Unnecessary Challenges and Retro Pleasures

Homebrew in 16-bits

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the
homebrew
channel
Wii Menu
Start

What’s Hacking?

The gaining of unauthorized access to data in a system or computer.

– Average dictionary

What Hacking Really Is

Hacking is an art form that uses something in a way in which it was not originally intended.

– Hackaday.com

So, What's Homebrew?

Give a consumer electronic product a use not intended by the manufacturer.

Who does this?

What we'll do today?

See how homebrewing in the Mega Drive looks like.

Hey
I’m Geri :)

Tried making a homebrew game and never finished it.

But learned a lot during the development.

Disclaimer

I’m not a programmer of the past.

Fun Fact: I was born after SEGA stopped making consoles.

Mega Drive Specs

2 CPUs (Motorola 68000 & Zilog Z80)

16-bits, 64kB RAM, 64kB VRAM

512 colors (only 61 at once)

2 Planes + 80 Sprites

4MB* Cartridges

2 sound chips (FM, PWM, PCM)

//TODO: Make a Mega Drive Game

Make a Hello World

Draw some tiles

Draw some sprites

Add sound

Save the game

Let’s make illegal things first 😈

Let’s break the TMSS

```
move.l #$53454741, ($A14000)
move.l #’SEGA’, ($A14000)
```

Sega Genesis Development Kit

A fully-featured Mega Drive development kit using C programming language.

Uses some Java programs to convert data.

Hello, World!

Hello, World!

```
#include <genesis.h>
```

Hello, World!

```c
#include <genesis.h>

int main() {
    VDP_drawText( str: "Hello, Mega Drive World!",  x: 8,  y: 5);
```

Hello, World!

```c
#include <genesis.h>

int main() {
    VDP_drawText( str: "Hello, Mega Drive World!", x: 8, y: 5);

    while (TRUE){
        SYS_doVBlankProcess();
    }
}
```

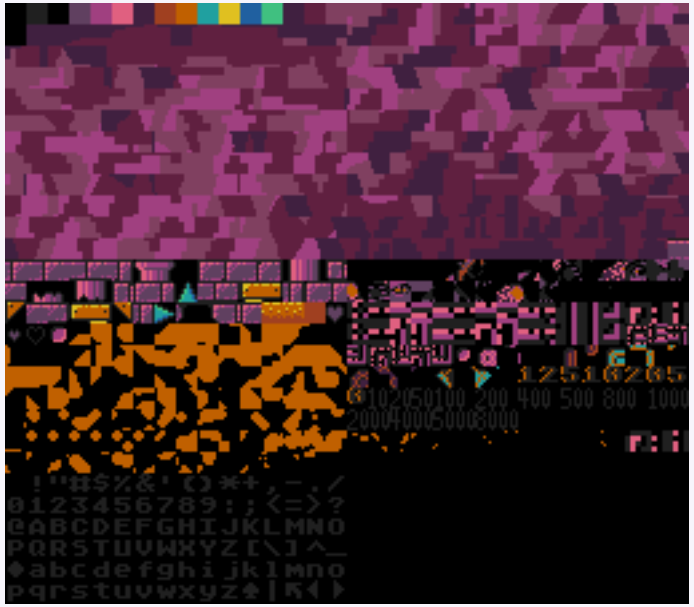
Hello, World!

Deconstructing a frame

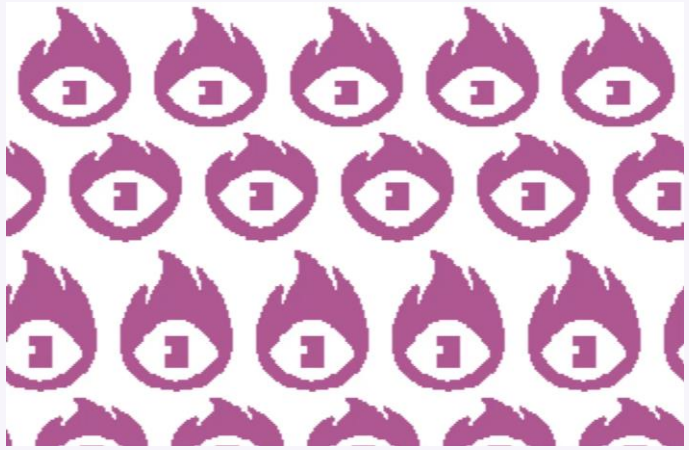
Game's art is drawn here line by line

Magic happens here (hBlank)

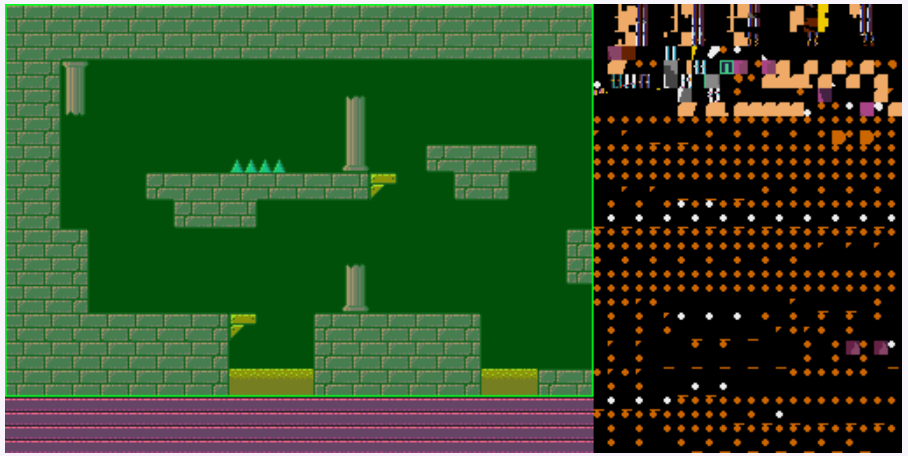
Main code usually runs here (vBlank)



Deconstructing a frame



Deconstructing a frame



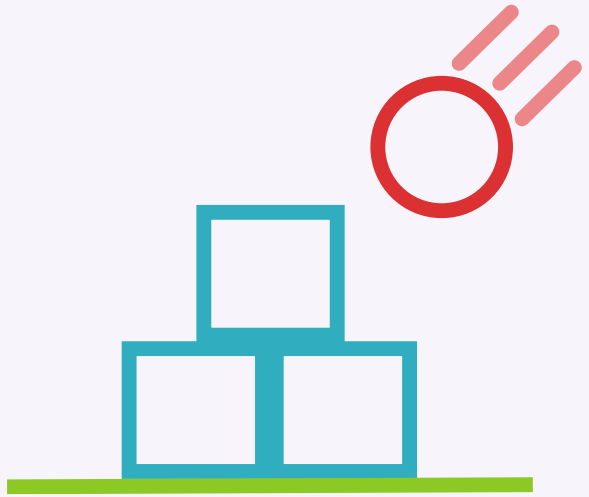
Deconstructing a frame

Let’s make a physics engine!

Why not using something like Box2D?

There’s this funny lil thing called IEEE 754 which we don’t have.

Plus, they are usually generalist and have a ton of overhead.



Fixed Point Math

10001101 10110101

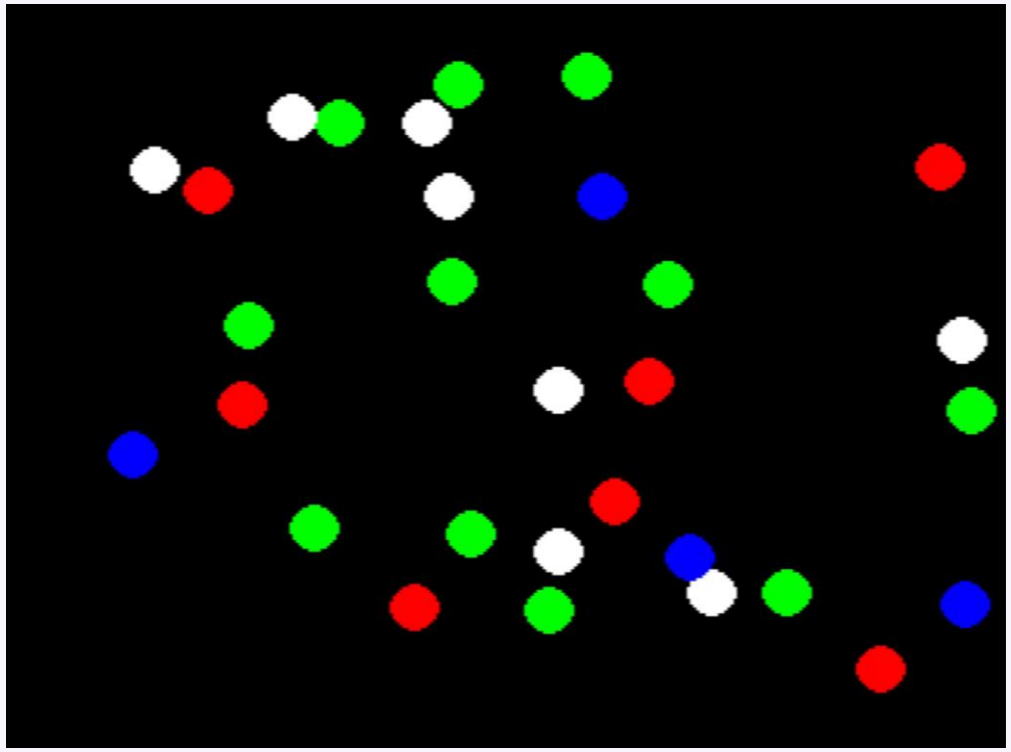
Fixed Point Math

```
10001101.10110101
128 64 32 16 8  4  2  1   ½  ¼ (...)
```

```
1*128 + 0*64 + 0*32 + 0*16 + 1*8 + 1*4 + 0*2 +
1*1 + 1/2 + 0/4 + 1/8 + 1/16 + 0/32 + 1/64 +
0/128 + 1/256 = 141.70703125
```

And do the rest

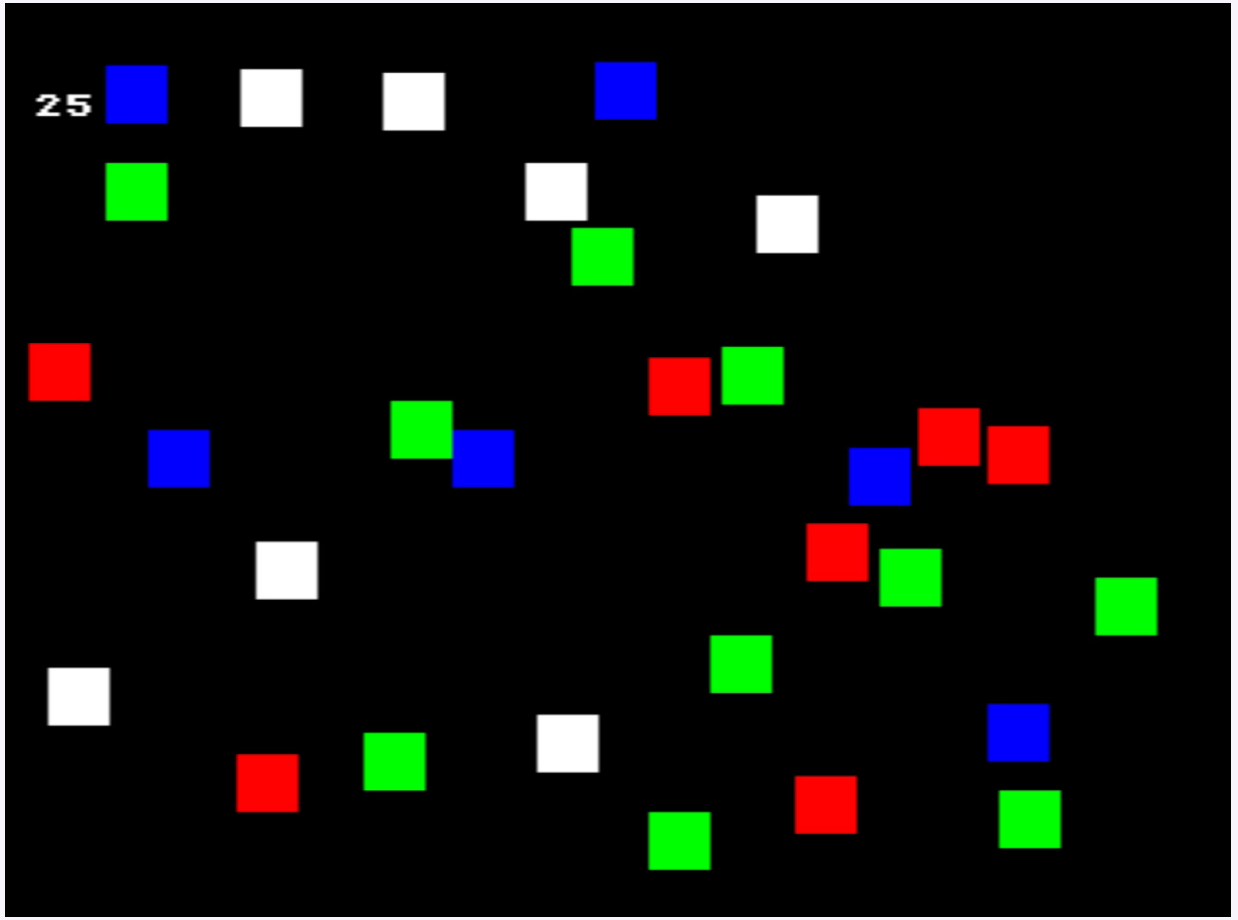
```
struct ball {
    Vect2D_f16 position;
    Vect2D_s16 integerPosition;

    Vect2D_f16 velocity;

    int radius;

    Sprite* sprite;
};
```



(And forget the fact it takes 100% of CPU time)

AABBs > Circles

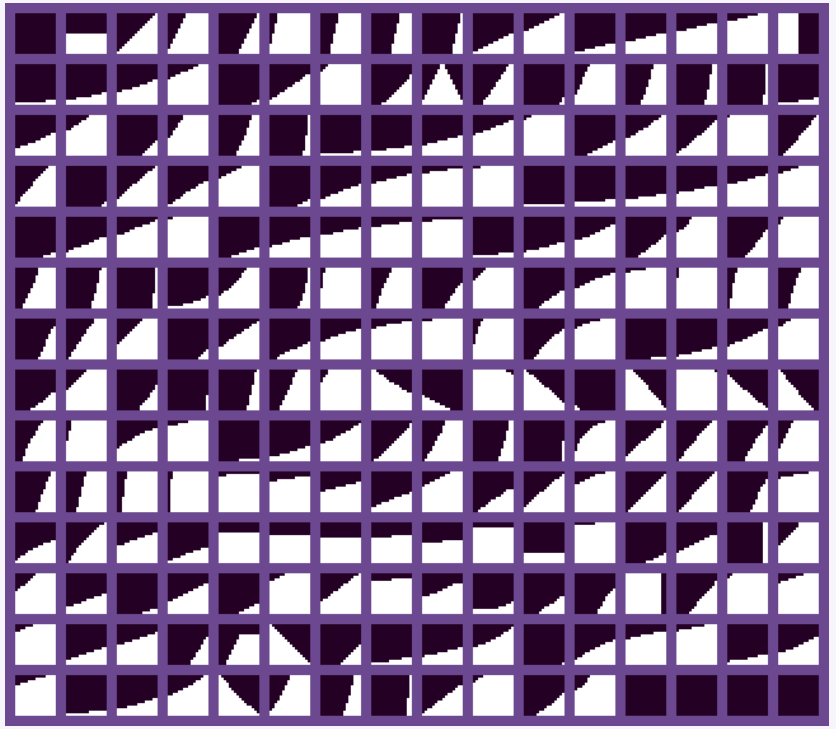
But still only 25 FPS →



So Yeah, Optimization

Almost everything tile-based.

Arrays are your best friends.

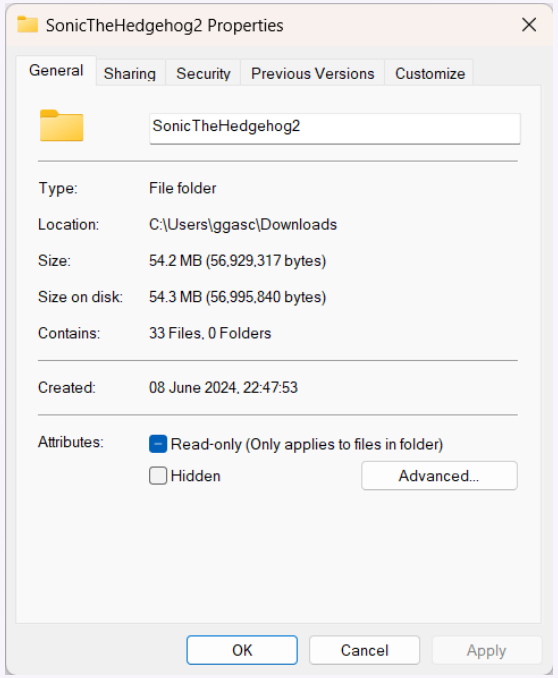


Even Sonic is tile-based

(info.sonicretro.org/Sonic_Physics_Guide)

Adding Sound

Friendly reminder that a standard cartridge can only hold 4MB.



(The game is less than 1MB)

Trackers come into play

Send sound instructions to the sound chips.

You define the sounds of the chips, and you play them as if they where a piano.

A wild Z80 appears

From the M68k we copy the driver binary into the 8kB RAM.

Our only way of communicating will be through the Z80's RAM.

The Z80 then will take care of properly communicating with the YM2612 and SN76489.

Saving the progress

Ignore it, it’s not important.

Use save codes.

Cartridges have a secret power

They are big.
You can fit anything into it.
And even make them bigger.

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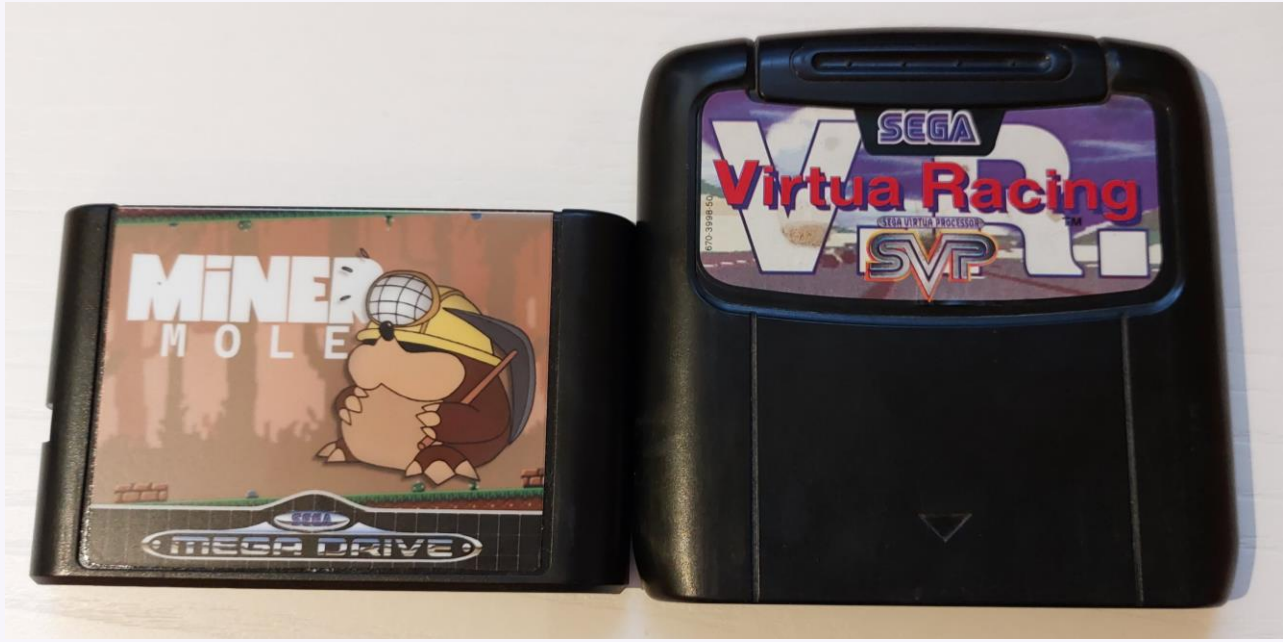
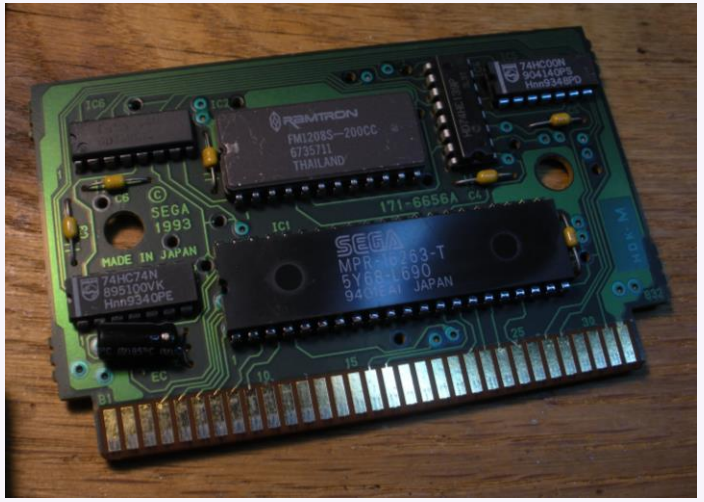


Saving the progress

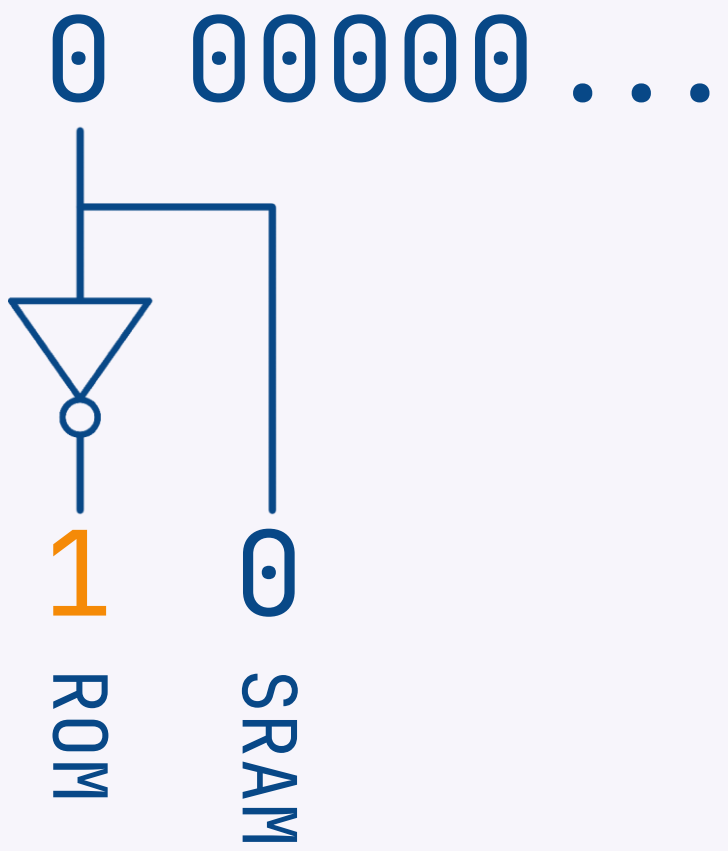
Ignore it, it’s not important.

Use save codes.

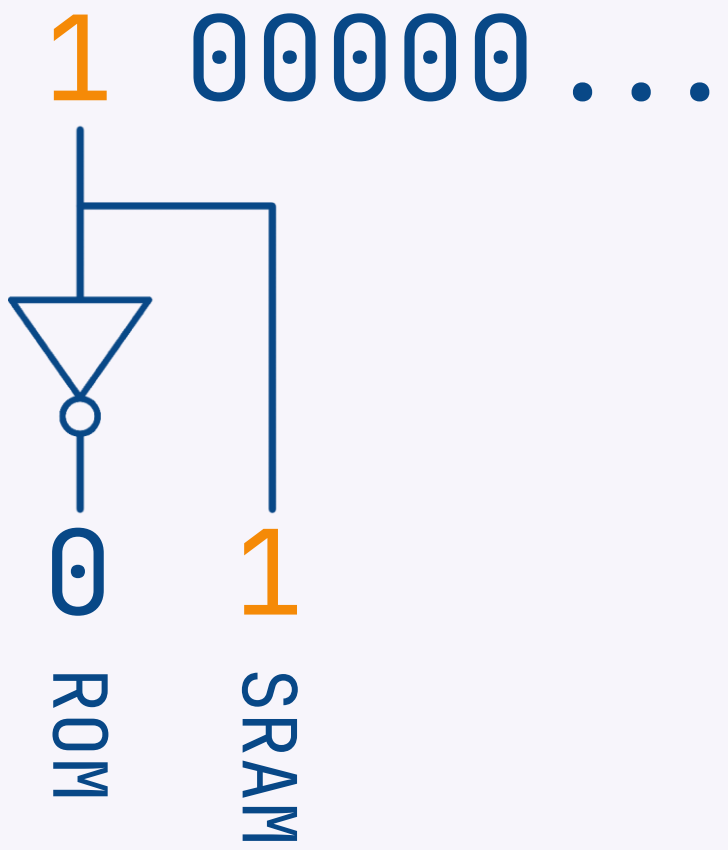
Use a battery-powered SRAM.



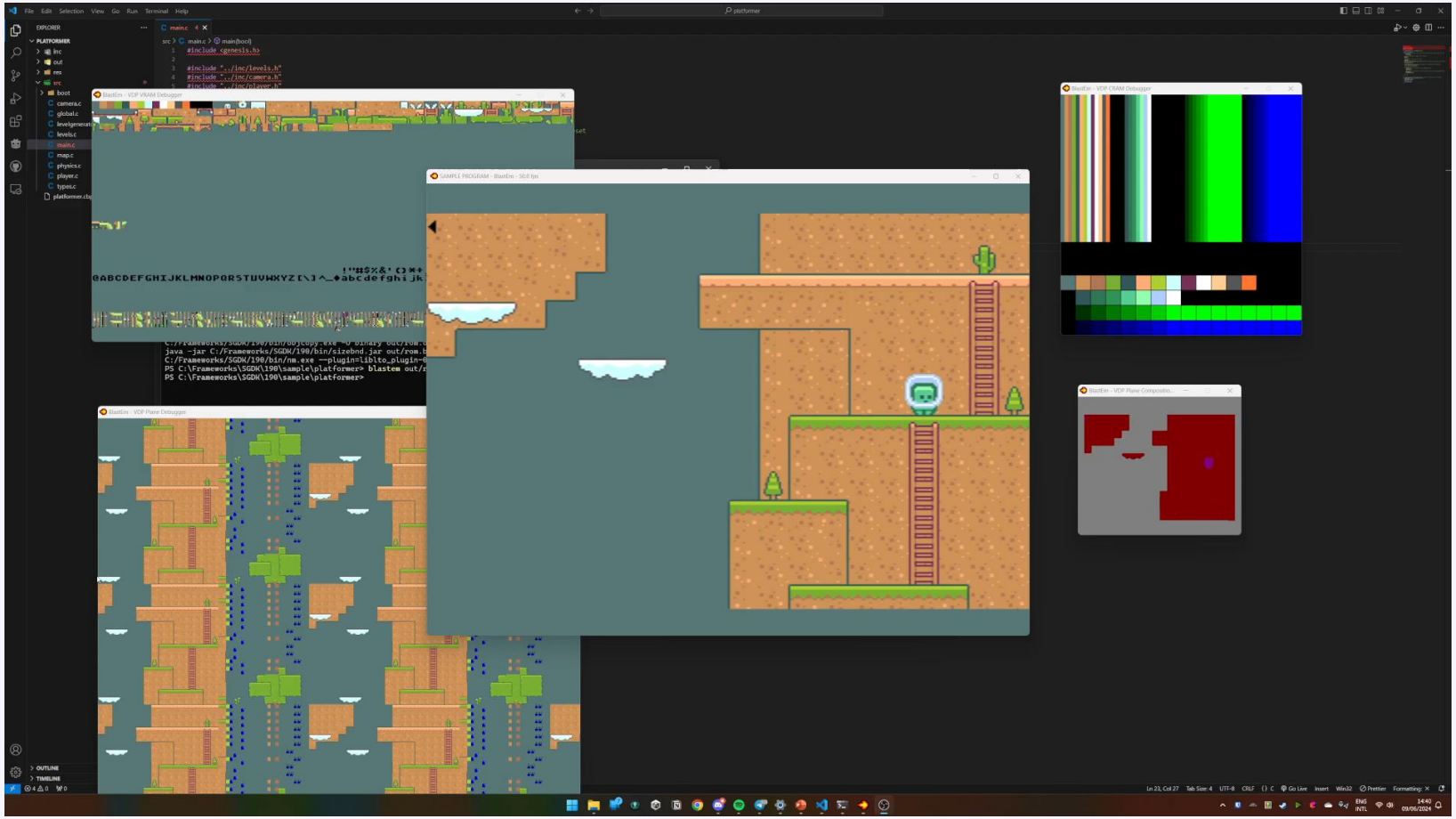
Cartridges secret power



Cartridges secret power

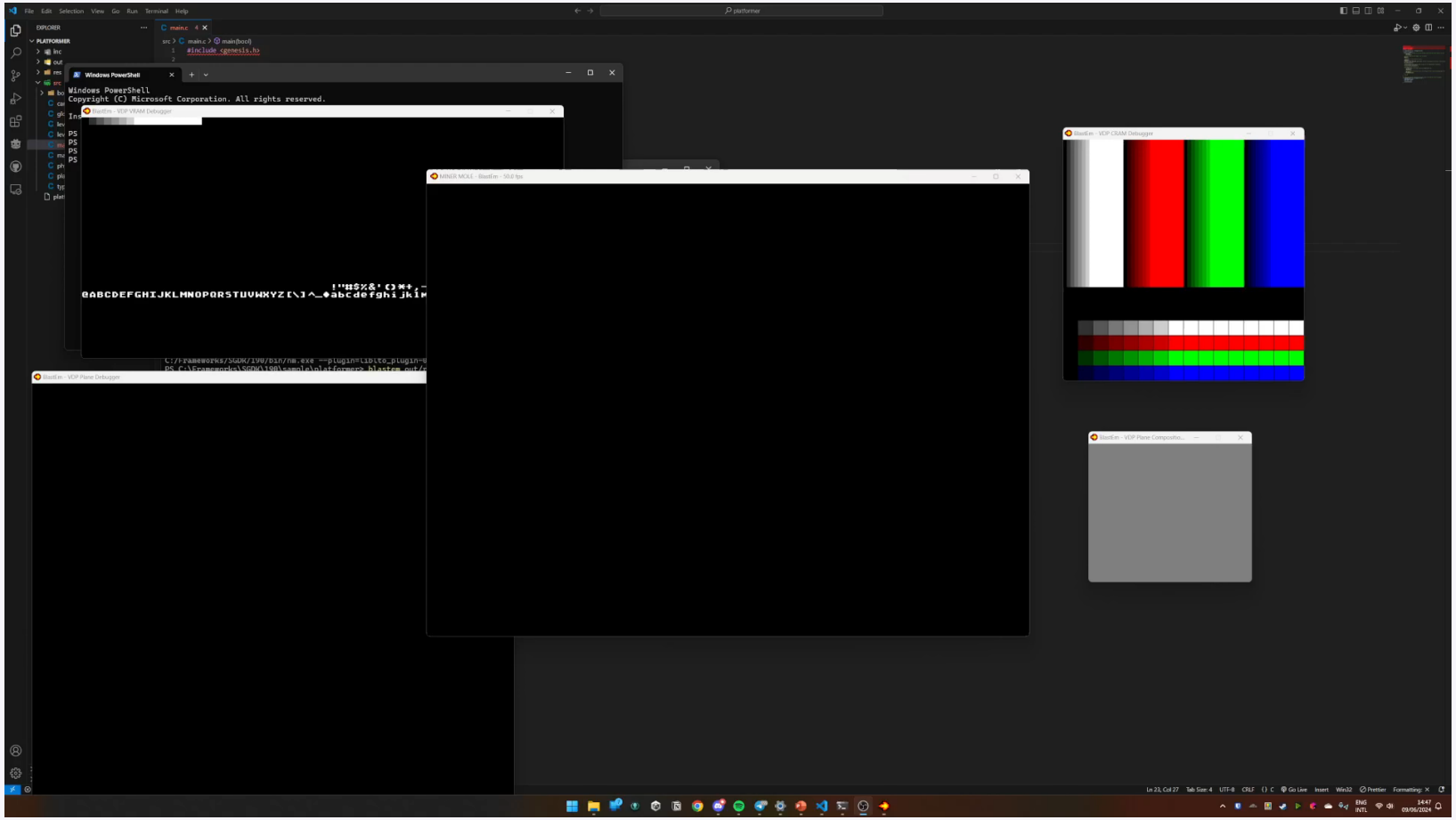


And here we go, we have a game!



(Sample available at github.com/GerardGascon/PlatformerEngine, also bundled with SGDK since 1.80)

But we can go even further



And still many more hidden things for you to explore

Highlight/Shadow
Palette Swapping
Mappers
Mega CD/32x
3D Objects
Raycasting
Sega Virtua Processor
Direct Color
NES
GameBoy
Wii
Nintendo 64
PlayStation
Nintendo DS
Nintendo Switch
SNES

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Thanks for listening and happy homebrewing 😊

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