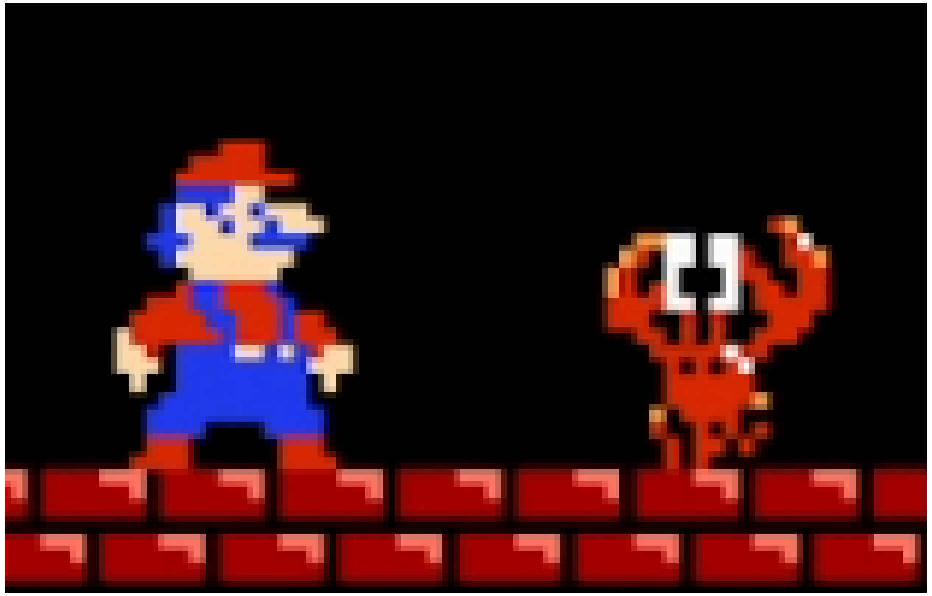
NES Programming in Rust

Sydney Rust Meetup 2023-03-01



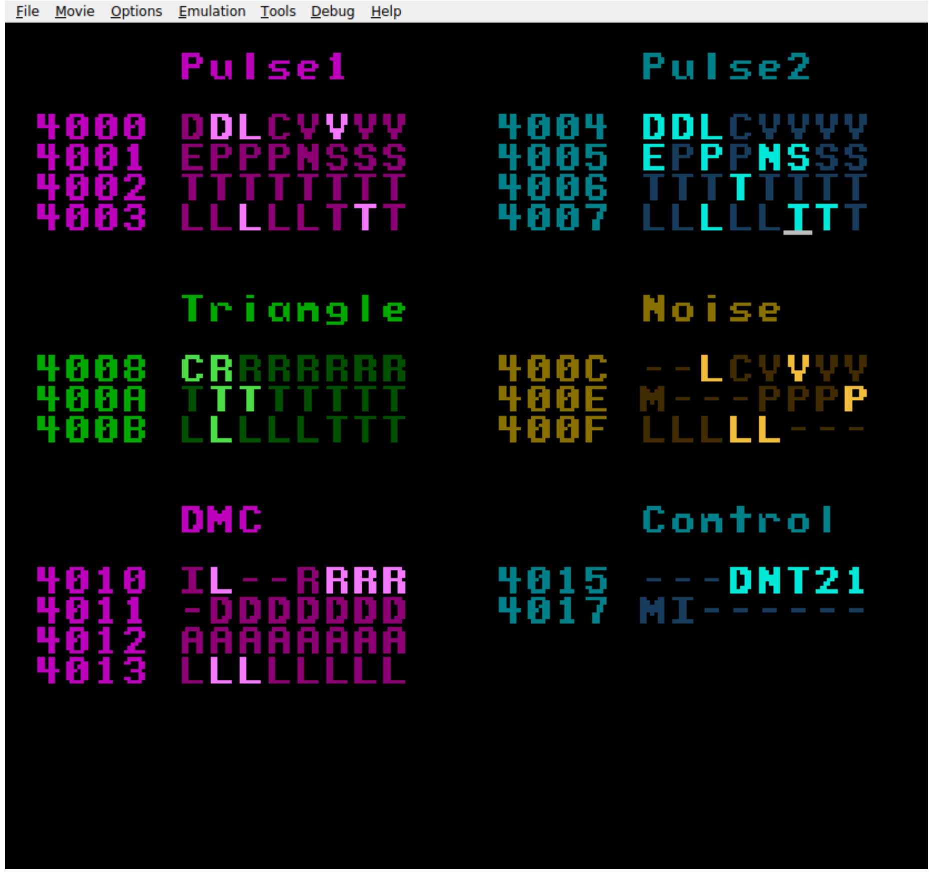
Stephen Sherratt (@gridbugs)

gridbugs.org

github.com/gridbugs

hachyderm.io/@gridbugs

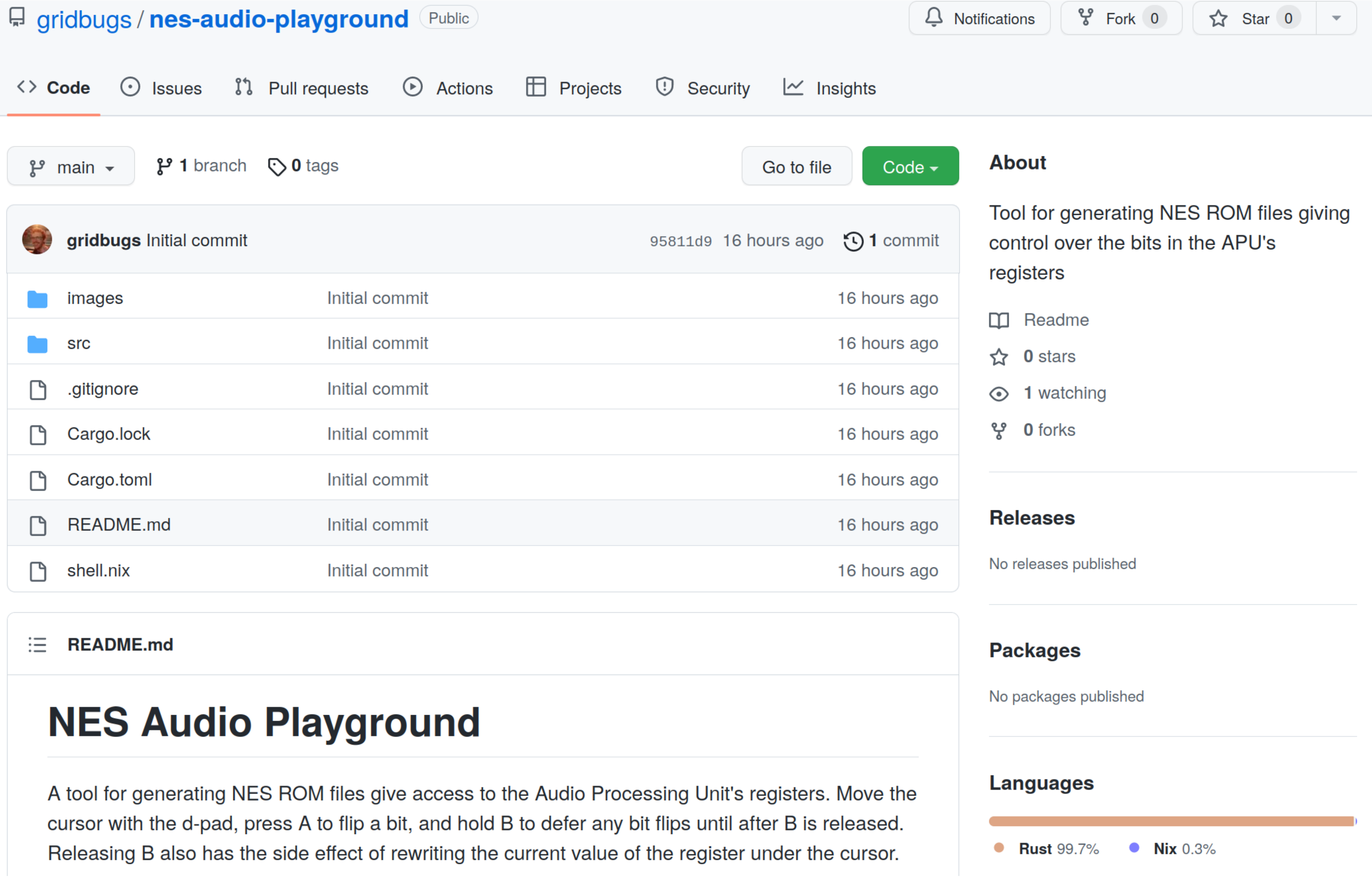
twitch.tv/gridbugs



```
        Pulse1                  Pulse2

4000 DDLCVVVV         4004 DDLCVVVV
4001 EPPPNSSS         4005 EPPPNSSS
4002 TTTTTTTT         4006 TTTTTTTT
4003 LLLLLTTT         4007 LLLLLITT

        Triangle                Noise

4008 CRRRRRRR         400C --LCVVVV
400A TTTTTTTT         400E M---PPPP
400B LLLLLTTT         400F LLLLL---

        DMC                     Control

4010 IL--RRRR         4015 ---DNT21
4011 -DDDDDDD         4017 MI------
4012 AAAAAAAA
4013 LLLLLLLL
```

Demo (video) 🤞🤞🤞

https://youtu.be/QHoISiWdPXo



gridbugs Initial commit 95811d9 16 hours ago 1 commit

images	Initial commit	16 hours ago
src	Initial commit	16 hours ago
.gitignore	Initial commit	16 hours ago
Cargo.lock	Initial commit	16 hours ago
Cargo.toml	Initial commit	16 hours ago
README.md	Initial commit	16 hours ago
shell.nix	Initial commit	16 hours ago

README.md

NES Audio Playground

A tool for generating NES ROM files give access to the Audio Processing Unit's registers. Move the cursor with the d-pad, press A to flip a bit, and hold B to defer any bit flips until after B is released. Releasing B also has the side effect of rewriting the current value of the register under the cursor.

About

Tool for generating NES ROM files giving control over the bits in the APU's registers

Readme

0 stars

1 watching

0 forks

Releases

No releases published

Packages

No packages published

Languages

● **Rust** 99.7% ● **Nix** 0.3%

Usage

```
cargo run -- -o playground.nes  # generate ROM file
fcoux playground.nes            # run ROM in NES emulator
```

Usage

```rust
use std::io::Write;
use ines::{Ines, Header};

let ines = Ines {
    header: Header { ... },
    chr_rom: chr_rom(), // tiles and sprites
    prg_rom: prg_rom(), // code and static data
};

let mut data = Vec::new();
ines.encode(&mut data);

let mut file = std::fs::File::create(output_path).unwrap();
file.write_all(&data).expect("Failed to write ROM file");
```

Usage

Character ROM

```
...
// 24: A
0b00111100,
0b01100110,
0b01100110,
0b01111110,
0b01100110,
0b01100110,
0b01100110,
...
```

Usage

```rust
use mos6502_assembler::Block;

fn prg_rom() -> Vec<u8> {
    // A Block is an intermediate representation that keeps track of labels
    // and a cursor so you can put code/data at specific addresses.
    let mut b = Block::new();
    // describe program
    b.inst(...);
    b.label(...);
    b.literal_byte(...);
    // ...etc

    // convert from intermediate representation to byte array
    // (this pass is needed to resolve labels)
    let mut prg_rom = Vec::new();
    b.assemble(/* start address */ 0x8000, /* ROM bank size */ 0x4000, &mut prg_rom)
        .expect("Failed to assemble");
    prg_rom
}
```

6502 Assembler Rust EDSL

Defining and calling a function with string labels:

```
b.label("set_cursor_to_tile_coord"); // define a function with a label
b.inst(Txa, ());               // x component passed in X register
b.inst(Asl(Accumulator), ());  // multiply by 8 (width of tile)
b.inst(Asl(Accumulator), ());
b.inst(Asl(Accumulator), ());
b.inst(Sta(Absolute), Addr(var::cursor::X));
b.inst(Tya, ());               // y component passed in Y register
...
b.inst(Rts, ());               // Return from subroutine
...
// call a function
b.inst(Ldx(ZeroPage), var::bit_table_entry::TILE_X);
b.inst(Ldy(ZeroPage), var::bit_table_entry::TILE_Y);
b.inst(Jsr(Absolute), "set_cursor_to_tile_coord");
```

6502 Assembler Rust EDSL

Static data:

```
b.label("blink_colour_table");
const BLINK_COLOURS: [u8; 8] = [
    0x20,
    0x20,
    0x10,
    0x10,
    0x00,
    0x00,
    0x10,
    0x10,
];
for c in BLINK_COLOURS {
    b.literal_byte(c);
}
...
b.inst(Tax, ()); // transfer the blink index into X register
b.inst(Ldy(AbsoluteXIndexed), "blink_colour_table"); // read current blink colour
b.write_ppu_address(0x3F11); // write the blink colour to the palette
b.inst(Sty(Absolute), Addr(0x2007));
```

6502 Assembler Rust EDSL

Platform-specific extension:

```
trait BlockNes {
    fn init_ppu(&mut self);
    fn write_ppu_address(&mut self, addr: u16);
    fn write_ppu_value(&mut self, value: u8);
    fn set_ppu_nametable_coord(&mut self, col: u8, row: u8);
    fn set_ppu_palette_universal_background(&mut self, value: u8);
    ...
}

impl BlockNes for Block { ... }

fn program(b: &mut Block) {
    b.inst(...);
    ...
}
```

6502 Assembler Rust EDSL

Rust is a macro language!

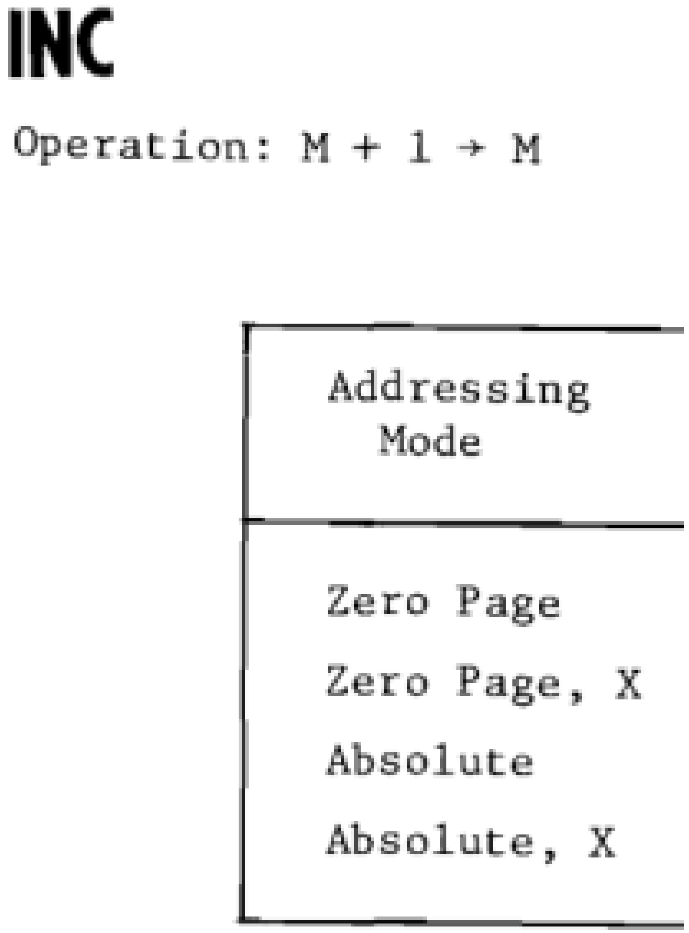
```rust
// Read 8 consecutive bytes from a little-endian address stored
// at var::bit_table_address::LO into a buffer beginning at
// var::bit_table_entry::START.
b.inst(Ldx(Immediate), 0);
for i in 0..8 {
    b.inst(Lda(XIndexedIndirect), var::bit_table_address::LO);
    b.inst(Sta(ZeroPage), var::bit_table_entry::START + i);
    b.inst(Inc(ZeroPage), var::bit_table_address::LO);
}
```

6502 Assembler Rust EDSL

Addressing mode errors are type errors:

```rust
b.inst(Inc(AbsoluteYIndexed), 0x0000);
```

```
error[E0277]: the trait bound
`AbsoluteYIndexed: instruction::inc::AddressingMode`
is not satisfied
```



INC

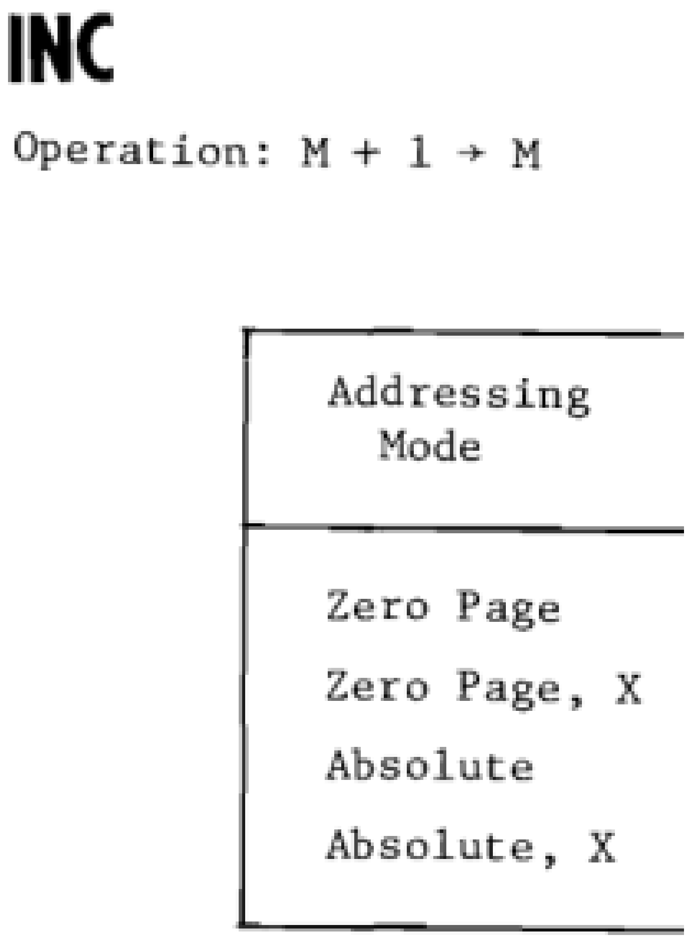
Operation: M + 1 → M

Addressing Mode
Zero Page
Zero Page, X
Absolute
Absolute, X

6502 Assembler Rust EDSL

How addressing mode errors are caught at compile time:

```
pub mod inc {
    pub trait AddressingMode: ReadData + WriteData { ... }

    impl AddressingMode for Absolute { ... }
    impl AddressingMode for AbsoluteXIndexed { ... }
    impl AddressingMode for ZeroPage { ... }
    impl AddressingMode for ZeroPageXIndexed { ... }

    pub struct Inst<A: AddressingMode>(pub A);

    pub fn interpret<A: AddressingMode, M: Memory>(
        _: A, cpu: &mut Cpu,
        memory: &mut M,
    ) -> u8 {
        let data = A::read_data(cpu, memory).wrapping_add(1);
        A::write_data(cpu, memory, data);
        cpu.status.set_negative_from_value(data);
        cpu.status.set_zero_from_value(data);
        cpu.pc = cpu.pc.wrapping_add(A::instruction_bytes());
        A::num_cycles()
    }
}
pub use inc::Inst as Inc;
```



INC

Operation: M + 1 → M

Addressing Mode
Zero Page
Zero Page, X
Absolute
Absolute, X