second

# 11. Set the type of Sprite



# Set Asteroid -> enemy type



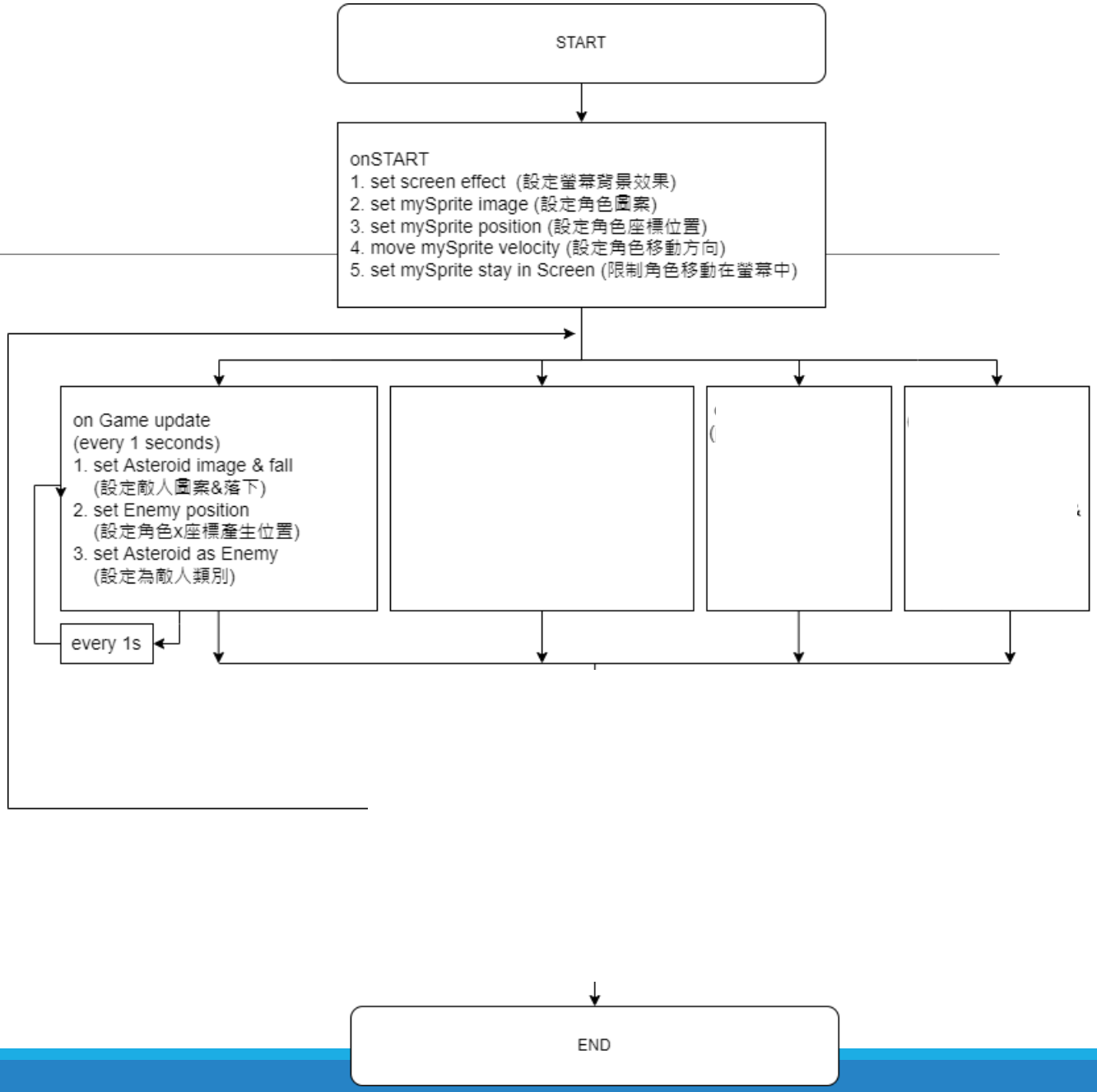



# Exercise#2

Try to increase the difficulty of game

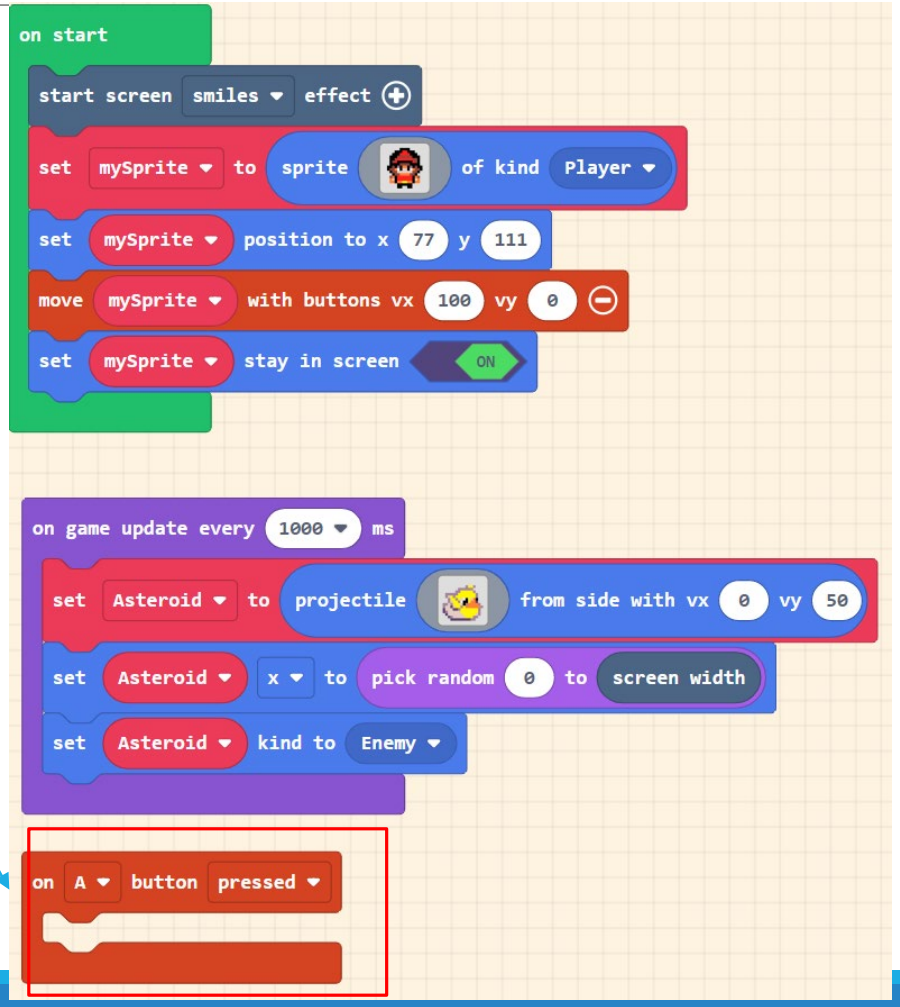
- Speed up the projectiles falling down

# flowchart

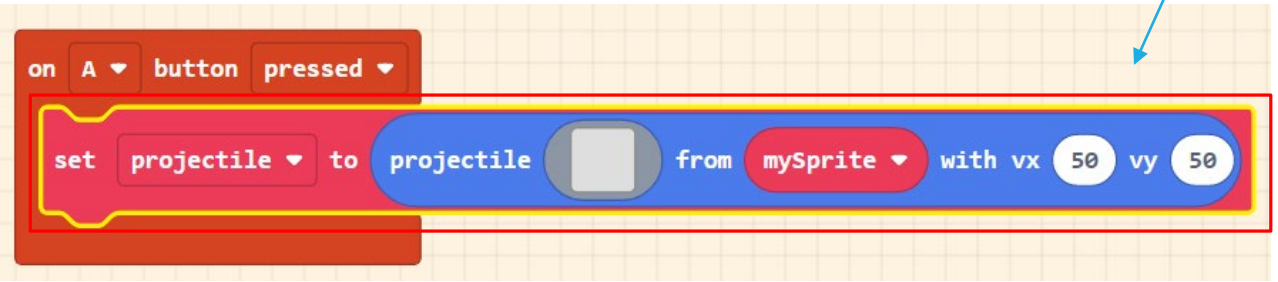

START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生位置)
3. set Asteroid as Enemy
(設定為敵人類別)
every 1s
END

# Part III
# Button Controller

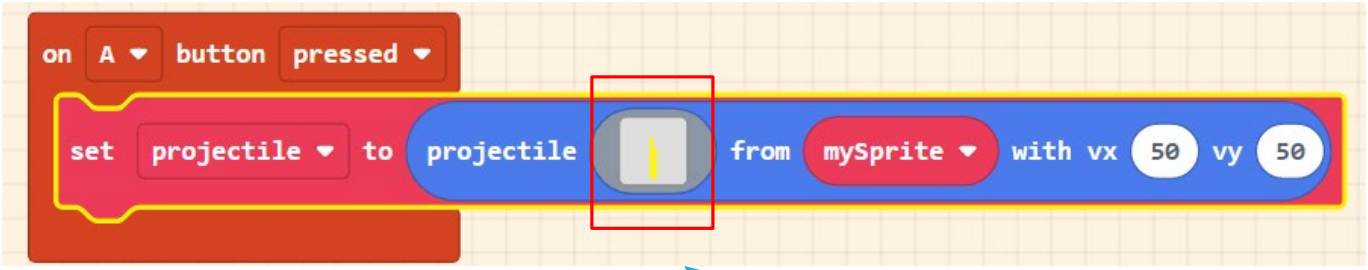
# 12. Shoot Lasters when you press a button

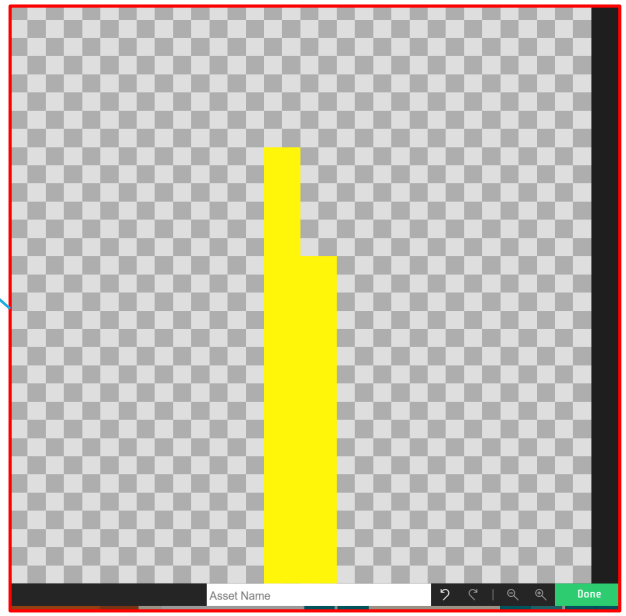


# 13. Set your laser sprite

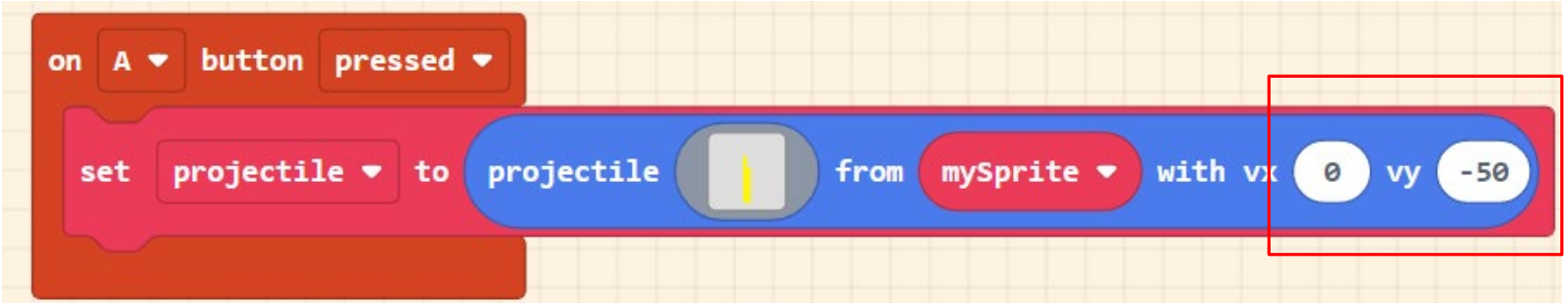


# 13. Design your laser sprite



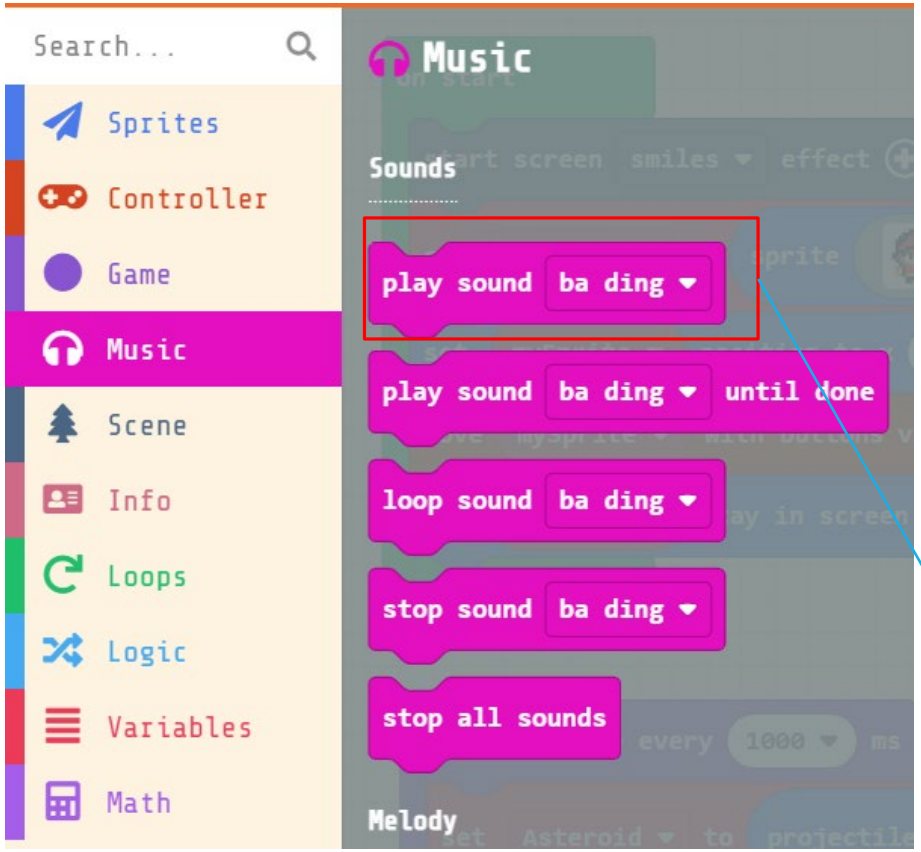
# 14. Set Laster velocity

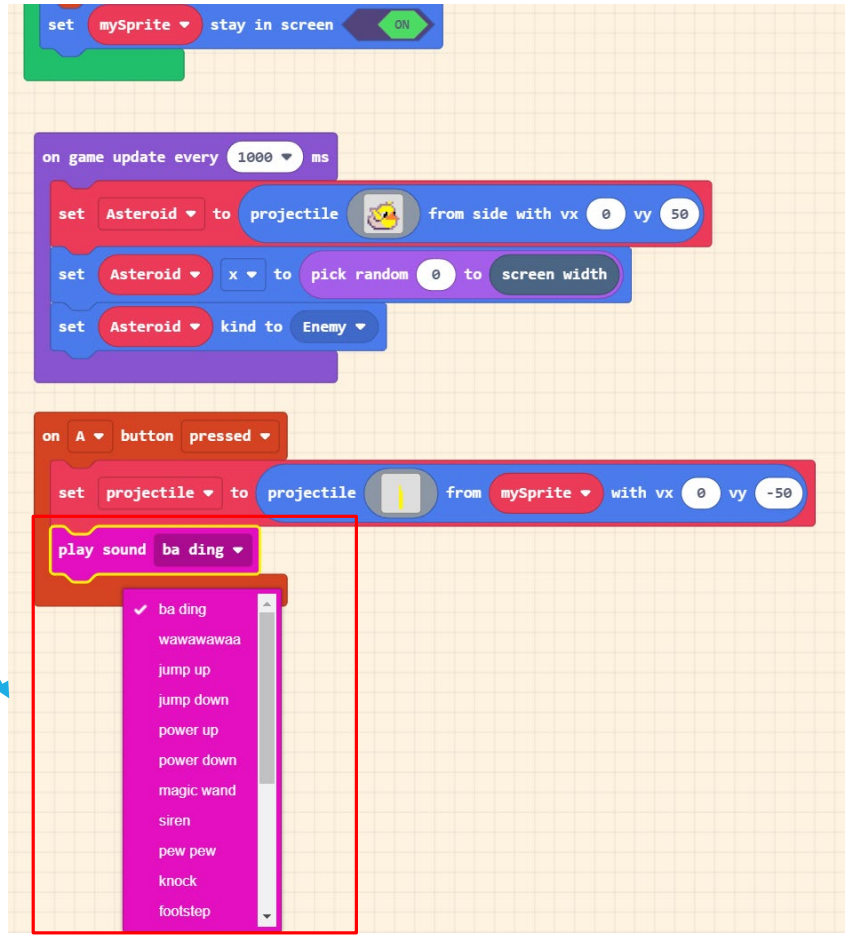



Set
vx: 0 vy: -50

# Result
# You can shoot the laster

# 15. Add Sound Effect

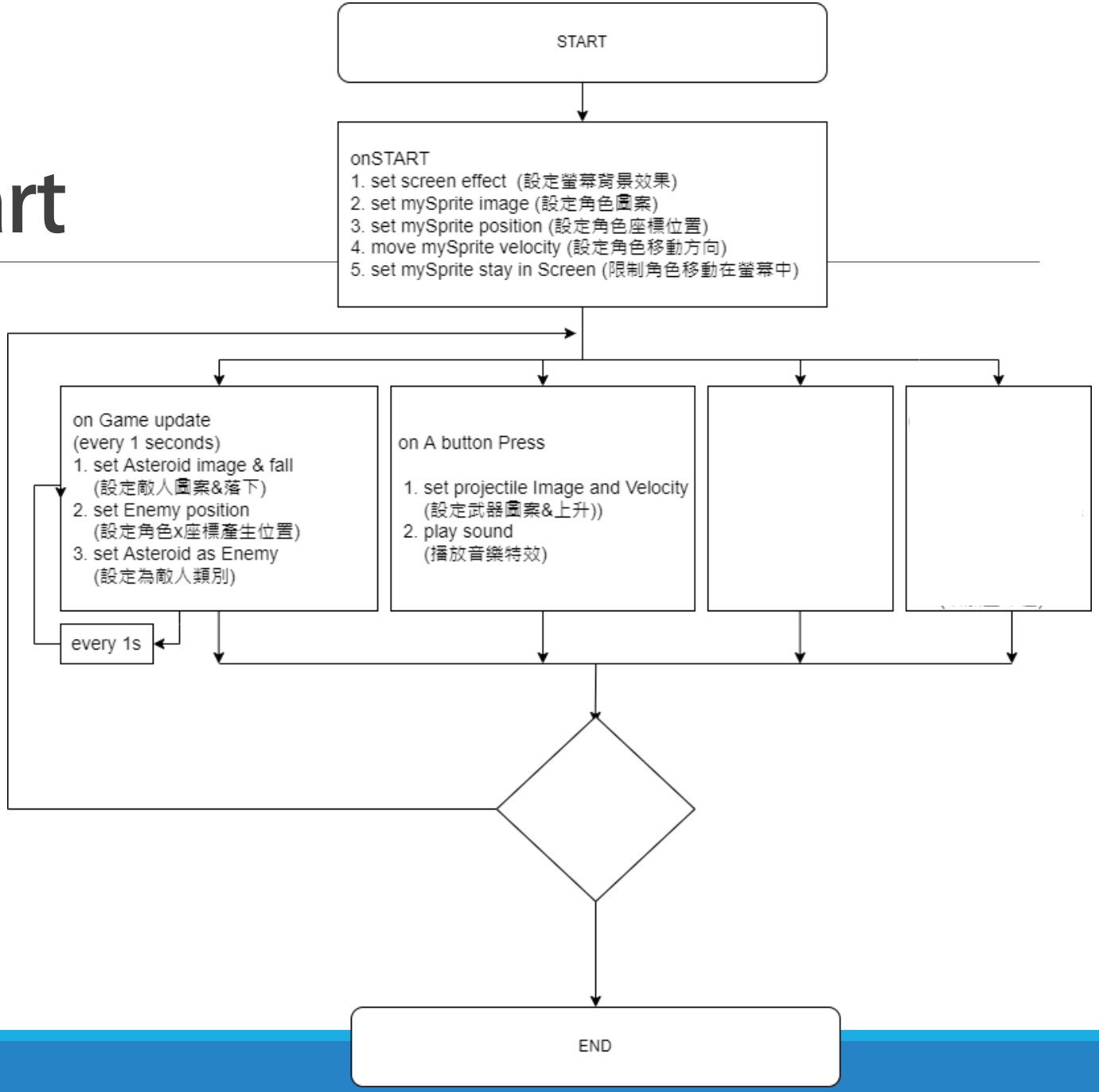


# Exercise#3

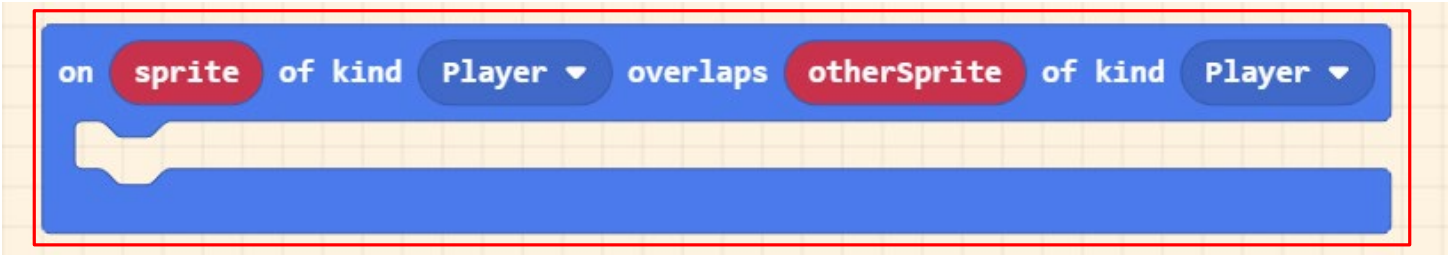
Select a your favorite sound effect and try it on.

# flowchart


START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生位置)
3. set Asteroid as Enemy
(設定為敵人類別)
every 1s
on A button Press
1. set projectile Image and Velocity
(設定武器圖案&上升))
2. play sound
(播放音樂特效)
END

# Part IV.
# Overlaps detection

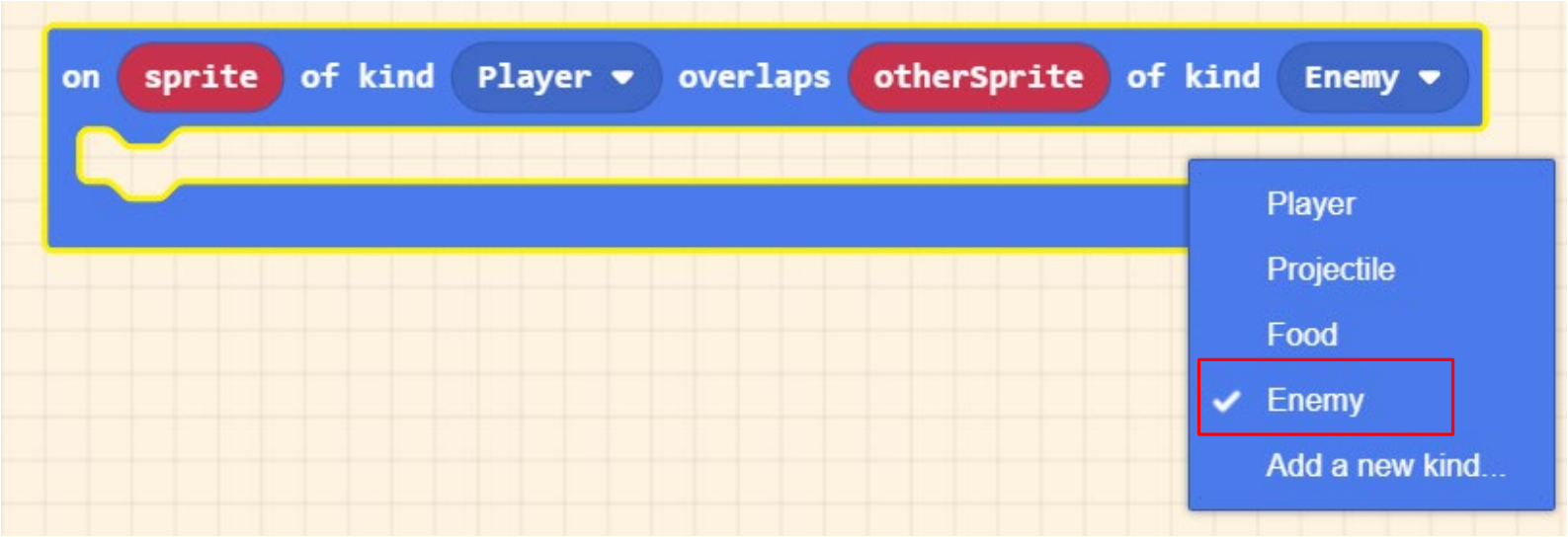
# 16. Add overlaps block sprites->overlaps



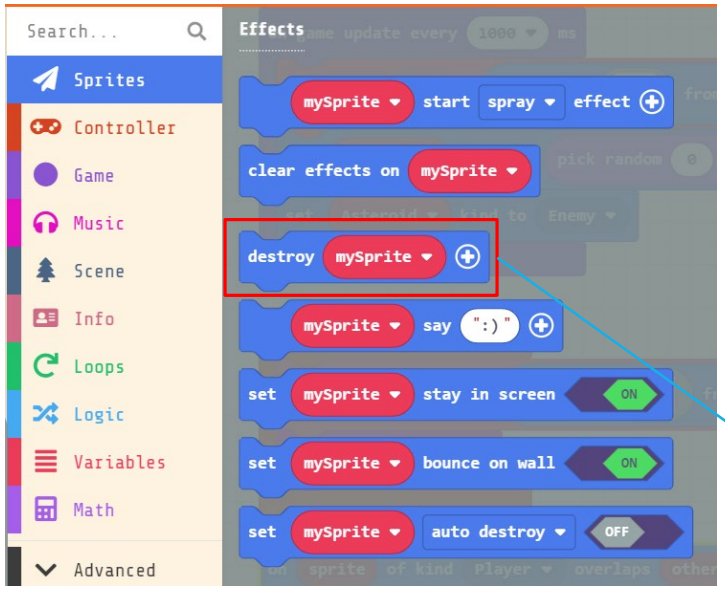
# When an asteroid crashes into your Spaceship

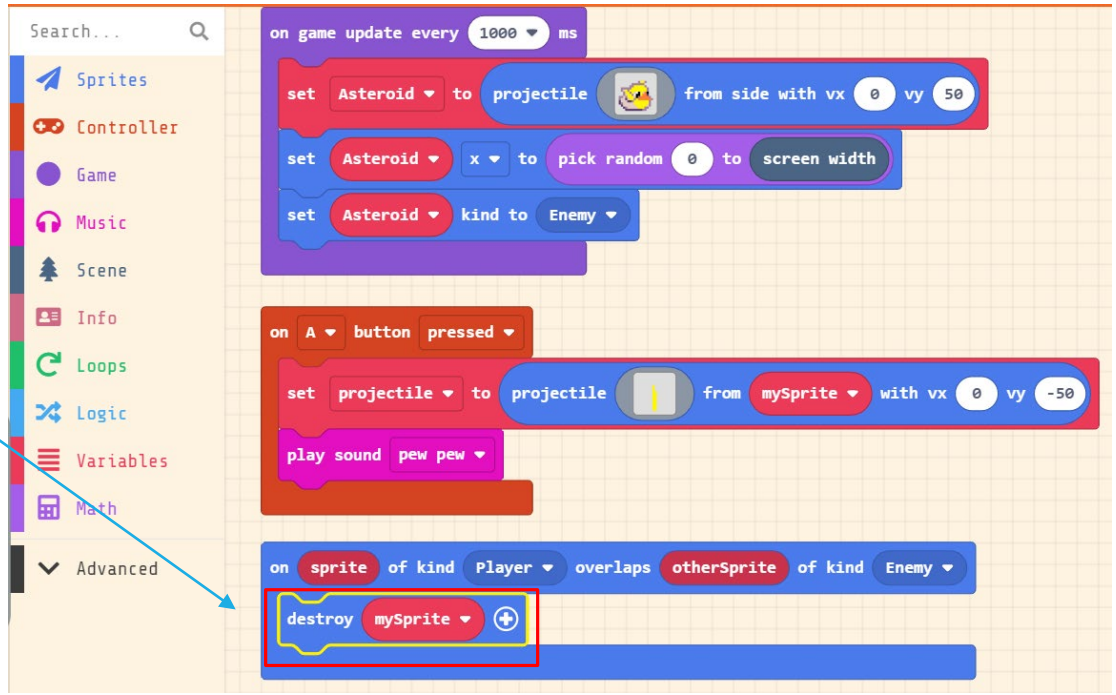
Click on the otherSprite of kind ‘Player’ -> ‘Enemy’

Setup when any asteroid overlaps your spaceship



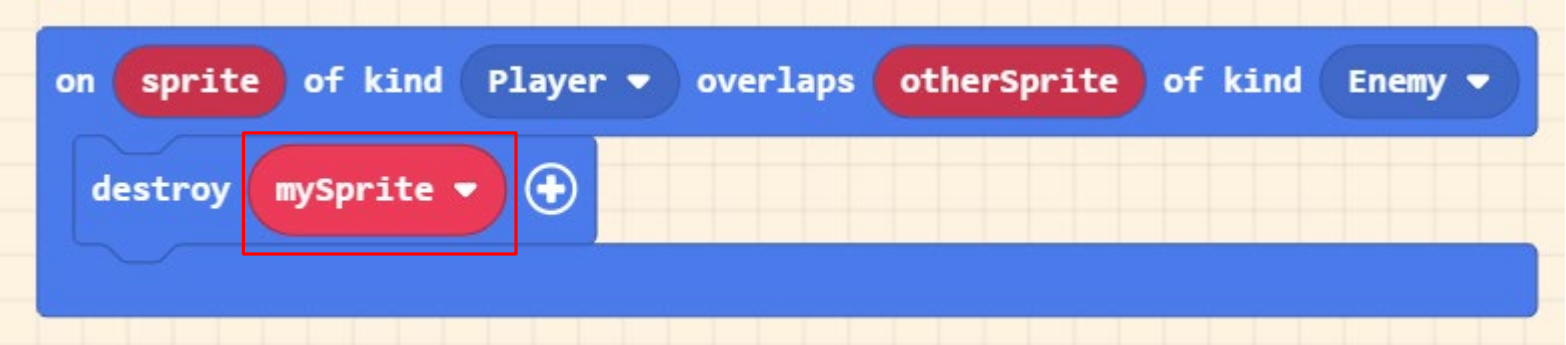
# 17. Destroy Asteroid



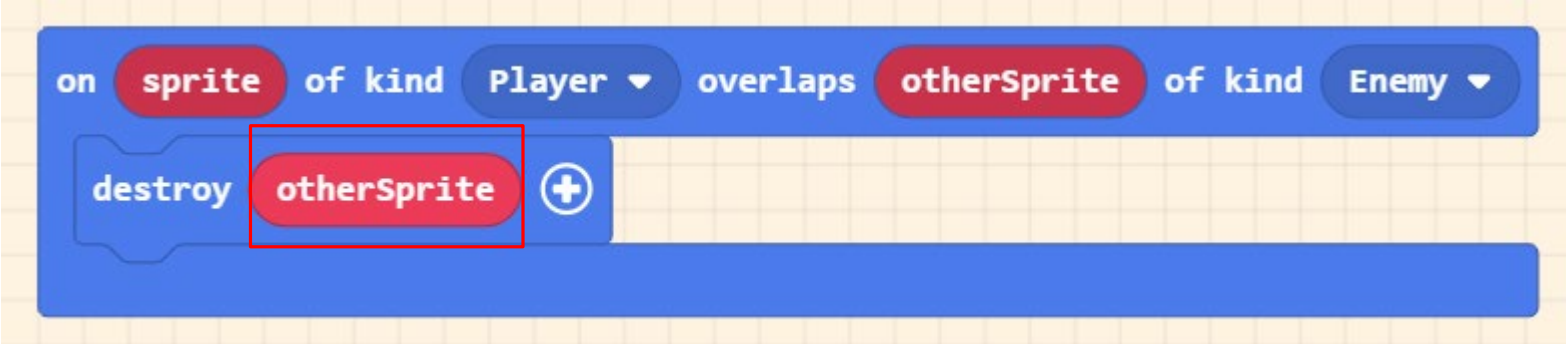



# Set the destroy target

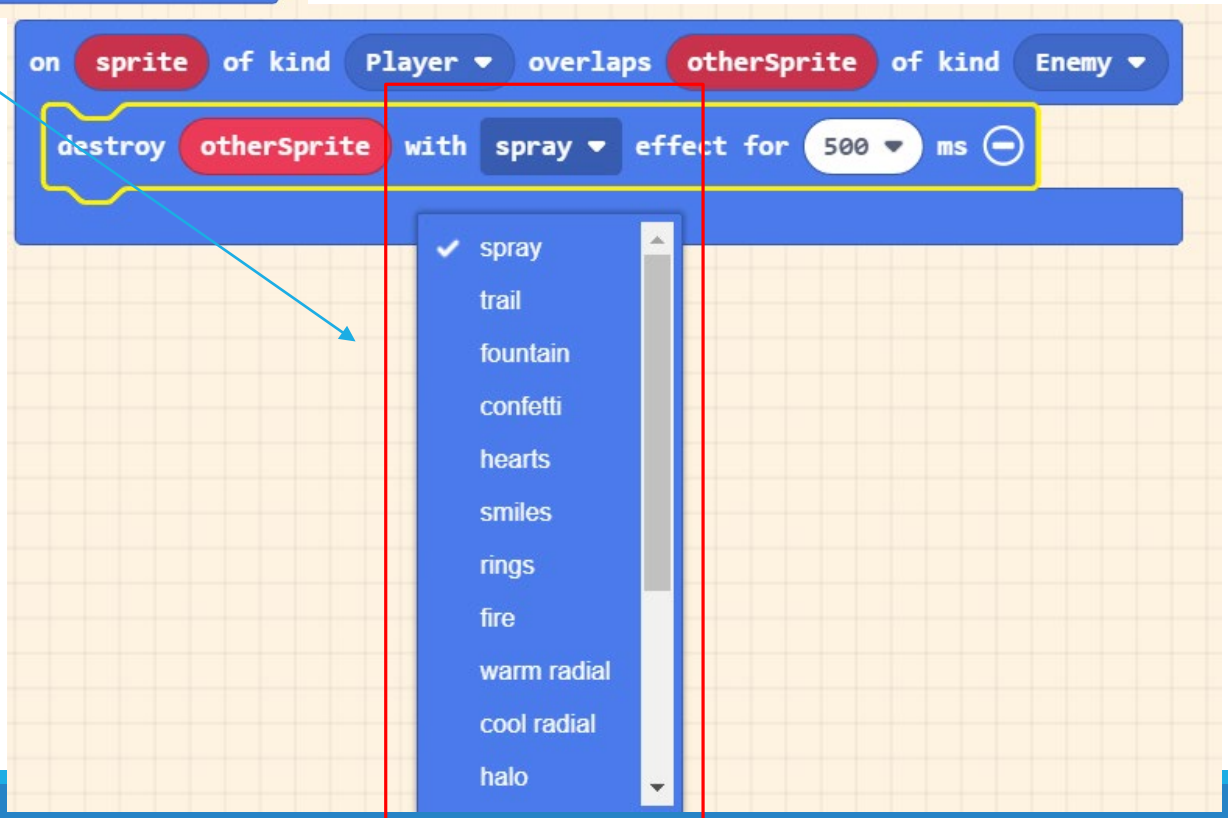
Original




Change to



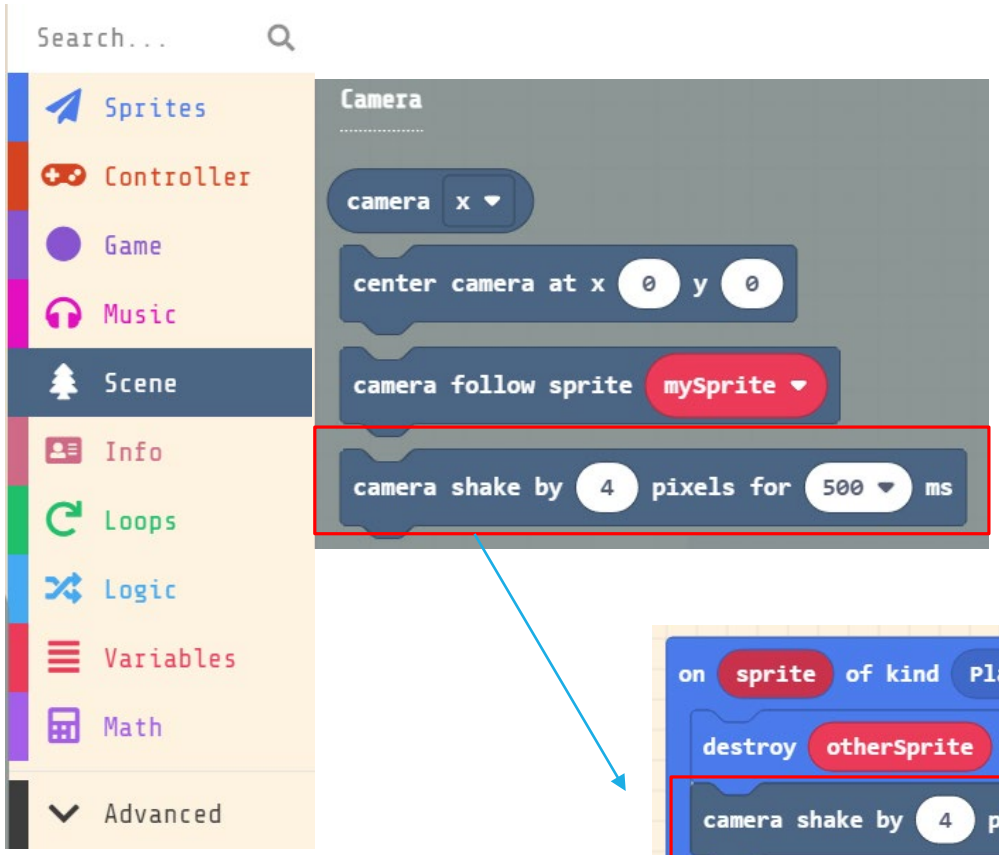
# Add an destroy effect



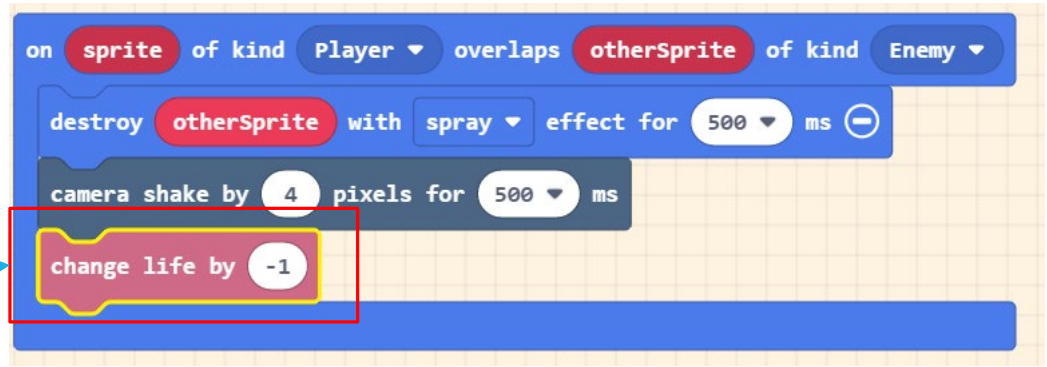
# Exercise#4

Select a favor crash effect and try it on.

# 17. Add a Camera Shake Effect

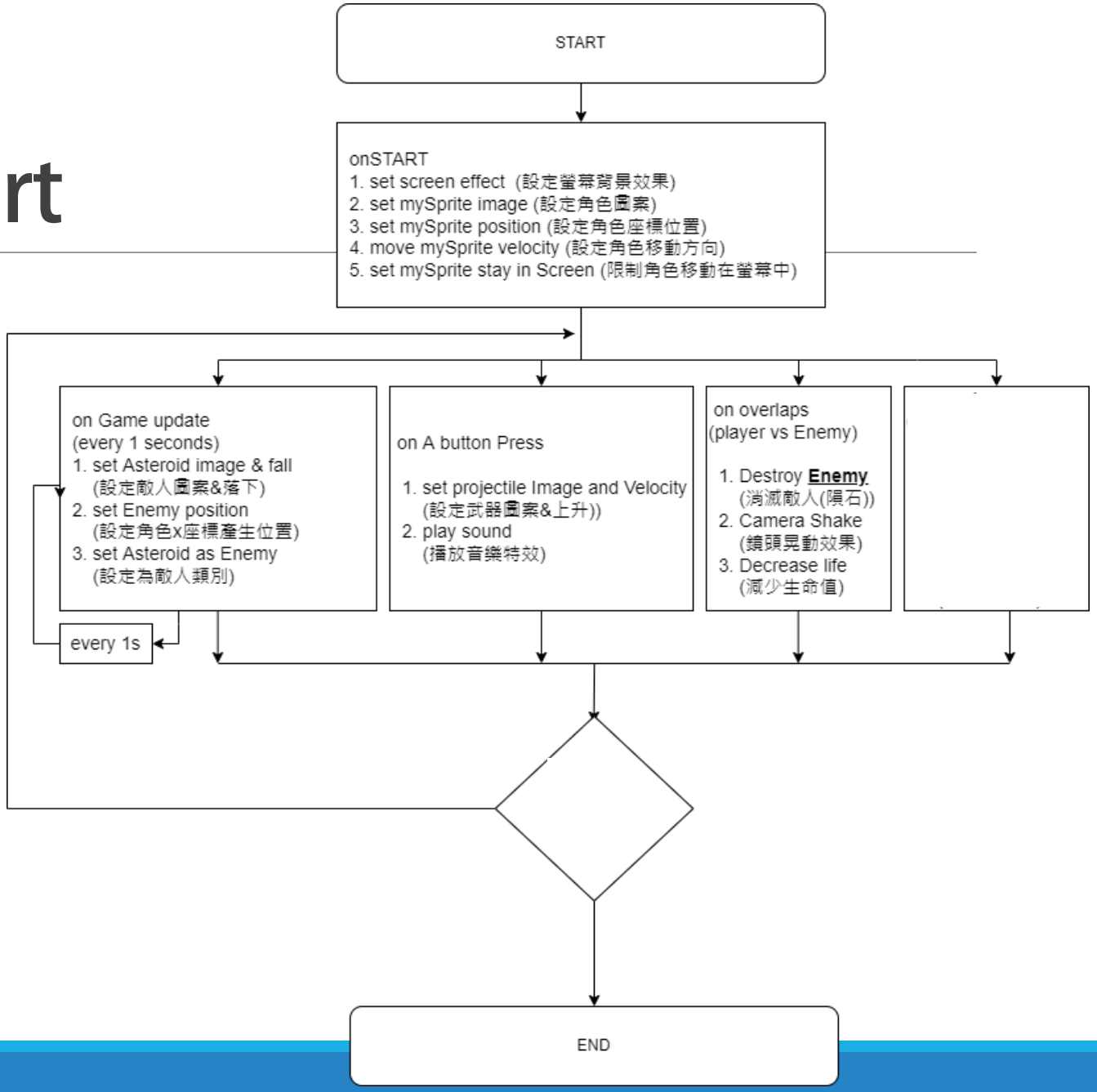


# 18. Decrease Life of your Spaceship



# Result
# You can see Life & Game Over

# flowchart


START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生位置)
3. set Asteroid as Enemy
(設定為敵人類別)
every 1s
on A button Press
1. set projectile Image and Velocity
(設定武器圖案&上升))
2. play sound
(播放音樂特效)
on overlaps
(player vs Enemy)
1. Destroy Enemy
(消滅敵人(隕石))
2. Camera Shake
(鏡頭晃動效果)
3. Decrease life
(減少生命值)
END

# Part V.
## Weapon (Laster) overlaps detection

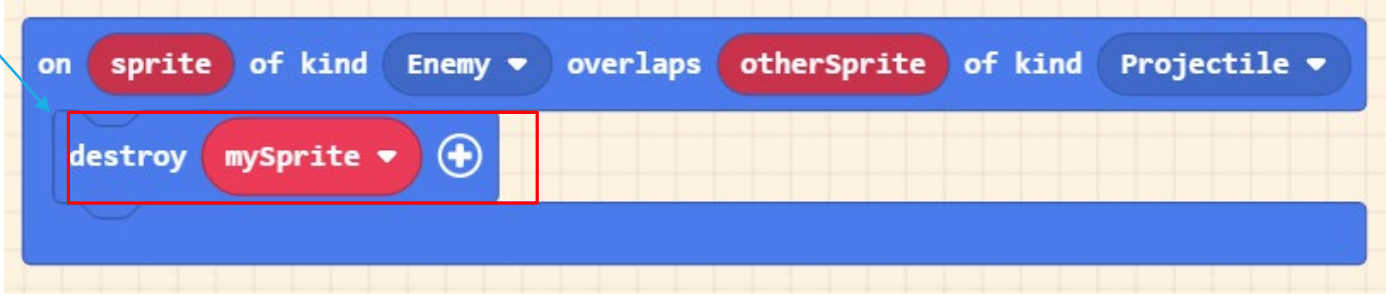
# 19. When the laser hits an Asteroid

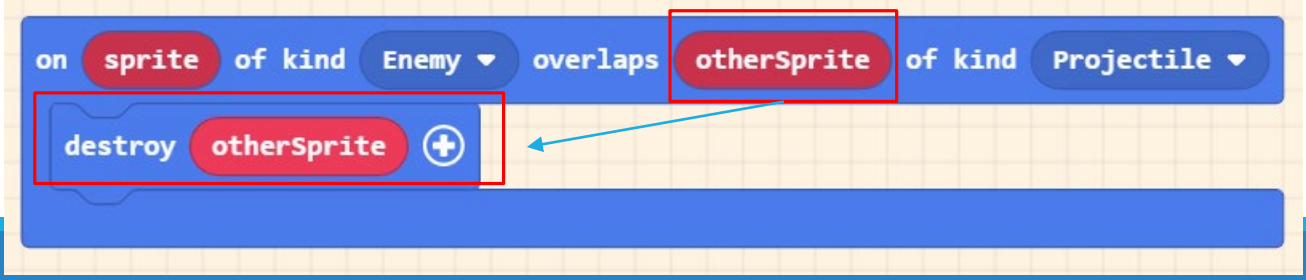
# Click on the 1st Player -> Enemy
# Click on the 2nd Player -> Projectile

Original

Change

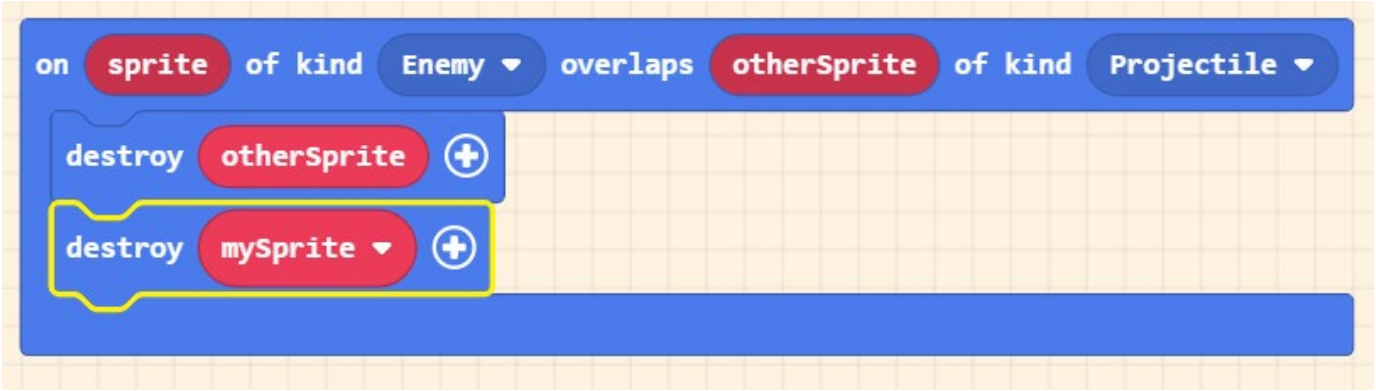
# 20. Destroy the Laster



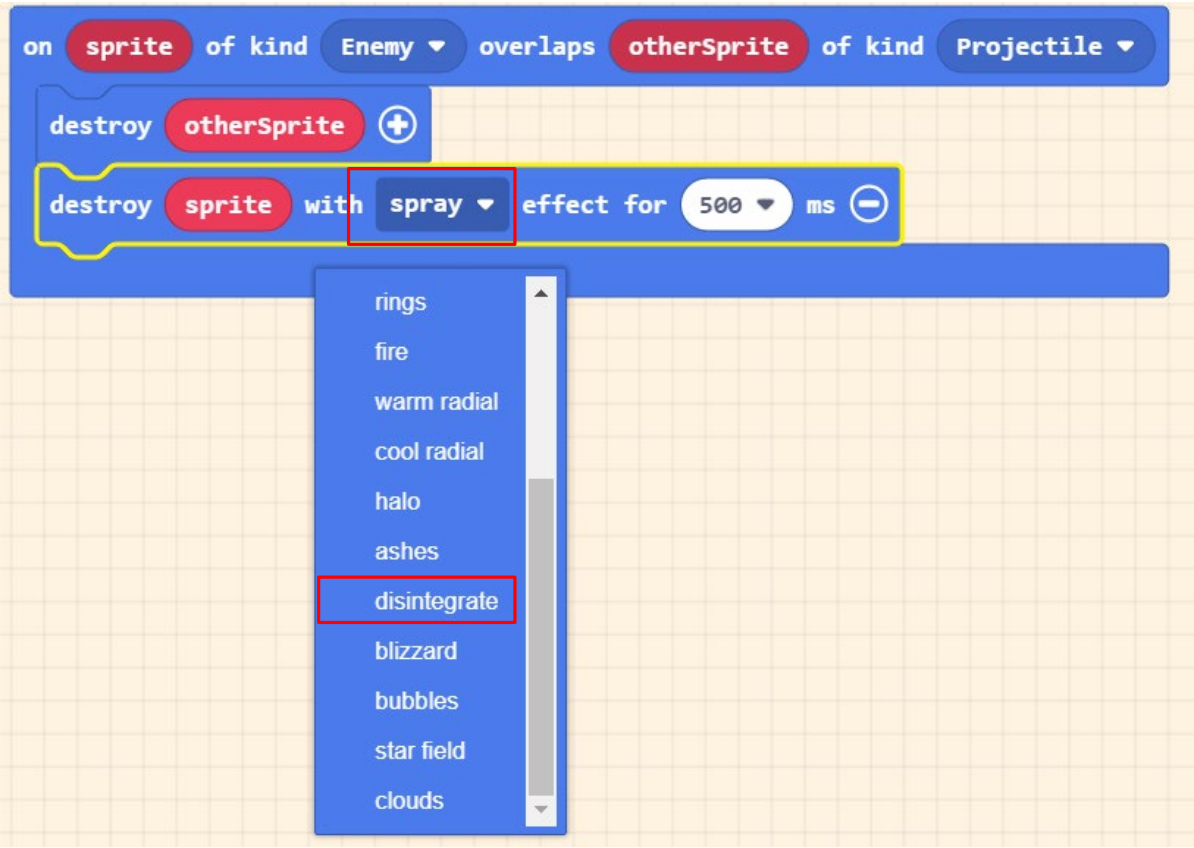
# 21. Destroy the Asteroid

## Original

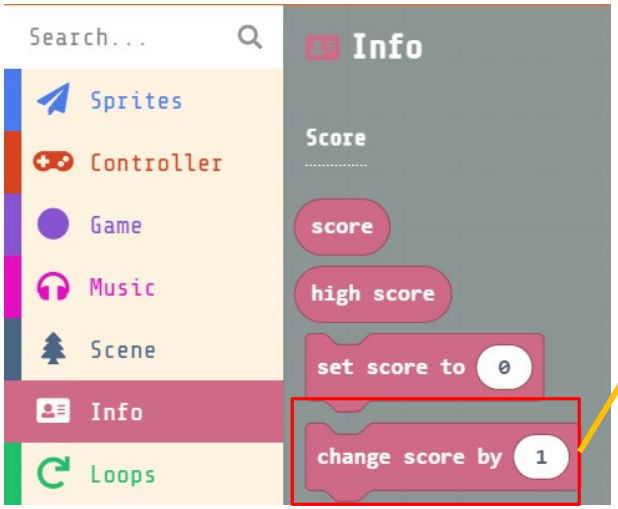



## Change

# 22. Add an Effect when Laster destroy the Asteroid



# 24. Add the Score



# Complete Code

```
on start
  start screen smiles effect
  set mySprite to sprite of kind Player
  set mySprite position to x 77 y 111
  move mySprite with buttons vx 100 vy 0
  set mySprite stay in screen ON

on game update every 1000 ms
  set Asteroid to projectile from side with vx 0 vy 50
  set Asteroid x to pick random 0 to screen width
  set Asteroid kind to Enemy
```

```
on A button pressed
  set projectile to projectile from mySprite with vx 0 vy -50
  play sound pew pew

on sprite of kind Player overlaps otherSprite of kind Enemy
  destroy otherSprite with spray effect for 500 ms
  camera shake by 4 pixels for 500 ms
  change life by -1

on sprite of kind Enemy overlaps otherSprite of kind Projectile
  destroy otherSprite
  destroy sprite with spray effect for 500 ms
  change score by 1
```

# Python version

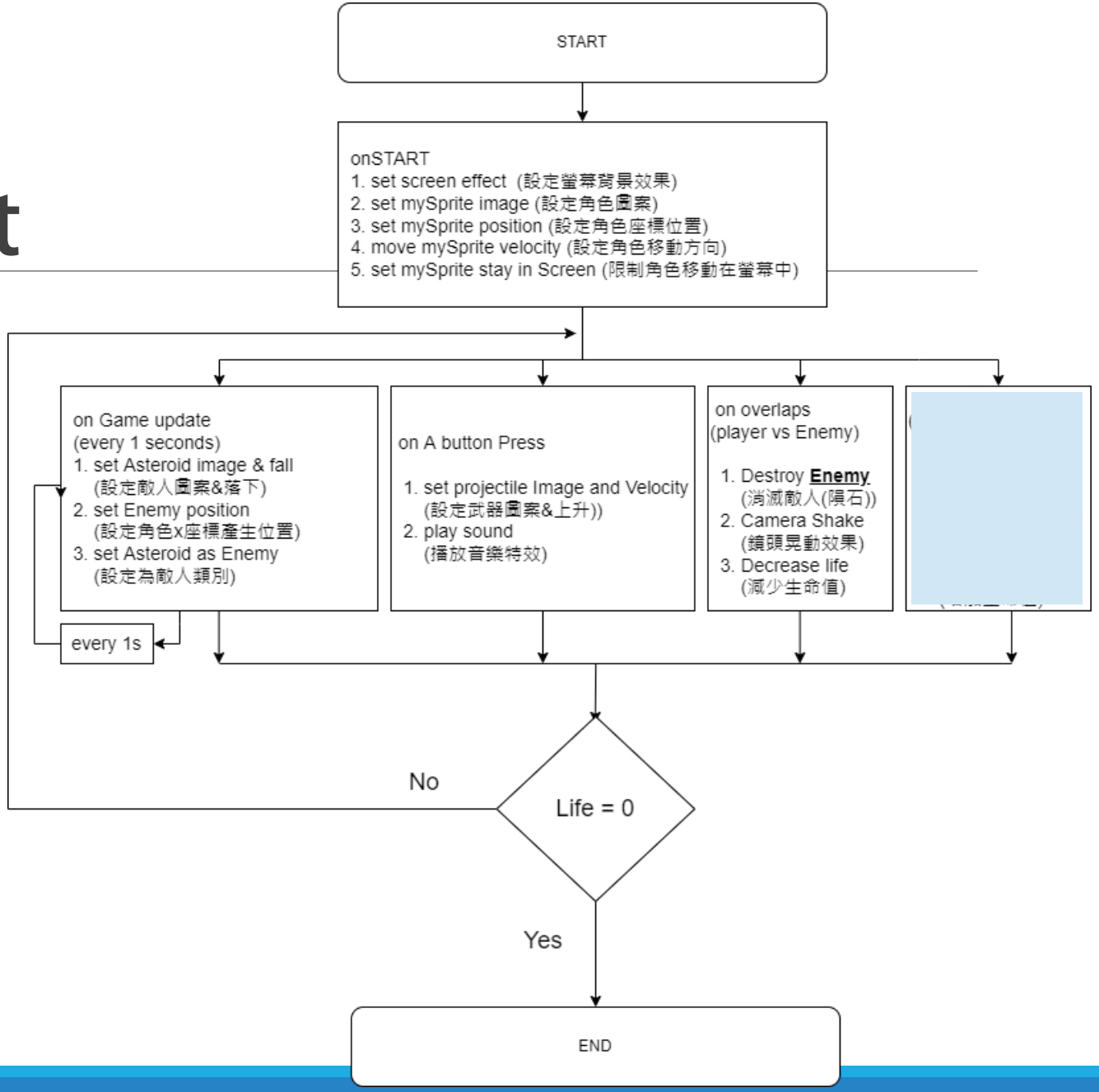
```python
def on_a_pressed():
    global projectile
    projectile = sprites.create_projectile_from_sprite(img("""…
        """),
        mySprite,
        0,
        -50)
    music.pew_pew.play()
controller.A.on_event(ControllerButtonEvent.PRESSED, on_a_pressed)

def on_on_overlap(sprite, otherSprite):
    otherSprite.destroy()
    sprite.destroy(effects.spray, 500)
    info.change_score_by(1)
sprites.on_overlap(SpriteKind.enemy, SpriteKind.projectile, on_on_overlap)

def on_on_overlap2(sprite2, otherSprite2):
    otherSprite2.destroy(effects.spray, 500)
    scene.camera_shake(4, 500)
    info.change_life_by(-1)
sprites.on_overlap(SpriteKind.player, SpriteKind.enemy, on_on_overlap2)
```

```python
Asteroid: Sprite = None
projectile: Sprite = None
mySprite: Sprite = None
effects.smiles.start_screen_effect()
mySprite = sprites.create(img("""…
    """),
    SpriteKind.player)
mySprite.set_position(77, 111)
controller.move_sprite(mySprite, 100, 0)
mySprite.set_stay_in_screen(True)

def on_update_interval():
    global Asteroid
    Asteroid = sprites.create_projectile_from_side(img("""…
        """),
        0,
        50)
    Asteroid.x = randint(0, scene.screen_width())
    Asteroid.set_kind(SpriteKind.enemy)
game.on_update_interval(1000, on_update_interval)
```

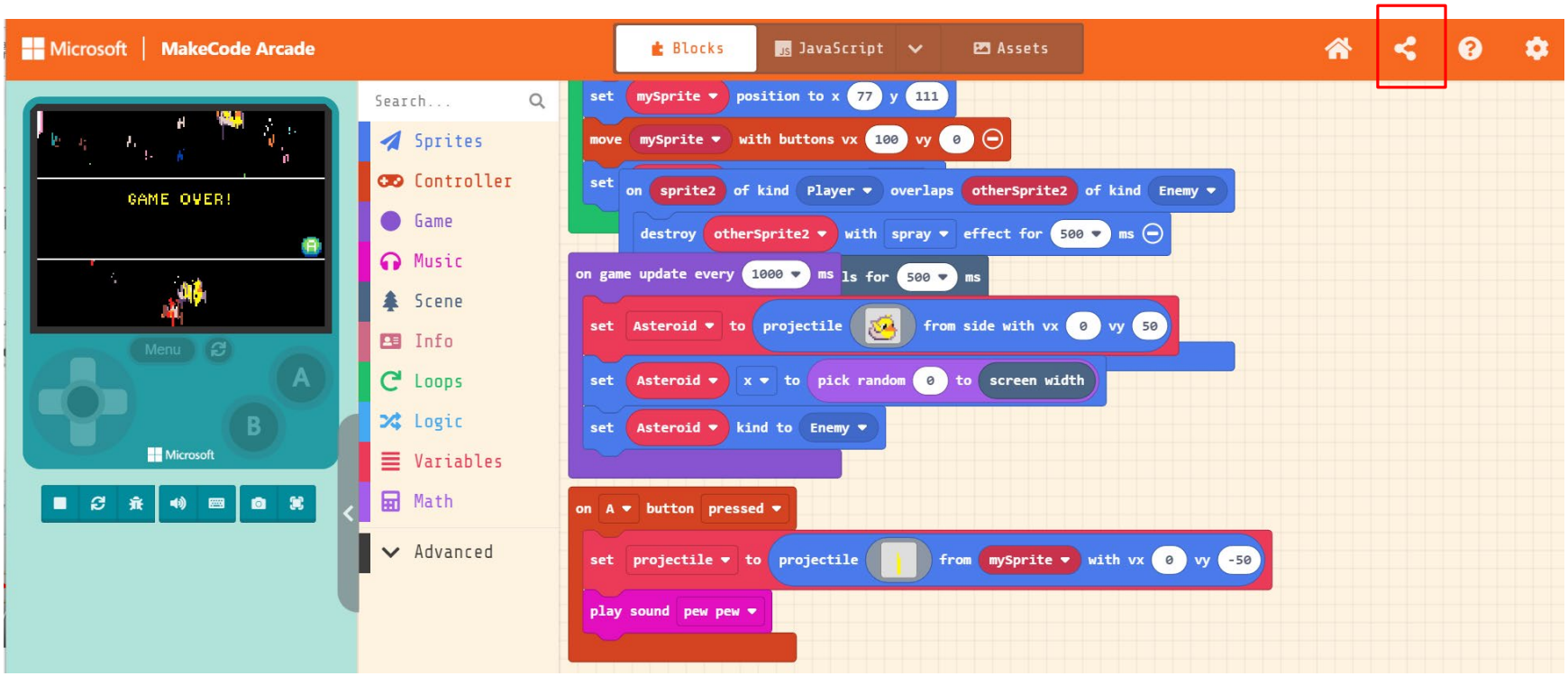
# JavaScript version

```
1   controller.A.onEvent(ControllerButtonEvent.Pressed, function on_a_pressed() {
2
3 >     projectile = sprites.createProjectileFromSprite(img` ···
20          `, mySprite, 0, -50)
21      music.pewPew.play()
22  })
23  sprites.onOverlap(SpriteKind.Enemy, SpriteKind.Projectile, function on_on_overlap(sprite: Sprite, otherSprite: Sprite) {
24      otherSprite.destroy()
25      sprite.destroy(effects.spray, 500)
26      info.changeScoreBy(1)
27  })
28  sprites.onOverlap(SpriteKind.Player, SpriteKind.Enemy, function on_on_overlap2(sprite2: Sprite, otherSprite2: Sprite) {
29      otherSprite2.destroy(effects.spray, 500)
30      scene.cameraShake(4, 500)
31      info.changeLifeBy(-1)
32  })
33  let Asteroid : Sprite = null
34  let projectile : Sprite = null
35  let mySprite : Sprite = null
36  effects.smiles.startScreenEffect()
37 > mySprite = sprites.create(img` ···
54      `, SpriteKind.Player)
55  mySprite.setPosition(77, 111)
56  controller.moveSprite(mySprite, 100, 0)
57  mySprite.setStayInScreen(true)
58  game.onUpdateInterval(1000, function on_update_interval() {
59
60 >     Asteroid = sprites.createProjectileFromSide(img` ···
77          `, 0, 50)
78      Asteroid.x = randint(0, scene.screenWidth())
79      Asteroid.setKind(SpriteKind.Enemy)
80  })
```

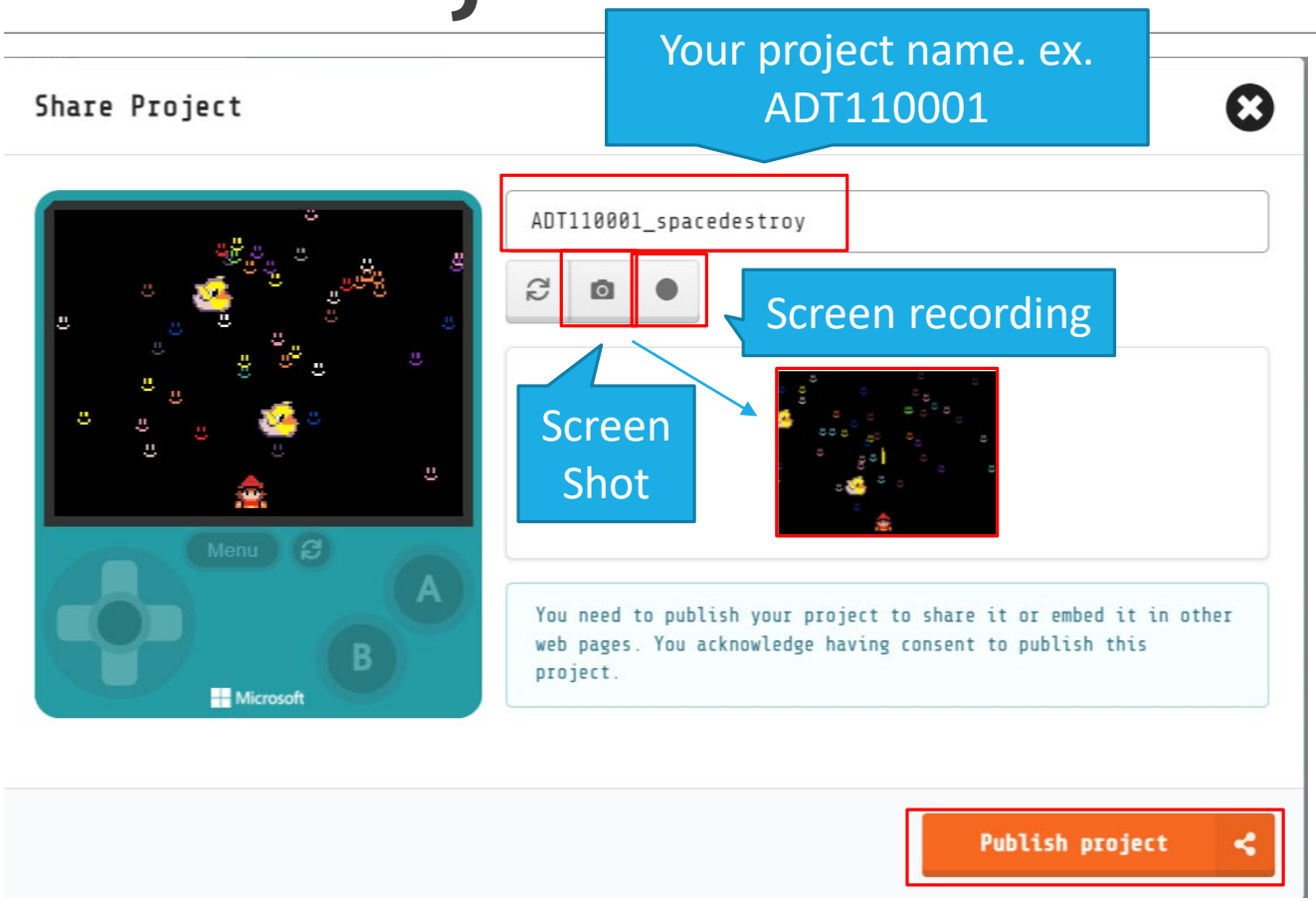
# flowchart


START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生位置)
3. set Asteroid as Enemy
(設定為敵人類別)
every 1s
on A button Press
1. set projectile Image and Velocity
(設定武器圖案&上升))
2. play sound
(播放音樂特效)
on overlaps
(player vs Enemy)
1. Destroy Enemy
(消滅敵人(隕石))
2. Camera Shake
(鏡頭晃動效果)
3. Decrease life
(減少生命值)
No
Life = 0
Yes
END

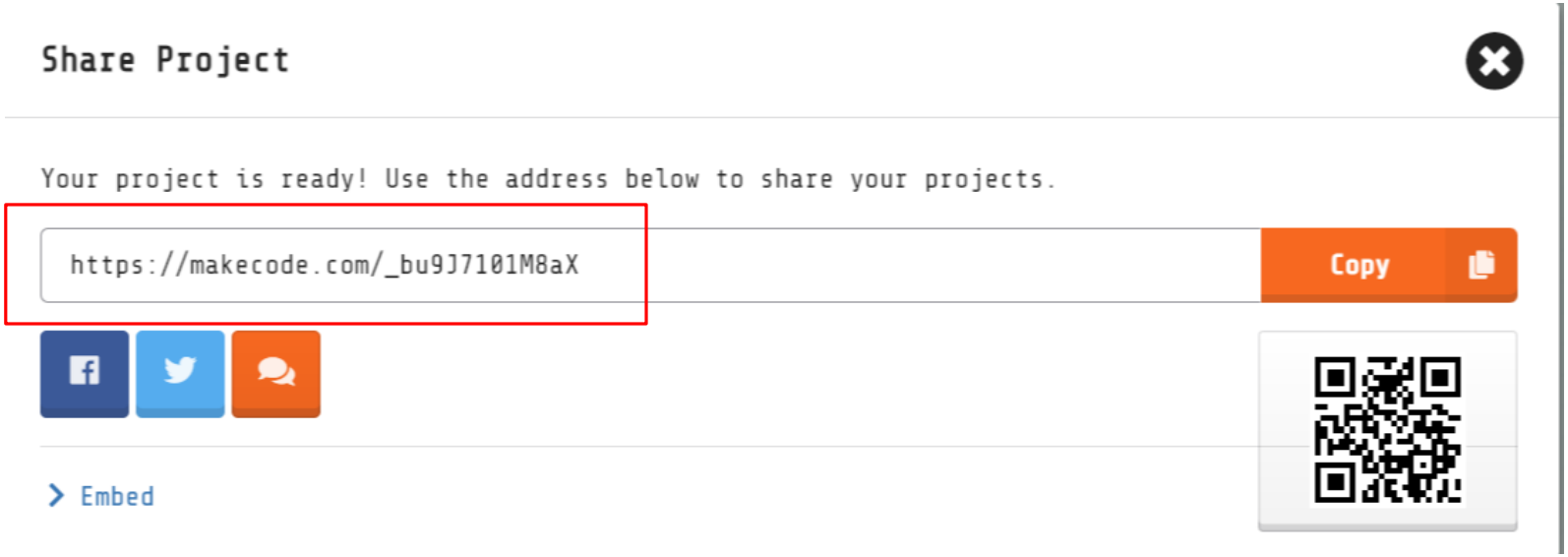
# 25. Share your game



# Share Project

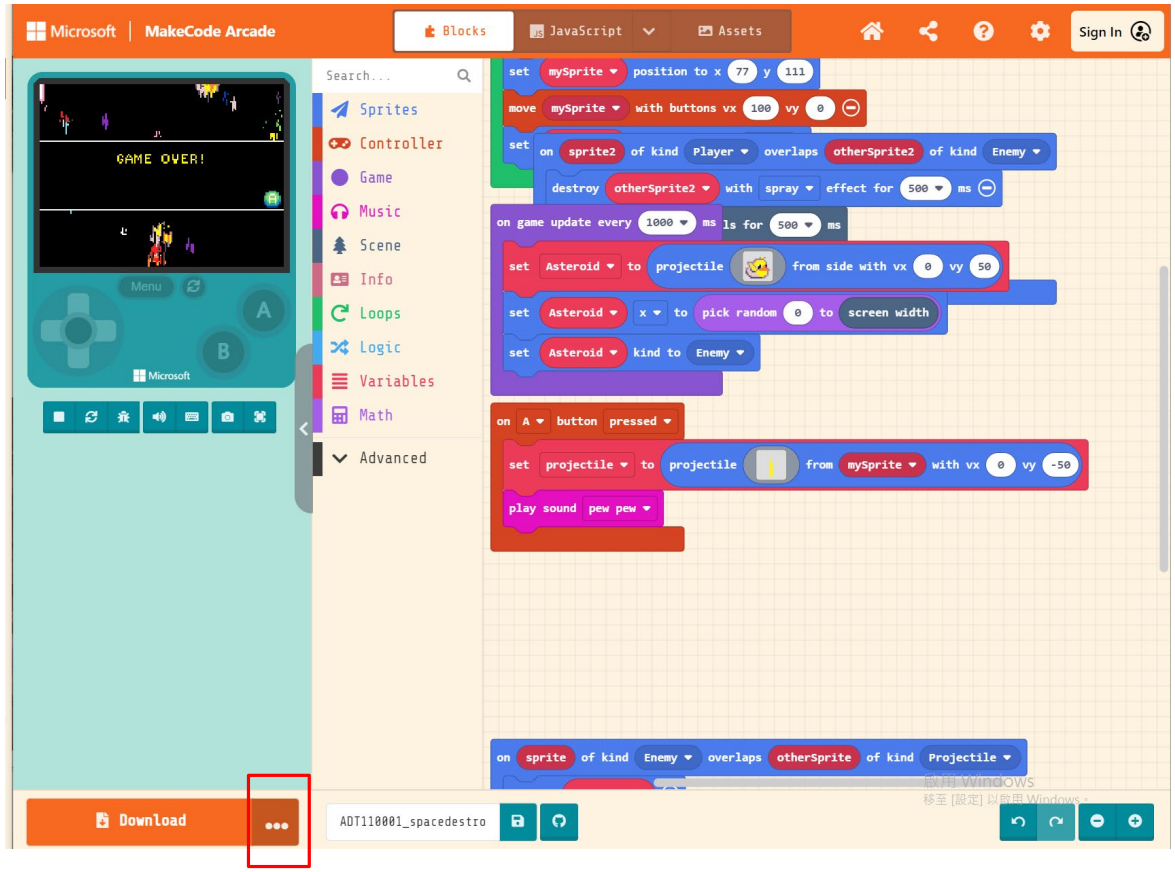


# Publish your project & Share

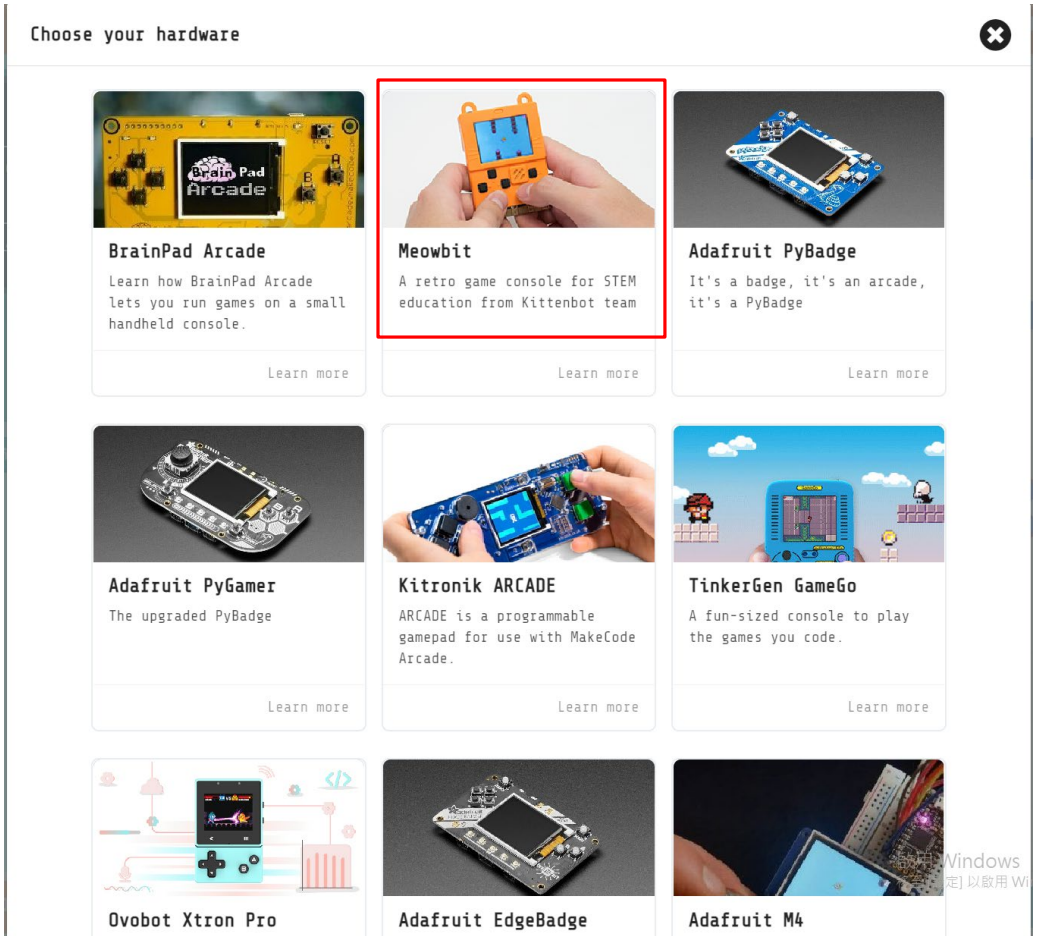


# Part VI.
# Installation of Meowbit

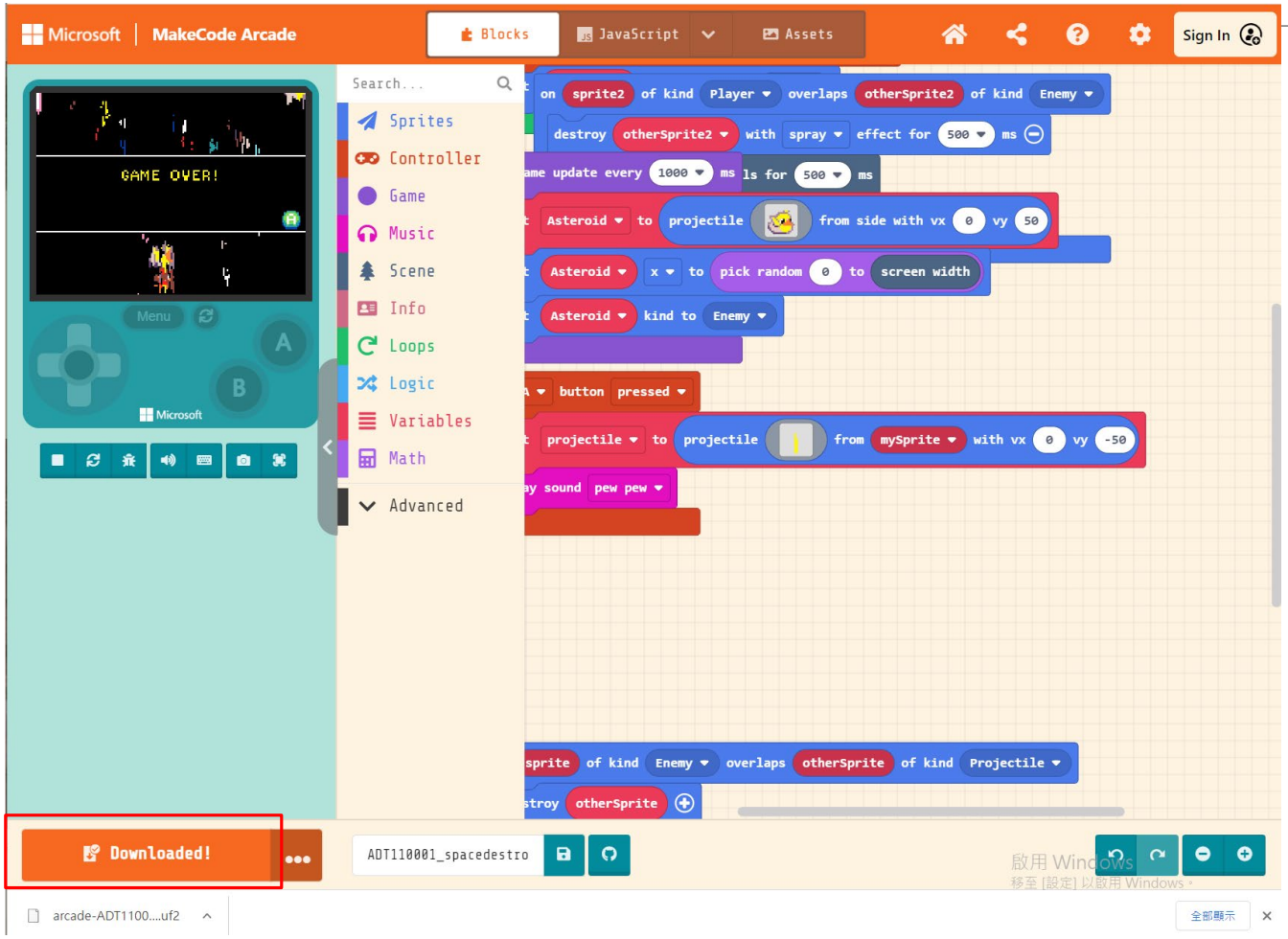
# 26. Installation & test on Meowbit



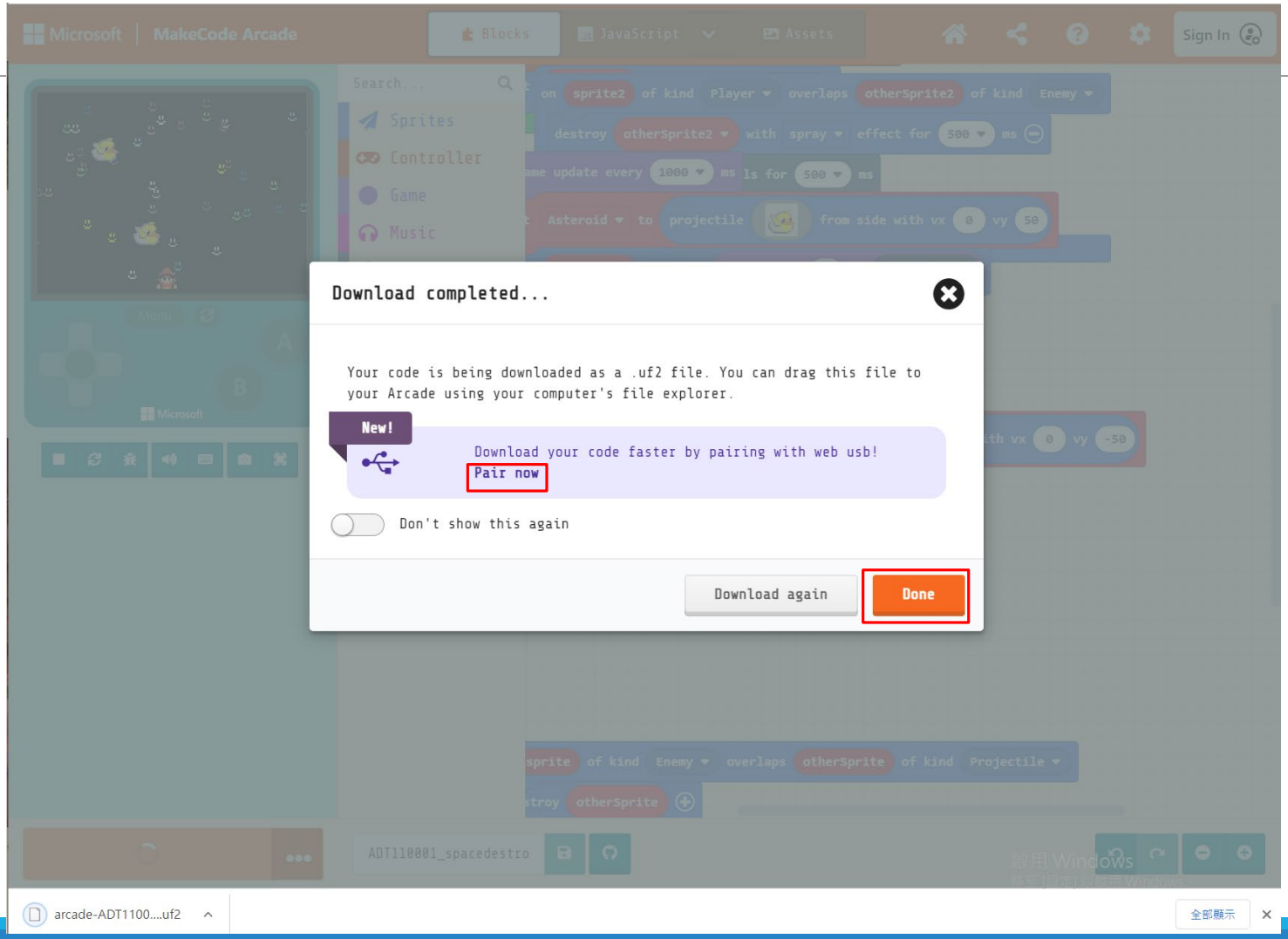
# Choose your hardware-> Meowbit



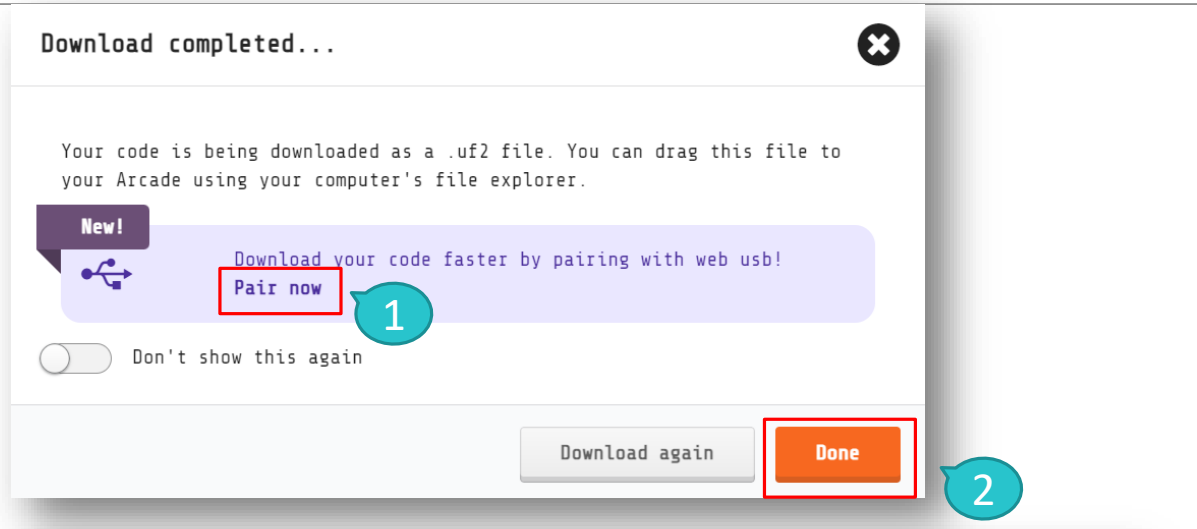
# Download to Meowbit

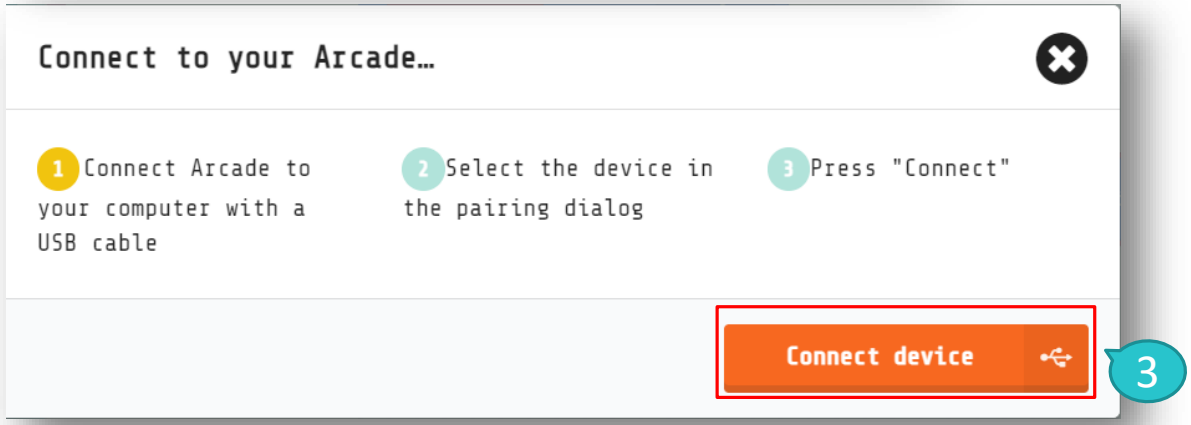


# Plug the USB cable to Meowbit



# Download process

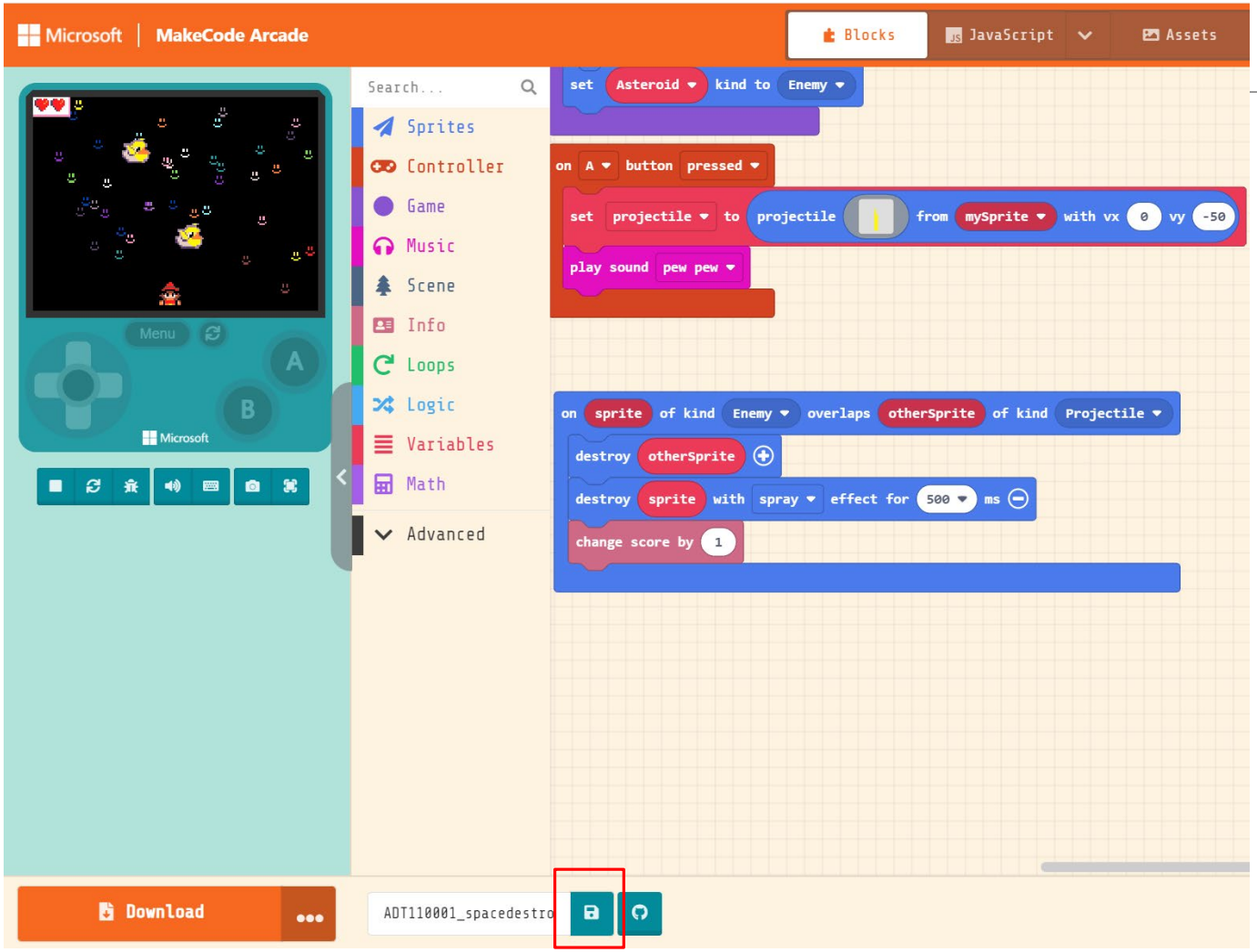


# Success install in Meowbit

# Save & Import Project

# Download save project



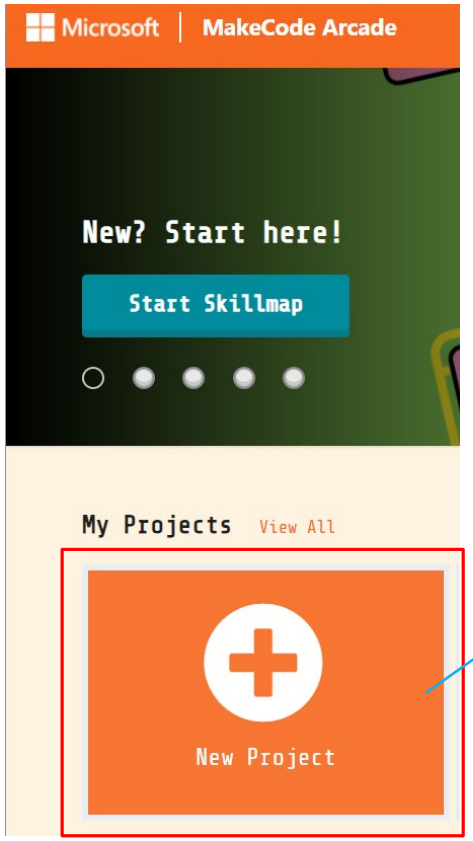
# Project will saved in the image as png format

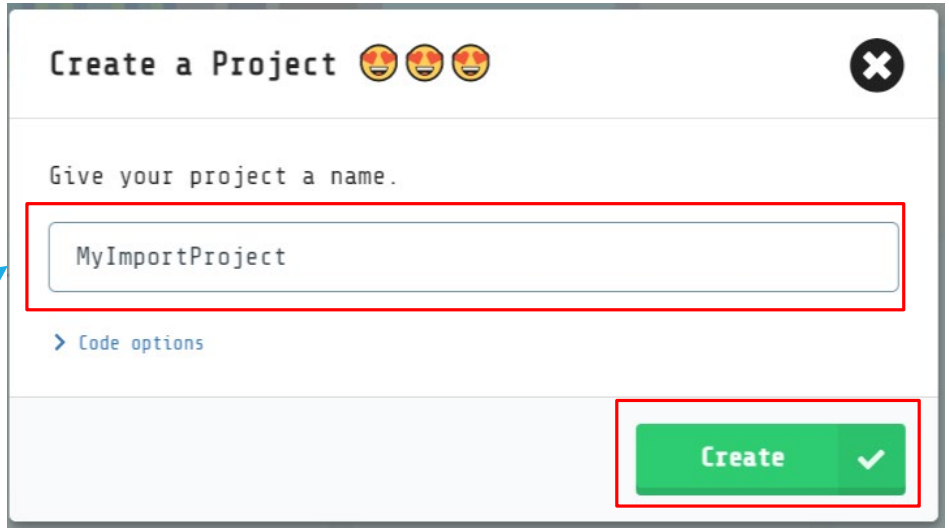
# Saved project in PNG format

Ex. Xxx.png

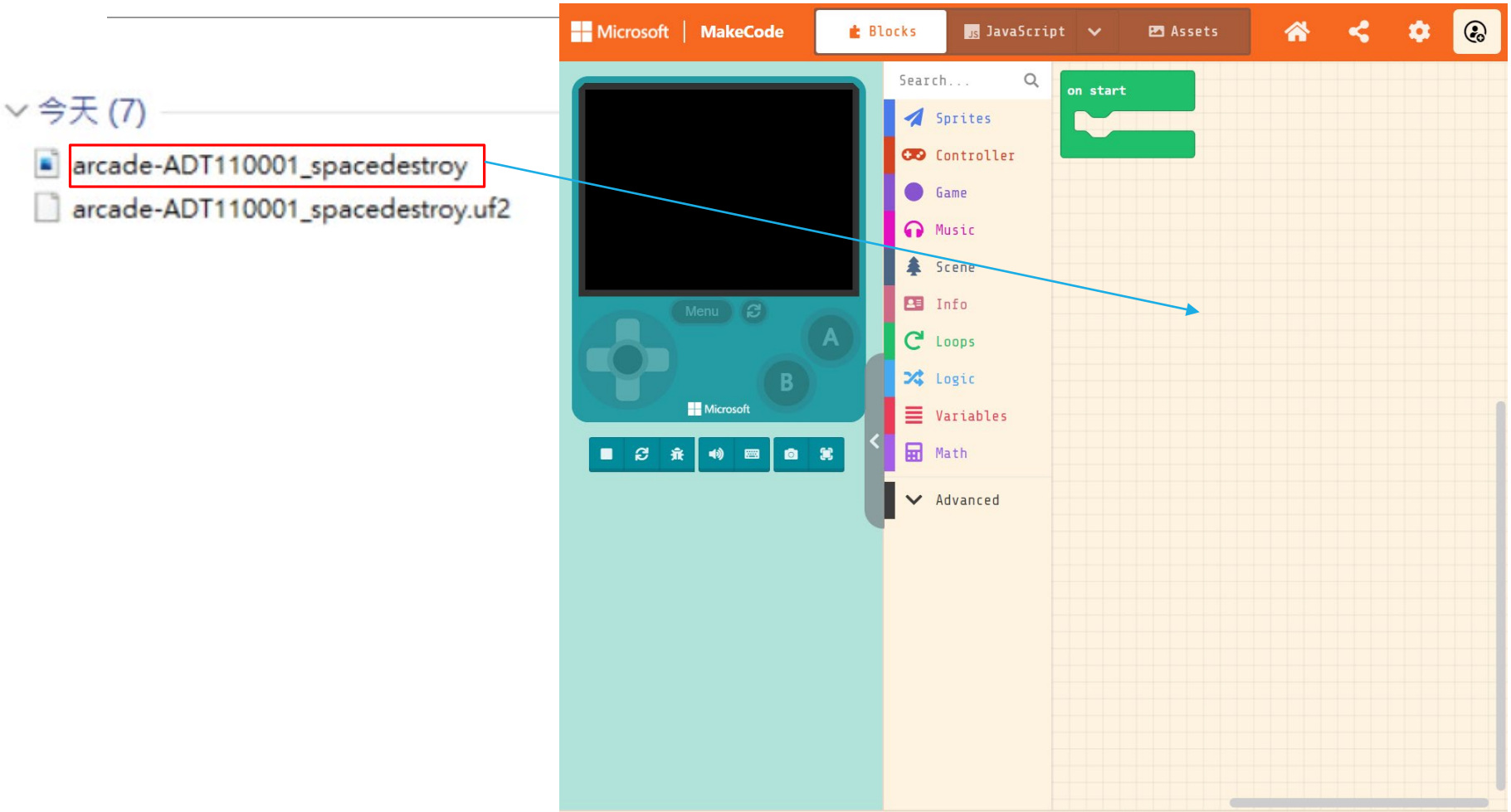
# Import saved project

## New project

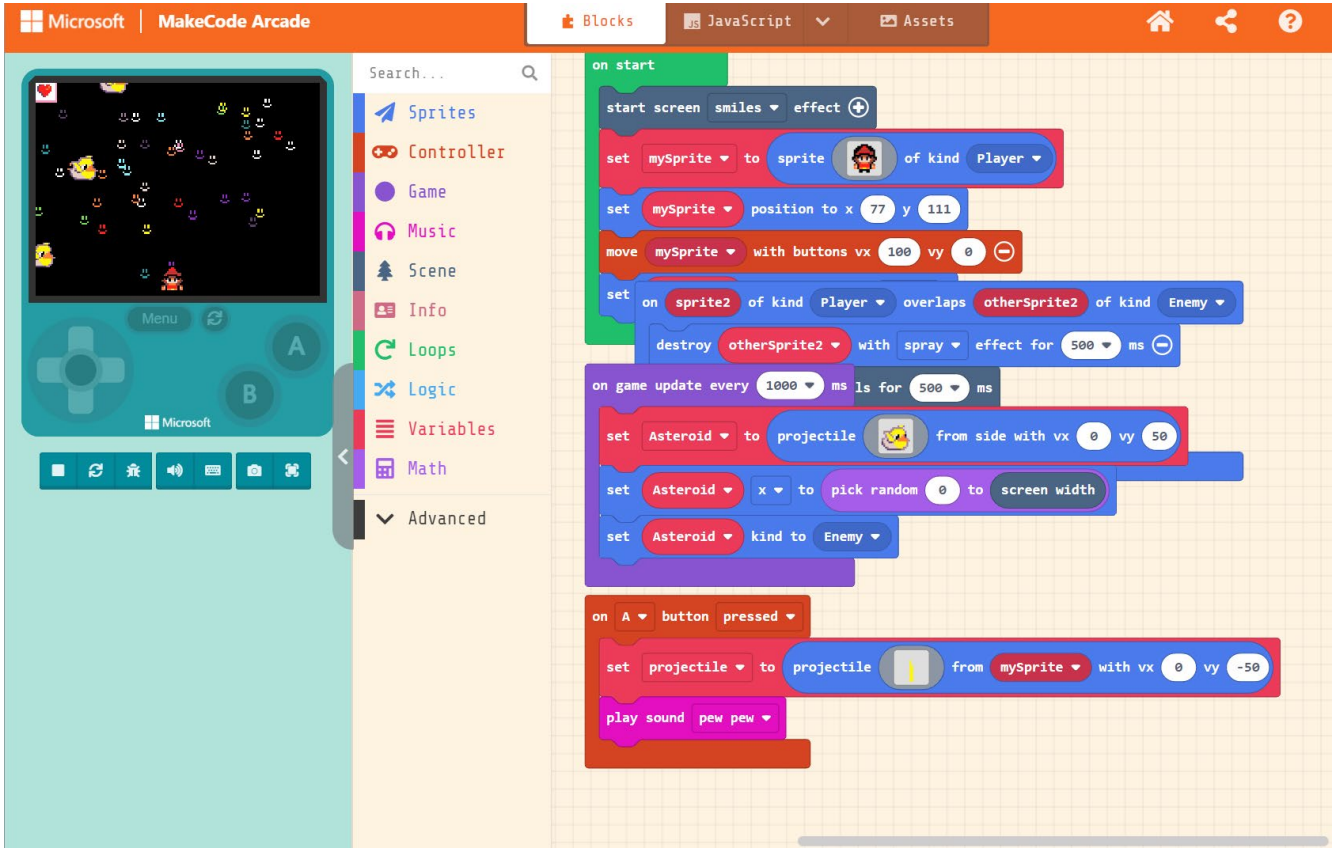


# Drag the png to the Editor



# Successful import the project



# Homework

# Homework

1. [ 課堂活動 ] 完成makecode arcade平台上的space destroy遊戲。並發揮你的創意設計角色。

   分享你的作品在FB社團上。

   學號:　姓名:

   人數: X 人 (可1人1組，或2人1組)

   主題:

   基礎 (完成基本功能) or 進階 (完成其他功能，需描述)

   [進階版]其他功能或特色 (ex. 設計B按鈕、有status bar…..)

   功能1:

   功能2:

   網址連結

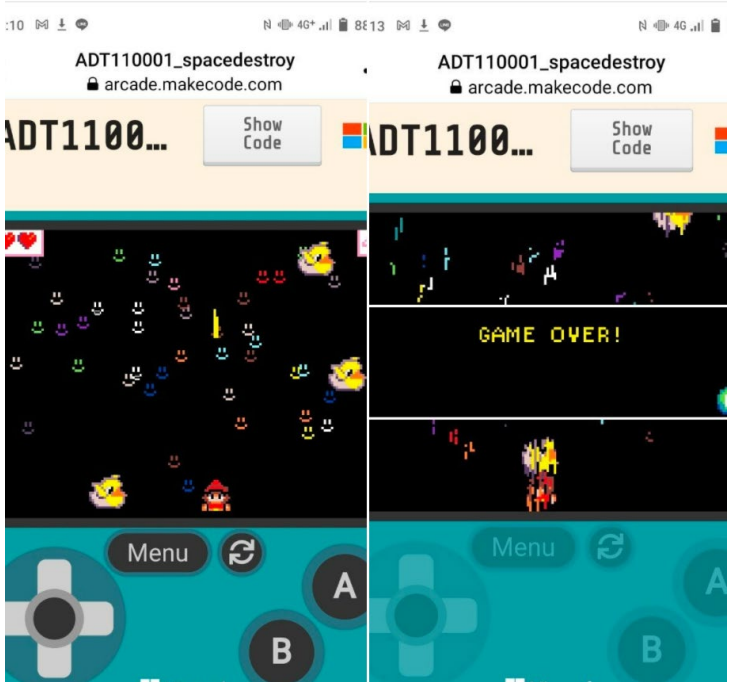
2. 完成學習單 繪製流程圖

# Homework#1 Demonstration

Chih-Hung Wu
29 分鐘 ·

計算機概論課程 實作單元
Makecode自製小遊戲

https://makecode.com/_bu9J7101M8aX



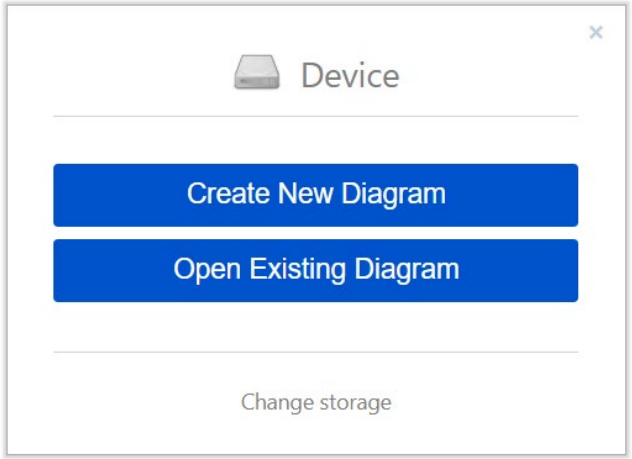
# Hoemwork#2
# FlowChart

# Online flowchart website

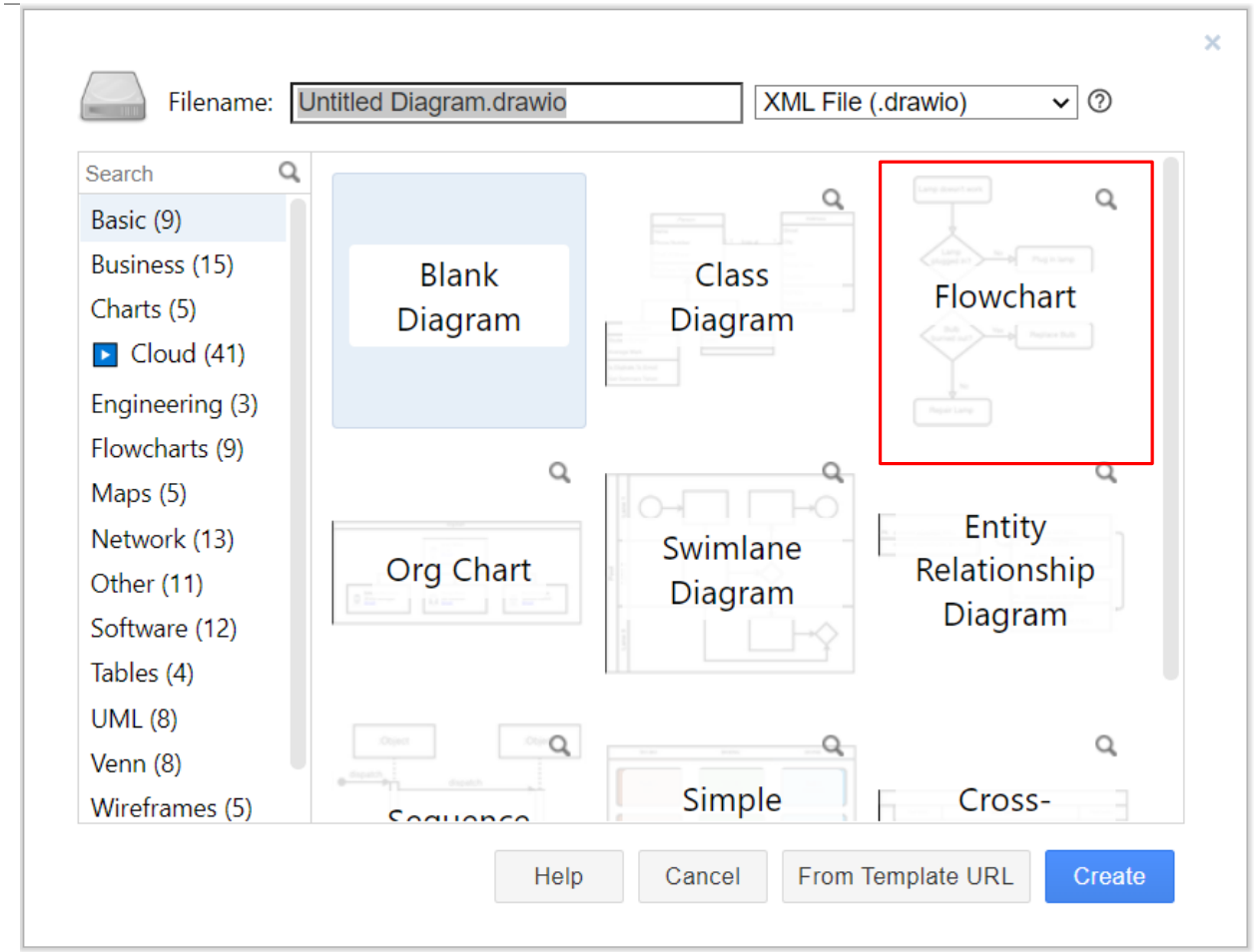
Use draw.io to draw the flowchart

Draw.io

https://app.diagrams.net/



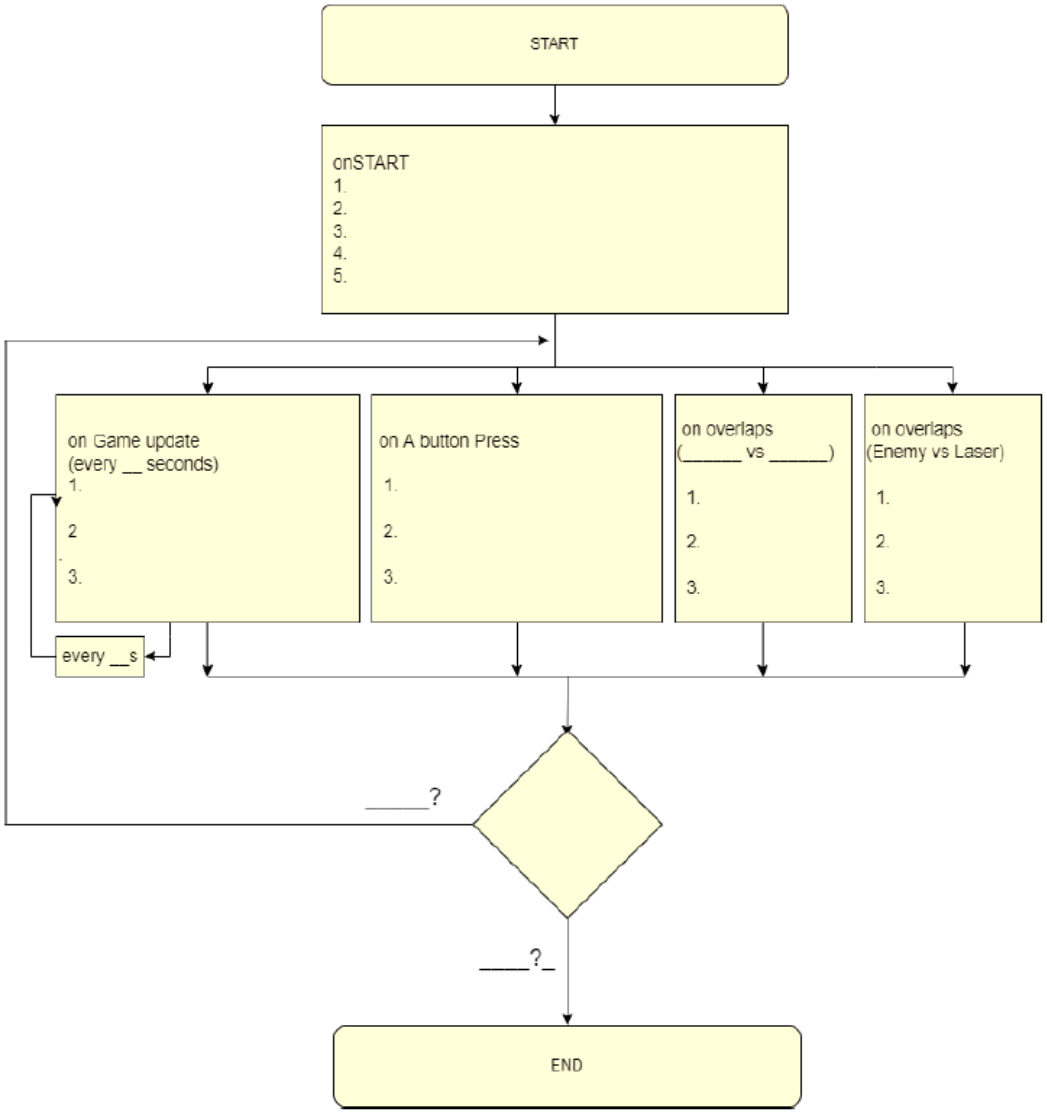
# Select Flowchat



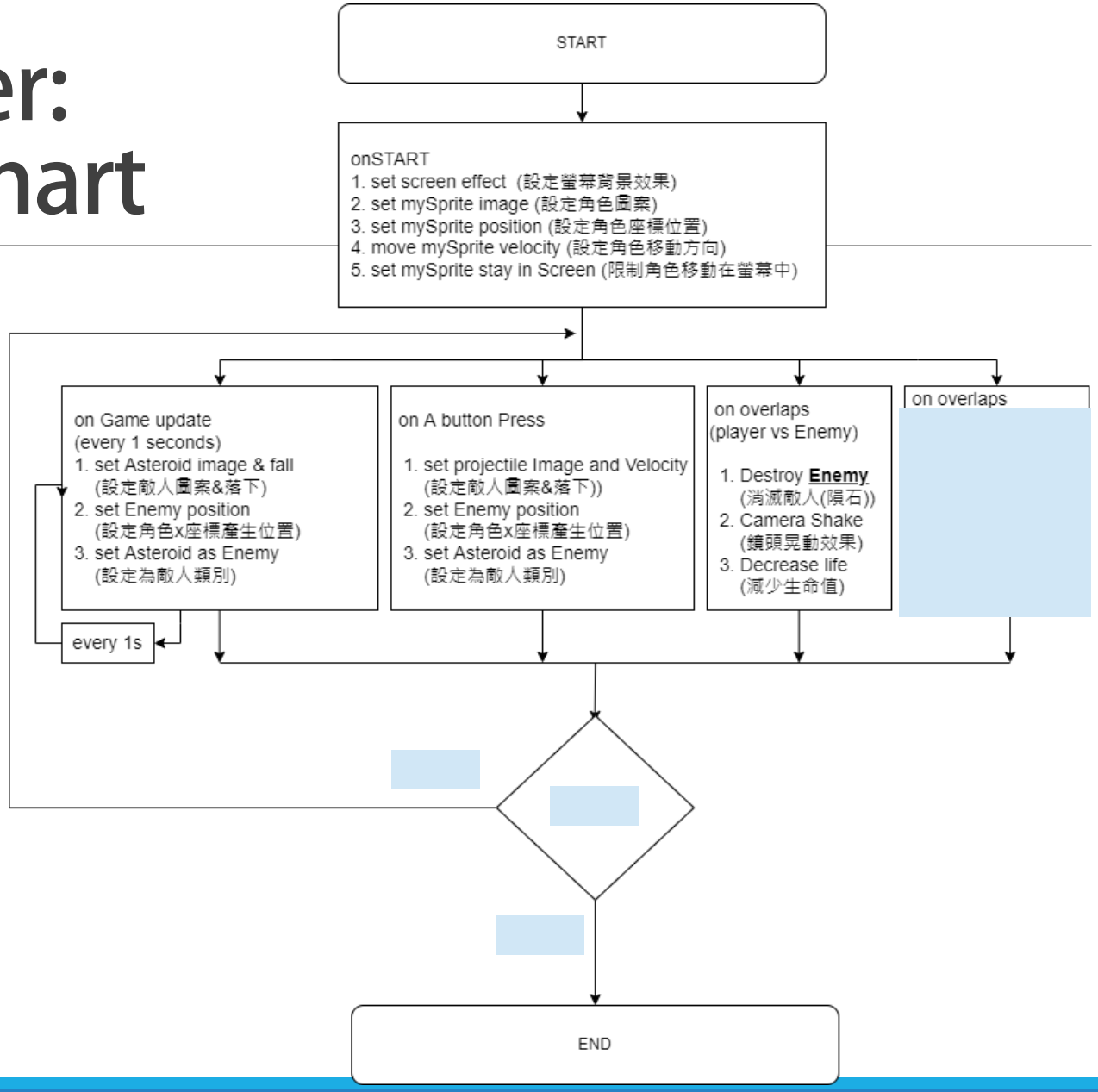
# Learning task

## FlowChart

Try the SpaceDestroy game and complete the following game design flowchart.
(試著以 SpaceDestroy 遊戲，完成以下遊戲設計流程圖)
Flowchart



# Answer: Flowchart



# Extension

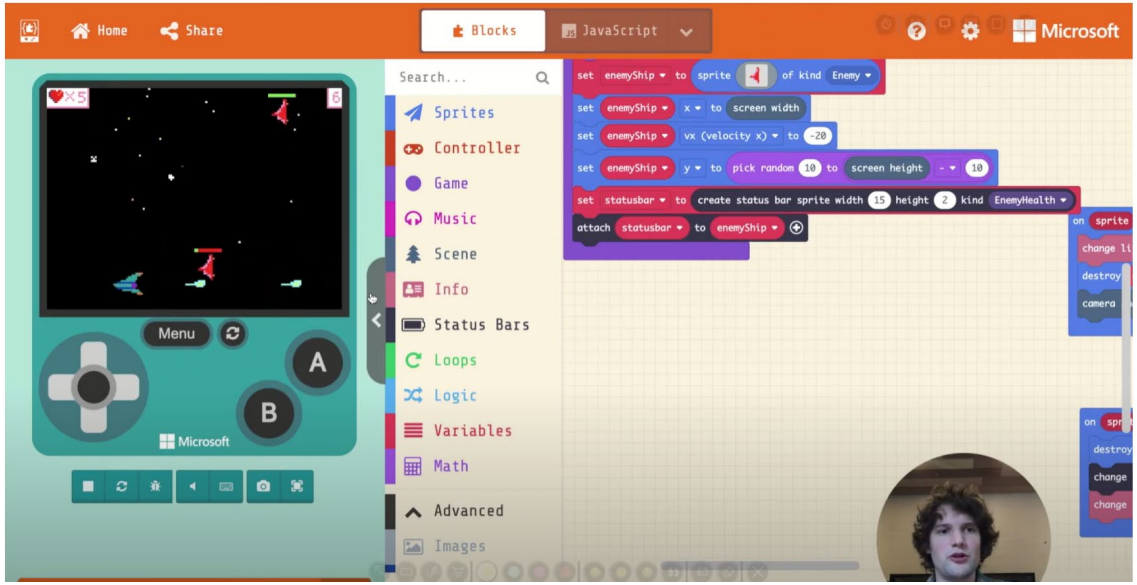
# MakeCode進階功能

## STATUS BAR

# Step

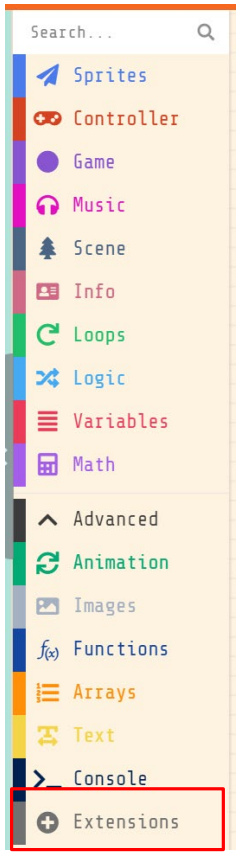
Advance
- Extension-> Status Bar

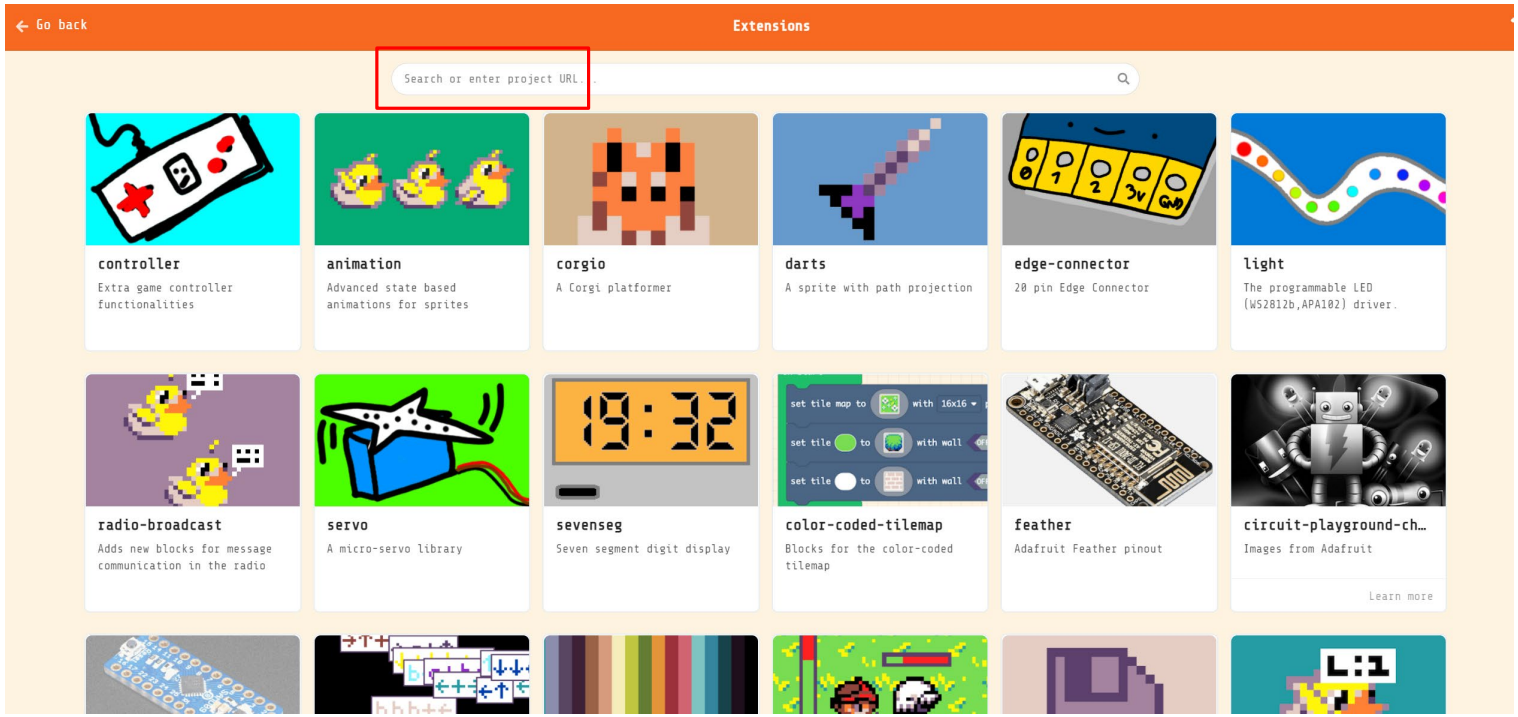
設定status bar步驟
- 附加至敵人
- 設定最大值
- 設定外觀、大小、顏色
- 設定減少數量
- 設定0時destroy敵人




## Tutorial Video
- https://www.youtube.com/watch?v=m7avrQrLP3M

# Advanced-> Extension



# Status-bar

**status-bar**

Create status bar sprites for your game

Learn more

# Watch
# status-bar (health bar) video

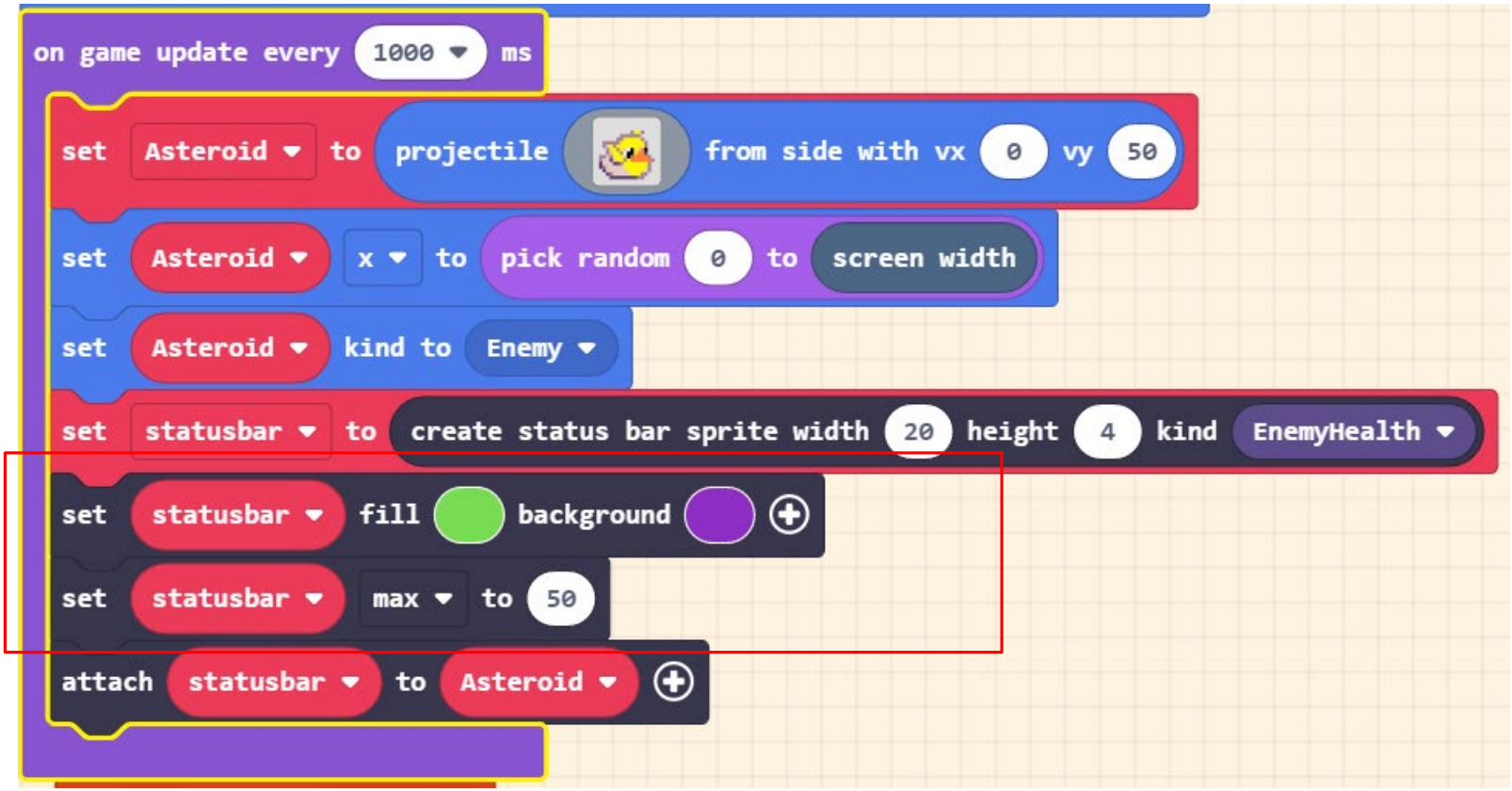
https://www.youtube.com/watch?v=m7avrQrLP3M

# Add status-bar to Enemy

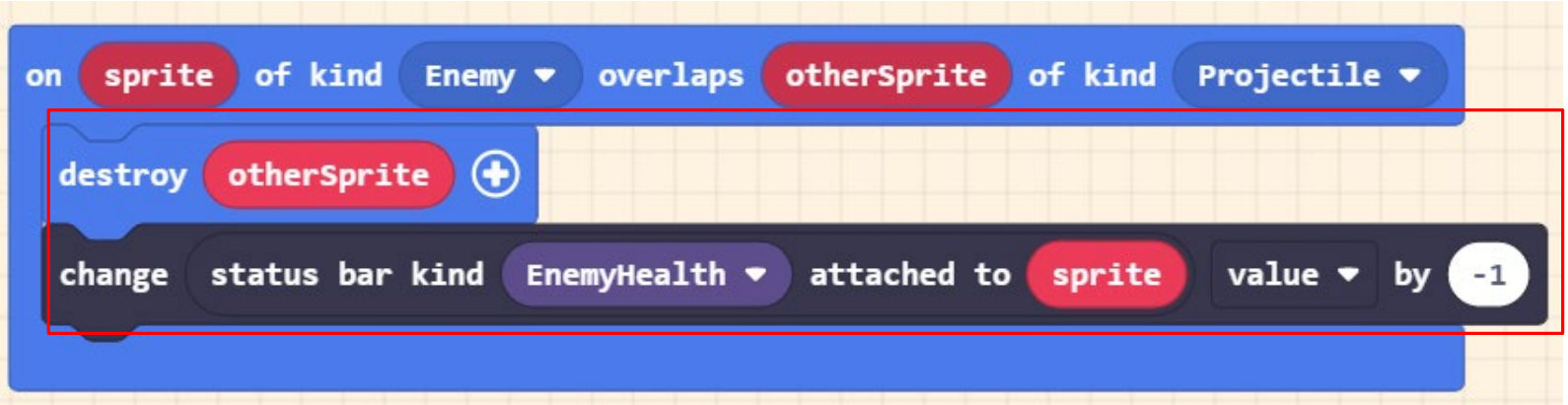
```
on game update every 1000 ms
    set Asteroid to projectile from side with vx 0 vy 50
    set Asteroid x to pick random 0 to screen width
    set Asteroid kind to Enemy
    set statusbar to create status bar sprite width 20 height 4 kind EnemyHealth
    attach statusbar to Asteroid
```

Enemy Health

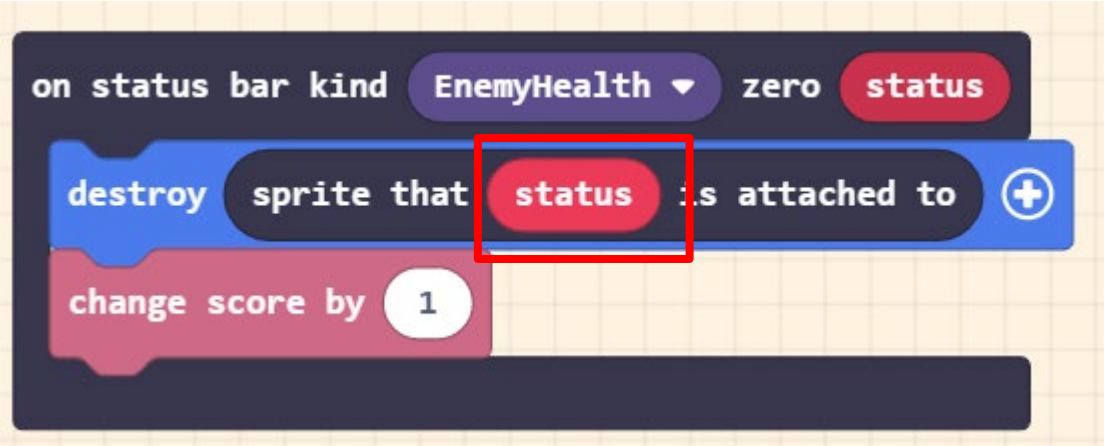
# Set status-bar



# Decrease status-bar (health)



# Add
# change score & destroy status -bar



# Completed Code for reference

```
on start
start screen hearts effect
set mySprite to sprite of kind Player
set mySprite position to x 72 y 108
move mySprite with buttons vx 100 vy 0
set mySprite stay in screen ON

on game update every 1000 ms
set astroid to projectile from side with vx 0 vy 50
set astroid x to pick random 0 to screen width
set astroid kind to Enemy
set statusbar to create status bar sprite width 20 height 4 kind EnemyHealth
set statusbar fill background
attach statusbar to astroid
set statusbar max to 50

on sprite of kind Player overlaps otherSprite of kind Enemy
destroy otherSprite with fire effect for 500 ms
camera shake by 4 pixels for 500 ms
change life by -1

on sprite of kind Enemy overlaps otherSprite of kind Projectile
destroy otherSprite
change status bar kind EnemyHealth attached to sprite value by -20
change score by 1

on status bar kind EnemyHealth zero status
destroy sprite that status is attached to with disintegrate effect for 500

on A button pressed
set projectile to projectile from mySprite with vx 0 vy -50
play sound pew pew
```

New add

New add

New add

# 進階功能#2
# PowerUp

# Watch the power ups video

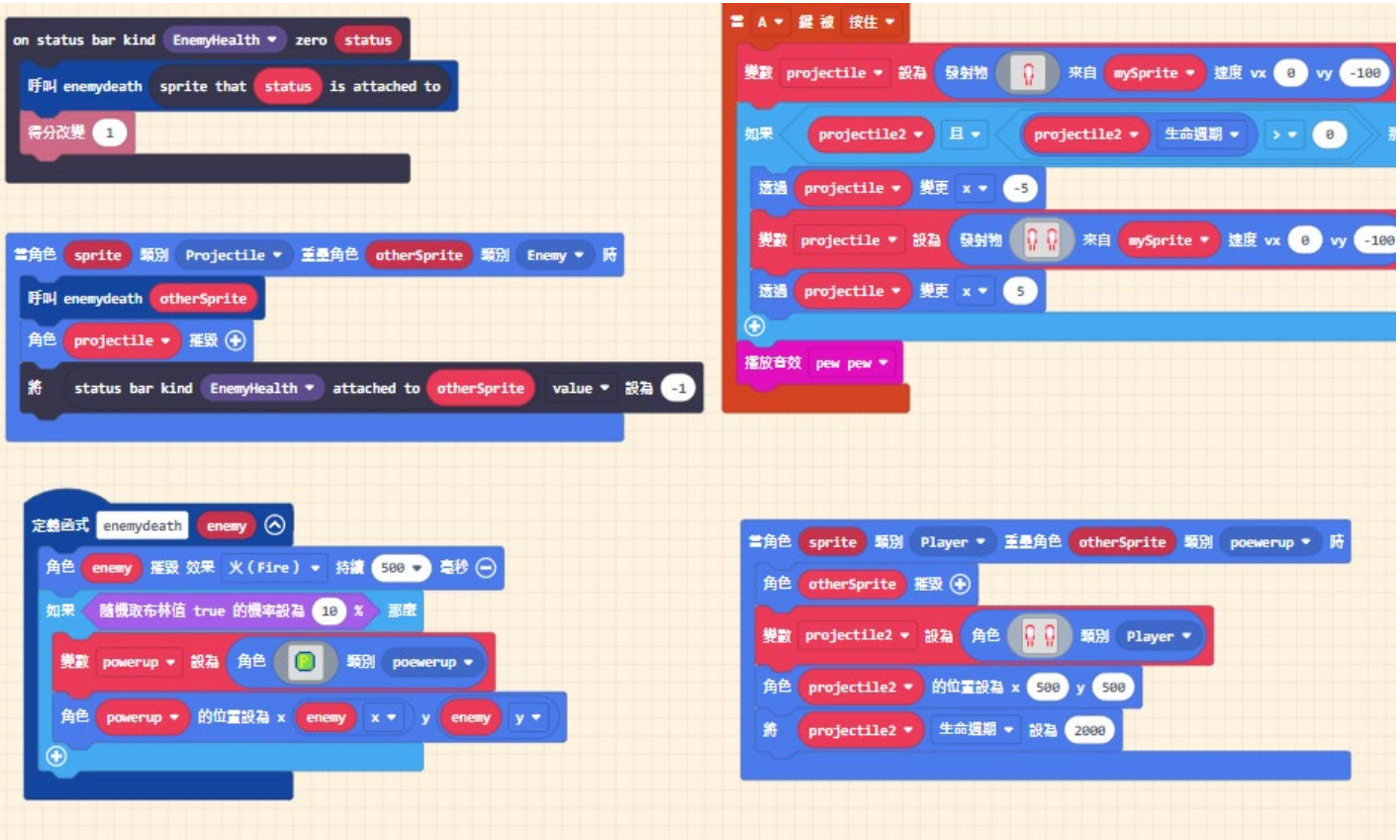
https://www.youtube.com/watch?v=S-WMUIwQ7uM

# Reference

Arcade Beginner Live, Microsoft MakeCode39/39

https://www.techbang.com/posts/69473-meowbit-ultra-mini-earth-gun-game-console-can-also-be-used-as-a-development-board

# PowerUp

```
on start
  start screen blizzard effect
  set mySprite to sprite of kind Player
  set mySprite position to x 79 y 107
  move mySprite with buttons vx 100 vy 100
  set mySprite stay in screen ON

on game update every 1000 ms
  set asteroid to projectile from side with vx 0 vy 23
  set asteroid x to pick random 0 to screen width
  set asteroid kind to Enemy
  set statusbar to create status bar sprite width 20 height 4 kind EnemyHealth
  set statusbar fill background
  set statusbar max to 50
  attach statusbar to asteroid

on sprite of kind Enemy overlaps otherSprite of kind Projectile
  destroy otherSprite
  change status bar kind EnemyHealth attached to sprite value by -25

on status bar kind EnemyHealth zero status
  call enemyDeath sprite that status is attached to
  change score by 1

function enemyDeath enemy
  destroy enemy with disintegrate effect for 500 ms
  if 80 % chance then
    set Powerup to sprite of kind PowerUp
    set Powerup x to enemy x
    set Powerup y to enemy y

on sprite of kind Player overlaps otherSprite of kind Enemy
  camera shake by 4 pixels for 500 ms
  change life by -1
  call enemyDeath otherSprite

on sprite of kind Player overlaps otherSprite of kind PowerUp
  destroy otherSprite
  set doublefireMode to sprite  of kind Player
  set doublefireMode position to x 75 y 5
  set doublefireMode lifespan to 2000

on A button pressed
  set projectile to projectile from mySprite with vx 0 vy -50
  if doublefireMode and doublefireMode lifespan > 0 then
    change projectile x by -5
    set projectile to projectile from mySprite with vx 0 vy -50
    change projectile x by 5
  play sound ba ding until done
```

# Power-up mode