NES Emulator

CAOS Project 2020
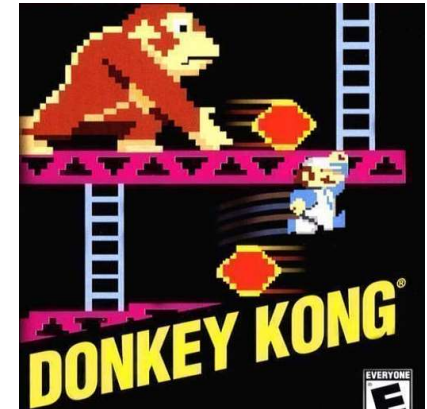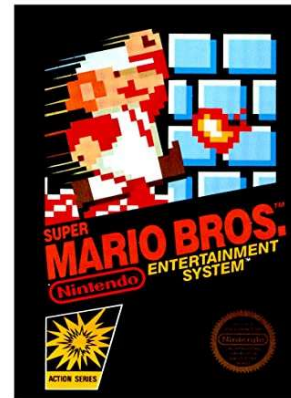
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Examples of Titles

- Super Mario Bros.
- Legend of Zelda
- Donkey Kong

And many more!

Goals

- Learn how to implement an emulator
  - Software <-> Hardware

- Console structure
  - What is unique or different to other systems

- Final Goal:
  - Have a working NES emulator for most games

Challenges

- New programming Language (C++)

- Understanding the hardware architecture and documentation.

- Teamwork, distribution of tasks

- Time management

Rough Implemenation

- C++

- Windows OS

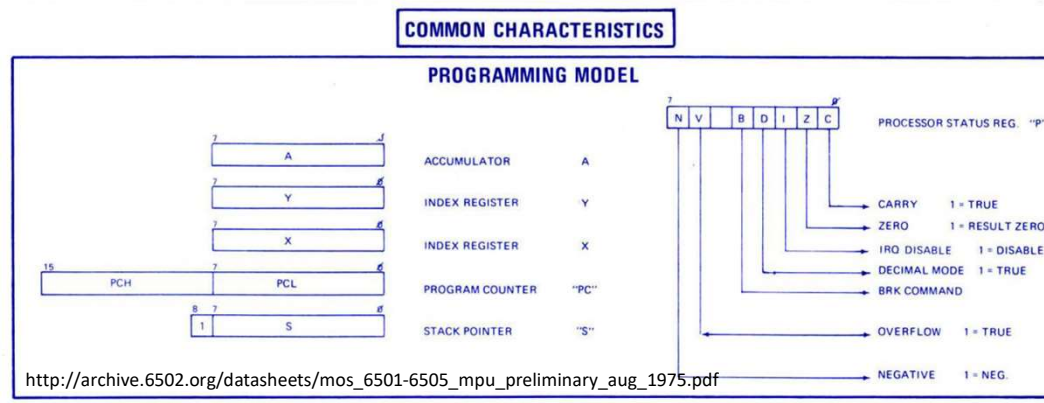- VisualStudio, Github, Zoom

- How will this....   ...look like in code?

6502 Mos Technologies CPU

Rough Implemenation
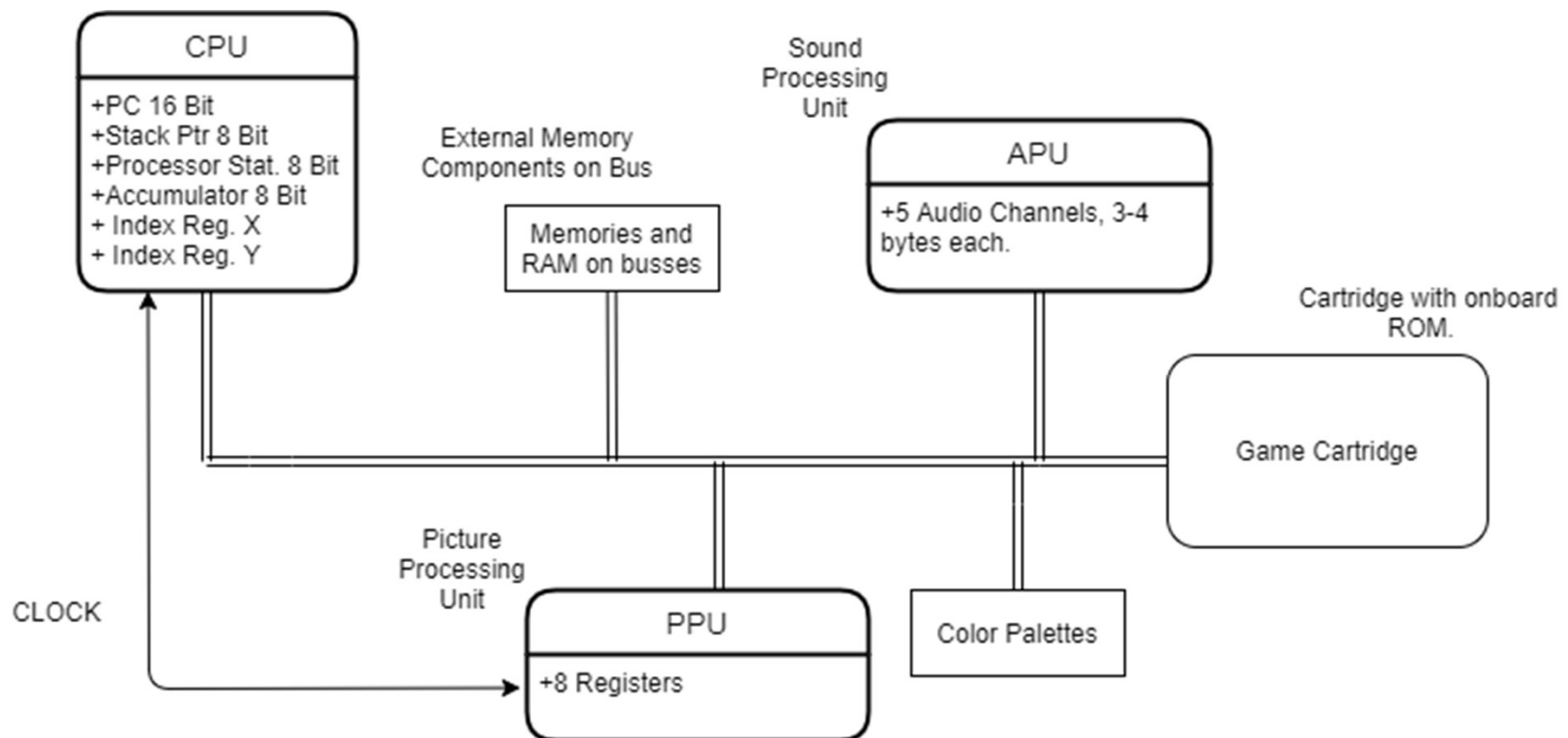
...it will look familiar.

- **OO-Programming** with classes being busses and components.

- **Attributes** are our byte ranges to read from and write to.

- **CPU**

Rough Implemenation

Material/Resources

- No additional Hardware needed and no costs

- VS Code/Clion

- NesDev Wiki

- Hardware References
  - CPU Memory Map, CPU Instructions, …

- Emulation Tests
  - CPU, PPU, APU, …

General

- Glossary
- Cartridge and mappers' history

Hardware reference

- 2A03: APU, CPU
- PPU
- Input devices
- Mappers
- Pinout
- Cycle reference chart for various PPU and frame-related timing details; includes CPU cycle cou
- Cartridge board
- RF Famicom wiring diagram (many parts also applicable to NES)
- Errata: Hardware bugs and quirks

Opcode Matrix

	+00	+01	+02	+03	+04	+05	+06	+07	+08	+09	+0A	+0B	+0C	+0D	+0E	+0F	+10	+11	+12	+13	+14	+15	+16	+17	+18	+19	+1A	+1B	+1C	+1D	+1E	+1F
00	BRK	ORA (d,x)	STP	SLO (d,x)	NOP d	ORA d	ASL d	SLO d	PHP	ORA #i	ASL	ANC #i	NOP a	ORA a	ASL a	SLO a	BPL *+d	ORA (d),y	STP	SLO (d),y	NOP d,x	ORA d,x	ASL d,x	SLO d,x	CLC	ORA a,y	NOP	SLO a,y	NOP a,x	ORA a,x	ASL a,x	SLO a,x
20	JSR a	AND (d,x)	STP	RLA (d,x)	BIT d	AND d	ROL d	RLA d	PLP	AND #i	ROL	ANC #i	BIT a	AND a	ROL a	RLA a	BMI *+d	AND (d),y	STP	RLA (d),y	NOP d,x	AND d,x	ROL d,x	RLA d,x	SEC	AND a,y	NOP	RLA a,y	NOP a,x	AND a,x	ROL a,x	RLA a,x
40	RTI	EOR (d,x)	STP	SRE (d,x)	NOP d	EOR d	LSR d	SRE d	PHA	EOR #i	LSR	ALR #i	JMP a	EOR a	LSR a	SRE a	BVC *+d	EOR (d),y	STP	SRE (d),y	NOP d,x	EOR d,x	LSR d,x	SRE d,x	CLI	EOR a,y	NOP	SRE a,y	NOP a,x	EOR a,x	LSR a,x	SRE a,x
60	RTS	ADC (d,x)	STP	RRA (d,x)	NOP d	ADC d	ROR d	RRA d	PLA	ADC #i	ROR	ARR #i	JMP (a)	ADC a	ROR a	RRA a	BVS *+d	ADC (d),y	STP	RRA (d),y	NOP d,x	ADC d,x	ROR d,x	RRA d,x	SEI	ADC a,y	NOP	RRA a,y	NOP a,x	ADC a,x	ROR a,x	RRA a,x
80	NOP #i	STA (d,x)	NOP #i	SAX (d,x)	STY d	STA d	STX d	SAX d	DEY	NOP #i	TXA	XAA #i	STY a	STA a	STX a	SAX a	BCC *+d	STA (d),y	STP	AHX (d),y	STY d,x	STA d,x	STX d,y	SAX d,y	TYA	STA a,y	TXS	TAS a,y	SHY a,x	STA a,x	SHX a,y	AHX a,y
A0	LDY #i	LDA (d,x)	LDX #i	LAX (d,x)	LDY d	LDA d	LDX d	LAX d	TAY	LDA #i	TAX	LAX #i	LDY a	LDA a	LDX a	LAX a	BCS *+d	LDA (d),y	STP	LAX (d),y	LDY d,x	LDA d,x	LDX d,y	LAX d,y	CLV	LDA a,y	TSX	LAS a,y	LDY a,x	LDA a,x	LDX a,y	LAX a,y
C0	CPY #i	CMP (d,x)	NOP #i	DCP (d,x)	CPY d	CMP d	DEC d	DCP d	INY	CMP #i	DEX	AXS #i	CPY a	CMP a	DEC a	DCP a	BNE *+d	CMP (d),y	STP	DCP (d),y	NOP d,x	CMP d,x	DEC d,x	DCP d,x	CLD	CMP a,y	NOP	DCP a,y	NOP a,x	CMP a,x	DEC a,x	DCP a,x
E0	CPX #i	SBC (d,x)	NOP #i	ISC (d,x)	CPX d	SBC d	INC d	ISC d	INX	SBC #i	NOP	SBC #i	CPX a	SBC a	INC a	ISC a	BEQ *+d	SBC (d),y	STP	ISC (d),y	NOP d,x	SBC d,x	INC d,x	ISC d,x	SED	SBC a,y	NOP	ISC a,y	NOP a,x	SBC a,x	INC a,x	ISC a,x

Note: Goroh's docs are in japanese

- NES ROM Pinouts 🔗 by Drk. Covers all PRG, CHR, and RAM chips used in NES cartridges.
- NES EPROM Conversions 🔗 by Drk. Instructions on how to modify certain boards to use EPROMs.
- EPROM Pinouts 🔗 by Drk.
- Famicom Cartridge Connector Pinout 🔗 by Siudym. DOC version 🔗 available.
- Super Mario Bros. 2 Pinout 🔗 by Siudym. Board is NES-TSROM-07.
- Super Mario Bros. 3 Pinout 🔗 by Siudym. Board is NES-TSROM-08.
- Solstice Pinout 🔗 by Siudym. Board is NES-ANROM-XX.
- Wizards and Warriors 2: Ironsword Pinout 🔗 by Siudym. Board is NES-AOROM-03.
- Donkey Kong Classics Pinout 🔗 by Siudym. Board is NES-CNROM-07. Comments in Polish.
- goroh's docs 1 🔗 by goroh, translated by Sgt. Bowhack.
- goroh's docs 2 🔗 by goroh, translated by Sgt. Bowhack.
- NES Cart Types 🔗 by Kevin Horton.
- Namcot 106 🔗 by goroh, fix by ZW4 and nori, english translation by nori.
- Preliminary Maxi-15 Mapper Hardware Description 🔗 by Mark.
- Comprehensive NES Mapper Document 🔗 v0.80 by \Firebug\. Includes viewer program by Troy McLeod.
- Mapper 90 Information 🔗 v2.0 by Fx3.
- Caltron / Myriad Games 6-in-1 🔗 v1.0 by The Mad Dumper.
- Konami VRC-VII Chip Info 🔗 by Kevin Horton.

Thank you for your Attention