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

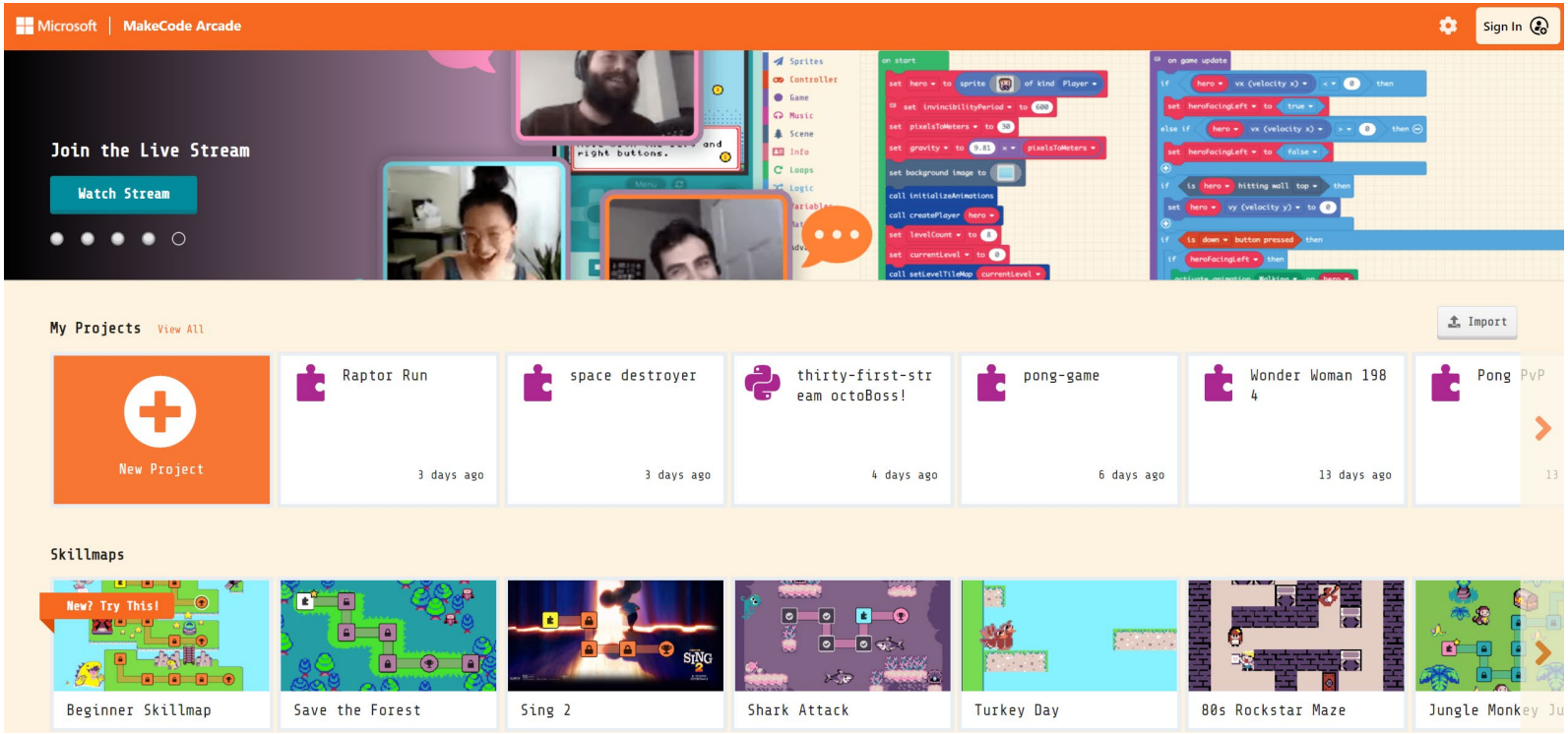
學生延伸作品

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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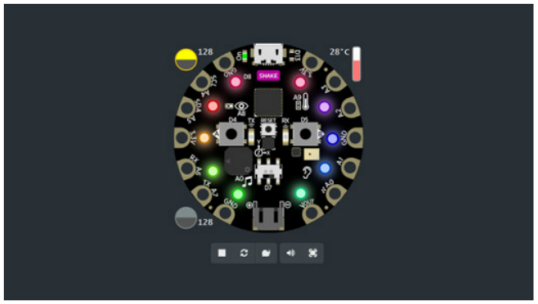
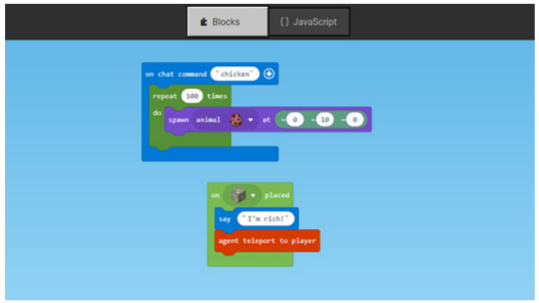


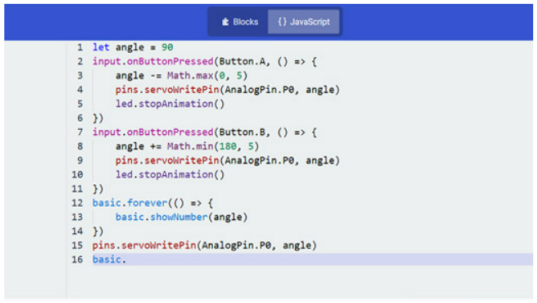
模擬器

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。

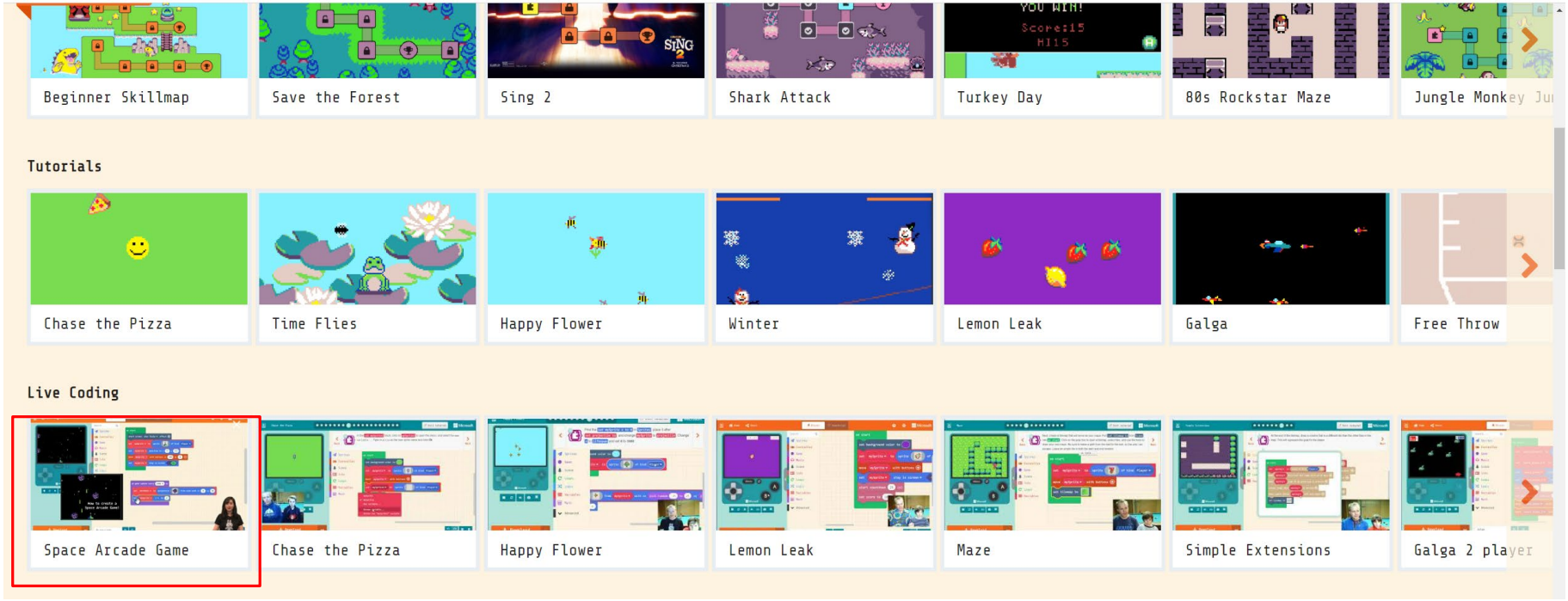


JavaScript 編輯器

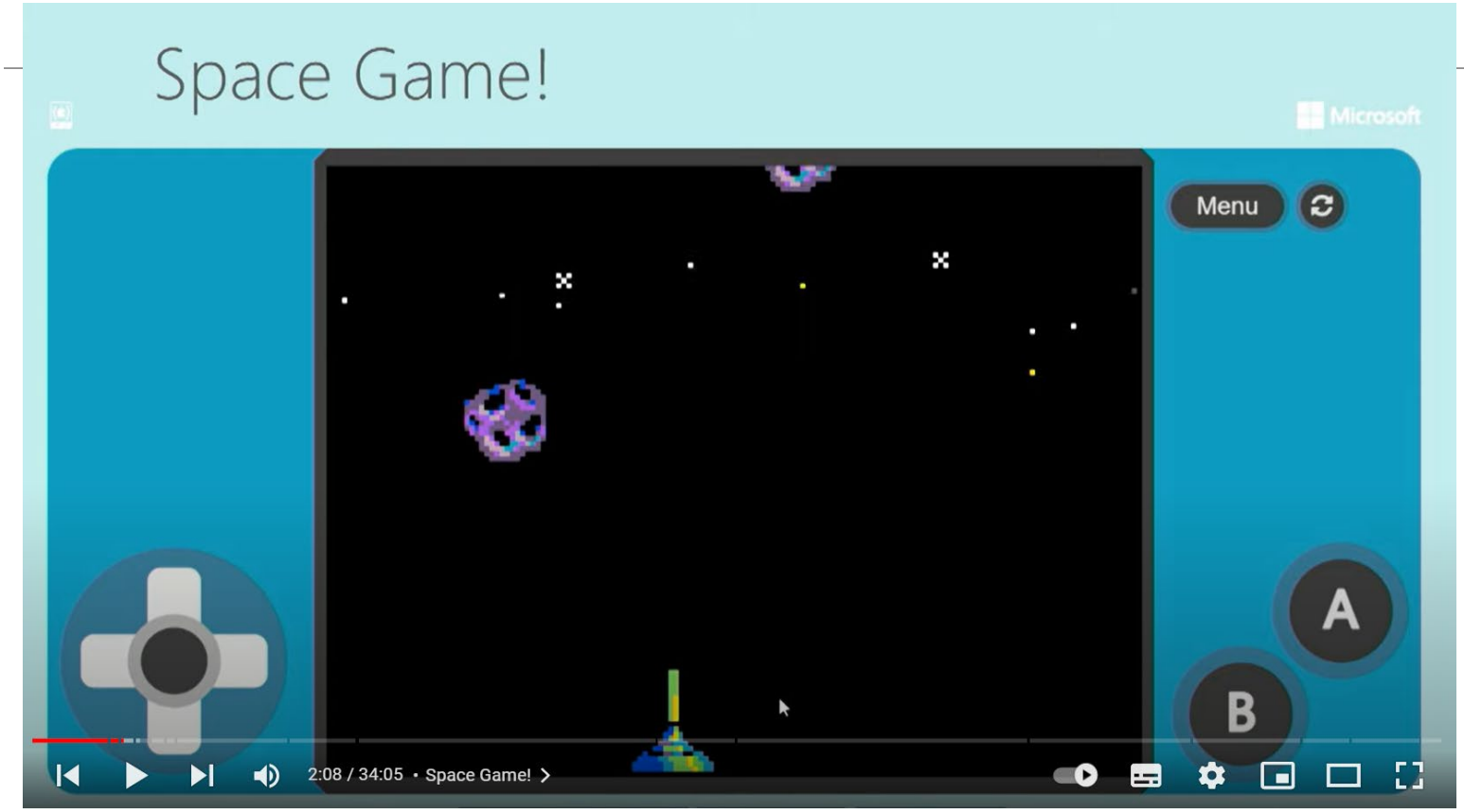
在準備就緒時，學生可以使用具備程式碼片段、工具提示和錯誤偵測、功能完整的 JavaScript 編輯器，協助他們寫程式。

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

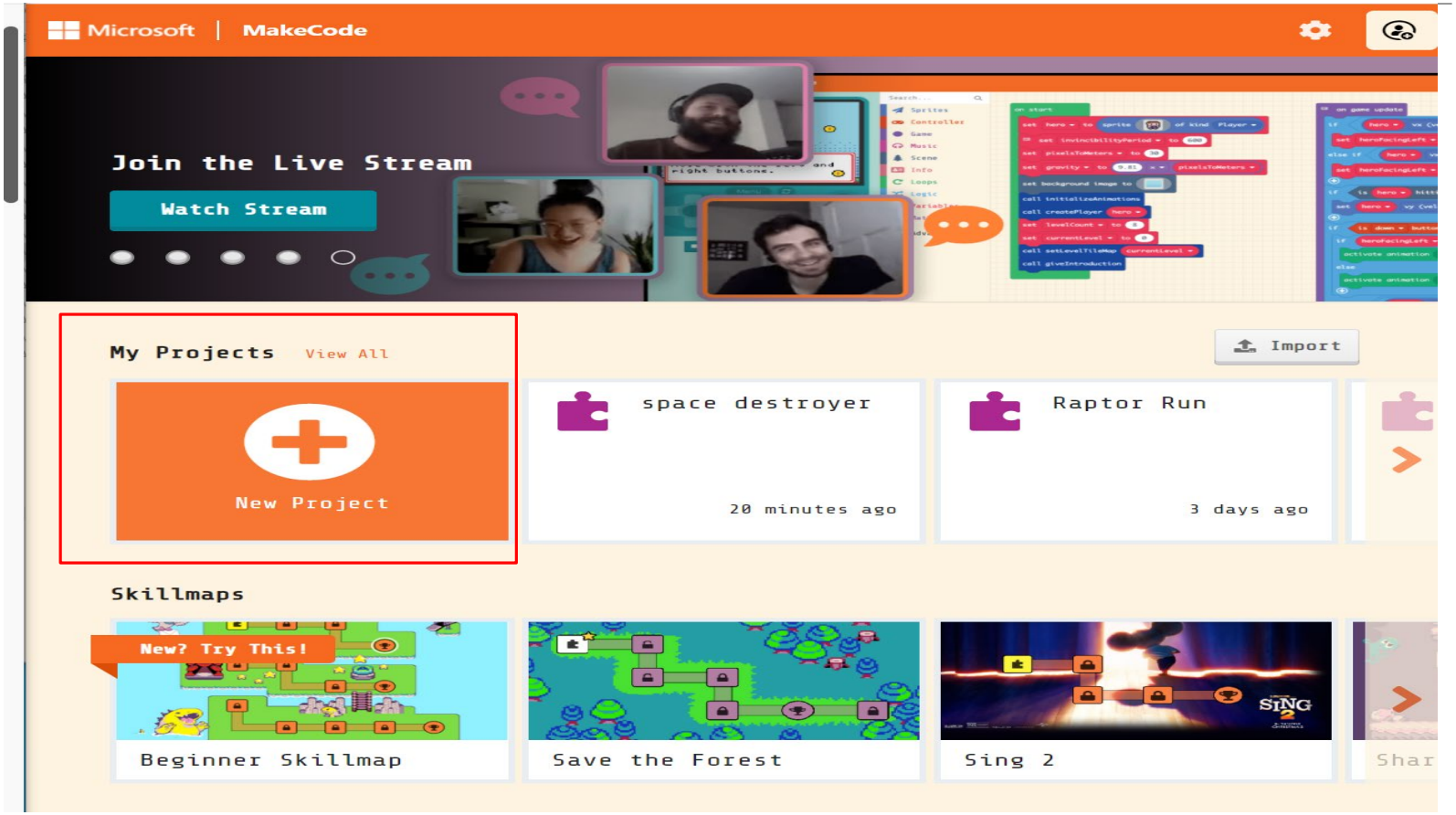
注意安装方式如右

安裝鋰電池

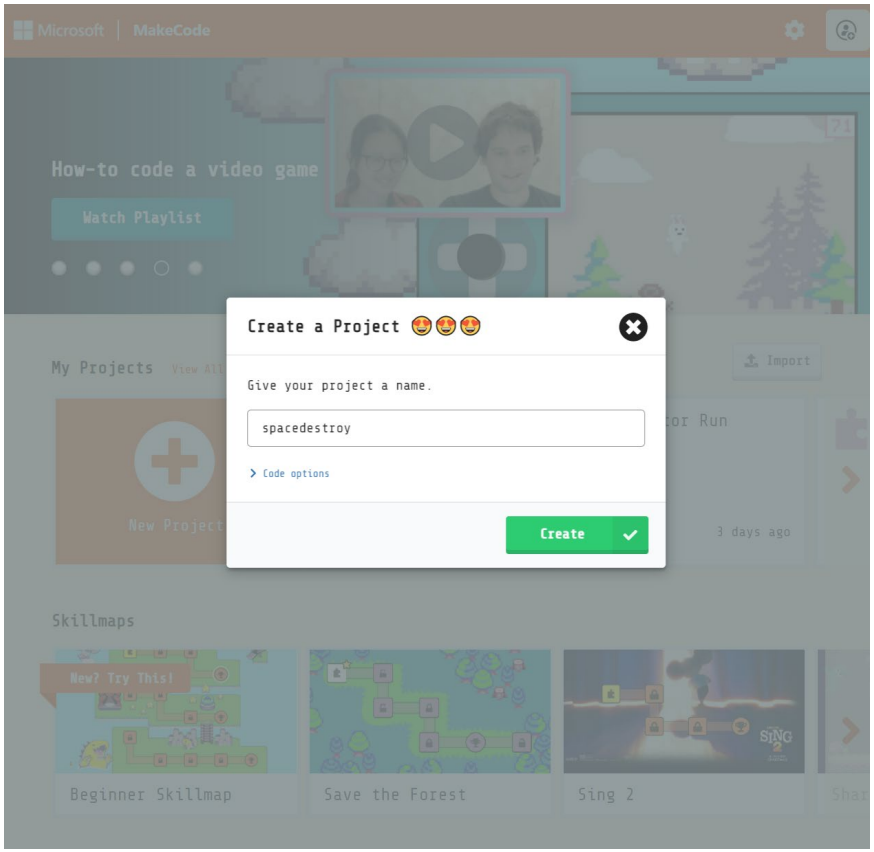
安裝完成

實作
Space Destroy Game

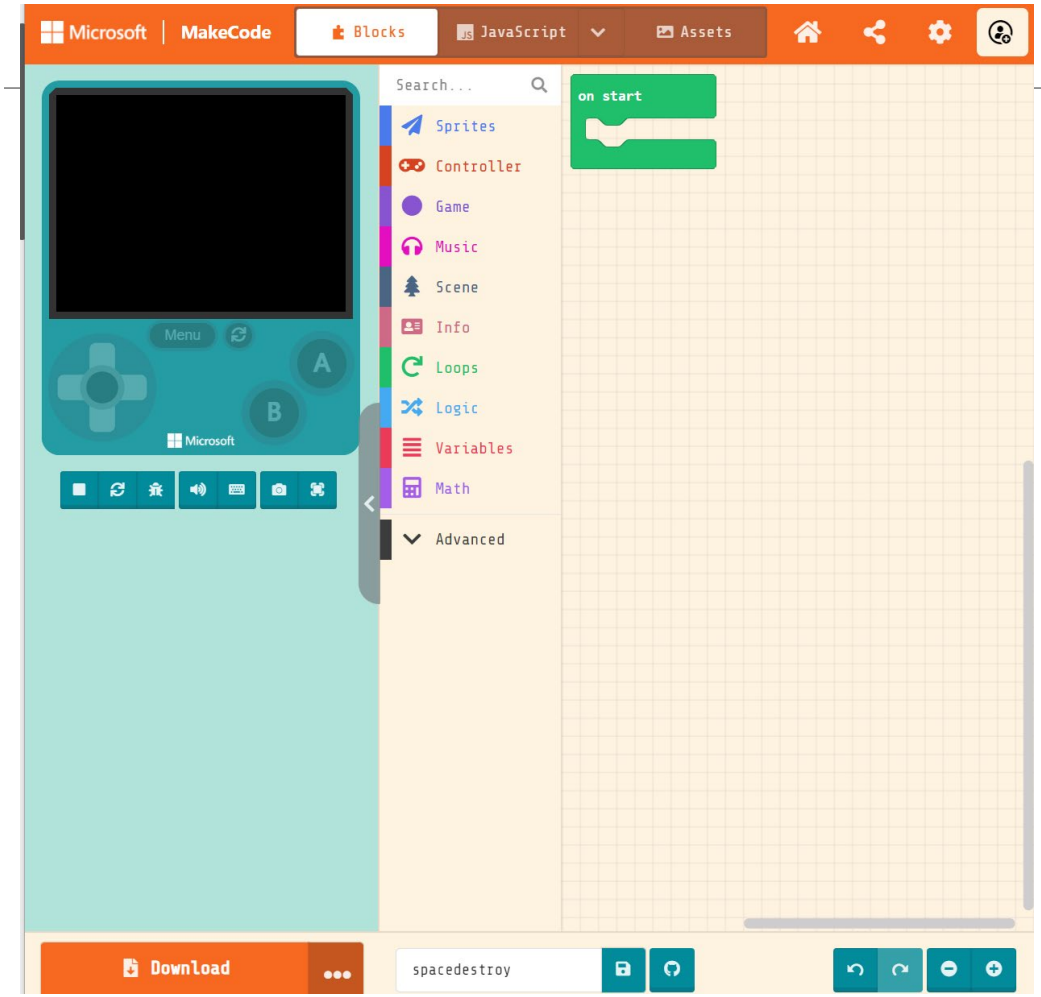
New Project


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

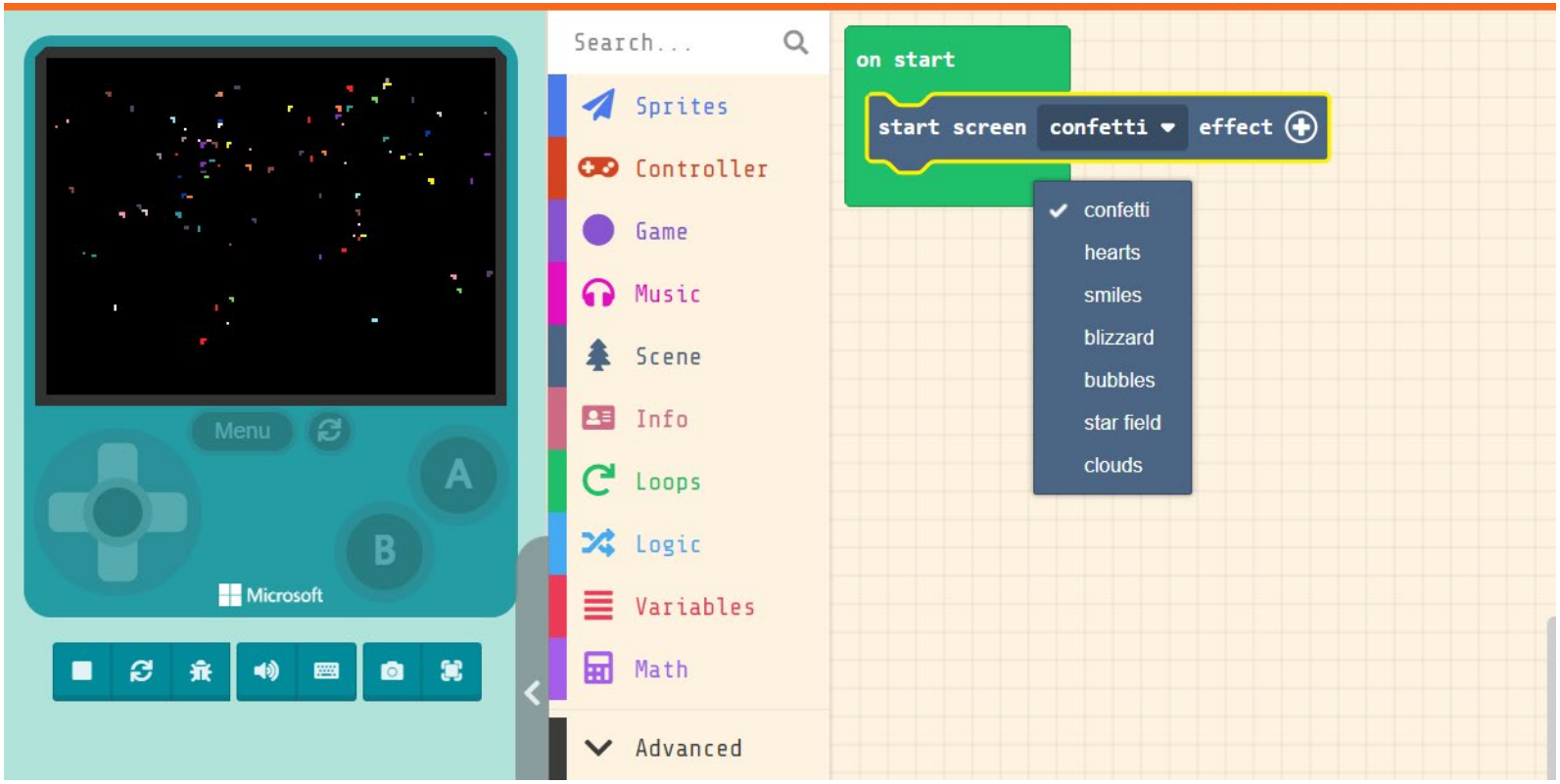


Editor

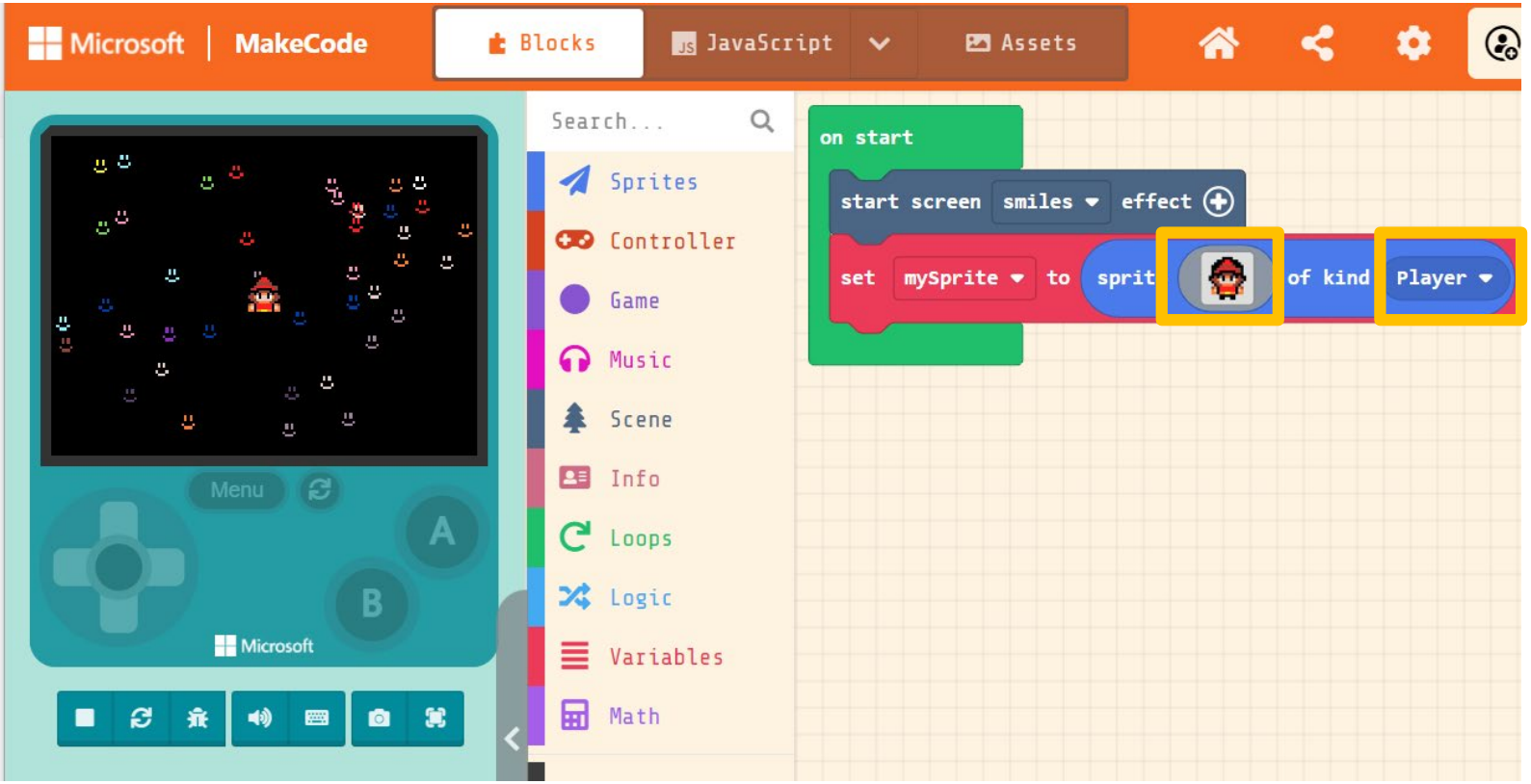

Microsoft
MakeCode
Blocks
JavaScript
Assets
Search...
Sprites
Controller
Game
Music
Scene
Info
Loops
Logic
Variables
Math
Advanced
on start
Menu
A
B
Microsoft
Download
spacedestroy

Part I.
Game start initialization

1. 設定背景效果

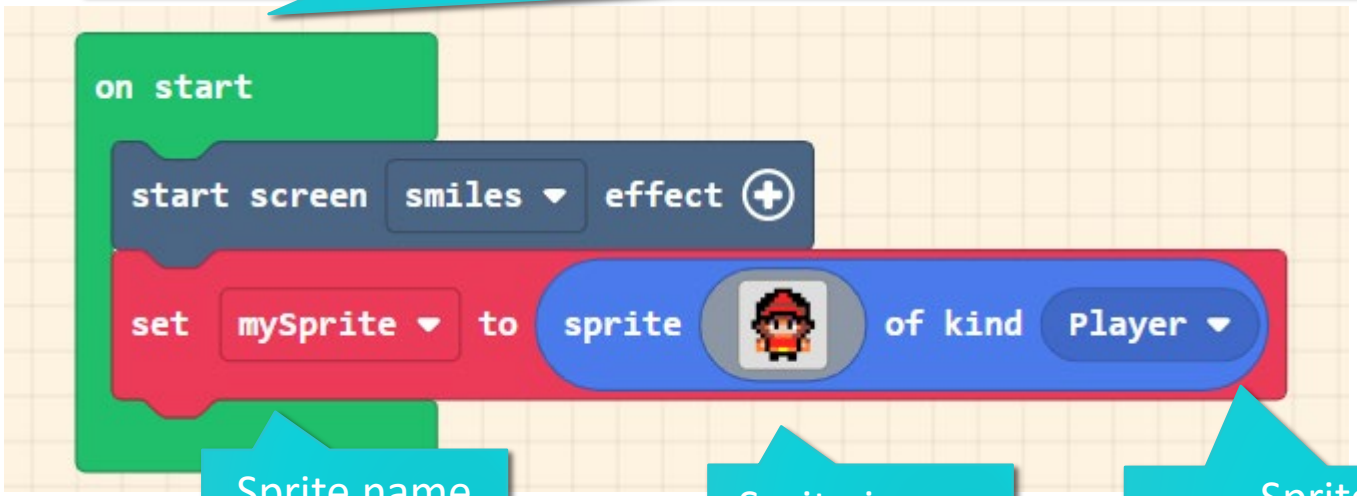

Search...
Sprites
Controller
Game
Music
Scene
Info
Loops
Logic
Variables
Math
Advanced
Menu
A
B
Microsoft
on start
start screen
confetti
effect
confetti
hearts
smiles
blizzard
bubbles
star field
clouds

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.



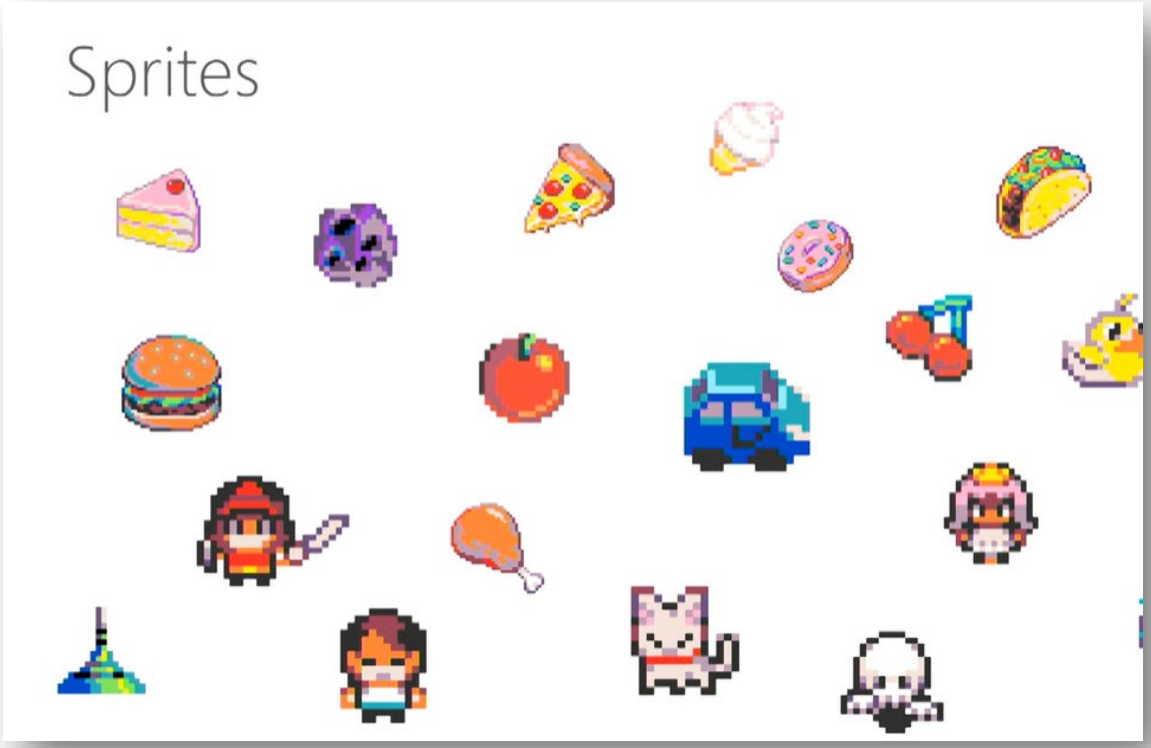
Sprite name

Sprite image

Sprite type
such as Player,
Enemy, ….

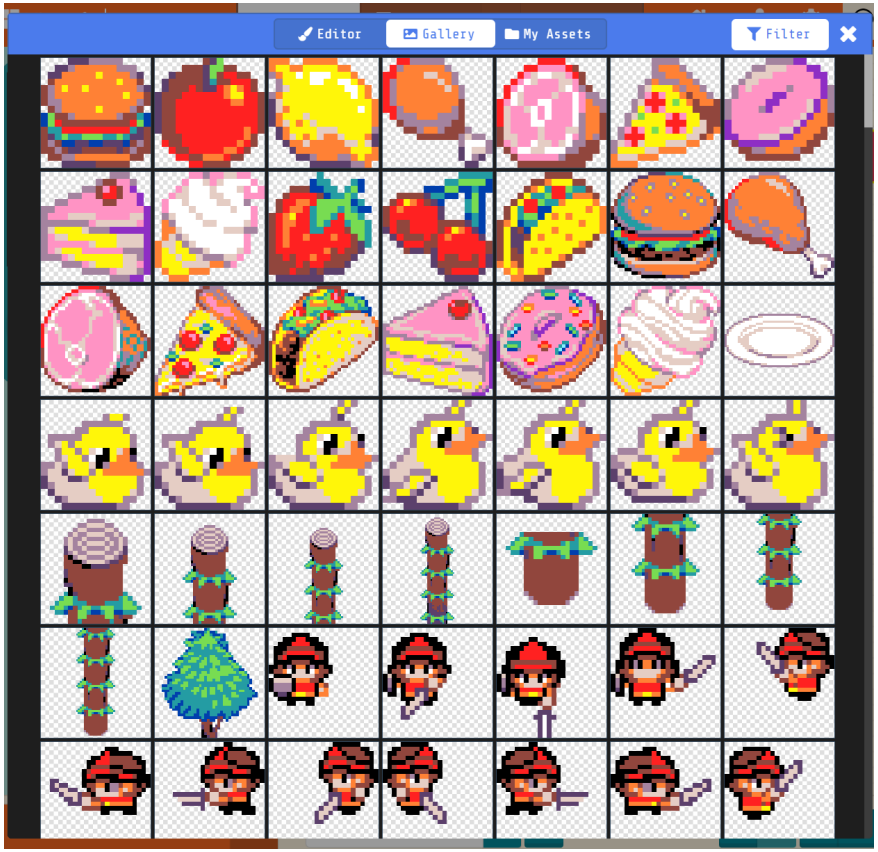
What is sprite

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

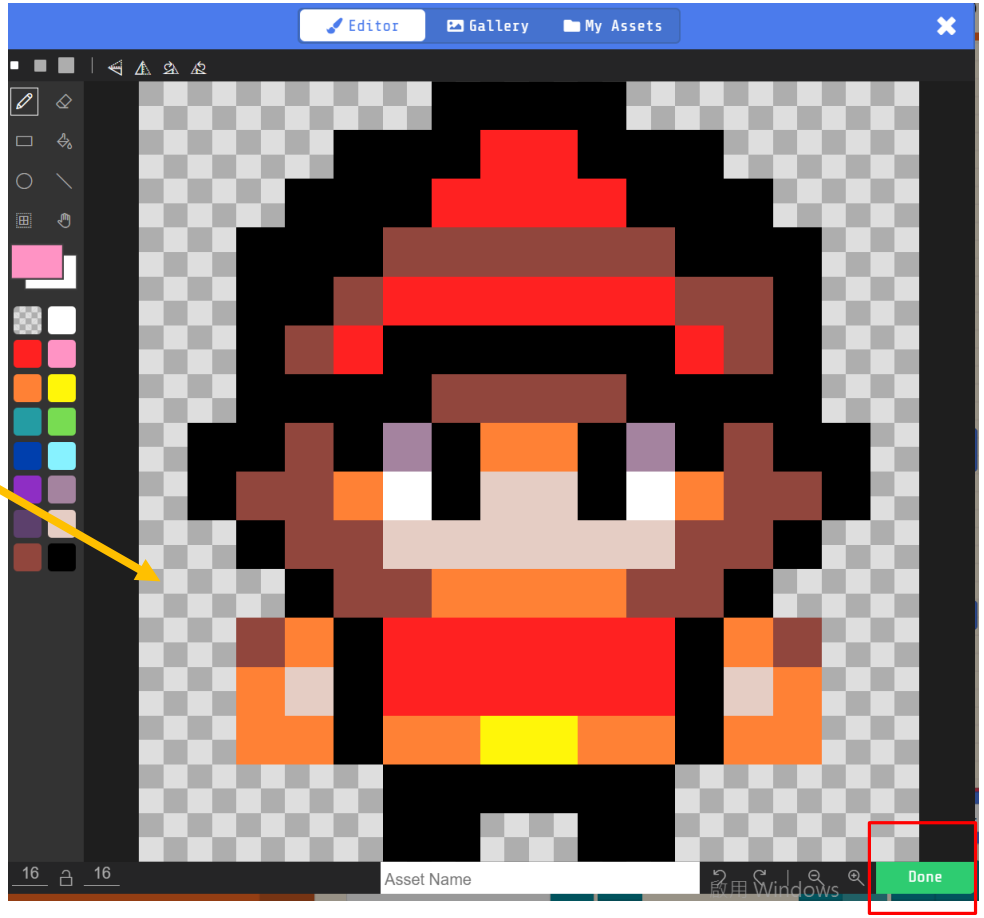


Build-in
Sprite image
In Makecode

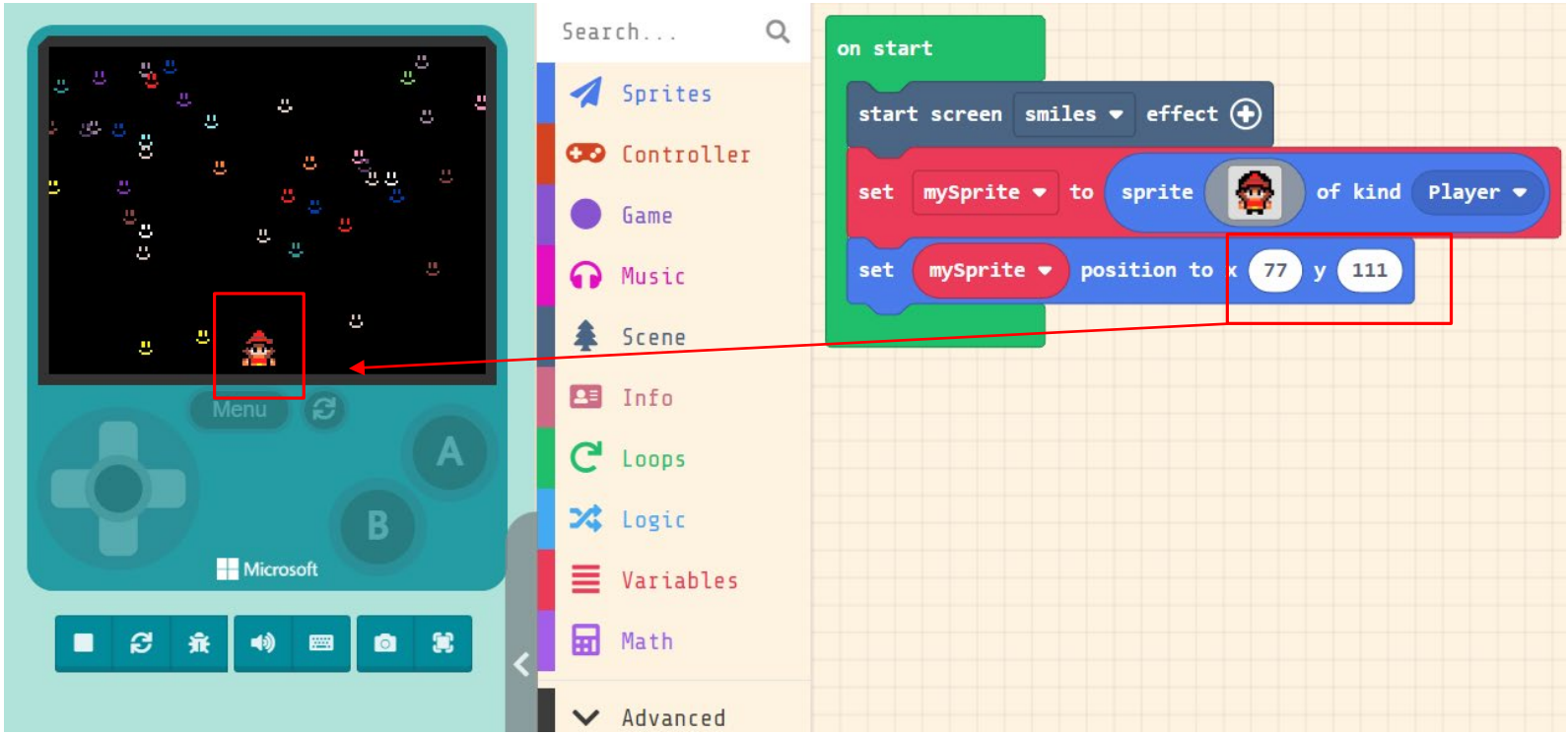
Build-in sprite (Gallery)



Create/design your own Sprite



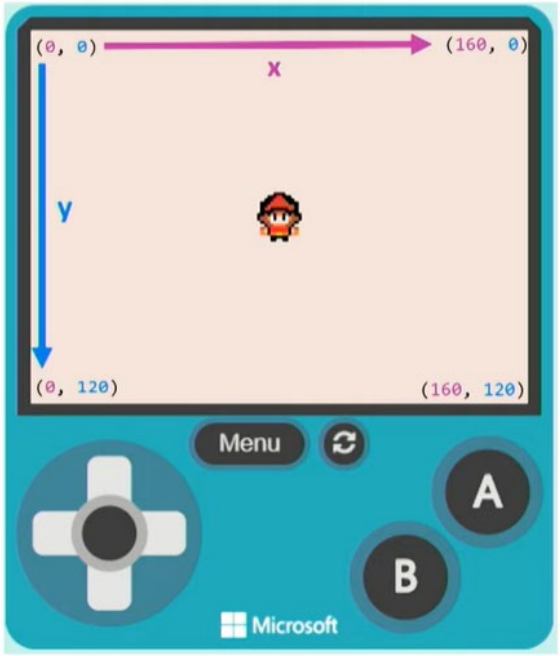
3. Set sprite position (x,y)->(77,111)



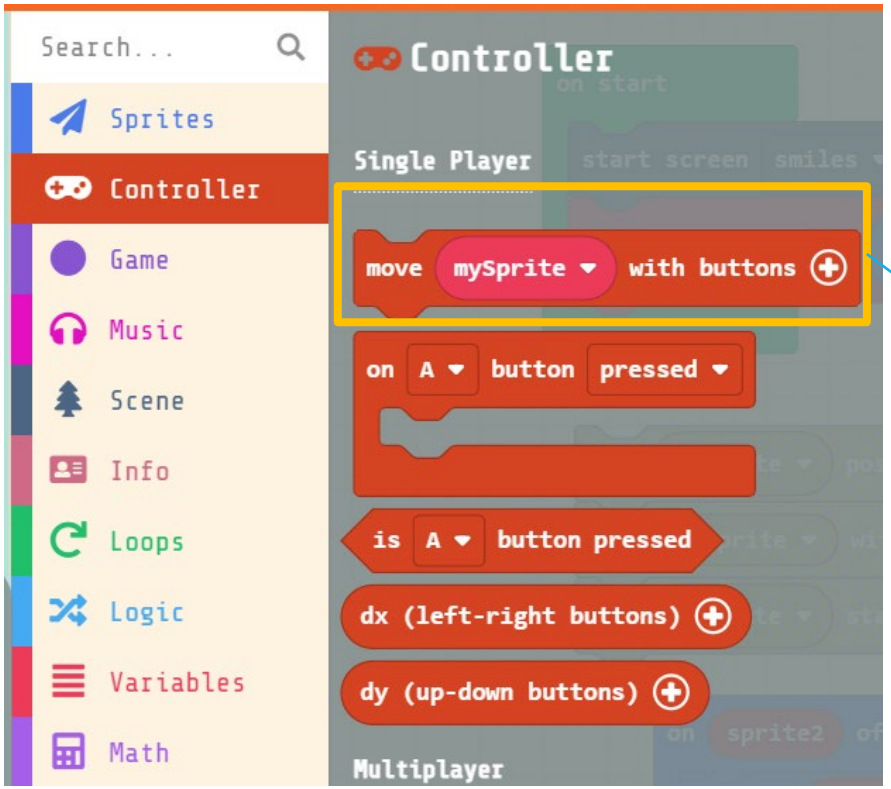
Coordinates in Arcade (座標系統)

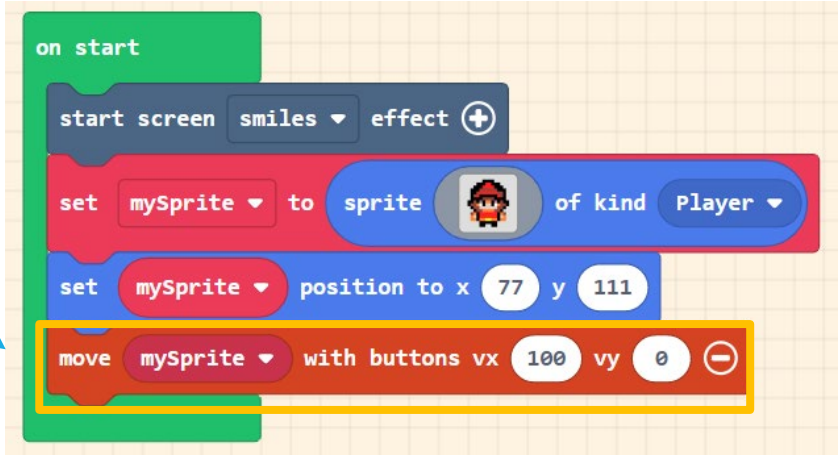
Coordinates

The Arcade game screen dimensions are 160 width x 120 height

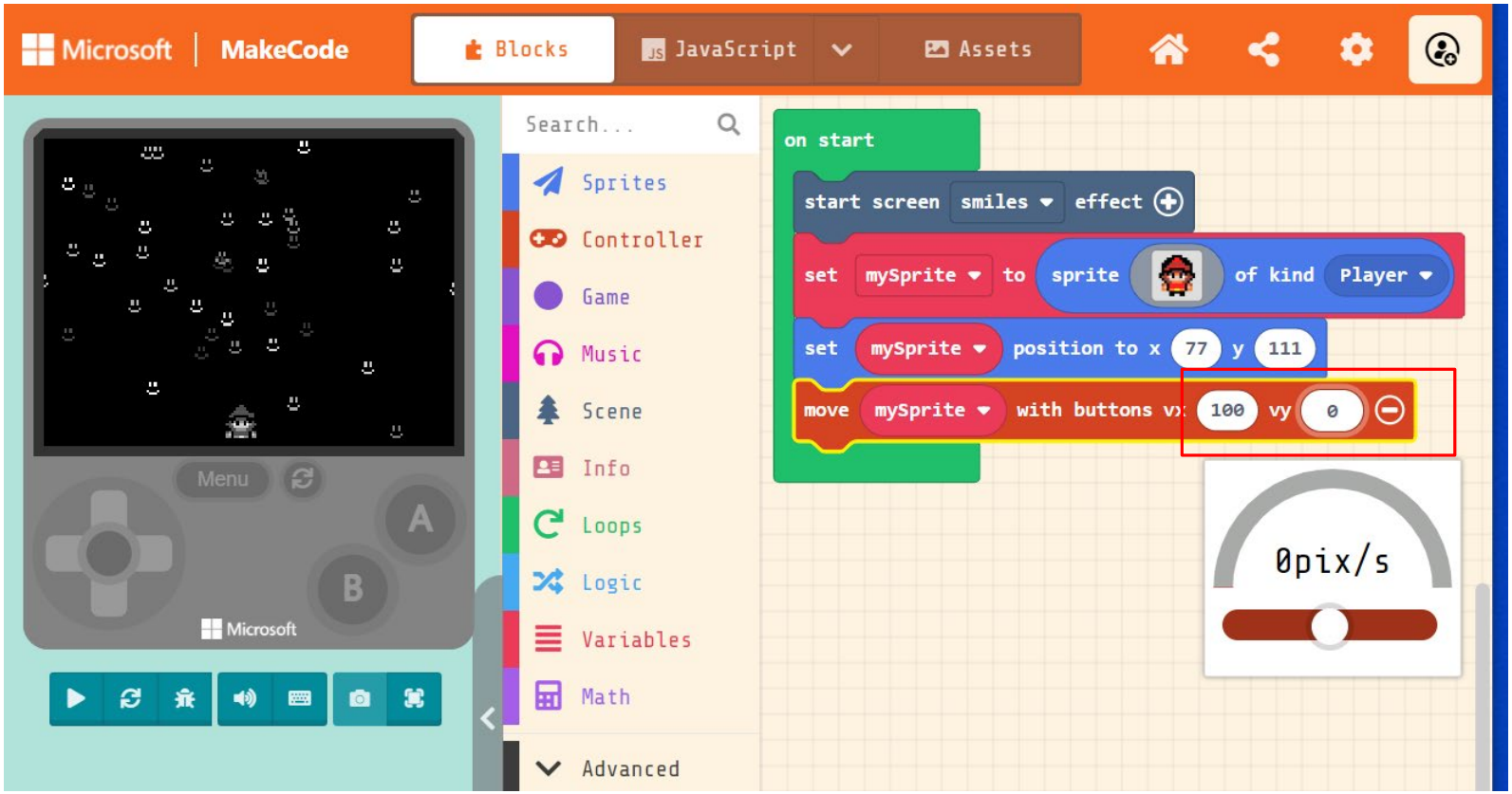


4. Control the movement of spaceship

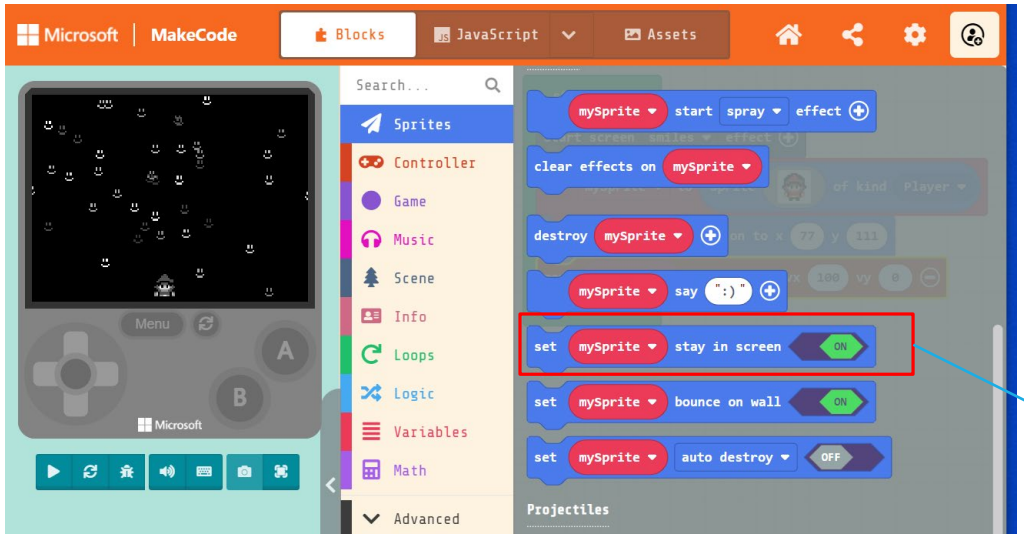


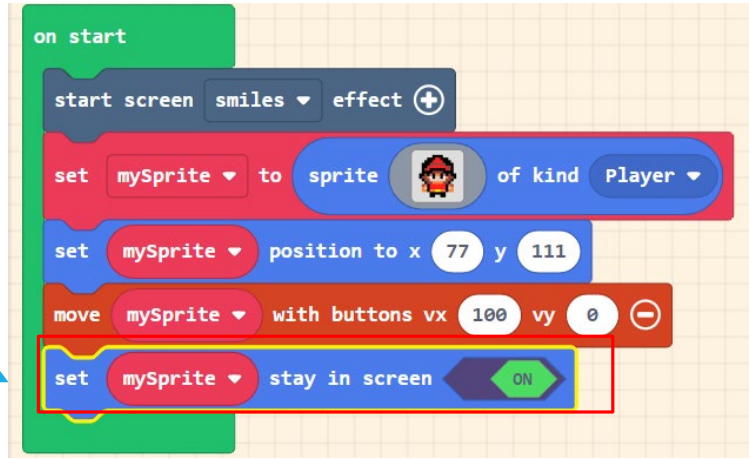


4. Set my sprite movement vx: 100, vy: 0

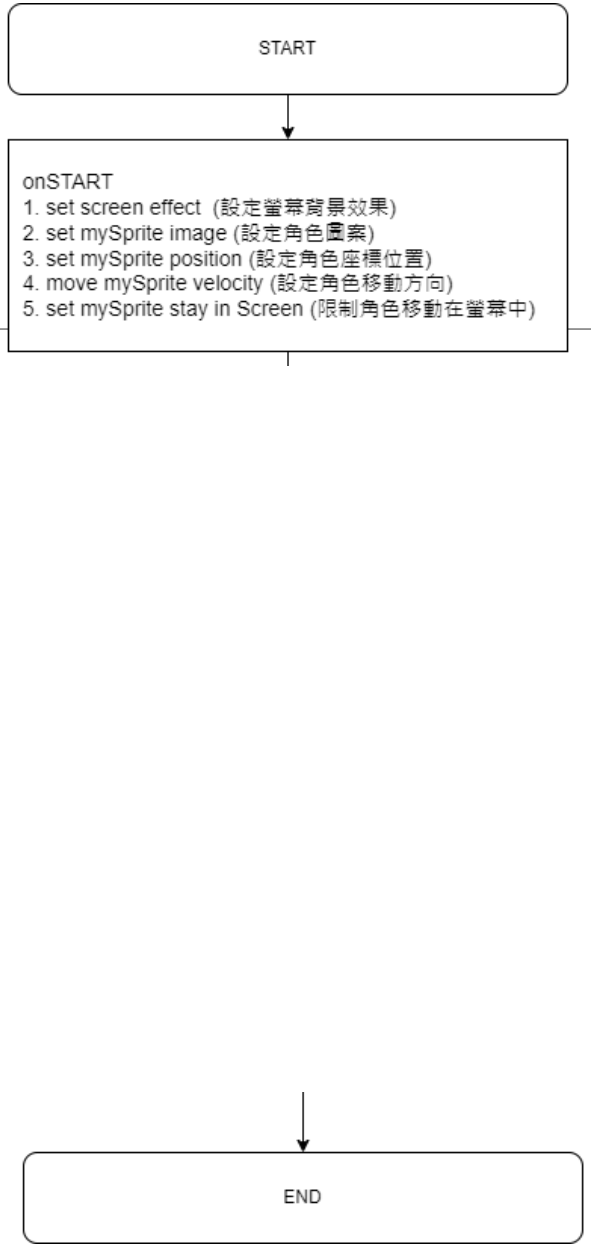


5. Keep your spaceship on the screen



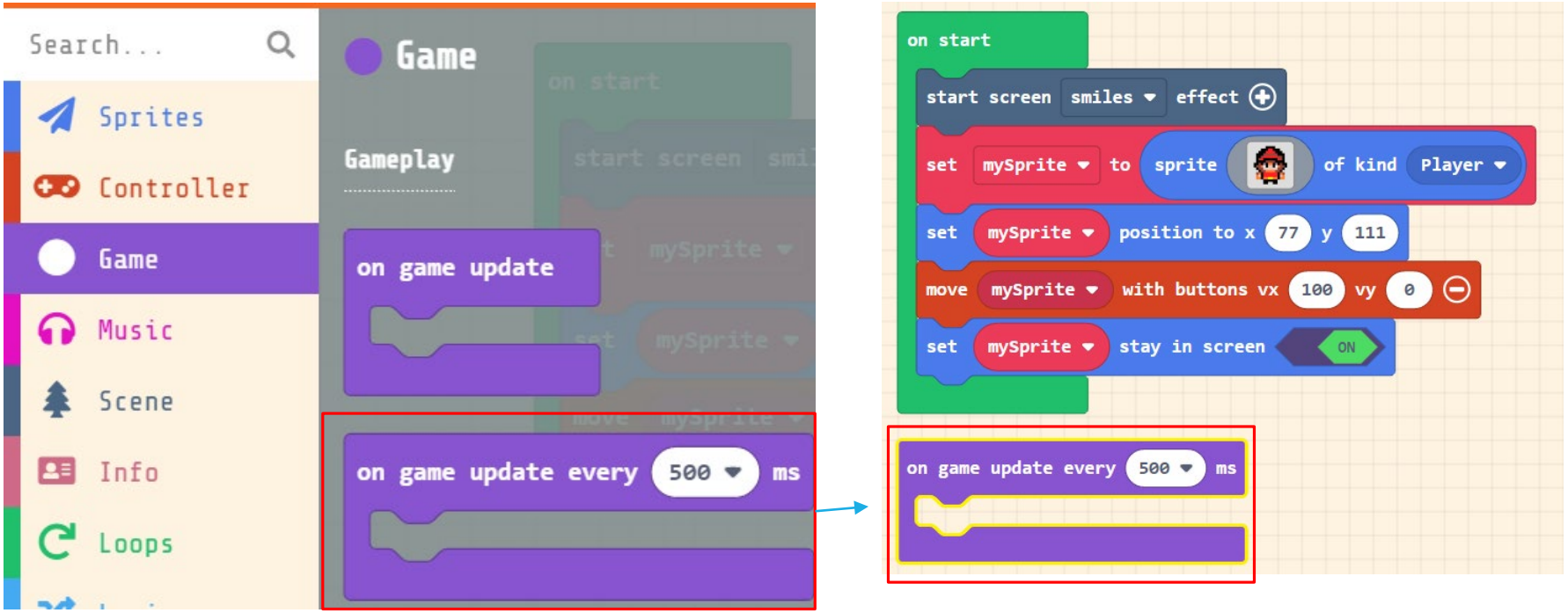


flowchart


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

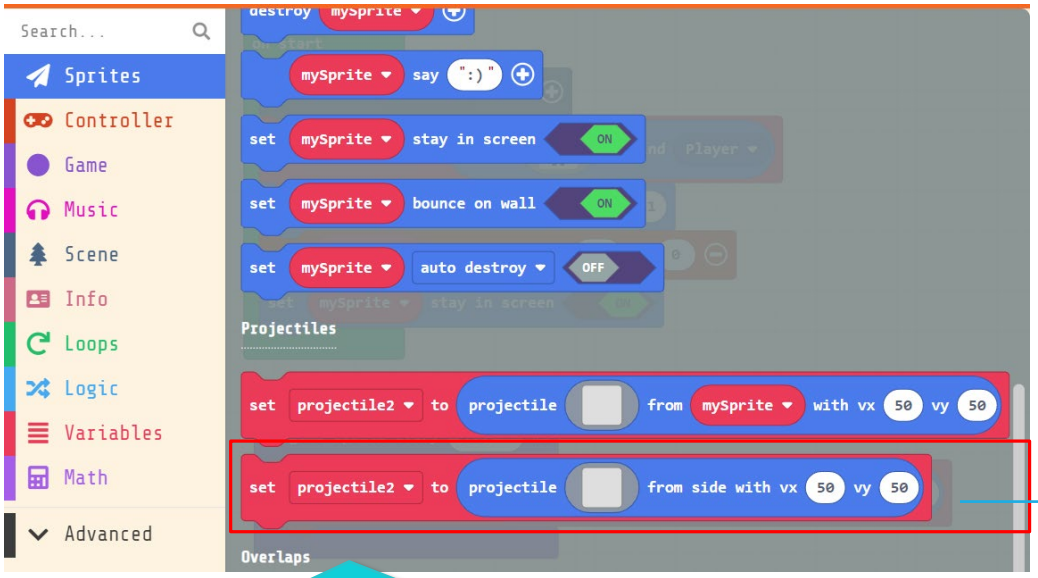
Part II
Game update event

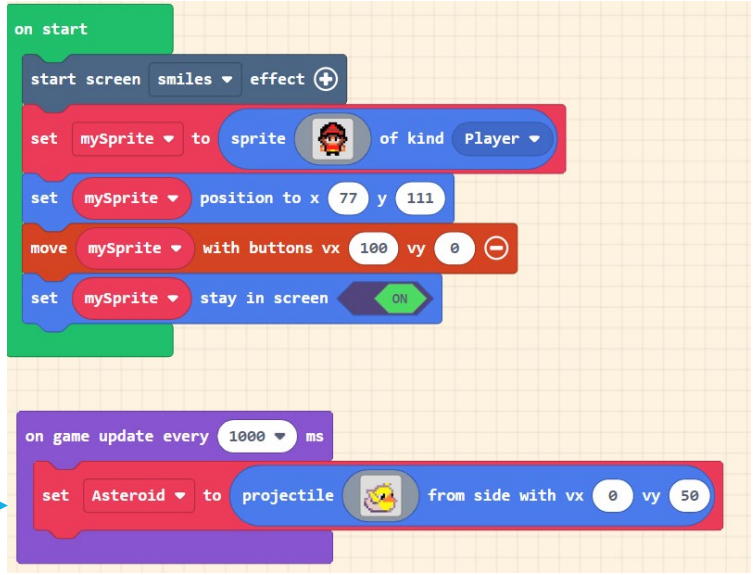
6. Make an Asteroid fall every 1 second



7. Set projectile

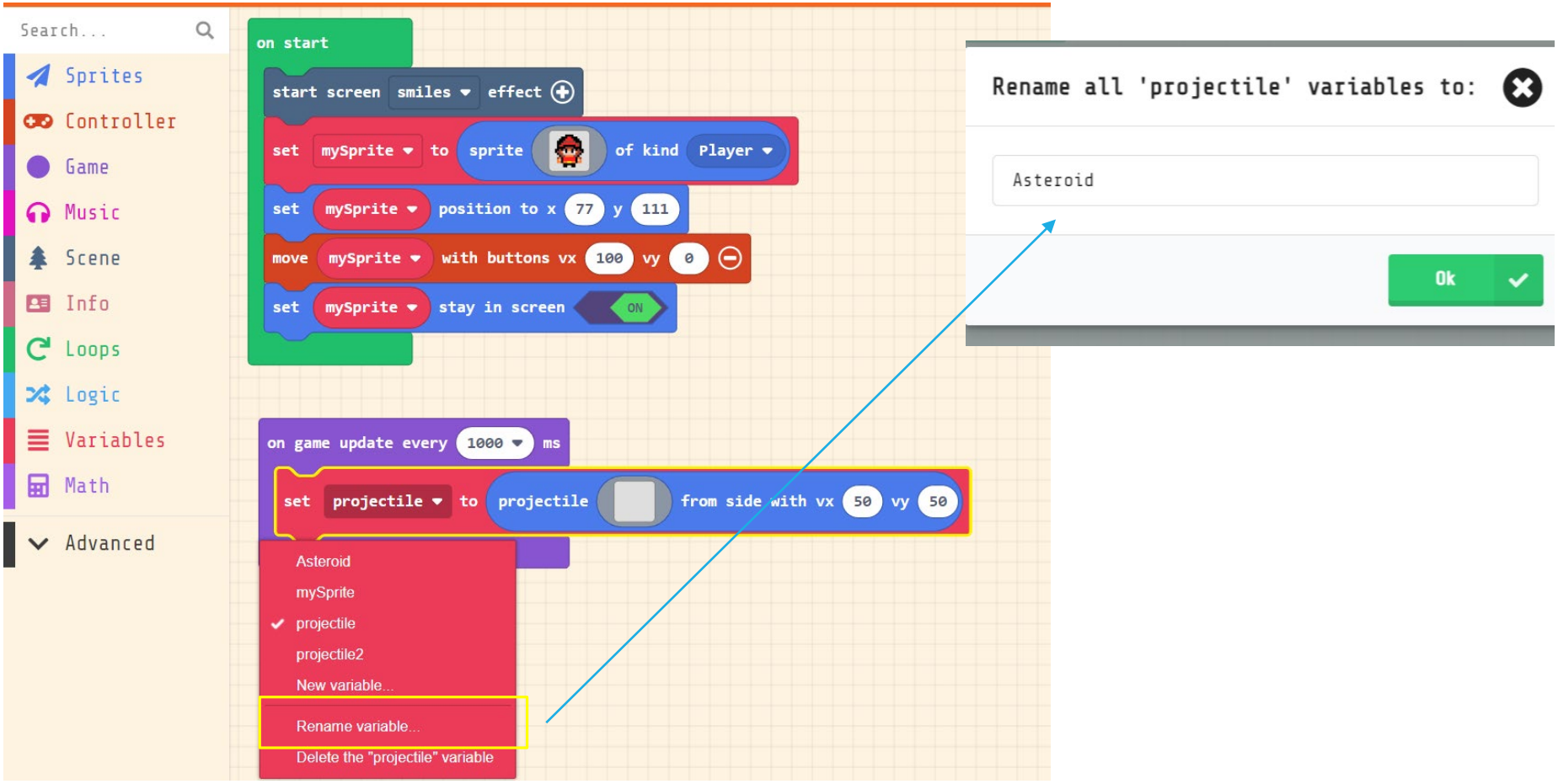
Sprites->set projectile -> on game update block



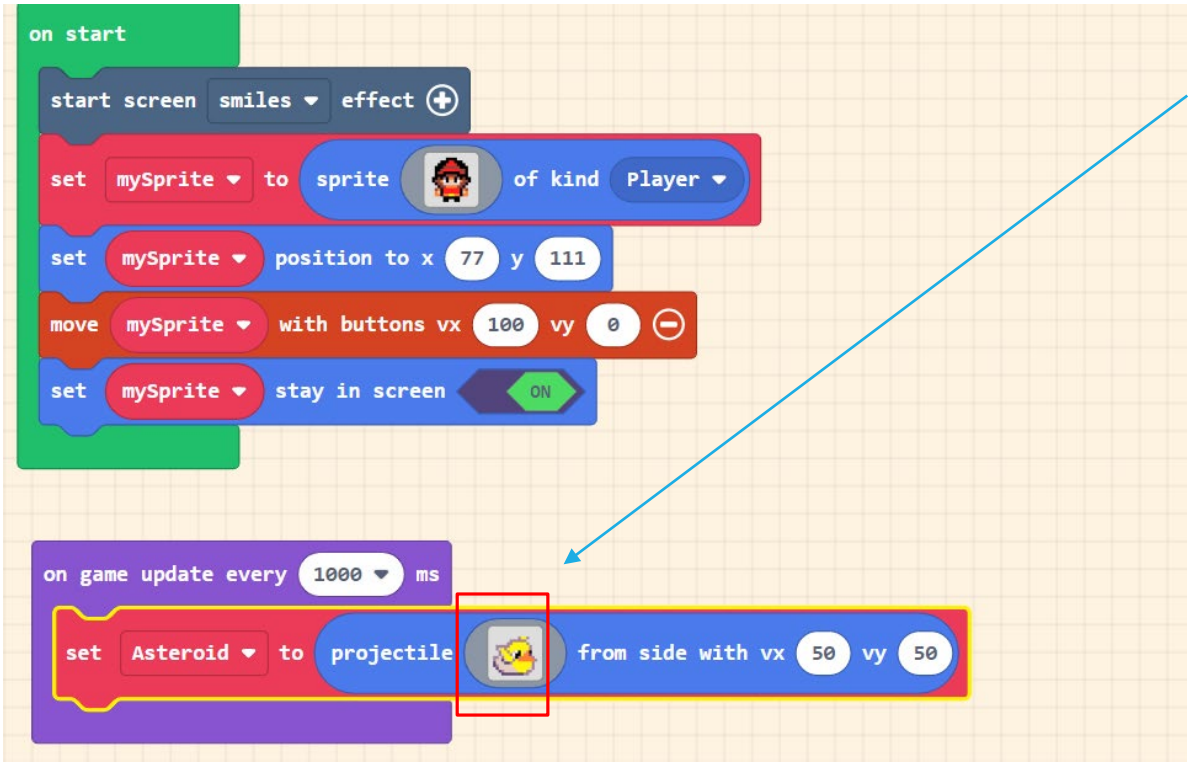


The projectile type is the object can move by itself such as ‘Enemy’ in the game.

Set projectile & rename to ‘Asteroid’

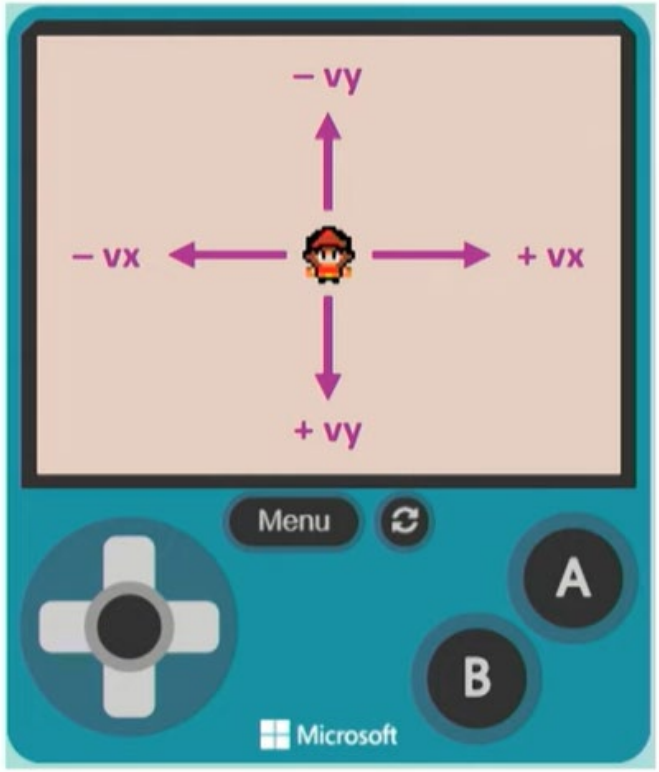


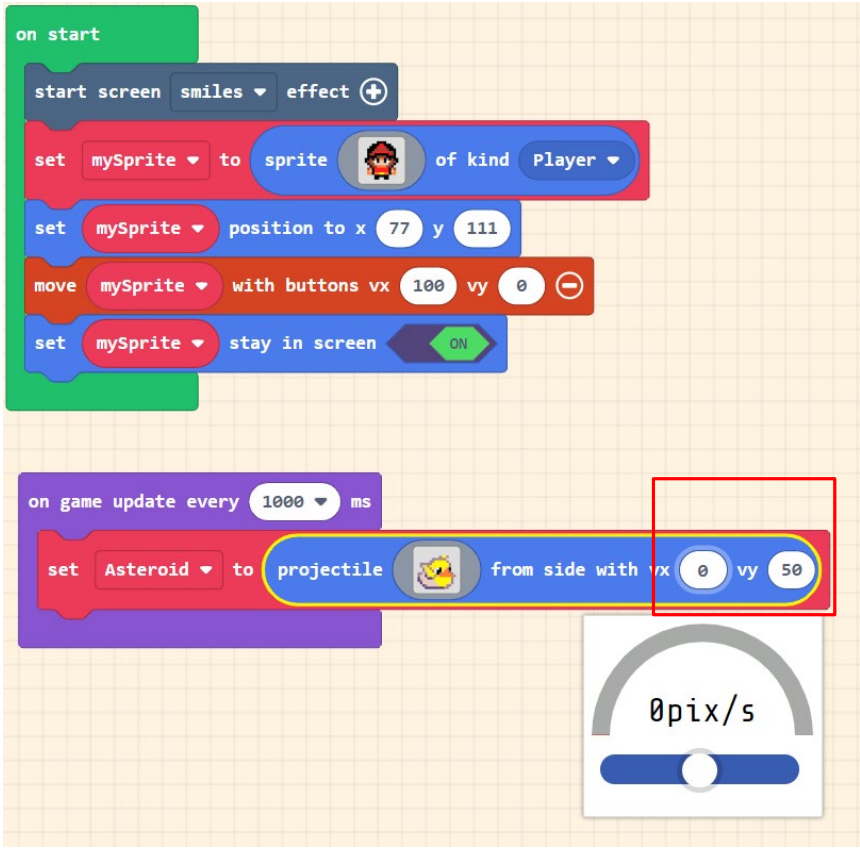
Create your Asteroid Image



Set Velocity = speed and direction

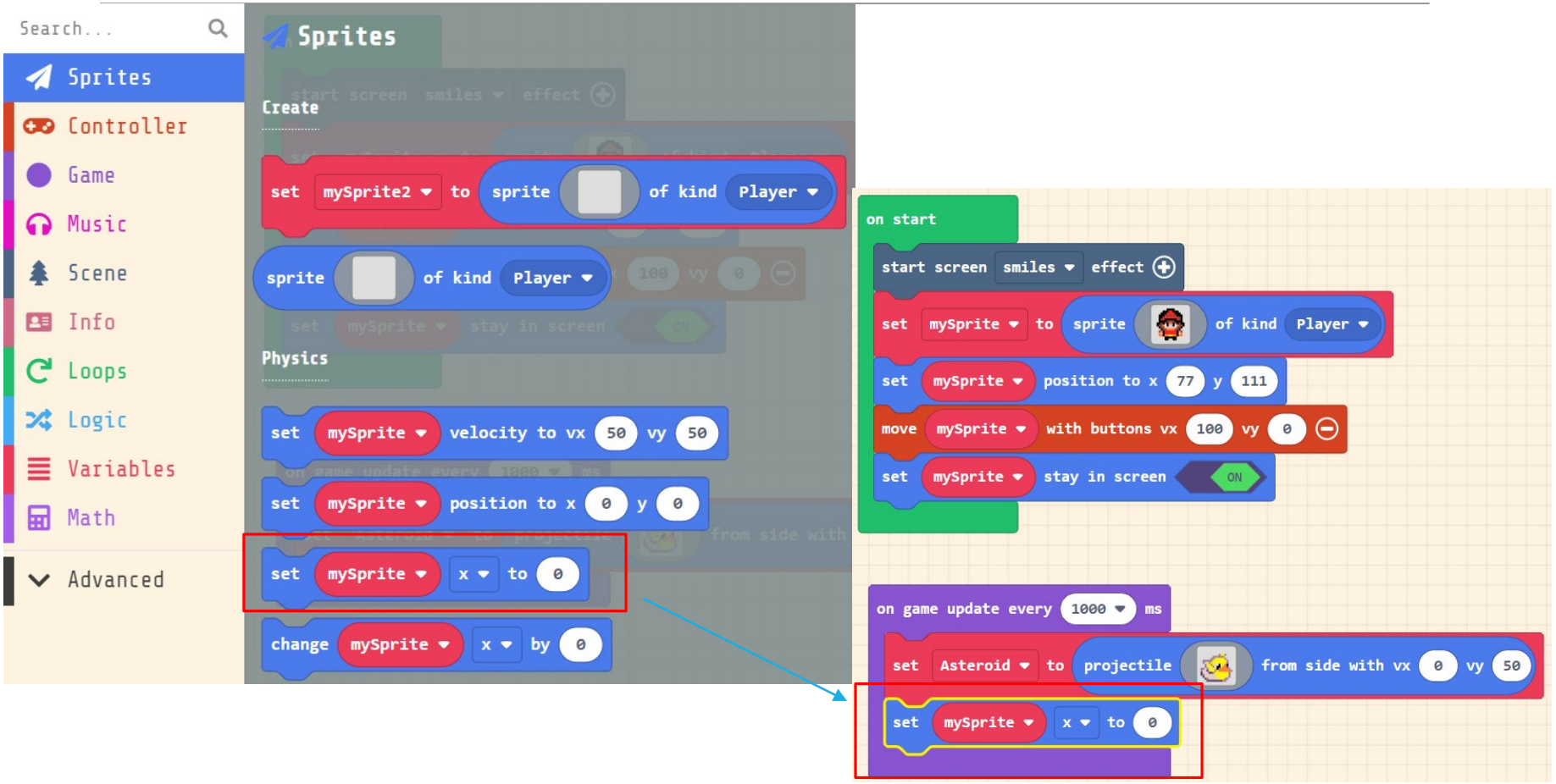
-vx: move to left + vx: move to right
-vy: move up + vy: move down



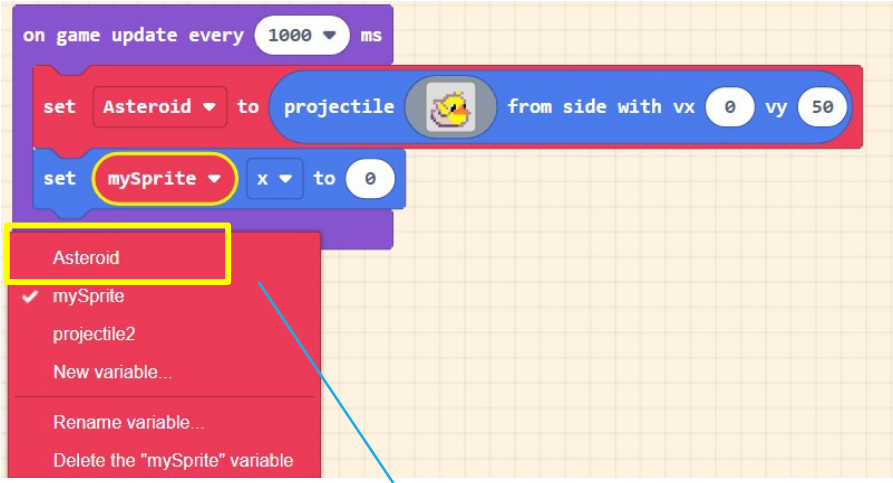


Result: The projectile is always move down in the left side

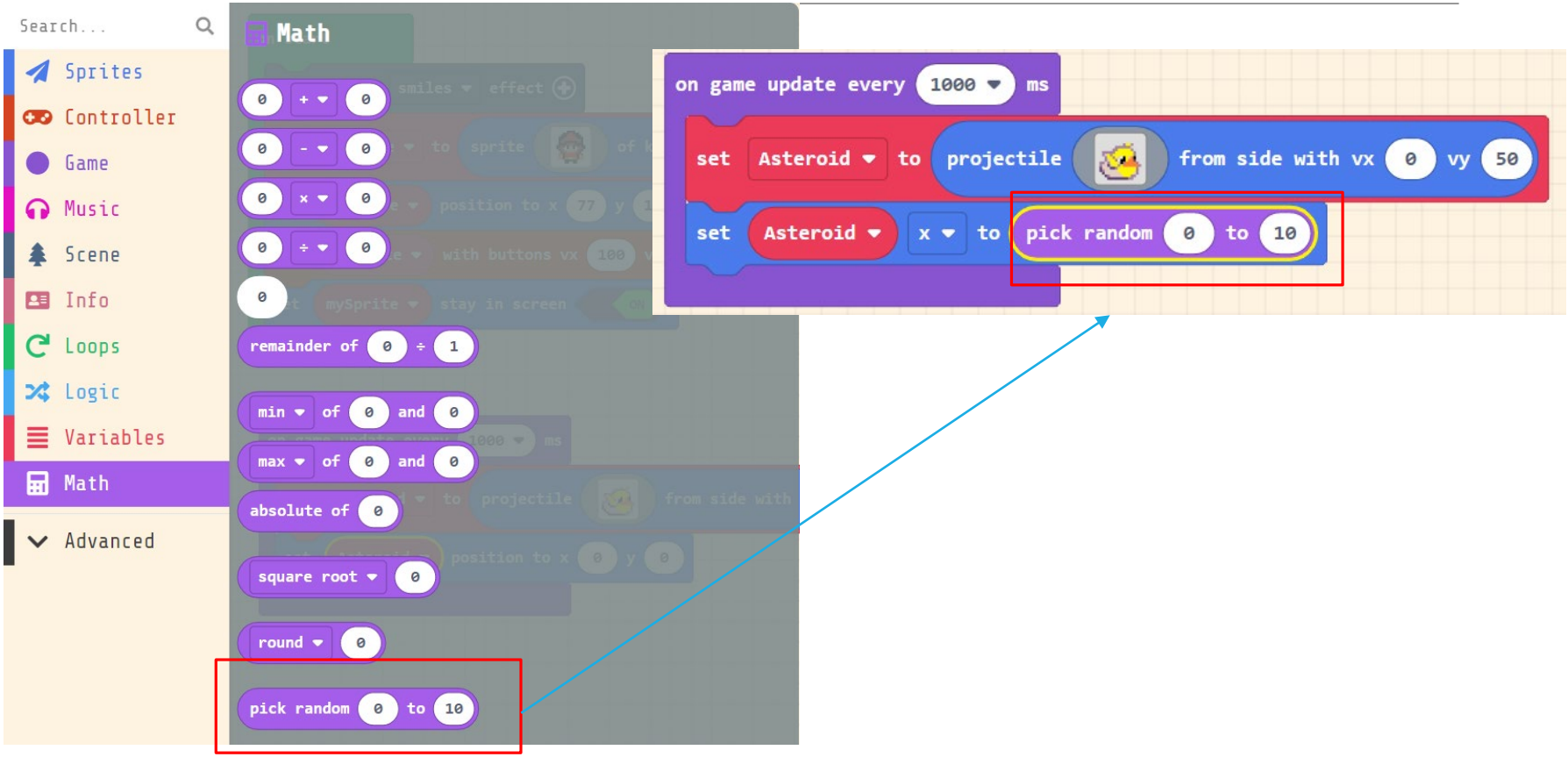
8. Set the Asteroid to fall from random x locations



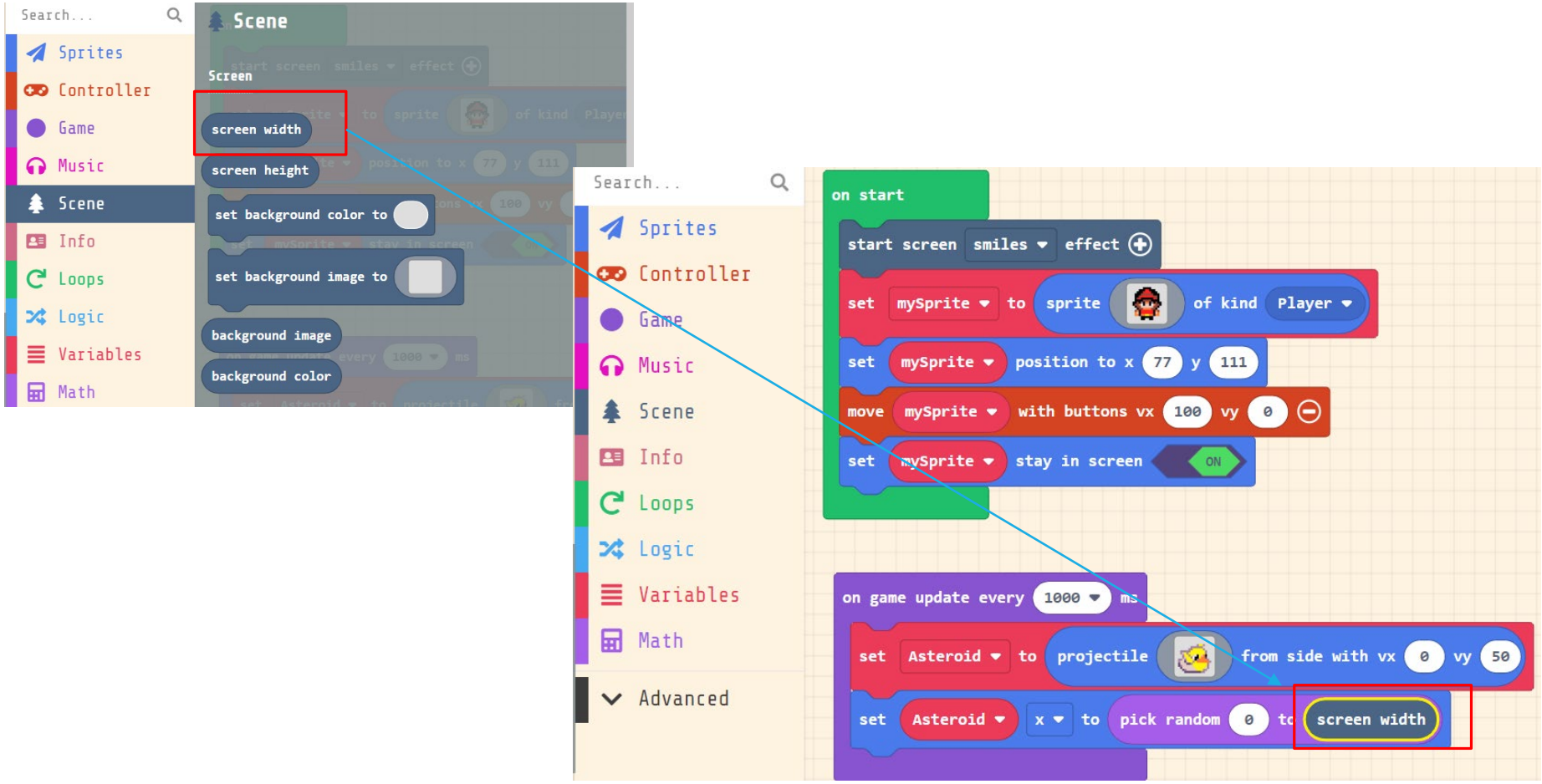
9. Select mySprite -> Asteroid



10. Set random x location
Math ->

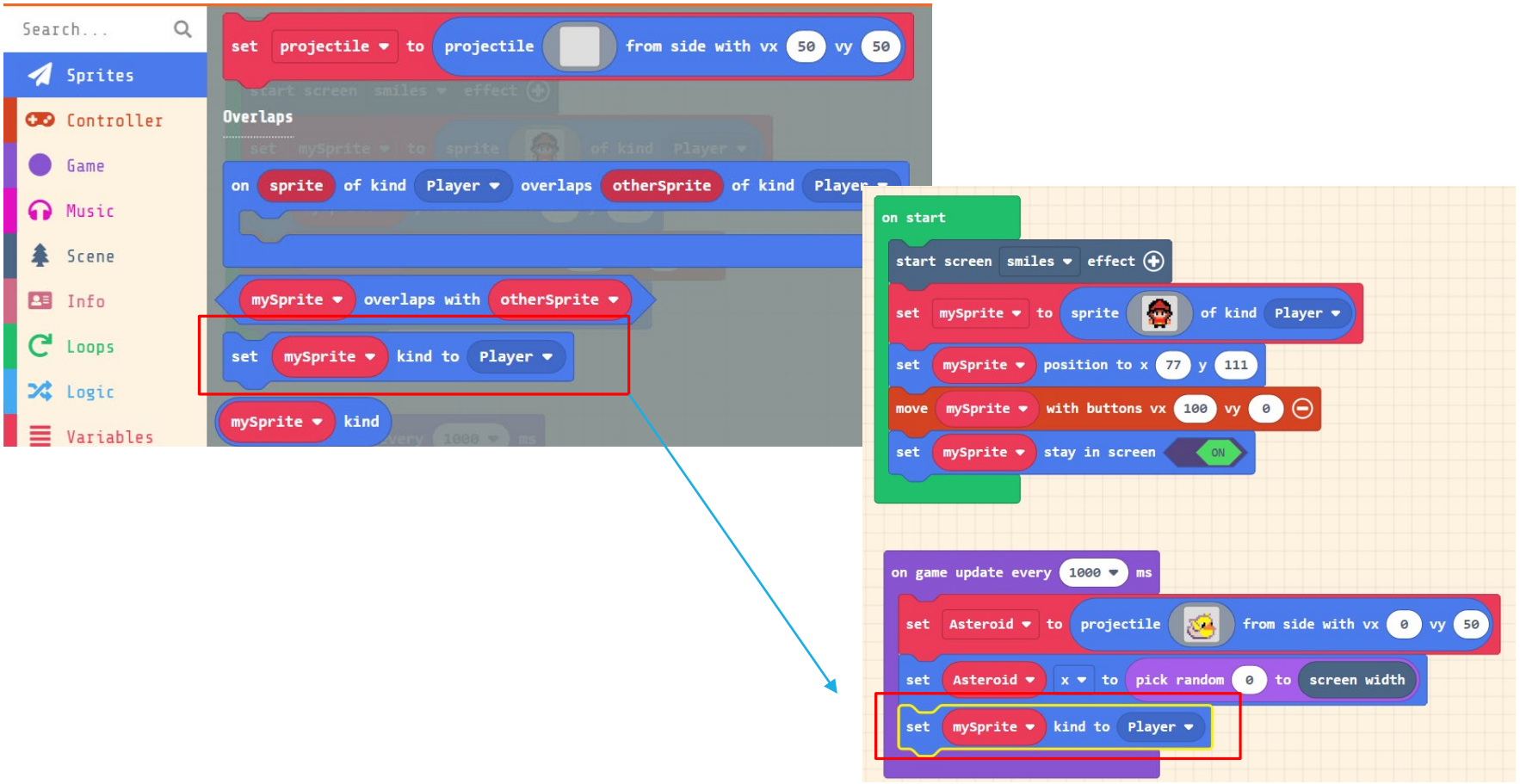


Use screen width as maximum value of x

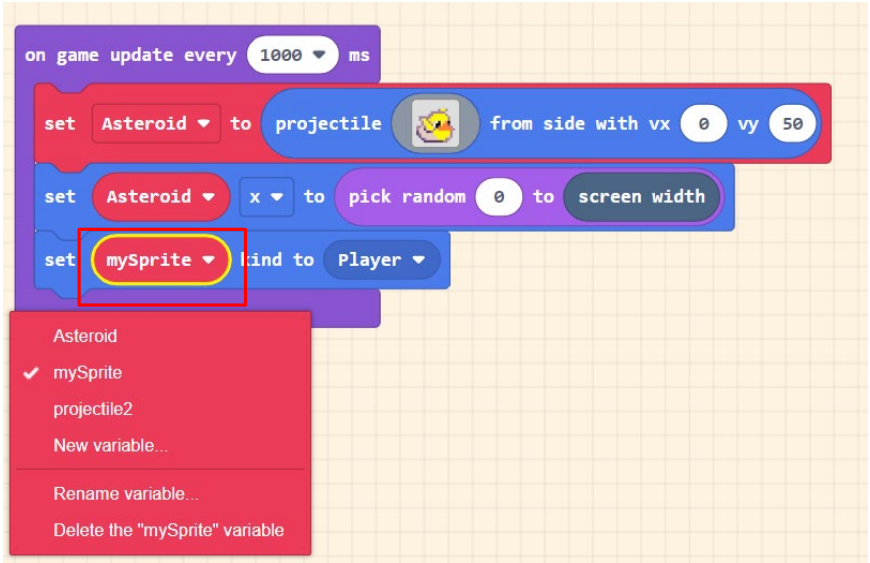


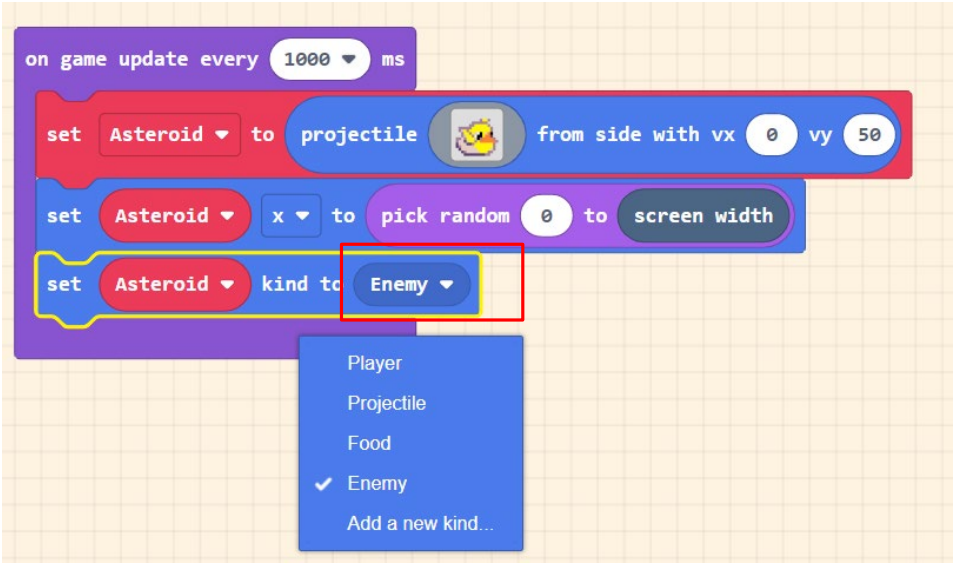
Result:
All projectiles are falling down randomly in x location every one second

11. Set the type of Sprite



Set Asteroid -> enemy type



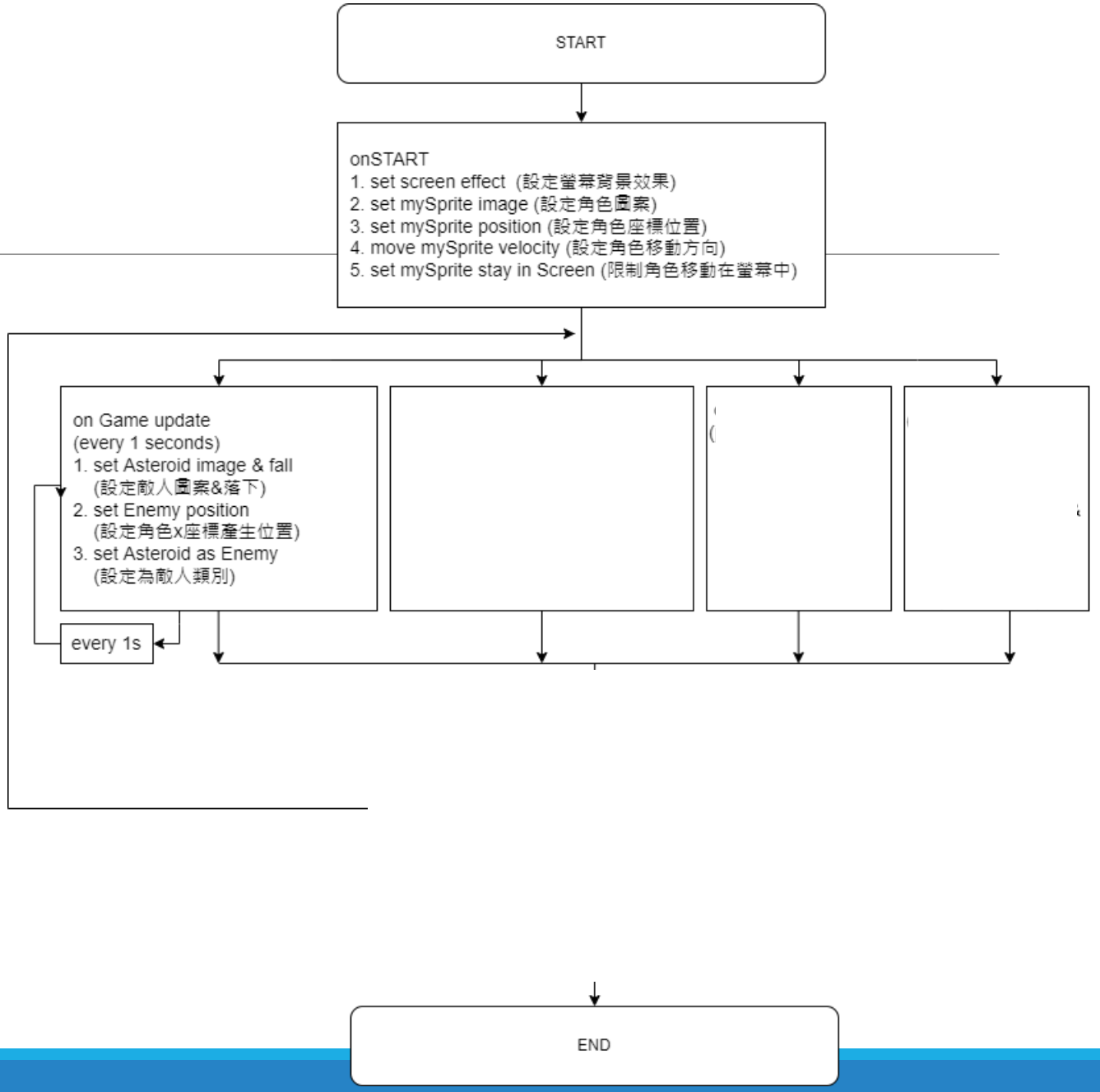


Exercise#2

Try to increase the difficulty of game

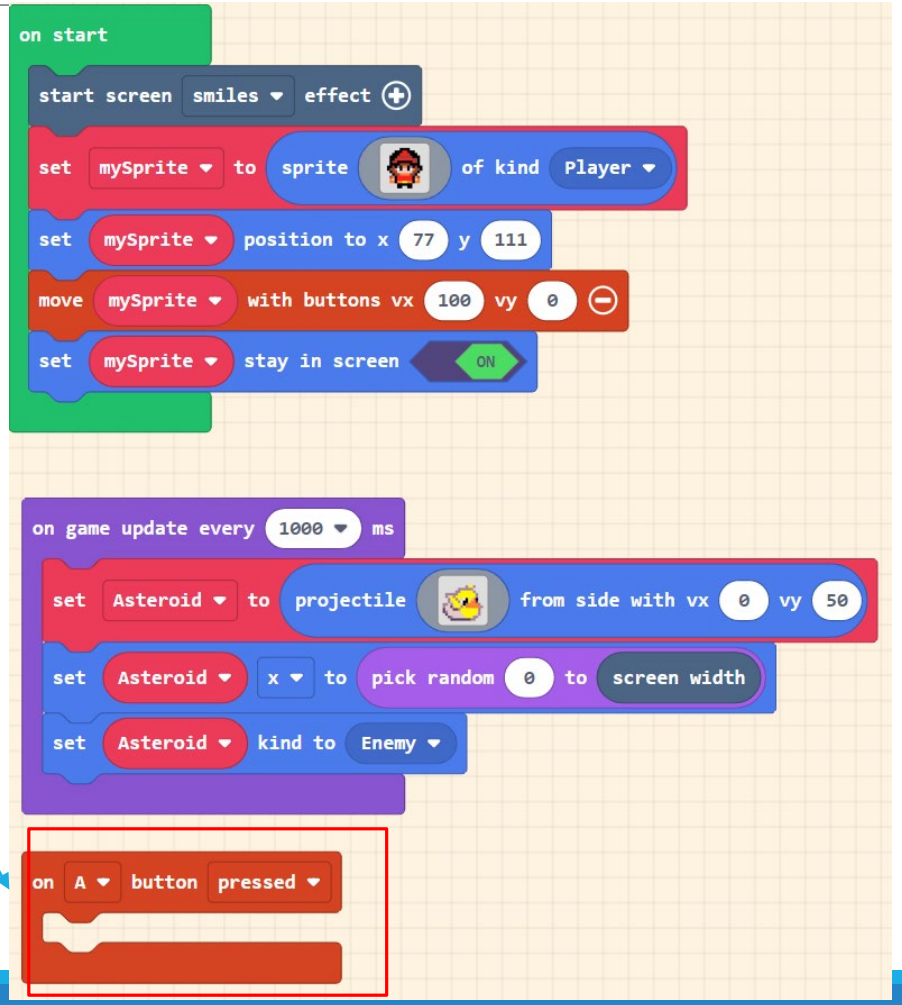
- Speed up the projectiles falling down

flowchart

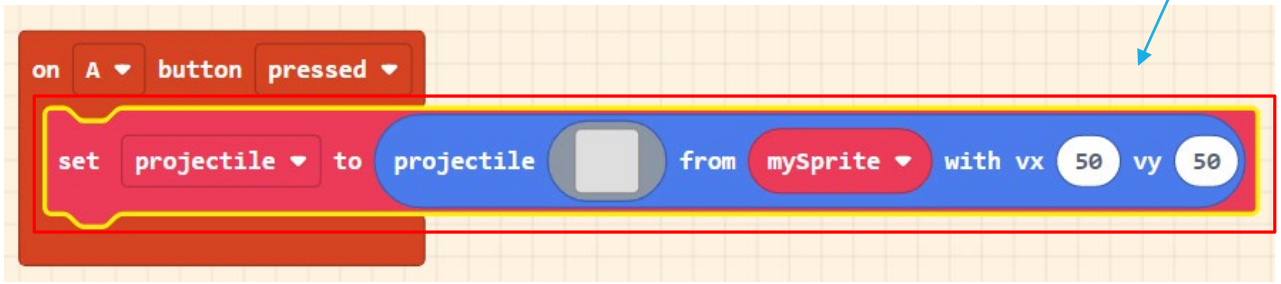

START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生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

Part III
Button Controller

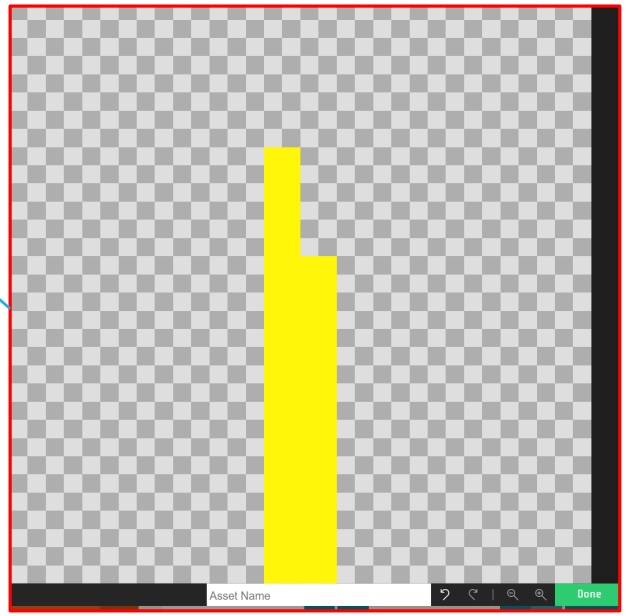
12. Shoot Lasters when you press a button



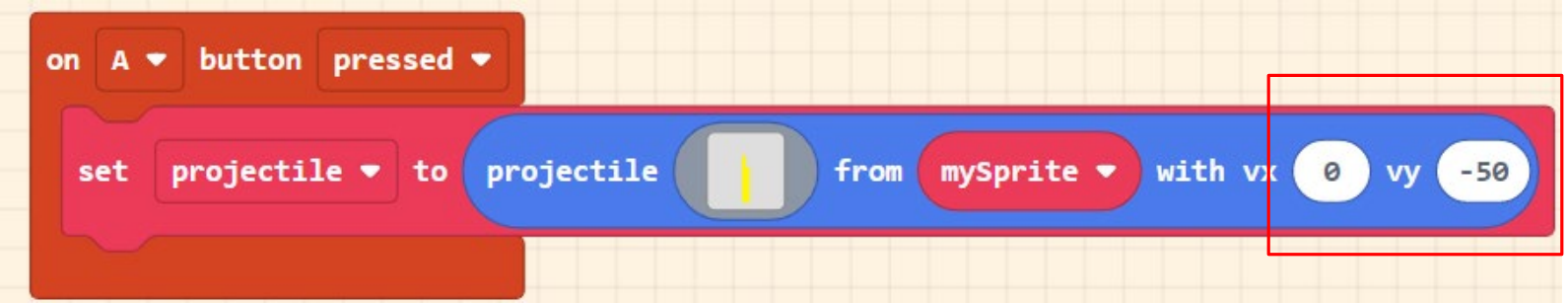
13. Set your laser sprite



13. Design your laser sprite



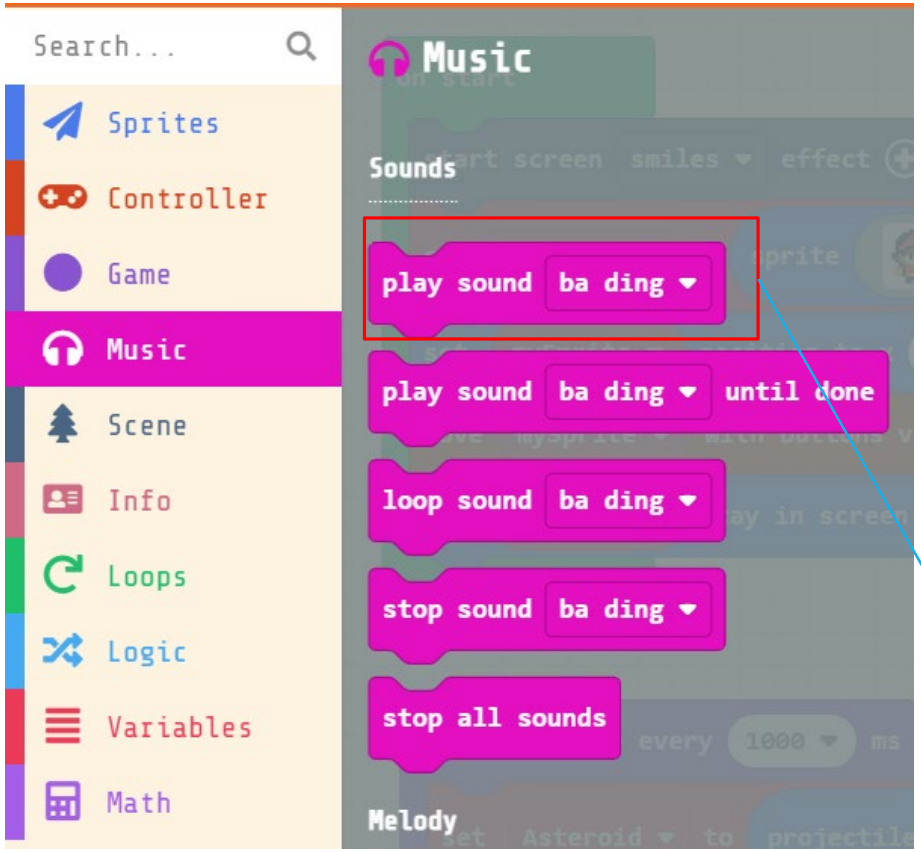
14. Set Laster velocity

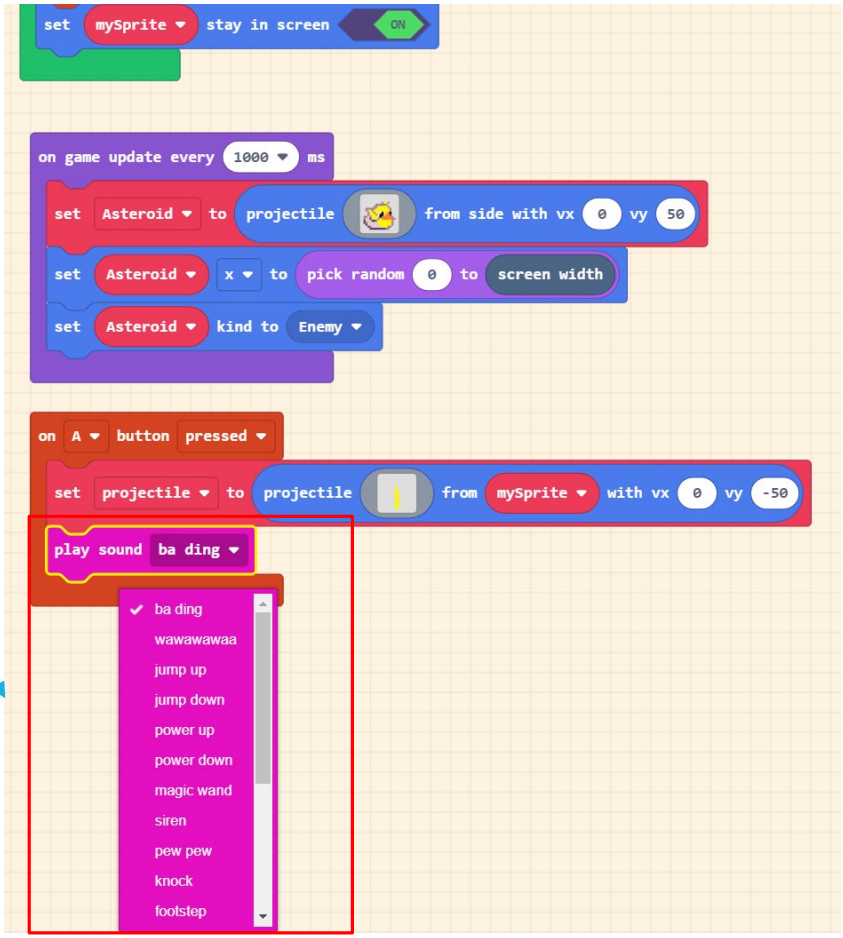


Set
vx: 0 vy: -50

Result
You can shoot the laster

15. Add Sound Effect

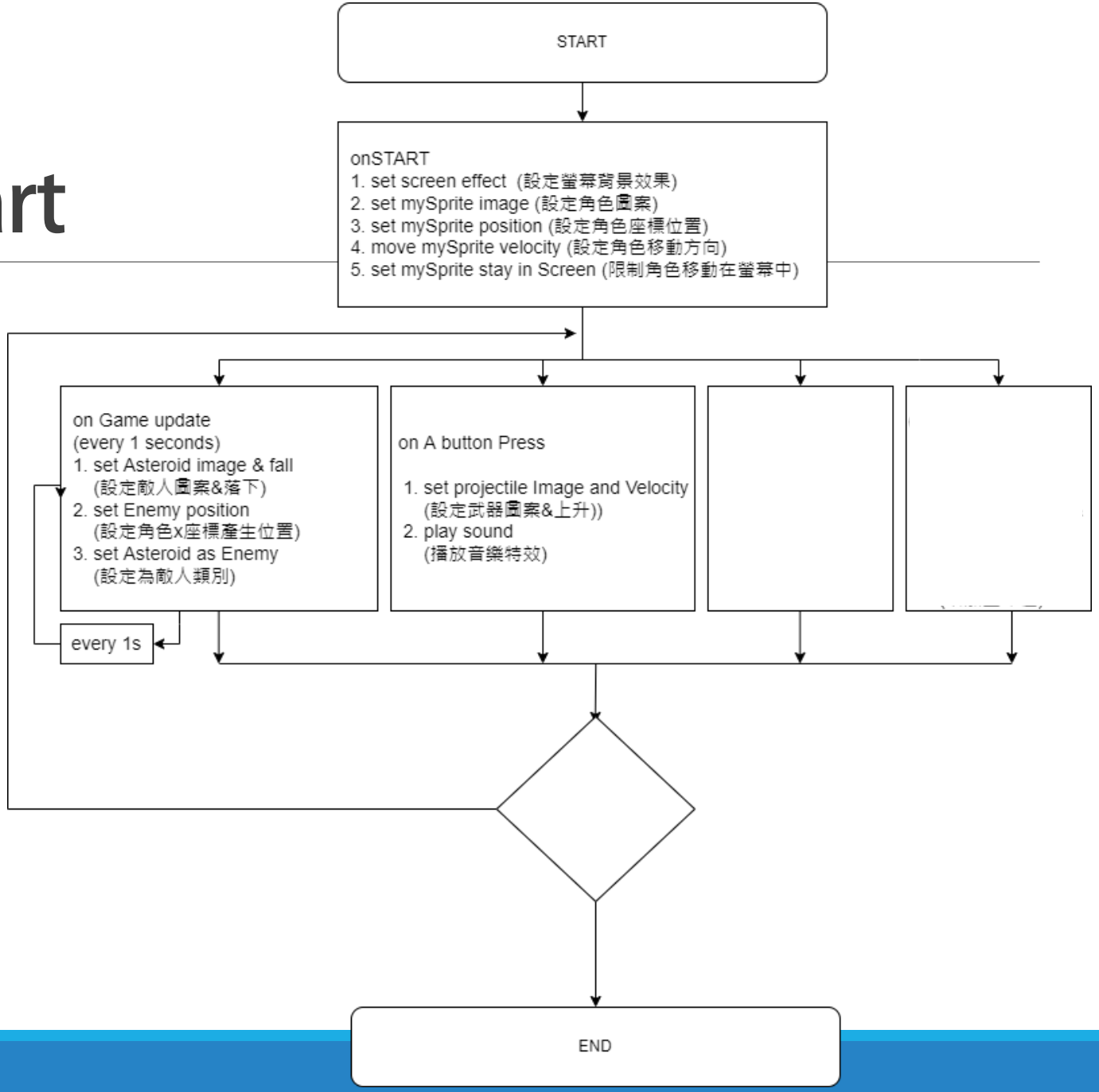




Exercise#3

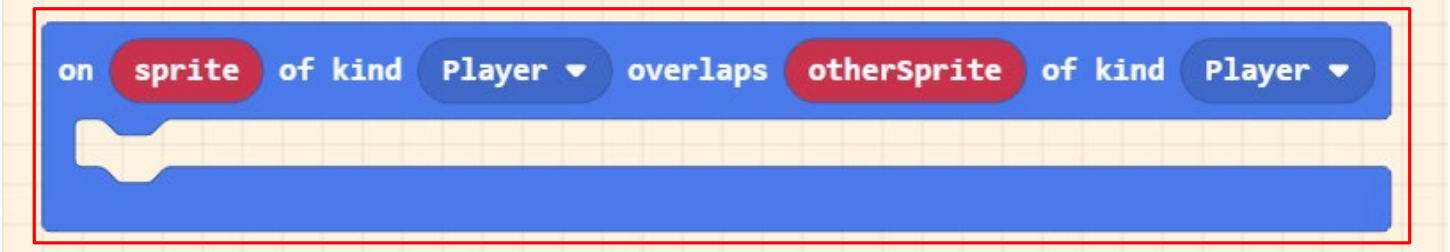
Select a your favorite sound effect and try it on.

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

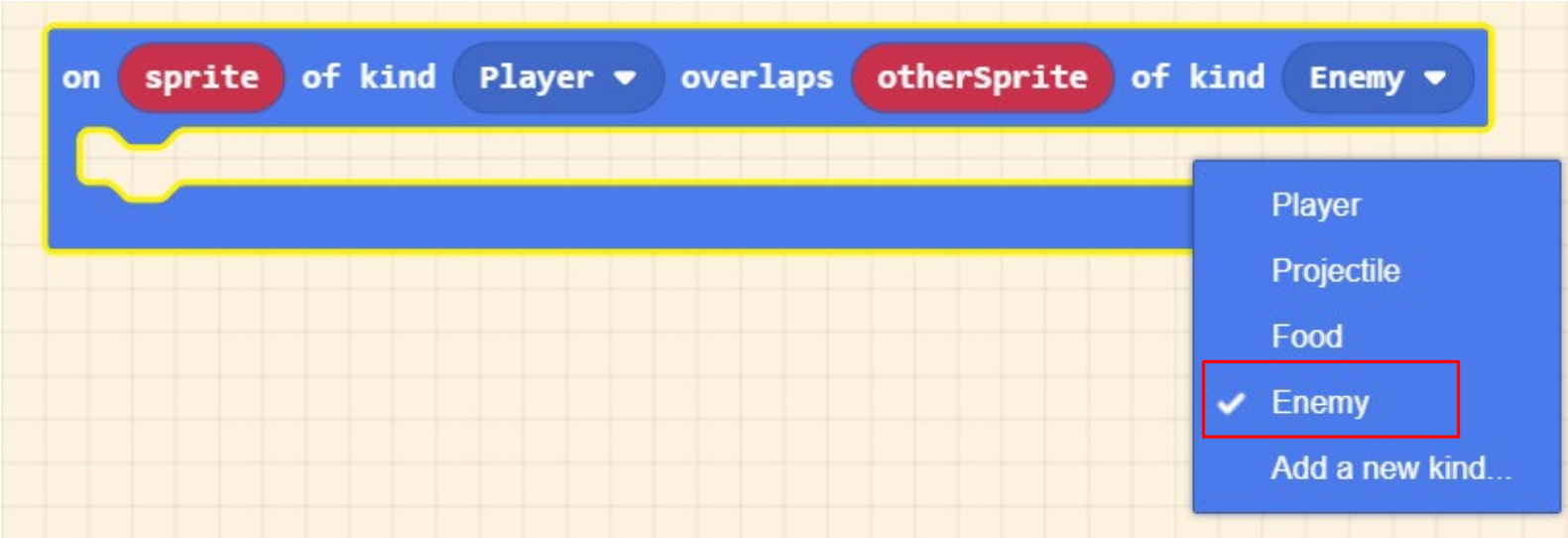
16. Add overlaps block sprites->overlaps



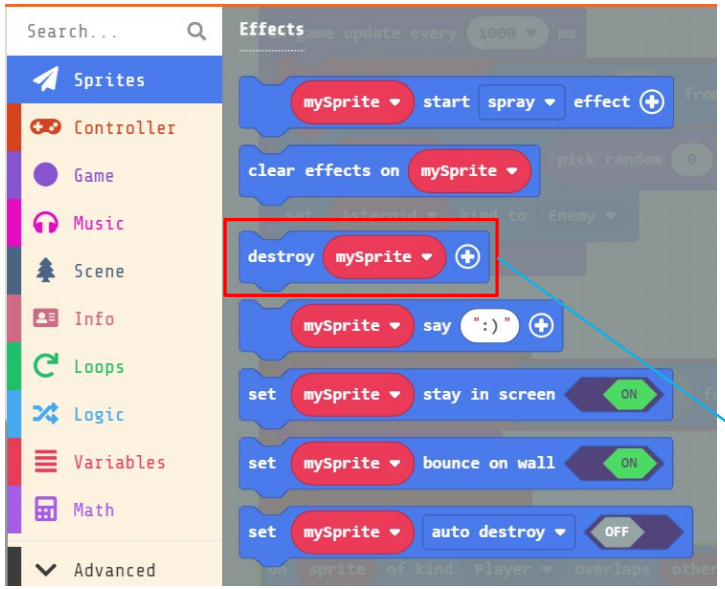
When an asteroid crashes into your Spaceship

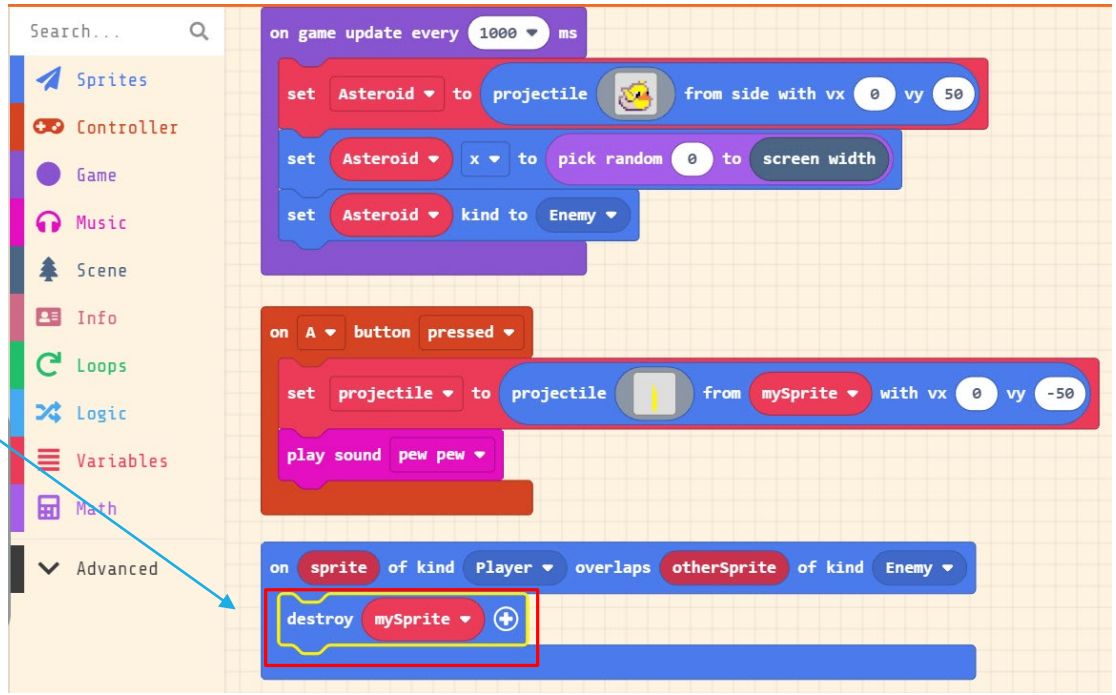
Click on the otherSprite of kind ‘Player’ -> ‘Enemy’

Setup when any asteroid overlaps your spaceship



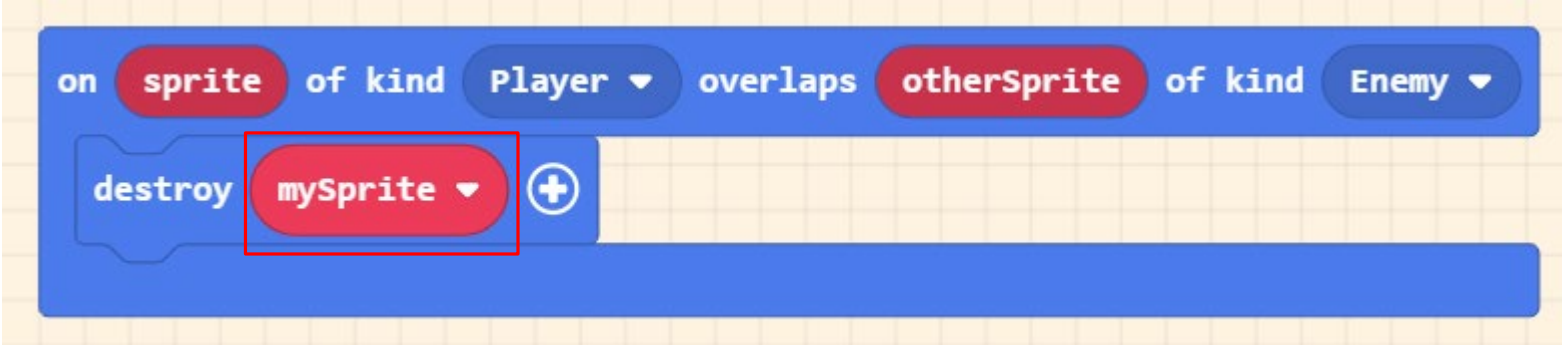
17. Destroy Asteroid





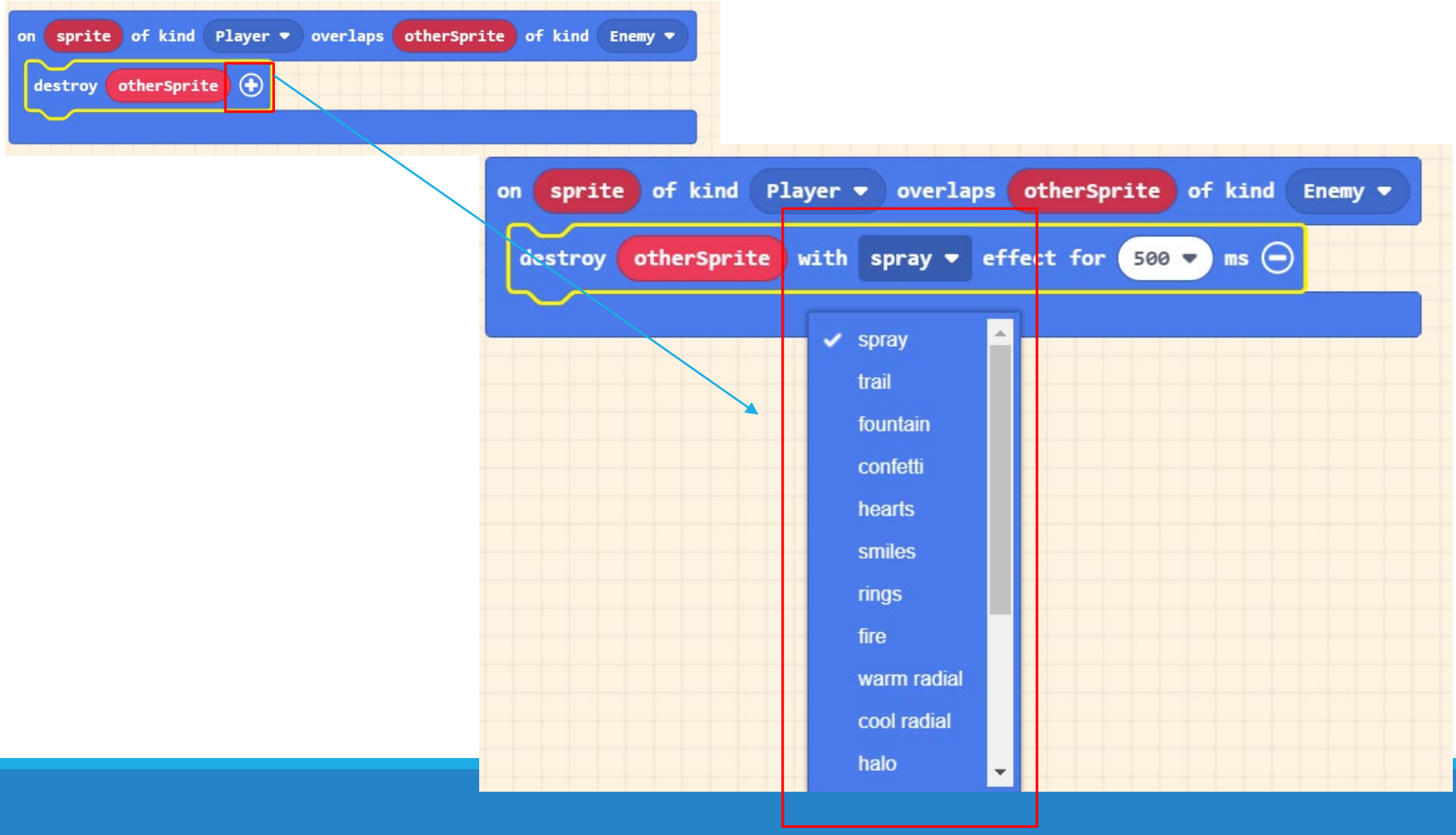
Set the destroy target

Original



Change to

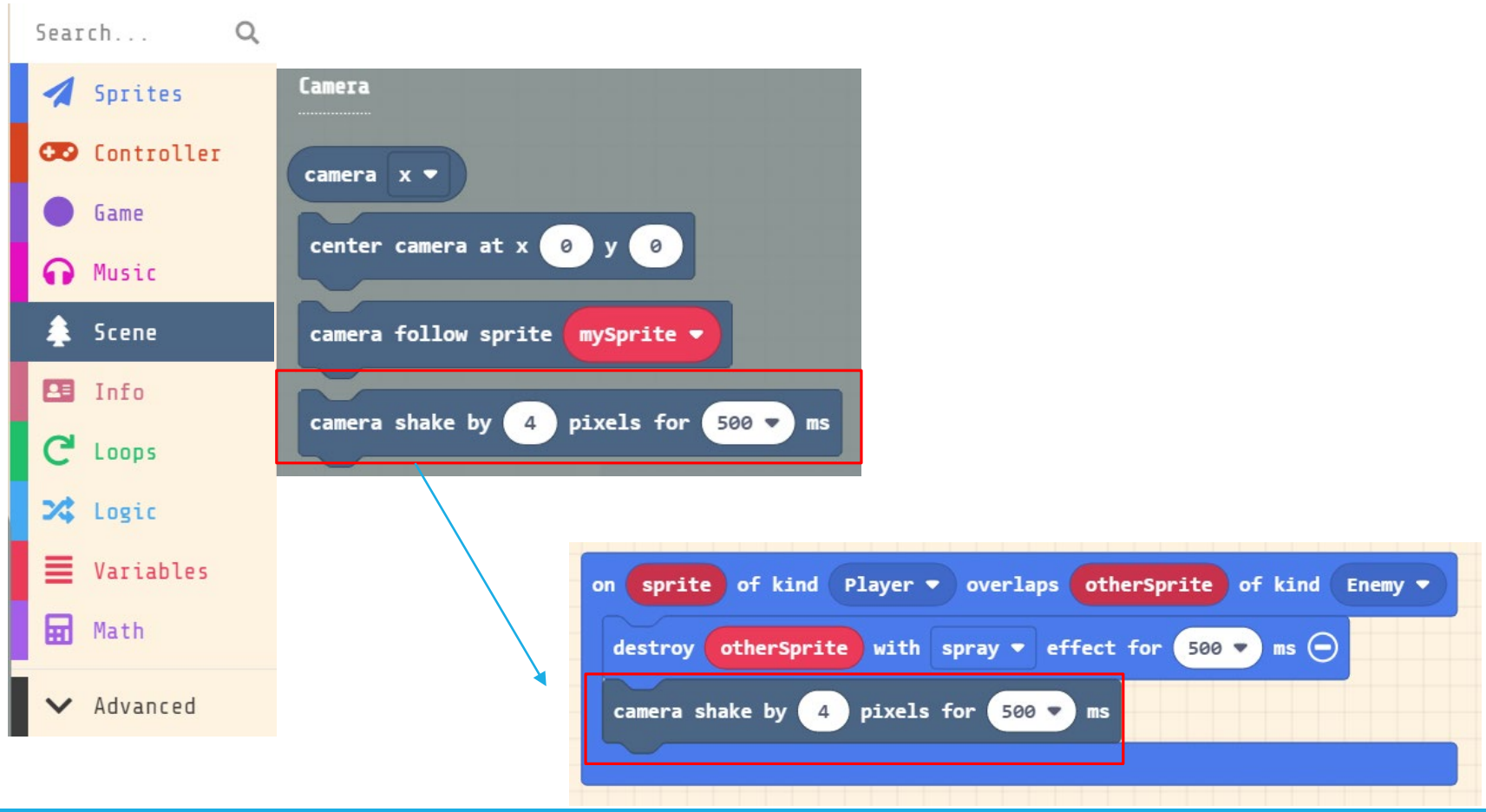
Add an destroy effect



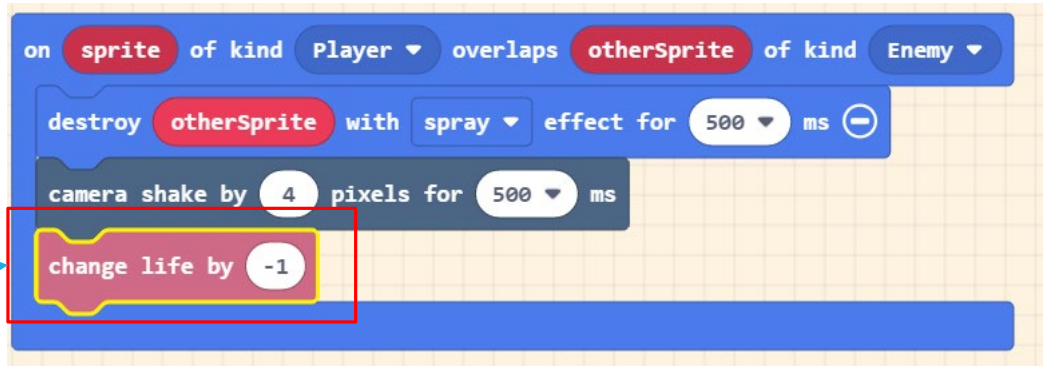
Exercise#4

Select a favor crash effect and try it on.

17. Add a Camera Shake Effect

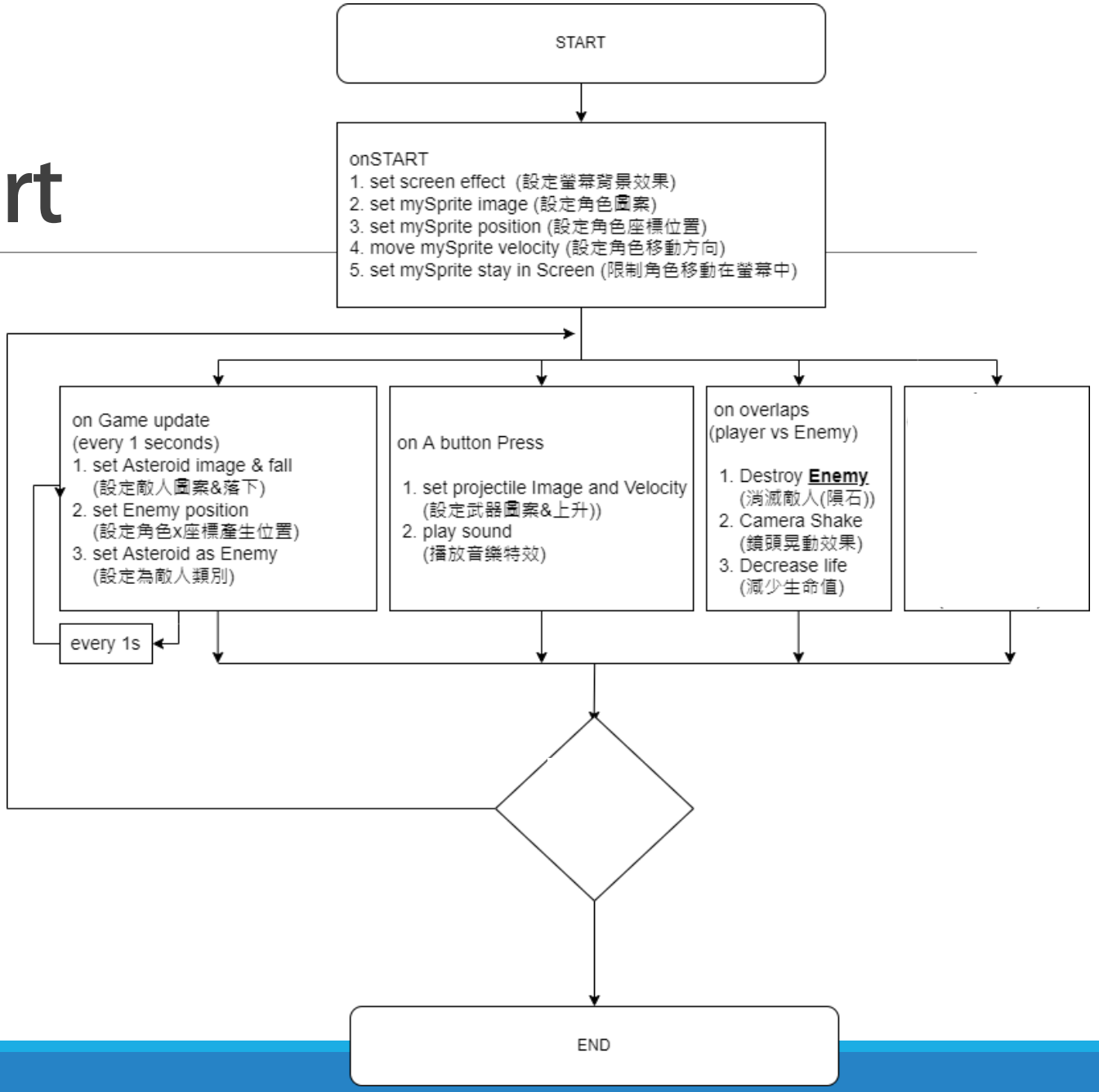


18. Decrease Life of your Spaceship



Result
You can see Life & Game Over

flowchart

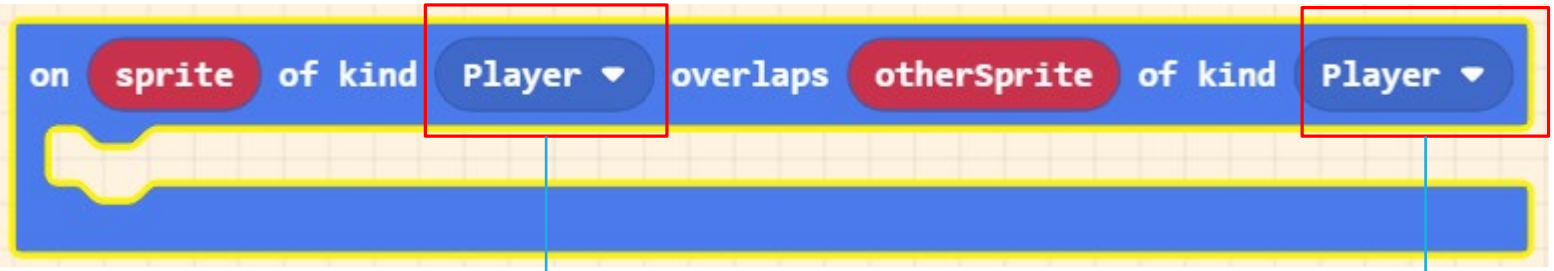

START
onSTART
1. set screen effect (設定螢幕背景效果)
2. set mySprite image (設定角色圖案)
3. set mySprite position (設定角色座標位置)
4. move mySprite velocity (設定角色移動方向)
5. set mySprite stay in Screen (限制角色移動在螢幕中)
on Game update
(every 1 seconds)
1. set Asteroid image & fall
(設定敵人圖案&落下)
2. set Enemy position
(設定角色x座標產生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

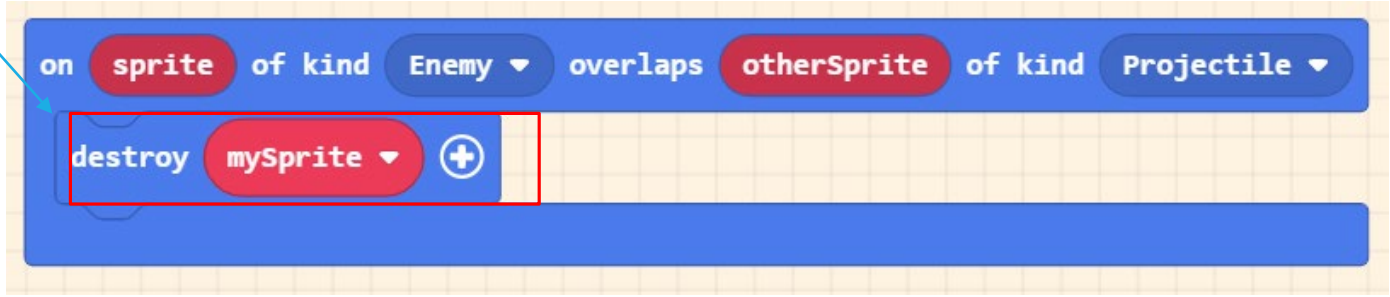
Click on the 1st Player -> Enemy
Click on the 2nd Player -> Projectile

Original



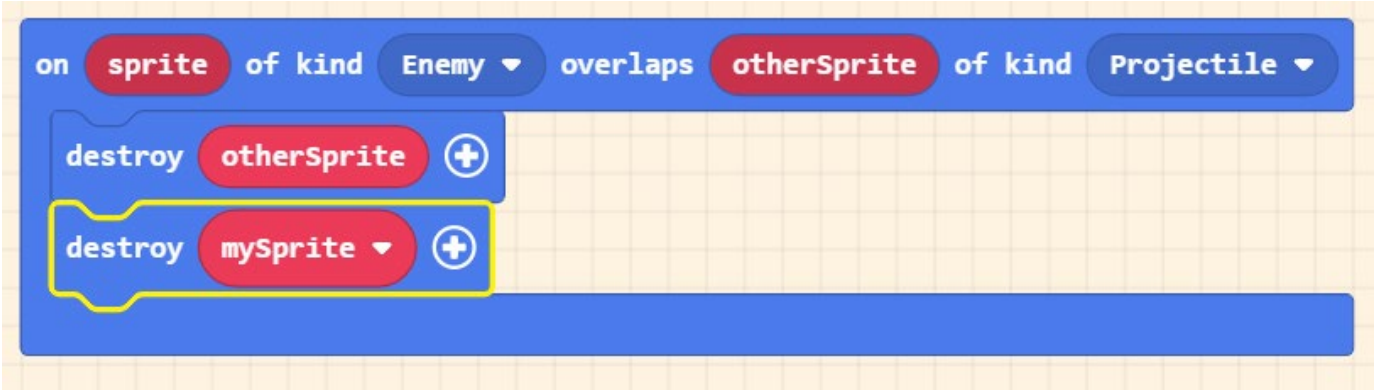
Change

20. Destroy the Laster



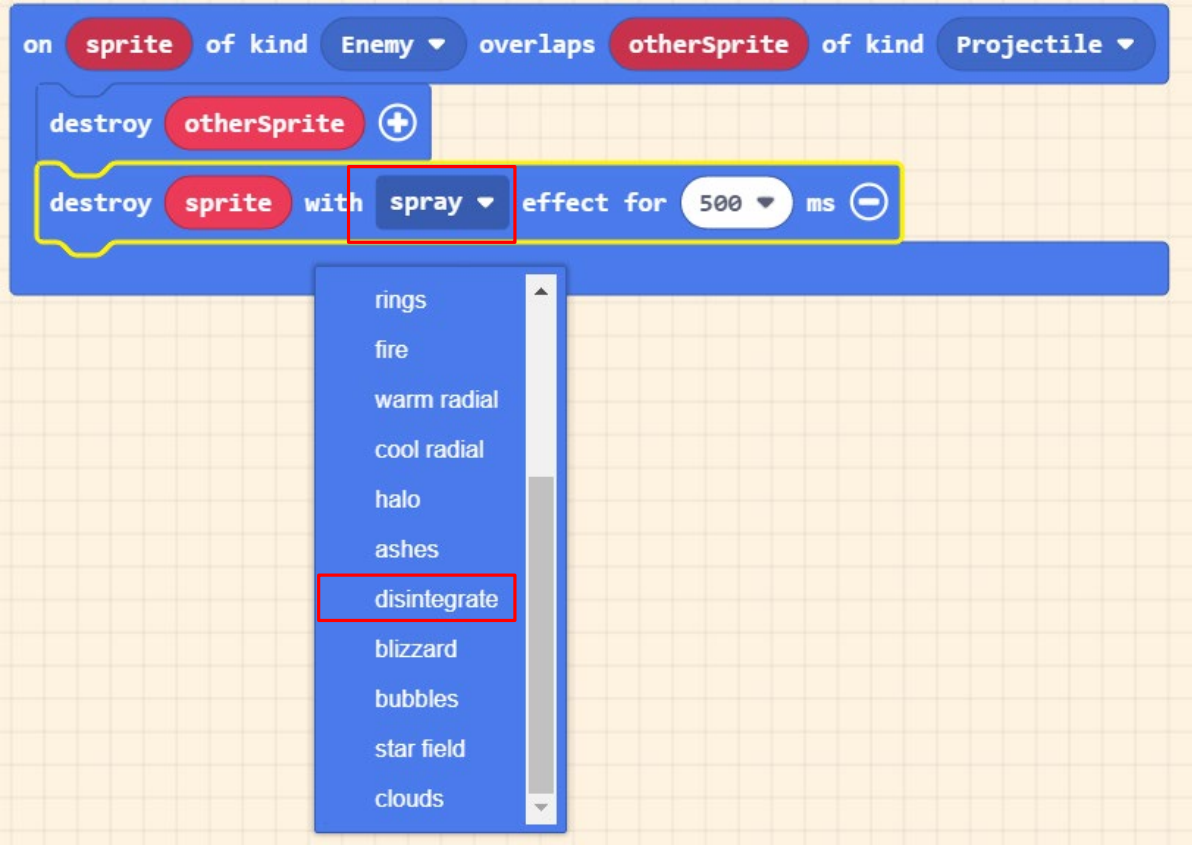
21. Destroy the Asteroid

Original

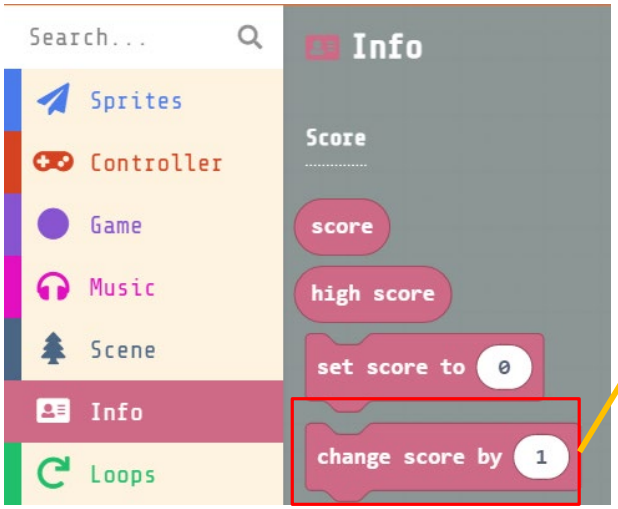


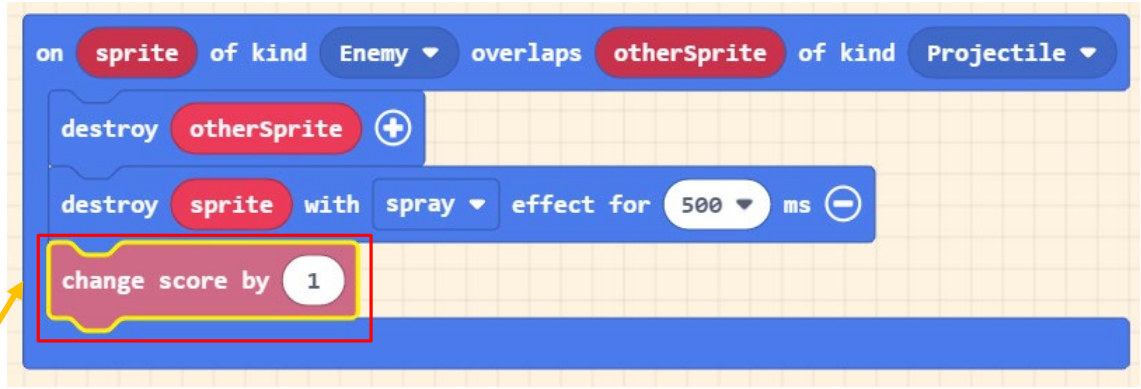
Change

22. Add an Effect when Laster destroy the Asteroid

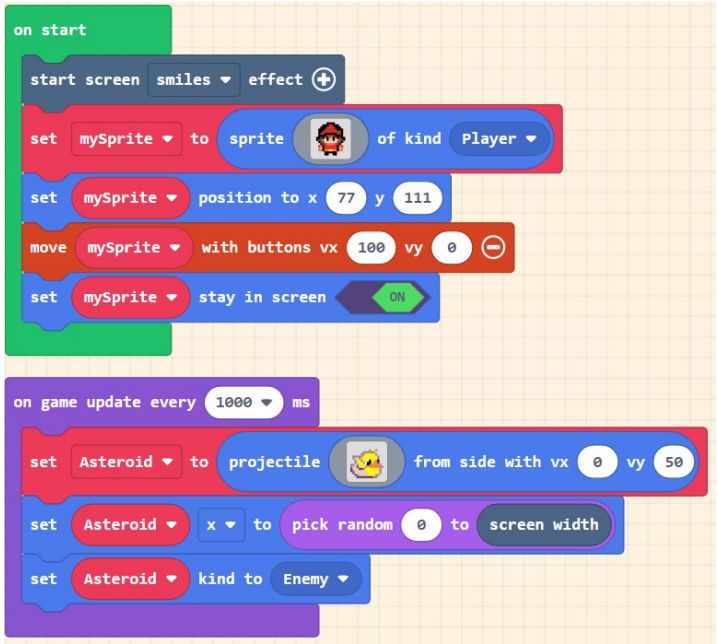


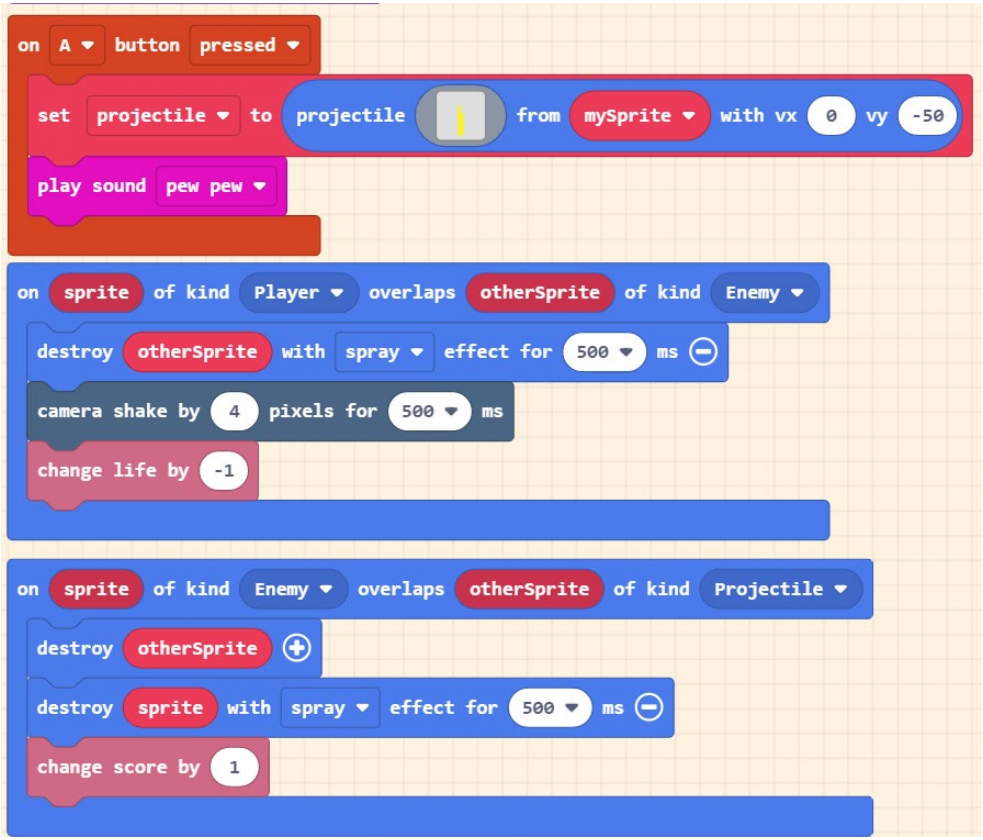
24. Add the Score





Complete Code





Python version

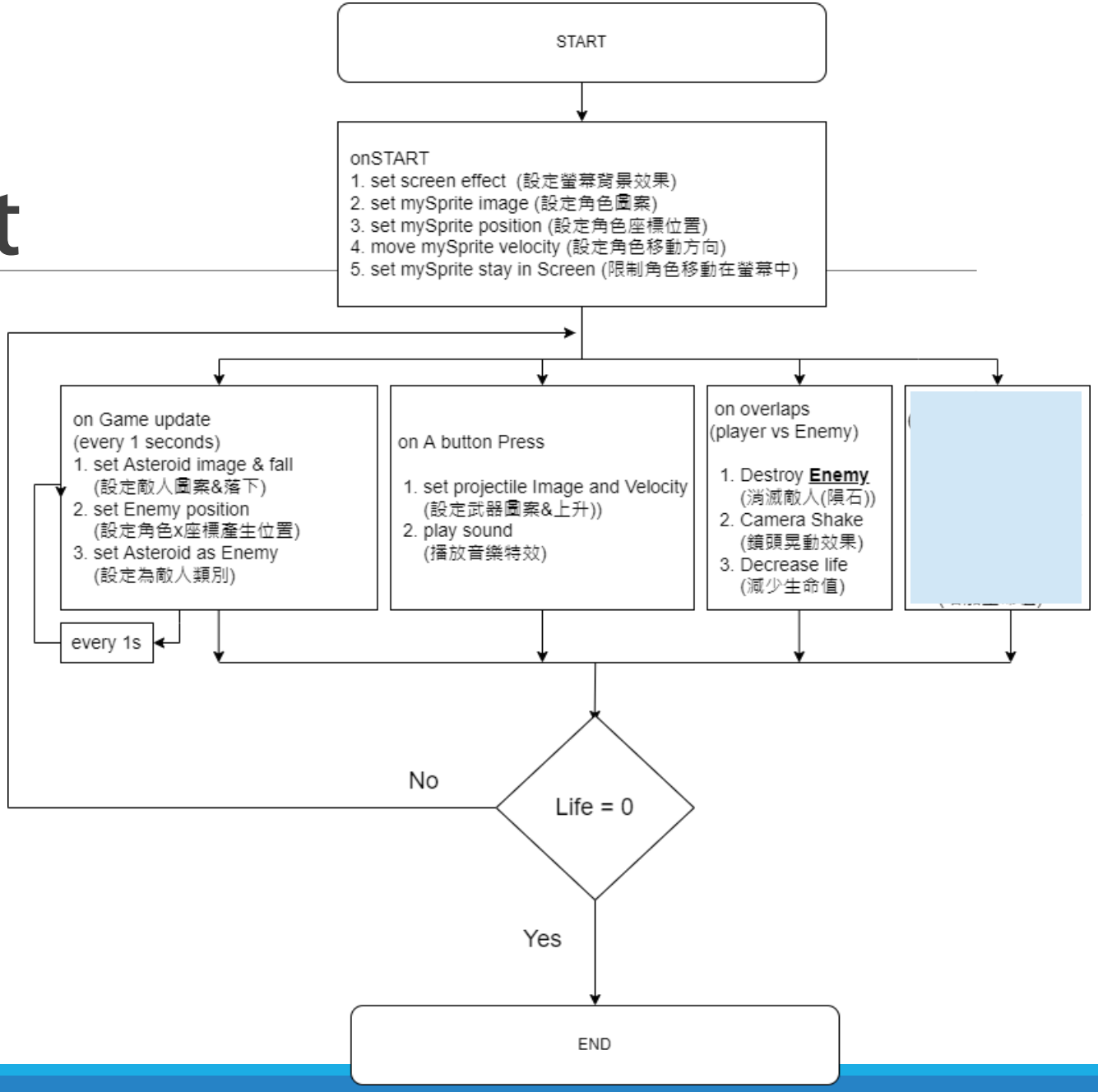
```
def on_a_pressed():
    global projectile
    projectile = sprites.create_projectile_from_sprite(img("""
        """),
        mySprite,
        0,
        -50)
    music.pew_pew.play()
controller.A.on_event(ControllerButtonEvent.PRESSED, on_a_pressed)

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)
```

```
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)
```

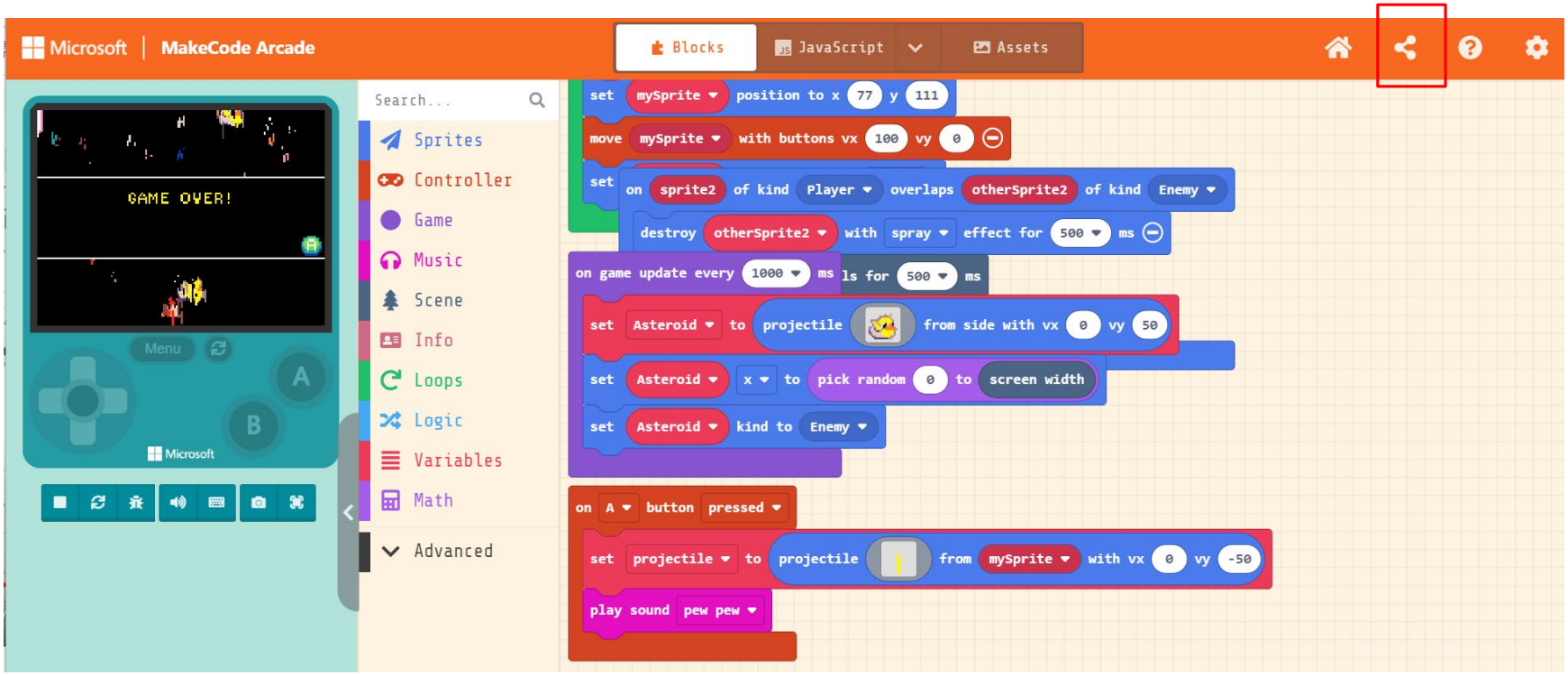
JavaScript version

```
controller.A.onEvent(ControllerButtonEvent.Pressed, function on_a_pressed() {

    projectile = sprites.createProjectileFromSprite(img` ···
        `, mySprite, 0, -50)
    music.pewPew.play()
})
sprites.onOverlap(SpriteKind.Enemy, SpriteKind.Projectile, function on_on_overlap(sprite: Sprite, otherSprite: Sprite) {
    otherSprite.destroy()
    sprite.destroy(effects.spray, 500)
    info.changeScoreBy(1)
})
sprites.onOverlap(SpriteKind.Player, SpriteKind.Enemy, function on_on_overlap2(sprite2: Sprite, otherSprite2: Sprite) {
    otherSprite2.destroy(effects.spray, 500)
    scene.cameraShake(4, 500)
    info.changeLifeBy(-1)
})
let Asteroid : Sprite = null
let projectile : Sprite = null
let mySprite : Sprite = null
effects.smiles.startScreenEffect()
mySprite = sprites.create(img` ···
    `, SpriteKind.Player)
mySprite.setPosition(77, 111)
controller.moveSprite(mySprite, 100, 0)
mySprite.setStayInScreen(true)
game.onUpdateInterval(1000, function on_update_interval() {

    Asteroid = sprites.createProjectileFromSide(img` ···
        `, 0, 50)
    Asteroid.x = randint(0, scene.screenWidth())
    Asteroid.setKind(SpriteKind.Enemy)
})
```

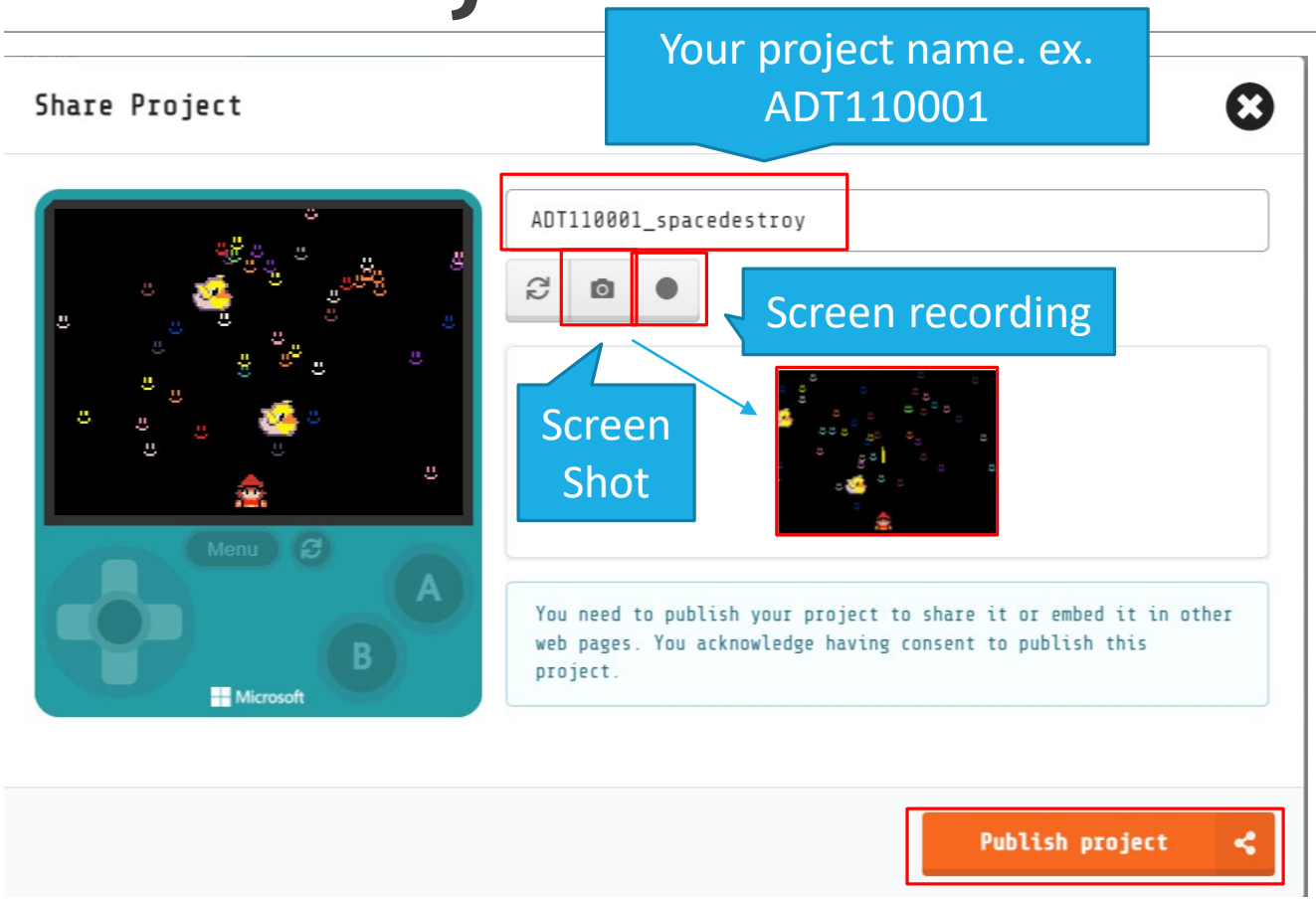
flowchart


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

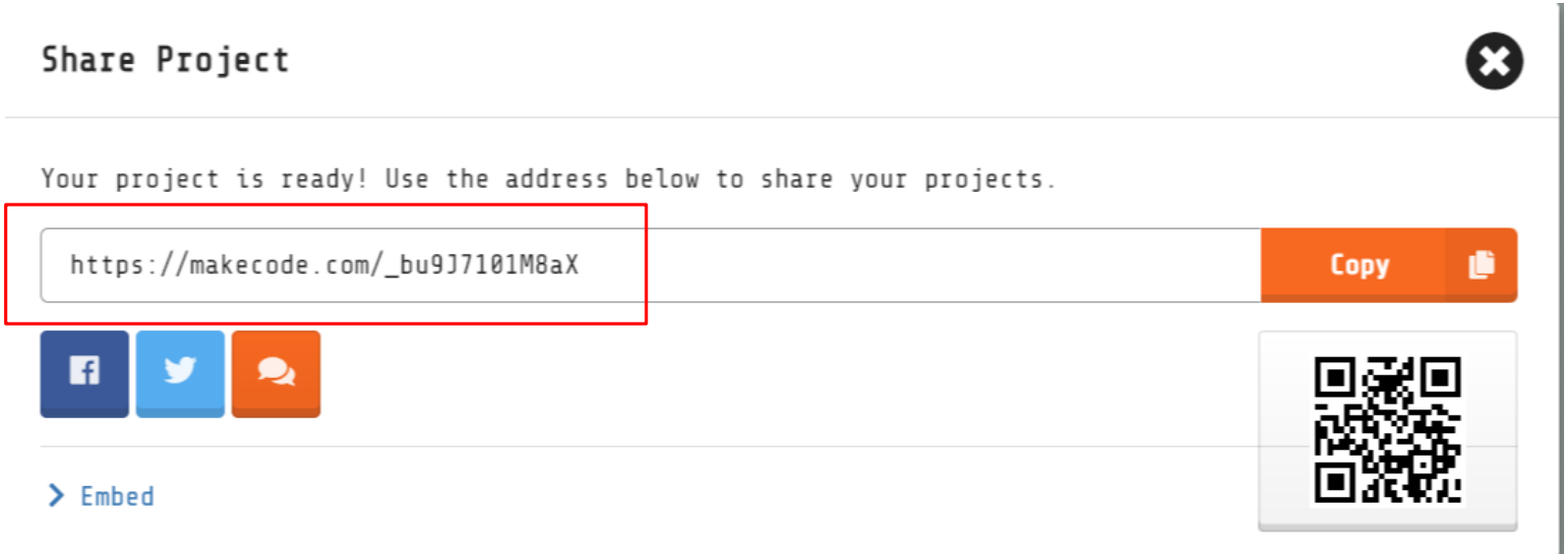
25. Share your game



Share Project

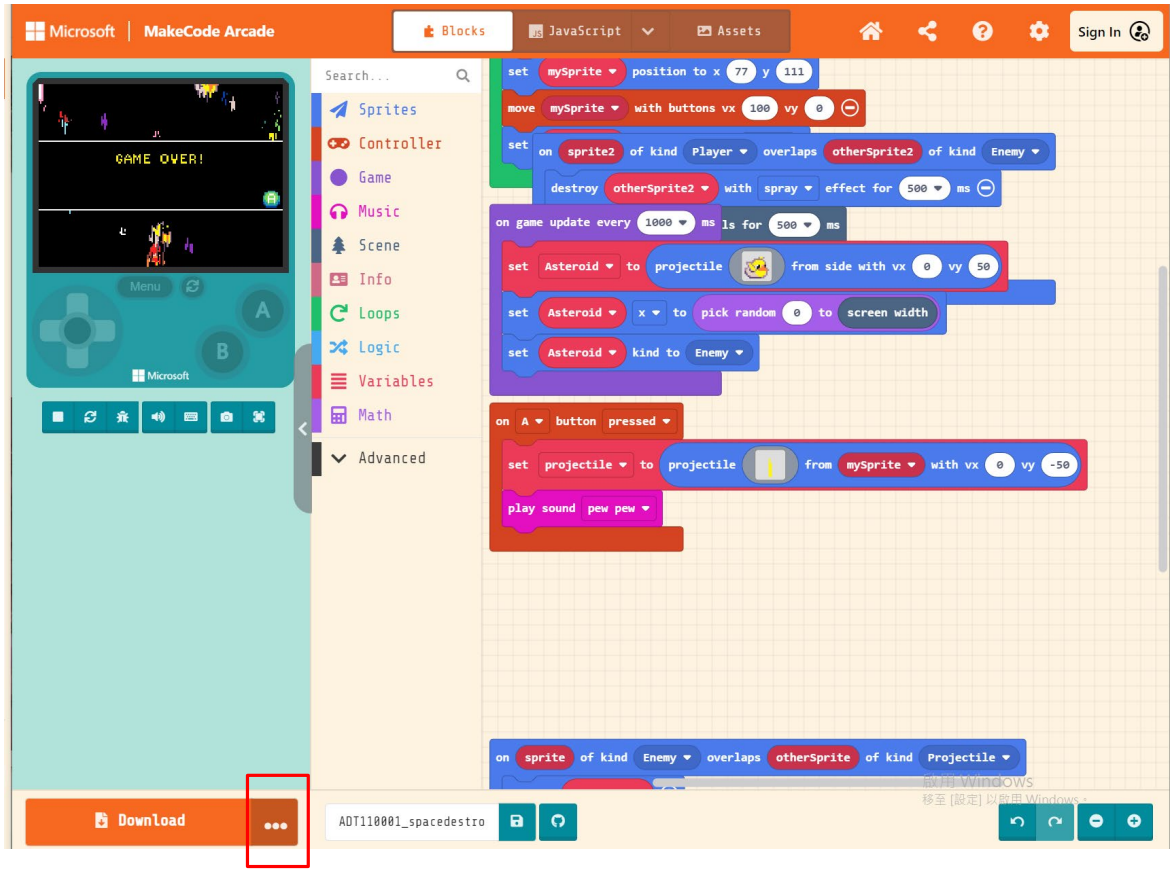


Publish your project & Share

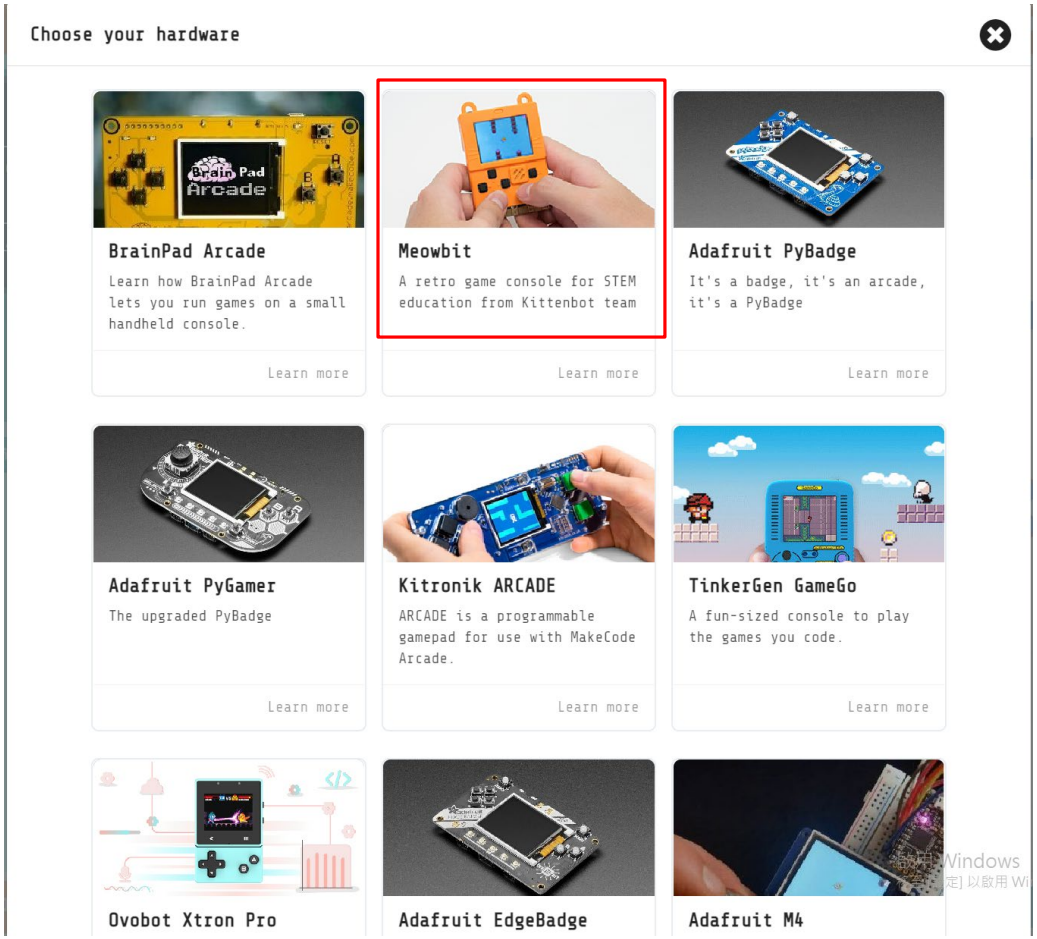


Part VI.
Installation of Meowbit

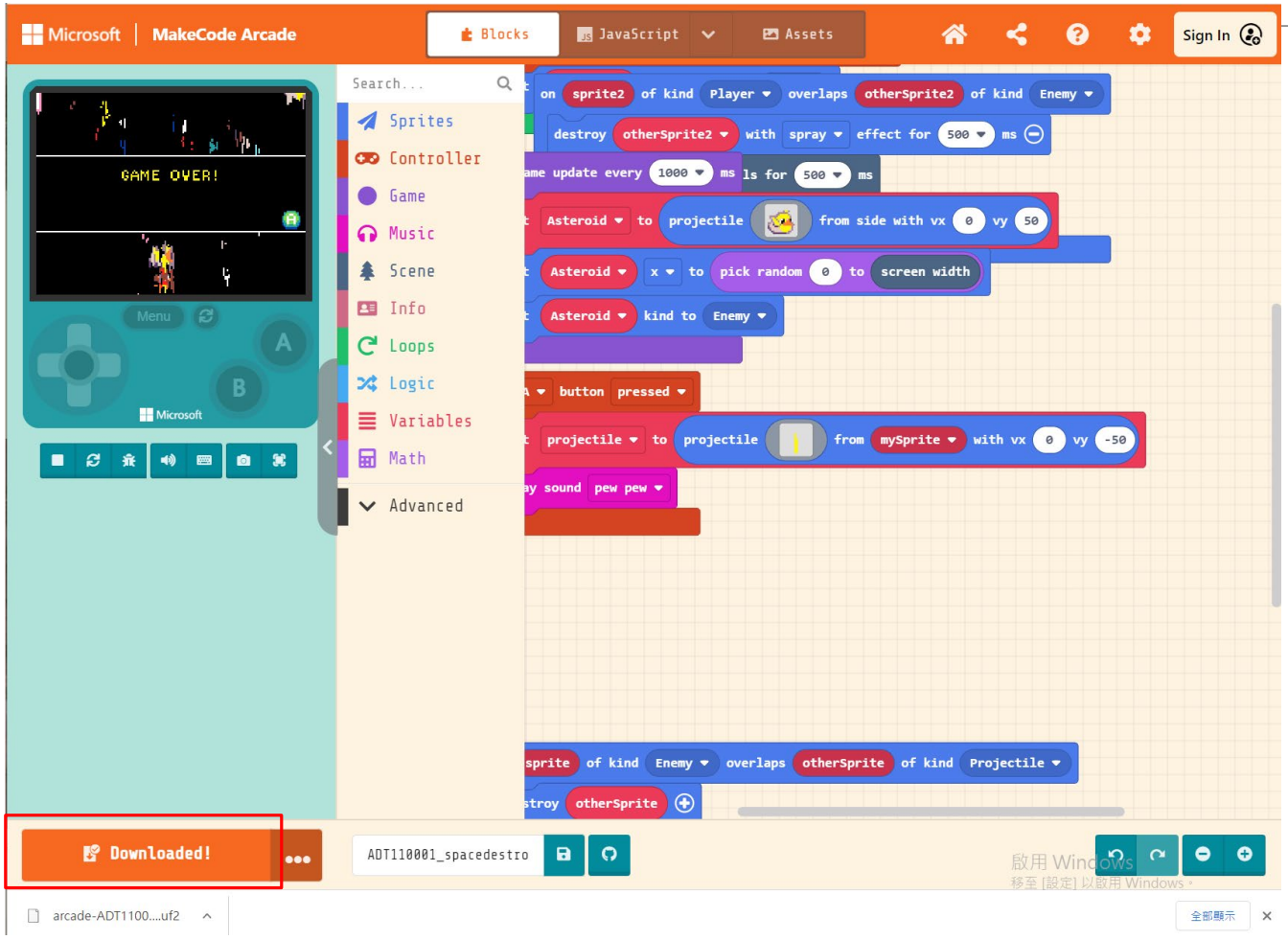
26. Installation & test on Meowbit



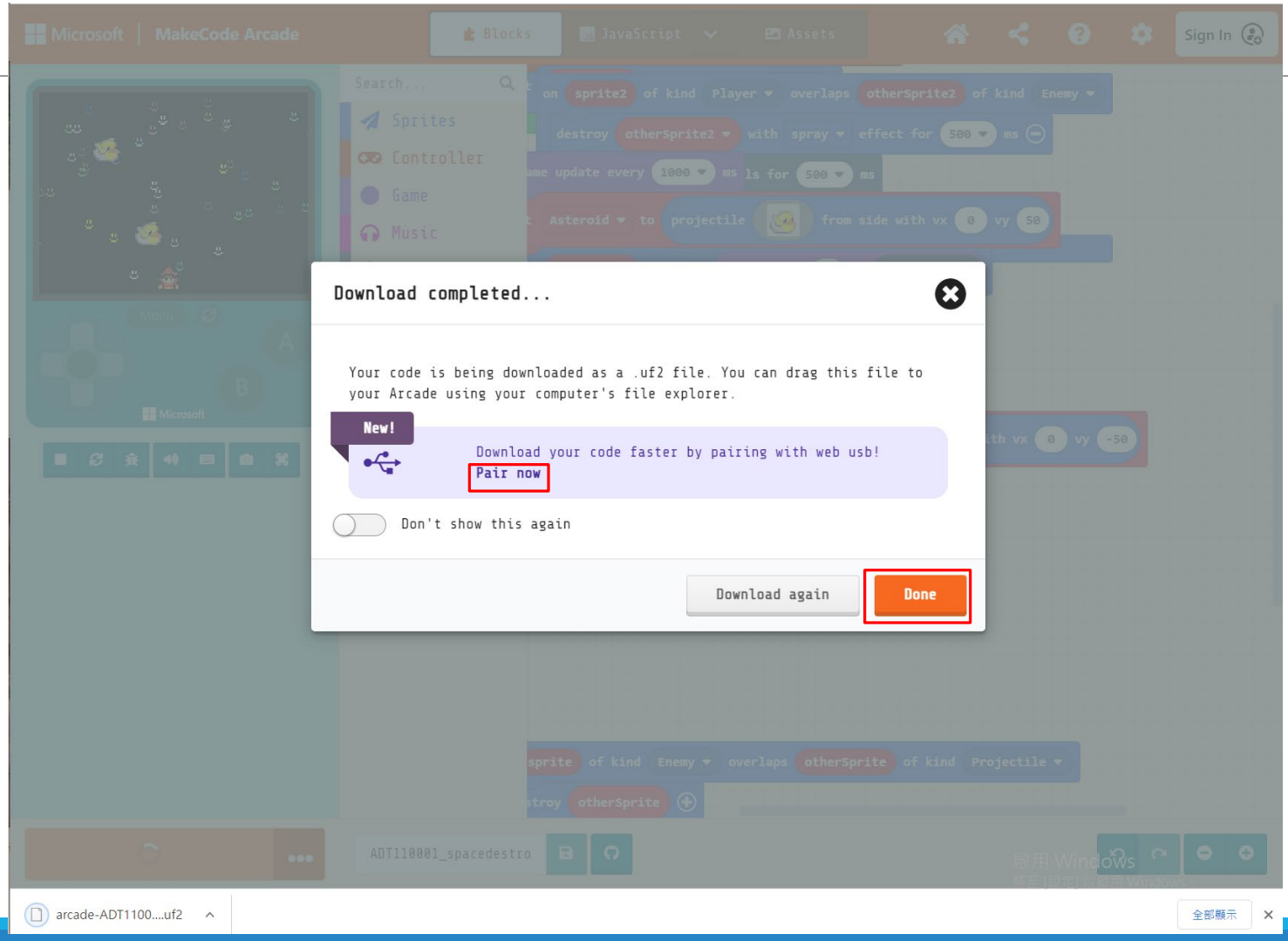
Choose your hardware-> Meowbit



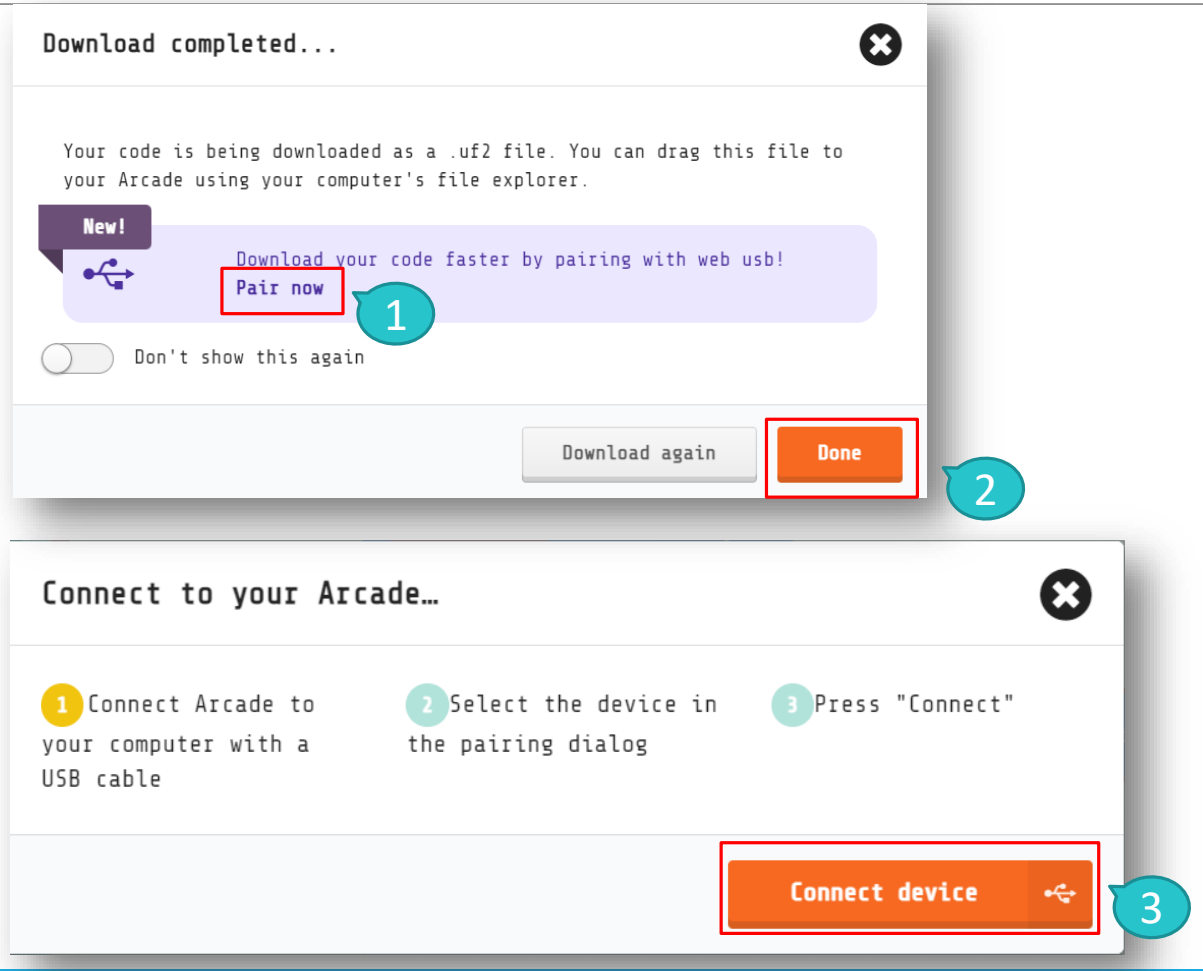
Download to Meowbit



Plug the USB cable to Meowbit



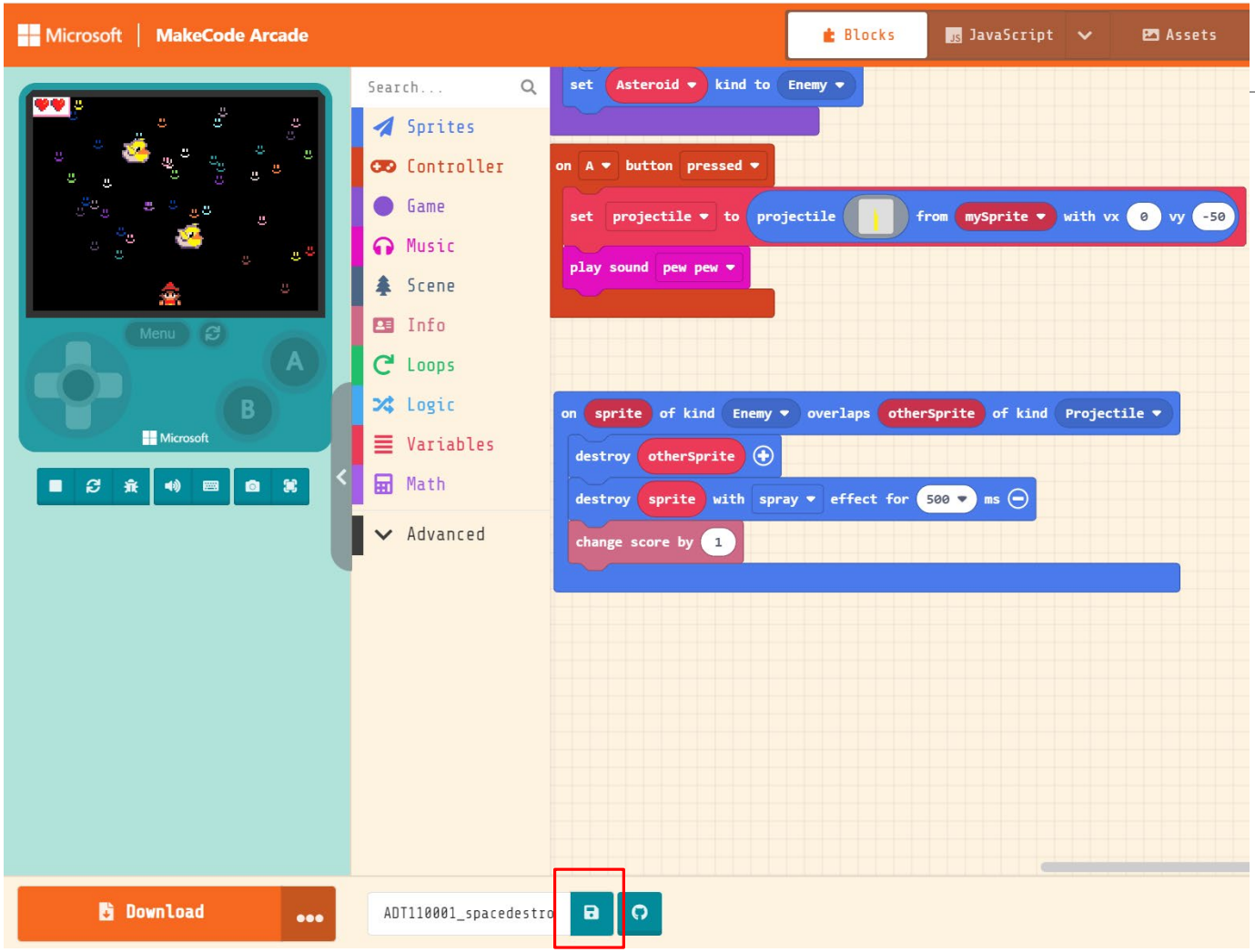
Download process



Success install in Meowbit

Save & Import Project

Download save project



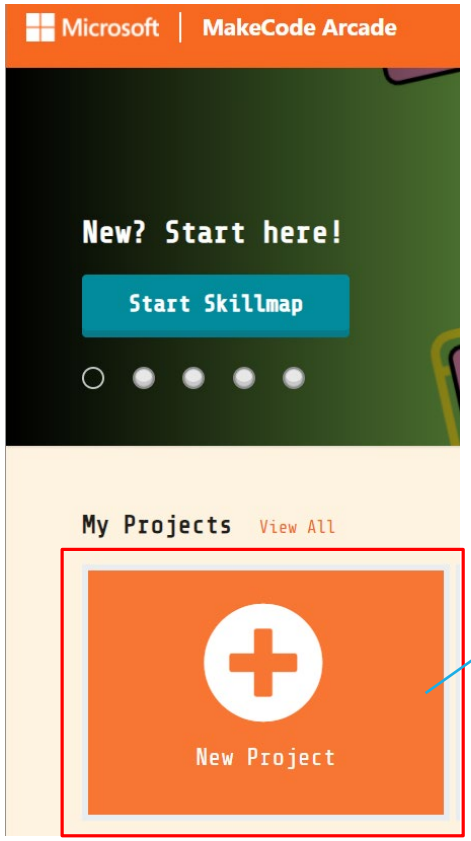
Project will saved in the image as png format

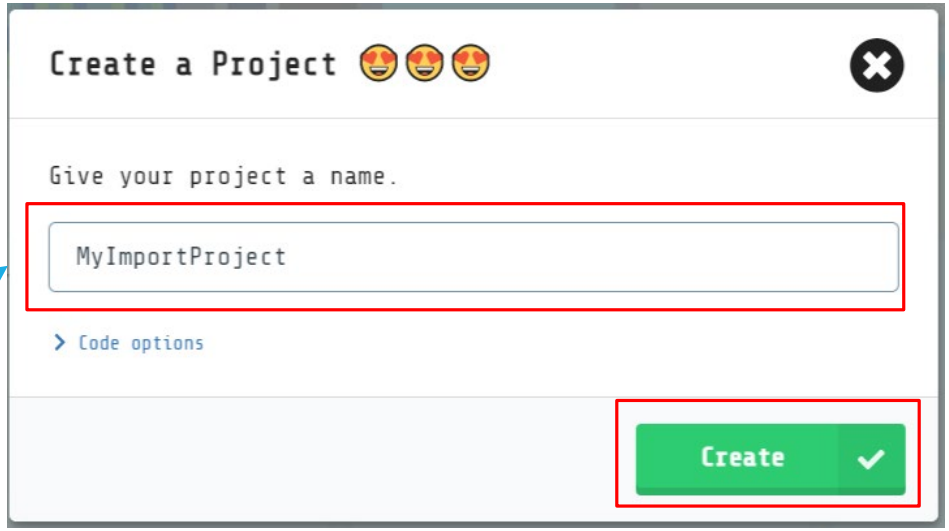
Saved project in PNG format

Ex. Xxx.png

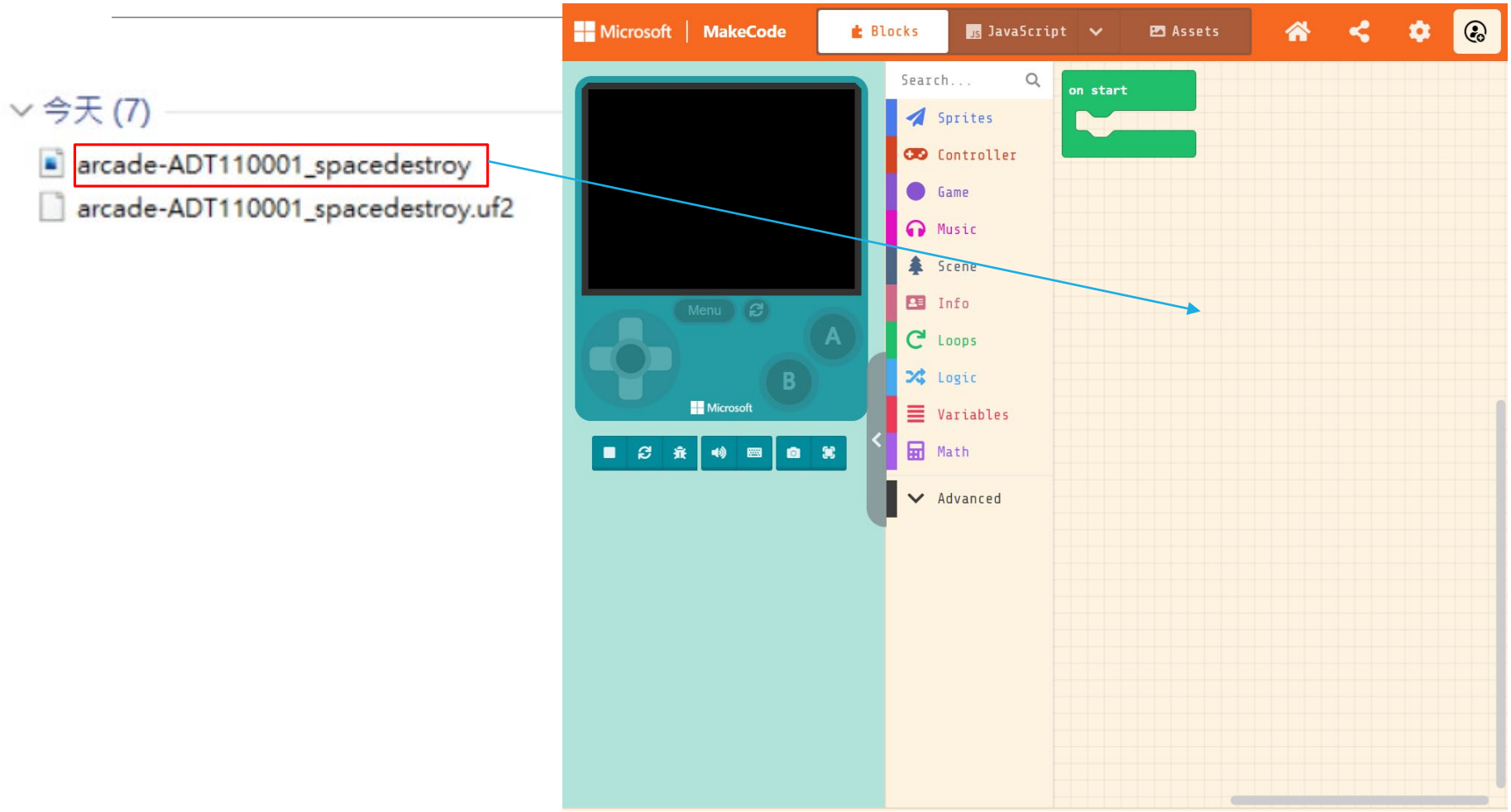
Import saved project

New project

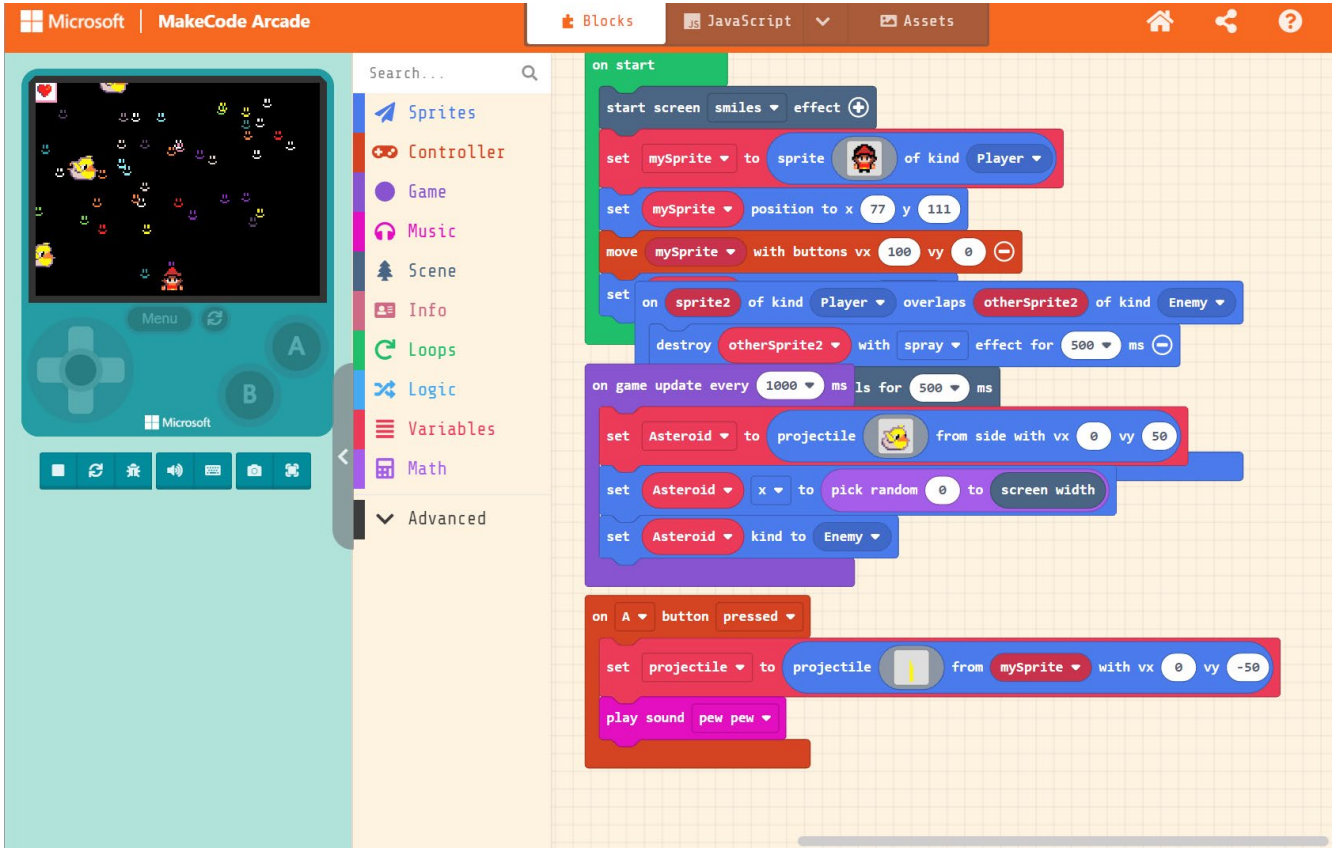




Drag the png to the Editor



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……)

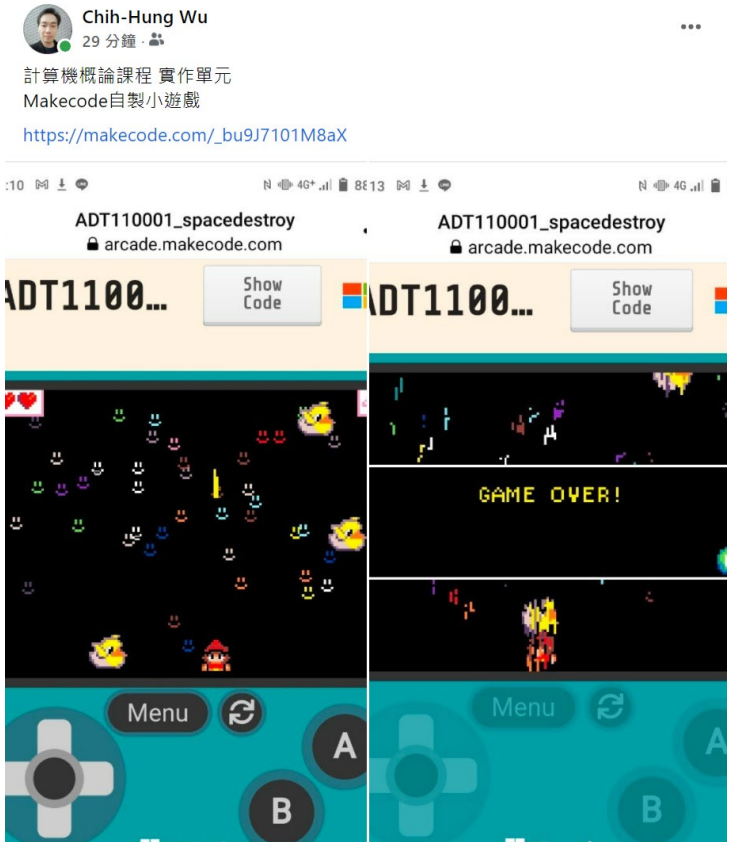
   功能1:

   功能2:

   網址連結

2. 完成學習單 繪製流程圖

Homework#1 Demonstration



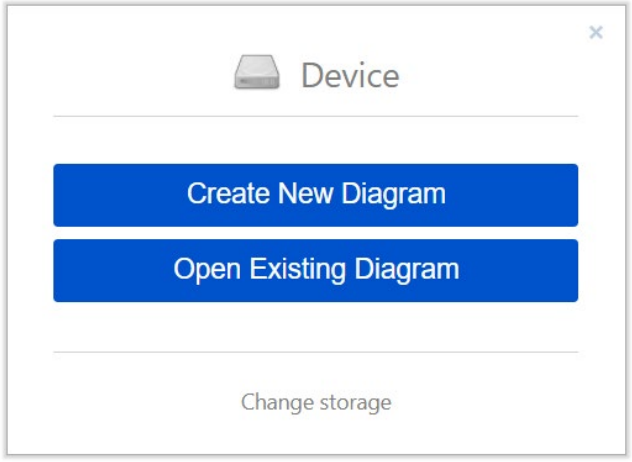
Hoemwork#2
FlowChart

Online flowchart website

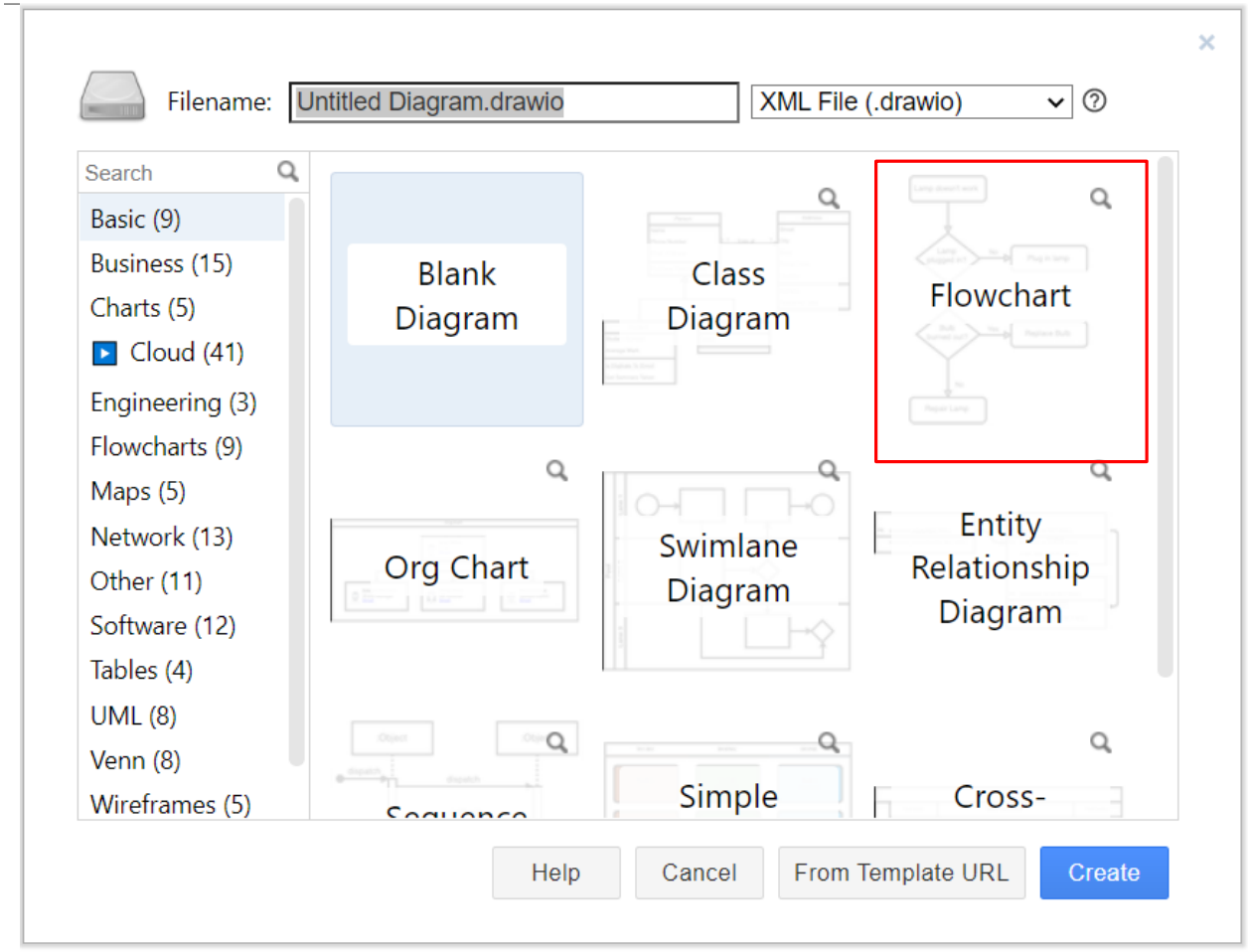
Use draw.io to draw the flowchart

Draw.io

https://app.diagrams.net/



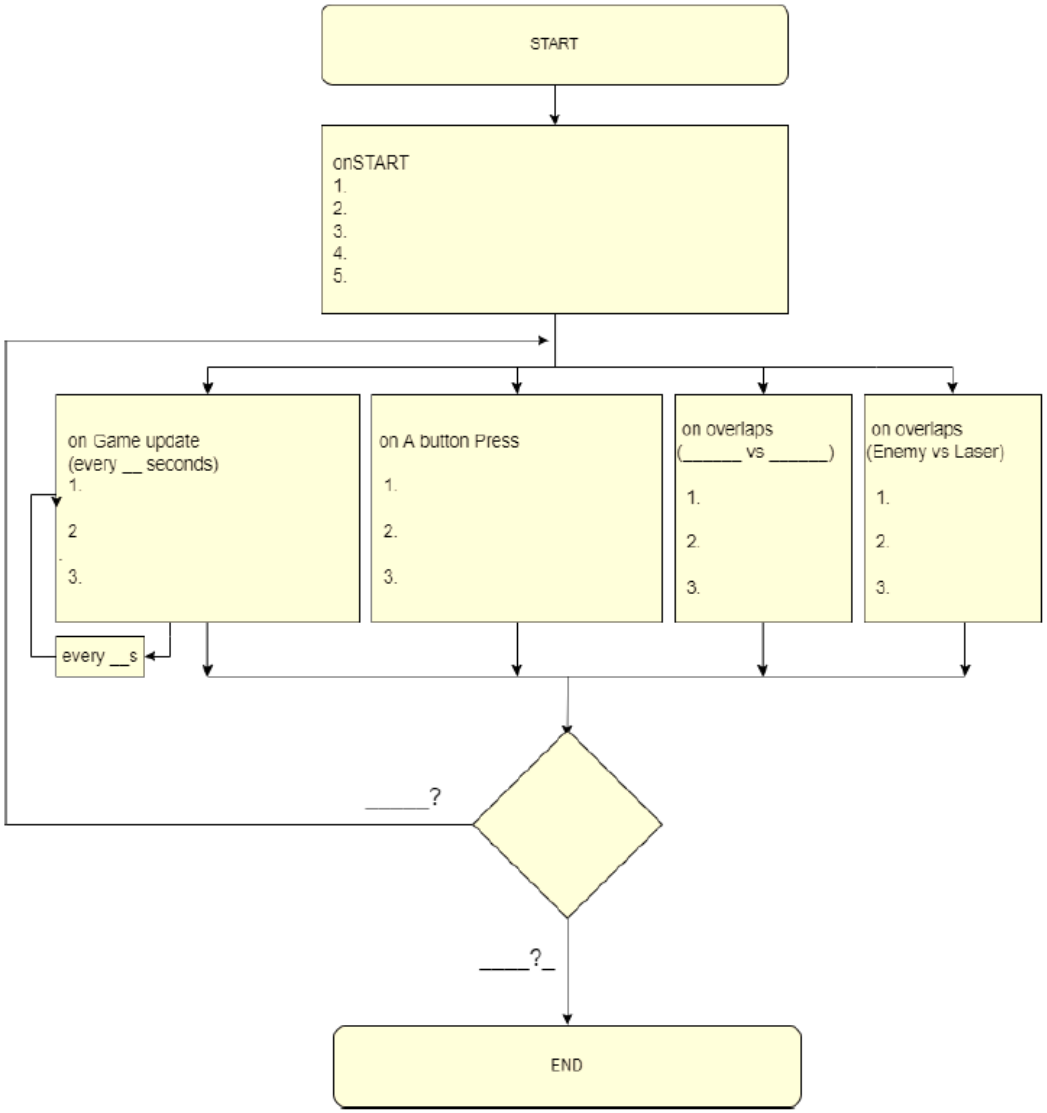
Select Flowchat



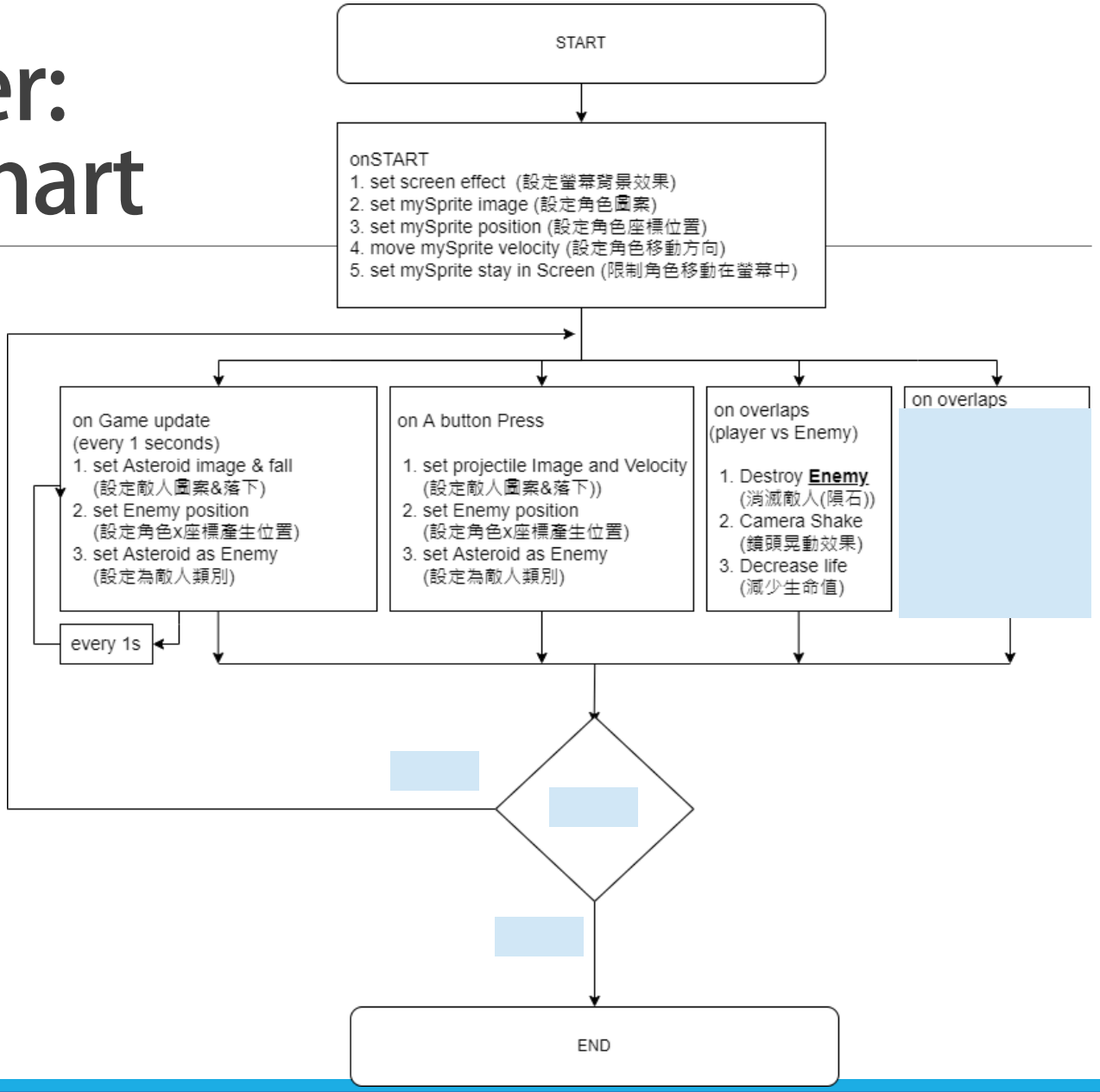
Learning task

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

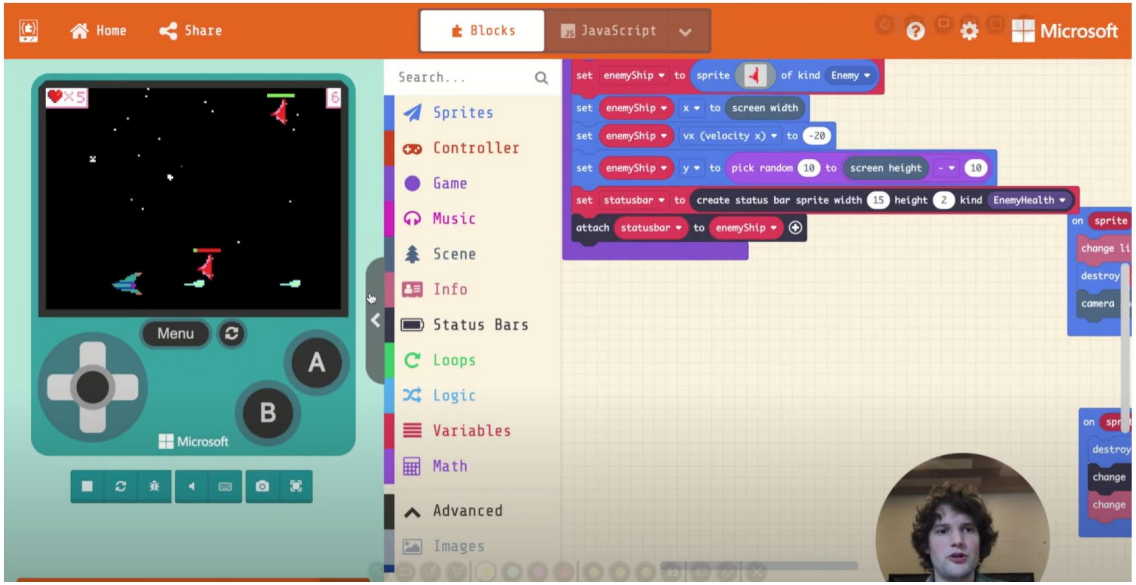
MakeCode進階功能

STATUS BAR

Step

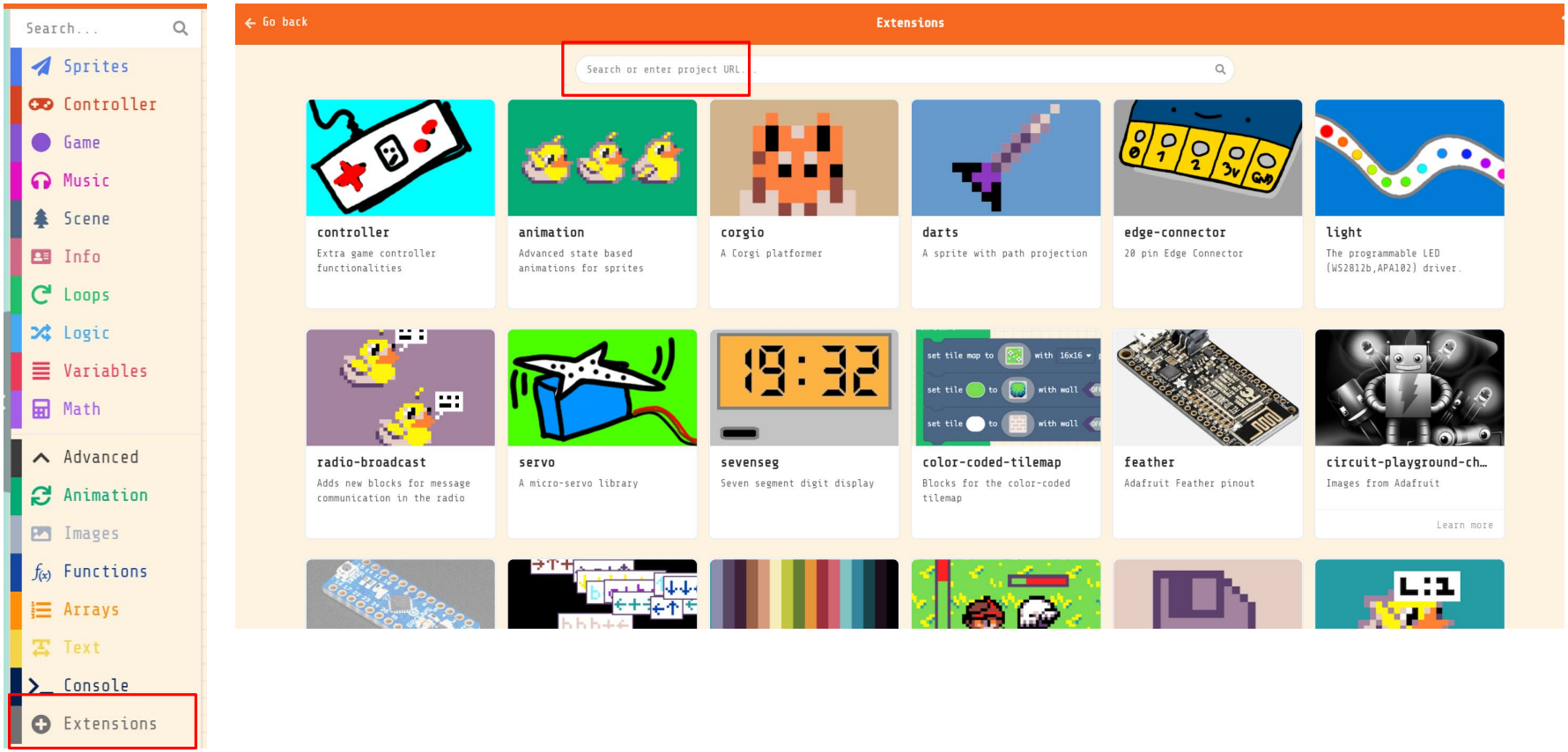
Advance
- Extension-> Status Bar

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

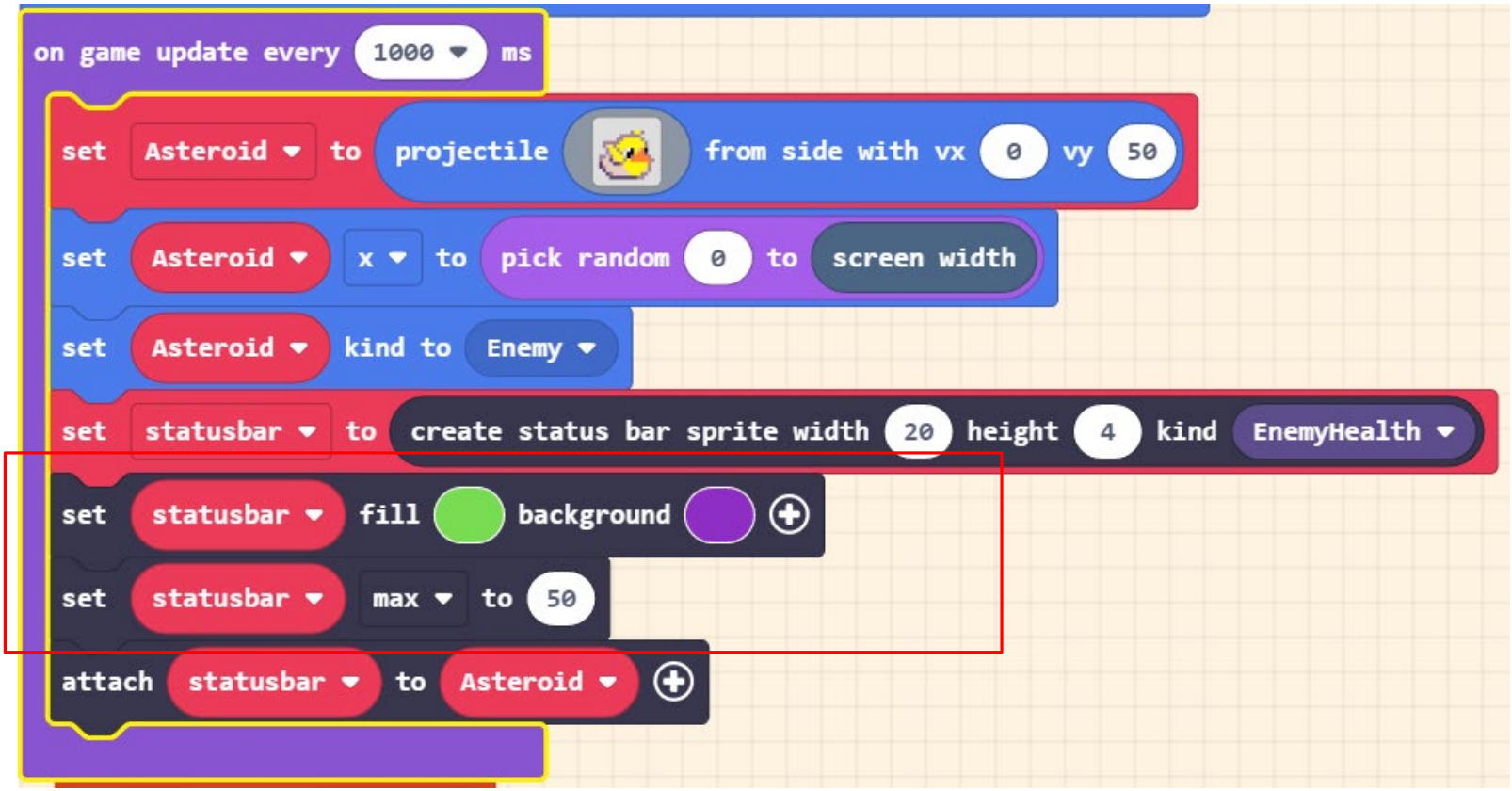
https://www.youtube.com/watch?v=m7avrQrLP3M

Add status-bar to Enemy

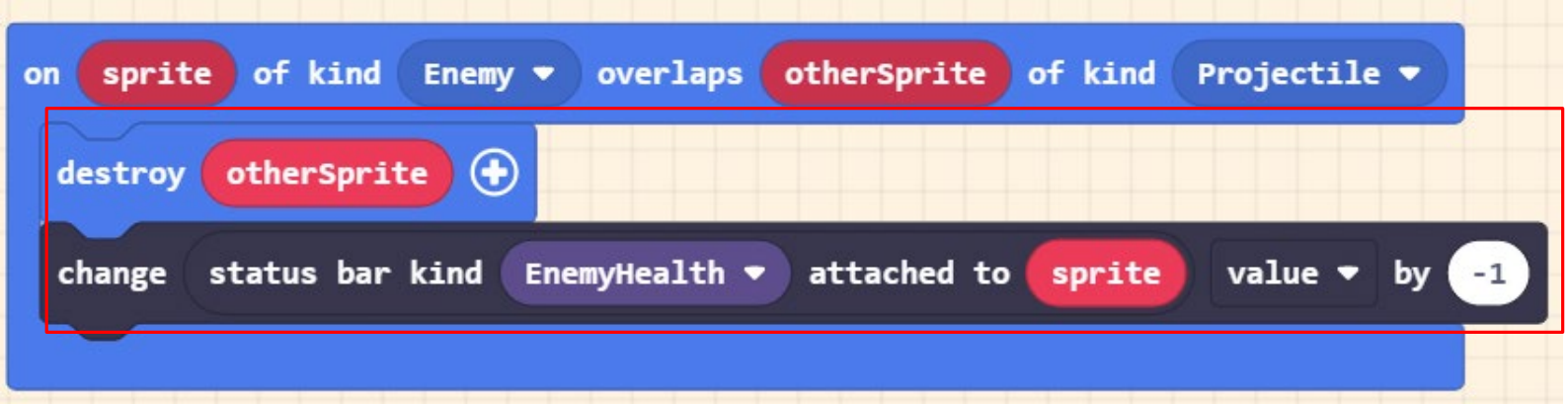
```
on game update every 1000 ms
    set Asteroid to projectile <image> from side with vx 0 vy 50
    set Asteroid x to pick random 0 to screen width
    set Asteroid kind to Enemy
    set statusbar to create status bar sprite width 20 height 4 kind EnemyHealth
    attach statusbar to Asteroid
```

Enemy Health

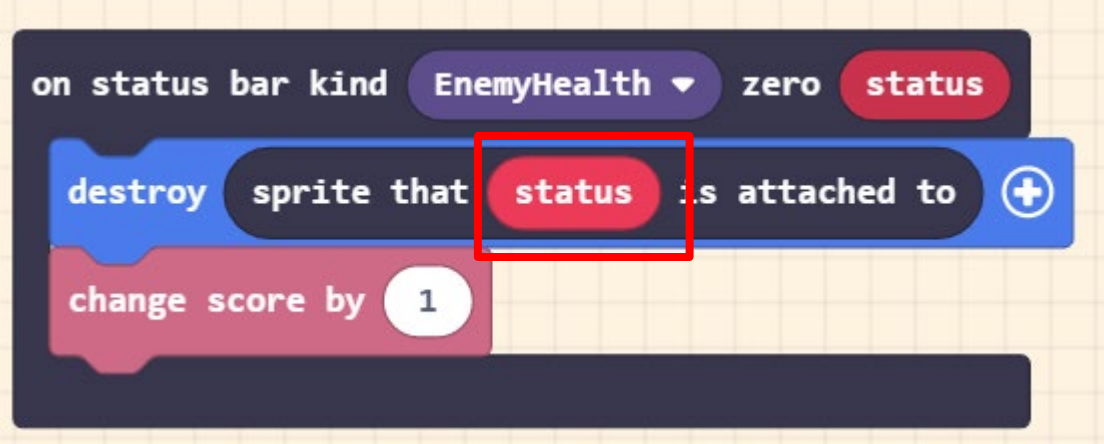
Set status-bar



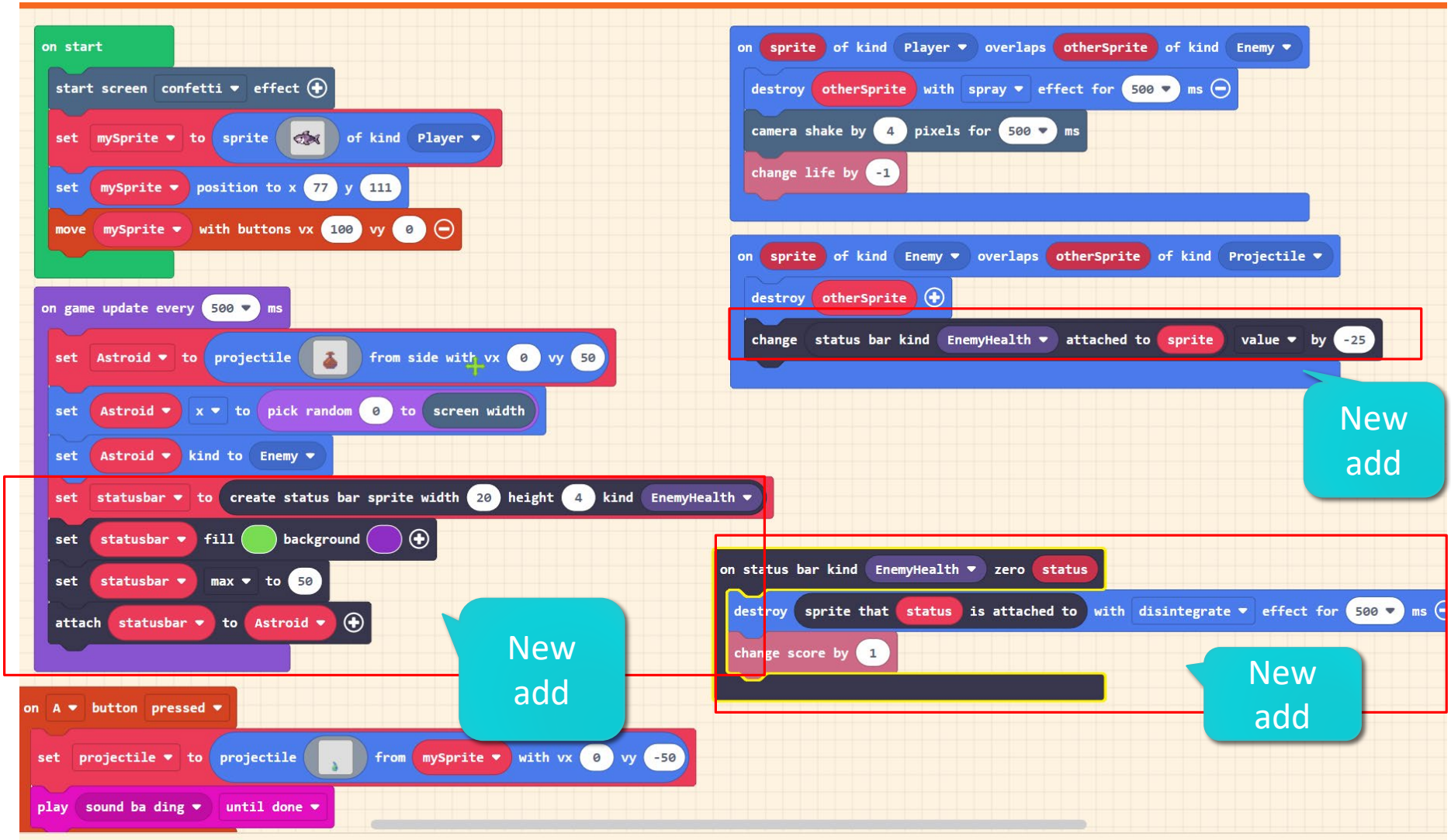
Decrease status-bar (health)



Add
change score & destroy status -bar



Completed Code for reference



進階功能#2
PowerUp

Watch the power ups video

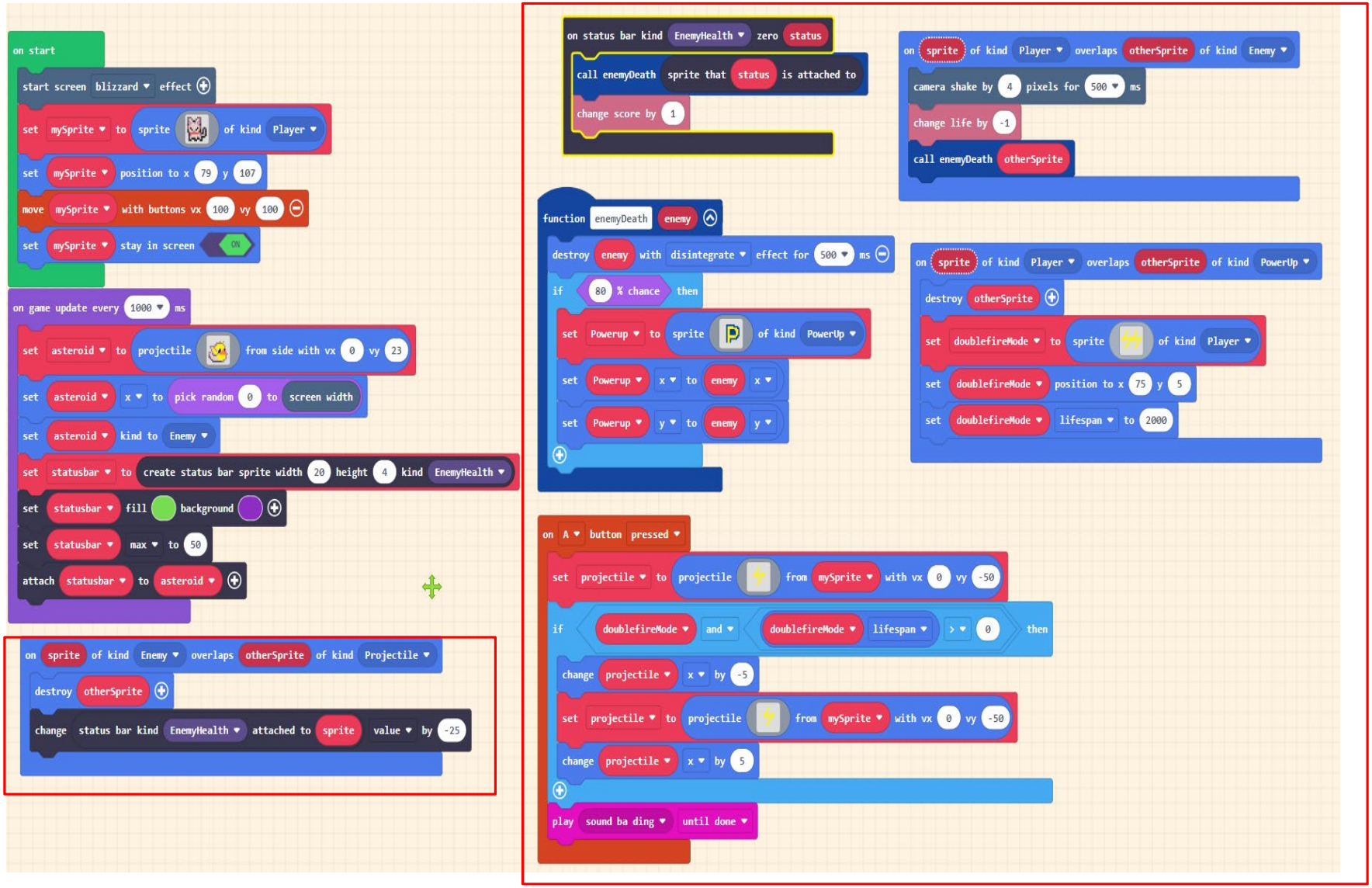
https://www.youtube.com/watch?v=S-WMUIwQ7uM

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