Installing SMW Hex Editor on Canoe (Switch, Wii U, SNES Classic, etc)

By SethBling and Mally

Introduction

This is a low-skill route for installing a hex editor onto Canoe, Nintendo's first-party SNES emulator, used on Switch, Wii U, Wii, and 3DS Virtual Consoles, as well as SNES Classic. It only requires a single controller. The route can be used on the Japanese ROM, but Powerup Incrementation must be performed 2 pixels right. You can pause frequently to check the instructions or make sure you've hit the right pixel, and use save states/rewind to correct any errors.

Here's a video of the installation process, up to the first 3 bytes of the actual hex editor code.

Instructions

1. Complete Yoshi's Island 2, getting Yoshi and passing through the midway checkpoint to become big.
2. Complete Yoshi's Island 3, getting fire power.

Powerup Incrementation

3. Perform Powerup Incrementation twice in YI3. (For faster first-pass Powerup Incrementation strategies, see this doc)
   To perform powerup incrementation:
   a. **High jump** off the brown platform here.
   
   b. Tap **A** to jump off of Yoshi about here.

c. Turn around and go **left** to land on this koopa. Mario must have leftward velocity or the koopa will fall the wrong way. It should fall to the left to land on the ?-blocks.

d. Land on the koopa again and grab its shell.

e. Stand here, aligned with the edge of the Yoshi block.

f. Tap **jump**, and on your way down at this height, throw the shell **up** to dupe the Yoshi block. If you hit the block without duping it, get on Yoshi, **start**+**select** and try again from the beginning. If the shell misses the block altogether, just try again.

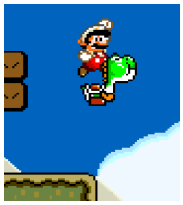
g. Quickly re-press **X** or **Y**. You'll want to time it so that your fireball doesn't hit the shell.

h. Once you've regrabbed the shell, throw it **up** to spawn a second Yoshi.

i. Turn to the **right** before re-pressing **X** or **Y** so that your fireball doesn't destroy the red shell.

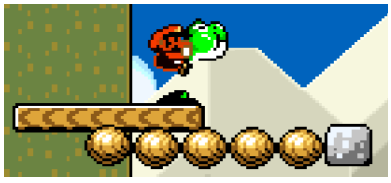
j. Run a few pixels **right** before performing a high **jump** to get on the Yoshi. That little bit of velocity before jumping will increase your jump height enough to be able to mount Yoshi directly from the jump.

k. If you land on an invisible Yoshi, quickly tap **B** then **A** to dismount and remount the visible Yoshi.
l. Run to the **right** off the block.
m. Turn around to face **left**, toward the red shell on the ground.
n. **Grab** the shell in Yoshi's mouth.
o. **Jump** to the **right** and **dismount** Yoshi so that he falls into the pit.



p. **High jump** so that you can land straight on the invisible Yoshi on top of the duped Yoshi block.
    i. It won't look like you're on a Yoshi, but you'll hear the Yoshi mounting sound, and Mario will get stalled out in midair for a second.
q. Once Mario's feet are on the ground, tap **right** and **jump**. this will avoid the invisible Yoshi becoming visible while you're on the ground, making you clip into the ground.
r. Go **left** and **jump** onto the brown platform.
s. Stand, facing **right**, at this pixel. You can **pause** to help identify whether you're on the right pixel or not.
t.

u. When the platform is as far left as it'll go, and the chain holding it is pointed directly left, press **X**/**Y** to spit the null sprite and perform powerup incrementation.



    i. You can be off by about 3 frames early or late, creating a ~7-frame window for the spit. If you spit outside the window, the game will likely crash.
4. After the second powerup incrementation, ditch Yoshi and **start**+**select**.

RAM Manipulation

5. Setup shell OAM ($3D8=$4C) and white splat ($2F4=$18)
    a. Enter YI2 without Yoshi.
    b. Jump on the leftmost walking koopa on the ledge and grab its shell
        i. You can use the shell from the ground at the beginning of the level to clear out as many koopas as you want besides that leftmost koopa.

    c. Hit the Yoshi block to spawn Yoshi.
    d. Stand at this pixel under the Yoshi block

    e. Hold **down** and let go of **run** to drop the shell.
    f. Hold **R** and let go of all other buttons to scroll the screen all the way right.
    g. **Run** left 17 pixels to this location (holding **left** for exactly 12 frames will usually accomplish this).

        i. If you run too far/too short, it's not a problem as long as the screen scroll doesn't change, just get into this position while holding the shell.

h. Throw the shell **up** and immediately run **right** so that you don't pick it back up. This will create a white splat that sets RAM address $2F4 to $18.
    i. It's important that you don't stomp on any additional enemies after this until the first two ACEs are complete, because it will generate a new white splat graphic and overwrite the value written here.
i. Position Yoshi on this pixel

j. **Screen scroll** all the way **left**, then **screen scroll right** so that you're centered again. This will reset the screen scroll.
k. Press **start**+**select**. This will despawn the shell on the ground to set RAM address $3D8 to $4C.

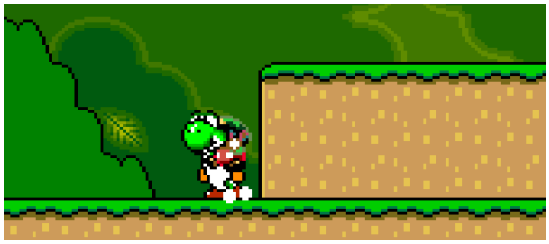
Powerup $15

6. Re-enter YI2 with Yoshi.

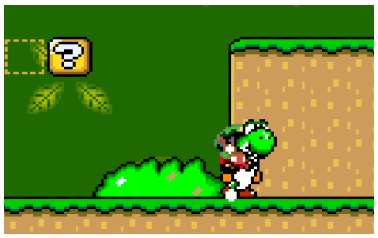
Notes on setting up the sprite x-coordinate table with Arbitrary Code: The sprite x-coordinate table has 12 sprite slots, numbered 0 through B, two of which (A and B) are set aside for special sprites like the goal tape and glitched berries. When a new sprite is loaded, it picks the highest available sprite slot to occupy. For example, when you enter the level with Yoshi, first the red shell on the ground occupies slot 9, then Yoshi occupies slot 8.

The spits are done starting at slot 0 (seen at address $E4) and iteratively going up. To do this, you need to make sure all of the remaining koopas/shells are loaded, and that you grab whatever sprite was the last to load (since it has the lowest slot number). You can always move away to unload all of the koopas/shells, and reload them all, to be sure that you're grabbing the lowest available sprite slot. If you can keep extra koopas from despawning, sometimes you don't need to reload them all to do the next spit, as long as you're able to grab the next-most recently spawned koopa in the next-lowest sprite slot.

Generally, you can reload all the koopas on the ledge by going left of the hill here:



Or to the right of the ledge here:



The sprite's final x-coordinate when spitting it out is the location where the fireballs spawn in front of Yoshi's mouth. If Yoshi faces right, the x-coordinate will be 32 pixels higher than if he faces left. Only the low byte of the sprite's x-coordinate matters, so every 256-pixel interval is the same for our purposes.

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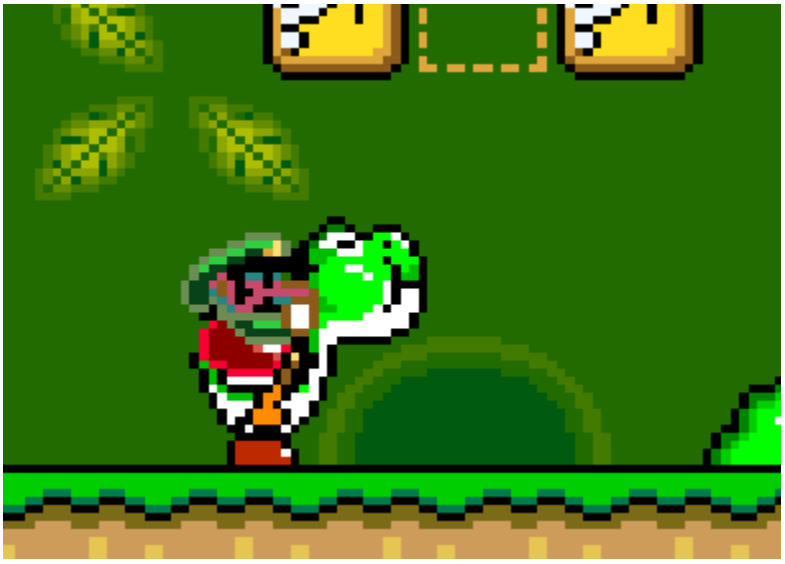
7. Run `STY $19; PLA; PLA; RTS` to get to powerup state $15.
    a. Eating berries is fine for the duration of this ACE.
    b. Spit 84 19 68 68 60
        i. Grab the rightmost walking koopa and spit it here:

        ii. Go right to reload the koopas, grab the shell on the ground and spit it here:

iii. Reload all the koopas, grab the rightmost koopa and spit it here:

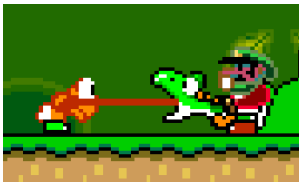


iv. Go left to reload the koopas, grab the rightmost koopa and spit it here (same as the previous spit):

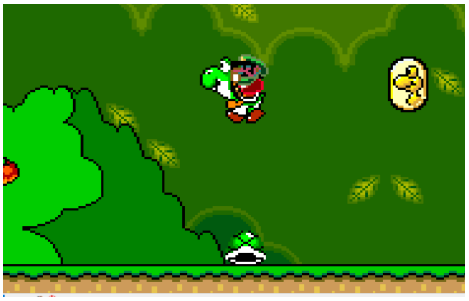
v. Go left to reload the koopas, grab the rightmost koopa and spit it here:

c. Kill the four sprite to the right without stomping any of them
   i. Go to the right, past all of the enemies, without killing any of them, until you get to the second ledge here

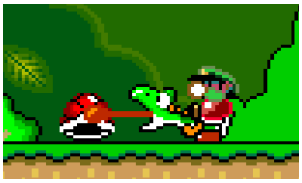
   ii. Go back to the left, and eat the walking koopa



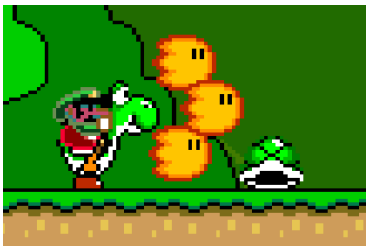
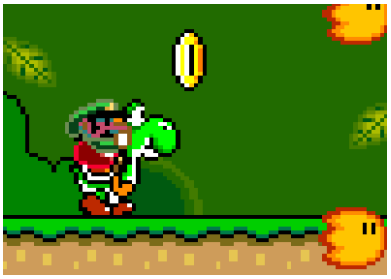
iii. Continue left, jumping over the green shell



iv. Eat the walking koopa and pick up the red shell in Yoshi's mouth

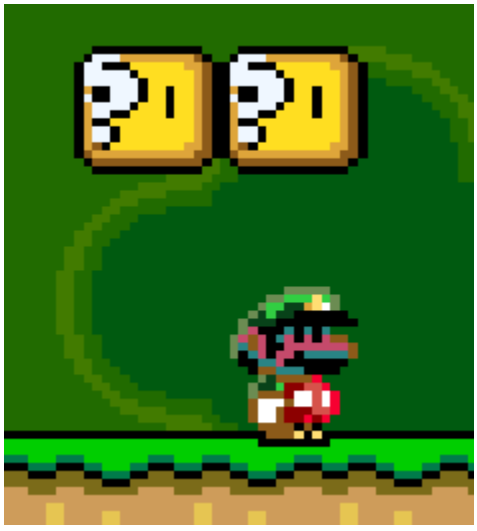



v. Go to the right and spit out fireballs to turn the green shell into a coin, and collect the coin

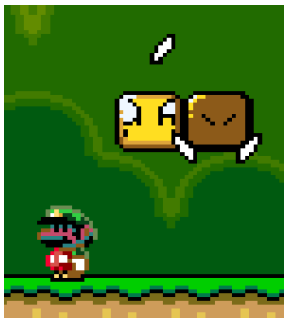
d. Position Yoshi at this pixel near the ledge, facing left

e. Run to the left and stand at this pixel, facing either direction



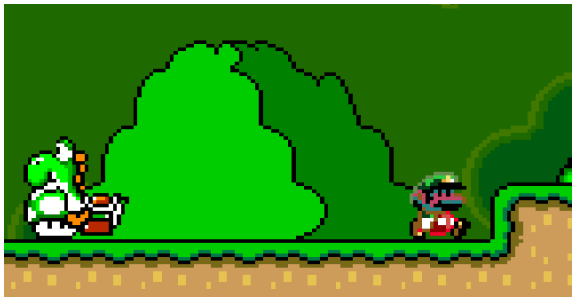
f. **Screen scroll** all the way left
g. *Optionally:* Make a save state.
h. Hold **down** and **Y**, then **left**, then **B**.
    i. You should jump and slide to a stop at exactly this pixel. If you don't, the setup failed and you need to try again by rewinding to before the jump, moving slightly left (but staying on the same pixel) and performing the inputs again.

i. Once the top right shell fragment has despawned, run to the right so that the 1-up doesn't get so far off screen that it despawns



j. Pursue the 1-up, and when it's safe to jump over it, do so to get ahead of it. Don't get so far ahead of it that it despawns, though.

k. Walk into ledge. Yoshi's on-screen position near the left edge is important.



l. Press **start** to pause the game.

m. Hold **shoulder L**, **Down**, **Y** and **B**

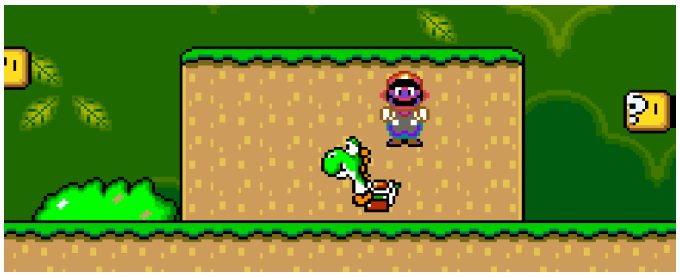
n. Unpause the game, then hold **select**.
    i. You can ignore the mushroom that gets dropped.

o. Let 1-up touch you. Mario should change colors.

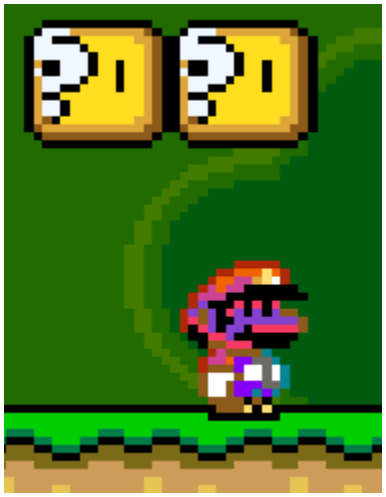
p. Get back onto Yoshi and use **start+select** to exit the level.

$E4 at $06F0

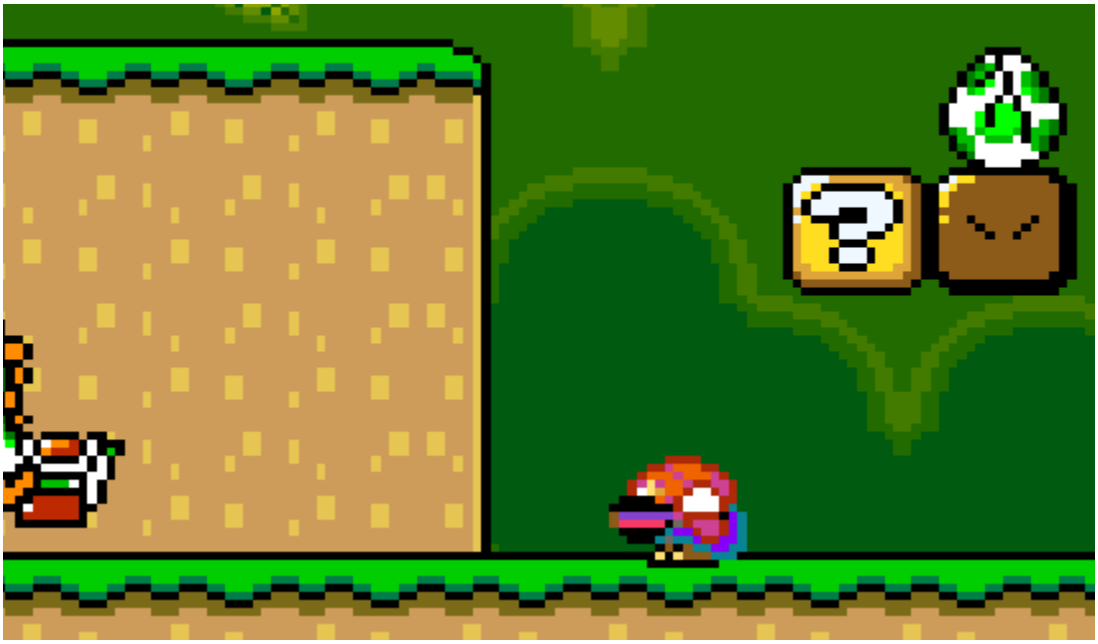
8. Run `LDA #$E4; STA $06F0; PLA; PLA; RTS` to write $E4 to $06F0
    a. Re-enter YI2 on Yoshi
    b. Glitch two mouth-height berries by getting to the right of them, running to the left, and tonguing just before hitting them. They should move down and to the left a little, then stop animating.
    c. Get off of Yoshi around here.



    d. Go under the Yoshi block and stand at this pixel, facing either direction



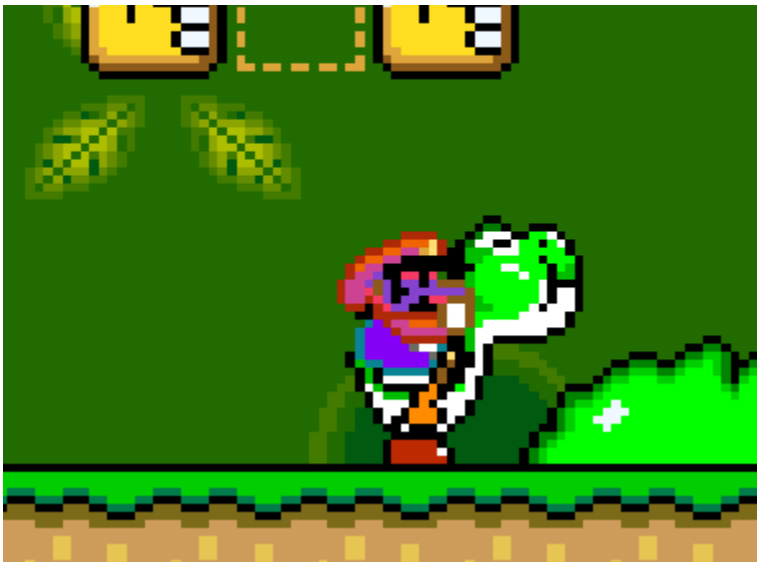
    e. **Screen scroll** all the way left
    f. Hold **down** and **Y**, then **left**, then **B**.
        i. You should jump and slide to a stop at exactly this pixel. If you don't, the setup failed and you need to try again by rewinding to before the jump, moving slightly left (but staying on the same pixel) and performing the inputs again.



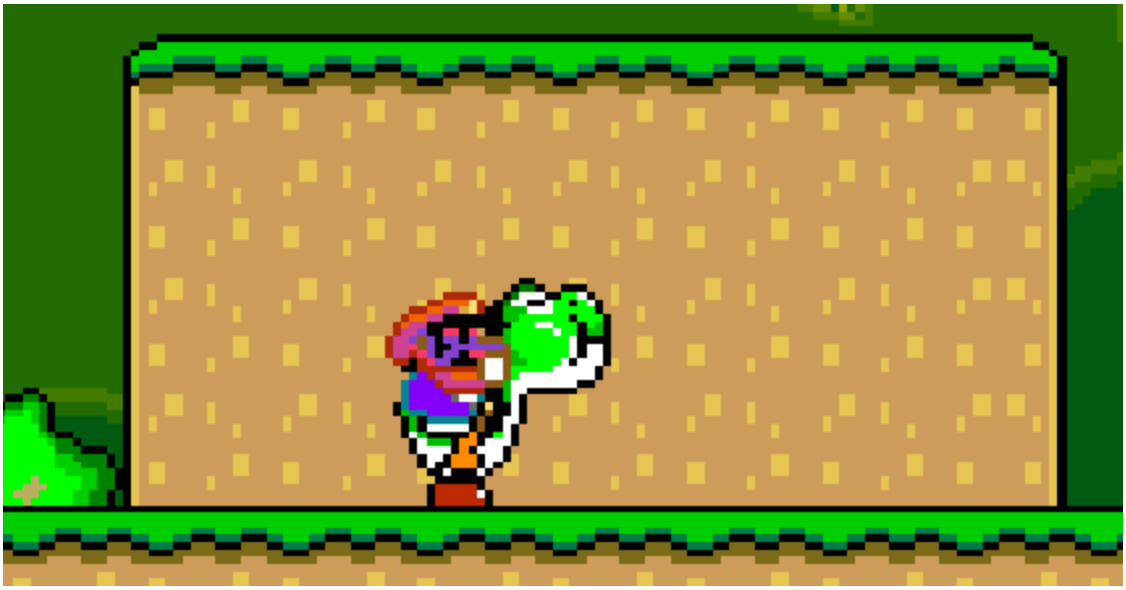
g. Once the eggshell fragments have despawned, get back on Yoshi
    i. [Optional] **Screen scroll right** to neutral to decrease the chances a koopa will fall on you
h. Spit A9 E4 8D F0 06 68 68 60
    i. Grab the shell on the ground at the beginning of the level and spit here (the glitched berry's position will vary):

    ii. Reload the koopas, grab the rightmost one, run right and spit here:

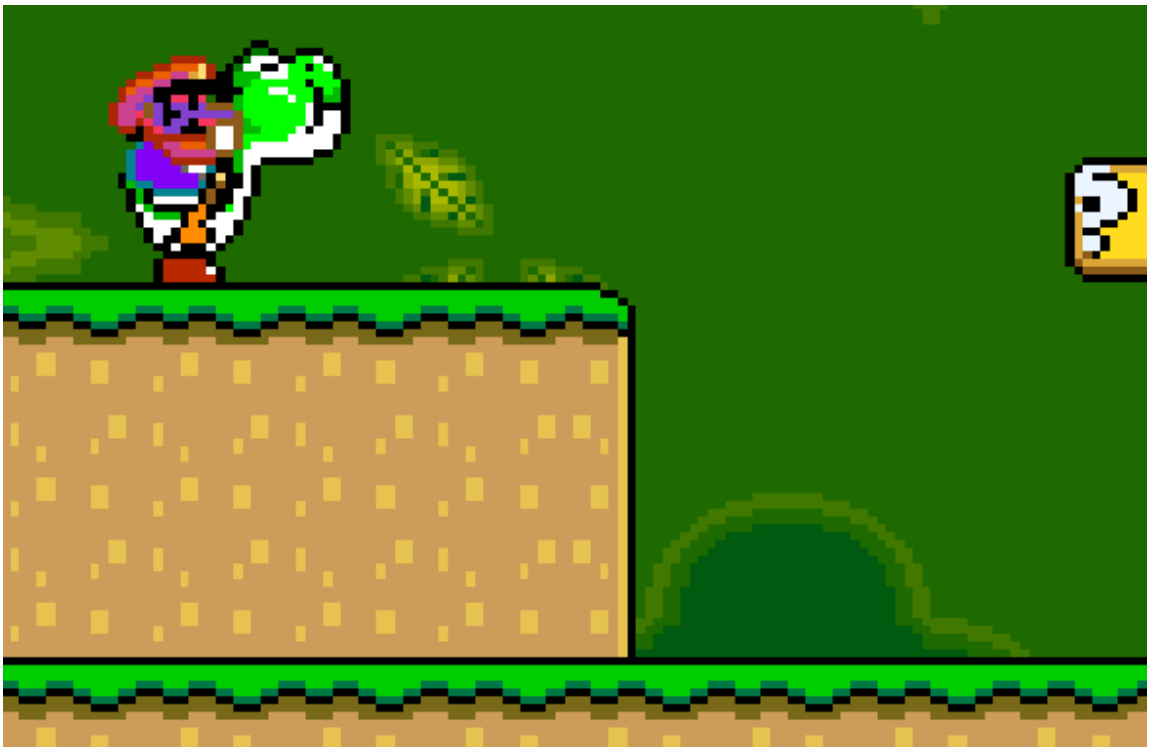
iii. Run left to reload the koopas, grab the rightmost one, run right and spit here:



iv. Run left to reload the koopas, grab the rightmost one, run right and spit here:

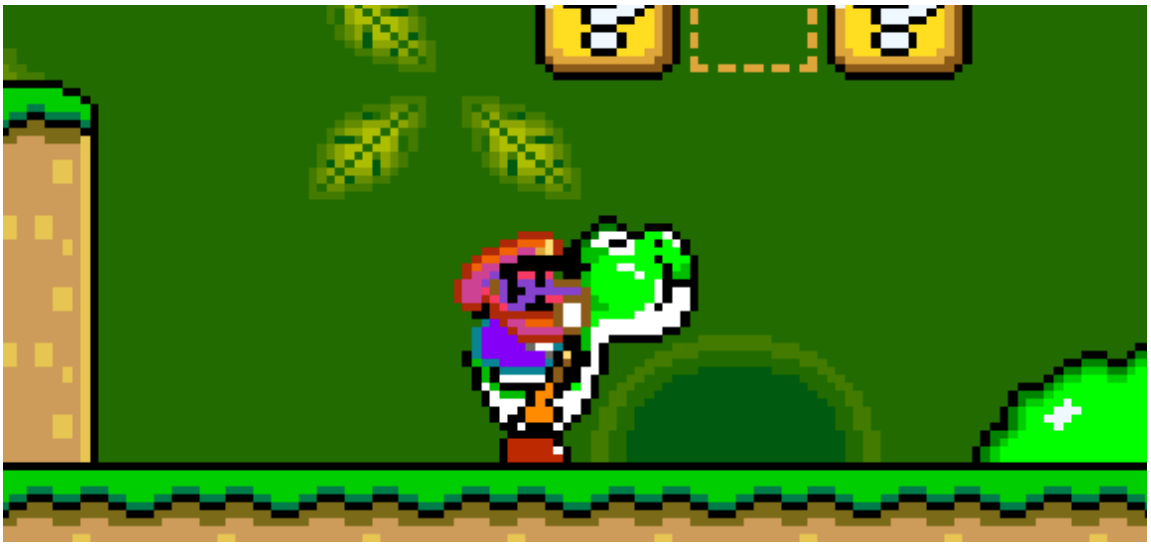


v. Run left to reload the koopas, grab the rightmost one, and spit here:



vi. Run left to reload the koopas, grab the rightmost one, run right and spit here:

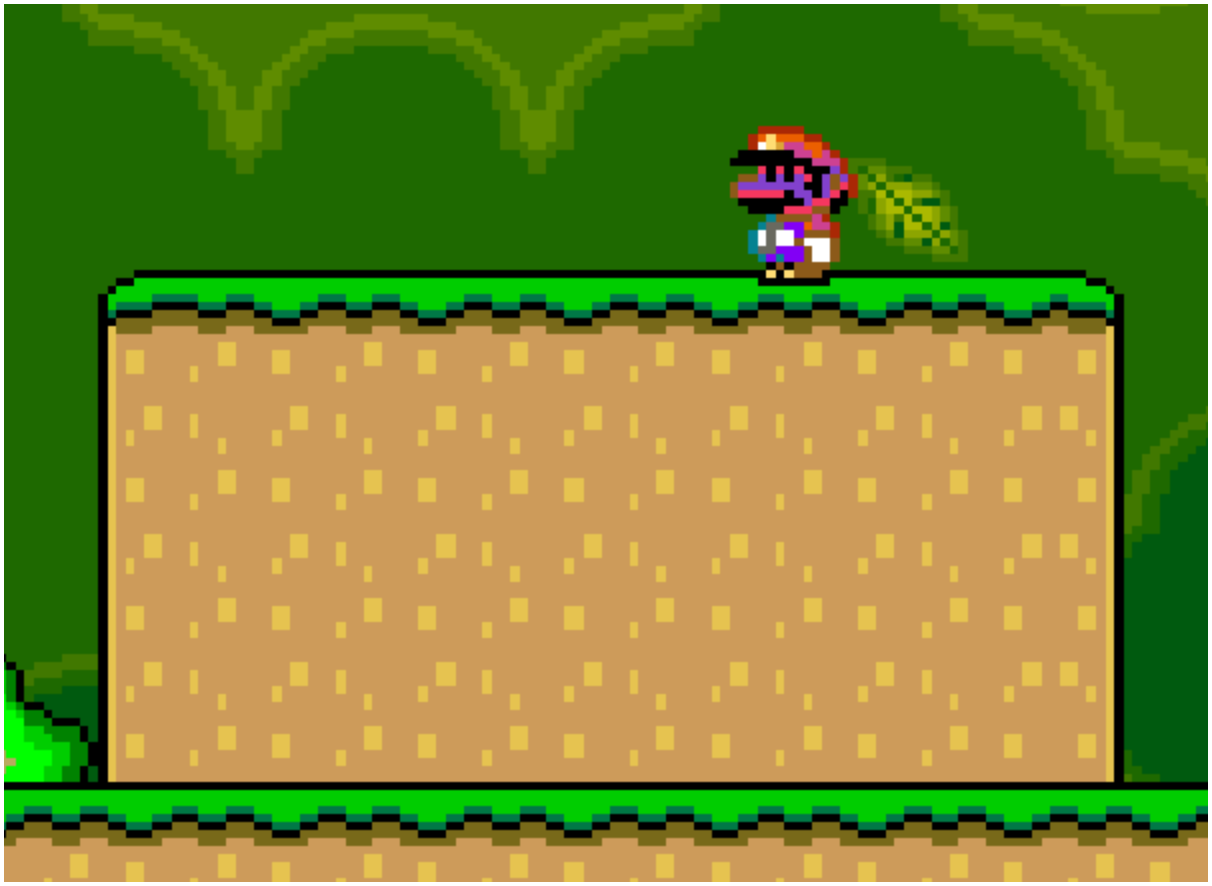
vii. Run left to reload the koopas, grab the rightmost one, run right and spit here (same as previous spit):



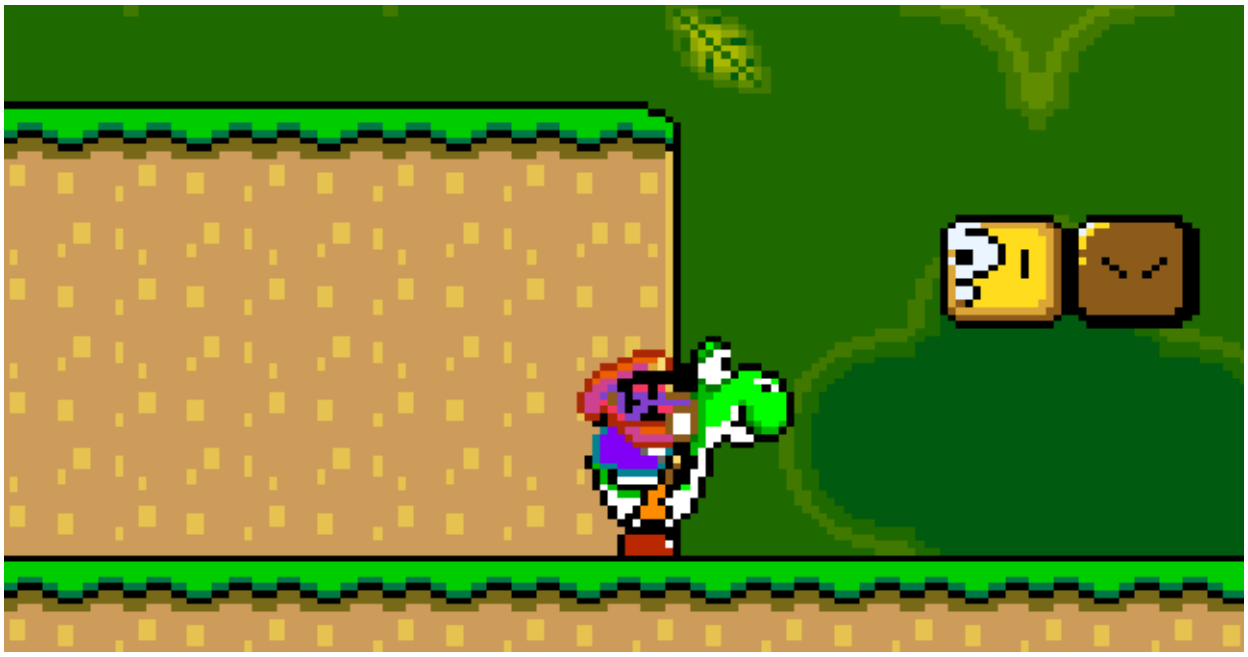
viii. Run left to reload the koopas, grab the rightmost one, run right and spit here:

i. Position Yoshi at this pixel, facing left:

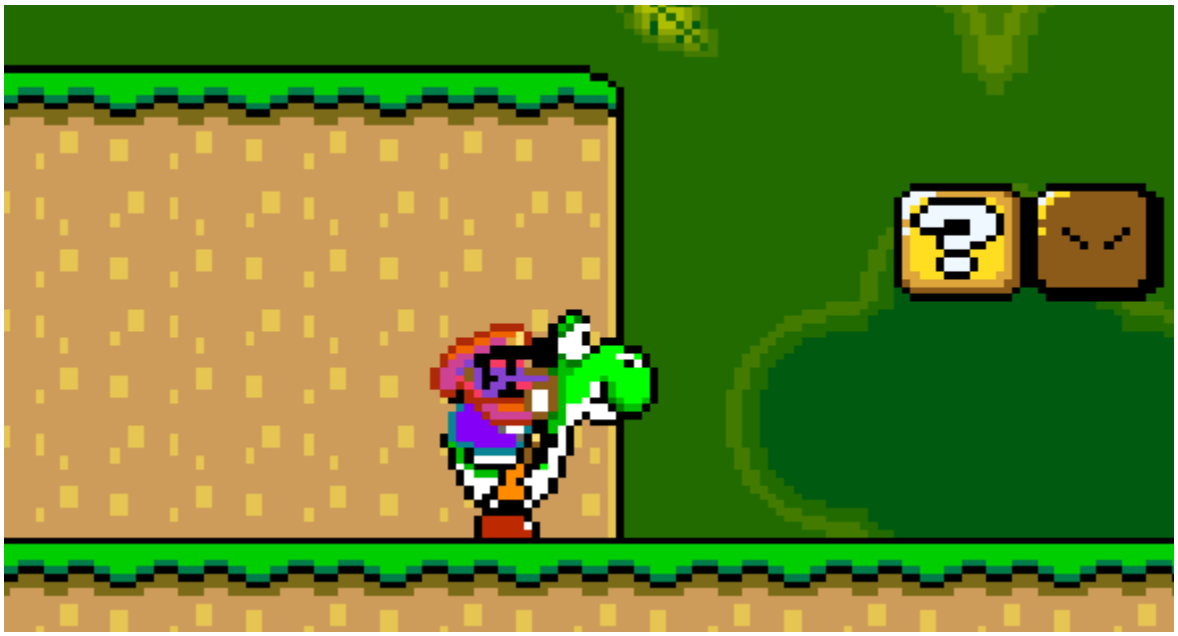
j. Jump off Yoshi and position Mario at this pixel (or the one to the left of it), facing left



k. **Screen scroll right** if necessary, then **screen scroll left** so that the screen scroll is neutral. Yoshi's on-screen position near the left edge is important.
l. Hold **down**, **shoulder L**, **Y**, and **B**, then also hold **select** and let the mushroom fall into Mario.
    i. Nothing will change visibly, but $E4 will be written to $06F0, which enables the next ACE.
m. Get back on Yoshi
n. Go right a bit, and stand at this pixel, facing right, with the screen scrolling right with Mario's movement.
    i. If you overscrolled, get to this position and **screen scroll left** then **screen scroll right** to reset the camera to neutral.



o. Without changing the camera scroll, move 10 pixels left, to this pixel, facing right.
    i. If the camera scrolls at all, retry from the previous step.



p. Press **B** then **A** to dismount Yoshi without moving horizontally. Yoshi's on-screen x-coordinate is important ($03D0=$6C).
q. Press **start**+**select** to exit the level without Yoshi.

Bootstrap ACE

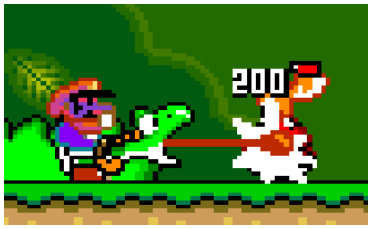
9. Set up code `LDA $94; LDY $EB; STA [$F0],y; RTS`. This will load Mario's position and store it to an offset from the address contained at $F0, the offset being Yoshi's position. Yoshi in slot 7.
    a. Re-enter YI2 without Yoshi

b. Without killing any sprites, jump on the leftmost walking koopa (in sprite slot 8) and grab its shell.

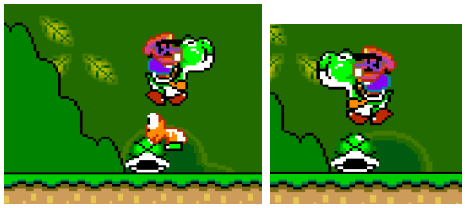
   i. You'll probably want to be holding **jump** when you land on the koopa, so that you bounce high and can control where you fall.
   ii. After you bounce on the koopa, you can wait a few seconds for the other koopas to walk away.

c. Grab the shell and proceed to the right, without killing any koopas on the ledge.
   i. You may want to go around to the left and under the ledge to avoid them.

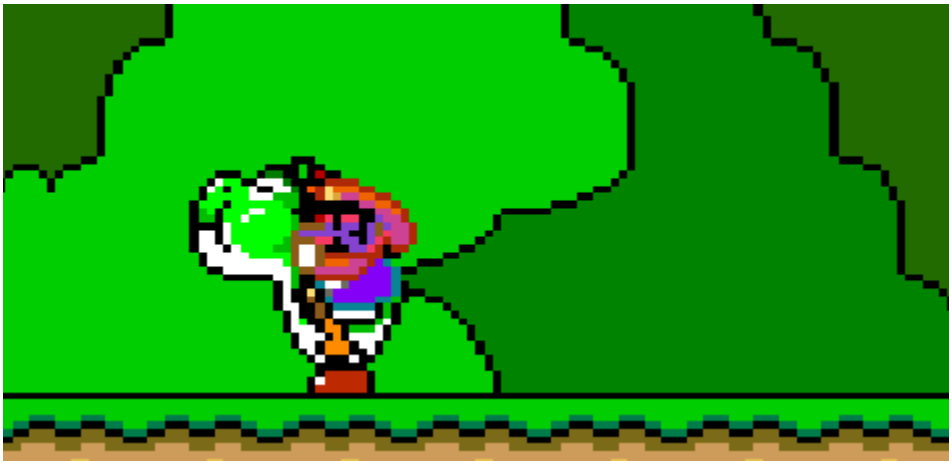
d. Run just past the Yoshi block, making sure the Message Box is on screen to the right, and kick the red shell up to hit the Yoshi block to spawn Yoshi into slot 7 (the message box is in slot 9 and the shell is in slot 8).
   i. This is slightly different than what's shown in the TAS video.
e. Kick the shell off the screen to the left
f. Get on Yoshi
g. Run to the right and grab the red shell before the koopa can get into it. This kills the koopa and puts the slot 8 red shell in Yoshi's mouth.



h. Keep the red shell in Yoshi's mouth.
i. Continue right and stomp the green koopa and green shell.
   i. You must stomp them separately. If the green koopa gets into the green shell, kill it, then run to the right to reload the green koopa and stomp it.



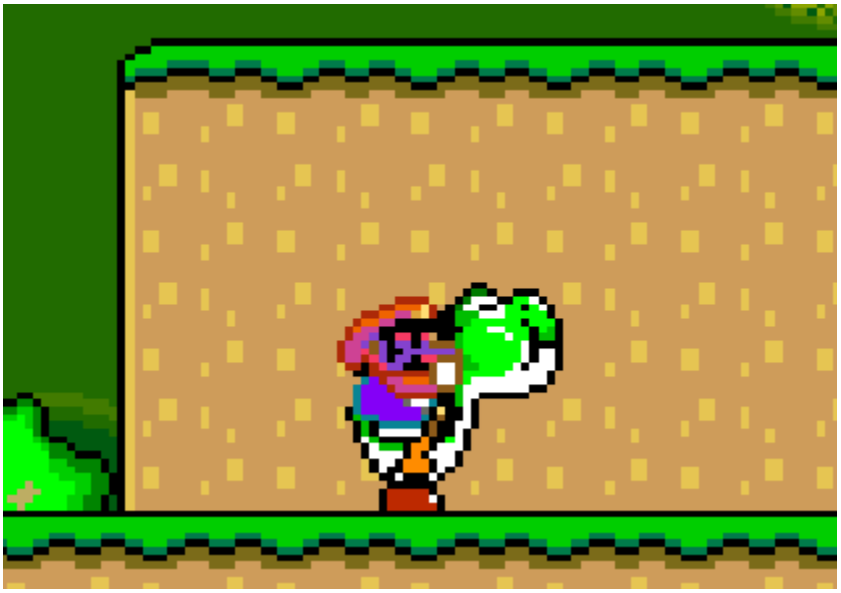
j. Once all of those enemies are dead, you may spit out or swallow the red shell in Yoshi's mouth.
k. Spit A5 94 A4 EB 97 F0 60
    i. Grab the shell on the ground at the beginning of the level and spit here:



    ii. Reload the koopas, grab the rightmost koopa, go right, and spit here:

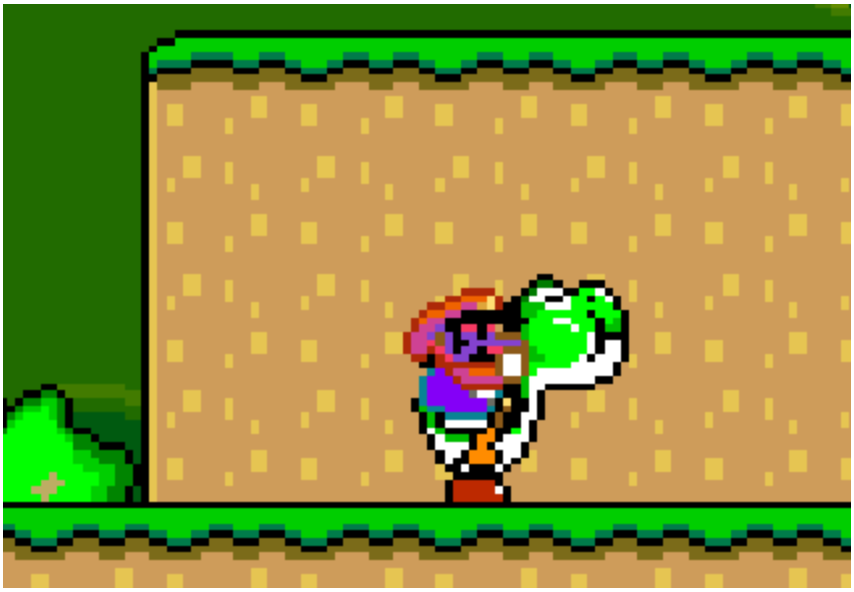
    iii. Run left to reload the koopas, grab the rightmost koopa, go right, and spit here:

iv. Run left to reload the koopas, grab the rightmost koopa, go right, and spit here:



v. Run left to reload the koopas, grab the rightmost koopa, go right, and spit here:

vi. Run left to reload the koopas, grab the rightmost koopa, go right, and spit here:



vii. Run left to reload the koopas, grab the rightmost koopa, go right, and spit here:

Bootstrap Writes

10. Now you'll need to repeatedly trigger the ACE by positioning Yoshi (facing directions in these pictures matter), then positioning Mario, then collecting the mushroom/fire flower (optionally jumping to collect it faster). Make sure that once you position Mario, you can collect the mushroom without moving Mario. Usually this is done by making sure the screen is scrolling left with Mario's movement. You can also face Mario left, then screen scroll all the way right, then screen scroll left. Once you're in position, press select and collect the coin, optionally jumping to do so.
    a. Write $7F80E8 to $F3
        i. Yoshi: $F3, Mario: $E8. Run far to the right, under the level's first Yoshi Coin.

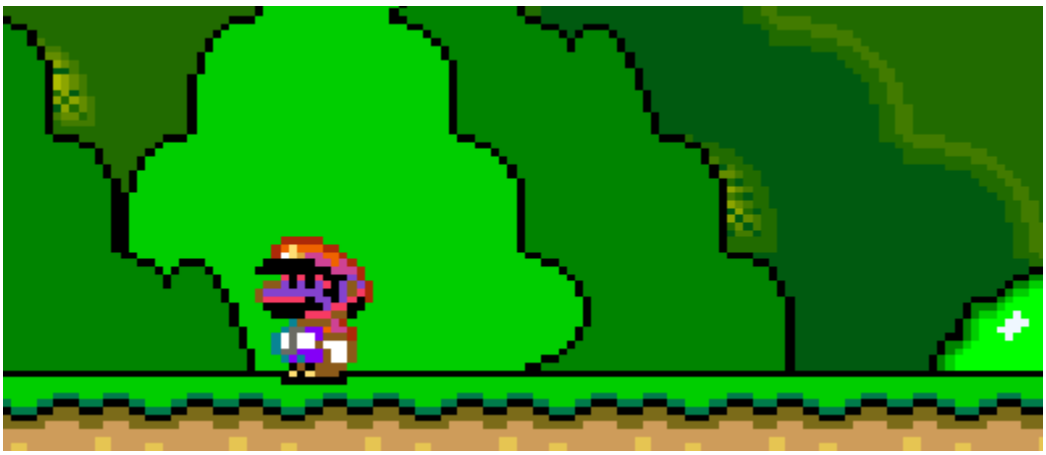
ii. Yoshi: $F4, Mario: $80

You can move Yoshi to the left by a pixel more easily by first positioning Mario, then jumping without moving left or right. Yoshi will snap to Mario's position without changing Yoshi's direction.

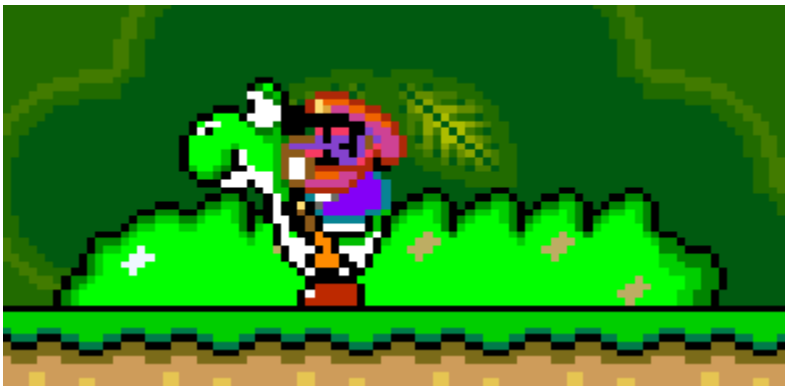
Then go to the left a bit

iii. Yoshi: $F5, Mario: $7F

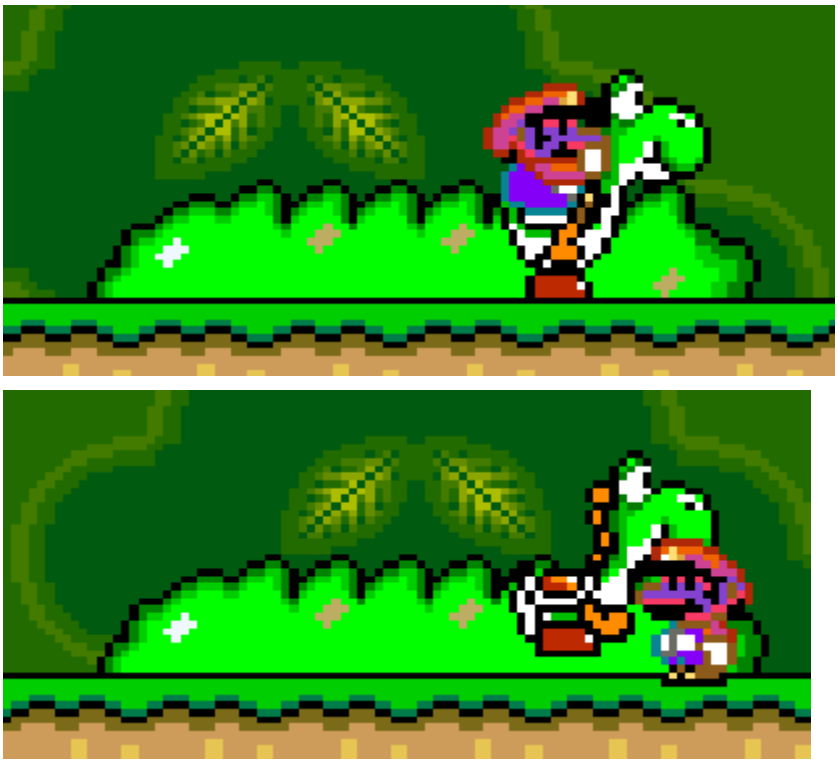
Then go to the left a bit.



b. Replace the $F0 in the multi-byte write code with $F3
    i. Yoshi: $E9, Mario: $F3



c. Write $0F to $7F80E8, giving yourself infinite time
    i. Yoshi: $00, Mario: $0F

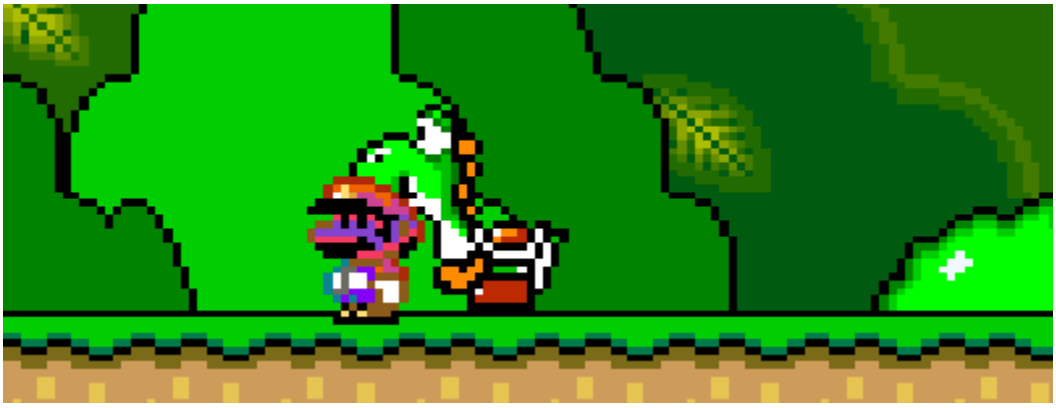


d. At $7F8182, write `LDY $94; STY $0DBF; RTL`
    i. A4 94 8C BF 0D 6B
    ii. Yoshi: $9F, Mario: $6B

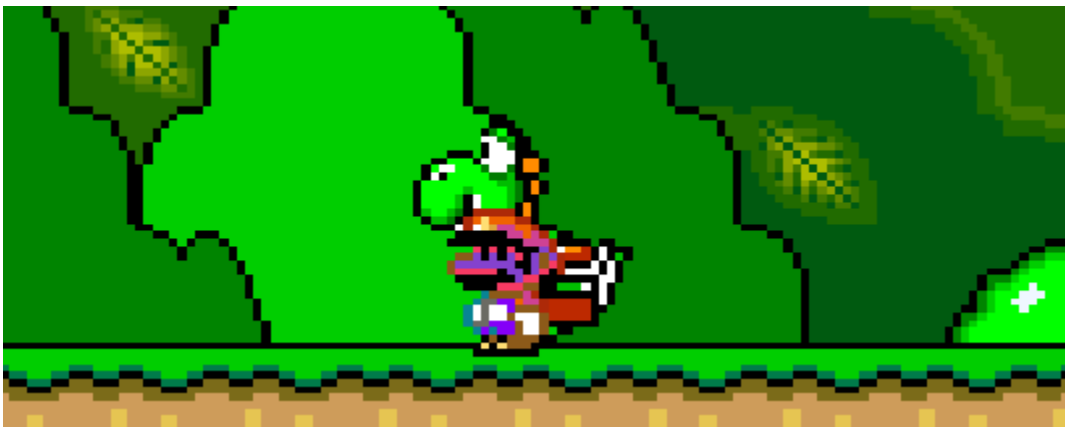
iii. Yoshi: $9E, Mario: $0D

iv. Yoshi: $9D, Mario: $BF

v. Yoshi: $9C, Mario: $8C



vi. Yoshi: $9B, Mario: $94



vii. Yoshi: $9A, Mario: $A4

e. With the coin display completed, the remaining writes can be done without visual reference. Yoshi should always be facing left when placing him via the coin counter.
f. At $7F8187, write Auto decrement: LDA $18; BPL +02; DEC $EC; RTL (first byte last)
    i. A5 18 10 02 C6 EC 6B
        1. Yoshi Coin: **G7**, Mario Coin: **A7**
        2. Yoshi Coin: **G6**, Mario Coin: **N5**
        3. Yoshi Coin: **G5**, Mario Coin: **J8**
        4. Yoshi Coin: **G4**, Mario Coin: **2** (notice it's not O2)
        5. Yoshi Coin: **G3**, Mario Coin: **16**
        6. Yoshi Coin: **G2**, Mario Coin: **24**
        7. Yoshi Coin: **G1**, Mario Coin: **G5**
    ii. Now every time you press A, Yoshi will automatically be moved 1 pixel to the left (unless you're using it to dismount Yoshi). This means you can spin jump to collect the fire flower in order to automatically decrement Yoshi's position, rather than remounting him each time.
g. At $7F818D, write Index display: LDX $EB; STX $0F48; RTL (using auto decrement)
    i. A6 EC 8E 48 0F 6B
        1. Yoshi Coin: **H2**, Mario Coin: **A7** (don't spin jump to collect)
        2. Mario Coin: **15** (Start spin jumping to collect from here on), *Yoshi Coin: H1*
        3. Mario Coin: **72**, *Yoshi Coin: H0*
        4. Mario Coin: **E2**, *Yoshi Coin: G9*
        5. Mario Coin: **N5**, *Yoshi Coin: G8*

6. Mario Coin: **G6**, *Yoshi Coin: G7*

ii. Now, you can verify Yoshi's position using the bonus star display.

h. At $7F8192, Finish bootstrap: BEQ $7F820D (**+$79**); TYA; STA 7F8201,X; RTL (using auto decrement)

i. F0 79 98 9F 01 82 7F 6B

1. Yoshi Coin: **H9** / Bonus Stars: 177 (displayed as 77), Mario Coin: **A7** (don't spin jump to collect)
2. Mario Coin: **C7** (Start spin jumping to collect from here on), *Yoshi Coin: H8 / Bonus Stars 176*
3. Mario Coin: **D0**, *Yoshi Coin: H7 / Bonus Stars 175*
4. Mario Coin: **1** (notice it's not O1), *Yoshi Coin: H6 / Bonus Stars 174*
5. Mario Coin: **F9**, *Yoshi Coin: H5 / Bonus Stars 173*
6. Mario Coin: **F2**, *Yoshi Coin: H4 / Bonus Stars 172*
7. Mario Coin: **C1**, *Yoshi Coin: H3 / Bonus Stars 171*
8. Mario Coin: **O0** (the letter O followed by the number 0), *Yoshi Coin: H2 / Bonus Stars 170*

Hex Editor Writes

11. Now the bootstrap is completed. You'll use Yoshi's x-coordinate (bonus star display) to control the write address, Mario's x-coordinate (coin display) to control the value, and **spin jump** to commit a write and auto-decrement the write address.
    a. Move Yoshi from $AA (170 decimal as seen in the bonus star counter/index display, though it'll look like 70) left a few pixels to to index 160 by pressing **A** ten times.
    b. Write Hex Editor code below
    c. Keep going until the index hits 0, preferably writing $0A (ASL A), which is coin=10, for the final bytes.

```
Idx: Coin
160: 96
159: K2
158: C7
157: D1
156: C9
155: F9
154: K2
153:  4
152:  0
151:  9
150:  3
149: K8
148: P1
147: J6
146: 56
145:  0
144:  9
```

143: 0
142: 15
141: 41
140: A7
139: C7
138: D5
137: D7
136: E3
135: F2
134: 48
133: M6
132: M8
131: 16
130: D6
129: D0
128: E2
127: 32
126: 74
125: 74
124: 74
123: 74
122: A4
121: D0
120: E2
119: 32
118: 72
117: N5
116: 1
115: K8
114: O8
113: J6
112: P4
111: G5
110: 7
109: 48
108: O8
107: J6
106: P3
105: I3
104: 1
103: 1
102: G0
101: H0
100: N5

99: C7
98: D1
97: C7
96: E3
95: 7
94: 4
93: G9
92: C7
91: D1
90: C5
89: E3
88: 0
87: 80
86: G9
85: 36
84: A0
83: 48
82: J4
81: P3
80: F1
79: 26
78: 26
77: 26
76: 3
75: K8
74: 48
73: M4
72: 23
71: G6
70: 58
69: 1
68: K8
67: 32
66: M4
65: 13
64: O0
63: 16
62: M4
61: 24
60: G6
59: P3
58: I3
57: G8
56: P1
55: E9

```
54: M3
53: O6
52: N9
51: A5
50:  4
49: K8
48:  6
47: J2
46: M3
45: L4
44: 15
43: A5
42:  4
41: K8
40:  2
39: J2
38: M2
37: L4
36: 58
35:  3
34: K8
33: D6
32: M2
31: O6
30: 26
29:  3
28: K8
27: D6
26: 22
25: G4
24: P1
23: G5
22: H0
21: 32
20: 41
19: 21
18: G5
17: O8
16: A0
15: O9
14: D3
13:  1
12: G9
```

The hex editor is done. Finishing the writes:

```
11: 10
```

```
10: 10
 9: 10
 8: 10
 7: 10
 6: 10
 5: 10
 4: 10
 3: 10
 2: 10
 1: 10
```
The hex editor should immediately appear on the final **A** press.

Post Hex-Editor

Once the hex editor is installed, there are a few cleanup tasks you might want to perform.

Disabling the Bootstrap

Since the bootstrap is still active, if you press **A**, it'll disable the hex editor. You can increment address 7F8188 from $18 to $19 by selecting it and pressing **shoulder R** in order to disable that (and make sure you don't subsequently give yourself any powerup state between $80-FF by editing address $19 directly).

You can increment address $7F8198 from $7F to $80 by selecting it and pressing **shoulder R**. This will prevent further writes from the bootstrap to the hex editor area.

If you want to be able to move Yoshi or load other sprites into sprite slot 8, you can make sure direct page $EC, $ED, $EE, $EF, and $F0 (accessed from page $00 of banks $00-$3F or $80-$CF) are $00, then increment $7F818E from $EB to $F0, by selecting it and pressing **shoulder R** four times.

Running your own code

1. Make sure $7F8202-$7F820C all contain $0A.
2. Write $80 to address $7F8201.
3. Decrement $7F8193 from $79 to $6D by pressing **shoulder L** twelve times.
4. Write up to 10 bytes of arbitrary code in $7F8203-$7F820C, leaving the value $0A for any unused bytes.
    a. You can include a JSR or JSL to anywhere else that you'd like, if this isn't enough space for the code you want to run. The hex editor uses $7F820D-$7F82A1, so don't mess with that memory, but feel free to put additional code after it.
5. Enable execution of that code every frame by incrementing $7F8193 to $6E
6. Disable execution of that code every frame by decrementing $7F8193 back down to $6D.

Hex Editor Assembly

```
org $7F820D

; Hex editor
; FB = 2-byte cursor index (only low byte is used)
; FD = Long pointer to page, low byte is always $00.

; Store $0100 to $F8. This is only used for a couple compare instructions
LDA #$01
STA $F9
STZ $F8

; Check if select is being pressed
LDA $15
AND #$20
TAX

; Move cursor/page/bank with UDLR
LDA $FB
LDY $16

; Check if right is being pressed
DEY
BNE noright
INC A
INC $DE,X
noright:

; Check if left is being pressed
DEY
BNE noleft
DEC A
DEC $DE,X
noleft:

; Check if down is being pressed
CPY #$02
BNE nodown
ADC #$0F        ; Carry is set
DEC $DF,X
nodown:

; Check if up is being pressed
CPY #$06
```

```
BNE noup
ADC #$EF        ; Carry is set
INC $DF,X
noup:

; Update the cursor if select isn't being pressed
STA $FB,X
TAY

; Increment/decrement value at cursor
LDA [$FD],Y

LDX $18

; Check if R is being pressed
CPX #$10
BEQ incVal

; Check if L is being pressed
CPX #$20
BNE noL
DEC A
noL:

; Check of both L and R are being held
LDX $17
CPX #$30
BNE noLR
INC A
INC A
incVal:
INC A
noLR:

STA [$FD],Y

draw:
; Set up stripe image loader
REP #$30 ; 16-bit accumulator and index registers

STZ $24

; Write 4-byte stripe image header
LDA #$0050
STA $7F837D
```

```
LDA #$0704
STA $7F837F

XBA         ; A becomes $0407
TAX

LDY #$0101

; Write all tiles to stripe data (400 bytes)
loop:
LDA [$FD],Y

; Special cases for bank/page numbers
CPY $F8         ; $F8 is $0100. Could just CPY #$0100 instead.
BMI skip
LDA $FE         ; A becomes $FF$FE
CPY $F8         ; $F8 is $0100. Could just CPY #$0100 instead.
BNE skip
XBA             ; A becomes $FE$FF
skip:

PHA
JSR.w writeTile
PLA
LSR A
LSR A
LSR A
LSR A
JSR.w writeTile

DEY
BPL loop

SEP #$30 ; 8-bit accumulator and index registers

TYA
STA $7F8789

RTL

writeTile:
AND #$000F      ; Draw hex digit
ORA #$3800      ; Tile properties
CPY $FB         ; Check if highlighted by cursor
BNE nocolor
```

```
ORA #$0400      ; Add color
nocolor:
DEX
STA $7F8381,X   ; Write tile ID and properties
DEX
RTS
```